Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

PRELIMINARY GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT
PROPOSED MIXED-USE DEVELOPMENT
901 ESSA ROAD AND BROWN BEAR STREET
BARRIE, ONTARIO

Prepared For: **Brown Bear Dev Ltd**
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Attention: Mr. Mohammed Raja

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1.0 THE PROJECT

Terraprobe Inc. (Terraprobe) was retained by Brown Bear Dev Ltd to conduct a preliminary subsurface investigation and prepare a geotechnical design report for the re-development of a parcel of land located on the north side of Salem Road, between Essa Road and Brown Bear Street, in the City of Barrie, Ontario. A site location plan is provided as Figure 1.

This report encompasses the geotechnical investigation conducted for the property to assess its geotechnical suitability for the intended re-development. The field investigation consisted of advancing a total of five (5) exploratory boreholes (Boreholes 1 to 5) across the site. The objective of the geotechnical investigation was to determine the prevailing subsurface soil and groundwater conditions, in order to provide geotechnical engineering recommendations for the design of proposed building foundations, basement floor-slab, earthquake and earth pressure design parameters, basement drainage, shoring design parameters, pipe bedding and installation of underground utilities. In addition, comments are also included on the pertinent project construction aspects including excavation, backfill and groundwater control.

Terraprobe was also retained to conduct a Phase One Environmental Site Assessment (ESA) and hydrogeological study for the property. The findings of the phase one ESA and hydrogeological study are reported under separate covers.

2.0 SITE AND PROJECT DESCRIPTION

The property is located on the north side of Salem Road, between Essa Road and Brown Bear Street, in the City of Barrie, Ontario. Moreover, the western portion of the site is known as 'Block 281,' and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario.

The western portion of the Property, ('Block 281'), is located at the northeast corner of the intersection of Salem Road and Brown Bear Street; Block 281 is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres). The eastern portion of the Property, 901 Essa Road, is located at the northwest corner of the intersection of Essa Road and Salem Road; this portion is irregular in shape with an area of approximately 0.79 hectares (1.96 acres) . Block 281 is currently used as a construction staging area for the neighbouring subdivision. The 901 Essa Road Property is occupied by a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. The surrounding properties are a mix of residential, commercial, and institutional land use.

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. The underground parking finished floor elevations (FFE) were not provided at the time of this report, however, it is understood that the lowest (P3) FFE it is expected to be set at a depth of about 9.95 m ± below existing grade, i.e., at about Elev. 302.3 m±, based on an average ground surface elev. of 312.2 m±. The geotechnical investigation was therefore conducted to assess the geotechnical suitability of the property for the intended development. The geotechnical investigation consisted of advancing a total of five (5) boreholes across the site to obtain subsurface soil and groundwater information.

3.0 INVESTRIGATION PROCEDURE

The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (Boreholes 1 to 5) extending to the depths ranging from about 15.4 to 15.5 m below existing ground surface.

The boreholes were staked out by Terraprobe based on the existing site features. The approximate borehole locations are shown on enclosed Borehole Location Plans (Figure 2A – Existing Condition and Figure 2B – Proposed Condition).

Various utility locate agencies (including a private locate company) were contacted by Terraprobe to clear the borehole locations prior to the commencement of the field investigation.

The ground surface elevations at the borehole locations were surveyed by Terraprobe. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T). It should be noted that the elevations provided on the Borehole Logs are approximate and provided only for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The borings were drilled by a specialist drilling contractor using a track mounted drill rig power auger and sampled at regular intervals with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe filed staff, who logged the boring and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into plastic jars and transported to our geotechnical laboratory for detailed inspection and testing. The borehole samples were examined (tactile) in detail by a geotechnical engineer and classified according to visual and index properties. Geotechnical laboratory testing consisted of water content determination on all samples, while a Sieve and Hydrometer analysis was conducted on four (4) selected soil samples (Borehole 1, Sample 6; Borehole 2, Sample 10; Borehole 4, Sample 12 and Borehole 5, Sample 9). The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analyses tests are plotted on the enclosed borehole logs at respective sampling depths. The results of the Sieve and Hydrometer analyses tests are also summarized in Section 4.5 of this report and appended.

Groundwater levels were observed in the open boreholes upon completion of drilling. Monitoring wells were installed in Boreholes 1 to 4 to facilitate groundwater monitoring and for hydrogeological purposes. The results of the groundwater monitoring are summarized in Section 4.6 of this report.

4.0 SUBSURFACE CONDITIONS

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

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

4.1 Topsoil

Surficial topsoil with thickness of about 600 mm was encountered at the ground surface in Boreholes 3, 4 and 5. The topsoil was dark brown to black in colour and had a silt matrix.

The above noted topsoil thicknesses was measured through the collar of the boreholes and are approximate. The topsoil is expected to vary between and beyond the boreholes. We recommend that a shallow test pit investigation be carried out to determine precise topsoil thickness present at the site for quantity estimation and costing purposes (if required).

4.2 Earth Fill

A layer of earth fill was encountered from the ground surface in Boreholes 1 and 2 and extended to a depth of about 1.1 and 1.5 m below grade, respectively. The earth fill material consisted of sand with trace to some gravel, trace silt, occasional rock fragments and some organics and brick fragments in the upper levels in Borehole 1.

Standard Penetration Test results (N-values) obtained from the sand earth fill zone ranged from 38 to greater than 50 blows per 300 mm of penetration or less, indicating a dense to very dense relative density. However, the elevated 'N' values may be due to the presence of rock fragments in the fill.

The in-situ moisture contents of the earth fill samples ranged from 9 to 13 percent by weight, indicating a generally moist condition. Elevated moisture contents may be attributable to possible the presence of organic matter in the fill.

4.3 Gravelly Sand to Sand

A cohesionless deposit of gravelly sand to sand was encountered below the fill in Boreholes 1 and 2 and below the surficial topsoil layer in Boreholes 3 to 5 and extended to a depth ranging from 7.6 to 10.9 m below grade. Sand and gravel zone was noted between 4.6 and 6.6 m depth in Borehole 1 and stone fragments were present in the deposit. The deposit generally became water bearing below about 6.1 to 7.6 m depth.

The Standard Penetration Test results (N-Value) obtained from gravelly sand to sand deposit ranged from 9 to greater than 50 blows per 300 mm of penetration, indicating a loose to very dense relative density (generally dense to very dense). The low 'N' of 9 blows per 300 mm of penetration recorded at 7.6 m depth in Borehole 1 is likely due to disturbance of the soil from augers.

The in-situ moisture contents of the gravelly sand to sand samples ranged from 2 to 26 percent by weight, indicating a moist to wet condition, i.e., generally moist and becoming wet below 6.1 to 7.6 m depth below grade.

4.4 Silty Sand Glacial Till

Silty sand glacial till was encountered below the gravelly sand to sand deposit and extended to the depth of investigation in all boreholes, i.e., depth ranging from 15.4 to 15.5 m below grade.

The till contained clayey silt zone at 11 m depth in Borehole 1 and occasional embedded permeable sand zones, and occasional rock fragments (cobbles) were noted in the deposit.

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

The Standard Penetration Test result (N-Value) obtained from silty sand till deposit ranged from 11 to over 50 blows per 300 mm of penetration, indicating a compact to very dense (typically very dense) relative density.

Measured moisture contents of silty sand till soil samples varied from 5 to 17 percent by weight, indicating a generally moist to locally wet condition.

4.5 Geotechnical Laboratory Test Results

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

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

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1, Sample 6	4.8	38	59	3	0	SAND AND GRAVEL, trace silt
Borehole 2, Sample 10	10.8	8	76	11	5	SAND, some silt, trace gravel, trace clay
Borehole 4, Sample 12	13.8	2	59	31	8	SILTY SAND, trace clay, trace gravel
Borehole 5, Sample 9	9.3	16	53	22	9	SILTY SAND, some gravel, trace clay

4.6 Groundwater

Observations pertaining to the depth of groundwater level and caving were made in the open boreholes immediately after completion of drilling in all boreholes and are noted on the enclosed Borehole Logs. Monitoring wells were installed in Boreholes 1 to 4 to facilitate groundwater level monitoring and for the purpose of Terraprobe's geotechnical and hydrogeological studies. The groundwater readings taken on February 17, 2022, are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Borehole No.	Ground Surface Elevation (m)	Depth of Boring below Grade (m)	Depth to Cave below Grade (m)	Groundwater Level Depth/Elevation (m)	
				At the Time of Drilling	Monitoring Well Feb. 17, 2022
1	312.1	15.4	Not measured	7.6/304.5	7.8/304.3
2	312.6	15.5	Not measured	8.0/304.6	8.0/304.6
3	312.1	15.4	Not measured	8.3/303.8	8.3/303.8

Borehole No.	Ground Surface Elevation (m)	Depth of Boring below Grade (m)	Depth to Cave below Grade (m)	Groundwater Level Depth/Elevation (m)	
				At the Time of Drilling	Monitoring Well Feb. 17, 2022
4	311.8	15.5	Not measured	7.6/304.2	8.3/303.5
5	312.4	15.5	Not measured	Not measured	Monitoring well not installed

The site is underlain by cohesionless gravelly sand to sand followed by glacial till deposit of relatively low to moderate permeability. The till contains occasional embedded permeable sand/silt zones. The till matrix is expected to yield only low amounts of free-flowing water in the short-term, however the relatively permeable silt/sand zone(s) in the till and the cohesionless gravelly sand to sand when wet, will result in considerable groundwater seepage. The prevailing stabilized groundwater table at the site is inferred to be Elev. 304.6 metres ± in the gravelly sand to sand deposit.

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

5.0 PRELIMINARY 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.

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. The underground parking finished floor elevations (FFE) were not provided at the time of this report, however, it is understood that the lowest (P3) FFE it is expected to be set at a depth of about 9.95 m ± below existing grade, i.e., at about Elev. 302.3 m±, based on an average ground surface elev. of 312.2 m±.

5.1 Foundation Design Parameters

5.1.1 Spread Footings

The lowest basement level P3 is expected to have a finished floor elevation set at a depth of about 9.95 m± (Elev. 302.3 ±m) below existing grade, and rest below the prevailing groundwater table. Spread footing foundations for the lowest level (P3) will likely be set at about 1.0 m below lowest FFE, i.e., Elev. 301.2 m± and below the prevailing groundwater table. The soils below elevation of 302.3 m± generally consists of very dense sands underlain by very dense glacial till.

Conventional spread footings made to bear on the dense to very dense sands or glacial till below Elev. 302.3 metres± may be designed using a maximum factored geotechnical resistance at ULS of 750 kPa. The maximum net geotechnical reaction at SLS is 500 kPa, for an estimated total settlement of 25 mm. For the bearing pressures given above, the minimum width of continuous strip footings supported must be 0.5 m, and the minimum size of isolated footings must be 1.0 m x 1.0 m. These 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.

All of the foundation excavations will extend below the prevailing groundwater table for P3 basement level as the excavation will penetrate through upper cohesionless water bearing gravelly sand to sand. The gravelly sand to sand deposit will yield free-flowing water when penetrated.

The groundwater table must be dewatered to a minimum 1.2 m below the deepest excavation prior to excavation, to preserve the in-situ integrity of the native soils. If the subsurface is not dewatered prior to excavation, the native soils will become disturbed by the ingress of groundwater and the above recommendations for bearing capacity will not be valid.

A dewatering contractor must be retained to review the site dewatering requirements and provide a dewatering plan for the site.

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

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 1.5 metres in the Barrie area.

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.

5.2 Earthquake Design Parameters

The Ontario Building Code stipulates the methodology for earthquake design analysis. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration, and the site classification.

Under Ontario Regulation 88/19, the ministry amended Ontario's Building Code (O. Reg 332/12) to further harmonize Ontario's Building Code with the 2015 National Codes. These changes will help reduce red tape for businesses and remove barriers to interprovincial trade throughout the country. The amendments are based on code change proposals the ministry consulted in 2016 and 2017. The majority of the amendments came into effect on January 1, 2020, which includes structural sufficiency of buildings to withstand external forces and improve resilience.

Seismic hazard is defined in the Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2s, 0.5s, 1.0s and 2.0s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g., shear wave velocity (vs), Standard Penetration Test (SPT) resistance, and undrained shear strength (s_u) in the top 30 meters of the site stratigraphy below the foundation level, as set out in the Ontario Building Code. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients Fa and Fv, respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above noted information, it is recommended that the site designation for seismic analysis be 'Site Class C', as per the Ontario Building Code. Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to confirm the average shear wave velocity in the top 30 metres of the site stratigraphy.

The values of the site coefficient for design spectral acceleration at period T, F(T), and of similar coefficients F(PGA) and F(PGV) shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I. using linear interpolation for intermediate values of PGA.

