Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION UPDATE
PROPOSED RESIDENTIAL BUILDING
65 WARD STREET
PORT HOPE, ONTARIO

Prepared for: Southbridge Health Care LP
766 Hespeler Road, suite 301
Cambridge, Ontario
N3H 5L8

Attention: Ms. Janet Pfeil

File No. 1-19-0660-02
Issued: June 14, 2021

Distribution

1 Electronic Copy	-	Southbridge Health Care LP
1 Copy	-	Southbridge Health Care LP
1 Copy	-	Terraprobe Inc., Brampton

Terraprobe Inc.

Greater Toronto
11 Indell Lane
Brampton, Ontario L6T 3Y3
(905) 796-2650 Fax: 796-2250
brampton@terraprobe.ca

Hamilton – Niagara
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560 Fax: 643-7559
stoneycreek@terraprobe.ca

Central Ontario
220 Bayview Drive, Unit 25
Barrie, Ontario L4N 4Y8
(705) 739-8355 Fax: 739-8369
barrie@terraprobe.ca

Northern Ontario
1012 Kelly Lake Rd., Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax: 670-0558
sudbury@terraprobe.ca

www.terraprobe.ca

TABLE OF CONTENTS

ENCLOSURES

Figures

Appendices

1 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Southbridge Health Care LP to provide updated geotechnical engineering design recommendations for the construction of a new structure at 65 Ward Street, Port Hope, Ontario. A site location plan is provided as Figure 1.

This report encompasses the results of the geotechnical investigation conducted for the proposed development to determine the prevailing subsurface soil and groundwater conditions, and based on this information, provides geotechnical engineering recommendations for the design of foundations, slab-on-grade, pavement design, earth pressure and seismic design parameters. Geotechnical comments are also included on pertinent construction aspects, excavation, backfill and groundwater control.

Terraprobe has also completed an updated hydrogeological study for the site. The results of this study is provided under separate cover.

2 SITE AND PROJECT DESCRIPTIONS

The site is located at the southwest corner of the intersection of Ward Street and Hope Street South with a municipal address of 65 Ward Street, in the Municipality of Port Hope, Ontario, where it is bounded by Ward Street to the north, Hope Street South to the east, residential properties to the south and Princess Street to the west. The general location of the site is presented on Figure 1.

The property currently consists of a parcel of land that is occupied by a nursing home (Community Nursing Home Port Hope) with four (4) buildings currently present at the Property with associated asphalt parking areas.

Terraprobe previously provided geotechnical engineering design advice for the proposed development, based on a design concept that included the construction of a new slab-on-grade, three to five (3-5) storey residential building. The findings of the previous geotechnical investigation are documented in our report titled "Geotechnical Investigation, Proposed Residential Building, 65 Ward Street, Port Hope, Ontario" File No. 1-19-0660-01, dated December 11, 2019. The findings of that report form the basis of this report and recommendations provided. There was no new field investigation carried out for this report update.

The following drawing was provided to Terraprobe and was reviewed in preparation of this updated report:

- *"Concept Site Plan"*, Project: Port Hope Nursing Home, Job Number: SL-1059-20, Sheet Number A1.0, dated May 6, 2021, by Lawrence Architect Incorporated.

Based on the provided drawing, it is now understood that the project was redesigned and will now include the demolition of the existing building within the north portion of the site and the construction of a new seven (7) storey slab-on-grade nursing home with associated new pavements (driveways and parking lots). Refer to Figure 2 for proposed development concept.

will consist of the construction of a new slab-on-grade three to five (3-5) storey residential building.

3 INVESTIGATION PROCEDURE

The field investigation was conducted during the period of October 29 and November 1, 2019, and consisted of drilling and sampling a total of twelve (12) boreholes, extending to about 3.1 to 8.2 m depth below grade. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figure 2).

The boreholes were drilled by a specialist drilling contractor using track-mounted drill rig power auger. The borings were advanced using continuous flight solid stem augers, and were sampled at 0.75 m intervals (up to 3.0 m depth) and 1.5 m intervals (below 3.0 m depth) with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling and testing) was observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic jars, and transported to our geotechnical testing laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties. Laboratory tests consisted of water content determination on all samples; and a Sieve and Hydrometer analysis on three (3) selected soil samples (Borehole 1, Sample 3, Borehole 8, Sample 5 and Borehole 9, Sample 1). The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analysis are plotted on the enclosed Borehole Logs at respective sampling depths. The results of Sieve and Hydrometer analysis are also summarized in Section 4.5 of this report, and appended.

Water levels were measured in open boreholes upon completion of drilling. Monitoring wells comprising 50 mm diameter PVC pipes were installed in selected boreholes (Boreholes 3 to 6, 8, 10 and 12) to facilitate groundwater monitoring. The PVC tubing was fitted with a bentonite clay seal as shown on the accompanying Borehole Logs. Water levels in the wells were measured on November 14, November 19 and December 9, 2019, as noted on the enclosed borehole logs. The results of groundwater monitoring are presented in Section 4.6 of this report.

The borehole ground surface elevations were surveyed by Terraprobe using a Trimble R10 GNSS System. The Trimble R10 system uses the Global Navigation Satellite System and the Can-Net reference system to determine target location and elevation. The Trimble R10 system is reported to have an accuracy of up to 10 mm horizontally and up to 30 mm vertically.

It should be noted that the elevations provided on the Borehole Logs are approximate only, for the purpose of relating soil stratigraphy and should not be used or relied on for other purposes.

4 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions encountered at the site.

It should be noted that the subsurface conditions are confirmed at the borehole locations only, and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.1 Surficial Pavement Structure/Topsoil

Boreholes 2, 4 and 9 encountered an asphalt pavement structure varying in thickness from about 380 mm (Borehole 2) to 800 mm (Borehole 4) at the ground surface. The measured asphaltic concrete layer thickness ranged between about 50 mm (Boreholes 9) and 85 mm (Borehole 2) underlain by an aggregate base layer varying in thickness from about 295 mm (Borehole 2) to 730 mm (Borehole 4). A surficial topsoil layer, varying in thickness from about 150 mm (Boreholes 1, 5, 7, 8, 10 to 12) to 300 mm (Borehole 3) was encountered at Boreholes 1, 3, 5 to 8 and 10 to 12 locations. The topsoil was brown/dark brown in colour and predominantly consisted of a silt matrix.

The topsoil and pavement structure component thicknesses noted above were measured from the borehole drilling and are approximate. These thicknesses may vary between and beyond the boreholes. The above information is not sufficient for estimating quantity and/or associated costs. A shallow test pit/pavement coring investigation should be carried out to obtain accurate material/component thickness information for quantity/estimation purposes, if required.

4.2 Earth Fill

Earth fill materials, consisting of clayey silt, trace to some sand, trace amounts of organics and rootlets/sand and gravel to sand with trace amounts of silt was encountered below the surficial topsoil layer or pavement structure, extending to the depths ranging from 0.8 m (Borehole 2) to 2.3 m (Boreholes 4, 8 and 12) below grade.

Standard Penetration Test results (N-values) obtained from the clayey silt earth fill zone ranged from 2 to 16 blows per 300 mm of penetration, indicating a soft to very stiff consistency, while the N-values obtained from the sand and gravel and sand, trace silt fill zone ranged from 8 to 24 blows per 300 mm of penetration, indicating a loose to compact relative density. The in-situ moisture contents of the earth fill samples ranged from 2 to 37%, indicating a moist to wet (typically moist) condition.

4.3 Glacial Till

Clayey silt, trace to some sand till deposit with trace amounts of gravel or silty sand, trace to some clay till deposit with trace amounts of gravel was encountered underlying the earth fill zone in each borehole and extended to the full depth of investigation up to about 8.2 m below grade (Borehole 7). At Borehole 10 the silty sand till is interrupted by a layer of sand with trace to some gravel and trace amounts of silt between 4.6 to 7.6 m depth below grade.

N-values obtained from the undisturbed clayey silt, trace to some sand till deposit ranged from 15 to greater than 50 blows per 300 mm of penetration, indicating a stiff to hard consistency while the N-values obtained from the silty sand, trace to some clay till deposit ranged from 12 to greater than 50 blows per 300 mm of penetration, indicating a compact to very dense relative density. The in-situ moisture contents of the glacial till samples ranged from 2 to 32%, indicating a generally moist condition.

It should be noted that the glacial till deposit may contain larger size particles (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for the particles of this size.

4.4 Sand

Sand with trace to some gravel with trace amounts silt was locally encountered (at Borehole 10) intersecting the silty sand till layer between about 4.6 and 7.6 m depth below grade. N-values obtained from the sand deposit were 50 and 53 blows per 300 mm of penetration, indicating a very dense relative density. The in-situ moisture content of the silty sand sample was about 10%, indicating a wet condition.

4.5 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural water content determination for all samples, while Sieve and Hydrometer analysis were conducted on selected soil samples. The test results are plotted on the enclosed Borehole Logs at respective sampling depths.

The results (graphs) of the Sieve and Hydrometer (grain size) analysis are appended and a summary of these results is presented as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1, Sample 3	1.8	0	18	44	38	SILT AND CLAY, some sand
Borehole 8, Sample 5	3.4	7	48	31	14	SILTY SAND, some clay, trace gravel
Borehole 9, Sample 1	0.3	0	18	51	31	CLAYEY SILT, some sand

4.6 Groundwater

Observations pertaining to the depth of water level and caving were made in the open boreholes immediately after completion of drilling, and are noted on the enclosed Borehole Logs. Monitoring wells were installed in Boreholes 3 to 6, 8, 10 and 12 to facilitate shallow groundwater level monitoring. The groundwater level measurements in the monitoring wells were taken on November 14, 19 and December 9, 2019 are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Bore hole No.	Depth of Boring	Depth to Cave	Water Level at the Time of Drilling	Water Level in Monitoring Wells on November 14, 2019	Water Level in Monitoring Wells on November 19, 2019	Water Level in Monitoring Wells on December 9, 2019
1	7.8 m BG	open	7.2 m BG	MW not installed	MW not installed	MW not installed
2	3.1 m BG	open	3.0 m BG	MW not installed	MW not installed	MW not installed
3	7.8 m BG	open	7.0 m BG	1.5 m BG	2.7 m BG	1.6 m BG
4	7.8 m BG	open	7.3 m BG	2.1 m BG	2.3 m BG	2.1 m BG
5	7.7 m BG	open	7.6 m BG	2.0 m BG	2.3 m BG	2.3 m BG
6	8.1 m BG	open	dry	3.1 m BG	3.5 m BG	3.0 m BG
7	8.2 m BG	open	5.9 m BG	MW not installed	MW not installed	MW not installed
8	7.9 m BG	7.3 m BG	5.5 m BG	2.8 m BG	3.1 m BG	2.9 m BG
9	3.7 m BG	open	dry	MW not installed	MW not installed	MW not installed
10	7.8 m BG	4.6 m BG	3.7 m BG	3.6 m BG	3.6 m BG	3.6 m BG
11	3.7 m BG	open	dry	MW not installed	MW not installed	MW not installed

Bore hole No.	Depth of Boring	Depth to Cave	Water Level at the Time of Drilling	Water Level in Monitoring Wells on November 14, 2019	Water Level in Monitoring Wells on November 19, 2019	Water Level in Monitoring Wells on December 9, 2019
12	7.8 m BG	7.3 m BG	1.8 m BG	1.8 m BG	1.8 m BG	1.9 m BG

BG = Below Grade; MW = Monitoring Well

The water levels noted above may fluctuate seasonally depending upon the amount of precipitation and surface runoff.

5 DISCUSSIONS AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for the use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. If there are any changes to the site development features or there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Foundation

Boreholes 1 to 5, 8 and 12 are located within or in close proximity of the footprints of the proposed Building. These boreholes encountered a layer of earth fill materials (beneath the surficial topsoil layer or pavement structure), which extended to a depth of about 0.8 m (Borehole 2) to 2.3 m (Boreholes 4, 8 and 12) below existing grade, generally underlain by undisturbed clayey silt, trace to some sand till deposit with trace amounts of gravel or silty sand, trace to some clay till deposit with trace amounts of gravel was encountered underlying the earth fill zone in each borehole and extended to the full depth of investigation up to about 8.1 m below grade (Borehole 6).

The detailed design information is not available during preparation of this report. Based on the preliminary design information provided, the proposed building would a seven (7) storey slab-on-grade structure, i.e. with no basement.

The undisturbed native till deposit is considered suitable to support the proposed building foundations. A maximum net geotechnical reaction of 250 kPa (Serviceability Limit States, SLS) and a maximum factored geotechnical resistance of 375 kPa (Ultimate Limit States, ULS) may be used for preliminary design of conventional spread footing foundations (for vertical and concentric loads) supported at least 0.3 m into the underlying competent undisturbed native till soils of stiff to hard consistency for cohesive soils and compact to very dense relative density for non-cohesive soils. Higher bearing pressures are also available and can be analyzed in detail based on the final building design. The final grading plan and design drawings should be reviewed by Terraprobe to better assess the design foundation elevations and to provide updated foundation bearing pressure (geotechnical reaction and resistance) recommendations prior to the development.

As previously noted, the relatively deep earth zone was encountered at Boreholes 4, 8 and 12 locations, extending up to 2.3 m depth below grade. In this area, the footings will be extended to be founded on the silty sand till deposit of compact to very dense relative density or clayey silt till deposit of very stiff to hard consistency. Alternatively, consideration may be given to backfill this over-excavation zone (from design foundation level to the underlying competent undisturbed native soils) with lean mix concrete (strength to be determined by the structural engineer) and the building foundations may be supported on this lean mix concrete pad/pedestal. The lean mix concrete pad must extend a minimum of 300 mm beyond the edge of the foundations in every direction.

