GEOTECHNICAL ENGINEERING REPORT

PREPARED FOR:
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1 Introduction

2555 Erin Centre c/o Trinity Point Developments has retained Grounded Engineering Inc. to provide geotechnical engineering design advice for their proposed development at 2555 Erin Centre, in Mississauga, Ontario.

The proposed project includes constructing three (3) high-rise towers, ranging from 28 to 33-storeys in height, extending from low-rise podium/parkade structures, all situated on a common P4 underground parking structure, set at an estimated lowest (P4) Finished Floor Elevation (FFE) of 156± m.

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

- Topographic Survey, "Plan of Survey and Topography of Block 116 - Registered Plan 43M-856"; Job No. 23-242, dated November 30, 2023, prepared by R-PE Surveying LTD.
- Architectural Progress Set, "2555 Erin Centre Blvd."; dated July 26th, 2024, prepared by Arcadis.

Grounded's subsurface investigation of the site to date includes the following nine (9) boreholes (Boreholes 101 to 109) which were advanced from June 24th to 28th, 2024:

- Boreholes 101 to 106 included rock coring (to confirm the transition from weathered to sound bedrock), and were installed with monitoring wells.
- Boreholes 107 and 108 inferred top of bedrock elevation (no rock coring), and were installed with monitoring wells.
- Borehole 109 was advanced by hand-auger methods (upon practical refusal at 0.6 m depth below grade) adjacent to the existing transformer for environmental engineering purposes.

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, basement drainage, and pavement design. 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 City of Mississauga vertical benchmark number 968 (ref. topographic survey provided). The horizontal coordinates are provided relative to the Universal Transverse Mercator (UTM) geographic coordinate system.

2.1 Stratigraphy

The following stratigraphic summary is based on the results of the boreholes and the geotechnical laboratory testing. A subsurface profile showing stratigraphy and engineering units is appended.

A summary of the relevant stratigraphic units is provided as follows. The summary elevations are provided for general guidance only. Details are provided on the borehole logs and in the following subsections. For discussion purposes, the average existing grade is estimated to be at Elev. 169.2± 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 glacial till at about Elev. 168± m, overlying
3. The top of weathered bedrock (Queenston Formation) at about Elev. 163 to 165± m.

The design groundwater table is at about Elev. 167± m. There is also a lower groundwater table within the bedrock. Within the zone of excavation, the earth fill will permit the free-flow of water when wet, whereas the native glacial till and sound bedrock will typically preclude free-flowing water when penetrated below the groundwater table. However, it can be expected that the weathered bedrock and fractures in the sound bedrock will produce groundwater seepage.

2.1.1 Surficial 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.

Boreholes 101 to 108 encountered a pavement structure consisting of 100 to 125 mm of asphalt overlying 75 to 225 mm thick aggregate layer. Borehole 109 encountered 150 mm of topsoil at ground surface.

Underlying the surficial materials, Boreholes 101 to 108 observed a layer of earth fill that extends to depths of 0.8 to 2.3 m below grade (Elev. 168.7 to 167.1 m). Borehole 109 was advanced by hand-auger methods for environmental sampling purposes and was terminated in the existing fill at a depth of 0.6 m below grade (Elev 168.4 m).

The earth fill varies in composition but generally consists of clayey silt, silty sand, and silt with some clay. It contains trace construction debris, trace to some rock fragments, trace to some gravel, and occasional light grey silt partings. The earth fill ranges in colour from dark brown, to brown, to reddish brown and is moist. Perched water within the fill was observed in Borehole 107 at a depth of 1.5 m below grade.

Due to inconsistent placement and the inherent heterogeneity of earth fill materials, the relative density of the earth fill could be variable.

2.1.2 Glacial Till

Underlying the fill materials, all the boreholes encountered an undisturbed native glacial till deposit with a matrix ranging from cohesive clayey silt, with some sand, to cohesionless silty sand to sandy silt. The glacial till contains trace to some gravel, occasional light grey silt partings and trace shale/rock fragments throughout, as well as possible cobbles and boulders.

The glacial till was encountered at depths of 0.8 to 2.3 m below grade (Elev. 168.7 to 167.1 m) and extends to depths of 4.3 to 6.5 m below grade (Elev. 164.8 to 162.9 m).

The glacial till is generally reddish brown and is moist. The Standard Penetration Test (SPT) results (N-Values) measured in the glacial till range from 27 to greater than 50 blows per 300 mm of penetration (bpf) indicating a very stiff to hard consistency.

2.1.3 Bedrock

Bedrock was either confirmed (by rock coring) or inferred (by split-spoon sampling and other drilling observations) in Boreholes 101 to 108, underlying the glacial till at depths of 4.3 to 6.5 m below grade (Elev. 164.8 to 162.9 m). Bedrock was confirmed by rock cores recovered in Boreholes 101 to 106 extending to depths of 18.5 to 19.9 m below grade (Elev. 150.8 to 149.5 m). Where coring was not conducted at Boreholes 107 and 108, the top of weathered bedrock was inferred through auger cuttings, split spoon samples, and auger grinding/resistance observations. Bedrock was not encountered in Borehole 109, as it was terminated at 0.6m below grade due to hand auger refusal.

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 (m)	Bulk Density (kg/m^3)	UCS (MPa)	Young’s Modulus, E (GPa)	Lithology
BH102	UCS2	14.3 to 14.6	2591	9.1	1.2	Shale and Limestone
BH104	UCS3	14.4 to 14.5	2631	39.5	7.2	Limestone and Shale
BH106	UCS1	15.6 to 15.8	2605	16.5	1.7	Shale and Limestone

Directly below the overburden soils, the uppermost portion of bedrock is typically weathered. The MTO[1] 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 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) ranges in thickness between 0.1 to 0.4 m in Boreholes 102 to 105, whereas Boreholes 101 and 106 (advanced on the eastern portion of the site) observed more extensive weathered bedrock with thicknesses of 2.7 and 0.9 m, respectively. Weathered and sound bedrock elevations are summarized as follows:

Borehole	Ground Surface Elevation (m)	Partially Weathered (Zone II) Bedrock		Sound (Zone I) Bedrock	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
101	169.1	4.6	164.5	7.3	161.8
102	169.1	4.3	164.8	4.6	164.5

[1] Franklin, J.A., Gruspier, J.E., 1983. "Evaluation of Shales for Construction Projects – An Ontario Shale Rating System", Ontario Ministry of Transportation and Communication, Research Report RR229.

Borehole	Ground Surface Elevation (m)	Partially Weathered (Zone II) Bedrock		Sound (Zone I) Bedrock	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
103	169.0	4.7	164.3	5.0	164.0
104	169.2	4.7	164.5	5.0	164.2
105	169.5	4.8	164.7	5.2	164.3
106	169.4	6.5	162.9	7.4	162.0

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 varied between 0 and 59% in the weathered bedrock and varies between 38% and 100% 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 Greater Toronto Area 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 Formation has been known to issue gases. 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 and constructability issue to be addressed.

2.2 Groundwater

The depth to groundwater and caved soils was measured in applicable boreholes immediately following the drilling. On completion of drilling, Boreholes 101 to 106 were filled with drill fluid (from rock coring) and measuring the unstabilized groundwater level after drilling was not practical. Boreholes 107 and 108 were cased by hollow stem augers on completion, and cave measurement was not practical.

Monitoring wells were installed in Boreholes 101 to 108, and stabilized groundwater levels were measured in each of the installed monitoring wells. The groundwater observations are shown on the Borehole Logs and are summarized as follows.

Well ID	Well Diameter (mm)	Ground Surface (masl)	Top of Screen (masl)	Bottom of Screen (masl)	Screened Geological Unit
BH 101	50	169.1	153.2	150.2	Bedrock
BH 102	50	169.1	167.5	164.5	Glacial Till
BH 103	50	169.0	153.6	150.5	Bedrock
BH 104	50	169.2	167.7	164.6	Glacial Till
BH 105	50	169.5	153.9	150.9	Bedrock
BH 106	50	169.4	166.4	163.4	Glacial Till
BH 107	50	169.4	167.6	166.1	Glacial Till
BH 108	50	169.4	167.1	164.0	Glacial Till

Borehole No.	Borehole depth (m)	Upon completion of drilling		Water Level in Well, highest (m)	
		Depth to cave (m)	Unstabilized water level (m)	Date	Depth/Elev.
101	18.9	n/a	Filled with drill water	2024-07-19	7.9 /161.2
102	18.8	n/a	Filled with drill water	2024-07-19	3.4 / 165.7
103	18.5	n/a	Filled with drill water	2024-07-19	7.3 / 161.7
104	18.6	n/a	Filled with drill water	2024-07-24	3.0 / 166.2
105	18.7	n/a	Filled with drill water	2024-07-19	8.3 / 161.2
106	19.9	n/a	Filled with drill water	2024-07-19	3.2 / 166.2
107	4.7	n/a	dry	**2024-07-11**	**2.4 / 167.0**
108	7.8	n/a	dry	2024-07-24	3.4 / 166.0

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 for engineering purposes is at Elev. 167± m.

The glacial till has a low permeability and will yield only minor seepage. It can be expected that fractures in the weathered and sound bedrock will produce groundwater seepage. There is also infiltrated stormwater perched in the earth fill which is flowing down towards the groundwater table.

Grounded has prepared a hydrogeological report for this site (File No. 24-095).

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.
- **One** of the three samples scored more than 10 points; corrosion protective measures may be recommended for cast iron alloys.
- A more recent study by the AWWA has suggested that soil with a resistivity of less than about 2000 ohm.cm should be considered aggressive. **All** of the three samples had a resistivity measurement of less than 2000 ohm.cm, and should be considered aggressive.

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

The proposed development will consist of three (3) high-rise towers, ranging from 28 to 33-storeys in height, extending from low-rise podium/parkade structures, all situated on a common P4 underground parking structure, set at an estimated lowest (P4) FFE of 156± m.

Foundations made for the proposed P4 level will bear at Elev. 155± m on sound bedrock of the Queenston Formation. Conventional spread footings made to bear on this soil may be designed using a maximum factored geotechnical resistance at ultimate limit state (ULS) of 7 MPa. The geotechnical reaction at serviceability limit state (SLS) is 5 MPa, for an estimated total settlement of 15 to 20 mm.

The geotechnical reaction at SLS refers to an estimated settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

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. This requirement exists to avoid undermining adjacent footings.

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 155± m, the boreholes encountered 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.

Consideration should be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) as part of a future scope of work, to determine the average shear wave velocity in the 30 meters of rock stratigraphy (Vs_{30}) below the proposed FFE. The current OBC anchors the seismic hazard data to the site class provided above; however, the National Building Code 2020 (and the current revision to the OBC) provides the option of calculating the seismic hazard (i.e. spectral acceleration) directly from average Vs_{30} measurement, which should provide a lower (improved) site response.

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	21	0.47	0.64	2.11
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 3.6.

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 subgrade and the base of the footing. The factored geotechnical resistance to friction (**R_f**) at ULS provided in the following equation:

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

R_f	=	frictional resistance (kN)
Φ	=	reduction factor per 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 lowest (P4) FFE at Elev. 156± m, a conventional slab on grade will be set on clear stone resting on sound bedrock of the Queenston Formation. The modulus of subgrade reaction appropriate for design of the slab resting on an aggregate drainage layer overlying unweathered (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). 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 9.5 mm clear stone (OPSS.MUNI 1004), High Performance Bedding (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.

The subgrade should be cut neat and inspected by Grounded prior to placement of the capillary moisture break and construction of the slab. Disturbed or otherwise unacceptable material (as determined by Grounded) must be subexcavated and replaced with Granular B (OPSS.MUNI 1010) compacted to a minimum of 98% SPMDD. The slab on grade should not be placed on frozen subgrade, to prevent excessive settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation.

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.

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. Perimeter drainage must be collected and conveyed directly to the building sumps, and not discharged into the subfloor drainage system, the granular layer, or beneath the floor slab.

Subfloor drainage pipes (min. 100 mm diameter) are to be spaced at a maximum 9 m (measured on-centres).

The walls of the substructure are to be fully drained to eliminate hydrostatic pressure. How the drainage system is installed depends on whether the basement wall is made in an open cut or over a shored excavation face. Where drained basement walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Seepage from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps.

A layer of waterproofing placed between the drainage layer and the foundation wall should be considered to protect interior finishes from moisture.

Typical basement drainage details are appended.

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

The permanent dewatering requirements are provided in Grounded's Hydrogeological Report (File No. 24-095).

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

4 Pavement Engineering Recommendations

It is expected that most of the pavements will be placed on top of the reinforced concrete parking structure and not on soil subgrade. In this case, the pavements resting on parking structure should consist of the following:

Component	Compaction Requirement	Pavement on Concrete Parking Structure Minimum Component Thickness
Asphalt Top Lift HL-3 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	40 mm
Asphalt Base Course HL-8 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	50 mm
Granular Base Course Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm
Total Thickness		**240 mm**

A waterproof membrane will be required between the asphalt and concrete parking structure deck. For pavements placed on top of the underground parking structure, all drainage, waterproofing, and protection considerations for these areas must be designed separately and in conjunction with the civil engineering design of the underground parking structure. Wherever they have to connect to the adjacent roadways or driveways, those adjacent pavement profiles will be different and so taper transitions and run-outs must be designed for the connections.

5 Considerations for Construction

5.1 Excavations

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

For practical purposes:

- The earth fill is a Type 3 soil, or Type 4 soil when wet
- 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 (ESM). 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.

Queenston Formation bedrock contains beds of harder calcareous beds (e.g. limestone). When excavating this bedrock, it should be expected that these harder layers will be encountered. Hard layers interbedded within the shale are normally broken with hoe mounted hydraulic rams before excavation.

Limestone beds may also be found to straddle the founding elevation, in which case the entire thickness of the hard limestone layer must be removed to expose founding subgrade as it is not possible to remove part of one of these layers. This will in turn result in excess rock removal not intrinsic to the project requirements. The risk and responsibility for the excess rock removal under these circumstances, and the supply and placement of the extra concrete to restore the foundation grade, must be addressed in the contract documents for foundations, excavation, and shoring contractors.

The Queenston Formation has been known to issue gases. There are instances where both methane and hydrogen sulphide gas emissions have been detected in excavations made in the Queenston Formation. The potential for gas emissions from this formation is recognized as a design and constructability issue to be addressed.

5.2 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 groundwater table at Elev. 167± m is above the bulk excavation elevation for the proposed P4 level. Excavations will generally be made below the groundwater table, in relatively low permeability materials (glacial till and sound bedrock) that preclude the free flow of water into excavations. There is also water within discrete fractures in the bedrock, and perched stormwater in the earth fill which is infiltrating down towards the groundwater table. On this basis, it is expected that seepage if encountered will be of limited extent. Seepage may be allowed to drain into the excavation and then pumped out. Regardless, excavation delays will occur as seepage (however limited) is controlled. These delays should be anticipated in the construction schedule.

A professional dewatering contractor should be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to assess the factual data and to provide recommendations on dewatering system requirements.

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

5.3 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.

The excavation for the P4 level will extend below the overburden soils and into bedrock. Excavation walls must be inspected by the geotechnical engineer for any fracturing or movement during excavation and construction. Based on the inspection, Grounded may recommend additional monitoring (e.g. multi-point borehole extensometers (MPBX)) or additional rock mass support such as a combination of shotcrete, rock pins, or rock bolts for alternative support. Rock mass support must be designed by the Geostructural Engineer, in consultation with the Geotechnical Engineer of Record.

5.3.1 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:

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

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. 167± 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.

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.

5.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in Queenston Formation Bedrock. 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.

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.

5.3.3 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 hard / very dense glacial till, it is expected that post-grouted anchors can be made such that an anchor will safely carry up to 80 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm). Conventional anchors made in Queenston Formation bedrock can be designed using a working adhesion of 600 kPa.

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

The sound bedrock below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on sound bedrock of the Queenston Formation at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 2.5 MPa.

5.4 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 in its 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 / rock 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 excess 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.

5.5 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 lands and buildings.

6 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.

6.1 Investigation Procedures

The geotechnical engineering analysis and advice provided are 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 mud rotary drilling equipment. 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 soil 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.

6.2 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.

6.3 Report Use

The authorized users of this report are 2555 Erin Centre c/o Trinity Point Developments 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 City of Mississauga may also make use of and rely upon this report, subject to the limitations as stated.

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

7 Closure

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

For and on behalf of our team,

GROUNDED ENGINEERING

LICENSED PROFESSIONAL ENGINEER
N. Y.-Q. NG
100510783
2024-08-16
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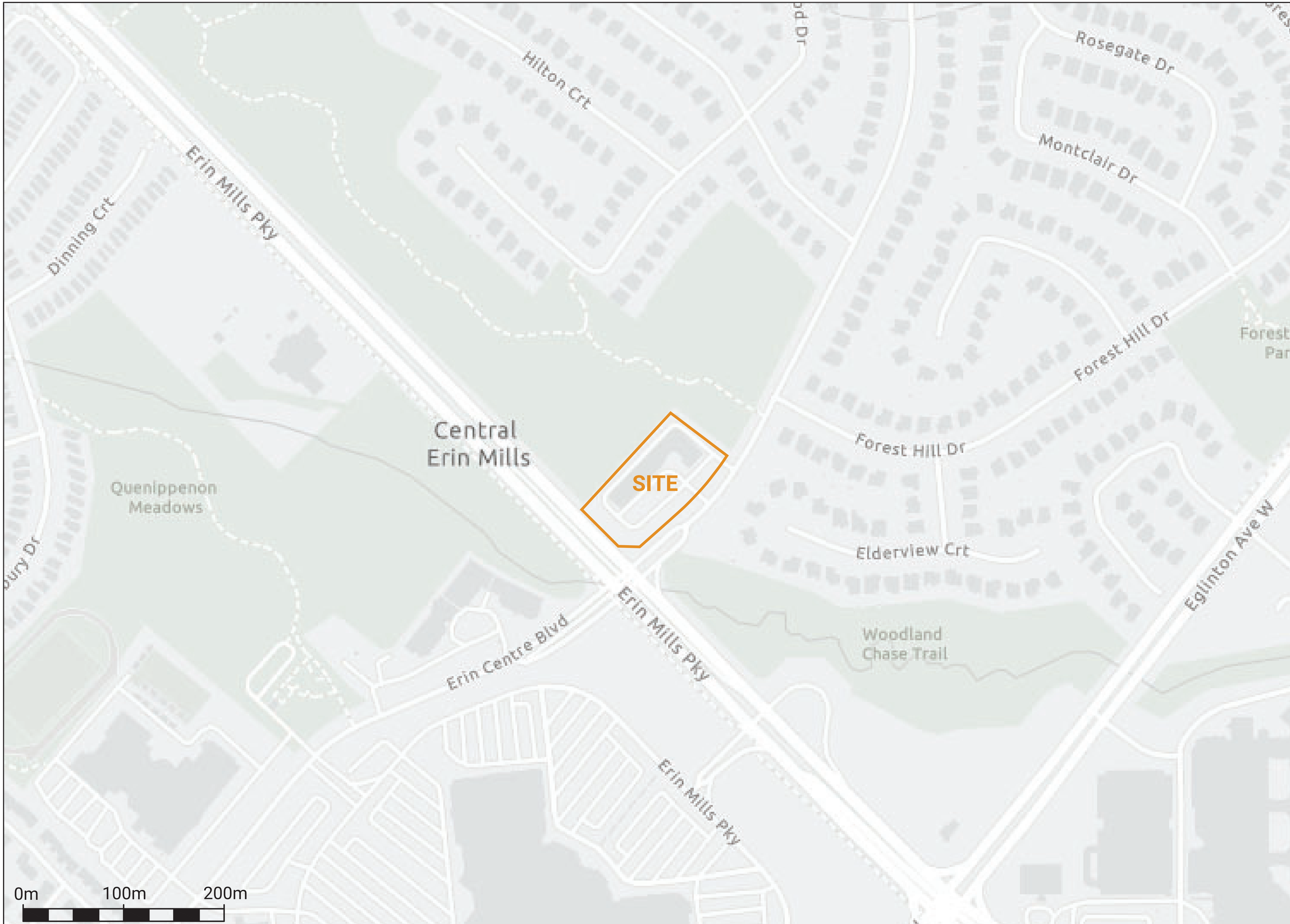
Principal

FIGURES



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LEGEND

APPROXIMATE PROPERTY BOUNDARY

Note

Reference

ArcGIS Online 2024

Project

2555 ERIN CENTRE, MISSISSAUGA, ONTARIO

Figure Title

SITE LOCATION PLAN

North

TRUE
PROJECT

Date

JULY 2024

Scale

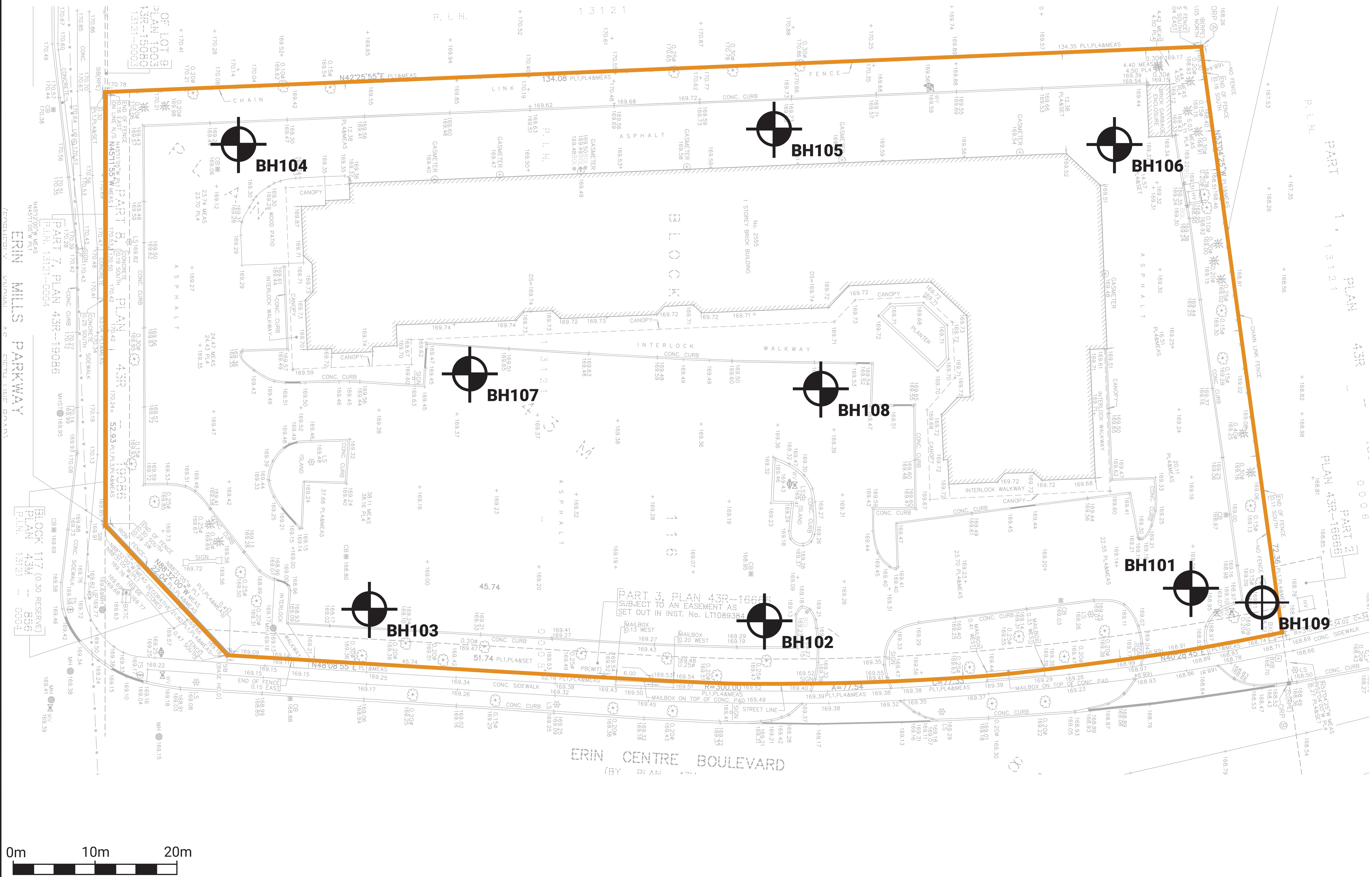
AS INDICATED

Job No

24-095

Figure No

FIGURE 1



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LEGEND

APPROXIMATE PROPERTY BOUNDARY

APPROXIMATE MONITORING WELL/BOREHOLE LOCATION BY GROUNDED

Note

Reference

Topographic Survey, "Plan of Survey and Topography of Block 116 - Registered Plan 43M-856"; Job No. 23-242, dated November 30, 2023, prepared by R-PE Surveying LTD.

