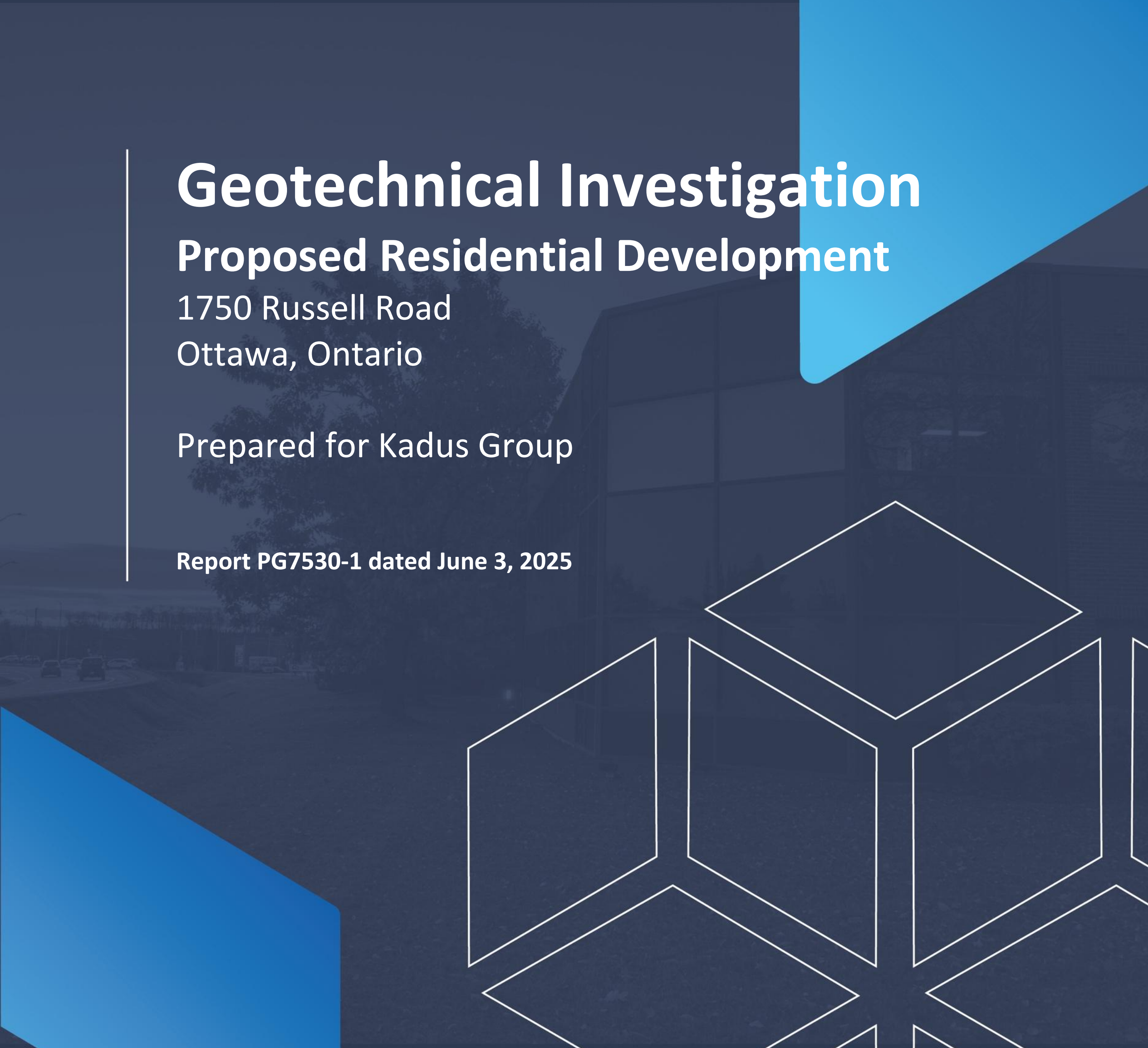

Geotechnical Investigation

Proposed Residential Development

1750 Russell Road
Ottawa, Ontario

Prepared for Kadus Group

Report PG7530-1 dated June 3, 2025

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Kadus Group to conduct a geotechnical investigation for the proposed residential development to be located at 1750 Russell Road in the City of Ottawa (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical investigation were to:

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

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

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

Investigating for 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 drawings, it is understood that the proposed development will consist of two multi-story buildings, the New Long-Term Care Block and the New Independent Living Block, each with a slab-on-grade, and which are to be located in the southwestern portion of the overall property.

At finished grades, the proposed buildings will generally be surrounded by landscaped areas and asphalt-paved and walkways. It is also understood that the proposed development is to be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on May 8, 2025, and consisted of advancing a total of 4 boreholes to a maximum depth of 9.8 m below existing ground surface. The borehole locations were distributed in a manner to provide general coverage of the proposed development, taking into consideration underground utilities and site features.

Previous investigations were completed by others in August 1990, June 1992, January 2010, and January 2020 within the overall property. During the previous investigations, a total of 20 test holes were advanced to a maximum depth of 14.5 m.

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

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.

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.

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.

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

Groundwater

Groundwater monitoring wells were installed in all boreholes to permit monitoring of the groundwater levels following the completion of drilling. The groundwater level readings were obtained after a suitable stabilization period subsequent to the completion of the field investigation.

3.2 Field Survey

The borehole locations, and ground surface elevation at each borehole location, were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum. The locations of the boreholes, and the ground surface elevations at each borehole location, are presented on Drawing PG7530-1 – 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. Additionally, 4 silty clay samples were submitted for Atterberg Limits testing, 2 soil samples were submitted for grain size distribution analysis, and 1 soil sample was submitted for shrinkage limit testing. During the previous investigations, 4 samples were submitted for Atterberg Limits testing, 8 samples were submitted for grain size distribution testing and compressive strength testing was carried out on 1 section of bedrock core.

Moisture content testing was also completed on all soil samples recovered by Paterson and are summarized on the Soil Profile and Test Data sheets included in Appendix 1. All test results are included in Appendix 1 and further discussed in Subsection 4.2 of the current report.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site is located within the southwest portion of the overall development and currently consists of landscaped areas located between existing buildings. The site is bordered by residential dwellings to the north and south, Russell Road to the east, and a multi-use pathway, and further by a multi-storey residential building to the west.

Based on a review of available aerial photographs, the subject site was generally undeveloped and vacant as recently as 1991. The majority of the overall development was observed to be constructed between 1991 and 1999.

The ground surface across the subject site is relatively flat and at grade with the surrounding development, at an approximate geodetic elevation of 75 m.

4.2 Subsurface Profile

Generally, the subsoil profile encountered at the borehole locations consists of topsoil, asphaltic concrete, or landscaping stone underlain by fill material, silty clay and glacial till. Fill material was encountered at all test holes completed between 2009 and 2025, extending to depths ranging from 0.7 to 3.1 m below existing grade. The fill material within the footprints of the proposed buildings was noted to consist of brown silty clay with trace to some sand, gravel and organics. The fill material within the eastern portion of the property was generally observed to consist of gravelly sand with silt, transitioning to a sandy silt to silty sand with clay and gravel. No fill material was encountered in the test holes completed during the 1990 and 1992 investigations.

A thin layer of loose brown silty sand was encountered underlying the fill material at test hole BH 4-25 and extended to an approximate depth of 0.9 m below the existing ground surface. A layer of sandy silt was encountered at underlying the fill material at test hole BH 20-05 and extended to a depth of 2.3 m. Further, a loose to compact silty sand was encountered underlying topsoil at test holes BH 90-22, BH 90-23, BH 90-24, BH 92-26, and BH 92-30 during the 1990 and 1992 investigations by others.

A silty clay deposit was encountered underlying the fill material at all boreholes. Within the footprint of the proposed buildings, the very stiff to stiff, brown silty clay was observed to extend to maximum depths of 2.2 to 6.0 m below the existing ground surface. The clay deposit was observed to transition to a stiff ,grey silty clay at an approximate depth of 3.8 m at boreholes BH 3-25 and BH 4-25.

Within the eastern portion of the subject site, a very stiff to hard, brown silty clay deposit was encountered underlying the fill material, becoming firm to stiff and grey in colour at approximate depths ranging from 2.0 to 3.7 m. The clay deposit was generally observed to increase in thickness within the eastern portion of the site, extending to maximum depths of 6.8 to 7.6 m.

A layer of loose grey clayey silt to sandy silt was noted underlying the clay deposit within select boreholes located within the eastern portion of the site, extending to approximate depths of 7.6 to 9.1 m.

A glacial till deposit was observed underlying the silty clay and/or silty clay deposit at approximate depths ranging from 2.2 to 9.1 m, generally increasing to the east. The glacial till deposit was observed to consist of a firm grey silty clay with sand and gravel, transitioning to a loose to compact grey silty sand with gravel cobbles and boulders at depth.

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

Bedrock

Practical refusal to auguring was encountered within the footprints of the proposed buildings at approximate depths of 5.3, 5.7 and 8.6 m at boreholes BH 1-25 to BH 3-25. Practical refusal to augering was not encountered at borehole BH 4-25 which was terminated at a depth of 9.8 m.

Within the eastern portion of the site, highly weathered black shale bedrock was encountered at approximate depths of 8.7 to 10.1 m. The bedrock was cored within the eastern portion of the site at boreholes BH 20-03, BH 20-05, BH 20-07, and BH 09-100 through BH 09-103, beginning at depths ranging from 8.8 to 10.8 m. Based on the RQDs of the recovered bedrock core, the bedrock was generally weathered and of and of very poor to poor quality black shale to approximate depths of 10 to 12 m, becoming good to excellent in quality with depth. The bedrock was cored to a maximum depth of 14.5 m below the existing ground surface.

Unconfined compressive strength (UCS) was carried out on 1 bedrock core sample during the historic investigation by others. The results of the testing are presented in Table 1 below.

Table 1 – Unconfined Compressive Strength Testing Results

Test Hole Number	Sample No.	Sample Depth (m)	Unconfined Compressive Strength (MPa)
BH 20-05	RC14	11.0 to 11.2	44.8

Grain Size Distribution and Hydrometer Testing

Two (2) hydrometer tests were completed to further classify selected soil samples. Grain size distribution analysis was completed on a total of 6 soil samples during the historic investigations. The results are summarized in Table 2 on the following page and are presented in Appendix 1.

Table 2 – Summary of Grain Size Distribution Analysis

Borehole Number	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 2-25	SS3	1.5 – 2.1	0	5.9	82.9	11.2
BH 3-25	SS4	2.3 – 2.9	0	9.5	41.0	49.5
BH 20-01	SS7	7.6 – 8.2	0	10	68	22
BH 20-02	SS6	6.1 – 6.7	0	0	28	72
BH 20-03	SS8	7.6 – 8.2	0	27	42	22
BH 20-05	13	7.6 – 8.2	14	33	34	19
BH 20-06	7	6.1 – 6.7	0	3	48	49
BH 09-103	6	7.6 – 8.2	4	21	75	

Atterberg Limit Tests

Four (4) silty clay samples were submitted for Atterberg Limits testing during the current investigation. The test results indicate that the silty clay is generally classified as Inorganic Clay of Ligh Plasticity (CL) and transitions to an Inorganic Silt of Low Plasticity (ML) at depth. These classifications are in accordance with the Unified Soil Classification System. The results are summarized in Table 3 below.

Table 3 – Summary of Atterberg Limits Results

Borehole Number	Sample	Depth (m)	LL (%)	PL (%)	PI (%)	Classification
BH 1-25	SS3	1.5 – 2.1	69	35	34	MH
BH 2-25	SS4	2.3 – 2.9	48	23	25	CL
BH 3-25	SS5	3.0 – 3.7	47	20	27	CL
BH 4-25	SS5	3.0 – 3.7	46	19	27	CL
BH 20-01	SS7	7.6 – 8.2	19	16	3	ML
BH 20-02	SS6	6.1 – 6.7	54	22	32	CH

BH 20-03	SS7	6.9 – 7.5	20	17	3	ML
BH 20-05	13	7.6 – 8.2	18	12	6	CL-ML
BH 20-06	7	6.1 – 6.7	36	18	18	CL

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

4.3 Groundwater

Ground water levels were measured with in the installed monitoring wells on May 15, 2025, and the results are presented in Table 4 below.

Table 4 – Summary of Groundwater Levels

Borehole Number	Ground Surface Elevation (m)	Measured Groundwater Level		Dated Recorded
		Depth (m)	Elevation (m)	
BH 1-25*	75.21	1.67	73.54	May 15, 2025
BH 2-25*	75.20	1.56	73.64	
BH 3-25*	75.09	1.93	73.16	
BH 4-25*	75.18	2.22	72.96	
BH 20-02*	75.36	3.16	72.20	January 27, 2020
BH 20-06*	75.10	2.43	72.67	
BH 09-101	74.86	2.53	72.33	January 21, 2010

Note: * indicates monitoring well. Ground surface elevations at borehole location are referenced to a geodetic datum.

Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at approximately 2 to 3 m below ground surface. The recorded groundwater levels are also provided on the applicable Soil Profile and Test Data sheet presented in Appendix 1. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. Foundation support for the proposed buildings may consist of:

☐ For the New Long-Term Care Block, conventional spread footings bearing on undisturbed, very stiff silty clay,

☐ For the New Independent Living Block, conventional spread footings bearing on the lean concrete trenches which extend to the bedrock.

☐ For either building, conventional spread footings bearing on the silty clay or glacial till which has been adequately improved with a ground improvement technique such as rigid inclusions.

Due to the presence of a silty clay deposit at the site, the proposed development will be subjected to grade raise restrictions. Our permissible grade raise recommendations are discussed in Section 5.3.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and any fill containing significant amounts of deleterious or organic materials, should be stripped from under any buildings and other settlement sensitive structures.

Any soft areas should be removed and backfilled with OPSS Granular B Type II, with a maximum particle size of 50 mm and compacted to 98% of the material’s SPMDD.

Vibration Considerations

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

The following construction equipment could be a source of vibrations: ground improvement equipment (if required), hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by ground improvement, or other construction operations, could be the cause or source of detrimental vibrations on the nearby buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, 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). It should be noted that these guidelines are for today’s construction standards.

Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the proposed 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 and beneath exterior parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted 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 a composite drainage blanket connected to a perimeter drainage system is provided.

Lean Concrete Filled Trenches for the New Independent Living Block

For the New Independent Living Block, where bedrock is expected below the underside of footing (USF) elevation, lean concrete (minimum 17 MPa 28-day compressive strength) can be used to reinstate the subgrade from the bedrock surface to the USF elevation. Typically, the excavation side walls will be used as the form to support the lean concrete. The trench excavation should be at least 150 mm wider than all sides of the footings. 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. Once the trench excavation is approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation. The trenches should be infilled with lean concrete (minimum 17 MPa, 28-day strength).

Ground Improvement – Rigid Inclusions

As discussed above, foundation support for the proposed buildings may consist of conventional spread footings bearing on undisturbed silty clay or glacial till which has been adequately improved with rigid inclusions, such as the proprietary Controlled Modulus Columns (CMC) system or approved equivalent.

Rigid inclusions generally involve advancing a reverse-flight auger to the target bearing stratum, which for this site consists of the bedrock, and which displaces and densifies the surrounding soils during the advancement process. A cement-based grout is then discharged under pressure at the base of the reverse-flight auger as it is retracted, creating a concrete column.

The rigid inclusions are installed in a grid pattern to create a stiffened matrix of the concrete columns and densified in-situ soils for the support of conventional foundations. Rigid inclusions can be installed to depths of up to approximately 20 m.

Following installation of the rigid inclusions, a load transfer platform, consisting of a specified thickness of compacted granular fill, is placed over the top of the rigid inclusions.

Ground improvement programs are completed by design-build contractors, many of which have proprietary systems. A ground improvement contractor specializing in these programs should be contacted to determine which system is most appropriate for the proposed development, and for more information regarding cost and design details.

The ground improvement design shall be presented by the ground improvement contractor to Paterson as a technical submittal for review during the design phase of the project.

Prior to commencing ground improvement, vibration effects on the existing services, buildings and other structures should be addressed, as discussed above.

5.3 Foundation Design

Conventional Spread Footings for the New Long-Term Care Block

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on undisturbed very stiff to stiff silty clay **at or above geodetic elevation 73 m** can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

Footings placed on an undisturbed soil bearing surface and designed using the bearing resistance values at SLS provided above will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

Conventional Spread Footings for the New Independent Living Block

Conventional spread footings supported on lean concrete filled trenches extending to the clean, surface sounded bedrock can be designed using a bearing resistance value at serviceability limit states (SLS) and ultimate limit states (ULS) of **1,000 kPa**.

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.

Footings supported on lean concrete placed over clean, surface-sounded bedrock, and designed for the bearing resistance values provided herein, will be subjected to negligible post-construction total and differential settlements.

It should also be noted that additional investigation will be needed prior to construction to confirm that the auger refusals within the footprint of the proposed New Independent Living Block are consistent with the bedrock elevation.

Conventional Spread Footings on Improved Ground

For preliminary design, footings bearing on an undisturbed silty clay or glacial till bearing surface which has been adequately improved using rigid inclusions, such as CMCs or an equivalent ground improvement method which has been approved by Paterson, can be designed using a bearing resistance value at serviceability limit states (SLS) of **170 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa.** However, the final bearing resistance values and associated deflection which will be applicable will be provided by the specialized ground improvement contractor.

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 silty clay, glacial till and engineered fill bearing media when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity as that of the bearing medium.

Permissible Grade Raise Recommendations

Due to the presence of the silty clay deposit at the site, a permissible grade raise restriction of **1.2 m** is recommended for grading at the subject site.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

Seismic shear wave velocity testing was completed at the subject site by others during the 2010 investigation to accurately determine the applicable seismic site classification for the proposed mid-rise buildings in accordance with Table 4.1.8.4.A of the Ontario Building Code (OBC) 2024. The results of the shear wave velocity testing conducted by others are provided in Appendix 1 of the current report.

Based on the results of the shear wave velocity testing by others, the average shear wave velocity from ground surface to a depth of 30 m was measured to be **448 m/s**. Therefore, a site **Class Xc** is applicable for design of the proposed buildings.

Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest version of the OBC for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill within the footprints of the proposed buildings, the silty clay or glacial till will be considered acceptable subgrades upon which to commence backfilling for slab-on-grade or basement slab construction.

For slabs-on-grade, it is recommended that the upper 200 mm of sub-floor fill consists of OPSS Granular A crushed stone which is compacted to 98% SPMDD.

5.6 Pavement Design

For design purposes, the pavement structures presented in the following tables are recommended for the design of car only parking areas, access lanes and heavy truck parking and loading areas.

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 Heavy Truck Parking/Loading Areas

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.

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.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material’s SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

Should the proposed buildings include below-grade space, a perimeter foundation drainage system is recommended to be provided for the proposed structures. The system should consist of a 150 mm diameter perforated and corrugated plastic pipe, surrounded on all sides by 150 mm of 19 mm clear crushed stone, which is placed at the footing level around the exterior perimeter of the structure. The pipe should have positive outlet, such as a gravity connection to the storm sewer.

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 Delta Drain 6000, connected to the perimeter foundation drainage system.

6.2 Protection of Footings Against Frost Action

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

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure, and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled.

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soil 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.

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.

A trench box is recommended 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.

Trench boxes may also be needed to support the zero-entry trenches down to bedrock prior to the placement of lean concrete for the New Independent Living Block.

Temporary Shoring

Depending on the depth of excavation of the buildings and the proximity of the proposed building to the property boundaries and existing building foundations, temporary shoring may be required to support the overburden soils of the adjacent properties. The design and approval of the 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 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.

The designer should also take into account the impact of a significant precipitation event and designate design measures to ensure that a precipitation event will not negatively impact the temporary shoring system or soils supported by the system. Any changes to the approved temporary shoring system design should be reported immediately to the owner’s structural designer prior to implementation.

The temporary shoring system may consist of a soldier pile and lagging system which could be cantilevered, anchored or braced. The shoring system is recommended to be adequately supported to resist toe failure. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below.

The earth pressure acting on the shoring system may be calculated using the parameters in Table 7 on the following page:

Table 7 – Soil Parameters

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 , kN/m_3	21
Submerged Unit Weight , 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 table.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight is calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil 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.

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

Cover material should extend from the spring line to at least 300 mm above the obvert of the pipe and should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The cover material should be placed in maximum 300 mm thick lifts and compacted to 99% of the material's standard Proctor maximum dry density.

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

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

6.5 Groundwater Control

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

Groundwater Control for Building Construction

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, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

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 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 (GU – General Use cement) would be appropriate for this site. The chloride content and pH of the sample indicate that they are not a significant factor in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a slightly aggressive corrosive environment.

6.8 Tree Planting Restrictions

Based on the subsurface profile at the test hole locations, a low to medium sensitivity clay soil was encountered throughout the site. Based on our Atterberg limits test results, the modified plasticity index does not exceed 40% in these areas. The following tree planting setbacks are recommended for the low to medium sensitivity area.

Large trees (mature height over 14 m) can be planted within these areas where 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 height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the conditions noted below 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.

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

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

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

☐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree).

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

☐ Review of the final design details, from a geotechnical perspective.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials used.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to determine the level of compaction achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

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

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

8.0 Statement of Limitations

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

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

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

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

Paterson Group Inc.

Kevin Pickard, P.Eng.

LICENSED PROFESSIONAL ENGINEER
June 3, 2025
S. S. DENNIS
100519516
Scott Dennis
PROVINCE OF ONTARIO

Scott Dennis

Scott S. Dennis, P.Eng.

Report Distribution:

☐ Kadus Group (Email Copy)
☐ Paterson Group (1 Copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

SOIL PROFILE AND TEST DATA SHEETS BY OTHERS

UNCONFINED COMPRESSIVE STRENGTH TESTING REUSLTS BY OTHERS

GRAIN SIZE DISTURBUTION TESTING RESULTS

GRAIN SIZE DISTURBUTION TESTING RESULTS BY OTHERS

ATTERBERG LIMITS TESTING RESULTS

ATTERBERG LIMITS TESTING RESULTS BY OTHERS

SEISMIC TESTING RESULTS BY OTHERS

ANALYTICAL TESTING RESULTS

ANALYTICAL TESTING RESULTS BY OTHERS

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

1750 Russell Road, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 372330.27 **NORTHING:** 5029578.74 **ELEVATION:** 75.21

PROJECT: Proposed Residential Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: May 8, 2025

FILE NO. : PG7530

HOLE NO. : BH 1-25

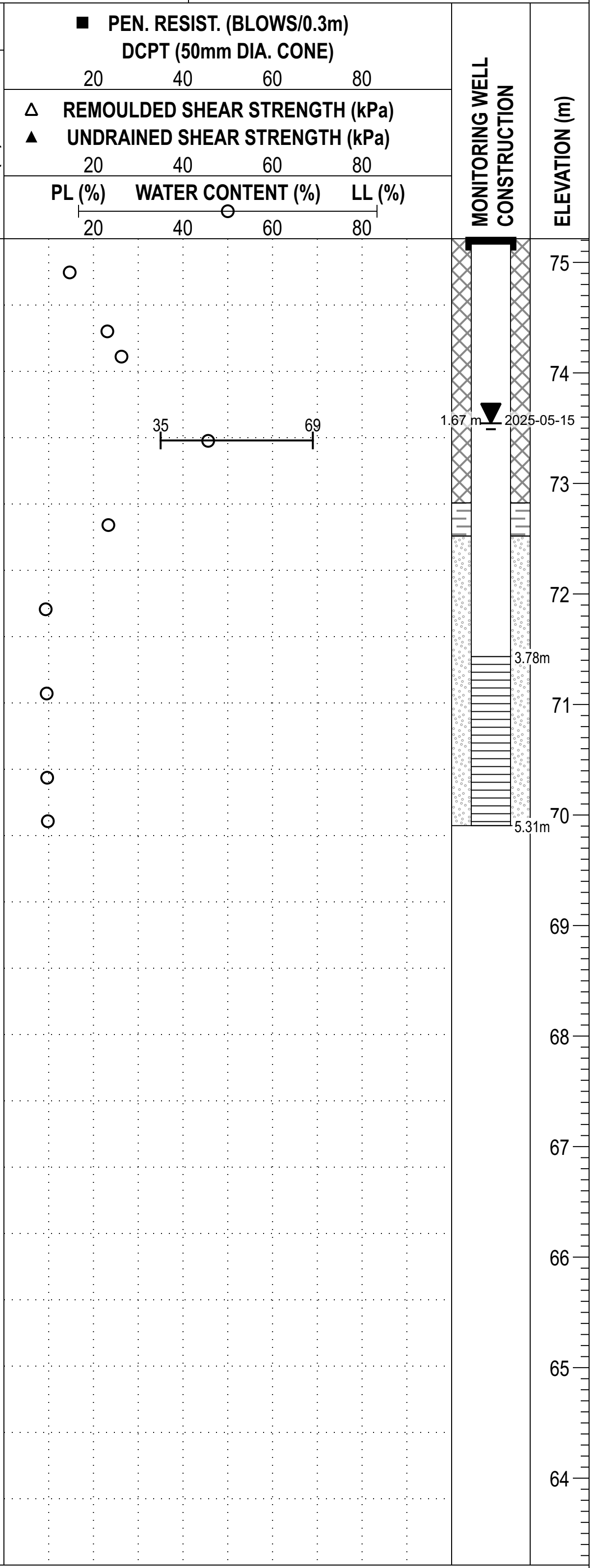
SAMPLE DESCRIPTION	Depth / [Elevation]
GROUND SURFACE	
TOPSOIL and organics	0.08m [75.13m]
FILL: Brown silty clay, with sand, some gravel, trace organics	1.45m [73.76m]
Stiff to firm, brown **SILTY CLAY**	2.21m [73.00m]
GLACIAL TILL: Firm, grey silty clay, with sand and gravel	2.95m [72.26m]
GLACIAL TILL: Loose to compact, grey silty sand, some clay, gravel, cobbles and boulders - Trace rock fragments by 4.5 m depth	5.31m [69.90m]

End of Borehole

Practical refusal to augering at 5.31 m depth

(GWL at 1.67 m depth - May 15, 2025)

TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			15
SS 2	75	3-8-6-7 14	23 26
SS 3	100	3-4-3-4 7	46
SS 4	75	0-2-4-8 6	23
SS 5	50	7-11-8-6 19	9
SS 6	42	1-3-2-3 5	10
SS 7	50	4-9-12-17 21	10
SS 8	95	50-/-/-/ 50/0.08	10



SOIL PROFILE AND TEST DATA

Geotechnical Investigation

1750 Russell Road, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 372311.69 **NORTHING:** 5029598.57 **ELEVATION:** 75.20

PROJECT: Proposed Residential Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: May 8, 2025

FILE NO. : PG7530

HOLE NO. : BH 2-25

SAMPLE DESCRIPTION

GROUND SURFACE

TOPSOIL and organics — 0.08m [75.12m]

FILL: Brown silty clay, trace sand and organics — 0.69m [74.51m]

Very stiff to stiff, brown **SILTY CLAY**, trace to some sand

- Sand content increasing with depth

2.95m [72.25m]

GLACIAL TILL: Firm, grey silty clay, with sand and gravel

- Sand content increasing with depth

5.26m [69.94m]

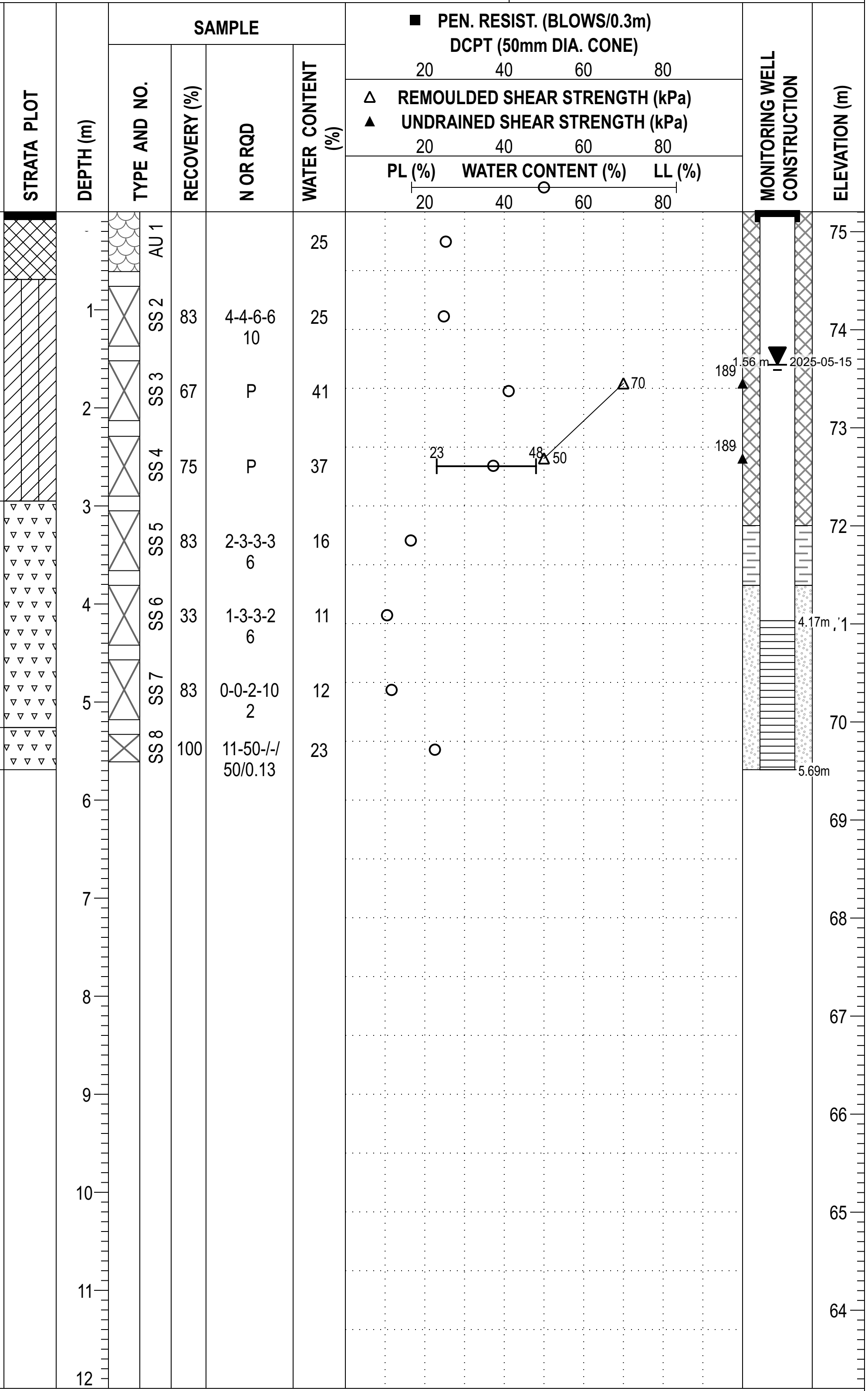
GLACIAL TILL: Grey silty sand, with gravel and rock fragments — 5.69m [69.51m]

End of Borehole

Practical refusal to augering at 5.69 m depth

(GWL at 1.56 m depth - May 15, 2025)

TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			25
SS 2	83	4-4-6-6 10	25
SS 3	67	P	41
SS 4	75	P	37
SS 5	83	2-3-3-3 6	16
SS 6	33	1-3-3-2 6	11
SS 7	83	0-0-2-10 2	12
SS 8	100	11-50-/-/ 50/0.13	23



SOIL PROFILE AND TEST DATA

Geotechnical Investigation

1750 Russell Road, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 372315.09 **NORTHING:** 5029638.69 **ELEVATION:** 75.09

PROJECT: Proposed Residential Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

DATE: May 8, 2025

FILE NO. : PG7530

HOLE NO. : BH 3-25

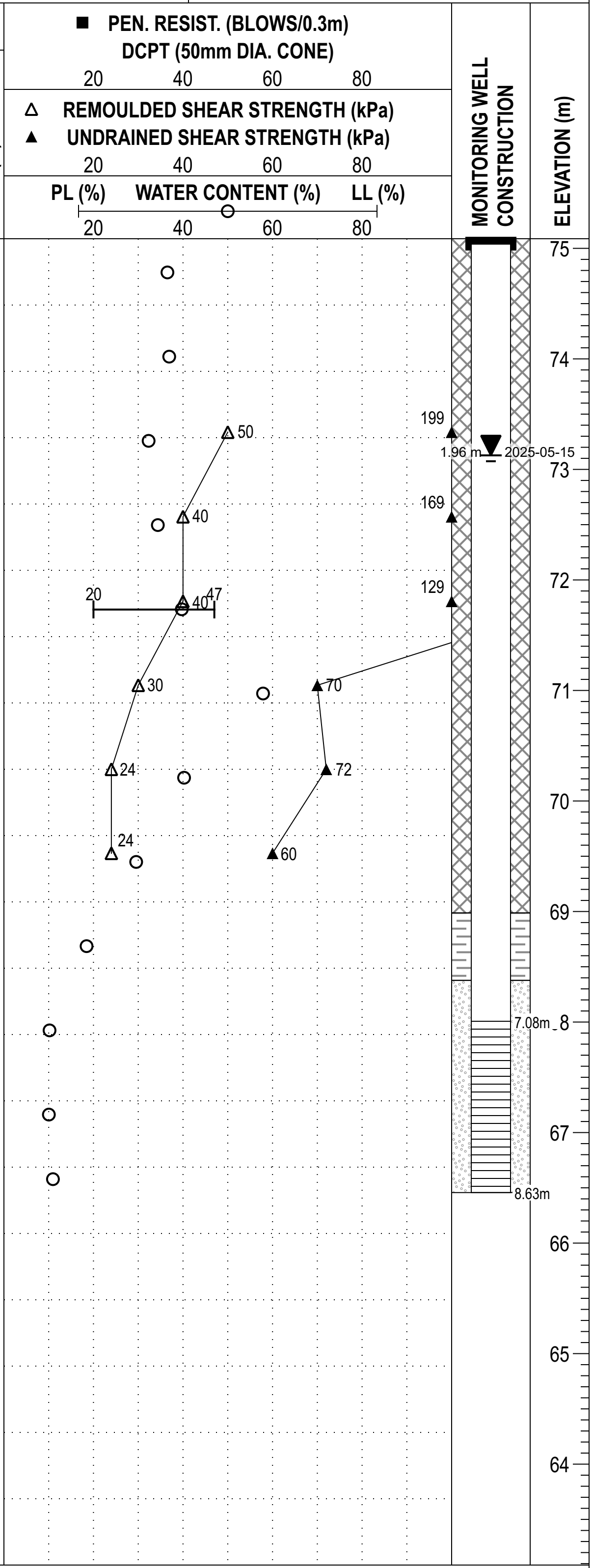
SAMPLE DESCRIPTION	
GROUND SURFACE	
TOPSOIL and organics	0.08m [75.01m]
FILL: Brown silty clay, trace sand	0.69m [74.40m]
Very stiff to stiff, brown **SILTY CLAY**	3.81m [71.28m]
Stiff, grey **SILTY CLAY**	5.94m [69.15m]
GLACIAL TILL: Loose to compact, grey silty sand, with clay and gravel - Clay content decreasing with depth	8.64m [66.45m]

End of Borehole

Practical refusal to augering at 8.64 m depth

(GWL at 1.93 m depth - May 15, 2025)

TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			37
SS 2	100	3-5-3-4 8	37
SS 3	92	P	32
SS 4	83	P	34
SS 5	100	P	40
SS 6	100	P	58
SS 7	100	P	40
SS 8	75	P	30
SS 9	67	1-1-3-4 4	18
SS 10	50	12-8-5-4 13	10
SS 11	50	2-3-3-5 6	10
SS 12	78	8-50-/-/ 50/0.1	11



SOIL PROFILE AND TEST DATA

Geotechnical Investigation

1750 Russell Road, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 372342.59 **NORTHING:** 5029649.80 **ELEVATION:** 75.18

PROJECT: Proposed Residential Development

ADVANCED BY: CME-55 Low Clearance Drill

REMARKS:

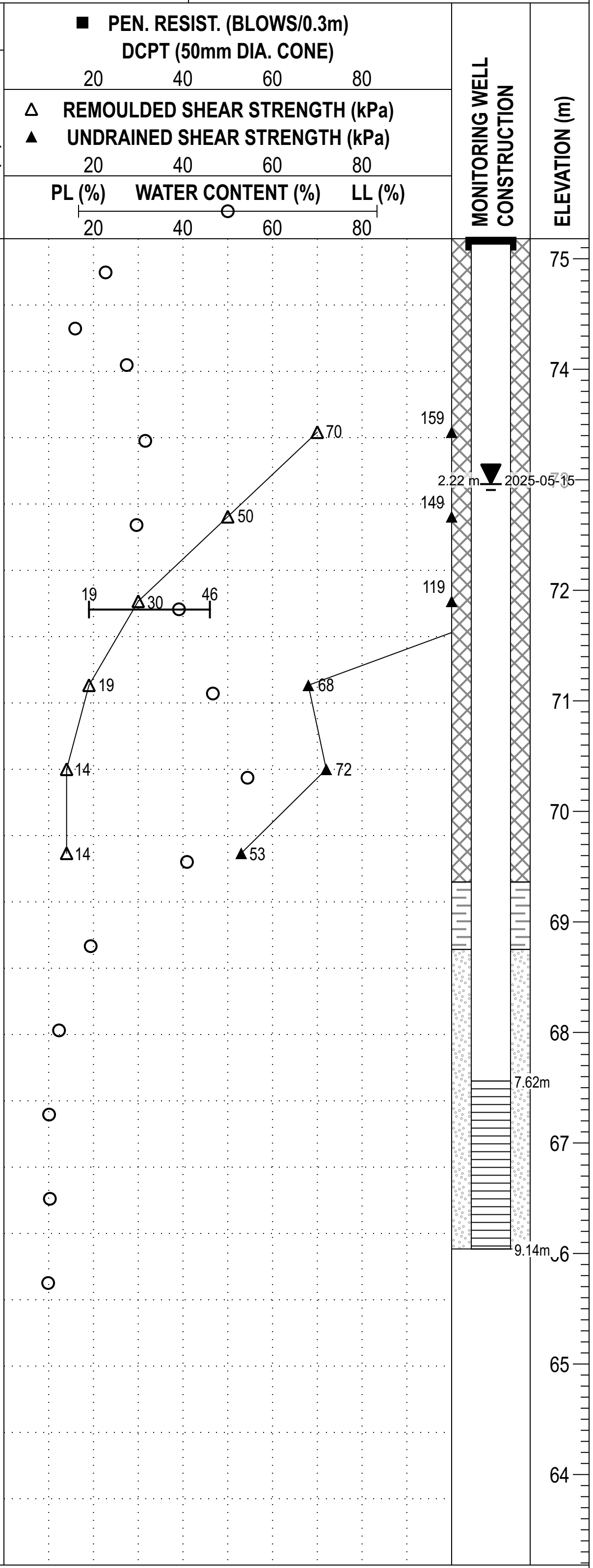
DATE: May 8, 2025

FILE NO. : PG7530

HOLE NO. : BH 4-25

SAMPLE DESCRIPTION	DEPTH (m)	ELEVATION (m)
GROUND SURFACE		
TOPSOIL and organics	0.08m	75.10m
FILL: Brown silty clay, trace sand	0.69m	74.49m
Loose, brown **SILTY SAND**	0.91m	74.27m
Stiff to very stiff, brown **SILTY CLAY**	3.81m	71.37m
Stiff, grey **SILTY CLAY**	5.99m	69.19m
GLACIAL TILL: Loose, grey silty sand, with clay and gravel - Clay content decreasing with depth	9.75m	65.43m
End of Borehole (GWL at 2.22 m depth - May 15, 2025)		

SAMPLE TYPE AND NO.	RECOVERY (%)	N OR RQD	WATER CONTENT (%)
AU 1			23
SS 2	83	3-3-2-3 5	16 27
SS 3	67	P	32
SS 4	25	P	30
SS 5	100	P	39
SS 6	100	P	47
SS 7	83	P	54
SS 8	92	P	41
SS 9	50	P	19
SS 10	42	21-5-4-3 9	12
SS 11	67	0-2-2-3 4	10
SS 12	58	0-1-1-1 2	10
SS 13	25	1-2-2-1 4	10



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

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

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

CONSOLIDATION TEST

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

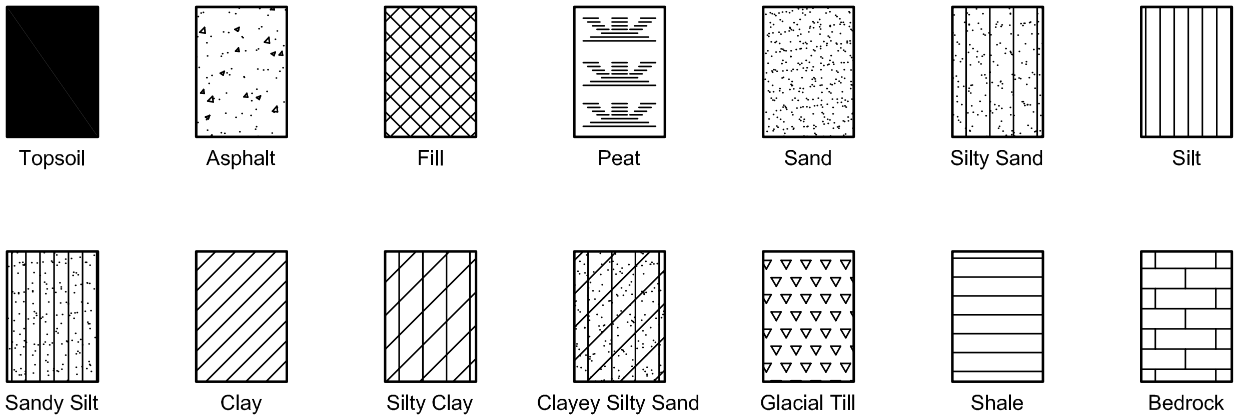
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

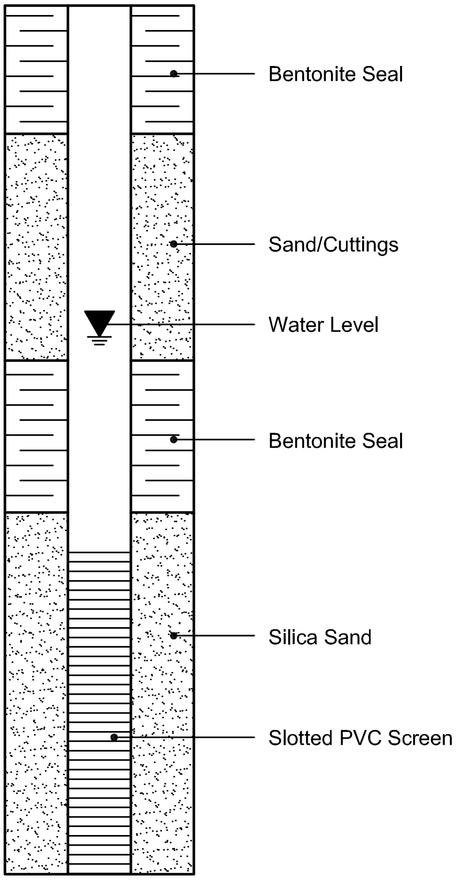
SYMBOLS AND TERMS (continued)

STRATA PLOT

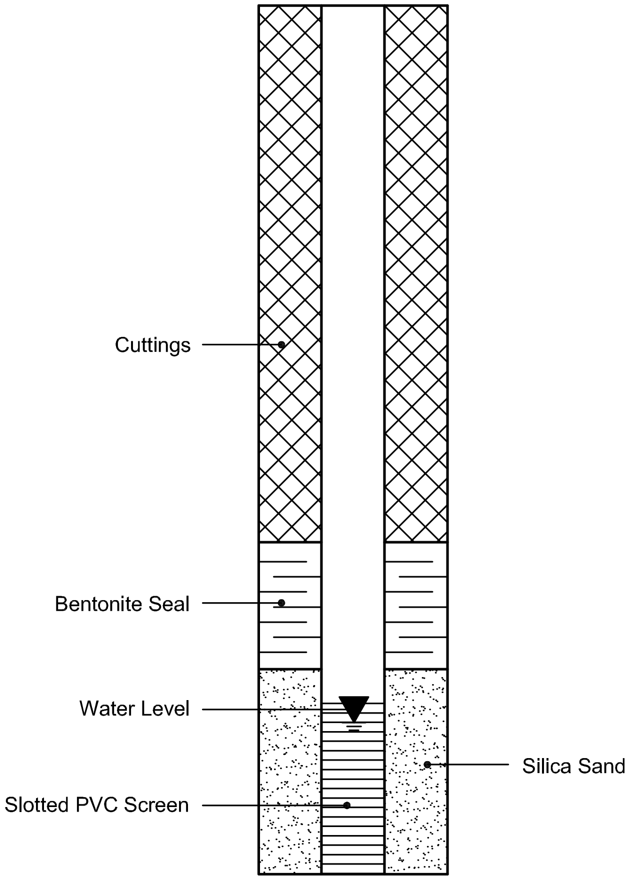


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PROJECT: 19130191

RECORD OF BOREHOLE: 20-01

SHEET 1 OF 1

LOCATION: N 5028053.7 ;E 450218.7

BORING DATE: January 21, 2020

DATUM: Local

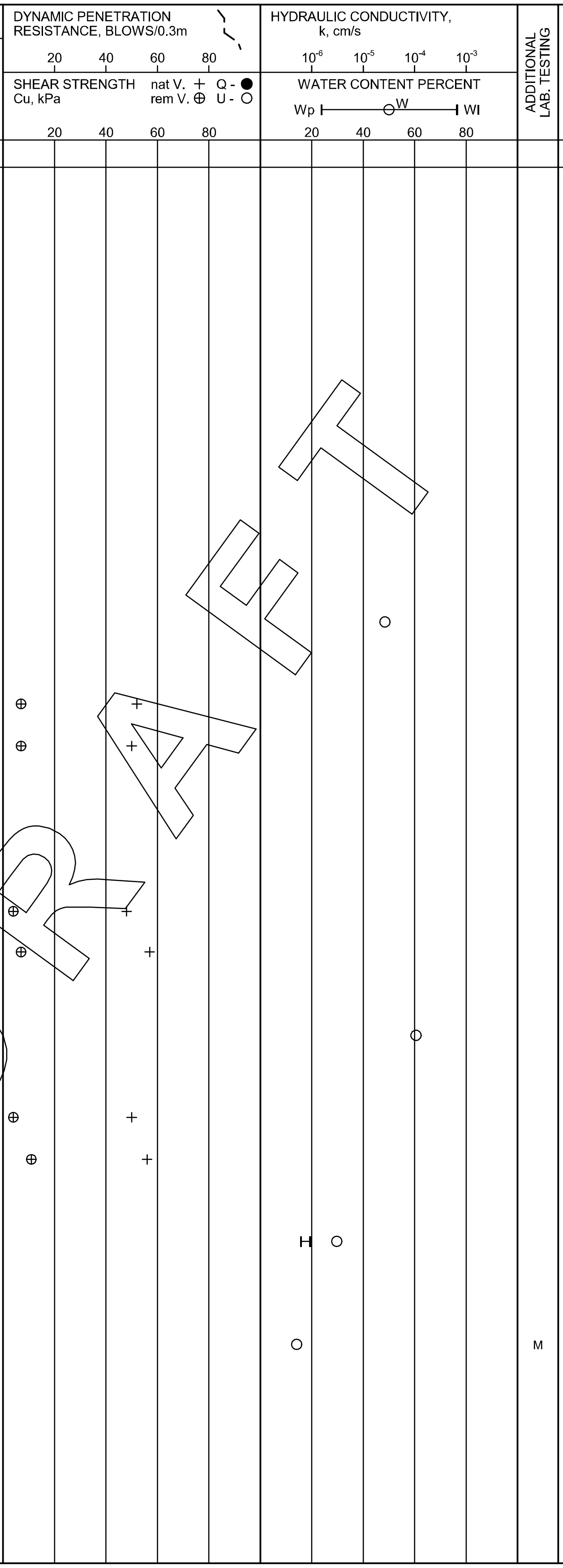
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	75.47
INTERLOCK	0.00
FILL - (SW) gravelly SAND, some silt; brown; non-cohesive, moist, compact	0.08
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose	74.71 0.76
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); cohesive, w~PL, very stiff	72.73 2.74
(CI/CH) SILTY CLAY, some silty fine sand seams; grey; cohesive, w>PL, firm to stiff	72.42 3.05
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, loose	67.85 7.62
(SM) gravelly SILTY SAND; grey; non-cohesive (GLACIAL TILL); wet, loose to compact	67.24 8.23
Weathered SHALE	66.33 9.14
End of Borehole	66.10 9.37

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	3	
3	SS	8	
4	SS	WH	
5	SS	WH	
6	SS	WH	
7	SS	2	
8	SS	7	M
9	SS	>50	



PIEZOMETER OR STANDPIPE INSTALLATION: ∇ (approx. 3.1 m)

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF BOREHOLE: 20-02

SHEET 1 OF 1

LOCATION: N 5028066.6 ;E 450233.3

BORING DATE: January 21, 2020

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

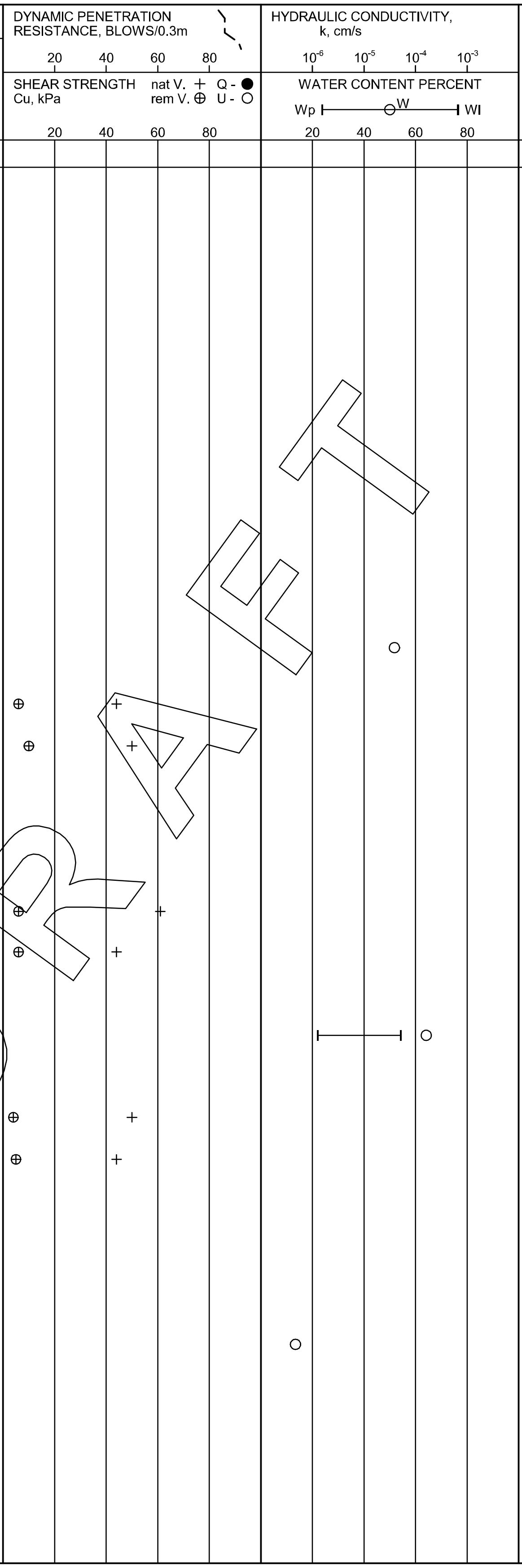
BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE

