

GEOTECHNICAL ENGINEERING REPORT

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2072 Lakeshore Road
Burlington, Ontario

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1 Introduction

Acamar Dwelling Corp. has retained Grounded Engineering Inc. ("Grounded") to provide geotechnical engineering design advice for their proposed development at 2072 Lakeshore Road, in Burlington, Ontario.

The proposed project includes demolishing the existing structure and constructing a 20-storey residential tower extending from a low-rise podium, with seven underground parking levels (P7) set at an estimated depth of 24.5± m below grade; therefore, the P7 lowest finished floor elevation (FFE) is estimated to be at Elev. 58.4± m.

Revision 1 of this report includes the following changes:

- Reduction in tower height (currently at 20-storeys).
- Deepening of P7 level lowest FFE (currently at Elev. 58.4± m).
- Additional boreholes (Boreholes 201 to 206) advanced on site for environmental engineering purposes.
- Additional long-term groundwater level monitoring.

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

- Plan of Survey, "Part of Lots 2, 3 and 4, Registered Plan 92, City of Burlington"; Project No. 19-002, dated February 15, 2019, prepared by Mackay Mackay and Peters Limited.
- Architectural Drawings, "2072 Lakeshore Road"; Project No. 2069.22, dated December 11, 2024, prepared by Graziani+Corazza Architects.
- Phase II Environmental Site Assessment, "2072 Lakeshore Road, Burlington"; Project No. 233698.001, dated March 5, 2019, prepared by Pinchin Ltd.

Grounded has been provided with factual borehole information for the subject site from Pinchin as listed above. Those borehole logs are provided in a report signed by Professional Geoscientists / Certified Engineering Technologists. As such, this borehole information (appended) is taken as factual for present purposes. Unless noted, borehole labels appended with "PIN-" refer to Pinchin's boreholes.

Grounded's subsurface investigation of the site to date includes thirteen (13) boreholes (Boreholes 101 to 107 and 201 to 206) which were advanced from March 6th to 16th, 2023 (100 series) and June 25th and 26th, 2024 (200 series).

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.

Grounded Engineering must conduct the on-site evaluation of founding subgrade as foundation and slab construction proceeds. This is a vital and essential part of the geotechnical engineering function and must not be grouped together with other “third-party inspection services”. Grounded will not accept responsibility for foundation performance if Grounded is not retained to carry out all the foundation evaluations during construction.

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.

Elevations are measured relative to geodetic datum. The horizontal coordinates are provided relative to the Universal Transverse Mercator (UTM) geographic coordinate system.

The boreholes were surveyed for horizontal coordinates and geodetic elevations with the Sokkia GCX3 system, connected to the Global Navigation Satellite System and the Can-Net Virtual Reference Station Network.

2.1 Stratigraphy

The following stratigraphy summary is based on the borehole results and the geotechnical laboratory testing. Our findings are generally consistent with those reported by Pinchin.

A subsurface profile showing stratigraphy and engineering units is appended and includes the relevant borehole and well information from the other consultants.

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. The average existing grade is estimated to be at Elev. 82.5± m. In general, three (3) main stratigraphic units were encountered on site as follows:

1. Surficial pavements/fills and earth fill, overlying
2. A native clayey silt glacial till at about Elev. 80.5± m, overlying
3. Bedrock of the Queenston Formation at about Elev. 79.0± m.

The design groundwater table is hydraulically connected with the water level of Lake Ontario, at about Elev. 75± m.

2.1.1 Surficial Materials and Earth Fill

Surficial fill (pavements, aggregate, topsoil, etc.) thicknesses were observed in individual borehole locations through the top of the open borehole. Thicknesses may vary between and beyond each borehole location.

At existing grade, the surficial materials observed includes 100 to 230 mm of topsoil in Borehole 103, and 202 to 206 (203 and 206 observed a 25 mm thick layer of aggregate below the top soil), a 430 mm thick layer of aggregate in Borehole 201, and pavements consisting of 40 to 65 mm of asphalt underlain by earth fill in the remaining boreholes (excluding Borehole 104, which observed earth fill at grade).

Underlying the surficial materials, the boreholes observed a layer of earth fill extending to depths of 0.8 to 3.0 m below grade (Elev. 79.6 to 81.7 m). The earth fill varies in composition from sand to gravelly sand, and silt, contains trace amounts of deleterious materials (incl. asphalt fragments, rootlets, topsoil inclusions) with faint to moderate petroleum hydrocarbon odours noted in Boreholes 102, 105 and 107. Borehole 101 experienced practical refusal on an inferred concrete obstruction at a depth of 3.0 m below grade (Elev. 79.6 m); the borehole was subsequently re-located and re-drilled to depth. The earth fill ranges in colour from brown to blackish brown/brownish black to reddish brown.

Due to the variation and inconsistent placement of the earth fill material, the relative density of the earth fill varies.

2.1.2 Glacial Till

Underlying the layer of earth fill, the boreholes observed a native undisturbed glacial till at depths of 0.8 to 3.0 m below grade (Elev. 79.6 to 81.5 m) extending to depths of 3.0 to 3.9 m below grade (Elev. 78.9 to 79.5 m). The glacial till generally consists of a clayey silt matrix (intermittently transitions to sandy silt to silt and sand matrices), contains a variable amount of sand (ranging from trace sand to sandy), trace to some gravel, trace shale fragments, with faint to moderate petroleum hydrocarbon odours noted in Boreholes 102, 105 and 106. The glacial till is reddish brown and moist. A surficial layer of sand was observed overlying the glacial till in Borehole 103 and 206 at a depth of 0.8 to 1.2 m below grade (Elev. 81.5 to 81.7 m) extending to a depth of 1.8 to 2.0 m below grade (Elev. 80.3 to 81.1 m), and the glacial till contains intermittent layers of gravelly sand and sandy silt. Boreholes 202 to 206 were terminated within this till.

The Standard Penetration Test (SPT) results (N-Values) measured in the glacial till ranges from 20 to 66 blows per 300 mm of penetration (bpf), suggesting a very stiff to hard consistency.

2.1.3 Bedrock

Underlying the glacial till, bedrock of the Queenston Formation was encountered at depths of 3.0 to 3.9 m (Elev. 78.9 to 79.5 m). Borehole 201 was terminated upon ‘inferred bedrock’. In the

remaining boreholes bedrock was confirmed by rock cores recovered, extending to the target depths of 8.0 to 27.9 m below grade (Elev. 54.4 to 74.5 m).

Detailed core logs are included with the corresponding borehole logs. Photographs of the recovered rock core and a guide of rock core terminology are appended. The rock core terminology sheet defines many of the descriptive terms used below.

The bedrock beneath the site is the Queenston Formation, which is a deposit predominantly comprising thin to medium bedded red to reddish brown calcareous shale and siltstone ("shale" by local convention) of Upper Ordovician age. The strength of the intact sound bedrock varies from weak to medium strong. The low-fissility shale contains grey-green mottling and banding which is occasionally harder than the red shale, possibly indicating a higher carbonate content which is called “limestone” by local convention. However, the Queenston shale within the study area is generally calcareous and is interbedded with stronger calcareous sandstone and silty bioclastic carbonate. Minor amounts of gypsum, in nodules and laminae, are found throughout. These, along with occasional weathered clay seams and partings, indicate the presence of groundwater within the bedrock.

Joints occurring within the shale are closely to very closely spaced, and typically weathered with a veneer to coating of clay. Widely-spaced subvertical joints (closed, planar, clean) were also observed within the shale.

A summary of information with respect to the Queenston Formation was presented in the Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects* (March 1983), as follows.

Table 2.1 – Summary of MTO Queenston Formation Parameters

	Uniaxial Compressive Strength (MPa)	Young’s Modulus (GPa)	Dynamic Modulus (GPa)	Poisson’s Ratio
Average	8.7	1.3	n/a	0.32
Range	7.2 to 9.6	0.5 to 2.3	n/a	0.28 to 0.35

Rock core samples were submitted for testing of unconfined compressive strength (ASTM D7012) and elastic moduli in uniaxial compression (ASTM D7012). The detailed rock laboratory testing results are appended. The test results are summarized as follows:

Borehole ID	Core ID	Depth / Elev. (m)	Bulk Density (kg/m^3)	UCS (MPa)	Young’s Modulus, E (GPa)	Lithology
BH101	RC1	20.2 / 62.4	2637	25.9	3.6	Shale
BH101	RC2	22.9 / 59.7	2640	46.6	9.5	Shale and Limestone

Borehole ID	Core ID	Depth / Elev. (m)	Bulk Density (kg/m^3)	UCS (MPa)	Young's Modulus, E (GPa)	Lithology
BH102	RC3	23.0 / 59.4	2648	27.9	5.4	Shale
BH102	RC4	26.1 / 56.3	2634	32.4	6.8	Shale
BH103	RC5	26.8 / 55.5	2643	28.6	6.6	Shale and Limestone

Directly below the overburden soils, the uppermost portion of bedrock is typically weathered. The MTO (Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects)* provides a *typical weathering profile of a low durability shale* reproduced from Skempton, Davis, and Chandler, which characterizes weathered versus unweathered shale as follows:

Table 2.2 – Typical Weathering Profile of a Low Durability Shale

	Zone	Description	Notes
Fully Weathered	IVb	soil-like matrix only	indistinguishable from glacial drift deposits, slightly clayey, may be fissured
Partially Weathered	IVa	soil-like matrix with occasional pellets of shale less than 3 mm dia.	little or no trace of rock structure, although matrix may contain relic fissures
	III	soil-like matrix with frequent angular shale particles up to 25 mm dia.	moisture content of matrix greater than the shale particles
	II	angular blocks of unweathered shale with virtually no matrix separated by weaker chemically weathered but intact shale	spheroidal chemical weathering of shale pieces emanating from relic joints and fissures, and bedding planes
Unweathered (Sound)	I	shale	regular fissuring

In glacial till overburden soils directly overlying bedrock, a zone of till with fragmented shale is often observed and interpreted as either the lowest portion of the till, or as partially weathered Zone III rock. This interpretation is subjective and depends on the investigator. There is occasionally a concentration of boulders in the soil just above the bedrock that can be mistakenly identified as bedrock where rock coring is not performed. Weathering Zones III and IV are frequently not present due to glacial scouring action, which often removes these zones from the bedrock surface.

The Pinchin boreholes observed "till/weathered shale complex". For practical purposes, based on our own borehole and rock coring findings, we have grouped the "till/shale complex" with the inferred Zone II weathered bedrock.

The bedrock surface as indicated on the Borehole Logs from this investigation is intended to be consistently interpreted as the surface of Zone II unless noted otherwise. Based on examination of the rock cores from this site, the partially weathered rock (Zone II) is approximately 0.1 m thick at the location of Borehole 106 to 3.2 m thick in the location of Borehole 104. Weathered and sound bedrock elevations are summarized as follows:

Borehole	Ground Surface Elevation (m)	Partially Weathered (Zone II) Bedrock		Unweathered/Sound (Zone I) Bedrock	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
101	82.6	3.5	79.1	5.0	77.6
102	82.4	3.2	79.2	4.2	78.2
103	82.3	3.4	78.9	3.9	78.4
104	82.8	3.9	78.9	7.1	75.7
105	82.5	3.2	79.3	3.6	78.9
106	82.5	3.3	79.2	3.5	79.0
107	82.3	3.2	79.1	3.6	78.7

Rock Quality Designation (RQD) is an index measurement that refers to the total length of pieces of sound core in a core run that are at least 100 mm in length, expressed as a percentage of the total length of that core run. Only natural discontinuities are used in assessing RQD. The RQD of the recovered rock cores ranges from 45 to 95% (on average 69%) in the weathered bedrock, and 47 to 100% (on average 82%) in the sound bedrock.

RQD underrepresents the competency of the Queenston Formation and is not appropriate for horizontally bedded fissile shale. In this formation, the RQD is typically low due to the fissility of the shale as well as the closely spaced horizontal bedding planes. Our results are typical of this formation.

There are near-vertical joint sets within this shale that are typically very widely spaced at over 2 m apart. There are also several faults typically referred to as “shear zones” found within the formation, which are observed as zones of rock rubble within the cores. These faults defy discovery in conventional vertical boreholes.

The jointing and crush zones in the rock are related to the state of stress in the deposit. Research in the Queenston Formation in Southern Ontario has revealed that the bedrock contains locked-in horizontal stresses that could be remnants of the foreshortening that occurred in the earth’s crust during continental glaciation several thousand years ago. Documented experiments have indicated that the major principal stress is of the order of 2 MPa in the upper 1 to 2 metres of the deposit where the rock is weathered and contains more fractures. Intact rock can have an internal major principal stress as high as 4 to 5 MPa. The major and minor principal stresses are horizontal and may be oriented in any direction. The empirical approach to vertical stress below the top of bedrock is to use a uniform pressure distribution below the top of bedrock elevation that is equal to the maximum earth pressure calculated for the lowest level of soil in the profile.

The Queenston has been known to issue gases when penetrated. There are instances where both methane and hydrogen sulphide gas emissions have been detected in excavations made in the Queenston Formation. While there was no specific indication of gas emissions from the boreholes made in this investigation, the potential for gas emissions from this formation is recognized as a design issue to be addressed.

2.2 Groundwater

On completion of drilling, the boreholes were filled with drill fluid (from rock coring) and measuring the unstabilized groundwater level after drilling was not practical. Monitoring wells were installed in each of the boreholes, and stabilized groundwater levels were measured in each of the monitoring wells at a minimum one week after the completion of drilling. The groundwater observations are shown on the Borehole Logs and are summarized as follows.

Borehole No.	Depth of well (m)	Strata Screened	Water Level in Well, Depth/Elev. (m)			
			Highest Level	Date	Most Recent Level	Date
101	27.6	Sound Bedrock	10.2 / 72.7	Apr 3, 2023	17.2 / 65.4	Dec 10, 2024
102*	7.6	Sound Bedrock	Dry	Mar 20, 2023	Dry	June 9, 2023
103	27.7	Sound Bedrock	9.0 / 73.3	May 5, 2023	17.7 / 64.6	Dec 10, 2024
104	9.7	Sound Bedrock	5.4 / 77.4	Mar 20, 2023	7.2 /75.6	Dec 10, 2024
105	7.9	Sound Bedrock	Dry	Mar 20, 2023	Dry	Dec 10, 2024
106*	7.9	Sound Bedrock	7.8 / 74.7	Mar 20, 2023	7.8 / 74.7	June 9, 2023
107	9.5	Sound Bedrock	8.6 / 73.7	May 5, 2023	9.1 / 73.2	Dec 10, 2024
201	9.9	Inferred Bedrock	9.1 / 73.4	Dec 10, 2024	9.1 / 73.4	Dec 10, 2024
202	10.0	Inferred Bedrock	8.9 / 73.6	Jul 11, 2024	9.3 / 73.2	Dec 10, 2024
PIN-MW01	4.6	Sand, Silt and Inferred Bedrock	1.4 / 81.0	Feb 7, 2019	1.8/ 80.6	Dec 10, 2024
PIN-MW02	4.6	Sand, Silt and Inferred Bedrock	2.2 / 80.3	Feb 7, 2019	2.2 / 80.3	Dec 10, 2024
PIN-MW03	4.6	Sand, Silt and Inferred Bedrock	1.4 / 81.1	Feb 7, 2019	2.2 / 80.5	Dec 10, 2024

*Monitoring wells were inaccessible; recent water level measurements could not be completed.

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.

The design groundwater table is hydraulically connected with the water level of Lake Ontario, at about Elev. 75± m. There is also infiltrated stormwater perched in the earth fill which is flowing down towards the groundwater table (as observed and previously reported in the Pinchin monitoring wells).

Locally higher water level readings (at Elev. 77± m) were observed in Borehole 104, which was completed in the north corner of the site. These higher water level readings are considered not representative of the stabilized groundwater condition across the site (as was observed in this monitoring well in December 2024). Long-term groundwater monitoring is presently ongoing as part of the hydrogeological scope of work; Grounded has prepared a hydrogeological report for this site (File No. 22-282).

Within the zone of excavation, the earth fill will permit the free-flow of water when wet, whereas the native clayey silt glacial till will typically preclude free-flowing water. It can be expected that weathered bedrock and fractures in sound bedrock will produce free-flowing water below the groundwater table.

2.3 Corrosivity and Sulphate Attack

Three (3) soil samples were submitted for corrosivity testing parameters (pH, Resistivity, Electrical Conductivity, Redox Potential, Sulphate, Sulphide and Chloride). The Certificate of Analyses and interpretation sheet is appended.

The soil samples were analysed for soluble sulphate concentration and compared to the Canadian Standard CAN3/CSA A23.1-M94 Table 3, *Additional Requirements for Concrete Subjected to Sulphate Attack*. Corrosivity parameters are also used for assessing soil corrosivity applicable to cast iron alloys, according to the 10-point soil evaluation procedure described in the American Water Work Association (AWWA) C-105 standard.

The analytical results only provide an indication of the potential for corrosion. The results of this analysis are in reference to only the soil samples collected from specific locations, and soil chemistry may vary between and beyond the locations of the analysed samples. In summary:

- All of the samples have negligible sulphate concentrations.
- Two out of the three samples scored greater than 10 points and corrosion protective measures are therefore recommended for cast iron alloys.

3 Geotechnical Engineering Recommendations

Based on the factual data summarized above, we are providing the following geotechnical engineering design recommendations. 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

Foundations made for the proposed P7 level (FFE of Elev. 58.4± m) will bear on sound bedrock of the Queenston Formation at about Elev. 57.4± m. Conventional spread footings made to bear on this sound bedrock may be designed using a maximum factored geotechnical resistance at ultimate limit state (ULS) of 5 MPa. The net geotechnical reaction at serviceability limit state (SLS) is 4 MPa, for an estimated total settlement of 15 to 20 mm.

Excavations for typical footings will be nominally 1± m below FFE, to as much as 3± m below FFE for the elevator core. Therefore,

- Foundation excavations will extend below the design groundwater table;
- Foundation excavations will penetrate into sound bedrock, which will typically preclude free-flowing water; however, free-flowing water is to be expected in fractures in the bedrock;
- Seepage from the bedrock may be allowed to drain into the foundation excavations and then controlled by a conventional sump pump arrangement.

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 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.

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 Seismic Site Classification

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 30 metres of the site stratigraphy below spread footing/grade beam elevation, 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) of Elev. 57.4± m, the boreholes observed sound bedrock of the Queenston Formation. Based on this information, the site designation for seismic analysis is **Class B**, 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.

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 Glacial Till	21	32	0.31	0.47	3.25
Sound Bedrock	26	28	n/a		

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

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.

The earth pressure design approach for foundation walls below the top of bedrock is empirical and assumes a uniform pressure distribution below the top of bedrock elevation equal to the maximum earth pressure calculated for the lowest level of soil overtop. This approach is conventional and likely conservative, but it is practical insofar as it acknowledges the requirement of having a foundation wall of a consistent width at the lower levels.

Foundation resistance to sliding is proportional to the friction between the rock subgrade and the base of the footing. The factored geotechnical resistance to friction ($\mathbf{R_f}$) at ULS provided in the following equation:

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

R_f	=	frictional resistance (kN)
Φ	=	reduction factor per CFEM 5th Ed. (0.8 for cohesionless soils or rock; 0.6 for cohesive soils)
N	=	normal load at base of footing (kN)
φ	=	internal friction angle (see table above)

3.4 Rock Swell

The earth pressure design approach for foundation walls below the top of bedrock is provided in the section above. However, this approach does not recognize the potential for pressures on the basement wall due to time-dependent rock swell that results when locked in horizontal stresses are released. For structures deeper than 2 m below the top of sound rock, rock swell must also be considered. The simplest approach to dealing with rock swell is scheduling. If there is a 120-day gap between rock excavation and construction of the permanent structure that will restrain the rock, experience on similar structures indicates the rock will de-stress and swell, and

no significant stresses are imposed on the structural wall. This requirement typically only impacts the lowest basement level (or two) in bedrock, acknowledging the 120-day window.

If the construction schedule does not allow for a 120-day gap, mitigation measures will be required. For structures subjected to unbalanced rock swell pressure (i.e. lowest exterior foundation walls, sumps, elevators, other features cast directly against the rock face), rock squeeze effects can be addressed by providing a crushable layer between the rock and the concrete, such as 50 mm thick Ethafoam 220 Polyethylene Foam planks. The subject walls are typically designed for the 50% compressive strength resistance of the foam. At 50% compression, a 220 Ethafoam 220 Polyethylene Foam plank provides 124 kPa of resistance. At 10% compression (which allows for concrete placement), this material provides 50 kPa of resistance.

