Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
MAYFIELD WEST PHASE II
PART OF LOT 19, CONCESSION 1
TOWN OF CALEDON, ONTARIO

Prepared For:	**Caledon 410 Developments Limited** c/o Fieldgate Developments 5400 Yonge Street, 5th Floor Toronto, Ontario M2N 5R5
Attention:	Ms. Mara Samardzic

File No. 7-17-0039-01
Original Issue: September 4, 2007
Revision 1: January 11, 2008
Revision 2: June 22, 2017

Distribution:

1 copy (pdf): Caledon 410 Developments Limited
1 copy: Terraprobe Inc., Stoney Creek

Terraprobe Inc.

Greater Toronto	Hamilton – Niagara	Central Ontario	Northern Ontario
11 Indell Lane	903 Barton Street, Unit 22	220 Bayview Drive, Unit 25	1012 Kelly Lake Rd., Unit 1
Brampton, Ontario L6T 3Y3	**Stoney Creek**, Ontario L8E 5P5	**Barrie**, Ontario L4N 4Y8	**Sudbury**, Ontario P3E 5P4
(905) 796-2650 Fax: 796-2250	(905) 643-7560 Fax: 643-7559	(705) 739-8355 Fax: 739-8369	(705) 670-0460 Fax: 670-0558

www.terraprobe.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

Terraprobe Inc. was retained by Caledon 410 Developments Limited to update a geotechnical investigation report for a property is located on the west side of Hurontario Street (Highway 10) in the Township of Caledon, Ontario. A site location plan is provided as Figure 1. A proposal and cost estimate to carry out the investigation were provided in our letter of March 28, 2017. Authorization to proceed with the work was provided by Ms. Mara Samardzic of Caledon 410 Developments Limited on March 28, 2017.

The property was investigated by Terraprobe in 2007[1] to provide a preliminary indication of the geotechnical engineering issues related to the proposed site development. This work included ten (10) exploratory boreholes. This report has been updated to reflect a revised site development plan. A visual inspection of the site was conducted on April 12, 2017 and it was noted that no noticeable development activities, including fill placement and cutting/regrading of the site, were carried out; and the site grade appeared to remain generally similar to the original grade which had existed at the time of our previous subsurface investigation.

The updated report encompasses the findings of the previous geotechnical investigation of the site. Based on this information, advice is provided with respect to the geotechnical aspects of the proposed development, including the design of foundations, floor slabs on grade, pavements, pipe bedding requirements, and a SWM pond. The anticipated construction conditions pertaining to excavation, backfill and temporary ground water control are discussed also, but only with regard to how these might influence the design.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Existing Site Conditions

The existing site features are shown on Figure 2, as derived from a topographical survey of the property, prepared by J.D. Barnes Limited, O.L.S., dated May 17, 2016. The site is located in a rural area and is currently in agricultural land use. It has not been previously developed. The surrounding land is also predominately agricultural, except for the lands to the south, which have been developed for residential use. The site topography is relatively flat; however there is a fall of about 5 m in elevation across the 600 m traverse of the site from the north to the south. The high ground was at about elevation 263.0 m and the lowest at about 258.0 m.

---

[1] Preliminary Geotechnical Investigation, Part of Lot 19, Concession 1, Town Of Caledon, Ontario; prepared by Terraprobe Limited for Caledon 410 Developments Limited; File No. 7-07-2081; September 4, 2007 (Revision1: January 11, 2008)

Two woodland areas were located at the northwest and southwest corners of the site. There were remnants of a former residence located on the east side of the site. Small piles of debris were observed in the area of the former buildings. Debris piles were also located in the wooded area at the southwest corner of the site.

Two streams enter the site from the north and one stream flows off the site to a catch basin at the south central property line. This catch basin has been installed presumably to divert surface runoff from entering the yards of the residential properties near this area. A small marsh area was located at the northeast corner of the woodland at the northwest corner of the Property. Several areas of standing water were observed in the low lying areas across the site. The occurrence of standing water has been delineated on Figure 2.

2.2 Site Geology

The near surface soil at and in the vicinity of the Property generally consists of Pleistocene age, Late Wisconsinan Halton Till. Halton Till consists of reddish brown clayey silt till. The crest of a small moraine was indicated running in a northeast/southwest trending direction across the northern portion of the Property.[2] The bedrock under the Property is the Queenston Formation, which is comprised of Ordovician age red shale.[3] Based upon historic borehole information from the MOECC well records online database, the depth to bedrock in the area of the Property is approximately 40 metres below the existing ground surface.

2.3 Proposed Development

The general arrangement of the site and the proposed development features are shown on Figure 3, as derived from a Site Plan drawing prepared by Glen Schnarr & Associates Inc. In this design, it is proposed to construct a residential subdivision, incorporating areas reserved for a storm water management (SWM) pond, commercial retail use, a transit hub, woodlots, wetlands and parks. The development will be provided with municipal services and roads meeting the standards of the Town of Caledon.

3.0 PROCEDURE

The field work for this investigation was carried out on July 5, 2007, during which time ten (10) boreholes were drilled to depths of about 6.6 metres below the existing ground surface (mBGS). The locations of the boreholes are shown on the Borehole Location Plan, Figure 2. The detailed results of the boreholes are shown on the accompanying Borehole Logs in Appendix A.

---

[2] Karrow, P.F. and Easton, J..; Quaternary Geology of the Brampton Area, Southern Ontario; Ontario Geological Survey; Map 2223; 2005

[3] Telford, P.G.; Paleozoic Geology, Brampton, Southern Ontario; Ontario Division of Mines; Map 2337; 1976

The borehole drilling and sampling was carried out using a track mounted drill rig supplied and operated by a specialist drill contractor. The boreholes were advanced using conventional interval augering and sampling techniques and soil samples were recovered at regular intervals of depth by split barrel sampling in accordance with ASTM Standard D1586. After the drilling, sampling, and logging was completed, the boreholes were backfilled with auger cuttings and bentonite sealant.

The field work was observed throughout by a member of our engineering staff who also arranged for underground services locates in advance of the work, logged the boreholes and cared for the samples recovered. The boreholes were located in the field with respect to the existing site features. The ground surface elevations at the borehole locations were inferred from spot elevations on a topographical plan of the site prepared by J.D. Barnes Limited, O.L.S., dated May 17, 2016. The ground surface elevations at the boreholes were referred to the geodetic datum.

Ground water observations were made in each borehole during and upon completion of drilling and sampling. There was no provision for long term ground water monitoring at the site. The boreholes were decommissioned and sealed with bentonite pellets in accordance with Ontario Regulation 903.

All of the samples recovered in the course of the investigation were brought to our laboratory for further examination, water content determinations, and selective classification testing.

4.0 SUBSURFACE INVESTIGATION

The subsurface soil and ground water conditions encountered in the boreholes, and the results of the field and laboratory testing, are shown on the Log of Borehole sheets in Appendix A. A list of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. These boundaries generally represent a transition from one soil or rock type to another and should not be inferred to represent exact planes of geological change. The conditions will vary between and beyond the locations investigated.

4.1 Soil Conditions

The following discussion has been simplified in terms of the major soil strata for the purposes of geotechnical design. In general, the boreholes drilled at the site penetrated topsoil and fill, overlying clayey silt till.

4.1.1 Topsoil

A layer of topsoil was encountered at the ground surface at most borehole locations and generally varied in thickness between about 100 and 300 mm.

4.1.2 Fill or Disturbed/Weathered Native Soil

Fill or disturbed/weathered native soil consisting predominantly of clayey silt with intermixed topsoil, rootlets and organics was encountered immediately beneath the ground cover in most of the boreholes and extended to a depth generally varying from 0.6 to 0.8 mBGS. At the location of Borehole 7, fill materials was encountered to a depth of approximately 1.0 mBGS. The N values, as determined in the Standard Penetration testing carried out within the fill or disturbed/weathered native soil, ranged from 13 to 22 blows per 0.3m, inferring a very stiff consistency or compact state of packing. The in-situ water content of the samples of fill or disturbed/ weathered native soil recovered from the standard penetration testing ranged from about 5 to 22 percent.

4.1.3 Clayey Silt Till

All of the boreholes were terminated in a stratum of clayey silt till. As is typical of till deposits, the clayey silt contained embedded sand and gravel. The presence of cobbles and boulders is characteristic of till deposits and although not reported at the borehole locations, it is likely that such coarse particles also exist within the till deposit that underlies this site. The N values determined within the clayey silt till ranged from 11 to greater than 100 blows per 0.3 m. The natural water content of the silty clay till samples ranged from about 5 to 21 percent.

4.2 Ground Water Conditions

Unstabilized ground water level observations were made in each of the boreholes as they were drilled and after completion of drilling, as noted on the enclosed borehole logs. All of the boreholes were dry during and upon completion of drilling. The colour change from brown to grey, which may coincide with the long term ground water level, was observed in the clayey silt till at depths in the range of about 4 to 5 mBGS. Ground water levels may fluctuate with time, depending on the amount of precipitation and surface run off. Long-term ground water monitoring was beyond the scope of work at the site and not considered necessary for design purposes.

5.0 GEOTECHNICAL DESIGN CONSIDERATIONS

The following discussion is based on our interpretation of the factual data obtained during this investigation and is intended for the use of the design engineer only. Comments made regarding the construction aspects are provided only in as much as they may impact on design considerations. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

The comments provided in the following sections are to be considered preliminary since details regarding the proposed development and the final design grades are not known at this time. For this reason, the geotechnical aspects of this project should be reviewed by this office at the final design stage. It is possible that additional subsurface exploration may be required at that time.

5.1 Site Preparation Works

The preliminary site development information indicates that some cutting and filling will be required. Any fill that will be required in areas to be developed for floor slabs on grade must be constructed as an engineered fill. A specification for the creation of an Engineered Fill is provided as Appendix B. It is expected that the site restoration and filling will be carried out in advance of construction.

It is noted that of surficial vegetative cover and topsoil varies in thickness between 100 mm and 300 mm as observed within all boreholes drilled during the geotechnical investigation. The variability is likely due to tilling operation as part of the site agricultural activities. Contractors bidding on the work should undertake test pits to better assess topsoil stripping requirements.

