SOLA ENGINEERING

RE: REVISED GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
418 and 422 GUELPH LINE BURLINGTON,
ONTARIO

FOR: Valour Capital Management Inc.
c/o S2S Environmental Inc
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REPORT NO.: 2017-10923R

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1.0 INTRODUCTION

Sola Engineering Inc. (Sola) was retained by Valour Capital Management Inc. c/o S2S Environmental Inc (*"the Client" or "the Clients"*) to carry out a geotechnical investigation for a proposed new commercial and residential building, located at 418 and 422 Guelph Line, in Burlington, Ontario (the subject site or site). Authorization to proceed with the investigation was received on August 25, 2017 through the acceptance of Sola's Email Proposal No. 2017-1471 dated July 24, 2017 and the subsequent correspondences after August 25, 2017.

It is understood that the Client was initially planning to redevelop the property into a 20+ storey mixed used (residential from floors 2 to 21, commercial on the first floor) condominium with 2 storey underground parking garage. In October 2019, the development was modified to a 13 story residential development.

This geotechnical investigation was carried out in tandem with the Phase II Environmental Site Assessment, carried out by the Client. All field related protocols, including safety, field testing and sampling procedures were managed by the Client. Sola was only present for the advancement of six (6) of the boreholes for geotechnical design purposes. The log sheets for the non-geotechnical boreholes prepared by the Client were provided to Sola for review. Soil descriptions given on the geotechnical Borehole Log Sheets may differ somewhat from the descriptions given in the Client's non-geotechnical ones, which are based on geological considerations. Therefore, the two reports should be read and interpreted in accordance with their respective purposes.

Geotechnical design parameters and construction considerations are significantly dependent on the field data, i.e. observations, measurements, and engineering interpretations. Careful verification of these data should be carried out during construction. Should any discrepancies in the subsurface conditions be identified in this report, it is requested that they be brought to the attention of this office.

As per the scope of services detailed in Sola's proposal, the purposes of this investigation are:

- To collect information on the soil and groundwater conditions at the site and based on the investigation data, provide pertinent engineering considerations; and,
- To provide recommendations to assist with the design of the proposed building foundations.

This report presents the details of Sola's fieldwork and laboratory testing, outlines the soil and groundwater conditions at the site, and provides recommendations on the aforementioned items.

The Client provided Sola with a conceptual drawing showing the proposed residential building, via email dated August 29, 2017. The drawings provide information pertaining to the layout of the proposed building development.

This report has been prepared for the Client, and their nominated engineers and designers. Third party use or reproduction, in part or in full, of this report is prohibited without written authorization from Sola. This report is also subject to the Statement of Limitations which forms an integral part of this document.

2.0 SITE SETTING

2.1 SITE LOCATION

The site of the proposed development is located at at 418 and 422 Guelph Line, in Burlington, Ontario.

2.2 SITE DESCRIPTION

The subject site is bound by a retail store to the south, Roseland Square Plaza to the west, Waterfront Trail to the east and Guelph Line to the north. The subject site is currently occupied by an office building and a commercial building with customer parking lots at south west end. The site is partially paved and generally flat.

2.3 PROPOSED DEVELOPMENT

As per the scope of work approved by the Client through Sola's Email Proposal No. 2017-1471 dated July 24, 2017 and subsequent correspondences, this report addresses the site conditions in relation to the redevelopment of the property into a 20+ storey mixed used (residential from floors 2 to 21, commercial on the first floor) condominium with 2 storey underground parking garage.

In October 2019, the development was modified to a 13 story residential development. No updated conceptual drawings were made available.

No loading details for the proposed development were available at the time of authoring this report.

3.0 GROUND INVESTIGATION

3.1 FIELD INVESTIGATION

3.1.1 Soil Investigation

Prior to undertaking field drilling, clearance of existing public utility services to the site was obtained by the client from all applicable agencies and companies. In addition, private utility locates were also carried out by the client.

The geotechnical investigation was carried out on September 5, 6 and 7, 2017 comprised the following:

- The drilling of six (6) boreholes to depth of 10.7 m or refusal if shallower; and,
- The extension of one (1) boreholes with coring to at least 3.0 m.

All boreholes were advanced using a track-mounted D50 power drill rig equipped with a split spoon sampling equipment. The approximate locations of the boreholes that were advanced for this investigation are shown on the site plan attached as **Enclosure 1**.

All drilling equipment was supplied and operated by Profile drilling of Mississauga, Ontario, and the geotechnical drilling works were completed under the supervision of a qualified Sola Technician.

Standard Penetration Tests (SPTs) split spoon samples were collected in the overburden in all drilled boreholes. Bedrock was cored using a diamond bit core barrel. All soil and rock samples were logged in the field and returned to Sola's laboratory in Vaughan for review and subsequent laboratory testing.

The existing grade elevations (Local) at the borehole locations were obtained from the Client and provided to Sola.

The logs of all boreholes completed, together with their depths relative to local elevation, are presented in **Enclosures 2 through 7.**

3.1.2 Groundwater Investigation

Groundwater level observations were made during drilling and in the open boreholes upon completion of the drilling operations.

The groundwater levels information in the wells installed at BH No's 102, 103, 104, 105, 106 were provided by the client via Email dated October 3, 2017. Details of groundwater observations for each borehole are presented on the respective borehole logs presented in **Enclosures 2 to 7**. Further discussion on groundwater is provided in 4.2 of this report.

3.2 SURVEY

The borehole locations were established with reference to the existing site features (existing building, garages, poles, fence lines, etc.) by the client. The temporary benchmark (TBM) was established on top of sewer grate located at northeast corner of property on the sidewalk of Guleph Line. The location of the TBM is shown on Plot Plan in **Enclosure 1**. This benchmark has an assumed elevation of 100.00 m (Local).

3.3 GEOTECHNICAL FIELD AND LABORATORY TESTING

Standard Penetration Tests (SPTs) were undertaken at selected intervals with depth using a 50 mm outer diameter and 35 mm inner diameter split barrel sampler driven with an automatic hammer of mass 63.5 kg dropping 760 mm in accordance with the ASTM D 1586-11 test method – "*The Standard Method of Standard Penetration Testing (SPT)*". The results of these tests (SPT "N" values) are presented on the borehole logs in **Enclosures 2 to 7** of this report.

