Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT
6463 TRAFALGAR ROAD
MILTON, ONTARIO

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1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by York Trafalgar Management Corp. on behalf of TRGI West Properties Inc. c/o Ruland Properties Inc. to carry out a preliminary geotechnical investigation at 6463 Trafalgar Road in Milton, 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 April 26, 2022. Authorization to proceed with the work was provided by York Trafalgar Management Corp. on April 27, 2022. It is understood that the investigation is required for due diligence purposes related to the proposed high density residential development being considered on the property.

The purpose of the work was to investigate and report on the subsurface soil and ground water conditions in a series of boreholes drilled at the site. Based on the information, advice is provided with respect to the geotechnical aspects of the proposed development, including the design of foundations, and floor slabs-on-grade, site servicing and pavement design. The anticipated construction conditions pertaining to excavation, backfill and temporary ground water control are also discussed, but only with regard to how these might influence the design.

Phase I & II Environmental Site Assessments (ESAs) were carried out by Terraprobe prior and concurrently to this geotechnical investigation and have been reported under separate cover.

2.0 SITE DESCRIPTION

2.1 Existing Conditions

The existing site features are shown on Figure 2, as derived from a Google Earth image of the property, dated June 2019. The Property is an irregular shaped parcel of land with an area of approximately 4.1 hectares (10.2 acres). For discussion purposes, Trafalgar Road is assumed to be aligned in a north-south direction. The Property has frontage along the east side of Trafalgar Road of approximately 116 m, and extends to the east approximately 300 m. The Property is currently occupied by a residential dwelling and agricultural land. A gravel driveway extends east through the central portion of the Property and leads to a telephone tower located on the southeast corner of the Property.

2.2 Site Geology

Based on public geological mapping the subsurface conditions beneath the site are expected to generally consist of Pleistocene age, Late Wisconsinan Halton Till: red to brown, gritty to clayey silt till[1].The

1 *Quaternary Geology, Brampton Area, Southern Ontario*; Ontario Geological Survey; Map No. 2223; 2005.

overburden is underlain by bedrock of the Queenston Formation[2]. The Queenston Formation consists of reddish brown shale, interbedded with limestone and calcareous sandstone. The regional well records indicate that the bedrock beneath the site could be about 10 to 15 metres below ground surface (m BGS).

2.3 Proposed Development

Development plans for the Property were not available at the time of the assessment, the preliminary geotechnical investigation was completed for due diligence purposes. Correspondence with the client indicated that the proposed development would consist of a high-density residential development. Once development plans have been finalized Terraprobe will recommend further investigation, if applicable, and will revise the geotechnical report.

3.0 PROCEDURE

The field work for this investigation was carried out between May 2nd and 4th, 2022, during which time six (6) boreholes were drilled to depths of about 6.1 m BGS. The locations of the boreholes are shown on the Borehole Location Plan, Figure 2. The results of the boreholes are shown on the Log of Borehole sheets presented in Appendix A. A list of abbreviations and symbols are provided to assist in the interpretation of the borehole logs.

The boreholes were drilled using track mounted power auger equipment supplied and operated by a specialist drilling contractor. The boreholes were advanced using conventional solid stem continuous flight augers. The samples of the strata were obtained using the Split-Barrel Method (ASTM D1586). After the drilling, sampling, and logging were completed, the boreholes were backfilled with auger cuttings and bentonite sealant in accordance with Ontario Regulation 903.

Ground water observations were made in each borehole during and upon completion of drilling and sampling. Three (3) ground water monitoring wells were installed as part of the concurrent Phase II ESA.

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 locations of the boreholes were located in the field by Terraprobe personnel with respect to the existing site features. The elevations of the boreholes on the property were surveyed by Terraprobe using a Trimble R10 survey system. The Trimble R10 is a differential global positioning system (GPS) which involves the cooperation of two receivers, one that's stationary and another that's roving around making position measurements.

[2] *Paleozoic Geology, Brampton Area, Southern Ontario*; Ontario Division of Mines; Map No. 2337; 1976.

All of the samples recovered during the course of the investigation were brought to our Stoney Creek laboratory for further examination and water content determinations. The results of moisture content tests and four (4) grain size analyses carried out on selected soil samples are shown in Appendix A.

4.0 SUBSURFACE CONDITIONS

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. They generally represent a transition from one soil type to another and should not be inferred to represent exact planes of geological change. Further, conditions will vary 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 surficial topsoil and fill material overlying clayey silt glacial till, silts and sands, and a lower clayey silt glacial till stratum.

4.1.1 Topsoil

Boreholes 1, 2, 5 and 6 encountered between 75 mm and 900 mm of surficial topsoil.

4.1.2 Earth Fill

Underlying the topsoil, Boreholes 1, 2, and 6 encountered earth fill extending to depths of 0.8 to 1.8 m BGS (Elev. 186.8 to 187.8 masl). The earth fill generally consisted of silty sand with varying amounts of gravel. The silty sand earth fill was generally brown and moist.

Boreholes 3 and 4 encountered earth fill at the surface, extending to depths of 0.9 to 1.8 m BGS. The earth fill at Boreholes 3 and 4 consisted of clayey silt with trace to some sand, rootlets and intermixed topsoil, and was generally brown and moist.

4.1.3 Upper Clayey Silt (Glacial Till)

Underlying the topsoil and earth fill all boreholes encountered a stratum of clayey silt glacial till with trace sand and gravel extending to depths of 3.8 to 6.7 m BGS (Elev. 181.7 to 184.9 masl). The clayey silt till was generally brown and moist, turning grey and wet between 3.0 and 3.8 m BGS. Wet sand seams within the clayey silt glacial till were observed between 4.3 and 4.9 m in Boreholes 1, 2, 3 and 5. Boreholes 1, 2, and 3 were terminated within this stratum. Standard Penetration testing carried out within the clayey silt till determined N values ranging from 13 to greater than 50 blows per 0.3 m, indicating a stiff to hard consistency. The in-situ water content of the samples of clayey silt till recovered from the boreholes ranged from approximately 9 to 26 percent

4.1.4 Silts and Sands

Underlying the clayey silt glacial till, Borehole 4 encountered a stratum of sandy silt with trace gravel, extending to a depth of 6.7 m BGS (Elev. 182.9 masl), which was the termination depth of the borehole. The silty sand was generally grey and wet. Standard Penetration Testing carried out within the silty sand glacial till indicated a single N value of 41, indicating a dense state of packing. The in-situ water content of the silty sand glacial till was approximately 12 percent.

Underlying the clayey silt glacial till, Boreholes 5 and 6 encountered a stratum of silty to sandy silt, extending to depths of 4.6 to 6.4 m BGS (Elev. 182.1 to 183.6 masl). The silt was generally grey and wet. Standard Penetration Testing carried out within the silt indicated N value ranging from 15 to 21 blows per 0.3 m, indicating a compact state of packing. The in-situ water content of the silt ranged from approximately 18 to 25 percent.