Topsoil within the limits of the project shall be salvaged prior to beginning excavating, fill or hauling, operations by excavating topsoil and stockpiling the material at designated locations on drawings or as designated by the owner in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage. All stockpiles (topsoil and/or earth fill) shall be protected from sediment transport by surface roughening and perimeter silt fencing.

The subgrade soils exposed after the removal of the surficial topsoil will consist of existing earth fill or disturbed/weathered native soil. Care will be required during excavation to separate any materials that appears to contain significant topsoil from the clean earth fill. Prior to backfilling or site grading activities, the exposed subgrade soils should be visually inspected, compacted if required, and proof rolled using large axially loaded equipment. Any soft, organic, or unacceptable areas should be removed as directed by the Geotechnical Engineer and replaced with suitable fill materials compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD). If the fill used to raise site grades in the building areas is to support foundations, then it will be necessary to remove all existing fill to competent native soils prior to filling. Clean earth fill used to raise grades in the proposed building and pavement areas should be placed in thin layers (150 mm thick or less) and compacted by a heavy sheep-foot type roller to 98 percent of SPMDD. For optimal performance, the placement water content of the fill should be maintained within about 2 percent of the laboratory optimum water content for compaction. Benches should be cut into the existing slopes at a maximum 600 mm height to allow placement of new fill in a horizontal manner.

The quality of imported soil should be consistent with the applicable property use standards of the MOECC's document entitled, '*Soil, Ground Water and Sediment Standards for Use Under Part XV. I of the Environmental Protection Act'*, dated April 15, 2011.

All aspects of the engineered fill construction should be verified by the geotechnical engineer including the final excavation, compacting of the native subgrade, and placement and compaction of the engineered fill. In-situ density testing should be carried out during construction to confirm that each lift has been compacted to the specified degree. Source acceptance testing of materials imported for use as engineered fill must be carried out prior to the importation to the site.

5.2 Foundation Design Parameters

5.2.1 Conventional Spread Footings

The boreholes penetrated fill materials overlying clayey silt till strata. The existing fill and the disturbed/weathered native soil are not suitable for the support of foundations. Based on the results of the boreholes, it is considered feasible to support the building foundations on the undisturbed clayey silt till or engineered fill.

Conventional spread footings must be founded at least 0.3 m into the undisturbed clayey silt till. The following table summarizes the bearing resistance at serviceability limit states (SLS) and factored geotechnical resistance at ultimate limit states (ULS) for design purposes possible for conventional spread footing foundations by borehole location at the highest permissible elevations.

Bearing Pressure Possible for Spread Footing Foundations

Borehole No.	Minimum Depth below existing grade (m)	Geodetic Elevation m	Allowable Bearing Pressure SLS (kPa)	Factored Bearing Capacity at ULS (kPa)	Bearing Stratum
BH 1	0.9	260.4	150	225	Clayey Silt Till
BH 2	0.9	261.5	150	225	Clayey Silt Till
BH 3	0.9	260.8	150	225	Clayey Silt Till
BH 4	0.9	259.3	150	225	Clayey Silt Till
BH 5	1.1	257.0	150	225	Clayey Silt Till
BH 6	0.9	258.1	150	225	Clayey Silt Till
BH 7	1.2	258.8	150	225	Clayey Silt Till
BH 8	0.5	261.8	150	225	Clayey Silt Till
BH 9	0.5	260.0	150	225	Clayey Silt Till
BH 10	0.5	259.1	150	225	Clayey Silt Till

A minimum footing width of 450 mm is recommended for strip footings and a minimum footing width of 900 mm should be considered for spread footings. The total and differential settlement (short term and long term) of spread footings established on the competent clayey silt till strata at the above design bearing pressures is expected to be less than 25 mm.

Some variability in the consistency and depth of the native undisturbed strata is expected. For this reason, it is important that all of the foundation excavations be inspected by Terraprobe to confirm that the soft surficial strata have been fully penetrated and to identify any preparatory work required prior to placing the footing concrete. Where deeper excavations are required, the footings should be lowered in a series of steps with maximum vertical increments of 0.6 m and with a rise to run ratio of 1:2.

All footings in unheated areas must be provided with at least 1.2 metres of earth cover for frost protection or equivalent insulation. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

5.2.2 Foundations on Engineered Fill

Based on the existing site grades, it is likely that some portions of the site will undergo some filling. Recommendations for the construction of engineered fill are provided in Section 5.1 of this report. A maximum net allowable bearing pressure of up to 150 kPa for SLS design and 225 kPa for a factored ULS design can be used for foundations placed within the engineered fill area.

Prior to placing engineered fill it will be necessary to remove all surficial fill in proposed footing areas to the top of the native soil stratum. The exposed subgrade surfaces should be visually inspected and proof rolled by an experienced geotechnical engineer to confirm the presence of competent native soils. The excavation for the engineered fill should extend beyond the footprint area of the proposed structure equal to the depth of fill beneath the proposed footing plus 0.5 m. The engineered fill should be placed in 150 mm thick layers and compacted to 98 percent of SPMDD. Foundations constructed on engineered fill must be provided with steel reinforcement designed to minimize the effects of post construction differential settlement.

5.3 Earthquake Design Parameters

The Ontario Building Code (2012) 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 Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 meters 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 noted information, it is recommended that the site designation for seismic analysis be 'Site Class C', as per Table 4.1.8.4.A of the Ontario Building Code (2012). 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				
	$S_a(0.2) \le 0.25$	$S_a(0.2) = 0.50$	$S_a(0.2) = 0.75$	$S_a(0.2) = 1.00$	$S_a(0.2) \ge 1.25$
C	1.0	1.0	1.0	1.0	1.0
Site Class	Values of F_v				
	$S_a(1.0) \le 0.1$	$S_a(1.0) = 0.20$	$S_a(1.0) = 0.30$	$S_a(1.0) = 0.40$	$S_a(1.0) \ge 0.50$
C	1.0	1.0	1.0	1.0	1.0

It should be noted that the seismic site designation above is estimated on the basis of rational analysis of penetration resistance (N-Values) observed in the boreholes (assuming the consistency for the deeper soil stratigraphy beyond the investigation depth was similar to that of the lowest soil strata penetrated within the investigation depth).

5.4 Floor Slabs on Grade

The subsurface conditions within the investigated area are expected to comprise of existing fill and/or the disturbed/weathered native soil materials. Based on the findings of the investigation, the upper portion the earth fill layer is not considered suitable for construction of a slab-on-grade structure and should be sub-excavated to an appropriate depth equivalent to a minimum of one half of the existing fill thickness and replaced with suitably compacted engineered fill. Test pits may be required in the slab on grade area to determine the existing fill thickness and to assess the subexcavation requirements. Also, some localized weak zones of native or suitable fill soils may be encountered at the design subgrade for the slab that should be sub-excavated and removed prior to backfilling for construction and replaced with suitable fill materials compacted to a minimum of 98 percent of SPMDD.

Final construction beneath slabs on grade should consist of 200 mm of uniformly compacted Granular A uniformly compacted to 98 percent of standard Proctor maximum dry density. A slab on grade founded on clayey silt till soils, engineered fill, or approved existing fill. The moduli of subgrade reaction appropriate for slab on grade design on the aforementioned soils are as follows:

Proof-rolled Earth Fill:	18,000 kPa/m
Engineered fill:	25,000 kPa/m
Clayey Silt Till:	30,000 kPa/m

If moisture sensitive floor finishes are proposed, a capillary moisture barrier will be required beneath the slab. The capillary moisture barrier may consist of a layer of suitably graded clear crushed stone rather than the Granular A as outlined above. If a clear stone capillary moisture barrier is selected for the underfloor design, this material has poor stability under wheel loading and can be an impediment to other site activities such as steel and mechanical erection. If this is the case, substitution of the upper 50 mm with compacted Granular A to provide a travel surface, constitutes no technical compromise to the capillary barrier effect intended. The placement of a polyethylene vapour barrier is to be at the discretion of the design engineer and architect, as this may have implications on slab curing and certain floor finishes are more sensitive to moisture diffusion through the slab than others.

All slabs on grade should be structurally separate from foundation walls and columns. Saw cut control joints should be incorporated into the slabs along column lines and at regular intervals. Interior load bearing walls should not be founded on the slab but on spread footings as outlined above.

The soil at this site is susceptible to frost effects which would have the potential to deform hard landscaping adjacent to the building. At locations where buildings are expected to have flush entrances, care must be taken in detailing the exterior slabs / sidewalks, providing insulation / drainage / non-frost susceptible backfill to maintain the flush threshold during freezing weather conditions.

5.5 Earth Pressure Design Considerations

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 (Rankin)	dimensionless
K_o	at-rest earth pressure coefficient (Rankin)	dimensionless
K_p	passive earth pressure coefficient (Rankin)	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	Ka	Ko	Kp
Compact Granular Fill Granular 'B' (OPSS 1010)	32	21.0	0.31	0.47	3.25
Clayey Silt Till or Similar Fill	30	19.0	0.33	0.50	3.00

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 ground water 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, acting in conjunction with the earth pressure, this equation can be simplified to:

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

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 on the soil contact (**N**) and the frictional resistance of the soil **(tan ϕ)** expressed as: **R = N tan ϕ**. This is an unfactored resistance. The factored resistance at ULS is $R_f = 0.8 N \tan \phi$. The K value to be used for the design will depend on the rigidity of the wall.

Heavy compaction equipment should not be used immediately behind the walls, as this may cause deflection or damage to the wall.

5.6 Site Servicing

Considering the relatively shallow depth of the fill material at the site, underground service lines will generally be installed on undisturbed clayey silt till materials, or on a prepared fill subgrade. The native deposits in the area provide adequate support for buried services. However, suitability of the material must be verified on site, during excavation and installation, by qualified geotechnical personnel experienced in such works.

It is possible that the excavation for some services would terminate in the fill. In this event, it will be necessary to sub-excavate all fill and replace it with engineered fill to ensure the service is properly supported and to minimize the potential of settlement. Engineered fill should consist of OPSS 1010 Granular A or Granular B Type II material placed and uniformly compacted to 98 percent of standard Proctor maximum dry density. Consideration could also be given to the use of lean concrete to restore the grade to the proposed invert elevation.