The underside of footing elevations must be designed to provide a minimum of 1.2 m of soil cover or equivalent insulation to the foundation subgrade for frost protection considerations in unheated areas. All footings must be designed to bear at least 0.3 m into the undisturbed native soil stratum.

The minimum width of the continuous strip footings must be 500 mm and the minimum footing area for column must be 1.5× 1.5 m^2 regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. The geotechnical resistance(s) as recommended allow for up to 25 mm of total settlement. This settlement will occur as load is applied and is linear elastic and non-recoverable. Differential settlement is a function of spacing, loading and foundation size.

5.2 Foundation Installation

All exterior foundations and foundations in unheated areas must be provided with a minimum soil cover of 1.2 m or equivalent insulation for frost protection.

It is recommended that all excavated footing base must be evaluated by a qualified geotechnical engineer to ensure that the founding soils exposed at the excavation base are consistent with the design bearing pressure intended by the geotechnical engineer.

Prior to pouring foundation concrete, the foundation subgrade should be cleaned of all deleterious materials such as topsoil, fill, softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the foundation subgrade and concrete must be provided.

It is noted that the native soils tend to weather rapidly and deteriorate on exposure to the atmosphere or surface water. Hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

5.3 Slab-on-Grade

Conventional lightly loaded concrete floor slab should be placed on at least 150 mm of granular base (OPSS MUNI 1010 Granular A) compacted to a minimum of 100 percent SPMDD. The earth fill materials may remain to support the slab-on-grade provided they are approved by the geotechnical engineer at the time of construction. Any subgrade area containing excessive amounts of deleterious materials must be sub-excavated. The subgrade must be assessed by a geotechnical engineer or its representative, prior to placement of the granular base. Any soft or wet subgrade areas identified should be locally sub-excavated and backfilled with clean earth fill compacted to a minimum of 98 percent SPMDD. Based on the borehole information, selection and sorting of the earth fill materials will be required.

The following subgrade parameters are recommended for the design of slab-on-grade supported on the undisturbed glacial deposit or engineered fill material compacted to 98 percent of SPMDD:

Ks =40,000 kPa/m (undisturbed native glacial till)
Ks =20,000 kPa/m (engineered fill)

Provided the finish floor level of the slab-on-grade building is at least 200 mm above the outside design grade, and the site is graded to promote drainage away from the building; subfloor drainage provisions are not required, other than the nominal drain for the granular base.

Regardless of the approach to slab construction, the floor slabs that are to have bonded floor finish (such as tiles with adhesives) should be provided with a capillary moisture break and a vapour barrier. The floor manufacturers have specific requirements for moisture and vapour barrier, therefore, the floor designer/architect must ensure that a provision of appropriate moisture and vapour barrier conforming to specific floor finish product requirements is incorporated in the project specifications. Adequate testing must be carried out to ensure acceptable levels of moisture and relative humidity in the concrete slab prior to the installation of floor finish. Studies indicate that a provision of 200 mm thick 19 mm Clear Stone base (OPSS MUNI 1004) under the slab helps provide a good capillary moisture break provided the granular base is positively drained. However, this provision does not provide protection against moisture vapour migration and/or replace the floor manufacturers' specific requirement(s) for a moisture and vapour barrier.

The under-slab vapour retarder specifications, selection and installation shall conform to ASTM E1745 and ASTM E1643. The moisture vapour measurement tests shall conform to RH: ASTM F2170, RH: ASTM F2420 and Calcium Chloride: ASTM F1869. The Surface Applied Moisture Vapour Barrier system shall meet the guidelines established in ASTM F3010-13.

The soils at this site are susceptible to frost effects which would have the potential to deform hard landscaping material adjacent to the building. It is likely that the buildings may have flush entrances, therefore care must be taken in detailing the exterior slabs/sidewalks by providing insulation/drainage /non-frost susceptible backfill to maintain the flush threshold during freezing weather conditions. Alternatively, a frost slab construction may be employed at these locations.

5.4 Earth Pressure Design Parameters

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

Where:

P = the horizontal pressure (kPa)
K = the earth pressure coefficient
h = the depth below the ground surface (m)
h_w = the depth below the groundwater level (m)
γ = the bulk unit weight of soil (kN/m^3)
γ_w = the bulk unit weight of water (9.8 kN/m^3)
γ' = the submerged unit weight of the exterior soil, (γ_{sat} - γ_w)
q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$P = K[\gamma h + q]$$

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction **(R)** depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan ϕ**) expressed as **R = N tan ϕ**. The factored geotechnical resistance at ULS is **0.8 R**.
Passive earth pressure resistance is generally not considered as a resisting force against sliding for conventional retaining structure design because a structure must deflect significantly to develop the full passive resistance.

The average values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follow:

Parameter	**Definition**	**Units**
ϕ	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/ m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

Stratum/Parameter	Φ (degree)	γ (kN/m^3)	K_a	K_o	K_p
Earth Fill	28	19.0	0.36	0.53	2.77
Undisturbed Clayey Silt Till, Silty Sand Till and Sand	34	21.5	0.28	0.44	3.54
Compact Granular Fill	32	21.0	0.31	0.47	3.25

The above values of the earth pressure coefficients are for the horizontal backfill grade behind the wall. The earth pressure coefficients for inclined grade will vary based on the inclination of the retained ground surface.

5.5 Earthquake Design Parameters

The current Ontario Building Code stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A. of the Ontario Building Code. The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated on the basis of rational analysis of undrained shear strength (s_u) or penetration resistance (N-values).

$$\upsilon_{s-avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{\upsilon_{si}}} \qquad S_{u-avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{s_{ui}}} \qquad N_{avg} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

Shear Wave Velocity | **Undrained Shear Strength** | **SPT N-values**

Based on the borehole data (advanced to a maximum of 8.2 depth below grade), it is understood that the proposed buildings will be founded on the glacial till deposit of stiff to hard consistency or compact to very dense relative density. It is expected that the deeper stratigraphy in this area is at least as competent as the lowest proven strata in the boreholes. On this basis, site seismic classification may be taken as Site Class C according to Table 4.1.8.4.A of the Ontario Building Code. Tables 4.1.8.4.B. and 4.1.8.4.C. of the Ontario Building Code provide the applicable acceleration and velocity based site coefficients. The applicable acceleration and velocity based site coefficients for Site Class C are provided as follows:

Site Class	**Values of F_a (acceleration based coefficients)**				
	$S_a(0.2) \leq 0.25$	**$S_a(0.2) = 0.50$**	**$S_a(0.2) = 0.75$**	**$S_a(0.2) = 1.00$**	**$S_a(0.2) \geq 1.25$**
C	1.0	1.0	1.0	1.0	1.0

Site Class	**Values of F_v (velocity based coefficients)**				
	$S_a(1.0) \leq 0.1$	**$S_a(1.0) = 0.2$**	**$S_a(1.0) = 0.3$**	**$S_a(1.0) = 0.4$**	**$S_a(1.0) \geq 0.5$**
C	1.0	1.0	1.0	1.0	1.0

It should be noted that the above site seismic designation is estimated on the basis of rational analysis of the undrained shear strength information obtained from the boreholes advanced at the site to a maximum depth of about 8.2 m below grade. A site specific Multichannel Analysis of Surface Waves (MASW) may be considered to confirm the site seismic classification.

6 EXCAVATIONS AND GROUNDWATER CONTROL

The boreholes data indicate that the earth fill and undisturbed native soils would be encountered in the excavations. Excavations must be carried out in accordance with the *Occupational Health and Safety Act and Regulations for Construction Projects*. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

The earth fill materials and native soils encountered in the boreholes are classified as Type 3 Soil above and Type 4 Soil below the prevailing groundwater level under these regulations. Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates the steepest slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

It should be noted that the glacial till deposit may contain larger particles (cobbles and boulders) that are not specifically identified in the Borehole Logs. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of the particles of this size. Provision should be made in excavation contracts to allocate risks associated with time spent and equipment utilized to remove or penetrate such obstructions when encountered.

Groundwater level upon completion of the drilling ranged from about 1.8 m to 7.6 m below grade in all boreholes. The groundwater levels measured in the monitoring wells (installed in Boreholes 3 to 6, 8, 10 and 12) varied from about 1.5 m (Borehole 3) to about 3.6 m (Borehole 10) below grade on November 14, 2019; about 1.8 m (Borehole 12) to 3.6 m (Borehole 10) below grade on November 19, 2019 and 1.6 m (Borehole 3) to 3.6 m (Borehole 10) below grade on December 9, 2019 respectively,

The site is underlain by relatively low permeability glacial till deposits that should preclude significant amounts of free-flowing groundwater seepage into the excavation in the short-term. Therefore, significant groundwater seepage is not expected for the relatively shallow excavation, and active dewatering (by well points etc.) would not be required. However, perched groundwater seepage may be encountered during the excavations primarily emanating from the fill materials and silt/sand lenses typically found in the glacial till deposit due to its mode of deposition. The perched groundwater seepage should diminish slowly and can be controlled by continuous pumping from a conventional sump and pump arrangement at the base of the excavation. For excavations extending to depths greater than 0.3 m below the prevailing water table, it will be necessary to lower the groundwater level below the excavation base, prior to, and maintain during the subsurface construction.

6.1 Regulatory Requirements

The volume of water entering the excavation will be based on both groundwater infiltration and precipitation events. Based on recent regulation changes within O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction Dewatering less than 50,000 L/day: The takings of both groundwater and storm water **does not require** a Construction Dewatering Assessment Report (CDAR) and **does not require** a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of groundwater and/or storm water **requires** a Construction Dewatering Assessment Report (CDAR) and **does not** require a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 400,000 L/day: The taking of groundwater and/or storm water **requires** a Construction Dewatering Assessment Report (CDAR) and **requires** a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).

If it is expected that greater than 50,000 L/day of water will be pumped, a CDAR and/or a PTTW should be obtained as soon as possible in advance of construction to avoid possible delays. Depending on the construction methodology for the site servicing (trench boxes or open cut, and length of trench) and the time of year (high versus low groundwater levels), there is the possibility that water taking of greater than 50,000 L/day may occur at this site.

A CDAR takes up to 1 month to complete if monitoring wells are already installed on site. Once the CDAR is completed, it is uploaded to the Environmental Activity and Sector Registry (EASR), which registers the construction dewatering with the MOECC without the need for a permit. If the results of the CDAR indicate that greater than 400,000 L/day will be pumped, a PTTW application must be submitted to the MOECC. A PTTW application can take up to an additional 3 months for the MOECC to process upon completion of the CDAR. Note that Environmental Compliance Assessments, Impact Study Reports and applicable municipal, provincial and conservation authority approvals (completed by others) will be required as part of the CDAR.

Detailed discussion on groundwater considerations for this site are discussed in Terraprobe’s Updated Hydrogeological Study for the site under a separate cover (File No. 3-20-0139-46).

6.2 Backfill

The native soils are considered suitable for backfill provided the moisture content of these soils is within 3% of the Optimum Moisture Content (OMC). It should be noted that there may be wet zones within the subsurface soils (particularly soils excavated from below the prevailing water level) which could be too wet to compact. Any soil material with 3% or higher in-situ moisture content than its OMC, could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less, and heavily compacted to a minimum of 95% SPMDD at a water content close to optimum (within 2%). The upper 1.2 m of the pavement subgrade must be compacted to a minimum of 98% SPMDD.

It should be noted that the soils encountered on the site are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that the earthworks will be difficult and may incur additional costs if carried out during wet periods (i.e. spring and fall) of the year.

6.3 Pavement Design

A total of twelve (12) boreholes were advanced across the site and extended to depths varying from about 3.1 to 8.2 m below grade. Three (3) of the above noted boreholes (Boreholes 1, 2, 6, 7, 8, 9, 10 and 11) were advanced within or in close proximity to the proposed parking and driveway areas, and extended to depths varying from about 3.1 to 8.2 m below grade. These boreholes encountered a topsoil or asphalt pavement layer at the ground surface underlain by a zone of earth fill materials which were in turn underlain by undisturbed native soil deposit.

It is understood that site grading may require both cut and fill, and therefore, the pavement subgrade may consist of undisturbed native soil or clean earth fill compacted to a minimum of 98 present SPMDD. The pavement subgrade should be proof-rolled with a heavy rubber tire vehicle (such as a grader) and any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill material placed in 150 mm thick lifts and compacted to a minimum of 98 percent SPMDD. Local subexcavation in some areas may be required due to loose/soft, wet and incompetent subgrade conditions or excessive topsoil/organic presence, as identified during the proof roll.

The existing earth fill materials encountered on the site may be utilized for subgrade preparation provided they do not contain excessive amounts of organics and deleterious materials, as well as their in-situ moisture content is within 3 percent of the optimum moisture content. The selection and sorting of these soils earth fill materials for reuse, should be conducted under the supervision of a geotechnical engineer. Pavement subgrade upfill and trench backfill material should be compacted to a minimum of 95 percent SPMDD, while the upper zone (within 1.2 m of the design subgrade) should be compacted to a minimum of 98 percent SPMDD.

A pavement design for parking areas and driveways is presented below. The pavement design methods are based on a design life of 15 for typical weather conditions and design traffic loadings. The following pavement thickness design is provided on the above noted considerations and subgrade basis.