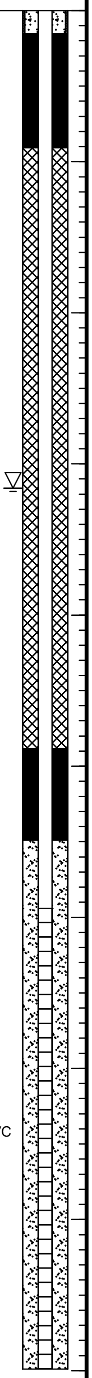
DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	75.36
INTERLOCK	0.00
FILL - (SM) gravelly SAND, some silt; brown (INTERLOCK STRUCTURE); non-cohesive	0.08
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose to compact	74.60 0.76
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); w~PL, very stiff to hard	72.31 3.05
(CI/CH) SILTY CLAY, some silty fine sand seams; grey; cohesive, w>PL, firm to stiff	71.88 3.48
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, very loose	67.74 7.62
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, compact	66.83 8.53
Weathered SHALE	66.22 9.14
End of Borehole	65.91 9.45

SAMPLES

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	10	
2	SS	6	
3	SS	13	
4	SS	WH	
5	SS	WH	
6	SS	WH	M
7	SS	1	
8	SS	18	M
9	SS	>50	



PIEZOMETER OR STANDPIPE INSTALLATION



Flush Mount Casing

Cuttings and Bentonite

Bentonite Seal

Silica Sand

32 mm Diam. PVC #10 Slot Screen

W.L. in Screen at 3.16 m depth on Jan. 27th, 2020

DEPTH SCALE 1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF BOREHOLE: 20-03

SHEET 1 OF 2

LOCATION: N 5028038.4 ;E 450229.4

BORING DATE: January 21, 2020

DATUM: Local

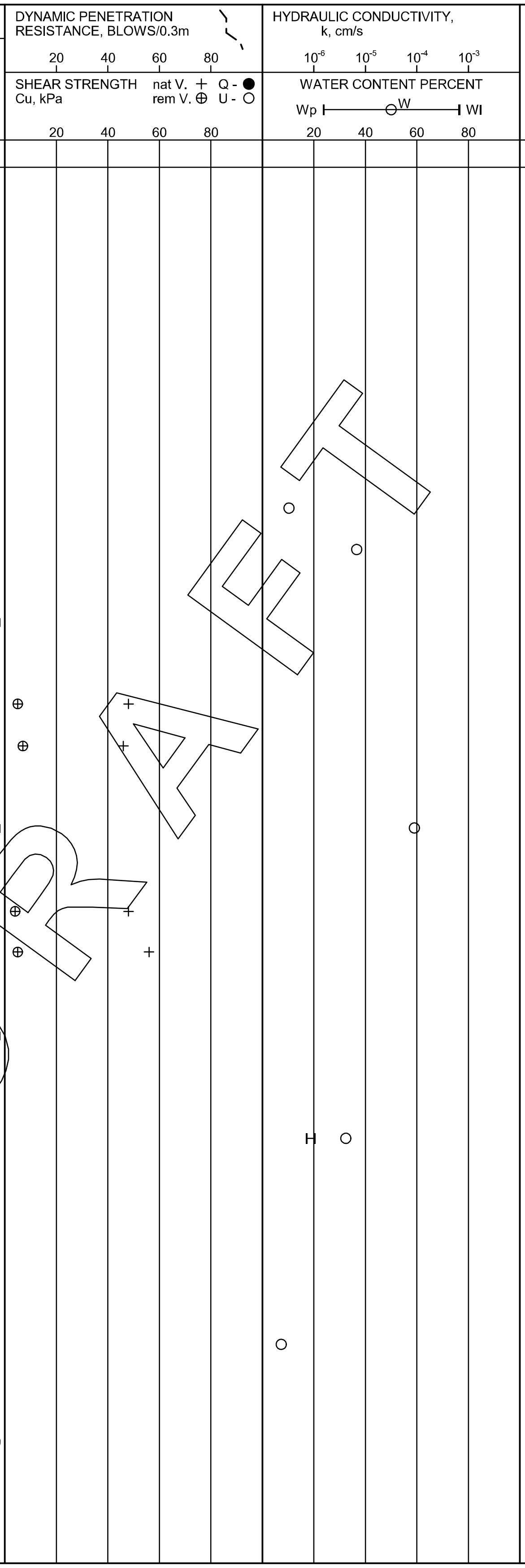
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	75.39	
TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose	74.78	0.61
(CI/CH) SILTY CLAY; grey brown, slighty fissured (WEATHERED CRUST); cohesive, w~PL, very stiff to hard	73.87	1.52
(CI/CH) SILTY CLAY, some fine silty sand seams; grey; cohesive, w>PL, firm to stiff	72.34	3.05
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, very loose	68.53	6.86
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, loose to dense	67.16	8.23
Weathered SHALE	66.25	9.14
Borehole continued on RECORD OF DRILLHOLE 19-03	65.71 9.68	9.8

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	8	
2	SS	5	
3	SS	3	
4	SS	WH	
5	SS	WH	
6	SS	WH	
7	SS	4	
8	SS	2	M
9	SS	10	
10	SS	>50	



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES

DEPTH SCALE 1 : 50

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF DRILLHOLE: 20-03

SHEET 2 OF 2

LOCATION: N 5028038.4 ;E 450229.4

INCLINATION: -90° AZIMUTH: ---

DRILLING DATE: January 21, 2020

DRILL RIG:

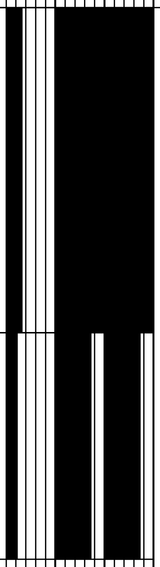
DRILLING CONTRACTOR: CCC Drilling

DATUM: Local

JN - Joint
FLT - Fault
SHR- Shear
VN - Vein
CJ - Conjugate
BD- Bedding
FO- Foliation
CO- Contact
OR- Orthogonal
CL - Cleavage
PL - Planar
CU- Curved
UN- Undulating
ST - Stepped
IR - Irregular
PO- Polished
K - Slickensided
SM- Smooth
Ro - Rough
MB- Mechanical Break
BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.25 m 5 10 15 20	DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jcon	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	Diametral Point Load Index (MPa) 2 4 6	RMC -Q' AVG.
		BEDROCK SURFACE		65.59														
10 11 12 13	Rotary Drill NQ Core	Highly weathered to fresh, thinly bedded, grey black SHALE, with limestone interbeds		9.80 61.94	1 2													
14 15 16 17 18 19		End of Drillhole		13.45														



DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF BOREHOLE: 20-04

SHEET 1 OF 1

LOCATION: N 5028030.2 ;E 450240.7

BORING DATE: January 20, 2020

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

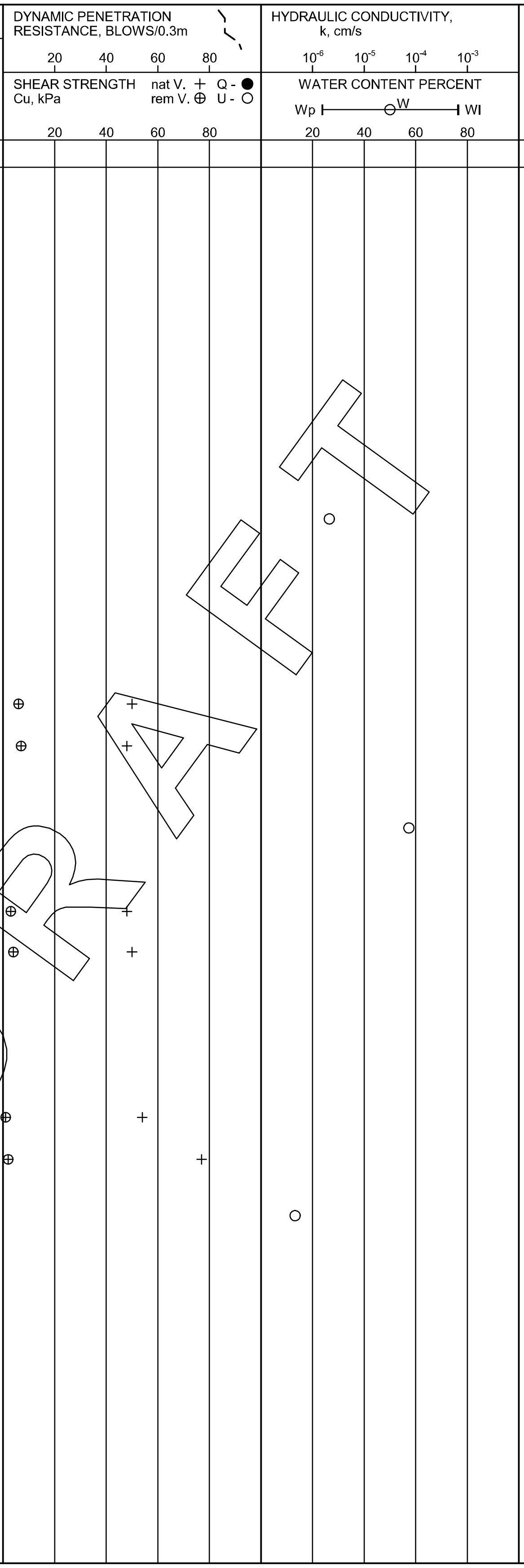
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m
GROUND SURFACE	75.31			
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00			
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose	74.78 0.53	1	SS	9
		2	SS	6
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); cohesive, w~PL, very stiff to hard	73.02 2.29	3	SS	10
(CI/CH) SILTY CLAY, some fine silty sand seams; grey; w>PL, firm to stiff	72.26 3.05	4	SS	WH
		5	SS	WH
		6	SS	WH
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, very loose	67.69 7.62	7	SS	2
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, compact	67.08 8.23	8	SS	17
Weathered SHALE	66.47 8.84			
End of Borehole	66.24 9.07			

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF BOREHOLE: 20-05

SHEET 1 OF 2

LOCATION: N 5028004.9 ;E 450221.4

BORING DATE: January 13 & 15, 2020

DATUM: Local

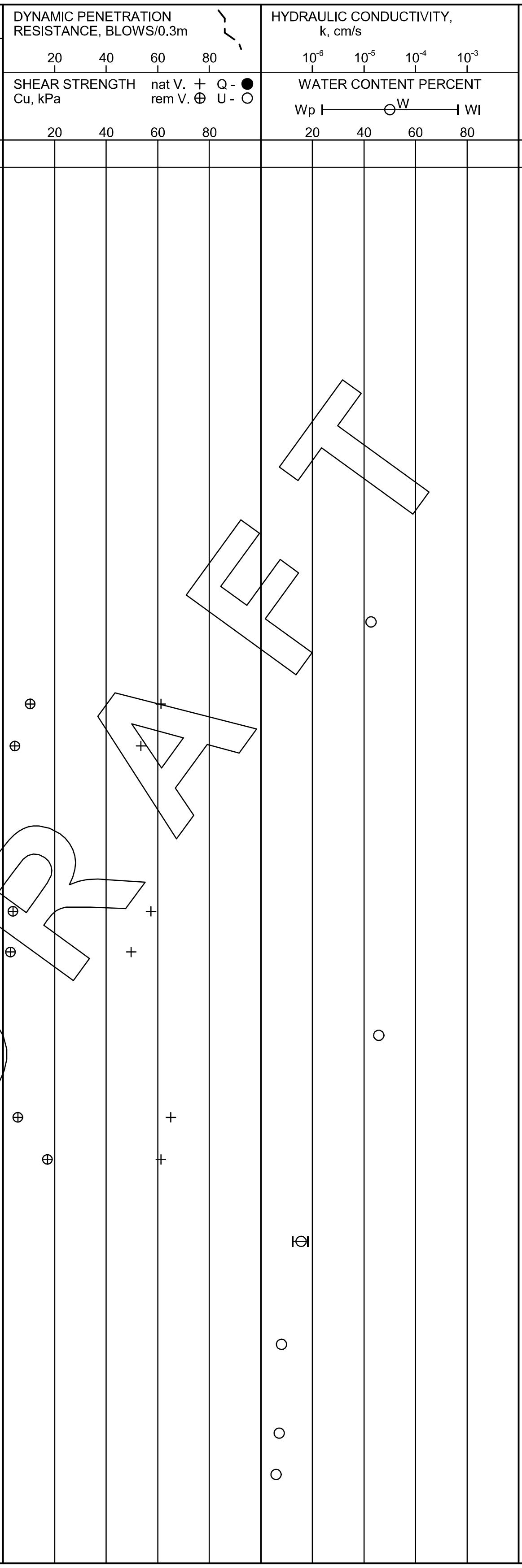
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	75.39
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose to compact	75.16 0.23
(ML) sandy SILT, some low plasticity fines; dark brown, contains rootlets; cohesive, w~PL, very stiff	73.10 2.29
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); w~PL, stiff	2.44
(CI/CH) SILTY CLAY; grey; cohesive, w>PL, firm to stiff	72.34 3.05
(ML/SM) CLAYEY SILT to sandy SILT, trace to some fine to medium sand; grey; non-cohesive, wet, loose	67.77 7.62
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, compact to dense	67.01 8.38
Borehole continued on RECORD OF DRILLHOLE 19-05	65.54 9.85

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	8	
2	SS	4	
3	SS	4	
4	SS	WH	
7	SS	WH	
10	SS	WH	
13	SS	6	M
14	SS	20	M
15	SS	31	M



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF DRILLHOLE: 20-05

SHEET 2 OF 2

LOCATION: N 5028004.9 ;E 450221.4

INCLINATION: -90° AZIMUTH: ---

DRILLING DATE: January 13 & 15, 2020

DRILL RIG:

DRILLING CONTRACTOR: CCC Drilling

DATUM: Local

JN - Joint
FLT - Fault
SHR- Shear
VN - Vein
CJ - Conjugate

BD- Bedding
FO- Foliation
CO- Contact
OR- Orthogonal
CL - Cleavage

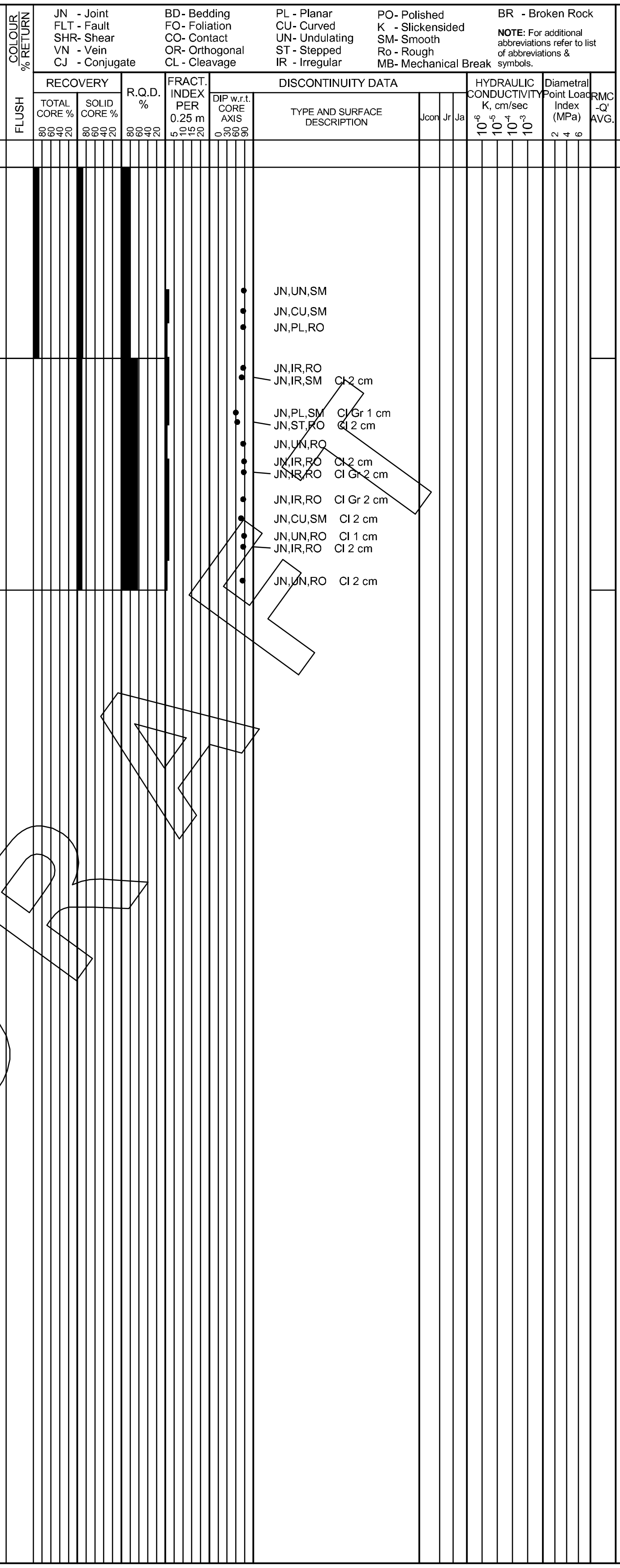
PL - Planar
CU- Curved
UN- Undulating
ST - Stepped
IR - Irregular

PO- Polished
K - Slickensided
SM- Smooth
Ro - Rough
MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.
		BEDROCK SURFACE		65.54	
10	Rotary Drill NQ Core	Highly weathered to fresh, thinly bedded, grey black SHALE, with limestone interbeds		9.85	1
11					
12					2
13				62.42 12.97	
		End of Drillhole			
14					
15					
16					
17					
18					
19					



TYPE AND SURFACE DESCRIPTION	
JN,UN,SM	
JN,CU,SM	
JN,PL,RO	
JN,IR,RO	
JN,IR,SM	Cl 2 cm
JN,PL,SM	Cl Gr 1 cm
JN,ST,RO	Cl 2 cm
JN,UN,RO	
JN,IR,RO	Cl 2 cm
JN,IR,RO	Cl Gr 2 cm
JN,IR,RO	Cl Gr 2 cm
JN,CU,SM	Cl 2 cm
JN,UN,RO	Cl 1 cm
JN,IR,RO	Cl 2 cm
JN,UN,RO	Cl 2 cm

UCS = 44.8 MPa

DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: AG

MIS-RCK 004 19130191.GPJ GAL-MISS.GDT 20-2-27 JEM

PROJECT: 19130191

RECORD OF BOREHOLE: 20-06

SHEET 1 OF 1

LOCATION: N 5028011.2 ;E 450236.4

BORING DATE: January 14, 2020

DATUM: Local

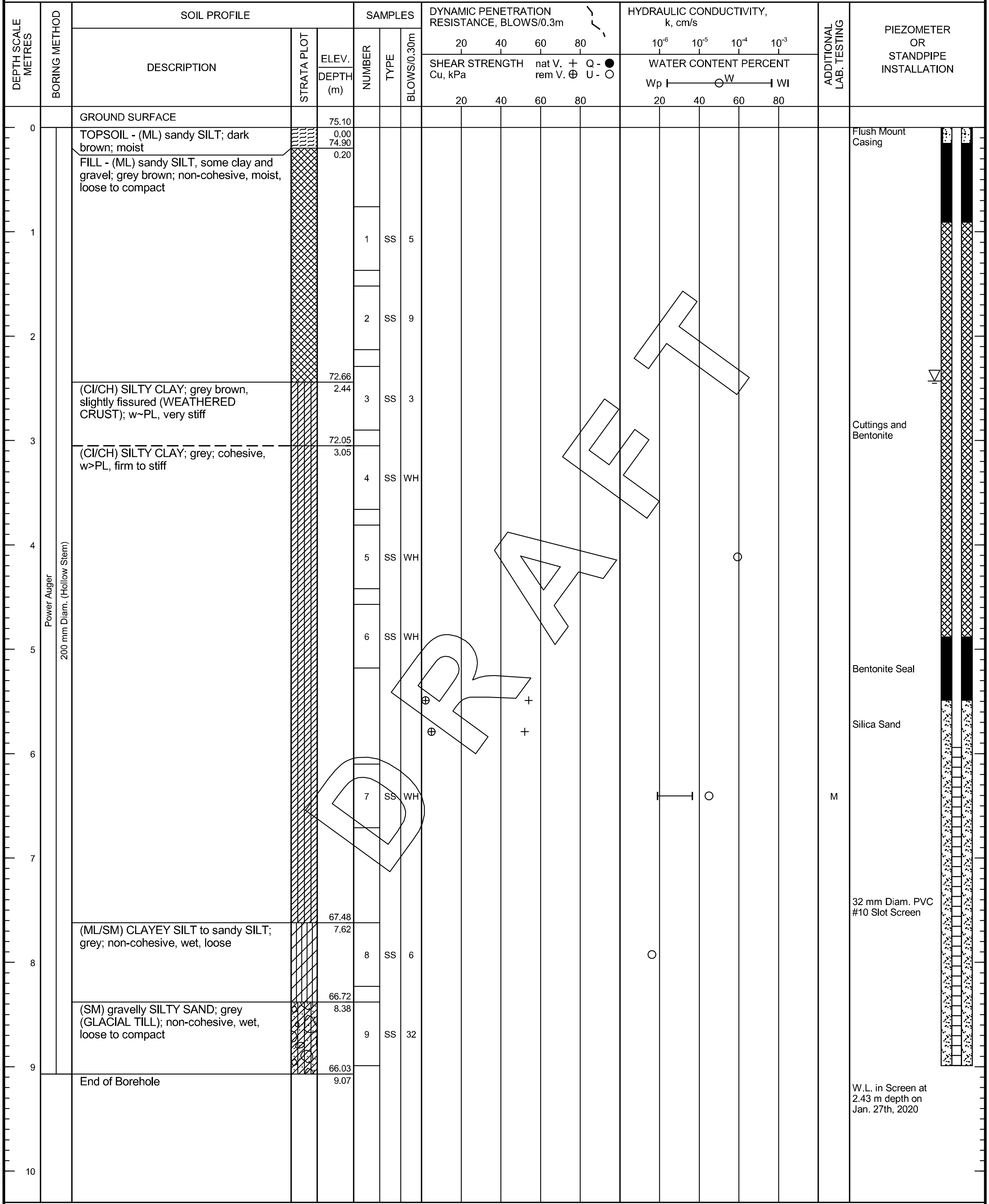
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	75.10
TOPSOIL - (ML) sandy SILT; dark brown; moist	0.00
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose to compact	74.90 0.20
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); w~PL, very stiff	72.66 2.44
(CI/CH) SILTY CLAY; grey; cohesive, w>PL, firm to stiff	72.05 3.05
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, loose	67.48 7.62
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, loose to compact	66.72 8.38
End of Borehole	66.03 9.07

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	5	
2	SS	9	
3	SS	3	
4	SS	WH	
5	SS	WH	
6	SS	WH	
7	SS	WH	M
8	SS	6	
9	SS	32	



Flush Mount Casing

Cuttings and Bentonite

Bentonite Seal

Silica Sand

32 mm Diam. PVC #10 Slot Screen

W.L. in Screen at 2.43 m depth on Jan. 27th, 2020

DEPTH SCALE

1 : 50

GOLDER

LOGGED: JD

CHECKED: AG

PROJECT: 19130191

RECORD OF BOREHOLE: 20-07

SHEET 1 OF 2

LOCATION: N 5028016.5 ;E 450254.0

BORING DATE: January 15, 2020

DATUM: Local

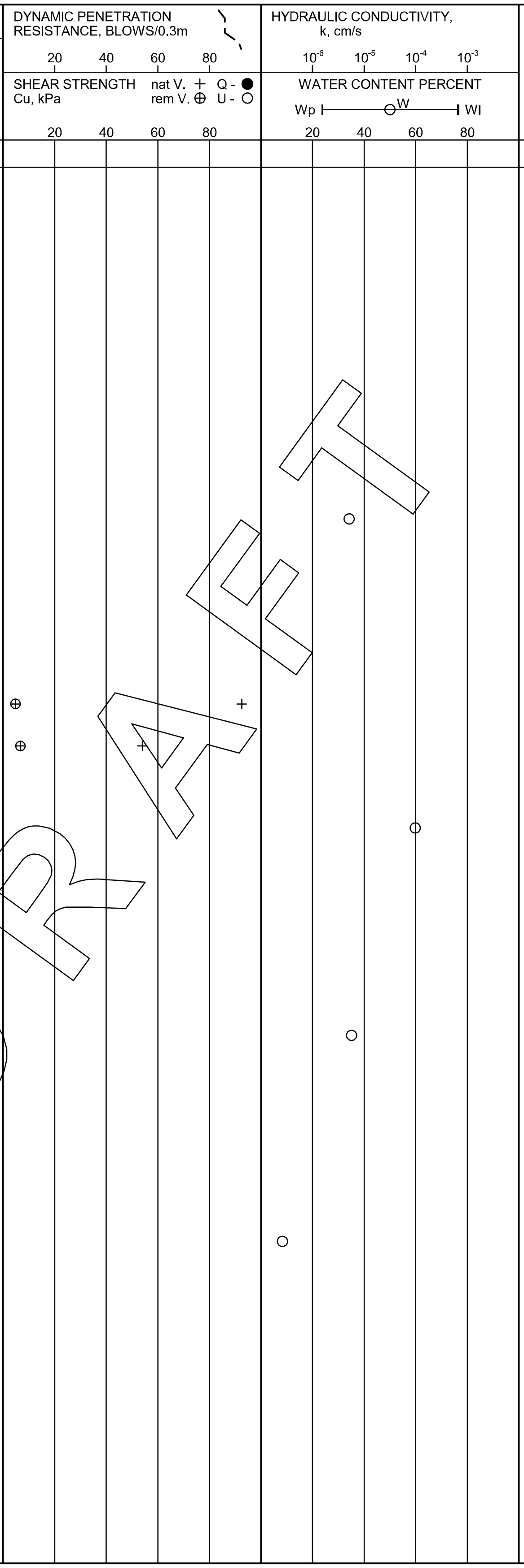
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	75.16	
TOPSOIL - (ML) sandy SILT; dark brown; moist		0.00
FILL - (ML) sandy SILT, some clay and gravel; grey brown; non-cohesive, moist, loose to compact	74.86	0.30
(CI/CH) SILTY CLAY; grey brown, slightly fissured (WEATHERED CRUST); cohesive, w~PL, very stiff to hard	72.87	2.29
(CI/CH) SILTY CLAY, some fine silty sand seams; grey; cohesive, w>PL, firm to stiff	72.11	3.05
(ML/SM) CLAYEY SILT to sandy SILT; grey; non-cohesive, wet, very loose	68.35	6.81
(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, wet, loose to compact	67.54	7.62
Borehole continued on RECORD OF DRILLHOLE 19-07	66.32	8.84