All soil samples were submitted to Sola's laboratory for natural moisture content determination. The results of the moisture content are presented in the borehole logs in **Enclosures 2 to 7**. One soil sample was submitted for grain size analysis and the results are in **Enclosure 10.**

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CHARACTERISATION

4.1.1 Pavement

The site was surfaced with a pavement structure on west side of the existing building where Borehole Nos. 102, 104 and 105 were advanced. The pavement consisted of an approximate 40 mm thick layer of asphaltic concrete (AC) course. Underlying the AC, a granular base consisting of sand and gravel, ranging in thickness from 150 mm to 175 mm, was found.

4.1.2 Topsoil

On east side of the existing building the site was covered with grass and mature trees. Topsoil was initially encountered at Borehole No. 103, 106 and 108 locations. The topsoil ranged in thickness from 100 mm to 125 mm.

It is important to note that topsoil thicknesses may vary throughout the site area, depending upon their location. As such, these findings should not be relied upon for any estimation of fill quantities to be stripped prior to construction.

4.1.3 Fill Soils

Fill (and possible fill) materials were encountered underlying the pavement structure and topsoil at all borehole locations. The fill extended to depths between 0.760 m (BH 103) and 2.89 m (BH102).

Fill materials encountered comprised silty sand to sandy silt. In-situ resistance testing results ranged from 1 to 20 blows per 300 mm of spoon penetration, indicating that the fill was not constructed under engineering control.

The moisture content test results for the fill material ranged approximately from 2.2% (BH106) to 26.4% (BH103), indicating generally moist to wet conditions.

It is important to note that fill thicknesses may vary throughout the site area, depending upon their location. As such, these findings should not be relied upon for any estimation of fill quantities to be stripped prior to construction.

4.1.4 Silty Sand to Silty Clay Till

Native soils were encountered directly below the fill materials in all boreholes. It comprised a layer of silty sand in all boreholes. The silty sand extended to depths of 0.8 mbgs in BH103, 3.0 mbgs in BH102 and 1.3 mbgs in BH104 and BH105. Layer of sandy silt is found 2.2 mbgs in BH 105.

Underlying silty sand, a silty clay till is found in all the boreholes (except in BH 106) prior to encountering shale bedrock. In BH 106, a silty clay was found to underlie the silty sand. The moisture content test results for the native material ranged approximately from 3.8% (BH108) to 23.6% (BH102), indicating generally moist to wet conditions.

Standard penetration tests (SPT) were carried out during the spoon sampling process. SPT "N" values recorded in the sandy silt ranged from 4 to more than 50 blows/300 mm, which is in a loose to very dense condition of the soil; in silty clay till and silty clay, the N-values ranged from 31 to more than 50 blows/300 mm, which is of a hard consistency.

4.1.5 Shale Bedrock

Inferred shale bedrock was observed in BHs 105, 106 and 108 upon refusal to auger drillingranging in Elevations between 93.0 and 94.2 m (Local). Shale bedrock was proven in BHs 102 through 104, ranging in Elevations between 94.4 and 95.4 m (Local). The shale bedrock is of the Queenston Formation. This material is coloured red to grey and features a weak upper sub-unit. As recognized by many engineers, this sub-unit is about 2 to 5 m thick and is highly weathered and fractured. It is in turn followed by a less weathered sub-unit of rock which is in poor to fair to good condition.

SPT tests carried out in this sub-unit of the weathered shale bedrock measured N-values of more than 50 blows/300 mm.

The highly weathered sub-unit of the bedrock can be readily penetrated using solid stem augers which indicates that in all likelihood, the material will have the engineering characteristics of a hard clayey till soil. However, localized thicker and harder limestone seams are indicated where refusal to power auger drilling was observed.

Below the highly weathered sub-unit, the results of observations made on rock cores indicate that the condition improves with values of rock quality designation (RQD) in the range from 90 % to 79% being recorded. An RQD of 75 % t0 90 % indicates a rock which is of good quality rocks.

The shale bedrock was found to be interbedded with limestone and occasional clay seams. The limestone seams were found to range from about 10 to 50 mm in the core samples. However, historical data obtained from the Ministry of Transportation (MTO) GeoCres database system indicated that the thickness of the limestone layers can range up to 450 mm. The limestone seams were contacted in both the highly weathered and less weathered sub-units of the bedrock.

The occasional clay seams was found at a depth of 8.53 mbgs and 9.90 mbgs in BH102.
Intact rock core samples can be crushed into crumbles with firm blows of geological hammer. It cannot be peeled readily with a pocket knife.

From BH 102 the intact rock core sample at depth between 9.47 m and 9.55 m was tested for point load strength test. The strength recorded, i.e. Is(50), was 1.121 MPa. In addition the intact sample at depth 9.32 to 9.47 m was tested for Unconfined Compression Strength (UCS) and recorded as 29.7 MPa.

The rock may be regarded as Grade R3 described as medium strong with an unconfined compressive strength ranging from 25 to 50 MPa as per Brown (1981).

Queenston Shale Bedrock can lose its strength considerably when in contact with excessive moistures. Based on the study by K. Y. Lo. on the shale bedrock of southern Ontario, the Queenston Shale has a high potential of swell characteristics, recognized as "rock squeenze".

4.2 GROUNDWATER

The depth at which groundwater was encountered during drilling is presented on the respective borehole logs in **Enclosures 2 through 7**.

Five (5) wells were installed in BH 102, 103, 104, 105 and BH 106 at the completion of the borehole. Subsequent water level readings were provided by the client. The groundwater levels were recorded as given below:

Table 1: Ground Water Measurement

BH No	Upon Completion of drilling		Groundwater Level by S2S (September 13, 2017)
	Caved at Depth	Water level	
102	Open	Dry	3.667
103	Open	Dry	2.471
104	Open	Dry	3.220
105	Open	Dry	3.270
106	Open	Dry	2.420
108	2.43	DRY	NA

It should be noted that the groundwater level can vary and is subject to seasonal fluctuations in response to major weather events. It should be also noted that a perched water condition may arise from the accumulation of surface water in the more pervious fill, particularly during wetter periods.

