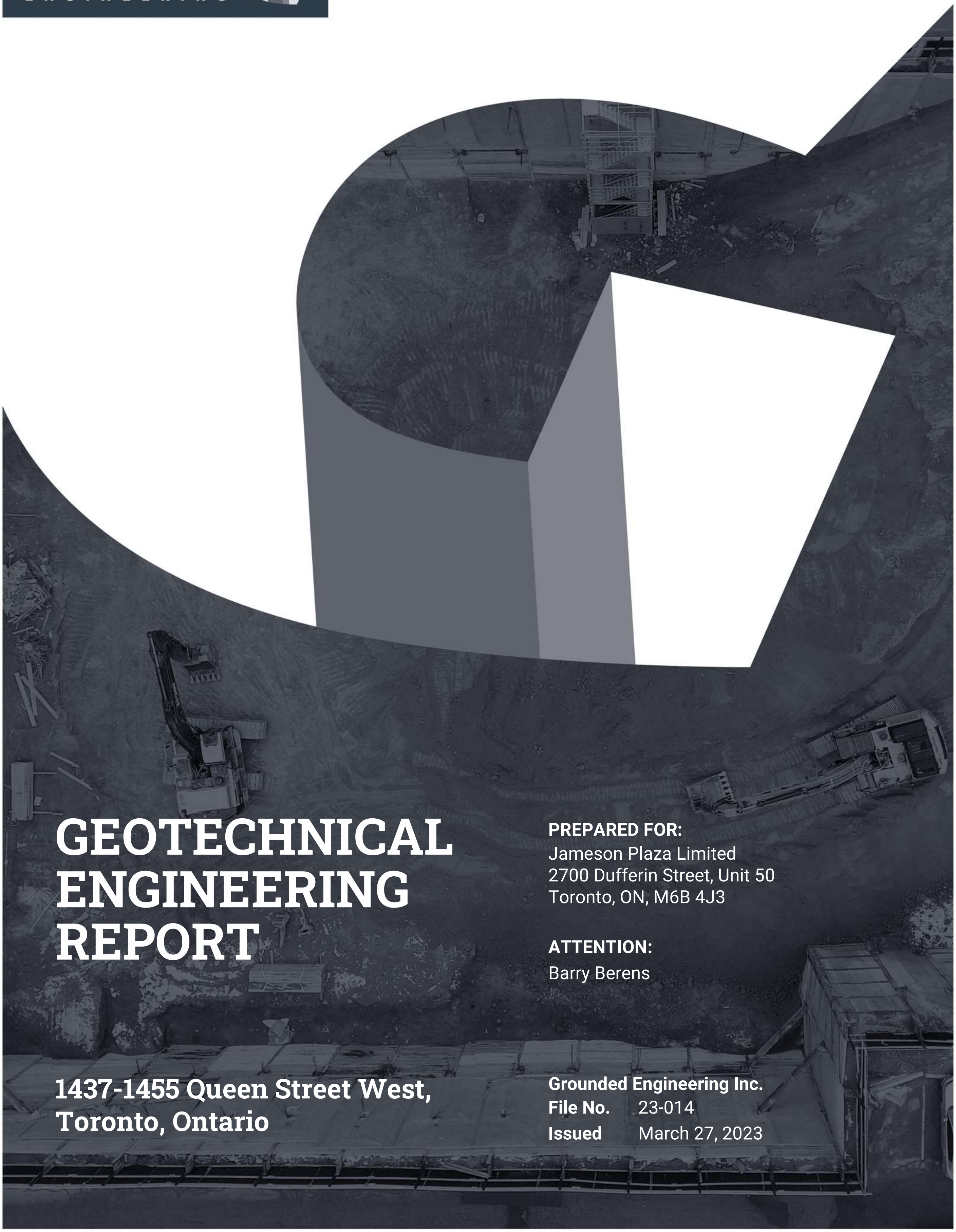

GEOTECHNICAL ENGINEERING REPORT

1437-1455 Queen Street West, Toronto, Ontario

PREPARED FOR:
Jameson Plaza Limited
2700 Dufferin Street, Unit 50
Toronto, ON, M6B 4J3

ATTENTION:
Barry Berens

Grounded Engineering Inc.
File No. 23-014
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TABLE OF CONTENTS

FIGURES

APPENDICES

1 Introduction

Jameson Plaza Limited has retained Grounded Engineering Inc. ("Grounded") to provide preliminary geotechnical engineering design advice for their proposed development at 1437-1455 Queen Street West, in Toronto, Ontario.

The proposed project includes demolishing the existing structures and constructing a 12-storey mixed-use building, with one underground parking level set at a lowest (P1) Finished Floor Elevation (FFE) of 94.6± m.

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

- Site survey, prepared by Schaeffer Dzaldov Purcell Ltd (Feb 13, 2023).
- Conceptual Site Plans, "1437-1455 Queen St W, Toronto, Ontario"; dated Feb 16, 2023 prepared by RAW Design.
- Limited Phase II Environmental Site Assessment (Draft), "1437 Queen Street West, Toronto, Ontario", Project No. 9157, dated December 3, 2019, by S2S Environmental Inc. (S2S).
- Limited Phase II Environmental Site Assessment (Draft), "1439-1455 Queen Street West, Toronto, Ontario", Project No. 9157, dated March 4, 2020, by S2S Environmental Inc. (S2S).

Grounded has been provided with factual borehole information for the subject site from other consultants as listed above. Those borehole logs are provided in draft reports that **are not** signed and sealed by professional engineers. Furthermore, these borehole logs do not include SPT N-values. As such, this borehole information is not appended in this report as it is not useful for geotechnical engineering purposes. Unless noted, borehole labels (Figures 2 and 3) appended with "S2S-" refer to S2S's boreholes.

Grounded's subsurface investigation of the site to date includes five (5) boreholes (Boreholes 101, 102 and 103) which were advanced from January 30th to February 10th, 2023.

Based on the borehole findings, preliminary geotechnical engineering advice for the proposed development is provided for foundations, seismic site classification, earth pressure design, slab on grade design and basement drainage. Construction considerations including excavation, groundwater control, and geostructural engineering design advice are also provided. Additional site-specific boreholes, wells, in situ and laboratory testing, and a detailed geotechnical engineering report will be required for detailed design.

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.

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

2.1 Stratigraphy

The following stratigraphy summary is based on the borehole results and the geotechnical laboratory testing.

A subsurface profile showing stratigraphy and engineering units is appended (Figure 4).

2.1.1 Surficial Materials and Earth Fill

Surficial material and/or fill thicknesses were observed in individual borehole locations through the top of the open boreholes. These thicknesses may vary between and beyond each borehole location.

Boreholes 101 and 102 encountered about 150 mm of asphalt pavement at the existing ground surface. Borehole 103 encountered approximately 75 mm of topsoil at the existing ground surface. Underlying the surficial materials, the boreholes observed a layer of earth fill that extends to depths of 1.5 to 2.3 metres below grade (Elev. 96.9 to 95.4 metres). The earth fill varies in composition but generally consists of silty sand to silt, and clayey silt with trace gravel. The fill was observed to contain some construction debris. BH103 also encountered trace rootlets and trace organics in the existing fill. The earth fill is typically brown to dark brown with orange staining, and moist. Due to the variation and inconsistent placement of the earth fill material, the consistency/relative density of the earth fill is highly variable. Standard Penetration Test (SPT) results (N-Values) measured in the earth fill range from 4 to 40 blows per 300 mm of penetration ("bpf"), indicating a relative density ranging from very loose to dense (on average, compact).

2.1.2 Sandy Silts

Underlying the fill materials, the boreholes encountered an undisturbed native cohesionless sandy silt unit (sandy silt to silt, some sand). This unit was encountered at depths of 1.5 to 2.3

metres below grade (Elev. 96.9 to 95.4 m) and extends down to depths of 4.6 to 7.6 m below grade (Elev. 93.3 to 90.1 m). The sandy silt contains trace gravel, and occasional sand and clayey silt seams, and is generally brown to brown and grey, and moist. SPT N-values measured in this unit range from 20 to greater than 81 bpf, indicating a compact to very dense relative density (on average, dense).

2.1.3 Sands

Underlying the sandy silt, the boreholes encountered a stratum of undisturbed native sand, comprising silty sand to sand. This unit was encountered at 4.6 to 7.6 metres below grade (Elev. 93.3 to 90.1 m) and extends down to depths of 12.2 to 15.2 m below grade (Elev. 85.7 to 82.5 m). The sands unit is generally brown to grey, and wet, and occasionally contains gravelly zones and shale fragments, with occasional seams and layers of sandy silt. SPT N-values measured in this unit range from 29 to greater than 96 bpf, generally indicating a dense to very dense relative density (on average, dense).

2.1.4 Glacial Till

Underlying the sand, the boreholes encountered an undisturbed glacial till deposit with a matrix of sand and silt to sandy, clayey silt. This unit was encountered at 12.2 to 15.2 metres below grade (Elev. 85.7 to 82.5 m) and extends down to the top of the underlying bedrock at depths of 13.2 to 15.3 m below grade (Elev. 84.7 to 82.4 m). The glacial till is generally grey and wet, and contains trace gravel, shale, and limestone fragments. SPT N-values measured in this unit were all greater than 50 bpf indicating a very dense relative density.

2.1.5 Bedrock

Bedrock was confirmed by rock cores observed in Boreholes 101 and 102 underlying the glacial till from depths of 13.2 to 15.3 m below grade (Elev. 84.7 to 82.4 m) to depths of 18.8 to 19.9 m below grade (Elev. 79.1 to 78.8). Where coring was not conducted (BH 103), the top of weathered bedrock was inferred through auger cuttings, split spoon samples, and auger grinding/resistance observations.

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 Georgian Bay Formation, which comprises thin to medium bedded grey shale and limestone of Ordovician age. The fissile shale is interbedded with non-fissile calcareous shale, limestone, dolostone, and calcareous sandstone (conventionally grouped together as “limestone”) which are typically laterally discontinuous. Per the appended terminology, the Georgian Bay shale is typically classified as “weak” whereas the limestone interbedding is classified as “medium strong to strong”. The percentage of strong limestone beds in each run is reported on the rock core logs. The overall percentage of limestone found in Boreholes 101 and 102 was 15% and 19%, respectively.

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 the engineering properties of the Georgian Bay Formation is presented in the Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects* (March 1983). The relevant parameters from that document are as follows:

Summary of MTO Georgian Bay Formation Parameters

	Uniaxial Compressive Strength (MPa)	Young's Modulus (GPa)	Dynamic Modulus (GPa)	Poisson's Ratio
Average	28	4	19	0.19
Range	8 to 41	0.5 to 12	6 to 38	0.1 to 0.25

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
BH101	CS1	18.5 to 18.8	2591	14.6	1.7	Shale
BH102	CS2	18.5 to 18.7	2624	16.0	1.5	Shale

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

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

	Zone	Description	Notes
	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 Weathered and sound bedrock elevations are summarized as follows:

Borehole	Ground Surface Elevation (m)	Partially Weathered (Zone II) Bedrock		Unweathered/Sound (Zone I) Bedrock	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
101	97.9	13.2	84.7	15.5	82.4
102	97.7	15.3	82.4	15.6	82.1
103	98.4	n/a	n/a	n/a	n/a

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 was typically 0% to 6% in the weathered bedrock, and varies between 62% and 87% in the sound bedrock.

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

2.2 Groundwater

The depth to groundwater and caved soils was measured in each of the boreholes immediately following the drilling. On completion of drilling, the boreholes were filled with drill fluid (from mud rotary drilling) and measuring the unstabilized groundwater level after drilling was not practical. Monitoring wells were installed in each of the boreholes, and stabilized groundwater levels were measured in each of the monitoring wells one week after the completion of drilling.

The groundwater observations are shown on the Borehole Logs and are summarized as follows.

Borehole No.	Borehole depth (m)	Upon completion of drilling		Strata Screened	Water Level in Well, highest (m)	
		Depth to cave (m)	Unstabilized water level (m)		Date	Depth/Elev.
101S	7.6	n/a	Filled with drill water	Silty Sand	2023-03-17	6.7 / 91.2
101D	18.8	n/a	Filled with drill water	Bedrock	2023-03-17	6.4/ 91.5
102S	9.1	n/a	Filled with drill water	Silt and Sand	2023-03-17	6.6 / 91.1
102D	19.9	n/a	Filled with drill water	Bedrock	2023-03-03	6.8 / 90.9
103	14.5	n/a	Filled with drill water	Sand / Gravelly Sand	2023-03-17	7.4 / 91.0

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. 91.5 m. The City of Toronto Maximum Anticipated Groundwater Level (MAGWL) is a planning elevation to determine whether or not the City will require a watertight below-grade structure, and is provided in the hydrogeological report.

The sands and silts have a high permeability and will yield free-flowing water when penetrated. It can be expected that fractures in the weathered and sound bedrock will produce seepage below the groundwater table.

Grounded has prepared a hydrogeological report for the proposed development at this site under separate cover (File No. 23-014).

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 samples scored less than 10 points, and **two** of the three samples scored higher than 10 points, so corrosion protective measures are therefore 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. **Two** of the three samples had a resistivity measurement of less than 2000 ohm.cm, and should be considered aggressive.

3 Preliminary Geotechnical Engineering Recommendations

Based on the factual data summarized above, we are providing the following preliminary 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. Additional site-specific boreholes, wells, in situ and laboratory testing, and a detailed geotechnical engineering report will be required for detailed design.

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.

Per Toronto Water's Infrastructure Management's Policy on Managing Foundation Drainage (November 1, 2021), long-term discharge of foundation drainage to the City's sewer system will not be permitted unless there is an exemption.

As part of their new policy, the City has defined a Maximum Anticipated Ground Water Level (MAGWL), which is the highest measured groundwater table elevation measured plus a regulatory offset called the "fluctuation allowance". The fluctuation allowance is based in part on the month in which the highest groundwater level measurement was made. The MAGWL is not a design groundwater table for engineering purposes, it is merely a planning elevation that the City uses to assess whether it will require a watertight below-grade structure or not.

The relevant groundwater information (based on the adjacent public information) is summarized as follows:

- Design groundwater table for engineering purposes: Elev. 91.5 m
- Lowest (P1) FFE: Elev. 94.6± m
- The design groundwater table is well below the lowest FFE.
- ***Therefore, a watertight below-grade structure is not anticipated.***

3.1 Foundation Design Parameters

The proposed project includes constructing a 12-storey building, with one underground parking level set at a lowest (P1) Finished Floor Elevation (FFE) of 94.6± m. The following foundation options are considered in the discussion below:

- Conventional spread footings
- Raft foundation
- End-bearing caissons (to rock)

The topsoil and earth fill soils are considered unsuitable for the support of the proposed building foundations.

When exposed to ambient environmental temperatures in the Greater Toronto Area, the design earth cover for frost protection of foundations and grade beams is 1.2 metres.

The design groundwater table is at Elev. 91.5 m. Based on the proposed depth of excavation (bulk + foundations) to accommodate the P1 (to approximately Elev. 93.0± m), this development, as presently proposed, will remain sufficiently above the groundwater table such that groundwater infiltration into the open excavation is not expected. For this reason, positive dewatering is not expected to be necessary. Regardless, the site should not be excavated below Elev. 92.4 m without positive dewatering in place, in order to preserve the native soils in their undisturbed state for foundation and/or slab construction.

3.1.1 Spread Footings

Conventional foundations made for the proposed P1 level will bear on undisturbed sandy silt. Spread footings made to bear on this soil may be designed using a maximum factored geotechnical resistance at ULS of 675 kPa. The net geotechnical reaction at SLS is 450 kPa, for an estimated total settlement of 25 mm. If these capacities are insufficient for the proposed development, spread footings (or drilled piers) can bear slightly deeper on the undisturbed sands at or below Elev. 92.0± m for a net geotechnical reaction at ULS of 900 kPa and SLS of 600 kPa, for an estimated total settlement of 25 mm.

Individual spread footing foundations designed to these capacities must be at least 1000 mm wide and must be embedded a minimum of 600 mm below FFE. These minimum requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to a settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

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

The founding subgrade must be cleaned of all unacceptable materials and approved by Grounded prior to pouring concrete for the footings. Such unacceptable materials may include disturbed or caved soils, ponded water, or similar as indicated by Grounded during founding subgrade inspection. During the winter, adequate temporary frost protection for the footing bases and concrete must be provided if construction proceeds during freezing weather conditions.

3.1.2 Raft Foundation

The proposed building could alternatively be supported by a raft foundation, with watertight foundation walls designed to withstand hydrostatic forces (lateral and uplift) if constructed below the water table. A 25 x 50 m raft underlying the tower is considered in the bearing capacity discussion below. Raft slabs for a podium structure will be subjected to much less load, and will not govern design.

Given a P1 FFE of 94.6 m, a raft would be founded at around Elev. 93.0± m on undisturbed dense native sands.

The preliminary raft design parameters are provided assuming a *uniform load* at the base of the raft. In reality, raft loads are non-uniform; they will be highest around the core and will decrease away from the core. Consequently, detailed raft design is an iterative process between the structural and geotechnical engineers. The preliminary parameters below are provided as the initial step in determining raft feasibility (a structural task).