Deeper protrusions (sumps, elevator pits, etc.) can be over-excavated as they are not typically constrained by the property lines or adjacent footings. In this case the rock can be horizontally over-excavated by a minimum 600 mm on all sides. Precast pits and sumps are then placed and backfilled with 19 mm clear stone (OPSS.MUNI 1004). The clear stone backfill then accommodates the rock swell.

Rock squeeze effects are not relevant to foundation excavations as the earth pressures exerted on foundation elements are balanced, and concrete is strong enough to resist the swell pressure and render it null.

3.5 Slab on Grade Design Parameters

At the proposed P7 level, the sound bedrock of the Queenston Formation 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 sound bedrock is 80,000 kPa/m.

If this basement structure is made as a conventional drained structure, a permanent drainage system including subfloor drains is required (see section below). In this case, 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 200 mm thick layer of 19 mm clear stone (OPSS.MUNI 1004).

Subfloor drains are typically installed in trenches below the capillary moisture break drainage layer per the typical detail appended. If trenches are to be avoided for whatever reason, the subfloor drainage system can be incorporated into the capillary moisture break and drainage layer. In this case, the subfloor drains are laid directly on the flat subgrade and backfilled with a minimum 300 mm thick layer of 19 or 9.5 mm clear stone (OPSS.MUNI 1004), HPB, or approved equivalent, vibrated to a dense state. Any solid collection pipes must be sloped so that they positively discharge to the sumps.

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.

3.6 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.

The requirement for a permanent basement drainage system depends on whether a fully watertight approach is adopted for this site. The following discussion pertains to a drained basement approach only.

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 (min. 100 mm diameter) are to be spaced at an average 9 m (measured on-centres).

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.

Although the basement will be made as a drained structure, the relative humidity at the interface between the foundation wall and the soil/shoring system will still be 100%. A layer of waterproofing placed between the drainage layer and the foundation wall is recommended to protect interior finishes and reinforcing steel from moisture. The building science engineer should confirm this and can provide further advice, as well as specifications for waterproofing products.

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.

The permanent dewatering requirements are provided in Grounded's Hydrogeological Report (File No. 22-282).

If any water is to be discharged to the storm or sanitary sewers, the City will require Discharge Agreements to be in place.

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 (and any sands/silts) is a Type 3 soil
- The glacial till 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, per Section 234:

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 239 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.

Bedrock is not considered a soil under the Act, per clause 234(2)(d). Vertical excavations made in sound bedrock are generally self-supporting provided the rock bedding is horizontally oriented. If deemed necessary, rock bolts and welded wire mesh/shotcrete (or other means and methods) can be used to protect workers from rock spalling from the face of excavation. The rock face must be inspected by Grounded to determine that no other support system is required to prevent the spalling of loose rock, and to confirm that all loose spall material at risk of falling upon a worker is removed (clause 234(2)(h) of the above noted regulations).

The exposed vertical bedrock face deteriorates with time and exposure. Exposed excavation faces have been found to flake and recede as much as 300 mm within a 12 month exposure. This recession generally takes the form of coin-sized shale particles dropping from the face on a constant basis. If deemed necessary, debris netting draped over the rock face can be used to contain and collect these coin-sized shale particles.

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.

Excess soil is governed by Ontario Regulation 406/19: On-Site and Excess Soil Management. The Project Leader (typically the owner) may be required to file a notice in the excess soil registry and a Qualified Person (within the meaning of O.Reg. 153/04) may be required to prepare the associated planning documents and/or develop and implement a tracking system in accordance with the Soil Rules, to track each load of excess soil during its transportation and deposit before removing excess soil from the project area.

Excavations will penetrate weathered and sound bedrock. Queenston Formation bedrock is a rippable rock that can be removed with conventional excavation equipment once it has been broken by ripper tooth or hoe ram. Creating detailed excavation shapes for foundations etc. is normally accomplished by hoe ram. The removal of rock from a vertical face without over-excavation, which can happen inadvertently by dislodging additional rock, is largely dependent on machine operator skill. The contractor shall exercise caution and implement the appropriate techniques to reduce the amount of disturbance to the rock mass (rock fracturing) with the excavator.

If excavation faces must be made neat (such as beside an existing footing), a line of excavation can be provided by line drilling the rock a series of closely-spaced vertical holes (100 mm diameter, spaced at 300 mm on centre) to provide a preferential vertical break path for the excavation face.

4.2 Short-Term Groundwater Control

Considerations pertaining to groundwater discharge quantities and quality are discussed in Grounded's hydrogeological report for the site, under separate cover.

The design groundwater table is hydraulically connected with the water level of Lake Ontario, at about Elev. 75± m. There is also infiltrated stormwater perched in the earth fill which is flowing down towards the groundwater table (as observed and previously reported in the Pinchin monitoring wells).

Locally higher water level readings (at Elev. 77± m) were observed in Borehole 104, which was completed in the north corner of the site. These higher water level readings are considered not representative of the stabilized groundwater condition across the site, as was confirmed in our observation in this well in December 2024. Long-term groundwater monitoring is presently ongoing as part of the hydrogeological scope of work; Grounded has prepared a hydrogeological report for this site (File No. 22-282).

Within the zone of excavation, the earth fill will permit the free-flow of water when wet, whereas the native clayey silt glacial till will typically preclude free-flowing water. It can be expected that weathered bedrock and fractures in sound bedrock will produce free-flowing water below the groundwater table. On this basis, seepage into excavations may be allowed to drain into the excavation and then controlled by a conventional sump pump arrangement. Nevertheless, delays in excavation will occur as the seepage is controlled and these delays should be anticipated in the construction schedule.

Positive dewatering of the bedrock is not required.

The City / Region will require a Discharge Agreement in the short term, if any water is to be discharged to the storm or sanitary sewers during construction.

4.3 Earth-Retention Shoring Systems

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

Excavation zone of influence guidelines are appended.

Continuous interlocking caisson wall shoring is to be used where the excavation must be constructed as a rigid shoring system. Caisson wall shoring preserves the support capabilities and integrity of the soil beneath existing foundations of adjacent buildings, in a state akin to the at-rest condition. Otherwise, excavations can be supported using conventional soldier pile and lagging walls; however, localized active dewatering of the perched water within the earth fill may be required prior to lagging board installation and during construction (to prevent sloughing soils).

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:

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

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), h_w is equal to zero. For the design of impermeable shoring, a design groundwater table at Elev. 75± m must be accounted for. There is infiltrated stormwater perched in the earth fill and upper native soils which may accumulate behind a caisson wall. This hydrostatic pressure needs to be accounted for in shoring design.

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. In cohesionless soils, the lateral earth pressure distribution is rectangular.

Where the excavation penetrates the bedrock, the rock excavation is nominally self-supporting in a vertical face, provided the rock bedding is horizontally oriented. The requirement for extending lagging into partially weathered rock depends on the quality of the excavation cut and the degree of weathering.

4.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in the sound bedrock of the Queenston Formation. Soldier pile toes resist horizontal movement due to the passive earth pressure acting on the toe below the base of excavation. The maximum factored vertical geotechnical resistance at ULS for the design of a pile embedded in the sound bedrock is 8 MPa. The maximum factored lateral geotechnical resistance at ULS of the undisturbed rock is 1 MPa.

There are zones of soil in the subgrade that are wet, cohesionless, and permeable. Augered holes for piles made into these soils will be prone to caving and blowback. Temporarily cased holes advanced to the bedrock surface may be required to prevent borehole caving during installations in drilled holes. To prevent groundwater issues (groundwater inflow, caving and blowback into the drill holes, disturbance to placed concrete, etc.) during drilling and installation, construction methods such as utilizing temporary liners, pre-advancing liners deeper than the augered holes, mud/slurry/polymer drilling techniques, tremie pour concrete, or other methods as deemed necessary by the shoring contractor are required. Concrete for shoring piles and fillers must be placed by tremie method wherever there is more than 300 mm of water or fluid at the base of the drill hole.

Exposed bedrock of the Queenston Formation deteriorates with time. Within 12 months of exposure, excavation faces made within this bedrock flake and recede as much as 300 mm, generally in the form of coin-size shale particles dropping from the face on a constant basis. The deteriorated rock loses internal integrity and bearing capability. Solider piles for the shoring system are typically advanced at least 1 metre below the base of the excavation (to be confirmed by the geostructural engineer) to accommodate this weathering and still ensure that the required lateral and vertical bearing resistances can be utilized.

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.

In the Queenston Formation, conventional micropile anchors (at a nominal borehole diameter of 115 mm) can be designed using an ultimate resistance of 1,200 kPa. Assuming that a site specific tension load test is performed, a resistance factor of 0.65 is applicable. The maximum factored geotechnical resistance at ULS is taken as the ultimate resistance multiplied by a resistance factor. Following the load test, the micropile capacity can be re-evaluated and potentially improved.

Production tiebacks require a minimum 3 m socket length.

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.

Every production anchor must be proof tested to 133% of design load, and then locked in at 100% of design load. For permanent applications, they must be proof tested to 150% of design load, and then locked in at 110% of design load

The sound bedrock below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on bedrock at an inclination of 45 degrees can be designed using a maximum factored geotechnical resistance at ULS of 2500 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. The slab on grade should not be placed on frozen subgrade, to prevent settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation. Depending on the project context, consideration should be given to frost effects (heaving, softening, etc.) on exposed subgrade surfaces.

Deteriorating bedrock loses internal integrity and bearing capability. If bedrock subgrade is to be exposed for prolonged periods of time, it is recommended that a skim coat of concrete be used to protect the bedrock subgrade from slaking and other degradation resulting from weathering.

4.5 Engineering Review

By issuing this 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 foundation installations and 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.

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 should be monitored by Grounded at the time of construction to confirm material quality, and thickness.

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 and geostructural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

5.1 Investigation Procedures

The geotechnical engineering analysis and advice provided are also based on the factual borehole information observed and recorded by Grounded. The investigation methodology and engineering analysis methods used to carry out this scope of work are consistent with Grounded's standard of practice as well as other reasonable and prudent geotechnical consultants, working under similar conditions and constraints (time, financial and physical).

Borehole drilling services were provided to Grounded by a specialist professional contractor. The drilling was observed and recorded by Grounded's field supervisor on a full-time basis. Drilling was conducted using conventional drilling rigs equipped with hollow stem augers and rock coring was carried out with HQ size diamond bit core drilling barrels. As drilling proceeded, groundwater observations were made in the boreholes. Based on examination of recovered borehole samples, our field supervisor made a record of borehole and drilling observations. The field samples were secured in air-tight clean jars and bags and taken to the Grounded soil laboratory where they were each logged and reviewed by the geotechnical engineering team and the senior reviewer.

The Split-Barrel Method technique (ASTM D1586) was used to obtain the soils samples. The sampling was conducted at conventional intervals and not continuously. As such, stratigraphic interpolation between samples is required and stratigraphic boundary lines do not represent exact depths of geological change. They should be taken as gradual transition zones between soil or rock types.

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 to potential site alteration.

The geotechnical engineering advice provided in this report is based on the factual observations made from the site investigations as reported. It is intended for use by the owner and their retained design team. If there are changes to the features of the development or to the scope, the interpreted subsurface information, geotechnical engineering design parameters, advice, and discussion on construction considerations may not be relevant or complete for the project. Grounded should be retained to review the implications of such changes with respect to the contents of this report.

5.3 Report Use

The authorized users of this report are Acamar Dwelling 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

Ruth Schoenhardt, B.A.Sc
Project Coordinator

Nick Ng, P.Eng.
Team Lead

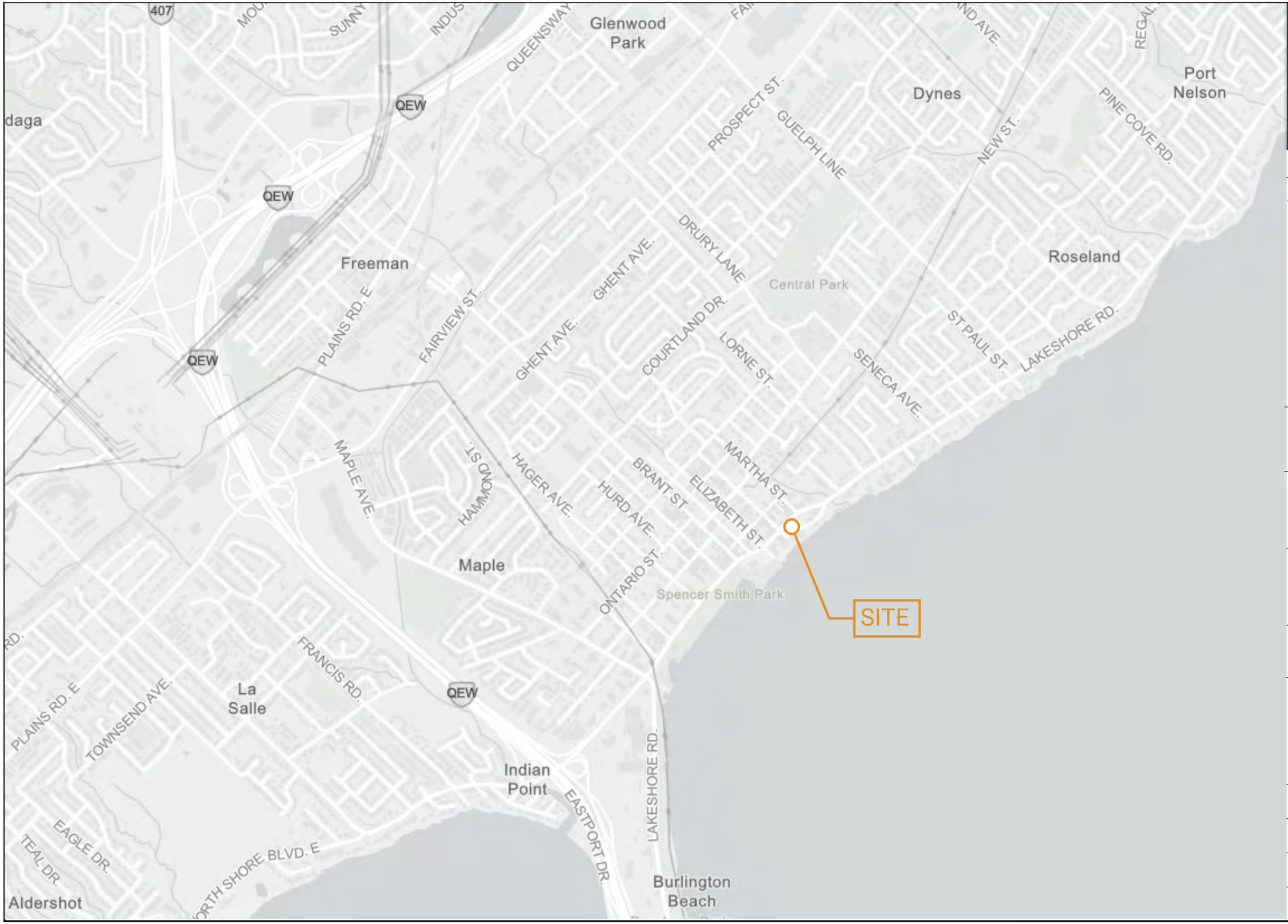
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100510783
2024.12.19
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LICENSED PROFESSIONAL ENGINEER
J. J. CROWDER
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Jason Crowder, Ph.D., P.Eng.
Principal

FIGURES





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LEGEND

APPROXIMATE PROPERTY BOUNDARY

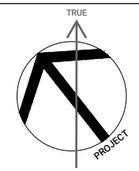
Note

Reference
ArcGIS My Map 2024.

Project
2072 LAKESHORE ROAD BURLINGTON, ONTARIO

Figure Title
SITE LOCATION PLAN

North

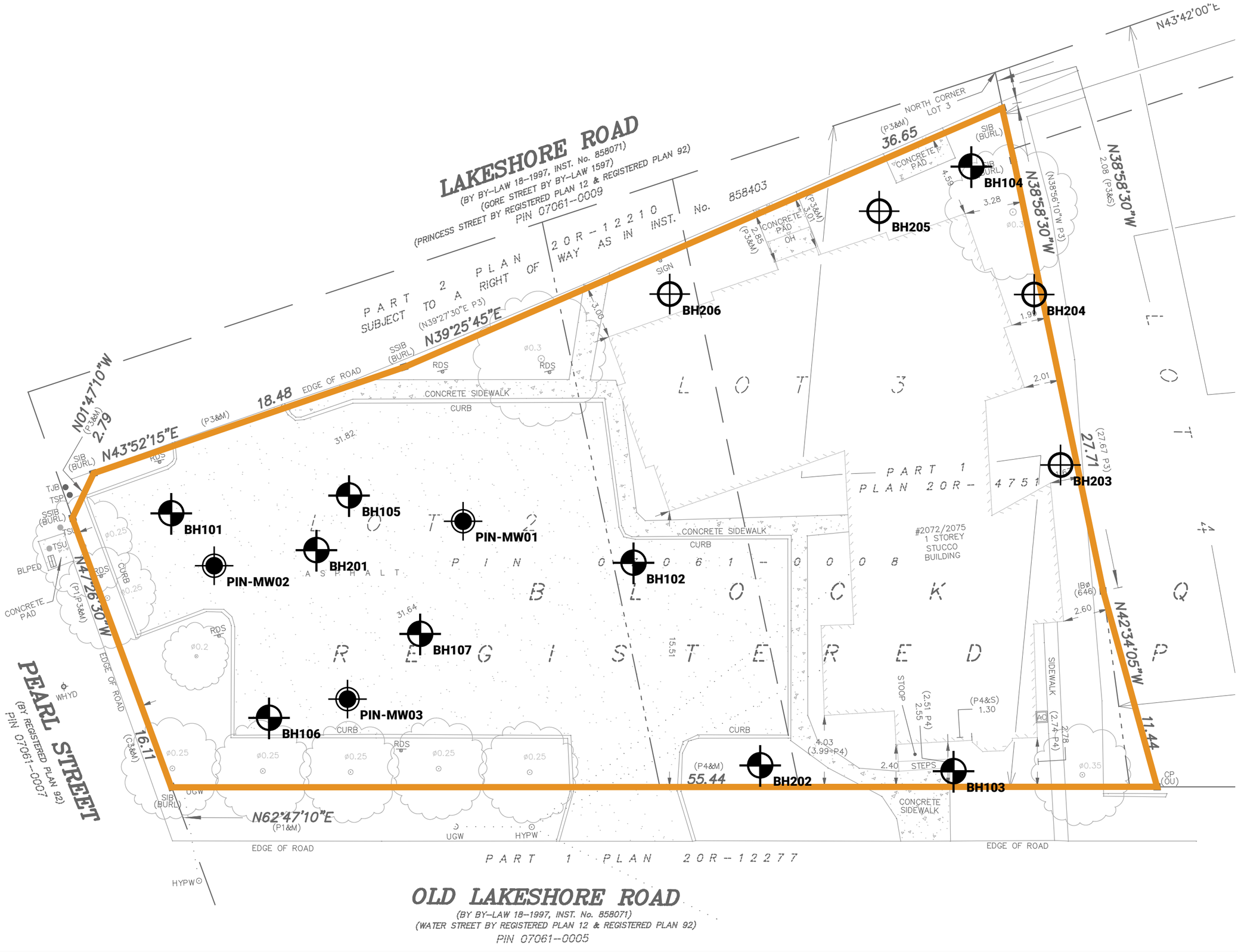


Date
DECEMBER 2024

Scale
N.T.S

Job No
22-282

Figure No
FIGURE 1



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LEGEND

- APPROXIMATE SITE BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- MONITORING WELL/BOREHOLE BY OTHERS

Note

Reference

Topographic Survey, "Plan of Survey of Part of Lots 2, 3 and 4, Registered Plan 92, City of Burlington", Project No. 19-002, dated February 15, 2019, prepared by Mackay Mackay and Peters Limited.

