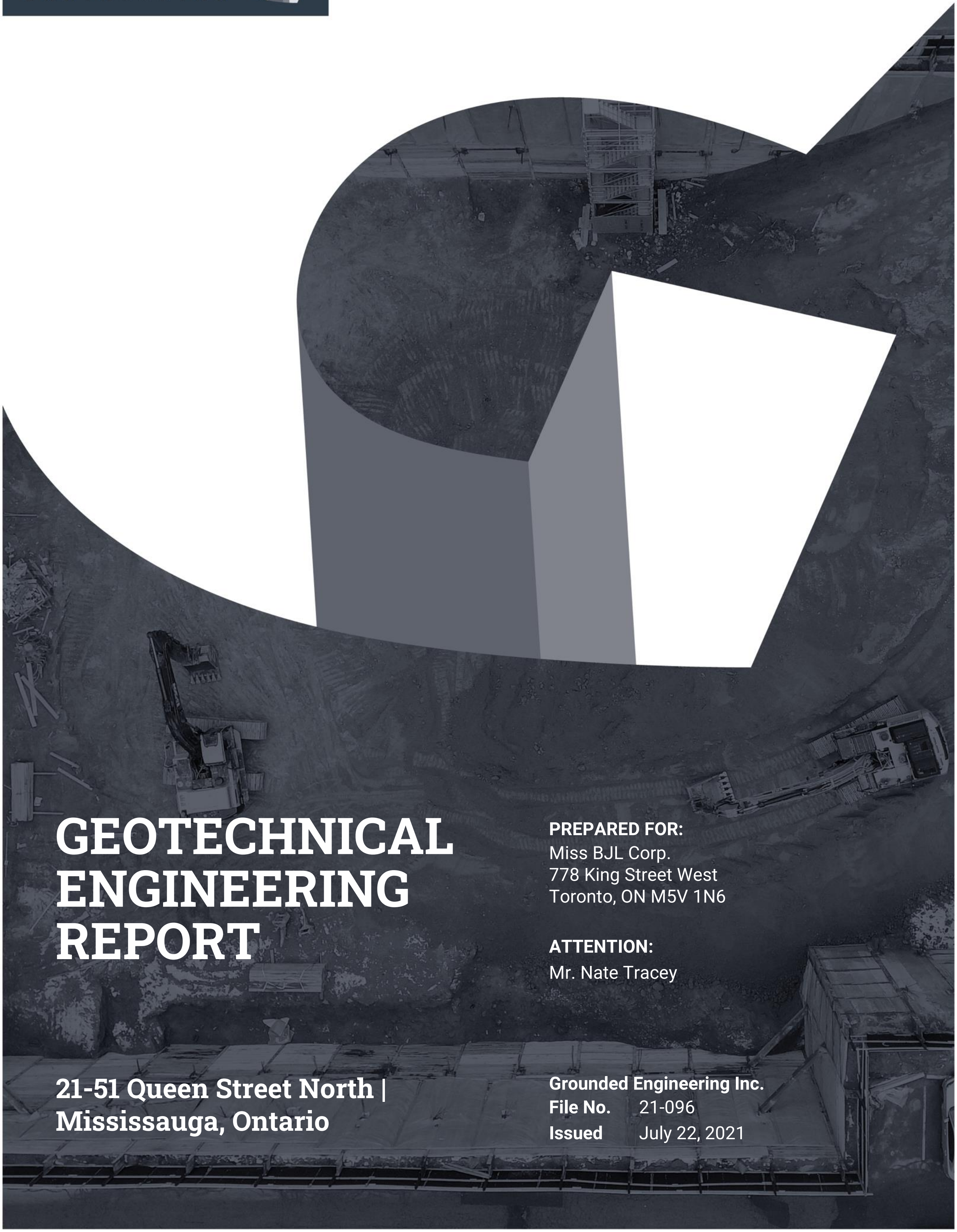


GEOTECHNICAL ENGINEERING REPORT

PREPARED FOR:
Miss BJL Corp.
778 King Street West
Toronto, ON M5V 1N6

ATTENTION:
Mr. Nate Tracey

21-51 Queen Street North | Mississauga, Ontario

Grounded Engineering Inc.
File No. 21-096
Issued July 22, 2021

TABLE OF CONTENTS

FIGURES

APPENDICES

1 Introduction

Miss BJL Corp. has retained Grounded Engineering Inc. ("Grounded") to provide preliminary geotechnical engineering design advice for their proposed development at 21-51 Queen Street North, in Mississauga, Ontario.

The proposed project includes demolishing the existing structure and constructing a 9-storey residential and retail mixed-use structure. The proposed structure will have either two levels of underground parking set at a lowest (P2) Finished Floor Elevation (FFE) of 158.6± m or three levels of underground parking set at a lowest (P3) FFE of 155.6± m.

Grounded has been provided with the following reports and drawings to assist in our geotechnical scope of work:

- KRCMAR, "Plan of survey showing topographical information of part of block C registered plan 548 City of Mississauga", Job No 17-245, DWG Name 17-245BT01, dated December 13, 2017
- Fisher Environmental Ltd., "Phase I Environmental Site Assessment, 21-51 Queen Street North, Mississauga, ON"; Project No FE-P 17-8381A, dated October 17, 2017
- Fisher Environmental Ltd., "Phase II Environmental Site Assessment, 21-51 Queen Street North, Mississauga, ON"; Project No FE-P 17-8381B, dated October 19, 2017

Grounded has been provided with factual borehole information from other consultants as listed above. Those borehole logs are provided in a report signed and sealed by professional engineers. As such, this borehole information (appended) is taken as factual for present purposes. Unless noted, borehole labels appended with "FEL-" refer to Fisher's boreholes.

Based on the borehole findings, geotechnical engineering advice for the proposed development is provided for foundations, seismic site classification, earth pressure design, slab on grade design, and basement drainage. Construction considerations including excavation, groundwater control, and geostructural engineering design advice are also provided.

This preliminary geotechnical engineering report is appropriate for due diligence and planning purposes only. Additional boreholes, wells, and a detailed geotechnical engineering report will be required for detailed design.

2 Ground Conditions

The borehole results are detailed on the attached borehole logs. Our assessment of the relevant stratigraphic units is intended to highlight the strata as they relate to geotechnical engineering. The ground conditions reported here will vary between and beyond the borehole locations.

The stratigraphic boundary lines shown on the borehole logs are assessed from non-continuous samples supplemented by drilling observations. These stratigraphic boundary lines represent transitions between soil types and should be regarded as approximate and gradual. They are not exact points of stratigraphic change.

The elevations of Fisher's monitoring wells and boreholes have been reported relative to the top nut of a nearby fire hydrant. For the purpose of Grounded's engineering analysis, Fischer's monitoring well FEL-1 was resurveyed and its elevation measured relative to the geodetic datum (as established on the KRCMAR survey). The elevations of the other boreholes and monitoring wells were surveyed by Grounded relative to FEL-1 as the baseline. The horizontal coordinates are provided relative to the Universal Transverse Mercator (UTM Zone 17T) geographic coordinate system.

2.1 Soil Stratigraphy

The following soil stratigraphy summary is based on the factual information from other consultant. A cross-section showing stratigraphy and engineering units is appended.

A summary of the relevant stratigraphic units is provided as follows. The summary elevations are provided for general guidance only. Details are provided on the borehole logs and in the following subsections. In general, two main stratigraphic units can be inferred on site as follows:

1. earth fill, overlying
2. a "**silty clay"** unit encountered at 0.3to 1.8 m depth.

There is groundwater within the cohesive silty clay unit at elevations varying from approximately Elev. 162.4 to 163.3± m, and perched water in the fill.

2.1.1 Surficial and Earth Fill

All boreholes were drilled from the ground surface through the asphalt pavement. Under the asphalt, surficial materials of varying composition and thickness were reported in some of the boreholes. Underlying the surficial materials or the asphalt, a layer of earth fill has been reported and extends to depths up to 1.8 m (Elev. 162.9 m). The earth fill varies in composition but generally consists of silty clay with trace sand and gravel. The earth fill is typically dark brown and moist. Due to the inconsistent placement and the inherent heterogeneity of earth fill materials, the relative density of the earth fill varies but is on average firm to stiff.

2.1.2 Silty Clay

Underlying the fill materials, all boreholes encountered an undisturbed silty clay deposit with trace gravel. This unit extends down to depths of 6.6 to 9.3 m below grade (Elev. 158.2 to 156.2 m). It is about 4.9 to 8.8 m thick. This unit is generally brown and changes to grey.

Standard Penetration Test (SPT) results (N-Values) measured range from 17 to 42 blows per 300 mm of penetration ("bpf"), indicating a consistency ranging from very stiff to hard.

The investigation was terminated in this unit due to auger refusal.

2.1.3 Possible Bedrock

Based on Grounded's experience in the area, we expect to find bedrock at somewhat shallow depths in this region, underlying the silty clay layer. Fisher boreholes FEL-1 and FEL-5 reported auger refusal at depths of 9.3 and 7.9 m (Elev. 156.2 and 156.8 m) respectively. This may be an indication of the top of either cobbles/boulders or possible weathered bedrock at Elev. 156.2± m. The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

Based on Ontario Geological Survey (OGS) publicly available bedrock geology database, as indicated in Figure 4, we can expect the bedrock beneath the site to be of the Queenston Formation, which is a dark red, low-fissility shale/siltstone with green mottling. The green mottled zones are occasionally harder than the softer red shale, possibly indicating a higher carbonate content which is called "limestone" by local convention.

2.2 Groundwater

The groundwater levels in the monitoring wells installed by others were measured by Grounded on May 27, 2021. The monitoring well observations by others and as measured by Grounded are summarized as follows:

Borehole No.	Depth of well (m)	Strata Screened	Water Level in Well, Depth/Elev. (m)	
			September 21, 2017*	May 27, 2021**
FEL-1	9.14	Silty Clay	2.7 / 162.8	3.1 / 162.4
FEL-2	7.65	Silty Clay	7.0 / 158.3	2 / 163.3
FEL-3	7.53	Silty Clay	5.4 / 159.2	2 / 162.6
FEL-4	7.62	Silty Clay	4.4 / 160.5	n/a[1]
FEL-5	7.5	Silty Clay	5.6 / 159.1	n/a[2]

* = measured by others
** = measured by Grounded
n/a[1] = no groundwater level taken(well could not be located)
n/a[2] = no groundwater level taken(well could not be opened)

Groundwater levels fluctuate with time depending on the amount of precipitation and surface runoff, and may be influenced by known or unknown dewatering activities at nearby sites.