Water seepage should be expected from sandy seams within the clayey silt till stratum or as a result of surficial runoff. Due to the fine-grained nature and low hydraulic conductivity of the material the amount of ground water seepage is not anticipated be a major issue during the trench excavations and service line installation could be easily managed through installation of dewatering sumps. Construction dewatering is not anticipated to require an MOE Permit to Take Water (PTTW - 50,000 L/day), if proper excavation staging is to be adopted by the Contractor. However, in the event of a large deep construction excavation carried out at the Site, a MOE PTTW should be obtained, primarily to manage potential surface water runoff into the excavation, and to address any potential unforeseen ground water seepages.

It is recommended that prior to commencing the construction of the site servicing, consideration be given to the excavation of a series of trial test pits along the alignment of the proposed sewers/ watermain to determine more accurately the soil behaviour and if any dewatering works are required.

The bedding materials should be adequately compacted to provide support and protection to the service pipes. Provided the base area for the sewer pipes and watermain are free of all soft and deleterious materials, the pipe bedding should comply with a Class B bedding configuration as per the requirements of OPSD 802.030 (rigid pipe) and/or OPSD 802.010 (flexible pipe). Where disturbance of the trench base has occurred, due to the presence of soft fine-grained soils, ground water seepage and the like, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill. If standing water is present in the base of the service and watermain trenches then High Performance Bedding (HPB) and/or HL6 clear stone wrapped in geo-textile may be adopted as bedding material below the pipe to provide stabilization.

Backfilling of trenches can be accomplished by reusing the excavated soils or similar fill material, provided the moisture content of the material is maintained within ±2 percent of optimum and the fill is free of topsoil, organics and any deleterious material. The fill placed in excavated trenches should be in loose lifts not exceeding 200 mm thick and compacted to not less than 95 percent of SPMDD.

5.7 Basement Drainage

To assist in maintaining basements dry from seepage, it is recommended that exterior grades around the buildings be sloped away at a 2 percent gradient or more, for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe surrounded by a granular filter (minimum 150 mm thick). The granular filter should consist of OPSS HL 8 Coarse Aggregate.

The basement wall must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the Ontario Building Code (2012). The basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material (OPSS 1010 Granular 'B'), or provided with a suitable alternative drainage cellular media.

Apart from the above recommended perimeter drainage, the provision of a sub-floor drainage system installed beneath the basement floor is also recommended. The sub-floor drainage system may consist of perforated pipes located at a distance of about 3 m centre to centre. The perimeter foundation drains and the sub-floor drains may be outlet to municipal sewer under gravity flow (if allowed), or to the exterior of the house under gravity provided adequate cross-fall is available to facilitate such drainage.

The size of the sump pit should be adequate to accommodate the water seepage. Further, the sub-floor drainage system should be adequately 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. The pumps should have sufficient capacity to accommodate a maximum peak flow of water of about 4 to 5 gallons per minute. This flow is not anticipated to be a sustained flow but could be achieved under certain conditions. The perimeter and sub-floor drain installation and outlet provisions must conform to the plumbing code requirements.

5.8 Pavement Design

5.8.1 Subgrade Preparation

Earth fills or disturbed soil strata, consisting predominantly of clayey silt, were encountered immediately beneath the ground cover in most of the boreholes. The fill and the disturbed/weathered native soil materials were occasionally observed to contain organics, and rootlets. These soil conditions may be suitable to support pavements for the potential roadway and parking areas provided the exposed subgrade is proofrolled, recompacted, and inspected as per Section 5.1 and provided the fill is free of all loose and deleterious materials.

Where there is existing fill on the site, caution needs to be exercised in the preparation of the subgrade on this material because there is no evidence to suggest it has been compacted appropriately. It is recommended that any subgrade comprising of existing fill be inspected for obvious soft/loose areas and presence of deleterious materials. Should such areas be found, Terraprobe can provide appropriate advice for replacement of the material and addressing local weak areas at that time.

If new fill is required to raise the grade, selected on-site fill could be used, provided it is free of any topsoil and other deleterious material. The fill should be placed in large areas where it can be compacted by a heavy sheep-foot type roller. The fill should be placed in large areas where it can be uniformly compacted in 300 mm thick lifts with each lift uniformly compacted to at least 95 percent of standard Proctor maximum dry density. The upper 1 m of backfill beneath areas to be developed as pavements should be compacted to 98 percent of SPMDD.

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

Control of surface water is a significant factor in achieving good pavement life. Grading of adjacent pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. The existing earth fill and native soils have anywhere from a moderate to severe frost susceptibility to frost heave, and pavement on these materials must be designed accordingly. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward subgrade drains.

Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into catch-basins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 metres below subgrade level. Subdrains should also be provided at all catch-basins within the parking areas.

5.8.2 Asphaltic Concrete Pavement Design

The industry pavement design methods are based on a design life of 15 to 20 years for typical weather conditions and for the design traffic loadings. On this basis, the following pavement component thicknesses are recommended for flexible pavements which will be subjected to “heavy duty” use (ie main site accesses and service accesses) and “light duty” use (ie car parking) constructed on a properly prepared clayey silt subgrade.

Minimum Asphaltic Concrete Pavement Structure

Pavement Layer	Compaction Requirements	Minor Local Road / Fire Route Minimum Component Thickness
Surface Course Asphaltic Concrete HL3 (OPSS 1150)	92-96.5% MRD	40 mm
Base Course Asphaltic Concrete HL8 (OPSS 1150)	92-96.5% MRD	65 mm

Pavement Layer	Compaction Requirements	Minor Local Road / Fire Route Minimum Component Thickness
Base Course: Granular A (OPSS 1010) or 19mm Crusher Run Limestone	98% standard Proctor Maximum Dry Density (ASTM-D1557)	150 mm
Subbase Course: Granular B Type II (OPSS 1010) or 50mm Crusher Run Limestone	98% standard Proctor Maximum Dry Density (ASTM-D1557)	300 mm

Some adjustment to the thickness of the granular subbase material may be required depending on the condition of the subgrade at the time of the pavement construction. The need for such adjustments can be best assessed by the geotechnical engineer during construction.

The granular materials should be placed in lifts 150 mm thick or less, and compacted to a minimum of 100 percent SPMDD for granular base and granular sub-base. Asphalt materials should be rolled and compacted as per OPSS 310. The granular and asphalt pavement materials and their placement should conform to OPSS Forms 310, 501, 1010, 1101 and 1150 and pertinent Town specifications. Town and other applicable specifications should be referred for use of higher grades of asphalt cement (PGAC 64-28) for asphaltic concrete where applicable.

It is recommended that the placement of the wearing surface be delayed for at least one year after construction of the binder course to minimize the effects of post construction settlement of subgrade fill. Prior to placing the wearing surface, the binder course should be evaluated and remedial work carried out as required in preparation for final construction.

5.9 SWM Pond

A SWM pond is proposed along the southern property boundary as shown on the site plan, Figure 3.
It is expected that the bottom of the pond would be formed in clayey silt till stratum.

Prior to excavating for the pond, all topsoil and any otherwise deleterious material should be stripped and carefully stockpiled to minimize contamination of the underlying subgrade materials which may be reused for general site regrading, for the construction of berms, embankments, and other features.

Cut slopes within the clayey silt till stratum with depths approaching about 5 m would be considered stable at inclinations approaching about 3 horizontal to 1 vertical, however operational standards for such facilities usually dictate somewhat flatter inclinations as required for public safety. Side slopes below the permanent water table should be 4 horizontal to 1 vertical or flatter.

Any containment berms must be keyed into the underlying undisturbed subgrade to a depth of at least 0.6m. It is considered feasible to construct the containment berms using the excavated clayey silt till from the SWM pond excavation provided that care is taken to exclude topsoil, any excessively wet, frozen, or otherwise deleterious material (ie. cobbles, boulders, etc…) during excavating. It should be noted that the excavated soils for the SWM pond may contain zones of cohesionless sand which must be excluded from use as fill to construct berms. Sand will be susceptible to piping erosion during high flow events. The fill for the berms should be placed in nominal lift thicknesses of 200 mm and each lift must be uniformly compacted to at least 98 percent of SPMDD. Post construction settlement of structural elements or utilities founded within the berm should be expected.

It should be noted that the fine grained soils which are predominant to the site and will be encountered during construction, are susceptible to erosion. All cut and filled slopes must be provided with adequate vegetation cover. Measures will be required to control surface runoff and the off-site migration of soil during the construction phase and until the vegetation cover has become established. Areas which will be exposed to stormwater flow should be provided with more durable erosion protection. Preference should be given to erosion protection which is free draining, flexible and incorporates adequate filter protection. Such protection could be achieved by blanketing the slope with a suitable filter fabric and a shell of granular material, such as OPSS 1010 Granular A. The filter fabric could consist of Terrafix 270R or equivalent.

Section SG 6 of the Supplementary Guidelines for the Ontario Building Code 1997 (August 2003 update), provides guidance for the selection of a percolation rate on the basis of soil type as outlined in the Unified Soil Classification System. Based on the results of sieve and hydrometer analyses, the order of magnitude of soil permeability to be used for any surficial stormwater infiltration system is estimated to be between 10^{-6} to 10^{-10} m/sec which is in low range of soil permeability values. It is recommended that a coefficient of permeability of no greater than 10^{-8} m/sec be used in the design of any surficial stormwater infiltration system.

6.0 DESIGN CONSIDERATIONS FOR CONSTRUCTABILITY

6.1 Excavations

All excavations must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. In this context, the near surface soil strata at the site, primarily consisting of fill, should generally be regarded as "Type 2 Soil", provided that effective ground water control is achieved where required and surface water is directed away from the excavation.

Where workmen must enter a trench or excavation carried deeper than 1.2 metres the trench or excavation must be suitably sloped and/or braced in accordance with the regulation requirements. Minimum support system requirements for steeper excavations are stipulated in Sections 235 thru 238 and 241 of the Act and Regulations and include provisions for timbering and shoring.

Although significant ground water was not encountered in the boreholes, depending on the actual ground water conditions at the time of construction, seepage from surface drainage and seepage from any preferentially permeable features in the soil should be expected. For the range in excavation depths expected, the volume of water anticipated is such that temporary pumping from properly filtered sumps located as required in the excavations should suffice to control ground water.