Pavement Layer	Car Parking (Light Duty) Minimum Component Thickness	Driveway/Fire Route (Heavy Duty) Minimum Component Thickness	Compaction Requirements
Hot Mix Asphalt Surface Course: OPSS 1150 HL 3	50 mm	40 mm	as per OPSS.MUNI 310
Hot Mix Asphalt Binder Course: OPSS 1150 HL 8 (MDB)	NA	80 mm	
Base Course: OPSS MUNI 1010 Granular A	150 mm	150 mm	100 percent Standard Proctor Maximum Dry Density
Subbase Course: OPSS MUNI 1010 Granular B Type II	375 mm	450 mm	

HL 3 and HL 8 hot mix asphalt mixes should be designed, produced and placed in conformance with OPSS 1150 and OPSS. MUNI 310 requirements and pertinent City/Region standards.

Granular base and subbase materials should meet the requirements of OPSS.MUNI 1010 and pertinent City/Region requirements. Granular materials should be compacted to 100 percent of Standard Proctor Maximum Dry Density (SPMDD). PG 58-34, conforming to OPSS 1101 is recommended in the HMA surface and binder courses. Tack coat SS-1 should be applied between hot mix asphalt binder course and surface course.

Consideration may also be given to the use of rigid Portland Cement concrete pavement where there is intense truck use, and turning of transport vehicles in conjunction with the waste handling, loading docks or delivery facilities. The following table provides the minimum recommended rigid pavement structure:

Pavement Layer	Heavy Duty Pavement	Compaction Requirements
Portland Cement Concrete: (CAN3-CSA A23.1) - Class C-2	200 mm	CAN3-CSA A23.1
Base Course: OPSS MUNI 1010 Granular A	300 mm	100 percent Standard Proctor Maximum Dry Density

It must be noted that this structure does not provide full protection of the subgrade from frost penetration; therefore, the pavement slab must be separated from the building structure. Truck loading bay is typically the lowest point in the pavement grading. It is recommended to provide a subgrade drain at the lowest point in the bay, usually at the trench drain, to facilitate an exit for subgrade drainage.

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of 3 percent) to provide effective drainage toward subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into respective catchbasins to facilitate drainage of the subgrade and granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level. Continuous subdrains should also be provided for the parking lot/driveway pavement areas along the curb-lines/sidewalk. Two lengths of subdrain (each minimum of 3.0 m long) should be installed at each catchbasin (refer to attached drawing - Pavement Drainage Alternatives).

The concrete surface sidewalk and entrance slabs (near flush-doors) must be supported on a minimum of 1.2 m thick non-frost susceptible material (Granular ‘A’ or ‘B’, OPSS.MUNI 1010) provided with a provision of a subdrain with a positive outlet to help minimize slab heave due to freezing weather conditions, alternatively consideration may be given to install a frost-slab in these areas.

The above pavement design thicknesses are considered adequate for the design traffic. However, if the pavement construction occurs in wet, winter or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular sub-base, base or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of the granular materials.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

It should be noted that in addition to the adherence to the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the designed pavement life. It is recommended that regular inspection and testing should be conducted during the pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

6.4 Quality Control

Excavations on this site must be shored to preserve the integrity of the surrounding properties and structures. The current Ontario Building Code stipulates that engineering review of the subsurface conditions is required on a continuous basis during the installation of earth retaining structures. Terraprobe should be retained to provide this review, which is an integral part of the geotechnical design function as it relates to the shoring design considerations. Terraprobe can provide detailed shoring design services for the project, if requested. All foundations must be monitored by the geotechnical engineer on a continuous basis as they are constructed. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the current Ontario Building Code. If Terraprobe is not retained to carry out foundation evaluations during construction, then Terraprobe accepts no responsibility for the performance or nonperformance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice provided in this report.

Concrete for this structure will be specified in accordance with the requirements of CAN3 - CSA A23.1. Terraprobe maintains a CSA certified concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

The requirements for fill placement on this project should be stipulated relative to SPMDD, as determined by ASTM D698. In-situ determinations of density during fill placement by Procedure Method B of ASTM D2922 are recommended to demonstrate that the contractor is achieving the specified soil density. Terraprobe is a CNSC licensed operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary.

Terraprobe can provide thorough in house resources, quality control services for Building Envelope, Roofing and Structural Steel in accordance with CSA W178, as necessary, for the Structural and Architectural quality control requirements of the project. Terraprobe is certified by the Canadian Welding Bureau under W178.1-1996.

7 LIMITATIONS AND RISK

7.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

7.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of Southbridge Health Care LP and their retained design consultants and is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. and Southbridge Health Care LP who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
O.B.
O. D. BENJAMIN
90337072
June 14, 2021
PROVINCE OF ONTARIO

O. Benjamin

Osbert (Ozzie) Benjamin, P.Eng.
Senior Geotechnical Project Manager

Michael Tanos.

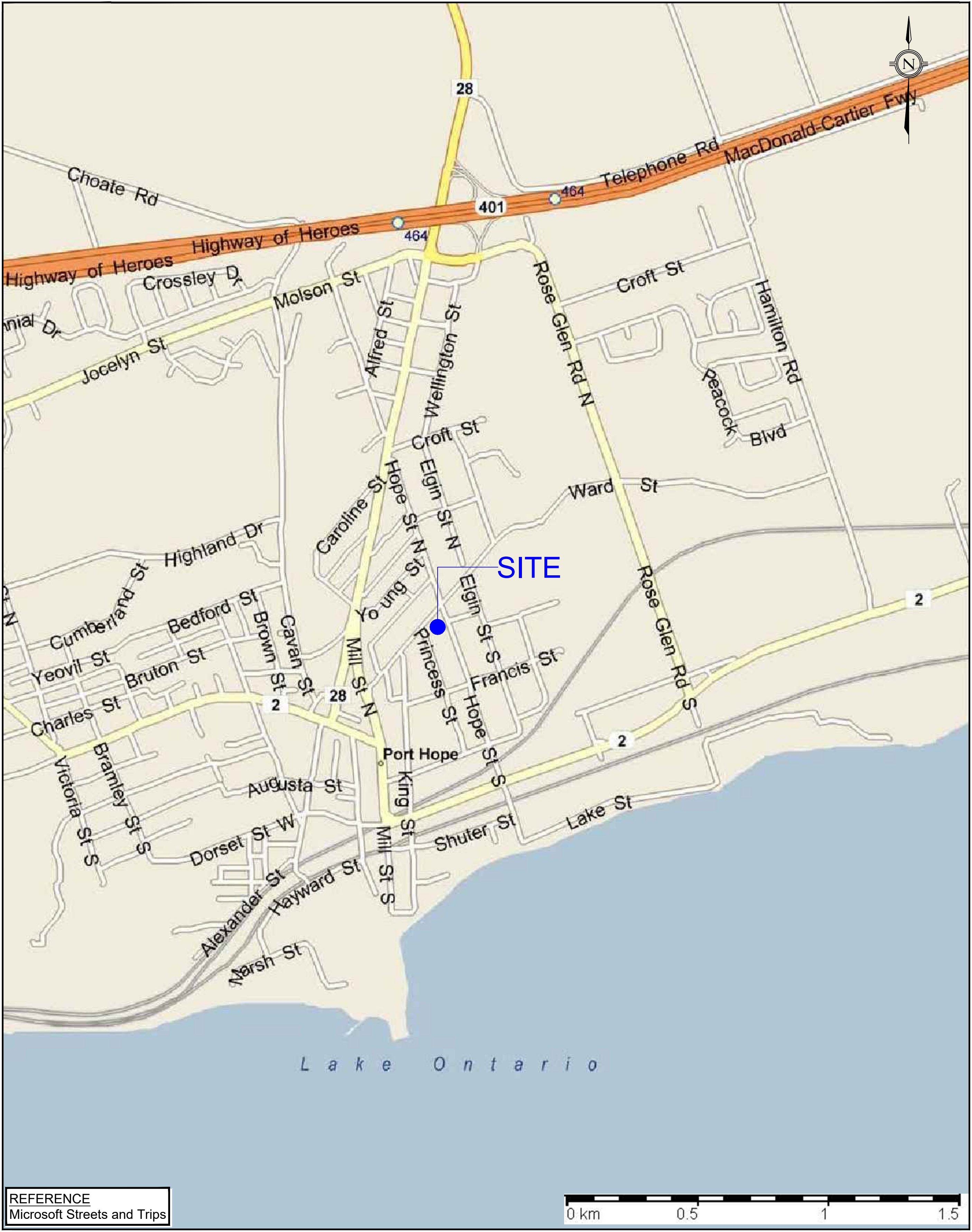
Michael Tanos, P. Eng.
Review/Consulting Principal

ENCLOSURES

TERRAPROBE INC.

FIGURES

TERRAPROBE INC.



REFERENCE
Microsoft Streets and Trips

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

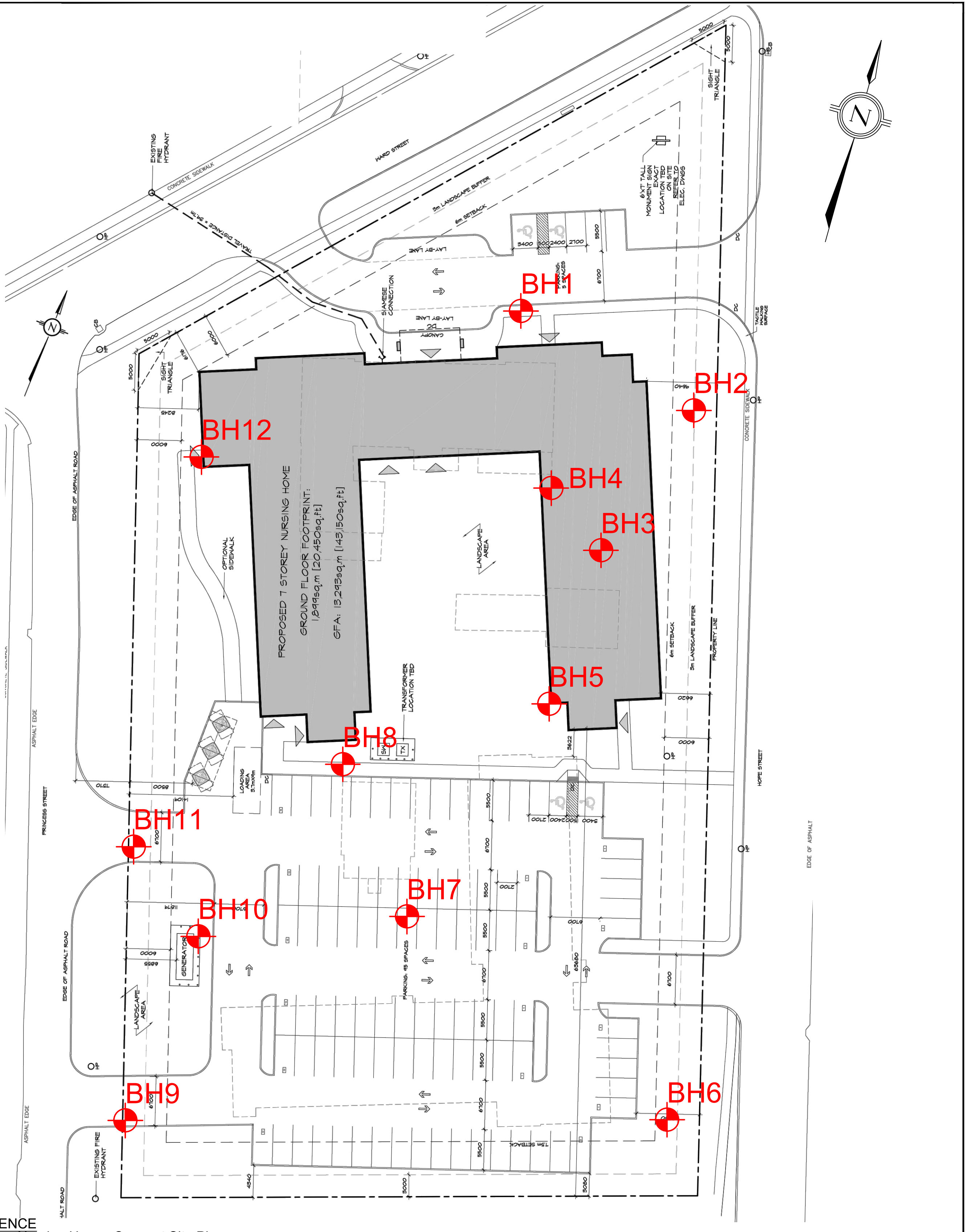
SITE LOCATION PLAN

File. No.: 1-16-0660-01

FIGURE : 1

Z:\1-Project Files\2019\1-19-0660 - 65 Ward Street, Port Hope\01-GEO Investigation\A. Dwgs. Logs\AutoCAD\1-19-0660-01 FIG 1 & 2.dwg.
Kamal

T:\1-Project Files\2019\1-19-0660 - 65 Ward Street, Port Hope\01-GEO Investigation\A. Dwgs, Logs\AutoCAD\1-19-0660-01 (2021 05 20) FIG 1 & 2.dwg, Sandy



REFERENCE
Port Hope Nursing Home, Concept Site Plan
Sheet No. A1.0, Job No. SL-105-20
Date: 2021.05.06
By: S.J. Lawrence Architect Incorporated

LEGEND
⊕ Approximate Borehole Location

8 0 20m
SCALE

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
BOREHOLE LOCATION PLAN

File No.: 1-19-0660-01

FIGURE :
2

APPENDICES

TERRAPROBE INC.