4.1.5 Lower Clayey Silt (Glacial Till)

Underlying the silt/sandy silt, Boreholes 5 and 6 encountered a lower stratum of clayey silt glacial till with trace sand and gravel extending to depths of 6.7 m BGS (Elev. 181.5 to 181.8 masl). The lower clayey silt till was generally grey and moist. Boreholes 5 and 6 were terminated within this stratum. Standard Penetration testing carried out within the lower clayey silt till determined N values ranging from 29 to greater than 50 blows per 0.3 m, indicating a very stiff to hard consistency. The in-situ water content of the samples of clayey silt till recovered from the boreholes ranged from approximately 11 to 14 percent.

4.2 Ground Water Conditions

Unstabilized ground water level observations were made in the open boreholes during and after drilling, as noted on the borehole logs. The water level measured within the installed wells is summarized below and are shown on the corresponding log of borehole sheet in Appendix A.

BH	Elevation of Well Screen (m)	Stratum Captured by Well Screen	Depth (m BGS) / Elevation of Water Level in Well (m)		
			During Drilling	May 17, 2022	May 26, 2022
1	185.6-182.5	Clayey Silt Glacial Till	4.9/183.7	1.8/186.8	1.9/186.7
2	185.6-182.5	Clayey Silt Glacial Till	4.3/184.3	1.8/186.8	1.9/186.7
5	185.5-182.4	Clayey Silt Glacial Till/Sandy Silt	4.9/183.6	1.6/186.9	1.8/186.7

5.0 GEOTECHNICAL DESIGN

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.

Development plans for the Property were not available at the time of the assessment, the preliminary geotechnical investigation was completed for due diligence purposes. Correspondence with the client indicated that the proposed development would consist of a high-density residential development. Once development plans have been finalized Terraprobe will recommend further investigation, if applicable, and will revise the geotechnical report.

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. The pertinent sections of the Ontario Building Code (2012) may require additional considerations beyond the recommendations provided in this report and should be referred. If there are any changes to the site development features, or if there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Site Preparation Works

At the time of the investigation the grading plan for the site had not yet been developed, however it can be expected that some cutting and/or filling will be required prior to construction. Any fill that will be required in areas to be developed for foundations or 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. The design aspects of the engineered fill are discussed below.

All topsoil and existing earth fill must be stripped from areas designated to receive engineered fill. The exposed subgrade soil should then be proof rolled and any soft or wet areas which deflect excessively during the proof roll should be sub-excavated.

Engineered fill required to restore grade or to achieve the site grading plan must consist of clean earth materials, free of topsoil, rubble, wood, plant materials etc. and at a suitable placement water content to consistently achieve the compaction requirements outlined below.

Selective re-use of excavated soil consisting of the underlying native soils from the site for engineered fill may be feasible subject to the weather conditions at the time of construction. For this reason, we do not recommend undertaking pre-grading activities during spring or spring-like conditions.

Imported earth for use as engineered fill must meet the applicable MECP site condition standards for the site as established in a Phase Two Environmental Site Assessment (ESA), as well as the physical requirements outlined above. If a Phase Two ESA is not available, MECP Table 1 standards should be used as the acceptance criteria. Alternatively, consideration could be given to using OPSS 1010 Granular B Type II material from a commercial source. Source acceptance testing of materials imported for use as engineered fill must be carried out prior to the importation to the site.

Engineered fill must be placed and uniformly compacted in 200 mm thick lifts to at least 98 percent of standard Proctor maximum dry density. 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. The limits of any engineered fill can best be determined by the geotechnical engineer during construction. Engineered fill will need to extend laterally a sufficient distance to develop adequate lateral resistance for foundations and pavements. The lateral distance required can be calculated by assuming a 10 horizontal to 7 vertical line extending down and away from the outer edge of the underside of any foundations, floor slabs and pavements constructed in engineered fill. Benches should be cut into the existing slopes at a maximum 600 mm height to allow placement of new fill in a horizontal manner.

All aspects of engineered fill construction including final excavation, material selection, placement and compaction must be verified by the geotechnical engineer. In-situ density testing is required during construction to confirm that each lift has been compacted to the specified degree and that the placement moisture content is within an acceptable range.

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

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

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

5.2 Building Foundations

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 and sandy silt to silty sand/silt till or engineered fill.

5.2.1 Conventional Spread Footings

Conventional spread footings must be founded at least 0.3 m into the undisturbed clayey silt or 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

BH No.	Minimum Depth below existing grade (m)	Geodetic Ground Surface Elevation (m)	Allowable Bearing Pressure (kPa)		Bearing Stratum
			SLS	ULS	
BH 1	2.1	186.5	200	300	Clayey Silt Till
BH 2	1.8	186.6	200	300	Clayey Silt Till
BH 3	1.8	186.8	200	300	Clayey Silt Till
BH 4	2.1	187.5	200	300	Clayey Silt Till
BH 5	1.1	187.4	200	300	Clayey Silt Till
BH 6	1.1	187.1	200	300	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 undisturbed soil 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 require substantial 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 200 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 Site Classification for Seismic Site Response

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 are intended to 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 2012 Ontario Building Code (OBC 2012) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 s, 0.5 s, 1.0 s and 2.0 s 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 (su)) in the top 30 meters of the site stratigraphy below the foundation level, as set out in Table 4.1.8.4A of the Ontario Building Code (2012). 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 Table 4.1.8.4.A of the Ontario Building Code (2012). 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 of the OBC 2012, as amended January 1, 2020, using linear interpolation for intermediate values of PGA.

5.4 Floor Slabs on Grade

Depending on the final site grading levels selected, the subgrade for slab on grade construction could consist of clayey silt till and/or engineered fill. The moduli of subgrade reaction appropriate for slab on grade design on the aforementioned soils are as follows:

- Engineered fill: 18,000 kPa/m
- Undisturbed clayey silt till: 25,000 kPa/m

Concrete floor slabs should be placed on at least 150 mm of granular base (OPSS Granular A or 19 mm crusher run limestone) compacted to a minimum of 95 percent of standard Proctor maximum dry density. Prior to the placement of the granular materials, the subgrade should be assessed by a geotechnical engineer or its representative. Any incompetent subgrade areas as identified must be subexcavated and backfilled with suitable compacted clean earth fill materials. Similarly, any soft or wet areas should also be subexcavated and be backfilled with suitably compacted clean earth fill. The granular fill base should be placed either on the undisturbed native subgrade or clean earth fill compacted to at least 95 percent of standard Proctor maximum dry density.

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.

5.5 Earth Pressure Design Considerations

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: $R = N \tan \phi$. 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.

5.6 Basement Drainage

The basement wall must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the current 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 such as Miradrain 2000 (Mirafi) or Terradrain 200 (Terrafix). The flow to the building storm water sump from the subsurface drainage will be governed largely by the building perimeter drainage collection during rainfall and runoff events.

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 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. Outlet provisions must conform to the plumbing code requirements.

5.7 Site Servicing

It is expected that site services will consist of storm and sanitary sewers and watermains, with relatively shallow inverts (less than 3 m). The invert elevation is expected to be within the undisturbed clayey silt till stratum. Excavations for underground services should be made as outlined in Section 6.1 of this report.