Bulk excavation to underside of raft elevation (Elev. 93.0± m) will induce a reduction in effective stress of about 100 kPa, which is the unload stress. Utilizing preliminary soil stiffness parameters, analysis of a *uniformly* loaded raft foundation shows that a uniform total SLS bearing pressure of 100 kPa (which is recompression) applied at the base of the raft will generate around 5± mm of settlement. For 25 mm of total settlement, the total uniform SLS bearing pressure is 250 kPa. Each additional increase of 150 kPa (which is now virgin loading) generates an additional 25 mm of settlement. Thus, a total (gross) *uniform* geotechnical reaction at SLS of 400 kPa will generate 50 mm of settlement.

The modulus of subgrade reaction for design of a raft slab is a function of the size of the raft, the applied load, and whether loading is within the recompression range or the virgin range. On the basis of our preliminary stiffness parameters and the assumption of uniform raft loading, the preliminary modulus of subgrade reaction appropriate for 25x50 m raft design at this site is about 6,400 kPa/m for loads over 250 kPa SLS.

The above parameters are based on assumed Young's Moduli (virgin and unload-reload) for each of the load-bearing strata, and can likely be improved by in situ testing of the Young's Modulus within the critical portions of the zone of influence of the raft, in future boreholes.

Settlement parameters can be improved by modelling the real non-uniform loading at the base of the raft. Detailed raft design is an iterative process between the structural and geotechnical engineers. Once a draft structural design is completed by the structural engineer, the resulting non-uniform raft pressure distribution is provided to us (typically as a contour plot). Grounded will then use numerical modelling to determine the real settlement more accurately at each point under the raft. The detailed settlement distribution and MSRs under the raft are then sent back to the structural engineer, and the structural design is modified as necessary.

The maximum factored geotechnical resistance of this 25 x 50 m raft foundation at ULS is 2,000 kPa for raft foundation design purposes.

During construction, the subgrade at founding elevation should be cut neat, inspected, and immediately protected by a mud slab (lean concrete) to provide a working surface. The subsurface must not be proofrolled as this activity would further weaken these soils. The raft slab is then constructed on top of the mud slab. Prior to pouring the mud mat and foundation, the foundation subgrade must be cleaned of all deleterious materials such as softened, disturbed or caved materials, or standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the raft foundation base and concrete must be provided.

Differential settlement is related to real non-uniform raft load distribution and must be assessed as part of the detailed design process. Differential settlement may become an issue if two different foundation types (conventional spread footings and deep foundations) are used to support structures with different column loads (e.g. towers and adjacent podiums) on a shared underground parking structure. Likewise, differential settlement issues may become apparent if different foundation types are designed using two different SLS criteria. Net geotechnical reactions at SLS have been provided for both foundations systems, which will occur as load is applied and is linear and non-recoverable. The tolerance for differential settlement is related to the structural design and is specified by the structural engineer as a function of column spacing. Impacts to adjacent structures caused by settlement within the raft's zone of influence will also need to be reviewed.

3.1.3 Caissons

End-bearing caissons may be used to support the proposed structure. End-bearing caissons made to bear on unweathered (sound) bedrock may be designed using a maximum factored geotechnical resistance at ULS of 12 MPa. The geotechnical reaction at SLS is 9 MPa. Unweathered bedrock was identified in Boreholes 101 and 102 at depths of 15.5 and 15.6 m below grade (Elev. 82.4 m and 82.1 m), respectively. Additional rock coring is required to determine the depth of unweathered bedrock across the site.

The top of weathered bedrock and the depth of the sound bedrock must also be confirmed through Grounded's geotechnical engineering supervision during caisson installation.

In addition to the displacement of the rock, there will be compression of the concrete caisson shaft under loading which will increase the apparent settlement at the structure level.

Caissons should be separated from each other by at least 2.5 times the largest caisson diameter (measured centre to centre) to avoid inducing additional settlement from group effect. Caissons placed closer than this will induce group effects, and a reduced bearing capacity will apply, which is dependent on caisson sizing, bearing stratum, founding elevation, and separation distance. If this situation is unavoidable from a structural engineering perspective, we can calculate the expected settlement for existing caissons in this situation on request.

Caisson foundations at different elevations must be designed such that the higher caissons are set below a line drawn up at 10 horizontal to 7 vertical from the closest edge of the lower caisson.

Frost protection for interior foundations (or pile caps) with 900 mm of cover will perform adequately, as will perimeter foundations with 600 mm of cover. Where foundations are next to ventilation shafts or are exposed to typical outdoor temperatures, earth cover of 1.2 m or equivalent insulation is required for frost protection.

There are zones of soil at this site that are sufficiently cohesionless, permeable and wet that augered boreholes for caissons may be unstable. Augered boreholes for caissons may require temporary liners, polymer mud drilling techniques, tremie pour concrete, or other means and methods as deemed necessary by the contractor to prevent groundwater inflow or loss of soil into the drill holes, disturbance to placed concrete, or similar issues. Concrete for caissons must be placed by tremie method where there is more than 300 mm of water or fluid at the base of the hole.

At this site it will be necessary to control the bases of any drill holes extending below Elev. 91.5 m to protect them against loss of ground, upheave, and basal disturbance due to the ingress of groundwater from the lower aquifer. This may include pre-advancing casing, the use of drilling muds, or other means and methods as deemed necessary by the contractor.

Caissons with these capacities have historically been hand-cleaned and base inspected. To eliminate the requirement for hand cleaning and end inspecting each caisson, the following construction methodology must be utilized:

The following construction methodology must be utilized for the caissons: All caisson excavations are to be inspected on a full-time basis by Grounded per the OBC.

- Caissons designed to bear on sound rock are to be initially advanced to the top of sound bedrock as identified in Borehole 101 and 102 (but may vary across the site), and as confirmed by Grounded through observation of the drilling and auger cuttings at each location.
- Once the top of sound bedrock elevation is established for a given caisson by Grounded, the caisson must then be advanced an additional 1-2 m deeper, to be sure that the caisson is seated in the sound bedrock. This also provides some additional sidewall adhesion resistance (i.e. side shear).
- Auger, cleanout bucket, or one-eyed bucket cleaning of the hole base is to then take place in each caisson hole, and visually inspected by Grounded to ensure that auger cleaning has been carried out as thoroughly as practically possible.
- Place 30 MPa (min.) concrete to a minimum depth of 600 mm in the base of the hole (volume to be determined based on caisson diameter) to be stirred with the auger without advancing the auger any further for about 5 minutes.
- The auger spun concrete is then removed and wasted, leaving no more than 100 mm depth of concrete at the base of the caisson.
- Tremie placement of concrete is required wherever the drill holes have more than 300 mm of water in the base or are full of polymer or other drilling fluids.
- Complete construction of the caisson to cut off elevation.

3.2 Earthquake Design Parameters

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration, and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the 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 or grade beams) of 92-93± metres, the boreholes observe dense to very dense soil overlying bedrock. Based on this information, the site designation for seismic analysis is **Class C**, per Table 4.1.8.4.A of the Ontario Building Code (2012). Tables 4.1.8.4.B and 4.1.8.4.C. of the same code provide the applicable acceleration- and velocity-based site coefficients.

3.3 Earth Pressure Design Parameters

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

Stratigraphic Unit	γ	φ	K_a	K_o	K_p
Compact Granular Fill Granular ‘B’ (OPSS.MUNI 1010)	21	32	0.31	0.47	3.25
Existing Earth Fill	19	29	0.35	0.52	2.88
Sandy Silt	21	34	0.28	0.44	3.54
Sand	21	38	0.24	0.38	4.20
Glacial Till	21	40	0.22	0.36	4.60
Sound Bedrock	26	28	n/a		

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

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

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

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

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

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

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

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

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

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

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

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

3.4 Slab on Grade Design Parameters

The slab-on-grade parameters provided here apply to a conventional slab on grade and drained basement approach only. If a fully watertight raft foundation approach is adopted (with no permanent drainage system), design parameters are provided in Section 3.1.2.

At the proposed lowest P1 elevation, the undisturbed native soils will provide adequate subgrade for the support of a conventional slab on grade. The modulus of subgrade reaction for slab-on-grade design supported by undisturbed native soils is 30,000 kPa/m.

If this basement structure is made as a conventional drained structure, a permanent drainage system including subfloor drains is required (see section below). In this case, the slab on grade must be provided with a drainage layer and capillary moisture break, which is achieved by forming the slab on a minimum 200 mm thick layer of 19 mm clear stone (OPSS.MUNI 1004) vibrated to a dense state. In this case, any subfloor drainage pipes must be in trenches with a minimum 200 mm clearance above for clear stone.

Wherever the slab-on-grade is made on native sands, the drainage layer must be separated from the sands using a non-woven geotextile (with an apparent opening size of less than 0.250 mm and a tear resistance of more than 200 N) with a minimum 600 mm overlap. The stone drainage layer is then placed over the geotextile. Without this filtering layer, fines from the underlying sand subgrade will enter the drainage layer potentially resulting in loss of ground, loss of slab support, and clogging of the subfloor drainage system.

Prior to placement of the capillary moisture break and construction of the slab, the cut subgrade be cut and inspected by Grounded for obvious exposed loose or disturbed areas, or for areas containing excessive deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 percent SPMDD). The slab on grade should not be placed on frozen subgrade, to prevent settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation.

3.5 Long-Term Groundwater and Seepage Control

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

The requirement for a permanent basement drainage system depends on whether a fully watertight approach is adopted for this site. Per the discussion above, the City may potentially permit a drained basement approach at this site. Grounded's Hydrogeological Report (File No. 23-014) provides further discussion on this. The following discussion pertains to a drained basement approach only.

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

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

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

The permanent dewatering requirements are provided in Grounded's Hydrogeological Report (File No. 23-014).

If any water is to be discharged to the storm or sanitary sewers, the City will require Discharge Agreements to be in place. Although a drained basement approach may be technically feasible, the City of Toronto may likely prohibit long-term discharge in light of their recent policy change.

Alternatively, if a raft foundation is preferred, the structure will be fully watertight and the above recommendations will not apply. A design groundwater table of Elev. 91.5 must be considered for design (uplift and lateral hydrostatic forces, if applicable).

4 Considerations for Construction

4.1 Excavations

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

- The earth fill is a Type 3 soil
- The glacial till is a Type 2 soil
- The cohesionless sands and silts soils are Type 3 soils (above the GWT or dewatered), or Type 4 if below the GWT.

In accordance with the regulation's requirements, the soil must be suitably sloped and/or braced where workers must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes (of no more than 3 m in height) by soil type are stipulated as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes. Any excavation slopes greater than 3 m in height should be checked by Grounded for global stability issues.

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

Excess soil is now governed by Ontario Regulation 406/19: On-Site and Excess Soil Management. As of January 1, 2023, 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.

4.2 Short-Term Groundwater Control

Considerations pertaining to groundwater discharge quantities and quality are discussed in Grounded's hydrogeological report for the site (File No. 23-014), under separate cover.

The groundwater table at Elev. 91.5± m is well below the bulk and foundation excavation levels for the proposed P1. Within the zone of excavation, the boreholes were generally dry and open with no seepage. There is infiltrated stormwater in the fill. On this basis, it is expected that seepage if encountered will be of limited extent. In open excavations, it is anticipated that seepage volumes will be limited to the extent that temporary pumping will sufficiently control any groundwater seepage. Regardless, excavation delays will occur as seepage (however limited) is controlled. These delays should be anticipated in the construction schedule.

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

4.3 Earth-Retention Shoring Systems

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

Excavation zone of influence guidelines are appended.

Continuous interlocking caisson wall shoring is to be used where the excavation must be constructed as a rigid shoring system. Caisson wall shoring preserves the support capabilities and integrity of the soil beneath existing foundations of adjacent buildings, in a state akin to the at-rest condition. Otherwise, excavations can be supported using conventional soldier pile and lagging walls.

4.3.1 Lateral Earth Pressure Distribution

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

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

$$\boldsymbol{P = 0.65\, K[\gamma H + q] + \gamma_w h_w}$$

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. 91.5 m must be accounted for. There is infiltrated stormwater perched in the earth fill which may accumulate behind a caisson wall. This hydrostatic pressure needs to be accounted for in shoring design. In cohesionless soils, the lateral earth pressure distribution is rectangular.

4.3.2 Soldier Pile Toe Embedment

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

Within the expected depth of soldier piles and caissons for rigid shoring, there are zones of soil in the subgrade that are wet, cohesionless, and permeable. Augered holes for piles made into these soils will be prone to caving and blowback. Temporarily cased holes are 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.

4.3.3 Lateral Bracing Elements

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

In the compact to dense sandy silts, 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).

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 compact to dense sandy silt below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on these soils at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 300 kPa.

4.4 Site Work

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

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

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

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

Adequate temporary frost protection for the founding subgrade must be provided if construction proceeds in freezing weather conditions. The subgrade at this site is susceptible to frost damage. The slab on grade should not be placed on frozen subgrade, to prevent settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation. Depending on the project context, consideration should be given to frost effects (heaving, softening, etc.) on exposed subgrade surfaces.

4.5 Engineering Review

By issuing this preliminary report, Grounded Engineering has assumed the role of Geotechnical Engineer of Record for this site. Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented. Additional site-specific boreholes, wells, and a detailed geotechnical engineering report will be required for detailed design.

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.

The long-term performance of a slab on grade is highly dependent upon the subgrade support and drainage conditions. Strict procedures must be maintained during construction to maintain the integrity of the subgrade to the extent possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Grounded at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

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

5 Limitations and Restrictions

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

The geotechnical engineering recommendations provided in this report are considered preliminary. At detailed design, additional boreholes, in-situ testing, groundwater monitoring wells, and updated detailed geotechnical engineering advice are required. Once completed, the future detailed geotechnical engineering report by Grounded Engineering would then supersede this preliminary report.

5.1 Investigation Procedures

The preliminary 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 conventional standard practice by Grounded as well as other 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 out with HQ size diamond bit core drilling barrels. As drilling proceeded, groundwater observations were made in the boreholes. Based on examination of recovered borehole samples, our field supervisor made a record of borehole and drilling observations. The field samples were secured in air-tight clean jars and bags and taken to the Grounded soil laboratory where they were each logged and reviewed by the geotechnical engineering team and the senior reviewer.

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

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

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

5.2 Site and Scope Changes

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

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

5.3 Report Use

The authorized users of this report are Jameson Plaza Limited 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 Toronto may also make use of and rely upon this report, subject to the limitations as stated.