APPENDIX A

TERRAPROBE INC.

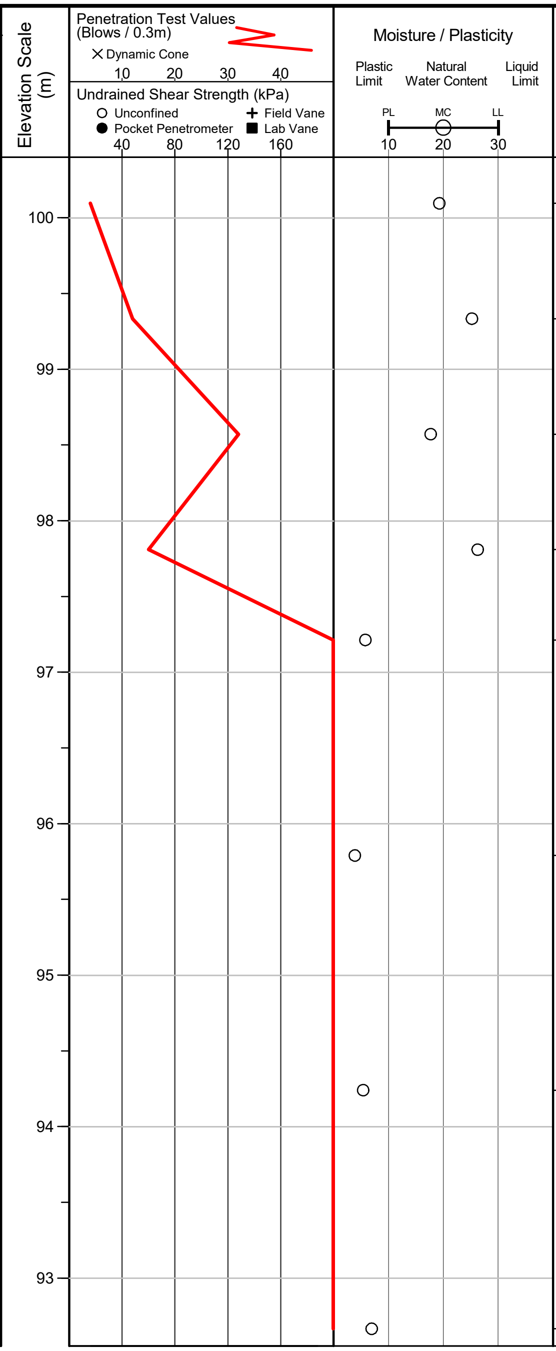
Terraprobe

LOG OF BOREHOLE 1

Project No. : 1-19-0660-01
Client : CVH (NO. 6) LP
Originated by : SM
Date started : October 29, 2019
Project : 65 Ward Street
Compiled by : AR
Sheet No. : 1 of 1
Location : Port Hope, Ontario
Checked by :

Position : E: 717532, N: 4870488 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES				
Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
100.4	**GROUND SURFACE**					
100.2 0.2	150mm **TOPSOIL**					
	FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist	1	SS	4	PID: 0	
		2	SS	12	PID: 0	
98.9 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)	3	SS	32	PID: 0	0 18 44 38
		4	SS	15	PID: 0	
97.4 3.0	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)	5	SS	50/ 150mm	PID: 0	
	...grey below	6	SS	50/ 100mm	PID: 0	
		7	SS	50/ 50mm	PID: 0	wet sampler
92.6 7.8		8	SS	50 / 75mm	PID: 0	



END OF BOREHOLE

Unstabilized water level measured at 7.2 m below ground surface; borehole was open upon completion of drilling.

Terraprobe

LOG OF BOREHOLE 2

Project No. : 1-19-0660-01
Client : CVH (NO. 6) LP
Originated by : SM

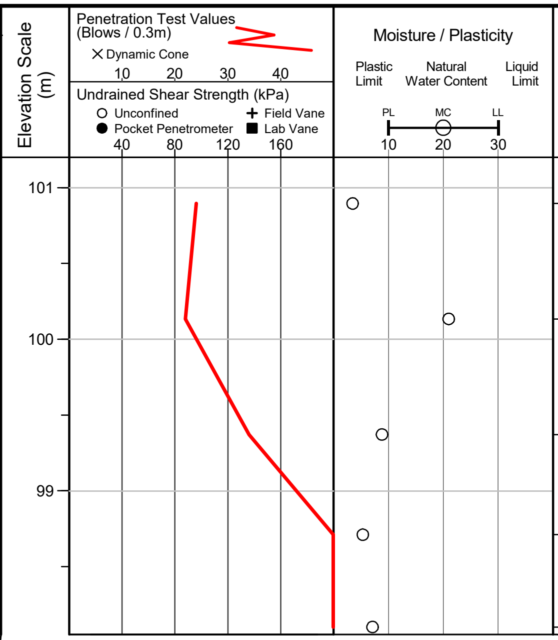
Date started : October 31, 2019
Project : 65 Ward Street
Compiled by : AR

Sheet No. : 1 of 1
Location : Port Hope, Ontario
Checked by :

Position : E: 717560, N: 4870475 (UTM 17T)
Elevation Datum : Geodetic

Rig type : Track-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Unstabilized Water Level
0	101.2	**GROUND SURFACE**					
		85mm **ASPHALT**					
	100.8 0.4	295mm **AGGREGATE**	1	SS	24	PID: 0.2	
	100.4 0.8	**FILL**, sand and gravel, trace silt, compact, brown, damp					
1	99.7 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)	2	SS	22	PID: 0.3	
2		**SILTY SAND**, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)	3	SS	34	PID: 0.2	
			4	SS	76 / 250mm	PID: 0.3	
3	98.1 3.1		5	SS	50 / 100mm	PID: 0.2	∇



Instrument Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

file: 1-19-0660-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 3

Project No. : 1-19-0660-01
Client : CVH (NO. 6) LP
Originated by : SM
Date started : November 1, 2019
Project : 65 Ward Street
Compiled by : AR
Sheet No. : 1 of 1
Location : Port Hope, Ontario
Checked by :

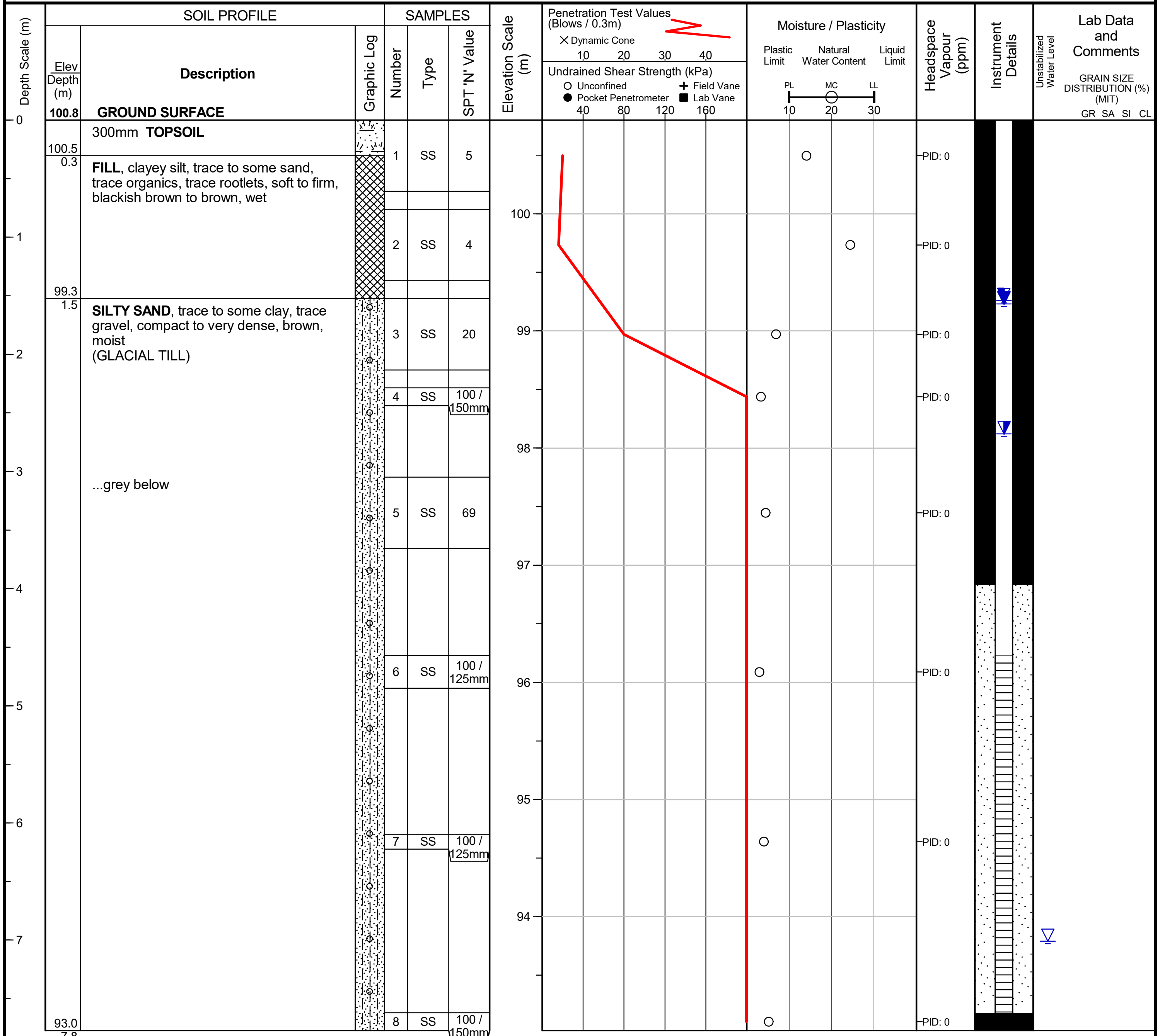
Position : E: 717559, N: 4870462 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE

Elev Depth (m)	Description
100.8	**GROUND SURFACE**
100.5 0.3	300mm **TOPSOIL**
99.3 1.5	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, wet
93.0 7.8	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL) ...grey below

SAMPLES

Number	Type	SPT 'N' Value
1	SS	5
2	SS	4
3	SS	20
4	SS	100 / 150mm
5	SS	69
6	SS	100 / 125mm
7	SS	100 / 125mm
8	SS	100 / 150mm



END OF BOREHOLE

Unstabilized water level measured at 7.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	1.5	99.3
Nov 19, 2019	2.7	98.1
Dec 9, 2019	1.6	99.2

file: 1-19-0660-01 bh logs.gpj

LOG OF BOREHOLE 4

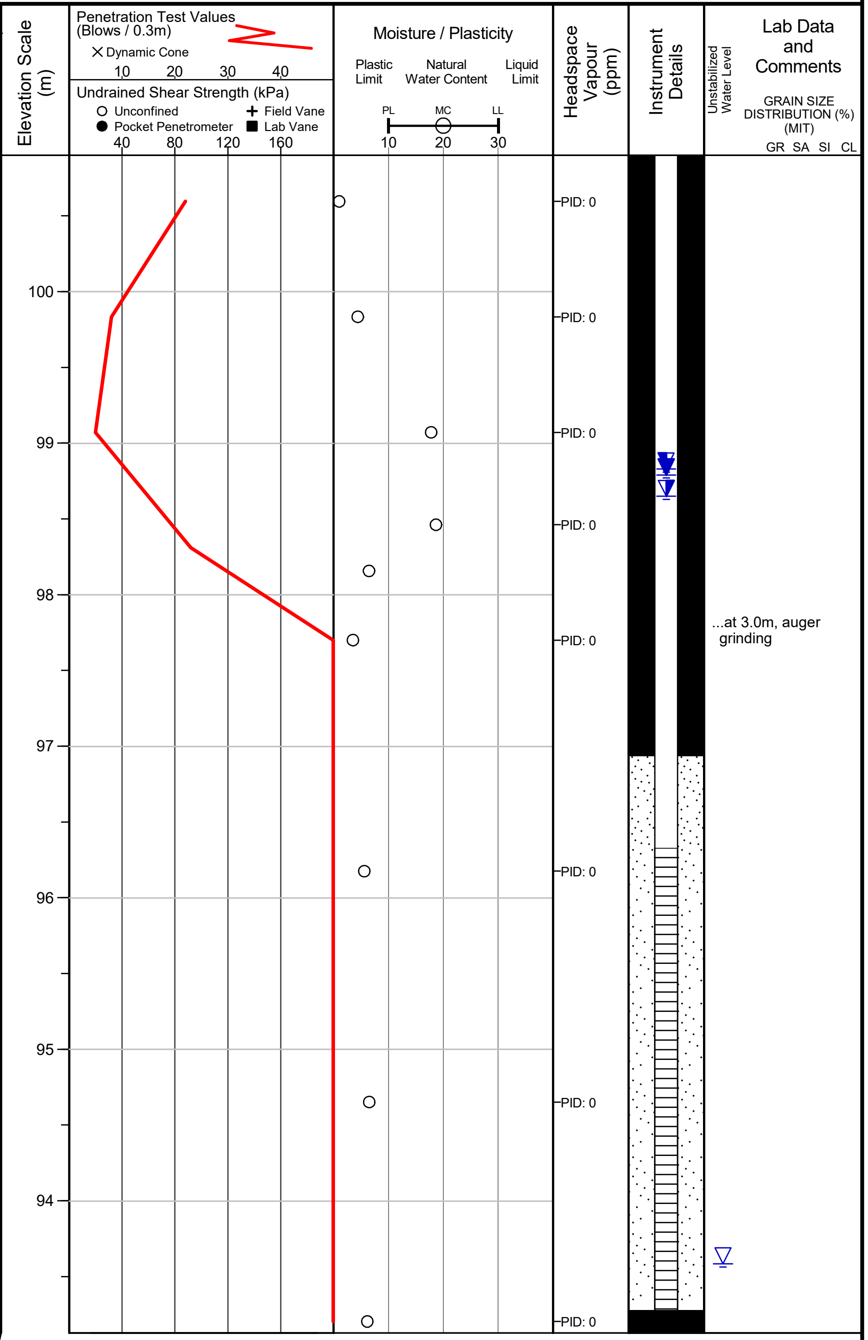
Project No. : 1-19-0660-01
Date started : October 31, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717546, N: 4870461 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	Description	Sample Number	Sample Type	SPT 'N' Value
100.9	**GROUND SURFACE**			
	70mm **ASPHALT**			
	730mm **AGGREGATE**	1	SS	22
100.1 0.8	**FILL**, sand, trace silt, loose, brown, wet	2	SS	8
99.4 1.5	**FILL**, clayey silt, trace to some sand, trace gravel, trace organics, firm, brown, wet	3	SS	5
98.6 2.3	**SILTY SAND**, trace clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)	4A 4B	SS	23
	...grey below	5	SS	100 / 150mm
		6	SS	100 / 150mm
		7	SS	100 / 150mm
		8	SS	100 / 150mm
93.1 7.8	**END OF BOREHOLE**			



