Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT PROPOSED RESIDENTIAL DEVELOPMENT 400 MAPLE STREET COLLINGWOOD, ONTARIO

Prepared For: Georgian Communities
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File No. 3-20-0102-01
November 18, 2020

Distribution of Report:

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1.0 THE PROJECT

Terraprobe Inc. (Terraprobe) was retained by Georgian Communities to conduct a subsurface investigation and provide geotechnical engineering design advice for the proposed residential development on the property located at 400 Maple Street (on west side of Maple Street between Fifth Street and Sixth Street) in Collingwood, Ontario. A site location plan is provided as Figure 1.

The site is a rectangular-shaped parcel with an approximate area of 1.5 acres and includes an existing building (former school house building – Victoria School Annex Building) which is understood may have been part of the original school building which was located centrally on the site and was destroyed in 1967.

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

- Concept Plan – Former Victoria School Annex, 400 Maple Street, Town of Collingwood, prepared by: traVis & Associates and dated November 6, 2020.

The proposed development includes constructing four (4) single detached residential units, ten (10) semi detached residential units, one to three (1-3) Unit coach house, and the existing school Annex Building will remain and be repurposed for two (2) custom residential dwellings. It is understood that the proposed single and semi detached structures will include one level of basement, with a finished basement floor elevation ranging between Elev. 183.50 and 183.75 ±m, and the Coach house apartment will not have any basement but the ground floor level will be used for car parking. The development will also include a new internal road.

Terraprobe was previously retained by others in 2005 to conduct a test pit program to explore the nature and extent of the fill (File: 3-04-0221, dated January 27, 2005) and a Phase 1 Environmental Site Assessment (ESA) (File: 3-04-0221, dated February 23, 2005) for the subject property. Terraprobe was again retained by others in 2015 to conduct a test pit investigation of the site (File: 32-15-2018, dated May 13, 2015).

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

2.0 FIELD WORK

The field investigation was conducted on October 8 and 9, 2020, and consisted of drilling and sampling a total of nine (9) boreholes, extending to about 1.6 to 4.7 m depth below ground surface. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figures 2 and 3).

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 Sieve and Hydrometer analysis on selected native soil samples. 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 3.5 of this report, and appended.

Water levels were measured in open boreholes upon completion of drilling. Standpipe type piezometers comprising 13 mm diameter PVC pipes were installed in selected boreholes (Boreholes 1, 6 and 8) 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 piezometers were measured on October 13, 2020. The results of groundwater monitoring are presented in Section 3.7 of this report.

The elevations of the boreholes were surveyed by Terraprobe. The elevations of the boreholes were referenced to a temporary benchmark. The benchmark used by Terraprobe is the top of the storm maintenance hole cover 3A, located on Fifth Street, north of the north entrance to the property. A geodetic elevation of 184.74 m was for the local benchmark was taken from the provided site plans. These locations and elevations are approximate only, for the purposes of relating borehole stratigraphy and should not be used or relied on for other purposes.

3.0 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, provided in Appendix A 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.

3.1 Topsoil

A surficial topsoil layer was encountered at all of the borehole locations, and had a thickness ranging from 50 to 300 mm. The topsoil was noted to be dark brown to black in colour and predominantly consisted of a sandy silt/sand matrix with organics.

The topsoil thickness noted on the Borehole Logs refers to the distinct topsoil layer present at the borehole location, however, organic inclusions extended deeper (typically about 300 mm below grade or locally deeper) than the topsoil thickness layer noted on the Borehole Logs. The topsoil thickness to be removed/stripped for site development may differ from the topsoil thickness noted on the Borehole Logs. Therefore, this information is not sufficient for estimating topsoil quantities and/or associated costs. Consideration should be given to conduct a shallow test pit investigation to obtain a more precise topsoil thickness (if required).

3.2 Earth Fill

Below the surficial topsoil in Boreholes 4, 6 and 9, a layer of earth fill was encountered and extended to a depth ranging from about 1.6 to 2.3 m (Elev. 183.0 m to 183.6 m) below ground surface, i.e. auger refusal depth in Borehole 9. At Boreholes 4 and 6, the fill materials consisted of sand with inclusions of silt, trace rootlets and organic stained seams. Grinding of augers was noted at 0.6 m depth in Borehole 4 which may indicate the presence of debris or cobbles/boulders in the fill which was not picked up in the split spoon sample. At Borehole 9, the fill material consisted of sand with some gravel, trace silt, trace brick fragments and trace concrete to 1.1 m depth followed by cobbles with some sand to the borehole auger refusal depth of 1.6 m. **Several attempts were may to advance Borehole 9 beyond the auger refusal depth without success, as such, the auger refusal at Borehole 9 may be attributable to buried obstruction. It should be noted that some of the test pits carried out in the vicinity of Borehole 9 from the previous investigations indicated the presence of buried concrete at about 1.5 m depth below ground surface. Once the detail design is available, it is recommended that an additional borehole and/or test pits be carried out explore the fill/buried obstructions and define the native soils in the area of the proposed coach house.**

Standard Penetration Test ‘N’ values within the fill ranged from 2 to 15 blows per 300 mm of penetration, indicating very loose to compact relative density but was typically very loose to loose. The measured moisture contents ranging from 2 to 29 percent by weight, indicating a moist to wet and generally wet condition.

3.3 Sand

Beneath the surficial topsoil in the remaining boreholes (Boreholes 1 to 3, 5, 7 and 8) a native sand deposit was encountered and extended to a depth ranging from 1.9 to 2.6 m (Elev. 182.2 m to 183.1 m) below ground surface. The sand had trace silt inclusions, and gravel inclusions in the lower levels of the deposit in some boreholes. **A thin 25 ±mm thick peat layer was noted in the sand deposit below a depth of about 1.5 to 2.0 m from existing grade in the test pits carried out in 2015. However, there was no peat noted in the test pits carried out in 2005 or the current boreholes.**

Standard Penetration Test 'N' values within the native sand ranged from 3 to 27 blows per 300 mm of penetration, indicating very loose to compact relative density but typically compact. The measured moisture contents ranging from 7 to 32 percent by weight, indicating a generally moist to wet, generally wet condition.

3.4 Sandy Silt Till

Below fill in Boreholes 4 and 6 and the sand deposit in Boreholes 1 to 3, 5, 7 and 8, a sandy silt glacial till deposit was encountered and extended to the auger refusal termination depth in all boreholes, i.e. a depth ranging from 2.6 to 4.7 m (Elev. 180.2 m to 182.4 m) below ground surface. The till consisted of a sandy silt matrix with trace clay and trace gravel. Standard Penetration 'N' values in the sandy silt till deposit ranged from 8 to greater than 50 blows per 300 mm of penetration or less, indicating a loose to very dense relative density, but typically dense to very dense. Measured moisture contents in the sandy silt till stratum ranged from 7 to 14 percent by weight, i.e. generally wet.

The bedrock surface was inferred by auger/sample refusal in Boreholes 1 to 8 at depths ranging from about 2.6 to 4.7 m (Elev. 180.2 m to 182.4 m) below ground surface, as noted above. The bedrock in the area generally consists of limestone of the Simcoe Group. The rock is horizontally bedded, and contains minor shale interbeds.

3.5 Geotechnical Laboratory Results

The geotechnical laboratory testing consisted of natural water content determination for all samples, while a Sieve and Hydrometer analysis was conducted on selected native 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 3, Sample 2	1.0	0	93	7	SAND, trace silt
Borehole 5, Sample 3	1.8	0	94	6	SAND, trace silt

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)			Descriptions (MIT System)
		Gravel	Sand	Silt & Clay	
Borehole 6, Sample 6	2.5	15	27	58	Sandy Silt, some gravel, some clay

3.6 Soil Corrosivity

Three (3) soil samples (from Borehole 1, Sample 3; Borehole 4, Sample 4; and Borehole 7, Sample 3A) were submitted to SGS Laboratories for a suite of corrosivity parameters consisting of pH, Resistivity, Electrical Conductivity, Redox Potential, Sulphate, Sulphide, and Chloride. A copy of the Certificates of Analyses is included in Appendix C. These parameters are used for assessing soil corrosivity applicable to cast iron alloys, according to the 10-point soil evaluation procedure described in the American Water Work Association (AWWA) C-105 standard. It should be noted that the analytical results only provide an indication of the potential for corrosion. The rating scale is a relatively simplistic, subjective procedure and should be viewed as a broad indicator that may not accurately predict specific cases of corrosion damage. A more recent study by the AWWA has suggested that soil with a resistivity of less than about 2000 ohm.cm should be considered aggressive.

Severity Ranking	Borehole and Sample Number		
	BH1; SS3	BH4; SS4	BH7; SS3A
Total Points	4	4	4

All samples scored less than 10 points; therefore, in general, corrosion protection measures for cast iron alloys are not recommended.

The above samples were also analysed for soluble sulphate concentration. The analytical results were compared to the Canadian Standard CAN3/CSA A23.1-09 *Table 3 Additional Requirements for Concrete Subjected to Sulphate Attack*. It is anticipated that these results would be used to determine the type of cementing materials to be used to produce concrete for this project. Comparison of the test results indicates that the water-soluble sulphate concentrations in soil are lower than 0.1 percent. Based on these results, there is a negligible potential for sulphate attack on the concrete.

3.7 Groundwater

Standpipe type piezometers were installed in Boreholes 1, 6 and 8 to facilitate groundwater level measurements. The groundwater levels were measured on October 13, 2020 and are shown on the individual borehole log. The following table summarizes the groundwater levels at the standpipe type piezometer locations.

Borehole Number	Ground Surface Elevation (m)	Groundwater Level			
		Noted During Drilling		Measured October 13, 2020	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH1	184.5	1.8	182.7	1.5	183.0
BH6	185.0	1.5	183.5	1.3	183.7
BH8	185.0	1.5	183.5	1.2	183.8

The groundwater levels encountered within the standpipe type piezometers (October 13, 2020 monitoring) were found to be at an elevation ranging from about 183.0 to 183.8 m. For design purposes, the stabilized groundwater level on the site is estimated to be at approximately Elev. 184.0 ±m. Groundwater conditions and levels will vary seasonally and could be higher during wetter seasons/years.

It should be noted that regrading of the site, construction dewatering and building drains, and seasonal fluctuations may cause significant changes to the depth of the groundwater table over time. It would be prudent to monitor groundwater levels through spring months in order to determine peak levels and magnitude of seasonal fluctuations. Groundwater levels may be at their lowest during the fall season.

4.0 GEOTECHNICAL DESIGN

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by 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 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.

It is understood that the development concept consists of the construction of four (4) single detached residential units, ten (10) semi detached residential units, one to three (1-3) Unit coach house, and the existing school Annex Building will remain and be repurposed for two (2) custom residential dwellings. It is understood that the proposed single and semi detached structures will include one level of basement, with a finished basement floor elevation ranging between Elev. 183.50 and 183.75 ±m, and the coach house apartment will not have any basement but the ground floor level will be used for car parking. The development will also include a new internal road.

Low-rise residential structures (such single and semi detached dwellings, etc.) are typically designed in accordance with the requirements of Part 9 of the current Ontario Building Code. Reference should be made to the following sections of the current Ontario Building Code which stipulate the geotechnical design and construction requirements for residential structures.

9.3. Materials, Systems and Equipment
9.4. Structural Requirements
9.12. Excavation
9.13. Dampproofing, Waterproofing, and Soil Gas Control
9.14. Drainage
9.15. Footings and Foundations
9.16. Slabs-on-ground

The existing topsoil, earth fill, and any disturbed native soils encountered at the site are not suitable for the support of spread footing foundations. The foundations must be made to bear on the undisturbed native soils at 0.6 to 2.3 m below existing ground surface, or at undisturbed native soil depths/elevations as noted on the pertinent boreholes. Based on the proposed basement finished floor level (between Elev. 183.50 and 183.75 ±m), it is expected that foundations for the single and semi detached homes will be set at or below the groundwater table and based on the ground surface elevation at Borehole 9 (Elev. 185.2 ±m), the foundations for the coach house will likely be set slightly above or at the water table.

Since, the coach house structure will not have a basement, footings are likely to be located above the native undisturbed soil stratum. If this is the case, footings for the coach house and any footings set above existing fill materials must be supported on engineered fill constructed to replace the existing earth fill.

4.1 Foundation Design Parameters

The minimum spread footing widths to be used shall be based on the provisions provided within the current Ontario Building Code, regardless of the design bearing pressure. All foundations exposed to freezing temperatures must be provided with not less than 1.4 metres of earth cover or equivalent insulation for protection from frost effects. Footings stepped from one level to another should be at a slope not exceeding 7 vertical to 10 horizontal.

4.1.1 Foundations on Native Soils

The proposed structures can be supported on conventional cast-in-place spread footings founded on the undisturbed native soil and can be designed using a maximum geotechnical reaction at SLS of 150 kPa for 25 mm of settlement or less. The maximum factored geotechnical resistance at ULS is 225 kPa. All footings must be provided with a minimum of 0.3 metres depth of embedment into the competent undisturbed native stratum. **A thin 25 ±mm peat thick layer was noted in the sand deposit below a depth of about 1.5 to 2.0 m from existing grade in the test pits carried out in 2015. However, there was no peat noted in**

the test pits carried out in 2005 or the current boreholes. As such, it may be prudent that all footings supported on native soils are founded below the sand on the sandy silt till. It is anticipated that foundations will be made within close proximity to or extend to / below the stabilized groundwater table at this site (bearing at or below Elev. 184 ±m). The groundwater table must be lowered a minimum of 1 m below the lowest excavation elevation prior to any excavation and maintained at that level during construction. If the subgrade soils are not dewatered prior to excavation and maintained throughout construction, the subgrade soils will become disturbed and the recommendations provided above for bearing capacity will not be valid.

For the recommended bearing pressures, the minimum width of continuous strip footings supported on the native glacial sols must be 0.6 m. The minimum size of isolated footings must be 0.9 m by 0.9 m. These minimum dimensions apply regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. The settlement at SLS will occur as load is applied, and is linear and non-recoverable. Differential settlement is a function of spacing, loading and foundation size.

4.1.2 Foundations on Engineered Fill

The project grading design may require site grades to be cut and/or raised and existing fill which is unsuitable for supporting foundations was encountered to depths of 1.6 to 2.3 m below ground surface in some boreholes. Considerations should be given to raise site grades by construction of engineered fill which may be used to support the proposed Conventional residential structure foundations and floor slabs, if needed. The engineered fill refers to earth fill designed and constructed with a full-time inspection and testing to support the foundations without excessive or differential settlement. Construction of engineered fill should only be conducted under the full-time engineering guidance and supervision, and must be certified by the geotechnical engineer.