6 Closure

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

For and on behalf of our team,

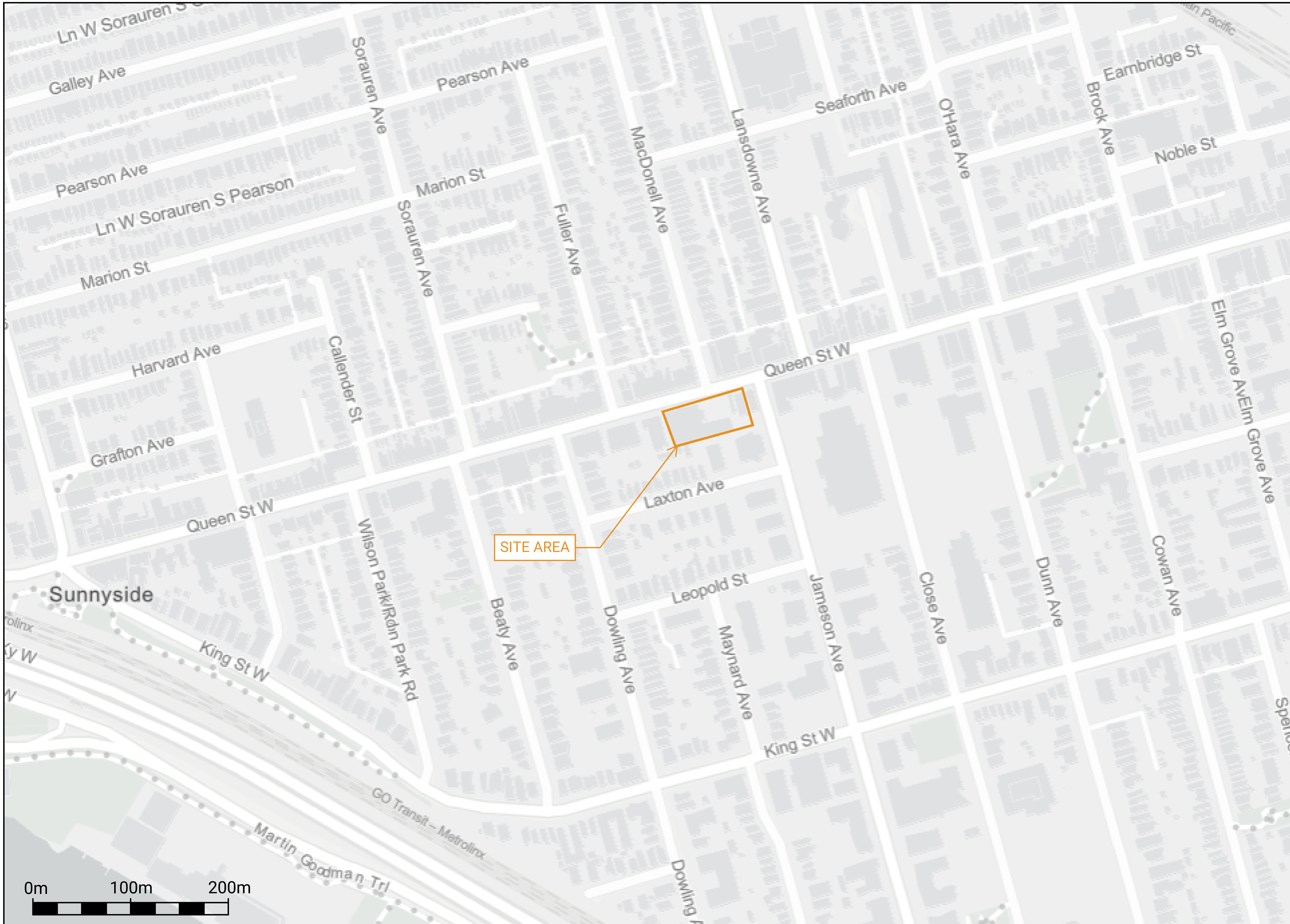
GROUNDED ENGINEERING

Nico Piers, BASc.
Project Coordinator

Kyle Byckalo, P.Eng.
Senior Geotechnical Engineer

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

FIGURES



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LEGEND

APPROXIMATE PROPERTY BOUNDARY

Note

Reference

ArcGis MyMap, 2023

Project

1437-1455 QUEEN ST W, TORONTO, ONTARIO

Figure Title

SITE LOCATION PLAN

North

TRUE
PROJECT

Date

MARCH 2023

Scale

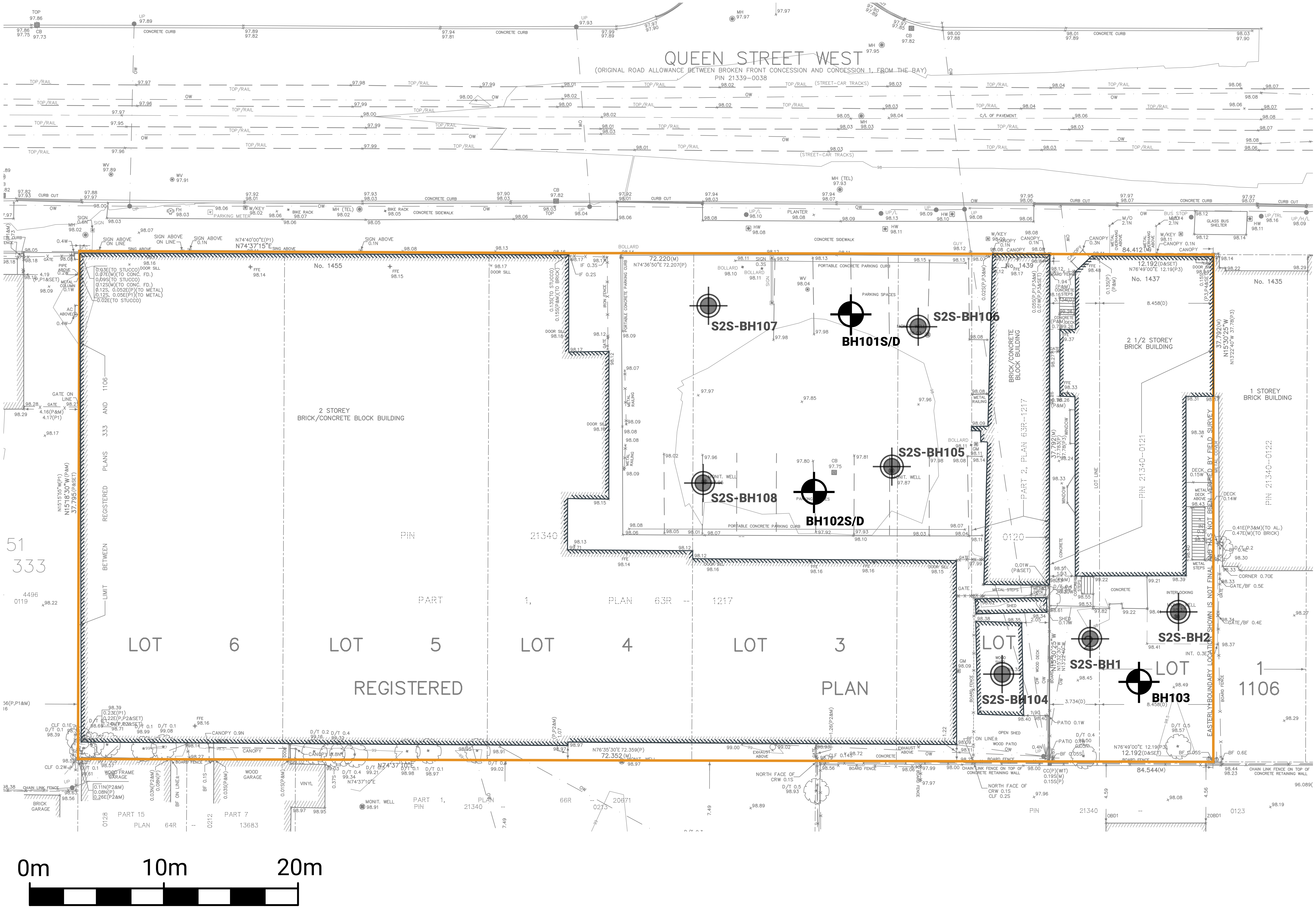
AS INDICATED

Job No

23-014

Figure No

FIGURE 1



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LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDING STRUCTURE
- MONITORING WELL/BOREHOLE BY GROUNDED
- MONITORING WELL/BOREHOLE BY OTHERS

Note

Reference

Plan of Survey, Parts of Lot 1 and All of Lots 2 to 6, Registered Plan 1106 of City of Toronto, Job No. 23-037-00, Schaeffer Dzaldov Purcell Ltd, Dated February 13, 2023

Project

1437-1455 QUEEN ST W, TORONTO, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - EXISTING SITE CONDITIONS

North

TRUE
PROJECT

Date

MARCH 2023

Scale

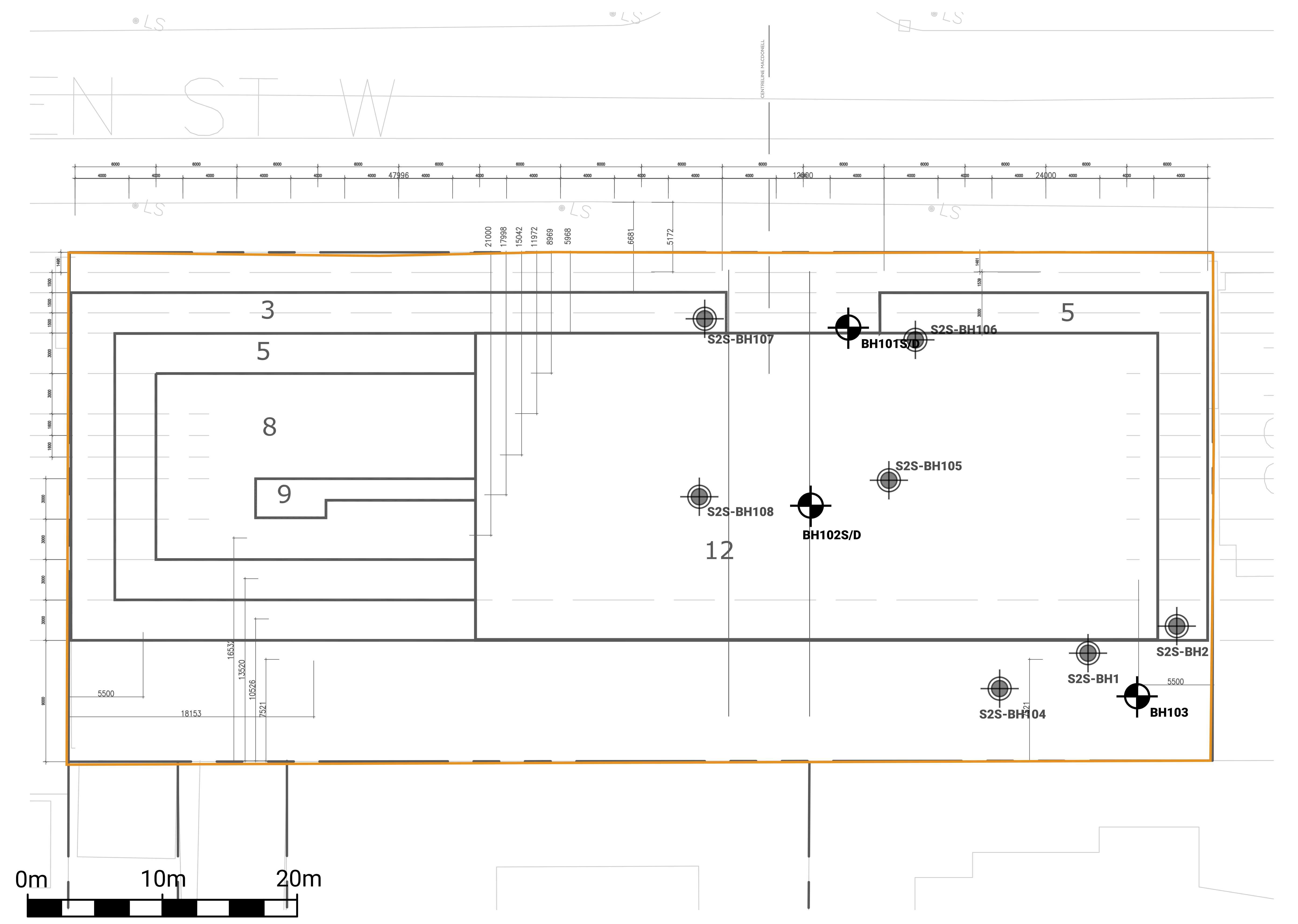
AS INDICATED

Job No

23-014

Figure No

FIGURE 2



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LEGEND

- PROPERTY BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- MONITORING WELL/BOREHOLE BY OTHERS

Note

Reference

Conceptual Site Plans, RAW Design, "1437-1455 Queen St W", Dated February 16, 2023

Project

1437-1455 QUEEN ST W, TORONTO, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN - PROPOSED SITE CONDITIONS

North

TRUE

PROJECT

Date

MARCH 2023

Scale

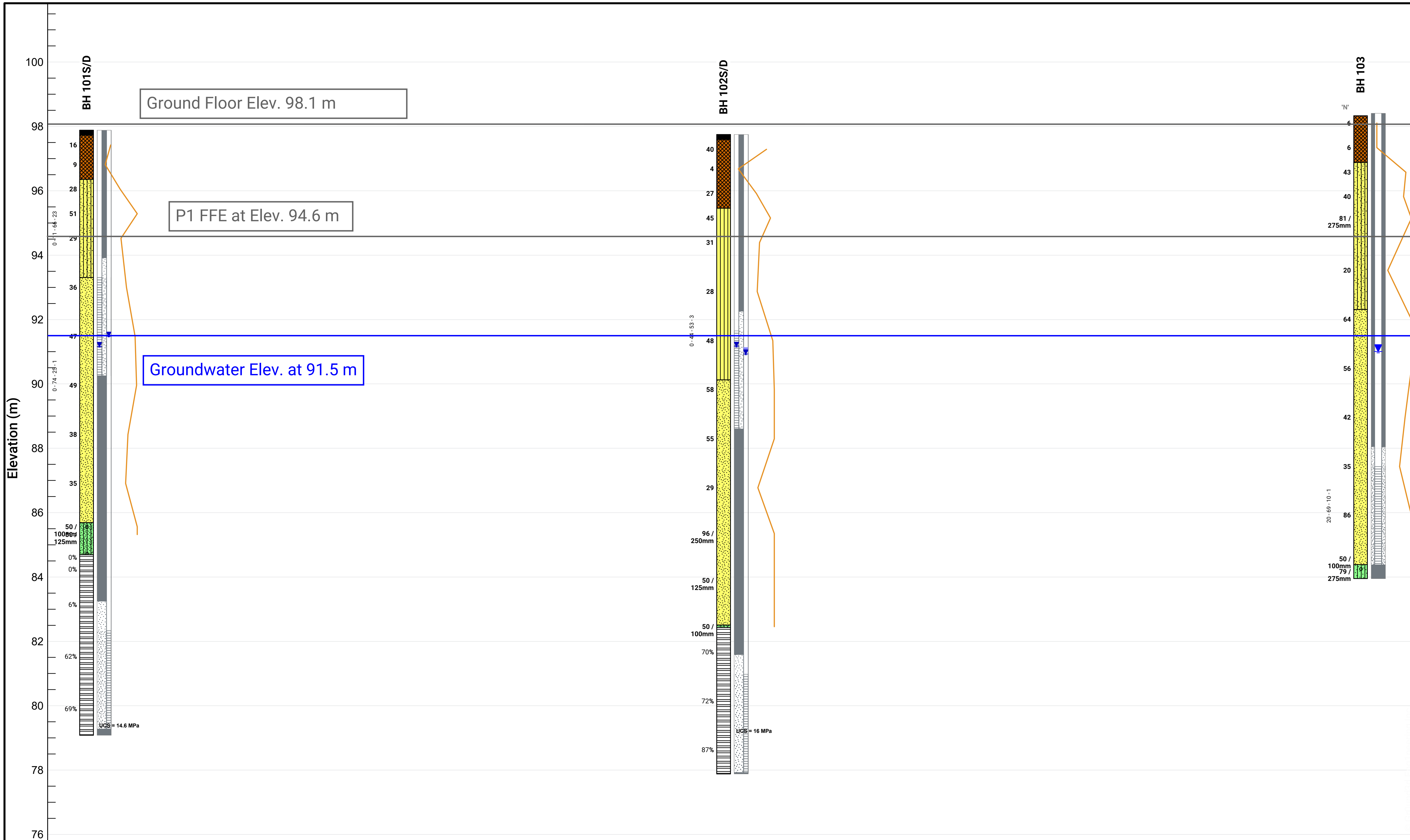
AS INDICATED

Job No

23-014

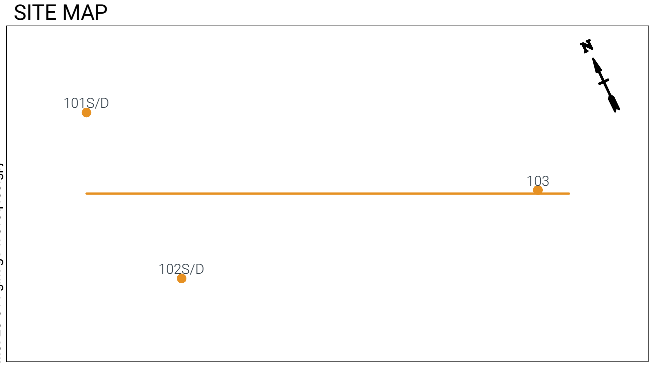
Figure No

FIGURE 3



Boreholes Equally Spaced

SITE MAP



file: 23-014 gint-ge-lt-6v6q103.gpj

BOREHOLE STRATIGRAPHY LEGEND

- Asphalt
- Fill
- Sandy Silt
- Sand
- Sand and Silt Till
- Shale
- Silt
- Sandy Silt Till

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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

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

Project
1437-1455 QUEEN ST W
1437-1455 QUEEN ST W

Figure Title
SUBSURFACE PROFILE

Date
MARCH 2023

Scale
AS INDICATED

Job No
23-014

Figure No
FIGURE 4

APPENDIX A

BOREHOLE LOG TERMINOLOGY

GROUNDED ENGINEERING

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

PI: plasticity index

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ 1st water level measurement

▼ 2nd water level measurement most recent

▼ water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

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

WET: visible pore water

COHESIONLESS

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

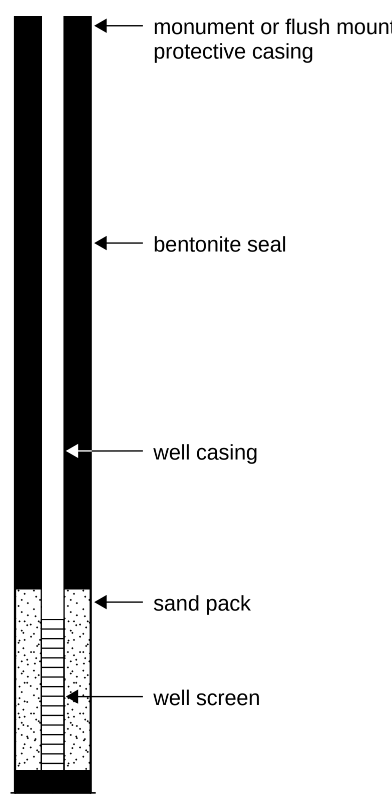
COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

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

WELL LEGEND



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.