Based on the water-level measurements, the preliminary design groundwater elevation is 163.3 m, in the silty clay deposit. This deposit is expected to have a very low permeability and should yield only minor seepage in the long-term. There may also be water within discrete fractures in the bedrock (if penetrated), and perched water in the earth fill. The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

3 Preliminary Geotechnical Engineering Recommendations

Based on the factual data summarized above, preliminary geotechnical engineering recommendations are provided. These preliminary recommendations are for due diligence purposes only. They must be supplemented and confirmed by additional boreholes, bedrock coring, wells, and a detailed geotechnical engineering report at the detailed design stage. Contractors must review the factual data while bidding or scoping services for this project and must provide their own opinion as to means, methods, and schedule.

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

3.1 Foundation Design Parameters

Grounded has been requested to provide foundation design parameters for a lowest FFE at P2 or P3.

3.1.1 Lowest Elevation as P2 Elevation

Foundations made for the proposed P2 level will bear about 1+/- m below the slab on undisturbed very stiff silty clays. Conventional spread footings made to bear on this soil may be designed using a maximum factored geotechnical resistance at ULS of 500 kPa. The net geotechnical reaction at SLS is 300 kPa, for an estimated total settlement of 25 mm.

Spread footing foundations must be at least 1000 mm wide and must be embedded a minimum of 1000 mm below FFE. These minimum requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to a settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

If additional capacity is required, foundations could be extended to bear on bedrock using the estimated capacities provided in Section 3.1.2 below.

3.1.2 Lowest Elevation as P3 Elevation

The deepest existing borehole on site provided to Grounded in the Fisher report is at Elev. 156.2± m. The estimated P3 Elevation is 155.6± m. Therefore foundations made for the proposed P3 level will be made deeper than the deepest known borehole information currently on site.

Therefore, two assumptions must be made for this preliminary engineering report: either the foundations are bearing on very stiff to hard clay as observed in the Fisher boreholes below the proposed P2 level using the bearing capacities provided in 3.1.1, or it can be assumed that the foundations will bear on weathered bedrock at some elevation deeper than the current boreholes. The conservative approach at this stage without detailed deep boreholes is to assume that foundations will rest on very stiff to hard clay.

If bedrock is encountered in future boreholes at elevations that are still to be determined, conventional spread footings made to bear on weathered bedrock may be designed using a maximum factored geotechnical resistance at ULS of 5000 kPa. The net geotechnical reaction at SLS is 3000 kPa, for an estimated total settlement of 25 mm. Spread footing foundations must be at least 1000 mm wide. These minimum requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to a settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

For footings on bedrock stepped from one level to another, they should be at a slope not exceeding 1 vertical to 1 horizontal for the above bearing pressures to be applicable. There must be a minimum of 300 mm between the edge of any footing and the top of a sloped 2V:1H sound rock cut down to another footing.

The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

3.1.3 General

The lowest levels of unheated underground parking structures two or more levels deep are, although unheated, still warmer than typical outdoor winter temperatures in the Greater Toronto Area. Interior foundations (or pile caps) with 900 mm of frost cover perform adequately, as do perimeter foundations with 600 mm of frost cover. Where foundations are next to ventilation shafts or are exposed to typical outdoor temperatures, 1.2 m of earth cover (or equivalent insulation) is required for frost protection.

Footings stepped from one elevation to another should be offset at a slope not steeper than 7 vertical to 10 horizontal.

The founding subgrade must be cleaned of all unacceptable materials and approved by Grounded prior to pouring concrete for the footings. Such unacceptable materials may include disturbed or caved soils, ponded water, or similar as indicated by Grounded during founding subgrade inspection. During the winter, adequate temporary frost protection for the footing bases and concrete must be provided if construction proceeds during freezing weather conditions. The bedrock surface can weather and deteriorate on exposure to the atmosphere or surface water; hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

3.2 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 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated from the rational analysis of undrained shear strength (s_u) or penetration resistance (N-values) according to the OBC and National Building Code of Canada.

Below the nominal founding elevations (for spread footings or grade beams) of 158.6-155.0± metres, the boreholes observe very stiff to hard clays. Based on this information, the site designation for seismic analysis is **Class D**, 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.

The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

We have estimated the site designation based on quantitative analysis of penetration resistance (N-values) with assumed N-values for the soil stratigraphy beyond the investigation depth. If an improved seismic site class provides economic benefit to the project, consideration should be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) to determine the average shear wave velocity in the top 30 meters of the site stratigraphy. MASW testing may result in an improved seismic site designation (to a Class C) which may help reduce the cost implication for the structure. If all foundations end up being uniformly founded on bedrock, then seismic Site Class B would apply.

3.3 Earth Pressure Design Parameters

At this site, the design parameters for structures subject to unbalanced earth pressures such as basement walls and retaining walls are shown in the table below.

Stratigraphic Unit	γ	φ	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS.MUNI 1010)	21	32	0.31	0.47	3.25
Existing Earth Fill	19	29	0.35	0.52	2.88
Native Silty Clays	22	34	0.28	0.44	3.53

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

These earth pressure parameters assume that grade is horizontal behind the retaining structure. If retained grade is inclined, these parameters do not apply and must be re-evaluated.

The following equation can be used to calculate the unbalanced earth pressure imposed on walls:

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

P = horizontal pressure (kPa) at depth h
h = the depth at which P is calculated (m)
K = earth pressure coefficient
h_w = height of groundwater (m) above depth h
γ = soil bulk unit weight (kN/m^3)
γ' = submerged soil unit weight (γ - 9.8 kN/m^3)
q = total surcharge load (kPa)

If the wall backfill is drained such that hydrostatic pressures on the wall are effectively eliminated, this equation simplifies to:

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

Where walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Water from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. This is discussed in Section 3.5.

The possible effects of frost on retaining earth structures must be considered. In frost-susceptible soils, pressures induced by freezing pore water are basically irresistible. Insulation typically addresses this issue. Alternatively, non-frost-susceptible backfill may be specified.

Foundation resistance to sliding is proportional to the friction between the soil or rock subgrade and the base of the footing. The factored geotechnical resistance to friction (**R_f**) at ULS provided in the following equation:

$$R_f = \Phi N \tan \varphi$$

R_f = frictional resistance (kN)
Φ = reduction factor per Canadian Foundation Engineering Manual (CFEM) Ed. 4 (0.8)
N = normal load at base of footing (kN)
φ = internal friction angle (see table above)

3.4 Slab on Grade Design Parameters

At the proposed lowest P2 or P3 elevation, the undisturbed native soils will provide adequate subgrade for the support of a conventional slab on grade. The modulus of subgrade reaction for slab-on-grade design supported by undisturbed native soils is 30,000 kPa/m. If bedrock is present at the P3 level, then the slab on grade can be designed using a modulus of subgrade reaction of 80,000 kPa/m.

The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

The slab on grade must be provided with a drainage layer and capillary moisture break, which is achieved by forming the slab on a minimum 300 mm thick layer of 19 mm clear stone (OPSS.MUNI 1004) vibrated to a dense state.

The use of excavated bedrock spoil to restore subgrade elevations is to be specifically prohibited. This bedrock spoil cannot be adequately compacted to provide support for the slab on grade and is not to be reused below any settlement sensitive areas.

A permanent drainage system including subfloor drains is required (see Section 3.5).

Prior to placement of the capillary moisture break and construction of the slab, the cut subgrade be cut and inspected by Grounded for obvious exposed loose or disturbed areas, or for areas containing excessive deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 percent SPMDD).

3.5 Long-Term Groundwater and Seepage Control

To limit seepage to the extent practicable, exterior grades adjacent to foundation walls should be sloped at a minimum 2 percent gradient away from the wall for 1.2 m minimum.

For a conventional drained basement approach, perimeter and subfloor drainage systems are required for the underground structure. Subfloor drainage collects and removes the seepage that infiltrates under the floor. Perimeter drainage collects and removes seepage that infiltrates at the foundation walls. The exterior faces of foundation walls should be provided with a layer of waterproofing to protect interior finishes.

Subfloor drainage pipes are to be spaced at an average 6 m (measured on-centres). If subdrain elevation conflicts with top of footing elevation, footings should be lowered as necessary.

The walls of the substructure are to be fully drained to eliminate hydrostatic pressure. Where drained basement walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Seepage from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. A layer of waterproofing placed between the drain core product and the basement wall should be considered to protect interior finishes from moisture. Typical basement drainage details are appended.

The perimeter and subfloor drainage systems are critical structural elements since they eliminate hydrostatic pressure from acting on the basement walls and floor slab. The sumps that ensure the performance of these systems must have a duplexed pump arrangement providing 100% redundancy, and they must be on emergency power. The sumps should be sized by the mechanical engineer to adequately accommodate the estimated volume of water seepage.

4 Considerations for Construction

4.1 Excavations

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

- The earth fill is a Type 3 soil
- The cohesive silty clay is a Type 2 soil

In accordance with the regulation's requirements, the soil must be suitably sloped and/or braced where workers must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes (of no more than 3 m in height) by soil type are stipulated 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. Any excavation slopes greater than 3 m in height should be checked by Grounded for global stability issues.

Larger obstructions (e.g. buried concrete debris, other obstructions) not directly observed in the boreholes are likely present in the earth fill. Similarly, larger inclusions (e.g. cobbles and boulders) may be encountered in the native soils. The size and distribution of these obstructions cannot be predicted with boreholes, as the split spoon sampler is not large enough to capture particles of this size. Provision must be made in excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

4.2 Short-Term Groundwater Control

For design purposes, the stabilized groundwater table is at about Elev. 163.3±m. The water table is present in the native soil unit. The lowest FFE will either be at Elev. 158.6± m (P2) or at Elev. 155.6± m (P3). Therefore,

- Bulk excavation will extend below the elevation of the prevailing groundwater table;
- Foundation excavations will extend below the prevailing groundwater table.

It is expected that groundwater if encountered will be of limited extent. Groundwater may be allowed to drain into the excavation and then pumped out. The volume of seepage anticipated in open excavations is limited to the extent that temporary pumping from the excavations is expected to sufficiently control groundwater seepage. Regardless, excavation delays will occur as seepage (however limited) is controlled. These delays should be anticipated in the construction schedule.