The locations and depths of any building foundations which would potentially be affected by the proposed utilities should be identified prior to commencing the excavation.

5.7.1 Bedding

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

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.

5.7.2 Backfill

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 standard Proctor maximum dry density in non-settlement sensitive areas and 98 percent of standard Proctor maximum dry density in settlement sensitive areas. If narrow trenches are constructed in areas where the subgrade integrity is important, then use of compacted granular fill is recommended for backfill.

5.8 Pavement Design

5.8.1 Subgrade Preparation

Earth fills or disturbed soil strata, consisting predominantly of clayey silt till, were encountered immediately beneath the ground cover in most of the boreholes. 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 Sections 6.1 and 6.4.

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 uniformly compacted by a heavy sheep-foot type roller in maximum 200 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 standard Proctor maximum dry density.

The most severe loading conditions on 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 are highly susceptible to frost heave, and pavements constructed 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 and Pertinent City Specifications)	92% MRD	40 mm
Base Course Asphaltic Concrete HL8 (OPSS 1150 and Pertinent City Specifications)	92% MRD	80 mm
Base Course: Granular A or 19mm Crusher Run Limestone (OPSS.MUNI 1010 and Pertinent City Specifications)	98% standard Proctor Maximum Dry Density (ASTM-D1557)	150 mm
Subbase Course: Granular B Type II or 50mm Crusher Run Limestone (OPSS.MUNI 1010 and Pertinent City Specifications)	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 200 mm thick or less, and compacted to a minimum of 98 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 municipal specifications. Municipal 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.

6.0 DESIGN CONSIDERATIONS FOR CONSTRUCTABILITY

6.1 Excavations

6.1.1 Topsoil

Topsoil was encountered at the ground surface at all test pit locations and varied in thickness between about 75 and 800 mm. The variability is likely due to tilling operation as part of the site agricultural activities.

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.

6.1.2 Overburden Soil

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, Sections 222 through 242. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes, the clayey silt soils at this site should be 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.

Ground water was encountered in the monitoring wells installed at the site. Depending on the actual ground water conditions at the time of construction, seepage from surface drainage and seepage from any 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 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

Grading plans based on topsoil thicknesses as indicated on the borings must be accompanied by a clear contractual definition of stripping depths. If clear direction is not provided, material may be removed as topsoil that is not intrinsic to the engineering or project requirements. This could result in the addition of fill to meet site grade requirements.

The foundation construction must be field reviewed by the geotechnical engineer to ensure that the founding soil 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 RISKS

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 Stoney Creek 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 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 was prepared for the express use of York Trafalgar Management Corp., TRGI West Properties Inc. c/o Ruland Properties Inc. 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 Inc. TRGI West Properties Inc. c/o Ruland Properties Inc. and their retained design consultants are authorized users. It is recognized that the Town of Milton will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

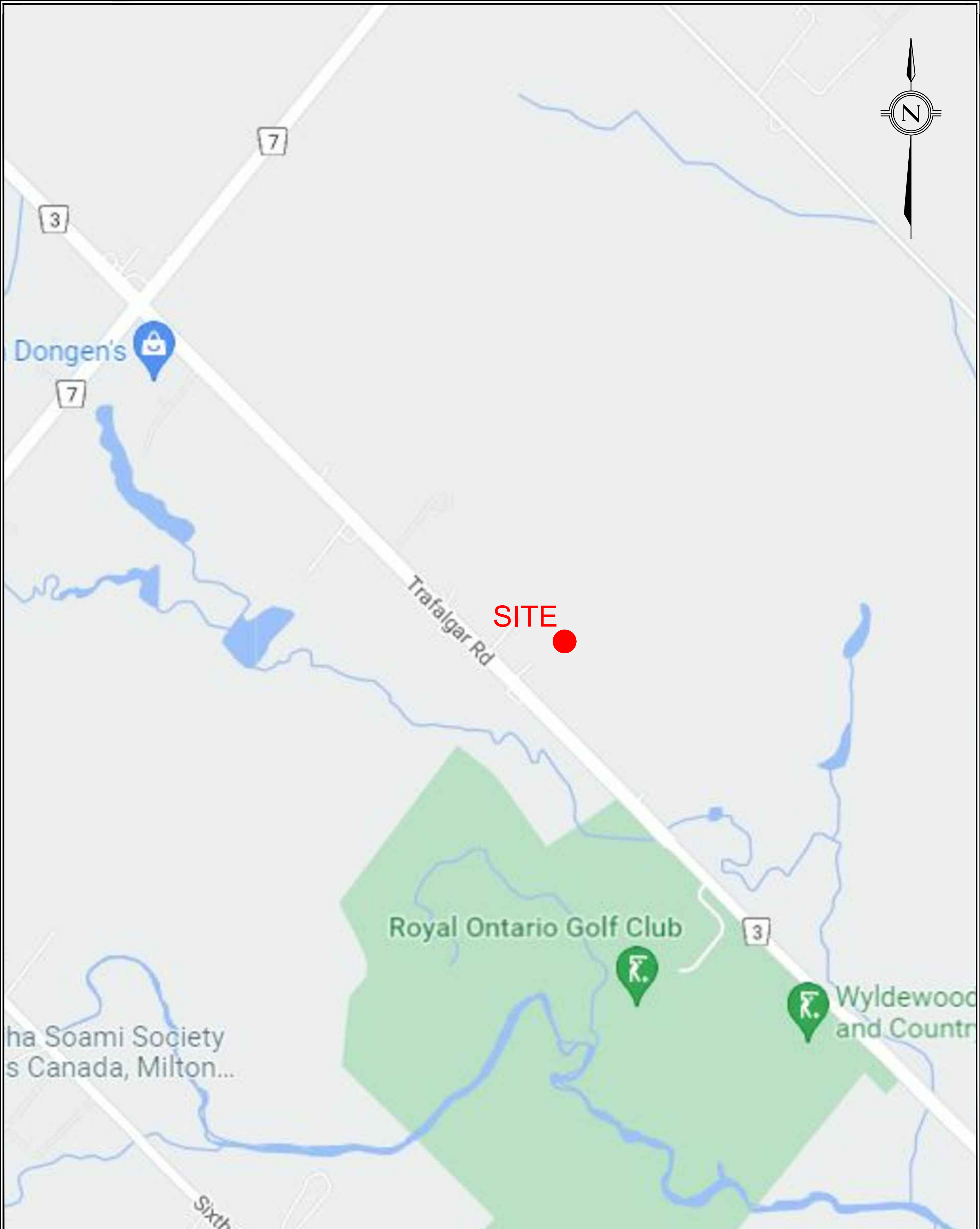
Terraprobe Inc.