ROCK CORE TERMINOLOGY (ISRM)

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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

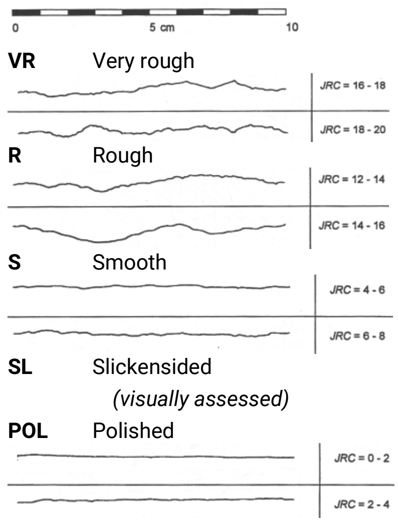
Coating

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

Weathering Grades (*after ISRM 1981b*)

Grade	**Term**	**Description**
I	fresh	no visible sign of rock material weathering; perhaps slight discoloration only
II	slightly weathered	discoloration indicates weathering; rock material may be somewhat weaker than in its fresh condition
III	moderately weathered	less than half of rock is decomposed to soil; fresh rock is present as continuous framework
IV	highly weathered	more than half of rock is decomposed to soil; fresh rock is present as discontinuous framework
V	completely weathered	soil-like matrix only; original mass structure is still largely intact

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 : Jul 2, 2023
Position : E: 626005, N: 4833100 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101S/D

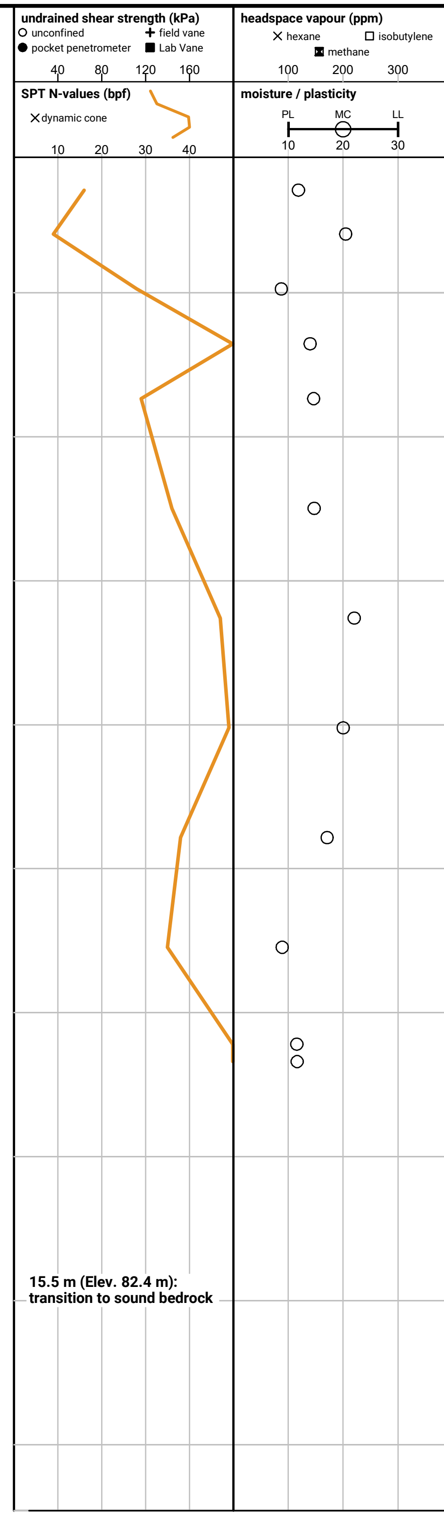
File No. : 23-014 **Project** : 1437-1455 Queen St W, 1437-1455 Queen St W **Client** : Jameson Plaza Limited

Stratigraphy

drill method : CME TRACK	elev / depth (m)	description
	97.9	**GROUND SURFACE**
hollow stem augers OD=215 mm		150mm **ASPHALT**
		FILL, silty sand, trace gravel, trace clay, trace construction debris, compact, brown to dark brown, moist ...at 0.8 m, clayey silt, some clay, trace gravel, trace construction debris, brown with orange staining, moist, stiff
	96.4 / 1.5	**SANDY SILT**, trace clay, trace gravel, orange staining, compact, brown, moist ...at 2.3 m, very dense ...at 3.0 m, clayey silt, some sand, brown to grey, compact
mud rotary small OD=100 mm	93.3 / 4.6	**SAND**, some silt, trace clay, seams and layers of sandy silt, dense, brown, moist ...at 6.1 m, wet ...at 7.6 m, silty sand, trace clay, grey ...at 9.1 m, trace gravel
	85.7 / 12.2	**SAND AND SILT**, trace gravel, trace shale and limestone fragments, very dense, grey, wet (GLACIAL TILL)
rock coring (HQ) OD=96 mm	84.7 / 13.2	**GEORGIAN BAY FORMATION**
	79.1 / 18.8	

Samples

number	type	SPT N-value	moisture (%)
1	SS	16	
2	SS	9	
3	SS	28	
4	SS	51	
5	SS	29	
6	SS	36	
7	SS	47	
8	SS	49	
9	SS	38	
10	SS	35	
11	SS	50 / 100mm	
12	SS	50 / 125mm	
1	RUN		
2	RUN		
3	RUN		
4	RUN		
5	RUN		



Lab data and comments

depth	comment	grain size distribution (%) (MIT) GR SA SI CL
Sample 5		0 11 66 23
4.6m	Auger grinding	
Sample 8		0 74 25 1
10.2m	Auger grinding	
11.6m	Auger grinding	
12.5m	Auger grinding	

END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

S: 50 mm dia. monitoring well installed.
D: 50 mm dia. monitoring well installed.

101S/D-S GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 13, 2023	6.8	91.1
Feb 21, 2023	6.8	91.1
Mar 3, 2023	6.8	91.1
Mar 17, 2023	6.7	91.2

101S/D-D GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 13, 2023	6.9	91.0
Feb 21, 2023	6.9	91.0
Mar 3, 2023	6.7	91.2
Mar 17, 2023	6.4	91.5

file: 23-014 gint-ge-lt-6v6q103.gpj

Tech : CH | **PM** : NP | **Rev** : KB

Date Started : Jul 2, 2023
Position : E: 626005, N: 4833100 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 101S/D

File No. : 23-014 **Project** : 1437-1455 Queen St W, 1437-1455 Queen St W **Client** : Jameson Plaza Limited

stratigraphy

Rock coring started at 13.2m below grade

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded to medium bedded, weak; joints are horizontal, closed, clean, smooth, planar;

interbedded with **limestone**, light green, laminated to thinly bedded, medium, occasionally fossiliferous

Overall shale: 85%, limestone: 15%

Run 1 : 21% limestone, 79% shale

Run 2 : 5% limestone, 95% shale

... at 15.5 m (Elev. 82.4 m), transition to sound rock

Run 3 : 0% limestone, 100% shale

Run 4 : 29% limestone, 71% shale

Run 5 : 20% limestone, 80% shale

END OF COREHOLE

Run	elev / depth (m)	recovery
	84.7 / 13.2	
R1	13.4	TCR = 101%, SCR = 72%, RQD = 0%
R2	13.9	TCR = 100%, SCR = 11%, RQD = 0%
R3	82.4 / 15.5	TCR = 100%, SCR = 19%, RQD = 6%
R4	80.8 / 17.1	TCR = 100%, SCR = 86%, RQD = 62%
R5	79.1 / 18.8m	TCR = 100%, SCR = 85%, RQD = 69%

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 (top to bottom): N/A, N/A, N/A, N/A, N/A, N/A, RZ, 2, 1, 2, 0, 2, 1, 3, 1, 2, 1, 3, 1, 0

laboratory testing:
El. 79.4m: UCS = 14.6 MPa, E = 1.70 GPa, γ = 25.4 kN/m^3

notes and comments

- **13.3 / 84.6 - 13.3 / 84.5m:** rubillized zone
- **13.4 / 84.5 - 13.4 / 84.5m:** rubillized zone
- **14.8 / 83.1 - 15.0 / 82.9m:** rubillized zone
- **15.2 / 82.7 - 15.3 / 82.5m:** IS clay
- **15.5 / 82.4 - 15.5 / 82.3m:** IS clay
- **16.2 / 81.7m:** JT SV PR GA CN
- **16.6 / 81.3m:** JT SV PR GA CN
- **17.0 / 80.9m:** JT SV PR GA CN
- **17.4 / 80.5 - 17.5 / 80.4m:** IS clay

depth (m): 14, 15, 16, 17, 18
elevation (m): 84, 83, 82, 81, 80

file: 23-014 gint-ge-lt-6v6q103.gpj

Tech : CH | PM : NP | Rev : KB

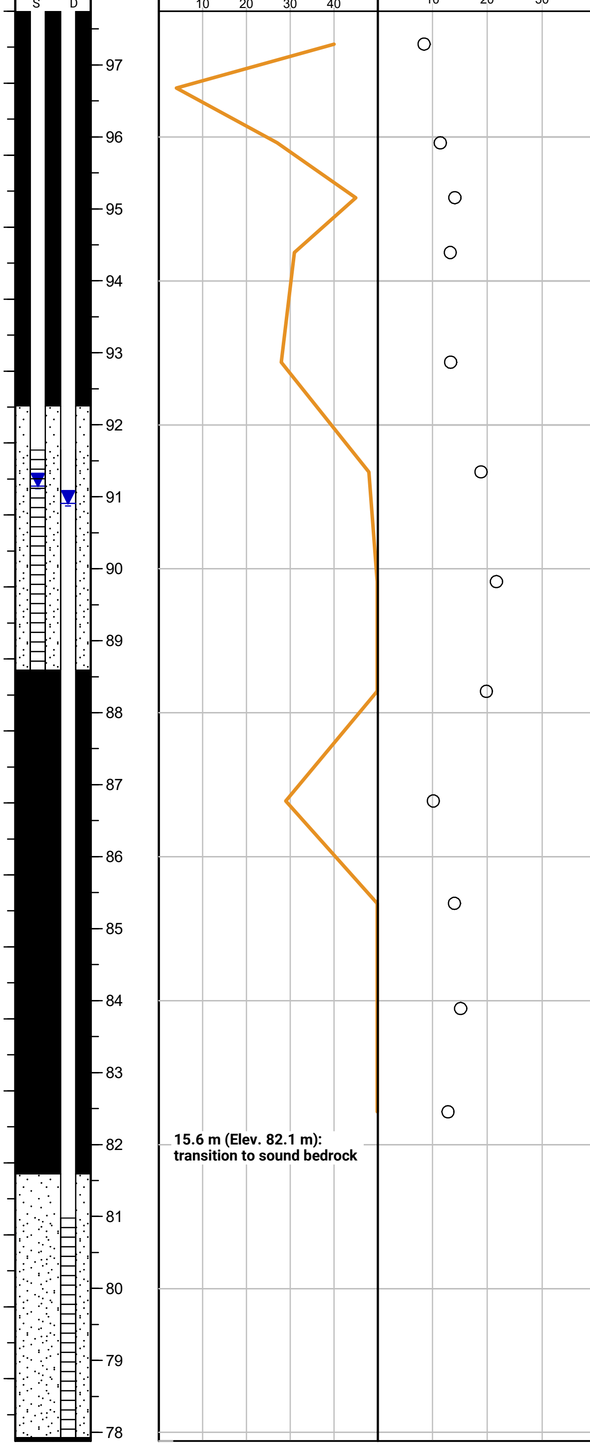
GROUNDED ENGINEERING

Date Started : Aug 2, 2023
Position : E: 626006, N: 4833086 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 102S/D

File No. : 23-014 **Project** : 1437-1455 Queen St W, 1437-1455 Queen St W **Client** : Jameson Plaza Limited

drill method : CME TRACK	elev depth (m)	stratigraphy description	sample number	type	SPT N-value	lab data and comments (grain size distribution (%) (MIT) GR SA SI CL)
	97.7	GROUND SURFACE				
hollow stem augers OD=215 mm		150mm **ASPHALT**				
		FILL, sand, some silt, dense, brown, moist	1	SS	40	
		...at 0.8 m, sandy silt, trace gravel, brown and grey, loose, moist	2	SS	4	
	95.4	...at 1.5 m, trace construction debris, compact	3	SS	27	
	2.3	**SILT**, some sand, trace clay, trace gravel, orange staining, dense, brown and grey, moist	4	SS	45	
mud rotary small OD=100 mm		...at 3.0 m, sandy silt	5	SS	31	
		...at 4.6 m, silty sand, wet	6	SS	28	
	90.1	...at 6.1 m, silt and sand	7	SS	48	0 44 53 3
	7.6	**SAND**, some silt, trace clay, very dense, brown, wet	8	SS	58	
		...at 9.1 m, grey	9	SS	55	
		...at 10.7 m, silty sand, compact	10	SS	29	
		...at 12.2 m, sand, some silt, very dense	11	SS	96 / 250mm	
	82.5		12	SS	50 / 125mm	
	15.2 / 82.4 / 15.3	**SAND AND SILT**, some clay, trace gravel, trace shale and limestone fragments, very dense, grey, wet (GLACIAL TILL)	13	SS	50 / 100mm	
rock coring (HQ) OD=96 mm		**GEORGIAN BAY FORMATION**	1	RUN		
			2	RUN		
	77.8 / 19.9		3	RUN		



END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

S: 50 mm dia. monitoring well installed.
D: 50 mm dia. monitoring well installed.

102S/D-S GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 13, 2023	6.7	91.0
Feb 21, 2023	6.7	91.0
Mar 3, 2023	6.7	91.0
Mar 17, 2023	6.6	91.1

102S/D-D GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 13, 2023	6.9	90.8
Feb 21, 2023	7.0	90.7
Mar 3, 2023	6.8	90.9
Mar 17, 2023	6.8	90.9

file: 23-014 gint-ge-lt-6v6q103.gpj

Tech : CH | **PM** : NP | **Rev** : KB

Date Started : Aug 2, 2023
Position : E: 626006, N: 4833086 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 102S/D

File No. : 23-014 **Project** : 1437-1455 Queen St W, 1437-1455 Queen St W **Client** : Jameson Plaza Limited

Rock coring started at 15.3m below grade (82.4)

Stratigraphy

GEORGIAN BAY FORMATION
Shale, grey, thinly bedded to medium bedded, weak; joints are horizontal, closed, clean, smooth, planar;

interbedded with **limestone**, light grey, laminated to thinly bedded, medium, occasionally fossiliferous

Overall shale: 81%, limestone: 19%
... at 15.6 m (Elev. 82.1 m), transition to sound rock

Run	elev / depth (m)	recovery	Composition
R1	82.4 / 15.3 – 80.9	TCR = **100%**, SCR = **92%**, RQD = **70%**	Run 1 : 14% limestone, 86% shale
R2	80.9 / 16.8 – 79.3	TCR = **100%**, SCR = **95%**, RQD = **72%**	Run 2 : 23% limestone, 77% shale
R3	79.3 / 18.4 – 77.8	TCR = **100%**, SCR = **97%**, RQD = **87%**	Run 3 : 20% limestone, 80% shale

19.9m

END OF COREHOLE

Natural fracture frequency (top to bottom)

RZ, 2, 2, 2, 2, 2, 3, 1, 1, 5, 1, 0, 2, 3, 2

Shale weathering zones: Z1, Z2, Z3, Z4
UCS (MPa): 5, 25, 50, 100, 250
Estimated strength: R1, R2, R3, R4, R5, R6

Laboratory testing

El. 79.2m:
UCS = 16 MPa
E = 1.50 GPa
γ = 25.7 kN/m^3

Notes and comments

15.3 / 82.4m: JT SV PR GA CN
16.0 / 81.8 - 16.1 / 81.7m: rubillized zone
16.9 / 80.8m: JT SV PR GA CN
18.0 / 79.7m: IS clay
18.1 / 79.7 - 18.1 / 79.7m: rubillized zone
18.4 / 79.4m: IS clay

depth (m): 16, 17, 18, 19
elevation (m): 82, 81, 80, 79, 78

file: 23-014 gint-ge-lt-6v6q103.gpj

 Tech : CH | **PM** : NP | **Rev** : KB

GROUNDED ENGINEERING

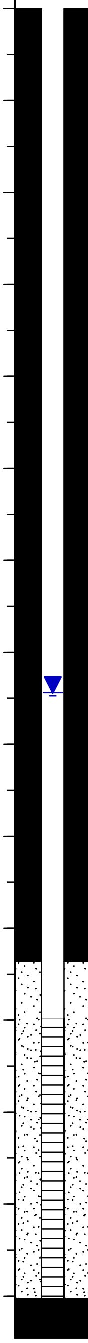
Date Started : Jun 2, 2023
Position : E: 626032, N: 4833081 (UTM 17T)
Elev. Datum : Geodetic