Long term groundwater conditions should reference to the project hydrogeology study.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 GEOTECHNICAL ISSUES

The following geotechnical issues are observed at this site:

- With two or three underground parking level(s), the building foundation may be positioned within the very dense soil or over the shale bedrock. Conventional spread footing is suitable for foundation design;
- Bedrock excavation is expected for installation of foundations and some service lines. Excavation in shale bedrock in the upper sub-unit may be carried out using conventional construction equipment (power backhoe with rock teeth). However, harder and thicker limestone seams may be encountered within the excavation depth; and,
- Reuse of the excavated bedrock as Subgrade Fill should not be considered.

The following sections outline our recommendations for the design of the proposed residential development, parking lot pavement structure, access road pavement structures and underground service connections.

5.2 FROST PROTECTION

All footings exposed to seasonal freezing conditions must have at least 1.2 metres of soil cover for frost protection. For conventional footings being positioned directly over the shale bedrock, the frost protection depth may be halved.

There is no official rule governing the required founding depth for footings below unheated basement floors. Certainly, it will not be greater than the 1.2 m required in Southern Ontario for exterior footings. Un-monitored experience indicates that a shallower depth ranging from 0.82 to 0.9 m for interior column footings and 0.4 m for wall footings has been successful where 2 or more basement levels apply. The 0.82 m depth is believed to be close to the minimum structural requirement for interior column footings. Adjacent to air shafts and entrance and exit doors, a footing depth of 1.2 m below floor level is required or, alternatively, insulation protection must be provided.

It is also emphasized that underfloor drainage and/or an adequate free draining gravel base is required to minimize the risk of floor dampness. Floor dampness could lead to temporary icing and the risk of accidents.

5.3 CONVENTIONAL SPREAD OR STRIP FOUNDATIONS

The following discussions are provided to advance the design phase of the highrise residential development with two basement levels. For geotechnical design purposes, it is assumed that the footings may be positioned at a depth of approximately 6 to 7 m below the existing grade. The founding stratum at this depth was found to be hard silty clay till (or silty clay) or highly weathered shale bedrock.

If found on hard silty clay till or silty clay, the proposed building with two levels of basement can be supported by spread and strip footings for a bearing capacity of 300 kPa at the serviceability limit states (SLS), and for a factored geotechnical resistance of 450 kPa at the ultimate limit states (ULS). If found on shale bedrock, the proposed building with two levels of basement can be supported by spread and strip footings for a bearing capacity of 500 kPa at the serviceability limit states (SLS), and for a factored geotechnical resistance of 750 kPa at the ultimate limit states (ULS).

Footings founded in the soil stratum designed to the specified bearing capacity at SLS are expected to settle less than 25 mm total and 20 mm differential. In the weathered shale, settlements are approximately half of the magnitude.

Where it is necessary to place footings on soil at different levels, the upper footing must be founded below an imaginary 1 horizontal to 1 vertical line (1H:1V) drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

Queenston shale bedrock can deteriorate in structure and strength when in contact with excessive moistures. For foundation construction purposes, the prepared rock excavation surfaces may be protected with a layer of mud mat, if necessary.

It should be noted that the recommended bearing capacities have been calculated by Sola from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by Sola to validate the information for use during the construction stage.

5.4 EARTHQUAKE CONSIDERATIONS

Using the information provided by the site investigation, the general subsurface profile may be classified as “Stiff Soil – Site Class C” as defined by Table 4.1.8.4.A “Site Classification for Seismic Site Response” of the Ontario Building Code.

If a higher site class is desired, a in-situ shear wave velocity test must be carried out by a specialist consultant.

5.5 ENGINEERED FILL

On-site excavated, clean inorganic earth (native and/or fill) may be reused as engineered fill material, provided the moisture contents are strictly controlled. Shale of Queenston Formation may deteriorate in structure and strength considerably when in contact with water, therefore, it may not be a good candidate to reused broken shale for engineered fill purposes.

If imported inorganic mineral soils are used for engineered fill construction, they must meet the applicable environmental guidelines, and their moisture contents should preferably be close to their respective optimum water content values.

For the on-site excavated clean fill/native soils, or similar imported soils, heavy compaction equipment should be employed to achieve the specified degree of field density.

Consideration may be also given to backfilling excavations with a well graded, compacted granular soil such as Granular B as it, if thoroughly compacted, would reduce the post construction settlements to an acceptable level and may also expedite the compaction process.

Fill materials required for replacing locally softened soils, or raising grades within the footprint of the structures are to comprise suitably organic free materials approved for use by the Geotechnical Engineer. Fill materials are to be placed in lifts of a maximum thickness of 300 mm and compacted, using appropriate compaction equipment, to 98 % of its Standard Proctor Maximum Dry Density (SPMDD).

Fill located in areas outside of the footprint of any proposed structure or driveway should be compacted to at least 95 % of the material's SPMDD to within 1.0 m of the subgrade level, and then to 98 % of its SPMDD up to the required grade. Imported granular fill used in confined areas should be compacted using only hand held compaction equipment.

Sola recommends that any and all engineered subgrades beneath proposed structures are to be inspected and/or proof rolled prior to construction.

5.6 BASEMENT FLOOR SLABS AND PERMANENT DRAINAGE

The basement floor slab for the proposed residential building can be adequately supported at grade. Any exposed subgrade must be profiled to meet the design requirement. Once the required subgrade has been developed, Sola recommends that the exposed subgrade be inspected and approved by the Geotechnical Engineer prior to the placement of any granular fill or concrete.

It is considered by Sola that completed excavations for floor slabs should not to be left open before pouring concrete for any period longer than 72 hours, particularly if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is to be left exposed for longer than 72 hours should be suitably covered and protected from water ponding.

A granular layer consisting of at least 200 mm thick layer of 19 mm Crusher Run Limestone (CRL) or OPSS Granular A should be installed under the floor slab as a bedding layer, as well to enhance under slab moisture condition.

Such a layer has been proven to be an effective moisture barrier for conventional floor surfaces. However, if special floor coverings such as sheet PVC with heat sealed seams are considered, either a high efficiency vapour barrier or venting may be added to the granular layer to prevent moisture accumulating between the concrete floor and the PVC flooring.

The design of the concrete slabs on shale bedrock may be made on the basis of a value of modulus of subgrade reaction (k) of 40 MPa/m on the surface of the granular moisture barrier. The design of the concrete slabs on dense native soil may be made on the basis of a value of modulus of subgrade reaction (k) of 25 MPa/m on the surface of the granular moisture barrier.