6.2 Depth of Frost Penetration

The design frost penetration depth for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2m or its thermal equivalent insulation is required for frost protection of foundations. All exterior footings, footings beneath unheated areas and foundations exposed to freezing temperatures should have at least such earth cover or equivalent synthetic insulation for frost protection. During winter construction exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins, heating, etc.

For buried utility lines, variations from the above noted depth of frost penetration might be considered, depending on various factors such as the type of backfilling materials or the temperature and moisture exposure of the area (prevailing winds, drifting snow, etc.). However, these variations do not generally represent a concern unless special equipment and/or buried utilities have specific requirements regarding the subsurface temperature and moisture regime (i.e., water lines or sensitive electrical utilities etc.). In such special situations further tests and analysis should be conducted on a case-by-case basis.

The depth of frost penetration is also defined as the zone of active weathering where sizeable variations in the moisture content accompany the yearly temperature fluctuations. Therefore, the foundation grades should be established at or below this depth. For the light poles and other light structures that are to be installed on a single footing, if some frost heave (25 mm to 50 mm) cannot be tolerated, the foundation elements should also be provided with the above noted minimum depth of soil cover or equivalent exterior-grade insulation.

6.3 Site Work

The soil at this site is fine-grained and will become weakened when subjected to traffic 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 fill material for site restoration or underfloor fill that is not intrinsic to the project requirements. Attempting to build slabs and pavements at this site during wet weather could significantly increase earthworks and pavement costs.

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 are 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.

6.4 Quality Control

The foundation construction must be field reviewed by the geotechnical engineer to ensure that the founding soil/rock exposed is consistent with the design bearing intended. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code 2012.

The long term performance of the pavements and any slab-on-grade structures are 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 boreholes. 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. In situ determinations of density during fill and asphaltic placement on site are required to demonstrate that the specified placement density is achieved.

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 specialist drilling contractor. The boreholes were made by a continuous flight power auger machine. A Terraprobe technician logged the boreholes and examined all of the recovered samples. The samples obtained were sealed in clean, air-tight containers and transferred to Terraprobe’s laboratory, where they were reviewed for consistency of description by a geotechnical engineer. Ground water observations were made in the borehole as drilling proceeded.

The samples of the strata penetrated were obtained using the Split-Barrel Method technique (ASTM D1586). The samples were taken at regular intervals of depth. The sampling procedure used for this investigation does not recover continuous samples of soil. Consequently there is 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 and/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.

7.2 Changes in Site and Scope

The subsurface conditions may potentially be altered with passage of time, natural occurrences, and direct or indirect human intervention at or near the site. 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 are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained 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 the Caledon 410 Developments Limited, Fieldgate Developments, and their retained design consultants, and is not intended 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. It is recognized that the Town of Caledon, 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.

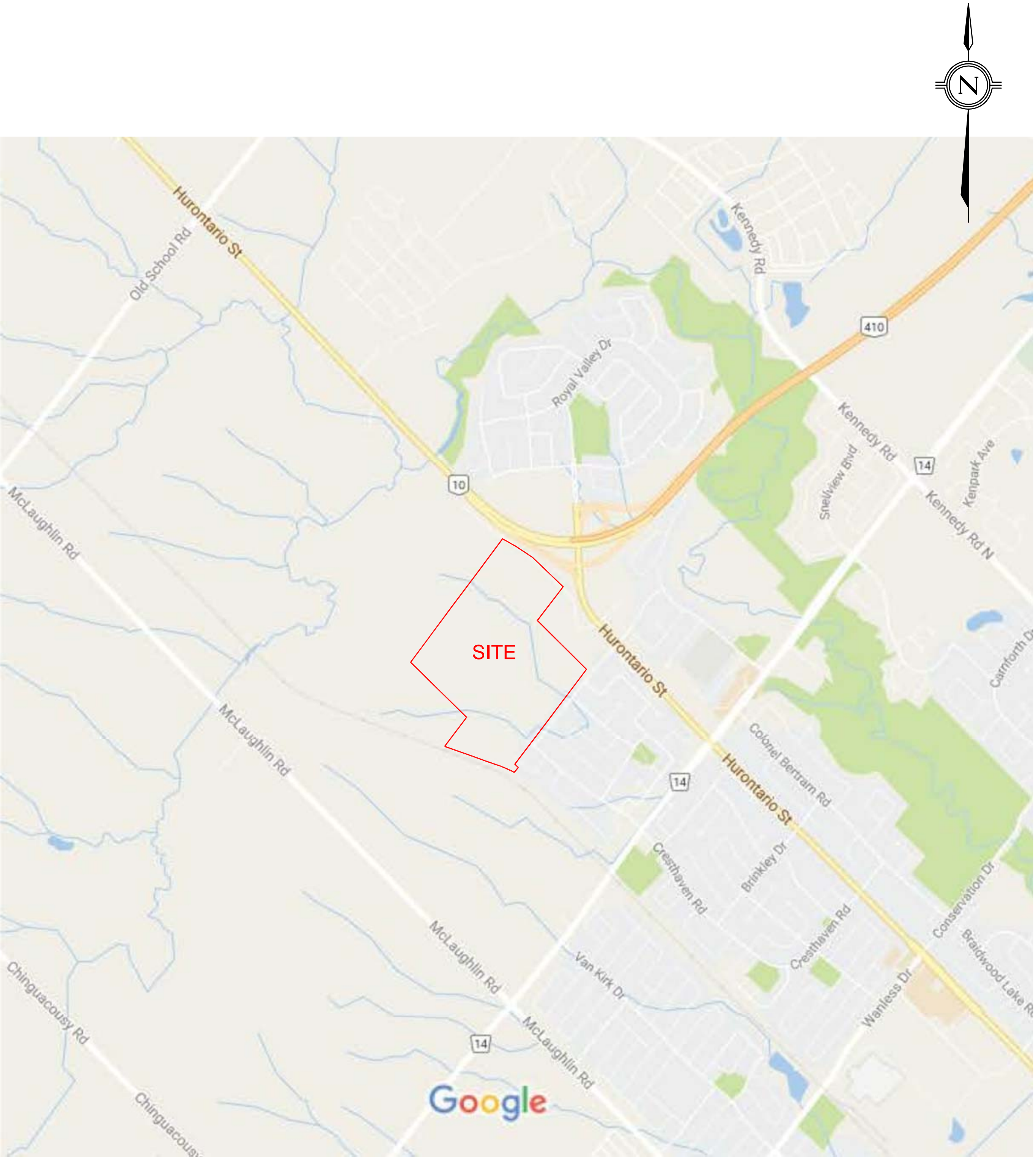
Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
P. T. CANNON
Jun 22/17
PROVINCE OF ONTARIO

Patrick Cannon, P. Eng.
Associate

FIGURES

Terraprobe Inc.



Terraprobe

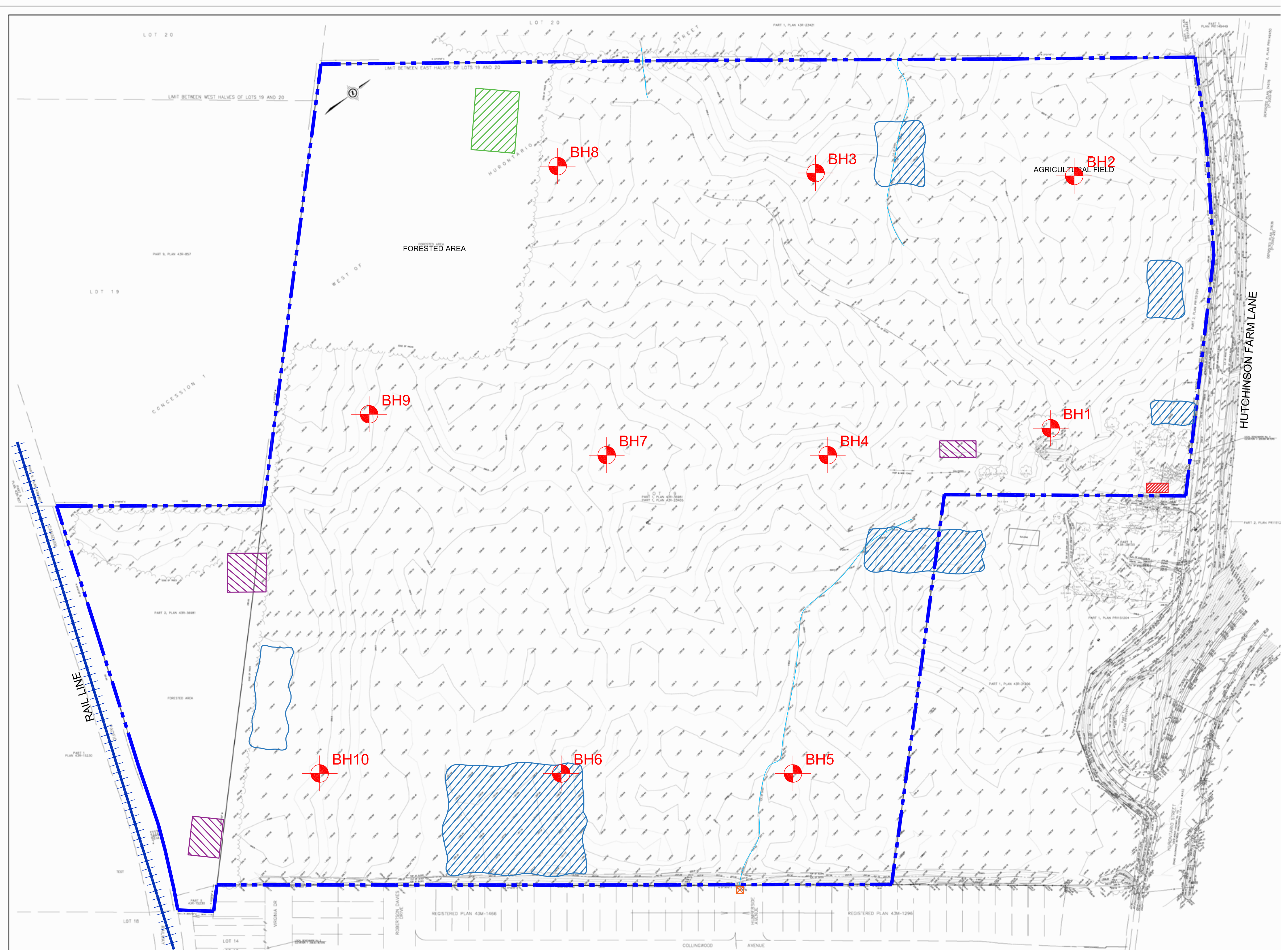
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5P5
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:

SITE LOCATION PLAN
Mayfield West Phase 2, Caledon, Ontario

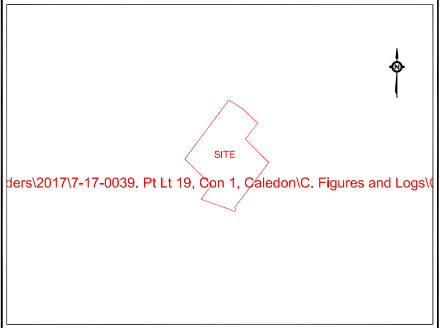
File No. 7-17-0039-01

FIGURE : 1



Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing

KEY MAP



REFERENCE:
2016 Google Maps
J.D.Barnes Ltd.