5.3 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
Compact Granular Fill Granular 'B' (OPSS 1010)	32	21.0	0.31	0.47	3.25
Existing Earth Fill	29	19.0	0.35	0.52	2.88
Dense to Very Dense Gravelly Sand to Sand	36	21.0	0.26	0.41	3.85
Cohesionless Glacial Till	34	21.0	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,
P = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient
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)
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:

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

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 $\boldsymbol{R_f = 0.8\ N\ tan\varphi}$.

5.4 Slab-on-Grade Design Parameters

The P3 slab is to be set at Elev. 302.3 m± and will be made on the dense to very dense native gravelly sand to sand or glacial till. The native soil constitutes an adequate subgrade for the support of a slab-on-grade provided adequate dewatering is in place. The modulus of subgrade reaction appropriate for the design of a fully drained slab-on-grade resting on the granular drainage layer resting on the dense to very dense native soils is 40,000 kPa/m.

Prior to the construction of the slab, it is recommended that the subgrade be proof-rolled and inspected under the supervision of Terraprobe for obvious loose or disturbed areas as exposed, or for areas containing excessively deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 % SPMDD).

It is necessary that building floor slabs be provided with a capillary moisture barrier and drainage layer. The drainage layer, which should comprise a minimum of 200 mm of HL8 coarse aggregate or 19 mm clear stone (OPSS.MUNI 1004), vibrated to a dense state. The new slab will be made on cohesionless soil below the groundwater table and therefore, the subgrade must be separated from the drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent) 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 bedding. This loss of ground could result in a loss of support of the slab and clogging of the subfloor drainage system.

The water level in the subgrade must be lowered from inside the excavation at least 1.2 m below the lowest excavation elevation prior to excavation for the duration of below-grade construction. To preserve the integrity of the subgrade once the subgrade elevation is reached, a skim coat of lean concrete could be applied to create a trafficable surface.

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 and vapour barrier. The floor manufacturers have specific requirements for moisture and vapour barrier, therefore, the floor designer/architect must ensure that a provision of appropriate moisture and vapour barrier conforming to specific floor finish product requirements is incorporated in the project specifications. Adequate testing must be carried out to ensure acceptable levels of moisture and relative humidity in the concrete slab prior to the installation of floor finish(es). Studies indicate that a provision of 200 mm thick 19 mm clear stone base (OPSS.MUNI 1004) under the slab helps provide a good capillary moisture break provided the granular base is positively drained. However, this provision does not replace the floor manufacturers' specific requirement(s) for a moisture and vapour barrier.

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

5.5 Basement Drainage

A separate Hydrogeological Study has been prepared by Terraprobe for this site (File. No. 3-22-0008-46), which provides the approximate amount of daily temporary (construction) and permanent groundwater collection and discharge.

To assist in maintaining dry basements and preventing seepage, it is recommended that exterior grades around the building be sloped away at a 2 % gradient or more, for a distance of at least 1.2 metres. Provision of subfloor drainage is required in conjunction with the perimeter drainage of the structure, to collect and remove the water that infiltrates at the building perimeter and under the floor. Perimeter and subfloor drainage are required throughout below grade areas.

It is recommended that the subfloor drainage system consists of minimum 100 mm diameter perforated pipes wrapped in filter fabric spaced at a maximum spacing of 5 metres on centre. The pipes must be surrounded by a minimum of 100 mm of 19 mm clear stone/HL-8 Coarse Aggregate, and the pipe inverts should be a minimum 300 mm below the base of the slab. The elevator pits/sumps can be drained separately with an independent lower pumping sump or can be designed as waterproof structures which are below the drainage level. A typical basement subdrain detail is provided in Appendix C. The subfloor drains can be constructed in trenches as shown in the typical detail, or alternatively they can be constructed on a flat subgrade subexcavated at least 300 mm below the base of the slab. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

Prefabricated drainage composites, such as CCW MiraDRAIN 6000 series® (or Terrafix Terradrain 200®, or approved equivalent) should be incorporated between the shoring and the cast-in-place concrete foundation wall to make a drained cavity. Drainage from the cavity must be collected at the base of the wall in non-perforated pipes and conveyed directly to the sumps using a solid pipe (separate from the subfloor drainage system) to remove collected water at the building sumps. The flow to the building sump from the subsurface drainage will be governed largely by the building perimeter drainage collection during rainfall and runoff events. Typical shored excavation drainage details are provided in Appendix C.

The drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation walls. As such, the sump that ensures the performance of this system must have a duplexed pump arrangement for 100% pumping redundancy and these pumps must be on emergency power. The size of the pump should be adequate to accommodate the anticipated groundwater and storm event flows. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

It must be noted that basement drainage provisions will need to be designed in conjunction with the findings of the hydrogeological report. The water volumes to be discharged in both short-term and long-term as well as City sewer capacity to allow groundwater discharge into the City sewers are critical factors to decide on basement drainage approach. Depending upon the groundwater volume to be discharged in the long-term, its chemical quality as well as sewer capacity a fully waterproofed (“Bath-tub”) option may have to be adopted particularly for 3 or more levels of basement/underground parking structure. These recommendations must be reviewed and revised based on the findings of the additional building location specific boreholes during detailed design stage, if required.

5.6 Site Servicing

5.6.1 Bedding

In general, the existing native gravelly sand to sand soils and earth fill compacted to a minimum of 98% SPMDD, or neatly cut glacial till, will provide adequate support for buried services on a conventional well graded granular base material. 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.

Granular bedding material should consist of a conventional Class ‘B’ bedding, such as Granular ‘A’, conforming to OPSS.MUNI 1010 specification. The use of HL 8 coarse aggregate or 19 mm clear stone (OPSS.MUNI 1004) bedding is also acceptable, however only in conjunction with a suitable geotextile filter (Terrafix 360R or equivalent); otherwise without proper filtering, there may be entry of fines from the surrounding soils into the subfloor drainage layer. This loss of ground could result in a loss of support to the pipes and possible future settlements. The bedding material should be compacted to a minimum of 98%

SPMDD. Clear stone type bedding material should be vibrated to a dense state. The bedding material should conform to the pertinent City and Region Specifications.

5.6.2 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.

The site soils may 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. The site soils have a low to moderate susceptibility to frost effects. If the building has flush entrances, care must be taken in detailing the exterior slabs/sidewalks, providing insulation and/or drainage and/or non-frost susceptible backfill/frost slab to maintain the flush threshold during freezing weather conditions.

5.7 Pavement Above Underground Parking Structure

It is understood that the project would also include new pavements/driveways constructed at grade over the underground parking concrete deck. The following design is provided for the pavement above parking structure.

5.7.1 Typical Pavement Above Parking Garage

A typical Pavement Components make-up above a concrete deck slab are as follows:

-Reinforced Concrete Slab Substrate

-Waterproofing with Protection Board (to be specified by Architect)

-Drainage Board (to be specified by Architect)

-Filter Fabric (to be specified by Architect)

-Min 300 mm Base Granular 'A' or 19 mm Crusher run limestone

-70 mm HL8

-40 mm HL3

The parking garage concrete structure must be designed to support the applicable loads of vehicles, i.e., fire trucks, delivery trucks, etc. which will likely access the driveways.

The 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 standards.

The Granular 'A' or 19 mm Crusher Run Limestone should meet City'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.

5.7.2 Drainage

Drainage measures shall be provided for the pavement above the garage deck. This is typically provided by provision of 2 to 3 % grade on the garage deck and installing a subdrain system. A perimeter drain at the edge(s) of the garage deck should be considered in addition to above noted subdrain system.

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, the earth fill and native gravelly sand to sand are considered Type 3 soils (Type 4 when wet) and native glacial till is considered Type 2 soil.

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.

The subsurface soils can be removed by conventional excavation equipment. Excavations at this site may encounter construction debris, deleterious materials and other obstructions in the earth fill and native cobble/boulder obstructions in the glacial till. Larger size particles (cobbles and boulders) that are not specifically identified in the boreholes may be present in the native soils. The size and distribution of cobbles/boulders/obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. The risk and responsibility for the removal and disposal of cobbles/boulders/obstructions must be addressed in the contract documents for foundations, excavations, and shoring contractors.

6.2 Groundwater Control

Groundwater control and considerations pertaining to groundwater and drainage are discussed in Terraprobe's Hydrogeological Study for the site under a separate cover (File No. 3-22-0008-46).

For design purposes, the stabilized groundwater table at the site is Elev. 304.6 m ±. In general, the bulk excavation to the P3 level (assumed FFE of Elev. 302.3 m±) will extend approximately 2.0 to 3.0 m below the stabilized groundwater table (Elev. 304.6 m±) at this site and excavations for foundations, elevator pits and sumps will extend even deeper below the stabilized groundwater table.

Within the zone of excavation, the glacial till is considered a low to moderate permeability material, which will typically preclude significant free-flow of water. However, the earth fill and native cohesionless gravelly sand to sand are considered high permeability materials, which will permit the free-flow of water when wet. In addition, the glacial till deposit is expected to include relatively permeable silt/sand zones which may yield free-flowing water when penetrated.

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, and the understood preliminary building design concept, it is expected that the foundations will be made below the stabilized groundwater table at this site at about Elev. 301.2 m±. The groundwater table must be lowered by positive dewatering to a minimum of

1.2 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 in Section 5.1 for bearing capacity will not be valid.

It must be noted that seasonal fluctuations in the groundwater table may result in higher groundwater levels than observed and reported.

The subsurface information must be provided to a professional dewatering contractor who will be responsible for the design and installation of the dewatering systems. The dewatering system must be properly installed and screened to ensure that sediment and fine soils are not removed, which could result in settlement of the ground or structures near the site. Once the dewatering method and shoring system are designed, Terraprobe should be retained to evaluate the potential impacts (i.e., settlement) to nearby structures and land caused by lowering the water table.

The dewatering system must remain on until such time as the subfloor drainage system and sumps are fully operational.

6.3 Shoring Design

The site is bounded by existing municipal roadway Essa Road to the east, Salem Road to the south, Brown Bear Street to the west and a few sparse building structures to the north. No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. Underpinning guidelines are provided as Appendix D.

Where excavations cannot be sloped, they can be supported using a shoring system such as soldier piles and lagging shoring or a continuous interlocking caisson wall shoring. Continuous interlocking caisson wall shoring is to be used where the excavation must be constructed as a rigid shoring system, to preserve the integrity and support of the soil beneath existing foundations of the adjacent buildings in a state approximating the at-rest condition or for groundwater cut-off, for the bulk excavation.

The shoring system would best be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. The use of anchors on adjacent properties requires the consent of the adjacent landowners, expressed in encroachment agreements. The City Transportation and Works Department negotiates “permits” for encroachment in City lands, which are generally allowed.

Decisions regarding shoring methods and sequencing are the responsibility of the Contractor. Temporary shoring should be carried out by a licensed Professional Engineer experienced in shoring design.

The detailed design of the proposed building was not available at the time of preparation of this report. The sections along the perimeter of the site will likely have to be shored to preserve the integrity of the boundary conditions (adjacent structures and roads). No excavation shall extend below a line cast as one vertical to one horizontal (1V:1H) from foundations of the existing structures without adequate alternate support being provided. Where the adjacent building foundations are removed from the excavation, a foundation which lies above a line drawn upward at 7 vertical to 10 horizontal (7V:10H) from the closest excavation edge is within the zone of potential influence of the excavation, and support for the existing foundations must be carefully assessed and possibly augmented.

The groundwater levels measured on February 17, 2022, in the monitoring wells installed in Boreholes 1 to 4 indicated that the groundwater levels ranged from about 7.8 to 8.3 m below existing grade (about Elev. 303.5 m to Elev. 304.6 m) in the boreholes. For design purposes, the stabilized groundwater table is at about Elev. 304.6 m±).

Consideration should be given to an impermeable shoring system (i.e., interlocking caisson wall) to support the excavation and around the entire perimeter for groundwater control purposes due to the presence of wet cohesionless gravelly sand/sand materials encountered within the excavation depth (P3). Convectional soldier piles and lagging shoring may be used provided adequate positive dewatering is carried out to lower the groundwater table to 1.2 m below the lowest excavation level as determined by the shoring designer.

6.3.1 Lateral Earth Pressure Distribution

If the shoring is supported with a single level of earth anchor or bracing, a triangular earth pressure distribution similar to that used for the basement wall design is appropriate. Where multiple supports are used to support the excavation, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors. For the cohesionless soils along the extent of the excavation, the multi-level supported shoring can be designed based on a rectangular earth pressure distribution with a maximum pressure defined by:

$$\mathbf{P = 0.65\ K\ (\gamma H+q)}$$

where,

P	=	the horizontal pressure at depth, **H** (kPa)
K	=	the earth pressure coefficient (see Section 5.3)
H	=	the total depth of the excavation (m)
γ	=	the bulk unit weight of soil, (kN/m3)
q	=	the complete surcharge loading (kPa)

For groundwater pressure distribution along the shoring wall in conjunction with the above soil pressures, the stabilized groundwater table should be taken at Elev. 304.6 ±m. The groundwater pressure distribution is only applicable where an impermeable boundary condition (a continuous interlocking caisson wall) is created along the perimeter of the excavation. Conventional soldier pile and lagging system does not experience the water pressures, as water is allowed to drain freely through the wall/lagging.