SAMPLES NUMBER	TYPE	BLOWS/0.30m
1	SS	5
2	SS	11
3	SS	6
4	SS	WH
5	SS	WH
6	SS	1
7	SS	1
8	SS	4
9	SS	11
10	SS	17



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

LOGGED: JD
CHECKED: AG

PROJECT: 19130191

RECORD OF DRILLHOLE: 20-07

SHEET 2 OF 2

LOCATION: N 5028016.5 ;E 450254.0

INCLINATION: -90° AZIMUTH: ---

DRILLING DATE: January 15, 2020

DRILL RIG:

DRILLING CONTRACTOR: CCC Drilling

DATUM: Local

JN - Joint
FLT - Fault
SHR- Shear
VN - Vein
CJ - Conjugate

BD- Bedding
FO- Foliation
CO- Contact
OR- Orthogonal
CL - Cleavage

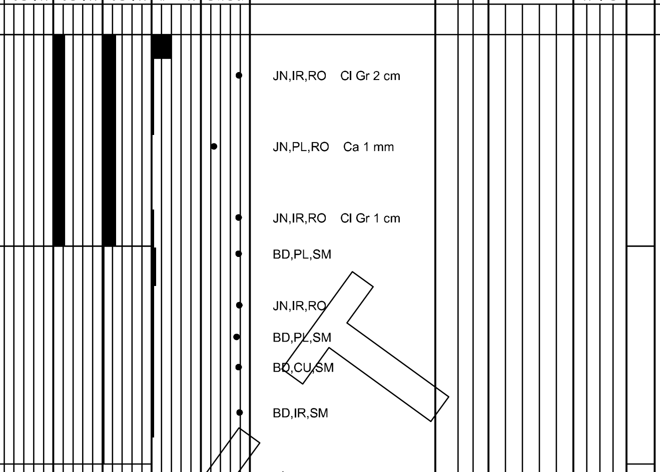
PL - Planar
CU- Curved
UN- Undulating
ST - Stepped
IR - Irregular

PO- Polished
K - Slickensided
SM- Smooth
Ro - Rough
MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN FLUSH	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION
		BEDROCK SURFACE		66.32			
9	Rotary Drill NQ Core	Slightly weathered to fresh, thinly bedded, grey black SHALE, with limestone interbeds		8.84	1		JN,IR,RO Cl Gr 2 cm JN,PL,RO Ca 1 mm
10							JN,IR,RO Cl Gr 1 cm
					2		BD,PL,SM JN,IR,RO BD,PL,SM
11				63.48 11.68			BD,CU,SM BD,IR,SM
		End of Drillhole					
12							
13							
14							
15							
16							
17							
18							



DEPTH SCALE
1 : 50

GOLDER

LOGGED: JD
CHECKED: AG

PROJECT: 09-1121-0141

RECORD OF BOREHOLE: 09-100

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Jan. 7, 2010

DATUM: Geodetic

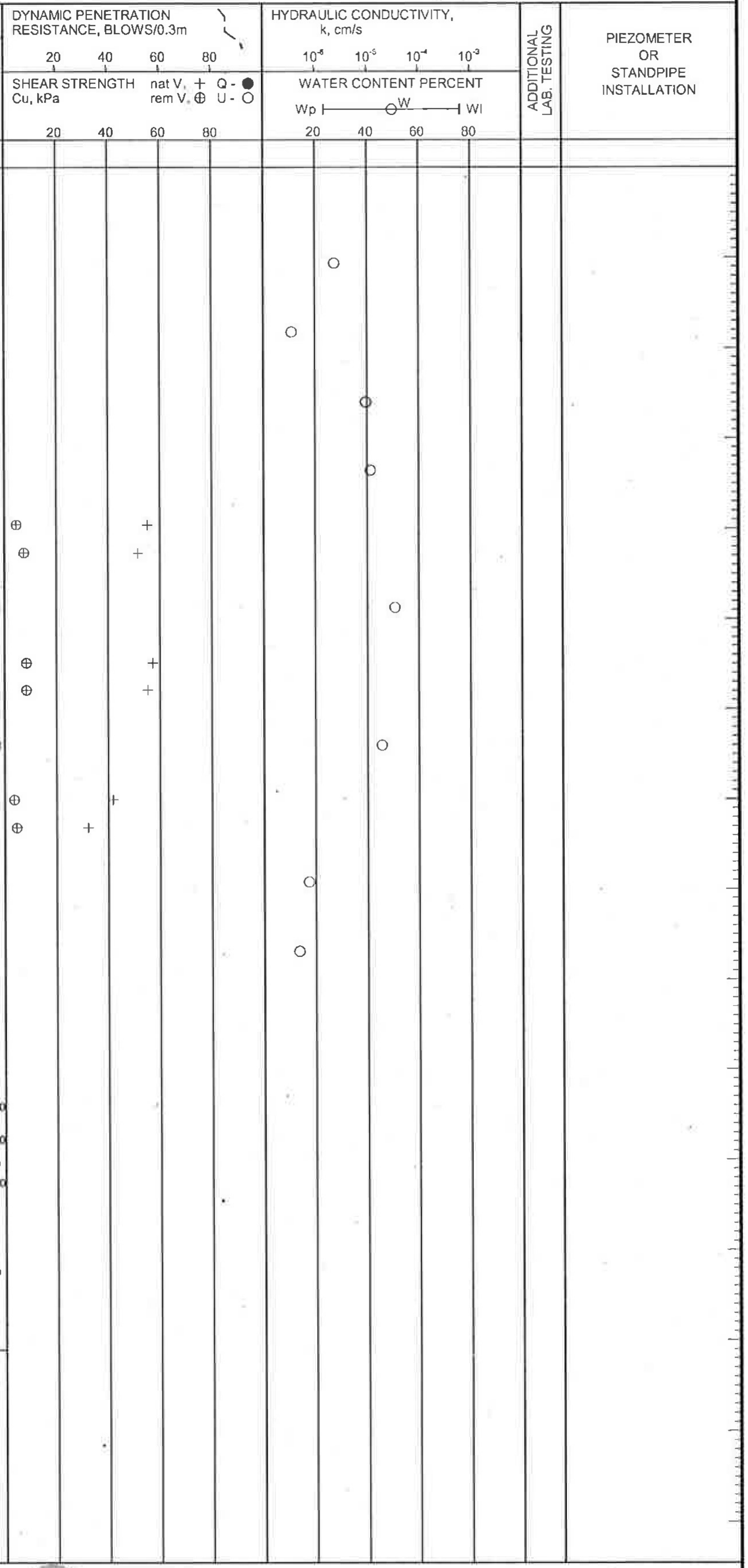
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger 200mm Diam. (Hollow Stem) (0 to 9.1 m); Wash Boring (9.1 to 13.1 m)

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	75.04
ASPHALTIC CONCRETE	0.08
Brown sand and gravel (BASE)	74.64 0.40
Grey brown sand, some gravel and silt (FILL)	
Very stiff grey brown SILTY CLAY (Weathered Crust)	73.04 2.00
Stiff grey SILTY CLAY, trace sand	72.14 2.90
Very loose to compact grey silty SAND and GRAVEL, some clay (GLACIAL TILL)	67.42 7.62
Weathered and fractured dark brown to black SHALE BEDROCK No core recovery from 11.4m to 13.1m depth	65.29 9.75
End of Borehole	61.93 13.11

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	18
3	50 DO	3
4	50 DO	WH
5	50 DO	WH
6	50 DO	WH
7	50 DO	2
8	50 DO	1
9	50 DO	12
10	NQ RC	DD
11	50 DO	>100
12	50 DO	>100
13	NQ RC	DD
14	50 DO	>100
15	NQ RC	DD



DEPTH SCALE

1 : 75

Golder Associates

LOGGED: J.D.

CHECKED: NBL

MIS-BHS 001 0911210141.GPJ GAL-MIS.GDT 9/17/10 JM

PROJECT: 09-1121-0141

RECORD OF BOREHOLE: 09-101

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: Jan. 8-11, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger 200mm Diam. (Hollow Stem)

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl : 20 40 60 80

ADDITIONAL LAB. TESTING

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	74.86			
ASPHALTIC CONCRETE	0.07			
Sand and gravel, some silt (BASE/SUBBASE/FILL)				
Grey brown silty sand, trace gravel (FILL)	73.34 1.52	1	50 DO	13
Grey SILTY CLAY	72.73 2.13	2	50 DO	WH
		3	50 DO	WH
Firm to stiff grey SILTY CLAY	69.68 5.18	4	50 DO	WH
		5	50 DO	WH
		6	50 DO	WH
Grey CLAYEY SILT, trace sand	67.24 7.62	7	50 DO	4
		8	50 DO	2
Very dense dark grey brown SANDY SILT, some gravel, occasional shale fragments (GLACIAL TILL)	65.72 9.14	9	50 DO	71
Weathered and fractured dark brown SHALE BEDROCK	64.80 10.06	10	50 DO	>100
Borehole continued next page	64.04 10.82			

PIEZOMETER OR STANDPIPE INSTALLATION

Flush mount casing

Bentonite Seal

∇

Native Backfill

Bentonite Seal

Silica Sand

Standpipe

Silica Sand

Bentonite Seal

W.L. in standpipe at Elev. 72.33m on Jan. 21, 2010

DEPTH SCALE

1 : 75

Golder Associates

LOGGED: J.D./D.W.M.

CHECKED: NAL

PROJECT: 09-1121-0141

RECORD OF DRILLHOLE: 09-101

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Jan. 8-11, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN FLUSH	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.3 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY, K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	DIAMETRAL POINT LOAD INDEX (MPa) 2 4 6	NOTES WATER LEVELS INSTRUMENTATION
		Borehole continued from previous page		64.04												
11	Rotary Drill NQ Core	Weathered and fractured dark brown SHALE BEDROCK		10.82	1											
12				62.42	2											Bentonite Seal
		Fresh to sound dark brown SHALE BEDROCK		12.44												
13				61.76												
		End of Drillhole		13.10												W.L. in standpipe at Elev. 72.66m on Jan. 21, 2010
14																
15																
16																
17																
18																
19																
20																
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22																
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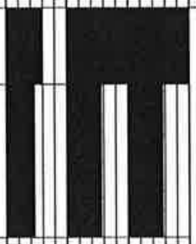
24																
25																



DEPTH SCALE
1 : 75

Golder Associates

LOGGED: J.D./D.W.M.
CHECKED: NBL

PROJECT: 09-1121-0141

RECORD OF BOREHOLE: 09-102

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: Jan. 12-14, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 20 40 60 80

ADDITIONAL LAB. TESTING

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	75.13				
Power Auger 200mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE					
	Grey crushed stone (BASE)	0.11				
	Sand and gravel (SUBBASE)	0.28				
	Brown silty clay, some sand and gravel (FILL)	0.53				
	Dense grey sand and gravel, trace sandy silt (FILL)	73.61 1.52	1	50 DO	48	
	Firm to stiff grey brown SILTY CLAY, trace sand (Weathered Crust)	72.69 2.44	2	50 DO	PH	
	Firm to stiff grey SILTY CLAY, trace silty sand seams	71.47 3.66	3	50 DO	PH	VSP Pipe
			4	50 DO	PH	
			5	50 DO	PH	
	Very loose to loose grey SILT, with silty sand seams, silty clay layers and gravel	67.97 7.16	6	50 DO	4	
	Compact SILTY SAND, some gravel, trace clay (GLACIAL TILL)	66.75 8.38	7	50 DO	41	
	Weathered and fractured to fresh brown SHALE BEDROCK	66.46 8.67				
		66.19 8.94				
	Borehole continued next page					

DEPTH SCALE

1 : 75

Golder Associates

LOGGED: D.W.M.

CHECKED: NBL

PROJECT: 09-1121-0141

RECORD OF DRILLHOLE: 09-102

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Jan. 12-14, 2010

DATUM: Geodetic

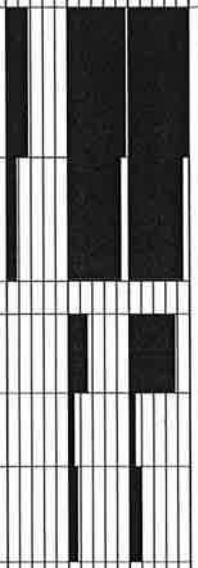
DRILL RIG: CME 75

INCLINATION: -90° AZIMUTH: ---

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	NOTES WATER LEVELS INSTRUMENTATION
		Borehole continued from previous page			
9	Rotary Drill NQ Core	Weathered and fractured to fresh brown SHALE BEDROCK	66.19 8.94	1 2 3	VSP Pipe
12		Fresh to sound brown SHALE BEDROCK, occasional mud seams	63.14 11.99	4 5	
13		Fresh to sound black SHALE BEDROCK	61.62 13.51	6	Cave
		End of Drillhole	60.67 14.46		



MIS-RCK 001 09112101 41-ROCK.GPJ GAL-MISS.GDT 9/17/10

DEPTH SCALE
1 : 75

LOGGED: D.W.M.
CHECKED: NAL

PROJECT: 09-1121-0141

RECORD OF BOREHOLE: 09-103

SHEET 1 OF 2

LOCATION: See Site Plan

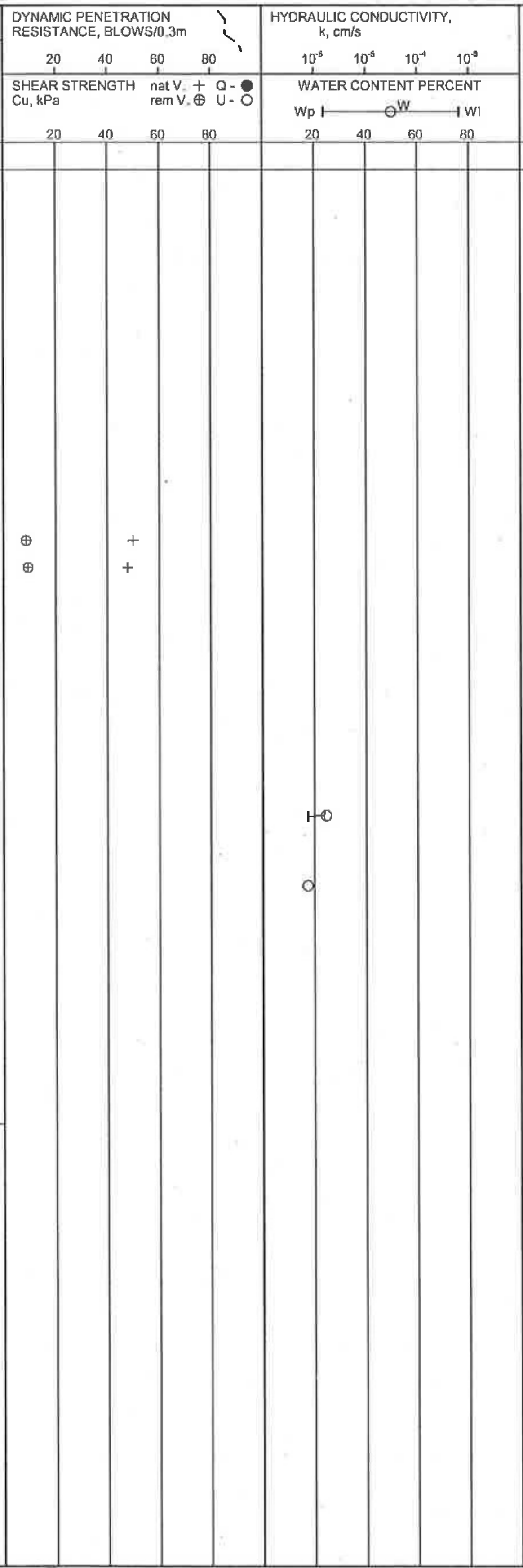
BORING DATE: Jan. 11-12, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	75.00					
0	Power Auger 200mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE	0.03					
		Grey crushed stone (BASE)	0.20					
		Grey sand and gravel (SUBBASE)	74.52 0.48					
1		Brown silty clay, trace to some sand and gravel (FILL)						
		Very stiff brown SILTY CLAY, trace sand (Weathered Crust)	73.33 1.67	1	50 DO	9		
2								
3		Firm to stiff grey SILTY CLAY, trace silty sand	71.95 3.05	2	50 DO	PH		
4								
5				3	50 DO	PH		
6		Firm to stiff grey SILTY CLAY, trace to some silty sand seams	68.90 6.10	4	50 DO	PH		
7		Very loose grey SILT, trace silty sand and silty clay seams	67.99 7.01	5	50 DO	2		
8				6	50 DO	3	MH	
				7	50 DO	3		
9		Loose to compact grey SILTY SAND, trace to some gravel and shale fragments (GLACIAL TILL)	66.31 8.69	8	50 DO	36		
10		Weathered and fractured SHALE BEDROCK	65.40 9.60					
		Borehole continued next page	64.43 10.57					
11								
12								
13								
14								
15								



DEPTH SCALE
1 : 75

LOGGED: D.W.M.

CHECKED: NRL

PROJECT: 09-1121-0141

RECORD OF DRILLHOLE: 09-103

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Jan. 11-12, 2010

DATUM: Geodetic

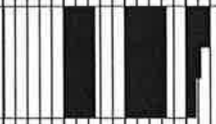
DRILL RIG: CME 75

INCLINATION: -90° AZIMUTH: ---

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE % 80 60 40 20	RECOVERY SOLID CORE % 80 60 40 20	R.Q.D. % 80 60 40 20	FRACT. INDEX PER 0.3 5 10 15 20	DISCONTINUITY DATA DIP w.r.t. CORE AXIS 0 30 60 90	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec 10^{-6} 10^{-5} 10^{-4} 10^{-3}	DIAMETRAL POINT LOAD INDEX (MPa) 2 4 6	NOTES WATER LEVELS INSTRUMENTATION
		Borehole continued from previous page		64.43													
11	Rotary Drill NQ Core	Weathered and fractured SHALE BEDROCK		10.57 63.32 11.68	1												
		End of Drillhole															
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	



MIS-RCK 001 0911210141-ROCK.GPJ GAL-MISS.GDT 9/17/10

DEPTH SCALE
1 : 75

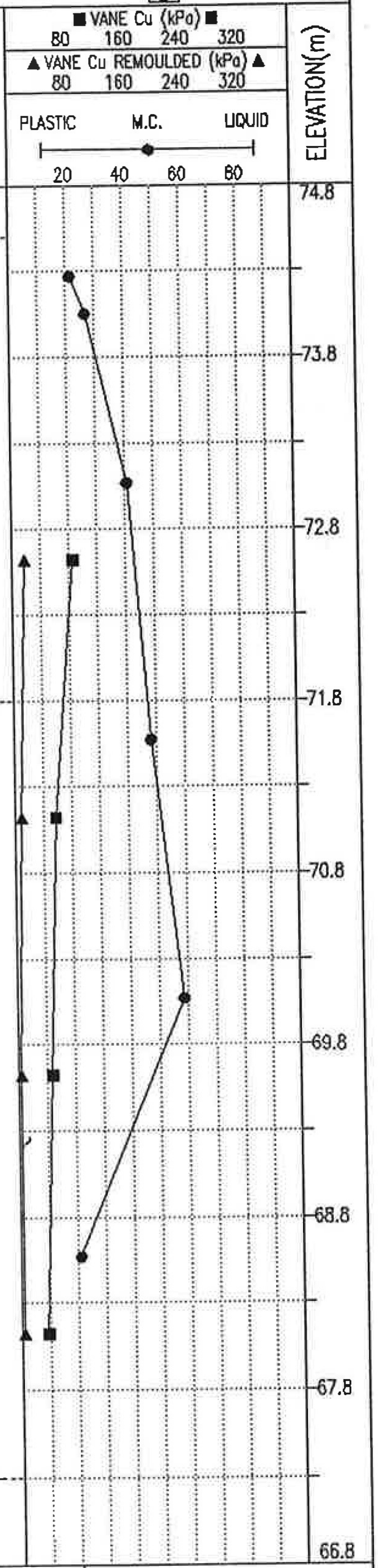
Golder Associates

LOGGED: D.W.M.
CHECKED: NBL

BOTSFORD ST. PERLEY HOSPITAL 1990	B.M.(ELEV 77.04m) geodetic: Spindle top	BOREHOLE No. 90-18
PERLEY HOSPITAL	of fire hydrant at N.W. cor. of Botsford	Project No: E-6293A
START DATE: 16/08/90 -	and Hastings.	ELEVATION 74.84 (m)

SAMPLE TYPE ■ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ▤ PROBING ▥ NO RECOVERY ▮ CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	USC	SOIL/ROCK DESCRIPTION
0.0						TOPSOIL
						74.54
		1/15cm 11	☒	1		
-1.0		4/15cm 23				
	120,50,25	1/15cm 6	☒	3		stiff sandy brownish gray CLAY
-2.0					▼	-Water level AUG.17/90 ELEV 72.95
-3.0						71.84
	-,-,10	wt of hammer /15cm 2	☒	4		
-4.0						
		wt of hammer /45cm	☒	5		
-5.0						stiff to medium soft silty gray CLAY
-6.0		wt of hammer /45cm	☒	6		
-7.0						67.34
		wt of hammer /30cm	▥	7		loose SAND Borehole continued 66.84
8.0						

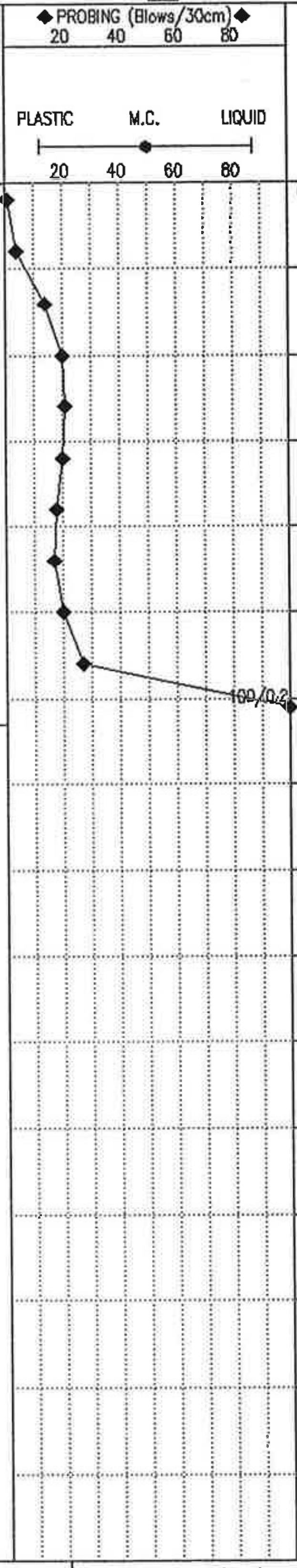


McROSTIE GENEST ST-LOUIS Ottawa, Canada	COMPLETION DEPTH 11.2 m	COMPLETE 16/08/90
	LOGGED BY JML	DWG NO. 29 — Page 1 of 2

BOTSFORD ST. PERLEY HOSPITAL 1990	B.M.(ELEV 77.04m) geodetic: Spindle top	BOREHOLE No. 90-18
PERLEY HOSPITAL	of fire hydrant at N.W. cor. of Botsford	Project No: E-6293A
START DATE: 16/08/90 -	and Hastings.	ELEVATION 74.84 (m)

SAMPLE TYPE ■ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ▤ PROBING ▯ NO RECOVERY ▮ CORE

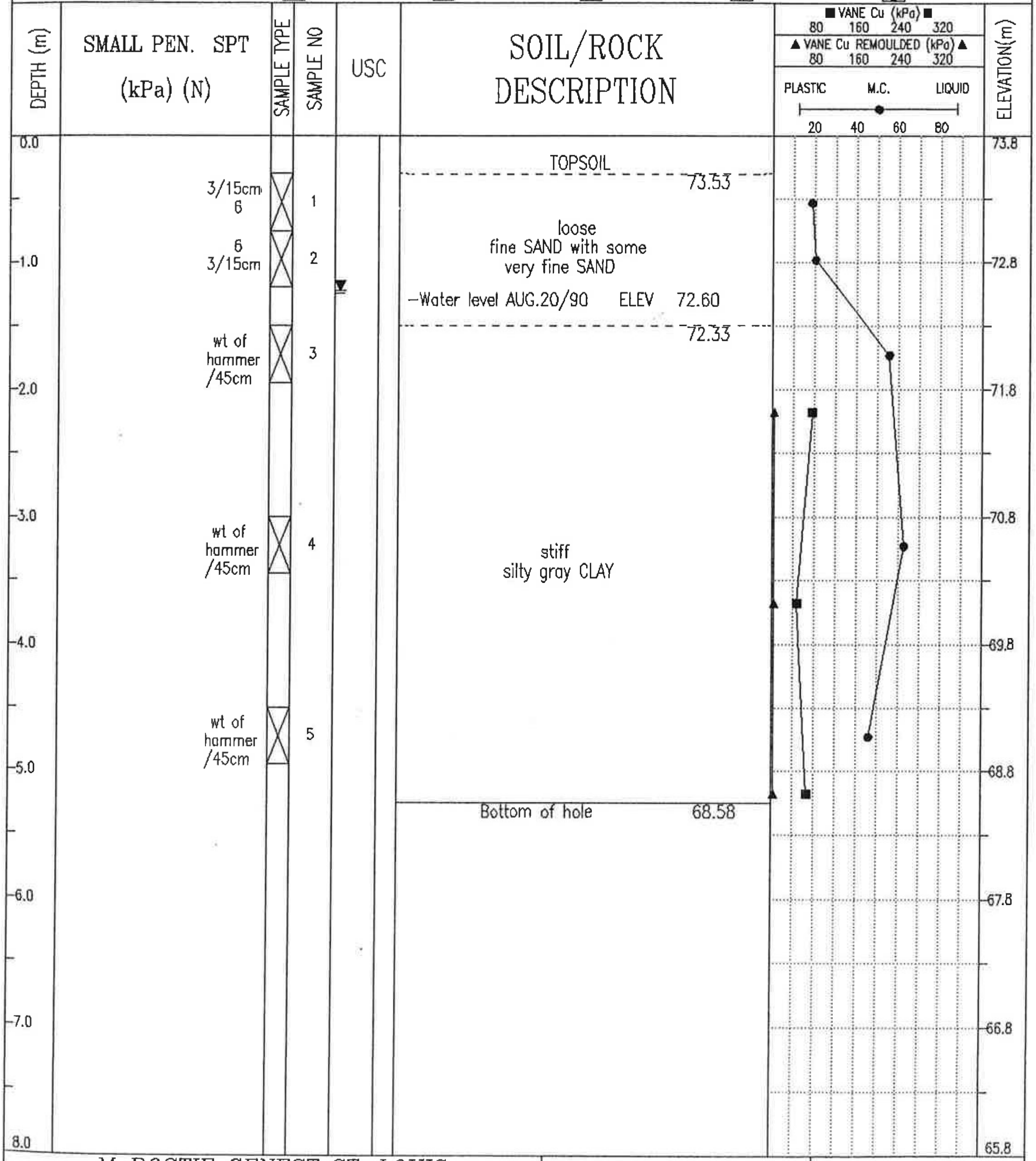
DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	USC	SOIL/ROCK DESCRIPTION	ELEVATION(m)
8.0			▤			PROBING 66.89	66.8
9.0			▤			SOIL with medium resistance to penetration	65.8
10.0			▤				64.8
11.0			▤			Bottom of hole 63.69	63.8
12.0							62.8
13.0							61.8
14.0							60.8
15.0							59.8
16.0							58.8