NOTES:

Client: Caledon 410 Developments Limited
c/o Fieldgate Developments

LEGEND:

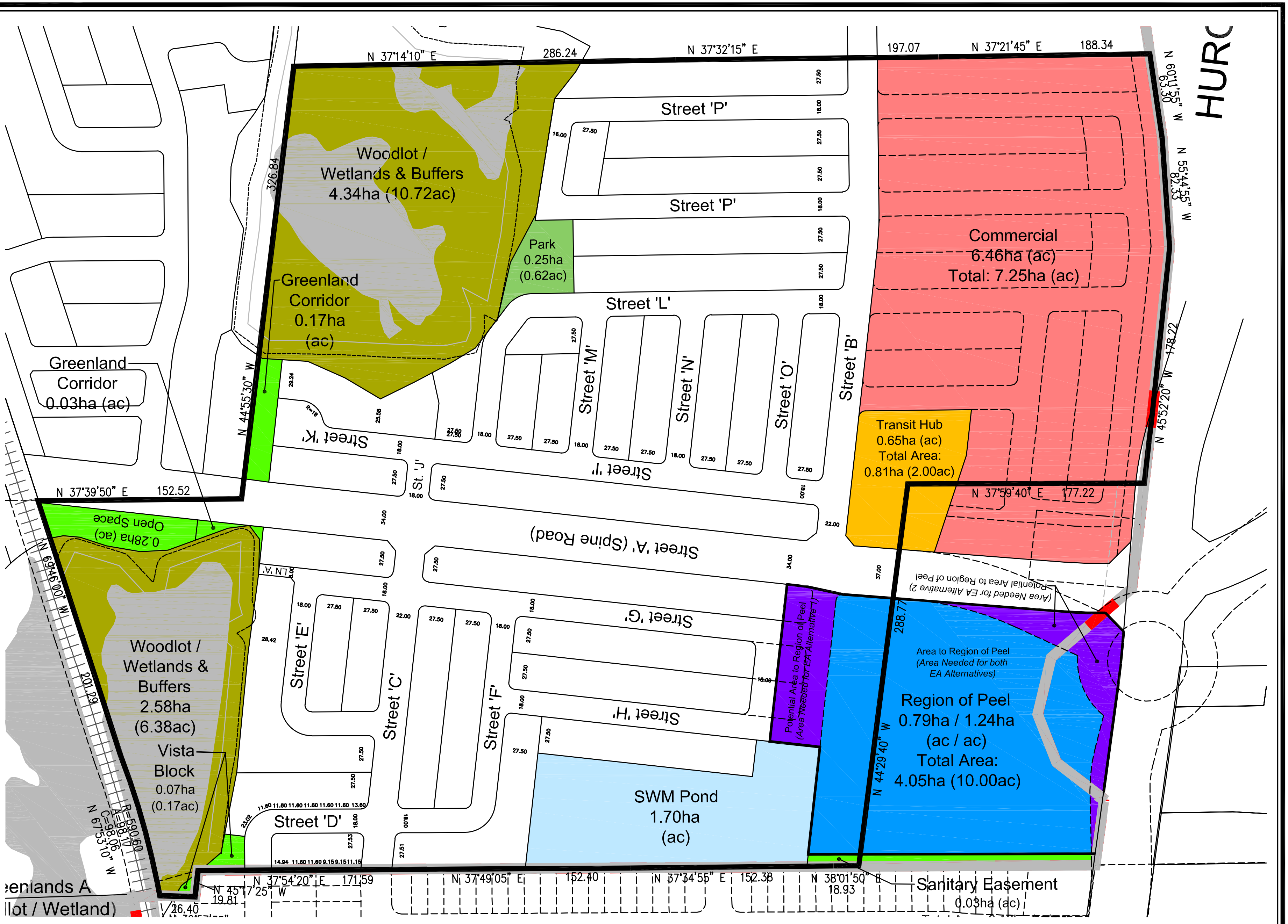
☒	City Storm Catch Basin
▨	Marsh Land
∿	Stream
▨	Scrap Pile
▨	Standing Water
⊕	Borehole Location
┼┼┼┼	Railway Line
▨	Location of Former Residence

PROJECT TITLE:
Geotechnical Investigation

SITE LOCATION:
Part Lot 19, Concession 1
Caledon, Ontario

FIGURE TITLE:
Borehole Location Plan

REV NO.: 0
FILE NO.: 7-17-0039-01
SCALE: NTS
DATE: June, 2017
FIGURE NO.: 2



Source

GLEN SCHNARR & ASSOCIATES INC.
URBAN & REGIONAL PLANNERS, LAND DEVELOPMENT CONSULTANTS
SUITE 700 10 KINGSBRIDGE GARDEN CIRCLE,
MISSISSAUGA, ONTARIO, L5R 3K6
TEL (905) 568-8888 FAX (905) 568-8894 www.gsai.ca

Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title: PROPOSED SITE DEVELOPMENT PLAN

File No. 7-17-0039-01

FIGURE : 3

LOGS OF BOREHOLES

APPENDIX A

Terraprobe Inc.

Terraprobe

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
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

Terraprobe Inc.

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

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

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

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

www.terraprobe.ca

Terraprobe

LOG OF BOREHOLE 1

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD
Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC
Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

Position : E: 4843543, N: 593875 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

Elev Depth (m)	SOIL PROFILE Description
261.3	**GROUND SURFACE**
261.1 0.2	200mm **TOPSOIL**
260.7 0.6	**CLAYEY SILT**, trace rootlets, very stiff, brown
254.7 6.6	**CLAYEY SILT**, embedded sand and gravel, very stiff, brown (GLACIAL TILL) ...becoming hard at 2.3m depth and grey at 4.6m depth

SAMPLES Number	Type	SPT 'N' Value
1	SS	13
2	SS	20
3	SS	30
4	SS	50
5	SS	49
6	SS	32
7	SS	33

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 7-17-0039-01 - mayfield west phase 2.gpj

Terraprobe

LOG OF BOREHOLE 2

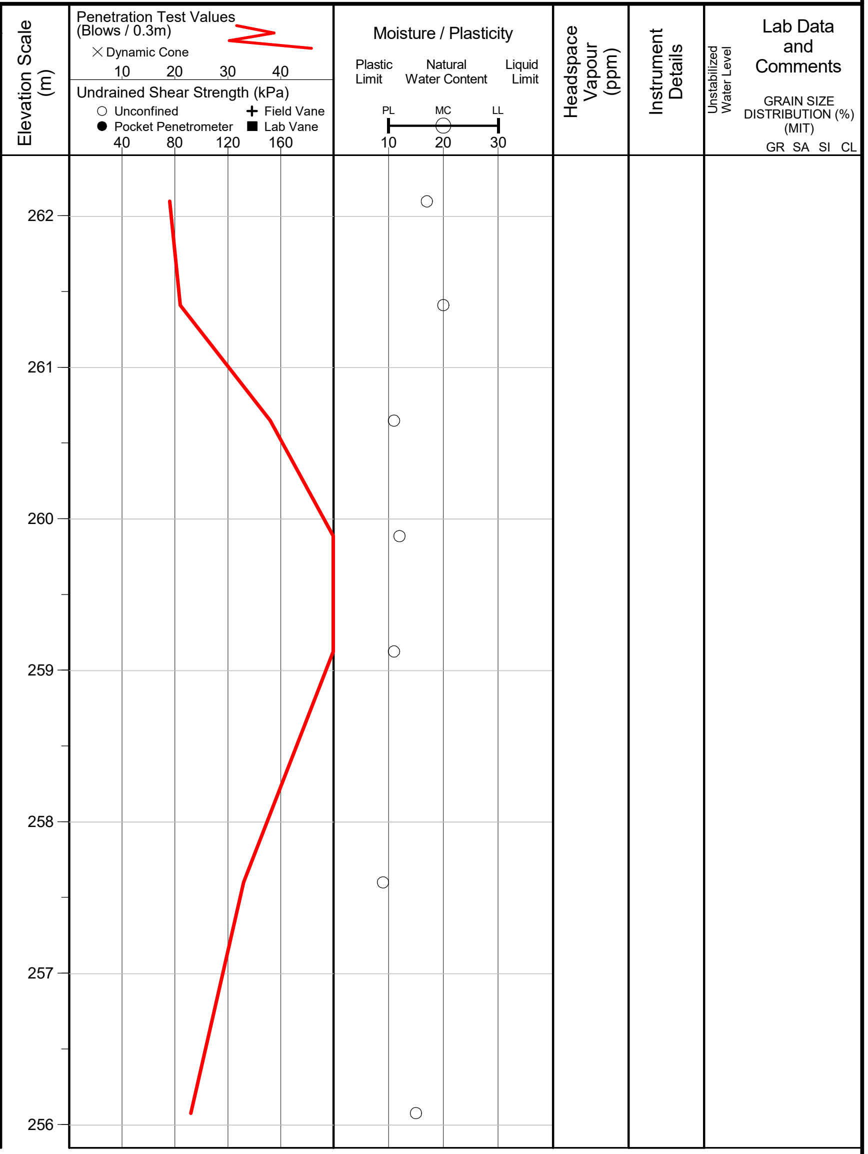
Project No. : 7-17-0039-01
Date started : June 5, 2007
Sheet No. : 1 of 1