Prior to the placement of the engineered fill, all existing topsoil, buried structures **(further investigation is recommended in the area of Borehole 9 – proposed coach house, to explore the fill/buried obstructions and to define the native soils in that area)** and earth fill soils must be stripped from beneath and beyond the proposed houses footprint (minimum of 2 m beyond), and that the subgrade be proof-rolled. Any soft or wet areas which deflect excessively during proof roll, should be sub-excavated and replaced with suitably compacted clean earth fill placed in maximum 150 mm thick lifts.

The selection and sorting of the earth fill materials should be conducted under the supervision of a geotechnical engineer. The native and clean earth fill soils may be utilized as engineered fill provided these soils are not too wet to achieve specified compaction, and do not contain excessive organic inclusion or debris. The moisture content of the engineered fill material must be within 2 percent of its optimum moisture content.

The engineered fill materials should be placed in lifts of 150 mm thickness (or less), and compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD). The engineered fill should extend for a distance of at least 2 m beyond the house footprint in every direction as measured at the founding level, and should extend downwards from this point at a 1 to 1 (horizontal to vertical) slope to the approved ground level. In addition, the engineered fill should extend at least 0.6 m above the proposed foundation elevation. This is to ensure that the foundations are placed on the engineered fill both in plan and elevation. The engineered fill must be provided with a minimum of 1.4 m of earth cover or equivalent insulation to provide adequate frost protection. Refer to the enclosed “Engineered Fill Earthworks Specifications” for engineered fill construction details (Appendix D).

Provided the engineered fill is placed and compacted as indicated above, a maximum net geotechnical reaction of 150 kPa at SLS and a factored geotechnical resistance of 225 kPa at ULS may be utilized for the design of conventional spread footing foundations supported on engineered fill, placed at least 0.3 m into the engineered fill strata. The finalized site grading plan should be reviewed by Terraprobe to better assess the suitability and requirements for the engineered fill.

In case of footings supported on engineered fill, the minimum width for the conventional spread strip footing must be 600 mm, and the minimum size of the individual column footing must be 1000 mm x 1000 mm, regardless of loading considerations.

It should be noted that for structures supported on an engineered fill, nominal reinforcing steel is recommended in the foundation walls. The reinforcing steel should consist of two (2) continuous 15 M bars at the top of the foundation wall and two (2) continuous 15 M bars at the bottom. A typical foundation wall detail for houses on engineered fill is provided as Appendix E.

Engineered fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the engineered fill. The time period over which this settlement occurs depends on the composition of the engineered fill as follows (after initial placement):

a) Sand or gravel soil; several days
b) Silt soil; several weeks
c) Clay or clayey soil; several months

The placement of engineered fill might also result in post-construction settlement of the underlying natural soil. The timing of foundation construction must take into account the post-construction settlement of the engineered fill and the foundation soil.

Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal.

The design earth cover for frost protection of foundations exposed to ambient environmental temperatures is 1.4 metres in the Collingwood area.

4.1.3 Placement of Footings

Prior to placing concrete for foundations of the structures, the foundation areas must be cleaned of all deleterious materials such as topsoil, fill, and softened, disturbed, or caved materials, as well as any standing water. Typically, house foundations designed under Part 9 of the Building Code (Conventional Townhouses) are approved by local building inspectors.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided. Native soils tend to weather rapidly and deteriorate on exposure to the atmosphere and surface water. Hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

4.2 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 4.1.8.4A of the current 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 above equation as it relates to the SPT "N" Values obtained in the boreholes, it is recommended that the site designation for seismic analysis is Class C, as per 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 same code provide the applicable acceleration and velocity based site coefficients.

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

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

It should be noted that the above site designation is estimated on the basis of rational analysis of penetration resistance (N-values) with assumed N-values for the soil stratigraphy beyond the investigation depth. Consideration should be given to conduct a site specific Multichannel Analysis of Surface Waves (MASW) to determine the average shear wave velocity in the top 30 meters of the site stratigraphy.

4.3 Earth Pressure Design Parameters

The parameters used in the determination of earth pressures acting on retaining walls are defined below.

Parameter	Definition	Units
φ	internal angle of 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

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

Stratum/Parameter	φ	γ	K_a	K_o	K_p
Earth Fill	28	19.0	0.36	0.53	2.77
Sand	32	20.0	0.31	0.47	3.25
Glacial Till	34	21.5	0.28	0.44	3.54

Walls 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,

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

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure, this equation can be simplified to:

$$\boldsymbol{P = K[\gamma h + q]}$$

This equation assumes that free-draining granular backfill such as Granular 'B' (OPSS.MUNI 1010) is used and effective drainage is provided. Consideration must also be given to the possible effects of frost on structures retaining earth. Pressures induced by freezing in frost-susceptible soils exert pressures and are effectively irresistible.

The factored geotechnical resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load of the soil contact (**N**) and the frictional resistance of the soil (**tan φ**) expressed as $\boldsymbol{R_f = N\, tan\varphi}$, which is the unfactored resistance. The factored geotechnical resistance at ULS is $\boldsymbol{R_f = 0.8\, N\, tan\varphi}$.

4.4 Slab-on-Grade Design Parameters

The proposed coach house will not have any basement. The ground 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 Standard Proctor Maximum Dry Density (SPMDD). The subgrade should be proof rolled to examine the competency of the fill materials. Where unsuitable subgrade is revealed during proof rolling, it should be subexcavated and replaced with suitable clean earth fill or granular fill (OPSS.MUNI 1010 Granular B) placed in 150 mm thick lifts and each lift compacted to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD). The modulus of subgrade reaction for slab-on-grade supported on compacted fill compacted to 98 percent SPMDD is 16,000 kPa/m. If engineered fill is used to support the building foundation, it will also suitable to support the slab-on-grade.

The subgrade for the basement slab on grade (single and semi detached houses) must be assessed by the geotechnical engineer, prior to the placement of an aggregate base. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD). The modulus of subgrade reaction appropriate for design of the basement slab on undisturbed native soils is 20,000 kPa/m, or 18,000 kPa/m for slabs resting on engineered fill.

It is necessary that the basement floor slabs be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 200 mm layer of HL-8 Coarse Aggregate or 19 mm clear stone compacted by vibration to a dense state. The upper 50 mm of clear stone can be replaced with 50 mm of 19 mm crusher run limestone for a working surface. Provision of subfloor drainage is required in conjunction with perimeter drainage of the structure to collect and remove water that infiltrates under the floor, as discussed in Section 4.5.

Cohesionless native soils or engineered fill will be likely be encountered at the subgrade for the slab on grade. Therefore, a suitable non-woven geotextile filter (Terrafix 360R or equivalent approved by Terraprobe) must be installed (with a minimum 900 mm overlap) below the HL-8 Coarse Aggregate or 19 mm clear stone; otherwise, without proper filtering there may be entry of fines from the surrounding subgrade soils into the subfloor drainage layer. This loss of ground could result in a loss of support of the slab and clogging of the subfloor drainage system.

Regardless of the approach to slab construction, the floor slabs that are to have bonded floor finishes (such as tiles with adhesives) should be provided with a capillary moisture/vapour barrier. The floor manufacturers have specific requirements for moisture/vapour barrier, therefore, the floor designer/architect must ensure that a provision of appropriate moisture/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/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 provides a good capillary moisture barrier provided the granular base is positively drained. However, this provision does not replace the floor manufacturers' specific requirement(s) for a moisture/vapour barrier.

4.5 Basement Drainage

To help prevent water from infiltrating into the basement of the residence, it is recommended that exterior grades around the building be sloped away at a 2 percent gradient or more, for a lateral distance of at least 2 metres. Perimeter foundation drains should be provided, consisting of a minimum 100 mm diameter perforated pipe surrounded by freely draining granular material (either HL8 Course Aggregate or 19 mm clear stone (OPSS 1004) surrounded by filter fabric). It is recommended that the perimeter drainage be connected directly to the municipal storm system if possible, and not directed into the building sumps or drainage layer.

For the single and semi detached houses, the basement wall must be provided with damp-proofing provisions in conformance to Section 9.13.2 of the current Ontario Building Code. Backfill along the foundation wall must consist of Granular 'B' Type 1 (OPSS.MUNI 1010) for a minimum lateral distance of 600 mm out from the foundation wall. Alternatively, if a filtered cellular drainage media is provided adjacent to the foundation wall, the backfill may consist of common earth fill. Basement drainage details and options are provided in Appendix F.

Subdrains must be provided under the basement slab on grade to facilitate the removal of seepage. The subdrains must consist of minimum 100 mm diameter perforated pipes at a maximum spacing of 5 metres on centre. The subdrains must be sufficiently covered on all sides by freely draining granular material (either HL8 Coarse Aggregate or 19 mm clear stone (OPSS 1004) surrounded by filter fabric). A basement subdrain detail is provided in Appendix F.

The size of the sump should be adequate to accommodate the water seepage. The sub-floor drainage system should be designed to prevent the possibility of back-flow. A duplex pumping arrangement (main pump with a provision of a backup pump) on emergency backup power is recommended. Typical commercially available sump pumps are designed to handle approximately 200 litres per minute of water flow. The size of the pump should be adequate to accommodate the anticipated groundwater seepage and storm event flows.,

4.6 Site Servicing

4.6.1 Bedding

The proposed development will include new internal road.

In general, the native soils and earth fills encountered at the site will provide adequate support for piping provided with conventional Class 'B' bedding. Granular bedding material should consist of a well graded material such as Granular A (OPSS 1010). All granular bedding must be placed in 150 mm lifts and compacted to a minimum of 98% of SPMDD. Where disturbance of the trench base has occurred, such as due to groundwater seepage or construction traffic, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill. The bedding material should conform to the pertinent City and Region specifications.

Clear stone bedding is not to be used at this site, due to the presence of sands.

4.6.2 Backfill

In general, excavated soils encountered on site may be re-used as backfill, provided the moisture content of these materials is within 2% of optimum to ensure adequate compaction, and the trenches are wide enough to accommodate a large compaction roller, and the soil is free of any deleterious material (e.g. topsoil, debris). Any native material with higher in-situ moisture content 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.

The backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less and compacted to a minimum of 95% SPMDD (in non-settlement sensitive areas) and 98% SPMDD (in settlement sensitive areas) at a water content within 2% of optimum. Existing native soils will be difficult to place and compact successfully in narrow trench excavations, where large compaction equipment could not operate. For narrow trench excavations, it is recommended that free draining granular material, such as OPSS.MUNI 1010 Granular 'B' be used in order to allow for adequate compaction using vibratory equipment. The placement and inspection of any earth fill as backfill must be conducted under the full time observation of the geotechnical engineer.

It should be noted that most of the shallow native soils at the site are not free draining, and will be difficult to handle and compact if they become wet as a result of inclement weather or seepage. Hence, it can be expected that earthworks carried out during wet periods (i.e., spring and fall) of the year may result in increased earthwork costs.

5.0 PAVEMENT DESIGN

5.1 Asphaltic Concrete Pavements

The proposed project will include a new internal roadway. Asphaltic concrete pavement design recommendations for the proposed internal roadway is provided in the following subsections.

5.2 Subgrade Preparation

The pavement subgrade depends on the final site grading plan (not yet completed), and may consist of engineered fill, earth fill, disturbed native soils, or undisturbed native sand. The native soil or engineered fill is considered to be an adequate subgrade for the support of a pavement structure, provided the subgrade is approved by Terraprobe, the geotechnical engineer, at the time of construction, and does not contain excessive amounts of organics or deleterious materials. The existing earth fill and any disturbed native soils will not provide adequate support for a pavement structure.

The subgrade must be exposed by the removal of any vegetation, topsoil, or disturbed soil. The pavement subgrade should be proof-rolled using a static drum roller or approved equivalent. Any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill placed in 150 mm thick lifts and compacted to a minimum of 98% SPMDD. The earth fill materials may require localized sub-excavation and re-compaction to support pavement structure, as identified during proof roll and subgrade preparation. These areas must be sub-excavated and backfilled with clean, approved and compacted earth fill as noted above. The upper 1.2 metres of the pavement subgrade fill should be compacted to a minimum of 98% SPMDD and the remaining (below 1.2 metres depth below grade) to a minimum of 95% SPMDD.

5.3 Drainage

Control of water is an important factor in achieving a good pavement life. 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 laneway and drained into respective catchbasins to facilitate drainage of the subgrade and granular materials. The subdrain should be installed in accordance with Region/City requirements for Subdrains. The subdrain invert should be maintained at least 0.3 m below subgrade level.

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 2 percent) to provide effective drainage toward curb drains. Grading adjacent to 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 laneway and drained into respective catchbasins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 metres below subgrade level. Pavement drainage alternatives are provided as Appendix G.

5.4 Pavement Structure

The following pavement thickness design are provided on the above noted considerations and subgrade basis for the soil subgrade. The local region/municipality's design, if thicker should be followed.

Pavement Layer	Minimum Component Thickness
Hot Mix Asphalt Surface Course, OPSS 1150 HL 3	40 mm
Hot Mix Asphalt Binder Course, OPSS 1150 HL 8	75 mm
Base Course, 20 mm Crusher Run Limestone	150 mm
Subbase Course, 50 mm Crusher Run Limestone	300 mm

5.5 General Pavement Recommendations

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's standards.

The 20 mm and 50 mm Crusher Run Limestone should meet Town's standards. Granular materials should be compacted to 100 percent SPMDD at ±2 percent of the OMC.

PG 58-28, conforming to OPSS.MUNI 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.

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 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 adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, 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.

6.0 DESIGN CONSIDERATION FOR CONSTRUCTABILITY

6.1 Excavations

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III - Excavations, Section 222 through 242. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

For practical purposes, at this site the earth fill and native sand soils are considered Type 3 soils above the groundwater table and Type 4 below the groundwater table. The sandy silt till is considered Type 3 soil. It is expected that the majority of the excavation for the proposed buildings will be accomplished by open cut methods. If there is not enough room to accommodate open cut excavation methods, Terraprobe can be retained to provide shoring design.

Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates safe 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 Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

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

6.2 Groundwater Control

To avoid significant dewatering, it is recommended that excavations are kept above Elev 184 ±m. This may be achievable with the coach hose structure provided that the site grading is not altered significantly. In general, the volume of water to be anticipated to flow into open excavations limited to be above the prevailing groundwater level, is such that temporary pumping from the excavations is expected to suffice for the control of the groundwater.

Open cut excavations for municipal services and basement are expected to extend below the groundwater table. Excavations that penetrate into the prevailing groundwater table may require dewatering to depress the groundwater table to a minimum 1 m below invert elevation, in order to facilitate construction and ensure trench stability. Experience in the area suggests that dewatering is likely not needed unless excavations penetrate more than 1 m into the water table or are kept open for longer than half a day.