Project

2555 ERIN CENTRE, MISSISSAUGA, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - EXISTING CONDITION

North

PROJECT

TRUE

Date

JULY 2024

Scale

AS INDICATED

Job No

24-095

Figure No

FIGURE 2

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LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE MONITORING WELL/BOREHOLE LOCATION BY GROUNDED

Note

Reference

Architectural Progress Set "2555 Erin Centre Blvd."; Drawing No. 200, dated July 26th, 2024, prepared by Arcadis

Project

2555 ERIN CENTRE, MISSISSAUGA, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - PROPOSED CONDITION

North

Date

JULY 2024

Scale

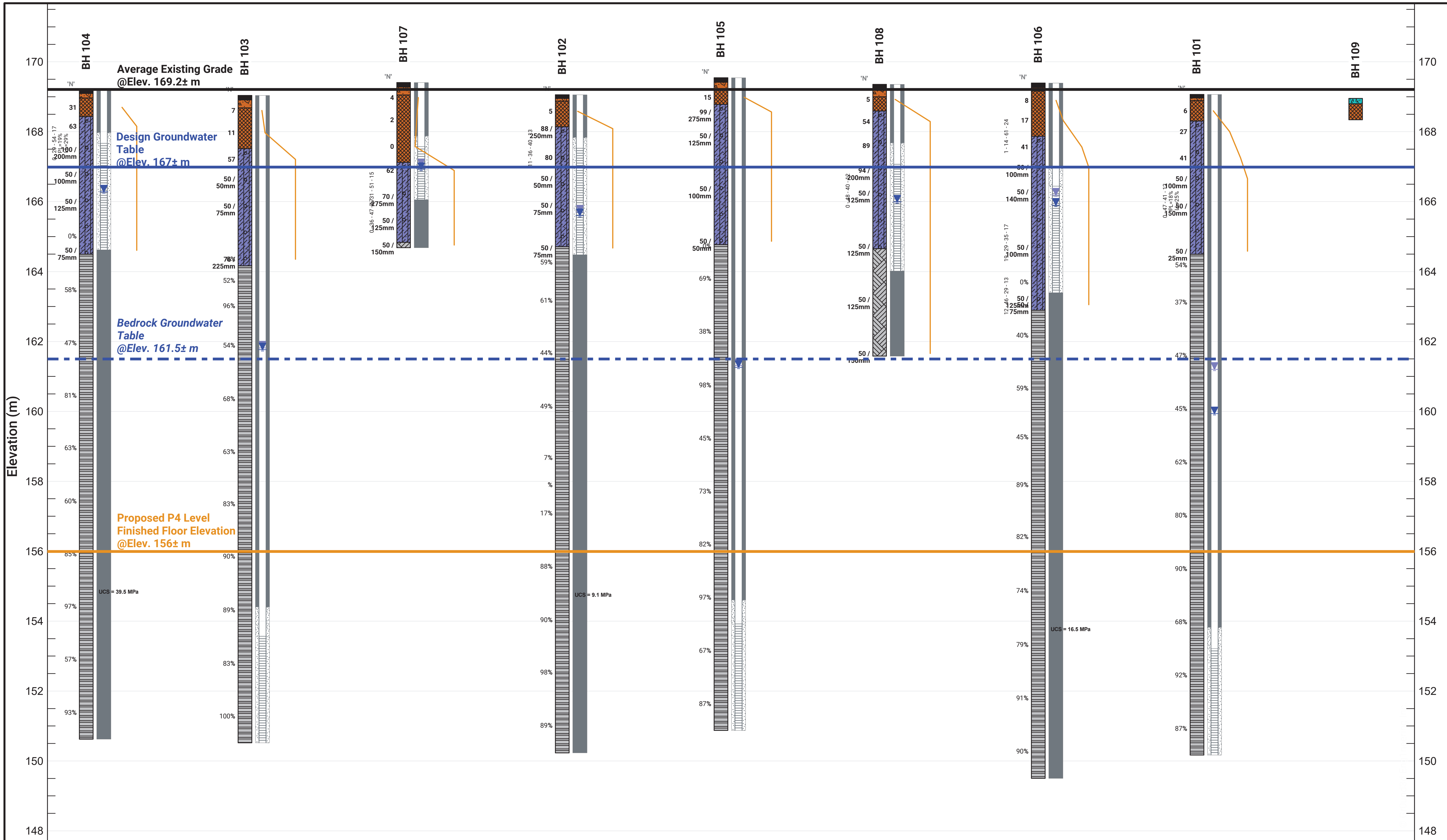
AS INDICATED

Job No

24-095

Figure No

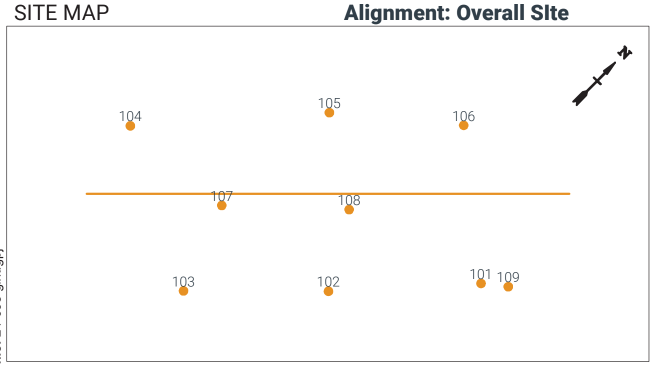
FIGURE 3



Boreholes Equally Spaced

SITE MAP

Alignment: Overall SIte



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BOREHOLE STRATIGRAPHY LEGEND

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

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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

2555 ERIN CENTRE MISSISSAUGA

Figure Title

SUBSURFACE PROFILE

Overall SIte

Date

AUGUST 2024

Scale

AS INDICATED

Job No

24-095

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

NP: non-plastic

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ water level measurement

▼ highest 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

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

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

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.

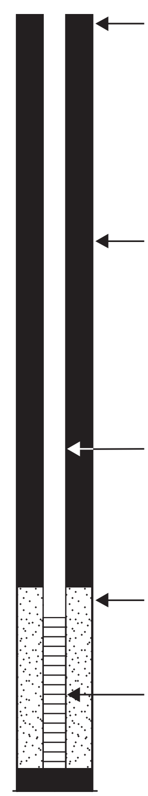
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

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)

GROUNDED ENGINEERING

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

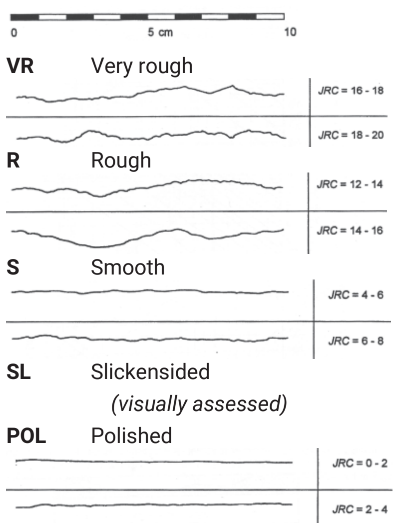
Coating

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

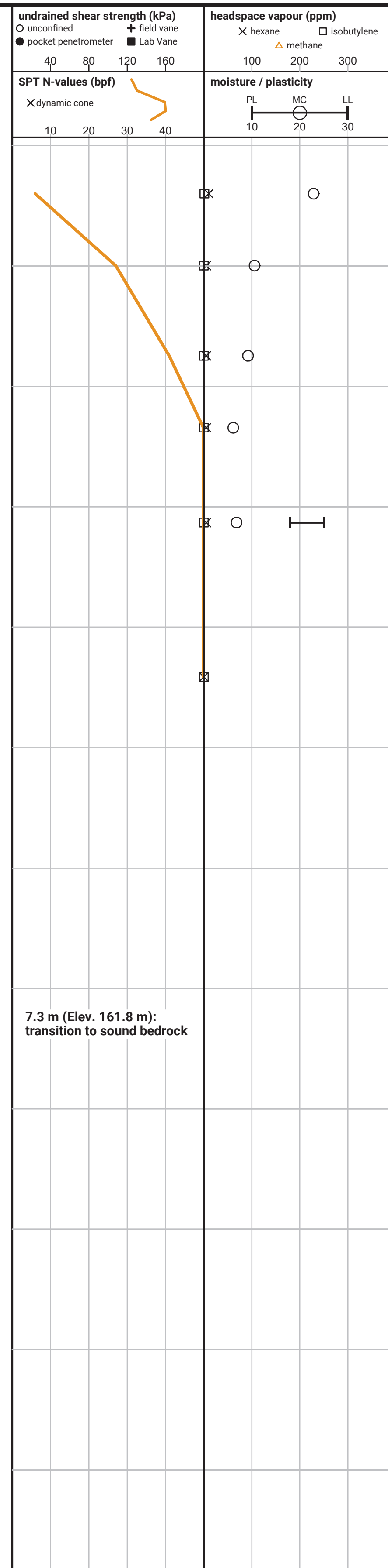
Date Started : Jun 27, 2024
Position : E: 604214, N: 4824137 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Drill method: CME TRACK — hollow stem augers OD=215 mm (0 to 4.6 m); rock coring (HQ) OD=96 mm

elev / depth (m)	stratigraphy description	sample number	type	SPT N-value	lab data and comments
169.1	**GROUND SURFACE**				
168.9 / 0.2	100mm **ASPHALT**				
	75mm **AGGREGATE**				
	FILL, clayey silt, some sand, trace gravel, trace rock fragments, trace construction debris, firm, dark brown, moist	1	SS	6	SS1: PAHs
168.3 / 0.8	**CLAYEY SILT**, trace sand, trace gravel, light grey silt partings, very stiff to hard, reddish brown, moist (GLACIAL TILL)	2	SS	27	SS2: BTEX, H-Ms, Metals, ORPs, PHCs, VOCs
		3	SS	41	SS3: PAHs
	...at 2.3 m, some shale fragments	4	SS	50 / 100mm	SS4: H-Ms, Metals, ORPs
	...at 3.0 m, sand and silt glacial till, some clay, very dense, below	5	SS	50 / 150mm	grain size (MIT) GR SA SI CL: 0 47 41 12; SS5: BTEX, PHCs, VOCs
		6	SS	50 / 25mm	
164.5 / 4.6	**QUEENSTON FORMATION** (See rock core log for details)	1	RUN		**4.7m:** split-spoon sampler bouncing
		2	RUN		
		3	RUN		
		4	RUN		
		5	RUN		
		6	RUN		



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 Tech : SN | **PM** : JAW | **Rev** : NN

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GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604214, N: 4824137 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME TRACK	elev depth (m)	stratigraphy description (continued)	graphic log	sample number	sample type	SPT N-value	depth scale (m)	elevation (m)
rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details) *(continued)*		6	RUN		12	157
				7	RUN		13	156
				8	RUN		14	155
				9	RUN		15	154
				10	RUN		16	153
							17	152
							18	151
	150.2 / 18.9							

Columns also shown: 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.

END OF BOREHOLE

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)
Jul 11, 2024	14.6	154.5
Jul 19, 2024	7.9	161.2
Jul 24, 2024	9.2	159.9

file: 24-095 gint.gpj

 Tech : SN | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604214, N: 4824137 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 101

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

stratigraphy

Rock coring started at 4.6m below grade (elev. 164.5)

QUEENSTON FORMATION
Shale, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 86%, limestone: 14%

Run 1 : 17% limestone, 83% shale

Run 2 : 6% limestone, 94% shale

... at 7.3 m (Elev. 161.8 m), transition to sound rock

Run 3 : 7% limestone, 93% shale

Run 4 : 18% limestone, 82% shale

Run 5 : 10% limestone, 90% shale

Run 6 : 10% limestone, 90% shale

Run 7 : 18% limestone, 82% shale

Runs and recovery

Run	depth (m)	elev (m)	recovery
R1	4.6 – 5.2	164.5 –	TCR = **96%**, SCR = **83%**, RQD = **54%**
R2	5.2 – 6.7	– 162.4	TCR = **100%**, SCR = **90%**, RQD = **37%**
R3	6.7 – 8.2	– 160.9	TCR = **100%**, SCR = **90%**, RQD = **47%**
R4	8.2 – 9.8	– 159.3	TCR = **100%**, SCR = **88%**, RQD = **45%**
R5	9.8 – 11.3	– 157.8	TCR = **100%**, SCR = **95%**, RQD = **62%**
R6	11.3 – 12.8	– 156.3	TCR = **100%**, SCR = **95%**, RQD = **80%**
R7	12.8 – 14.3	– 154.8	TCR = **100%**, SCR = **100%**, RQD = **90%**
R8	14.3 –		

Column headings: depth (m); graphic log; 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)

natural fracture frequency (top to bottom)

3, 3+RZ, 2, 2+RZ, 2, 2, 5, 4+RZ, 4+RZ, 5, 3, 3, 3+RZ, 2, 5, 4, 1, 2, 4, 3, 2, 4, 2, 4+RZ, 3, 2, 0, 2, 0, 0, 0, 1, 1

notes and comments

4.9 / 164.2m: 75mm rubbilized zone
5.4 / 163.7m: 100mm FC SV PR S T CN
5.5 / 163.6m: 50mm rubbilized zone
5.6 / 163.4m: 13mm FC D PR S GA CN
6.0 / 163.1m: 50mm FC SV PR S GA CN
6.1 / 163.0m: 25mm rubbilized zone
6.1 / 163.0 - 6.2 / 162.8m: FC SV PR S T CN
6.3 / 162.8m: 50mm FC SV PR S T CN
6.4 / 162.6m: 13mm weathered zone
6.5 / 162.6m: 100mm FC SV PR S T CN
6.6 / 162.5m: 13mm weathered zone
6.6 / 162.4m: 13mm weathered zone
6.7 / 162.4m: 88mm FC SV PR S T CN
6.8 / 162.3m: 13mm rubbilized zone
6.9 / 162.2m: 50mm rubbilized zone
7.0 / 162.1 - 7.1 / 162.0m: FC SV PR S T CN
7.1 / 162.0m: 75mm rubbilized zone
8.2 / 160.8m: 50mm rubbilized zone
8.6 / 160.4 - 8.8 / 160.3m: FC SV IR S T CN
8.9 / 160.2m: 25mm rubbilized zone
8.8 / 160.2 - 9.4 / 159.6m: weathered zone
9.7 / 159.3m: 25mm rubbilized zone
9.8 / 159.3m: 50mm rubbilized zone
10.2 / 158.9m: 25mm rubbilized zone
10.9 / 158.2m: 25mm rubbilized zone
11.8 / 157.3m: 38mm rubbilized zone
12.0 / 157.0m: 25mm weathered zone
12.4 / 156.7m: 25mm rubbilized zone
12.8 / 156.3m: 25mm weathered zone

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 (continued next page) **Tech** : SN | **PM** : JAW | **Rev** : NN

Date Started : Jun 27, 2024
Position : E: 604214, N: 4824137 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 101

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

depth (m)	stratigraphy	Run	elev / depth (m)	recovery
			164.5	
15	**QUEENSTON FORMATION** **Shale**, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 86%, limestone: 14%* Run 8 : 9% limestone, 91% shale	R8	153.3	TCR = **100%** SCR = **98%** RQD = **68%**
16–17	Run 9 : 32% limestone, 68% shale	R9	15.8 – 151.7	TCR = **100%** SCR = **100%** RQD = **92%**
18	Run 10 : 13% limestone, 87% shale	R10	17.4 – 150.2	TCR = **98%** SCR = **97%** RQD = **87%**
	END OF COREHOLE		**18.9m**	

Columns: elevation (m) 154, 153, 152, 151; 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).

Natural fracture frequency (top to bottom): 1, 4, 3, 0, 2, 1, 1, 1, 0, 1, 1, 0, 2, 0

notes and comments

15.2 / 153.9m: 13mm weathered zone
15.4 / 153.7m: JT PR T CT; gypsum
16.6 / 152.4m: 13mm weathered zone
16.8 / 152.2m: JT PR T CT; gypsum
18.5 / 150.6m: 25mm weathered zone

file: 24-095 gint.gpj

Tech : SN | **PM** : JAW | **Rev** : NN

BOREHOLE LOG 102

GROUNDED ENGINEERING

Date Started : Jun 25, 2024
Position : E: 604180, N: 4824099 (UTM 17T)
Elev. Datum : Geodetic

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Stratigraphy

drill method : CME TRACK	elev depth (m)	description
hollow stem augers (med) OD=175 mm	169.1	GROUND SURFACE
	168.9 / 0.2	100mm **ASPHALT**
		75mm **AGGREGATE**
		FILL, silty sand, some gravel, some rock fragments, trace clay, trace asphalt, loose, brown, moist ...at 0.8 m, clayey silt, some sand, trace gravel, trace rock fragments, brown, moist, hard
	168.2 / 0.9	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL) ...at 1.5 m, silt and sand glacial till, some clay, some gravel, very dense, below
rock coring (HQ) OD=96 mm	164.8 / 4.3	**QUEENSTON FORMATION** (See rock core log for details)

Samples

number	type	SPT N-value	headspace vapour / lab data and comments
1	SS	5	SS1: BTEX, PAHs, PHCs, VOCs
2A	SS	88 / 250mm	2A: H-Ms, Metals, ORPs
2B	SS		
3	SS	80	grain size distribution (%) (MIT): GR 11, SA 36, SI 40, CL 13; SS3: BTEX, PHCs, VOCs
4	SS	50 / 50mm	SS4: H-Ms, Metals, ORPs
5	SS	50 / 75mm	SS5: PAHs
6	SS	50 / 75mm	
1	RUN		
2	RUN		
3	RUN		
4	RUN		
5	RUN		
6	RUN		
7	RUN		

Column headings: depth scale (m) 0–11; well details; elevation (m) 169–158; 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.