The floor slab should be structurally independent from any load bearing structural elements.

Queenston shale bedrock can deteriorate in structure and strength when in contact with excessive moistures. For slab-on-grade construction purposes, the prepared rock excavation surfaces may be protected with a layer of mud mat, if necessary.

Should the lowest construction element extend below the site permanent water table, proper permanent water control provisions, i.e. watertight structure considerations, positive pumping plus backup systems, waterproofing, etc., must be included in the basement design and construction. Further, depending on the results of the hydrogeological study, the Client may wish to consider the installation of waterproofing or an underslab drainage system.

5.7 EXCAVATION AND BACKFILL

5.7.1 Excavatability

Given the layout of the proposed development in relation to the site area, it has been assumed that all excavations for the building and utilities will be open cut. In order to enable entry into excavations during the construction process, all excavations must comply with the definitions prescribed by the “Occupational Health and Safety Act” (OHSA), Ontario Regulation 213/91 “Construction Projects”.

The borehole data indicate that the native sandy silt till should present as a Type 2 soil as defined in the OHSA and Regulations for Construction Projects (Part III Excavations, Section 226); the fill, Type 3. Weathered shale bedrock should present as Type 1. Excavations in these materials should be constructed in conformance with the regulations. It is noted that the above soil classifications have been estimated based on small, discontinuous samples from boreholes. The excavation conditions must be confirmed and/or modified on the basis of field inspections during construction stage, when large scale observations can be made with ease.

As defined by the OHSA, excavation walls within the Type 3 soils will require battering back at slopes no steeper than 1H (horizontal):1V (vertical). For Type 1 or Type 2, the bottom 1.2 m high of trench wall can be vertical. Depending on the construction feasibility the excavation walls can be supported by temporary shoring systems. During excavations, adjacent existing structures must be protected by proper shoring or sloping.

It is important to realize that the excavation side stability condition in Queenston Shale Formation can deteriarate quickly when in contact with significant amount of water. The excavation in such a condition must be regularly monitored throughout the construction. Based on the findings of the investigation, it is considered that excavation of the overburden native soils at the site can be carried out using a conventional backhoe excavator.

Using the estimated parameters of degree of weathering, rock strength, joints and bedding spacing, and diggability index rating developed by Scoble and Muftuoglu (2001), it is anticipated that the rock materials, their ease of digging and typical construction equipment should conform to the following **Table 2:**

Table 2: Excavatability of Soil

Stratigraphic Unit	Class	Ease of Digging	Typical Plant Fitted with Rock Teeth and Ripper which may be used Without Blasting
Weather shale	II	Easy	Hydraulic shovel or Backhoe, e.g., CAT 245
Unweathered shale	III	Moderately	Hydraulic shovel, e.g., CAT 245
Limestone	IV	Difficult	Hydraulic shovel, Short Boom of backhoe e.g., CAT 245, O and K RH 40

It is assumed that the excavations for the building and utilities will be within a depth range from 3 to 6.5 m below existing ground level. Groundwater is reported at a depth of approximately 2.4 to 3.6 m below ground level. However, the water encountered was likely perched water condition. Queenston Formation is recognized to be very fractured and include occasional thin layers of limestone interbeds. Therefore, seepage through fractures

and limestone seams is likely. Seepage will likely be controlled by the use of conventional pumping from collection sumps and ditches.

5.7.2 Temporary Shoring Design Considerations

Given that the footings may be positioned at 6 to 7 m below the existing grade and that the proposed building will take up a large portion of the property, it is expected that shoring may be required to facilitate the construction of the proposed building. It should be noted however, that, if shoring is required, a specialist shoring contractor should be consulted to establish the most appropriate design and seating depths for the construction shoring solution.

The shoring system may be designed in accordance with the Canadian Foundation Engineering Manual (CFEM), 4th Edition. Though not a design code, the CFEM design manual provides a comprehensive guide for shoring and anchor design, and still considered the most widely used and accepted design approach in the Greater Toronto Area (herein "GTA").

Shoring subject to unbalanced earth pressures must be designed to resist a pressure distribution that can be calculated as follows:

$$p = K [\gamma (h-hw) + \gamma' hw + q] + \gamma whw$$

where: p = Lateral earth pressure in kPa acting at depth h
K = parameters are provided below
h = the depth below the ground surface (m)
hw = the depth below the ground water level (m)
γ = the bulk unit weight of soil, (kN/m3) use 20.0
γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m3)
q = equivalent value of surcharge on the ground surface in kPa (min 12 kPa)

Where the backfill against the buried structure can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$p = K (\gamma h + q)$$

The soil parameters estimated to be applicable for this design are as follows:

At Rest Lateral Earth Pressure Coefficient (K): 0.5
Active Earth Pressure Coefficient (Ka): 0.33
Passive Earth Pressure (unfactored) (Kp): 3.0

For a global stability check:

ϕ = 30°
c = 0
γ = 20 kN/m3

Wall friction should be considered negligible.

Design groundwater table should be assumed at a depth of 3.5 m below the ground surface. The surcharge needs should be determined by the Structural Engineer, but should not be less than 12 kPa.

The earth pressure acting on the buried structure may be evaluated using the earth pressure diagram for design of bracing elements provided as per the CFEM.

Design calculations should be submitted to Sola for geotechnical review.

The soil parameters estimated to be applicable for the shoring design are presented in **Table 3**.

Table 3: Soil Parameters for Shoring

Material	Undrained Shear Strength c_u (kPa)	Effective Cohesion c' (kPa)	Effective Friction Angle ⍰' (deg)	Unit Weight γ (kN/m^3)	Coeff. Of Earth Pressure		
					Active Ka	Paasive Kp	At-rest Ko
OPSS Granular A or B	–	0	34	22	0.28	3.6	0.44
Fill	–	0	28	19	0.37	2.7	0.53
Native Soil	-	0	30	20	0.33	3.0	0.50
Highly Weathered Shale	-	0	36	21	0.26	3.8	0.41

Movement of the shoring system is considered inevitable. The magnitude of this movement can be controlled by sound construction practices, and it is anticipated that the horizontal movement will be in the range of 0.1 % H to 0.25 % H. Vertical movements increase the horizontal movements to some degree. The shoring design must be carried out to minimize vertical movement of the shoring system.