4.3 Earth-Retention Shoring Systems

No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. Underpinning guidelines are appended.

4.3.1 Lateral Earth Pressure Distribution

If the shoring is supported with a single level of earth anchor or bracing, a triangular earth pressure distribution like that used for the basement wall design is appropriate.

Where multiple rows of lateral supports are used to support the shoring walls, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors. A multi-level supported shoring system can be designed based on an earth pressure distribution with a maximum pressure defined by:

$\boldsymbol{P = 0.8\,K[\gamma H + q] + \gamma_w h_w}$ … in cohesive soils

P = maximum horizontal pressure (kPa)
K = earth pressure coefficient (see Section 3.3)
H = total depth of the excavation (m)
h_w = height of groundwater (m) above the base of excavation
γ = soil bulk unit weight (kN/m3)
q = total surcharge loading (kPa)

Where shoring walls are drained to effectively eliminate hydrostatic pressure on the shoring system (e.g. pile and lagging walls), $\boldsymbol{h_w}$ is equal to zero. For the design of impermeable shoring, a design groundwater table at Elev. 163.3 m must be accounted for.

In cohesive soils, the lateral earth pressure distribution is trapezoidal, uniformly increasing from zero to the maximum pressure defined in the equation above over the top and bottom quarter (H/4) of the shoring.

4.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in very stiff to hard clays. Soldier pile toes resist horizontal movement due to the passive earth pressure acting on the toe below the base of excavation.

4.3.3 Lateral Bracing Elements

The shoring system at this site will require lateral bracing. If feasible, the shoring system should be supported by pre-stressed soil anchors (tiebacks) extending into the subgrade of the adjacent properties. To limit the movement of the shoring system as much as is practically possible, tiebacks are installed and stressed as excavation proceeds. The use of tiebacks through adjacent properties requires the consent (through encroachment agreements) of the adjacent property owners.

Anchors made in the plastic till tend to creep over time and therefore, if possible, it is better to anchor in the bedrock. In the very stiff silty clay below Elev. 163± m, it is expected that post-grouted anchors can be made such that an anchor will safely carry up to 40 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm). If Queenston Formation bedrock is proven at this site, then conventional grouted rock anchors can be designed using a working adhesion of 400 kPa. The presence and elevation of the weathered and sound bedrock layers must be confirmed by future site-specific geotechnical boreholes with rock coring in multiple locations.

At least one prototype anchor per tieback level must be performance-tested to 200% of the design load to demonstrate the anchor capacity and validate design assumptions. Given the potential variability in soil conditions or installation quality, all production anchors must also be proof-tested to 133% of the design load.

Raker footings established on very stiff to hard silty clays at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 200 kPa.

4.4 Site Work

To better protect wet undisturbed subgrade, excavations exposing wet soils must be cut neat, inspected, and then immediately protected with a skim coat of concrete (i.e. a mud mat). Wet sands are susceptible to degradation and disturbance due to even mild site work, frost, weather, or a combination thereof.

The effects of work on site can greatly impact soil integrity. Care must be taken to prevent this damage. Site work carried out during periods of inclement weather may result in the subgrade becoming disturbed, unless a granular working mat is placed to preserve the subgrade soils in their undisturbed condition. Subgrade preparation activities should not be conducted in wet weather and the project must be scheduled accordingly.

If site work causes disturbance to the subgrade, removal of the disturbed soils and the use of granular fill material for site restoration or underfloor fill will be required at additional cost to the project.

It is construction activity itself that often imparts the most severe loading conditions on the subgrade. Special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during placement of the granular base and other work may be required, especially if construction is carried out during unfavourable weather.

Adequate temporary frost protection for the founding subgrade must be provided if construction proceeds in freezing weather conditions. The subgrade at this site is susceptible to frost damage. Depending on the project context, consideration should be given to frost effects (heaving, softening, etc.) on exposed subgrade surfaces.

The exposed Queenston Formation deteriorates with time. Exposed excavation faces have been found to flake and recede as much as 300 mm with 12 months exposure. This recession generally takes the form of coin size shale particles dropping from the face on a constant basis. The deteriorated rock loses internal integrity and bearing capability. If bedrock is to be exposed for prolonged periods of time, it is recommended that a skim coat of concrete be used to protect the surface of bedrock from slaking and other degradation resulting from weathering.

4.5 Engineering Review

By issuing this preliminary report, Grounded Engineering has assumed the role of Geotechnical Engineer of Record for this site. Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

All foundation installations must be reviewed in the field by Grounded, the Geotechnical Engineer of Record, as they are constructed. The on-site review of the condition of the founding subgrade as the foundations are constructed is as much a part of the geotechnical engineering design function as the design itself; it is also required by Section 4.2.2.2 of the Ontario Building Code. If Grounded is not retained to carry out foundation engineering field review during construction, then Grounded accepts no responsibility for the performance or non-performance of the foundations, even if they are constructed in general conformance with the engineering design advice contained in this report.

The long-term performance of a slab on grade is highly dependent upon the subgrade support and drainage conditions. Strict procedures must be maintained during construction to maintain the integrity of the subgrade to the extent 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 Grounded at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

A visual pre-construction survey of adjacent lands and buildings is recommended to be completed prior to the start of any construction. This documents the baseline condition and can prevent unwarranted damage claims. Any shoring system, regardless of the execution and design, has the potential for movement. Small changes in stress or soil volume can cause cracking in adjacent buildings.

5 Limitations and Restrictions

Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

This preliminary geotechnical engineering feasibility study is intended for due diligence purposes only. At detailed design, site-specific boreholes, groundwater monitoring wells, and updated detailed geotechnical engineering advice are required. Once completed, the future detailed geotechnical engineering report by Grounded Engineering would then supersede this preliminary report.

5.1 Investigation Procedures

The geotechnical engineering analysis and advice provided here are based on factual data obtained from investigations at this site conducted by other consultants as described in Section 1. This previous consultant subsurface information is provided in a professional engineer's signed and sealed geotechnical report, and as such this borehole information is taken as factual for present purposes.

A carefully conducted, fully comprehensive investigation and sampling scope of work carried out under the most stringent level of oversight may still fail to detect certain ground conditions. As such, users of this report must be aware of the risks inherent in using engineered field investigations to observe and record subsurface conditions. As a necessary requirement of working with discrete test locations, Grounded has assumed that the conditions between test locations are the same as the test locations themselves, for the purposes of providing geotechnical engineering advice.

It is not possible to design a field investigation with enough test locations that would provide complete subsurface information, nor is it possible to provide geotechnical engineering advice that completely identifies or quantifies every element that could affect construction, scheduling, or tendering. Contractors undertaking work based on this report (in whole or in part) must make their own determination of how they may be affected by the subsurface conditions, based on their own analysis of the factual information provided and based on their own means and methods. Contractors using this report must be aware of the risks implicit in using factual information at discrete test locations to infer subsurface conditions across the site and are directed to conduct their own investigations as needed.

5.2 Site and Scope Changes

Natural occurrences, the passage of time, local construction, and other human activity all have the potential to directly or indirectly alter the subsurface conditions at or near the project site. Contractual obligations related to groundwater or stormwater control, disturbed soils, frost protection, etc. must be considered with attention and care as they relate this potential site alteration.

This report provides preliminary geotechnical engineering advice intended for use by the owner and their retained design team for due diligence only. These preliminary interpretations, design parameters, advice, and discussion on construction considerations are not complete. A detailed site-specific geotechnical investigation must be conducted by Grounded during detailed design to confirm and update the preliminary recommendations provided here.

5.3 Report Use

The authorized users of this report are Miss BJL Corp. and their design team, for whom this report has been prepared. Grounded Engineering Inc. maintains the copyright and ownership of this document. Reproduction of this report in any format or medium requires explicit prior authorization from Grounded Engineering Inc.

The local municipal/regional governing bodies may also make use of and rely upon this report, subject to the limitations as stated.

6 Closure

If the design team has any questions regarding the discussion and advice provided, please do not hesitate to have them contact our office. We trust that this report meets your requirements at present.