...at 3.0m, auger grinding

Unstabilized water level measured at 7.3 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.1	98.8
Nov 19, 2019	2.3	98.7
Dec 9, 2019	2.1	98.8

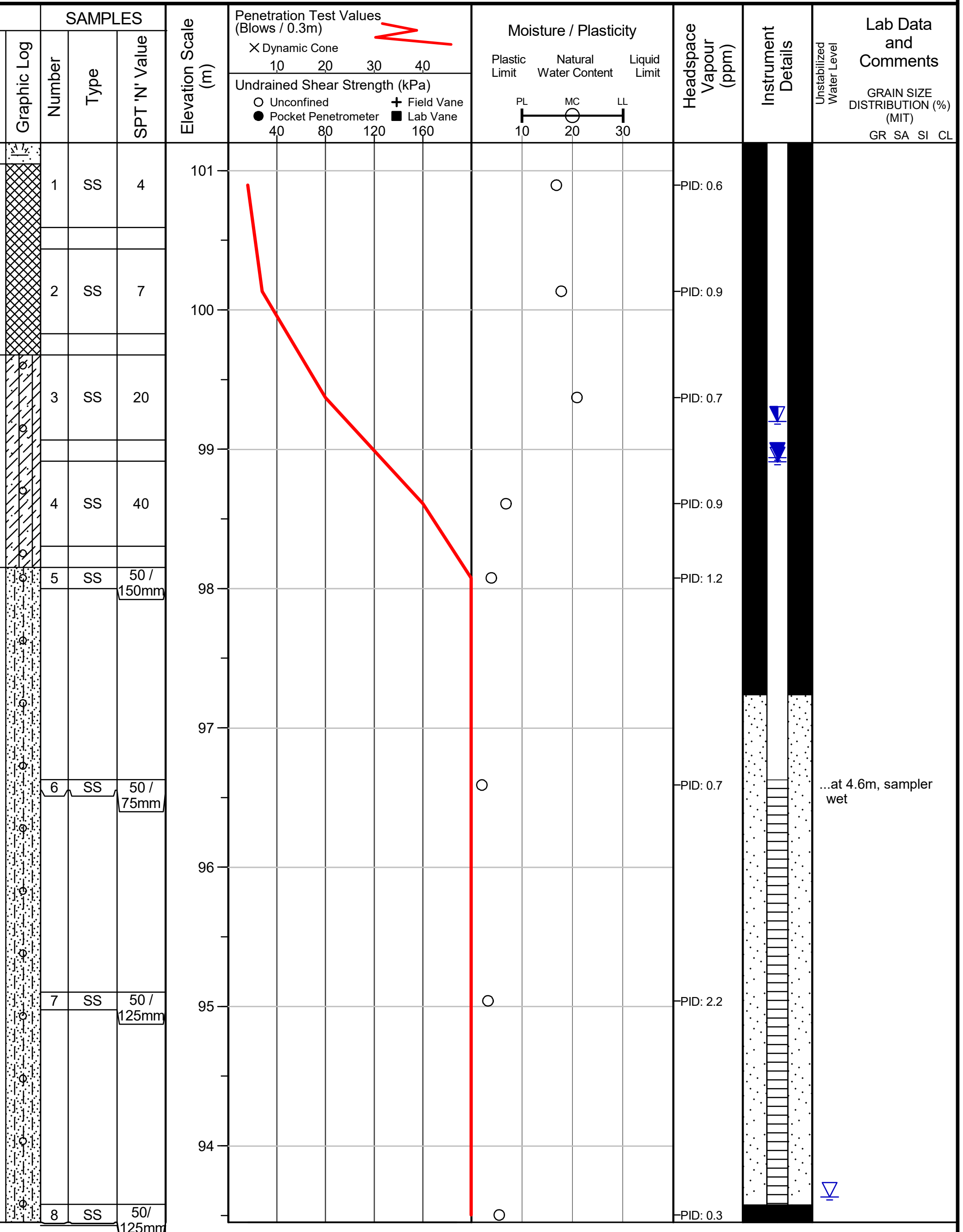
file: 1-19-0660-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 5

Project No. : 1-19-0660-01
Client : CVH (NO. 6) LP
Originated by : SM
Date started : October 29, 2019
Project : 65 Ward Street
Compiled by : AR
Sheet No. : 1 of 1
Location : Port Hope, Ontario
Checked by :

Position : E: 717549, N: 4870436 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Solid stem augers



Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
101.2	**GROUND SURFACE**					
101.0 0.2	150mm **TOPSOIL**					
	FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist	1	SS	4	PID: 0.6	
		2	SS	7	PID: 0.9	
99.7 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)	3	SS	20	PID: 0.7	
		4	SS	40	PID: 0.9	
98.2 3.0	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)	5	SS	50 / 150mm	PID: 1.2	
	...grey below	6	SS	50 / 75mm	PID: 0.7	...at 4.6m, sampler wet
		7	SS	50 / 125mm	PID: 2.2	
93.5 7.7		8	SS	50/ 125mm	PID: 0.3	

END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

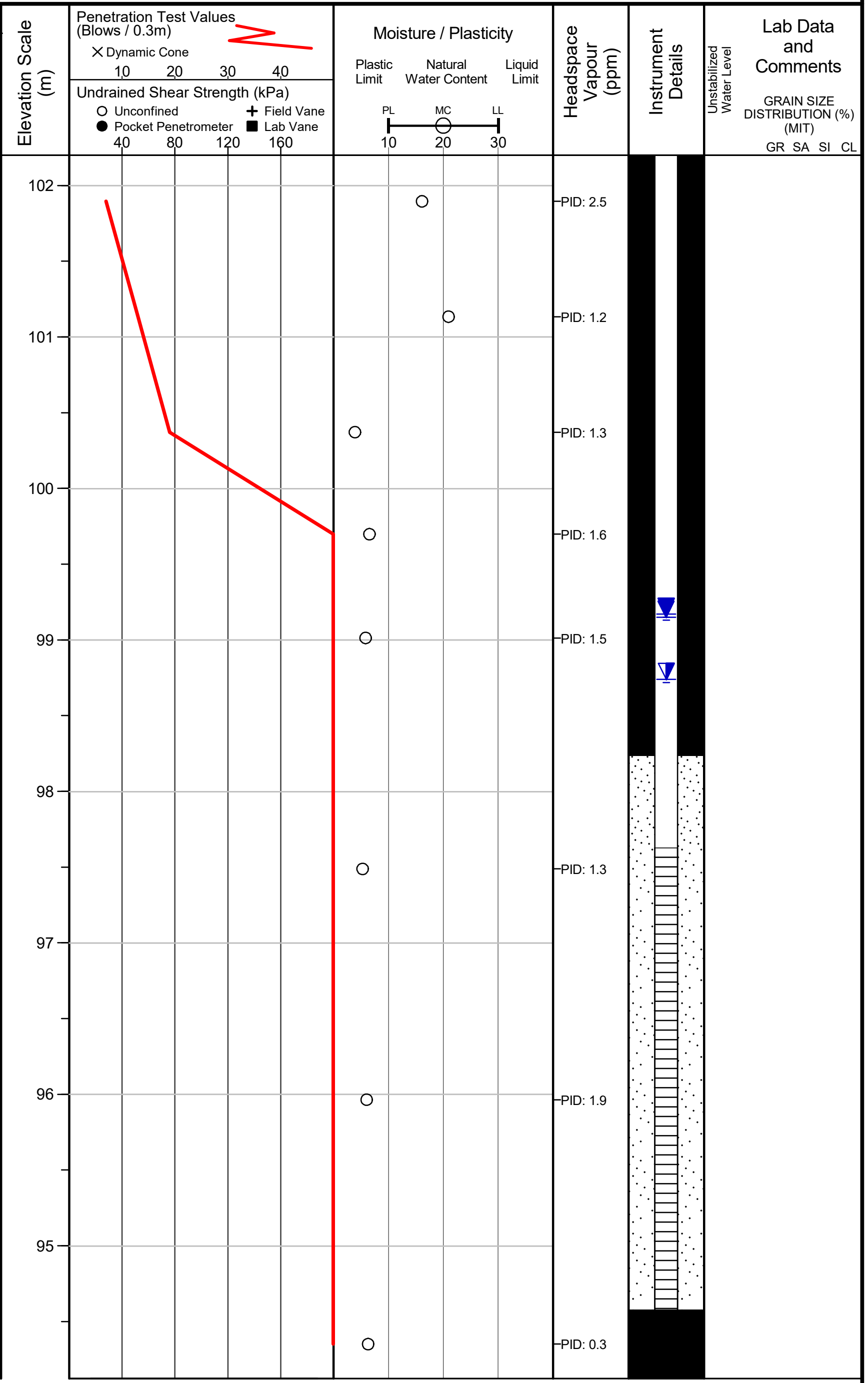
Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.0	99.2
Nov 19, 2019	2.3	98.9
Dec 9, 2019	2.3	98.9

LOG OF BOREHOLE 6

Project No.	: 1-19-0660-01	Client	: CVH (NO. 6) LP	Originated by	: SM
Date started	: October 31, 2019	Project	: 65 Ward Street	Compiled by	: AR
Sheet No.	: 1 of 1	Location	: Port Hope, Ontario	Checked by	:

Position	: E: 717590, N: 4870358 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: Track-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
0	**102.2**	**GROUND SURFACE**			
	102.0 0.2	200mm **TOPSOIL**			
		FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist	1	SS	7
1			2	SS	13
	100.7 1.5	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL)	3	SS	19
2			4	SS	85 / 275mm
3			5	SS	50 / 125mm
4		...grey below	6	SS	50 / 125mm
5					
6			7	SS	100 / 125mm
7					
8	94.1 8.1		8	SS	100/ 275mm



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	3.1	99.2
Nov 19, 2019	3.5	98.7
Dec 9, 2019	3.0	99.2

LOG OF BOREHOLE 7

Project No. : 1-19-0660-01
Date started : October 29, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

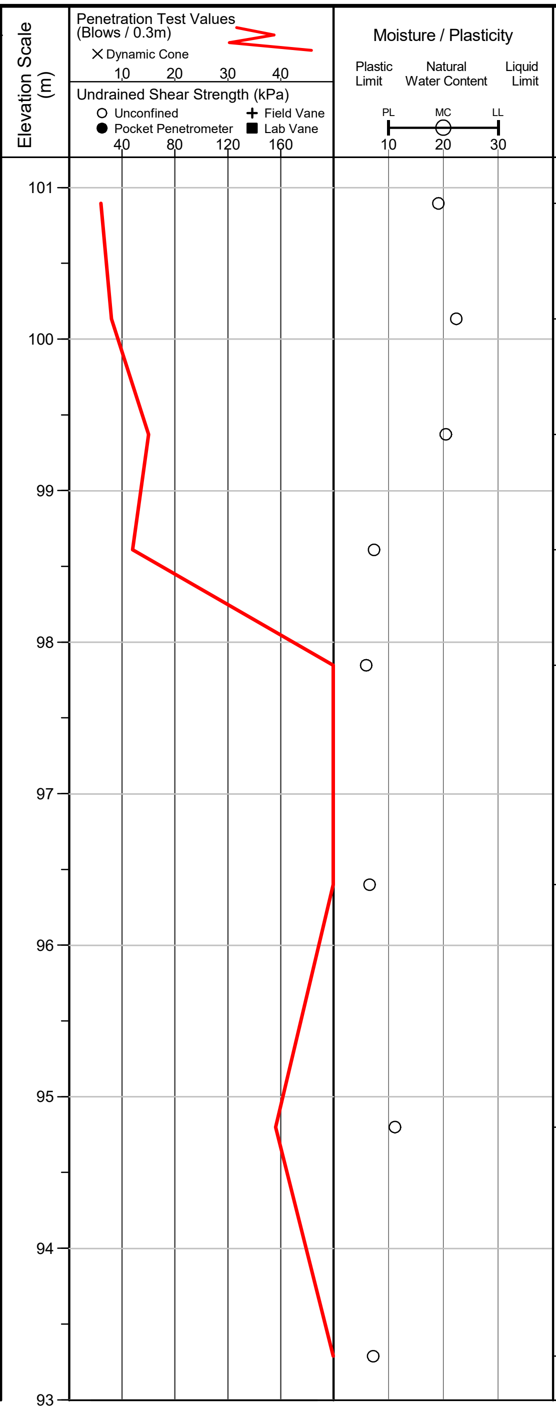
Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717546, N: 4870401 (UTM 17T)
Rig type : Track-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE – Description
101.2	**GROUND SURFACE**
101.0 0.2	150mm **TOPSOIL**
	FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist
99.7 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)
98.9 2.3	**SILTY SAND**, trace to some clay, trace gravel, compact to very dense, brown, moist (GLACIAL TILL) ...grey below
93.0 8.2	**END OF BOREHOLE**

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	6	PID: 0
2	SS	8	PID: 0
3	SS	15	PID: 0
4	SS	12	PID: 0
5	SS	62	PID: 0
6	SS	99	PID: 0
7	SS	39	PID: 0
8	SS	68	PID: 0



Depth Scale (m): 0 – 8

Unstabilized Water Level: ∇ (5.9 m)

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

...at 7.6m, wet sampler

Unstabilized water level measured at 5.9 m below ground surface; borehole was open upon completion of drilling.