Project

2072 LAKESHORE ROAD BURLINGTON, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN (EXISTING CONDITION)

North

TRUE PROJECT

Date

DECEMBER 2024

Scale

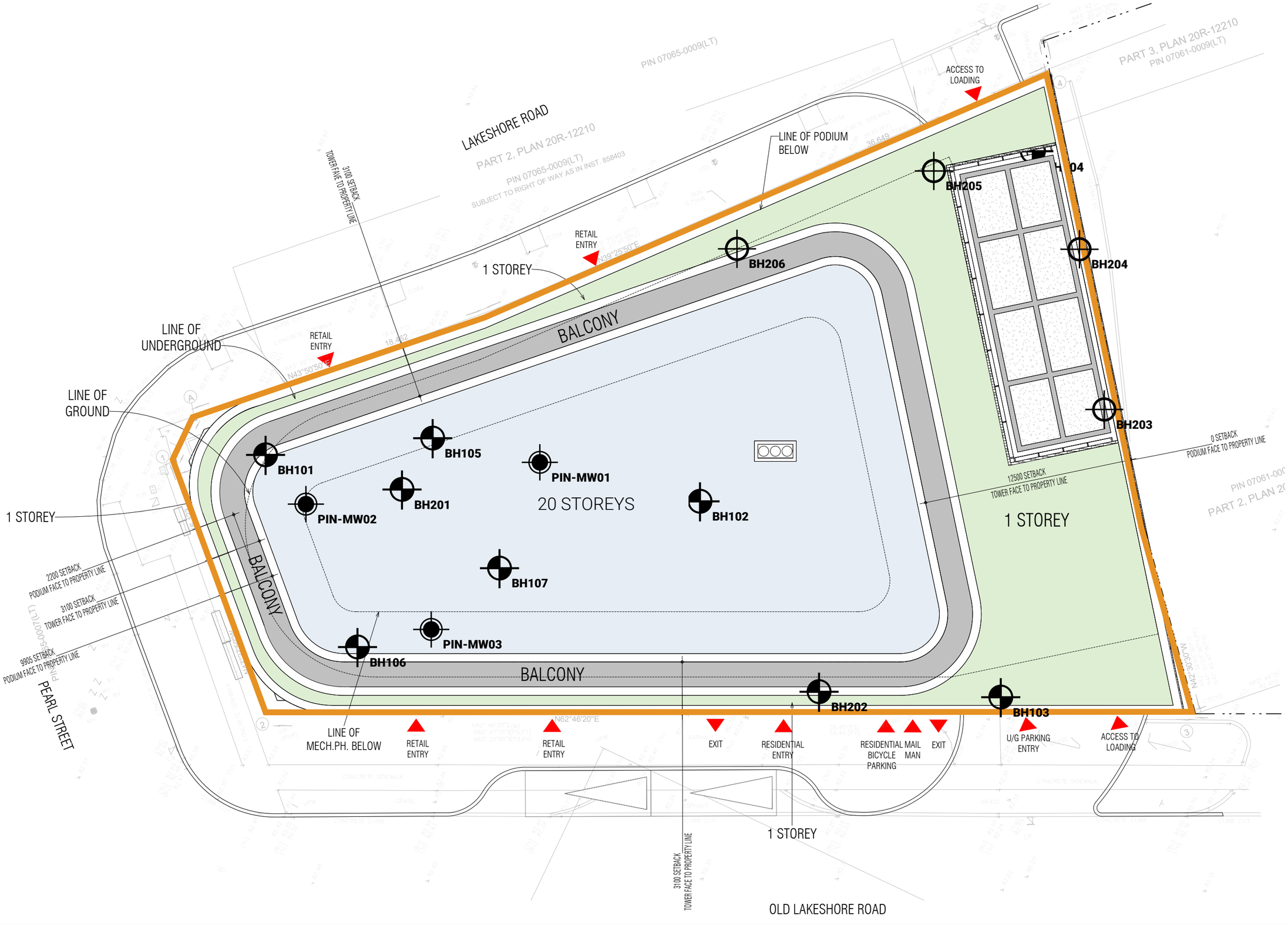
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Job No

22-282

Figure No

FIGURE 2



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LEGEND

- APPROXIMATE SITE BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- MONITORING WELL/BOREHOLE BY OTHERS

Note

Reference

Architectural Set, "2072 Lakeshore Road"; Drawing No: A.103 (Site Plan); Project No. 2069.22, dated December 11, 2024, prepared by Graziani and Corazza Architects.

Project

2072 LAKESHORE ROAD BURLINGTON, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN (PROPOSED CONDITION)

North

TRUE
PROJECT

Date

DECEMBER 2024

Scale

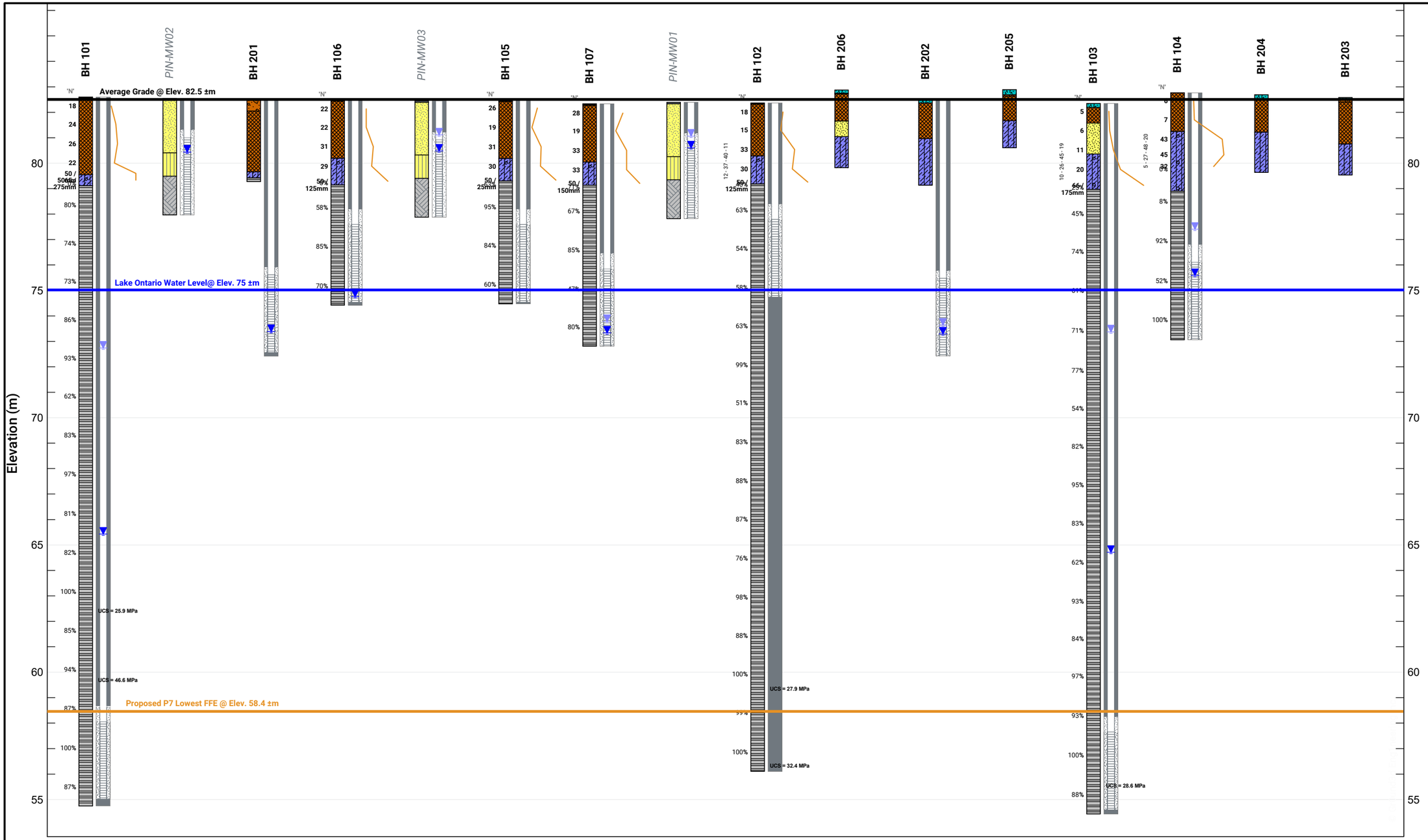
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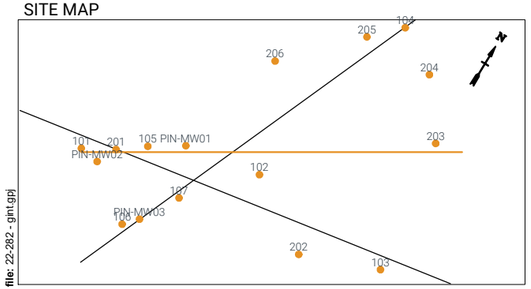
22-282

Figure No

FIGURE 3



SITE MAP



file: 22-282 - gint.gpj

Boreholes Equally Spaced

BOREHOLE STRATIGRAPHY LEGEND

- Asphalt
- Topsoil
- Silt
- Fill
- Sand
- Bedrock (inferred)
- Clayey Silt Till
- Aggregate
- Bedrock (cored)
- Clayey Silt

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LEGEND

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

BH 101 BOREHOLES BY GROUNDED

T-BH7 BOREHOLES BY OTHERS

- water level, unstabilized
- water level, stabilized (latest)
- water level, stabilized (highest)

Project
2072 LAKESHORE ROAD BURLINGTON, ON

Figure Title
SUBSURFACE PROFILE

Date
DECEMBER 2024

Scale
AS INDICATED

Job No
22-282

Figure No
FIGURE 4

APPENDIX A



BOREHOLE LOG TERMINOLOGY

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SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

PI: plasticity index

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ 1st water level measurement

▼ 2nd water level measurement most recent

▼ water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (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	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

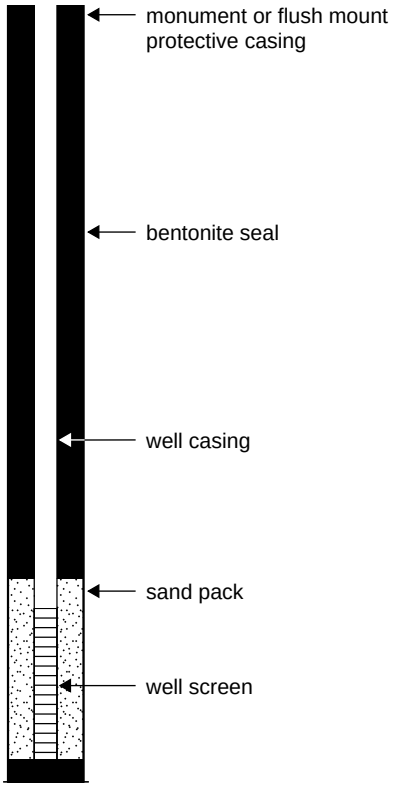
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



ROCK CORE TERMINOLOGY (MTO SHALE)

TCR **Total Core Recovery** the total length of recovery (soil or rock) per run, as a percentage of the drilled length
SCR **Solid Core Recovery** the total length of sound full-diameter rock core pieces per run, as a percentage of the drilled length
RQD **Rock Quality Designation** the sum of all pieces of sound rock core in a run which are 10 cm or greater in length, as a percentage of the drilled length

Natural Fracture Frequency (typically per 0.3 m) The number of natural discontinuities (joints, faults, etc.) which are present per 0.3m. Ignores mechanical or drill-induced breaks, and closed discontinuities (e.g. bedding planes).

LOGGING DISCONTINUITIES

Discontinuity Type

BP bedding parting
CL cleavage
CS crushed seam
FZ fracture zone
MB mechanical break
IS infilled seam
JT Joint
SS shear surface
SZ shear zone
VN vein
VO void

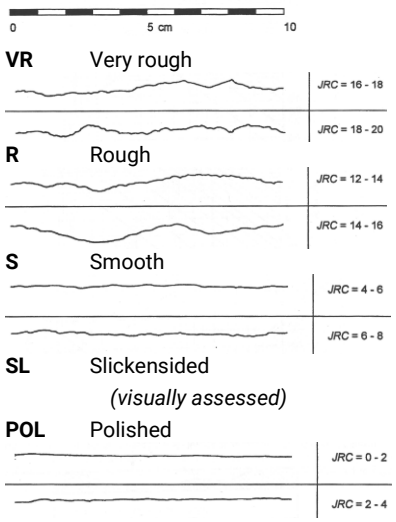
Coating

CN Clean
SN Stained
OX Oxidized
VN Veneer
CT Coating (>1 mm)

Dip Inclination

H	horizontal/flat	0 - 20°
D	dipping	20 - 50°
SV	sub-vertical	50 - 90°
V	vertical	90±°

Roughness (Barton et al.)



Spacing in Discontinuity Sets (*ISRM 1981*)

VC	very close	< 60 mm
C	close	60 – 200 mm
M	mod. close	0.2 to 0.6 m
W	wide	0.6 to 2 m
VW	very wide	> 2 m

Aperture Size

T	closed / tight	< 0.5 mm
GA	gapped	0.5 to 10 mm
OP	open	> 10 mm

Planarity

PR	Planar
UN	Undulating
ST	Stepped
IR	Irregular
DIS	Discontinuous
CU	Curved

GENERAL

Degree of Weathering (*after MTO, RR229 Evaluation of Shales for Construction Projects*)

Zone	Degree	Description
Z1	unweathered	shale, regular jointing
Z2	partially weathered	angular blocks of unweathered shale, no matrix, with chemically weathered but intact shale
Z3		soil-like matrix with frequent angular shale fragments < 25mm diameter
Z4a		soil-like matrix with occasional shale fragments < 3mm diameter
Z4b	fully weathered	soil-like matrix only

Strength classification (*after Marinos and Hoek, 2001; ISRM 1981b*)

Grade		UCS (MPa)	Field Estimate (Description)
R6	extremely strong	> 250	can only be chipped by geological hammer
R5	very strong	100 - 250	requires many blows from geological hammer
R4	strong	50 - 100	requires more than one blow from geological hammer
R3	medium strong	25 - 50	can't be scraped, breaks under one blow from geological hammer
R2	weak	5 - 25	can be peeled / scraped with knife with difficulty
R1	very weak	1 - 5	easily scraped / peeled, crumbles under firm blow of geo. hammer
R0	extremely weak	< 1	indented by thumbnail

Bedding Thickness (*Q. J. Eng. Geology, Vol 3, 1970*)

Very thickly bedded	> 2 m
Thickly bedded	0.6 – 2m
Medium bedded	200 – 600mm
Thinly bedded	60 – 200mm
Very thinly bedded	20 – 60mm
Laminated	6 – 20mm
Thinly Laminated	< 6mm

GROUNDED ENGINEERING

Date Started : Mar 7, 2023
Position : E: 597841, N: 4797701 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *LC rig*

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
82.6	**GROUND SURFACE**				
	50mm **ASPHALT**				
	FILL, sand, some gravel, trace to some silt, compact, brown, moist ...at 0.4 m, trace asphalt fragments		1	SS	18
			2	SS	24
			3	SS	26
			4	SS	22
79.6 3.0	...at 3.0 m, inferred concrete obstruction		5	SS	50 / 50mm
			6	SS	65 / 275mm
79.1 3.5	**CLAYEY SILT**, trace shale fragments, trace sand, trace gravel, hard, reddish brown, moist (GLACIAL TILL)				
	QUEENSTON FORMATION (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
			6	RUN	
			7	RUN	
			8	RUN	
			9	RUN	

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

well details

elevation (m): 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

5.0 m (Elev. 77.6 m): transition to sound bedrock

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS3: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs
3.0m: auger grinding and sampler bouncing with practical refusal, re-located borehole and re-drilled to depth, resumed sampling
3.3m: Run 1 encountered inferred caved materials overlapping with the SS6 interval

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

(continued next page)

Date Started : Mar 7, 2023
Position : E: 597841, N: 4797701 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : LC rig

rock coring (HQ) OD=96 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
	(continued)				
	QUEENSTON FORMATION (See rock core log for details) *(continued)*		9	RUN	
			10	RUN	
			11	RUN	
			12	RUN	
			13	RUN	
			14	RUN	
			15	RUN	
			16	RUN	
			17	RUN	
54.8 27.8	**END OF BOREHOLE**				

depth scale (m): 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27

well details

elevation (m): 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
△ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

Contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	10.2	72.4
Apr 3, 2023	9.9	72.7
Jun 9, 2023	10.1	72.5
Dec 10, 2024	17.2	65.4

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 7, 2023
Position : E: 597841, N: 4797701 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 101

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

Rock coring started at 3.3m below grade (elev. 79.3)

CLAYEY SILT, trace shale fragments, trace sand, trace gravel, hard, reddish brown, moist (GLACIAL TILL)
3.3 / R1 / 3.5 — TCR = **0%** SCR = **0%** RQD = **0%**

QUEENSTON FORMATION
Shale, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous

R2 — 3.5 to 77.6 — TCR = **98%** SCR = **92%** RQD = **80%**

... at 5.0 m (Elev. 77.6 m), transition to sound rock

Run	elev. depth (m)	recovery	natural fracture frequency	notes and comments
	3.3		core loss	**3.3 / 79.3 - 3.5 / 79.1m:** inferred caved materials and subsequent core loss
R1	3.5	TCR = **0%** SCR = **0%** RQD = **0%**	4	**3.5 / 79.1m:** observed weathered bedrock, with 25mm of rubblized core
R2	77.6	TCR = **98%** SCR = **92%** RQD = **80%**	3 1 1 0	**3.8 / 78.8m:** 75mm of rubblized core
R3	76.1	TCR = **100%** SCR = **98%** RQD = **74%**	2 1 3 1 2	**5.7 / 76.9 - 5.9 / 76.7m:** JT SV PR SU CN 125mm
R4	74.6	TCR = **90%** SCR = **80%** RQD = **73%**	4 1 3 4	**7.3 / 75.3m:** 25mm of rubblized core **7.4 / 75.2m:** IS CI 63mm
R5	73.1	TCR = **98%** SCR = **95%** RQD = **86%**	0 1 2 2 1	
R6	71.6	TCR = **98%** SCR = **98%** RQD = **93%**	4 1 3 1 2 1	
R7	70.1	TCR = **98%** SCR = **87%** RQD = **62%**	0 0 7 4	**11.5 / 71.1m:** 50mm of rubblized core **11.6 / 71.0m:** IS CI 38mm
R8	68.6	TCR = **98%** SCR = **89%** RQD = **83%**	1 4 7 3 0	**12.3 / 70.3m:** 25mm of rubblized core **12.5 / 70.1m:** JT D PR SU CN **12.9 / 69.7m:** 25mm of rubblized core
R9	67.0	TCR = **100%** SCR = **100%** RQD = **97%**	0 0 0 0 1 2	
R10	65.5	TCR = **100%** SCR = **95%** RQD = **81%**	0 0 0 0 0 4 5	**16.8 / 65.8m:** JT D PR SU CN; , with 150mm of rubblized core **17.0 / 65.6m:** JT D PR SU CN
R11	64.4	TCR = **100%** SCR = **90%** RQD = **82%**	0 1 2	**17.9 / 64.7m:** 38mm of rubblized core **18.2 / 64.4m:** JT D PR SU CN

(continued next page)

Tech : CSH/MW | **PM** : NN | **Rev** : NN

file: 22-282 - gint.gpj

GROUNDED ENGINEERING

Date Started : Mar 7, 2023
Position : E: 597841, N: 4797701 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 101

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

depth (m)	graphic log	stratigraphy	Run / elev / depth (m)	recovery	elevation (m)	shale weathering zones (Z1 Z2 Z3 Z4)	UCS (MPa) 5 25 50 100 250 / estimated strength (R1 R2 R3 R4 R5 R6)	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
		QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous	R11 63.9		64			2			64
19			18.7 R12 62.4	TCR = **100**% SCR = **100**% RQD = **100**%				7			
								0			
					63			0			63
20								0			
								0	**El. 62.4m**: UCS = 25.9 MPa E = 3.60 GPa γ = 25.9 kN/m^3		
			20.2 R13 60.9	TCR = **99**% SCR = **98**% RQD = **85**%	62			0			62
21								0			
								1		**21.2 / 61.4m:** JT D PR SU CN	
								3			
22			21.7 R14 59.3	TCR = **100**% SCR = **100**% RQD = **94**%	61			0			61
								0			
								0			
23					60			0	**El. 59.7m**: UCS = 46.6 MPa E = 9.50 GPa γ = 25.9 kN/m^3		60
								1			
			23.3 R15 57.8	TCR = **100**% SCR = **95**% RQD = **87**%				0		**23.3 / 59.3m:** JT D PR SU CN	
24					59			1			59
								2			
								0			
					58			0			58
25			24.8 R16 56.3	TCR = **100**% SCR = **100**% RQD = **100**%				2			
								0			
					57			0			57
								0			
26								0			
								0			
			26.3 R17 54.8	TCR = **100**% SCR = **96**% RQD = **87**%	56			0			56
27								3		**26.8 / 55.8m:** calcareous, green-grey band **26.8 / 55.8m:** JT D PR SU CN **27.3 / 55.3m:** JT D PR SU CN	
								2			
					55			2			55
			27.9m								
		END OF COREHOLE									