Dewatering will take some time to accomplish prior to the start of excavation. The dewatering may require a Permit to Take Water from the Ministry of Environment, as well as the relevant discharge permits from the Region/Town.

Utility structures such as catchbasins, manholes and utility chambers must be designed for uplift/floatation pressure originating from an assumed high water level located at the finished ground surface elevation. Although a temporary and short-term occurrence, this water level can be achieved during wet seasons such as spring and fall.

Consideration should be given to conducting trial excavations (test pits) to assess the stability of the excavation and groundwater influx once the design details of the development are finalized (including the invert elevations of the underground utilities). This information would help finalize the requirements for groundwater control and dewatering.

It is recommended to consult a professional dewatering contractor to review the subsurface conditions and to design a site specific dewatering system. It is the dewatering contractor's responsibility to make an assessment of the factual data and to provide recommendations on dewatering system requirements.

6.3 Site Work

The soils found at this site will become weakened when subjected to traffic, particularly when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is highly susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

Prior to pouring concrete for the footings, the footing subgrade must be cleaned of deleterious materials, softened, disturbed, or caved materials, and any standing water. The footing excavations must be inspected and approved by Terraprobe to ensure the bearing capacities stated above are applicable. If soft soils are encountered at the proposed bearing depths during footing excavation, sub-excavation to competent soil is required under the direction of the geotechnical engineer. Furthermore, native soils tend to weather and deteriorate on exposure to the atmosphere or to surface water, therefore foundation bases that will remain open and exposed to the atmosphere for an extended period of time shall be protected by applying a skim coat of lean concrete. If construction is to proceed in freezing conditions, temporary frost protection for the footing bases and concrete must be provided.

6.4 Quality Control

The proposed structure will be founded on spread footing foundations. The foundation installations must be field reviewed by the geotechnical engineer 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 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 non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice contained in this report.

The long term performance of the slab on grade is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the borings. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Terraprobe at the time of construction to confirm material quality, thickness and to ensure adequate compaction.

The requirements for fill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density as determined by ASTM D698. In situ determinations of density during fill and asphaltic placement on site are required to demonstrate that the specified placement density is achieved. Terraprobe is a CNSC certified operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary, with our qualified technical staff.

Concrete 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.

Terraprobe provides quality control services for Building Envelope, Roofing and Structural Steel, 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.

7.0 LIMITATIONS AND USE OF REPORT

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 from this investigation.

The drilling work was carried out by a drilling contractor and was observed and recorded by Terraprobe on a full time basis. The boreholes were made by a continuous flight power auger machine using solid and hollow stem augers. A Terraprobe technician logged the boreholes and examined the samples as they were obtained. The samples obtained were sealed in clean, air-tight containers and transferred to the Terraprobe laboratory, where they were reviewed for consistency of description by a geotechnical engineer. Groundwater observations were made in the boreholes as drilling proceeded.

The samples of the strata penetrated were obtained using the technique, Split-Barrel Method, ASTM D1586. The samples were taken at intervals. The conventional interval sampling procedure used for this investigation does not recover continuous samples of soil at any borehole location. There is consequently some interpolation of the borehole layering between samples and indications of changes in stratigraphy as shown on the borehole logs are approximate.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. 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.

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 and geotechnical advice to completely identify all aspects of the site and works that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project must 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, and their approach to the construction works, cognizant of the risks implicit in the subsurface investigation activities.

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Borehole Logs. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes, and will vary between and beyond the borehole locations. The discussion has been simplified in terms of the major soil strata for the purposes of geotechnical design.

7.2 Changes in Site and Scope

It must 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. In particular, caution should be exercised in the consideration of contractual responsibilities as they relate to control of seepage, disturbance of soils, and frost protection.

The design parameters provided and the engineering advice offered in this report is based on the factual data obtained from this investigation made at the site by Terraprobe and is intended for use by the owner and its retained design consultants 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, advice and comments relating to constructability issues and quality control may not be relevant or complete for the project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

7.3 Use of Report

This report is prepared for the express use of Georgian Communities and their retained design consultants. It 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, Georgian Communities and their retained design consultants are authorized users.

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report meets with your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
O. D. BENJAMIN
90337072
Nov. 18, 2020
PROVINCE OF ONTARIO

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

Mike Tanos, P.Eng.
Consulting Principal

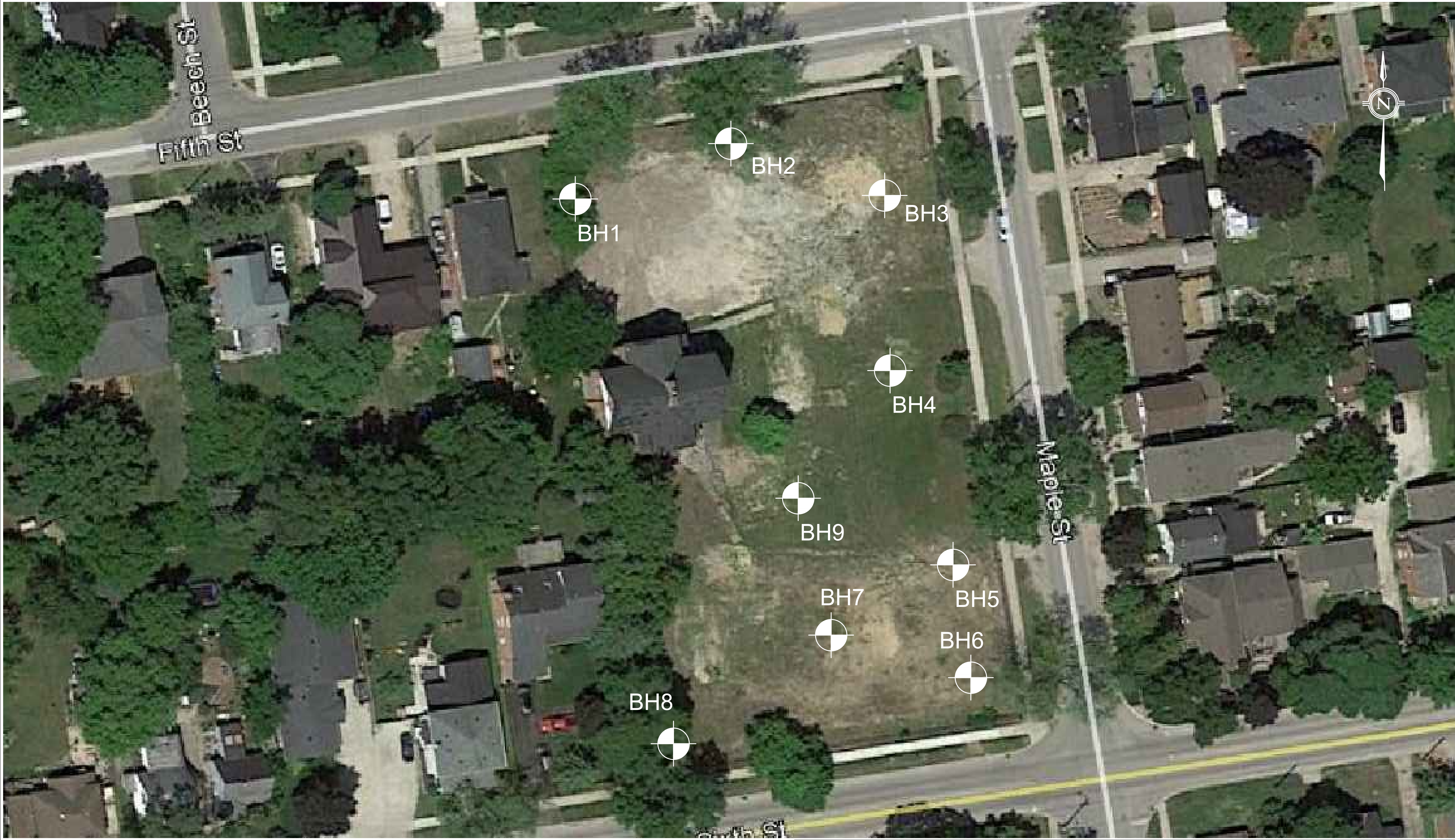
FIGURES

TERRAPROBE INC.

Terraprobe

220 Bayview Drive, Barrie, Ontario, L4N 4Y8
Tel: (705) 739-8355 Fax: (705) 739-8369

Title:	FIGURE :
SITE LOCATION PLAN	1
File No. 3-20-0102-01	



NOT TO SCALE.
BOREHOLE LOCATIONS ARE APPROXIMATE.

Terraprobe
220 Bayview Drive, Barrie, Ontario, L4N 4Y8
Tel: (705) 739-8355 Fax: (705) 739-8369

Title: BOREHOLE LOCATION PLAN (EXISTING CONDITION)

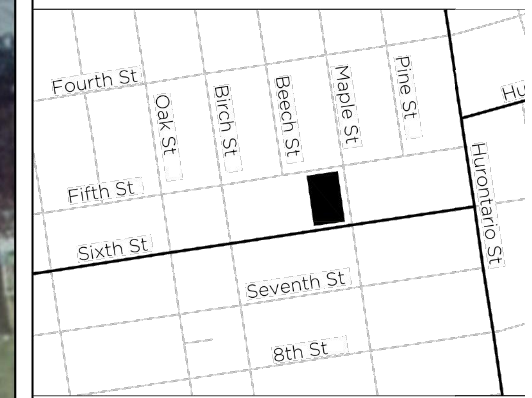
File No. 3-20-0102-01

FIGURE : 2

CONCEPT PLAN

Former Victoria School Ann

400 Maple Street, Town of Collingwo



Key Map | Scale 1 : 15,0

LEGEND

SUBJECT LANDS
Lot Area: 5,994.3m² (1.4
No. of Proposed Units: 19
Density Target: 32 u/ha
Proposed Density: 31.7 u/ha

SINGLE DETACHED - 4 Lots
GFA: 379.8m² (4,087.9ft²) min.

SEMI DETACHED - 10 Units
GFA: 350.1m² (3,768.4ft²) min.

VICTORIA SCHOOL BUILDING - 4 Un

COACH HOUSE - 1 Unit
above 10 parking spaces including 5 t

Porch

Scale: 1 : 500

Drawn By: A.M. | Date: June 4, 2020

GEORGIAN COMMUNITIES
85 Bayfield Street,
Barrie, Ontario, L4
705 730-5900

ZONING REQUIREMENTS - R3 ZONE

	Singles		Semis		Apartment Units	
	Required	Proposed	Required	Proposed	Required	Proposed
Number of Units		4		10		5
Lot Area	325m²	368.9m²	275m²	264.0m²	nil	1,842.2m²
Lot Frontage	10.0m	13.9m	9.0m	9.6m	nil	13.9m
Front Yard	4.5m	4.5m	4.5m	4.5m	7.5m	42.6m
Ext. Side Yard	4.5m	4.5m	4.5m	n/a	7.5m	n/a
Int. Side Yard	1.2m	1.2m	1.2m & 0.0	1.2m & 0.0	7.5m	4.6m
Rear Yard	7.5m	7.5m	7.5m	7.5m	7.5m	0.3m (existing)
Height (max)	12.0m	12.0m	12.0m	12.0m	15.0m	±10.0m
Coverage (max)	40%	45.9%	40%	47.6%	40%	24.8%
Landscaped Area	35%	49.3%	35%	45.6%	40%	47.8%
Parking Spaces	2 / unit	2 / unit	2 / unit	2 / unit	1.25 / unit	2.6 / unit
Accessible Parking					1	1
Accessory Bldgs						
Interior Side Yard	1.0m	1.0m			1.0m	2.5m
Rear Yard	1.0m	1.0m			1.0m	14.6m

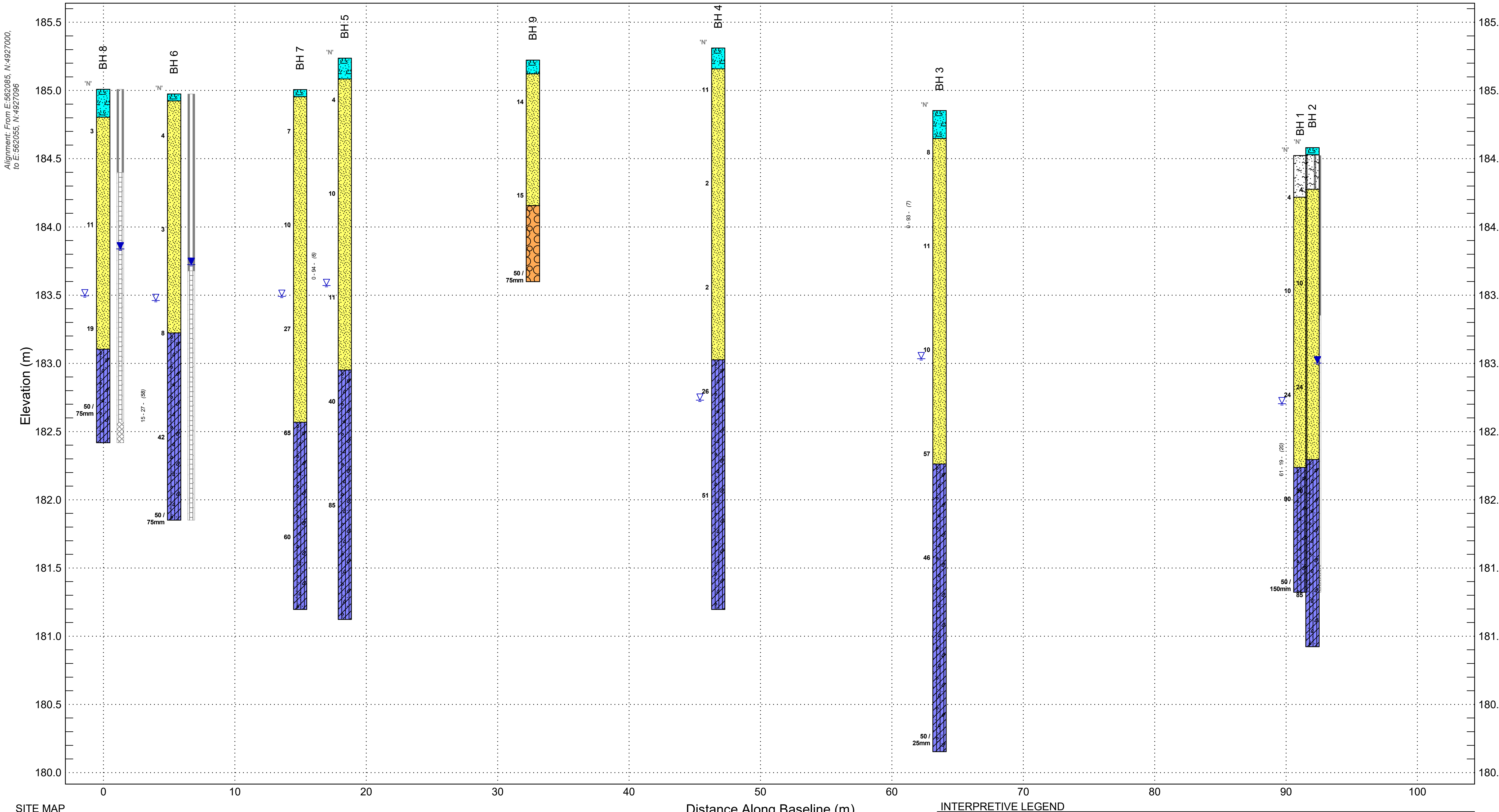
NOT TO SCALE.
BOREHOLE LOCATIONS ARE APPROXIMATE.