6.3.2 Caisson and Soldier Pile Toe Embedment

Caisson and soldier pile toes should be made in the very dense glacial till or sands and silts below Elev. 303.2 metres ±. The horizontal resistance of the soldier pile toes will be developed by embedment below the base of excavation, where resistance is developed from passive earth pressure. It is noted that the resistance from these soils will be different depending on whether the soils are dewatered or remain below the groundwater level. Where soils exist beneath the groundwater level, the unit weight of the soil is diminished by buoyancy. The design of the shoring will therefore have to consider the construction plan and sequence with respect to depth of groundwater control.

The soils at this site are cohesionless, permeable and sufficiently wet such that augered borings made into these soils will be unstable. It is necessary to advance temporarily cased holes to prevent excess caving during the soldier pile and all augered hole installations. Drill holes for piles, caissons, and/or fillers, utilizing temporary liners, mud drilling techniques, and/or other methods as deemed necessary by the contractor may be required to prevent issues such as: groundwater inflow or loss of soil into the drill holes, and disturbance to placed concrete, basal instability, and loss of bearing.

The groundwater table must be lowered a minimum of 1.2 m below the lowest excavation elevation prior to any excavation and maintained at that level during construction.

6.3.3 Lateral Bracing Elements

If anchor support is necessary and determined to be feasible, the shoring system should be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. It will be necessary to secure encroachment agreements from the Region/City and the adjacent landowners, in order to use soil anchors on the adjoining properties. Pre-construction condition surveys should be carried out for the adjacent structures to establish existing conditions prior to excavation and mitigate the possibility of spurious claims for excavation induced damages. Access to the properties for such surveys must be part of any encroachment agreements. A careful evaluation of the subsurface soil conditions is required by the shoring designer to establish appropriate levels/elevations and design the soil anchors. The anchor design will be governed by the weakest material in the profile. It is imperative that a detailed design is carried out at different anchor levels/locations, and anchors must be tested at each level.

Conventional earth anchors could be made with continuous hollow stem augers or alternatively post grouted anchors can be made. The design adhesion for earth anchors is controlled as much by the installation technique as the soil and therefore a proto-type anchor must be made in each anchor level executed to demonstrate the anchor capacity and validate the design assumptions. A prototype anchor must be made to demonstrate the anchor capacity (performance tested to 200% of the design load). All production anchors must be proof-tested to 133% of the design load, to validate the design assumptions.

The subsurface soils are sufficiently cohesionless, permeable and/or wet that augered holes could experience caving. It will be necessary to advance temporarily cased holes to maintain sidewall support and to prevent the ingress of water during installation, use slurry, etc. or other means or methods deemed necessary by the contractor.

Conventional earth anchors made in the generally dense gravelly sand to sand or glacial till may be designed using a working adhesion of 50 to 60 kPa. It is expected that post-grouted anchors can be made such that an anchor will likely carry about 60 to 80 kN/m of adhered anchor length (at a nominal diameter of 150 mm) in the dense tills and sands depending upon the material type as confirmed by a performance/load test. It should be noted that these values are provided as preliminary guidance only and the actual anchor performance must be verified by a performance/load test. Regardless, the subsurface soil information should be reviewed by the shoring designer to decide on the suitable type of earth anchors and anchor capacity to be employed at this site.

If adjacent landowners are not agreeable to anchored support, then internal bracing or rakers would be necessary. The compact to very sands are suitable for the placement of raker foundations. Raker footings established on the undisturbed (dewatered) compact to dense native soils at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 350 kPa.

6.4 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.

6.5 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 Brown Bear Dev Ltd 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, Brown Bear Dev Ltd 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.

Sincerely,

Terraprobe Inc.

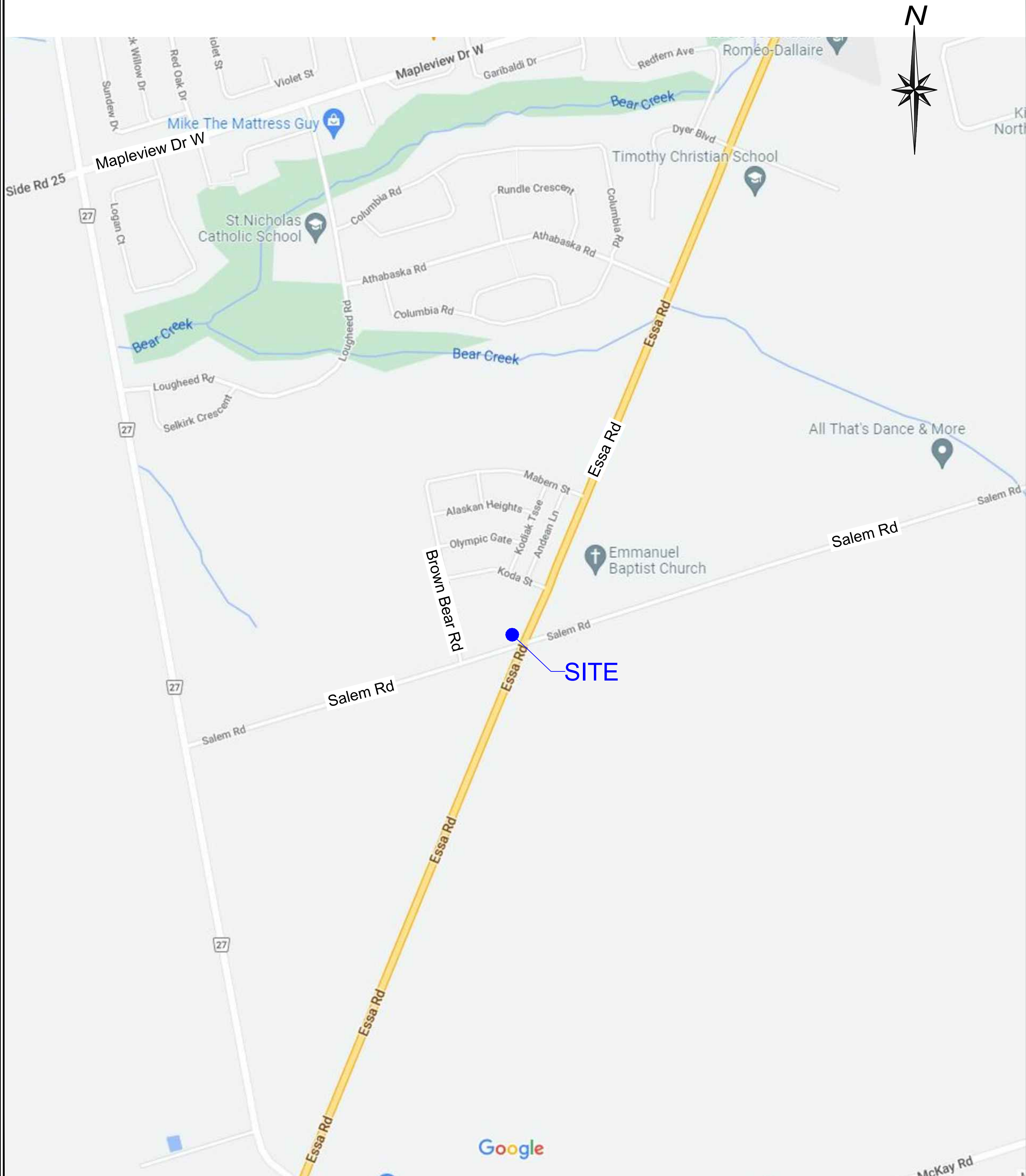
LICENSED PROFESSIONAL ENGINEER
O.B.
O. D. BENJAMIN
90337072
2022-03-21
PROVINCE OF ONTARIO

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

Mike Tanos, P.Eng.
Review Principal

FIGURES

TERRAPROBE INC.



REFERENCE
Map data © 2022 Google

SCALE 80 0 200m

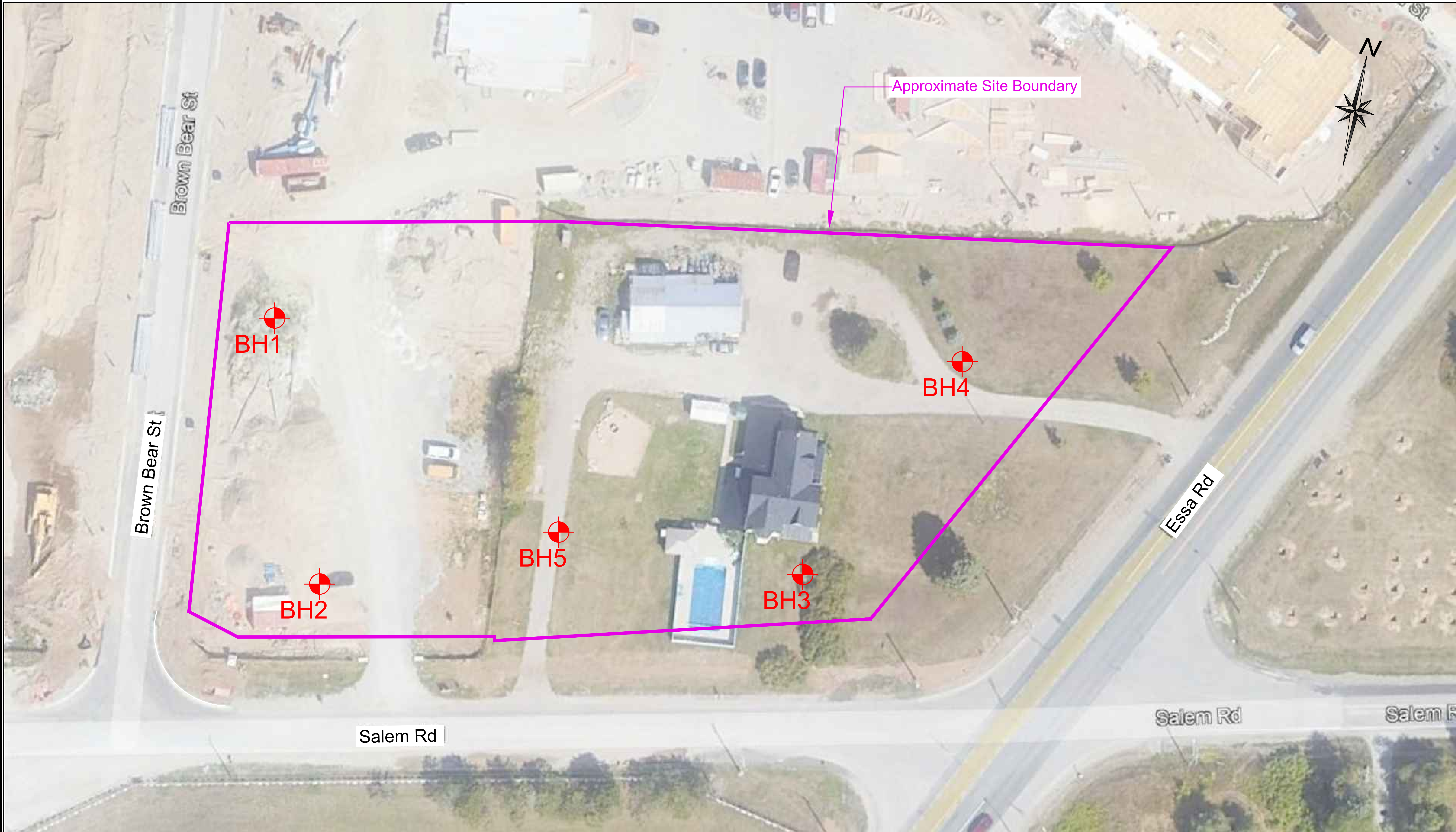
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: SITE LOCATION PLAN

File. No.: 3-22-0008-01

FIGURE : 1

Y:\Shared\CA\Terraprobe\Brampton\1-Project Files\2022\2022_Branch Folders\3-22-0008 - 901 Essa Road and Brown Bear Street, Barrie\01- Geotechnical Investigation\A. Dwgs, Logs\AutoCAD\3-22-0008-01 Figures.dwg,
DWG To PDF.pc3, Kamal, Kamal