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 9, 2023
Position : E: 597865, N: 4797712 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 102

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : LC rig

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

elev depth (m)	description	graphic log	number	type	SPT N-value	depth scale (m)	elevation (m)	lab data and comments
82.4	**GROUND SURFACE**					0	82	
	50mm **ASPHALT**		1	SS	18			
	FILL, sand, some gravel, trace to some silt, moderate petroleum hydrocarbon odour, compact, brown, moist ...at 0.4 m, trace asphalt fragments		2	SS	15	1	81	SS2: BTEX, PAHs, PHCs, VOCs
	...at 1.5 m, dense		3A	SS	33	2	80	3A: EC/SAR, H-Ms, Metals, ORPs, pH
80.3 2.1	**CLAYEY SILT**, some gravel, trace sand, moderate petroleum hydrocarbon odour, hard, reddish brown, moist (GLACIAL TILL) ...at 2.6 m, layer of silt and sand glacail till, some gravel, some clay, dense, reddish brown, moist		3B					12 37 40 11
			4	SS	30	3	79	SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs
79.2 3.2			5	SS	50 / 125mm			**3.0m:** auger grinding
	QUEENSTON FORMATION (See rock core log for details)		1	RUN		4	78	**4.2 m (Elev. 78.2 m): transition to sound bedrock**
			2	RUN		5	77	
			3	RUN		6	76	
			4	RUN		7	75	
			5	RUN		8	74	
			6	RUN		9	73	
			7	RUN		10	72	RUN7: BTEX, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs
			8	RUN		11	71	
			9	RUN		12	70	
						13	69	
						14	68	

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160

SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300

moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

grain size distribution (%) (MIT): GR SA SI CL

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

(continued next page)

GROUNDED ENGINEERING

Date Started : Mar 9, 2023
Position : E: 597865, N: 4797712 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 102

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *LC rig*
rock coring (HQ) OD=96 mm

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
	(continued)				
	QUEENSTON FORMATION (See rock core log for details) *(continued)*		9	RUN	
			10	RUN	
			11	RUN	
			12	RUN	
			13	RUN	
			14	RUN	
			15	RUN	
			16	RUN	
56.1 26.3	**END OF BOREHOLE**				

depth scale (m): 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26
well details
elevation (m): 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
△ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments
grain size distribution (%) (MIT)
GR SA SI CL

Contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	dry	n/a
Apr 3, 2023	dry	n/a
May 5, 2023	dry	n/a
Jun 9, 2023	dry	n/a

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 9, 2023
Position : E: 597865, N: 4797712 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 102

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

Rock coring started at 2.9m below grade

CLAYEY SILT, some gravel, trace sand, moderate petroleum hydrocarbon odour, hard, reddish brown, moist (GLACIAL TILL)

QUEENSTON FORMATION
Shale, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous
... at 4.2 m (Elev. 78.2 m), transition to sound rock

Run	elev. depth (m)	recovery
	79.5	
R1	2.9	TCR = **88%** SCR = **55%** RQD = **40%**
	3.5	
R2		TCR = **100%** SCR = **88%** RQD = **63%**
	77.4	
R3	5.0	TCR = **100%** SCR = **92%** RQD = **54%**
	75.9	
R4	6.5	TCR = **100%** SCR = **85%** RQD = **58%**
	74.4	
R5	8.0	TCR = **100%** SCR = **87%** RQD = **63%**
	72.9	
R6	9.5	TCR = **99%** SCR = **99%** RQD = **99%**
	71.4	
R7	11.0	TCR = **100%** SCR = **90%** RQD = **51%**
	69.9	
R8	12.5	TCR = **100%** SCR = **100%** RQD = **83%**
	68.3	
R9	14.1	TCR = **99%** SCR = **99%** RQD = **88%**
	66.8	
R10	15.6	TCR = **100%** SCR = **98%** RQD = **87%**
	65.3	
R11	17.1	TCR = **100%** SCR = **97%** RQD = **76%**

natural fracture frequency
n/a
0
3
3
1
0
3
3
1
3
3
4
2
1
3
4
3
5
1
5
0
1
1
2
0
0
0
0
4
2
7
5
7
0
1
0
0
0
3
0
0
0
0
1
2
7
0
3
2
1

notes and comments

2.9 / 79.5 - 3.2 / 79.2m: recovered caved materials and native soil
3.2 / 79.2m: observed weathered bedrock
3.7 / 78.7m: 25mm of rubblized core
3.9 / 78.4m: JT SV PR SU CN 88mm
4.9 / 77.5m: JT SV PR SU CN 25mm
6.3 / 76.0m: 50mm of rubblized core
7.3 / 75.1m: 63mm of rubblized core
7.4 / 75.0m: 25mm of rubblized core
8.1 / 74.3m: 50mm of rubblized core
8.2 / 74.1m: 50mm of rubblized core
8.4 / 74.0m: JT SV PR SU CN 75mm
8.6 / 73.7m: 50mm of rubblized core
12.2 / 70.1m: 13mm of rubblized core
12.4 / 70.0m: 38mm of rubblized core

(continued next page)
Tech : CSH/MW | **PM** : NN | **Rev** : NN

file: 22-282 - gint.gpj

GROUNDED ENGINEERING

Date Started : Mar 9, 2023
Position : E: 597865, N: 4797712 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 102

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

depth (m)	graphic log	stratigraphy	Run elev depth (m)	recovery	elevation (m)	shale weathering zones Z1 Z2 Z3 Z4	UCS (MPa) 5 25 50 100 250 estimated strength R1 R2 R3 R4 R5 R6	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
18		**QUEENSTON FORMATION** **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous	**79.5** R11 63.8	TCR = **100**% SCR = **97**% RQD = **76**%				6			
			18.6		64			0			64
19			R12 62.2	TCR = **100**% SCR = **100**% RQD = **98**%				0 0 0 0 0			
20			20.2		63						63
			R13 60.7	TCR = **99**% SCR = **94**% RQD = **88**%	62			2 0 0 1		**20.2 / 62.1m:** calcareous, green-grey band **20.9 / 61.5m:** calcareous, green-grey band	62
21			21.7		61			0			61
			R14 59.2	TCR = **100**% SCR = **100**% RQD = **100**%				4 0 0 0			
22			23.2		60						60
23			R15 57.7	TCR = **99**% SCR = **99**% RQD = **99**%	59			0 1 0 0 1	**El. 59.4m**: UCS = 27.9 MPa E = 5.40 GPa γ = 26.0 kN/m^3		59
24			24.7		58						58
			R16 56.1	TCR = **100**% SCR = **100**% RQD = **100**%				0 0 0 1 0			
25			**26.3m**		57						57
26		**END OF COREHOLE**						1	**El. 56.3m**: UCS = 32.4 MPa E = 6.80 GPa γ = 25.8 kN/m^3		

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

BOREHOLE LOG 103

Date Started : Mar 15, 2023
Position : E: 597887, N: 4797709 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : LC rig

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

elev / depth (m)	description	graphic log	number	type	SPT N-value
82.3	**GROUND SURFACE**				
82.1 / 0.2	150mm **TOPSOIL**				
	FILL, sand, trace silt, trace rock fragments, trace rootlets, loose, blackish brown, moist		1	SS	5
81.5 / 0.8	**SAND**, some silt, trace gravel, loose to compact, brown, moist to wet		2	SS	6
			3A	SS	11
80.3 / 2.0	**CLAYEY SILT**, trace sand, trace gravel, very stiff, reddish brown, moist (GLACIAL TILL)		3B		
			4	SS	20
	...at 3.0 m, layer of sandy silt glacial till, some clay, some gravel, some shale fragments, hard, reddish brown, moist		5	SS	66 / 175mm
78.9 / 3.4			1	RUN	
	QUEENSTON FORMATION (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
			6	RUN	
			7	RUN	
			8	RUN	
			9	RUN	

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

well details

elevation (m): 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

3.9 m (Elev. 78.4 m): transition to sound bedrock

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: BTEX, PAHs, PHCs, VOCs

3A: EC/SAR, H-Ms, Metals, ORPs, pH

10 26 45 19

SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

file: 22-282 - gint.gpj

Tech : CSH | **PM** : NN | **Rev** : NN

(continued next page)

GROUNDED ENGINEERING

Date Started : Mar 15, 2023
Position : E: 597887, N: 4797709 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 103

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : LC rig

rock coring (HQ) OD=96 mm

elev depth (m)	description (continued)	graphic log	number	type	SPT N-value
	QUEENSTON FORMATION (See rock core log for details) *(continued)*		9	RUN	
			10	RUN	
			11	RUN	
			12	RUN	
			13	RUN	
			14	RUN	
			15	RUN	
			16	RUN	
			17	RUN	
54.4					
27.9	**END OF BOREHOLE**				

depth scale (m): 15 16 17 18 19 20 21 22 23 24 25 26 27

well details

elevation (m): 67 66 65 64 63 62 61 60 59 58 57 56 55

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
△ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

RUN12: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

Borehole was filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	10.4	71.9
Apr 3, 2023	10.1	72.2
May 5, 2023	9.0	73.3
Jun 9, 2023	9.2	73.1
Dec 10, 2024	17.7	64.6

file: 22-282 - gint.gpj

Tech : CSH | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 15, 2023
Position : E: 597887, N: 4797709 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 103

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

Rock coring started at 3.0m below grade

depth (m)	stratigraphy	Run	elev depth (m)	recovery	elevation (m)	natural fracture frequency	notes and comments
			79.3				
	CLAYEY SILT, trace sand, trace gravel, very stiff, reddish brown, moist (GLACIAL TILL)	R1	3.0	TCR = **100%** SCR = **70%** RQD = **25%**		core loss	**3.0 / 79.3 - 3.2 / 79.1m:** inferred caved materials and subsequent core loss
			3.6		79	>10	**3.2 / 79.1 - 3.4 / 78.9m:** observed native soil
4	**QUEENSTON FORMATION** **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous **... at 3.9 m (Elev. 78.4 m), transition to sound rock**	R2		TCR = **100%** SCR = **90%** RQD = **45%**		3	**3.4 / 78.9m:** observed weathered bedrock
						2	
						2	**4.1 / 78.2m:** JT SV UN R GA CN 50mm
					78	2	**4.2 / 78.2m:** JT SV UN R GA CN 38mm
5			77.2			1	**4.7 / 77.6m:** JT SV UN R GA CN 88mm
			5.1			3	**5.2 / 77.1m:** JT SV UN R GA CN 50mm
		R3		TCR = **100%** SCR = **88%** RQD = **74%**	77	2	**5.3 / 77.1m:** JT SV IR R GA CN 25mm
						1	
6						1	
			75.7		76	5	**6.2 / 76.1m:** 38mm of rubblized core
			6.6			5	**6.6 / 75.8m:** JT SV CU R T CN
							6.7 / 75.7m: 113mm of rubblized core
7						9	**7.1 / 75.3m:** 50mm of rubblized core
		R4		TCR = **100%** SCR = **74%** RQD = **61%**	75	4	**7.4 / 74.9m:** 25mm of rubblized core
						>10	
8			74.2			1	**7.9 / 74.4m:** 38mm of rubblized core
			8.1			3	**8.1 / 74.2 - 8.3 / 74.0m:** IS CI 175mm; , with 25mm of rubblized core
					74	3	**8.5 / 73.9m:** 75mm of rubblized core
						6	**8.7 / 73.6m:** 50mm of rubblized core
9		R5		TCR = **100%** SCR = **78%** RQD = **71%**		3	
					73	2	
			72.6			4	**9.8 / 72.5m:** IS CI 50mm
			9.7			1	
10						0	
					72	4	
		R6		TCR = **100%** SCR = **95%** RQD = **77%**		1	
						0	
11			71.0		71	5	**11.6 / 70.7m:** 50mm of rubblized core
			11.3			3	**11.7 / 70.7m:** JT D UN R GA CN
						8	**11.8 / 70.5m:** JT D UN R GA CN
12		R7		TCR = **100%** SCR = **93%** RQD = **54%**	70	4	
			69.6			7	
			12.7			3	
13						0	
		R8		TCR = **100%** SCR = **95%** RQD = **82%**	69	0	
			68.1			0	
14			14.2			0	
						0	
					68	3	
		R9		TCR = **100%** SCR = **98%** RQD = **95%**		0	**14.8 / 67.5m:** JT SV ST R GA CN
15			66.6			0	
			15.7		67	0	
						1	
						0	
16		R10		TCR = **100%** SCR = **95%** RQD = **83%**		1	
			65.1		66	5	
			17.2			1	
17						2	
		R11		TCR = **100%** SCR = **97%** RQD = **62%**	65	4	**17.8 / 64.6m:** JT D UN R GA CN
18						1	

shale weathering zones: Z1 Z2 Z3 Z4

UCS (MPa) / estimated strength: 5 25 50 100 250 — R1 R2 R3 R4 R5 R6

laboratory testing

(continued next page)

file: 22-282 - gint.gpj

GROUNDED ENGINEERING

Date Started : Mar 15, 2023
Position : E: 597887, N: 4797709 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 103

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

depth (m)	graphic log	stratigraphy	Run / elev / depth (m)	recovery	elevation (m)	shale weathering zones	UCS (MPa) / estimated strength	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
			79.3			Z1 Z2 Z3 Z4	5 25 50 100 250 R1 R2 R3 R4 R5 R6				
		QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous	R11 63.5	TCR = **100**% SCR = **97**% RQD = **62**%	64			3			64
19			18.8 R12 62.0	TCR = **100**% SCR = **100**% RQD = **93**%	63			0 0 0 2 0 0			63
20			20.3 R13 60.6	TCR = **100**% SCR = **96**% RQD = **84**%	62			0 0 5		**20.4 / 61.9m:** calcareous, green-grey band **21.0 / 61.3m:** 63mm of rubblized core	62
21					61			0 0 0			61
22			21.7 R14 59.0	TCR = **100**% SCR = **98**% RQD = **97**%	60			2 0 0			60
23			23.3 R15 57.5	TCR = **100**% SCR = **97**% RQD = **93**%	59			1 2 0 0			59
24					58			0 3 3			58
25			24.8 R16 55.9	TCR = **100**% SCR = **100**% RQD = **100**%	57			0 0 0			57
26			26.4 R17 54.4	TCR = **100**% SCR = **100**% RQD = **88**%	56			0 0 1	**El. 55.5m**: UCS = 28.6 MPa E = 6.60 GPa γ = 25.9 kN/m^3	**26.7 / 55.7m:** calcareous, green-grey band **26.7 / 55.6m:** JT D PR R GA CN	56
27					55			0 0 0			55
			27.9m								
		END OF COREHOLE									

file: 22-282 - gint.gpj

Tech : CSH | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 6, 2023
Position : E: 597872, N: 4797741 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 104

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

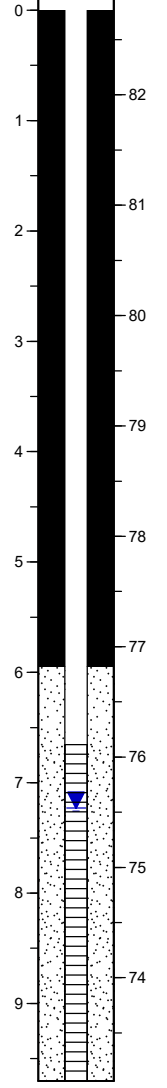
drill method : LC rig

elev depth (m)	description	graphic log	number	type	SPT N-value
82.8	**GROUND SURFACE**				
	FILL, silt, some sand, some gravel, some rootlets, trace clay, trace topsoil inclusions, loose, brownish black, moist		1	SS	6
	...at 0.2 m, sand fill, some gravel, trace silt, brown with oxidation staining, moist to wet		2A	SS	7
	...at 0.9 m, no topsoil inclusions, mottled brownish grey		2B		
81.3					
1.5	**CLAYEY SILT**, sandy, trace gravel, hard, reddish brown, moist (GLACIAL TILL)		3	SS	43
			4	SS	45
			5	SS	32
	...at 3.0 m, sandy silt, clayey, trace gravel, trace shale fragments		1	RUN	
78.9					
3.9	**QUEENSTON FORMATION** (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
73.1					
9.7					

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

depth scale (m) | well details | elevation (m)

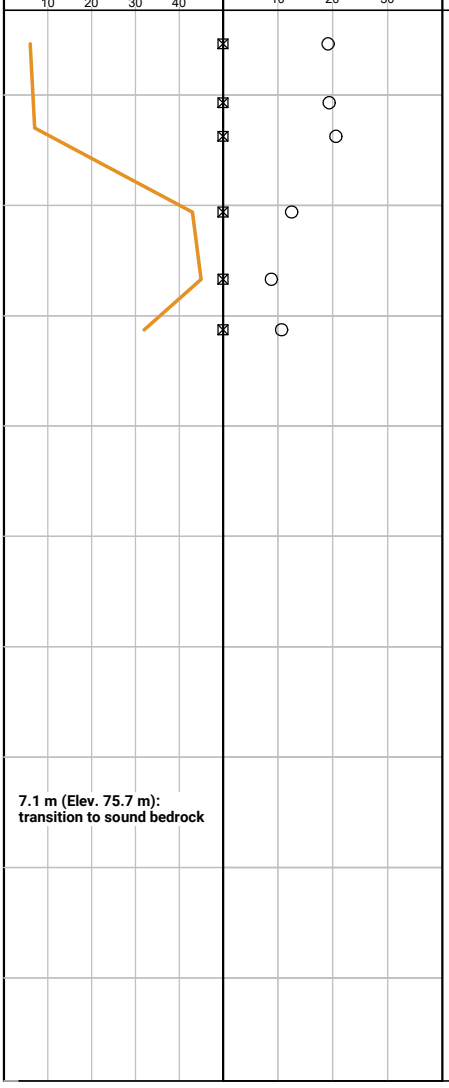


undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
△ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30



unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS1: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

SS3: BTEX, PAHs, PHCs, VOCs
1.8m: auger grinding
5 27 48 20

SS4: EC/SAR, H-Ms, Metals, ORPs, pH
2.6m: auger grinding with refusal, and Run 1 encountered inferred caved materials overlapping with the SS4 and SS5 intervals

END OF BOREHOLE

Contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	5.4	77.4
Apr 3, 2023	5.5	77.3
May 5, 2023	5.7	77.1
Jun 9, 2023	5.8	77.0
Dec 10, 2024	7.2	75.6

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 6, 2023
Position : E: 597872, N: 4797741 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 104

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

depth (m)	stratigraphy	Run elev / depth (m)	recovery	elevation (m)	shale weathering zones (Z1 Z2 Z3 Z4)	UCS (MPa) 5 25 50 100 250 / estimated strength (R1 R2 R3 R4 R5 R6)	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
	Rock coring started at 2.5m below grade	**80.3**								
3	**CLAYEY SILT**, sandy, trace gravel, hard, reddish brown, moist (GLACIAL TILL)	2.5 R1 79.3	TCR = **69%** SCR = **0%** RQD = **0%**	80			n/a		**2.5 / 80.3 - 3.2 / 79.6m:** inferred caved materials	80
							n/a		**3.2 / 79.6 - 3.9 / 78.9m:** recovered native soil	
4	**QUEENSTON FORMATION** **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous	3.5 R2 77.8	TCR = **98%** SCR = **64%** RQD = **8%**	79			n/a		**3.9 / 78.9m:** observed weathered bedrock	79
							>10		**4.2 / 78.6m:** 75mm of rubblized core	
							>10		**4.4 / 78.4m:** 50mm of rubblized core	
5		5.0 R3 76.2	TCR = **100%** SCR = **98%** RQD = **92%**	78			4			78
							6			
							4			
							3		**5.5 / 77.3m:** JT SV PR R GA CN 50mm	
6				77			3			77
							6			
							5		**6.4 / 76.4m:** 75mm of rubblized core	
7	**... at 7.1 m (Elev. 75.7 m), transition to sound rock**	6.6 R4 74.6	TCR = **100%** SCR = **95%** RQD = **52%**	76			4		**6.7 / 76.1m:** JT SV IR R T CN 25mm **6.7 / 76.0m:** 25mm of rubblized core	76
							2			
							1			
							3		**7.6 / 75.1m:** JT SV IR R T CN 25mm	
8				75			2			75
							1			
		8.2 R5 73.1	TCR = **100%** SCR = **100%** RQD = **100%**	74			1			74
							0			
9							1			
							1			
		9.7m					0			