Terraprobe

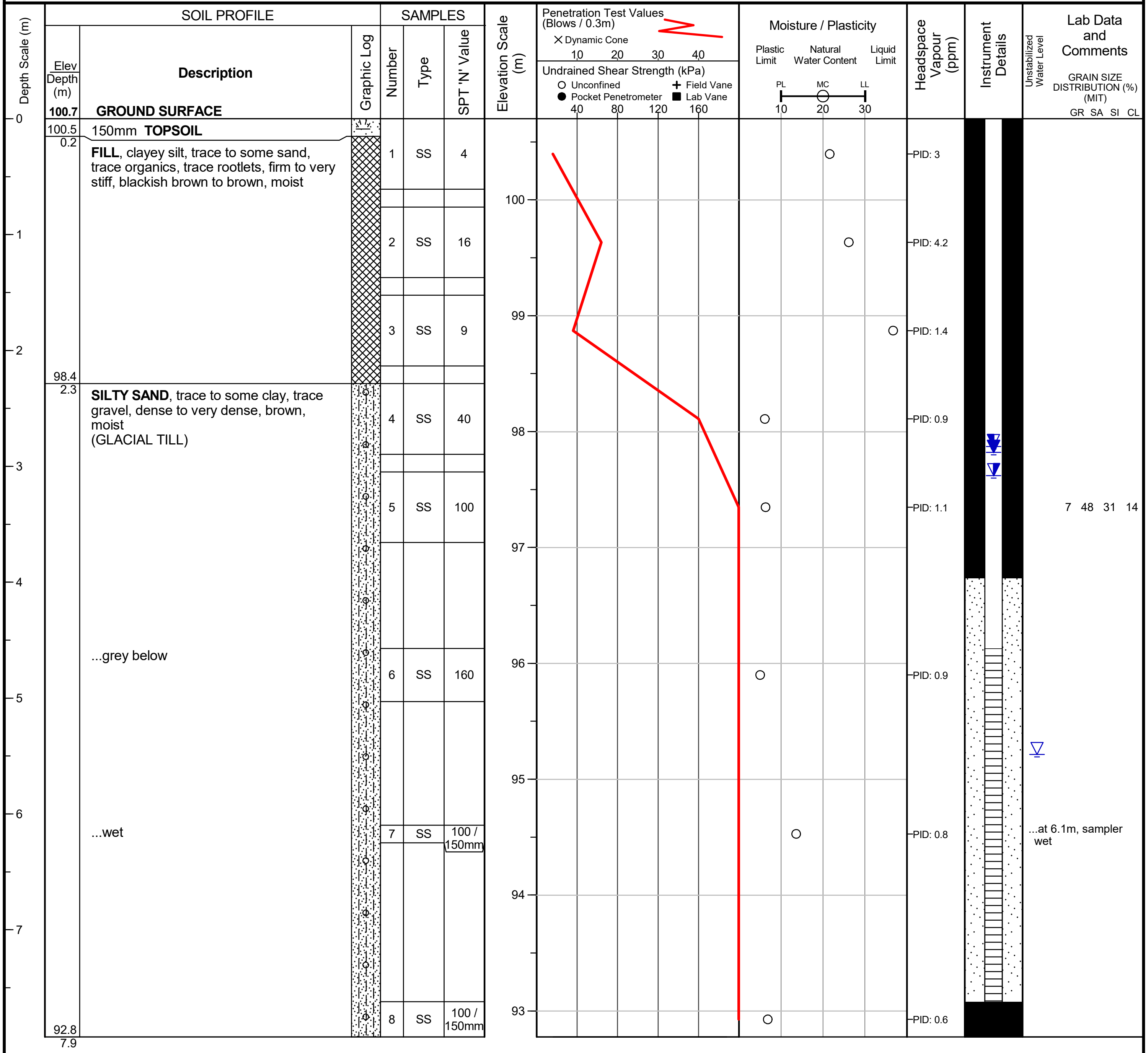
LOG OF BOREHOLE 8

Project No. : 1-19-0660-01
Date started : October 30, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717535, N: 4870415 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers



Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
100.7	**GROUND SURFACE**					
100.5 0.2	150mm **TOPSOIL**					
	FILL, clayey silt, trace to some sand, trace organics, trace rootlets, firm to very stiff, blackish brown to brown, moist	1	SS	4	PID: 3	
		2	SS	16	PID: 4.2	
98.4		3	SS	9	PID: 1.4	
2.3	**SILTY SAND**, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)	4	SS	40	PID: 0.9	
		5	SS	100	PID: 1.1	7 48 31 14
	...grey below	6	SS	160	PID: 0.9	
	...wet	7	SS	100 / 150mm	PID: 0.8	...at 6.1m, sampler wet
92.8		8	SS	100 / 150mm	PID: 0.6	
7.9						

END OF BOREHOLE

Unstabilized water level measured at 5.5 m below ground surface; borehole caved to 7.3 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	2.8	97.9
Nov 19, 2019	3.1	97.6
Dec 9, 2019	2.9	97.8

LOG OF BOREHOLE 9

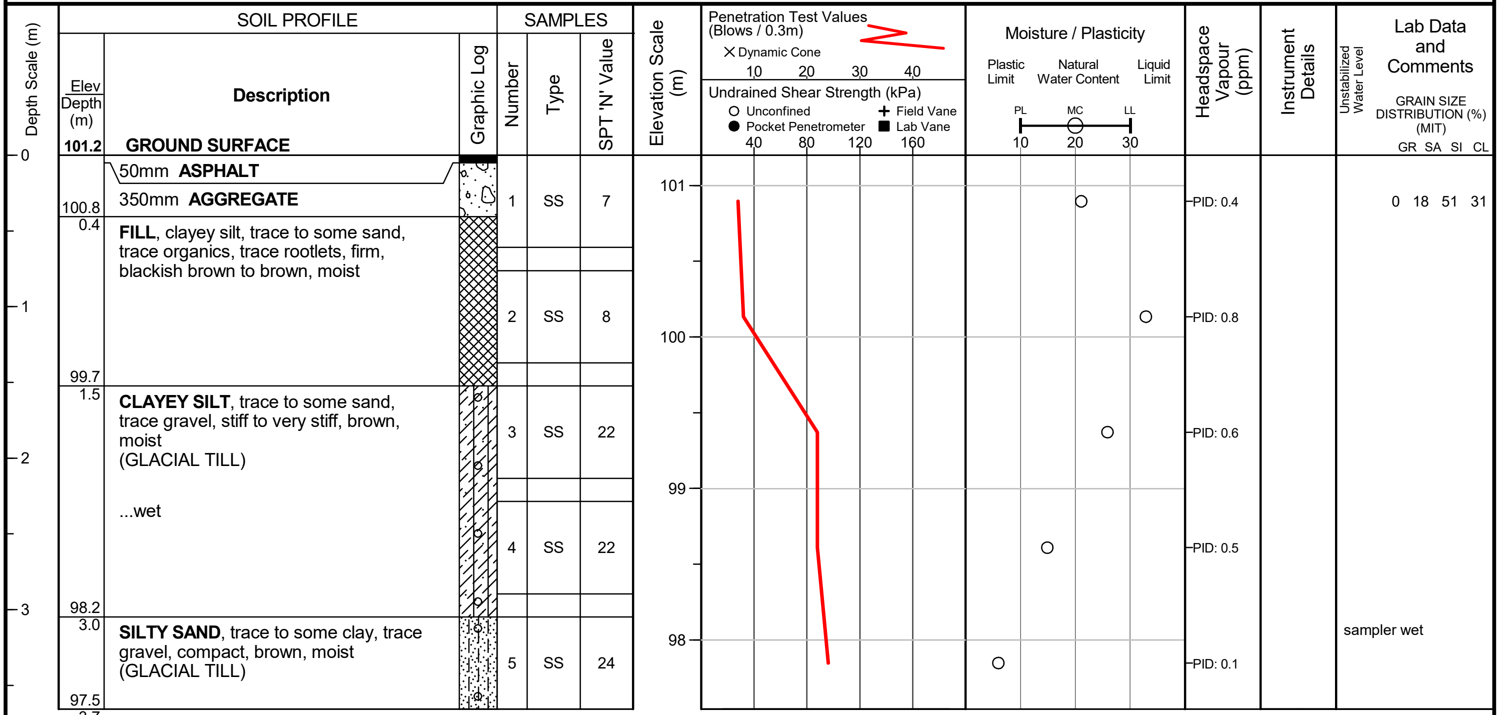
Project No. : 1-19-0660-01
Date started : October 29, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717524, N: 4870359 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	GR	SA	SI	CL
101.2	**GROUND SURFACE**								
	50mm **ASPHALT**								
	350mm **AGGREGATE**	1	SS	7	PID: 0.4	0	18	51	31
100.8 0.4	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm, blackish brown to brown, moist	2	SS	8	PID: 0.8				
99.7 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)	3	SS	22	PID: 0.6				
	...wet	4	SS	22	PID: 0.5				
98.2 3.0	**SILTY SAND**, trace to some clay, trace gravel, compact, brown, moist (GLACIAL TILL)	5	SS	24	PID: 0.1	sampler wet			
97.5 3.7	**END OF BOREHOLE**								



Borehole was dry and open upon completion of drilling.

Terraprobe

LOG OF BOREHOLE 10

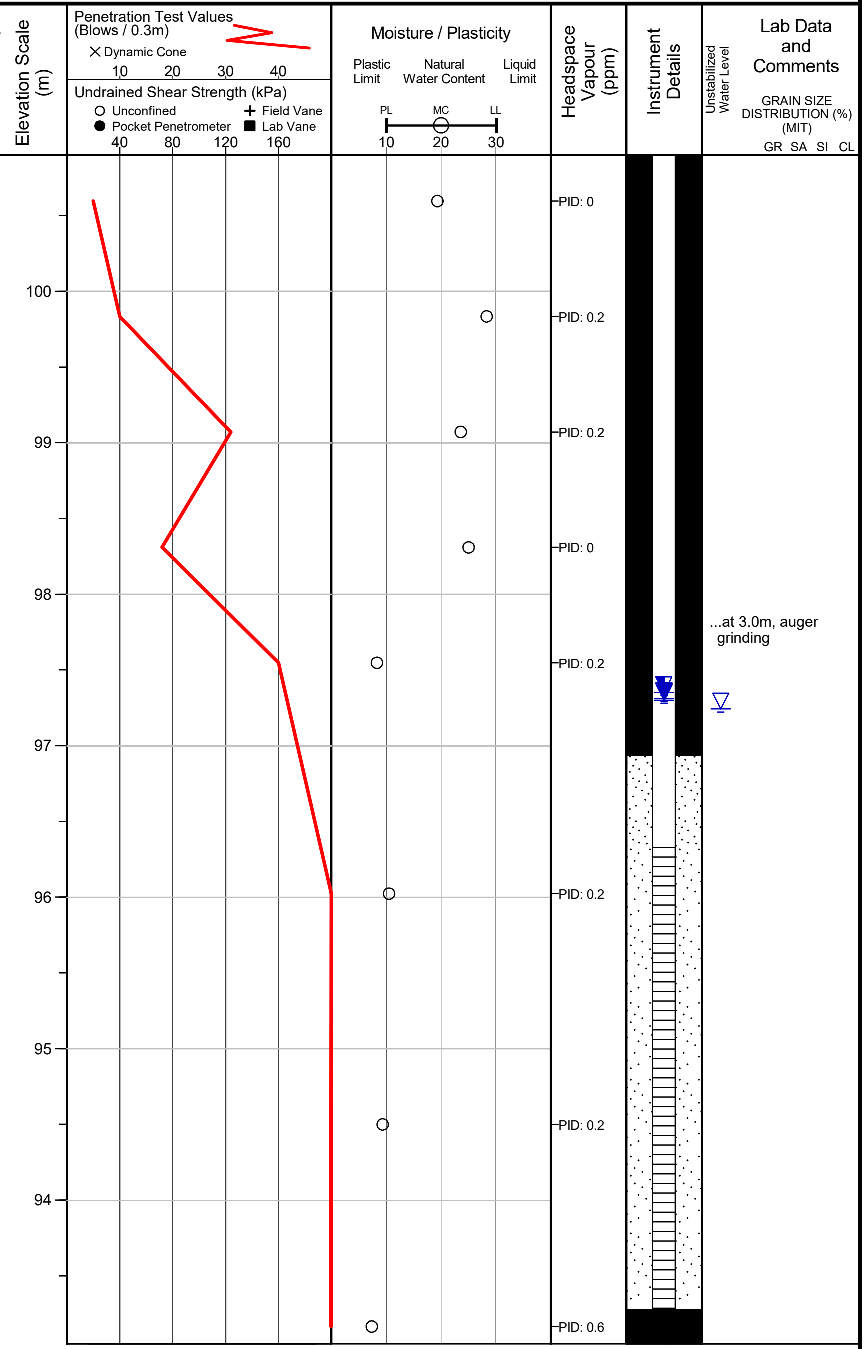
Project No. : 1-19-0660-01
Date started : October 29, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717517, N: 4870387 (UTM 17T)
Rig type : Track-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
100.9	**GROUND SURFACE**					
100.7	150mm **TOPSOIL**					
0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, firm to stiff, blackish brown to brown, moist	1	SS	5	PID: 0	
		2	SS	10	PID: 0.2	
99.4 1.5	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)	3	SS	31	PID: 0.2	
		4	SS	18	PID: 0	
97.9 3.0	**SILTY SAND**, trace to some clay, trace gravel, dense to very dense, brown, moist (GLACIAL TILL)	5	SS	40	PID: 0.2	...at 3.0m, auger grinding
96.3 4.6	**SAND**, trace to some gravel, trace silt, very dense, brown, wet	6	SS	50	PID: 0.2	
		7	SS	53	PID: 0.2	
93.3 7.6 93.1 7.8	**SILTY SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)	8	SS	50 / 75mm	PID: 0.6	