Anthony Felice, P. Eng.
Project Manager, Geotechnical

Patrick Cannon, P. Eng.
Principal, Branch Manager

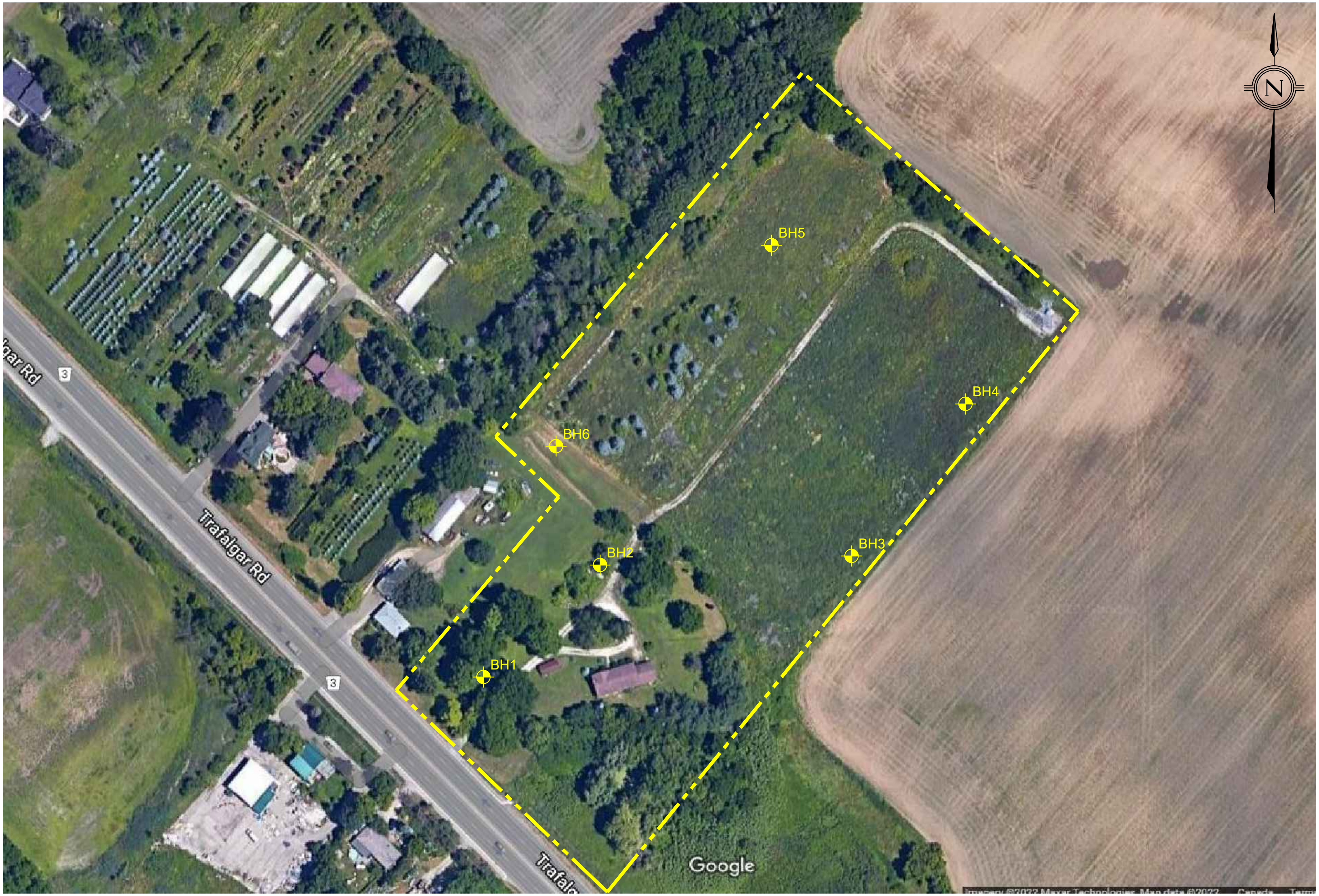
FIGURES

Terraprobe Inc.



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

Title:	FIGURE :
SITE LOCATION PLAN 6463 Trafalgar Road, Milton, Ontario	1
File No. 7-22-0008-01	



LEGEND

⌖ Borehole Location

Terraprobe

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

Title: BOREHOLE LOCATION PLAN
6463 Trafalgar Road, Milton, Ontario

File No. 7-22-0008-01

FIGURE : 2

LOGS OF BOREHOLES

APPENDIX A

Terraprobe Inc.

SAMPLING METHODS

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

PENETRATION RESISTANCE

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

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

COHESIONLESS SOILS

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

COHESIVE SOILS

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

COMPOSITION

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

TESTS AND SYMBOLS

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

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

FIELD MOISTURE DESCRIPTIONS

Damp refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.

Moist refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water

Wet refers to a soil sample that has visible pore water

Terraprobe

LOG OF BOREHOLE 1

Project No. : 7-22-0008-01 | Client : York Trafalgar Management Corp | Originated by : KG

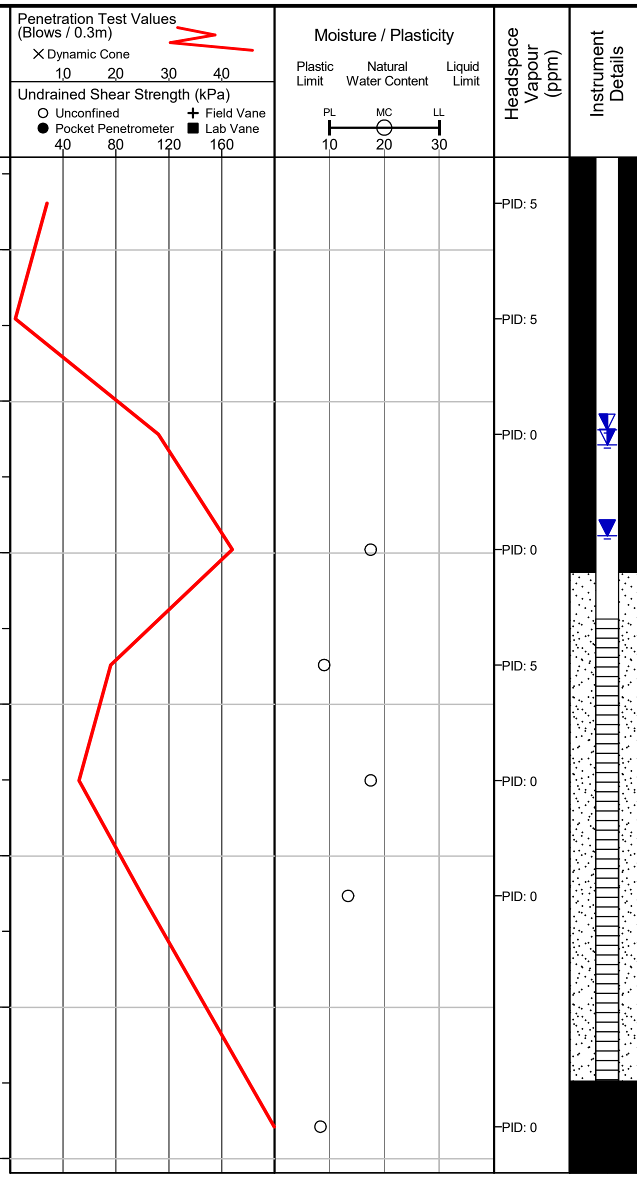
Date started : May 2, 2022 | Project : 6463 Trafalgar Road | Compiled by : KG