END OF COREHOLE

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

Date Started : Mar 14, 2023
Position : E: 597849, N: 4797707 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

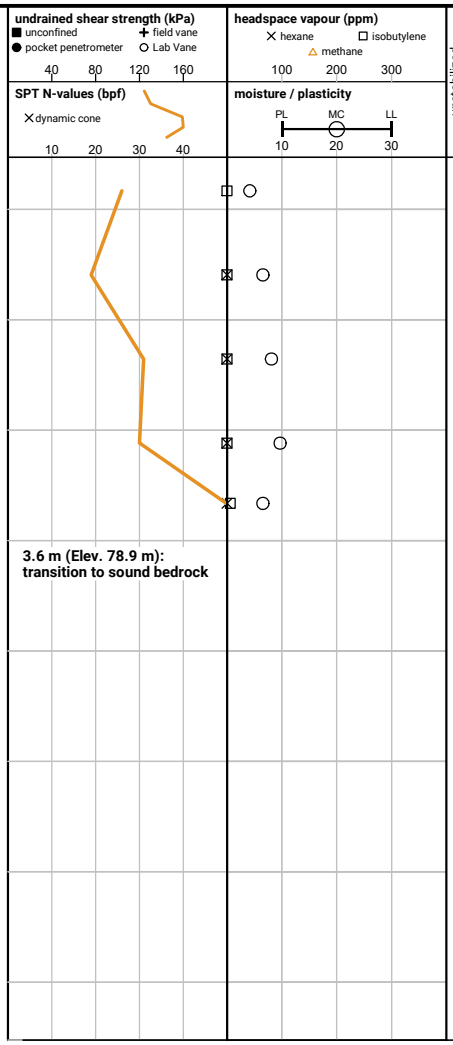
File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *LC rig*

elev depth (m)	description	number	type	SPT N-value
82.5	**GROUND SURFACE**			
	50mm **ASPHALT**	1	SS	26
	FILL, gravelly sand, trace to some silt, faint petroleum hydrocarbon odour, compact to dense, brownish grey, moist	2	SS	19
		3	SS	31
80.2 2.3	**CLAYEY SILT**, some gravel, trace sand, hard, brownish red, moist (GLACIAL TILL)	4	SS	30
79.3 3.2	...at 3.1 m, some shale fragments, faint petroleum hydrocarbon odour	5	SS	50 / 25mm
		1	RUN	
	QUEENSTON FORMATION (See rock core log for details)	2	RUN	
		3	RUN	
		4	RUN	
74.5 8.0	**END OF BOREHOLE**			

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm



unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

3.2m: sampler bouncing

RUN3: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

Water level and cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	dry	n/a
Apr 3, 2023	dry	n/a
May 5, 2023	dry	n/a
Jun 9, 2023	dry	n/a
Dec 10, 2024	dry	n/a

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 14, 2023
Position : E: 597849, N: 4797707 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 105

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

depth (m)	graphic log	stratigraphy	Run elev depth (m)	recovery	elevation (m)	shale weathering zones Z1 Z2 Z3 Z4	UCS (MPa) 5 25 50 100 250 estimated strength R1 R2 R3 R4 R5 R6	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
		Rock coring started at 3.2m below grade	**79.3**								
		QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous **... at 3.6 m (Elev. 78.9 m), transition to sound rock**	3.2 R1 3.5	TCR = **100%** SCR = **100%** RQD = **63%**	79			2			79
4								2		**3.6 / 78.9m:** JT D PR S GA CN	
			R2	TCR = **100%** SCR = **100%** RQD = **95%**				2			
			77.6					0			
					78			0			78
5			4.9					1		**4.7 / 77.8m:** JT SV PR S T CN 50mm	
			R3	TCR = **84%** SCR = **98%** RQD = **84%**				4			
			76.0					1			
					77			0			77
6			6.5					1			
								2		**6.3 / 76.2m:** JT SV PR R T CN 25mm	
					76			3			76
7			R4	TCR = **97%** SCR = **85%** RQD = **60%**				1			
								4		**7.3 / 75.1m:** JT SV IR R T CN 25mm	
					75			4		**7.6 / 74.9m:** 38mm of rubblized core	75
			74.5					7		**7.8 / 74.7 - 7.9 / 74.6m:** 125mm of rubblized core	
8			**8.0m**								
		END OF COREHOLE									

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

BOREHOLE LOG 106

Date Started : Mar 13, 2023
Position : E: 597852, N: 4797695 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

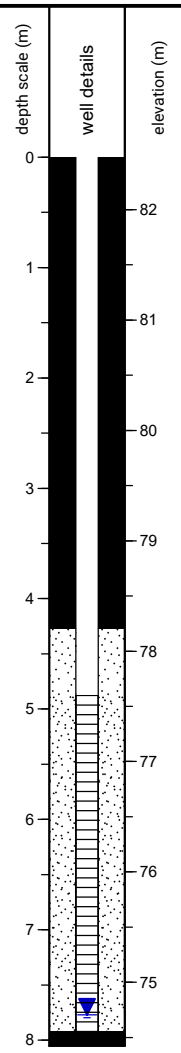
drill method : *LC rig*

elev depth (m)	description	graphic log	number	type	SPT N-value
82.5	**GROUND SURFACE**				
	40mm **ASPHALT**		1	SS	22
	FILL, sand, some gravel, trace to some silt, moderate petroleum hydrocarbon odour, compact to dense, brown, moist		2	SS	22
			3	SS	31
80.2 / 2.3	**CLAYEY SILT**, some gravel, trace sand, trace shale fragments, very stiff to hard, brownish red, moist (GLACIAL TILL)		4	SS	29
			5	SS	50 / 125mm
79.2 / 3.3	...at 3.2 m, layer of gravelly sand, trace silt, moderate petroleum hydrocarbon odour, very dense, grey, wet		1	RUN	
	QUEENSTON FORMATION (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
74.4 / 8.1	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

depth scale (m) / well details / elevation (m)

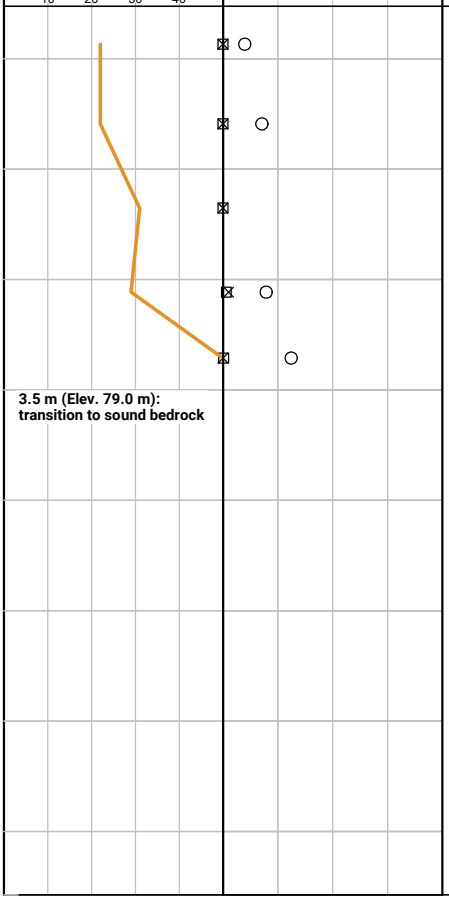


undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30



3.5 m (Elev. 79.0 m): transition to sound bedrock

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS3: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

2.4m: auger grinding

SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs
2.9m: auger grinding
3.0m: Run 1 encountered inferred caved materials overlapping with the SS5 interval

Contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	7.8	74.7
Apr 3, 2023	7.8	74.7
May 5, 2023	7.8	74.7
Jun 9, 2023	7.8	74.7

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 13, 2023
Position : E: 597852, N: 4797695 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 106

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

Rock coring started at 3.0m below grade

depth (m)	stratigraphy	Run	elev. depth (m)	recovery
			79.5	
	CLAYEY SILT, some gravel, trace sand, trace shale fragments, very stiff to hard, brownish red, moist (GLACIAL TILL)	R1	3.0	TCR = **100%** SCR = **16%** RQD = **0%**
			3.5	
4	**QUEENSTON FORMATION** **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous	R2		TCR = **100%** SCR = **100%** RQD = **58%**
	... at 3.5 m (Elev. 79.0 m), transition to sound rock		77.5	
5		R3	5.0	TCR = **100%** SCR = **97%** RQD = **85%**
6			76.0	
		R4	6.5	TCR = **100%** SCR = **88%** RQD = **70%**
7				
8			74.4	
	END OF COREHOLE		**8.1m**	

elevation (m)	shale weathering zones (Z1 Z2 Z3 Z4)	UCS (MPa) / estimated strength (R1 R2 R3 R4 R5 R6)	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
			n/a		**3.0 / 79.4 - 3.4 / 79.1m:** inferred caved materials	
79			1		**3.4 / 79.1m:** observed weathered bedrock	79
			1			
			4			
			4		**4.3 / 78.2m:** JT D PR R GA OX	
78			2		**4.3 / 78.1m:** JT D PR R GA OX	78
			1			
			0			
77			1			77
			3			
			0			
			2			
76			4			76
			0			
			2			
75			4		**7.5 / 75.0m:** IS Cl 38mm	75
			>10		**7.5 / 74.9m:** 38mm of rubblized core **7.7 / 74.7m:** 50mm of rubblized core **7.9 / 74.6m:** JT SV IR R T CN	

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

BOREHOLE LOG 107

Date Started : Mar 13, 2023
Position : E: 597857, N: 4797703 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *LC rig*

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
82.3	**GROUND SURFACE**				
	65mm **ASPHALT**				
	FILL, sand, some gravel, trace silt, faint petroleum hydrocarbon odour, compact to dense, brown, moist		1	SS	28
			2	SS	19
			3	SS	33
80.0					
2.3	**CLAYEY SILT**, some gravel, trace sand, trace shale fragments, hard, reddish brown, moist (GLACIAL TILL)		4	SS	33
79.1			5	SS	50 / 150mm
3.2	**QUEENSTON FORMATION** (See rock core log for details)		1	RUN	
			2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
72.8					
9.5	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

rock coring (HQ) OD=96 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9

well details

elevation (m): 82 81 80 79 78 77 76 75 74 73

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

3.6 m (Elev. 78.7 m): transition to sound bedrock

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS3: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs

2.4m: auger grinding

SS4: BTEX, EC/SAR, H-Ms, Metals, ORPs, PAHs, pH, PHCs, VOCs
3.0m: sampler bouncing
3.1m: Run 1 encountered inferred caved materials overlapping with the SS5 interval

Water level and cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Mar 20, 2023	8.9	73.4
Apr 3, 2023	8.7	73.6
May 5, 2023	8.6	73.7
Jun 9, 2023	8.7	73.6
Dec 10, 2024	9.1	73.2

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Mar 13, 2023
Position : E: 597857, N: 4797703 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 107

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

Rock coring started at 3.1m below grade

depth (m)	stratigraphy	Run	elev depth (m)	recovery	elevation (m)	shale weathering zones	UCS (MPa) / estimated strength	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
			79.2								
	CLAYEY SILT, some gravel, trace sand, trace shale fragments, hard, reddish brown, moist (GLACIAL TILL)	R1	3.1	TCR = **100**% SCR = **100**% RQD = **71**%				n/a		**3.1 / 79.2 - 3.2 / 79.1m:** inferred caved materials	
			3.5		79			7		**3.2 / 79.1m:** observed weathered bedrock	79
	QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak; joints are horizontal, closed to gapped, clean, calcareous **... at 3.6 m (Elev. 78.7 m), transition to sound rock**	R2		TCR = **100**% SCR = **93**% RQD = **67**%				4			
4								5		**3.9 / 78.4m:** 25mm of rubblized core	
					78			3			78
								2			
			77.3					1		**4.7 / 77.6m:** JT SV UN R GA OX 38mm	
5		R3	5.0	TCR = **100**% SCR = **93**% RQD = **85**%				1			
					77			2			77
								1			
6								3		**6.0 / 76.3m:** 50mm of rubblized core	
			75.8		76			2		**6.3 / 76.0 - 6.4 / 75.9m:** JT SV PR R T CN 100mm	76
			6.5					4		**6.6 / 75.8m:** JT D PR R T CN	
		R4		TCR = **100**% SCR = **90**% RQD = **47**%				1			
7								3			
					75			7		**7.3 / 75.1 - 7.4 / 74.9m:** 125mm of rubblized core	75
								5		**7.5 / 74.8m:** 63mm of rubblized core	
			74.3					0			
8		R5	8.0	TCR = **100**% SCR = **92**% RQD = **80**%				6			
					74			1		**8.4 / 73.9m:** JT SV UN R T CN 50mm	74
								6		**8.5 / 73.9m:** 25mm of rubblized core	
9								1		**8.9 / 73.5m:** IS Cl; , with 12mm of rubblized core	
			72.8		73			0			73
			9.5m								

END OF COREHOLE

file: 22-282 - gint.gpj

Tech : CSH/MW | **PM** : NN | **Rev** : NN

BOREHOLE LOG 201

Date Started : Jun 25, 2024
Position : E: 597846, N: 4797704 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : Geoprobe

elev depth (m)	description	graphic log	number	type	SPT N-value
82.5	**GROUND SURFACE**				
82.1	425mm **AGGREGATE**		1	DP	
0.4	**FILL**, gravelly sand, trace silt, trace rock fragments, brown, moist		2	DP	
			3	DP	
79.7			4A	DP	
2.8			4B		
79.5	**CLAYEY SILT**, some gravel, trace sand, some rock fragments, brownish red, moist (GLACIAL TILL)		5	DP	
3.0					
79.3	**SHALE FRAGMENTS**, trace gravel, red, moist				
3.2					

direct push OD=50 mm

solid stem augers OD=150 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10

elevation (m): 82 81 80 79 78 77 76 75 74 73

well details

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
△ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP2: H-Ms, Metals, ORPs

4A: BTEX, PHCs

END OF BOREHOLE

Borehole was dry and caved to 9.9 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jul 3, 2024	dry	n/a
Jul 11, 2024	9.4	73.1
Jul 27, 2024	dry	n/a
Dec 10, 2024	9.1	73.4

file: 22-282 - gint.gpj

Tech : MW | **PM** : LL | **Rev** : FS

GROUNDED ENGINEERING

Date Started : Jun 25, 2024
Position : E: 597876, N: 4797705 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 202

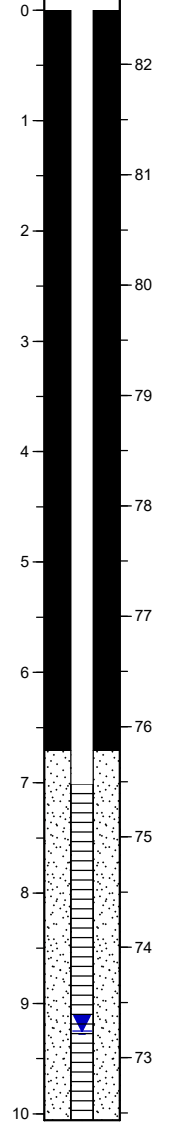
File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

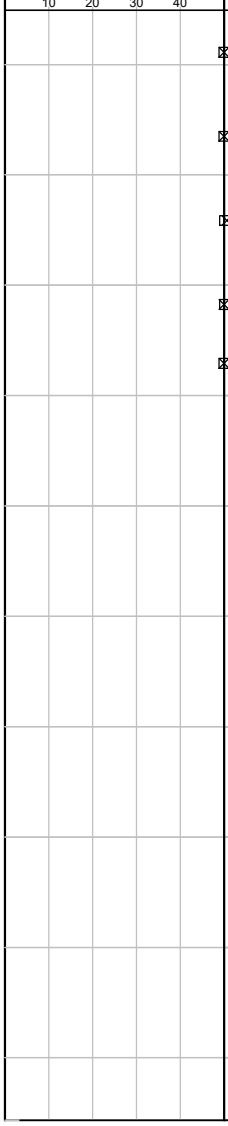
drill method : *Geoprobe*

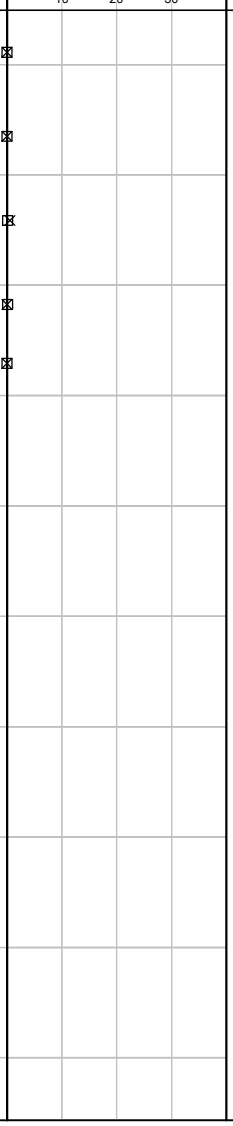
elev depth (m)	description	graphic log	number	type	SPT N-value
82.5	**GROUND SURFACE**				
	125mm **TOPSOIL**				
	FILL, sand, some silt, trace to some gravel, trace rootlets, light brown, moist		1	DP	
			2	DP	
81.0					
1.5	**CLAYEY SILT**, some gravel, trace sand, reddish brown, moist (GLACIAL TILL)		3	DP	
			4	DP	
79.1			5	DP	
3.4					

direct push OD=50 mm

solid stem augers OD=150 mm







unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP2: H-Ms, Metals, ORPs

END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jul 3, 2024	9.0	73.5
Jul 11, 2024	8.9	73.6
Jul 24, 2024	8.9	73.6
Dec 10, 2024	9.3	73.2

file: 22-282 - gint.gpj

Tech : MW | **PM** : LL | **Rev** : FS

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 597884, N: 4797729 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 203

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *Geoprobe*

direct push OD=50 mm

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
82.6	**GROUND SURFACE**				
82.4 / 0.2	100mm **TOPSOIL** 75mm **AGGREGATE**		1	DP	
	FILL, sand, some silt, trace gravel, brown, moist		2	DP	
	...at 1.2 m, reddish brown		3	DP	
80.8 / 1.8	**CLAYEY SILT**, trace sand, trace gravel, reddish brown, moist (GLACIAL TILL)		4	DP	
			5	DP	
79.6 / 3.0	**END OF BOREHOLE**				

depth scale (m): 0, 1, 2, 3

well details

elevation (m): 82, 81, 80

undrained shear strength (kPa)
■ unconfined ● pocket penetrometer + field vane ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP5: BTEX, PHCs

Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 597878, N: 4797737 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 204

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *Geoprobe*

direct push OD=50 mm

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
82.7	**GROUND SURFACE**				
82.5 / 0.2	175mm **TOPSOIL**				
	FILL, sand, some silt, trace gravel, reddish brown, moist		1	DP	
			2	DP	
	...at 1.2 m, trace clay pockets		3A	DP	
81.2 / 1.5	**CLAYEY SILT**, trace sand, trace gravel, brownish grey, moist (GLACIAL TILL)		3B		
	...at 1.8 m, reddish brown		4	DP	
			5	DP	
79.7 / 3.0	**END OF BOREHOLE**				

Borehole was dry upon completion of drilling.

depth scale (m): 0, 1, 2, 3

well details

elevation (m): 82, 81, 80

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP5: BTEX, PHCs

file: 22-282 - gint.gpj

Tech : MW | **PM** : LL | **Rev** : FS

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 597868, N: 4797737 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 205