REFERENCE
Image © 2022 Google Earth

LEGEND
Approximate Borehole Location

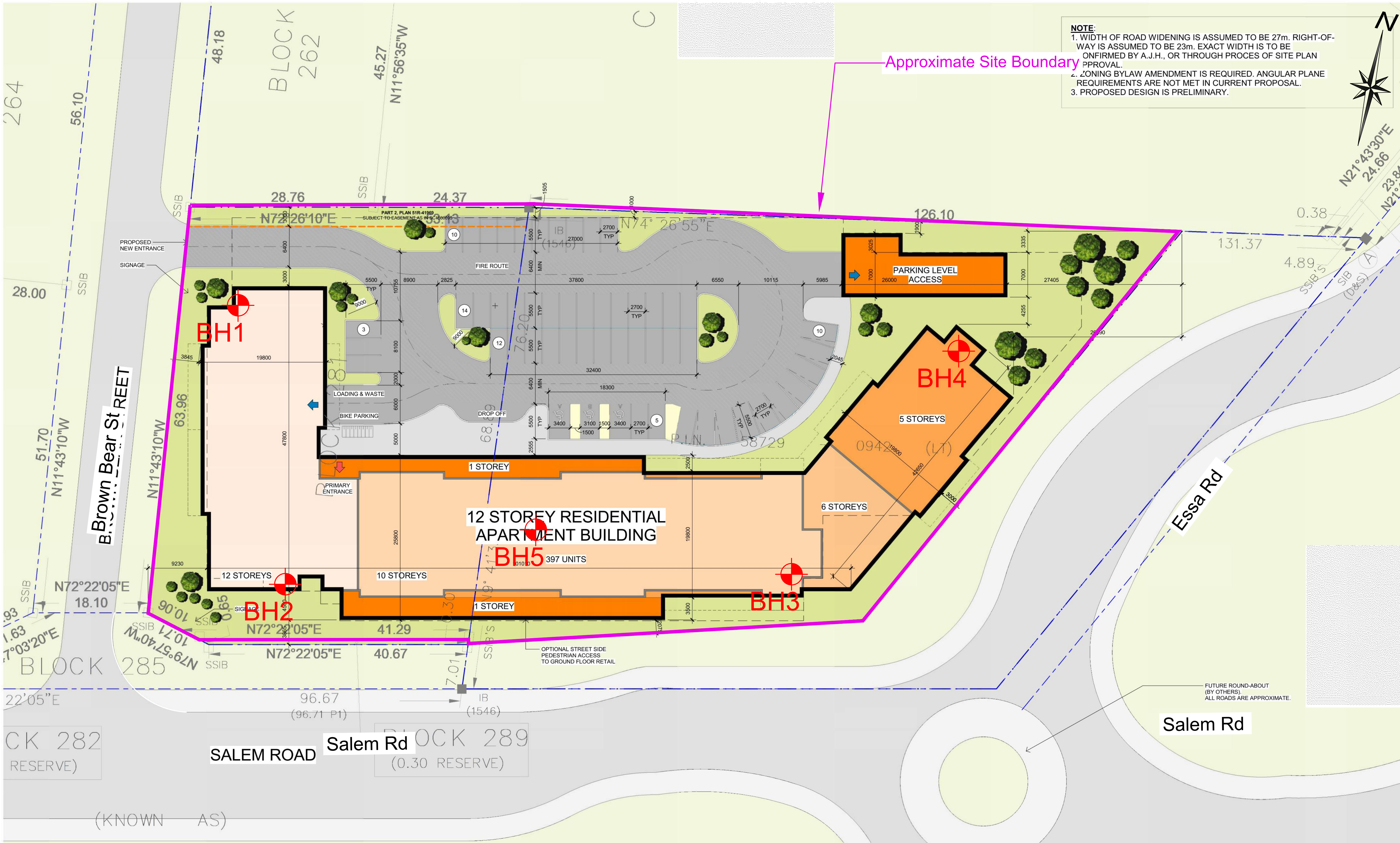
4 2 0 10m
SCALE 1:600

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

Title: BOREHOLE LOCATION PLAN EXISTING CONDITION

File No. 3-22-0008-01

FIGURE : 2A



REFERENCE
Project: Brown Bear Apartments
Sheet Name: Site Plan, Project No.: 122001
Drawing: A001, Date: Jan. 2022
By: Chamberlain Architect Services Ltd.

LEGEND
Approximate Borehole Location

4 2 0 10m
SCALE 1:600

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

Title: BOREHOLE LOCATION PLAN
PROPOSED CONDITION

File No. 3-22-0008-01

FIGURE : 2B

APPENDIX A

TERRAPROBE INC.

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ABBREVIATIONS AND TERMINOLOGY

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
G_s	specific gravity
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
PID	photoionization detector
FID	flame ionization detector

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

Terraprobe

LOG OF BOREHOLE 1

Project No. : 3-22-0008-01 | Client : Brown Bear Dev. Ltd. | Originated by : CB

Date started : February 8, 2022 | Project : 901 Essa Road and Brown Bear Street | Compiled by : GO

Sheet No. : 1 of 2 | Location : Barrie, Ontario | Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T) | Elevation Datum : Geodetic

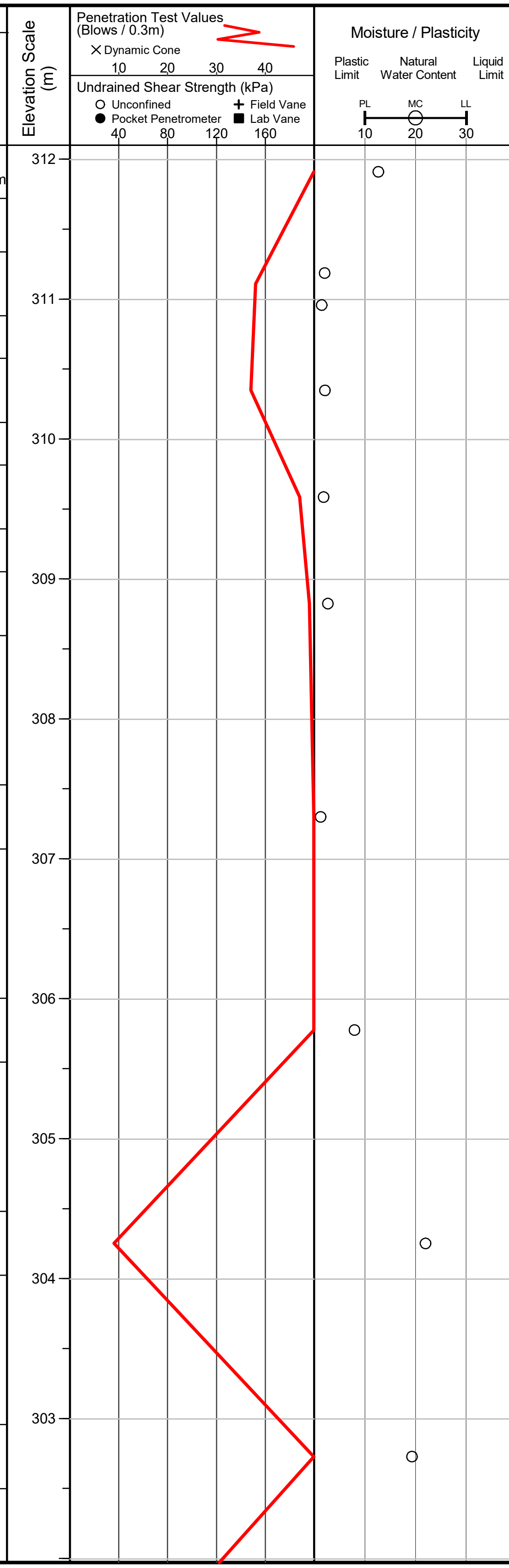
Rig type : Track-mounted | Drilling Method : Hollow stem augers

SOIL PROFILE

Elev / Depth (m)	Description
312.1	GROUND SURFACE
	FILL, sand, some clay, some organics, some brick fragments, trace gravel, trace silt, dense to very dense, brown, moist
	...trace rock fragments
311.0 / 1.1	**GRAVELLY SAND to SAND**, trace silt, dense to very dense, brown, moist
	...stone fragemnts
307.5 / 4.6	**SAND AND GRAVEL**, trace silt, stone fragments, very dense, brown, moist
305.5 / 6.6	.
	...loose, grey, wet
	...wet below

SAMPLES

Number	Type	SPT 'N' Value
1	SS	84 / 225mm
2A	SS	38
2B		
3	SS	37
4	SS	47
5	SS	49
6	SS	56
7	SS	53
8	SS	9
9	SS	61



Depth Scale (m): 0 – 10

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR	SA	SI	CL
38	59	3	0

(Sample 6)

disturbed sample (at water level, approx. 7.7 m)

(continued next page)

Terraprobe

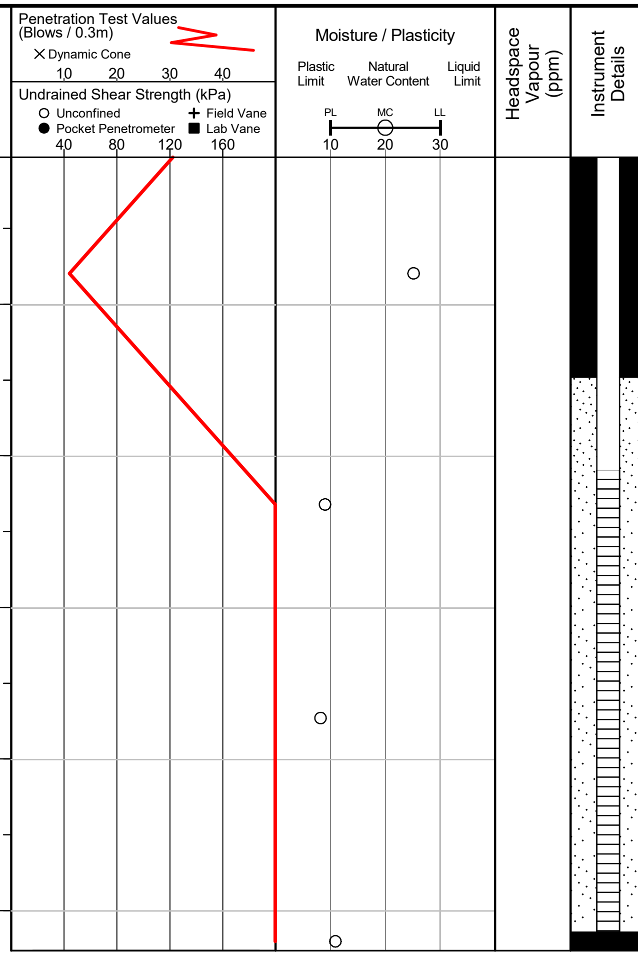
LOG OF BOREHOLE 1

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T) Elevation Datum : Geodetic

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

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments
		(continued)						
		. *(continued)*						
	301.2 10.9			10	SS	11		disturbed sample
11		**SILTY SAND**, trace to some clay, trace silt, trace gravel, compact to very dense, grey, moist (GLACIAL TILL) ...at 11.0 m, clayey silt seams					301	
12							300	
				11	SS	71		
13							299	
				12	SS	50 / 75mm		
14							298	
15							297	
	296.7 15.4	...rock fragments		13	SS	50 / 125mm		



END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	7.8	304.3

file: 3-22-0008-01 bh logs.gpj

LOG OF BOREHOLE 2

Terraprobe

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 7, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T) | Elevation Datum : Geodetic