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

Position : E: 597226, N: 4822290 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Geoprobe | Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
188.6	GROUND SURFACE					
	75mm **TOPSOIL**					
	FILL, silty sand, trace gravel, very loose to loose, brown	1	SS	7	PID: 5	SS1 Analysis: M&I, PAH, Pest.
		2	SS	1	PID: 5	SS2 Analysis: VOC, PHC
186.8 / 1.8	**CLAYEY SILT**, with embedded sand and gravel, very stiff to hard, grey (GLACIAL TILL)	3	SS	28	PID: 0	
		4	SS	42	PID: 0	SS4 Analysis: M&I, PAH
		5	SS	19	PID: 5	SS5 Analysis: VOC, PHC
	...becoming grey at 3.8m depth	6	SS	13	PID: 0	7 13 45 35
	...wet sand seams at 4.9m depth	7	SS	25	PID: 0	
181.9 / 6.7		8	SS	74	PID: 0	



END OF BOREHOLE

Unstabilized water level measured at 4.3 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 17, 2022	1.8	186.8
May 26, 2022	1.9	186.7
Jul 8, 2022	2.5	186.1

file: 7-22-0008-01 - 6463 trafalgar rd milton.gpj

LOG OF BOREHOLE 2

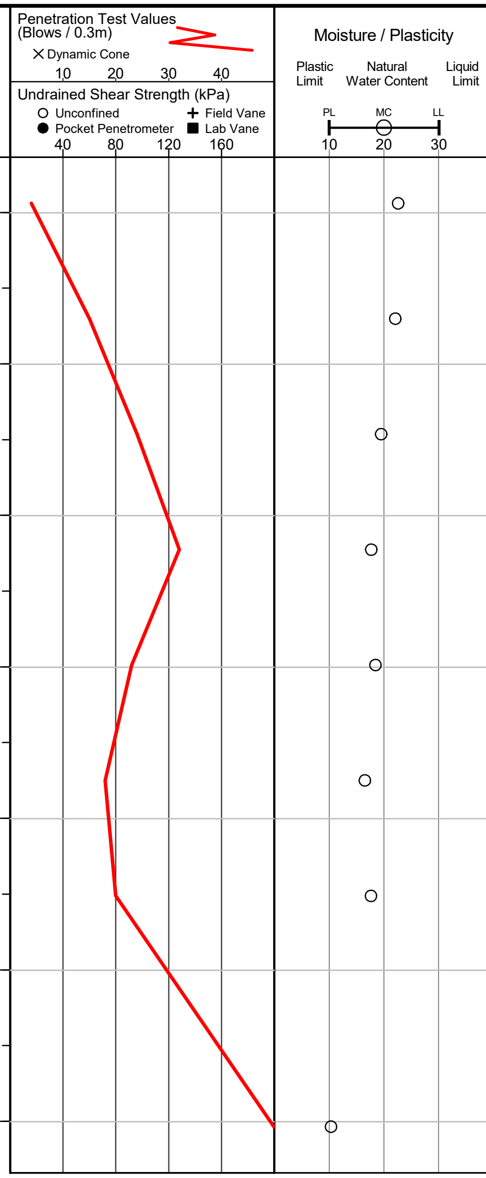
Terraprobe

Project No. : 7-22-0008-01	Client : York Trafalgar Management Corp	Originated by : KG
Date started : May 2, 2022	Project : 6463 Trafalgar Road	Compiled by : KG
Sheet No. : 1 of 1	Location : Milton, Ontario	Checked by : PC

Position : E: 597275, N: 4822334 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Geoprobe — Drilling Method : Solid stem augers

Elev / Depth (m)	Description (SOIL PROFILE)	Sample Number	Type	SPT 'N' Value	Headspace Vapour (ppm)
188.4	**GROUND SURFACE**				
188.2 / 0.2	150mm **TOPSOIL**				
	FILL, silty sand, very loose, brown	1	SS	4	PID: 0
187.6 / 0.8	**CLAYEY SILT**, with embedded sand and gravel, very stiff to hard, brown (GLACIAL TILL)	2	SS	15	PID: 0
		3	SS	24	PID: 0
		4	SS	32	PID: 0
	...becoming grey at 3.3m depth	5	SS	23	PID: 0
		6	SS	18	PID: 0
	...wet sand seams at 4.9m depth	7	SS	20	PID: 0
		8	SS	63	PID: 0
181.7 / 6.7	**END OF BOREHOLE**				



Unstabilized water level measured at 4.3 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

Depth Scale (m) | Graphic Log | Elevation Scale (m) | Instrument Details | Unstabilized Water Level | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

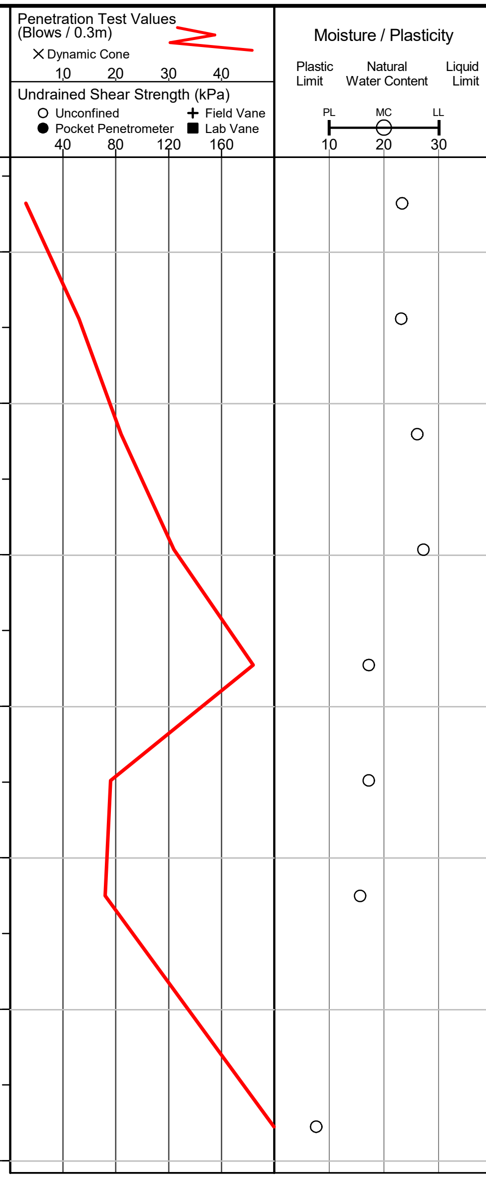
Terraprobe

LOG OF BOREHOLE 3

Project No. : 7-22-0008-01	Client : York Trafalgar Management Corp		Originated by : KG
Date started : May 2, 2022	Project : 6463 Trafalgar Road		Compiled by : KG
Sheet No. : 1 of 1	Location : Milton, Ontario		Checked by : PC