McROSTIE GENEST ST-LOUIS Ottawa, Canada	COMPLETION DEPTH 11.2 m	COMPLETE 16/08/90
	LOGGED BY JML	DWG NO. 30 — Page 2 of 2

BOTSFORD ST. PERLEY HOSPITAL 1990	B.M.(ELEV 77.04m) geodetic: Spindle top	BOREHOLE No. 90–22
PERLEY HOSPITAL	of fire hydrant at N.W. cor. of Botsford	Project No: E-6293A
START DATE: 17/08/90 –	and Hastings.	ELEVATION 73.83 (m)

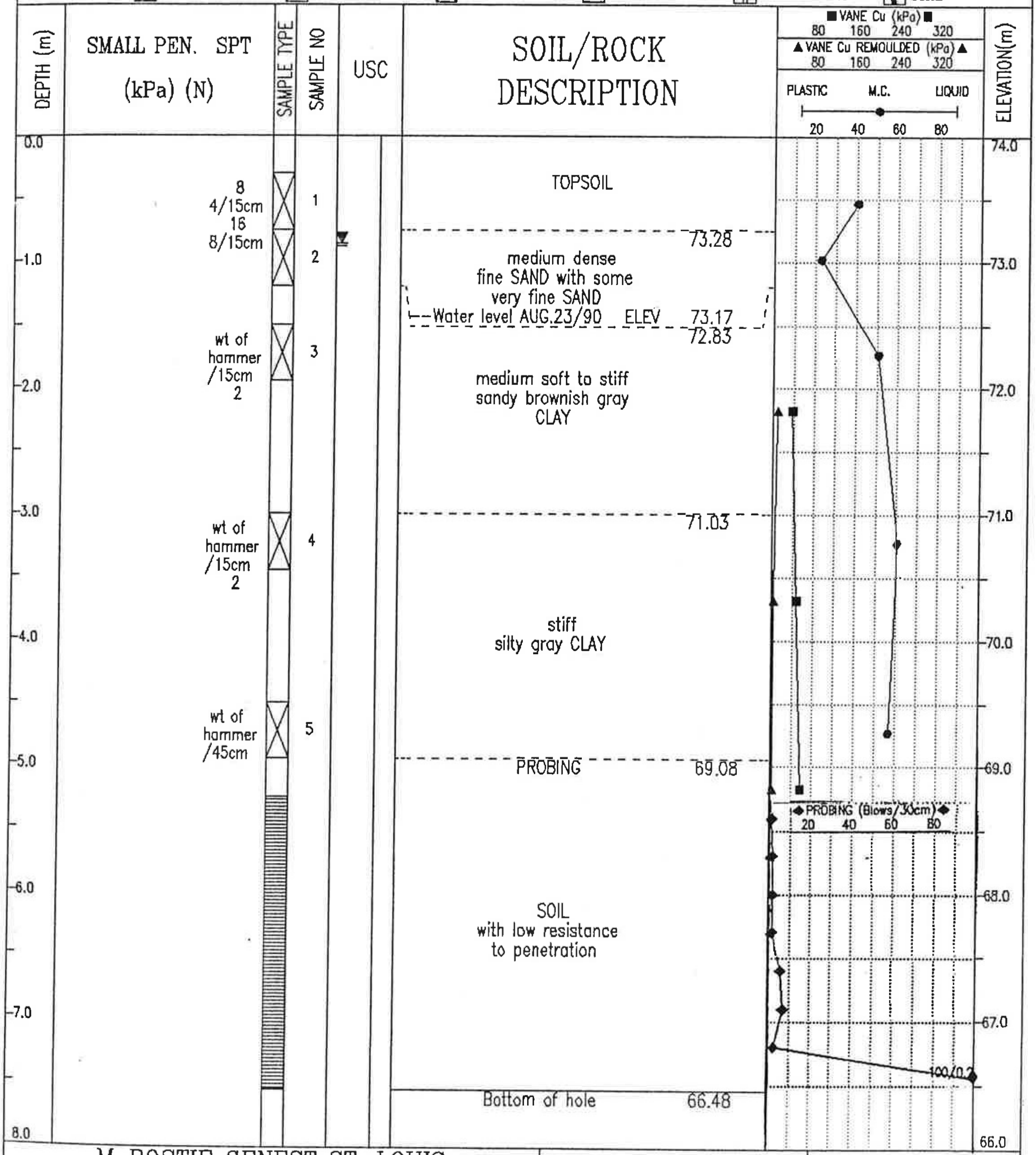
SAMPLE TYPE ■ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ▤ PROBING ◫ NO RECOVERY ▮ CORE



McROSTIE GENEST ST–LOUIS Ottawa, Canada	COMPLETION DEPTH 5.3 m	COMPLETE 17/08/90
	LOGGED BY JML	DWG NO. 42 / Page 1 of 1

BOTSFORD ST. PERLEY HOSPITAL 1990	B.M.(ELEV 77.04m) geodetic: Spindle top	BOREHOLE No. 90-23
PERLEY HOSPITAL	of fire hydrant at N.W. cor. of Botsford	Project No: E-6293A
START DATE: 16/08/90 –	and Hastings.	ELEVATION 74.03 (m)

SAMPLE TYPE ▩ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ☰ PROBING ▯ NO RECOVERY ▮ CORE



McROSTIE GENEST ST-LOUIS	COMPLETION DEPTH 7.6 m	COMPLETE 16/08/90
Ottawa, Canada	LOGGED BY JML	DWG NO. 43 — Page 1 of 1

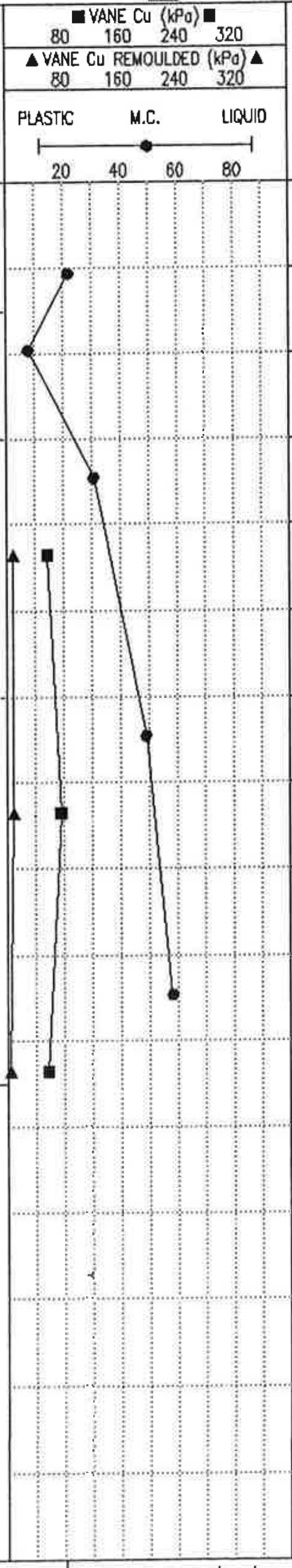
BOTSFORD ST. PERLEY HOSPITAL 1990
PERLEY HOSPITAL
START DATE: 16/08/90 -

B.M.(ELEV 77.04m) geodetic: Spindle top of fire hydrant at N.W. cor. of Botsford and Hastings.

BOREHOLE No. 90-24
Project No: E-6293A
ELEVATION 74.29 (m)

SAMPLE TYPE ■ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ☰ PROBING ▯ NO RECOVERY ▮ CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	USC	SOIL/ROCK DESCRIPTION	ELEVATION(m)
0.0						TOPSOIL	74.3
		1/15cm 7	☒	1			
						73.54	
-1.0		13 7/15cm	☒	2	▼	loose fine SAND with some very fine SAND	-73.3
						--Water level AUG.17/90 ELEV 73.30	
						72.79	
	-,50,50	2 1/15cm	☒	3			
-2.0						stiff sandy brownish gray CLAY	-72.3
-3.0						71.29	-71.3
		wt of hammer /15cm 2	☒	4			
-4.0						stiff silty gray CLAY	-70.3
		wt of hammer /45cm	☒	5			
-5.0							-69.3
						Bottom of hole 69.04	
-6.0							-68.3
-7.0							-67.3
8.0							66.3



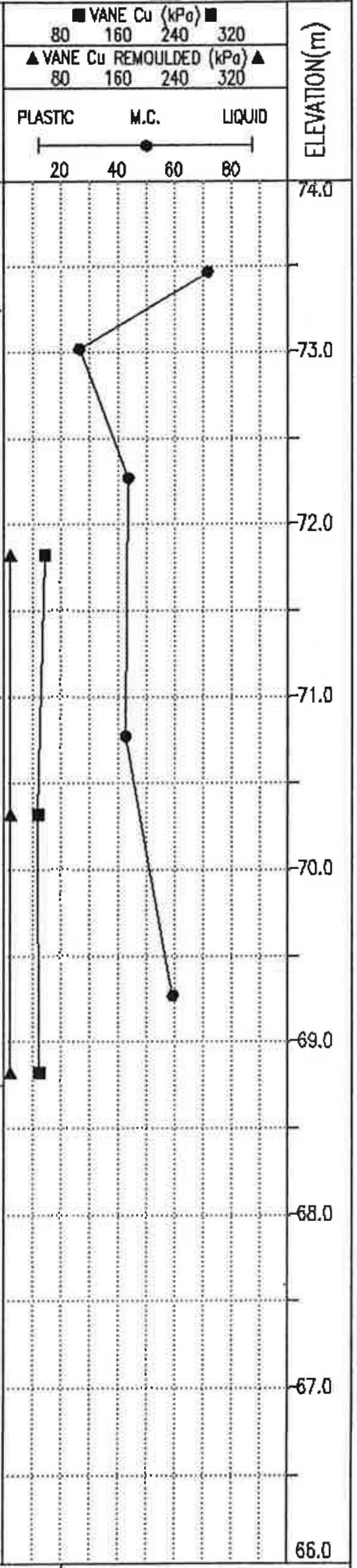
McROSTIE GENEST ST-LOUIS
Ottawa, Canada

COMPLETION DEPTH 5.3 m
COMPLETE 16/08/90
LOGGED BY JML
DWG NO. 44
Page 1 of 1

BOTSFORD ST. PERLEY HOSPITAL 1990	B.M.(ELEV 77.04m) geodetic: Spindle top	BOREHOLE No. 90-25
PERLEY HOSPITAL	of fire hydrant at N.W. cor. of Botsford	Project No: E-6293A
START DATE: 17/08/90 –	and Hastings.	ELEVATION 74.04 (m)

SAMPLE TYPE ■ DISTURBED ▨ SHELBY TUBE ☒ SPLIT SPOON ▤ PROBING ▯ NO RECOVERY ▮ CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	USC	SOIL/ROCK DESCRIPTION	ELEVATION(m)
0.0						TOPSOIL	74.0
		2 8/15cm	☒	1	▼	--Water level AUG.20/90 ELEV 73.41 73.29	
-1.0		3/15cm 7	☒	2			-73.0
	70,70,25	2 wt of hammer /15cm	☒	3		stiff sandy brownish gray CLAY	
-2.0							-72.0
-3.0						71.04	-71.0
		wt of hammer /45cm	☒	4			
-4.0						stiff silty gray CLAY	-70.0
		wt of hammer /45cm	☒	5			
-5.0							-69.0
						Bottom of hole 68.79	
-6.0							-68.0
-7.0							-67.0
8.0							66.0

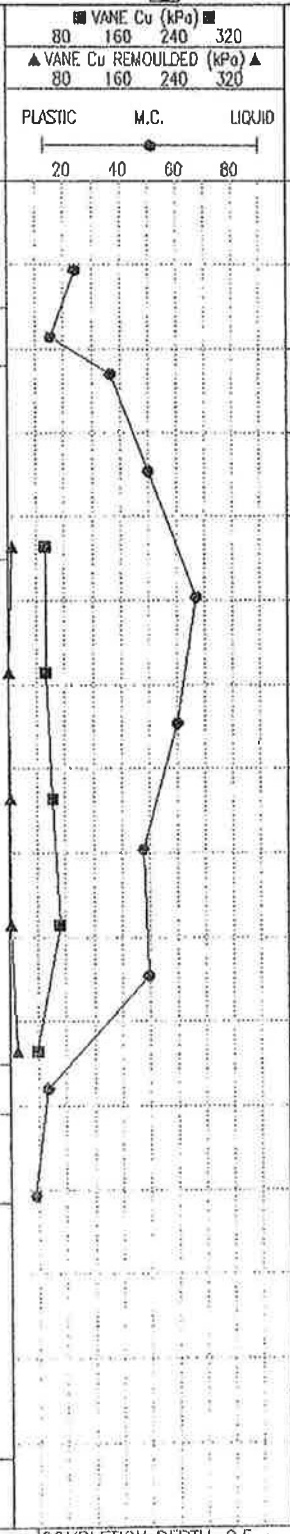


McROSTIE GENEST ST-LOUIS Ottawa, Canada	COMPLETION DEPTH 5.3 m	COMPLETE 17/08/90
	LOGGED BY JML	DWG NO. 45

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–26
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E–6293
START DATE: 04/06/92	accross from No.1794	ELEVATION: 74.1 (m)

SAMPLE TYPE ▩ REMOULDED–AUGER ◿ SHELBY TUBE ☒ SPLIT–SPOON ▤ BW–CASING ▯ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa) SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0					Clayey TOPSOIL with a little crushed stone	74.1
	3/15cm 5	☒	1		Water level June 09/92 – ELEV 73.51m	
	6	☒	2		73.38 Medium dense Medium SAND with some fine sand	
-1.0						-73.1
	3/15cm	☒	2A		73.03	
	1/45cm	☒	3		Stiff Sandy brownish gray CLAY	
-2.0						-72.1
					71.88	
	wt of hammer /45cm	☒	4			
-3.0						-71.1
	1/45cm	☒	5		Stiff to medium soft Silty gray CLAY	
-4.0						-70.1
	wt of hammer /45cm	☒	6			
	wt of hammer /15cm 5	☒	7			
-5.0						-69.1
					68.88	
	wt of hammer /15cm 77/15cm	☒	8		Sandy TILL	
					68.58	
					Weathered SHALE	
-6.0	81/8cm Auger refusal	☒	9			-68.1
					68.05	
		▮		100	Interbedded limey SHALE and shaley LIMESTONE	
-7.0		▮				-67.1
		▮			Interbedded limey SHALE 66.53 and shaley LIMESTONE	
8.0		▮			Borehole continued 66.13	66.1



McROSTIE GENEST ST–LOUIS Ottawa, Canada	LOGGED BY: CNM	COMPLETION DEPTH: 8.5 m
	REVIEWED BY:	COMPLETE: 05/05/92
	Fig. No:	Page 1 of 2

Plate No. 2

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–26
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E–6293
START DATE: 04/06/92	accross from No.1794	ELEVATION: 74.1 (m)

SAMPLE TYPE ▨ REMOULDED–AUGER ◸ SHELBY TUBE ☒ SPLIT–SPOON ▤ BW–CASING ▯ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	■ VANE Cu (kPa) ■ 80 160 240 320 ▲ VANE Cu REMOULDED (kPa) ▲ 80 160 240 320 PLASTIC M.C. LIQUID 20 40 60 60	ELEVATION (m)
8.0			▮		100	Interbedded limey SHALE and shaley LIMESTONE		66.1
						Bottom of hole 65.60		
9.0								65.1
10.0								64.1
11.0								63.1
12.0								62.1
13.0								61.1
14.0								60.1
15.0								59.1
16.0								58.1

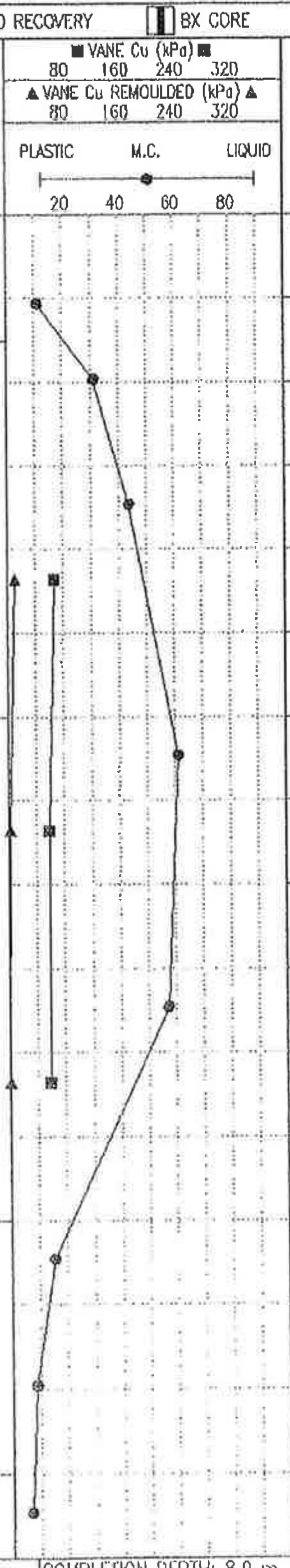
McROSTIE GENEST ST–LOUIS	LOGGED BY: CNM	COMPLETION DEPTH: 8.5 m
Ottawa, Canada	REVIEWED BY:	COMPLETE: 05/06/92
	Fig. No:	Page 2 of 2

Plate No. 3

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–30
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E–6293
START DATE: 05/06/92	accross from No.1794	ELEVATION: 74.8 (m)

SAMPLE TYPE ■ REMOULDED–AUGER ◿ SHELBY TUBE ☒ SPLIT–SPOON ▤ BW–CASING ▯ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa) SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0					Medium dense Fine SAND with a little very fine sand	74.8
▼	1/15cm 7	☒	1			▼
					74.02	
	6 4/15cm	☒	2		Water level June 09/92 – ELEV 74.22m	
-1.0						73.8
	2	☒	3		Stiff Sandy brownish gray CLAY	
-2.0						72.8
					71.77	
-3.0						71.8
	wt of hammer /45cm	☒	4			
-4.0						70.8
	wt of hammer /45cm	☒	5		Stiff Silty gray CLAY	
-5.0						69.8
					68.77	
-6.0	wt of rods /15cm 3/15cm 8/15cm	☒	6			68.8
					Loose to medium dense Sandy TILL	
-7.0	7 12/15cm	☒	7			67.8
					67.27	
	10/15cm 22/15cm 31/15cm	☒	8		Weathered SHALE	
8.0					Borehole continued 66.77	66.8



McROSTIE GENEST ST–LOUIS Ottawa, Canada	LOGGED BY: CNM	COMPLETION DEPTH: 8.9 m
	REVIEWED BY:	COMPLETE: 05/06/92
	Fig. No:	Page 1 of 2

Plate No. 8

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–30
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E–6293
START DATE: 05/06/92	accross from No.1794	ELEVATION: 74.8 (m)

SAMPLE TYPE ▨ REMOULDED–AUGER ◪ SHELBY TUBE ☒ SPLIT–SPOON ☰ BW–CASING ▯ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	■ VANE Cu (kPa) ■ 80 160 240 320 ▲ VANE Cu REMOULDED (kPa) ▲ 80 160 240 320 PLASTIC M.C. LIQUID 20 40 60 80	ELEVATION(m)
8.0								66.8
						Weathered SHALE		
9.0	Auger refusal					Bottom of hole 65.83		65.8
10.0								64.8
11.0								63.8
12.0								62.8
13.0								61.8
14.0								60.8
15.0								59.8
16.0								58.8

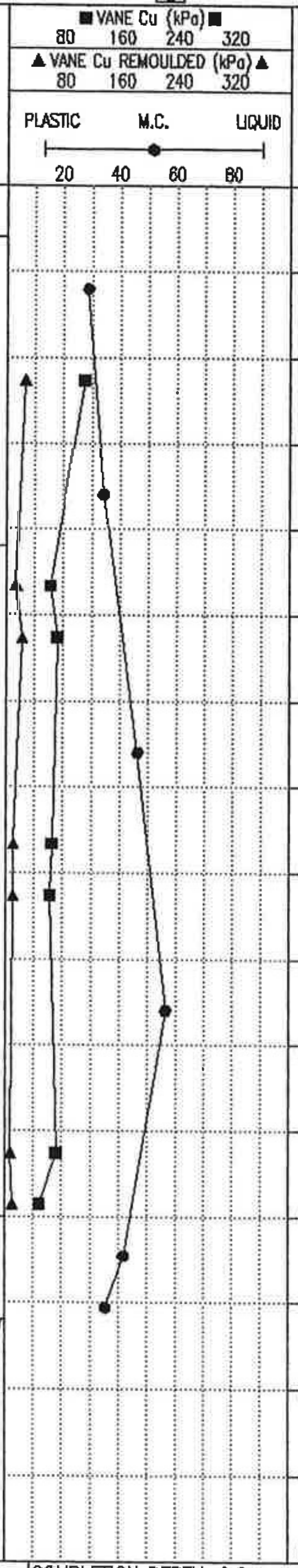
McROSTIE GENEST ST–LOUIS	LOGGED BY: CNM	COMPLETION DEPTH: 8.9 m
Ottawa, Canada	REVIEWED BY:	COMPLETE: 05/06/92
	Fig. No:	Page 2 of 2

Plate No. 9

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–32
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E-6293
START DATE: 16/06/92	accross from No.1794	ELEVATION: 74.2 (m)

SAMPLE TYPE ■ REMOULDED–AUGER ▨ SHELBY TUBE ☒ SPLIT–SPOON ▤ BW–CASING ▥ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0						TOPSOIL	74.2
						73.93	
		5 10	☒	1			
1.0						Very stiff to stiff Sandy brownish gray CLAY	73.2
		4 5	☒	2			
2.0							72.2
						72.13	
3.0							71.2
	30,60,60	2 2	☒	3			
4.0						Stiff Silty gray CLAY	70.2
		wt of hammer /30cm	☒	4			
5.0	60,60,60	2					69.2
▼						Water level June 17/92 – ELEV 68.67m	▼
						68.23	
6.0		wt of hammer /30cm	☒	5		Layered Silty gray CLAY and Clayey SILT	68.2
		3	☒	5A			
						Bottom of hole 67.63	
7.0							67.2
8.0							66.2

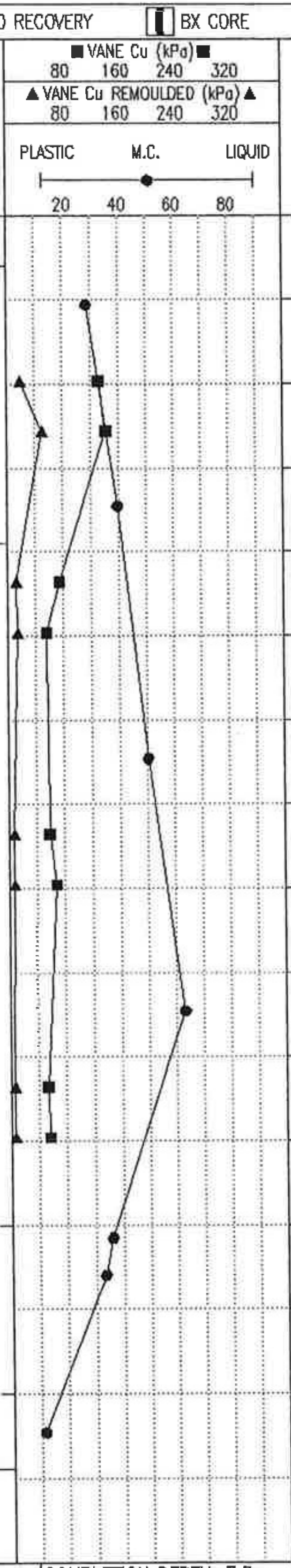


McROSTIE GENEST ST–LOUIS Ottawa, Canada	LOGGED BY: CNM	COMPLETION DEPTH: 6.6 m
	REVIEWED BY:	COMPLETE: 16/06/92
	Fig. No:	Page 1 of 1

BOTSFORD STREET – PERLEY HOSPITAL 1992	B.M.(ELEV 76.67m goedetic): Spindle top	BOREHOLE No: 92–34
PERLEY HOSPITAL	of hydrant on West side of Botsford,	Project No: E–6293
START DATE: 17/06/92	accross from No.1794	ELEVATION: 74.0 (m)

SAMPLE TYPE ■ REMOULDED–AUGER ◸ SHELBY TUBE ☒ SPLIT–SPOON ▤ BW–CASING ▯ NO RECOVERY ▮ BX CORE

DEPTH (m)	SMALL PEN. (kPa)	SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0						TOPSOIL	74.0
						73.70	
	240,220,305	6 5/15cm	☒	1			
1.0						Very stiff to stiff Sandy brownish gray CLAY	73.0
	135,165,145	2/15cm 2	☒	2			
2.0						72.05	72.0
3.0							71.0
	50,50,50	2/45cm	☒	3			
						Stiff Silty gray CLAY	
4.0							70.0
	65,65,65	1/45cm	☒	4			
5.0							69.0
						Water level June 17/92 – ELEV 67.59m	
6.0						68.00	68.0
		wt of hammer /30cm	☒	5		Layered Clayey SILT and silty gray CLAY with a little sand	
▼		10/15cm	☒	5A			▼
7.0						67.00	67.0
						Loose to medium dense Sandy TILL	
		3/15cm 23	☒	6			
						Bottom of hole 66.55	
8.0							66.0