For and on behalf of our team,

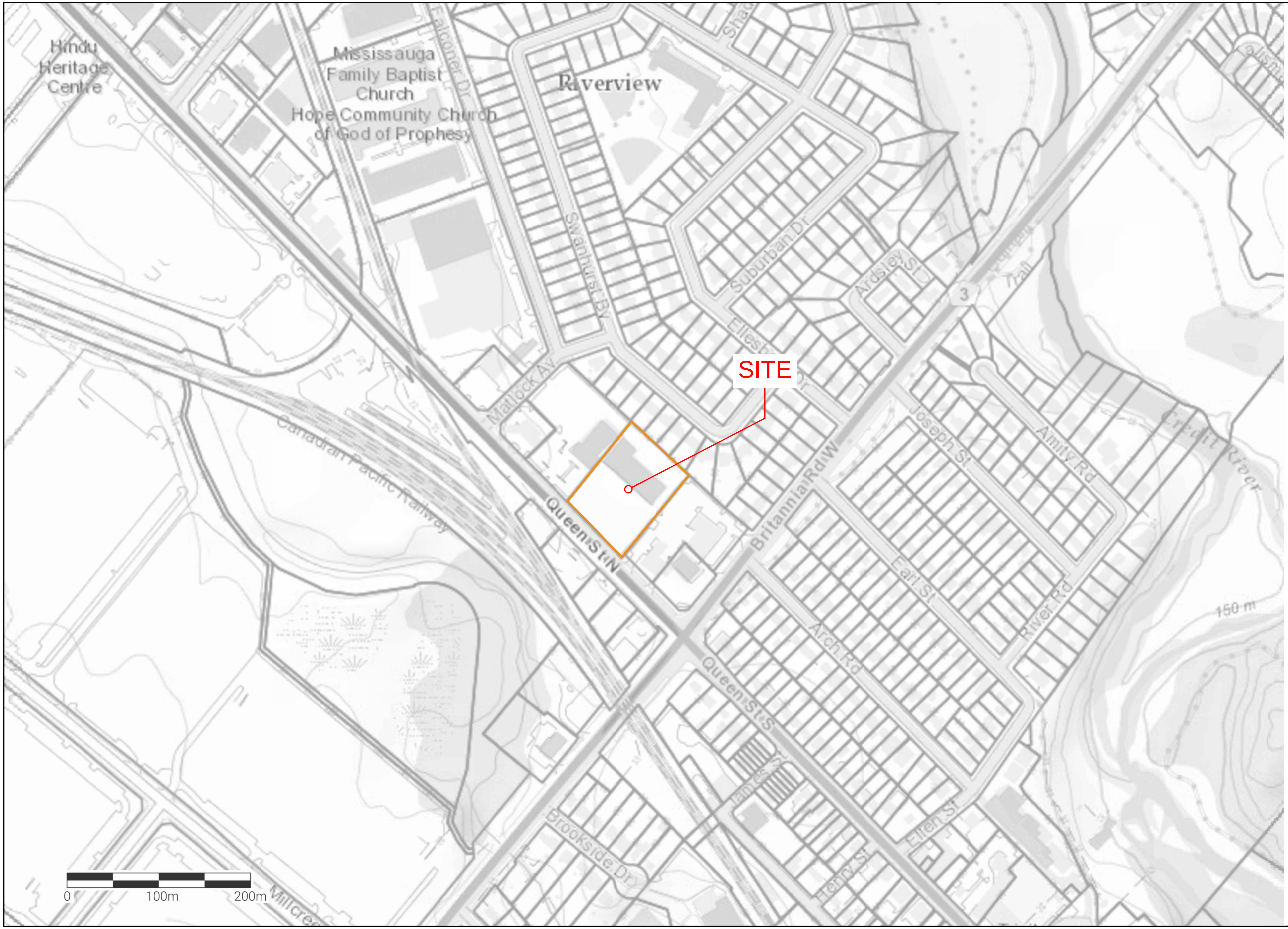
GROUNDED
ENGINEERING

LICENSED PROFESSIONAL ENGINEER
J. J. CROWDER
100077148
22/7/2021
PROVINCE OF ONTARIO

Deepak Kanraj, M.A.Sc., EIT

Jason Crowder, Ph.D., P.Eng.
Principal

FIGURES



GROUNDED
ENGINEERING

1 Banigan Drive, Toronto, Ont., M4H 1G3
www.groundedeng.ca

LEGEND

— APROXIMATE PROPERTY BOUNDARY

Note

Reference

ArcGIS Map 2021

Project

21-51 QUEEN STREET NORTH, MISSISSAUGA, ONTARIO

Figure Title

SITE LOCATION PLAN

North

TRUE
PROJECT

Date

JULY, 2021

Scale

AS INDICATED

Job No

21-096

Figure No

FIGURE 1

GROUNDED
ENGINEERING

1 Banigan Drive, Toronto, Ont., M4H 1G3
www.groundedeng.ca

LEGEND

—	APPROXIMATE PROPERTY BOUNDARY
▨	EXISTING BUILDING STRUCTURE
● ○	MONITORING WELL/BOREHOLE BY OTHERS

Note

Reference

Survey Drawing no. 17-245.
Prepared by KRCMAR Surveyors Inc.
Dated December 13, 2017.

Project

21-51 QUEEN STREET NORTH, MISSISSAUGA, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN

North

TRUE
PROJECT

Date

JULY, 2021

Scale

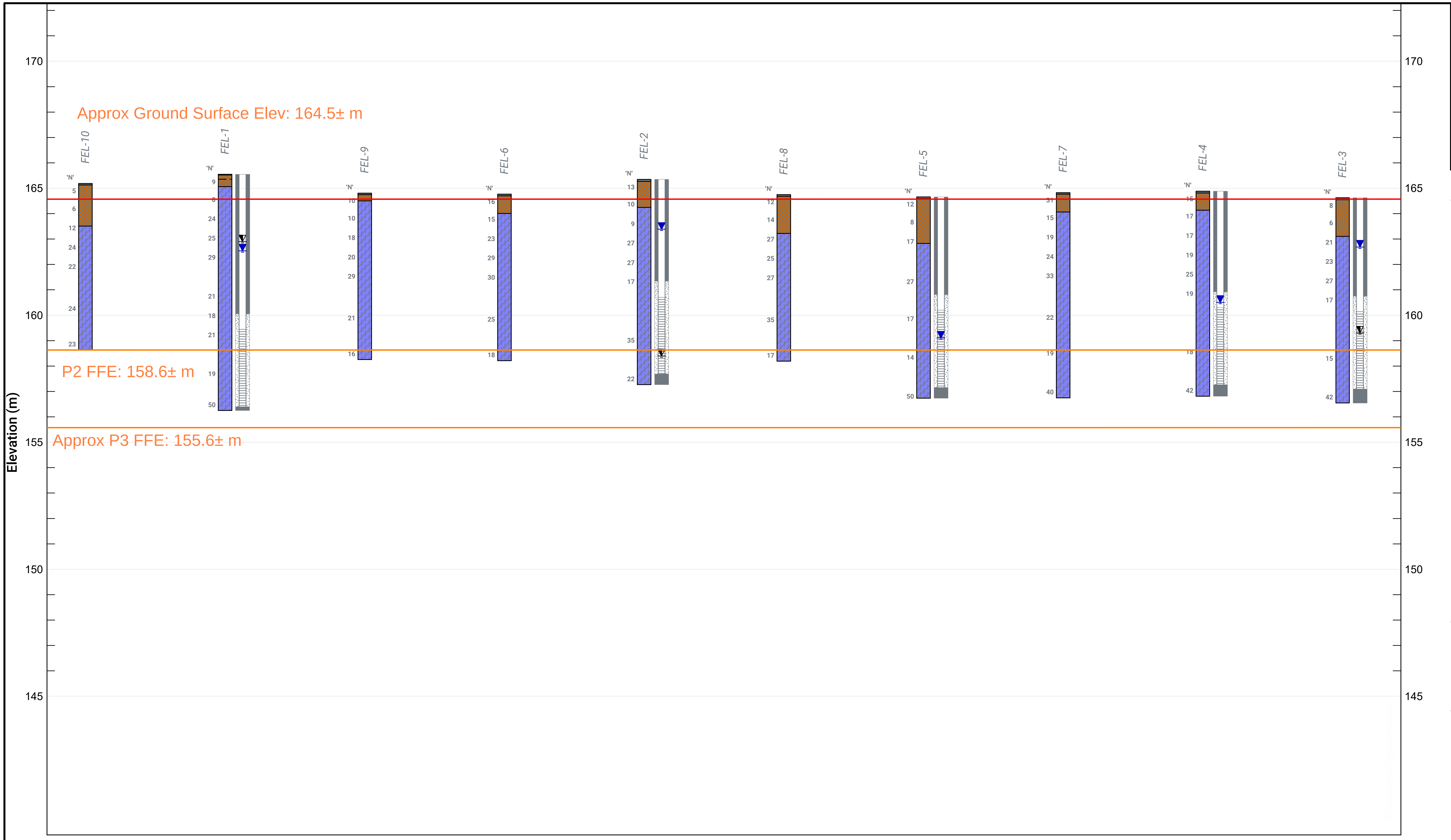
AS INDICATED

Job No

21-096

Figure No

FIGURE 2



GROUNDED
ENGINEERING

1 Banigan Drive, Toronto, Ont., M4H 1G3
www.groundedeng.ca

LEGEND

🟫 FILL

🟧 GRAVELS (gravel to gravelly sand)

🟨 SILT TO SAND (not till)

🟩 COHESIONLESS TILLS

🟪 COHESIVE SOILS (clayey silt to clay, incl. tills)

🟦 DISTURBED/REWORKED SOILS

▽ water level, unstabilized

▼ water level, stabilized

Project

**21-51 QUEEN ST N
MISSISSAUGA**

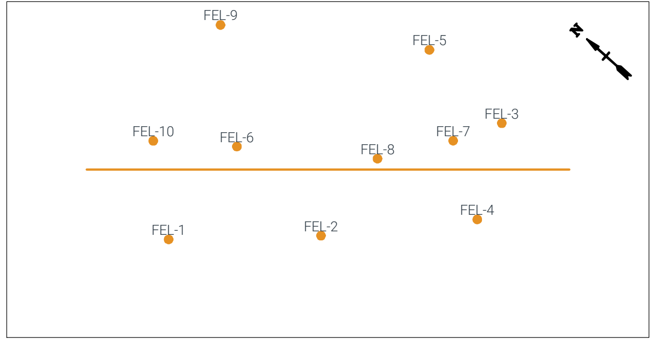
Figure Title

**SUBSURFACE
CROSS-SECTION**

A-A'

SITE MAP

Alignment: A-A'