To ensure that movements of the shoring are within an acceptable range, monitoring must be undertaken throughout the site development process. Vertical and horizontal targets must be located and surveyed before excavation begins. Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results should enable directions to be given to improve the shoring.

In the event that the shoring design is to be incorporated into the structural design of the buildings, i.e. shored basement wall construction, then drainage considerations should also be accommodated at the design stage.

5.7.3 Soil Reusability and Disposal

On site excavated soils, either fill or native, consist of a significant proportion of silt particles. The silty soil is generally poor in its workability. The Contractor should plan appropriately with their construction methodology as well as equipment in the fill placement if silty soils are reused.

Excavated shale bedrock may not be reused.
It is recommended, that the soil to be excavated should be tested for compliance with prevailing Ministry of Environment and Climate Change (MOECC) regulations for off-site disposal.

5.8 SERVICE INSTALLATION CONSIDERATIONS

5.8.1 General

The materials contacted in the boreholes at the expected elevations of the proposed storm sewer trench bottoms generally consist of compact to dense silty sand, or shale bedrock which are suitable for pipeline support.

Prior to placement of bedding, the exposed subgrade at the bottoms of sewer trench excavations should be inspected by a qualified geotechnical engineer, to identify any soft, loose or disturbed base conditions. All disturbed soils/rock resulted from the construction activities should be removed and replaced as above noted.

Details of the storm sewer configuration have not been made available at the time of the preparation of this report. Design and construction consideration for both flexible (PVC) and rigid (concrete) pipes are included in the following sections.

5.8.2 Bedding

The silty sand or prepared shale bedrock, in an undisturbed state will provide adequate support for the proposed service pipes and will allow the use of normal Class B type bedding. The bedding should conform to the current Ontario Provincial Standard Specifications (OPSS 1010) and/or the City of Toronto's standards for bedding stone gradation requirements. The pipes should be placed with a minimum bedding thickness in conformance of OPSD 802.010 (for flexible pipes) or OPSD802.030 (for rigid pipes), though the bedding thickness will be subject to variation and ultimately based on the proposed pipe diameter, bedding specifications used etc.

On completion of the storm sewer pipe installation, a granular surround of the same bedding material should be placed around the pipe to cover it to at least 300 mm above the pipe obvert.

Backfill above the bedding and cover materials may consist of clean, compactable fill which possess similar properties to the existing subgrade soil; based on the borehole data it is anticipated that the local soil material may be used as trench backfill. Some moisture conditioning of the soil may be required to facilitate soil compaction. In the event that an imported soil is used as trench backfill, it must be ensured that the drainage properties of the subgrade are maintained and that there is no differential frost movement. Trench backfill should be compacted to at least 95% of the material's SPMDD, or City of Toronto's standards, wherever is more stringent.

5.8.3 Trench Backfill

The native soils are, subject to environmental classification, considered suitable for re-use as fill to backfill wider service trenches, provided that heavy compaction equipment (e.g. vibrating impact "sheep's foot" roller) can be used to compact the fill material. In confined areas, consideration may be also given to backfilling the areas with a well graded, compacted granular soil such as Granular 'B' material as such material, if thoroughly compacted, would reduce the post construction settlements to an acceptable level and may also expedite the compaction process.

Each lift should be no greater than 300 mm thick and compacted using a vibrating smooth drum roller to at least 95 % of the material's SPMDD to within 1 m of the top of the sub-grade, and then to 98 % SPMDD up to the required grade.

Exposed, excavated soil stockpiles that are to be re-used as fill on site should be compacted at the surface or temporarily covered during wet weather to help maintain their original

moisture content. Such stockpiles are prone to wet weather exposure and, as such, the increased moisture contents will make these materials too wet to achieve the required levels of compaction.

Conversely, if the excavated native soils are too dry to achieve the required levels of compaction, some moisture addition/conditioning by means of water hosing or misting should be expected if the trench excavation works are to be undertaken during the dry seasons.

5.8.4 Rock Squeenze

The Queenston Shale Formation is recognized of its swell characteristics for trench work, known as "Rock Squeeze". The designer should take this phenomenon into consideration if the trench is entirely positioned in the shale bedrock.

5.9 PAVEMENTS

The recommended pavement structures provided in **Table 4** are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. The values may need to be adjusted based on the city/regional standards. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 4: Recommended Pavement Structure Thickness

Pavement Layer	Light Duty (Cars)	Heavy Duty (Delivery Trucks)	Compaction Requirements
Asphaltic Concrete OPSS	40 mm HL 3 40 mm HL 8	40 mm HL 3 80 mm HL 8	97% Marshall Density
OPSS Granular A Base (or 20mm Crushed Limestone)	150 mm	150 mm	100% SPMDD*
OPSS Granular B	200 mm	300 mm	100% SPMDD

* Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 300 mm unless accepted by Sola Engineering Inc.

OPSS – Ontario Provincial Standard Specifications

The long term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped (preferably at a minimum grade of two percent (2%) to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent subgrade softening. This is particularly important in heavy-duty pavement areas.

Additional comments on the construction of parking areas and access roadways are as follows:

1. As part of the subgrade preparation, proposed pavement work area should be stripped of topsoil layers and other obvious objectionable material. Fill required to raise the grades to design elevations should conform to backfill requirements outlined in previous sections of this report. The subgrade should be properly shaped, crowned then proof-rolled in the fulltime presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD.
2. The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed lot grading. Assuming that satisfactory crossfalls in the order of two percent (2%) have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by Sola Engineering Inc.
3. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted access lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather.
4. It is recommended that Sola Engineering Inc. be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

5.10 CONSTRUCTION CONSIDERATIONS

5.10.1 Site Preparatory Works

The site preparation work should include stripping of asphalt concrete, topsoil and fill in order to develop the required construction or engineered fill subgrades. Stripping depths will likely vary locally and should be adjusted to remove all unsuitable material.

It is recommended that a Geotechnical Engineer monitor the stripping operations to ensure that unsuitable materials have been fully removed prior to construction works or the placement of engineered fill. Unacceptable areas identified are to be remediated as soon as practicable with procedures for which would be dependent upon conditions encountered. This could include additional undercutting of unsuitable materials and replaced with controlled, engineered fill as prescribed in **Section 5.5** of this report.