4.6 m (Elev. 164.5 m): transition to sound bedrock

(continued next page)

GROUNDED ENGINEERING

Date Started : Jun 25, 2024
Position : E: 604180, N: 4824099 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 102

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME TRACK	elev / depth (m)	stratigraphy description (continued)	graphic log	sample number	type	SPT N-value	depth scale (m)	well details	elevation (m)
rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details) *(continued)*		7	RUN		12		157
				8	RUN		13		156
				9	RUN		14, 15		155, 154
				10	RUN		16, 17		153, 152
	150.3 / 18.8			11	RUN		18		151

Plot headings: 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

END OF BOREHOLE

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)
Jul 11, 2024	3.9	165.2
Jul 19, 2024	3.4	165.7
Jul 24, 2024	3.5	165.6

file: 24-095 gint.gpj

 Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 25, 2024
Position : E: 604180, N: 4824099 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 102

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Rock coring started at 4.4m below grade (elev. 164.7)

QUEENSTON FORMATION
Shale, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 90%, limestone: 10%
... at 4.6 m (Elev. 164.5 m), transition to sound rock

Run	Depth (m)	Elev. (m)	Composition	Recovery
R1	4.4 – 5.2	164.7 – 163.9	Run 1: 7% limestone, 93% shale	TCR = **100%**, SCR = **93%**, RQD = **59%**
R2	5.2 – 6.6	163.9 – 162.5	Run 2: 14% limestone, 86% shale	TCR = **100%**, SCR = **93%**, RQD = **61%**
R3	6.6 – 8.2	162.5 – 160.9	Run 3: 7% limestone, 93% shale	TCR = **100%**, SCR = **95%**, RQD = **44%**
R4	8.2 – 9.7	160.9 – 159.4	Run 4: 13% limestone, 87% shale	TCR = **100%**, SCR = **88%**, RQD = **49%**
R5	9.7 – 11.1	159.4 – 158.0	Run 5: 0% limestone, 100% shale	TCR = **25%**, SCR = **16%**, RQD = **7%**
R6	11.1 – 11.2	158.0	Run 6: 0% limestone, 100% shale	TCR = **0%**
R7	11.2 – 12.7	– 156.4	Run 7: 3% limestone, 97% shale	TCR = **53%**, SCR = **38%**, RQD = **17%**
R8	12.7 – 14.2	156.4 – 154.9	Run 8: 11% limestone, 89% shale	TCR = **100%**, SCR = **100%**, RQD = **88%**

Natural fracture frequency (top to bottom): 4, 3, 1, 2, 4, 4, 2, 1, 4, 2, 1, 0, 2, 1, 1, 3, 4, 5, 3, NA, NA, NA, NA, NA, 4, 3+RZ, 3+RZ, NA, NA, 2, 4, 1, 0, 1, 0

Columns: 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–R6); natural fracture frequency; laboratory testing; notes and comments; elevation (m)

Notes and comments

- **4.6 / 164.5m:** 50mm rubbilized zone
- **5.0 / 164.0m:** 13mm rubbilized zone
- **5.5 / 163.6m:** 25mm rubbilized zone
- **5.8 / 163.3m:** 75mm rubbilized zone
- **5.8 / 163.2m:** 50mm FC SV PR R GA CN
- **6.0 / 163.0 - 6.2 / 162.8m:** FC SV PR R T CN
- **7.0 / 162.1m:** 50mm FC SV PR S T CN
- **7.6 / 161.4m:** FC D CU S GA clay
- **8.8 / 160.2m:** 50mm rubbilized zone
- **9.0 / 160.0m:** JT PR S GA clay
- **9.1 / 159.9m:** 50mm weathered zone
- **9.3 / 159.7m:** 25mm weathered zone
- **9.5 / 159.5m:** FC SV PR R GA CN; 100mm FC SV PR R GA CN
- **9.9 / 159.2 - 10.0 / 159.0m:** rubbilized zone
- **10.0 / 159.0 - 11.1 / 158.0m:** lost core (potential clay seam)
- **11.4 / 157.6m:** 25mm rubbilized zone
- **11.8 / 157.3 - 11.9 / 157.1m:** rubbilized zone
- **12.0 / 157.1m:** 50mm rubbilized zone
- **12.0 / 157.0 - 12.7 / 156.3m:** lost core
- **13.0 / 156.0m:** 38mm weathered zone

file: 24-095 gint.gpj

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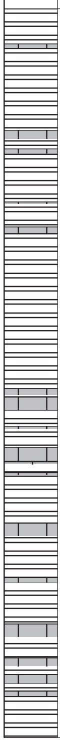
Tech : BMS | **PM** : JAW | **Rev** : NN

Date Started : Jun 25, 2024
Position : E: 604180, N: 4824099 (UTM 17T)
Elev. Datum : Geodetic

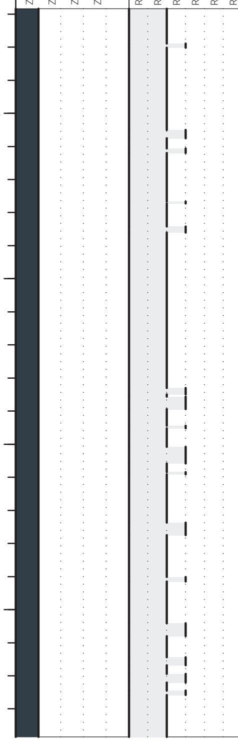
ROCK CORE LOG 102

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

depth (m)	graphic log	stratigraphy	Run / elev / depth (m)	recovery
		**QUEENSTON FORMATION** **Shale**, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 90%, limestone: 10%*	**164.7**	
15		Run 9 : 10% limestone, 90% shale	R9 (153.3)	TCR = **100%** SCR = **97%** RQD = **90%**
16 – 17		Run 10 : 16% limestone, 84% shale	15.8 – R10 (151.9)	TCR = **100%** SCR = **98%** RQD = **98%**
18		Run 11 : 19% limestone, 81% shale	17.2 – R11 (150.3)	TCR = **97%** SCR = **92%** RQD = **89%**
		END OF COREHOLE	**18.8m**	

elevation (m): 154, 153, 152, 151

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: 0, 1, 0, 3, 2, 0, 2, 5, 1, 0, 0, 1, 0, 3, 1

laboratory testing

El. 154.8m:
UCS = 9.1 MPa
E = 1.20 GPa
γ = 25.4 kN/m^3

notes and comments

15.3 / 153.8m: 38mm rubbilized zone

16.4 / 152.7m: 25mm weathered zone

16.6 / 152.4m: 25mm weathered zone

18.3 / 150.8m: 38mm rubbilized zone

file: 24-095 gint.gpj

Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

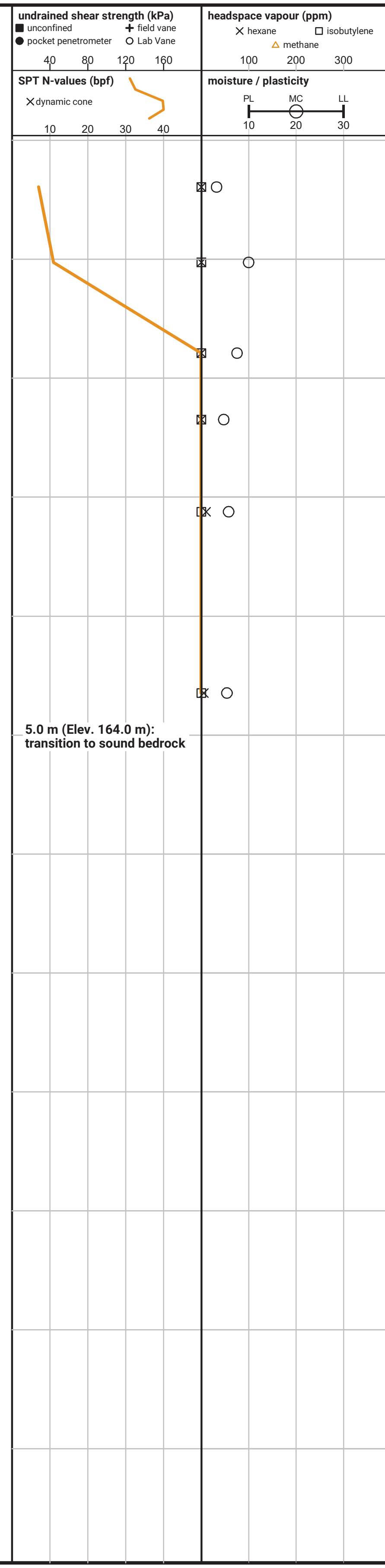
Date Started : Jun 28, 2024
Position : E: 604146, N: 4824065 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 103

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Drill method: CME 55 — hollow stem augers (med) OD=175 mm (0 to 4.4 m); rock coring (HQ) OD=96 mm

elev / depth (m)	description (stratigraphy)	sample number	type	SPT N-value	lab data and comments
169.0	**GROUND SURFACE**				
	125mm **ASPHALT**				
168.6 / 0.4	225mm **AGGREGATE**				
	FILL, silty sand, some gravel, trace rock fragments, clayey silt nodules, loose, light brown, moist ...at 0.8 m, silt, some clay, trace sand, trace gravel, reddish brown, moist, compact	1	SS	7	
		2	SS	11	SS2: BTEX, H-Ms, Metals, ORPs, PAHs, PHCs, VOCs
167.5 / 1.5	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)	3	SS	57	SS3: H-Ms, Metals, ORPs, PAHs
		4	SS	50 / 50mm	
		5	SS	50 / 75mm	SS5: BTEX, PHCs, VOCs
					4.4m: Run 1 recovered caved material (overlapping with SS6); refer to Rock Core Log 103
		6	SS	76 / 225mm	
164.3 / 4.7	**QUEENSTON FORMATION** (See rock core log for details)	2	RUN		
		3	RUN		
		4	RUN		
		5	RUN		
		6	RUN		
		7	RUN		



 Tech : DB | **PM** : JAW | **Rev** : NN

file: 24-095 gint.gpj

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drill method : CME 55	elev depth (m)	description (continued)	graphic log	number	type	SPT N-value	depth scale (m)	well details	elevation (m)	undrained shear strength (kPa) / SPT N-values (bpf)	headspace vapour (ppm) / moisture / plasticity	unstabilized water level	lab data and comments / grain size distribution (%) (MIT) GR SA SI CL
rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details) *(continued)*		7	RUN		12		157				
				8	RUN		13		156				
				9	RUN		14		155				
				10	RUN		15, 16, 17		154, 153, 152				
	150.5 18.5			11	RUN		18		151				

END OF BOREHOLE

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)
Jul 19, 2024	7.3	161.7
Jul 24, 2024	7.3	161.7

ROCK CORE LOG 103

GROUNDED ENGINEERING

Date Started : Jun 28, 2024
Position : E: 604146, N: 4824065 (UTM 17T)
Elev. Datum : Geodetic

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Rock coring started at 4.4m below grade (elev. 164.6)

CLAYEY SILT, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)

QUEENSTON FORMATION
Shale, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 85%, limestone: 15%
... at 5.0 m (Elev. 164.0 m), transition to sound rock

Run	Composition
Run 1 :	0% limestone 100% shale
Run 2 :	12% limestone 88% shale
Run 3 :	2% limestone 98% shale
Run 4 :	2% limestone 98% shale
Run 5 :	8% limestone 92% shale
Run 6 :	23% limestone 77% shale
Run 7 :	19% limestone 81% shale
Run 8 :	10% limestone 90% shale
Run 9 :	18% limestone 82% shale

Run	depth (m)	elev (m)	recovery
R1	4.4 – 4.9	164.6 –	TCR = **85%**, SCR = **50%**, RQD = **0%**
R2	4.9 – 5.7	– 163.3	TCR = **100%**, SCR = **90%**, RQD = **52%**
R3	5.7 – 6.4	– 162.6	TCR = **100%**, SCR = **100%**, RQD = **96%**
R4	6.4 – 7.9	– 161.1	TCR = **98%**, SCR = **98%**, RQD = **54%**
R5	7.9 – 9.4	– 159.6	TCR = **100%**, SCR = **100%**, RQD = **68%**
R6	9.4 – 10.9	– 158.1	TCR = **100%**, SCR = **100%**, RQD = **63%**
R7	10.9 – 12.4	– 156.6	TCR = **100%**, SCR = **100%**, RQD = **83%**
R8	12.4 – 13.9	– 155.1	TCR = **100%**, SCR = **100%**, RQD = **90%**
R9	13.9 –		TCR = **100%**, SCR = **100%**, RQD = **89%**

Column headings: 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–R6) | natural fracture frequency | laboratory testing | notes and comments | elevation (m)

Natural fracture frequency (top to bottom): NA, 2, 3, 3, 3, 2, 1, 0, 2, 0, 4, 7, 2, 4, 2, 2, 3, 1, 3, 2, 3, 1, 2, 0, 3, 1, 4, 0, 0, 1, 3, 0, 1, 3, 0

notes and comments

- **4.4 / 164.6 - 4.7 / 164.4m:** Run 1 recovered caved material (overlapping with SS6); refer to Borehole Log 103
- **4.7 / 164.4m:** observed weathered bedrock
- **5.3 / 163.7m:** JT PR S GA CT clay
- **5.6 / 163.4m:** 25mm weathered zone
- **7.0 / 162.0m:** 13mm FC D PR S T CN
- **7.4 / 161.6m:** 13mm FC D PR S T CN
- **7.5 / 161.5m:** 13mm FC D PR S T CN
- **7.6 / 161.4m:** 13mm FC D PR S T CN
- **8.7 / 160.3m:** 13mm FC D PR S T CN
- **9.6 / 159.5m:** 75mm FC SV PR S T CN
- **9.7 / 159.4m:** 25mm clay infilled seam
- **10.0 / 159.1m:** 75mm FC SV PR S T CN
- **10.1 / 159.0m:** 25mm weathered zone
- **11.9 / 157.2m:** 25mm FC SV PR R GA CN
- **13.1 / 155.9m:** 25mm clay infilled seam
- **14.0 / 155.0m:** FC D PR S T CN

file: 24-095 gint.gpj

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Tech : DB | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 28, 2024
Position : E: 604146, N: 4824065 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 103

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

depth (m)	stratigraphy	Run	elev depth (m)	recovery	natural fracture frequency	notes and comments
	164.6					
	QUEENSTON FORMATION **Shale**, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 85%, limestone: 15%* Run 9 : 18% limestone, 82% shale	R9	153.5 / 15.5	TCR = **100**% SCR = **100**% RQD = **89**%	0, 3, 0, 1	**15.3 / 153.7m:** 25mm clay infilled seam
15 – 17	Run 10 : 22% limestone, 78% shale	R10	152.0 / 17.0	TCR = **100**% SCR = **98**% RQD = **83**%	3, 1, 0, 1, 0	**15.6 / 153.4m:** FC D IR R T CN
17 – 18.5	Run 11 : 35% limestone, 65% shale	R11	150.5	TCR = **100**% SCR = **100**% RQD = **100**%	0, 1, 0, 1, 1	**17.3 / 151.7m:** JT PR S GA; gypsum

18.5m

END OF COREHOLE

Column headings: shale weathering zones (Z1 Z2 Z3 Z4); UCS (MPa) 5 25 50 100 250; estimated strength (R1 R2 R3 R4 R5 R6); laboratory testing; elevation (m) 154, 153, 152, 151.

file: 24-095 gint.gpj

 Tech : DB | **PM** : JAW | **Rev** : NN

BOREHOLE LOG 104

GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604095, N: 4824092 (UTM 17T)
Elev. Datum : Geodetic

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME 55

elev / depth (m)	description	sample number	type	SPT N-value
169.2	**GROUND SURFACE**			
169.0 / 0.2	100mm **ASPHALT**			
	125mm **AGGREGATE**			
168.4 / 0.8	**FILL**, clayey silt, trace sand, trace gravel, trace rock fragments, light grey silt partings, hard, reddish brown, moist	1	SS	31
	CLAYEY SILT, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)	2	SS	63
	...at 1.5 m, sandy silt, some clay, inferred cobble / rock fragments	3	SS	100 / 200mm
	...at 2.3 m, trace shale fragments	4A / 4B	SS	50 / 100mm
		5	SS	50 / 125mm
		1	RUN	
		6	SS	50 / 75mm
164.5 / 4.7	**QUEENSTON FORMATION** (See rock core log for details)	2	RUN	
		3	RUN	
		4	RUN	
		5	RUN	
		6	RUN	

Drill method: hollow stem augers (med) OD=175 mm (0 to 3.4 m); rock coring (HQ) OD=96 mm (below 3.4 m)

Depth scale (m): 0–11; elevation (m): 169–158

Chart headers: 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

5.0 m (Elev. 164.2 m): transition to sound bedrock

Lab data and comments:

- **0.8m:** split-spoon sampler bouncing
- SS2: BTEX, H-Ms, Metals, ORPs, PAHs, PHCs, VOCs
- **1.5m:** split-spoon sampler bouncing
- Grain size (SS3): GR 0, SA 29, SI 54, CL 17
- SS3: H-Ms, Metals, ORPs
- **2.3m:** split-spoon sampler bouncing
- 4B: PAHs
- **3.0m:** split-spoon sampler bouncing
- SS5: BTEX, PHCs, VOCs
- **3.4m:** inferred caved material prior to coring Run 1 (overlapping with SS6); core loss was experienced during coring (refer to Rock Core Log 104) **to 4.7m**
- **4.5m:** split-spoon sampler bouncing

file: 24-095 gint.gpj

 Tech : BMS | **PM** : JAW | **Rev** : NN

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BOREHOLE LOG 104

GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604095, N: 4824092 (UTM 17T)
Elev. Datum : Geodetic

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME 55	elev depth (m)	description *(continued)*	graphic log	number	type	SPT N-value	depth scale (m)	elevation (m)
rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details) *(continued)*		6	RUN		12	157
				7	RUN		13	156
				8	RUN		14	155
				9	RUN		15	154
				10	RUN		16	153
							17	152
	150.6 18.6						18	151

Column headings: stratigraphy; samples; 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

END OF BOREHOLE

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)
Jul 11, 2024	3.7	165.5
Jul 19, 2024	3.2	166.0
Jul 24, 2024	3.0	166.2

file: 24-095 gint.gpj

Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604095, N: 4824092 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 104

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Column headings: 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)

stratigraphy

Rock coring started at 3.4m below grade (165.8)

CLAYEY SILT, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)

QUEENSTON FORMATION
Shale, reddish black, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 81%, limestone: 19%
... at 5.0 m (Elev. 164.2 m), transition to sound rock

Run	Limestone	Shale
Run 1 :	2% limestone	98% shale
Run 2 :	14% limestone	86% shale
Run 3 :	3% limestone	97% shale
Run 4 :	15% limestone	85% shale
Run 5 :	18% limestone	82% shale
Run 6 :	17% limestone	83% shale
Run 7 :	0% limestone	100% shale

Runs and recovery

Run	Top elev / depth (m)	Bottom elev / depth (m)	recovery
R1	165.8 / 3.4	164.2 / 5.0	TCR = **16%** SCR = **8%** RQD = **0%**
R2	164.2 / 5.0	162.7 / 6.5	TCR = **100%** SCR = **95%** RQD = **58%**
R3	162.7 / 6.5	161.2 / 8.0	TCR = **60%** SCR = **43%** RQD = **47%**
R4	161.2 / 8.0	159.7 / 9.5	TCR = **100%** SCR = **97%** RQD = **81%**
R5	159.7 / 9.5	158.2 / 11.0	TCR = **100%** SCR = **87%** RQD = **63%**
R6	158.2 / 11.0	156.7 / 12.5	TCR = **100%** SCR = **100%** RQD = **60%**
R7	156.7 / 12.5		TCR = **100%** SCR = **100%** RQD = **85%**

natural fracture frequency (top to bottom)

NA, NA, NA, NA, 2, 3, 4, 1, 4, 3, 1, 1, 1, LC, LC, 1, 1, 1, 0, 3, 2, 5+WZ, 4, 1, 1, 3, 2, 1, 2, 5, 2, 1, 3

notes and comments

3.4 / 165.8 - 4.7 / 164.5m: inferred caved material prior to coring Run 1 (overlapping with SS6); core loss was experienced during coring (refer to Borehole Log 104)

4.7 / 164.5m: observed weathered bedrock, 100mm rubbilized zone

5.2 / 164.0m: FC D PR S GA CN

5.4 / 163.8m: 25mm rubbilized zone

5.6 / 163.6m: 25mm rubbilized zone

5.9 / 163.3m: 50mm rubbilized zone

6.7 / 162.5m: 50mm rubbilized zone

7.1 / 162.1 - 7.2 / 162.0m: rubbilized zone

7.4 / 161.8 - 8.0 / 161.2m: lost core

8.0 / 161.2m: 25mm rubbilized zone

8.1 / 161.1m: 25mm rubbilized zone

9.3 / 159.9m: FC SV IR R T CN

9.7 / 159.5m: 75mm weathered zone

9.8 / 159.4m: 100mm clay infilled seam

9.9 / 159.3m: 50mm weathered zone

11.8 / 157.4m: JT PR S GA; gypsum

12.3 / 156.9m: JT PR S GA; gypsum

12.3 / 156.9m: JT PR S GA; gypsum

13.4 / 155.8m: 50mm weathered zone

file: 24-095 gint.gpj

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Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 27, 2024
Position : E: 604095, N: 4824092 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 104

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

stratigraphy	Run (elev / depth (m)) 165.8	recovery
QUEENSTON FORMATION **Shale**, reddish black, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 81%, limestone: 19%*	R7 (155.2 / 14.0)	TCR = **100%** SCR = **100%** RQD = **85%**
Run 7 : 0% limestone, 100% shale	R8 (153.7 / 15.5)	TCR = **100%** SCR = **100%** RQD = **97%**
Run 8 : 17% limestone, 83% shale	R9 (152.2 / 17.0)	TCR = **100%** SCR = **100%** RQD = **57%**
Run 9 : 34% limestone, 66% shale	R10 (150.6)	TCR = **100%** SCR = **100%** RQD = **93%**
Run 10 : 47% limestone, 53% shale		

18.6m

END OF COREHOLE

Columns: depth (m), graphic log, 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)

Natural fracture frequency (top to bottom): 2, 0, 1, 0, 0, 1, 0, 3, 0, 1, 3, 2, 0, 1, 0, 1, 2

Laboratory testing:
El. 154.8m:
UCS = 39.5 MPa
E = 7.20 GPa
γ = 25.8 kN/m^3

Notes and comments:
15.3 / 153.9m: 25mm clay infilled seam
15.4 / 153.7m: 25mm weathered zone
16.9 / 152.3m: 25mm weathered zone
17.8 / 151.4m: JT PR S GA; gypsum
18.1 / 151.1m: JT PR S GA; gypsum

file: 24-095 gint.gpj

Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 604139, N: 4824141 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

File No. : 24-095   **Project** : 2555 Erin Centre, Mississauga   **Client** : Trinity Point Developments

Drill method: CME 55 — hollow stem augers (med) OD=175 mm (0 to 4.8 m); rock coring (HQ) OD=96 mm (4.8 m onward)

elev / depth (m)	description	sample number	type	SPT N-value	lab data and comments
169.5	**GROUND SURFACE**				
	125mm **ASPHALT**				
169.1 / 0.4	225mm **AGGREGATE**				
	FILL, clayey silt, trace sand, trace gravel, light grey silt partings, very stiff, reddish brown, moist	1	SS	15	SS1: H-Ms, Metals, ORPs, PAHs
168.7 / 0.8	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)	2A / 2B	SS	99 / 275mm	**0.8m:** split-spoon sampler bouncing; 2A: BTEX, PHCs, VOCs
		3	SS	50 / 125mm	**1.5m:** split-spoon sampler bouncing; SS3: H-Ms, Metals, ORPs, PAHs
		4A / 4B	SS	50 / 100mm	4A: BTEX, PHCs, VOCs; **3.0m:** split-spoon sampler bouncing
		5	SS	50 / 50mm	**4.6m:** auger grinding, split-spoon sampler bouncing
164.7 / 4.8	**QUEENSTON FORMATION** (See rock core log for details)	1	RUN		
		2	RUN		
		3	RUN		
		4	RUN		
		5	RUN		
		6	RUN		