Terraprobe
220 Bayview Drive, Barrie, Ontario, L4N 4Y8
Tel: (705) 739-8355 Fax: (705) 739-8369

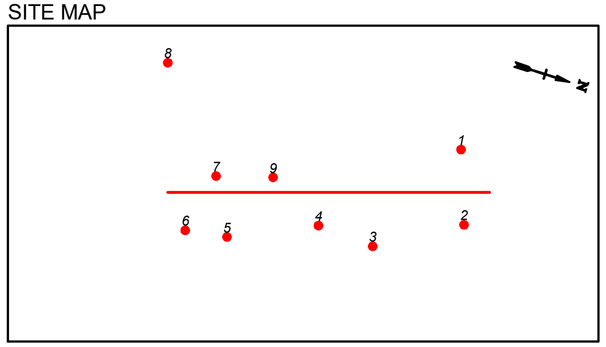
Title: BOREHOLE LOCATION PLAN (PROPOSED CONDITION)

File No. 3-20-0102-01

FIGURE : 3



SITE MAP



LITHOLOGY GRAPHIC LEGEND

- Organic Sands (MTO)
- TTC Cobbles
- Sand
- Sandy Gravel and Clay and Silt
- Topsoil

INTERPRETIVE LEGEND

- ▽ WL on completion of drilling
- ▼ Stabilized WL, most recent

- *FILL*
- *GRAVELS (gravel to gravelly sand)*
- *SILT TO SAND (not till)*
- *COHESIONLESS TILLS*
- *COHESIVE SOILS (clayey silt to clay, incl. tills)*
- *DISTURBED/REWORKED SOILS*

Terraprobe

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

Title: **SUBSURFACE PROFILE**

File No.: **3-20-0102-01**

FIGURE: 4

Report: ISECTION - TABLOID - ELEV

APPENDICES

TERRAPROBE INC.

APPENDIX A

TERRAPROBE INC.

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

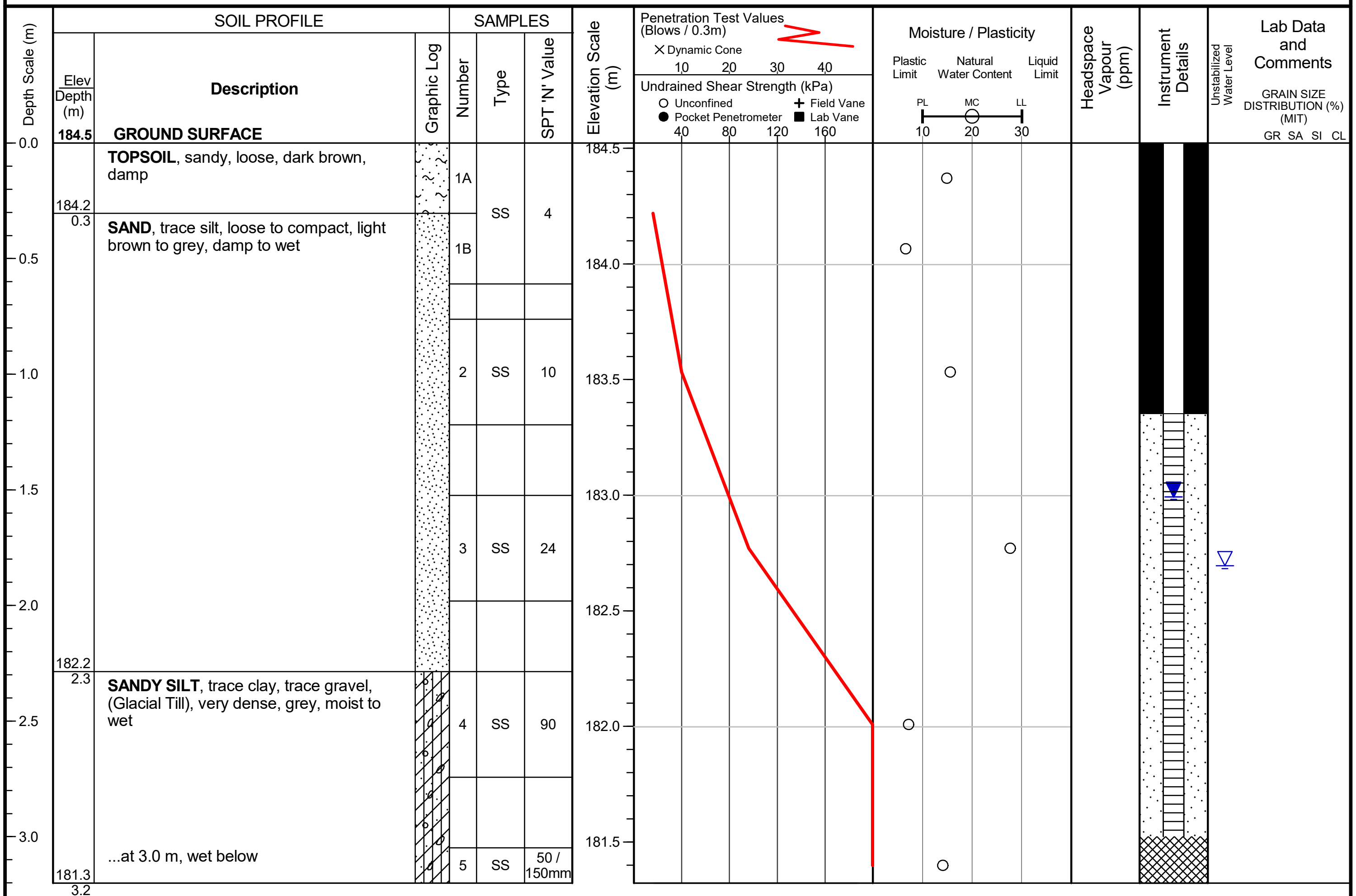
Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

LOG OF BOREHOLE 1

Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES	Originated by : JA
Date started : October 8, 2020	Project : 400 Maple St, Collingwood, ON	Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON	Checked by : OB

Position : E: 562045, N: 4927083 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers



END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 1.8 m below ground surface; borehole was open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 13, 2020	1.5	183.0

file: 3-20-0102.gpj

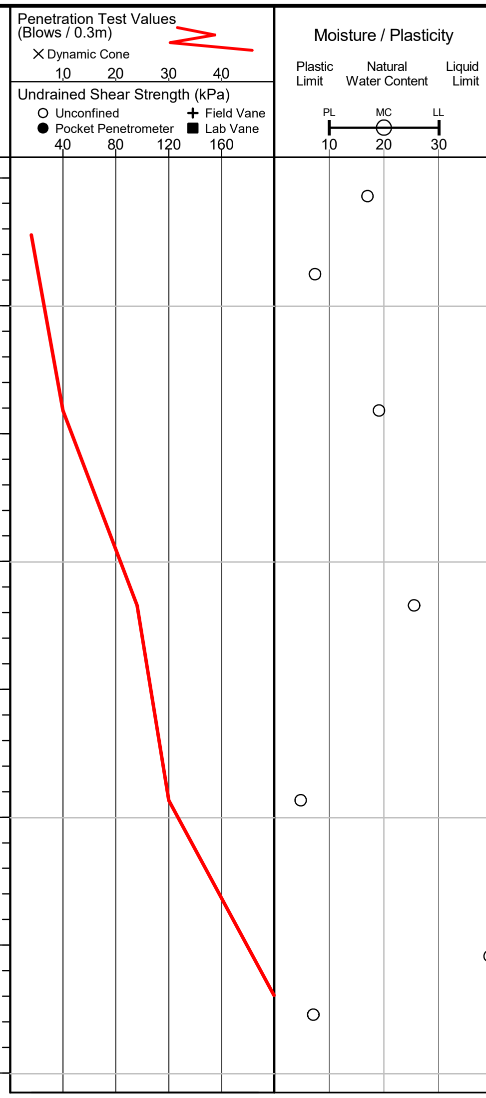
LOG OF BOREHOLE 2

Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES	Originated by : JA
Date started : October 8, 2020	Project : 400 Maple St, Collingwood, ON	Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON	Checked by : OB

Position : E: 562067, N: 4927091 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0.0	184.6	GROUND SURFACE					
		50mm **TOPSOIL**					184.5
		SAND, trace silt, loose to compact, brown, moist to wet		1A / 1B	SS	4	
0.5							184.0
1.0				2	SS	10	183.5
1.5		...at 1.5 m, trace organics					183.0
				3	SS	24	
2.0							182.5
	182.3 / 2.3	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), compact to very dense, grey, wet		4	SS	30	
2.5							182.0
3.0		...at 3.0 m, wet sand layer		5A / 5B	SS	85	181.5
3.5		...at 3.5 m, Auger grinding					181.0
	180.9 / 3.7						



Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE
Auger refusal possible bedrock or boulders

Borehole was dry and open upon completion of drilling.

file: 3-20-0102.gpj

Terraprobe

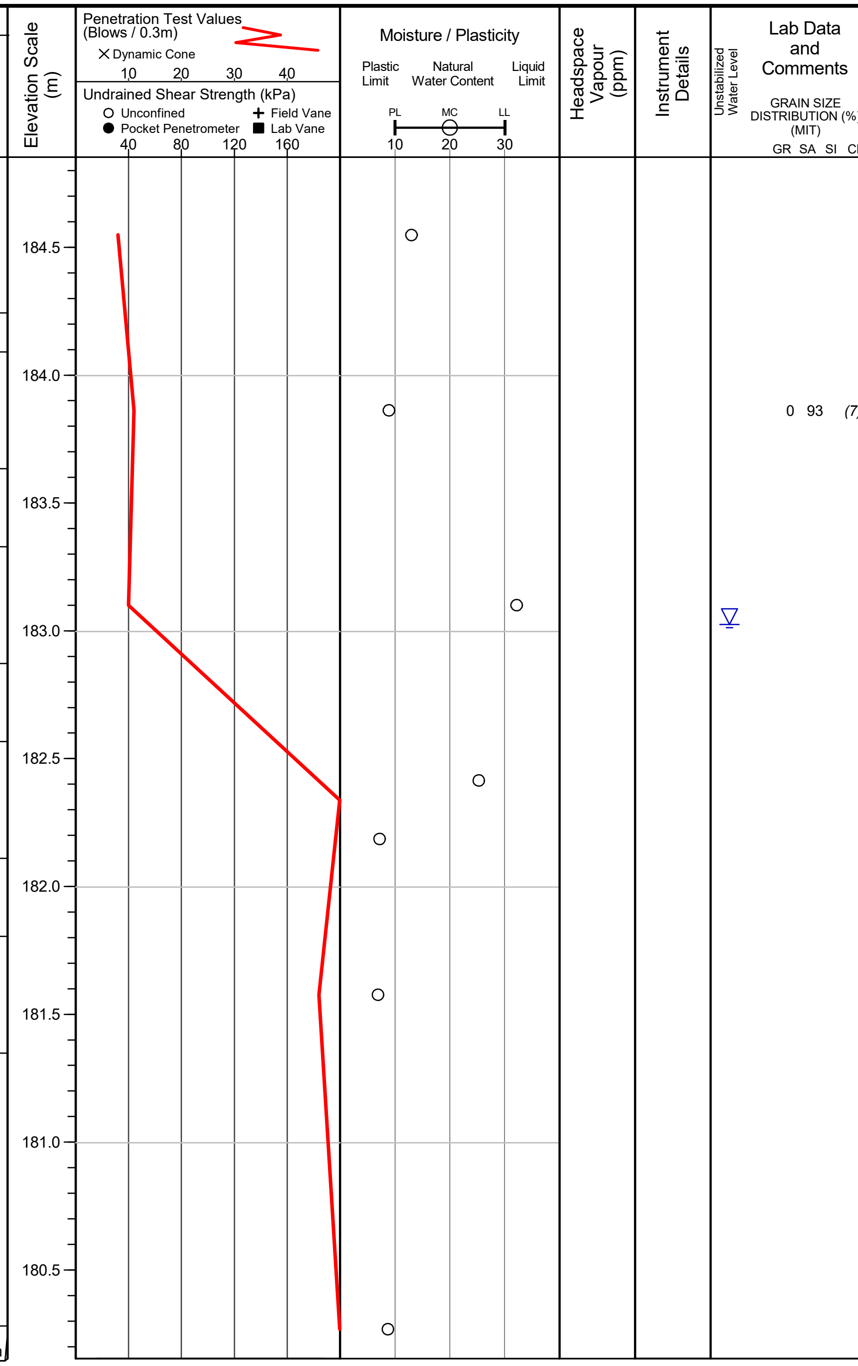
LOG OF BOREHOLE 3

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES		Originated by : JA
Date started : October 8, 2020	Project : 400 Maple St, Collingwood, ON		Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON		Checked by : OB

Position : E: 562082, N: 4927066 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : Geoprobe, track-mounted | Drilling Method : Solid stem augers

Elev / Depth (m)	Description (SOIL PROFILE)	Sample Number	Type	SPT 'N' Value	Lab Data and Comments (GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL)
184.9	**GROUND SURFACE**				
184.7 / 0.2	200mm **TOPSOIL**				
	SAND, trace silt, loose to very dense, brown to yellowish brown, damp to wet	1	SS	8	
		2	SS	11	0 93 (7)
	...at 1.5 m, Wet/Saturated	3	SS	10	
182.3 / 2.6		4A	SS	57	
	SANDY SILT, trace clay, trace gravel, (Glacial Till), very dense, grey, moist to wet ...at 2.7 m, Auger grinding	4B			
		5	SS	46	
	...at 3.7 m, Auger grinding				
180.2 / 4.7	...at 4.6 m, becoming cobbley	6	SS	50 / 25mm	