Client : Caledon 410 Developments Limited
Project : Mayfield West Phase 2
Location : Caledon, Ontario

Originated by : WD
Compiled by : PC
Checked by : PC

Position : E: 4843697, N: 593741 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

SOIL PROFILE			SAMPLES		
Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
262.4	**GROUND SURFACE**				
262.2 0.2	200mm **TOPSOIL**				
261.8 0.6	**CLAYEY SILT**, trace rootlets, very stiff, brown		1	SS	19
255.8 6.6	**CLAYEY SILT**, embedded sand and gravel, very stiff, brown (GLACIAL TILL) ...becoming hard at 1.5m depth and grey at 4.6m depth		2	SS	21
			3	SS	38
			4	SS	50/ 100
			5	SS	57
			6	SS	33
			7	SS	23



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 7-17-0039-01 - mayfield west phase 2.gpj

Terraprobe

LOG OF BOREHOLE 3

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD

Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC

Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

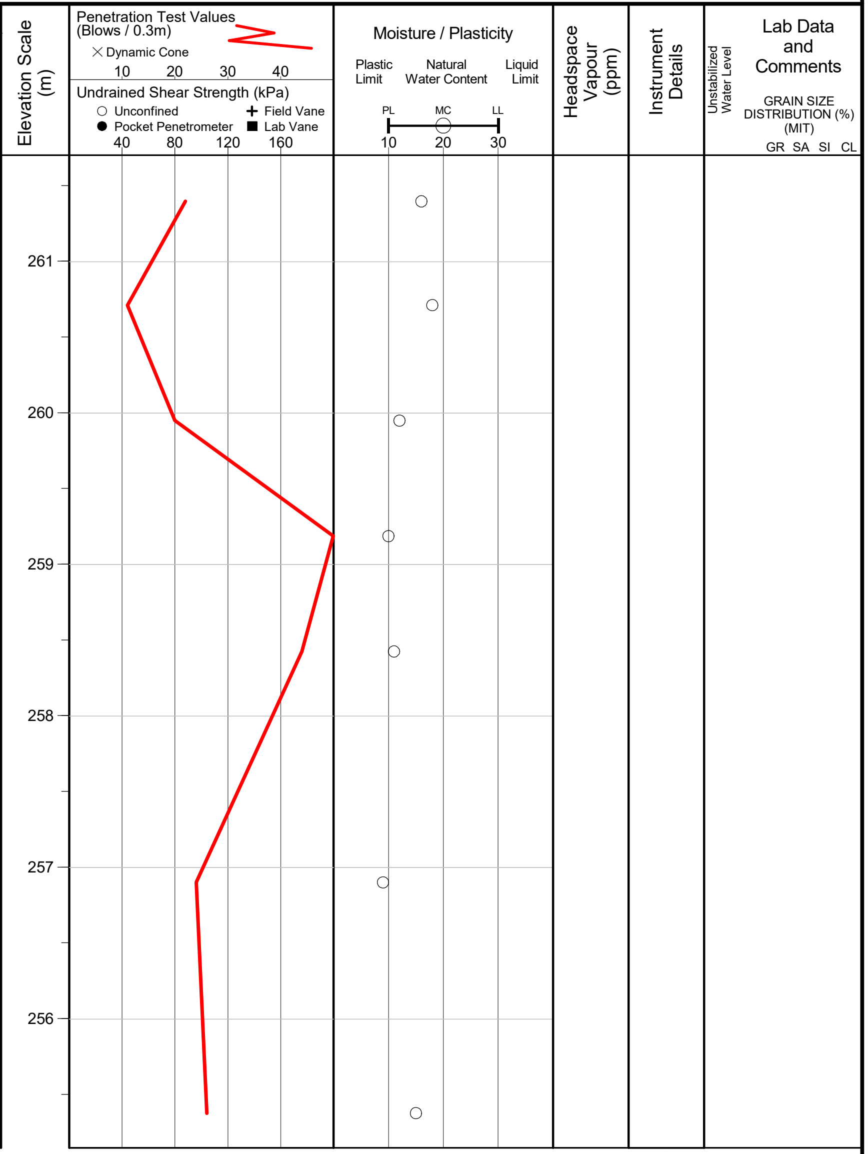
Position : E: 4843538, N: 593620 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

SOIL PROFILE

Elev Depth (m)	Description
261.7	**GROUND SURFACE**
	300mm **TOPSOIL**
261.4 0.3	**CLAYEY SILT**, trace rootlets, very stiff, brown
261.1 0.6	**CLAYEY SILT**, embedded sand and gravel, stiff to very stiff, brown (GLACIAL TILL) ...becoming hard at 2.3m depth and very stiff and grey at 4.6m depth
255.1 6.6	**END OF BOREHOLE** Borehole was dry and open upon completion of drilling.

SAMPLES

Number	Type	SPT 'N' Value
1	SS	22
2	SS	11
3	SS	20
4	SS	52
5	SS	44
6	SS	24
7	SS	26



LOG OF BOREHOLE 4

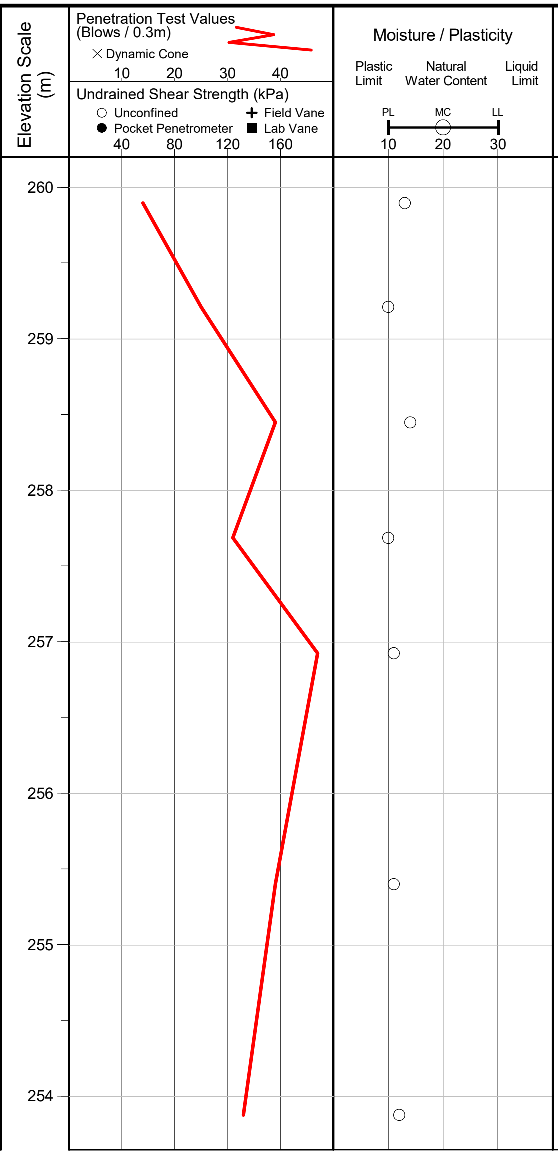
Project No. : 7-17-0039-01
Date started : June 5, 2007
Sheet No. : 1 of 1

Client : Caledon 410 Developments Limited
Project : Mayfield West Phase 2
Location : Caledon, Ontario

Originated by : WD
Compiled by : PC
Checked by : PC

Position : E: 4843414, N: 593790 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
260.2	**GROUND SURFACE**			
	200mm **TOPSOIL**			
260.0 0.2	**CLAYEY SILT**, trace rootlets, very stiff, brown	1	SS	14
259.6 0.6	**CLAYEY SILT**, embedded sand and gravel, very stiff, brown (GLACIAL TILL)	2	SS	25
	...becoming hard at 1.5m depth and grey at 4.6m depth	3	SS	39
		4	SS	31
		5	SS	47
		6	SS	39
		7	SS	33
253.6 6.6	**END OF BOREHOLE**			



Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

Borehole was dry and open upon completion of drilling.

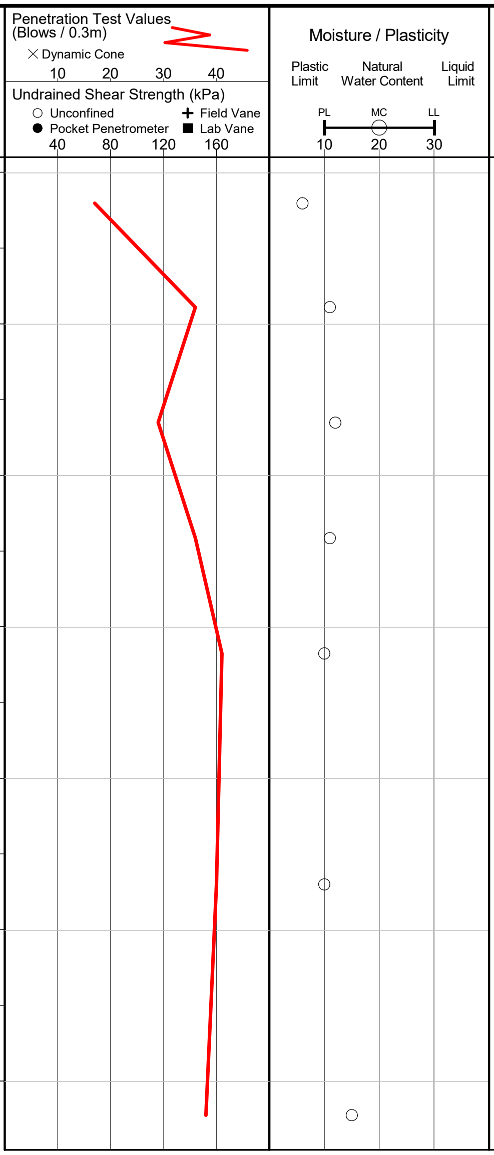
Terraprobe

LOG OF BOREHOLE 5

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD
Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC
Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