5.2 m (Elev. 164.3 m): transition to sound bedrock

Graph columns: depth scale (m) 0–11; well details; elevation (m) 169–158; 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: 24-095 gint.gpj

    Tech : BMS | **PM** : JAW | **Rev** : NN

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Date Started : Jun 26, 2024
Position : E: 604139, N: 4824141 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME 55

elev / depth (m)	description	number	type	SPT N-value	depth scale (m)
	(continued) **QUEENSTON FORMATION** (See rock core log for details) *(continued)*	6	RUN		12
		7	RUN		13
		8	RUN		14–15
		9	RUN		16–17
		10	RUN		18
150.8 / 18.7	**END OF BOREHOLE**				

rock coring (HQ) OD=96 mm

Elevation (m) scale: 157, 156, 155, 154, 153, 152, 151

Column headings: stratigraphy; samples; graphic log; 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

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)
Jul 11, 2024	8.8	160.7
Jul 19, 2024	8.3	161.2
Jul 24, 2024	8.3	161.2

file: 24-095 gint.gpj

Tech : BMS | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 604139, N: 4824141 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 105

File No. : 24-095 | **Project** : 2555 Erin Centre, Mississauga | **Client** : Trinity Point Developments

Rock coring started at 4.6m below grade (elev. 164.9)

Stratigraphy

CLAYEY SILT, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)

QUEENSTON FORMATION
Shale, reddish black, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 82%, limestone: 18%
... at 5.2 m (Elev. 164.3 m), transition to sound rock

Run	Elev (m) / depth (m)	Recovery	Composition
R1	164.9 / 4.6 – 5.0	TCR = **100%**, SCR = **53%**, RQD = **0%**	
R2	5.0 – 163.0 / 6.5	TCR = **100%**, SCR = **97%**, RQD = **69%**	Run 1: 7% limestone, 93% shale
R3	6.5 – 161.5 / 8.0	TCR = **100%**, SCR = **87%**, RQD = **38%**	Run 2: 16% limestone, 84% shale
R4	8.0 – 160.0 / 9.5	TCR = **100%**, SCR = **98%**, RQD = **98%**	Run 3: 8% limestone, 92% shale
R5	9.5 – 158.4 / 11.1	TCR = **100%**, SCR = **90%**, RQD = **45%**	Run 4: 15% limestone, 85% shale
R6	11.1 – 156.9 / 12.6	TCR = **100%**, SCR = **98%**, RQD = **73%**	Run 5: 13% limestone, 87% shale
R7	12.6 – 155.4 / 14.1	TCR = **100%**, SCR = **95%**, RQD = **82%**	Run 6: 25% limestone, 75% shale
R8	14.1 –	TCR = **100%**, SCR = **100%**, RQD = **97%**	Run 7: 12% limestone, 88% shale; Run 8: 10% limestone, 90% shale

Natural fracture frequency (top to bottom): 3, 3, 1, 3, 2, 1, 3, 4, 4, 2, 4, 2, 3, 1, 1, 2, 1, 6, 2, 4, 5, 1, 0, 2, 6, 2, 0, 1, 3, 3, 0, 1, 2

Columns: depth (m); graphic log; stratigraphy; Run; recovery; elevation (m); shale weathering zones (Z1–Z4); UCS (MPa) ● (5, 25, 50, 100, 250) / estimated strength (R1–R6); natural fracture frequency; laboratory testing; notes and comments; elevation (m)

Notes and comments

4.6 / 164.9 - 4.8 / 164.8m: recovered caved material
4.8 / 164.8m: observed weathered bedrock
5.1 / 164.5m: FC D PR S T CN
5.1 / 164.5m: 25mm weathered zone
5.2 / 164.3m: FC D PR S T CN
5.6 / 163.9m: 25mm rubbilized zone
6.5 / 163.1m: 50mm rubbilized zone
6.6 / 162.9m: 75mm rubbilized zone
7.2 / 162.4m: FC D PR R GA CN
7.3 / 162.3m: FC D PR R GA CN
7.5 / 162.0m: FC D PR R GA CN
7.7 / 161.9m: FC D PR R GA CN
7.7 / 161.8m: FC D PR R GA CN
8.6 / 161.0m: FC D PR S GA CN
9.6 / 159.9m: 25mm weathered zone
9.6 / 159.9m: IS clay; 75mm clay infilled seam
9.7 / 159.8m: 25mm weathered zone
10.1 / 159.5m: 13mm weathered zone
10.1 / 159.4m: 50mm FC SV IR R T CT clay
10.5 / 159.1m: 50mm clay infilled seam
10.9 / 158.6m: JT PR S GA CT clay
13.4 / 156.2m: 75mm clay infilled seam

file: 24-095 gint.gpj

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Tech : BMS | **PM** : JAW | **Rev** : NN

depth (m)	stratigraphy	Run / elev / depth (m)	recovery	elevation (m)	natural fracture frequency	notes and comments
		164.9				
15	**QUEENSTON FORMATION** **Shale**, reddish black, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 82%, limestone: 18%*	R8 153.9	TCR = **100%** SCR = **100%** RQD = **97%**	154	0 0 0	
16	Run 8 : 10% limestone, 90% shale	15.6 R9 152.4	TCR = **83%** SCR = **82%** RQD = **67%**	153	2 2 0 1	**15.8 / 153.7m:** 25mm rubbilized zone
17	Run 9 : 14% limestone, 86% shale	17.1 R10 150.8	TCR = **100%** SCR = **97%** RQD = **87%**	152	1 1 1	**16.9 / 152.6 - 17.2 / 152.4m:** lost core
18	Run 10 : 55% limestone, 45% shale			151	1 3 2	**18.3 / 151.3m:** 50mm clay infilled seam
		18.7m				

Other columns: graphic log; shale weathering zones (Z1, Z2, Z3, Z4); UCS (MPa) ● (5, 25, 50, 100, 250); estimated strength (R1, R2, R3, R4, R5, R6); laboratory testing.

END OF COREHOLE

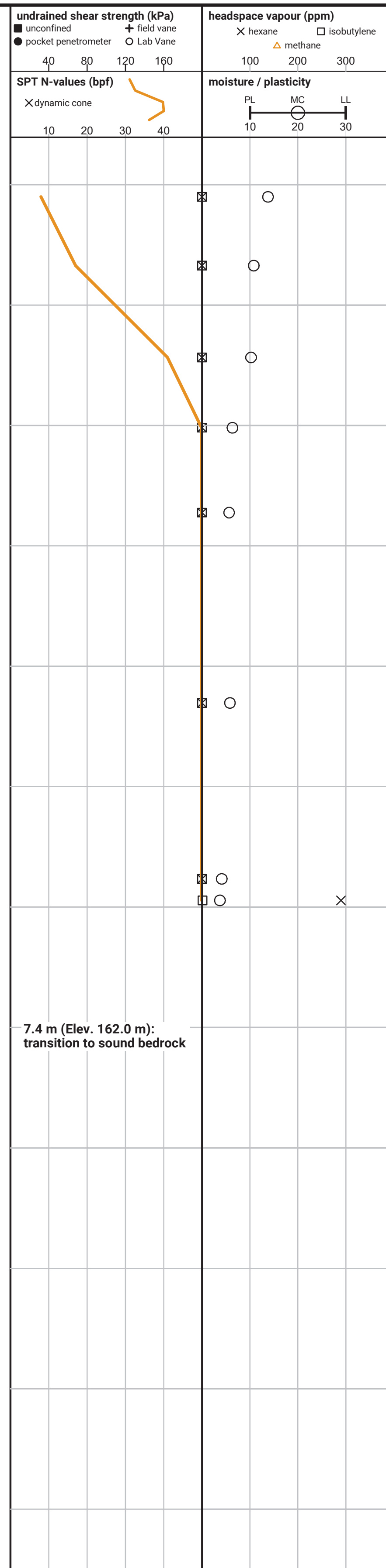
Date Started : Jun 24, 2024
Position : E: 604173, N: 4824170 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 106

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Drill method: CME 55

drill method	elev / depth (m)	description	sample number	type	SPT N-value
	169.4	**GROUND SURFACE**			
hollow stem augers OD=215 mm	169.2 / 0.0	125mm **ASPHALT**			
	0.2	100mm **AGGREGATE**			
		FILL, clayey silt, trace sand, trace gravel, trace construction debris, firm, brown, moist	1	SS	8
		...at 0.8 m, reddish brown, very stiff	2	SS	17
	167.9 / 1.5	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)	3	SS	41
			4	SS	50 / 100mm
hollow stem augers (med) OD=175 mm			5	SS	50 / 140mm
		...at 4.6 m, sandy silt glacial till, some gravel, some clay, trace shale fragments, very dense	6	SS	50 / 100mm
rock coring (HQ) OD=96 mm			1	RUN	
		...at 6.1 m, silty sand glacial till, some clay, some gravel, trace shale fragments, very dense, below	7	SS	50 / 125mm
			8	SS	50 / 75mm
	162.9 / 6.5	**QUEENSTON FORMATION** (See rock core log for details)	2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	



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

depth	comment	GR	SA	SI	CL
	SS1: PAHs, PCBs				
	SS2: BTEX, H-Ms, Metals, ORPs, PHCs, VOCs				
	SS3: PAHs	1	14	61	24
2.3m	split-spoon sampler bouncing				
	SS4: H-Ms, Metals, ORPs				
3.0m	split-spoon sampler bouncing				
4.6m	split-spoon sampler bouncing	19	29	35	17
	SS6: BTEX, PHCs, VOCs				
4.9m	inferred caved material prior to coring Run 1 (overlapping with SS7 & SS8); core loss was experienced during coring (refer to Rock Core Log 106) **to 5.5m**				
5.5m	Run 1 recovered inferred caved material (refer to Rock Core Log 106) **to 6.5m**	12	46	29	13
6.1m	auger grinding, split-spoon sampler bouncing				

file: 24-095 gint.gpj

 Tech : BMS | **PM** : JAW | **Rev** : NN

(continued next page)

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME 55	elev depth (m)	description (continued)	graphic log	number	type	SPT N-value	depth scale (m)	elevation (m)
rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details) *(continued)*		5	RUN		12	157
				6	RUN		13	156
				7	RUN		14, 15	155, 154
				8	RUN		16	153
				9	RUN		17, 18	152, 151
	149.5 19.9			10	RUN		19	150

Other column headings: 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.

END OF BOREHOLE

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)
Jul 11, 2024	4.1	165.3
Jul 19, 2024	3.2	166.2
Jul 24, 2024	3.5	165.9

file: 24-095 gint.gpj

GROUNDED ENGINEERING

Date Started : Jun 24, 2024
Position : E: 604173, N: 4824170 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 106

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

Columns: 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)

stratigraphy

Rock coring started at 4.9m below grade (164.5)

CLAYEY SILT, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)

QUEENSTON FORMATION
Shale, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean;

interbedded with **limestone**, grey, laminated to thinly bedded, strong

Overall shale: 82%, limestone: 18%
... at 7.4 m (Elev. 162.0 m), transition to sound rock

Run	Composition
Run 1 :	0% limestone, 100% shale
Run 2 :	8% limestone, 92% shale
Run 3 :	19% limestone, 81% shale
Run 4 :	22% limestone, 78% shale
Run 5 :	19% limestone, 81% shale
Run 6 :	13% limestone, 87% shale
Run 7 :	23% limestone, 77% shale

Run	Elev / depth (m) top	Elev / depth (m) bottom	Recovery
R1	164.5 / 4.9	162.9 / 6.5	TCR = **63**%, SCR = **0**%, RQD = **0**%
R2	162.9 / 6.5	161.4 / 8.0	TCR = **100**%, SCR = **95**%, RQD = **40**%
R3	161.4 / 8.0	159.9 / 9.5	TCR = **100**%, SCR = **95**%, RQD = **59**%
R4	159.9 / 9.5	158.6 / 10.8	TCR = **100**%, SCR = **94**%, RQD = **45**%
R5	158.6 / 10.8	157.2 / 12.2	TCR = **100**%, SCR = **98**%, RQD = **89**%
R6	157.2 / 12.2	155.7 / 13.7	TCR = **100**%, SCR = **98**%, RQD = **82**%
R7	155.7 / 13.7		TCR = **100**%, SCR = **98**%, RQD = **74**%

natural fracture frequency (top to bottom, per 0.25 m interval from 4.9 m): NA, NA, NA, NA, NA, 4, 6, 2, 2, 4, 5, 2, 2, 1, 6, 3, 2, 4, 3, 0, 2, 2, 2, 2, 1, 2, 2, 3, 2, 1, 1, 0, 0

notes and comments

4.9 / 164.5 - 5.5 / 163.9m: inferred caved material prior to coring Run 1 (overlapping with SS7 & SS8); core loss was experienced during coring (refer to Borehole Log 106)

5.5 / 163.9 - 6.5 / 162.9m: recovered caved material

6.5 / 162.9m: observed weathered bedrock
6.5 / 162.9m: FC D PR R GA CN
6.6 / 162.8m: FC D PR R GA CN
7.0 / 162.4m: FC D PR R GA CN
8.1 / 161.3m: 50mm rubbilized zone
8.4 / 161.0m: 50mm weathered zone
9.6 / 159.8m: 25mm clay infilled seam
9.7 / 159.7m: 25mm clay infilled seam
10.2 / 159.2m: JT PR R GA clay
11.7 / 157.7m: 13mm rubbilized zone
11.8 / 157.6m: 13mm rubbilized zone
12.7 / 156.7m: 25mm rubbilized zone
13.1 / 156.3m: 25mm rubbilized zone
13.2 / 156.2m: 25mm weathered zone

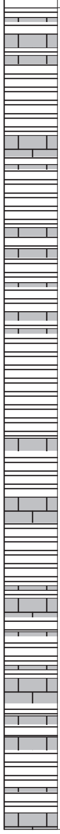
file: 24-095 gint.gpj

(continued next page)
Tech : BMS | **PM** : JAW | **Rev** : NN

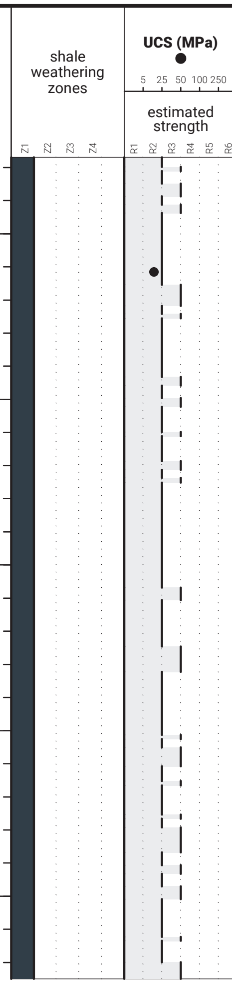
Date Started : Jun 24, 2024
Position : E: 604173, N: 4824170 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 106

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

depth (m)	graphic log	stratigraphy	Run / elev / depth (m)	recovery
15		**QUEENSTON FORMATION** **Shale**, reddish brown, laminated to thinly bedded, weak, calcareous, green-grey banding; joints are horizontal, closed to gapped, clean; interbedded with **limestone**, grey, laminated to thinly bedded, strong *Overall shale: 82%, limestone: 18%* Run 7 : 23% limestone, 77% shale	164.5 R7 154.1	
16		Run 8 : 21% limestone, 79% shale	15.3 R8 152.6	TCR = **100%** SCR = **100%** RQD = **79%**
17–18		Run 9 : 17% limestone, 83% shale	16.8 R9 151.1	TCR = **100%** SCR = **100%** RQD = **91%**
19		Run 10 : 39% limestone, 61% shale	18.3 R10 149.5	TCR = **100%** SCR = **100%** RQD = **90%**
		END OF COREHOLE	**19.9m**	

elevation (m): 154, 153, 152, 151, 150



natural fracture frequency (top to bottom): 1, 2, 1, 2, 2, 2, 1, 2, 1, 1, 0, 1, 1, 2, 0, 2

laboratory testing:
El. 153.8m:
UCS = 16.5 MPa
E = 1.70 GPa
γ = 25.6 kN/m³

notes and comments

BOREHOLE LOG 107

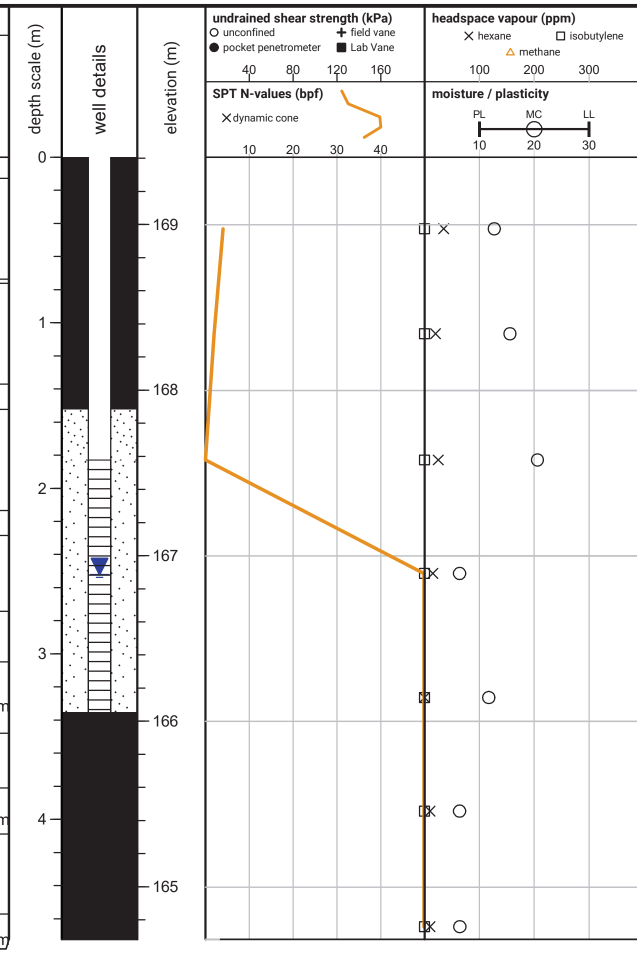
GROUNDED ENGINEERING

Date Started : Jun 26, 2024
Position : E: 604135, N: 4824095 (UTM 17T)
Elev. Datum : Geodetic

File No. : 24-095 | **Project** : 2555 Erin Centre, Mississauga | **Client** : Trinity Point Developments

drill method : CME TRACK — hollow stem augers (med) OD=175 mm

elev / depth (m)	description (stratigraphy)	graphic log	sample number	type	SPT N-value	lab data and comments
169.4	**GROUND SURFACE**					
	125mm **ASPHALT**					
	100mm **AGGREGATE**					
169.0 / 0.4	**FILL**, clayey silt, trace sand, trace gravel, trace rock fragments, soft to very soft, reddish brown, moist		1	SS	4	SS1: PAHs
			2	SS	2	SS2: BTEX, H-Ms, Metals, ORPs, PHCs, VOCs
	...at 1.5 m, wet		3	SS	0	SS3: BTEX, PHCs, VOCs
167.1 / 2.3	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)		4	SS	62	SS4: H-Ms, Metals, ORPs, PAHs
	...at 3.0 m, sandy silt glacial till, some clay, trace gravel, very dense		5	SS	70 / 275mm	GR 3, SA 31, SI 51, CL 15
	...at 3.8 m, silt and sand, some clay, very dense		6	SS	50 / 125mm	GR 0, SA 36, SI 47, CL 17
164.8 / 164.7 / 4.7	**INFERRED BEDROCK**		7	SS	50 / 150mm	4.7m: split-spoon sampler bouncing



END OF BOREHOLE
Refusal on inferred bedrock

Borehole was dry upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jul 11, 2024	2.4	167.0
Jul 19, 2024	2.5	166.9
Jul 24, 2024	2.5	166.9

file: 24-095 gint.gpj

Tech : SN | **PM** : JAW | **Rev** : NN

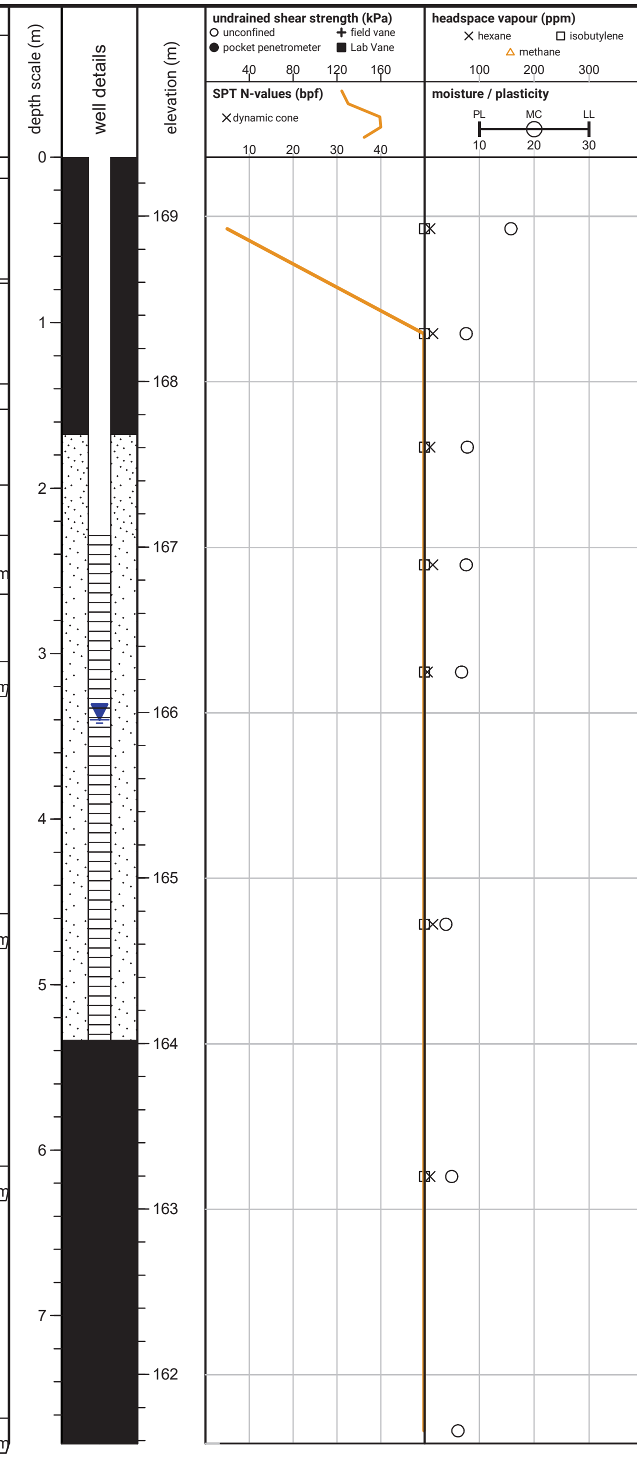
Date Started : Jun 26, 2024
Position : E: 604166, N: 4824123 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 108

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : CME TRACK — hollow stem augers (med) OD=175 mm

elev depth (m)	description	graphic log	number	type	SPT N-value	lab data and comments
169.4	**GROUND SURFACE**					
	125mm **ASPHALT**					
169.0 / 0.4	100mm **AGGREGATE**					
	FILL, clayey silt, trace sand, trace gravel, firm, brown, moist		1	SS	5	SS1: PAHs
168.6 / 0.8	**CLAYEY SILT**, some sand, trace gravel, light grey silt partings, hard, reddish brown, moist (GLACIAL TILL)		2	SS	54	SS2: BTEX, H-Ms, Metals, ORPs, PHCs, VOCs
			3	SS	89	SS3: PAHs
			4	SS	94 / 200mm	SS4: BTEX, H-Ms, Metals, ORPs, PHCs, VOCs
	...at 3.0 m, sand and silt, some clay, below, very dense, below		5	SS	50 / 125mm	grain size distribution (%) (MIT) GR SA SI CL: 0 48 40 12; **3.2m:** split-spoon sampler bouncing
			6	SS	50 / 125mm	
164.7 / 4.7	**INFERRED BEDROCK**		7	SS	50 / 125mm	**6.7m:** auger grinding
161.6 / 7.8			8	SS	50 / 150mm	**7.8m:** split-spoon sampler bouncing



END OF BOREHOLE
Refusal on inferred bedrock

Borehole was dry upon completion of drilling.