Position : E: 597377, N: 4822335 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Geoprobe
Drilling Method : Solid stem augers

Elev / Depth (m)	Description (SOIL PROFILE)	Sample Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
188.6	**GROUND SURFACE**					
	900mm **TOPSOIL**, with intermixed clayey silt, trace to some sand, very loose, brown	1	SS	3	PID: 0	SS1 Analysis: M&I, Pest.
187.7 / 0.9	**CLAYEY SILT**, with embedded sand and gravel, very stiff to hard, brown (GLACIAL TILL)	2	SS	13	PID: 0	SS2 Analysis: VOC, PHC
		3	SS	21	PID: 0	GR SA SI CL: 8 20 43 29
		4	SS	31	PID: 0	
		5	SS	46	PID: 0	
	...becoming grey at 3.8m depth	6	SS	19	PID: 0	
	...wet sand seams at 4.9m depth	7	SS	18	PID: 0	
		8	SS	51	PID: 0	
181.9 / 6.7	**END OF BOREHOLE**					



Elevation Scale (m): 188, 187, 186, 185, 184, 183, 182
Depth Scale (m): 0, 1, 2, 3, 4, 5, 6

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 17, 2022	1.8	186.8
May 26, 2022	1.9	186.7
Jul 8, 2022	2.5	186.1

LOG OF BOREHOLE 4

Terraprobe

Project No. : 7-22-0008-01	Client : York Trafalgar Management Corp	Originated by : KG
Date started : May 2, 2022	Project : 6463 Trafalgar Road	Compiled by : KG
Sheet No. : 1 of 1	Location : Milton, Ontario	Checked by : PC

Position : E: 597425, N: 4822396 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Geoprobe
Drilling Method : Solid stem augers

SOIL PROFILE

Elev / Depth (m)	Description
189.6	**GROUND SURFACE**
188.8 / 0.8	800mm **TOPSOIL**, with intermixed clayey silt, trace sand and rootlets, very loose, brown
187.8 / 1.8	**FILL**, fine to medium sand, trace silt, clay, loose, brown
183.5 / 6.1	**CLAYEY SILT**, with embedded sand and gravel, stiff to hard, brown (GLACIAL TILL) ...becoming grey at 3.0m depth
182.9 / 6.7	**SILTY SAND**, dense, grey, wet (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	4	PID: 0	SS1 Analysis: M&I, Pest.
2	SS	9	PID: 0	SS2 Analysis: VOC, PHC
3	SS	10	PID: 0	
4	SS	22	PID: 0	
5	SS	48	PID: 0	
6	SS	26	PID: 0	
7	SS	18	PID: 0	
8	SS	41	PID: 0	Grain size distribution (%) (MIT): GR 9, SA 56, SI 27, CL 8

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6
Elevation Scale (m): 189, 188, 187, 186, 185, 184, 183

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
Instrument Details
Unstabilized Water Level

END OF BOREHOLE

Unstabilized water level measured at 4.3 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

file: 7-22-0008-01 - 6463 trafalgar rd milton.gpj

Terraprobe

LOG OF BOREHOLE 5

Project No. : 7-22-0008-01 | Client : York Trafalgar Management Corp | Originated by : KG

Date started : May 3, 2022 | Project : 6463 Trafalgar Road | Compiled by : KG

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

Position : E: 597347, N: 4822460 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Geoprobe | Drilling Method : Solid stem augers

SOIL PROFILE

Elev / Depth (m)	Description
188.5	GROUND SURFACE
188.5 / 0.0	800mm **TOPSOIL**, (reworked) with rootlets, loose, brown
187.7 / 0.8	**CLAYEY SILT**, with embedded sand and gravel, stiff to hard, brown (GLACIAL TILL) ...becoming grey at 3.3m depth ...wet sand seams at 4.3m depth
183.9 / 4.6	**SANDY SILT**, compact, grey, wet
182.1 / 6.4	**CLAYEY SILT**, with embedded sand and gravel, very stiff, grey (GLACIAL TILL)
181.8 / 6.7	

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
1	SS	6	PID: 0	SS1 Analysis: M&I, Pest.
2	SS	23	PID: 0	
3	SS	33	PID: 0	
4	SS	42	PID: 0	
5	SS	30	PID: 0	
6	SS	19	PID: 0	
7	SS	15	PID: 0	Grain size distribution (%) (MIT): GR 0, SA 48, SI 46, CL 6
8	SS	29	PID: 0	

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

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

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

Elevation Scale (m): 188, 187, 186, 185, 184, 183, 182

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

Instrument Details | Unstabilized Water Level

END OF BOREHOLE

Unstabilized water level measured at 4.9 m below ground surface; borehole caved to 5.5 m below ground surface upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 17, 2022	1.6	186.9
May 26, 2022	1.8	186.7
Jul 8, 2022	2.4	186.1

file: 7-22-0008-01 - 6463 trafalgar rd milton.gpj

Terraprobe

LOG OF BOREHOLE 6

Project No. : 7-22-0008-01 | Client : York Trafalgar Management Corp | Originated by : KG

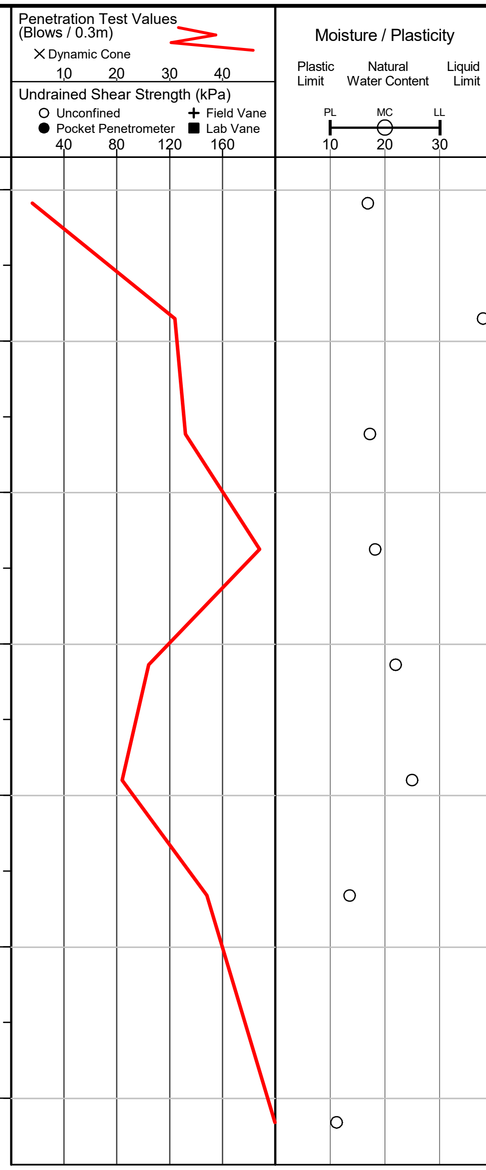
Date started : May 4, 2022 | Project : 6463 Trafalgar Road | Compiled by : KG