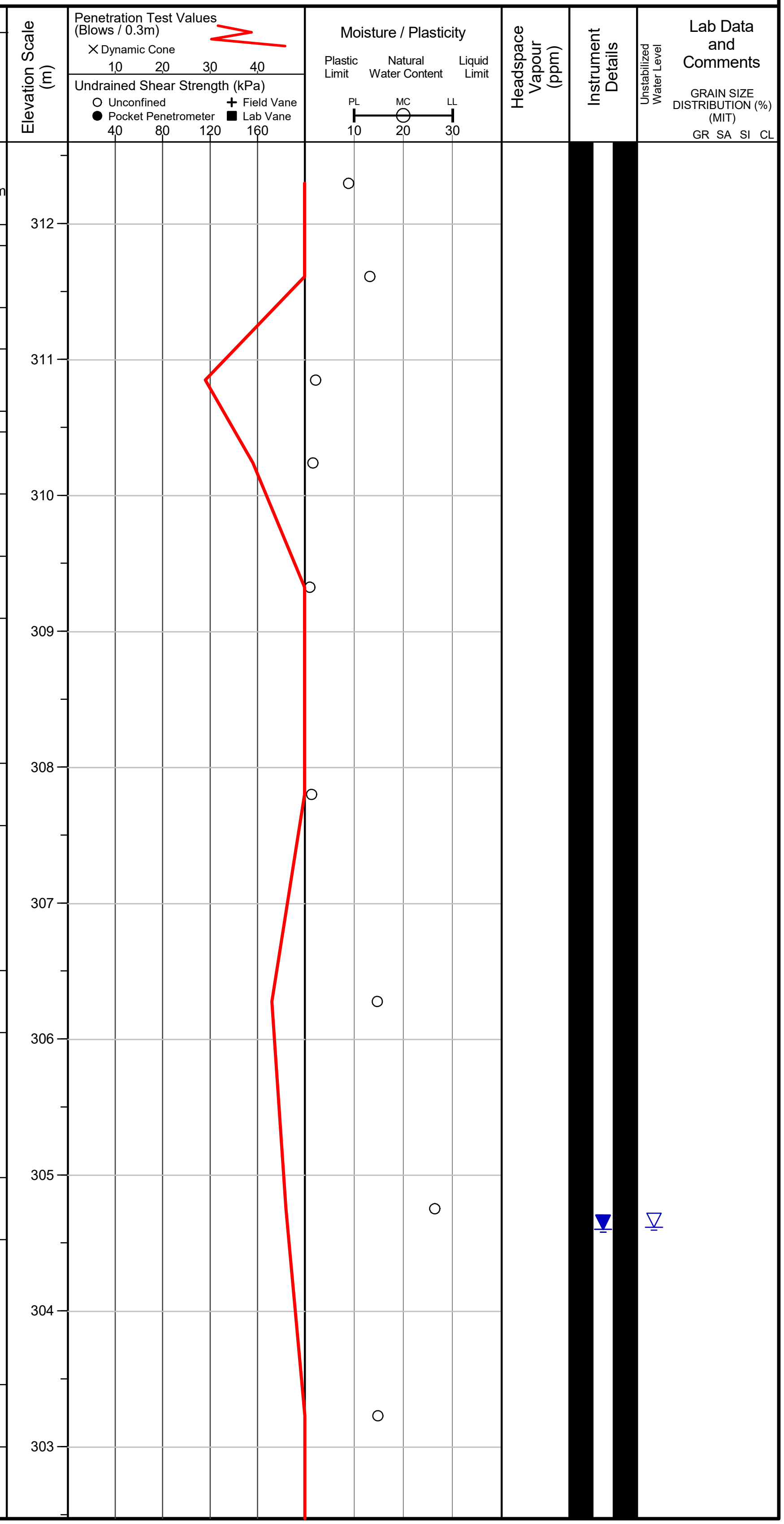
Rig type : Track-mounted | Drilling Method : Hollow stem augers

SOIL PROFILE

Elev Depth (m)	Description
312.6	**GROUND SURFACE**
	FILL, sand, some gravel, some rock fragments, trace silt, very dense, brown, moist
	...rock fragments
311.1 / 1.5	...compact to dense
	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist
	...wet
	...some silt, wet
303.5 / 9.1	**SILTY SAND to SAND**, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value
1	SS	50/ 180mm
2	SS	85
3	SS	29
4	SS	39
5	SS	79
6	SS	80
7	SS	43
8	SS	46
9	SS	50



Depth Scale (m): 0 – 10

(continued next page)

file: 3-22-0008-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 2

Project No. : 3-22-0008-01 | Client : Brown Bear Dev. Ltd. | Originated by : CB

Date started : February 7, 2022 | Project : 901 Essa Road and Brown Bear Street | Compiled by : GO

Sheet No. : 2 of 2 | Location : Barrie, Ontario | Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Track-mounted | Drilling Method : Hollow stem augers

Elev Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Lab Data and Comments (Grain Size Distribution (%) (MIT): GR SA SI CL)
	(continued) **SILTY SAND to SAND**, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL) *(continued)*				
	...wet	10	SS	100 / 200mm	8 76 11 5
	...some clay, some gravel, wet	11	SS	50 / 150mm	
	...rock fragments	12	SS	50 / 125mm	
297.1 15.5		13	SS	50 / 75mm	

Depth Scale (m): 11, 12, 13, 14, 15

Elevation Scale (m): 302, 301, 300, 299, 298

Penetration Test Values (Blows / 0.3m): X Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): O Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level

END OF BOREHOLE

Unstabilized water level measured at 8.0 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.0	304.6

file: 3-22-0008-01 bh logs.gpj

Terraprobe

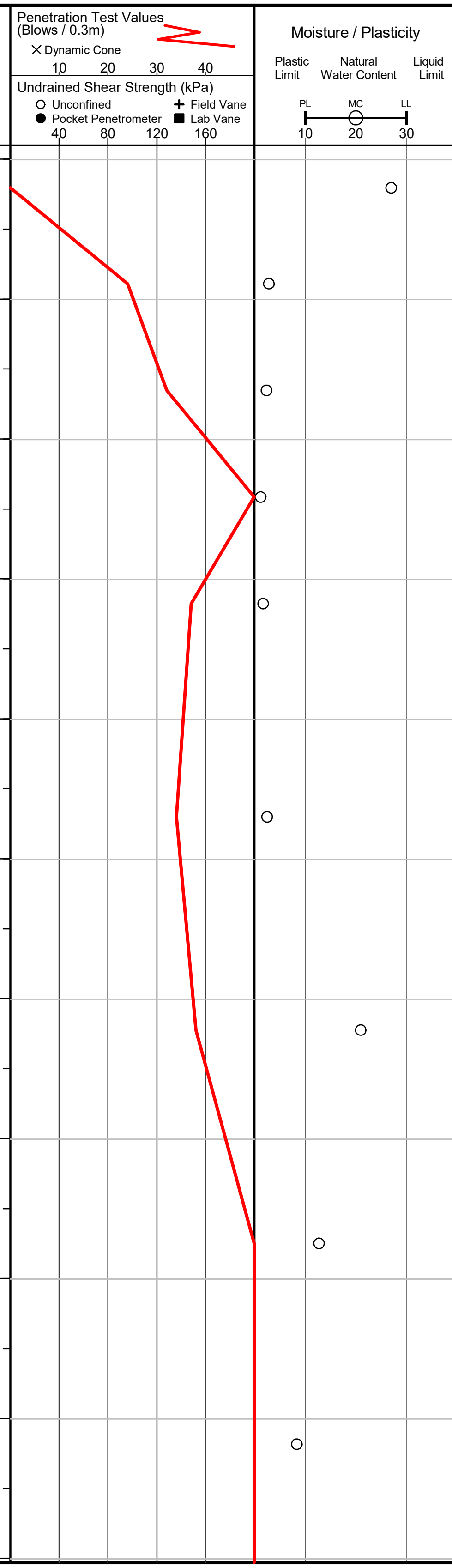
LOG OF BOREHOLE 3

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Track-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
0	312.1	GROUND SURFACE				312
		600mm **TOPSOIL**	1	SS	0	
	311.5 / 0.6	**GRAVELLY SAND to SAND**, trace silt, compact to very dense, brown, moist				
1			2	SS	24	311
			3	SS	32	
2						310
			4	SS	60	
3			5	SS	37	309
4						308
			6	SS	34	
5						307
6		...wet	7	SS	38	306
7						305
	304.5 / 7.6	**SILTY SAND**, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL)	8	SS	61	
8						304
9						303
			9	SS	50 / 125mm	
10						



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

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file: 3-22-0008-01 bh logs.gpj

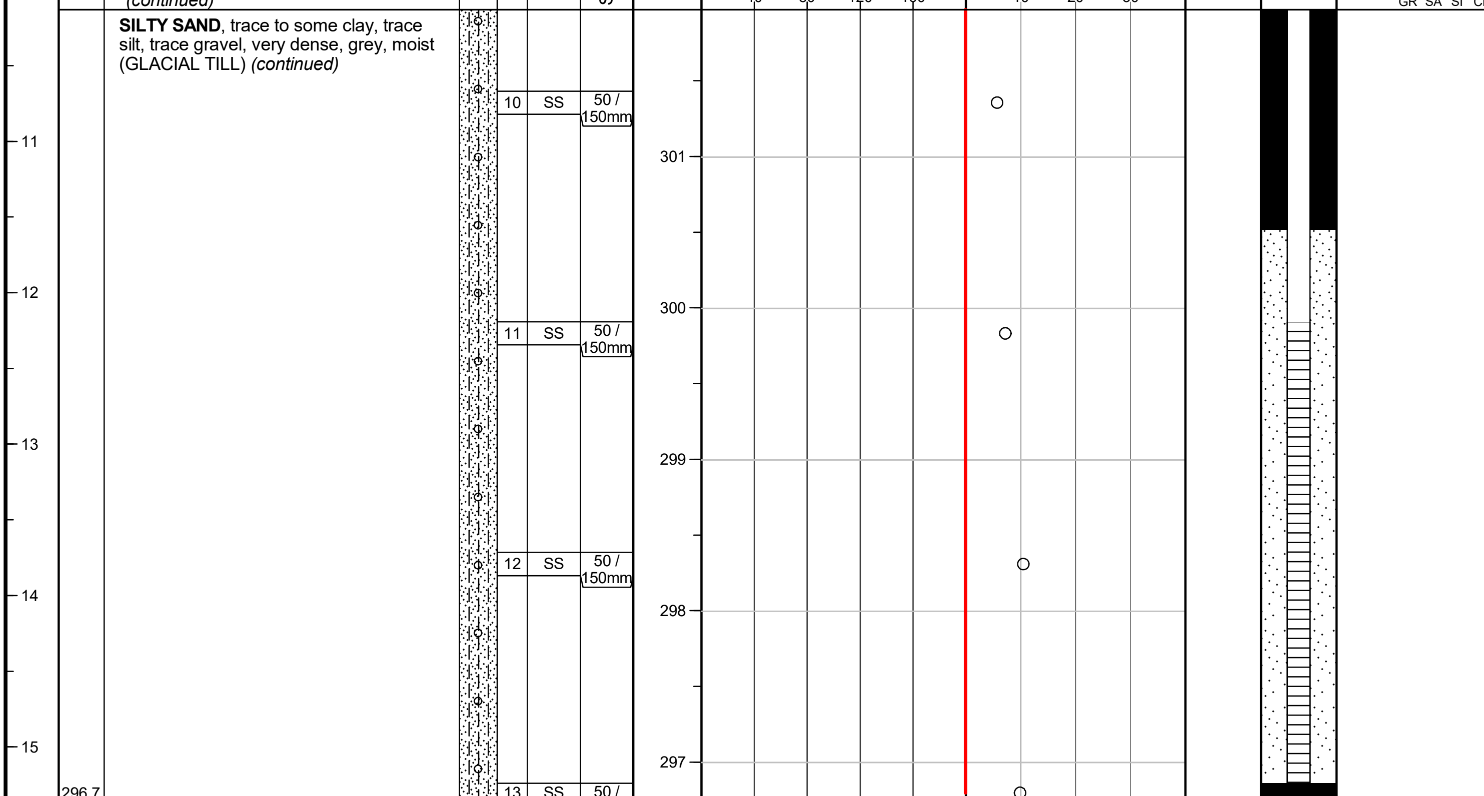
Terraprobe

LOG OF BOREHOLE 3

Project No. : 3-22-0008-01
Client : Brown Bear Dev. Ltd.
Originated by : CB
Date started : February 8, 2022
Project : 901 Essa Road and Brown Bear Street
Compiled by : GO
Sheet No. : 2 of 2
Location : Barrie, Ontario
Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Hollow stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
	(continued)			
	SILTY SAND, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) *(continued)*	10	SS	50 / 150mm
		11	SS	50 / 150mm
		12	SS	50 / 150mm
296.7 15.4		13	SS	50 / 125mm



END OF BOREHOLE

Unstabilized water level measured at 8.3 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.3	303.8

file: 3-22-0008-01 bh logs.gpj

LOG OF BOREHOLE 4

Terraprobe

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 9, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : OB

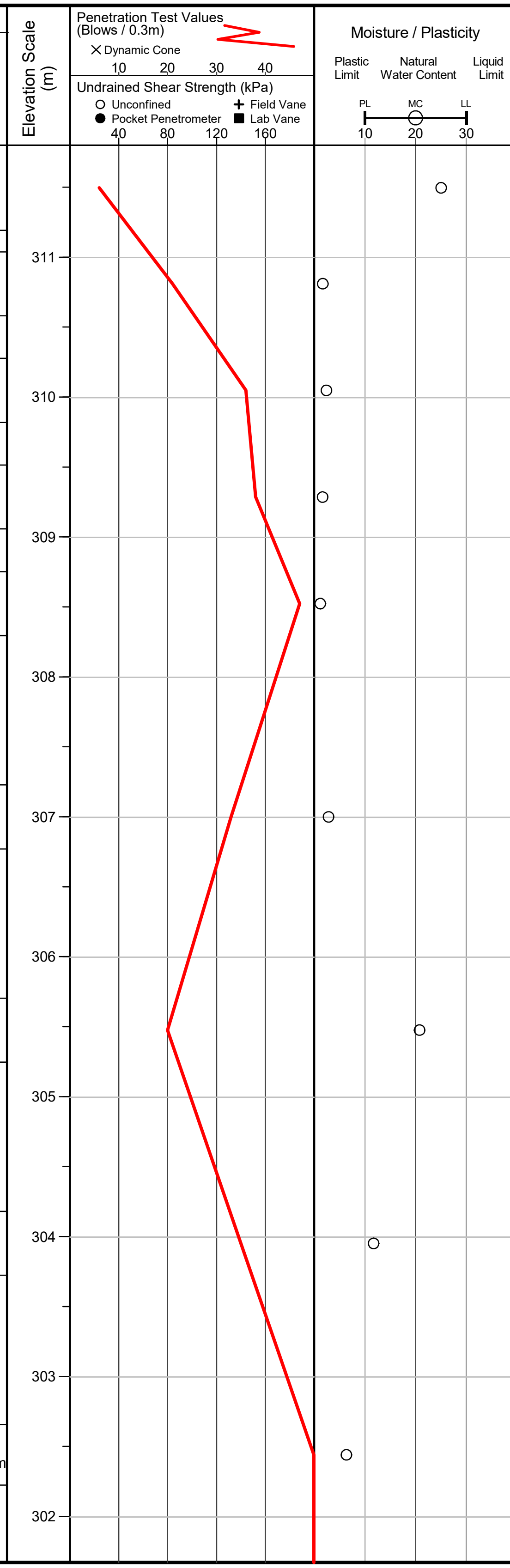
Position : E: 601826, N: 4907647 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers

SOIL PROFILE

Depth Scale (m)	Elev / Depth (m)	Description
0	311.8	**GROUND SURFACE**
0		600mm **TOPSOIL**
0.6	311.2 / 0.6	**GRAVELLY SAND to SAND**, trace silt, compact to dense, brown, moist
6.2		...grey, wet below
7.6	304.2 / 7.6	**SILTY SAND**, trace to some clay, trace silt, trace gravel, dense to very dense, grey, moist (GLACIAL TILL)
9.3		...rock fragments below

SAMPLES

Number	Type	SPT 'N' Value
1	SS	6
2	SS	21
3	SS	36
4	SS	38
5	SS	47
6	SS	33
7	SS	20
8	SS	35
9	SS	92 / 275mm



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

file: 3-22-0008-01 bh logs.gpj

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Terraprobe

LOG OF BOREHOLE 4

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.		Originated by : CB
Date started : February 9, 2022	Project : 901 Essa Road and Brown Bear Street		Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario		Checked by : OB

Position : E: 601826, N: 4907647 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)	Moisture / Plasticity	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
		(continued) **SILTY SAND**, trace to some clay, trace silt, trace gravel, dense to very dense, grey, moist (GLACIAL TILL) *(continued)*						
			10	SS	50 / 75mm	301		
11								
12						300		
			11	SS	50 / 75mm			
13						299		
14			12	SS	50 / 75mm	298		2 59 31 8
15						297		
	296.3 15.5		13	SS	50 / 75mm			

Penetration Test Values (Blows / 0.3m): × Dynamic Cone 10 20 30 40
Undrained Shear Strength (kPa): ○ Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane 40 80 120 160
Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) 10 20 30
Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level

END OF BOREHOLE

Unstabilized water level measured at 7.5 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.3	303.5

LOG OF BOREHOLE 5

Terraprobe

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 14, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T) — Elevation Datum : Geodetic

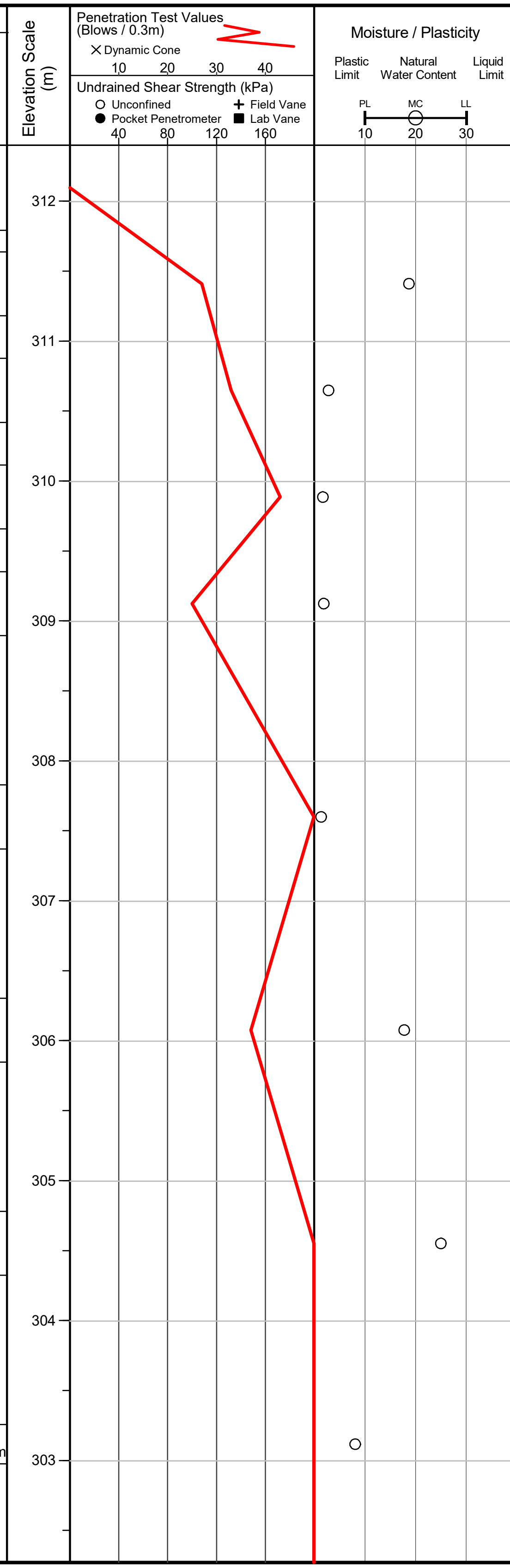
Rig type : Track-mounted — Drilling Method : Hollow stem augers

SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description
0	312.4	GROUND SURFACE
		600mm **TOPSOIL**
	311.8 / 0.6	**GRAVELLY SAND to SAND**, trace silt, compact to very dense, brown, moist to wet
6		...very moist
7.5		...wet
9	303.3 / 9.1	**SILTY SAND**, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments: Grain Size Distribution (%) (MIT) GR SA SI CL
1	SS	0	
2	SS	27	
3	SS	33	
4	SS	43	
5	SS	25	
6	SS	64	
7	SS	37	
8	SS	51	
9	SS	60 / 125mm	16 53 22 9



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file: 3-22-0008-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 5

Project No. : 3-22-0008-01 | Client : Brown Bear Dev. Ltd. | Originated by : CB

Date started : February 14, 2022 | Project : 901 Essa Road and Brown Bear Street | Compiled by : GO

 | Location : Barrie, Ontario | Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Track-mounted | Drilling Method : Hollow stem augers

Elev (m) / Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
	(continued) **SILTY SAND**, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) *(continued)*				302
301.7 / 10.7	**GRAVELLY SAND**, very dense, brown, wet	10	SS	69 / 250mm	
301.3 / 11.1	.				301
		11	SS	50 / 100mm	300
					299
		12	SS	100 / 225mm	298
296.9 / 15.5		13	SS	50 / 150mm	297

Depth Scale (m): 11, 12, 13, 14, 15

Penetration Test Values (Blows / 0.3m) — X Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa): O Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane: 40, 80, 120, 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

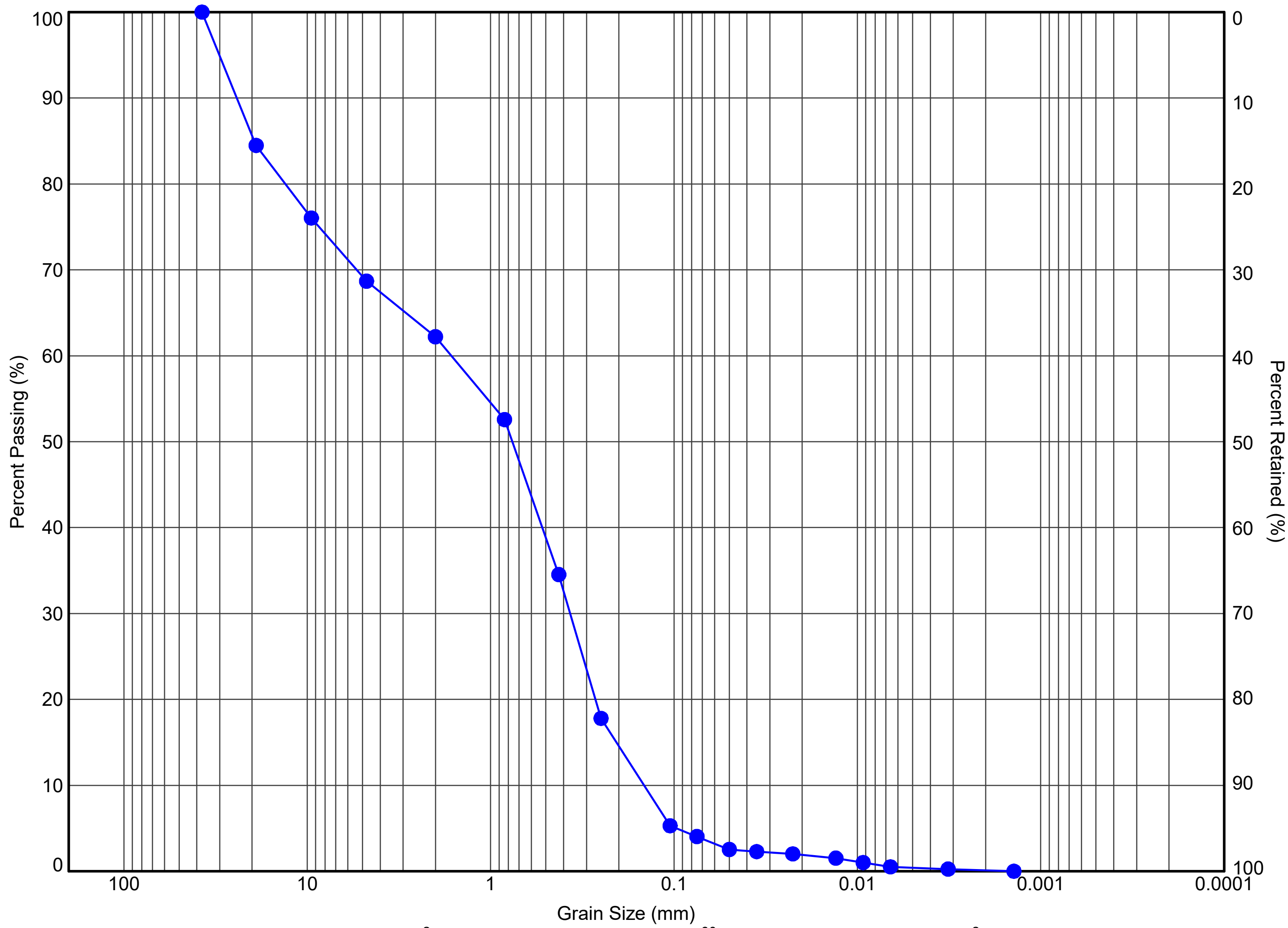
Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Water level and cave not measured upon completion of drilling.

APPENDIX B

TERRAPROBE INC.