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

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jul 11, 2024	4.4	165.0
Jul 19, 2024	3.6	165.8
Jul 24, 2024	3.4	166.0

file: 24-095 gint.gpj

 Tech : SN | **PM** : JAW | **Rev** : NN

GROUNDED ENGINEERING

Date Started : Jun 28, 2024
Position : E: 604222, N: 4824142 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 109

File No. : 24-095 **Project** : 2555 Erin Centre, Mississauga **Client** : Trinity Point Developments

drill method : Manual methods	elev / depth (m)	stratigraphy: description	graphic log	samples: number	samples: type	samples: SPT N-value	depth scale (m)	well details	elevation (m)	undrained shear strength (kPa) / SPT N-values (bpf)	headspace vapour (ppm) / moisture / plasticity	unstabilized water level	lab data and comments
	169.0	GROUND SURFACE					0						
hand augers	168.8 / 0.2	150mm **TOPSOIL**											
	168.4 / 0.6	**FILL**, sandy silt, some clay, trace gravel, trace rootlets, brown, moist		1	GS								GS1: BTEX, PCBs, PHCs

Legend – undrained shear strength (kPa): ○ unconfined, + field vane, ● pocket penetrometer, ■ Lab Vane; scale 40, 80, 120, 160. SPT N-values (bpf): × dynamic cone; scale 10, 20, 30, 40. Headspace vapour (ppm): × hexane, □ isobutylene, △ methane; scale 100, 200, 300. Moisture / plasticity: PL, MC, LL; scale 10, 20, 30. Grain size distribution (%) (MIT): GR SA SI CL.

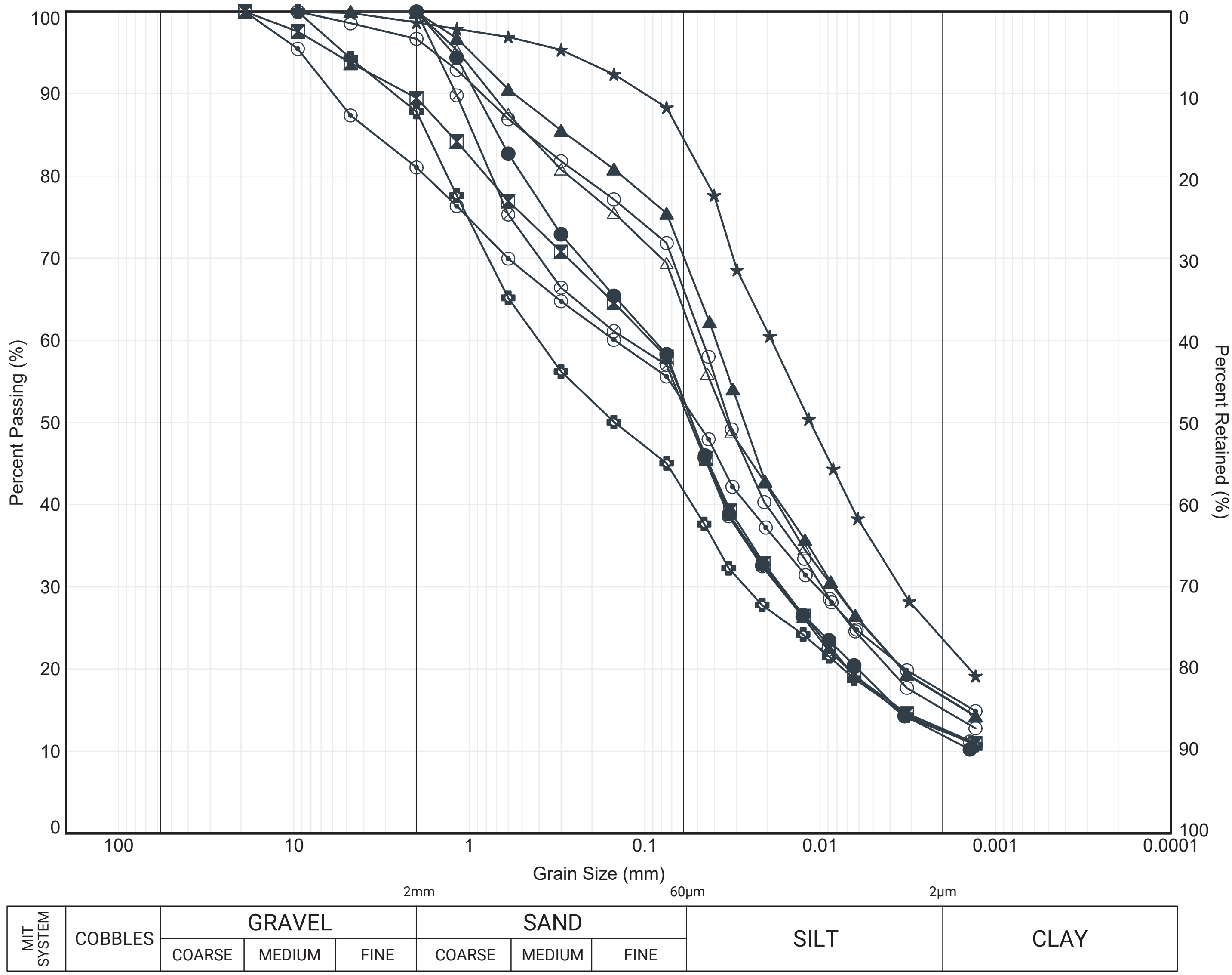
END OF BOREHOLE
Auger refusal

Dry and open upon completion of drilling.

file: 24-095 gint.gpj

Tech : DB | **PM** : JAW | **Rev** : NN

APPENDIX B



MIT SYSTEM

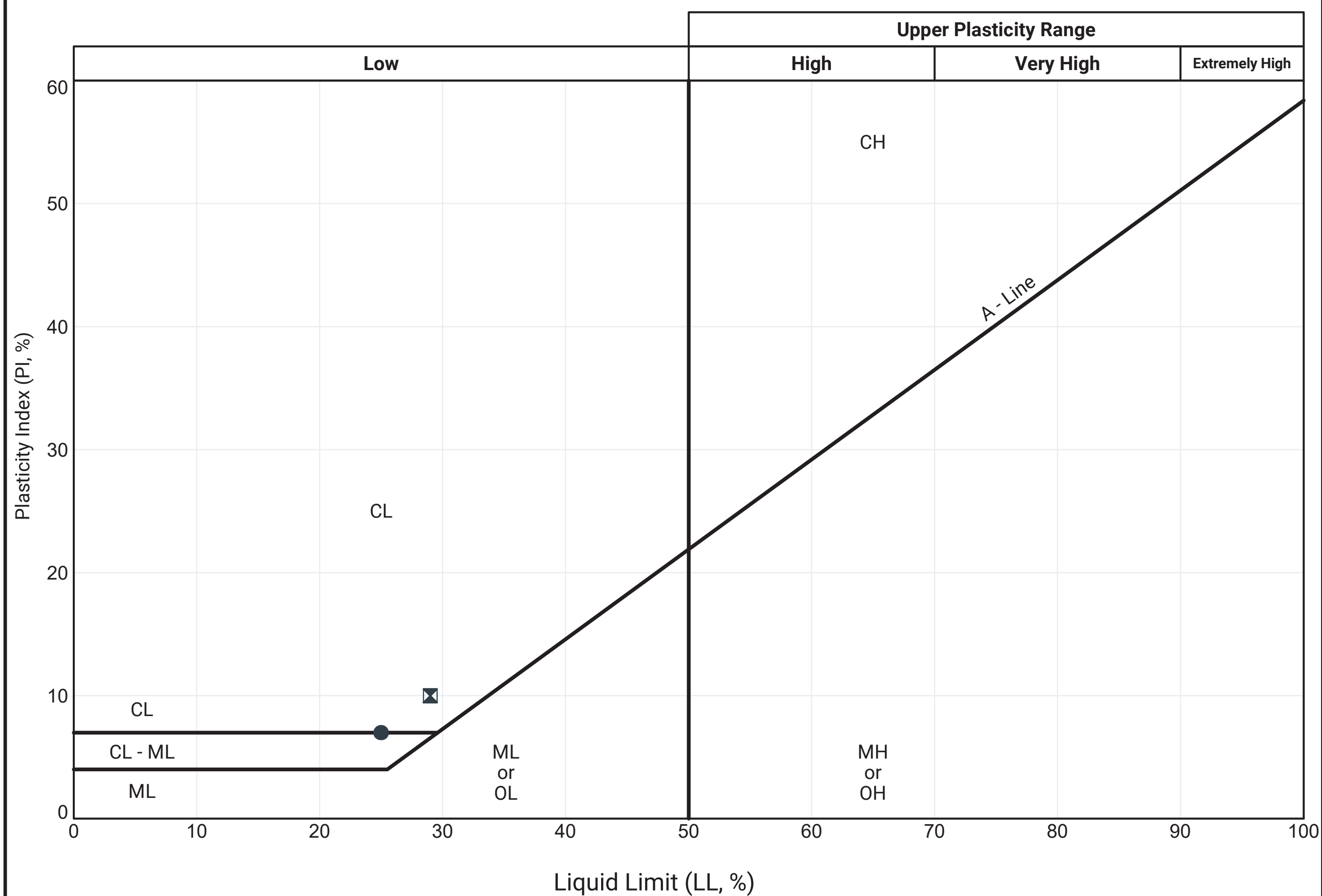
Symbol	Location	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**BH 101**	SS5	3.2	165.9	0	47	41	12	*(0)*
⊠	**BH 102**	SS3	1.8	167.3	11	36	40	13	*(0)*
▲	**BH 104**	SS3	1.7	167.5	0	29	54	17	*(0)*
★	**BH 106**	SS3	1.8	167.6	1	14	61	24	*(0)*
⊙	**BH 106**	SS6	4.7	164.7	19	29	35	17	*(0)*
✪	**BH 106**	SS7	6.2	163.2	12	46	29	13	*(0)*
○	**BH 107**	SS5	3.3	166.1	3	31	51	15	*(0)*
△	**BH 107**	SS6	3.9	165.5	0	36	47	17	*(0)*
⊗	**BH 108**	SS5	3.1	166.2	0	48	40	12	*(0)*

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION GLACIAL TILL**

File No.: **24-095**

file: 24-095 gint.gpj



	Location	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	**BH 101**	SS5	3.2	165.9	25	18	7
⊠	**BH 104**	SS3	1.7	167.5	29	19	10

GROUNDED ENGINEERING

Title: **ATTERBERG LIMITS CHART**

File No.: **24-095**

file: 24-095 gint.gpj

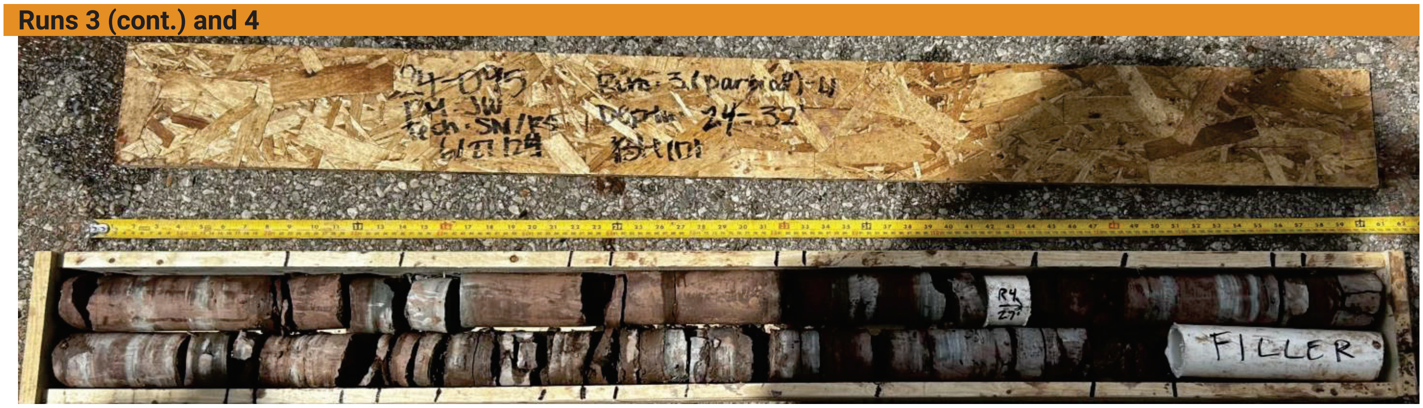
APPENDIX C

Borehole 101

Run #	Depth (m)	Elevation (m)
1	4.6 – 5.2	164.5 – 163.9
2	5.2 – 6.7	163.9 – 162.4
3	6.7 – 8.2	162.4 – 160.9
4	8.2 – 9.8	160.9 – 159.3
5	9.8 – 11.3	159.3 – 157.8
6	11.3 – 12.8	157.8 – 156.3
7	12.8 – 14.3	156.3 - 154.8
8	14.3 – 15.8	154.8 – 153.3
9	15.8 – 17.4	153.3 – 151.7
10	17.4 – 18.9	151.7 – 150.2

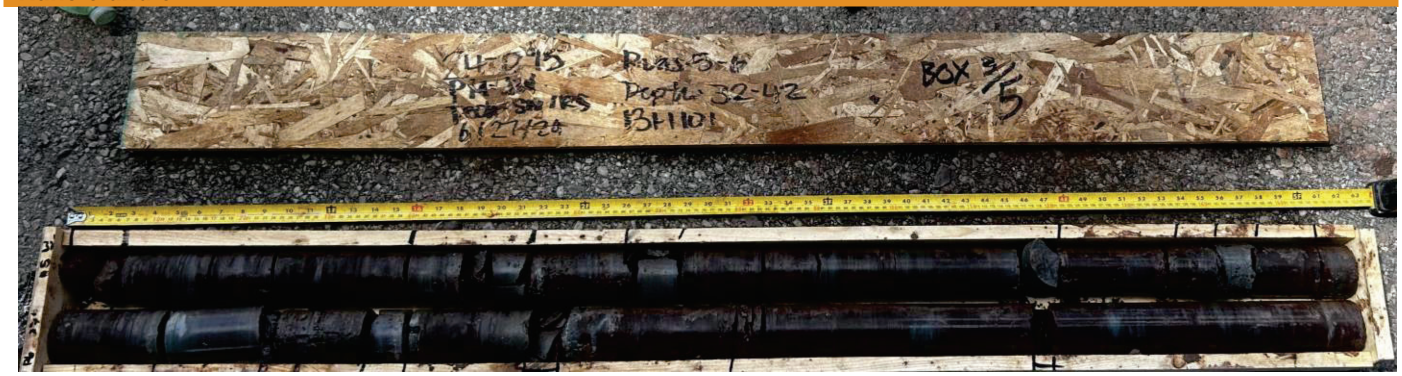
Runs 1 to 3

Runs 3 (cont.) and 4



Core Photos
2555 Erin Centre, Mississauga , Ontario
File No. 24-095

Runs 5 and 6



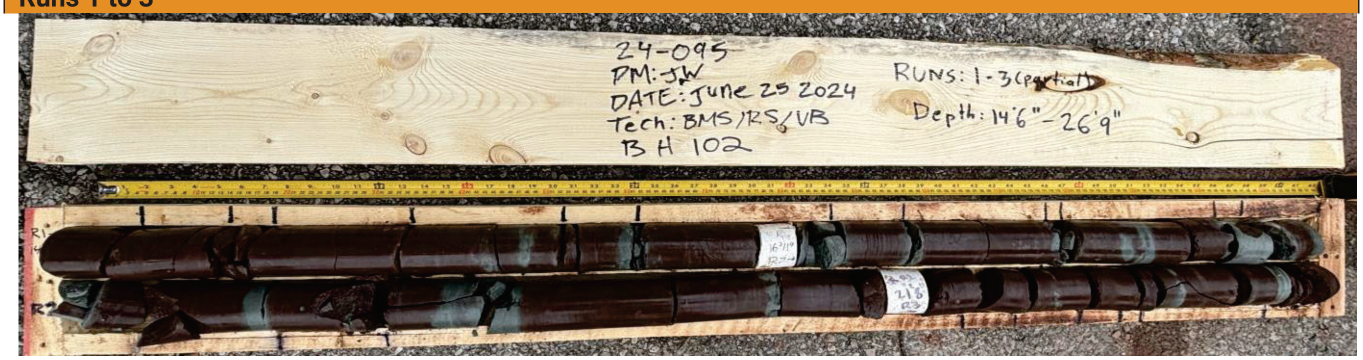
Runs 7 and 8

Runs 9 and 10

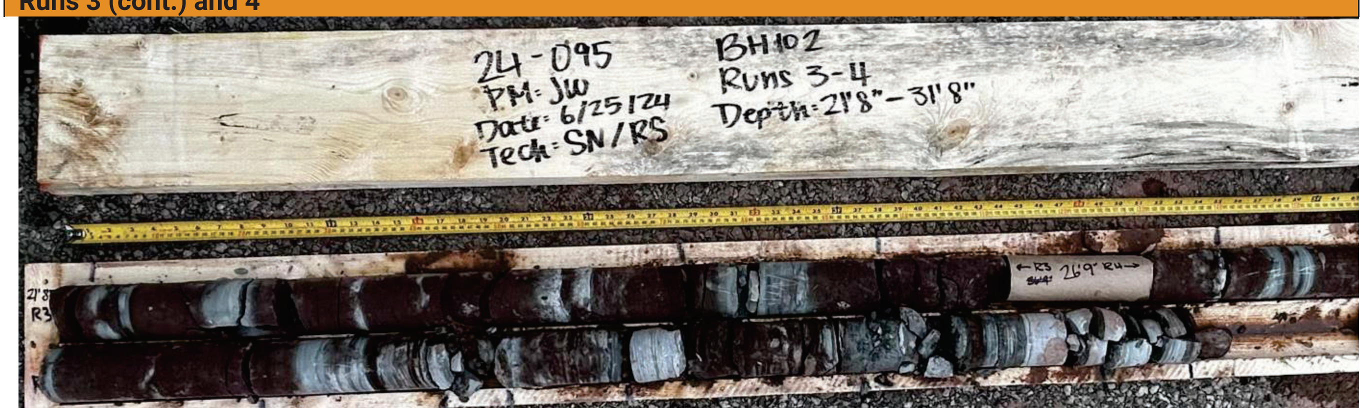
Borehole 102

Run #	Depth (m)	Elevation (m)
1	4.4 – 5.2	164.7 – 163.9
2	5.2 – 6.6	163.9 – 162.5
3	6.6 – 8.2	162.5 – 160.9
4	8.2 – 9.7	160.9 – 159.4
5	9.7 – 11.1	159.4 – 158.0
6	11.1 – 11.2	158.0 – 157.9
7	11.2 – 12.7	157.9 – 156.4
8	12.7 – 14.2	156.4 – 154.9
9	14.2 – 15.8	154.9 – 153.3
10	15.8 – 17.2	153.3 – 151.9
11	17.2 – 18.8	151.9 – 150.3