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

Position : E: 597257, N: 4822383 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Geoprobe | Drilling Method : Solid stem augers

Elev (m)	Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
188.2	0	GROUND SURFACE					
		400mm **TOPSOIL**	1	SS	4	PID: 0	SS1 Analysis: M&I, Pest.
187.8	0.4	**FILL**, silty sand, very loose, brown					
187.4	0.8	**CLAYEY SILT**, with embedded sand and gravel, stiff to hard, brown (GLACIAL TILL)	2	SS	31	PID: 0	
			3	SS	33	PID: 0	
			4	SS	47	PID: 0	
		...becoming grey at 3.0m depth	5	SS	26	PID: 0	
184.4	3.8	**SILT**, compact, grey, wet	6	SS	21	PID: 0	Unstabilized water level (4.3 m)
183.6	4.6	**CLAYEY SILT**, with embedded sand and gravel, hard, grey (GLACIAL TILL)	7	SS	37	PID: 0	
			8	SS	53	PID: 0	
181.5	6.7	**END OF BOREHOLE**					

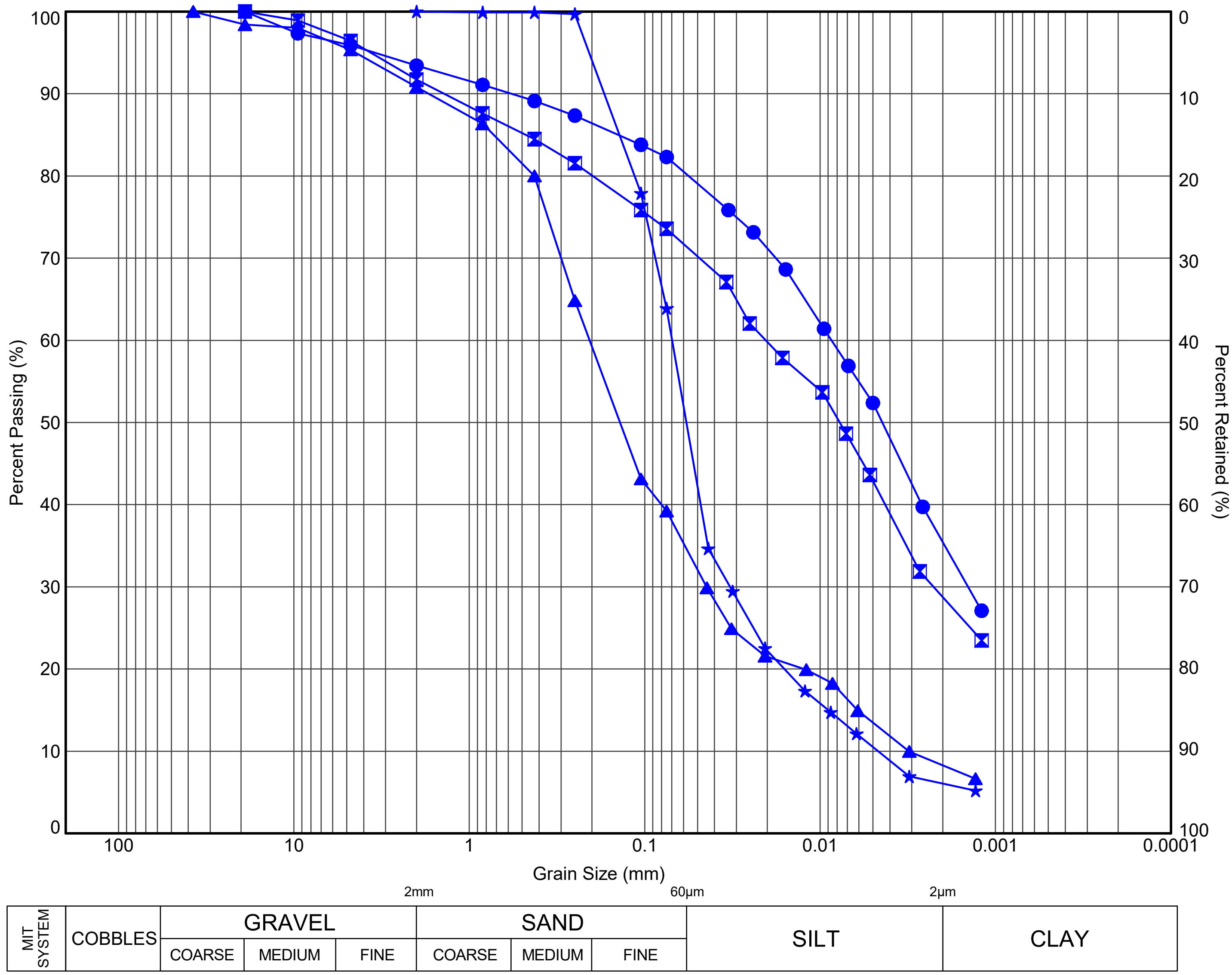


Elevation Scale (m): 188, 187, 186, 185, 184, 183, 182

Unstabilized water level measured at 4.3 m below ground surface; borehole caved to 4.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

file: 7-22-0008-01 - 6463 trafalgar rd milton.gpj



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**1**	SS6	4.1	184.5	7	13	45	35	
⊠	**3**	SS3	1.8	186.8	8	20	43	29	
▲	**4**	SS8	6.4	183.2	9	56	27	8	
★	**5**	SS7	4.9	183.6	0	48	46	6	

Terraprobe

903 Barton Street, Unit 22, Stoney Creek ON L8E 5P5
(905) 643-7560

Title: **GRAIN SIZE DISTRIBUTION**

File No.: **7-22-0008-01**

“DRAFT” ENGINEERED FILL
EARTHWORKS SPECIFICATIONS

APPENDIX B

Terraprobe Inc.

PART 1 GENERAL

1.01 Description

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

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

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

a) Stripping of the existing topsoil, fill layer, and weathered/disturbed soil as needed 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 or visual inspection (as directed by the geotechnical engineer) of the subgrade below areas to be covered with Engineered Fill, to detect the presence and extent of unstable ground conditions,

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

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

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

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

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

1.02 The Project Parties

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

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

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

PART 2 MATERIALS

2.01 Definitions

A) Topsoil Layer is the surface layer of naturally organic soil typically found at the ground surface and with thickness on the order of 25 to 250 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) Weathered/disturbed soil is natural or native soil that has been disrupted by weathering processes such as frost damage.

D) Subgrade soil is the “in situ” (in place) natural or native soil beneath any earth fill and/or weathered/disturbed soil and/or topsoil layer(s).

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

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

PART 3 ENGINEERED FILL DESIGN

3.01 Design Foundation Pressure

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

a) Sand or gravel soil; several days,

b) Silt soil; several weeks,

c) Clay or clayey soil; several months.

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

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

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

C) The Engineered Fill is to extend up to 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.