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *Geoprobe*

direct push OD=50 mm

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
82.9	**GROUND SURFACE**				
82.7 / 0.2	230mm **TOPSOIL**				
82.6 / 0.3	25mm **AGGREGATE**		1	DP	
	FILL, sand, some gravel, trace silt, brown, moist ...at 0.6 m, trace organics		2	DP	
81.7 / 1.2	**CLAYEY SILT**, some gravel, trace sand, brownish grey, moist (GLACIAL TILL) ...at 1.8 m, reddish brown		3	DP	
80.6 / 2.3			4	DP	

depth scale (m): 0, 1, 2

well details

elevation (m): 82, 81

undrained shear strength (kPa)
■ unconfined ● pocket penetrometer + field vane ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP2: H-Ms, Metals, ORPs

DP4: BTEX, PHCs

END OF BOREHOLE

Borehole was dry upon completion of drilling.

file: 22-282 - gint.gpj

Tech : MW | **PM** : LL | **Rev** : FS

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 597858, N: 4797727 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 206

File No. : 22-282 **Project** : 2072 Lakeshore Road, Burlington, ON **Client** : Trinity Point

drill method : *Direct Push*

elev depth (m)	description	graphic log	samples: number	samples: type	samples: SPT N-value
82.9	**GROUND SURFACE**				
82.7 / 0.2	125mm **TOPSOIL**				
	25mm **AGGREGATE**		1	DP	
	FILL, silt, trace to some sand, trace gravel, brown, moist		2	DP	
81.7 / 1.2	...at 0.6 m, reddish light brown				
	SAND, some silt, light brown, moist		3	DP	
81.1 / 1.8	**CLAYEY SILT**, some gravel, trace sand, reddish brown, moist (GLACIAL TILL)		4	DP	
			5	DP	
79.9 / 3.0	**END OF BOREHOLE**				

direct push OD=50 mm

depth scale (m): 0, 1, 2, 3

well details

elevation (m): 82, 81, 80

undrained shear strength (kPa)
■ unconfined ● pocket penetrometer + field vane ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

DP3: H-Ms, Metals, ORPs

DP4: BTEX, PHCs

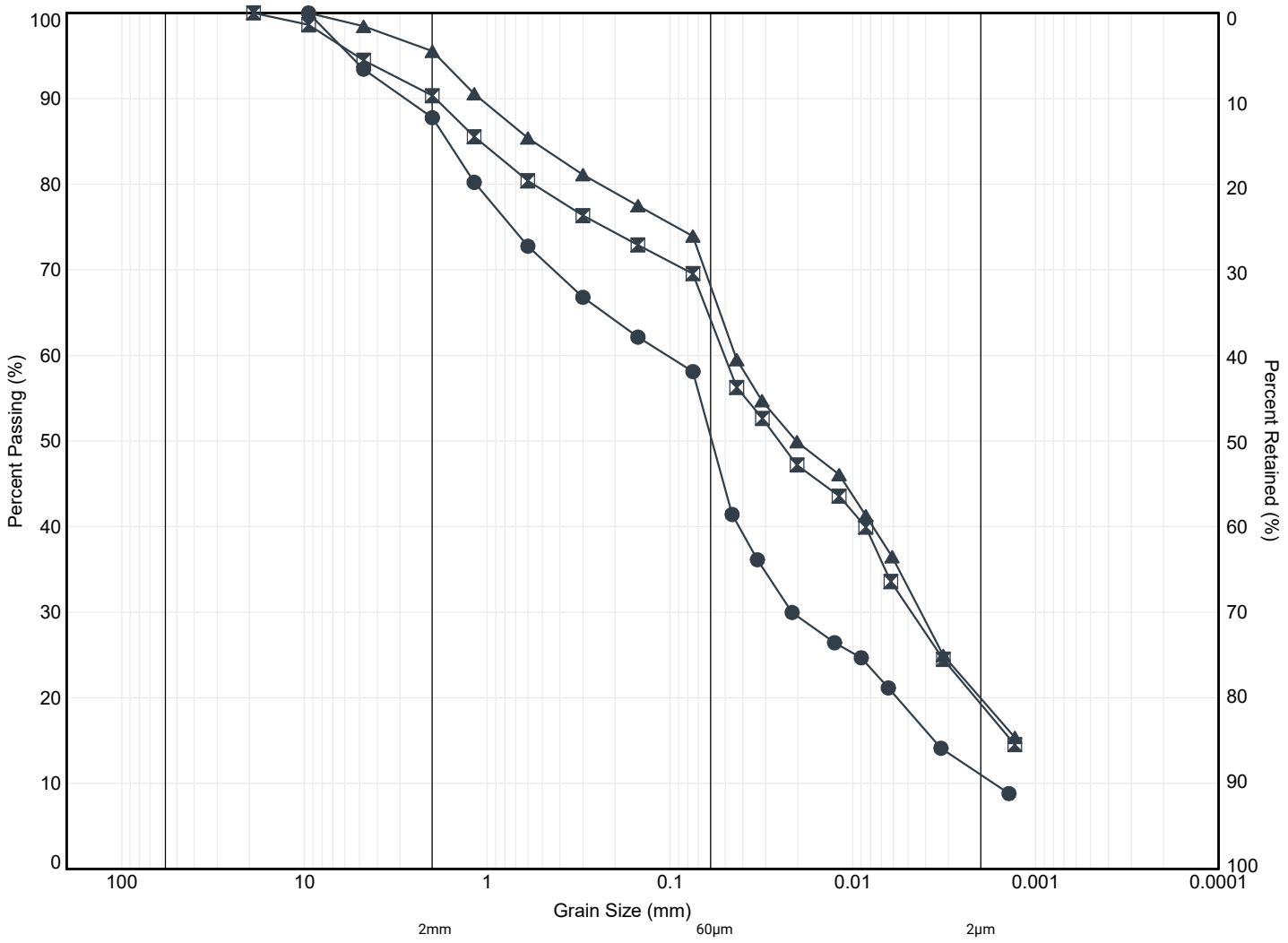
Unstabilized water level measured at 1.2 m below ground surface upon completion of drilling.

file: 22-282 - gint.gpj

Tech : MW | **PM** : LL | **Rev** : FS

APPENDIX B





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**102**	SS4	2.6	79.8	12	37	40	11
⊠	**103**	SS4	2.6	79.8	10	26	45	19
▲	**104**	SS4	2.6	80.2	5	27	48	20

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION GLACIAL TILL**

File No.: **22-282**

file: 22-282 - gint.gpj

APPENDIX C



BOREHOLE 101

Borehole 101 – Box 1 – Runs 1, 2 and 3



Depth: 3.3 to 6.5 m below grade (Elev. 79.3 to 76.1 m)

Borehole 101 – Box 2 – Runs 4 and 5



Depth: 6.5 to 9.5 m below grade (Elev. 76.1 to 73.1 m)

Borehole 101 – Box 3 – Runs 6 and 7



Depth: 9.5 to 12.5 m below grade (Elev. 73.1 to 70.1 m)

Borehole 101 – Box 4 – Runs 8 and 9



Depth: 12.5 to 15.6 m below grade (Elev. 70.1 to 67.0 m)

Borehole 101 – Box 5 – Runs 10 and 11



Depth: 15.6 to 18.7 m below grade (Elev. 67.0 to 63.9 m)

Borehole 101 – Box 6 – Runs 12 and 13



Depth: 18.7 to 21.7 m below grade (Elev. 63.9 to 60.9 m)

Borehole 101 – Box 7 – Runs 14 and 15



Depth: 21.7 to 24.8 m below grade (Elev. 60.9 to 57.8 m)

Borehole 101 – Box 8 – Runs 16 and 17



Depth: 24.8 to 27.8 m below grade (Elev. 57.8 to 54.8 m)

BOREHOLE 102

Borehole 102 – Box 1 – Runs 1, 2 and 3



Depth: 2.9 to 5.8 m below grade (Elev. 79.5 to 76.6 m)

Borehole 102 – Box 2 – Runs 3, 4 and 5



Depth: 5.8 to 8.5 m below grade (Elev. 76.6 to 73.9 m)

Borehole 102 – Box 3 – Runs 5 and 6



Depth: 8.5 to 11.0 m below grade (Elev. 73.9 to 71.4 m)

Borehole 102 – Box 4 – Runs 7 and 8



Depth: 11.0 to 14.1 m below grade (Elev. 71.4 to 68.3 m)

Borehole 102 – Box 5 – Runs 9 and 10



Depth: 14.1 to 17.1 m below grade (Elev. 68.3 to 65.3 m)

Borehole 102 – Box 6 – Runs 11 and 12



Depth: 17.1 to 20.2 m below grade (Elev. 65.3 to 62.2 m)

Borehole 102 – Box 7 – Runs 13 and 14



Depth: 20.2 to 23.2 m below grade (Elev. 62.2 to 59.2 m)

Borehole 102 – Box 8 – Runs 15 and 16



Depth: 23.2 to 26.3 m below grade (Elev. 59.2 to 56.1 m)

BOREHOLE 103

Borehole 103 – Box 1 – Runs 1, 2 and 3



Depth: 3.0 to 6.0 m below grade (Elev. 79.3 to 76.3 m)

Borehole 103 – Box 2 – Runs 3, 4 and 5



Depth: 6.0 to 8.7 m below grade (Elev. 76.3 to 73.6 m)

Borehole 103 – Box 3 – Runs 5 and 6



Depth: 8.7 to 11.3 m below grade (Elev. 73.6 to 71.0 m)

Borehole 103 – Box 4 – Runs 7 and 8



Depth: 11.3 to 14.2 m below grade (Elev. 71.0 to 68.1 m)

Borehole 103 – Box 5 – Runs 9 and 10



Depth: 14.2 to 17.2 m below grade (Elev. 68.1 to 65.1 m)

Borehole 103 – Box 6 – Runs 11 and 12



Depth: 17.2 to 20.3 m below grade (Elev. 65.1 to 62.0 m)

Borehole 103 – Box 7 – Runs 13 and 14



Depth: 20.3 to 23.3 m below grade (Elev. 62.0 to 59.0 m)

Borehole 103 – Box 8 – Runs 15 and 16



Depth: 23.3 to 26.4 m below grade (Elev. 59.0 to 55.9 m)

Borehole 103 – Box 9 – Run 17



Depth: 26.4 to 27.9 m below grade (Elev. 55.9 to 54.4 m)

BOREHOLE 104

Borehole 104 – Box 1 – Runs 1, 2 and 3



Depth: 2.5 to 5.7 m below grade (Elev. 80.3 to 77.1 m)

Borehole 105 – Box 2 – Runs 3, 4 and 5



Depth: 5.7 to 8.6 m below grade (Elev. 77.1 to 74.2 m)

Borehole 105 – Box 3 – Run 5



Depth: 8.6 to 9.7 m below grade (Elev. 74.2 to 73.1 m)

BOREHOLE 105

Borehole 105 – Box 1– Runs 1, 2 and 3



Depth: 3.2 to 5.9 m below grade (Elev. 79.3 to 76.6 m)

Borehole 105 – Box 2 – Runs 3 and 4



Depth: 5.9 to 8.0 m below grade (Elev. 76.6 to 74.5 m)

BOREHOLE 106

Borehole 106 – Box 1 – Runs 1, 2 and 3



Depth: 3.0 to 6.0 m below grade (Elev. 79.5 to 76.5 m)

Borehole 106 – Box 2 – Runs 3 and 4



Depth: 6.0 to 8.1 m below grade (Elev. 76.5 to 74.4 m)

BOREHOLE 107

Borehole 107 – Box 1 – Runs 1, 2 and 3



Depth: 3.1 to 6.0 m below grade (Elev. 79.2 to 76.3 m)

Borehole 107 – Box 2 – Runs 3, 4 and 5



Depth: 6.0 to 8.9 m below grade (Elev. 76.3 to 73.4 m)

Borehole 107 – Box 3 – Run 5



Depth: 8.9 to 9.5 m below grade (Elev. 73.4 to 72.8 m)

Geomechanica Inc.
Unit 14 – 1240 Speers Rd.
Oakville Ontario
Canada L6L 2X4

March 30, 2023

Mr. Nick Ng
Grounded Engineering
1 Banigan Drive
Toronto, ON
Canada, M4H 1E9

Re: UCS Testing
(Grounded Project No. 22-282)

Dear Mr. Ng:

On March 15th and and March 21st, 2023, four (4) HQ-sized core samples and one (1) HQ-sized core sample were received by Geomechanica Inc. via drop-off by Grounded personnel, respectively. These samples were identified as being from Grounded project 22-282. From these samples, five (5) Uniaxial Compressive Strength (UCS) test specimens were prepared and tested.

Details regarding the steps of specimen preparation and testing along with the test results are presented in the accompanying laboratory report and summary spreadsheet.

Sincerely,



Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: bryan.tatone@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

NIck Ng
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Prepared by:

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March 30, 2023
Project number: 22-282

Abstract

This document summarizes the results of rock laboratory testing, including 5 Uniaxial Compressive Strength (UCS) tests. The UCS and Young's modulus values along with photographs of specimens before and after testing are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests 1
Appendices 4

Disclaimer: This report was prepared by Geomechanica Inc. for Grounded Engineering Inc.. The material herein reflects Geomechanica Inc.'s best judgment given the information available at the time of preparation. Any use which a third party makes of this report, any reliance on or decision to be made based on it, are the responsibility of such third parties. Geomechanica Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.15 mm/min (Figure 1). The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of the specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimen to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and tangent Young's modulus.



Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness

criteria, as checked with a feeler gauge, was met for all specimens. The length to diameter ratio was not met for several specimens due to the short sample lengths provided (as noted in Table 1). Testing of the specimens followed ASTM D7012-14 with the following note:

- Testing included measurement of the UCS and elastic modulus, but not the Poisson's ratio. This represents a hybrid between Methods C and D of ASTM D7012-14.

1.2 Results

The results of UCS testing are summarized in Table 1. The corresponding stress-strain curves are presented in Figure 2. The Young's modulus is the tangent modulus calculated as the slope of the best-fit line through a selection of data points defining the stress-strain curve at 50% of the UCS strength. The stress ranges used to establish the best-fit lines along with additional specimen details and measurements are provided in the summary spreadsheet that accompanies this report.

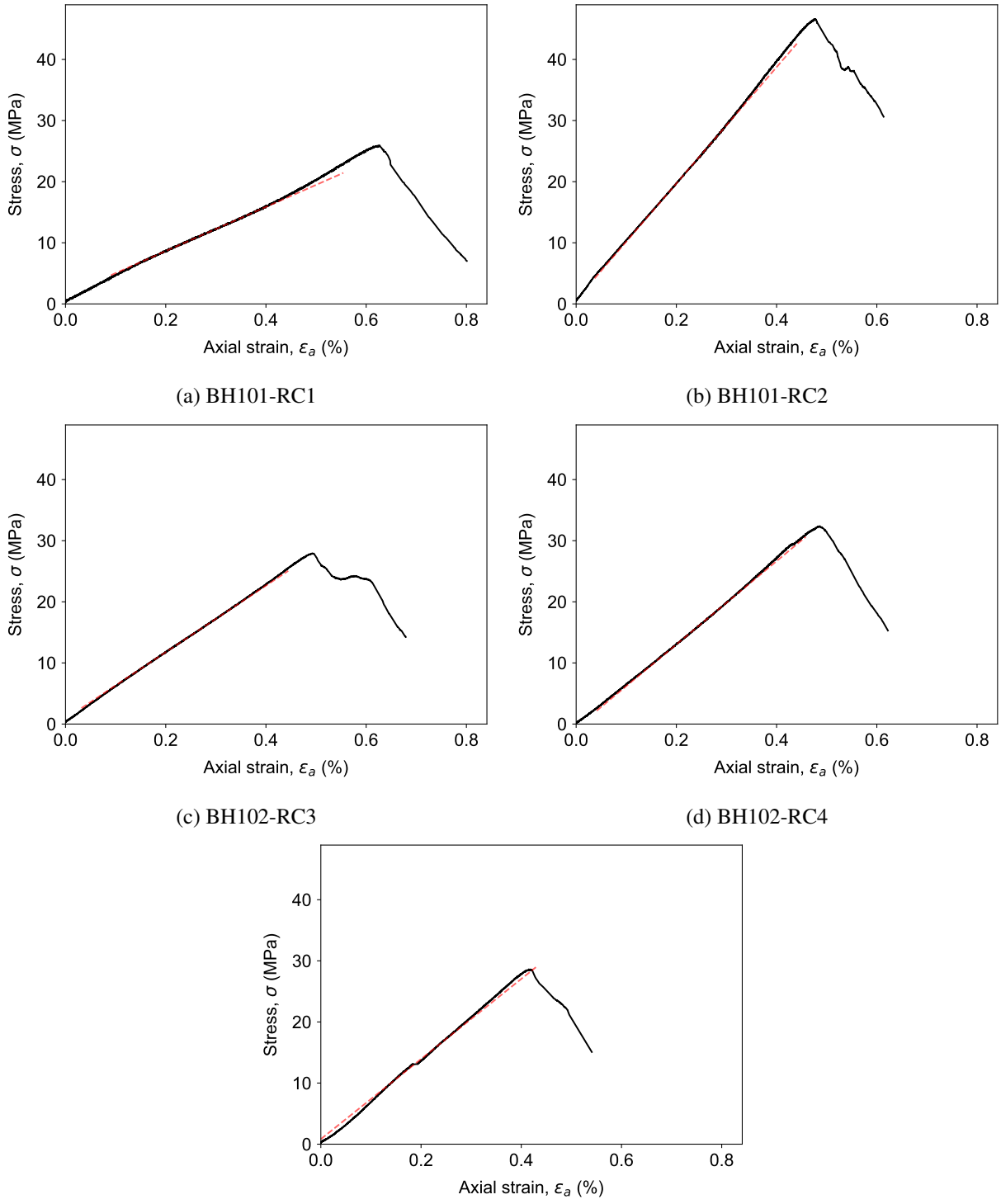
Table 1: Summary of Uniaxial Compression test results.

Sample	Depth (ft' in")	Bulk density ρ (g/cm^3)	UCS (MPa)	Young's modulus E (GPa)	Lithology	Failure description
BH101, RC1	66'3" - 67'2.5"	2.637	25.9	3.6	Red Shale	1
BH101, RC2	75'2" - 76'1"	2.640	46.6	9.5	Red Shale and Limestone	3, 1
BH102, RC3	75'6" - 76'1"	2.648	27.9	5.4	Red Shale	1
BH102, RC4	85'5.5" - 86'2"	2.634	32.4	6.8	Red Shale	3
BH103, RC5	87'11.75" - 88'9.5"	2.643	28.6	6.6	Red Shale and Limestone	4

[1] Failure localized in softer shale layer
[3] Axial splitting failure
[4] Inclined shear failure

1.3 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.



(a) BH101-RC1

(b) BH101-RC2

(c) BH102-RC3

(d) BH102-RC4

(e) BH103-RC5

Figure 2: Measured stress-strain curves.