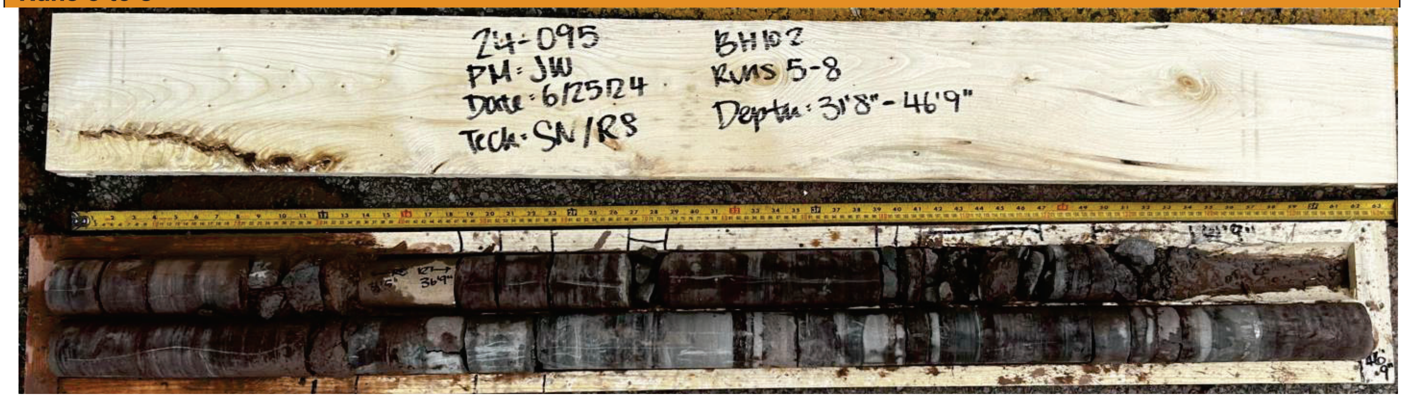
Runs 1 to 3



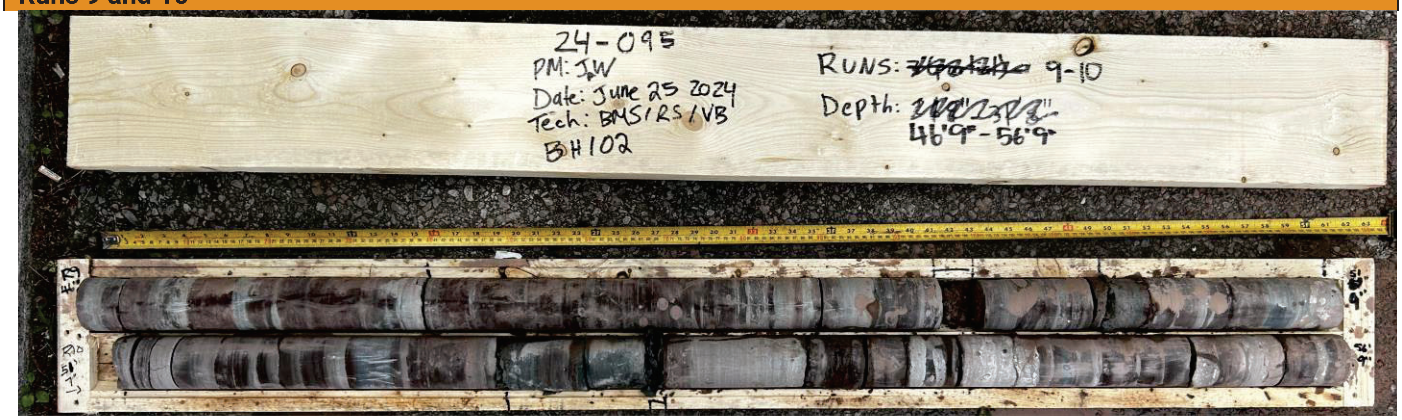
Runs 3 (cont.) and 4



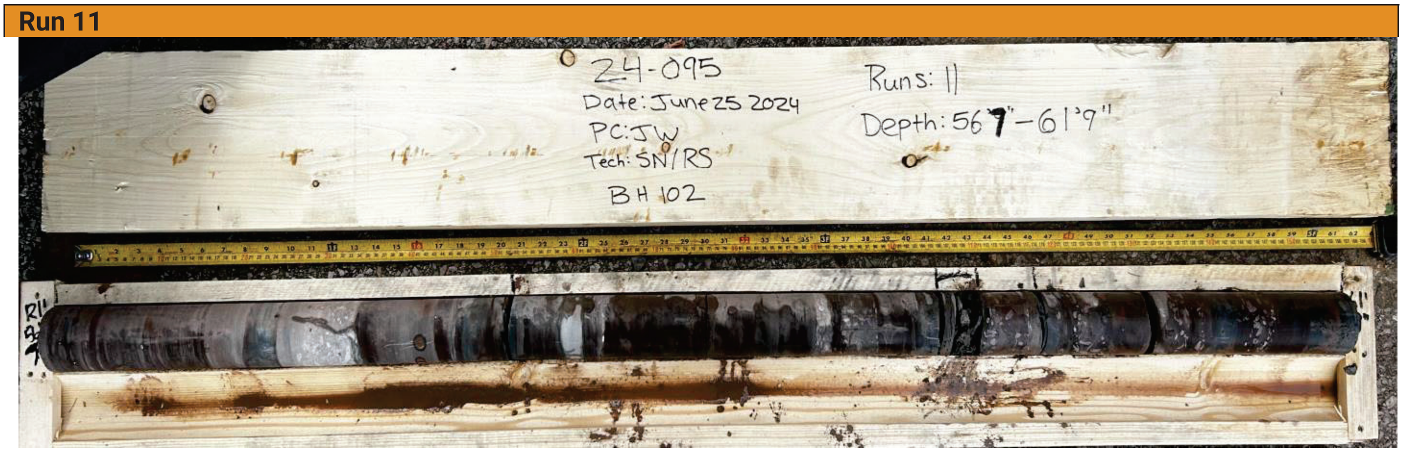
Runs 5 to 8



Runs 9 and 10



Run 11



Borehole 103

Run #	Depth (m)	Elevation (m)
1	4.4 - 4.9	164.6 - 164.1
2	4.9 - 5.7	164.1 - 163.3
3	5.7 - 6.4	163.3 - 162.6
4	6.4 - 7.9	162.6 - 161.1
5	7.9 - 9.4	161.1 - 159.6
6	9.4 - 10.9	159.6 - 158.1
7	10.9 - 12.4	158.1 - 156.6
8	12.4 - 13.9	156.6 - 155.1
9	13.9 - 15.5	155.1 - 153.5
10	15.5 - 17.0	153.5 - 152.0
11	17.0 - 18.5	152.0 - 150.5

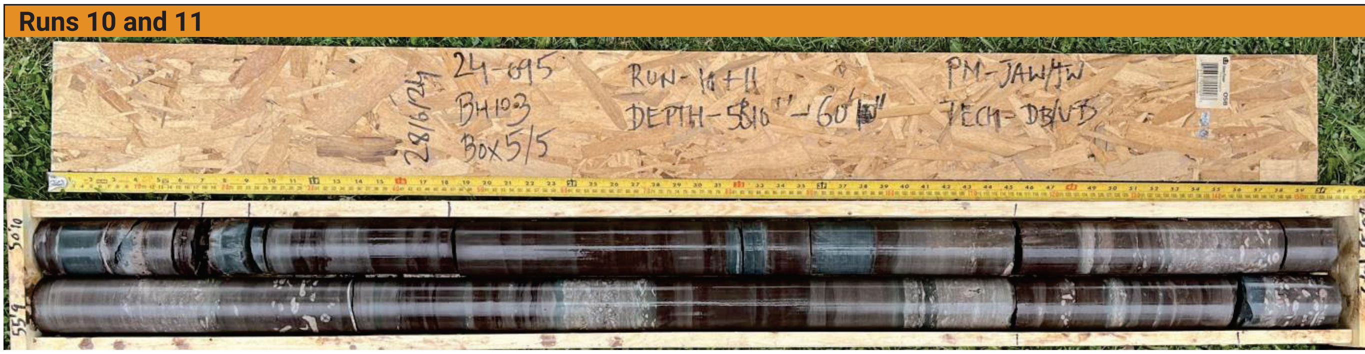
Runs 1 to 3

Runs 4 and 5

Runs 6 and 7

Runs 8 and 9

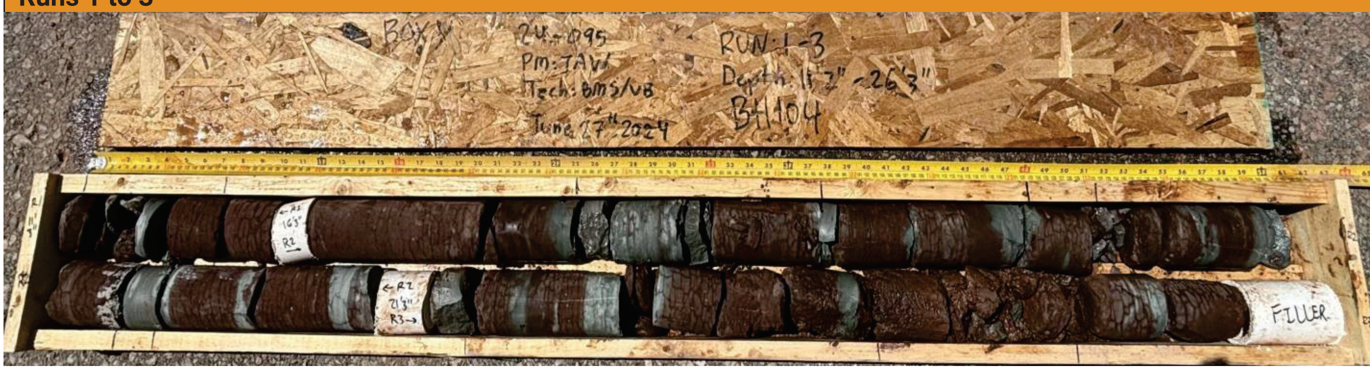
Runs 10 and 11



Borehole 104

Run #	Depth	Elevation
1	3.4 - 5.0	165.8 - 164.2
2	5.0 - 6.5	164.2 - 162.7
3	6.5 - 8.0	162.7 - 161.2
4	8.0 - 9.5	161.2 - 159.7
5	9.5 - 11.0	159.7 - 158.2
6	11.0 - 12.5	158.2 - 156.7
7	12.5 - 14.0	156.7 - 155.2
8	14.0 - 15.5	155.2 - 153.7
9	15.5 - 17.0	153.7 - 152.2
10	17.0 - 18.6	152.2 - 150.6

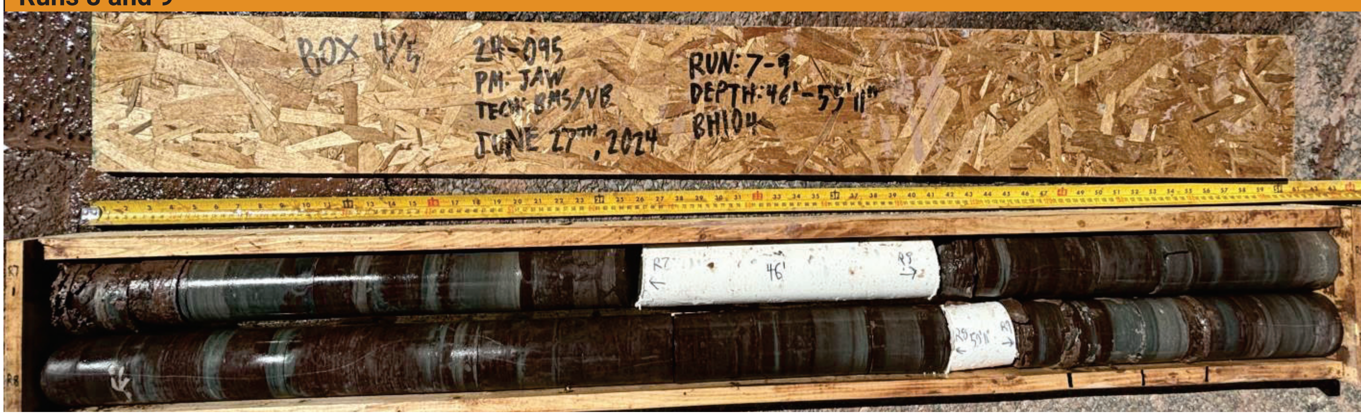
Runs 1 to 3



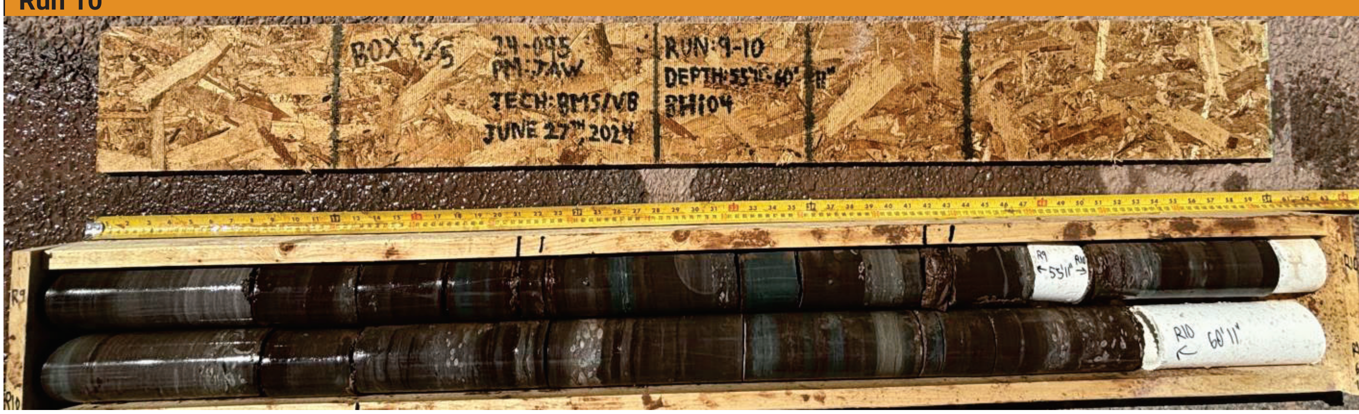
Runs 4 and 5

Runs 6 and 7

Runs 8 and 9



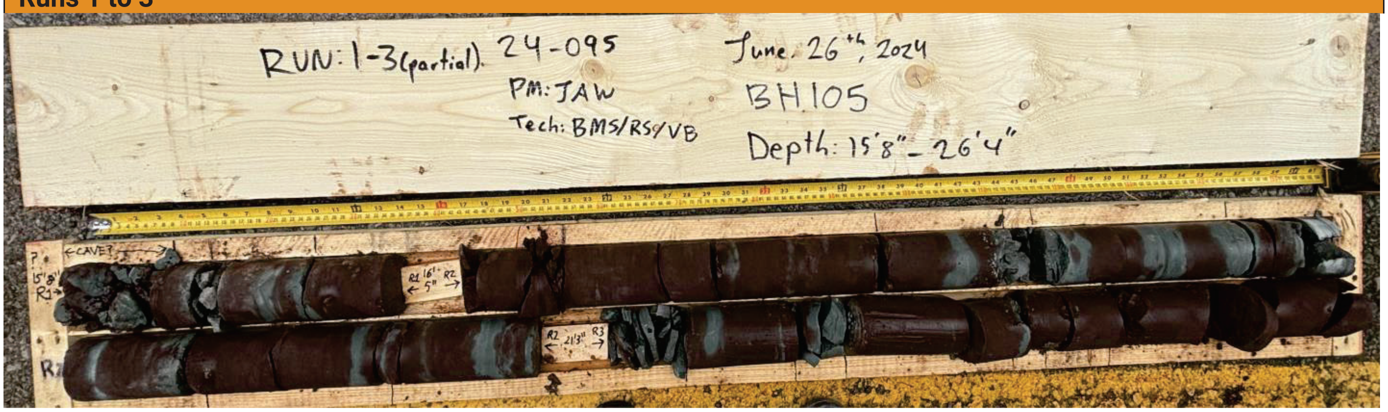
Run 10



Borehole 105

Run #	Depth	Elevation
1	4.6 - 5.0	164.9 - 164.5
2	5.0 - 6.5	164.5 - 163.0
3	6.5 - 8.0	163.0 - 161.5
4	8.0 - 9.5	161.5 – 160.0
5	9.5 - 11.1	160.0 - 158.4
6	11.1 - 12.6	158.4 - 156.9
7	12.6 - 14.1	156.9 - 155.4
8	14.1 - 15.6	155.4 - 153.9
9	15.6 - 17.1	153.9 - 152.4
10	17.1 - 18.7	152.4 - 150.8

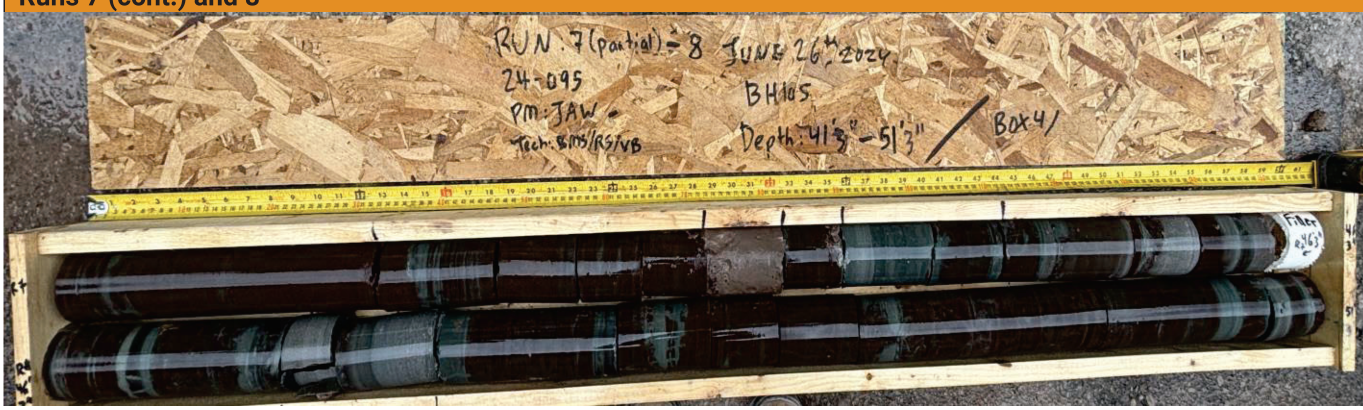
Runs 1 to 3



Runs 3 (cont.) to 5

Runs 5 (cont.) to 7

Runs 7 (cont.) and 8



Runs 9 and 10

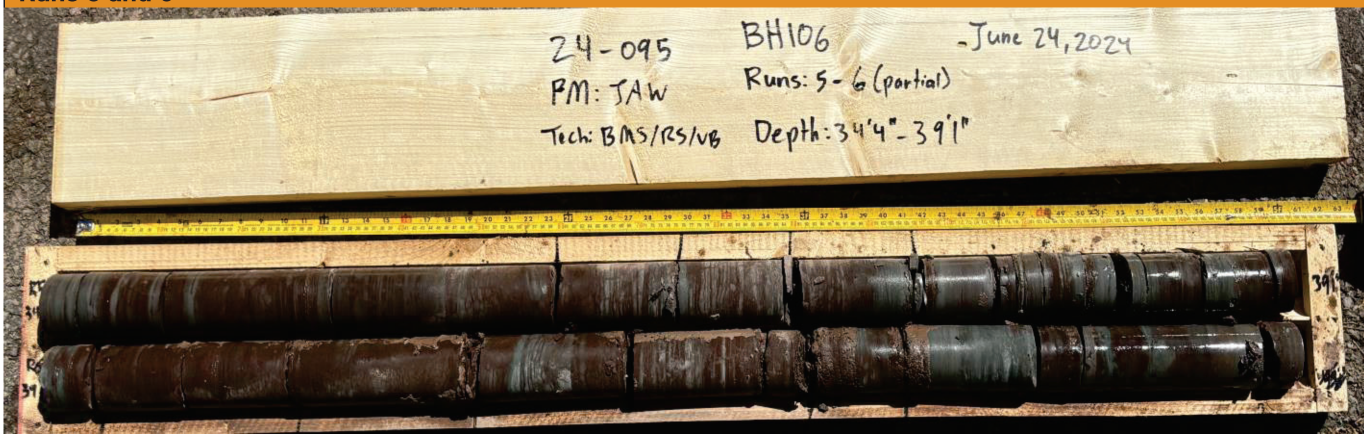
Borehole 106

Run #	Depth (m)	Elevation (m)
1	4.9 - 6.5	164.5 - 162.9
2	6.5 - 8.0	162.9 - 161.4
3	8.0 - 9.5	161.4 - 159.9
4	9.5 - 10.8	159.9 - 158.6
5	10.8 - 12.2	158.6 - 157.2
6	12.2 - 13.7	157.2 - 155.7
7	13.7 - 15.3	155.7 - 154.1
8	15.3 - 16.8	154.1 - 152.6
9	16.8 - 18.3	152.6 - 151.1
10	18.3 - 19.9	151.1 - 149.5