END OF BOREHOLE

Unstabilized water level measured at 3.7 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	3.6	97.4
Nov 19, 2019	3.6	97.3
Dec 9, 2019	3.6	97.3

LOG OF BOREHOLE 11

Project No. : 1-19-0660-01
Client : CVH (NO. 6) LP
Originated by : SM

Date started : October 29, 2019
Project : 65 Ward Street
Compiled by : AR

Sheet No. : 1 of 1
Location : Port Hope, Ontario
Checked by :

Position : E: 717512, N: 4870398 (UTM 17T)
Elevation Datum : Geodetic

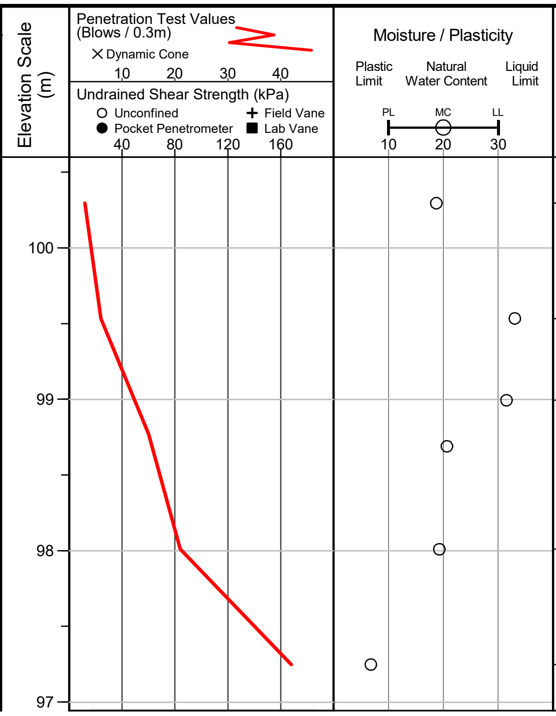
Rig type : Track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE

Elev Depth (m)	Description
100.6	**GROUND SURFACE**
	150mm **TOPSOIL**
100.4 0.2	**FILL**, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, moist
98.9 1.7	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)
97.6 3.0	**SILTY SAND**, trace to some clay, trace gravel, dense, brown, moist (GLACIAL TILL)
96.9 3.7	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	3	PID: 0
2	SS	6	PID: 0
3A	SS	15	PID: 0
3B			
4	SS	21	PID: 0
5	SS	42	PID: 0



Depth Scale (m): 0, 1, 2, 3

Instrument Details

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

LOG OF BOREHOLE 12

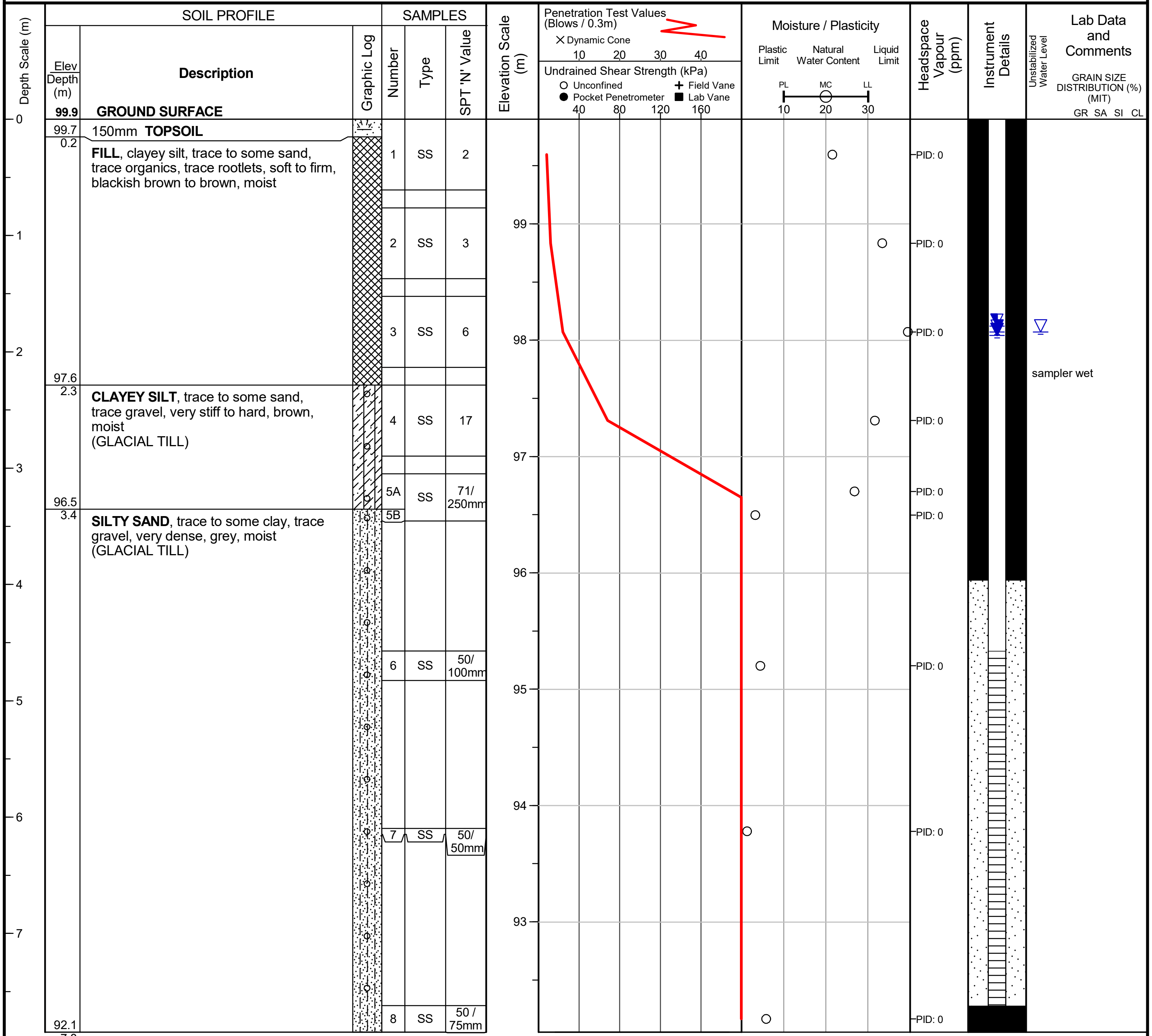
Project No. : 1-19-0660-01
Date started : October 29, 2019
Sheet No. : 1 of 1

Client : CVH (NO. 6) LP
Project : 65 Ward Street
Location : Port Hope, Ontario

Originated by : SM
Compiled by : AR
Checked by :

Position : E: 717503, N: 4870444 (UTM 17T)
Rig type : Track-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers



Elev Depth (m)	Description
99.9	**GROUND SURFACE**
99.7 0.2	150mm **TOPSOIL**
	FILL, clayey silt, trace to some sand, trace organics, trace rootlets, soft to firm, blackish brown to brown, moist
97.6 2.3	**CLAYEY SILT**, trace to some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)
96.5 3.4	**SILTY SAND**, trace to some clay, trace gravel, very dense, grey, moist (GLACIAL TILL)
92.1 7.8	

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
1	SS	2	PID: 0
2	SS	3	PID: 0
3	SS	6	PID: 0
4	SS	17	PID: 0
5A	SS	71/ 250mm	PID: 0
5B			PID: 0
6	SS	50/ 100mm	PID: 0
7	SS	50/ 50mm	PID: 0
8	SS	50 / 75mm	PID: 0

END OF BOREHOLE

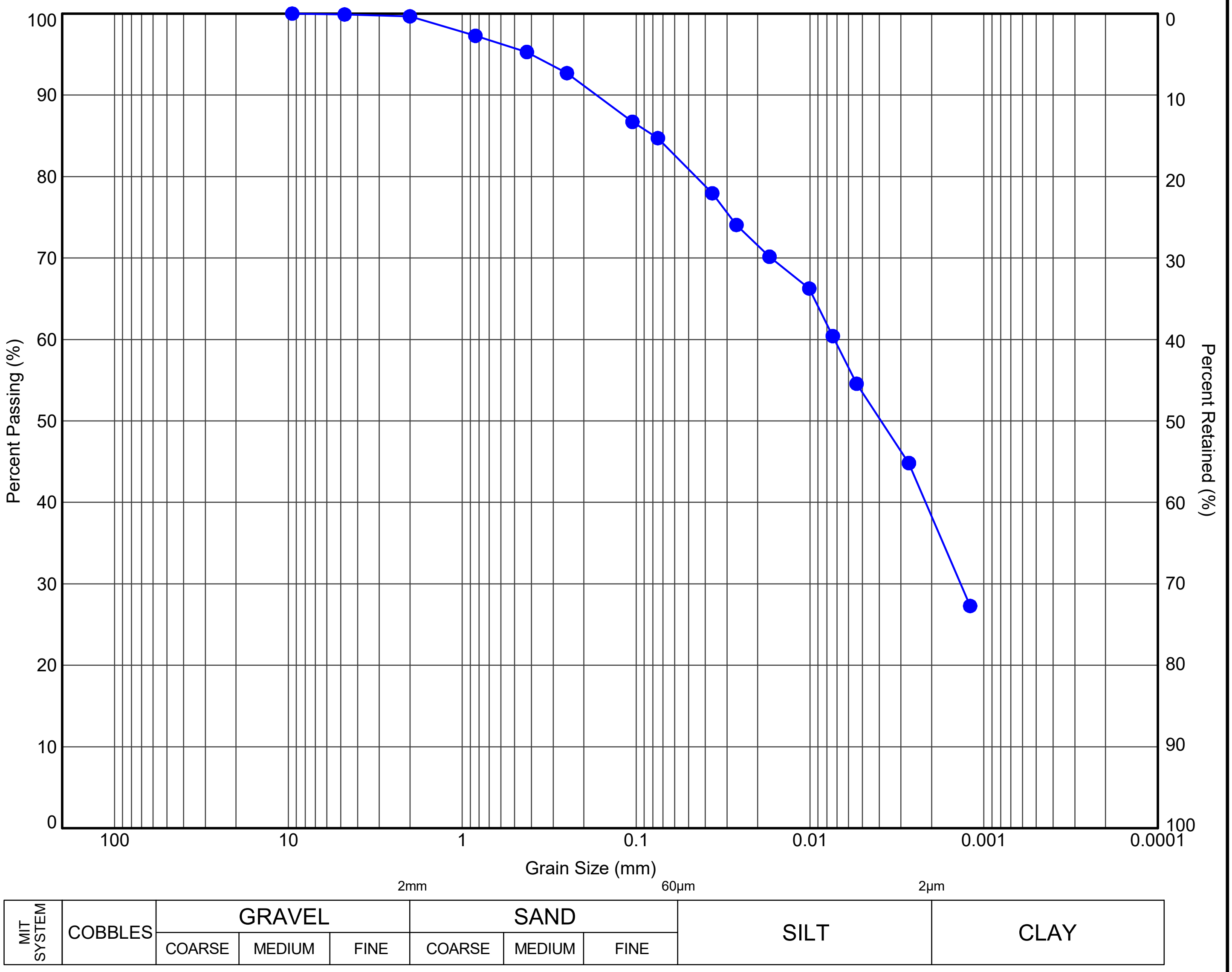
Unstabilized water level measured at 1.8 m below ground surface; borehole caved to 7.3 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 14, 2019	1.8	98.1
Nov 19, 2019	1.8	98.1
Dec 9, 2019	1.9	98.0

APPENDIX B

TERRAPROBE INC.