Boreholes Equally Spaced

LITHOLOGY GRAPHIC LEGEND

■ Asphalt

▦ Fill

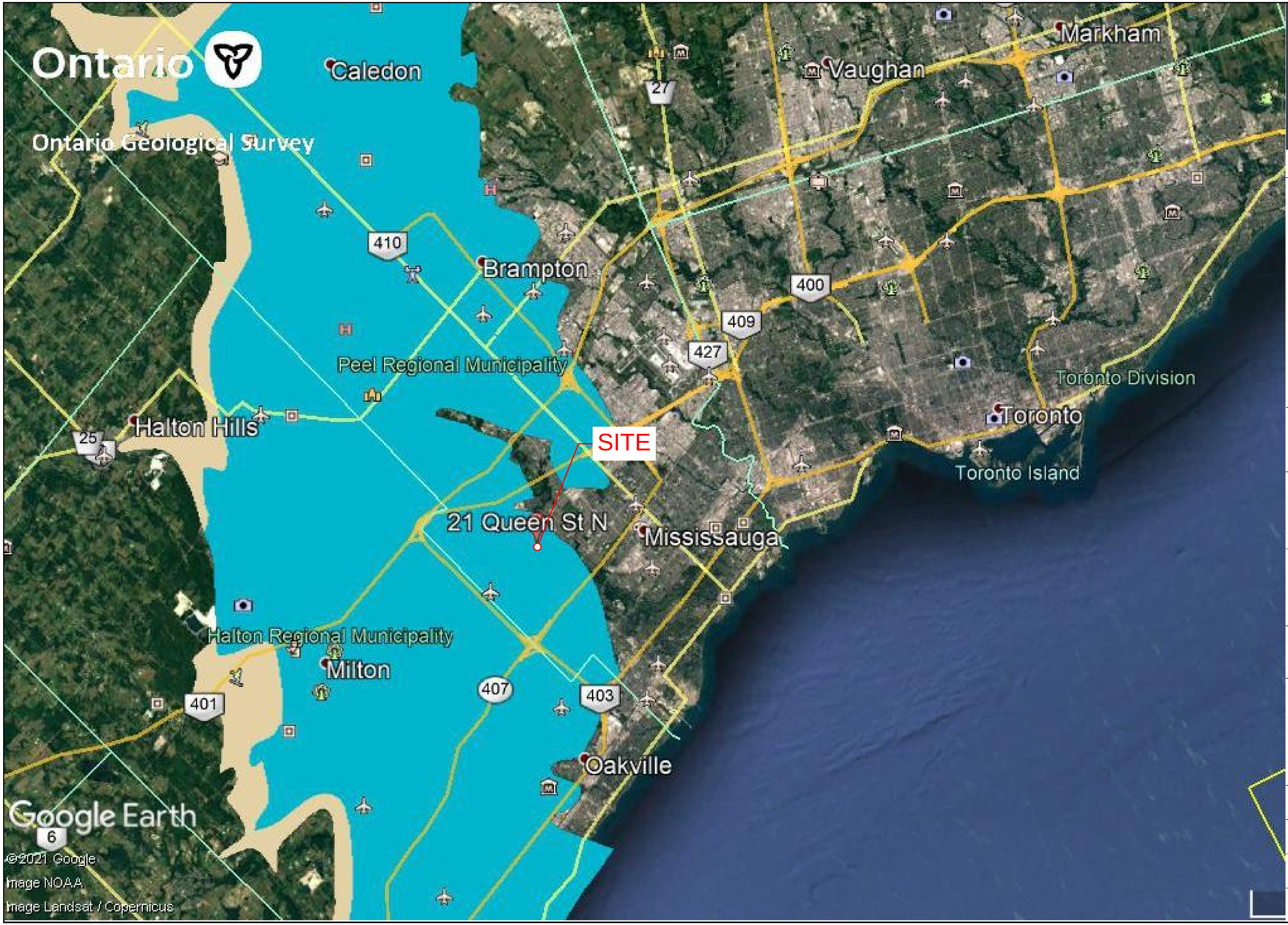
▨ Silty Clay

Date
JULY 2021

Scale
AS INDICATED

Job No
21-096

Figure No
FIGURE 3



GROUNDED
ENGINEERING

1 Banigan Drive, Toronto, Ont., M4H 1G3
www.groundedeng.ca

LEGEND

🟦	SHALE, LIMESTONE, DOLOSTONE, SILTSTONE QUEENSTON FORMATION
○	APPROXIMATE PROPERTY LOCATION AND BOUNDARY

Note

Reference

Ontario Geological Survey, Bedrock Geology, Google Earth

Project

21-51 QUEEN STREET NORTH, MISSISSAUGA, ONTARIO

Figure Title

ONTARIO BEDROCK GEOLOGY

North

TRUE
PROJECT

Date

JULY, 2021

Scale

NTS

Job No

21-096

Figure No

FIGURE 4

APPENDIX A

Fisher Environmental Ltd.

400 Esna Park Dr., #15
Markham, Ontario
L3R 3K2

Tel: 905 475-7755
Fax: 905 475-7718

KEY PLAN

N

LEGEND

⊕ BOREHOLE

● MONITORING WELL

↘ GROUNDWATER FLOW DIRECTION

93.11m BH/MW ELEVATION

PROJECT NAME AND ADDRESS

PHASE II ESA

21-51 QUEEN STREET NORTH
MISSISSAUGA, ON

PROJECT NO.	FE-P 17-8381
DATE	19 OCTOBER 2017
SCALE	AS SHOWN

FIGURE 2:

SITE PLAN WITH BOREHOLE AND MONITORING WELL LOCATIONS AND GROUNDWATER FLOW DIRECTION

SHEET NO.

2

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE

NO. BH1(MW) SHEET 1 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 7 September 2017

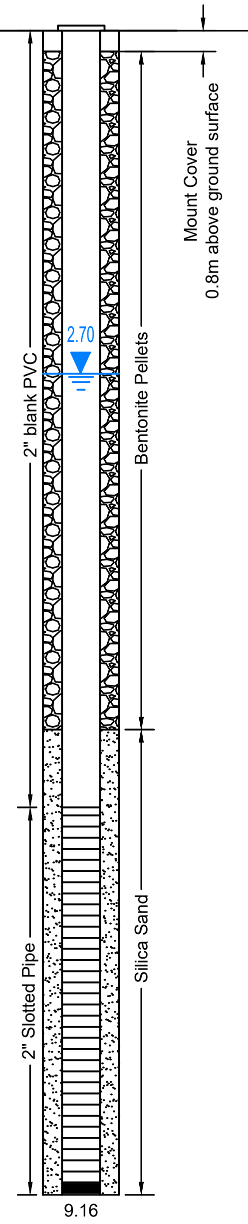
SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE (m asl)	99.40
ASPHALT 76mm	
FILL: Gravelly sand, brown, trace clay, dry, loose.	
FILL: Silty clay, dark brown, some organics, trace rootlets, moist, firm.	
SILTY CLAY: Brown/grey, changes to grey at 4.57m, trace gravel, some gravel at 9.14m, dry, moist at 4.57m, very stiff to hard. Refusal at 9.30m.	
End of Borehole	

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	9	Metals, pH	0
2	SS	8		0
3	SS	24		0
4	SS	25		0
5	SS	29		0
6	SS	21		0
7	SS	18		0
8	SS	21		0
9	SS	19	VOCs, PHCs	0
10	SS	>50		0

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): On 21 September 2017: 2.70m

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH2(MW) SHEET 2 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

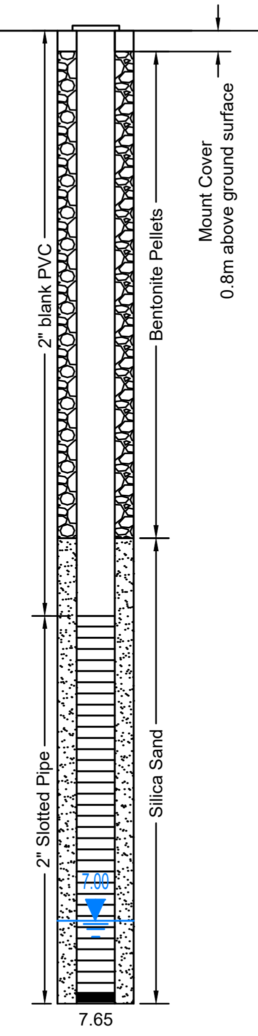
LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 7 September 2017

SOIL PROFILE		SAMPLES				
DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
GROUND SURFACE (m asl)	99.20					
ASPHALT 76mm						
FILL: Sandy gravel, brown, trace clay, dry, compact.		1A	SS	13	Metals	0.6
		1B	SS	13		0.9
FILL: Silty clay, dark brown, trace gravel, dry, stiff.		2A	SS	10		0
		2B	SS	10		0
SILTY CLAY: Brown/grey, changes to grey at 3.40m, trace gravel, dry, moist at 3.81m, very stiff to hard.		3	SS	9		0
		4	SS	27		0
		5	SS	27		0.7
		6	SS	17	VOCs, PHCs	1.6
		7	SS	35		0.8
		8	SS	22		0
End of Borehole						

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): On 21 September 2017: 7.00m

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH3(MW) SHEET. 3 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 7 September 2017

SOIL PROFILE

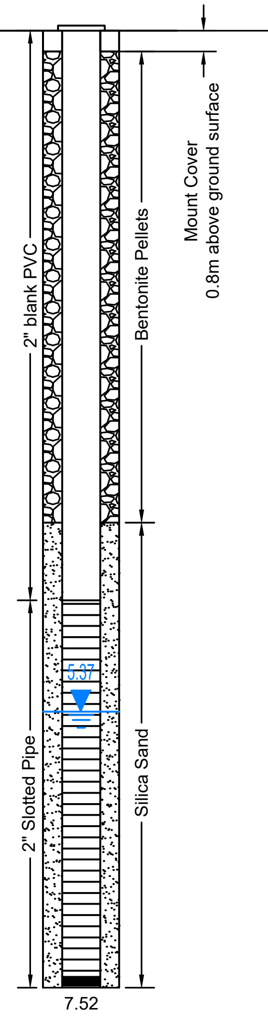
GROUND SURFACE (m asl): 98.48

DEPTH (metres)	DESCRIPTION
0	ASPHALT 76mm
	FILL: Sandy gravel, brown, trace clay, dry, loose.
~1	FILL: Silty clay, dark brown, trace gravel, dry, firm.
~1.8	SILTY CLAY: Brown/grey, changes to grey at 4.57m, trace gravel, moist, stiff to hard.
~8	End of Borehole

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1A	SS	8		0
1B	SS	8	Metals, pH	0
2	SS	6		0.4
3	SS	21		0.6
4	SS	23		0
5	SS	27		0
6	SS	17	VOCs, PHCs	0
7	SS	15		0
8	SS	42		0

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): On 21 September 2017: 5.37m

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH4(MW) SHEET. 4 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21–51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D–50

DRILLING DATE: 7 September 2017

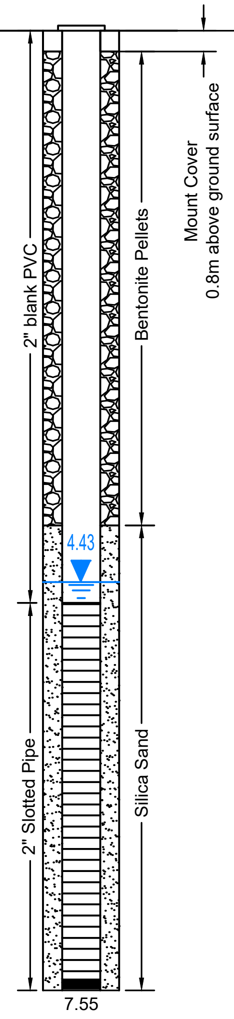
SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE (m asl)	98.74
ASPHALT 76mm	
FILL: Silty clay, dark brown, some sand and gravel, dry, stiff to very stiff.	
SILTY CLAY: Brown/grey, changes to grey at 3.51m, trace gravel, dry, moist at 4.57m, very stiff to hard.	
End of Borehole	