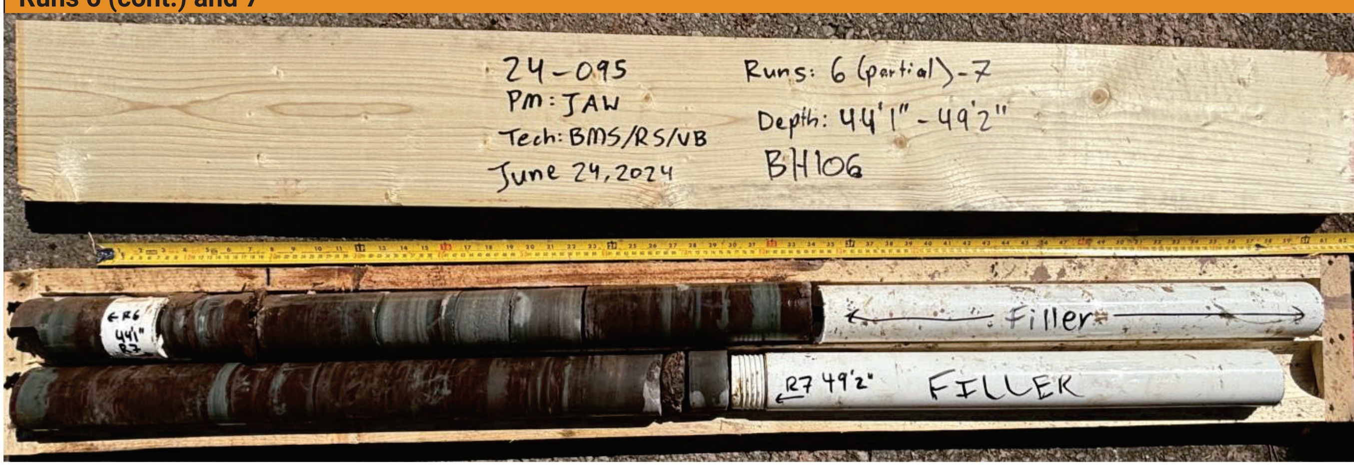
Runs 1 to 3

Runs 3 (cont.) and 4

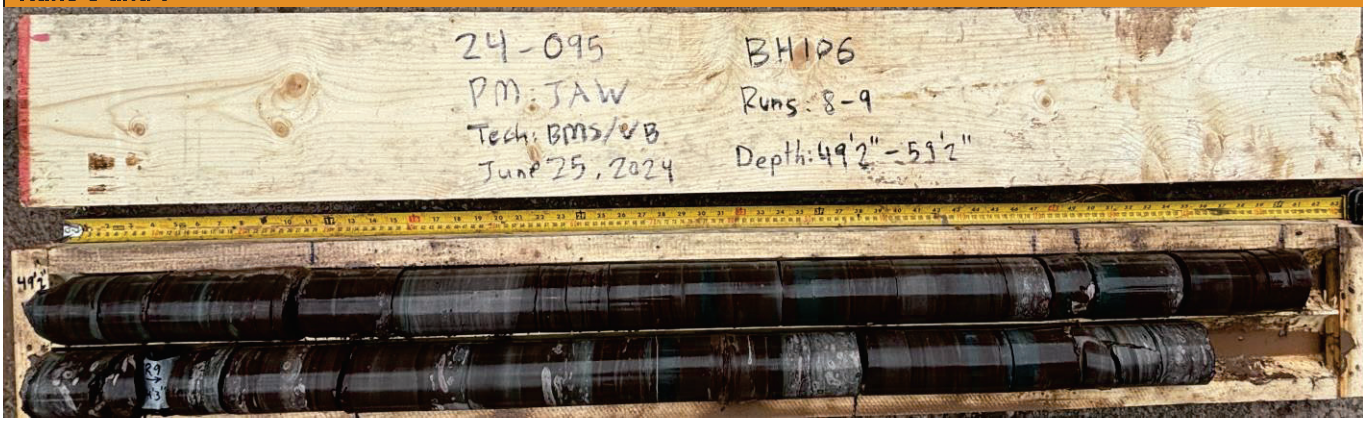
Runs 5 and 6



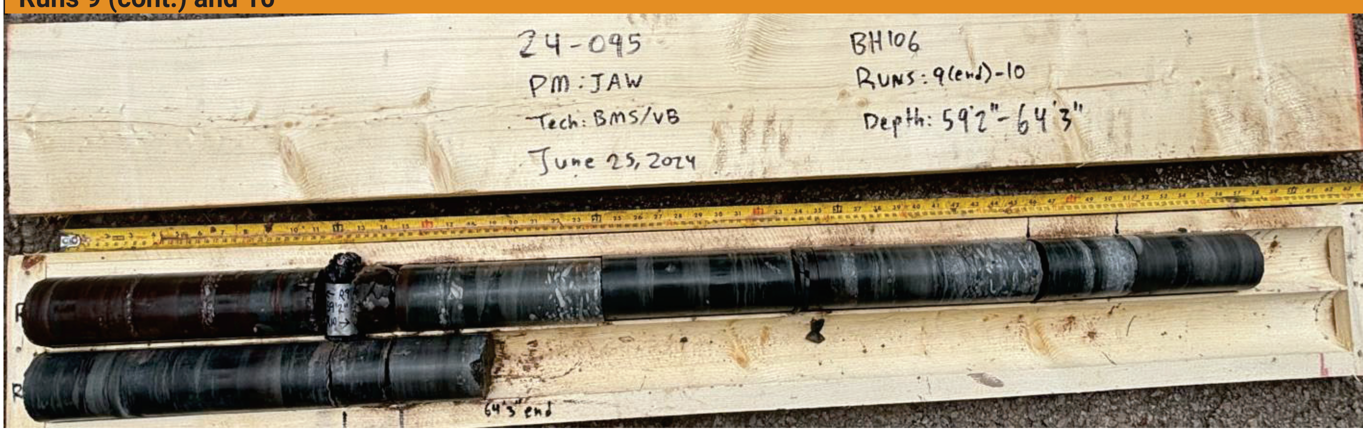
Runs 6 (cont.) and 7



Runs 8 and 9



Runs 9 (cont.) and 10



GEOMECHANICA

Geomechanica Inc.
#14-1240 Speers Rd.
Oakville ON
L6L 2X4 Canada

July 10, 2024

James Wagner
Grounded Engineering Inc.
1 Banigan Drive,
Toronto, Ontario
Canada, M4H 1G3

Re: UCS Testing (Grounded Engineering Inc. Project No. 24-095)

Dear James Wagner:

On July 04, 2024 a series of three (3) core samples (HQ-sized) were received by Geomechanica Inc. via drop-off by Grounded personnel. These samples were identified as being from Grounded Engineering Inc. Project No. 24-095. From these samples, 3 Uniaxial Compressive Strength (UCS) tests were completed.

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, PhD, PEng

Geomechanica Inc.
Tel: +1-647-478-9767
lab@geomechanica.com

Rock Laboratory Testing Results

A report submitted to:
James Wagner
Grounded Engineering Inc.
1 Banigan Drive,
Toronto, Ontario
Canada, M4H 1G3

Prepared by:
Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng
Geomechanica Inc.
#14-1240 Speers Rd.
Oakville ON
L6L 2X4 Canada
Tel: +1-647-478-9767
lab@geomechanica.com

July 10, 2024
Project number: 24-095

Abstract

This document summarizes the results of rock laboratory testing of 3 Uniaxial Compressive Strength (UCS) tests. The UCS values 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

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 Inc.'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 0.150 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 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 to determine the peak strength (UCS) and the axial deformation to determine the 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, and the minimum length:diameter criteria were met for all specimens unless noted otherwise in Table 1. Testing of the specimens included the 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. Typically the modulus is defined at 50% of the UCS strength. However, due to non-linear pre-peak stress-strain behaviour of some specimens, a custom stress range (where the specimen deformed linearly) was selected for modulus determination. These stress ranges along with additional specimen details and measurements are provided in the summary spreadsheet that accompanies this report.

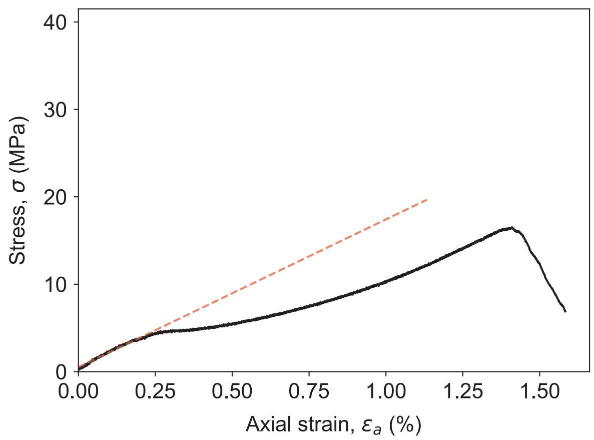
Table 1: Summary of UCS test results.

Sample	Depth (ft' in")	Bulk density ρ (g/cm^3)	UCS (MPa)	Young's modulus E (GPa)	Lithology	Failure description
BH106, UCS1	51'3" - 51'10"	2.605	16.5	1.7	Red Shale and Limestone	1, 2
BH102, UCS2	46'11" - 47'10"	2.591	9.1	1.2	Red Shale and Limestone	1, 2, 3
BH104, UCS3	47'1" - 47'8"	2.631	39.5	7.2	Limestone and Red Shale	4

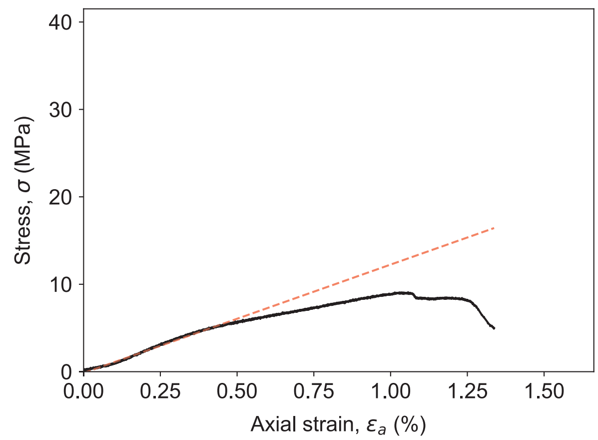
[1] Inclined shear failure
[2] Specimen emitted pore water upon loading
[3] Length:Diameter ratio less than 2
[4] Inclined shear fracture and axial splitting failure

1.3 Specimen photographs

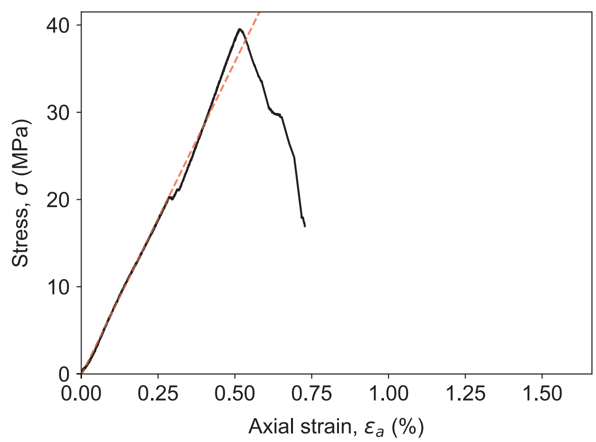
Photographs of the specimens before and after testing are presented in the Appendix of this report.



(a) BH106-UCS1



(b) BH102-UCS2



(c) BH104-UCS3

Figure 2: Measured stress-strain curves.

Appendices

Specimen sheets

- BH106, UCS1
- BH102, UCS2
- BH104, UCS3

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	24-095
Sample	BH106, UCS1	**Depth**	51’3” - 51’10”

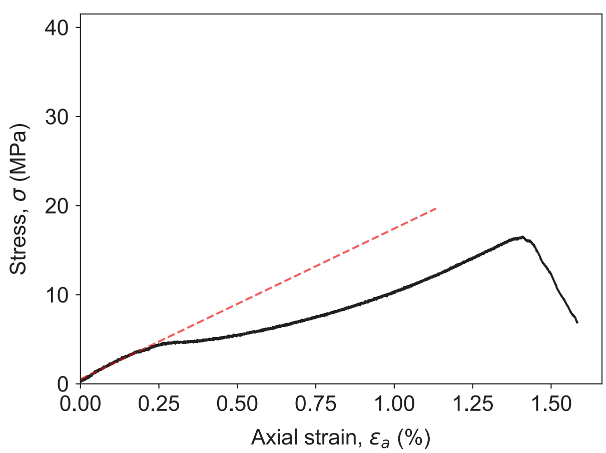
Specimen parameters

Diameter (mm) [a]	63.12
Length (mm) [a]	126.09
Bulk density ρ (g/cm^3)	2.605
UCS (MPa)	16.5
Young’s modulus E (GPa) [b]	1.7
Lithology	Red Shale and Limestone
Failure description [c]	1, 2

[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 15.0% of the peak strength.
[c] Failure description: [1] Inclined shear failure; [2] Specimen emitted pore water upon loading;

Prior to testing

After testing



Remarks: Loading Rate: 0.15mm/min.

Performed by	AB	**Date**	2024-07-08

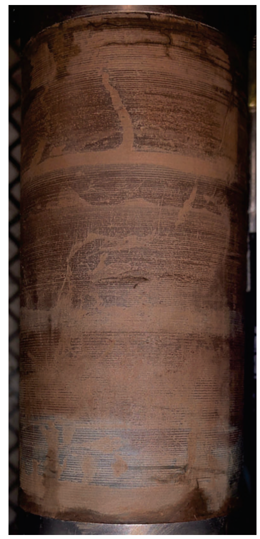
Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	24-095
Sample	BH102, UCS2	**Depth**	46’11” - 47’10”

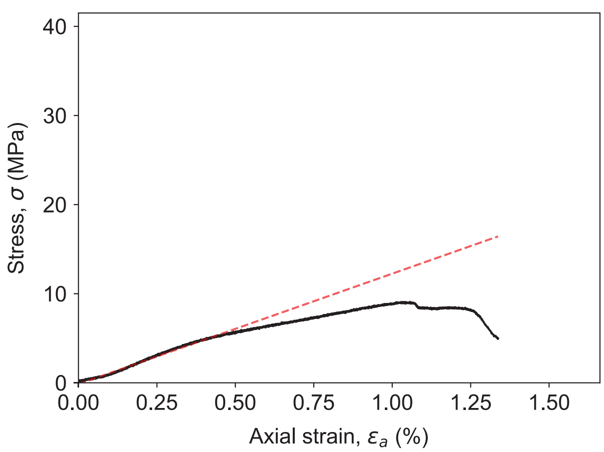
Specimen parameters	
Diameter (mm) [a]	63.13
Length (mm) [a]	121.46
Bulk density ρ (g/cm^3)	2.591
UCS (MPa)	9.1
Young’s modulus E (GPa) [b]	1.2
Lithology	Red Shale and Limestone
Failure description [c]	1, 2, 3

[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 15.0% of the peak strength.
[c] Failure description: [1] Inclined shear failure; [2] Specimen emitted pore water upon loading; [3] Length:Diameter ratio less than 2;

Prior to testing



After testing



Remarks: Loading Rate: 0.15mm/min.

Performed by	AB	**Date**	2024-07-08

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	24-095
Sample	BH104, UCS3	**Depth**	47’1” - 47’8”

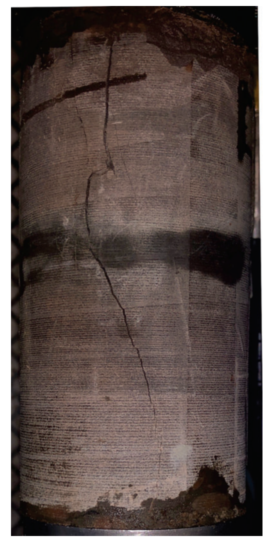
Specimen parameters

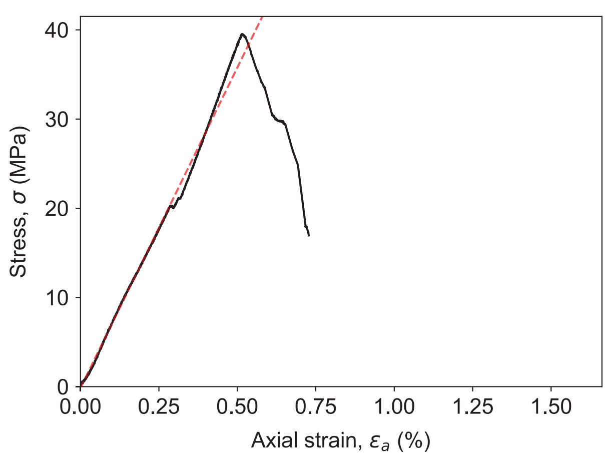
Diameter (mm) [a]	63.25
Length (mm) [a]	124.35
Bulk density ρ (g/cm^3)	2.631
UCS (MPa)	39.5
Young’s modulus E (GPa) [b]	7.2
Lithology	Limestone and Red Shale
Failure description [c]	4

[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 15.0% of the peak strength.
[c] Failure description: [4] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing





Remarks: Loading Rate: 0.15mm/min. Specimen experienced pre-peak localized failure(s).

Performed by	AB	**Date**	2024-07-08

APPENDIX D

CORROSIVITY (SGS)

Report No.	**CA40152-JUL24**
Customer	**Grounded Engineering Inc.**
Attention	**James Wagner**
Reference	**24-095, James Wagner**
Works#	
Title	**Final Report**

Sample ID		Analysis Start Date	Analysis Start Time	Analysis Completed Date	Analysis Completed Time	BH 101 SS6	BH 101 SS3	BH 108 SS2
Sample Date / Time						15-Jul-24 17:00	15-Jul-24 17:00	15-Jul-24 17:00
Analysis	**Units**							
Corrosivity Index	none	22-Jul-24	15:22	22-Jul-24	15:22	9	11	11
Soil Redox Potential	mV	18-Jul-24	14:52	19-Jul-24	12:58	291	266	260
Sulphide (Na2CO3)	%	22-Jul-24	10:25	22-Jul-24	11:43	< 0.01	< 0.01	< 0.01
Moisture Content	%	18-Jul-24	12:13	22-Jul-24	08:54	5.3	8.2	6.0
pH	pH Units	22-Jul-24	08:18	22-Jul-24	15:21	8.89	7.97	8.46
Chloride	µg/g	22-Jul-24	08:31	24-Jul-24	15:04	160	390.0	1100
Sulphate	µg/g	22-Jul-24	08:31	24-Jul-24	15:04	21	12.0	31
Conductivity	uS/cm	22-Jul-24	08:18	22-Jul-24	15:21	512	695	1930
Resistivity (calculated)	ohms.cm	22-Jul-24	08:18	22-Jul-24	15:22	1950	1440	519

INTERPRETATION

AWWA C-105 Standard	**Points**	**Points**	**Points**
% Moisture	**2**	**2**	**2**
pH			
Is pH bet 6.5-7.5 ?	NO	NO	NO
Is Redox Potential < 100 mv?	NO	NO	NO
Are Sulphides present ?	NO	NO	NO
If above three conditions are met, pH is assigned 3 points			
pH - Score	**3**	**0**	**0**
Redox Potential	**0**	**0**	**0**
Resistivity	**1**	**2**	**10**
Acid Volatile Sulphides	**0**	**0**	**0**
TOTAL SCORE (AWWA C-105)	**6**	**4**	**12**

Sample	**BH 101 SS6**	**BH 101 SS3**	**BH 108 SS2**
Corrosion Protection Recommended?	**No**	**No**	**YES**
Resistivity less than 2000 ohm.cm?	**YES**	**YES**	**YES**

Anions and Nutrients (Soil)

Sulphate	%	0.0021	0.0012	0.0031
CLASS OF EXPOSURE		**Negligible**	**Negligible**	**Negligible**

FINAL REPORT

CA40152-JUL24 R1

24-095, 2555 Erin Centre

Prepared for

Grounded Engineering Inc.

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Grounded Engineering Inc.	Project Specialist	Maarit Wolfe, Hon.B.Sc
		Laboratory	SGS Canada Inc.
Address	1 Banigan Drive Toronto, Ontario M4H 1E9, Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	James Wagner	Telephone	705-652-2000
Telephone	647-264-7909	Facsimile	705-652-6365
Facsimile		Email	Maarit.Wolfe@sgs.com
Email	jwagner@groundedeng.ca	SGS Reference	CA40152-JUL24
Project	24-095, 2555 Erin Centre	Received	07/17/2024
Order Number		Approved	07/24/2024
Samples	Soil (3)	Report Number	CA40152-JUL24 R1
		Date Reported	07/24/2024

COMMENTS

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present:yes

Custody Seal Present:yes

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc

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First Page 1

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FINAL REPORT

CA40152-JUL24 R1

Client: Grounded Engineering Inc.
Project: 24-095, 2555 Erin Centre
Project Manager: James Wagner
Samplers: James Wagner

MATRIX: SOIL

			Sample Number	5	6	7
			Sample Name	BH 101 SS6	BH 101 SS3	BH 108 SS2
			Sample Matrix	Soil	Soil	Soil
			Sample Date	15/07/2024	15/07/2024	15/07/2024
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**
Corrosivity Index						
Corrosivity Index	none	1		9	11	11
Soil Redox Potential	mV	no		291	266	260
Sulphide (Na2CO3)	%	0.01		< 0.01	< 0.01	< 0.01
pH	pH Units	0.05		8.89	7.97	8.46
Resistivity (calculated)	ohms.cm	-9999		1950	1440	519
General Chemistry						
Conductivity	uS/cm	2		512	695	1930
Metals and Inorganics						
Moisture Content	%	0.1		5.3	8.2	6.0
Sulphate	µg/g	0.4		21	12	31
Other (ORP)						
Chloride	µg/g	0.4		160	390	1100

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0436-JUL24	µg/g	0.4	<0.4	7	35	105	80	120	102	75	125
Sulphate	DIO0436-JUL24	µg/g	0.4	<0.4	1	35	95	80	120	78	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0064-JUL24	%	0.01	< 0.01								

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0427-JUL24	uS/cm	2	< 2	1	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0427-JUL24	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

SGS Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No:

Laboratory Information Section - Lab use only

Received By: B. Cunnon
Received Date (mm/dd/yy): 07 · 17 · 24
Received Time: 15:00
Received By (signature): [signature]
Custody Seal Present: ☒
Custody Seal Intact: ☐
Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 6 ×3
LAB LIMS #: CA 40152-Jul24

REPORT INFORMATION

Company: Grounded Engineering
Contact: James Wagner
Address: 1 Banigan Drive, Toronto, ON
Phone: ~~647-264-7009~~ 647 918 9985
Email: jwagner@groundedeng.ca
Email:

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 24-095
Site Location/ID: 2555 Erin Centre

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:
Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ; ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ CCME ☐ MISA ☐ MMER ☐ Other:

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

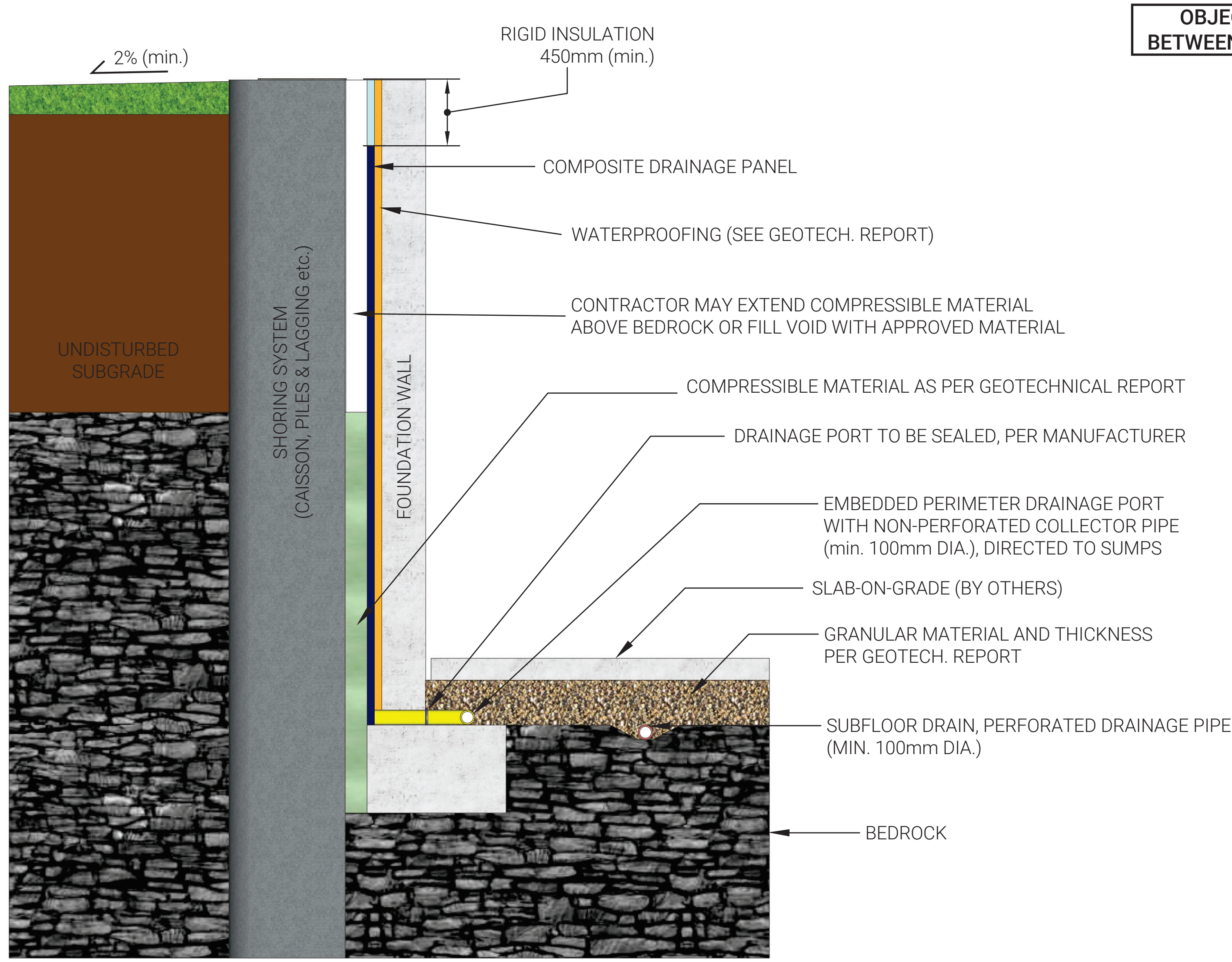
#	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH☐ ABN☐ SVOC(all)☐	PCB Total ☐ Aroclor ☐	PHC F1-F4☐ VOC☐ BTEX☐ BTEX/F1☐ F2-F4☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC☐ OP☐	TCLP M&I☐ VOC☐ PCB☐ B(a)P☐ ABN☐ Ignit.☐	Water Pkg Gen.☐ Ext.☐	Sewer Use:	Soil Corrosivity					COMMENTS:
1	BH 101 SS6	July 15/24 ~~17:00~~	17:00	1	Soil		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
2	BH 101 SS3	↓	17:00	1	↓		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
3	BH 108 SS 2	↓	17:00	1	↓		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME): James Wagner	Signature: [signature]	Date: July 15/24	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Signature:	Date:	(mm/dd/yy)	Yellow & White Copy - SGS

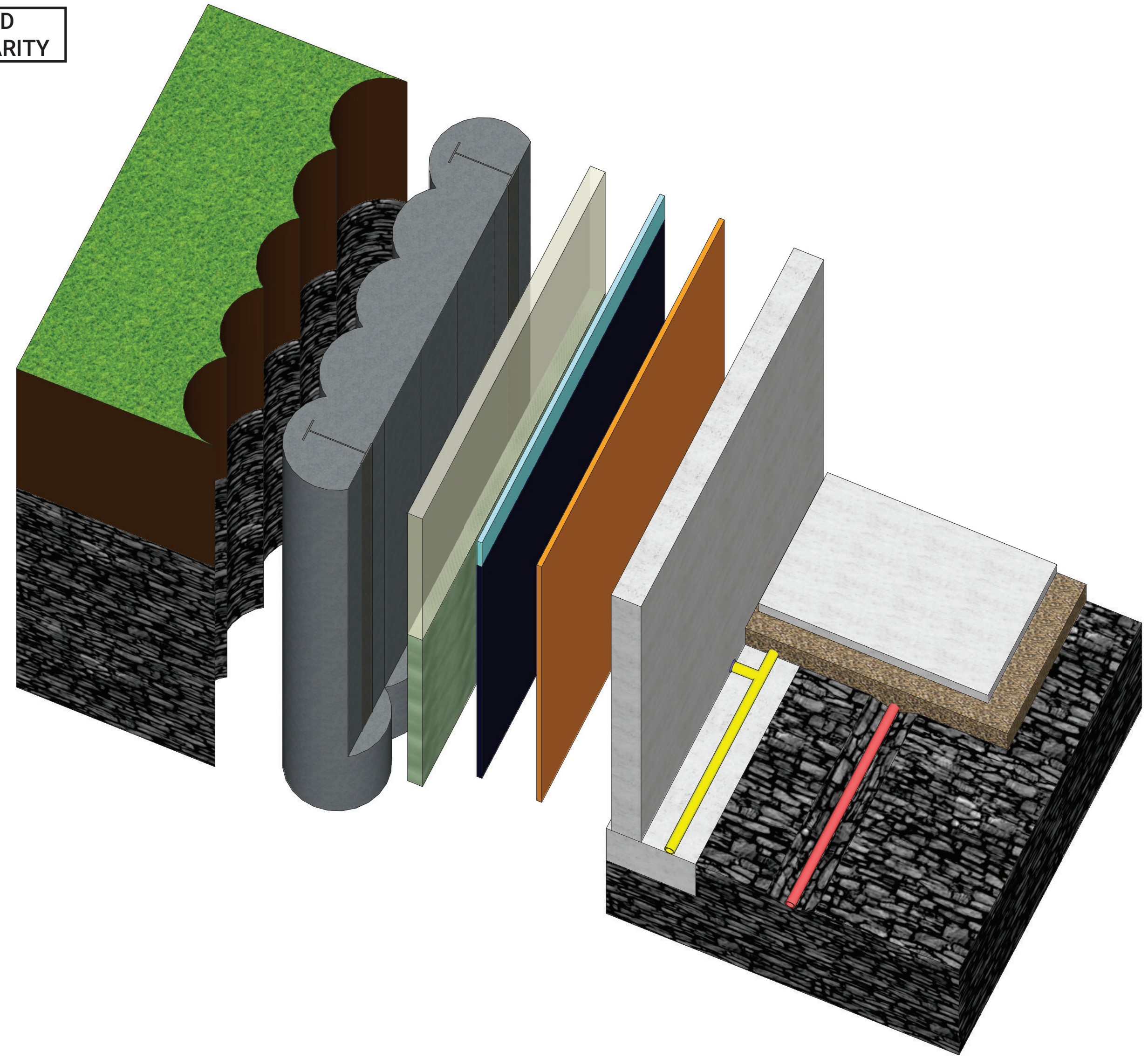
Revision #: 1.1
Date of Issue: 04 April, 2018

APPENDIX E



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

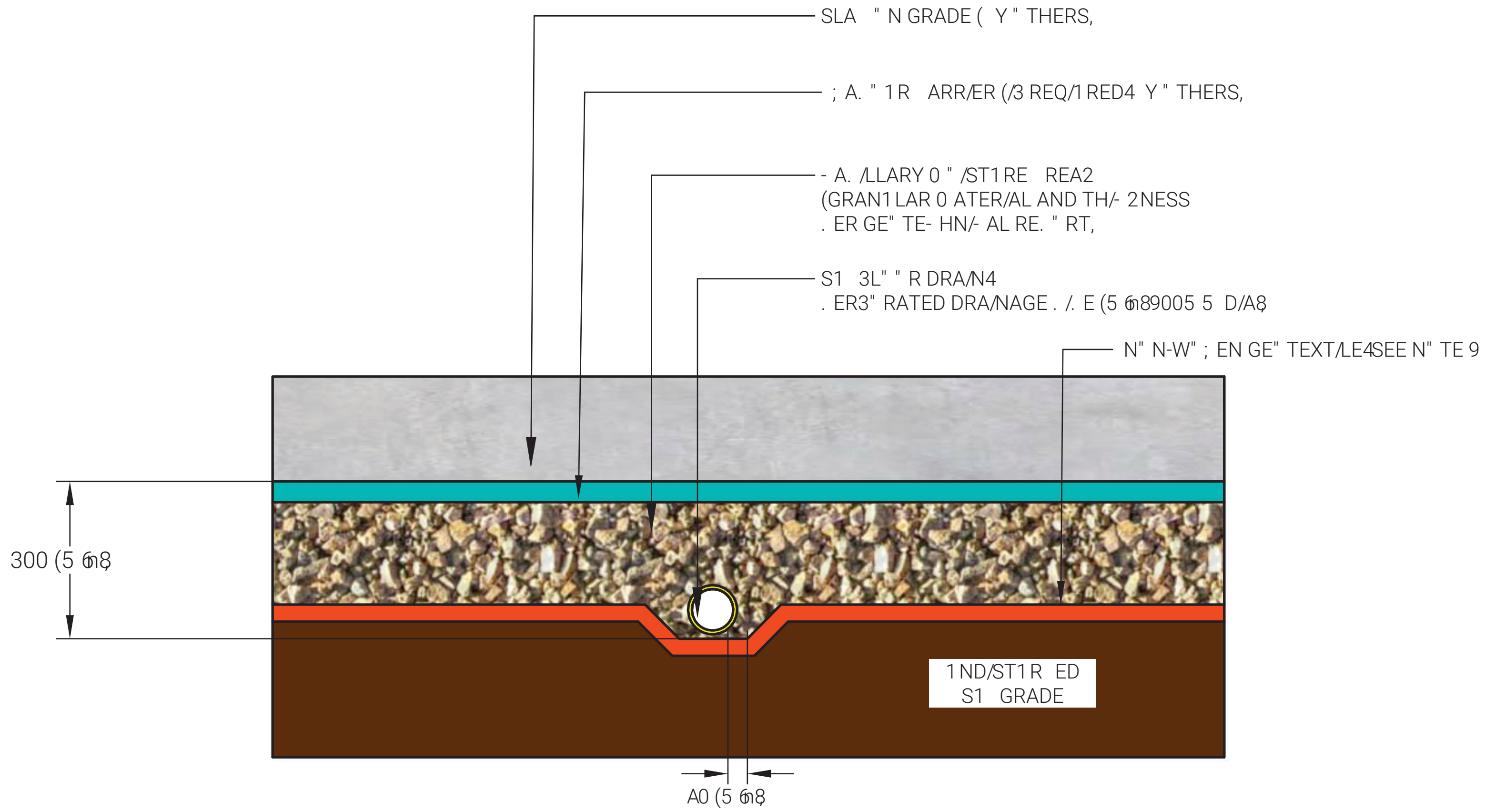
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC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

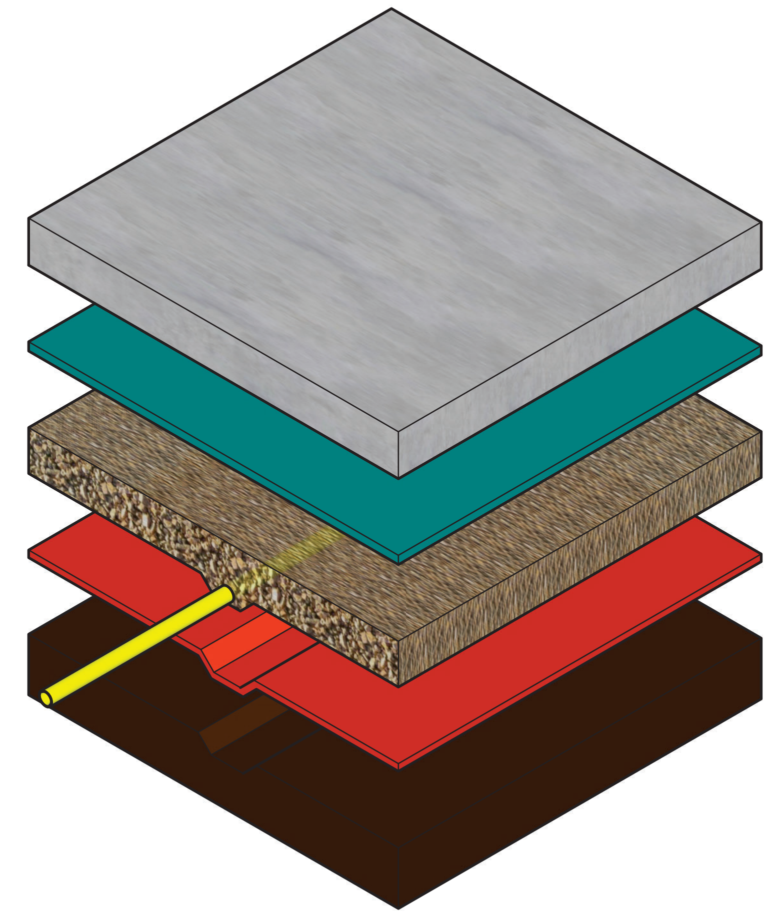
GROUNDED ENGINEERING

Title

FOUNDATION WALL BLINDSIDE DRAINAGE SYSTEM (IN DEEP ROCK) DETAIL

OBJ CTS AR COLOR-COD D
B TW N TWO , - WS . OR CLAR-TY





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2. TY72D. 4) 0HE6 . T20 1 (4Y. 6 U) T BE - E. D 2(01 (EU(0T21 (W2TH , E1 TE0H(20. 4 - E71 - T.

GROUNDED ENGINEERING

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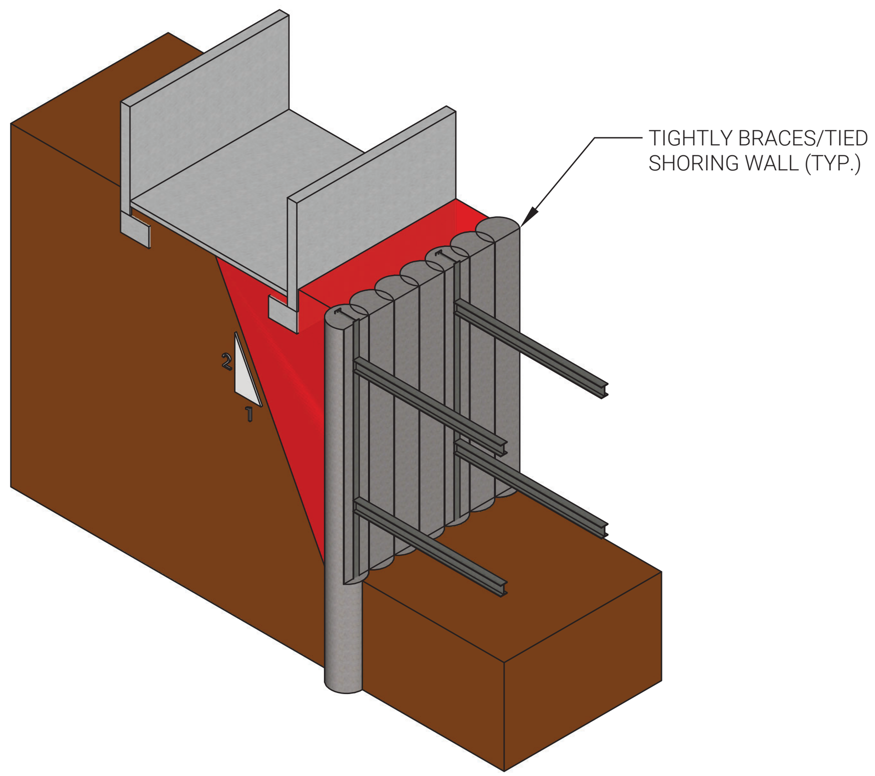
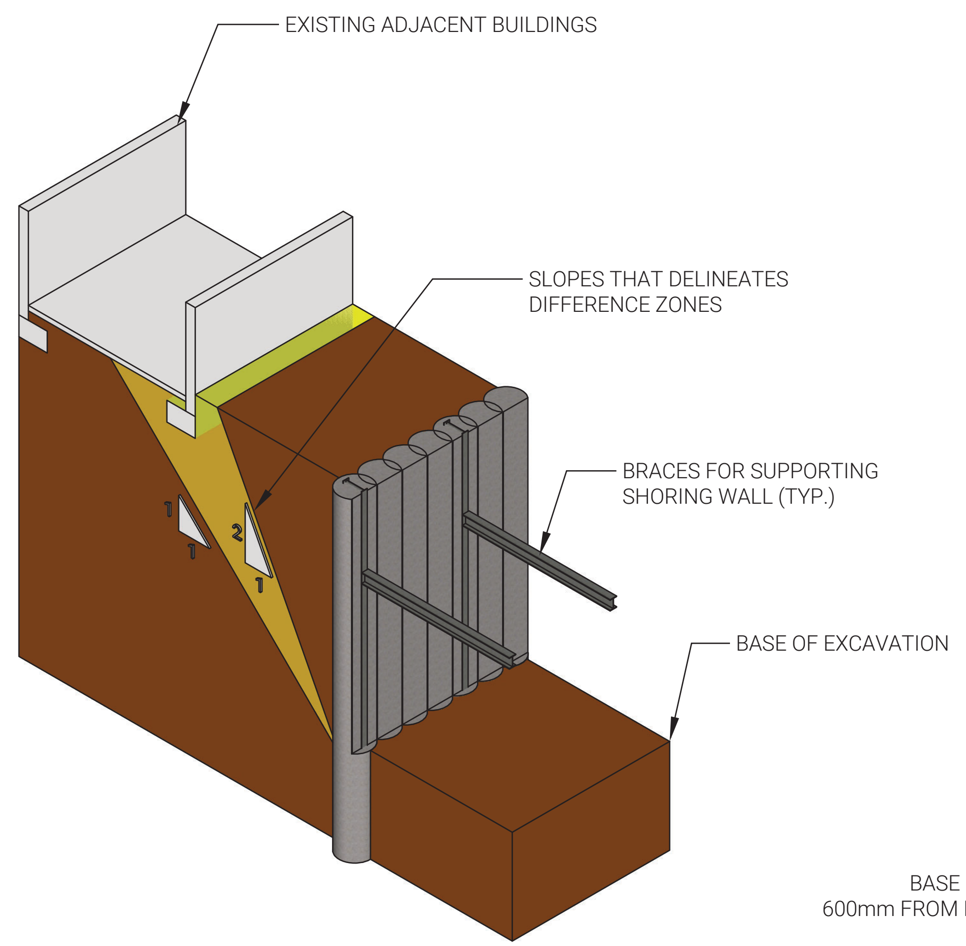
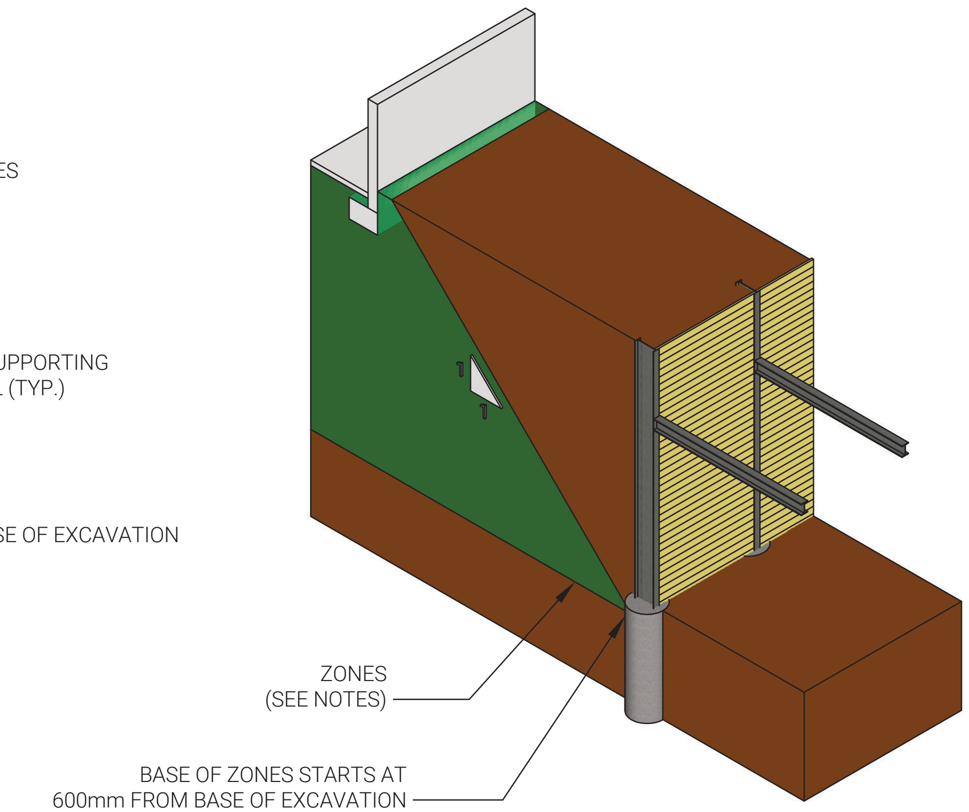
B.) E6 E(T) UBD- . 2(TY72D. 4 DET. 24







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