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

MIT SYSTEM

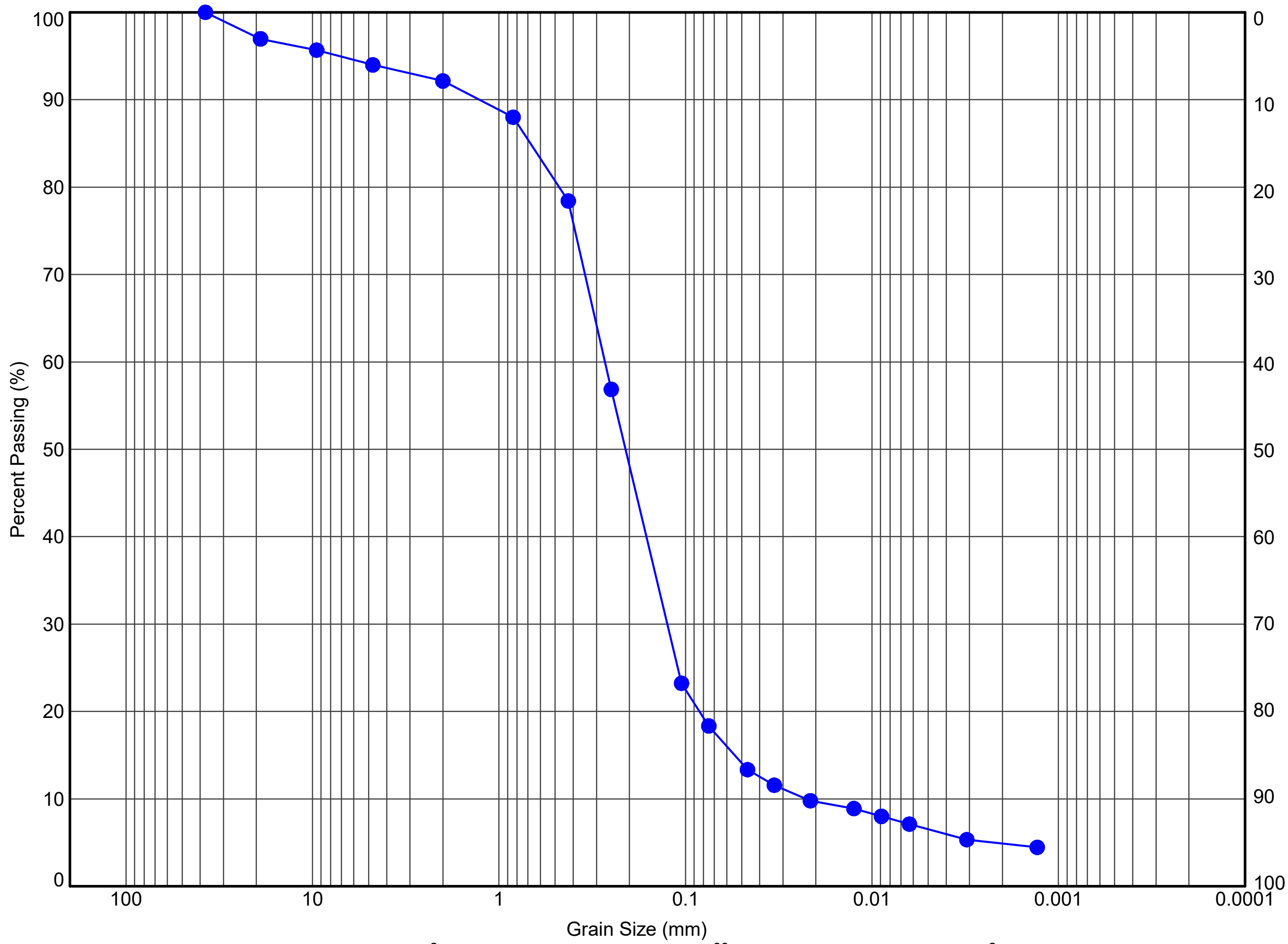
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS6	4.8	307.3	38	59	3	0	

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

Title:

GRAIN SIZE DISTRIBUTION
SAND AND GRAVEL, TRACE SILT

File No.: **3-22-0008-01**



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, %)*
●	**2**	SS10	10.8	301.8	8	76	11	5	

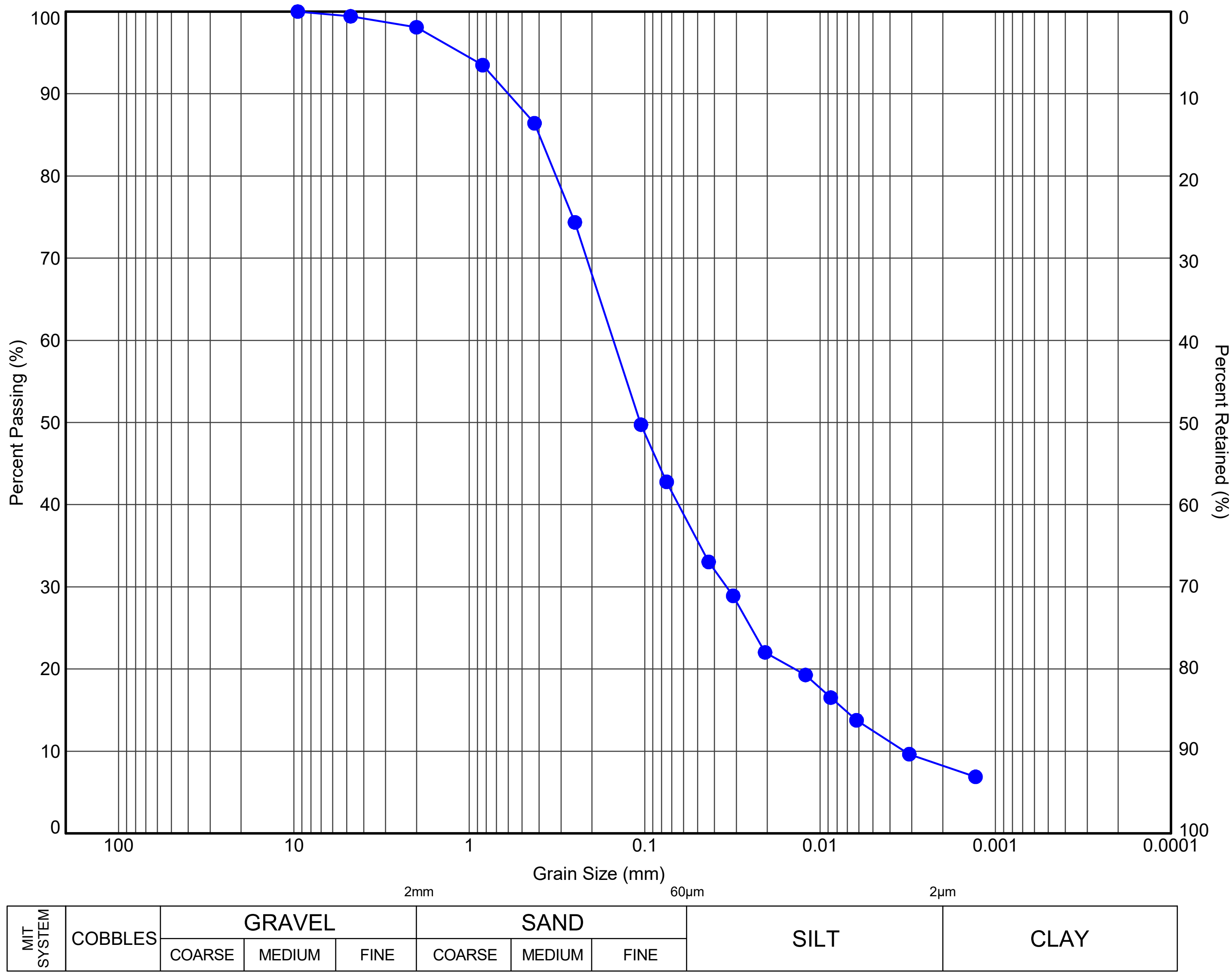
Terraprobe

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

Title:

GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY

File No.: **3-22-0008-01**



MIT SYSTEM

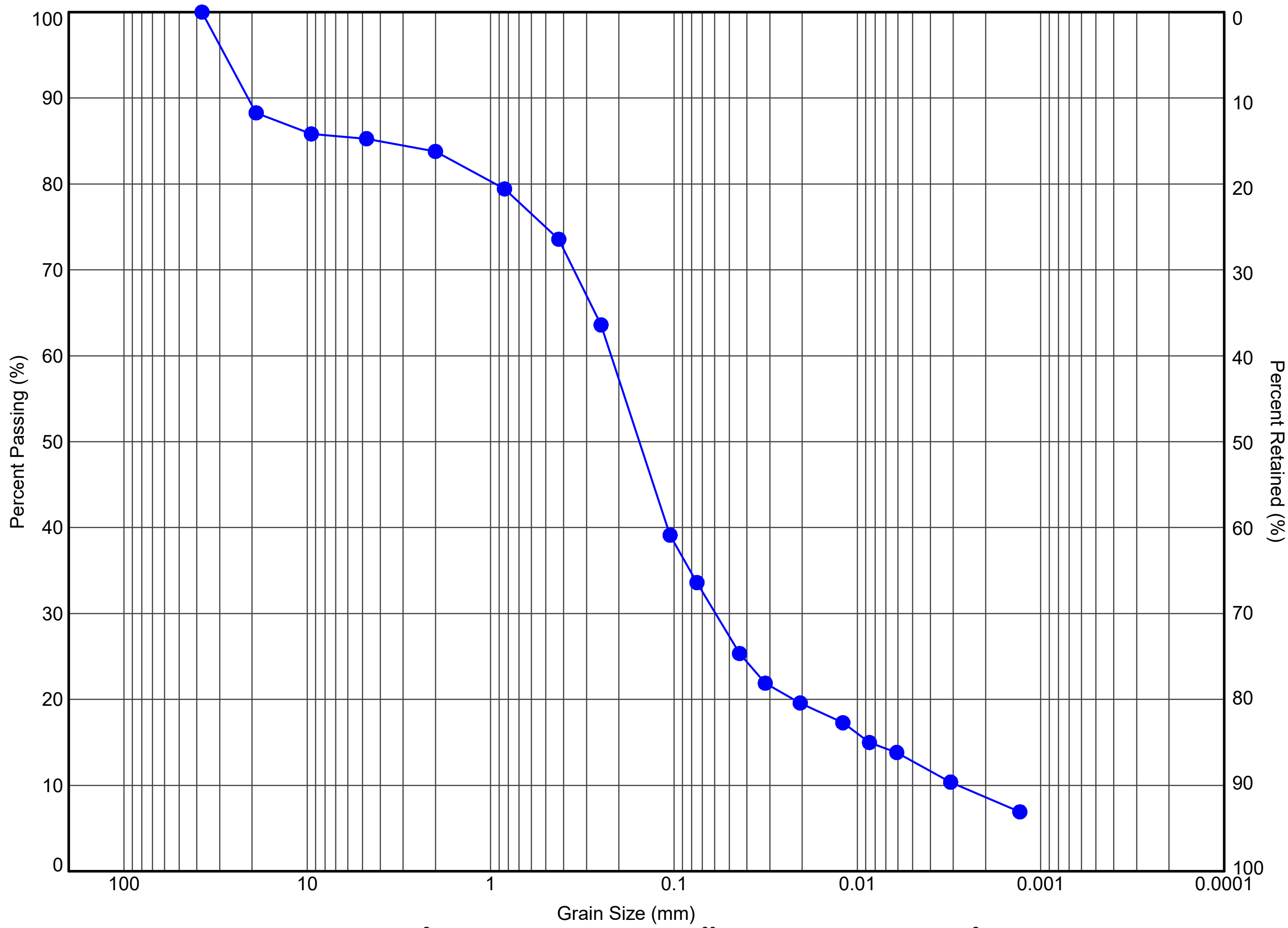
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**4**	SS12	13.8	298.0	2	59	31	8	

Terraprobe

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

Title: **GRAIN SIZE DISTRIBUTION**
SILTY SAND, TRACE CLAY, TRACE GRAVEL

File No.: **3-22-0008-01**



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, %)*
●	**5**	SS9	9.3	303.1	16	53	22	9	

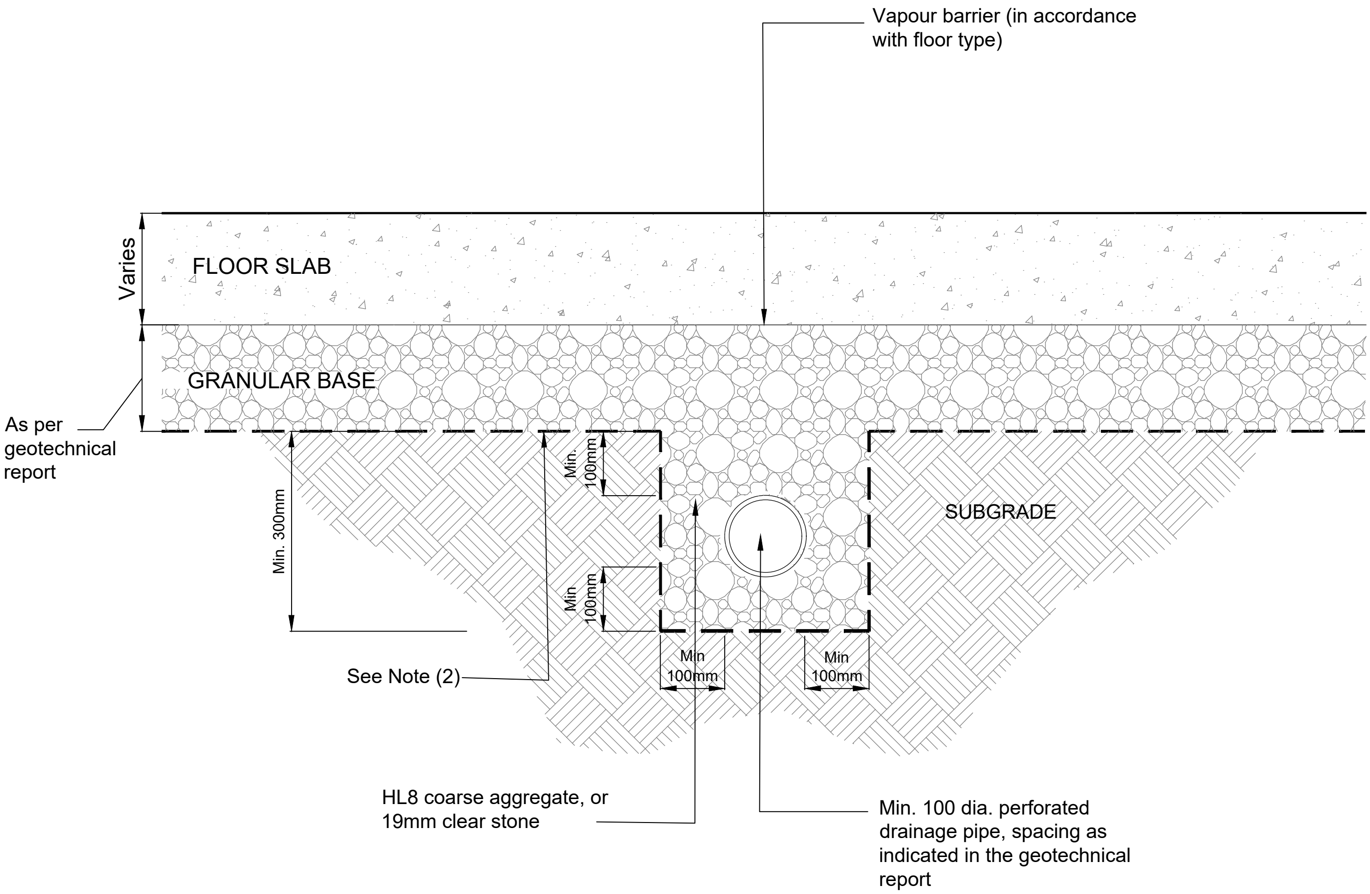
Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:
GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME GRAVEL, TRACE CLAY

File No.: **3-22-0008-01**

APPENDIX C

TERRAPROBE INC.