McROSTIE GENEST ST–LOUIS Ottawa, Canada	LOGGED BY: CNM	COMPLETION DEPTH: 7.5 m
	REVIEWED BY:	COMPLETE: 17/06/92
	Fig. No:	Page 1 of 1

Plate No. 13

Golder Associates Ltd.
1931 Robertson Road
Ottawa, Ontario
K2H 5B7

GOLDER

UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE

Project: Urban Equation/1750 Russell Rd/Ott

Project No.: 19130191

Date: February 14, 2020

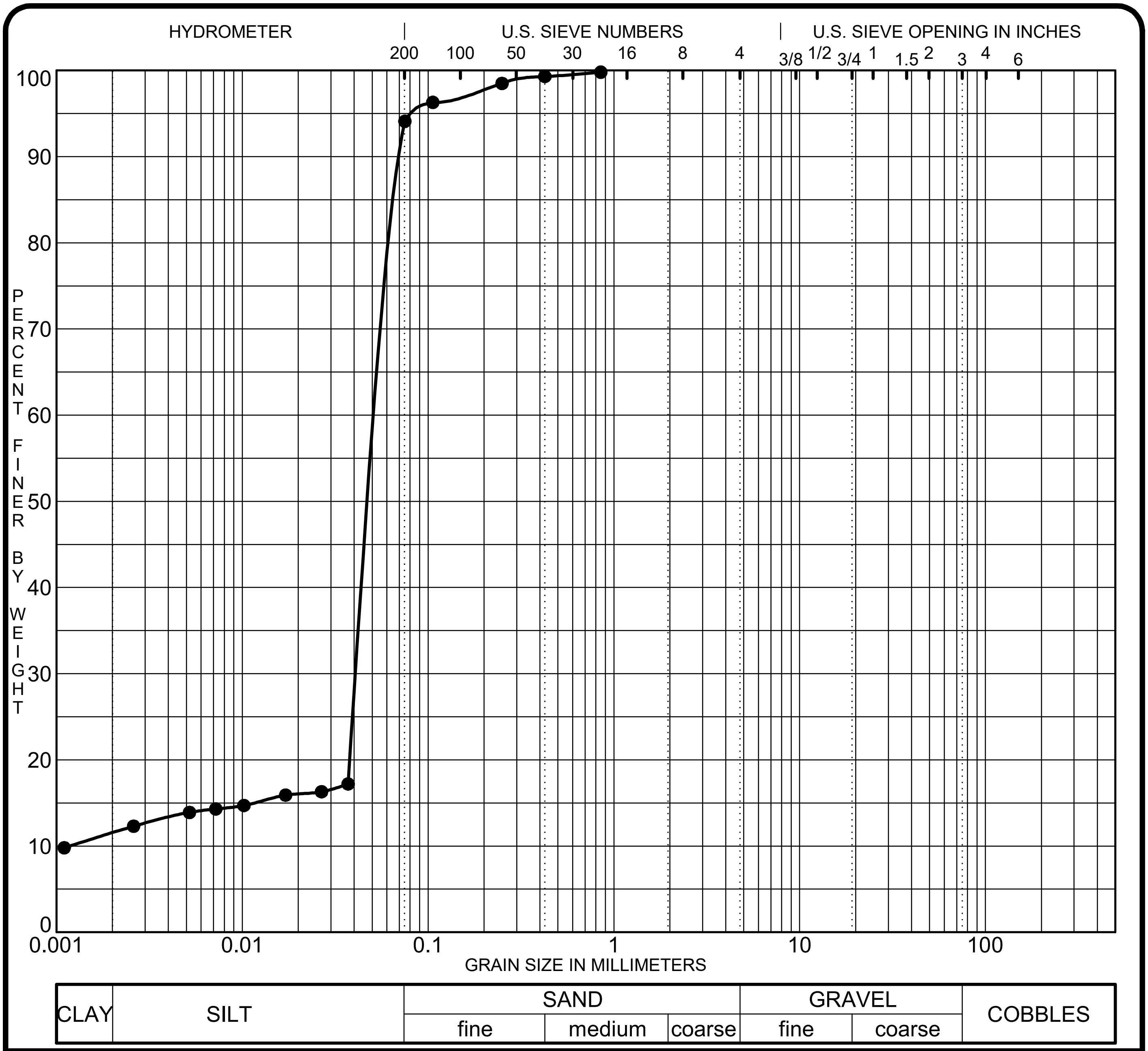
Location(s): See Table Below

Bore Hole No.	Depth (m)	Date Tested	Core Size	Diameter (mm)	Density (kg/m³)	Compressive Strength (MPa)	Failure Mode
20-05	11.03-11.17	Feb 12/20	HQ	60.4	2583	44.8	

REMARKS :
- Cores tested in vertical direction.
- Weak shale rock formation : Cores tested in as-received moisture condition
- Specimen ends prepared with sulfur compound, but un-restrained.
- L/D ratio's between 2.0:1 and 2.5:1
- This report constitutes a testing service only. Interpretation of results will be provided on request only

TESTING WAS CARRIED OUT IN GENERAL ACCORDANCE WITH ASTM D7012 - Method C

SIGNED:



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 2-25**	**SS3**		**36.5**				**26.90**	**46.6**
☒									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 2-25**	**SS3**	**0.85**	**0.05**	**0.042**	**0.0012**	**0.0**	**5.9**	**82.9**	**11.2**
☒										
▲										
★										

CLIENT **Kadus Group**

PROJECT **Geotechnical Investigation - Proposed Residential Development - 1750 Russell Road, Ottawa, ON**

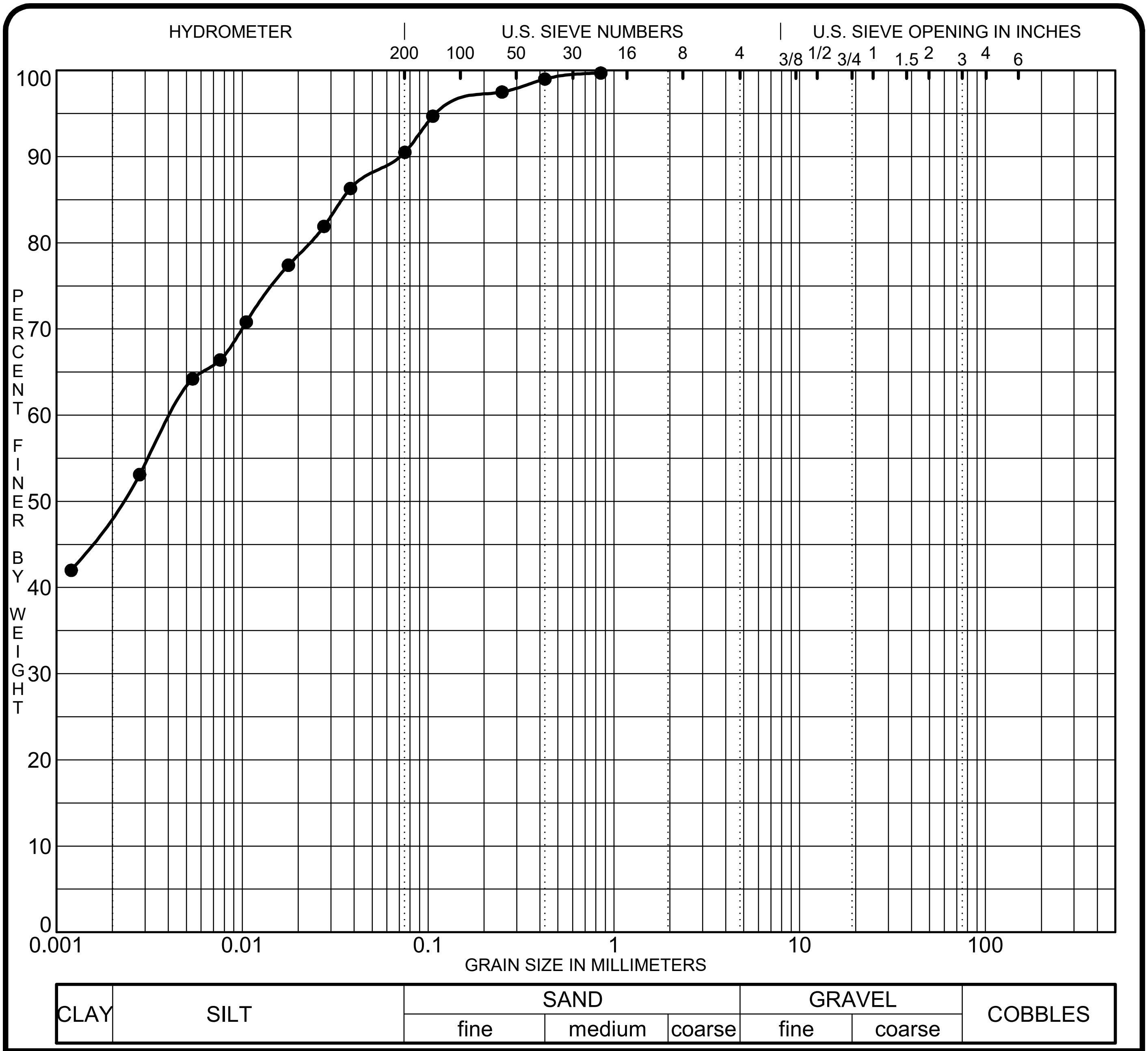
FILE NO. **PG7530**

DATE **8 May 25**

PATERSON GROUP

9 Auriga Drive
Ottawa, Ontario
K2E 7T9
TEL: (613) 226-7381

GRAIN SIZE DISTRIBUTION



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **BH 3-25 SS4**		**32.0**					
☒							
▲							
★							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **BH 3-25 SS4**	**0.85**	**0.00**			**0.0**	**9.5**	**41.0**	**49.5**
☒								
▲								
★								

CLIENT **Kadus Group**

PROJECT **Geotechnical Investigation - Proposed Residential Development - 1750 Russell Road, Ottawa, ON**

FILE NO. **PG7530**

DATE **8 May 25**

PATERSON GROUP

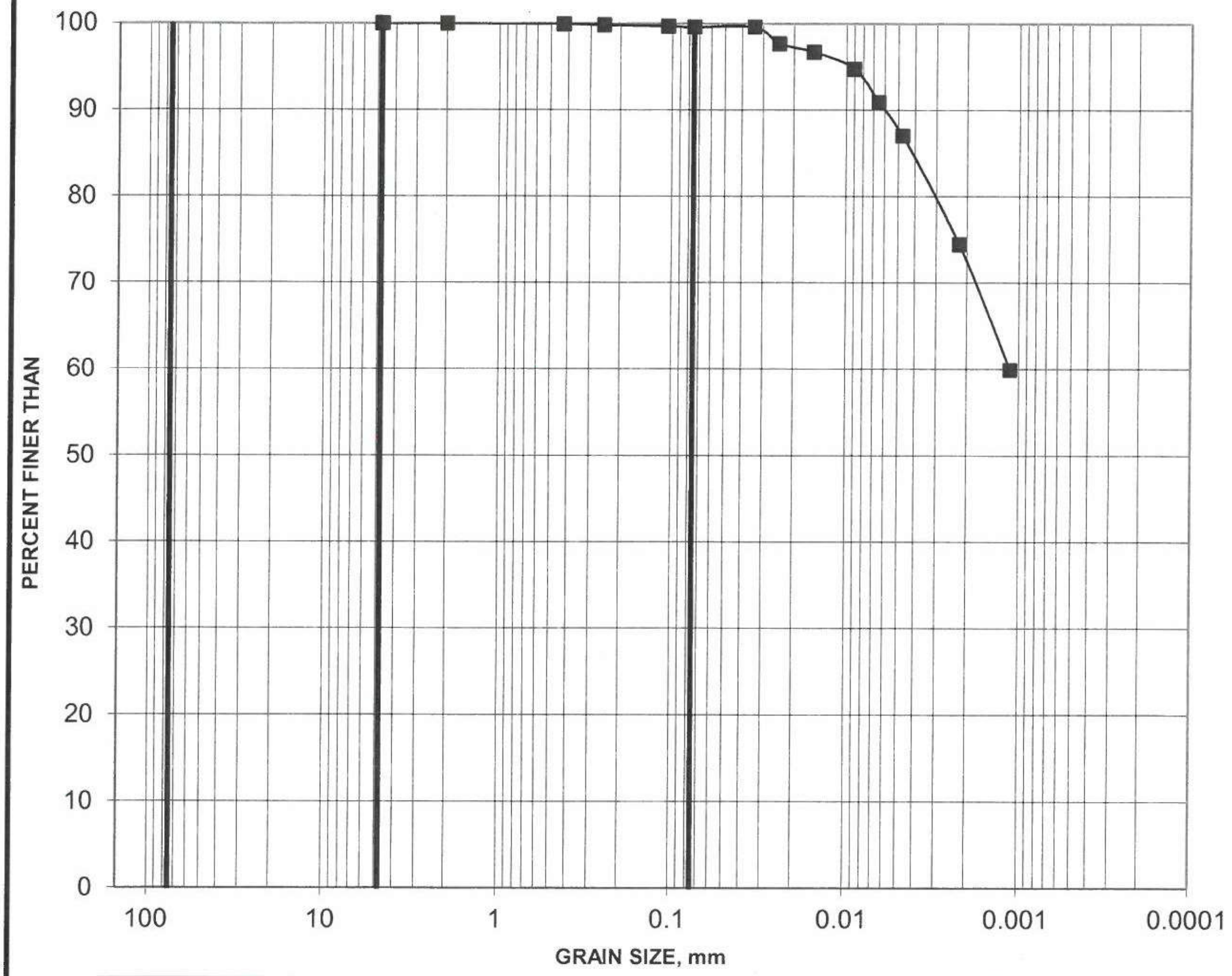
9 Auriga Drive
Ottawa, Ontario
K2E 7T9
TEL: (613) 226-7381

GRAIN SIZE DISTRIBUTION

GRAIN SIZE DISTRIBUTION

C-1

SILTY CLAY



COBBLE SIZE	COARSE	FINE	COARSE	MEDIU	FINE	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
—■—	20-02	6	6.10-6.71	0	0	28	72

GOLDER

Project: 19130191

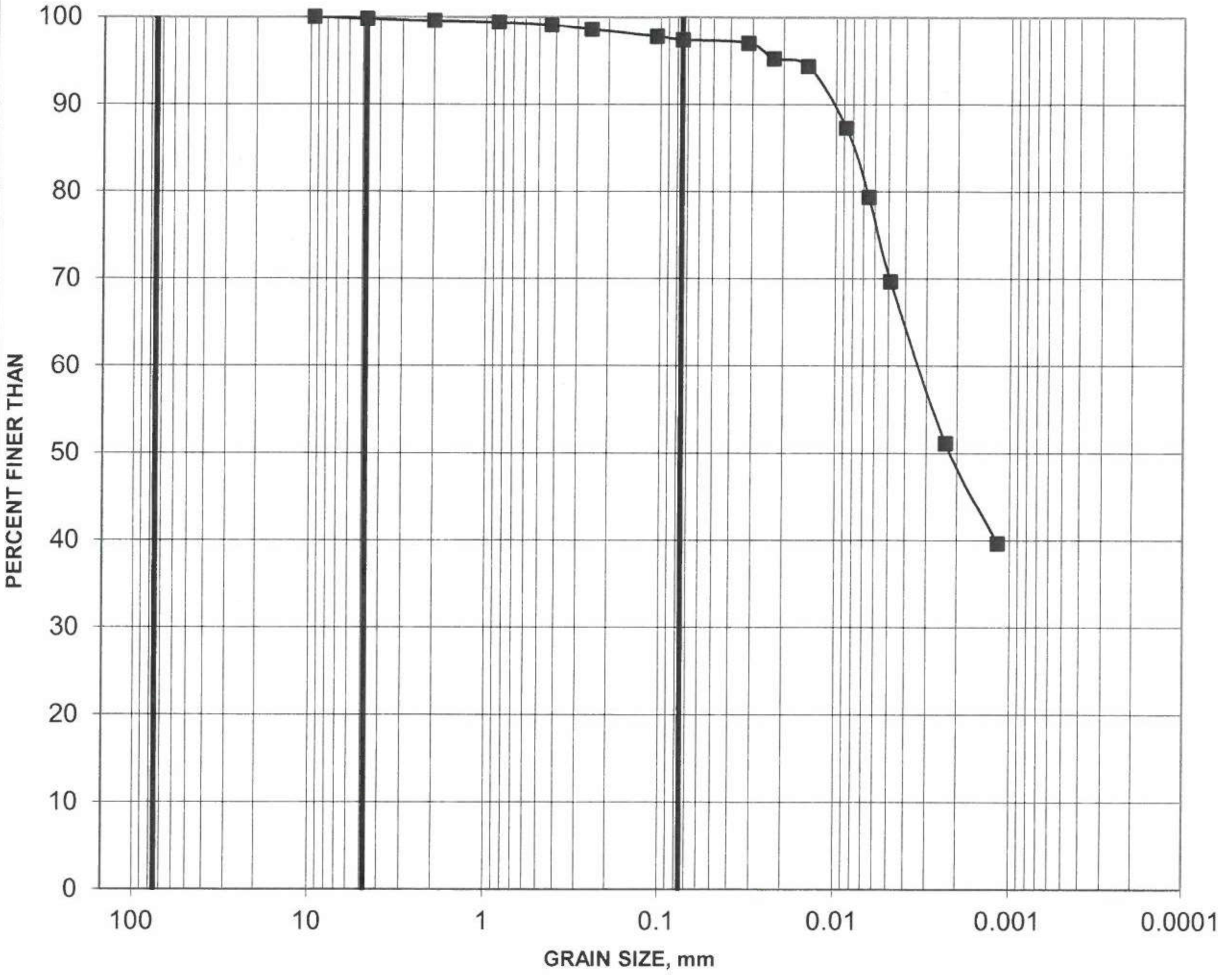
Created by:

Checked by:

GRAIN SIZE DISTRIBUTION

C-2

SILTY CLAY



COBBLE SIZE	COARSE	FINE	COARSE	MEDIU	FINE	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
—■—	20-06	7	6.10-6.71	0	3	48	49

GOLDER

Project: 19130191

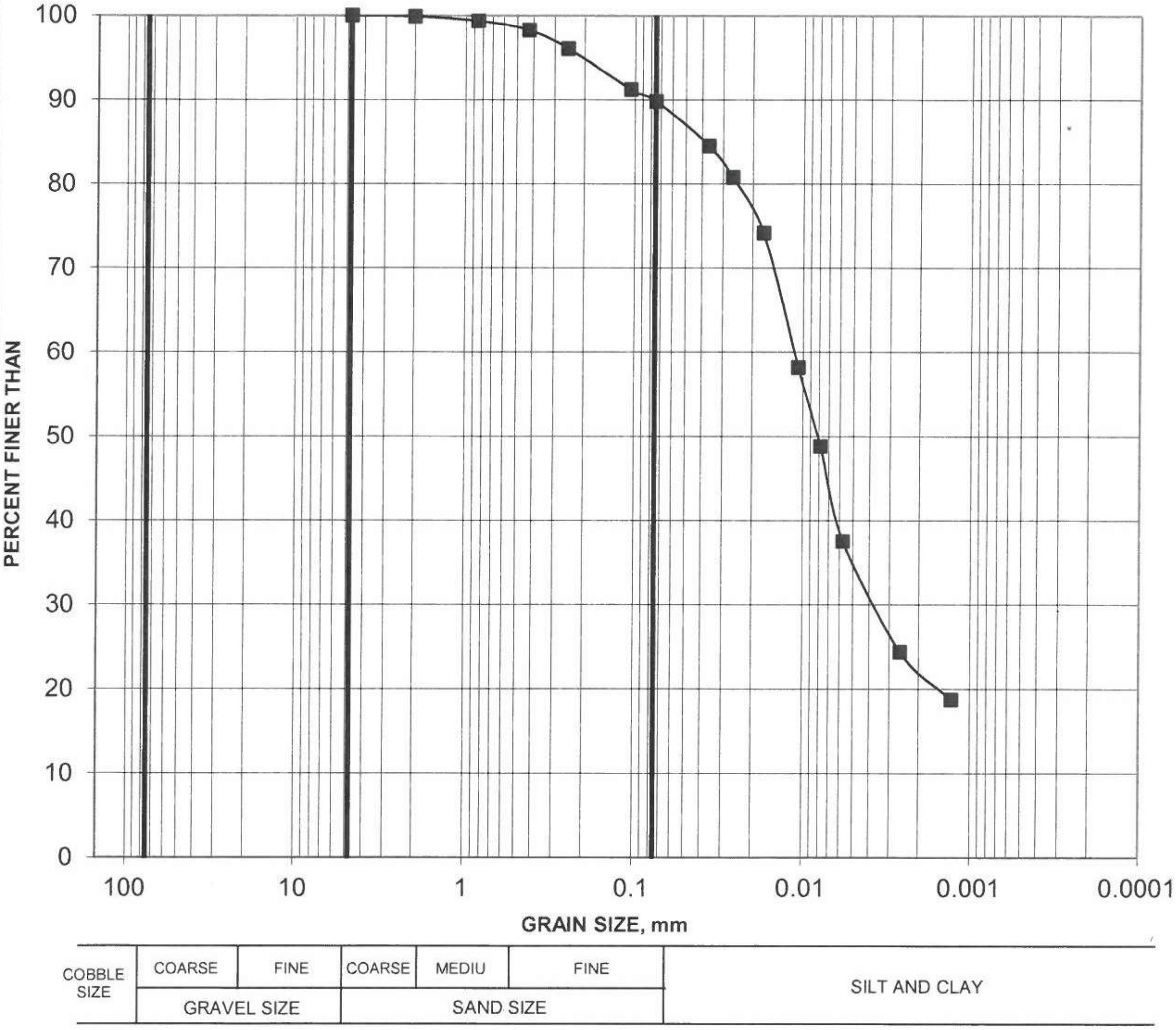
Created by: MI

Checked by:

GRAIN SIZE DISTRIBUTION

C-3

CLAYEY SILT



				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
━■━	20-01	7	7.62-8.23	0	10	68	22

GOLDER

Project: 19130191

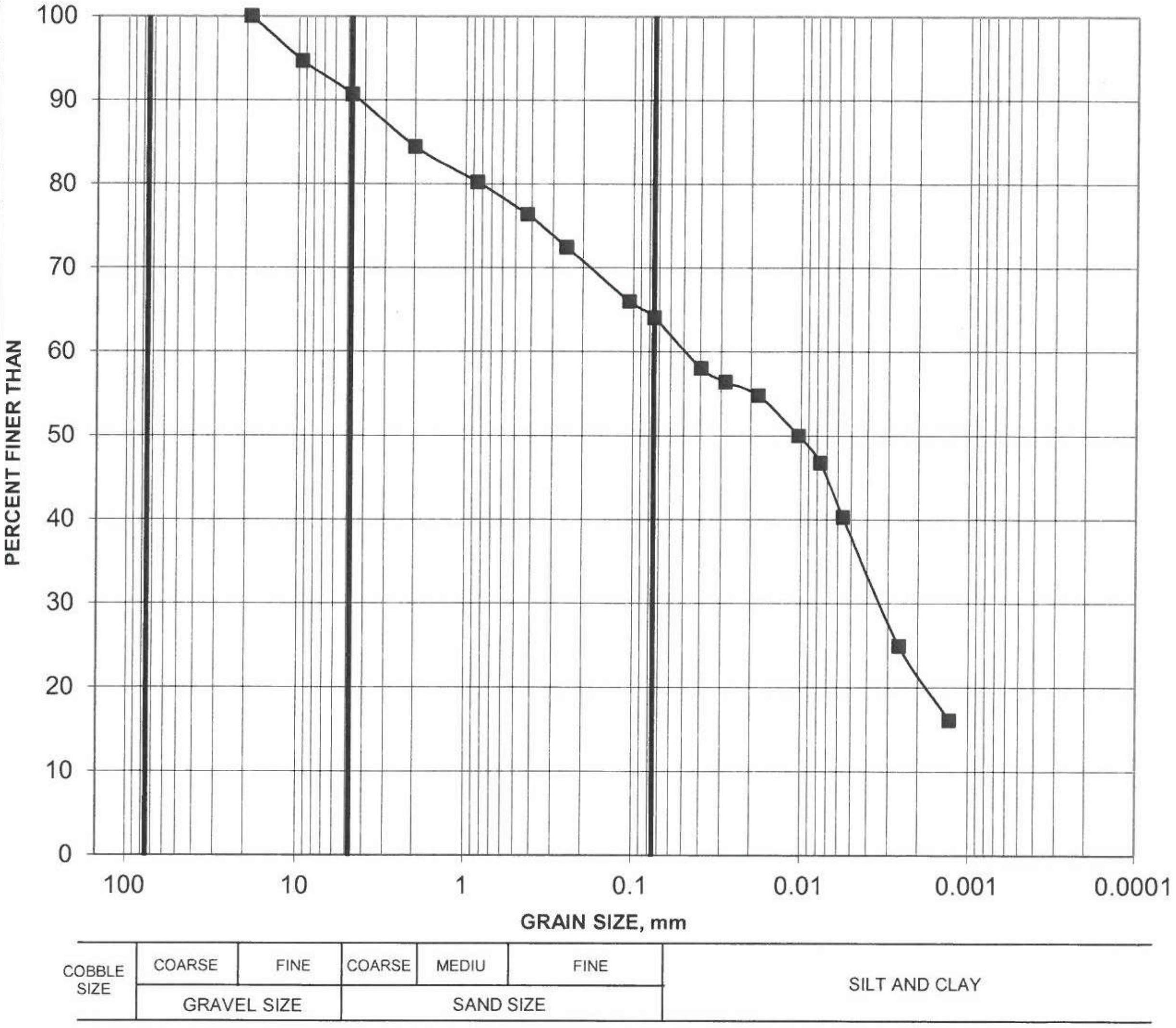
Created by:

Checked by:

GRAIN SIZE DISTRIBUTION

C-4

SANDY SILT



			Constituents (%)			
Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
—■— 20-03	8	7.62-8.23	9	27	42	22

GOLDER

Project: 19130191

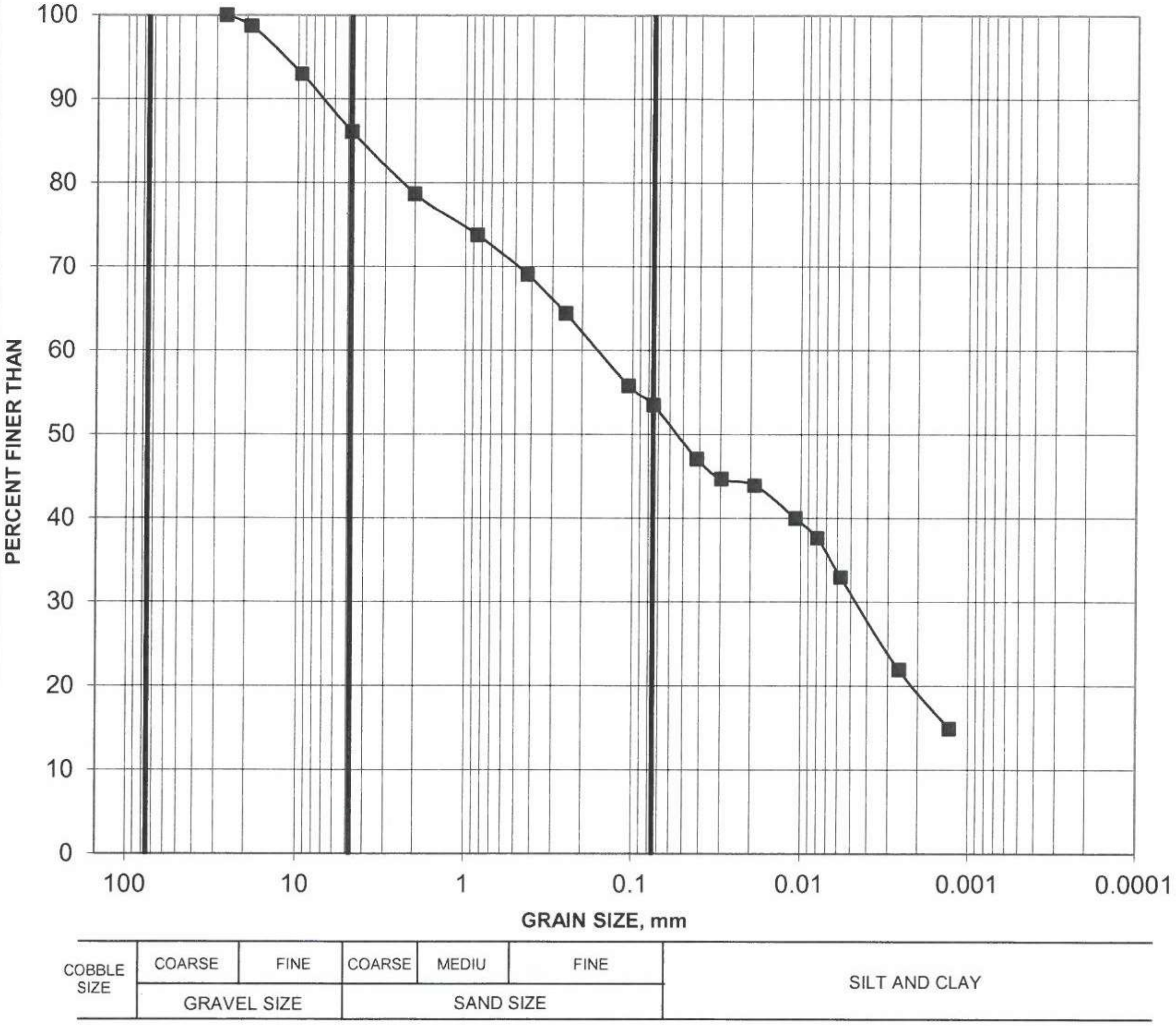
Created by:

Checked by:

GRAIN SIZE DISTRIBUTION

C-5

SANDY SILT



				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
■	20-05	13	7.62-8.23	14	33	34	19

GOLDER

Project: 19130191

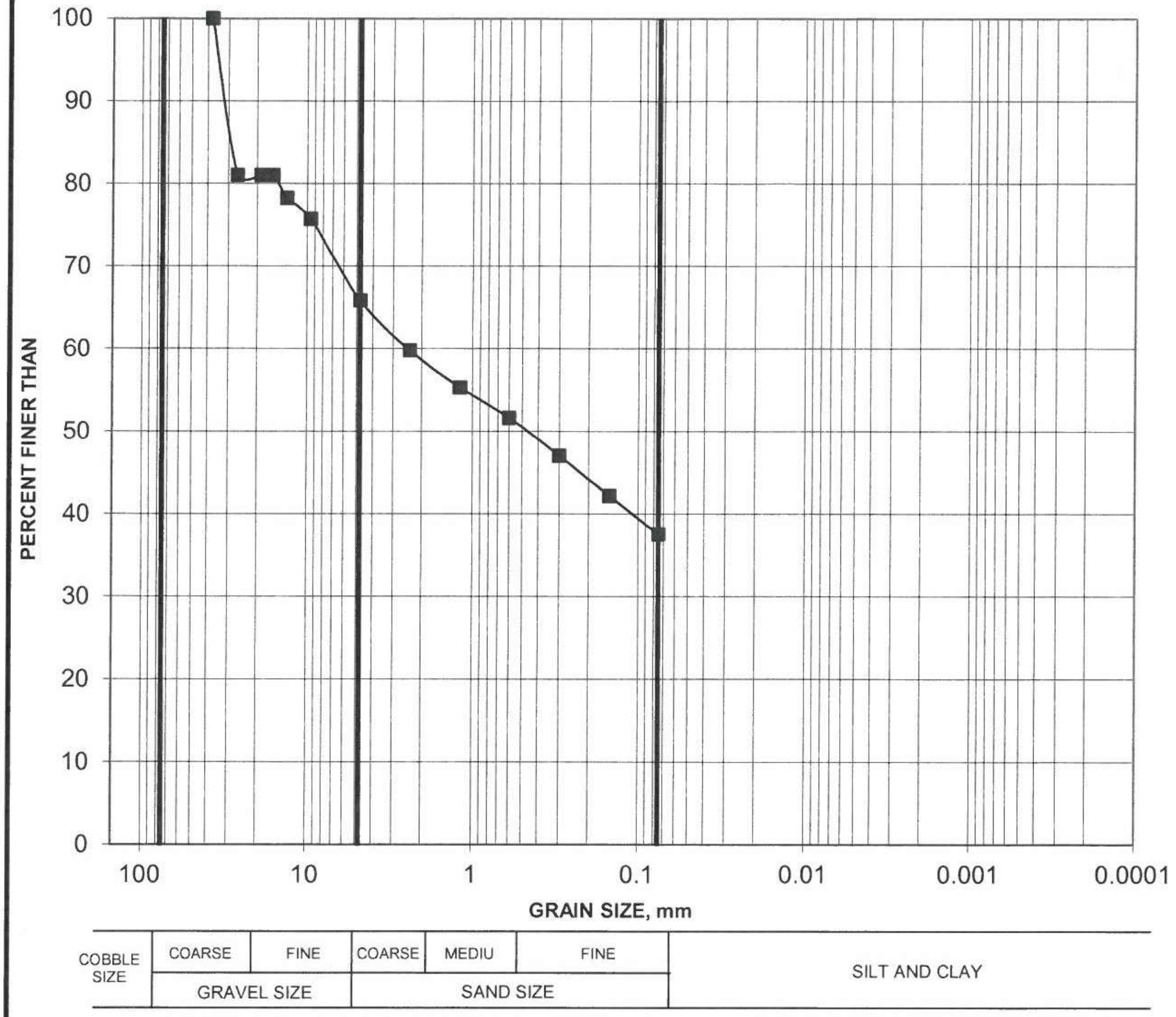
Created by: MT

Checked by:

GRAIN SIZE DISTRIBUTION

C-6

GLACIAL TILL



				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
■	20-02	8	8.38-8.94	34	28	38	

Project: 19130191

Golder Associates

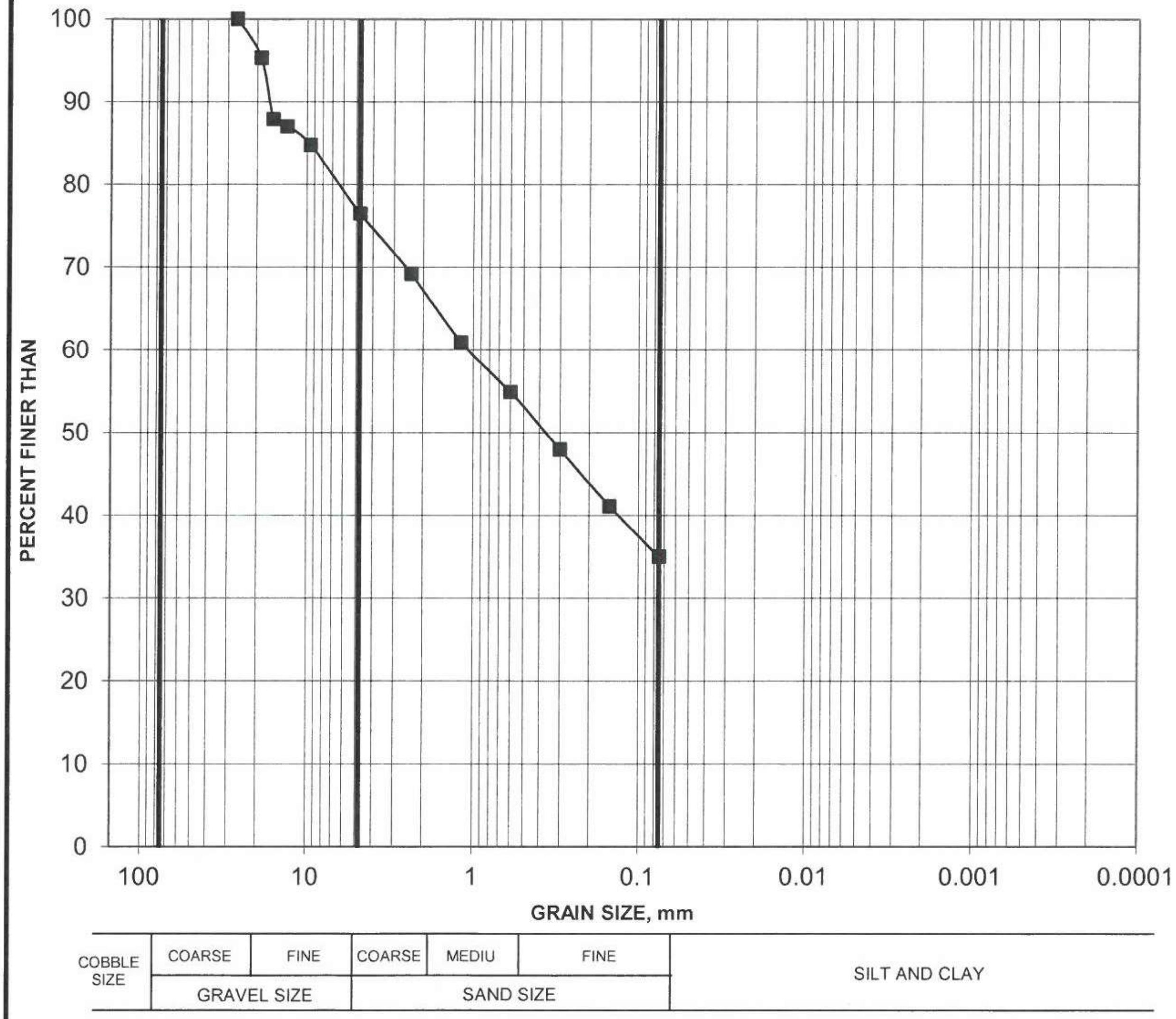
Created by:

Checked by:

GRAIN SIZE DISTRIBUTION

C-7

GLACIAL TILL



				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
■	20-05	14	8.38-8.99	24	41	35	

Created by:

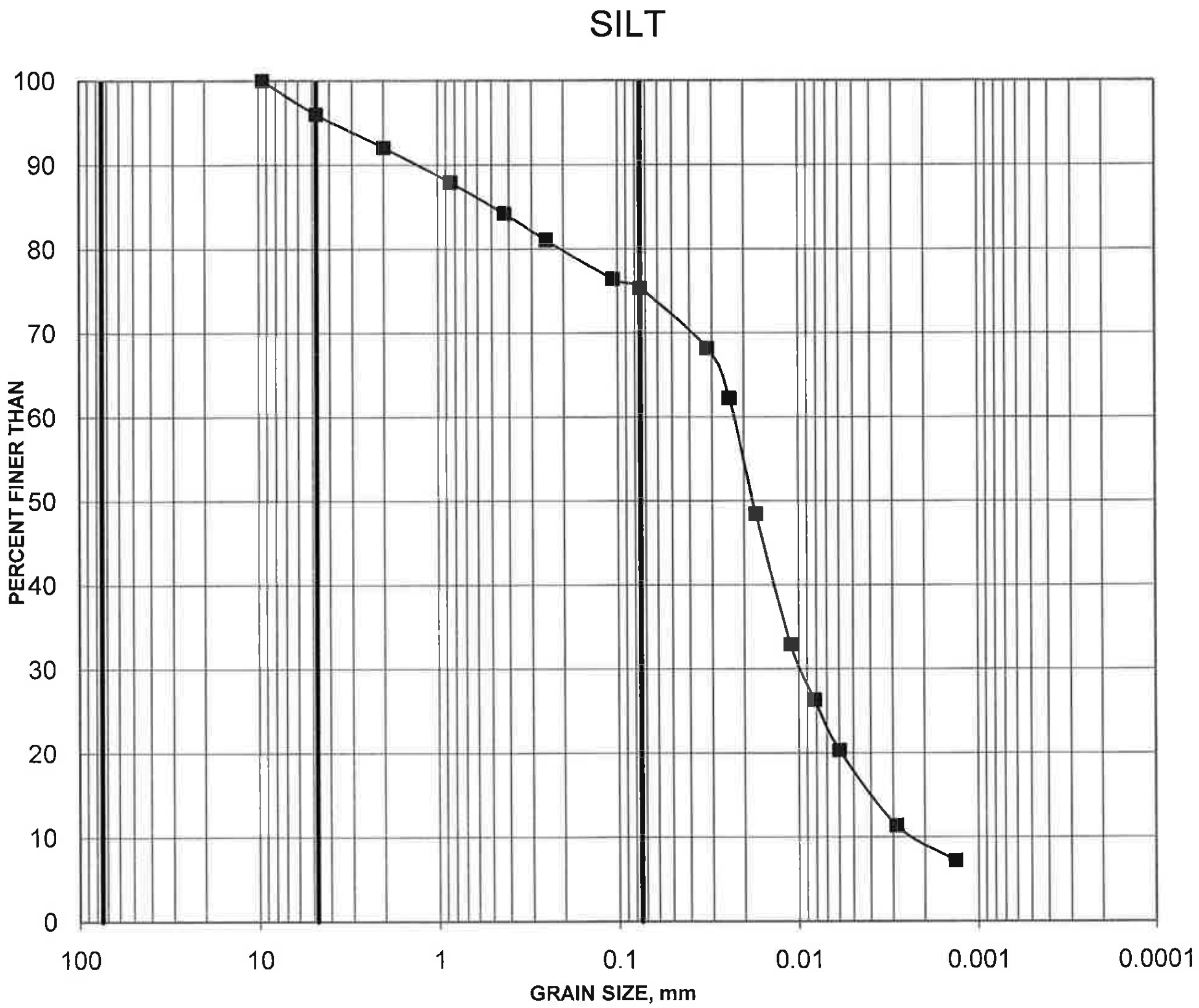
Checked by:

Project: 19130191

Golder Associates

GRAIN SIZE DISTRIBUTION

FIGURE 3



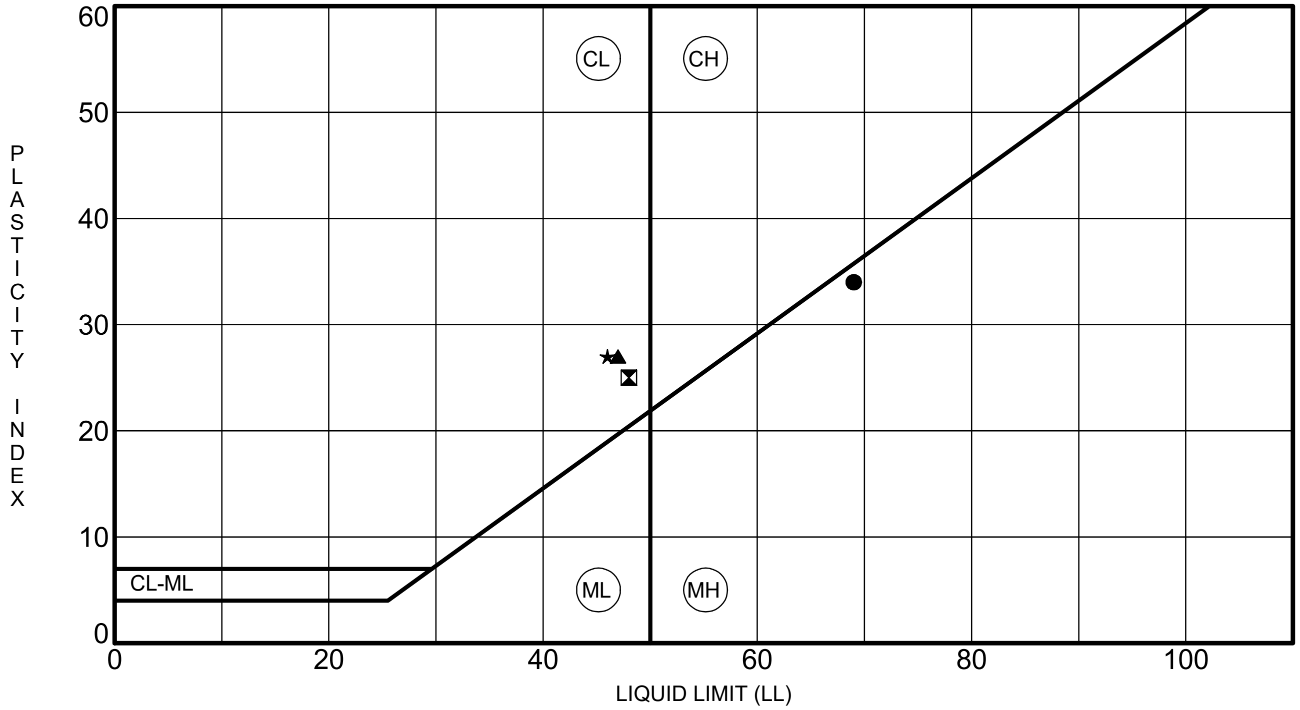
Cobble	coarse	fine	coarse	medium	fine	SILT AND CLAY
Size	GRAVEL SIZE		SAND SIZE			

Borehole	Sample	Depth (m)
—■—09-103	6	7.62-8.23

Project: 09-1121-0141

Golder Associates

Created by: CW
Checked by: CNM



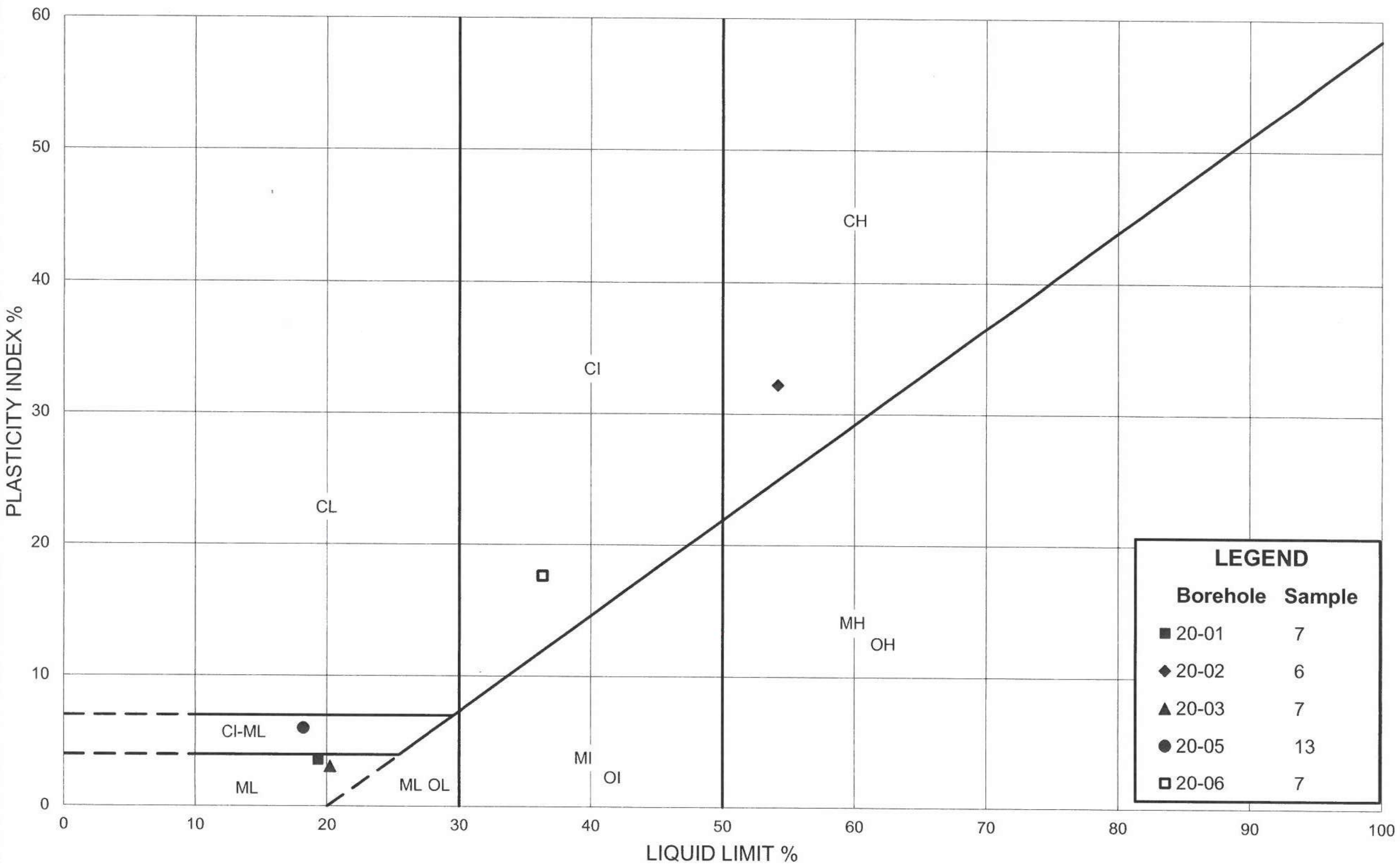
Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 1-25**	**SS3**	**69**	**35**	**34**		**MH - Inorganic silts of high plasticity**
⧗	**BH 2-25**	**SS4**	**48**	**23**	**25**		**CL - Inorganic clays of low plasticity**
▲	**BH 3-25**	**SS5**	**47**	**20**	**27**		**CL - Inorganic clays of low plasticity**
★	**BH 4-25**	**SS5**	**46**	**19**	**27**		**CL - Inorganic clays of low plasticity**

CLIENT	**Kadus Group**	FILE NO.	**PG7530**
PROJECT	**Geotechnical Investigation - Proposed Residential Development - 1750 Russell Road, Ottawa, ON**	DATE	**8 May 25**

PATERSON
GROUP

9 Auriga Drive
Ottawa, Ontario
K2E 7T9
TEL: (613) 226-7381

ATTERBERG LIMITS' RESULTS



GOLDER

PLASTICITY CHART

Figure: **C-8**

Project: 19130191

Created By: MI Checked By:

TECHNICAL MEMORANDUM

DATE	January 26, 2010	**PROJECT No.**	09-1121-0141
TO	Nicolas Leblanc, GAL - Ottawa		
CC	Michael Snow, GAL - Ottawa		
FROM	Stephane Sol, Christopher Phillips, GAL - Mississauga	**EMAIL**	ssol@golder.com, cphillips@golder.com

VERTICAL SEISMIC PROFILE DATA PROCESSING AND RESULTS
RUSSELL ROAD, OTTAWA, ONTARIO

This memorandum presents the results of the vertical seismic profile (VSP) testing performed on Russell Road in Ottawa, Ontario. VSP test was completed in Borehole BH09-102 on January 21, 2010.

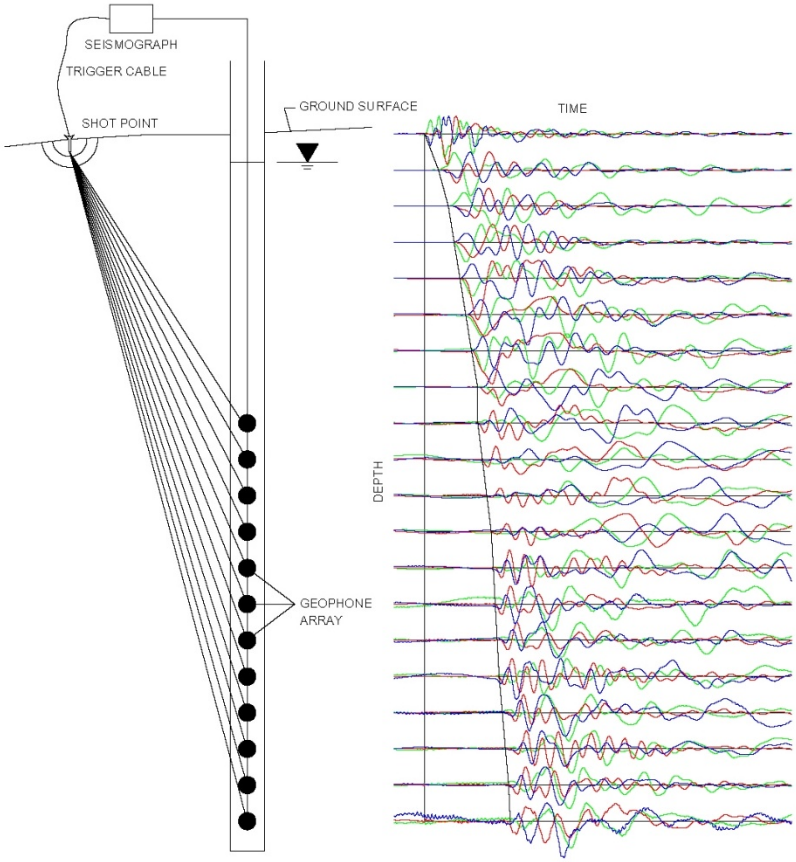
1.0 SITE DESCRIPTION

Borehole BH09-102 is located on a parking lot and cased with a PVC pipe and grouted in place. BH09-102 consists of about 2.5 metres of fill material overlying approximately 6 metres of silty clay. The 8.5 metres of overburden are overlying shale bedrock that transitions from highly weathered to fresh.