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	15	Metals	0.9
2	SS	17		0
3	SS	17		0
4	SS	19		1.4
5	SS	25		0.5
6	SS	19		0.2
7	SS	18	VOCs, PHCs	1.2
8	SS	42		0

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): On 21 September 2017: 4.43m

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE

NO. BH5(MW) SHEET. 5 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

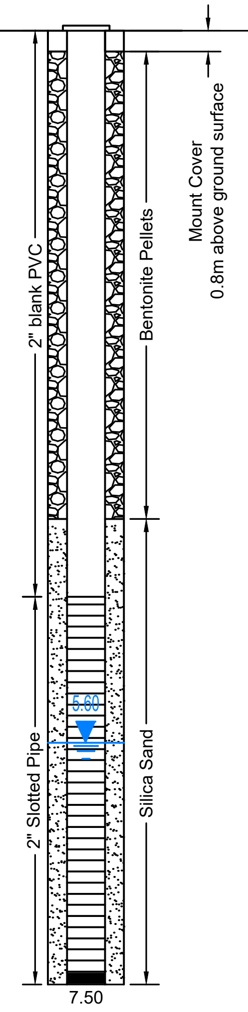
LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 7 September 2017

SOIL PROFILE			SAMPLES				
DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
GROUND SURFACE (m asl)		98.51					
ASPHALT 76mm							
FILL: Sandy gravel, brown, some clay, moist, compact.			1	SS	12	Metals,pH	1.2
FILL: Silty clay, dark brown, trace gravel and organics, moist, firm.			2	SS	8		0
			3	SS	17		0
SILTY CLAY: Brown/grey, changes to grey at 6.10m, trace gravel, dry, moist at 6.10m, stiff to very stiff. Refusal at 7.92m.			4	SS	27		0.2
			5	SS	17		0
			6	SS	14	VOCs, PHCs	0
			7	SS	50		0
End of Borehole							

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): On 21 September 2017: 5.60m

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH6 SHEET. 6 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 7 September 2017

SOIL PROFILE

GROUND SURFACE (m asl) 98.62

ASPHALT 76mm

FILL:
Silty clay, dark brown, some sand and gravel, moist, very stiff.

SILTY CLAY:
Brown/grey, changes to grey at 6.10m, trace gravel, dry, moist at 6.10m, stiff to hard.

End of Borehole

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	16	Metals,pH	0
2	SS	15		0
3	SS	23		1.3
4	SS	29		0.3
5	SS	30		0.6
6	SS	25		0.8
7	SS	18	VOCs, PHCs	0.3

PIEZOMETER OR WELL CONSTRUCTION

Groundwater Depth (m): N/A

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH7 SHEET. 7 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 8 September 2017

SOIL PROFILE

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE (m asl)		98.68
ASPHALT 76mm		
FILL: Gravelly sand, brown, some silt and clay, moist, dense.		
SILTY CLAY: Brown/grey, changes to grey at 4.57m, trace gravel, dry, moist at 4.88m, stiff to hard.		
End of Borehole		

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	31	Metals	0
2	SS	15		0
3	SS	19		0
4	SS	24		0.5
5	SS	33		0
6	SS	22		0
7	SS	19	VOCs, PHCs	0
8	SS	40		0

PIEZOMETER OR WELL CONSTRUCTION

Groundwater Depth (m): N/A

LOGGED: AH

CHECKED: BC

FISHER
ENVIRONMENTAL LTD.

LOG OF BOREHOLE

NO. BH8 SHEET. 8 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 8 September 2017

DEPTH (feet): 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

DEPTH (metres): 0 1 2 3 4 5 6 7 8 9 10

SOIL PROFILE

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE (m asl)		98.60
ASPHALT 76mm	■	
FILL: Sandy gravel, brown, trace clay, moist, compact.	▩	
FILL: Silty clay, dark brown, some sand and gravel, moist, stiff.	▩	
SILTY CLAY: Brown/grey, changes to grey at 4.57m, some to trace gravel, dry, moist at 6.10m, very stiff.	▨	
End of Borehole		

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	12	Metals	0
2	SS	14		0
3	SS	27		0
4	SS	25		0
5	SS	27		0
6	SS	35		0
7	SS	17	VOCs, PHCs, Grain Size	0

PIEZOMETER OR WELL CONSTRUCTION

Groundwater Depth (m): N/A

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE

NO. BH9 SHEET. 9 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 11 September 2017

SOIL PROFILE

GROUND SURFACE (m asl): 98.66

ASPHALT 76mm

FILL: Gravelly sand, brown, some clay, moist, loose.

SILTY CLAY: Brown/grey, changes to grey at 6.10m, trace gravel, moist, wet at 6.40m, stiff to very stiff.

End of Borehole

SAMPLES

NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)
1	SS	10	Metals	0
2	SS	10		0
3	SS	18		0
4	SS	20		0
5	SS	29		0
6	SS	21		0
7	SS	16	VOCs, PHCs	0

PIEZOMETER OR WELL CONSTRUCTION

Groundwater Depth (m): N/A

LOGGED: AH

CHECKED: BC

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH10 SHEET. 10 of 10

PROJECT NO.: FE-P 17-8381

PROJECT NAME: Phase II ESA

LOCATION: 21-51 Queen Street North, Mississauga, ON

DRILLING METHOD: Diedrich D-50

DRILLING DATE: 11 September 2017

DEPTH (feet): 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

DEPTH (metres): 0 1 2 3 4 5 6 7 8 9 10

SOIL PROFILE			SAMPLES					PIEZOMETER OR WELL CONSTRUCTION
DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	"N" VALUE	LAB ANALYSIS	PID READING (ppm)	
GROUND SURFACE (m asl)		99.04						
ASPHALT 76mm	■							
FILL: Gravelly sand, brown, some clay, wet, loose.	▩		1	SS	5	Metals	0.5	
			2	SS	6		0	
FILL: Silty clay, dark brown, some gravel, moist, firm.	▩		3	SS	12		0	
SILTY CLAY: Brown/grey, changes to grey at 4.57m, trace gravel, moist, stiff to very stiff.	▨		4	SS	24		0.3	
			5	SS	22		0	
			6	SS	24		0.2	
			7	SS	23	VOCs, PHCs	0	
End of Borehole								