5.10.2 General Considerations

Load bearing soils are susceptible to disturbance from environmental (temperature, moisture change, etc.) and construction activity and, as such, due care should be given to minimizing trafficking of such areas during periods of excavation and the construction of floor slab and footings to minimize disturbance of the bearing soils.

Any excessive disturbances of the load bearing and underlying soils affected during construction works could influence the long term settlement of the structures and will therefore, require further excavation and replacement of such impacted soils with suitably engineered fill.

A representative of Sola should evaluate all subgrade surfaces to confirm that the subgrade and founding conditions are consistent with the recommendations given by this report.

6.0 MATERIALS TESTING AND INSPECTION

It is recommended that a qualified geotechnical firm is appointed to carry out field inspection and material testing during construction to ensure that the construction complies with the design recommendations.

7.0 DRAWING REVIEW

Once the final design drawings for this project are prepared, it is recommended that one (1) set of the drawings should be submitted to Sola for review to make any amendments to our recommendations that may be required, prior to starting construction.

Sola should also be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Sola will assume no responsibility for interpretation of the recommendations in this report.

The comments given in this report are preliminary and intended only for the guidance of design engineers. Contractors bidding on or undertaking the works should make their own interpretations of the factual borehole results, so that they may draw their own conclusions on how the subsurface conditions may affect them.

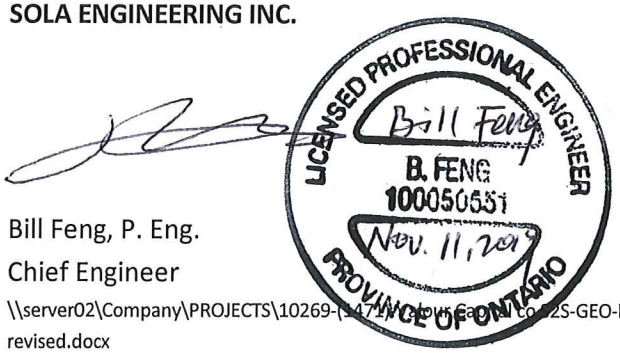
The information in this report in no way reflects on the environmental aspects of the soil conditions at the site and has not been addressed in this report, since this aspect was beyond the scope and terms of reference.

8.0 CLOSURE

This report is subject to the Statement of Limitations which forms an integral part of this document. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Sola, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

We trust that this report meets your needs. Should you have any queries, please contact the Sola office.

Sincerely,
SOLA ENGINEERING INC.



Bill Feng, P. Eng.
Chief Engineer
\\server02\Company\PROJECTS\10269-(1417)-Valour Capital co S2S-GEO-Highrise-418_422 Guelph-Burlington-Aug\GEO\08 Draft Reports\S0197-10923R-revised.docx
Enclosures

STATEMENT OF LIMITATIONS

Standard of Care and Basis of this Report
Sola Engineering Inc. ("Sola Engineering") has prepared this report in a manner consistent with generally accepted engineering and/or environmental practices in the jurisdiction in which the specified services were provided. The information and conclusions set out in this report reflects Sola Engineering's best professional judgment in light of the information available to Sola Engineering at the time of preparation. Sola Engineering disclaims any and all warranties, express or implied, including without limitation any warranty of merchantability and/or fitness for a particular purpose, and makes no representations concerning the legal effect, interpretation or significance of this report or the information, conclusions or recommendations contained in it.

The conclusions and recommendations provided in this report have been prepared in relation to the specified site (the "Site") and the proposed project (the "Project"), as described by the Client to Sola Engineering. Given the nature of the work undertaken by Sola Engineering as part of this report, the Client acknowledges that ground conditions may vary over distances and may change over time. Should there arise any changes to the conditions of the Site or the Project (as to purpose or design), Sola Engineering is to be notified within a reasonable period of time, and in any event within 24 hours of the Client's learning of such changes, so as to give Sola Engineering an opportunity to review and revise this report in light of such changes. Sola Engineering accepts no liability or responsibility for any use of this report or reliance on this report following any changes to the conditions of the Site or the Project.

The scope of professional services provided by Sola Engineering for the Project are as set out in this report. Should such services be limited to those of a geotechnical nature, Sola Engineering shall not be held liable or responsible for any environmental services that may be required, nor shall this report be interpreted to reflect any environmental aspects of the Project. Alternatively, should such services be limited to those of an environmental nature, Sola Engineering shall not be held liable or responsible for any geotechnical services that may be required, nor shall this report be interpreted to reflect any geotechnical aspects of the Project.

This report is not intended to provide recommendations for possible future conditions or use of the Site or adjoining properties. Should the need arise for such recommendations Sola Engineering may need to conduct further investigations.

Use of this Report
This report is intended to be read and used in its entirety. No reliance may be made upon any individual portion or section of this report without reference to the entire report as a whole. In preparing this report, Sola Engineering has relied on information, instructions and communications given by the Client to Sola Engineering, the applicability, truth and accuracy of which is the sole responsibility of the Client.

This report with the information, sampling data, analysis, conclusions and recommendations contained in it (if any), has been prepared for and may only be used by the Client and only for the specific purpose as specified by the Client to Sola Engineering in connection with the Project. Without prior written consent from Sola Engineering, use of this report or any portion thereof by any person or entity other than the Client, or for any purpose other than as communicated by the Client to Sola Engineering, is strictly prohibited. Sola Engineering accepts no liability or responsibility for the unauthorized use of this report. This report and all documents that form part of it are the sole property of Sola Engineering. Sola Engineering relies on and retains any and all intellectual property rights it has in this report, including any copyright to which it is entitled. The Client shall not give, lend or sell this report, or any portion thereof, to any entity, person or association without the express prior written consent of Sola Engineering. This report and the information contained herein shall be treated as strictly confidential.

The contents of this report, inclusive of Sola Engineering's conclusions and recommendations in relation to the Project, are intended only for the guidance of the Client in carrying out the specified services for the Project, as described by the Client to Sola Engineering. Accordingly, Sola Engineering does not accept any liability or responsibility for any inaccuracy contained in this report arising as a result of or in any way connected with any exclusion, oversight or falsification of the information provided to Sola Engineering by the Client. This report, including the effect of the subsurface conditions as described in this report, is to be interpreted at the risk and discretion of the Client and any contractors or others bidding on or undertaking contractual work to be performed as part of the Project who may come into possession of or learn of this report or its contents. It is exigent that all contractors bidding or undertaking the work are to rely on their own interpretations of the data contained in this report in addition to their own investigations and conclusions. Sola Engineering shall not be held liable or responsible for any interpretation of or conclusions that may be drawn from the data or information contained in this report.