2.0 METHODOLOGY

For the VSP (Vertical Seismic Profiling) method, seismic energy is generated at the ground surface by an active seismic source and recorded by a geophone located in a nearby borehole at a known depth. The active seismic source can be either compressional or shear wave. The time required for the energy to travel from the source to the receiver (geophone) provides a measurement of the average compressional or shear-wave seismic velocity of the medium between the source and the receiver. Data obtained from different geophone depths are used to calculate a detailed vertical seismic velocity profile of the subsurface in the immediate vicinity of the test borehole.

The high resolution results of a VSP survey are often used for earthquake engineering site classification, as per the National Building Code of Canada, 2005.



Example 1: Layout and resulting time traces from a VSP survey

3.0 FIELD WORK

The field work was completed on January 21, 2010, by Golder Associates personnel from the Mississauga office.

Both compressional and shear-wave seismic sources were used and both were located in close vicinity to the borehole. The seismic source for the compressional wave test consisted of a 5.5 kilogram sledge hammer vertically impacted on a metal plate. The plate was located 2 metres from the borehole. The seismic source for the shear-wave test consisted of a 2.4 metres long, 150 millimetres by 150 millimetres wooden beam, weighted by a vehicle and horizontally struck with a 5.5 kilogram sledge hammer on alternate ends of the beam to induce polarized shear waves. The shear source was located 2 metres from the borehole BH09-102. The measurements started at 1-metre below the surface. Data were recorded in the borehole with a 3-component receiver spaced sequentially at 1-metre intervals below the ground surface, to a maximum depth of the borehole (13 metres).

The seismic records collected for each source location were stacked a minimum of five times to minimize the effects of ambient background seismic noise on the collected data. The data was sampled at 0.020833 millisecond intervals and a total time window of 0.341 seconds collected for each seismic shot.

4.0 DATA PROCESSING

Processing of the VSP test results consisted of the following main steps:

1) Combination of seismic records to present seismic traces for all depth intervals on a single plot for each seismic source and for each component;
2) Low Pass Filtering of data to remove spurious high frequency noise;
3) First break picking of the compressional and shear-wave arrivals; and
4) Calculation of the average compression and shear-wave velocity to each tested depth interval.

Processing of the VSP data was completed using the SeisImager/SW software package (Geometrics Inc.). The seismic records are presented on the following two plots and show the first break picks of the P-wave and S-wave arrivals overlaid on the seismic waveform traces recorded at the different geophone depths (Figures 1 and 2). The arrivals were picked on the vertical component for the compressional source and on the two horizontal components for the shear source.

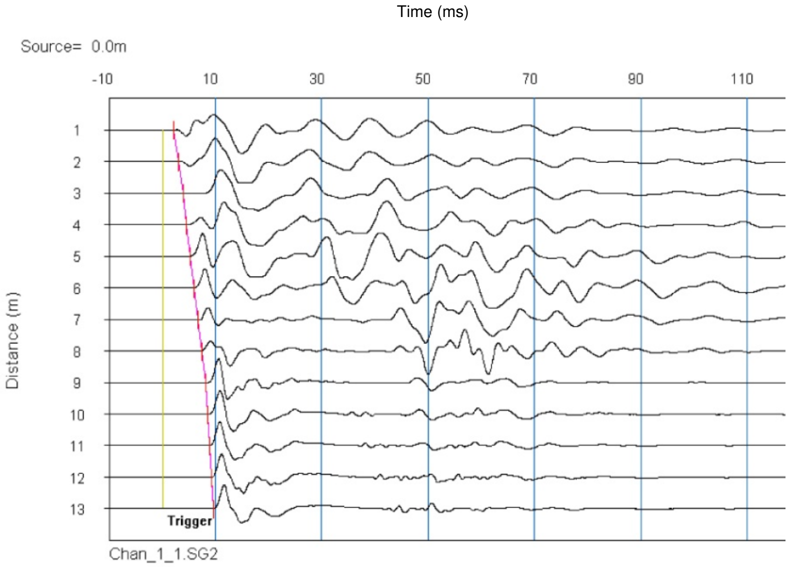


Figure 1: First break picking of P wave arrivals (red) along the seismic traces recorded at each receiver depth

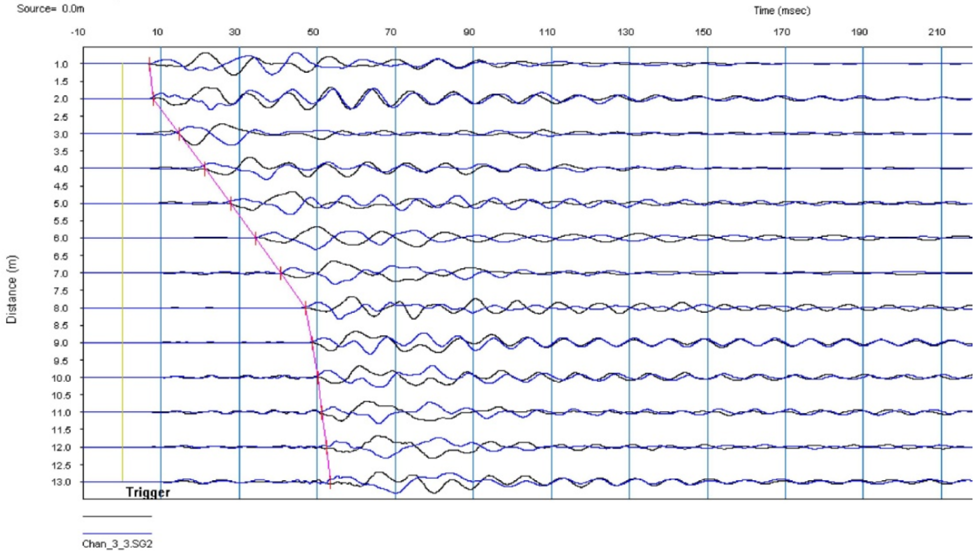


Figure 2: First break picking of S wave arrivals (red) along the seismic traces recorded at each receiver depth

5.0 RESULTS

The VSP results are summarized in Table 1. The S-wave and P-wave layer velocities, at one metre intervals, were calculated by best fitting a theoretical travel time model to the field data collected at one metre intervals. The depths presented on the tables are relative to ground surface.

The estimated dynamic engineering moduli, based on the calculated wave velocities, are also presented on Table 1. The engineering moduli were calculated using an estimated bulk density, based on the borehole log, but a more detailed geotechnical investigation would be necessary to determine a more exact density for each layer. For the top soil down to a depth of approximately 9 metres, a bulk density of 1750 kg/m3 was estimated. Further down to a depth of 30 metres, the bulk density for the shale bedrock was estimated at 2300 kg/m3.

At borehole BH09-102, the compressional and the shear wave average velocities show a similar velocity pattern from the surface down to about 3 metres (Fill material) with greater velocities for the top layer. Below 3 metres in the silty clay the shear-wave velocities average about 150 m/s down to 8 metres while the compressional velocities average about 1300 m/s. The compressional average velocities increase from 1300 m/s to about 2900 m/s. The shear-wave average velocities increase from 500 m/s to about 1100 m/s. This change in both P wave and S wave velocities correlates with the borehole log which indicates a change from loose silt to weathered shale bedrock.

The average velocity was calculated assuming that the velocity from 13 metres to a depth of 30 metres was constant with an average shear-wave velocity value of 1100 m/s and equal to the velocity of the bedrock at the bottom of the borehole.

The average shear-wave velocity from ground surface to a depth of 30 metres was measured to be 448 m/s.

6.0 CLOSURE

We trust that these results meet your current needs. If you have any questions or require clarification, please contact the undersigned at your convenience.

PROFESSIONAL GEOSCIENTIST
CHRISTOPHER R. PHILLIPS
PRACTISING MEMBER
1503
ONTARIO

Stephane Sol, Ph.D.
Geophysics Group

Christopher Phillips, M.Sc., P.Geo
Associate, Senior Geophysicist

SS/CRP

Attachments: Table 1 – Shear Wave Velocity Profile at BH09-102

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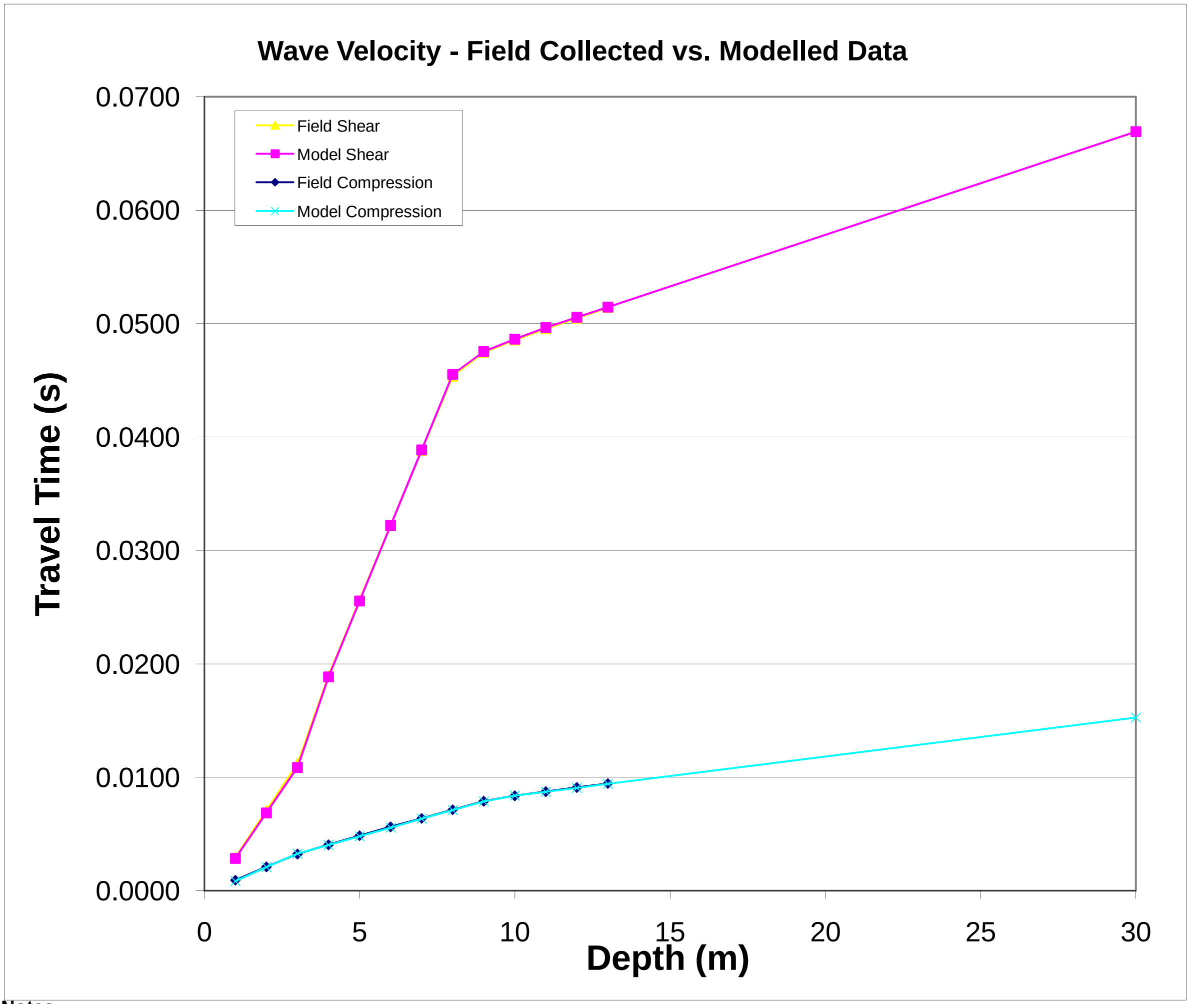
TABLE 1
VSP SURVEY RESULTS - BOREHOLE BH09-102
RUSSELL ROAD
OTTAWA

Layer Depth (m)				Estimated Bulk Density (kg/m^3)	Dynamic Engineering Properties			
Top	Bottom	Compression Wave (m/s)	Shear Wave (m/s)		Poissons Ratio	Shear Modulus (MPa)	Youngs Modulus (MPa)	Bulk Modulus (MPa)
0.00	1	1200	350	1750	0.45	214	623.1926	2234.1667
1	2	800	250	1750	0.45	109	316.2879	974.1667
2	3	850	250	1750	0.45	109	317.7675	1118.5417
3	4	1300	125	1750	0.50	27	81.7761	2921.0417
4	5	1300	150	1750	0.49	39	117.5937	2905.0000
5	6	1300	150	1750	0.49	39	117.5937	2905.0000
6	7	1300	150	1750	0.49	39	117.5937	2905.0000
7	8	1300	150	1750	0.49	39	117.5937	2905.0000
8	9	1300	500	1750	0.41	438	1236.5451	2374.1667
9	10	2000	900	2300	0.37	1863	5115.9498	6716.0000
10	11	2900	1000	2300	0.43	2300	6589.6086	16276.3333
11	12	2900	1100	2300	0.42	2783	7881.3014	15632.3333
12	13	2900	1100	2300	0.42	2783	7881.3014	15632.3333
13	30.0	2900	1100	2300	0.42	2783	7881.3014	15632.3333



Notes

1. Depth Presented relative to ground surface or mudline.
2. This Table to be analyzed in conjunction with the accompanying report.

Certificate of Analysis

Report Date: 16-May-2025

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 12-May-2025

Client PO: 63078

Project Description: PG7530

	Client ID:	BH3-25 (SS3)	-	-	-	-	-
	Sample Date:	09-May-25 09:00	-	-	-		
	Sample ID:	2520114-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	76.7	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.60	-	-	-	-	-
Resistivity	0.1 Ohm.m	26.4	-	-	-	-	-
Anions							
Chloride	10 ug/g	125	-	-	-	-	-
Sulphate	10 ug/g	17	-	-	-	-	-

eurofins | Environment Testing

Certificate of Analysis

Client:	Golder Associates Ltd. (Ottawa) 1931 Robertson Road Ottawa, ON K2H 5B7	Report Number:	1925119
		Date Submitted:	2020-02-05
		Date Reported:	2020-02-12
		Project:	19130191
		COC #:	854179
Attention:	Ms. Ali Ghirian		
PO#:			
Invoice to:	Golder Associates Ltd. (Ottawa)		

				Lab I.D.	1478526
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2020-01-15
				Sample I.D.	20-03 sa4 / 3.05-3.66m
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	0.002	%		0.012
	SO4	0.01	%		0.04
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.38
	pH	2.00			7.77
	Resistivity	1	ohm-cm		6230

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

REPORT OF ANALYSIS

Client: Golder Associates Ltd. (Ottawa)
32 Steacie Drive
Kanata, ON
K2K 2A9
Attention: Mr. Nicolas Leblanc

Report Number: 2922180
Date: 2009-09-17
Date Submitted: 2009-09-11

Project: 09-1121-0141

P.O. Number:
Matrix: Soil

Chain of Custody Number: 94866

								GUIDELINE		
LAB ID:			742818							
Sample Date:			2009-09-03							
Sample ID:			BH09-4 SA3							
PARAMETER	**UNITS**	**MRL**						**TYPE**	**LIMIT**	**UNITS**
Chloride	%	0.002	0.044							
Electrical Conductivity	mS/cm	0.05	0.73							
pH			7.5							
Resistivity	ohm-cm	1	1370							
Sulphate	%	0.01	0.02							

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Lorna Wilson
Agriculture Lab Supervisor

EXOVA ACCUTEST

REPORT OF ANALYSIS

Client: **Golder Associates Ltd. (Ottawa)**
32 Sleacie Drive
Kanata, ON
K2K 2A9
Attention: **Mr. Nicolas Leblanc**

Report Number: 1001318
Date: 2010-01-29
Date Submitted: 2010-01-21

Project: 09-1121-0141 PH2000

P.O. Number:
Matrix: Soil

Chain of Custody Number: **94860**

		LAB ID:	772581					**GUIDELINE**		
		Sample Date:	2010-01-12							
		Sample ID:	BH09-102 Sa2							
PARAMETER	**UNITS**	**MRL**						**TYPE**	**LIMIT**	**UNITS**
Chloride	%	0.002	0.044							
Electrical Conductivity	mS/cm	0.05	0.84							
pH			7.7							
Resistivity	ohm-cm	1	1190							
Sulphate	%	0.01	0.02							

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:
Lorna Wilson
Agriculture Lab Supervisor

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG7530-1 - TEST HOLE LOCATION PLAN

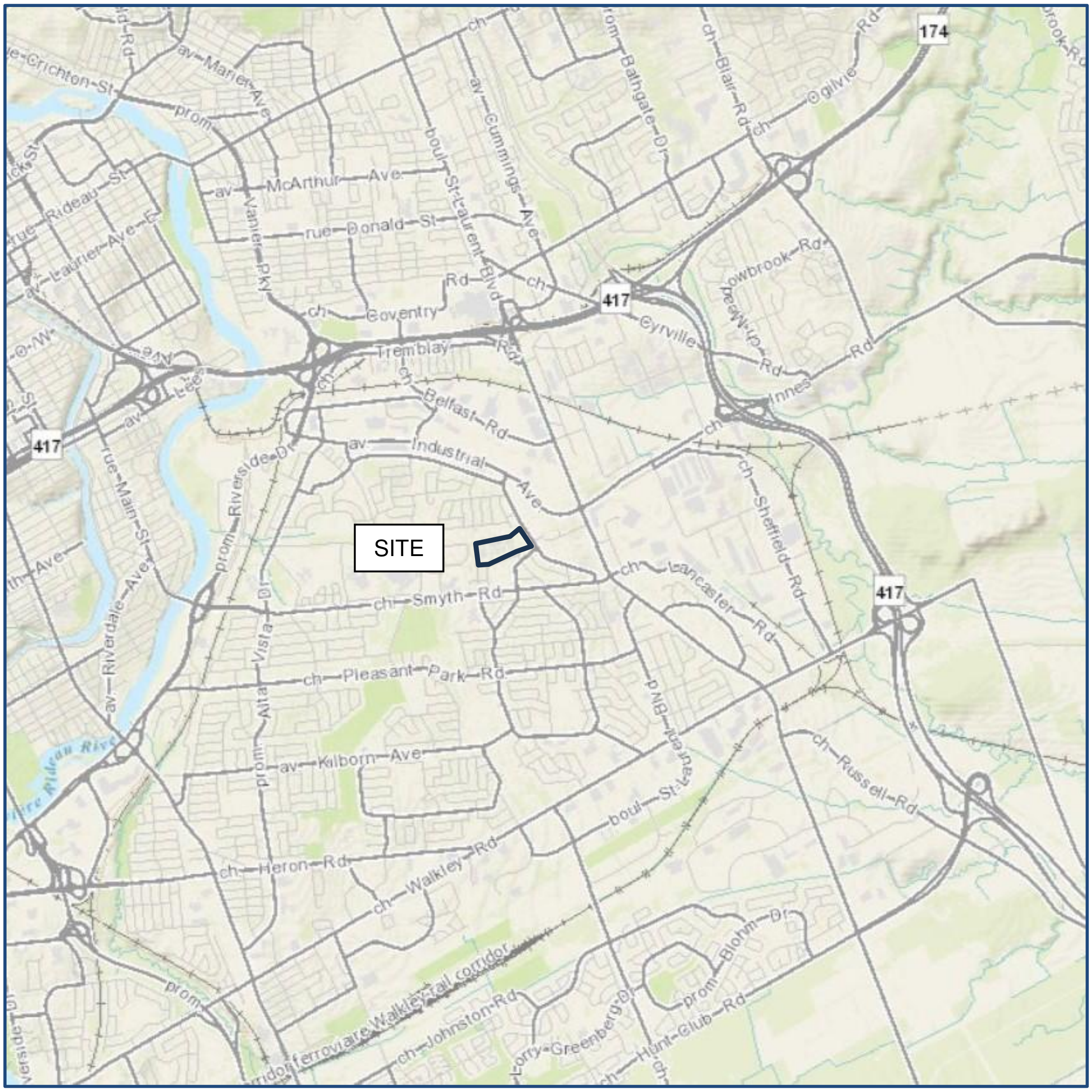
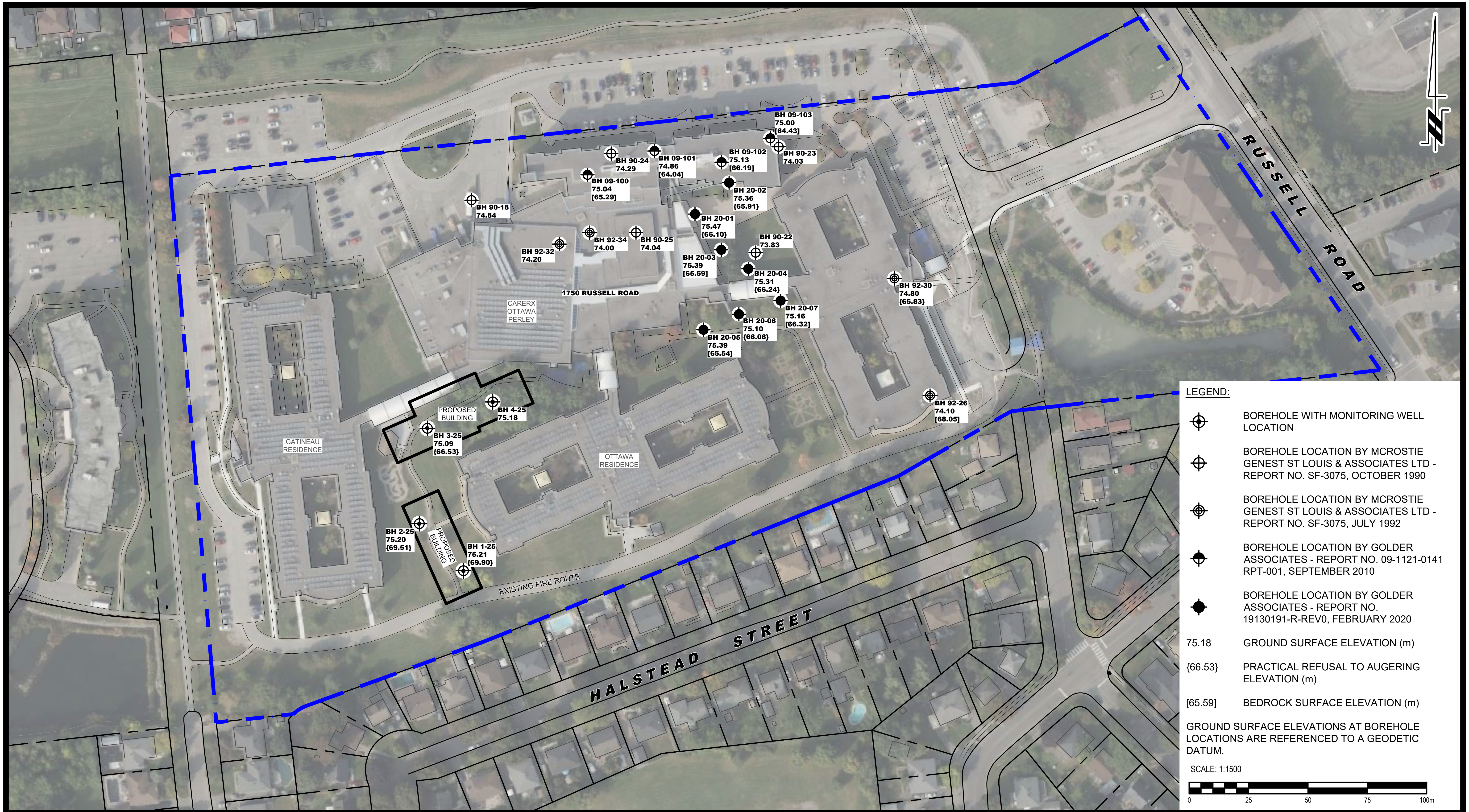


FIGURE 1

KEY PLAN

PATERSON GROUP



LEGEND:

⌖	BOREHOLE WITH MONITORING WELL LOCATION
⌖	BOREHOLE LOCATION BY MCROSTIE GENEST ST LOUIS & ASSOCIATES LTD - REPORT NO. SF-3075, OCTOBER 1990
⌖	BOREHOLE LOCATION BY MCROSTIE GENEST ST LOUIS & ASSOCIATES LTD - REPORT NO. SF-3075, JULY 1992
⌖	BOREHOLE LOCATION BY GOLDER ASSOCIATES - REPORT NO. 09-1121-0141 RPT-001, SEPTEMBER 2010
●	BOREHOLE LOCATION BY GOLDER ASSOCIATES - REPORT NO. 19130191-R-REV0, FEBRUARY 2020
75.18	GROUND SURFACE ELEVATION (m)
{66.53}	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
[65.59]	BEDROCK SURFACE ELEVATION (m)

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

SCALE: 1:1500

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

NO.	REVISIONS	DATE	INITIAL

KADUS GROUP
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
1750 RUSSELL ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500	Date: 05/2025
Drawn by: ZS	Report No.: PG7530-1
Checked by: KS	Dwg. No.: PG7530-1
Approved by: KP	Revision No.:

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11x17