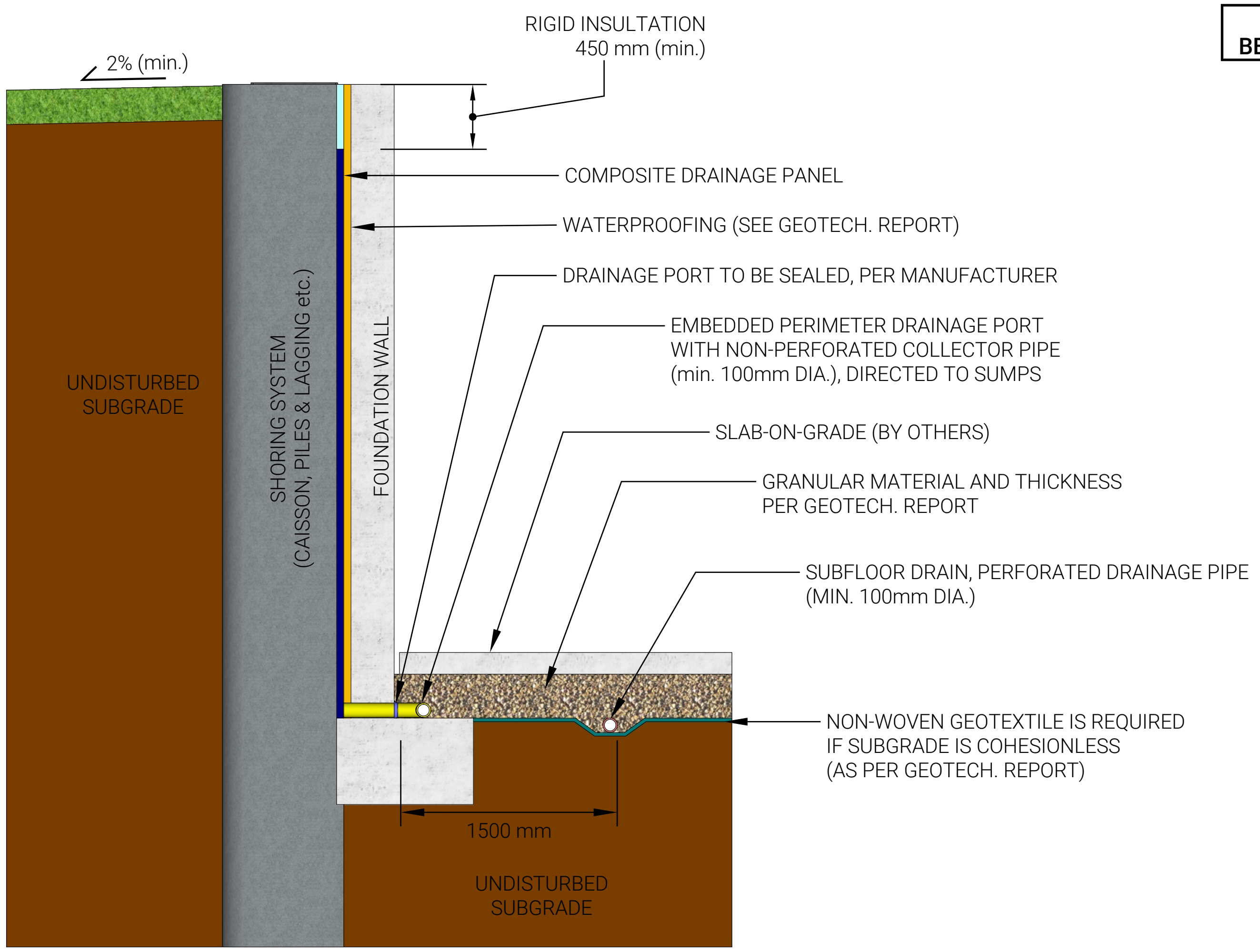
Groundwater Depth (m): N/A

LOGGED: AH

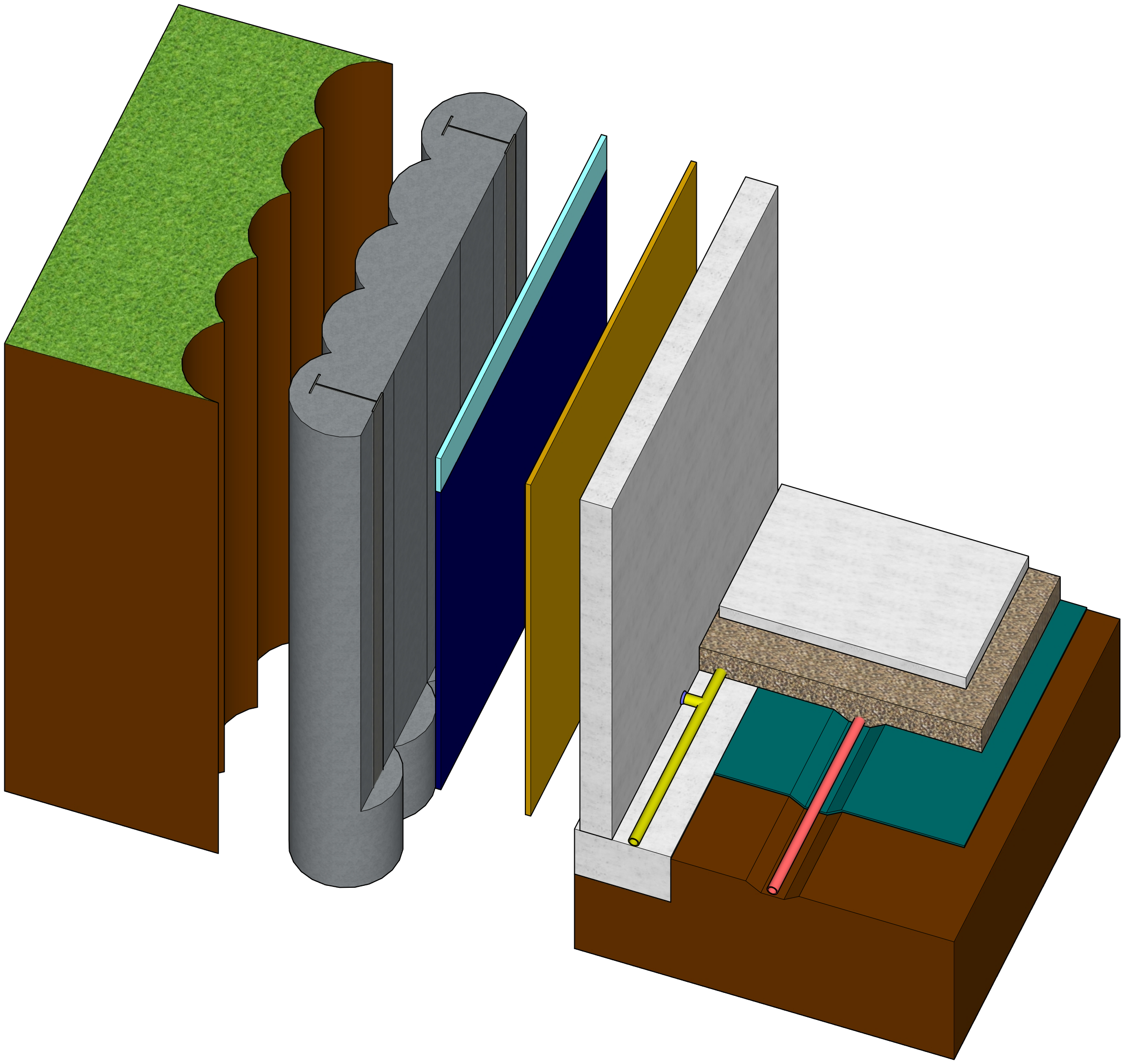
CHECKED: BC

APPENDIX B

OBJECTS ARE COLOR-CODED
BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC VIEW

SUBFLOOR DRAINAGE SYSTEM

1. THE SUBFLOOR DRAINS SHOULD BE SET IN PARALLEL ROWS, IN ONE DIRECTION, AND SPACED AS PER THE GEOTECHNICAL REPORT.
2. THE INVERT OF THE PIPES SHOULD BE A MINIMUM OF 300mm BELOW THE UNDERSIDE OF THE SLAB-ON-GRADE.
3. A CAPILLARY MOISTURE BARRIER (I.E. DRAINAGE LAYER) CONSISTING OF A MINIMUM 200 mm LAYER OF CLEAR STONE (OPSS MUNI 1004) COMPACTED TO A DENSE STATE (OR AS PER THE GEOTECHNICAL REPORT). WHERE VEHICULAR TRAFFIC IS REQUIRED, THE UPPER 50 mm OF THE CAPILLARY MOISTURE BARRIER MAY BE REPLACED WITH GRANULAR A (OPSS MUNI 1010) COMPACTED TO A MINIMUM 98% SPMDD.
4. A NON-WOVEN GEOTEXTILE MUST SEPARATE THE SUBGRADE FROM THE SUBFLOOR DRAINAGE LAYER IF THE SUBGRADE IS COHESIONLESS. THE NON-WOVEN GEOTEXTILE MAY CONSIST OF TERRAFIX 360R OR AN APPROVED EQUIVALENT.

PERIMETER DRAINAGE SYSTEM

1. FOR A DISTANCE OF 1.2m FROM THE BUILDING, THE GROUND SURFACE SHOULD HAVE A MINIMUM 2% GRADE.
2. PREFABRICATED COMPOSITE DRAINAGE PANEL (CONTINUOUS COVER, AS PER MANUFACTURER'S REQUIREMENTS) IS RECOMMENDED BETWEEN THE BASEMENT WALL AND RIGID SHORING WALL. THE DRAINAGE PANEL MAY CONSIST OF MIRADRAIN 6000 OR AN APPROVED EQUIVALENT.
3. PERIMETER DRAINAGE IS TO BE COLLECTED IN NON-PERFORATED PIPES AND CONVEYED DIRECTLY TO THE BUILDING SUMPS.
4. PERIMETER DRAINAGE PORTS SHOULD BE SPACED A MAXIMUM 3m ON-CENTRE. EACH PORT SHOULD HAVE A MINIMUM CROSS-SECTIONAL AREA OF 1500 mm2.

GENERAL NOTES

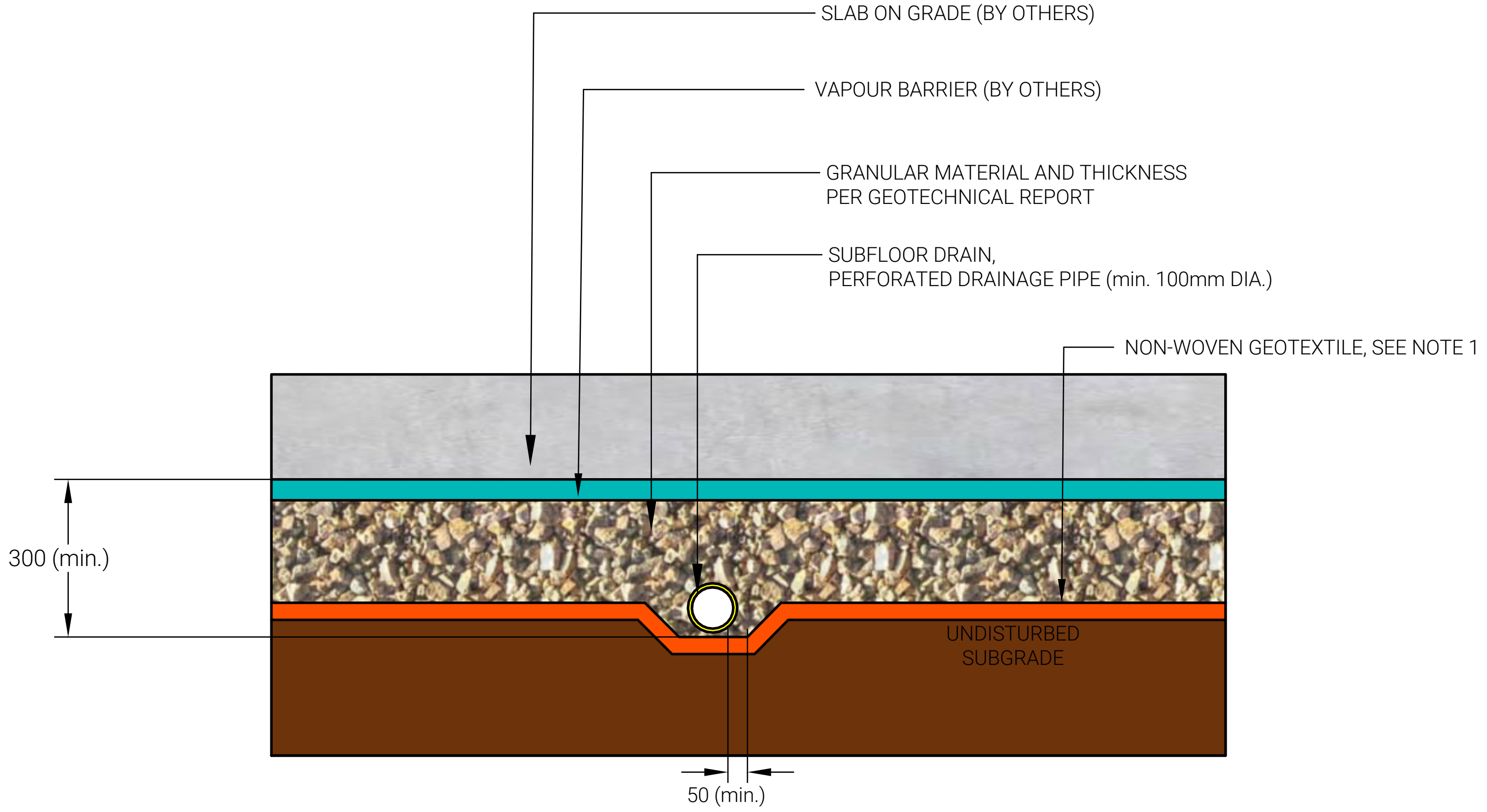
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC RECOMMENDATIONS.
4. THE FINAL BASEMENT DRAINAGE DESIGN SHOULD BE REVIEWED BY THE GEOTECHNICAL ENGINEER TO CONFIRM THE DESIGN IS ACCEPTABLE.