END OF BOREHOLE
Auger refusal possible bedrock or boulders

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

Terraprobe

LOG OF BOREHOLE 4

Project No.	: 3-20-0102-01	Client	: GEORGIAN COMMUNITIES	Originated by	: JA
Date started	: October 8, 2020	Project	: 400 Maple St, Collingwood, ON	Compiled by	: HS
Sheet No.	: 1 of 1	Location	: Collingwood, ON	Checked by	: OB

Position : E: 562081, N: 4927048 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE

Elev (m)	Depth (m)	Description
185.3	0.0	**GROUND SURFACE**
185.1	0.2	125mm **TOPSOIL**
		FILL, sand, trace silt, (organic stained seams), compact to very loose, brown, moist ...at 0.6 m, Auger grinding
183.0	2.3	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), compact to very dense, grey, wet
181.2	4.1	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value	Elevation (m)	Natural Water Content (%)
1	SS	11	185.0	~10
2	SS	2	184.3	~9
3	SS	2	183.5	~14
4	SS	26	182.8	~8
5	SS	51	182.0	~9

Unstabilized Water Level: 2.6 m

Headspace Vapour (ppm) | Instrument Details | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 2.6 m below ground surface; borehole was open upon completion of drilling.

file: 3-20-0102.gpj

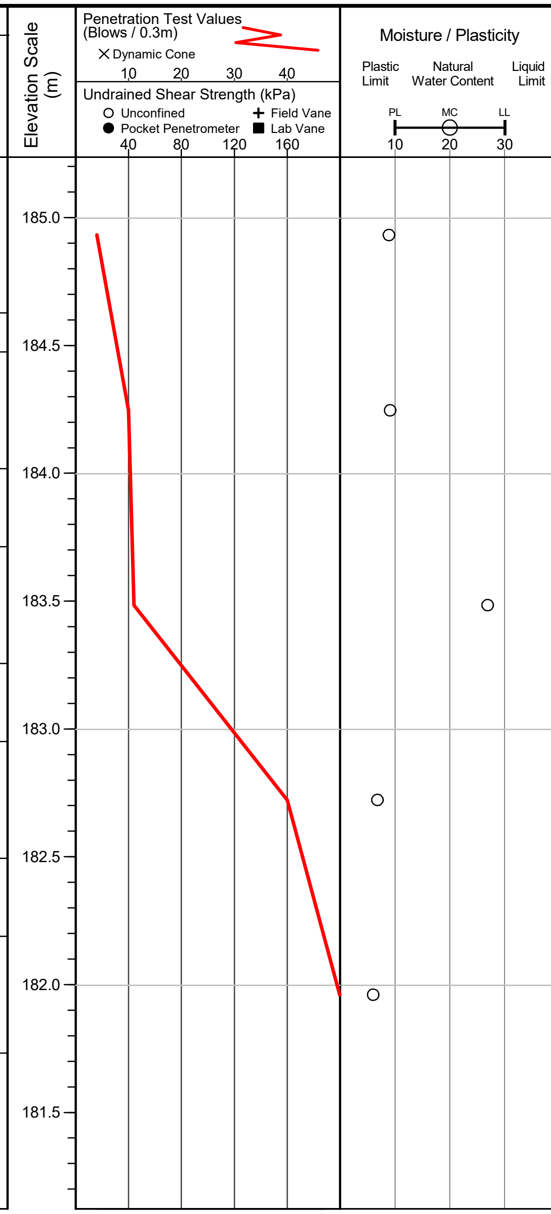
LOG OF BOREHOLE 5

Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES		Originated by : JA
Date started : October 8, 2020	Project : 400 Maple St, Collingwood, ON		Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON		Checked by : OB

Position : E: 562093, N: 4927022 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers

Elev / Depth (m)	Description (SOIL PROFILE)	Sample Number	Type	SPT 'N' Value	Unstabilized Water Level	Lab Data and Comments (GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL)
185.2	GROUND SURFACE					
185.0 / 0.2	125mm **TOPSOIL**					
	SAND, trace silt, loose to compact, light brown to yellowish brown, damp to wet ...at 0.3 m, some organics	1	SS	4		
		2	SS	10		
		3	SS	11	∇ (1.7 m)	0 94 (6)
	...at 2.0 m, Auger grinding					
182.9 / 2.3	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), dense to very dense, grey, wet	4	SS	40		
		5	SS	85		
	...at 3.7 m, Auger grinding					
181.1 / 4.1	**END OF BOREHOLE**					



END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 1.7 m below ground surface; borehole caved to 1.8 m below ground surface upon completion of drilling.

file: 3-20-0102.gpj

LOG OF BOREHOLE 6

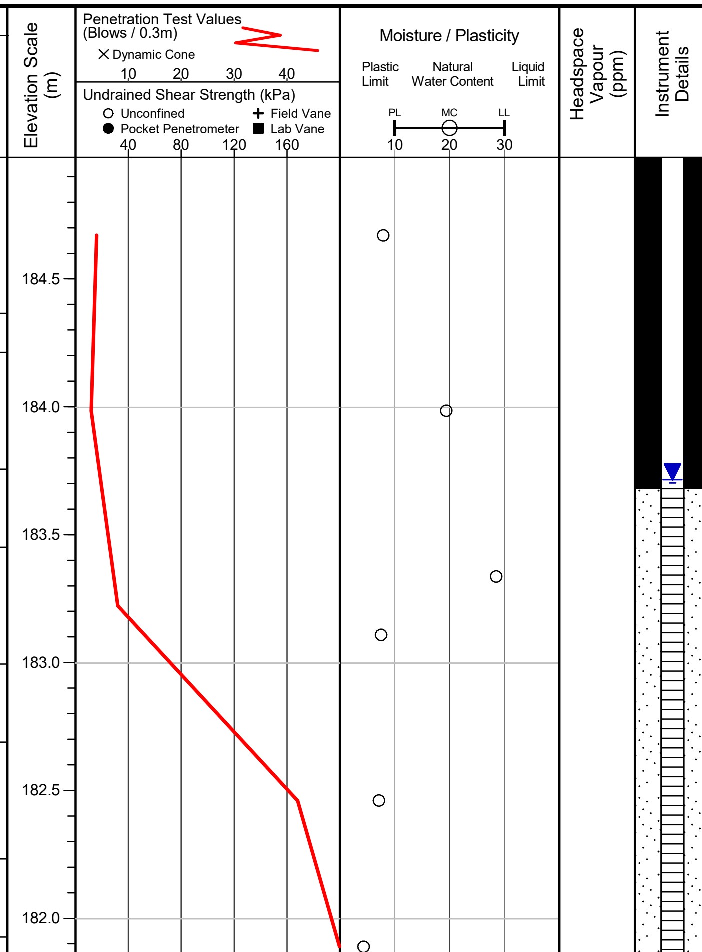
Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES		Originated by : JA
Date started : October 9, 2020	Project : 400 Maple St, Collingwood, ON		Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON		Checked by : OB

Position : E: 562095, N: 4927009 (UTM 17T) — Elevation Datum : Geodetic (NAD83)

Rig type : Geoprobe, track-mounted — Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Lab Data and Comments (Grain Size Distribution (%) (MIT) GR SA SI CL)
0.0	185.0	**GROUND SURFACE**				
		50mm **TOPSOIL**				
		FILL, sand, trace silt, trace rootlets, tr. organic stained seams, loose, brown to grey, wet	1	SS	4	
			2	SS	3	
1.5		...at 1.5 m, wet	3A	SS	8	
	183.2 / 1.8	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), loose to very dense, grey, moist	3B			
2.5			4	SS	42	15 27 (58)
3.0	181.9 / 3.1	...at 3.0 m, Auger grinding, becoming cobbley	5	SS	50 / 75mm	



END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 1.5 m below ground surface; borehole caved to 3.0 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 19, 2020	1.3	183.7

file: 3-20-0102.gpj

LOG OF BOREHOLE 7

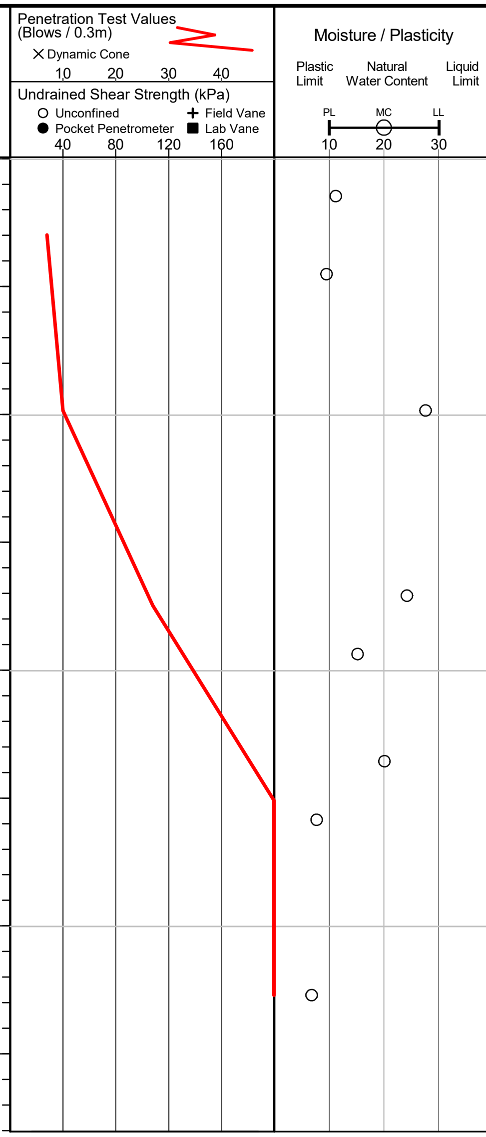
Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES		Originated by : JA
Date started : October 8, 2020	Project : 400 Maple St, Collingwood, ON		Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON		Checked by : OB

Position : E: 562076, N: 4927013 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
0.0	185.0	GROUND SURFACE				185.0
		50mm **TOPSOIL**				
		SAND, trace silt, loose to compact, brown to yellowish brown, moist to wet ...at 0.2 m, some organics	1A / 1B	SS	7	
0.5						184.5
		...at 0.8 m, becoming wet				
1.0			2	SS	10	184.0
1.5		...at 1.5 m, gravel inclusions				183.5
			3A / 3B	SS	27	
2.0						183.0
	182.6 2.4	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), very dense, grey, moist	4A / 4B	SS	65	182.5
3.0						182.0
			5	SS	60	
3.5						181.5
	181.2 3.8	...at 3.8 m, Auger grinding				



Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level: at 1.5 m | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 1.5 m below ground surface; borehole caved to 1.5 m below ground surface upon completion of drilling.

file: 3-20-0102.gpj

LOG OF BOREHOLE 8

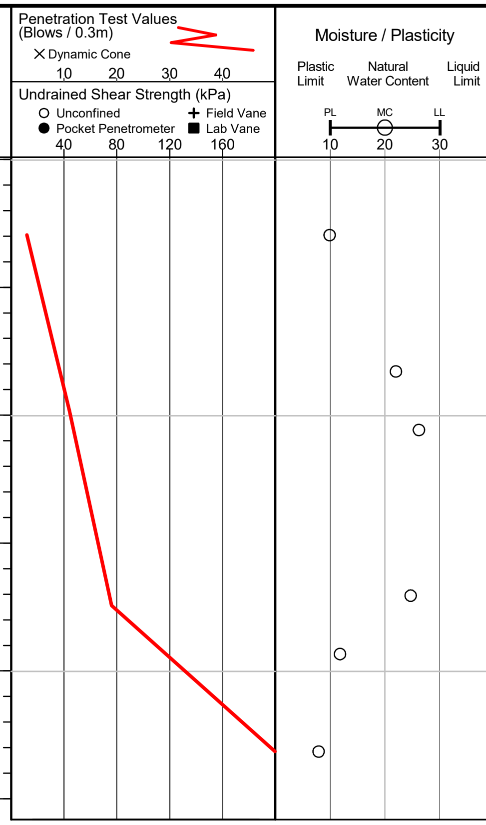
Terraprobe

Project No. : 3-20-0102-01	Client : GEORGIAN COMMUNITIES	Originated by : JA
Date started : October 9, 2020	Project : 400 Maple St, Collingwood, ON	Compiled by : HS
Sheet No. : 1 of 1	Location : Collingwood, ON	Checked by : OB

Position : E: 562047, N: 4926988 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : Geoprobe, track-mounted
Drilling Method : Solid stem augers

SOIL PROFILE

Elev / Depth (m)	Description	Sample Number	Type	SPT 'N' Value
185.0	**GROUND SURFACE**			
	200mm **TOPSOIL**			
184.8 / 0.2	**SAND**, trace silt, very loose to compact, yellowish brown, moist to wet ...at 0.3 m, trace organics	1	SS	3
		2A	SS	11
	...at 1.1 m, becoming light brown	2B		
		3A	SS	19
183.1 / 1.9	**SANDY SILT**, trace clay, trace gravel, (Glacial Till), compact to very dense, grey, wet	3B		
		4	SS	50 / 75mm
182.4 / 2.6	...at 2.6 m, Auger grinding			



Elevation Scale (m): 185.0, 184.5, 184.0, 183.5, 183.0, 182.5

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE
Auger refusal possible bedrock or boulders

Unstabilized water level measured at 1.5 m below ground surface; borehole caved to 2.6 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Oct 13, 2020	1.2	183.8

file: 3-20-0102.gpj

Terraprobe

LOG OF BOREHOLE 9

Project No. : 3-20-0102-01 | Client : GEORGIAN COMMUNITIES | Originated by : JA

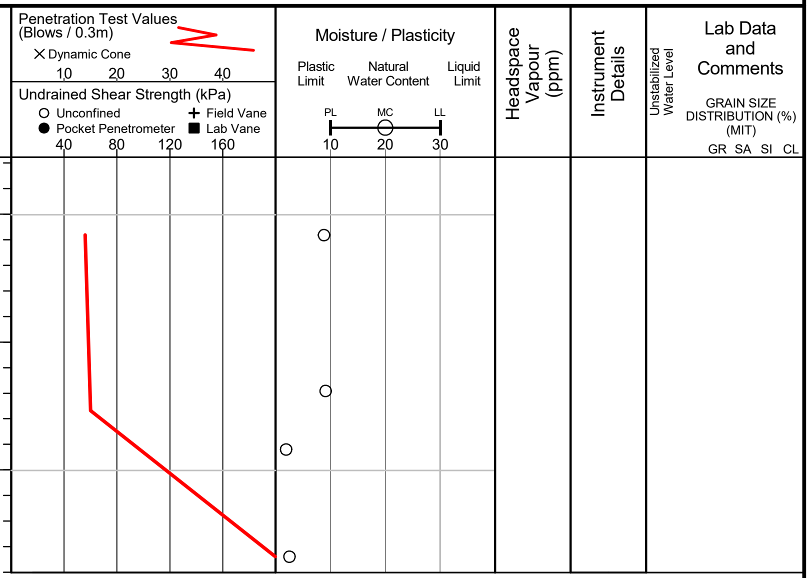
Date started : October 8, 2020 | Project : 400 Maple St, Collingwood, ON | Compiled by : HS