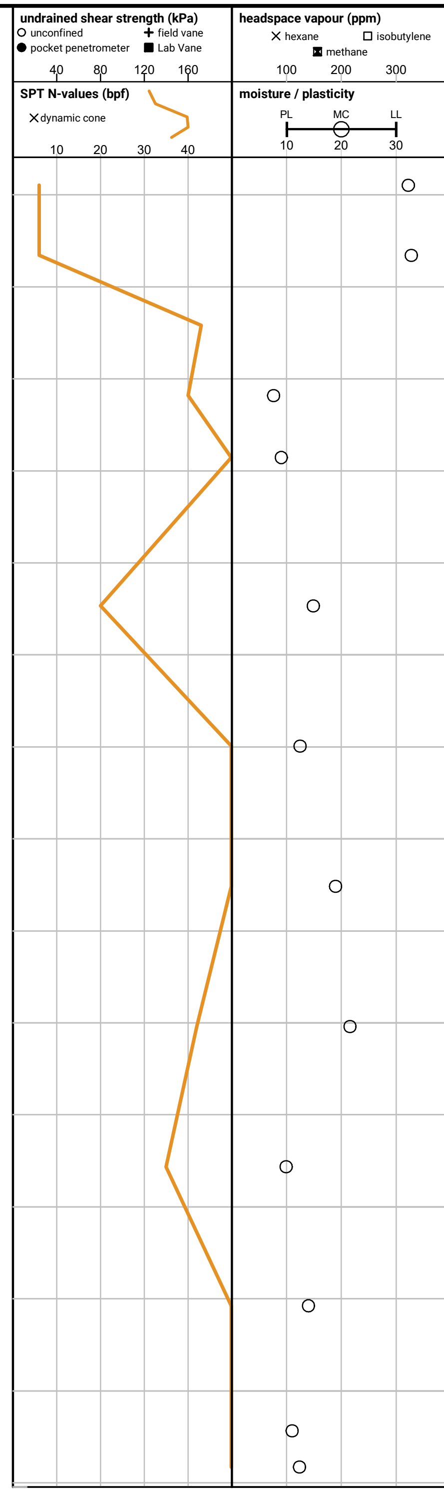
BOREHOLE LOG 103

File No. : 23-014 **Project** : 1437-1455 Queen St W, 1437-1455 Queen St W **Client** : Jameson Plaza Limited

drill method : CME TRACK	elev depth (m)	stratigraphy description	sample number	type	SPT N-value	lab data and comments
	98.4	**GROUND SURFACE**				
hollow stem augers OD=215 mm		75mm **TOPSOIL**				
		FILL, silt, some sand, some clay, trace rootlets, trace organics, loose, dark brown, moist	1	SS	6	
			2	SS	6	
	96.9 / 1.5	**SANDY SILT**, trace gravel, dense, brown and grey, moist	3	SS	43	
		...at 2.3 m, orange staining	4	SS	40	
mud rotary small OD=100 mm		...at 3.0 m, sand seams, very dense	5	SS	81 / 275mm	
		...at 4.6 m, silt, some sand, some clay, grey, compact	6	SS	20	
	92.3 / 6.1	**SAND**, some silt, seams and layers of sandy silt, very dense, grey, moist	7	SS	64	
		...at 7.6 m, wet	8	SS	56	
		...at 9.1 m, dense	9	SS	42	
			10	SS	35	
						11.4m: Auger grinding
		...at 12.2 m, gravelly sand, trace clay, very dense	11	SS	86	grain size distribution (%) (MIT) GR 20 SA 69 SI 10 CL 1
						13.5m: Auger grinding
	84.4 / 14.0	...at 13.7 m, silty, trace shale and limestone fragments	12	SS	50 / 100mm	**13.8m:** Auger grinding
	83.9 / 14.5	**SANDY SILT**, clayey, trace gravel, trace shale and limestone fragments, very dense, grey, wet (GLACIAL TILL) ...at 14.3 m, shale and limestone fragments	13	SS	79 / 275mm	

well details





END OF BOREHOLE

Dry and open upon completion of drilling.

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

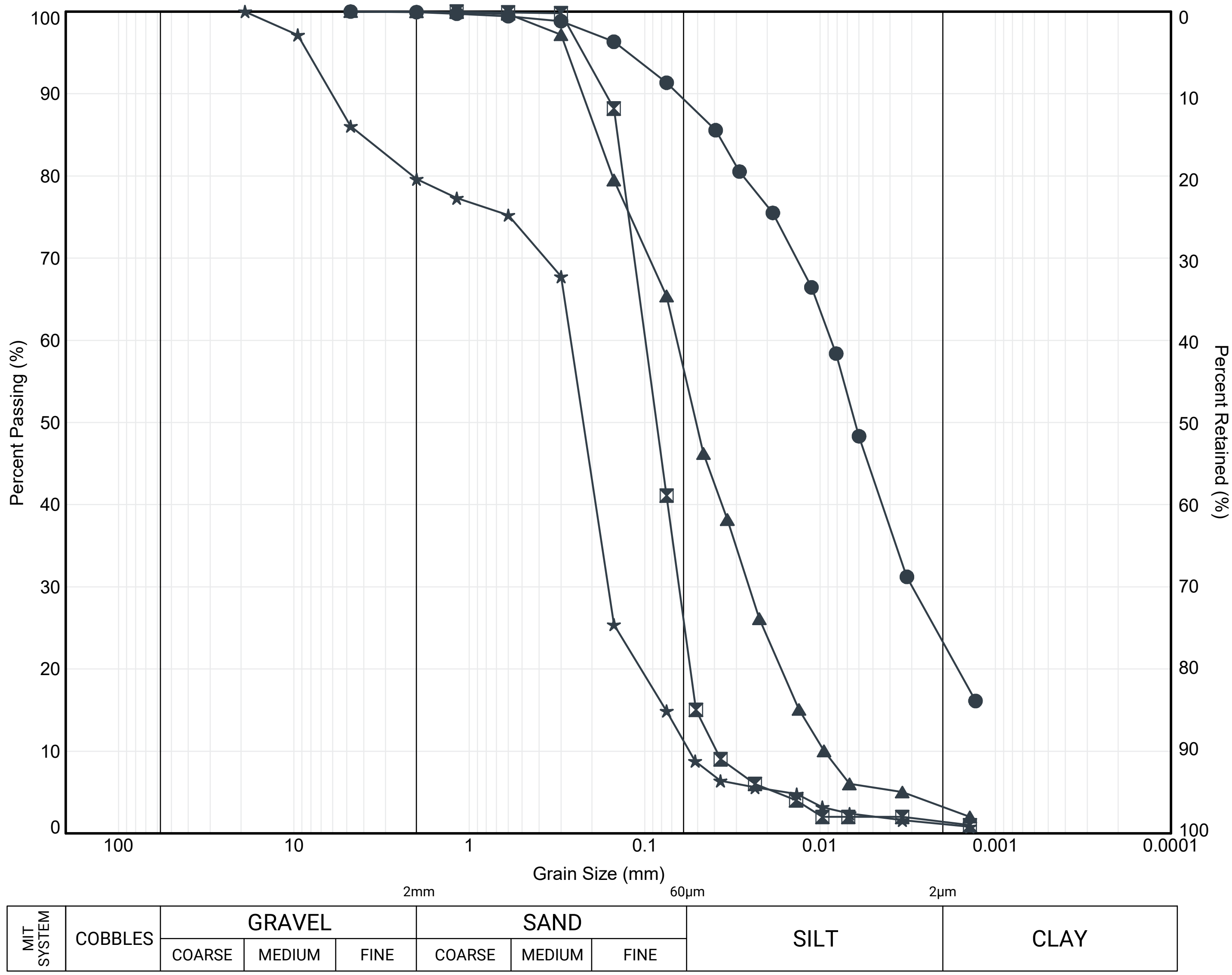
GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Feb 13, 2023	7.5	90.9
Feb 21, 2023	7.5	90.9
Mar 3, 2023	7.5	90.9
Mar 17, 2023	7.4	91.0

file: 23-014 gint-ge-lt-6v6q103.gpj

Tech : CH | **PM** : NP | **Rev** : KB

APPENDIX B



	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					MIT SYSTEM			
●	**101S/D**	SS5	3.4	94.5	0	11	66	23
⊠	**101S/D**	SS8	7.9	90.0	0	74	25	1
▲	**102S/D**	SS7	6.4	91.3	0	44	53	3
★	**103**	SS11	12.5	85.9	20	69	10	1

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**

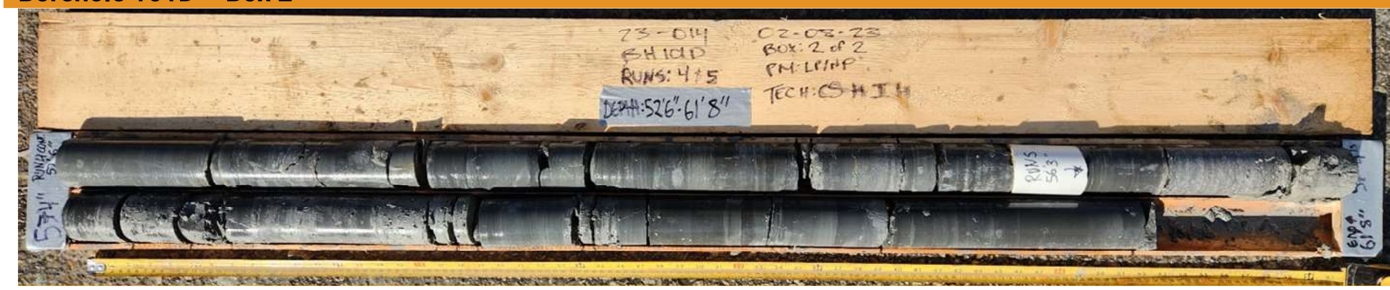
File No.: **23-014**

APPENDIX C

Borehole 101D – Box 1

Depth: 13.2 to 16.0 m below grade (Elev. 84.7 to 81.9 m)

Borehole 101D – Box 2

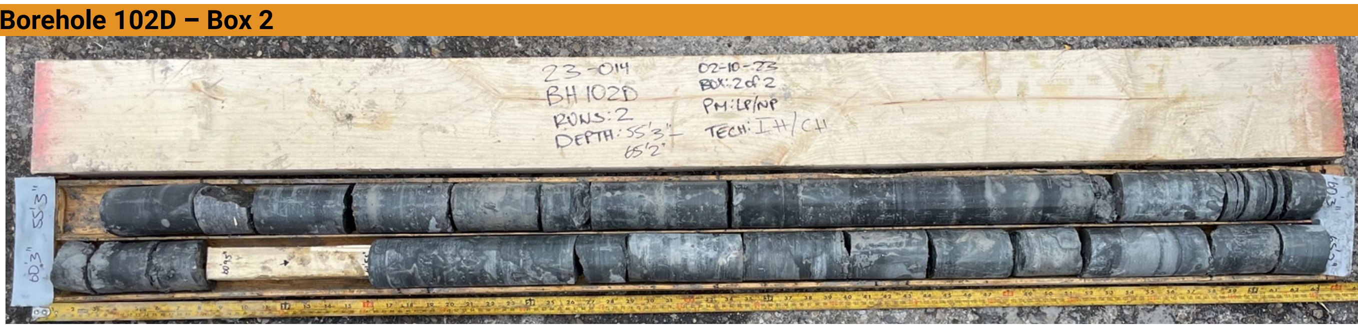


Depth: 16.0 to 18.8 m below grade (Elev. 81.9 to 79.1 m)

Borehole 102D – Box 1

Depth: 15.2 to 16.8 m below grade (Elev. 82.5 to 80.9 m)

Borehole 102D – Box 2



Depth: 16.8 to 19.9 m below grade (Elev. 80.9 to 77.8 m)

GEOMECHANICA

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

February 23, 2023

Mr. Nico Piers
Grounded Engineering
1 Banigan Drive
Toronto, ON
Canada, M4H 1E9

Re: UCS Testing
(Grounded Project No. 23-014)

Dear Mr. Piers:

On February 10th, 2023, a total of two (2) HQ-sized core samples were received by Geomechanica Inc. via drop-off by Grounded personnel. These samples were identified as being from Grounded project 23-014. From these samples, two (2) Uniaxial Compressive Strength (UCS) test specimens were prepared and tested.

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

Sincerely,

Bryan Tatone Ph.D., P. Eng.

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

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

Nico Piers
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

February 23, 2023
Project number: 23-014

Abstract

This document summarizes the results of rock laboratory testing, including 2 Uniaxial Compressive Strength (UCS) tests. The UCS and Young's modulus values along with photographs of specimens before and after testing are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests

1.1 Overview

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

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

Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, was met for all specimens. The length to diameter ratio was not met for several specimens due to the short sample lengths provided (as noted in Table 1). Testing of the specimens followed ASTM D7012-14 with the following note:

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

1.2 Results

The results of UCS testing are summarized in Table 1. The corresponding stress-strain curves are presented in Figure 2. The Young's modulus is the tangent modulus calculated as the slope of the best-fit line through a selection of data points defining the stress-strain curve. Typically the modulus is defined at 50% of the UCS strength. However, due to non-linear pre-peak stress-strain behaviour, a custom stress range (where the specimen deformed linearly) was selected for modulus determination. This stress range along with additional specimen details and measurements are provided in the summary spreadsheet that accompanies this report.

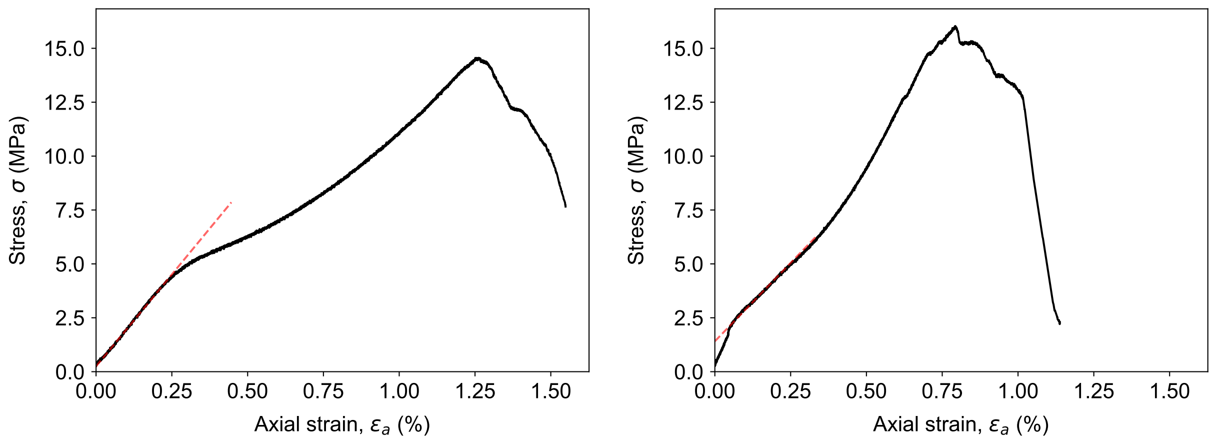
Table 1: Summary of Uniaxial Compression test results.

Sample	Depth (ft' in")	Bulk density ρ (g/cm^3)	UCS (MPa)	Young's modulus E (GPa)	Lithology	Failure description
BH101D, CS1	60'8" - 61'7"	2.591	14.6	1.7	Shale	1, 2
BH101D, CS2	60'9.5" - 61'5.5"	2.624	16.0	1.5	Shale	3, 1, 2

[1] Localized crushing near platen
[2] Specimen emitted pore water upon loading
[3] 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) BH101D-CS1 (b) BH101D-CS2

Figure 2: Measured stress-strain curves.

Appendices

Specimen sheets

- BH101D, CS1
- BH101D, CS2

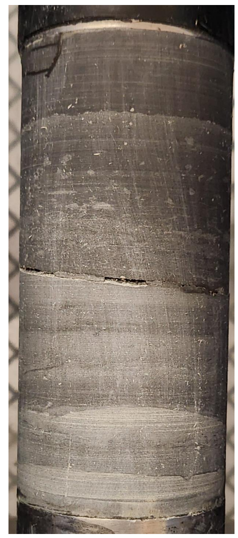
Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	23-014
Sample	BH101D, CS1	**Depth**	60’8” - 61’7”

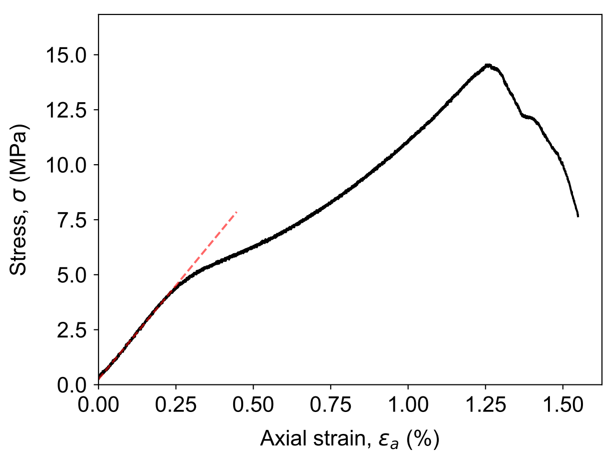
Specimen parameters	
Diameter (mm) [a]	61.03
Length (mm) [a]	126.78
Bulk density ρ (g/cm^3)	2.591
UCS (MPa)	14.6
Young’s modulus E (GPa) [b]	1.7
Lithology	Shale
Failure description [c]	1, 2

[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 20.0% of the peak strength.
[c] Failure description: [1] Localized crushing; [2] Specimen emitted pore water upon loading;

Prior to testing



After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-02-22

Uniaxial Compression Test

Client	Grounded Engineering Inc.	**Project**	23-014
Sample	BH101D, CS2	**Depth**	60’9.5” - 61’5.5”

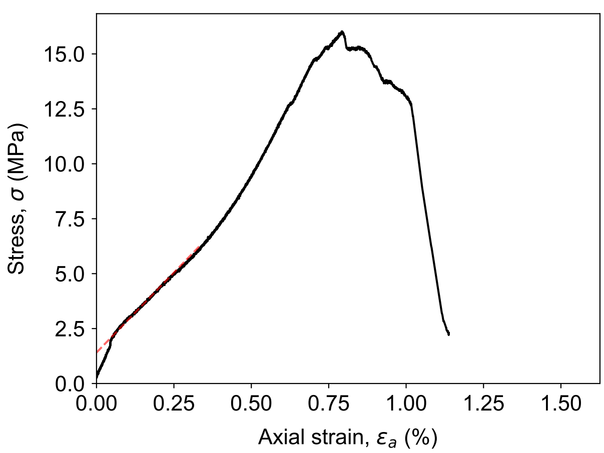
Specimen parameters

Diameter (mm) [a]	61.04
Length (mm) [a]	127.53
Bulk density ρ (g/cm^3)	2.624
UCS (MPa)	16.0
Young’s modulus E (GPa) [b]	1.5
Lithology	Shale
Failure description [c]	3, 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 20.0% of the peak strength.
[c] Failure description: [3] Inclined shear fracture and axial splitting failure; [1] Localized crushing; [2] Specimen emitted pore water upon loading;

Prior to testing

After testing



Remarks: Loading rate: 0.15 mm/min.