Position : E: 4843249, N: 593961 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	**258.1**	**GROUND SURFACE**				
		300mm **TOPSOIL**				258
	257.8 0.3	**CLAYEY SILT**, trace rootlets, very stiff, light brown	1	SS	17	
	257.3 0.8	**CLAYEY SILT**, embedded sand and gravel, hard, brown (GLACIAL TILL)				
1			2	SS	36	257
			3	SS	29	
2						256
			4	SS	36	
3						255
			5	SS	41	
4						254
			6	SS	40	
5						253
6						252
		...becoming grey at 6.1m depth	7	SS	38	
	251.5 6.6					



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

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 7-17-0039-01 - mayfield west phase 2.gpj

Terraprobe

LOG OF BOREHOLE 6

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD

Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC

Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

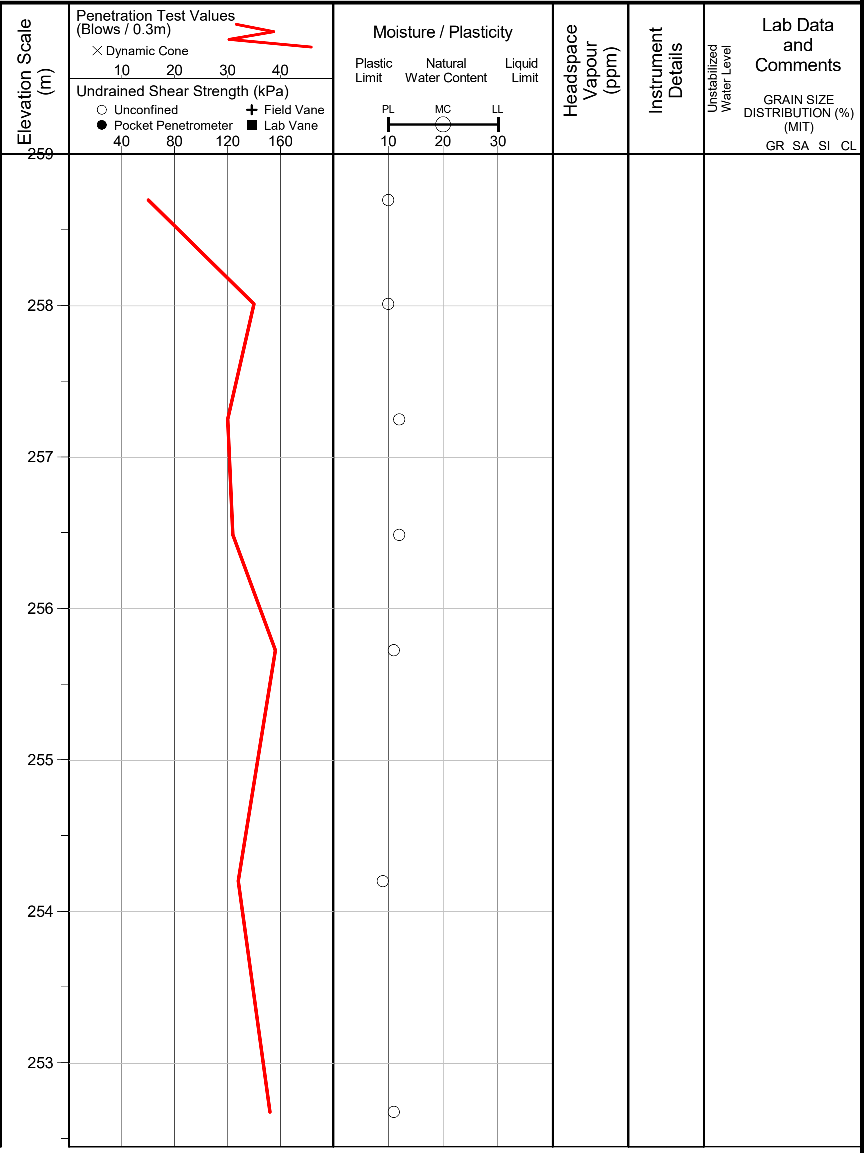
Position : E: 4843122, N: 593862 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

SOIL PROFILE

Elev Depth (m)	Description
259.0	**GROUND SURFACE**
	100mm **TOPSOIL**
	CLAYEY SILT, trace rootlets, trace sand, very stiff, light brown
258.4 0.6	**CLAYEY SILT**, embedded sand and gravel, hard, brown (GLACIAL TILL) ...becoming grey at 4.6m depth
252.4 6.6	

SAMPLES

Number	Type	SPT 'N' Value
1	SS	15
2	SS	35
3	SS	30
4	SS	31
5	SS	39
6	SS	32
7	SS	38



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 7-17-0039-01 - mayfield west phase 2.gpj

Terraprobe

LOG OF BOREHOLE 7

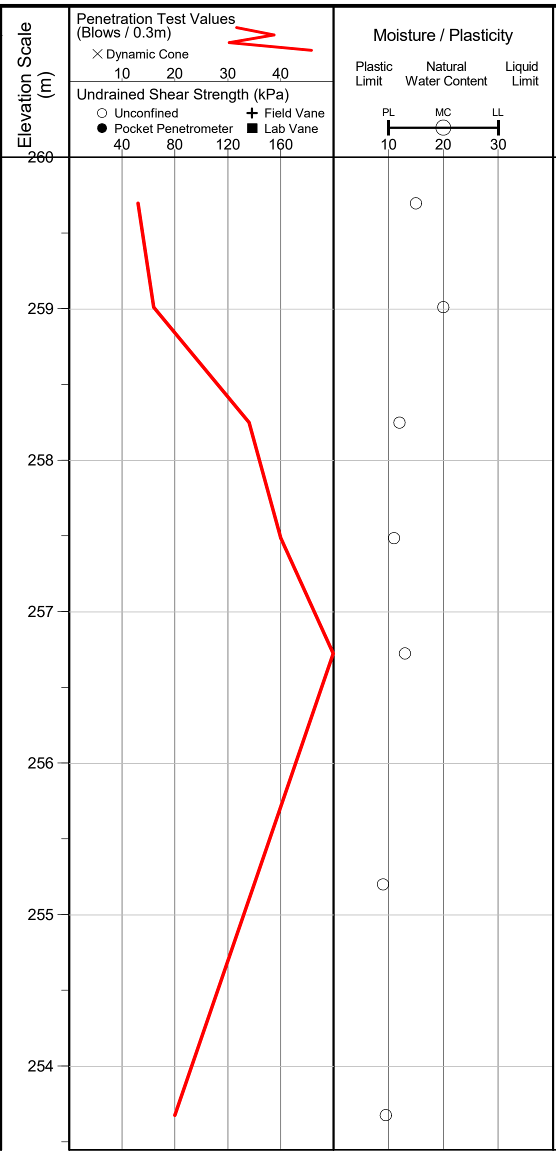
Project No. : 7-17-0039-01
Date started : June 5, 2007
Sheet No. : 1 of 1

Client : Caledon 410 Developments Limited
Project : Mayfield West Phase 2
Location : Caledon, Ontario

Originated by : WD
Compiled by : PC
Checked by : PC

Position : E: 4843285, N: 593691 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
0	**260.0**	**GROUND SURFACE**				
	259.8	200mm **TOPSOIL**				
	0.2	**FILL**, sandy silt, trace gravel, trace topsoil, trace wood fragments, stiff, brown and grey		1	SS	13
1	259.1 0.9	**CLAYEY SILT**, embedded sand and gravel, hard, brown (GLACIAL TILL)		2	SS	16
2				3	SS	34
				4	SS	40
3				5	SS	57
4						
5		...becoming grey at 4.6m depth and stiff at 6.1m depth		6	SS	35
6				7	SS	20
	253.4 6.6					



Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

file: 7-17-0039-01 - mayfield west phase 2.gpj

LOG OF BOREHOLE 8

Project No. : 7-17-0039-01
Date started : June 5, 2007
Sheet No. : 1 of 1

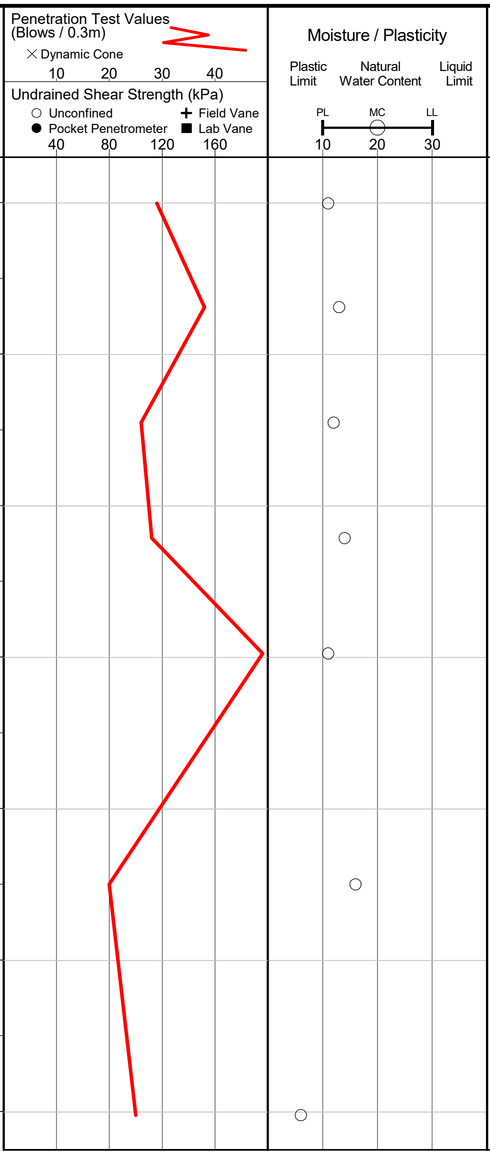
Client : Caledon 410 Developments Limited
Project : Mayfield West Phase 2
Location : Caledon, Ontario

Originated by : WD
Compiled by : PC
Checked by : PC

Position : E: 4843384, N: 593502 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