Sheet No. : 1 of 1 | Location : Collingwood, ON | Checked by : OB

Position : E: 562071, N: 4927030 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : Geoprobe, track-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
0.0	185.2	GROUND SURFACE					
		100mm **TOPSOIL**					
		FILL, sand, some gravel, trace silt, trace brick fragments, trace concrete, compact, brown, moist ...at 0.3 m, Auger grinding		1	SS	14	185.0
0.5							184.5
1.0				2A	SS	15	
	184.1 1.1	**SANDY SILT**, trace to some clay, trace to some gravel, compact to very dense, grey to brown, moist ...at 1.1 m, Possible debris, brick, concrete, cobbles		2B			184.0
1.5	183.6 1.6	...at 1.5 m, Auger grinding		3	SS	50 / 75mm	



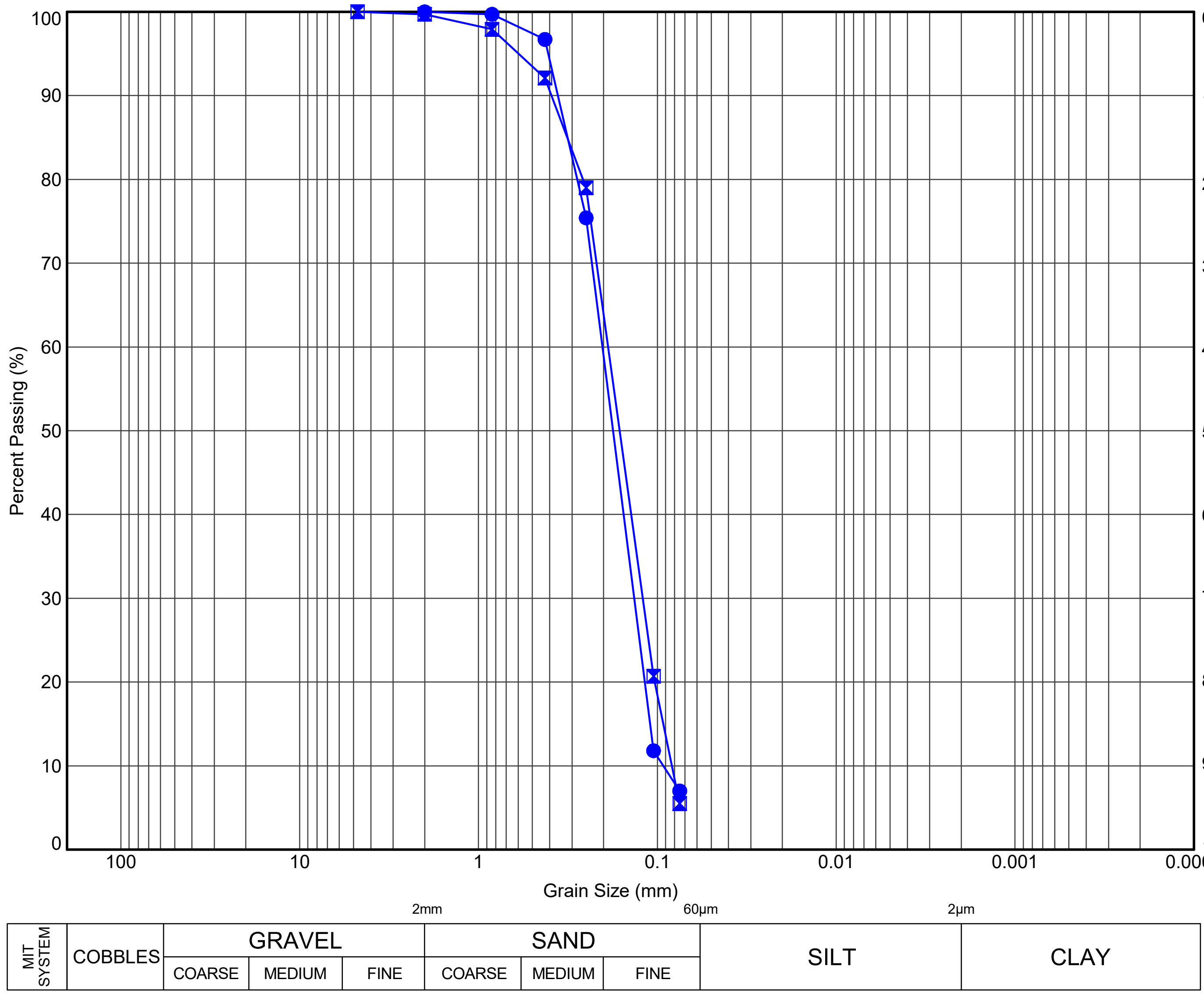
END OF BOREHOLE
Auger refusal on possible buried concrete or debris

Borehole was dry and open upon completion of drilling.

file: 3-20-0102.gpj

APPENDIX B

TERRAPROBE INC.



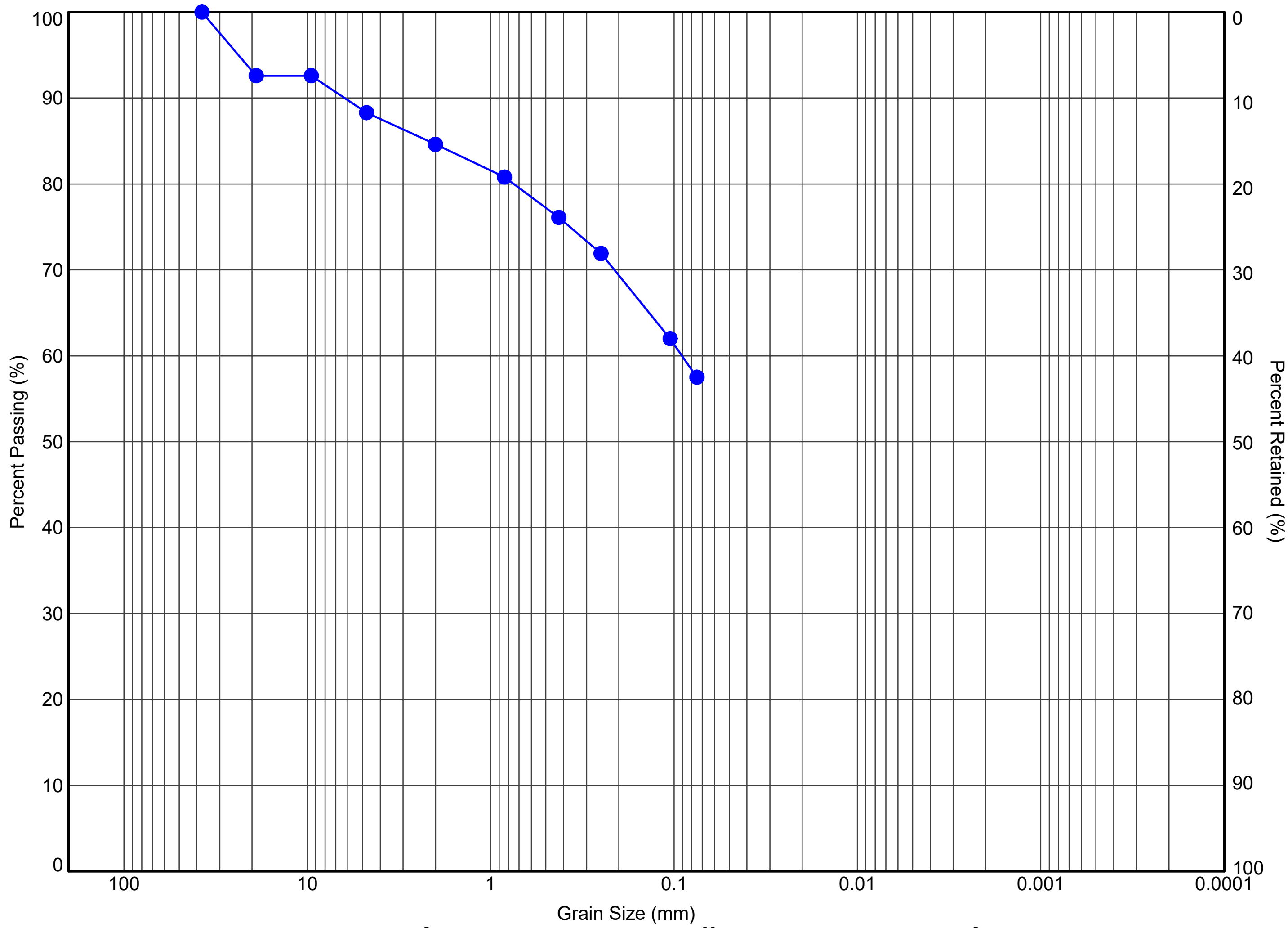
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
					MIT SYSTEM				
●	**3**	SS2	1.0	183.9	0	93			*(7)*
⊠	**5**	SS3	1.8	183.5	0	94			*(6)*

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

Title:

GRAIN SIZE DISTRIBUTION
SAND, TRACE SILT

File No.: **3-20-0102-01**



	2mm					60µm	2µm	
MIT SYSTEM	COBBLES	GRAVEL			SAND		SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**6**	SS4	2.5	182.5	15	27			*(58)*

Terraprobe

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

Title:

GRAIN SIZE DISTRIBUTION
SANDY SILT, SOME CLAY, SOME GRAVEL

File No.: **3-20-0102-01**

APPENDIX C

TERRAPROBE INC.

FINAL REPORT

CA15874-OCT20 R1

3-20-0102-49, 400 Maple St., Collingwood

Prepared for

Terraprobe Inc

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Terraprobe Inc	Project Specialist	Jill Campbell, B.Sc.,GISAS
		Laboratory	SGS Canada Inc.
Address	11 Indell Lane Brampton, ON L6T 3Y3, Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Melissa Cautillo	Telephone	2165
Telephone	(905) 796-2650	Facsimile	705-652-6365
Facsimile	(905) 796-2250	Email	jill.campbell@sgs.com
Email	mcautillo@terraprobe.ca	SGS Reference	CA15874-OCT20
Project	3-20-0102-49, 400 Maple St., Collingwood	Received	10/29/2020
Order Number		Approved	11/04/2020
Samples	Soil (3)	Report Number	CA15874-OCT20 R1
		Date Reported	11/04/2020

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:017867

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Terraprobe Inc

Project: 3-20-0102-49, 400 Maple St., Collingwood

Project Manager: Melissa Cautillo

Samplers: Ryan

PACKAGE: **- Corrosivity Index** (SOIL)

			Sample Number	5	6	7
			Sample Name	BH1-SA3	BH4-SA4	BH7-SA3A
			Sample Matrix	Soil	Soil	Soil
			Sample Date	09/10/2020	08/10/2020	08/10/2020
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**
Corrosivity Index						
Corrosivity Index	none	1		4	4	4
Soil Redox Potential	mV	-		241	196	224
Sulphide (Na2CO3)	%	0.04		< 0.04	< 0.04	< 0.04
pH	pH Units	0.05		9.08	9.09	9.41
Resistivity (calculated)	ohms.cm	-9999		13700	9520	7410

PACKAGE: **- General Chemistry** (SOIL)

			Sample Number	5	6	7
			Sample Name	BH1-SA3	BH4-SA4	BH7-SA3A
			Sample Matrix	Soil	Soil	Soil
			Sample Date	09/10/2020	08/10/2020	08/10/2020
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**
General Chemistry						
Conductivity	uS/cm	2		73	105	135

PACKAGE: **- Metals and Inorganics** (SOIL)

			Sample Number	5	6	7
			Sample Name	BH1-SA3	BH4-SA4	BH7-SA3A
			Sample Matrix	Soil	Soil	Soil
			Sample Date	09/10/2020	08/10/2020	08/10/2020
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**
Metals and Inorganics						
Moisture Content	%	0.1		20.4	13.4	17.3
Sulphate	µg/g	0.4		12	15	6.3

FINAL REPORT

CA15874-OCT20 R1

Client: Terraprobe Inc
Project: 3-20-0102-49, 400 Maple St., Collingwood
Project Manager: Melissa Cautillo
Samplers: Ryan

PACKAGE: **- Other (ORP)** (SOIL)

			Sample Number	5	6	7
			Sample Name	BH1-SA3	BH4-SA4	BH7-SA3A
			Sample Matrix	Soil	Soil	Soil
			Sample Date	09/10/2020	08/10/2020	08/10/2020
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**
Other (ORP)						
Chloride	µg/g	0.4		7.2	23	48

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0040-NOV20	µg/g	0.4	<0.4	11	20	93	80	120	99	75	125
Sulphate	DIO0040-NOV20	µg/g	0.4	<0.4	11	20	94	80	120	90	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0003-NOV20	%	0.04	< 0.04	ND	20	118	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0007-NOV20	uS/cm	2	< 2	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0007-NOV20	pH Units	0.05	NA	0		101			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

-- End of Analytical Report --

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No: 017867

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: D. REID
Received Date: 10/29/20 (mm/dd/yy)
Received Time: 15:40 (hr : min)
Received By (signature): [signature]
Custody Seal Present: Yes ☐ No ☐
Custody Seal Intact: Yes ☐ No ☐
Cooling Agent Present: Yes ☐ No ☑ Type: ____
Temperature Upon Receipt (°C) 8°, 9°, 9°
LAB LIMS #: CA15874-Oct20

REPORT INFORMATION	INVOICE INFORMATION
Company: Terraprobe	☐ (same as Report Information)
Contact: Melissa Cautillo	Company: Terraprobe
Address: 11 Indell Lane Brampton, ON, L6T 3Y3	Contact: Lorena Rossi
Phone: 905-796-2650	Address:
Fax:	Phone:
Email:	Email:

Quotation #: ____ P.O. #: ____
Project #: 3-20-0102-49 Site Location/ID: 400 Maple St. Collingwood

TURNAROUND TIME (TAT) REQUIRED

☐ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: ____

*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium/Fine
☐ Table ____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA ☐ ODWS Not Reportable *See note

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality: ____

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

M & I: Field Filtered (Y/N); Metals & Inorganics incl CrVI, CN, Hg pH, (B(HWS), EC, SAR-soil) (Cl, Na-water); Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI; ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,
SVOC: PAHs only; SVOCs all incl PAHs, ABNs, CPs
PCB: PCBs ☐ Total ☐ Aroclor
PHC: F1-F4 + BTEX; F1-F4 only no BTEX
VOC: VOCs all incl BTEX; BTEX only
Pest: ☐ Pesticides Organochlorine or specify other
Other (please specify): Corrosivity; Appendix 2: 406/19 Leachate Screening Levels Table: ____; Sewer Use: Specify pkg:; Water Characterization Pkg General ☐ Extended ☐
TCLP: Specify TCLP tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.