The information, recommendations and conclusions presented in this report are based on Sola Engineering's interpretation of conditions revealed through the limited investigation conducted within a defined scope of services. In no event will Sola Engineering be held responsible or liable to the Client or any other person or entity for any special, indirect, incidental, punitive or consequential loss or damage (including, loss of use, lost profits or expenses incurred) resulting from or in any way related to the independent interpretations, interpolations, conclusions or decisions of the Client or any other person or entity, based on the information contained in this report. The restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Notwithstanding the exclusions of liability contained herein but without in any way limiting their effect or generality, if there is found to be any finding of liability or responsibility whatsoever on the part of Sola Engineering which in any way relates to or arises from this report, or the information, conclusions or recommendations contained in it, such liability and/or responsibility shall cease and forever be extinguished from and after the date which is two (2) years from the date of this report. In no event shall any liability or responsibility of Sola Engineering exceed the fees charged by Sola Engineering to the Client for the preparation of this report (excluding any arms' length disbursements or expenditures made or incurred by Sola Engineering as a result thereof and reimbursed by the Client).

Site Conditions
The material conditions, classifications, conclusions and recommendations contained in this report were based on the site conditions observed or tested by Sola Engineering or otherwise communicated to Sola Engineering by the Client. The description, identification and classification of soils, rocks, chemical contamination and other materials have been made based on limited investigations, sampling and testing of materials performed by Sola Engineering and its qualified representatives in reliance on the use of relevant or applicable equipment, all in accordance with commonly acceptable standards in the geotechnical and/or environmental disciplines. Accordingly, this report may include assumptions of conditions which are based on discrete sample locations and thus some conditions may not have been detected. The Client accepts all liability and risk for the use of this report and the information and data contained in it. Sola Engineering shall not be held liable or responsible for any conditions beyond the scope of tests conducted on samples of the subsurface and soil conditions of the subject property as set out in this report.

For clarity, the Client acknowledges and accepts that unique risks exist whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive sampling and testing program may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical and hydrogeological conditions that Sola Engineering interprets to exist between sampling points may differ from those that actually exist. As a result, the Client acknowledges and accepts that because of the inherent uncertainties in subsurface evaluations, unanticipated underground conditions may occur or become known subsequent to Sola Engineering's investigation that could affect conclusions, recommendations, total Project cost and/or execution.

Indemnification of Risk
Though Sola Engineering adheres to the highest degree of integrity and employs due diligence in limiting the potential release of toxins and hazardous substances, the risk of accidental release of such substances is a possibility when providing geotechnical and environmental services.

In consideration of the provision of services by Sola Engineering, the Client agrees to defend, indemnify and hold Sola Engineering and its employees and agents harmless from and against any and all claims, liabilities, damages, causes of action, judgments, costs or expenses (including reasonable legal fees and disbursements), resulting from or arising by reason of the death or bodily injury to persons, damage to property, or other loss, whether related to an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project or otherwise, and whether or not resulting from Sola Engineering's negligent actions or omissions. This indemnification shall include and extend to any and all third party claims brought or threatened against Sola Engineering under any federal or provincial law or statute as a result of Sola Engineering conducting work on the Project. In addition to and notwithstanding the foregoing, the Client further agrees to unconditionally and irrevocably release Sola Engineering from, and not to bring any claims against Sola Engineering in connection with, any of the aforementioned claims or causes.

Subconsultants and Contractor Services
In conjunction with the services provided by Sola Engineering's own employees, external services provided by other persons or entities that are specializing in services other than those offered by Sola Engineering, such as drilling, excavation and laboratory testing, are often employed in order to carry out the defined scope of work. If such external services have been employed for this Project, the Client acknowledges that Sola Engineering is not in any way liable or responsible for any costs, claims or damages in relation to the services rendered by such other persons or entities or payment therefor, nor shall Sola Engineering be liable or responsible for damages for errors, omissions or negligence caused by such other persons or entities while providing such external services.

Work and Job Site Safety
Sola Engineering shall be responsible only for its activities and that of its employees on the Site. Sola Engineering shall not direct any of the fieldwork nor the work of any other person or entity on the Project. The presence of Sola Engineering staff on the Site does not relieve the Client or any contractor on the Site from their responsibilities pertaining to site safety. The Client at all times retains any and all responsibility for the safety of those individuals present on the Site and/or working on the Project, including Sola Engineering's employees.



SOLA ENGINEERING	File No.: 2017-10269	Borehole Locations Plan	The figure provided is for the intended purpose of presenting the approximate borehole locations. This figure should not be used for any other purposes including construction, architecture or for accuracy of dimensions and orientation of objects.	Enclosure No.: 1
	Report Number: 10923-S0197-GEO	Geotechnical Investigation Proposed Highrise Building 418 and 422 Guelph Line, Burlington		
	Date: October 2017	S2S Environmental Inc.		Not to Scale

BOREHOLE LOG

BOREHOLE NO.: 102

ENCLOSURE 2
PAGE 1 **OF** 1

PROJECT NO.: 10269 **DATE:** September 6, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.979 Local **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS BLOW COUNTS	STANDARD PENETRATION TESTS "N" VALUE	ELEV./ DEPTH (m)
0			ASPHALTIC CONCRETE - 40 mm	10.1			
		1	GRANULAR BASE - sand and gravel	9.1	4-4-3-3	7	
			FILL - silty sand, trace gravel, dark brown, moist				
		2		9	1-1-1-1-2	2	
100.5 1.5			- trace rootlets				
		3		10.7	2-2-1-1	3	
		4		18.7	2-2-4-8	6	
99 3			SILTY SAND - brown, compact, moist				
		6		23.6	5-7-12-13	19	
97.5 4.5		6		22.9	5-7-7-10	14	
96 6		7	SILTY CLAY TILL - trace shale fragments, brown, hard, moist	9.9	15-38-50***/13	50*	
94.5 7.5		8	- limestone seams	7.7	50**/5	50*	
		R1	SHALE BEDROCK - QUEENSTON FORMATION, trace limestone seams, greyish red, highly weathered to moderately weathered, flat bedded, osccasionally gapped filled with clay lences, weak to medium strong TCR=95%, RQD=90%				
93 9		R2	- TCR=92%, RQD=81%				
91.5 10.5		R3	- TCR=85%, RQD=79%				
			END OF BOREHOLE at TARGETED DEPTH of 10.82 m				