Performed by	MB/MB	**Date**	2023-02-22

APPENDIX D

CORROSIVITY (ALS)

Results Summary WT2303980

Project	23-014
Report To	Nicholas Piers, Grounded Engineering Inc.
Date Received	17-Feb-2023 10:00
Issue Date	27-Feb-2023 10:27
Amendment	0

Client Sample ID			BH101-SS4	BH102-SS0	BH103-SS3
Date Sampled			13-Feb-2023	13-Feb-2023	13-Feb-2023
Time Sampled			17:00	17:00	17:00
ALS Sample ID			WT2303980-001	WT2303980-002	WT2303980-003
Analyte	Lowest Detection Limit	Units	Sub-Matrix: Soil/Solid	Sub-Matrix: Soil/Solid	Sub-Matrix: Soil/Solid
Physical Tests (Matrix: Soil/Solid)					
Conductivity (1:2 leachate)	5	μS/cm	1010	2990	421
Moisture	0.25	%	11.7	10.6	7.58
pH	0.1	pH units	7.94	8.04	7.87
Redox Potential	0.1	mV	263	273	265
Resistivity	100	ohm cm	990	330	2380
Leachable Anions & Nutrients (Soil)					
Chloride	5	mg/kg	536	1770	93.8
Anions and Nutrients (Soil)					
Sulphate	20	mg/kg	54	51	172
Inorganic Parameters (Soil)					
Acid Volatile Sulphides	0.2	mg/kg	1.87	0.83	<0.22

INTERPRETATION

AWWA C-105 Standard		**Points**	**Points**	**Points**
% Moisture		1	1	1
pH		0	0	0
Redox Potential		0	0	0
Resistivity		8	10	0
Acid Volatile Sulphides		3.5	3.5	0
TOTAL SCORE (AWWA C-105)		**12.5**	**14.5**	**1**
Sample		**BH101-SS4**	**BH102-SS0**	**BH103-SS3**
Corrosion Protection Recommended?		**YES**	**YES**	**No**
Resistivity less than 2000 ohm.cm?		**YES**	**YES**	**No**
Anions and Nutrients (Soil)				
Sulphate	%	0.0054	0.0051	0.0172
CLASS OF EXPOSURE		**Negligible**	**Negligible**	**Negligible**

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right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **WT2303980**		Page	: 1 of 3
Client	: **Grounded Engineering Inc.**		Laboratory	: Waterloo - Environmental
Contact	: Nicholas Piers		Account Manager	: Amanda Overholster
Address	: 1 Banigan Drive Toronto ON Canada M4H 1G3		Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 647 264 7928		Telephone	: 1 416 817 2944
Project	: 23-014		Date Samples Received	: 17-Feb-2023 10:00
PO	: ----		Date Analysis Commenced	: 17-Feb-2023
C-O-C number	: ----		Issue Date	: 27-Feb-2023 10:27
Sampler	: CLIENT			
Site	: 1437-1455 QUEEN ST. W TORONTO			
Quote number	: 2023 SOA Pricing			
No. of samples received	: 3			
No. of samples analysed	: 3			

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Centralized Prep, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
FR5	*As per applicable reference method(s), soil:water ratio for Fixed Ratio Leach was modified to 1:5 due to high soil organic content*

Analytical Results

Sub-Matrix: **Soil/Solid**

(Matrix: **Soil/Solid)**

					Client sample ID	BH101-SS4	BH102-SS0	BH103-SS3	----	----
					Client sampling date / time	13-Feb-2023 17:00	13-Feb-2023 17:00	13-Feb-2023 17:00	----	----
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		WT2303980-001	WT2303980-002	WT2303980-003	--------	--------
						Result	Result	Result	----	----
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm		1010 FR5	2990	421	----	----
Moisture	----	E144	0.25	%		11.7	10.6	7.58	----	----
Oxidation-reduction potential [ORP]	----	E125	0.10	mV		263	273	265	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units		7.94	8.04	7.87	----	----
Resistivity	----	EC100R	100	ohm cm		990	330	2380	----	----
Inorganics										
Sulfides, acid volatile	----	E396-L	0.20	mg/kg		1.87	0.83	<0.22	----	----
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg		536	1770	93.8	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg		54	51	172	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2303980**	Page	: 1 of 8
Client	: **Grounded Engineering Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Nicholas Piers	Account Manager	: Amanda Overholster
Address	: 1 Banigan Drive Toronto ON Canada M4H 1G3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 647 264 7928	Telephone	: 1 416 817 2944
Project	: 23-014	Date Samples Received	: 17-Feb-2023 10:00
PO	: ----	Issue Date	: 27-Feb-2023 10:25
C-O-C number	: ----		
Sampler	: CLIENT		
Site	: 1437-1455 QUEEN ST. W TORONTO		
Quote number	: 2023 SOA Pricing		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation: Preparation Date	Extraction / Preparation: Holding Times Rec	Extraction / Preparation: Holding Times Actual	Extraction / Preparation: Eval	Analysis: Analysis Date	Analysis: Holding Times Rec	Analysis: Holding Times Actual	Analysis: Eval
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap BH101-SS4	E396-L	13-Feb-2023	17-Feb-2023	14 days	4 days	✓	17-Feb-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap BH102-SS0	E396-L	13-Feb-2023	17-Feb-2023	14 days	4 days	✓	17-Feb-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap BH103-SS3	E396-L	13-Feb-2023	17-Feb-2023	14 days	4 days	✓	17-Feb-2023	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap BH101-SS4	E236.Cl	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap BH102-SS0	E236.Cl	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap BH103-SS3	E236.Cl	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap BH101-SS4	E236.SO4	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation: Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis: Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap BH102-SS0	E236.SO4	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap BH103-SS3	E236.SO4	13-Feb-2023	22-Feb-2023	30 days	9 days	✓	22-Feb-2023	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap BH101-SS4	E100-L	13-Feb-2023	22-Feb-2023	----	----		23-Feb-2023	30 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap BH102-SS0	E100-L	13-Feb-2023	22-Feb-2023	----	----		23-Feb-2023	30 days	10 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap BH103-SS3	E100-L	13-Feb-2023	22-Feb-2023	----	----		23-Feb-2023	30 days	10 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap BH101-SS4	E144	13-Feb-2023	----	----	----		17-Feb-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap BH102-SS0	E144	13-Feb-2023	----	----	----		17-Feb-2023	----	----	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap BH103-SS3	E144	13-Feb-2023	----	----	----		17-Feb-2023	----	----	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap BH101-SS4	E125	13-Feb-2023	22-Feb-2023	----	----		22-Feb-2023	180 days	8 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times* Rec	*Holding Times* Actual	*Eval*	*Analysis Date*	*Holding Times* Rec	*Holding Times* Actual	*Eval*
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap BH102-SS0	E125	13-Feb-2023	22-Feb-2023	----	----		22-Feb-2023	180 days	8 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap BH103-SS3	E125	13-Feb-2023	22-Feb-2023	----	----		22-Feb-2023	180 days	8 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap BH101-SS4	E108A	13-Feb-2023	17-Feb-2023	----	----		21-Feb-2023	30 days	8 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap BH102-SS0	E108A	13-Feb-2023	17-Feb-2023	----	----		21-Feb-2023	30 days	8 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap BH103-SS3	E108A	13-Feb-2023	17-Feb-2023	----	----		21-Feb-2023	30 days	8 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	838740	1	5	20.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	840351	1	18	5.5	5.0	✓
Moisture Content by Gravimetry	E144	838741	1	18	5.5	5.0	✓
ORP by Electrode	E125	841223	1	5	20.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	838473	2	40	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	841790	1	4	25.0	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	841789	1	4	25.0	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	838740	1	5	20.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	840351	2	18	11.1	10.0	✓
Moisture Content by Gravimetry	E144	838741	1	18	5.5	5.0	✓
ORP by Electrode	E125	841223	1	5	20.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	838473	2	40	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	841790	2	4	50.0	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	841789	2	4	50.0	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	838740	1	5	20.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	840351	1	18	5.5	5.0	✓
Moisture Content by Gravimetry	E144	838741	1	18	5.5	5.0	✓
Water Extractable Chloride by IC	E236.Cl	841790	1	4	25.0	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	841789	1	4	25.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L Waterloo - Environmental	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A Waterloo - Environmental	Soil/Solid	MOEE E3137A	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode.
ORP by Electrode	E125 Waterloo - Environmental	Soil/Solid	APHA 2580 (mod)	Oxidation Redution Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 Waterloo - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl Waterloo - Environmental	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO4 Waterloo - Environmental	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L Waterloo - Environmental	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.
Resistivity Calculation for Soil Using E100-L	EC100R Waterloo - Environmental	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions

Preparation Methods	*Method / Lab*	*Matrix*	*Method Reference*	*Method Descriptions*
Leach 1:2 Soil:Water for pH/EC	EP108 Waterloo - Environmental	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A Waterloo - Environmental	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 Waterloo - Environmental	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 Waterloo - Environmental	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP396-L Waterloo - Environmental	Soil/Solid	APHA 4500S2J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

QUALITY CONTROL REPORT

Work Order	: **WT2303980**	Page	: 1 of 5
Client	: Grounded Engineering Inc.	Laboratory	: Waterloo - Environmental
Contact	: Nicholas Piers	Account Manager	: Amanda Overholster
Address	: 1 Banigan Drive Toronto ON Canada M4H 1G3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: 1 416 817 2944
Project	: 23-014	Date Samples Received	: 17-Feb-2023 10:00
PO	: ----	Date Analysis Commenced	: 17-Feb-2023
C-O-C number	: ----	Issue Date	: 27-Feb-2023 10:25
Sampler	: CLIENT 647 264 7928		
Site	: 1437-1455 QUEEN ST. W TORONTO		
Quote number	: 2023 SOA Pricing		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Centralized Prep, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

- Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO = Data Quality Objective.
- LOR = Limit of Reporting (detection limit).
- RPD = Relative Percent Difference
- # = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 838473)											
WT2303684-003	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.88	7.85	0.381%	5%	----
Physical Tests (QC Lot: 838741)											
WT2303702-001	Anonymous	Moisture	----	E144	0.25	%	11.1	11.4	1.90%	20%	----
Physical Tests (QC Lot: 839001)											
WT2303684-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.74	7.74	0.00%	5%	----
Physical Tests (QC Lot: 840351)											
WT2304100-070	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.0384 mS/cm	36.6	1.80	Diff <2x LOR	----
Physical Tests (QC Lot: 841223)											
FC2300424-001	Anonymous	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	336	290	14.7%	25%	----
Leachable Anions & Nutrients (QC Lot: 841789)											
WT2303735-001	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	41	43	2	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 841790)											
WT2303735-001	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	7.0	7.0	0.06	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Result*	*Qualifier*
Physical Tests (QCLot: 838741)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 840351)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Inorganics (QCLot: 838740)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 841789)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 841790)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 838473)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 838741)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Physical Tests (QCLot: 839001)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 840351)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	101	90.0	110	----
Inorganics (QCLot: 838740)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	2.472 mg/kg	85.0	70.0	130	----
Leachable Anions & Nutrients (QCLot: 841789)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	102	80.0	120	----
Leachable Anions & Nutrients (QCLot: 841790)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	102	80.0	120	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	RM Target Concentration	Recovery (%) RM	Recovery Limits (%) Low	Recovery Limits (%) High	Qualifier
Physical Tests (QCLot: 840351)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1031.5 µS/cm	93.7	70.0	130	----
Physical Tests (QCLot: 841223)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	106	80.0	120	----
Leachable Anions & Nutrients (QCLot: 841789)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	589 mg/kg	105	70.0	130	----
Leachable Anions & Nutrients (QCLot: 841790)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	466 mg/kg	94.7	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

ALS www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: 20 - 1005699

Page 1 of 1

Environmental Division
Waterloo
Work Order Reference
WT2303980

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	Grounded Engineering
Contact:	Nico Piers
Phone:	416-984-5734
	Company address below will appear on the final report
Street:	1 Banigan Dr
City/Province:	Toronto, ON
Postal Code:	M4H 1G3

Invoice To	
Same as Report To	☑ YES ☐ NO
Copy of Invoice with Report	☑ YES ☐ NO
Company:	Grounded Engineering
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: npiers@groundedeng.ca

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: npiers@groundedeng.ca

Email 2

Turnaround Time (TAT) Requested

- ☑ Routine [R] if received by 3pm M-F - no surcharges apply
- ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimu
- ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimu
- ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimu
- ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimu
- ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Addi may apply to rush requests on weekends, statutory holidays and non-ro

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please c

Project Information

ALS Account # / Quote #:	
Job #:	23-014
PO / AFE:	
LSD:	1437-1455 Queen St W, Toronto
ALS Lab Work Order # (ALS use only):	JG

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Analysis Re

Indicate Filtered (F), Preserved (P) or Filtered an

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Corrosivity	SAMPLES ON HOLD	EXTENDED STORAGE REQUIR	SUSPECTED HAZARD (see note
	BH101-SS4	13-02-23	17:00	Soil	1	X			
	BH102-SS5	↓	↓	↓	1	X			
	BH103-SS3	↓	↓	↓	1	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

Corrosivity suite

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☑ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C: 9.8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: Nico Piers	Date: 13/02/23	Time: 17:30	Received by:	Date:	Time:	Received by: [illegible]	Date: 2/17/23	Time: 1000

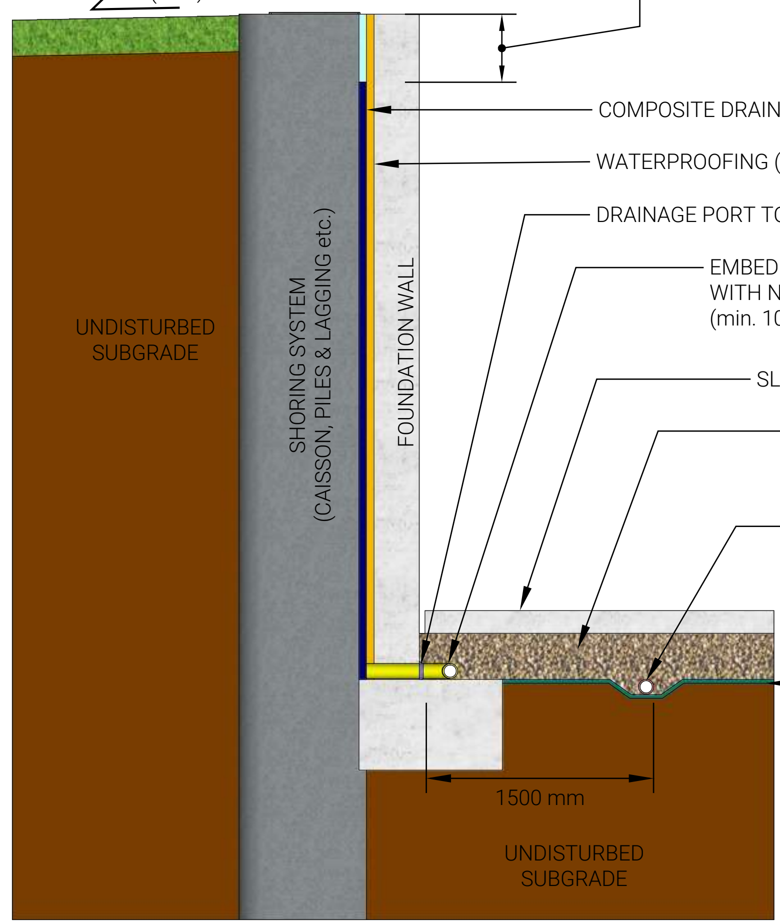
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