Appendices

Specimen sheets

- BH101, RC1
- BH101, RC2
- BH102, RC3
- BH102, RC4
- BH103, RC5

GEOMECHANICA

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	22-282
Sample	BH101, RC1	**Depth**	66'3" - 67'2.5"

Specimen parameters

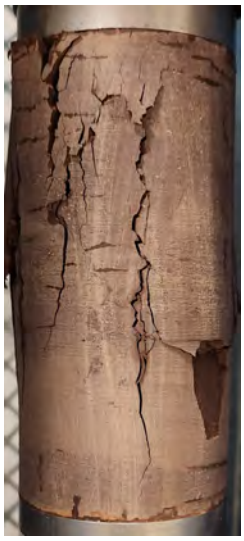
Diameter (mm) [a]	63.17
Length (mm) [a]	129.56
Bulk density ρ (g/cm^3)	2.637
UCS (MPa)	25.9
Young's modulus E (GPa) [b]	3.6
Lithology	Red Shale
Failure description [c]	1

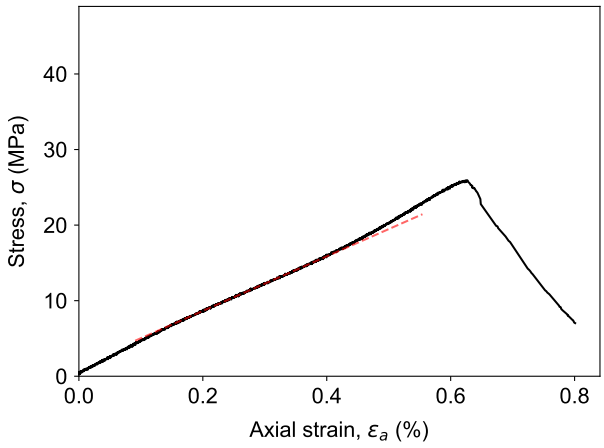
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Failure localized in softer shale layer;

Prior to testing



After testing





Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-03-27

GEOMECHANICA

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	22-282
Sample	BH101, RC2	**Depth**	75'2" - 76'1"

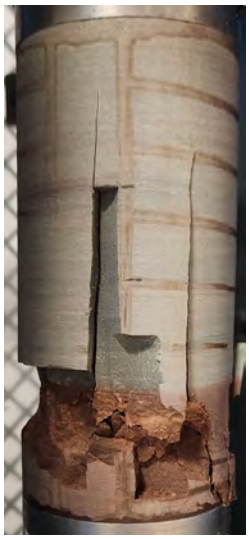
Specimen parameters	
Diameter (mm) [a]	63.05
Length (mm) [a]	129.25
Bulk density ρ (g/cm^3)	2.640
UCS (MPa)	46.6
Young's modulus E (GPa) [b]	9.5
Lithology	Red Shale and Limestone
Failure description [c]	3, 1

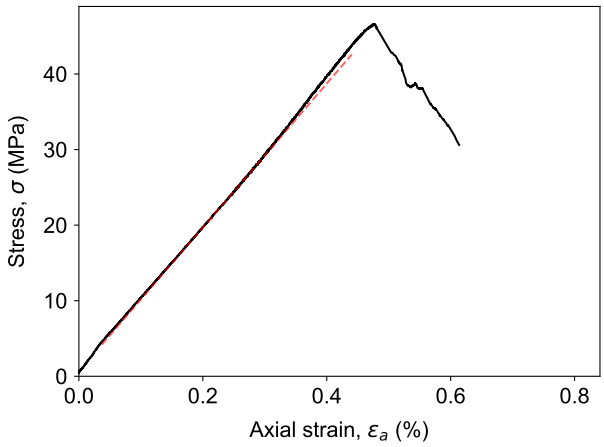
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure; [1] Failure localized in softer shale layer;

Prior to testing



After testing





Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-03-27

GEOMECHANICA

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	22-282
Sample	BH102, RC3	**Depth**	75'6" - 76'1"

Specimen parameters	
Diameter (mm) [a]	63.10
Length (mm) [a]	129.35
Bulk density ρ (g/cm^3)	2.648
UCS (MPa)	27.9
Young's modulus E (GPa) [b]	5.4
Lithology	Red Shale
Failure description [c]	1

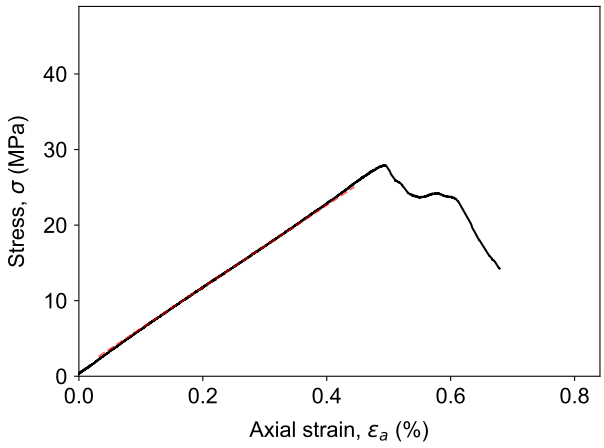
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [1] Failure localized in softer shale layer;

Prior to testing



After testing





Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-03-27

GEOMECHANICA

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	22-282
Sample	BH102, RC4	**Depth**	85'5.5" - 86'2"

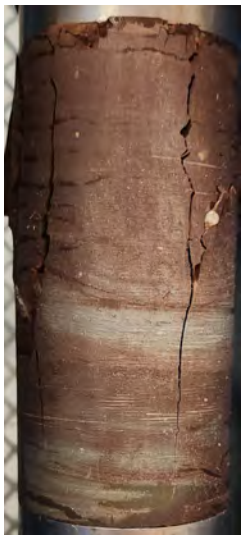
Specimen parameters	
Diameter (mm) [a]	63.07
Length (mm) [a]	129.45
Bulk density ρ (g/cm^3)	2.634
UCS (MPa)	32.4
Young's modulus E (GPa) [b]	6.8
Lithology	Red Shale
Failure description [c]	3

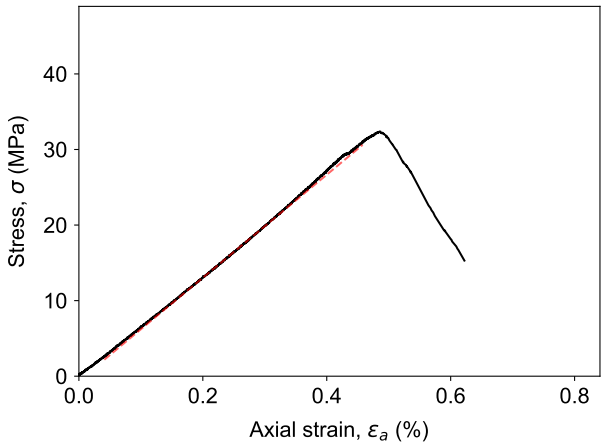
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [3] Axial splitting failure;

Prior to testing



After testing





Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-03-27

GEOMECHANICA

Uniaxial Compression Test

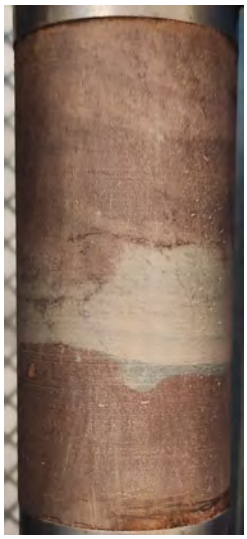
Client	Grounded Engineering Inc.	**Project**	22-282
Sample	BH103, RC5	**Depth**	87'11.75" - 88'9.5"

Specimen parameters

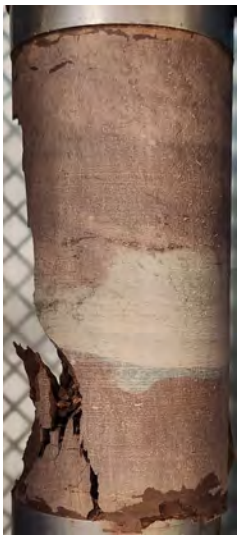
Diameter (mm) [a]	63.12
Length (mm) [a]	128.97
Bulk density ρ (g/cm^3)	2.643
UCS (MPa)	28.6
Young's modulus E (GPa) [b]	6.6
Lithology	Red Shale and Limestone
Failure description [c]	4

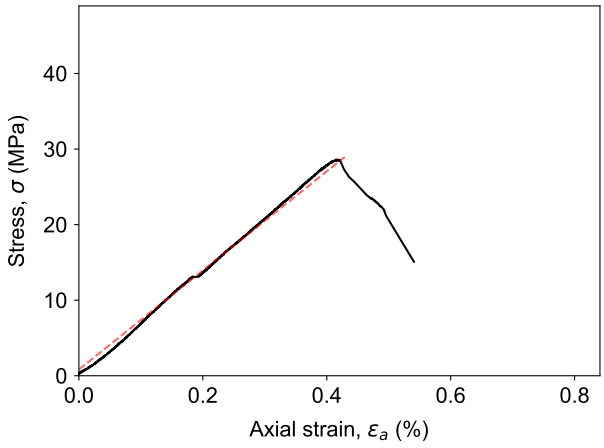
[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Tangent modulus, calculated as the slope of the best fit line through ±300 data points on either side of the point representing 50.0% of the peak strength.
[c] Failure description: [4] Inclined shear failure;

Prior to testing



After testing





Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-03-27

APPENDIX D





PINCHIN

PROJECT NAME: PHASE II ENVIRONMENTAL SITE ASSESSMENT			
CLIENT NAME: THE DAVID LANDRY FAMILY TRUST			
PROJECT LOCATION: 2072 LAKESHORE ROAD, BURLINGTON, ONTARIO			
FIGURE NAME: KEY MAP			FIGURE NO.: 1
APPROXIMATE SCALE: AS SHOWN	PROJECT NO.: 233963.001	DATE: FEB. 2019	



PINCHIN

PROJECT NAME: PHASE II ENVIRONMENTAL SITE ASSESSMENT			
CLIENT NAME: THE DAVID LANDRY FAMILY TRUST			
PROJECT LOCATION: 2072 LAKESHORE ROAD, BURLINGTON, ONTARIO			
FIGURE NAME: MONITORING WELL LOCATION PLAN			FIGURE NO.: 2
APPROXIMATE SCALE: AS SHOWN	PROJECT NO.: 233963.001	DATE: FEB. 2019	

Log of Borehole: MW01

Project #: 233963.001 **Logged By:** AH

Project: Phase II Environmental Site Assessment

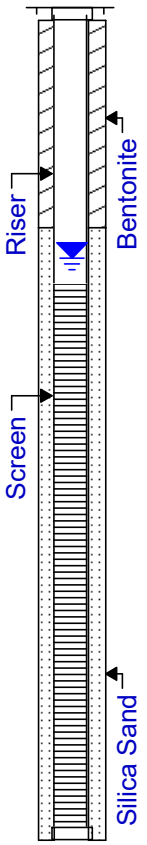
Client: The David Landry Family Trust

Location: 2072 Lakeshore Road, Burlington, Ontario

Drill Date: February 2, 2019

SUBSURFACE PROFILE

Depth (ft / m)	Description	Measured Depth (m)
0 / 0	Ground Surface	0.00
	Asphalt	
	Sand Brown, some gravel, damp.	
4 / 1	Wet below 1.52 mbgs.	
7 / 2		2.13
	Silt Red-brown to grey, trace weathered shale, damp.	
10 / 3	Sampler refusal at 3.05 mbgs. Augered to 4.57 mbgs for well installation.	3.05
	Silt Till / Weathered Shale Complex (Inferred) Red-brown to grey, damp.	
15 / 4		4.57
	End of Borehole	
18 / 5	Soil vapour concentrations measured using a RKI Eagle 2 equipped with a photoionization detector (PID) and a combustible gas indicator (CGI).	



Water level measured at 1.38 mbgs on February 7, 2019.

SAMPLE

Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
30	MW01-1	0/0	PAHs
90	MW01-2	0/0	Grain Size, PHCs, VOCs
	MW01-3	0/0	pH

Contractor: Strata

Drilling Method: Direct Push & Solid Stem Auger

Well Casing Size: 5.1 cm

Grade Elevation: NM

Top of Casing Elevation: NM

Sheet: 1 of 1

Log of Borehole: MW02

Project #: 233963.001 ***Logged By:*** AH

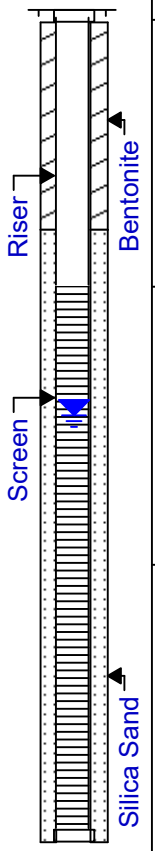
Project: Phase II Environmental Site Assessment

Client: The David Landry Family Trust

Location: 2072 Lakeshore Road, Burlington, Ontario

Drill Date: February 2, 2019

SUBSURFACE PROFILE					SAMPLE			
Depth (ft / m)	Symbol	Description	Measured Depth (m)	Monitoring Well Details	Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
0 / 0		Ground Surface	0.00					
		Asphalt						
1		***Sand*** Brown, some gravel, damp.			60	MW02-1	0/0	
2 / 1						MW02-2	0/2	
		Wet below 1.52 mbgs.						
6 / 2			2.13			MW02-3	0/2	PHCs, VOCs, Lead
7		***Silt*** Red-brown to grey, trace weathered shale, damp.			80			
8						MW02-4	0/0	
9		Sampler refusal at 3.05 mbgs. Augered to 4.57 mbgs for well installation.						
10 / 3			3.05					
11		***Silt Till / Weathered Shale Complex (Inferred)*** Red-brown to grey, damp.						
12								
13 / 4								
14								
15			4.57					
		End of Borehole						
16 / 5								
17								
18		Soil vapour concentrations measured using a RKI Eagle 2 equipped with a photoionization detector (PID) and a combustible gas indicator (CGI).						
19								
20 / 6								



Water level measured at 2.23 mbgs on February 7, 2019.

Contractor: Strata

Drilling Method: Direct Push & Solid Stem Auger

Well Casing Size: 5.1 cm

Grade Elevation: NM

Top of Casing Elevation: NM

Sheet: 1 of 1

Log of Borehole: MW03

Project #: 233963.001 **Logged By:** AH

Project: Phase II Environmental Site Assessment

Client: The David Landry Family Trust

Location: 2072 Lakeshore Road, Burlington, Ontario

Drill Date: February 2, 2019

SUBSURFACE PROFILE

Depth (ft / m)	Description	Measured Depth (m)
0 / 0	Ground Surface	0.00
	Asphalt	
	Sand Brown, some gravel, damp.	
	Wet below 1.52 mbgs.	
7 / 2		2.13
	Silt Red-brown to grey, trace weathered shale, damp.	
	Sampler refusal at 3.05 mbgs. Augered to 4.57 mbgs for well installation.	3.05
	Silt Till / Weathered Shale Complex (Inferred) Red-brown to grey, damp.	
15 / 4.57		4.57
	End of Borehole	

Soil vapour concentrations measured using a RKI Eagle 2 equipped with a photoionization detector (PID) and a combustible gas indicator (CGI).

Monitoring Well Details: Riser, Bentonite, Screen, Silica Sand

Water level measured at 1.42 mbgs on February 7, 2019.

SAMPLE

Recovery (%)	Sample ID	Soil Vapour Concentration (ppm) CGI/PID	Laboratory Analysis
60	MW03-1	0/0	
	MW03-2	0/0	pH
80	MW03-3	0/0	PHCs, VOCs, Lead
	MW03-4	0/0	

Contractor: Strata

Drilling Method: Direct Push & Solid Stem Auger

Well Casing Size: 5.1 cm

Grade Elevation: NM

Top of Casing Elevation: NM

Sheet: 1 of 1

APPENDIX E



CORROSIVITY (BVL)

Bureau Veritas Job Number: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD

Sampler Initials: NG

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID			VHZ730	VHZ731	VHZ732
Sampling Date			2023-03-13	2023-03-13	2023-03-09
Sampling Time					
COC Number			915722-32-01	915722-32-01	915722-32-01
	UNITS	**RDL**	**BH107 SS4**	**BH107 SS2**	**BH102 SS2**
Calculated Parameters					
Resistivity	ohm-cm		770.00	780.00	1500
Inorganics					
Soluble (20:1) Chloride (Cl-)	ug/g	20	1100	750	300
Conductivity	umho/cm	2	1300	1280	647
Available (CaCl2) pH	pH		7.9	8.11	8.1
Soluble (20:1) Sulphate (SO4)	ug/g	20	68	20	20
Sulphide	mg/kg	0.5	<0.5	0.80	1.00
Physical Testing					
Moisture-Subcontracted	%	0.3	11	6.3	7.4
Subcontracted Analysis					
Redox Potential	mV		230	290	240

RDL = Reportable Detection Limit

INTERPRETATION

AWWA C-105 Standard		**Points**	**Points**	**Points**
% Moisture		2	1	1
pH		0	0	0
Redox Potential		0	0	0
Resistivity		8	8	1
Acid Volatile Sulphides		0	2	2
TOTAL SCORE (AWWA C-105)		**10**	**11**	**4**
Sample		**BH107 SS4**	**BH107 SS2**	**BH102 SS2**
Corrosion Protection Recommended?		**YES**	**YES**	**No**
Resistivity less than 2000 ohm.cm?		**YES**	**YES**	**YES**
Anions and Nutrients (Soil)				
Sulphate	%	0.0068	0.002	0.002
CLASS OF EXPOSURE		**Negligible**	**Negligible**	**Negligible**

Your Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Your C.O.C. #: 915722-32-01

Attention: Nick Ng

Grounded Engineering Inc.
1 Banigan Drive
Toronto, ON
CANADA M4H 1G3

Report Date: 2023/03/28
Report #: R7564170
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C376714
Received: 2023/03/17, 15:14

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	3	2023/03/22	2023/03/23	CAM SOP-00463	MOE E3013 m
Conductivity	3	2023/03/22	2023/03/22	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	3	N/A	2023/03/25	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	3	N/A	2023/03/22	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	3	2023/03/21	2023/03/21	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	3	2023/03/21	2023/03/22	CAM SOP-00421	SM 2580 B
Resistivity of Soil	3	2023/03/18	2023/03/22	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	3	2023/03/22	2023/03/23	CAM SOP-00464	MOE E3013 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE , Calgary, AB, T2E 6P8
(2) Offsite analysis requires that subcontracted moisture be reported.
(3) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode. The test is therefore, not SCC accredited for this matrix.

Your Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Your C.O.C. #: 915722-32-01

Attention: Nick Ng

Grounded Engineering Inc.
1 Banigan Drive
Toronto, ON
CANADA M4H 1G3

Report Date: 2023/03/28
Report #: R7564170
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C376714
Received: 2023/03/17, 15:14

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Marijane Cruz, Senior Project Manager
Email: Marijane.Cruz@bureauveritas.com
Phone# (905)817-5756

==========

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas Job #: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		VHZ730		VHZ731			VHZ731			VHZ732		
Sampling Date		2023/03/13		2023/03/13			2023/03/13			2023/03/09		
COC Number		915722-32-01		915722-32-01			915722-32-01			915722-32-01		
	UNITS	BH107 SS4	RDL	BH107 SS2	RDL	QC Batch	BH107 SS2 Lab-Dup	RDL	QC Batch	BH102 SS2	RDL	QC Batch
Calculated Parameters												
Resistivity	ohm-cm	770		780		8560314				1500		8560314
CONVENTIONALS												
Redox Potential	mV	230	N/A	290	N/A	8564005	260	N/A	8564005	240	N/A	8564005
Inorganics												
Soluble (20:1) Chloride (Cl-)	ug/g	1100	40	750	20	8566150				300	20	8566150
Conductivity	umho/cm	1300	2	1280	2	8566227	1360	2	8566227	647	2	8566227
Available (CaCl2) pH	pH	7.90		8.11		8563702	8.09		8563702	8.10		8563702
Soluble (20:1) Sulphate (SO4	ug/g	68	20	<20	20	8566166				<20	20	8566166
Sulphide	mg/kg	<0.5 (1)	0.5	0.8 (1)	0.5	8576121				1.0 (1)	0.5	8576121
Physical Testing												
Moisture-Subcontracted	%	11	0.30	6.3	0.30	8576124				7.4	0.30	8576124

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Sample contained greater than 10% headspace at time of extraction.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

TEST SUMMARY

Bureau Veritas ID: VHZ730 **Collected:** 2023/03/13
Sample ID: BH107 SS4 **Shipped:**
Matrix: Soil **Received:** 2023/03/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8566150	2023/03/22	2023/03/23	Massarat Jan
Conductivity	AT	8566227	2023/03/22	2023/03/22	Gurparteek KAUR
Moisture (Subcontracted)	BAL	8576124	N/A	2023/03/25	Ashley Henderson
Sulphide in Soil	SPEC	8576121	N/A	2023/03/22	Ly Vu
pH CaCl2 EXTRACT	AT	8563702	2023/03/21	2023/03/21	Taslima Aktar
Redox Potential	COND	8564005	2023/03/21	2023/03/22	Kien Tran
Resistivity of Soil		8560314	2023/03/22	2023/03/22	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8566166	2023/03/22	2023/03/23	Massarat Jan

Bureau Veritas ID: VHZ731 **Collected:** 2023/03/13
Sample ID: BH107 SS2 **Shipped:**
Matrix: Soil **Received:** 2023/03/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8566150	2023/03/22	2023/03/23	Massarat Jan
Conductivity	AT	8566227	2023/03/22	2023/03/22	Gurparteek KAUR
Moisture (Subcontracted)	BAL	8576124	N/A	2023/03/25	Ashley Henderson
Sulphide in Soil	SPEC	8576121	N/A	2023/03/22	Ly Vu
pH CaCl2 EXTRACT	AT	8563702	2023/03/21	2023/03/21	Taslima Aktar
Redox Potential	COND	8564005	2023/03/21	2023/03/22	Kien Tran
Resistivity of Soil		8560314	2023/03/22	2023/03/22	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	8566166	2023/03/22	2023/03/23	Massarat Jan

Bureau Veritas ID: VHZ731 Dup **Collected:** 2023/03/13
Sample ID: BH107 SS2 **Shipped:**
Matrix: Soil **Received:** 2023/03/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	8566227	2023/03/22	2023/03/22	Gurparteek KAUR
pH CaCl2 EXTRACT	AT	8563702	2023/03/21	2023/03/21	Taslima Aktar
Redox Potential	COND	8564005	2023/03/21	2023/03/22	Kien Tran

Bureau Veritas ID: VHZ732 **Collected:** 2023/03/09
Sample ID: BH102 SS2 **Shipped:**
Matrix: Soil **Received:** 2023/03/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	8566150	2023/03/22	2023/03/23	Massarat Jan
Conductivity	AT	8566227	2023/03/22	2023/03/22	Gurparteek KAUR
Moisture (Subcontracted)	BAL	8576124	N/A	2023/03/25	Ashley Henderson
Sulphide in Soil	SPEC	8576121	N/A	2023/03/22	Ly Vu
pH CaCl2 EXTRACT	AT	8563702	2023/03/21	2023/03/21	Taslima Aktar
Redox Potential	COND	8564005	2023/03/21	2023/03/22	Kien Tran
Resistivity of Soil		8560314	2023/03/22	2023/03/22	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

TEST SUMMARY

Bureau Veritas ID: VHZ732
Sample ID: BH102 SS2
Matrix: Soil

Collected: 2023/03/09
Shipped:
Received: 2023/03/17

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	8566166	2023/03/22	2023/03/23	Massarat Jan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

GENERAL COMMENTS

Cooler custody seal present and intact.