GROUNDED
ENGINEERING

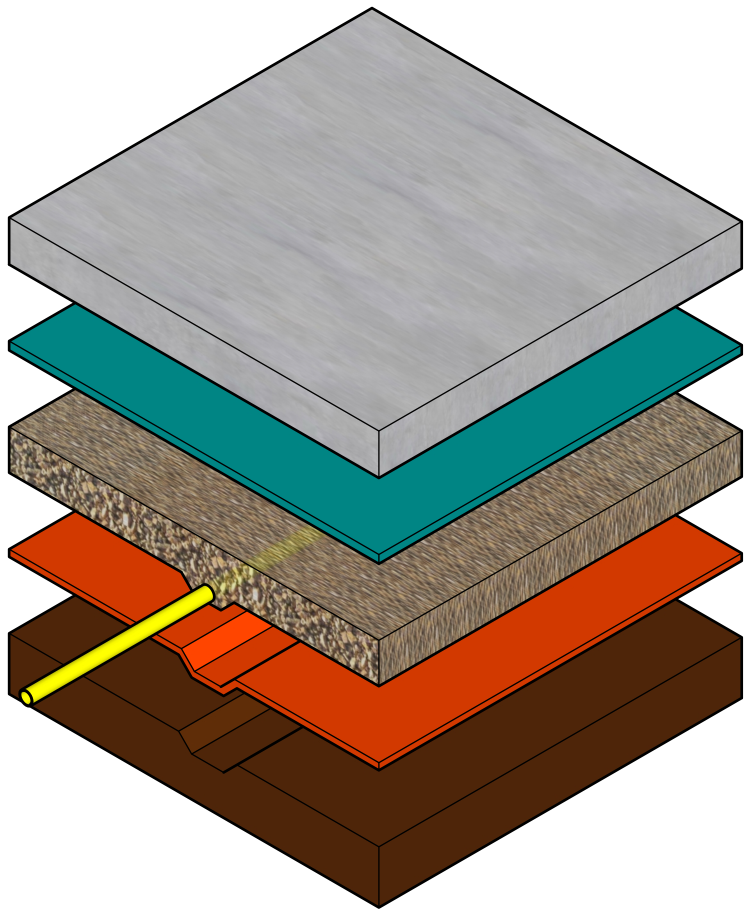
Title

BASEMENT DRAINAGE SHORING SYSTEM TYPICAL DETAILS

OBJECTS ARE COLOR-CODED
BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC VIEW

NOTES

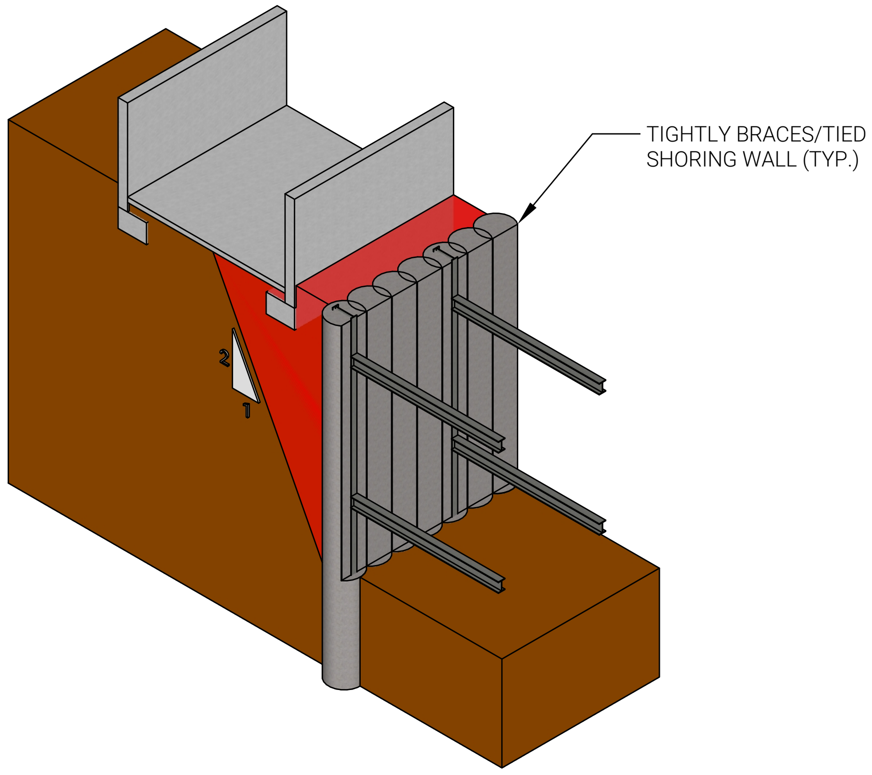
1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N).

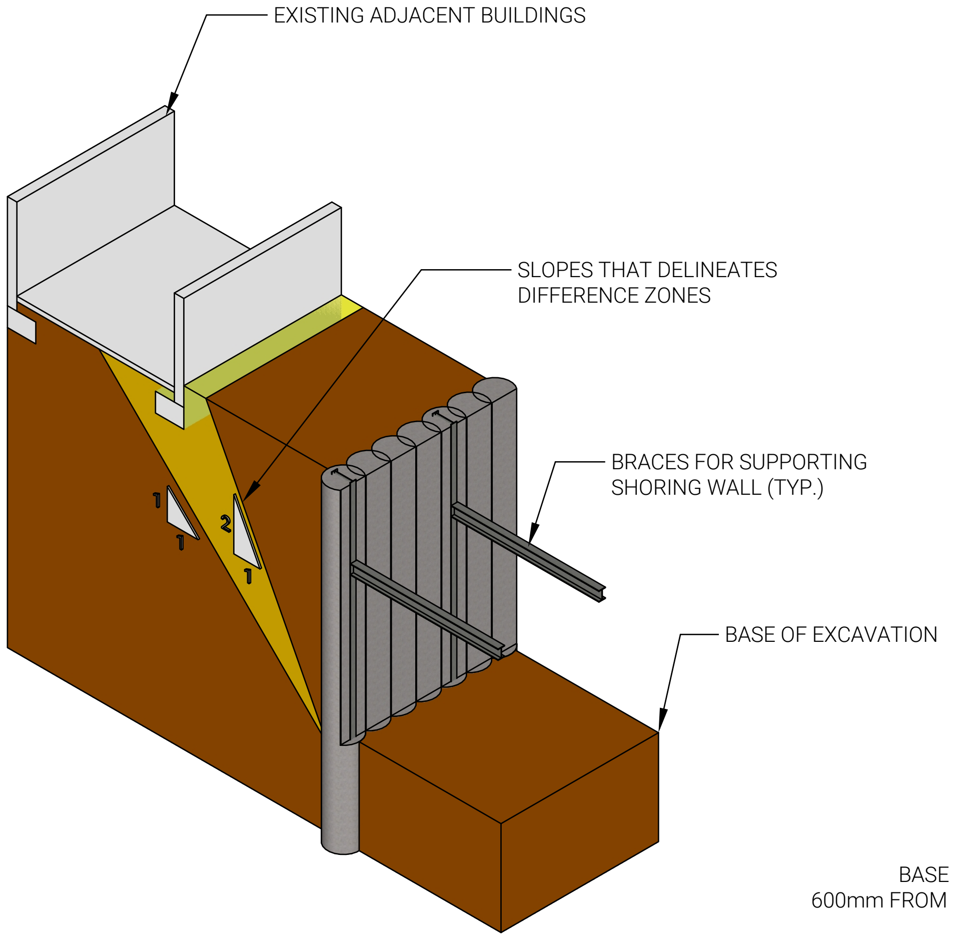
2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

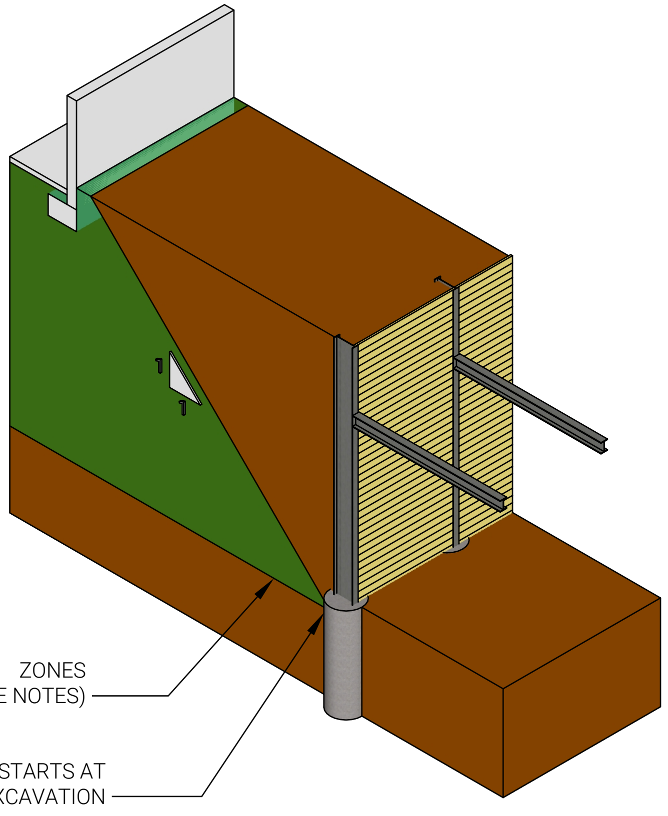
GROUNDED ENGINEERING

Title

BASEMENT SUBDRAIN TYPICAL DETAIL







ZONE A (RED)

FOUNDATIONS WITHIN THIS ZONE OFTEN REQUIRE UNDERPINNING OR SHORING SYSTEM. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATION MUST BE CONSIDERED

ZONE B (YELLOW)

FOUNDATIONS WITHIN THIS ZONE OFTEN DO NOT REQUIRE UNDERPINNING BUT MAY REQUIRE SHORING SYSTEM. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATION MUST BE CONSIDERED

ZONE C (GREEN)

FOUNDATIONS WITHIN THIS ZONE USUALLY DO NOT REQUIRE UNDERPINNING OR SHORING SYSTEM

NOTES:
1. USER'S GUIDE - NBC 2005 STRUCTURAL COMMENTARIES (PART 4 OF DIVISION B) - COMMENTARY K.

GROUNDED
ENGINEERING

Title

EXCAVATION ZONE OF INFLUENCE GUIDELINES