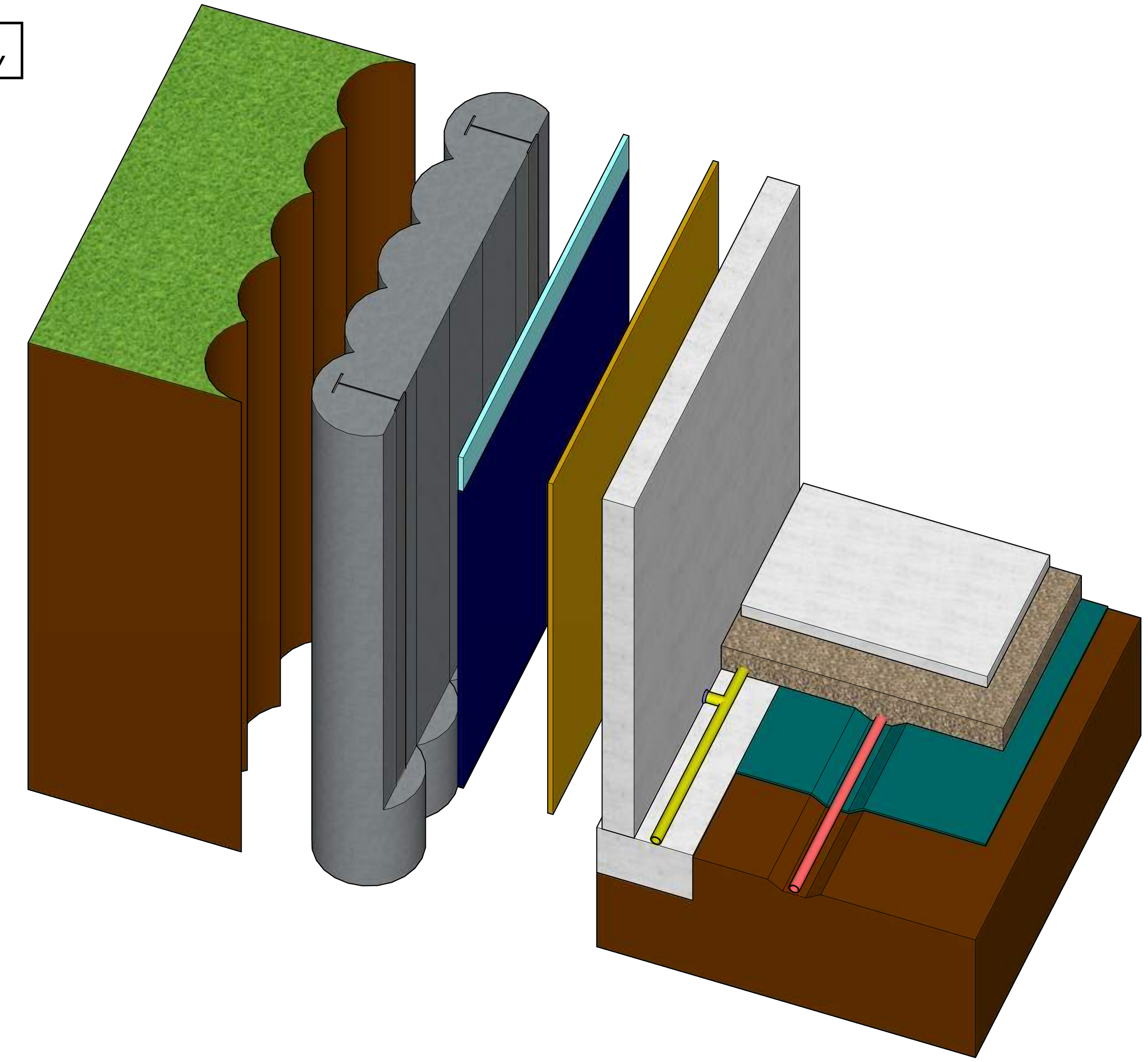
SOL808

APPENDIX E



SECTIONAL VIEW

OBJECTS ARE COLOR-CODED
BETWEEN TWO VIEWS FOR CLARITY



ISOMETRIC VIEW

SUBFLOOR DRAINAGE SYSTEM

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

PERIMETER DRAINAGE SYSTEM

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

GENERAL NOTES

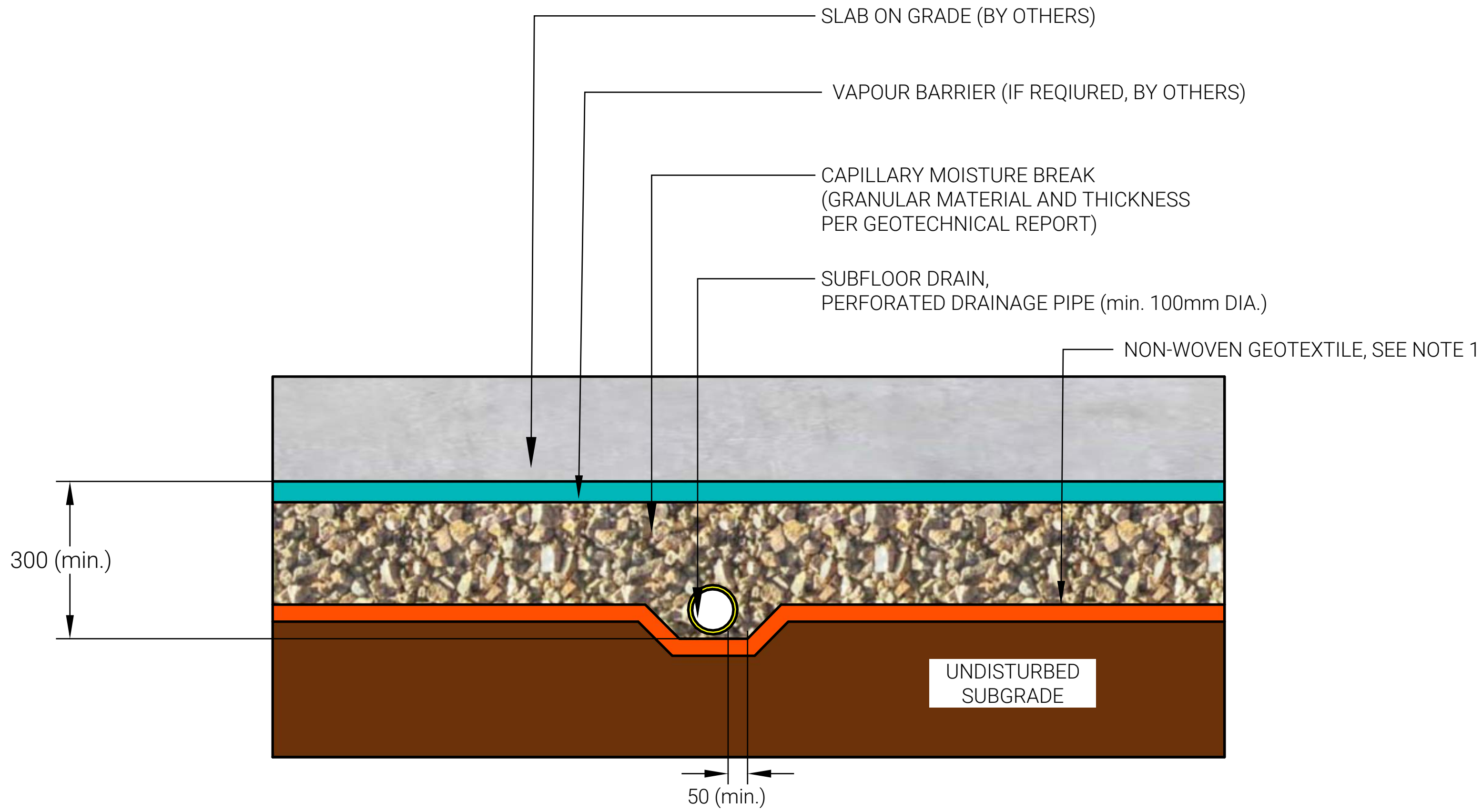
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC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

GROUNDED ENGINEERING

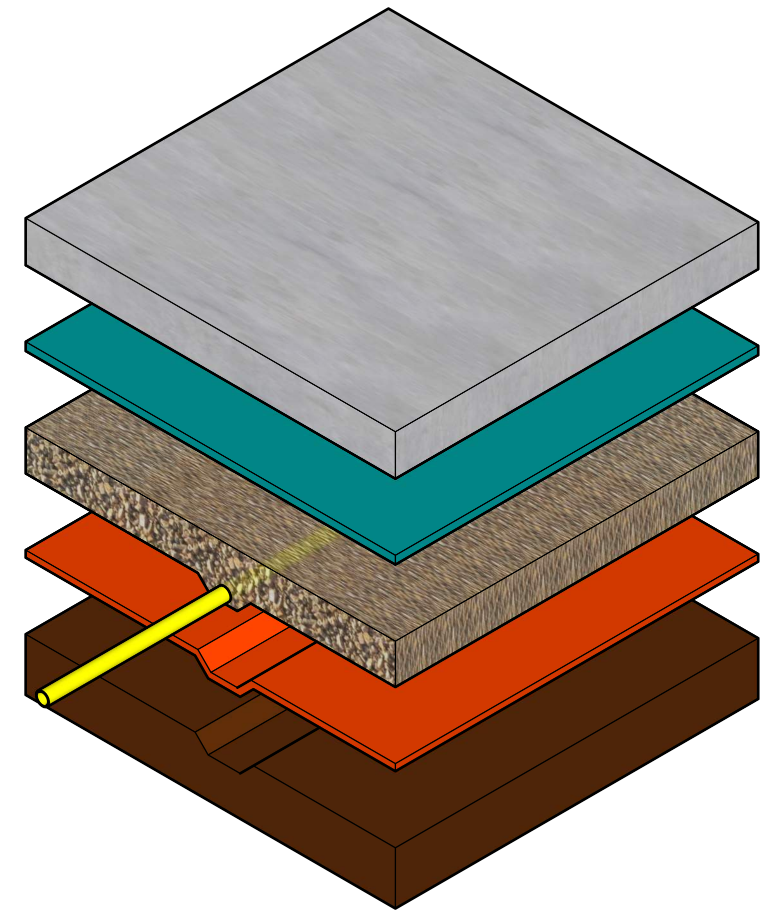
Title

BASEMENT DRAINAGE SHORING SYSTEM TYPICAL DETAILS

OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC VIEW

NOTES

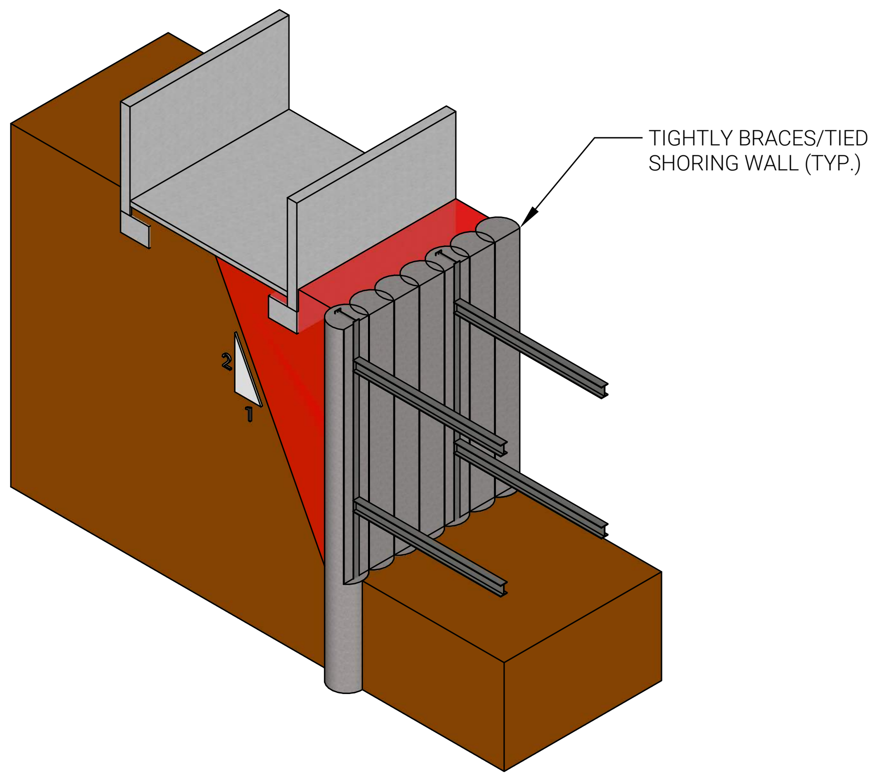
1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N).

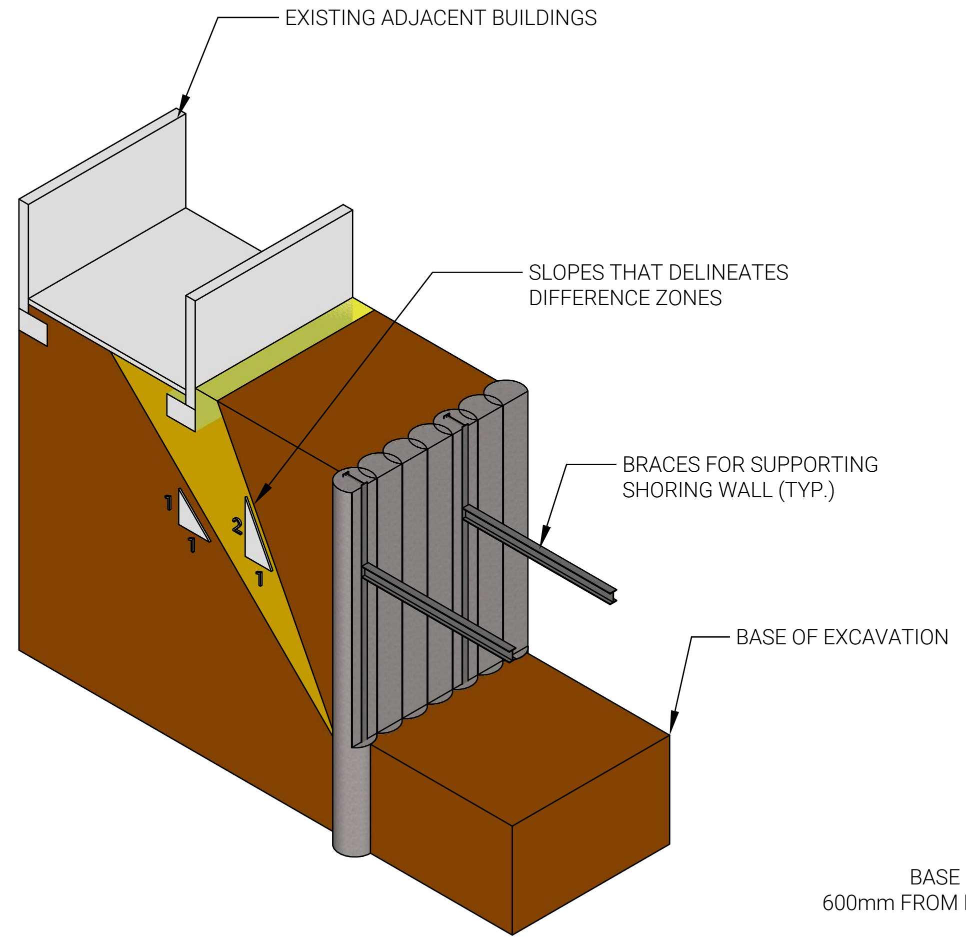
2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

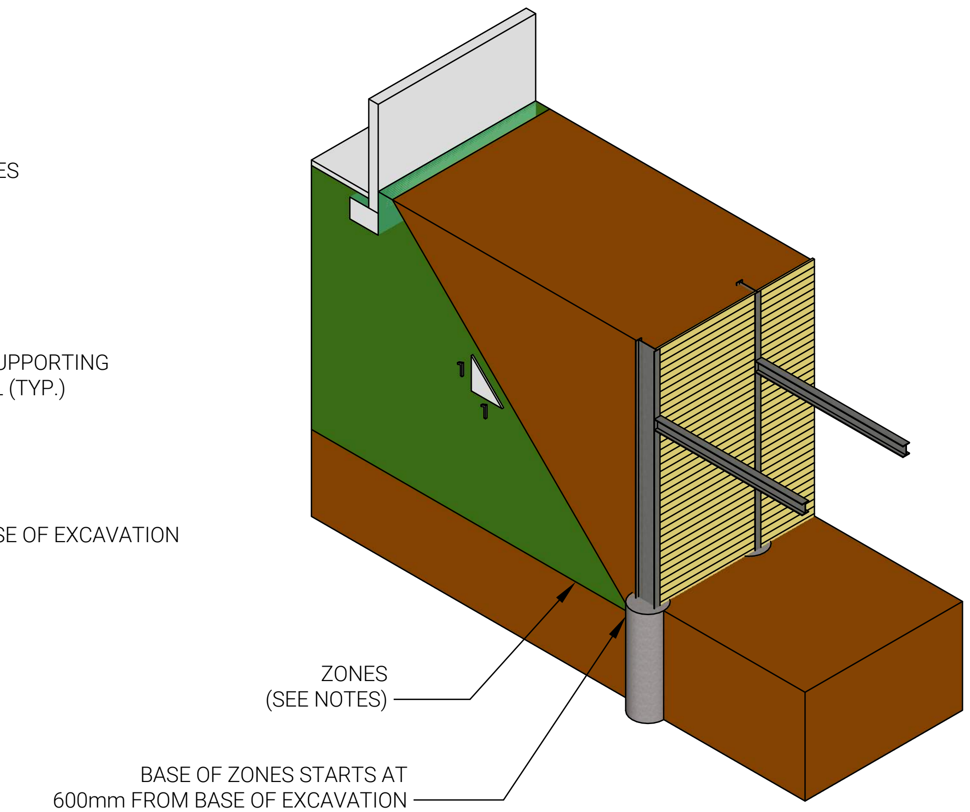
GROUNDED ENGINEERING

Title

BASEMENT SUBDRAIN TYPICAL DETAIL







ZONE A (RED)

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

ZONE B (YELLOW)

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

ZONE C (GREEN)

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

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

GROUNDED ENGINEERING

Title

EXCAVATION ZONE OF INFLUENCE GUIDELINES

APPENDIX F

S2S Environmental Inc.