#	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Corrosivity	COMMENTS
1	BH1-SA3	Oct.9/20		1	soil	X	
2	BH4-SA4	Oct8/20		1	soil	X	
3	BH7-SA3A	Oct8/20		1	soil	X	
4							
5							
6							
7							
8							
9							
10							
11							
12							

Observations/Comments/Special Instructions

Sampled By (NAME): Ryan Signature: ____ Date: Oct/29/20 (mm/dd/yy) Pink Copy - Client

Relinquished by (NAME): ____ Signature: ____ Date: __/__/__ (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.4
Date of Issue: 22 May. 2020

SGS Canada Inc.
P.O. Box 4300 - 185 Consession Street
Lakefield, Ontario, - K0L 2H0
Phone: (705) 652 2000 FAX: (705) 652 6365

SIR Issued Date:
Date Received:
Received By:

Terraprobe Inc
Attn: Melissa Cautillo
11 Indell Lane, Brampton, ON
Canada
Phone: (905) 796-2650

SGS Report:
Project Number:
Reference:
Version:

SAMPLE INTEGRITY REPORT

Sample Integrity of Submission
The following have been identified as Sample Integrity Violations Related to SGS Canada Report: CA15874-OCT20
The report was found to contain NO ISSUES

GENERAL INTEGRITY VIOLATIONS

SAMPLE SPECIFIC INTEGRITY VIOLATIONS

PARTICULATE LOG

Printed on : 30 Oct 2020 14:01

30-Oct-2020
29-Oct-2020
Katrina Wells

CA15874-OCT20
3-20-0102-49, 400 Maple St., Collingwood
3-20-0102-49, Melissa Cautillo
V 1.0

APPENDIX D

TERRAPROBE INC.

PART 1 GENERAL

1.01 Description

Engineered Fill refers to earth fill (earthworks) designed and constructed with engineering inspection and testing, so as to be capable of supporting structure foundations without excessive settlement. Poured concrete foundation walls must be provided with nominal reinforcing steel to provide stiffening of the foundation walls and to protect against excessive crack formation within the foundation walls.

Preparation for Engineered Fill and Engineered Fill operations must only be conducted under full time inspection and testing by the Geotechnical Engineer, in order to ensure adequate compaction and fill quality.

The work for the construction of Engineered Fill, is shown on the Design Drawings prepared by the Design Civil Engineer and as described by these specifications. The work included in this section includes the following:

a) Stripping of the topsoil layer from the ground surface below all areas to be covered with Engineered Fill,

b) Excavation of Test Holes into the subgrade to investigate the suitability of subsurface conditions for support of the Engineered Fill and determine if any prior existing fill materials are present,

c) Proof-rolling of the subgrade below areas to be covered with Engineered Fill, to detect the presence and extent of unstable ground conditions,

d) Excavation and removal of unstable subgrade materials or other approved stabilization measures, if required prior to the placement of Engineered Fill,

e) Surveying of ground elevations prior to placing Engineered Fill,

f) Supply, placement, and compaction of approved clean earth as specified herein, with full time inspection and testing,

g) Surveying of ground elevations on completion of Engineered Fill placement,

h) Providing and maintaining survey lay out of areas to receive Engineered Fill, and monitoring of ground elevations throughout the construction of Engineered Fill.

1.02 The Project Parties

A) The term Contractor shall refer to the individual or firm who will be carrying out the earthworks related to preparation and construction of Engineered Fill.

B) The term Geotechnical Engineer shall refer to the individual or firm who will be carrying out the full time inspection and testing of the earthworks related to preparation and construction of Engineered Fill.

C) The term Design Civil Engineer shall refer to the individual or firm who will be carrying out the Site Grading Design (pre-grading), the determination of Design Foundation Grades for the structures on the site, and the choice of lots and site areas to receive Engineered Fill.

PART 2 MATERIALS

2.01 Definitions

A) Topsoil Layer is the surface layer of naturally organic soil typically found at the ground surface and commonly with thickness on the order of 100 to 300 mm thick.

B) Earth fill is soil material which has been placed by man-made effort and has not been deposited by nature over a long period of time.

C) Subgrade soil is the "in situ" (in place) natural or native soil beneath any earth fill and/or topsoil layer(s).

D) Engineered Fill soils must consist of clean earth materials (not excessively wet), free of organics and topsoil, free of deleterious materials such as building rubble, wood, plant materials, placed in thin lifts not exceeding 150 mm in thickness. Cohesionless soils such as sand or gravel, are the easiest to handle and compact.

E) All values stated in metric units shall be considered as accurate.

PART 3 ENGINEERED FILL DESIGN

3.01 Design Foundation Pressure

A) Engineered Fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the Engineered Fill. The time period over which this settlement typically occurs, depends on the composition of the Engineered Fill as follows (after initial placement);

a) sand or gravel soil;	several days
b) silt soil;	several weeks
c) clay or clayey soil;	several months.

The placement of Engineered Fill might also result in post-construction settlement of the underlying natural soil.

The timing of foundation construction must take into account the post-construction settlement of the Engineered Fill and the foundation soil.

B) Unless otherwise stated, the Engineered Fill is to be placed over the entire lot area or site area.

C) The Engineered Fill is to extend up to at least 1 m above the highest level of required foundation support. Typically this can be within 1 m of the design final grades. Additional common fill can be placed over the Engineered Fill to provide protection against environmental factors such as wind, frost, precipitation, and the like.

D) An allowable design foundation pressure of 150 kPa is typically recommended for the Engineered Fill, unless it consists of glaciolacustrine silt and clay in which case a lower design foundation pressure will need to be determined on a site specific basis. Foundations shall have minimum widths of 0.6 m for continuous strip footings, and minimum dimensions of 1 m for column footings.

E) At the foundation level, sufficient Engineered Fill shall be constructed to ensure that it extends at least 1.0 m laterally beyond the edge of any foundations, and that it extends outward within an area defined by a 1 to 1 line downward from the edge of any Engineered Fill.

F) Foundations placed on the Engineered Fill must be provided with nominal reinforcing steel for stiffening of basement foundation walls and for protection against excessive minor cracking. The reinforcing steel must consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls.

G) At the time of foundation construction, foundation excavations must be reviewed by the Geotechnical Engineer to confirm suitable bearing capacity of the Engineered Fill. The Geotechnical Engineer must inspect the foundation subgrade immediately after excavation, and must inspect the foundation subgrade immediately prior to placement of concrete for footings. The Geotechnical Engineer must also inspect the placement of reinforcing steel in the foundation walls. Written approval must be obtained from the Geotechnical Engineer prior to,

a) placement of footing concrete, and
b) placement of foundation wall concrete.

PART 4 CONSTRUCTION

4.01 Survey Layout

A) The survey layout shall be carried out and maintained throughout the construction of Engineered Fill activities. A suitable layout stake shall be placed at the corners of the start and finish of every block or work area to receive Engineered Fill.

B) At least two temporary survey elevation benchmarks shall be provided for every work area to receive Engineered Fill, to assist in monitoring the level of the Engineered Fill as it is constructed.

C) The ground elevations of the subgrade approved for receiving Engineered Fill shall be surveyed and recorded on a regular grid pattern. Engineered Fill shall not be placed on any work area without the written approval of the Geotechnical Engineer.

D) The ground elevations of the Engineered Fill on each work area shall be surveyed and recorded on a regular grid pattern at the end of each day during the placement of Engineered Fill.

E) On completion of Engineered Fill construction, the boundaries of the engineered fill shall be **determined and in addition**, the final ground elevations shall be surveyed and recorded on a regular grid pattern.

F) If Engineered Fill placement is to be stopped for any reason, the final ground elevations shall be **immediately surveyed. Should the Engineered Fill placement resume in the future, the ground elevations shall be surveyed again to determine whether there has been any unsupervised placement of fill.**

4.02 Topsoil Stripping

A) The Geotechnical Engineer must observe the stripping of topsoil from the areas proposed for Engineered Fill, from start to finish.

B) Topsoil must be stripped from the entire building site area. The Geotechnical Engineer must photograph the work areas which have been suitably stripped.

4.03 Test Holes Into Subgrade

A) After topsoil has been stripped, the exposed subgrade must be investigated for the presence of old buried fill or deleterious material, which may be unsuitable for the support of Engineered Fill.

B) Exploratory test holes must be dug using a small backhoe, on a suitable pattern to obtain a representative indication of the entire site area.

C) The Geotechnical Engineer must observe the digging and backfilling of the test holes; must log the test hole stratigraphy; must obtain soil samples at maximum depth intervals of 0.3m; and must photograph each dug test hole.

D) If the test holes discover any old buried fill or deleterious materials, it must be excavated and removed from the lot area down to undisturbed, stable native soil.

E) All test holes must be properly backfilled and compacted in thin lifts (max. 150mm thickness) to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent. The Geotechnical Engineer must observe the backfilling and compaction of the test holes.

4.04 Subgrade Proof-rolling

A) Prior to placing any Engineered Fill, the exposed subgrade must be proof-rolled and the Geotechnical Engineer must observe the proof-rolling.

B) If unstable subgrade conditions are encountered, the unstable subgrade must be sub-excavated. If wet site conditions exist during filling, stabilization with granular materials may be required.

4.05 Engineered Fill Placement

A) Engineered fill must not be placed without the approval of the Geotechnical Engineer. Prior to placing any Engineered Fill, the topsoil must be stripped, the subgrade must be investigated for old buried fill or deleterious material, the subgrade must be proof-rolled, and the subgrade elevations must be surveyed.

B) Prior to the placement of Engineered Fill, the source or borrow area for the Engineered Fill must be evaluated for its suitability. Samples of the proposed fill material must be obtained by the Geotechnical Engineer and tested in the geotechnical laboratory for Standard Proctor Maximum Dry Density, prior to approval of the material for use as Engineered Fill. The Engineered Fill must consist of clean earth, free of organics and other deleterious material (wood, building debris, rubble, cobbles, boulders, and the like). The hauler of all imported Engineered Fill must provide documentation to **certify that the material is free of hazardous contaminants.**

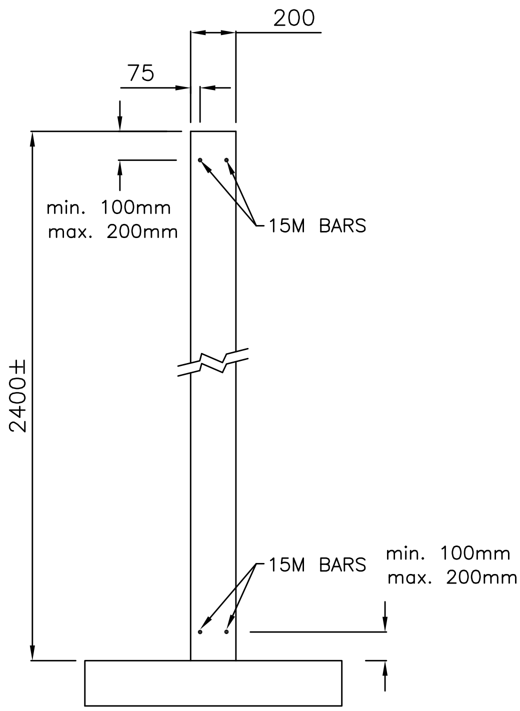
C) The Engineered Fill must be placed in maximum loose lift thicknesses of 150 mm. Each lift of Engineered Fill must be compacted with a heavy roller, to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent.

D) Field density tests must be taken by the Geotechnical Engineer, on each lift of Engineered Fill, on each lot area. Any Engineered Fill which is tested and found to not meet the specifications, shall be either removed or, reworked and retested.

E) Engineered fill must not be placed during the period of the year when cold weather occurs, i.e, when **there are freezing ambient temperatures during the daytime and overnight.**

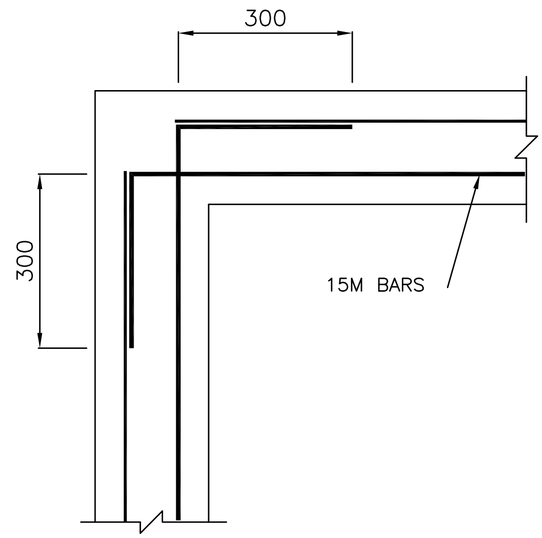
APPENDIX E

TERRAPROBE INC.