E) A geotechnical reaction at SLS of 150 kPa for 25 mm of settlement is typically recommended for the Engineered Fill, unless it consists of glaciolacustrine silt and clay in which case a lower design foundation pressure will need to be determined on a site specific basis. Foundations shall have minimum widths of 0.6 m for continuous strip footings, and minimum dimensions of 1 m for column footings.

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

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

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

a) placement of footing concrete, and

b) placement of foundation wall concrete.

PART 4 CONSTRUCTION

4.01 Survey Layout

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

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

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

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

E) On completion of Engineered Fill construction, the 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 had the earth fill suitably stripped.

4.03 Test Holes Into Subgrade

A) After the topsoil has been stripped, the exposed subgrade must be investigated for the presence of weak zones 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 loose lifts of maximum 150 mm 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 with a static smooth-drum roller and the Geotechnical Engineer must observe the proof-rolling.

B) Cohesive soil will be disrupted by proof-rolling. Competency must be determined by a geotechnical engineer by cutting and inspecting the soil.

C) 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

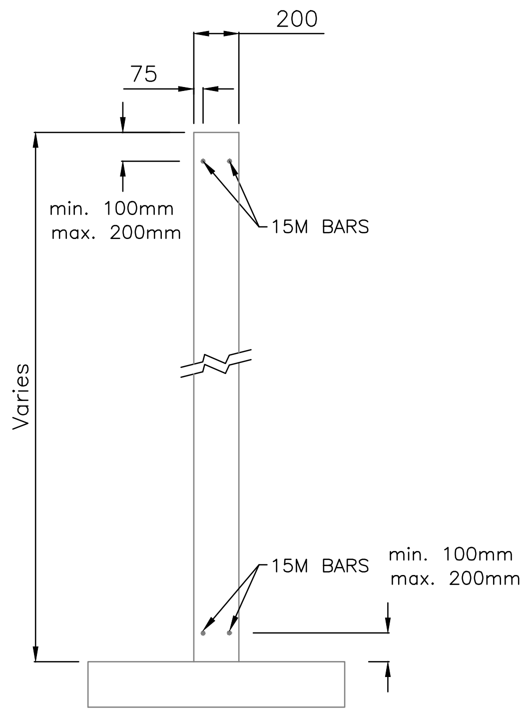
A) Engineered fill must not be placed without the approval of the Geotechnical Engineer. Prior to placing any Engineered Fill, the existing fill must be removed down to native soil subgrade, the subgrade must be investigated for old buried fill or deleterious material, the subgrade must be proof-rolled, 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. Some of the existing site fill that is removed prior to placement of Engineered Fill may be sorted and reused as Engineered Fill, but must first be approved by the Geotechnical Engineer. 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 be free of organics and other deleterious material (wood, building debris, rubble, cobbles, boulders, and the like).

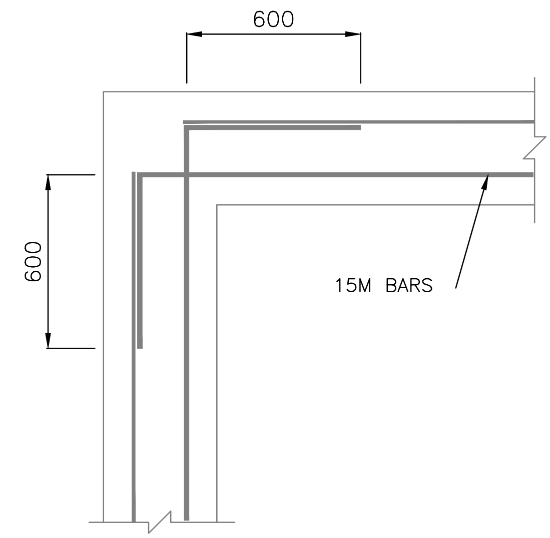
C) The Engineered Fill must be placed in maximum loose lift thicknesses of 150 mm. Each lift of Engineered Fill must be compacted with a heavy roller, to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent.

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

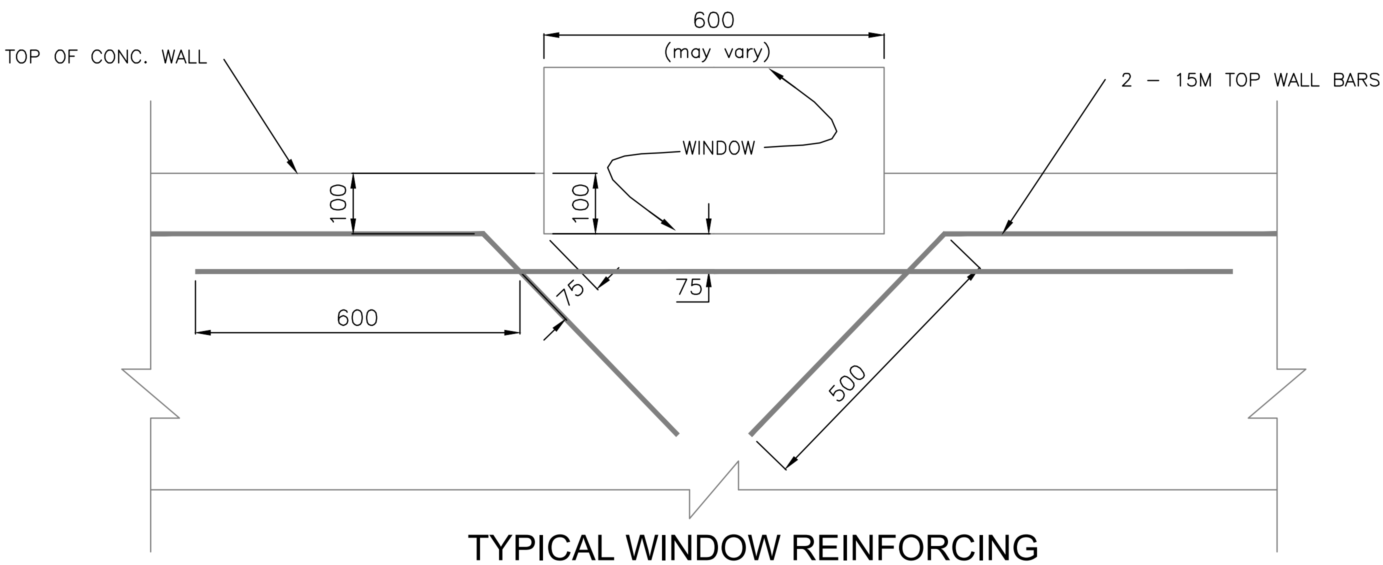
E) Engineered fill must not be placed during the period of the year when cold weather occurs, i.e., when there are freezing ambient temperatures during the daytime and overnight.



TYPICAL
REINFORCED WALL
NOT TO SCALE



TYPICAL SPLICING
AT CORNERS
NOT TO SCALE



TYPICAL WINDOW REINFORCING
NOT TO SCALE

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

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
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Title:

TYPICAL FOUNDATION WALL DETAILS FOR
STRUCTURES ON ENGINEERED FILL