Project Number: 9157
Client: Multibay Investments Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: November 28, 2019

Log of Borehole: BH1

SUBSURFACE PROFILE / SAMPLE

Depth (m)	Description	Number	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
0	TOPSOIL					
	SAND, fine/medium, with silt, dense, brown, moist	1	40%		<25	<1
		2	50%		<25	<1
	SILT, trace fine/medium sand, very dense, brown, moist	3	50%		<25	<1
		4	65%		<25	<1
		5	65%		<25	<1
	- Grey from approximately 3.8 m bgs	6	50%		<25	<1
		7	65%		<25	<1
		8	65%		<25	<1
	- Brown from approximately 6.7 m bgs	9	80%		<25	<1
	SAND, fine/medium, loose, brown, moist	10	80%	PHCs, sVOCs	<25	<1
	- Grey, wet at approximately 7.3 m bgs	11	40%	pH, Grain Size	<25	<1
9		12	100%	VOCs	<25	<1

Depth scale: 0–30 ft; 0–9 m.

Hex (%LEL): 0–100; Hex (ppm): 0–500; IBL (ppm): 0.01–1000

End of Borehole

Well Completion Details

Flush Mount Casing
J-Plug
2.0" Riser
2.0" x 10' #10 Slot Screen
End Cap
Silica Sand
Bentonite Seal

Monitoring well installed to approximately 9.1 m bgs

November 29, 2019

Drill Rig: B-45HD

Hole Size/Drill Method: 152 mm/HSA

Logged by: AU

Checked by: LF

Sheet: 1 of 1

Notes: One groundwater sample (BH1) was collected on November 29, 2019 and submitted for laboratory analyses of PHCs, selected VOCs and ABNs.

S2S Environmental Inc.

Project Number: 9157
Client: Multibay Investments Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: November 28, 2019

Log of Borehole: BH2

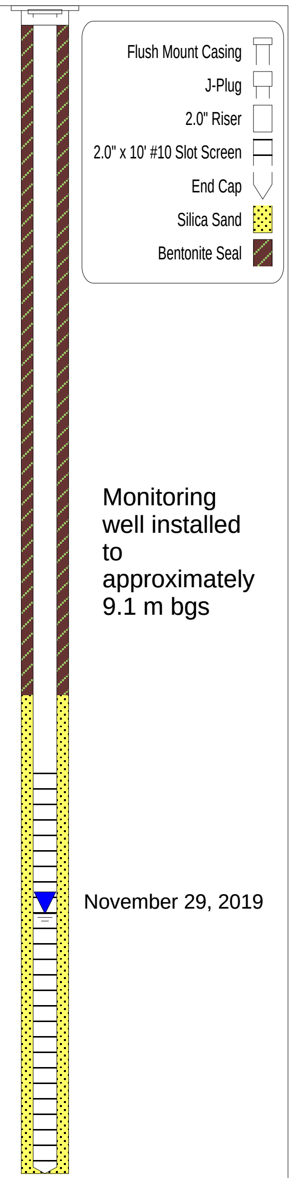
SUBSURFACE PROFILE / SAMPLE

Depth (m)	Description	Number	Type	Recovery	Laboratory Analyses	Hex (%LEL)	IBL (ppm)
0	CONCRETE						
0–2	FILL, sand and gravel, fine/medium, loose, brown, moist - with silt at approximately 1.2 m bgs - Rootlets at approximately 1.5 m bgs	1		40%		<25	<1
		2		50%		<25	<1
2–7	SILT, trace fine/medium sand, very dense, brown, moist	3		50%	sVOCs	<25	<1
		4		65%		<25	<1
		5		40%		<25	<1
	- Grey from approximately 3.8 m bgs	6		50%		<25	<1
		7		50%		<25	<1
		8		50%		<25	<1
		9		20%		<25	<1
7–9	SAND, fine/medium, loose, grey, wet	10		100%	PHCs	<25	<1
	- Wet at approximately 7.01 m bgs	11		100%		<25	<1
		12		100%	VOCs	<25	<1

Hex (%LEL): 0–100; Hex (ppm): 0–500; IBL (ppm): 0.01–1000

End of Borehole

Well Completion Details



Drill Rig: B-45HD

Hole Size/Drill Method: 152 mm/HSA

Logged by: AU

Checked by: LF

Sheet: 1 of 1

Notes: One groundwater sample (BH2) was collected on November 29, 2019 and submitted for laboratory analyses of PHCs, selected VOCs and ABNs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 11, 2020

Log of Borehole: BH104

SUBSURFACE PROFILE / SAMPLE

Depth (ft)	Depth (m)	Description	Elevation (m)	Number	Recovery	Hex (%LEL) / Hex (ppm)	IBL (ppm)	Well Completion Details
0	0	TOPSOIL, rootlets, rocks/gravel, loose, dark brown	96.33	1	10%	<25	<1	
1		SILT, with sand, fine/medium, cohesive, low plasticity, loose, brown, moist	96.18					
22		SAND, fine/medium, loose, brown, wet	89.63					February 18, 2020

Hex (%LEL): 0 – 100
Hex (ppm): 0 – 500
IBL (ppm): 0.01 – 1000

Well Completion Details legend: Flush Mount Casing; J-Plug; 2.0" Riser; 2.0" x 10' #10 Slot Screen; End Cap; Silica Sand; Bentonite Seal

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626025.4 E
Northing: 4833078 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 1 of 2

Notes: One groundwater sample (BH104) was collected on February 18, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 11, 2020

Log of Borehole: BH104

SUBSURFACE PROFILE | **SAMPLE** | Hex (%LEL) 0–100 / Hex (ppm) 0–500 | IBL (ppm) 0.01–1000 | Well Completion Details

Depth (ft)	Depth (m)	Description	Number	Type	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
26–30	8–9							
31	9.4	- grey/brown at approximately 9.4 m bgs	2		95%		<25	<1
36	11	- grey from approximately 10.8 m bgs	3		100%		<25	<1
41	12.5		4		100%		<25	<1
43	13	- trace cobble at approximately 13.1 m bgs	5		100%	VOCs	<25	<1

Monitoring well installed to approximately 13.4 m bgs

End of Borehole

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626025.4 E
Northing: 4833078 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 2 of 2

Notes: One groundwater sample (BH104) was collected on February 18, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 12, 2020

Log of Borehole: BH105

SUBSURFACE PROFILE / SAMPLE

Depth (ft)	Depth (m)	Description	Elevation (m)	Number	Recovery
0	0	ASPHALT	96.05		
		TOPSOIL, rootlets, rocks/gravel, loose, dark brown	95.95	1	75%
		SAND AND SILT, trace cobble, loose, light brown, moist	95.65		
22		SAND, fine/medium, trace gravel, loose, brown, wet	89.35		

Hex (%LEL) 0–100; Hex (ppm) 0–500; IBL (ppm) 0.01–1000

Readings at sample 1: Hex <25; IBL <1

Well Completion Details

Legend
Flush Mount Casing
J-Plug
2.0" Riser
2.0" x 10' #10 Slot Screen
End Cap
Silica Sand
Bentonite Seal

Water level: February 18, 2020

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626010.1 E
Northing: 4833091 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 1 of 2

Notes: One groundwater sample (BH105) was collected on February 18, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 12, 2020

Log of Borehole: BH105

SUBSURFACE PROFILE					SAMPLE				Hex (%LEL) 0–100 / Hex (ppm) 0–500	IBL (ppm) 0.01–1000	Well Completion Details
Depth (ft)	Depth (m)	Symbol	Description	Elevation (m)	Number	Type	Recovery	Laboratory Analyses			
31					2		100%		<25	<1	
34–35	10.5		- slight PHC odor at approximately 10.5 m bgs								
36	11		- wet, grey at approximately 11 m bgs		3		100%		<25	<1	
41					4		100%		<25	<1	
43.5					5		100%	VOCs	80	<1	Monitoring well installed to approximately 13.7 m bgs
45.5					6		100%		25	<1	
46	14		CLAY, trace silt, high plasticity, medium stiff, grey, wet	82.18							

End of Borehole

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626010.1 E
Northing: 4833091 N
Datum: Geodetic

Logged by: BZ
Checked by: LF

Notes: One groundwater sample (BH105) was collected on February 18, 2020 and submitted for laboratory analysis of selected VOCs.

Log of Borehole: BH106

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 14, 2020

Depth (ft)	Depth (m)	Description	Elevation (m)	Sample Number	Recovery	Laboratory Analyses	Hex (%LEL) / Hex (ppm)	IBL (ppm)
0	0	CONCRETE	96.22					
		SILT, with clay, medium density, brown, moist	96.17	1	50%	PHCs, PAH, M&I	<25	<1
		SAND, with silt, loose, light brown, moist	95.76					

Hex (%LEL): 0 – 100; Hex (ppm): 0 – 500; IBL (ppm): 0.01 – 1000

Well Completion Details

Flush Mount Casing
J-Plug
2.0" Riser
2.0" x 10' #10 Slot Screen
End Cap
Silica Sand
Bentonite Seal

February 19, 2020

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626010.3 E
Northing: 4833101 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 1 of 2

Notes: One groundwater sample (BH106) was collected on February 19, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 14, 2020

Log of Borehole: BH106

SUBSURFACE PROFILE

Depth (ft) | Depth (m) | Symbol | Description | Elevation (m)

- trace silt, dense, grey, wet at approximately 9.1 m bgs
- trace cobble at approximately 11.3 m bgs
- fractured rock from approximately 12.2 m bgs to approximately 12.6 m bgs
- coarse sand, loose, grey at approximately 13.7 m bgs

CLAY, with silt, high plasticity, very dense, grey, wet — 82.04

End of Borehole

SAMPLE

Depth (ft)	Number	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
31	2	100%		<25	<1
38	3	100%		<25	<1
41	4	10%		<25	<1
44	5			<25	1
46	6		VOCs	<25	3

Hex (%LEL): 0 – 100
Hex (ppm): 0 – 500
IBL (ppm): 0.01 – 1000

Well Completion Details

Monitoring well installed to approximately 14.3 m bgs

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 626010.3 E
Northing: 4833101 N
Datum: Geodetic
Logged by: BZ
Checked by: LF

Notes: One groundwater sample (BH106) was collected on February 19, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 13, 2020

Log of Borehole: BH107

SUBSURFACE PROFILE					SAMPLE				Hex (%LEL) 0–100 / Hex (ppm) 0–500	IBL (ppm) 0.01–1000	Well Completion Details
Depth (ft)	Depth (m)	Symbol	Description	Elevation (m)	Number	Type	Recovery	Laboratory Analyses			
0	0		ASPHALT	96.19							
1			FILL, sand and gravel, trace silt, loose, brown, moist, rocks	96.04	1		80%		<25	<1	
2			SILT, with sand, fine/medium, slightly cohesive, low plasticity, dense, dark brown, moist	95.58							
5			SAND, fine/medium, with silt, loose, stiff, brown, moist								

Depth scale: 0–25 ft; 0–7 m.

Well Completion Details legend:
- Flush Mount Casing
- J-Plug
- 2.0" Riser
- 2.0" x 10' #10 Slot Screen
- End Cap
- Silica Sand
- Bentonite Seal

February 19, 2020

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 625995.1 E
Northing: 4833096 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 1 of 2

Notes: One groundwater sample (BH107) was collected on February 19, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 13, 2020

Log of Borehole: BH107

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Description
26–46	8–14	- wet, slight PHC odor from approximately 9.9 m bgs to approximately 12.9 m bgs
		- with silt, stiff at approximately 12.2 m bgs
		- loose at approximately 13.7 m bgs

End of Borehole

SAMPLE

Number	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
2	100%		<25	<1
3	100%		30	<1
4	100%		65	1
5	100%		65	1
6	100%		60	1
7	100%		70	1
8	100%	PHC F1 + BTEX	75	1
9	100%	VOCs	75	1
10	15%		<25	1

Hex (%LEL) 0–100; Hex (ppm) 0–500; IBL (ppm) 0.01–1000

Well Completion Details

Monitoring well installed to approximately 13.2 m bgs

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 625995.1 E
Northing: 4833096 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 2 of 2

Notes: One groundwater sample (BH107) was collected on February 19, 2020 and submitted for laboratory analysis of selected VOCs.

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 12-13,2020

Log of Borehole: BH108

SUBSURFACE PROFILE

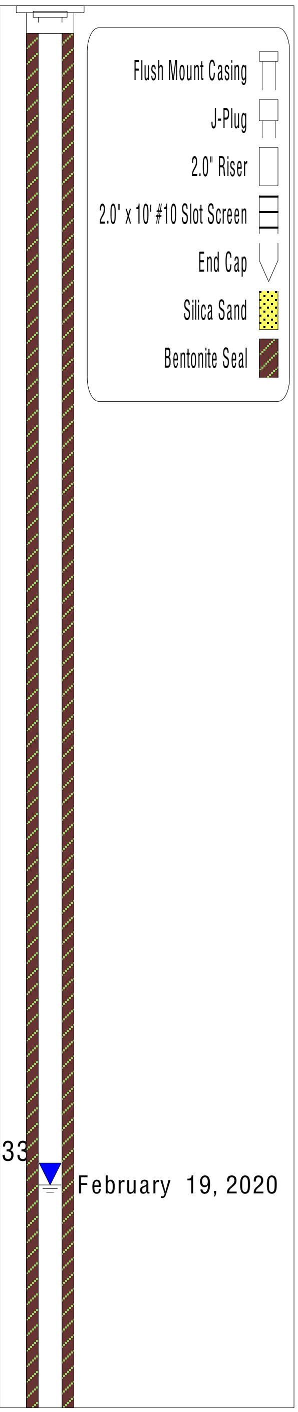
Description	Elevation (m)
ASPHALT	96.13
FILL, sand and silt, trace cobble, loose, light brown, moist	95.98
SAND, fine/medium, trace silt, loose, brown, moist, rock fragments - slight orange mottling at approximately 1.1 m bgs - stiff, orange mottling throughout at approximately 2.4 m bgs - light brown sand, end of trace silt, loose, soft at approximately 4 m bgs - grey sand, trace silt, stiff, slightly cohesive, low plasticity at approximately 5 m bgs - brown sand, loose, moist at approximately 5.5 m bgs - strong PHC odor, orange mottling, wet, grey at approximately 6.4 m bgs	95.68

SAMPLE

Number	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
1A	60%		<25	<1
1B	60%		<25	1
2	70%		25	1
3	100%	PHCs, BTEX, PAHs, M&I	65	1
4	90%		<25	1
5	60%		35	1
6	100%		<25	<1
7	100%		35	<1
8	100%		35	1
9	80%		25	<1
10	100%	PHCs, BTEX, PAHs, VOCs	310	233
11	100%		30	4

Hex (%LEL) 0 – 100; Hex (ppm) 0 – 500; IBL (ppm) 0.01 – 1000

Well Completion Details



Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 625997 E
Northing: 4833086 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 1 of 2

Notes: Two groundwater samples (BH108) and (BH108-DUP) were collected on February 19, 2020 and submitted for laboratory analyses of selected PAHs, selected VOCs and metals/ inorganics

S2S Environmental Inc.

Project Number: 9157
Client: Jameson Plaza Inc.
Location: 1437 Queen Street West, Toronto
Drill Date: February 12-13,2020

Log of Borehole: BH108

Depth (ft)	Sample Number	Recovery	Laboratory Analyses	Hex (ppm)	IBL (ppm)
26	12	100%		45	2
28.5	13	80%		125	<1
31	14	80%		35	<1
33.5	15	90%		75	<1
36	16	90%	PHCs, BTEX, PAHs, VOCs	165	4
38.25	17	25%		50	<1
40.25	18	40%	VOCS	45	<1
43.5	19	100%		<25	<1

Description:

- clay seam from approximately 10.2 m bgs to 10.4 m bgs
- some clay at approximately 11 m bgs

End of Borehole

Well Completion Details: Monitoring well installed to approximately 13.4 m bgs

Drill Rig: Track-Mounted B-45HD
Hole Size/Drill Method: 152 mm/HSA
Easting: 625997 E
Northing: 4833086 N
Datum: Geodetic
Logged by: BZ
Checked by: LF
Sheet: 2 of 2

Notes: Two groundwater samples (BH108) and (BH108-DUP) were collected on February 19, 2020 and submitted for laboratory analyses of selected PAHs, selected VOCs and metals/ inorganics