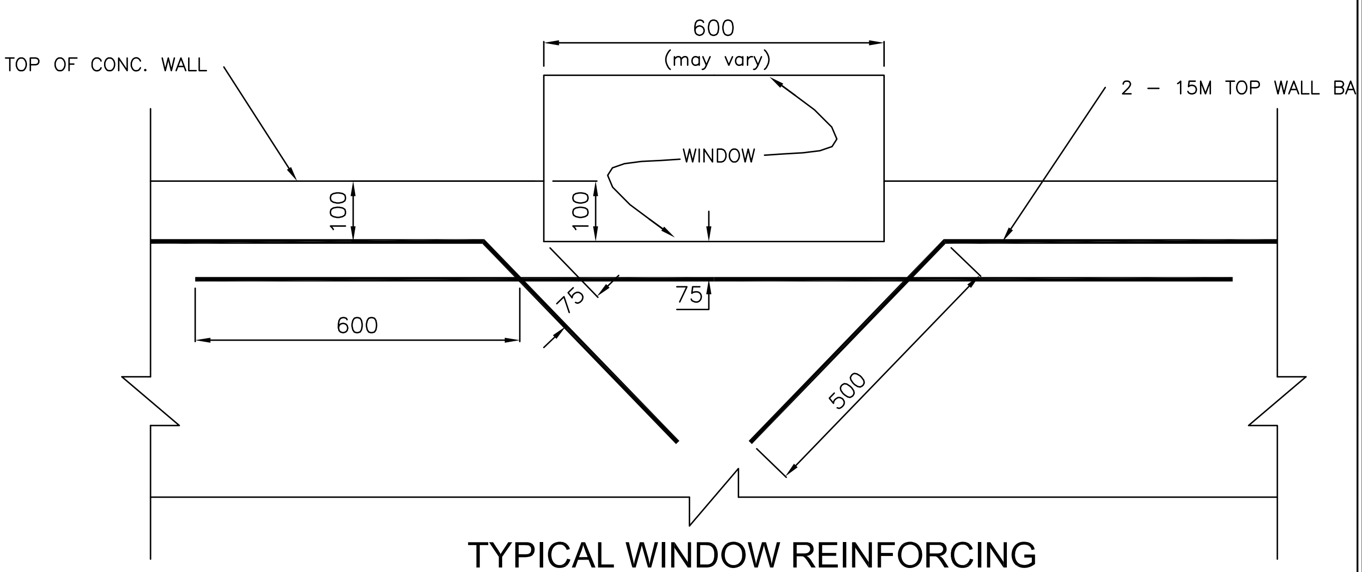
TYPICAL REINFORCED WALL

NOT TO SCALE



TYPICAL SPLICING AT CORNERS

NOT TO SCALE



TYPICAL WINDOW REINFORCING

NOT TO SCALE

NOTES:

1. Reinforcing steel C.S.A. G30.18–09 Grade 400
2. Concrete min. 28 day strength 20MPa (3000psi)
3. Base of all footing excavations to be inspected and approved prior to placing formwork.
4. All dimensions are in mm.

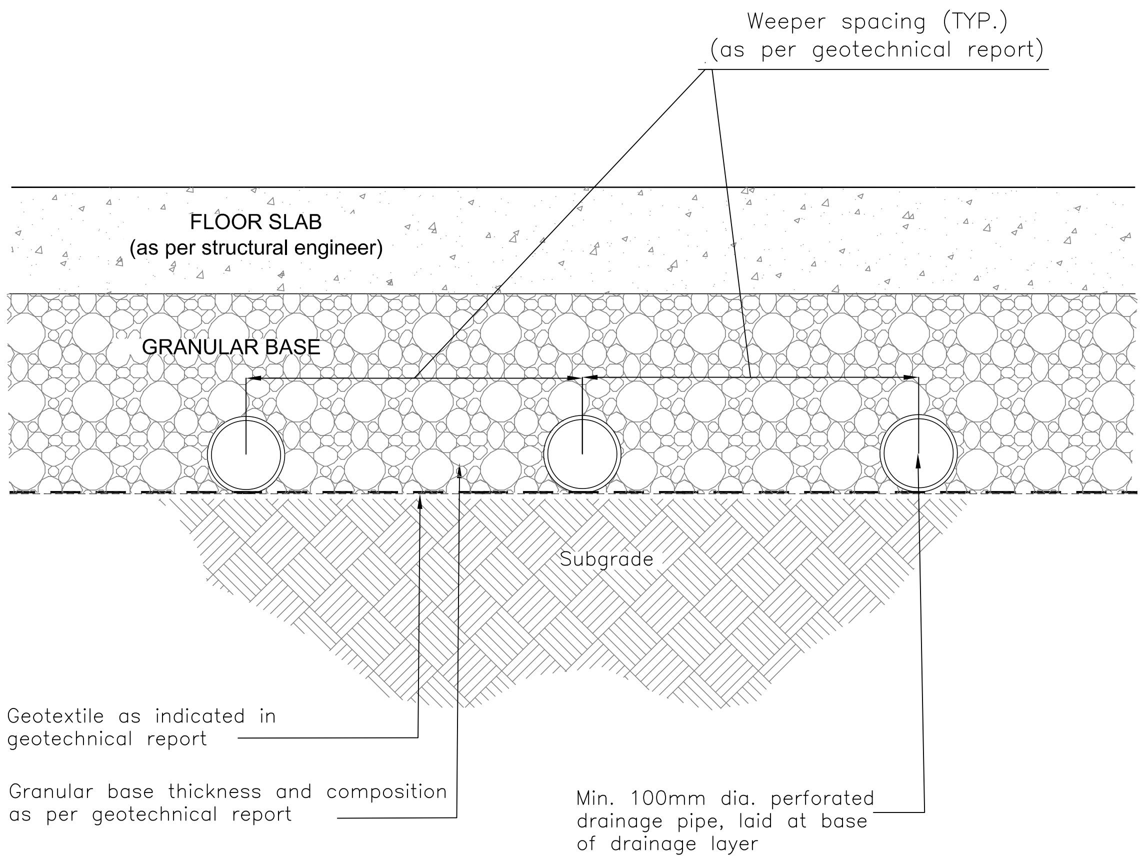
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

TYPICAL REINFORCED WALL DETAILS FOR STRUCTURES ON ENGINEERED FILL

APPENDIX F

TERRAPROBE INC.



NOTE:
If top of footing conflicts with drainage layer, lower footings as necessary

Schematic Only
Not to Scale

Terraprobe
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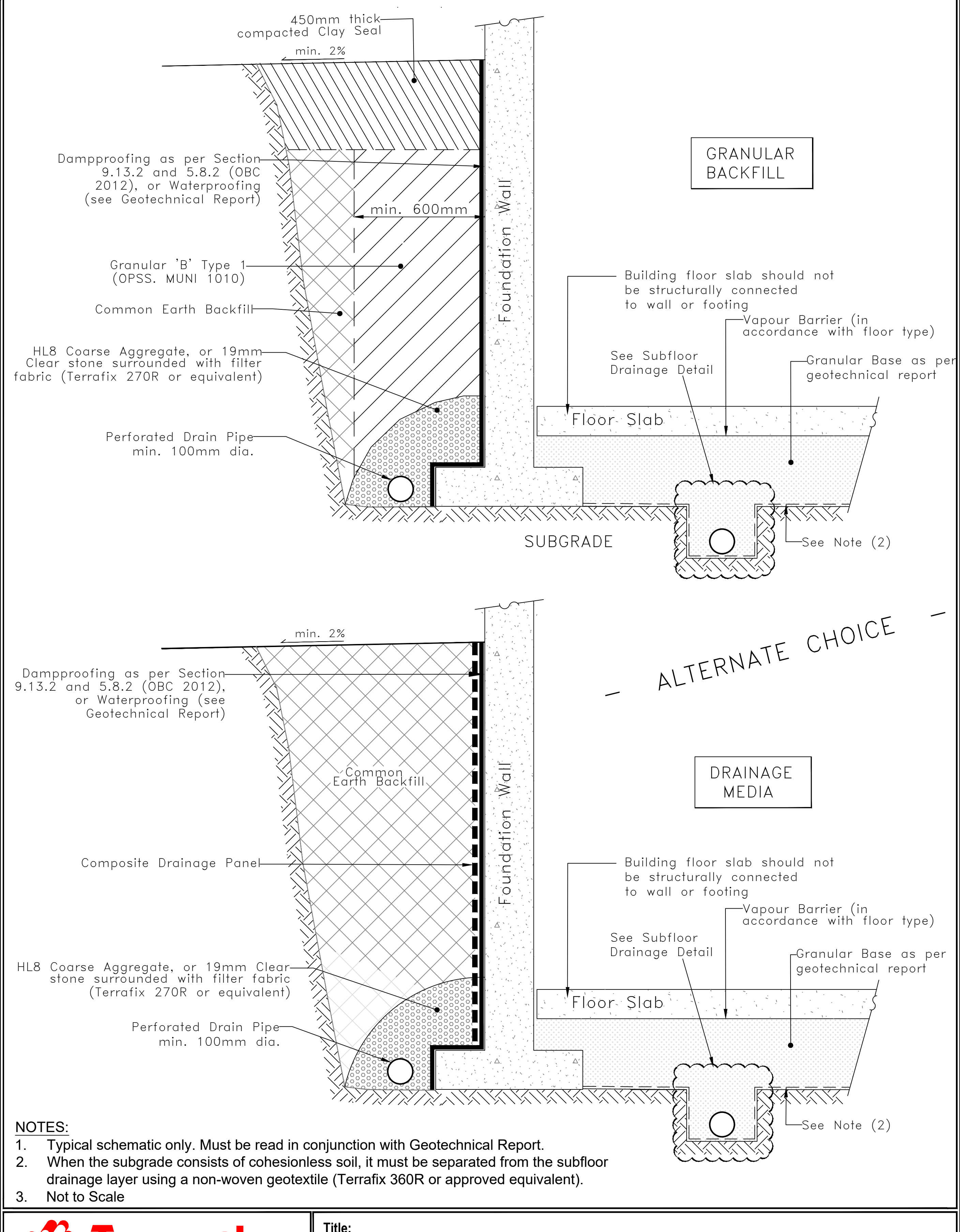
Title:

SUBFLOOR DRAINAGE DETAIL



NOTES:
1. Typical schematic only. Must be read in conjunction with Geotechnical Report.
2. When the subgrade consists of cohesionless soil, it must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).
3. Not to Scale

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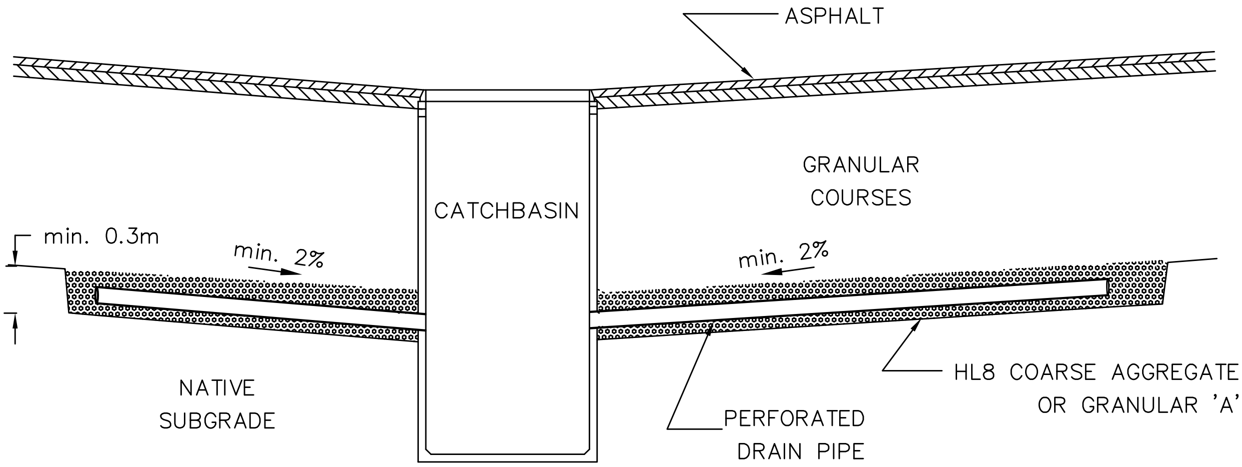
Title:

TYPICAL BASEMENT DRAINAGE SCHEMATIC
(OPEN EXCAVATION)

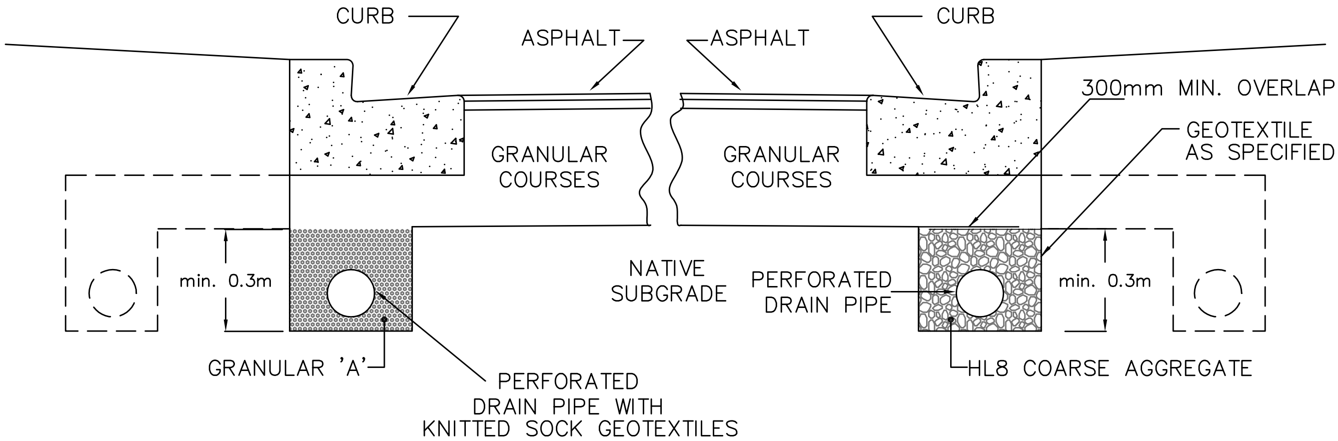
APPENDIX G

TERRAPROBE INC.

Longitudinal Subdrain Connection to Catchbasin



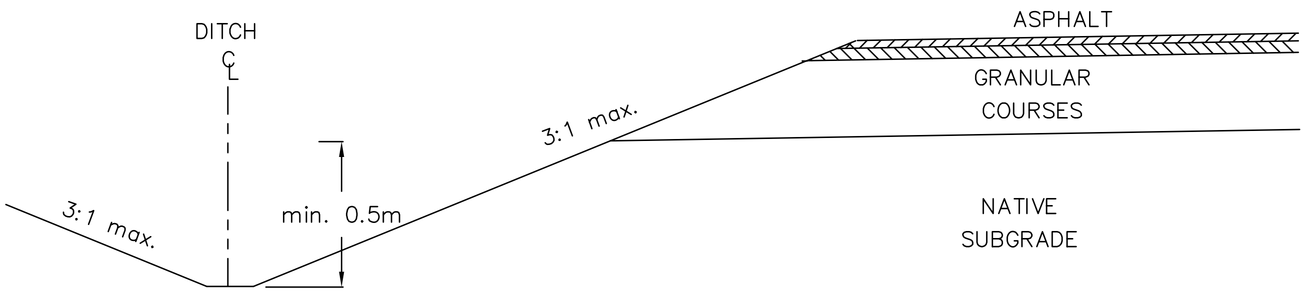
Urban Cross Sections



Unwrapped Trench

Wrapped Trench

Rural Cross Section



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Title:

PAVEMENT DRAINAGE ALTERNATIVES