SOIL PROFILE		SAMPLES			
Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Elevation Scale (m)
262.3	**GROUND SURFACE**				
262.1 0.2	150mm **TOPSOIL**				
	CLAYEY SILT, embedded sand and gravel, very stiff to hard, brown (GLACIAL TILL)	1	SS	29	262
		2	SS	38	261
		3	SS	26	
		4	SS	28	260
		5	SS	49	259
					258
	...becoming grey at 4.6m depth	6	SS	20	257
		7	SS	25	256
255.7 6.6	**END OF BOREHOLE**				

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6



Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

LOG OF BOREHOLE 9

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD
Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC
Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

Position : E: 4843160, N: 593550 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

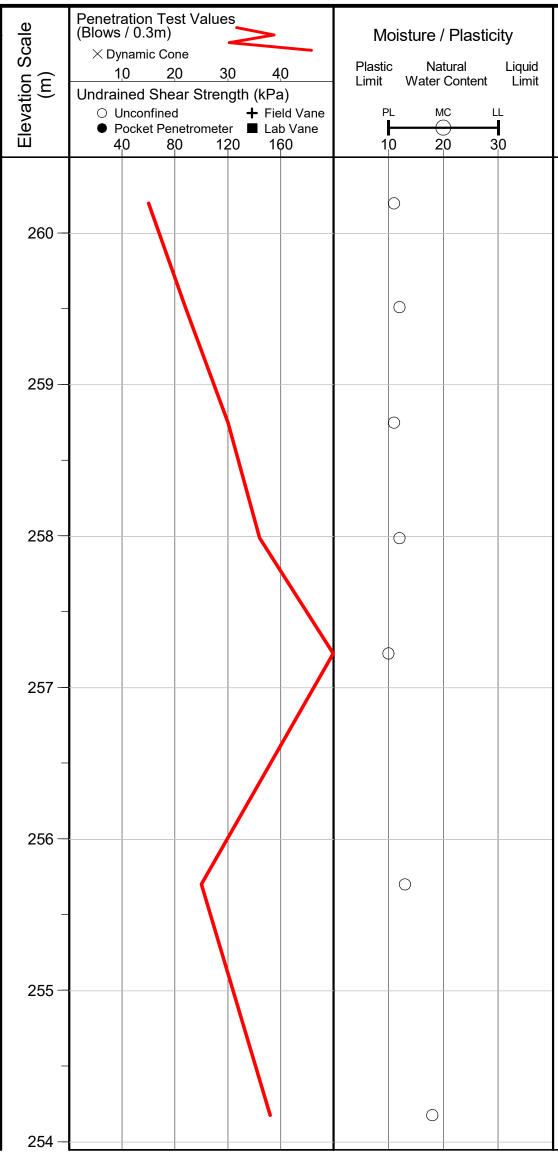
SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description
0	260.5	**GROUND SURFACE**
	260.3 0.2	200mm **TOPSOIL**
		CLAYEY SILT, embedded sand and gravel, very stiff to hard, brown (GLACIAL TILL)
		...becoming grey at 4.6m depth
	253.9 6.6	**END OF BOREHOLE**

Borehole was dry and open upon completion of drilling.

SAMPLES

Number	Type	SPT 'N' Value
1	SS	15
2	SS	22
3	SS	30
4	SS	36
5	SS	72
6	SS	25
7	SS	38



Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

file: 7-17-0039-01 - mayfield west phase 2.gpj

Terraprobe

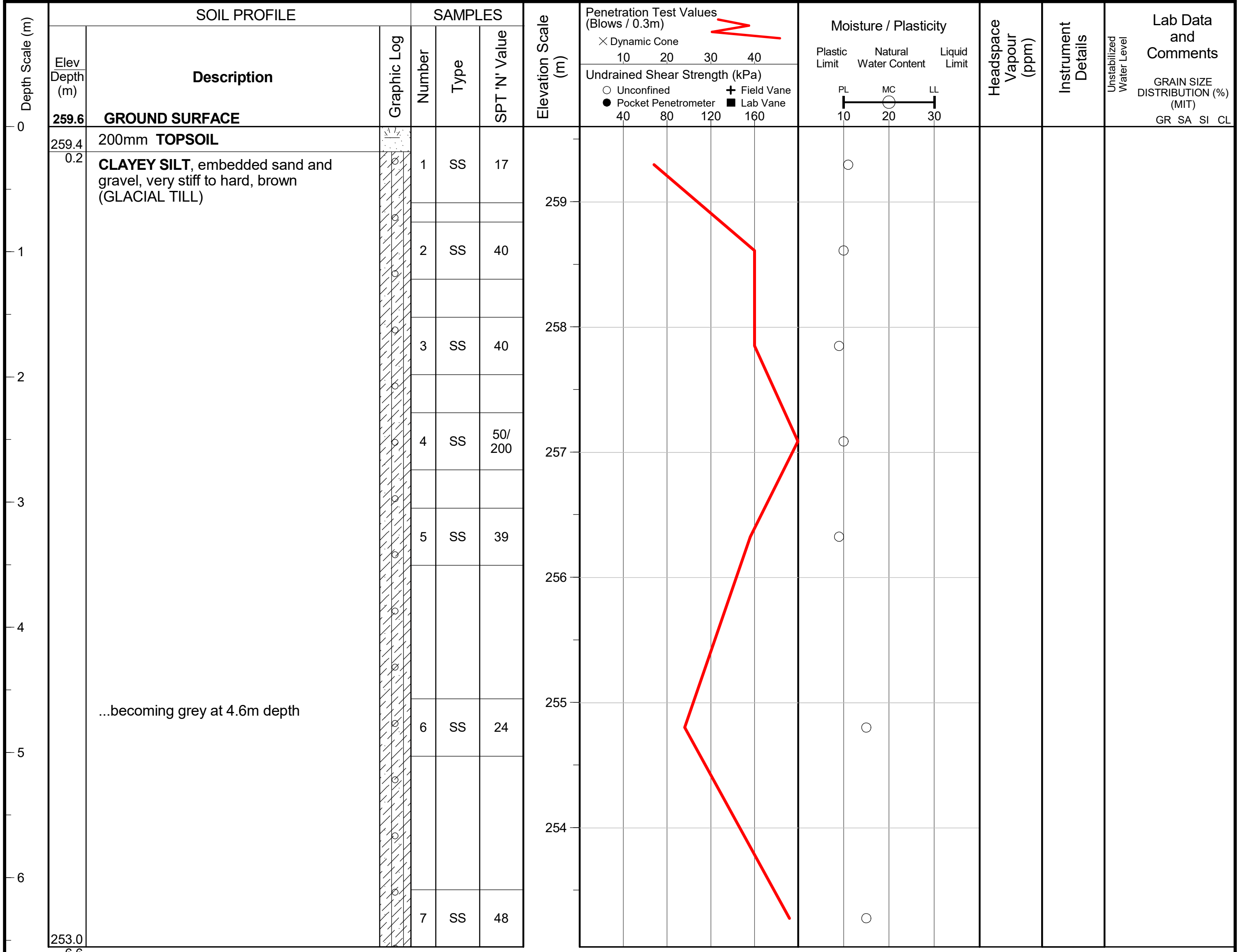
LOG OF BOREHOLE 10

Project No. : 7-17-0039-01
Client : Caledon 410 Developments Limited
Originated by : WD
Date started : June 5, 2007
Project : Mayfield West Phase 2
Compiled by : PC
Sheet No. : 1 of 1
Location : Caledon, Ontario
Checked by : PC

Position : E: 4842971, N: 593745 (UTM 17T)
Elevation Datum : Geodetic (NAD83)

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
259.6	**GROUND SURFACE**			
259.4 0.2	200mm **TOPSOIL**			
	CLAYEY SILT, embedded sand and gravel, very stiff to hard, brown (GLACIAL TILL)	1	SS	17
		2	SS	40
		3	SS	40
		4	SS	50/200
		5	SS	39
	...becoming grey at 4.6m depth	6	SS	24
		7	SS	48
253.0 6.6	**END OF BOREHOLE**			

Borehole was dry and open upon completion of drilling.



file: 7-17-0039-01 - mayfield west phase 2.gpj

“DRAFT” ENGINEERED FILL EARTHWORKS SPECIFICATIONS

APPENDIX B

Terraprobe Inc.

ENGINEERED FILL
EARTHWORKS SPECIFICATIONS

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 building foundations without excessive settlement. 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.

Engineered fill is a suitable and economical method to support building foundations in areas of deep filling or large grade changes. The building foundations can consist of conventional shallow spread footings constructed on engineered fill which extends down to competent and stable native soil capable of supporting the engineered fill and foundation loads without excessive settlement.

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

The work covered by this section includes the furnishing of all labour, materials, equipment and incidentals for the construction of engineered fill, as shown on the Design Drawings prepared by the Design Civil Engineer and as described by these specifications. The work included in this section consists of, but is not limited to, 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 (with a heavy rubber-tired equipment such as a grader or loaded dump truck) 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 Contractor

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 Contractor must have the necessary experience for the project and have successfully completed projects of similar scope and size.

1.03 The Geotechnical Engineer

A) 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.

B) The Geotechnical Engineer must have the necessary experience for the project and have successfully completed projects of similar scope and size.

1.04 The Design Civil Engineer

A) 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 buildings on the site, and the choice of lots and site areas to receive Engineered fill.

B) The Design Civil Engineer must have the necessary experience for the project and have successfully completed projects of similar scope and size.

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 200 to 400 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 should 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 200 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 Standard

A) The Geotechnical Engineer is responsible for providing a design that shall consider the external stability, internal stability, and local stability, including global stability, total and differential settlement.

B) 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;

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.

3.02 Design Foundation Pressure

A) Unless otherwise stated, the engineered fill is to be placed over the entire lot area or site area.

B) 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.

C) An allowable design foundation pressure of 150 kPa is typically recommended for the engineered fill. Foundations shall have minimum widths of 600 mm for continuous strip footings, and minimum dimensions of 900 mm for column footings.

D) 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 to the base of the engineered fill.

E) Foundations placed on the engineered fill must be provided with nominal reinforcing steel for stiffening of strip footing foundations and for protection against excessive minor cracking of the concrete strip footing foundations. 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.

F) 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 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 final ground elevations shall be surveyed and recorded on a regular grid pattern.

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 using a heavy rubber-tired vehicle such as a loaded grader or dump truck. 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).

C) The engineered fill must be placed in maximum loose lift thicknesses of 200 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.