Results relate only to the items tested.

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Bureau Veritas Job #: C376714
Report Date: 2023/03/28

QUALITY ASSURANCE REPORT

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8563702	Available (CaCl2) pH	2023/03/21			100	97 - 103			0.23	N/A
8564005	Redox Potential	2023/03/22			102	95 - 105			11	35
8566150	Soluble (20:1) Chloride (Cl-)	2023/03/23	102	70 - 130	103	70 - 130	<20	ug/g	NC	35
8566166	Soluble (20:1) Sulphate (SO4)	2023/03/23	93	70 - 130	93	70 - 130	<20	ug/g	NC	35
8566227	Conductivity	2023/03/22			104	90 - 110	<2	umho/cm	6.6	10
8576121	Sulphide	2023/03/22	105	75 - 125	120	75 - 125	<0.5	mg/kg	14	30
8576124	Moisture-Subcontracted	2023/03/25					<0.30	%		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Bureau Veritas Job #: C376714
Report Date: 2023/03/28

Grounded Engineering Inc.
Client Project #: 22-282
Site Location: 2072 LAKESHORE ROAD
Sampler Initials: NG

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Suwan (Sze Yeung) Fock, B.Sc., Scientific Specialist

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Page of

CHAIN OF CUSTODY RECORD

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:	Laboratory Use Only:
Company Name: #36876 Grounded Engineering Inc.	Company Name:	Quotation #: C20582	Bureau Veritas Job #: / Bottle Order #: 915722
Attention: ~~Sean Morris~~ Nick Ng	Attention: Sean Morris Nick Ng	P.O. #:	
Address: 1 Banigan Drive Toronto ON M4H 1G3	Address:	Project: ~~22-317~~ 22-282	
Tel: ~~(289) 697-0973~~ ~~647 247 7936~~	Tel: 647 247 7936 (289) 697-0973 Fax:	Project Name: 2072 Lakeshore Road	COC #: C#915722-32-01 / Project Manager: Marijane Cruz
Email: ~~smorris@groundedeng.ca~~ nng@groundedeng.ca	Email: ~~smorris@groundedeng.ca~~ nng@groundedeng.ca	Site #: Sampled By:	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☑ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☑ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	O.Reg 406 Excess Soil Bulk VOCs/F1-F4	O.Reg 406 Excess Soil Bulk Inorganics	O.Reg 406 Excess Soil Bulk PAHs	O.Reg 406 Excess Soil SPLP VOCs	SPLP PAHs	Soil Corrosivity	# of Bottles	Comments
1		BH107 SS4	Mar 13, 2023	PM	Soil							✓		
2		BH107 SS2	Mar 13, 2023	PM	Soil							✓		
3		BH102 SS2	Mar 9, 2023	PM	Soil							✓		
4														
5														
6														
7														
8														
9														
10														

17-Mar-23 15:14
Marijane Cruz
C376714
RJM ENV-1378

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Nick Ng	2023/03/16	PM	[illegible]	23/03/17	10:19	
				2023/03/17	15:14	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei: 10 / 9 / 9	Custody Seal	Yes	No
		Present		
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

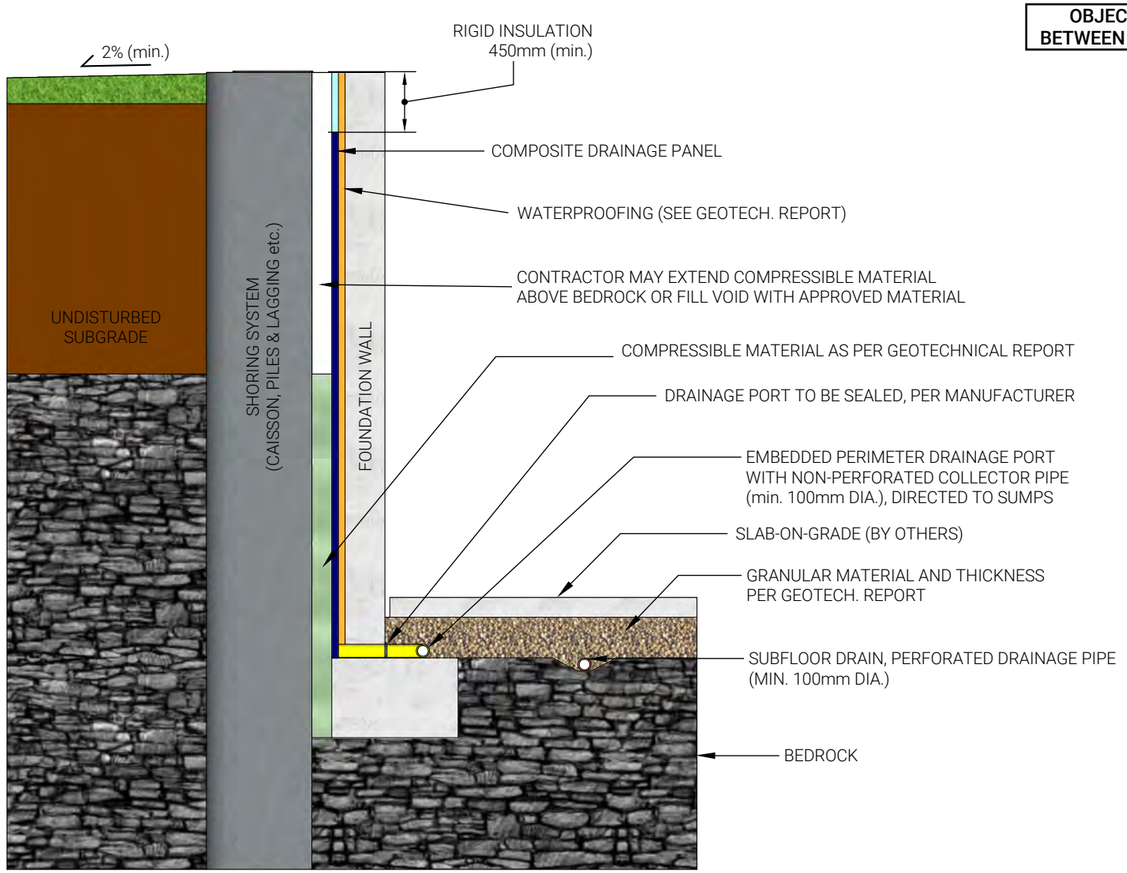
White: Bureau Veritas Yellow: Client

Bureau Veritas Canada (2019) Inc.

264323

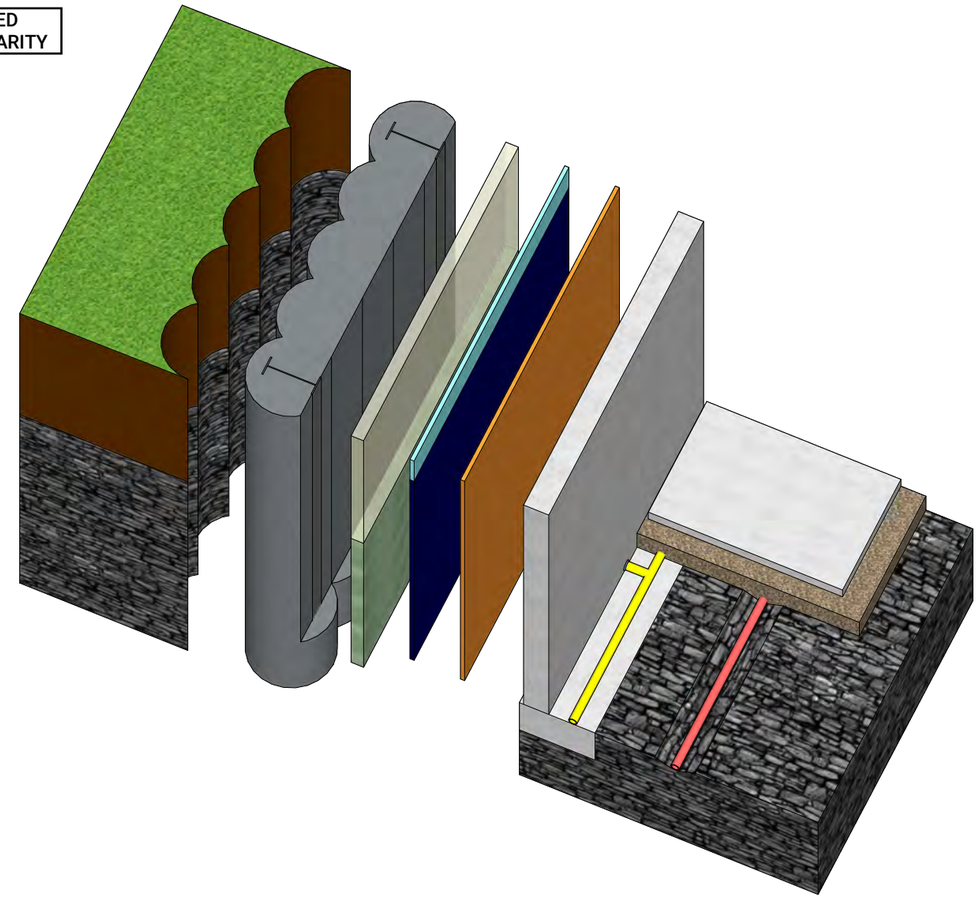
APPENDIX F





SECTIONAL VIEW

OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY



ISOMETERIC 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.

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

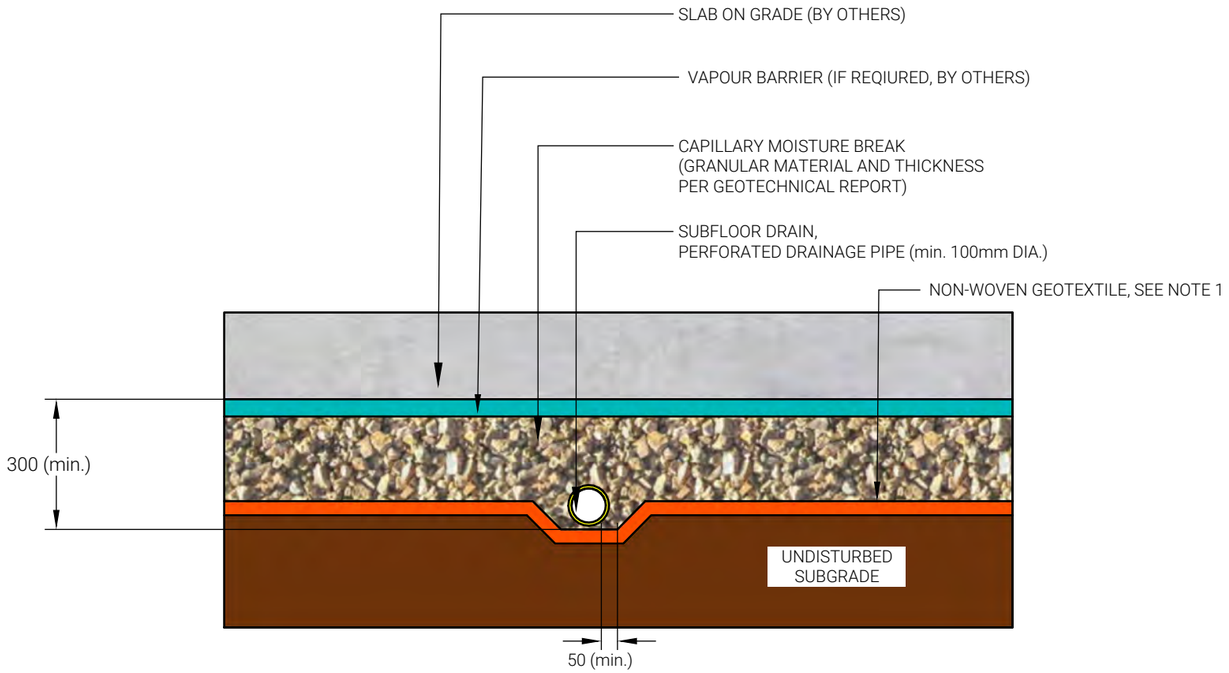
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC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

GROUNDED ENGINEERING

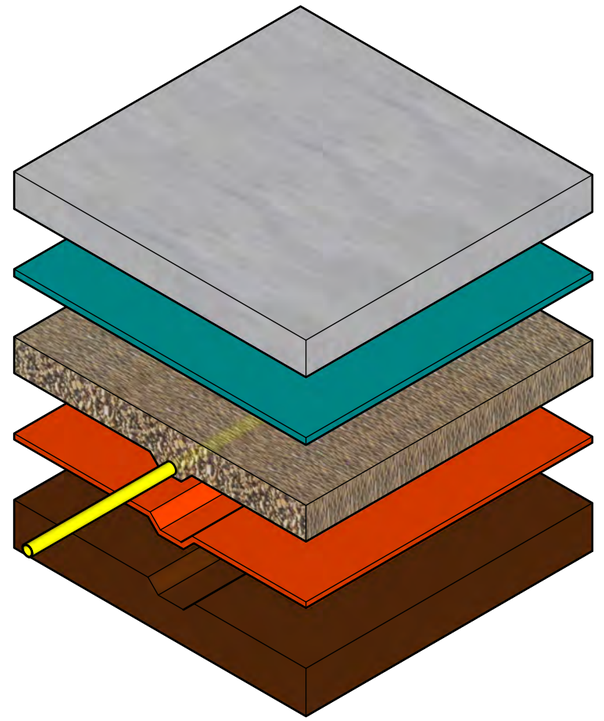
Title

FOUNDATION WALL BLINDSIDE DRAINAGE SYSTEM (IN DEEP ROCK) DETAIL

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.

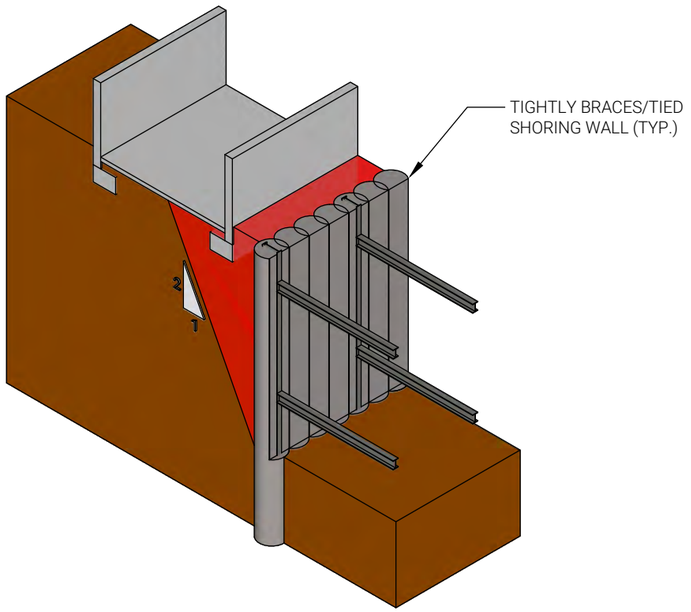
GROUNDED ENGINEERING

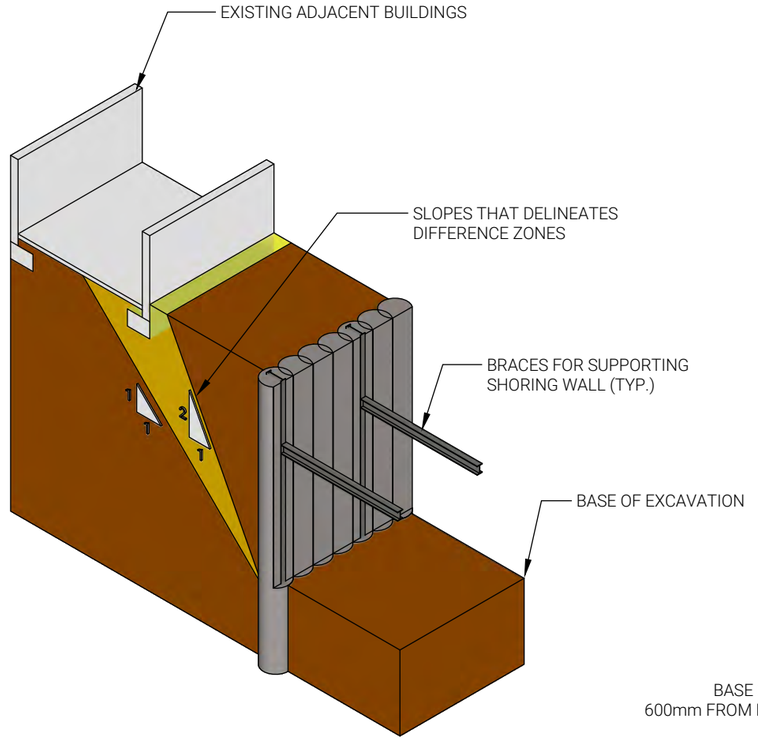
Title

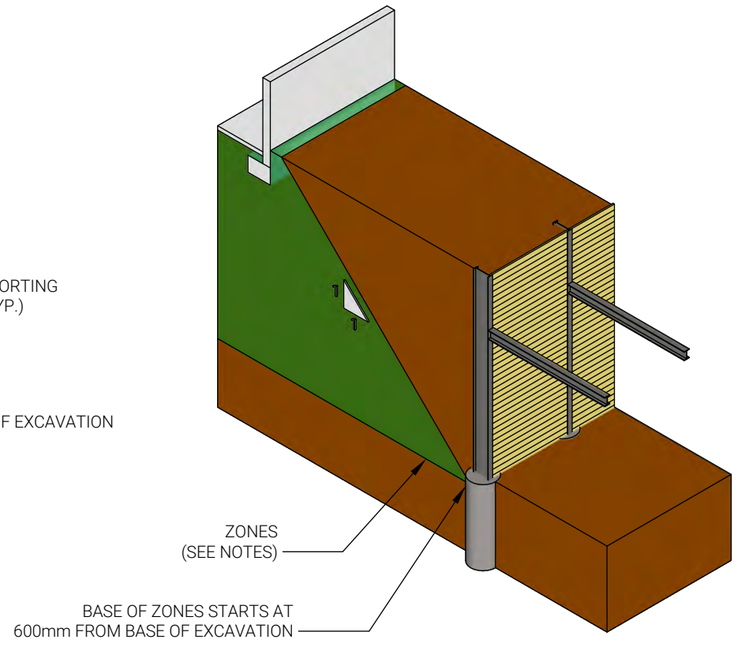
BASEMENT SUBDRAIN TYPICAL DETAIL

APPENDIX G









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