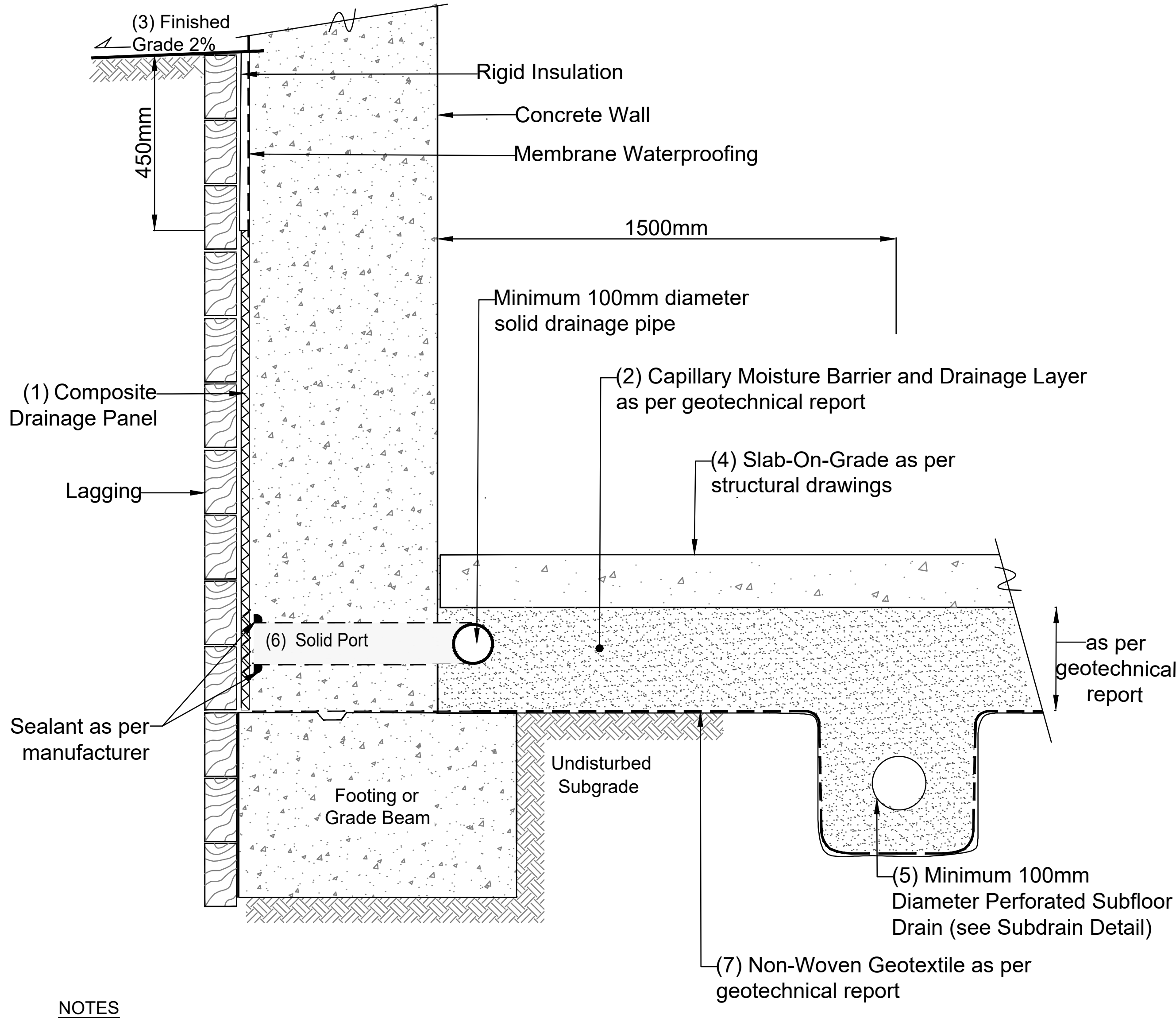
NOTES:

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

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

Title:

TYPICAL BASEMENT SUBDRAIN DETAIL



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.

3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.

4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.

5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.

6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.

7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).

8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S.

Terraprobe
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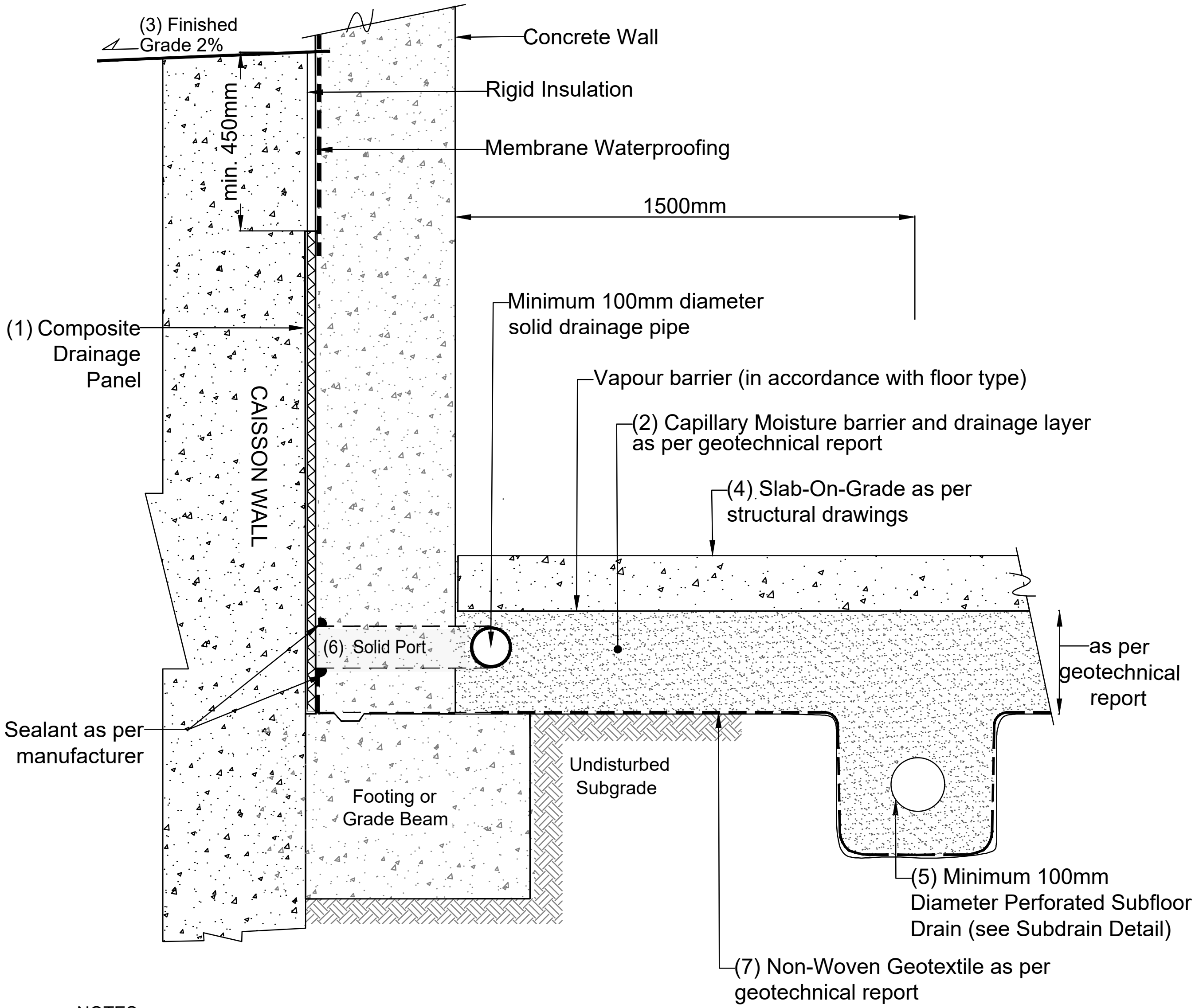
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE & LAGGING SHORING SYSTEM
(DRAINED BASEMENT CONDITION)



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.

3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.

4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.

5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.

6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.

7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).

8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S

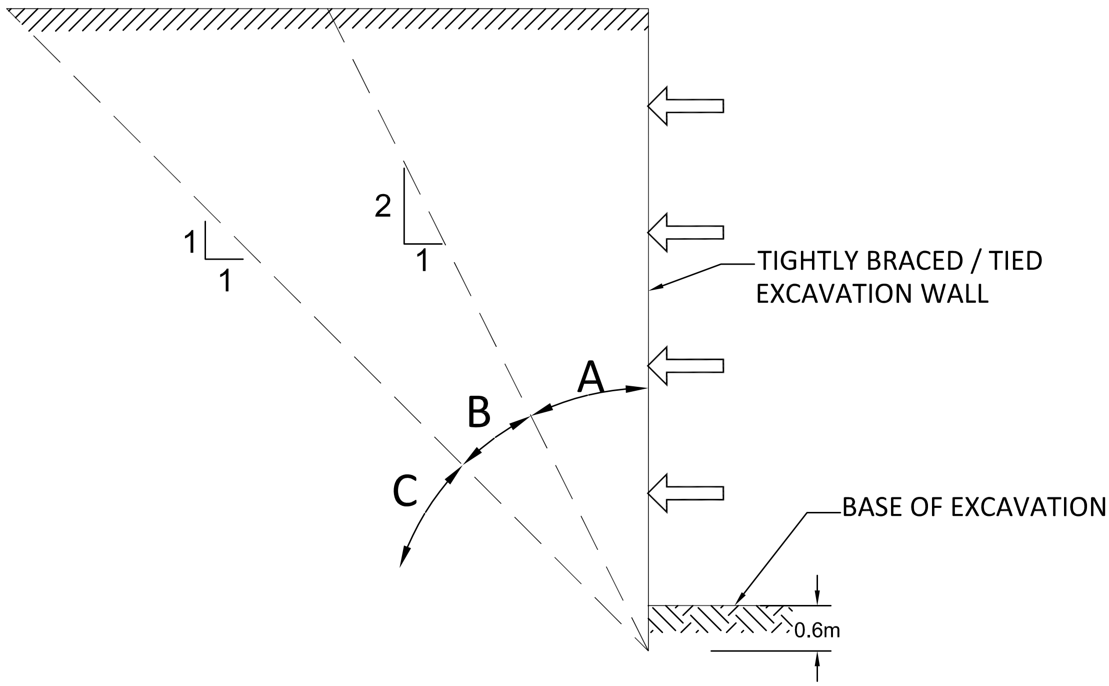
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SCHEMATIC DRAINAGE DETAIL
CASSION WALL SHORING SYSTEM
(DRAINED BASEMENT CONDITION)

APPENDIX D

TERRAPROBE INC.



Zone A: Foundations within this zone often require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone B: Foundation within this zone often do not require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone C: Foundations within this zone usually do not require underpinning.

REFERENCE:

User's Guide - NBC 2005 Structural Commentaries
(Part 4 of Division B) - Commentary K

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

Title:

GUIDELINES FOR UNDERPINNING SOILS