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS3	1.8	98.6	0	18	44	38	

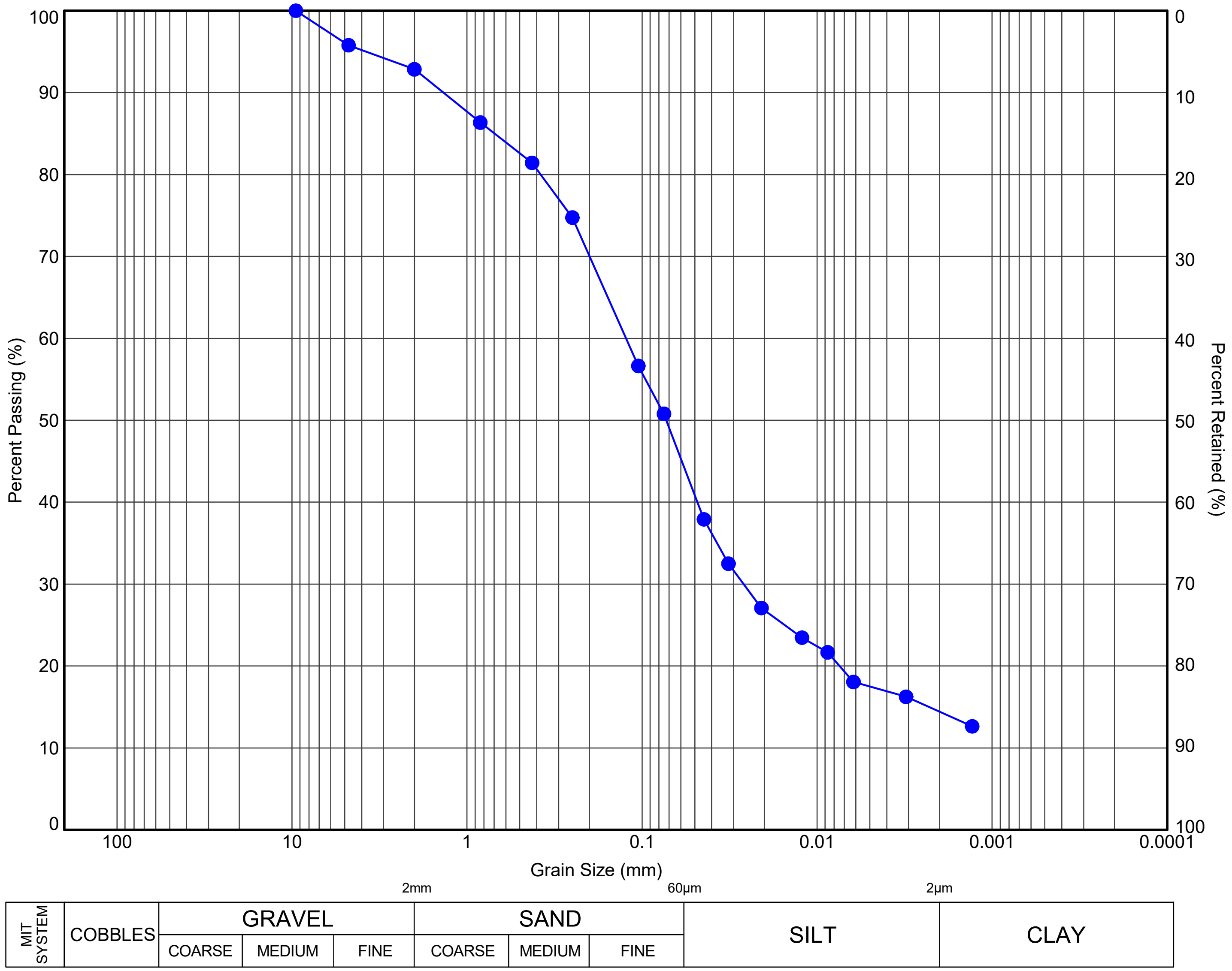
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT AND CLAY, SOME SAND

File No.: **1-19-0660-01**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**8**	SS5	3.4	97.3	7	48	31	14	

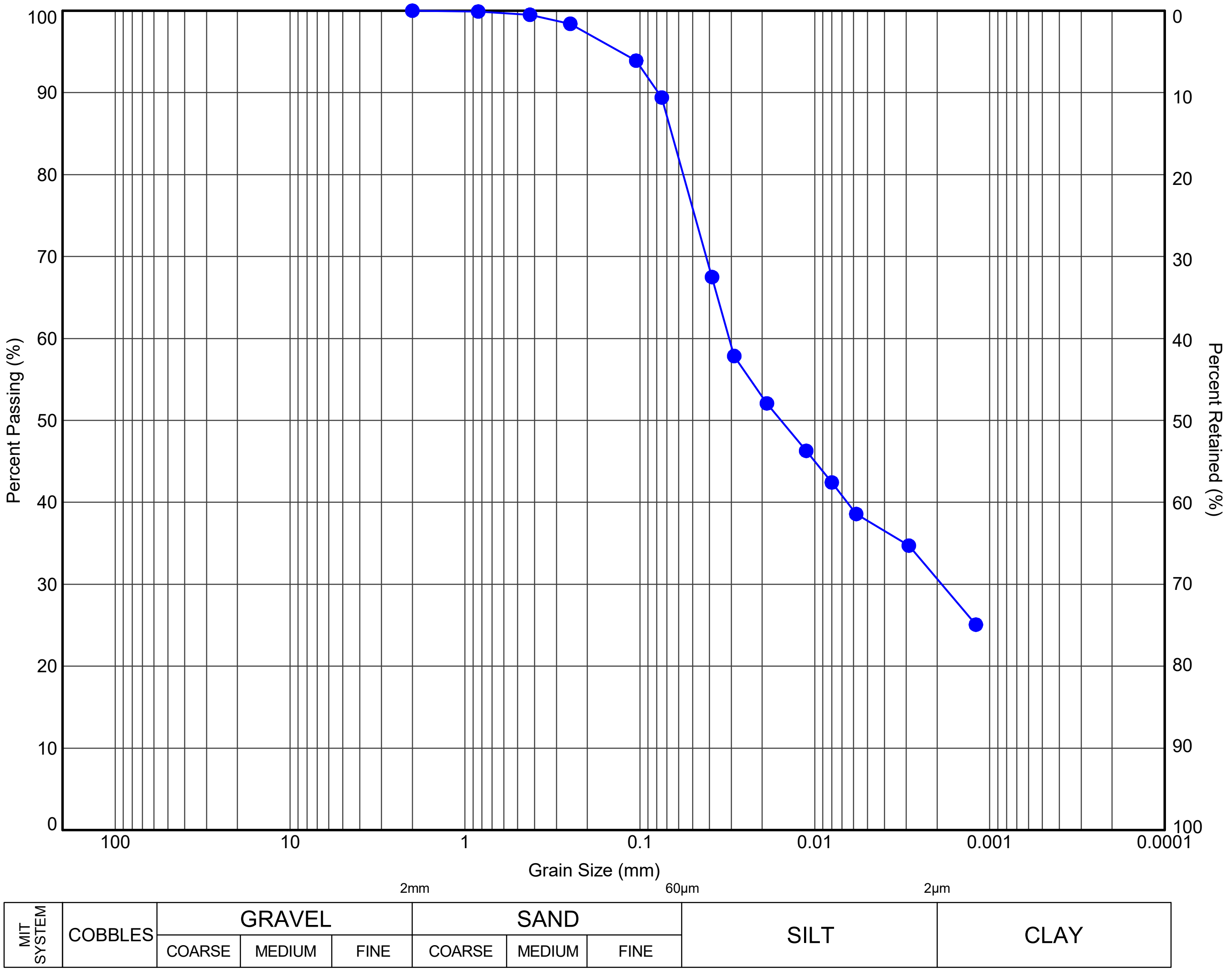
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME CLAY, TRACE GRAVEL

File No.: **1-19-0660-01**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**9**	SS1	0.3	100.9	0	18	51	31	

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

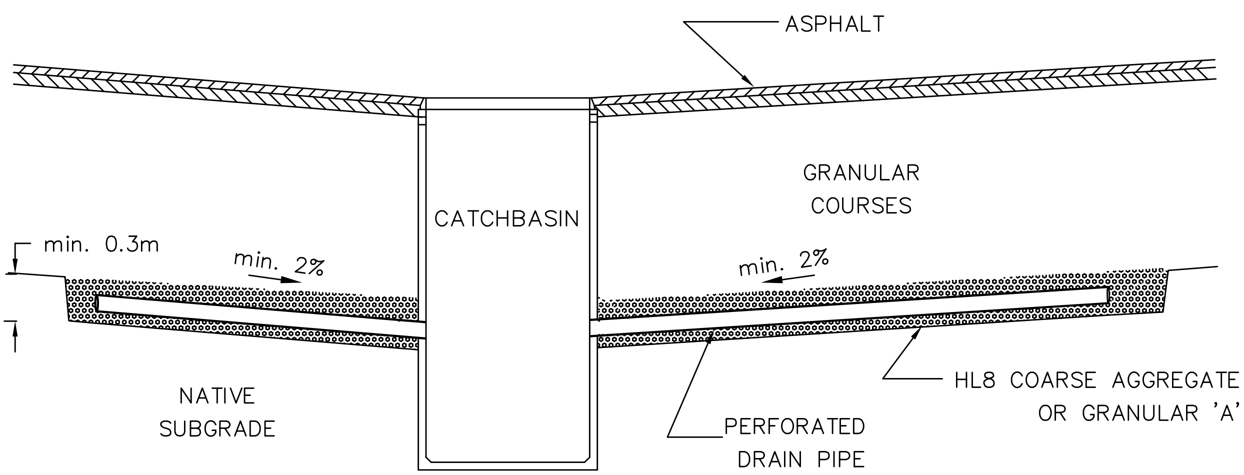
GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SOME SAND

File No.: **1-19-0660-01**

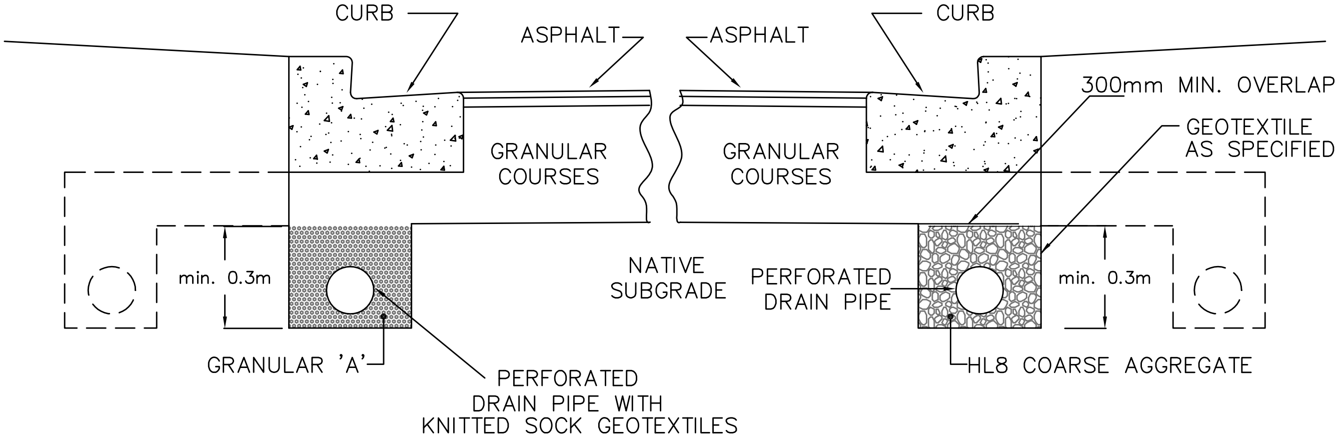
APPENDIX C

TERRAPROBE INC.

Longitudinal Subdrain Connection to Catchbasin



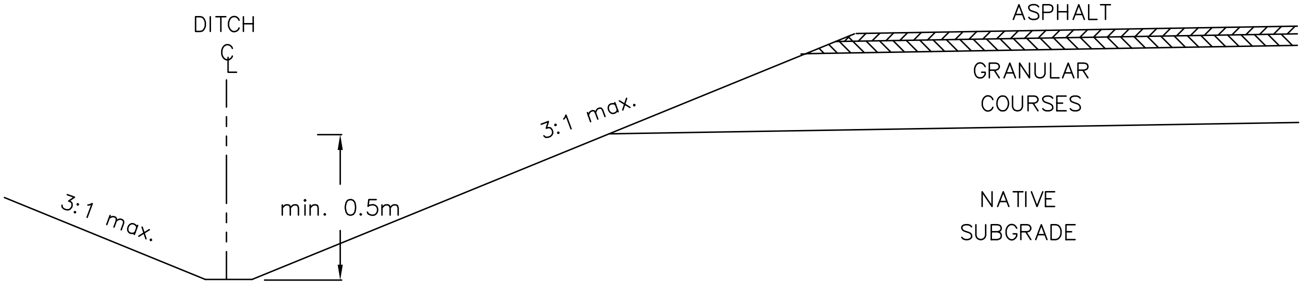
Urban Cross Sections



Unwrapped Trench

Wrapped Trench

Rural Cross Section



Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

PAVEMENT DRAINAGE ALTERNATIVES