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50***/13 denotes 50 plus blows for 13 cm of sampler penetration after 1st 30 cm;
50**/5 denotes 50 plus blows for 5 cm of sampler penetration;
RQD denotes rock quality designation

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 3
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 103

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 100.437 Local **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)	P.L.-L.L. / M.C. / "N" Value (20 40 60 80)
0		1	TOPSOIL - 125 mm	26.4				
			FILL - silty sand, trace gravel, trace organic, dark brown, moist	2.5	4-10-10-8	20		
99 1.5		2	SILTY SAND - trace rootlest, dark brown, loose, moist	10.5	1-2-3-4	5		
		3		15.7	2-5-7-8	12		
			- wet					
		4		21.5	6-7-9-8	16		
97.5 3			- brown					
		5		20.3	6-11-12-12	23		
96 4.5		6	SILTY CLAY TILL - trace gravel, brownish grey, hard, moist	13.6	10-13-23-16	36		
94.5 6		7	SHALE BEDROCK - QUEENSTON FORMATION, trace limestone seams, red trace grey, completely to highy weathered, very weak to weak	5.6	50*/8	50*		
93 7.5		8	END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m	10.2	50*/5	50*		
91.5 9								
90 10.5								

Notes: 50*/8 denotes more then 50 blows after 8 cm of sampler penetration;
50*/5 denotes more then 50 blows after 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 4
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 104

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:**
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.614 Local **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
0			ASPHALTIC CONCRETE - 40 mm					
		1	GRANULAR BASE - sand and gravel	3.1 4.1	4-5-7-6	12		
100.5		2	FILL - silty sand, brown, moist	4.9	3-3-5-7	8		
1.5			POSSIBLE FILL - silty sand, brown, moist					
		3	SILTY SAND - brown, compact, moist	4.7	4-5-6-7	11		
99		4		20.1	5-12-17-19	29		
3			- very dense, wet					
		5		17.1	15-24-26-27	50		
97.5								
4.5		6		18.7	13-26-35-39	61		
96								
6		7	SILTY CLAY TILL - trace gravel, trace shale fragments, redish brown, hard, moist	12.1 2.0	45- 50**/10	50*		
94.5			SHALE BEDROCK - QUEENSTON SHALE FORMATION, red trace grey, completely weathered to highy weathered, very weak to weak, occasional limestone thin seams					
7.5		8			50*/5	50*		
			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m					
93								
9								
91.5								
10.5								

Notes: 50*/5 denotes 50 plus blows for 5 cm of sampler penetration;
50**/10 denotes 50 plus blows for 10 cm of sampler penetration after 1st 15 cm

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 5
PAGE 1 OF 1

BOREHOLE LOG

BOREHOLE NO.: 105

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 6, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 101.780 Local **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: JA **REVIEWED BY:** HG

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS		ELEV./ DEPTH (m)	P.L.-L.L. M.C. "N" Value 20 40 60 80
					BLOW COUNTS	"N" VALUE		
0			ASPHALTIC CONCRETE - 40 mm	2.3				
		1	GRANULAR BASE - sand and gravel	6.0	3-2-3-4	5		
		4	FILL - silty sand, brown, moist	6.0	1-2-1-2	3		
100.5 1.5			POSSIBLE FILL - silty sand, brown, moist					
		3	SILTY SAND - brown, loose, moist	11.2	1-2-2-1	4		
		4	SANDY SILT -light brown, loose, moist	13.9	1-1-3-3	4		
99 3		5	SILTY SAND - brown, compact, moist	22.9	4-6-9-11	15		
97.5 4.5		6		22.5	5-5-9-9	14		
96 6		7	SILTY CLAY TILL - trace gravel, reddish brown, hard, moist	10.5	18-40-35-42	75		
94.5 7.5		8	- inferred limestone cap	12.7	50***/8	50*		
			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.69 m					
93 9								
91.5 10.5								

Notes: 50***/8 denotes 50 plus blows for 8 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 6
PAGE 1 **OF** 1

BOREHOLE LOG

BOREHOLE NO.: 106

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** Septemner 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 100.433 Local **CAVED AT DEPTH (M):** ----
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)
0		1	TOPSOIL - 150 mm	2.2	3-5-7-5	12	
			FILL - silty sand, trace asphalt, trace gravel, brown, moist	12.4			
99 1.5		2		9.3	2-3-3-2	6	
			- trace organic, brownish red				
		3		19.3	3-3-3-2	6	
			SILTY SAND - dark brown, compact, wet				
97.5 3		4		23.5	8-10-13-14	23	
		5	- trace gravel, brown, dense, wet	20.9	11-14-16-17	30	
96 4.5							
		6	SILTY CLAY - trace sand, trace shale fragments, brownish grey, hard, moist	14.6	11-14-17-23	31	
94.5 6							
		7		6.8	31-50**/10	50*	
93 7.5		8	END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 7.51 m		50*/5	50*	
91.5 9							
90 10.5							

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50**/10 denotes 50 plus blows for 10 cm of sampler penetration after 1st 15 cm;
50*/5 denotes 50 plus blows for 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.

ENCLOSURE 7
PAGE 1 **OF** 1

BOREHOLE LOG

BOREHOLE NO.: 108

SOLA ENGINEERING

PROJECT NO.: 10269 **DATE:** September 5, 2017
PROJECT: Proposed Residential Development

CLIENT: Valour Capital Managment Inc. c/o S2S Enviromental Inc.
LOCATION: 418 and 422 Guleph Line, Burlington, ON
ELEVATION (M): 99.714 Local **CAVED AT DEPTH (M):** 2.43
WATER LEVEL DEPTH (M): **DRILLING METHOD:** Hollow Stem
DRILLER: Profile Drilling **DRILL RIG:** D50
LOGGED BY: HG **REVIEWED BY:** KB

LEGEND:

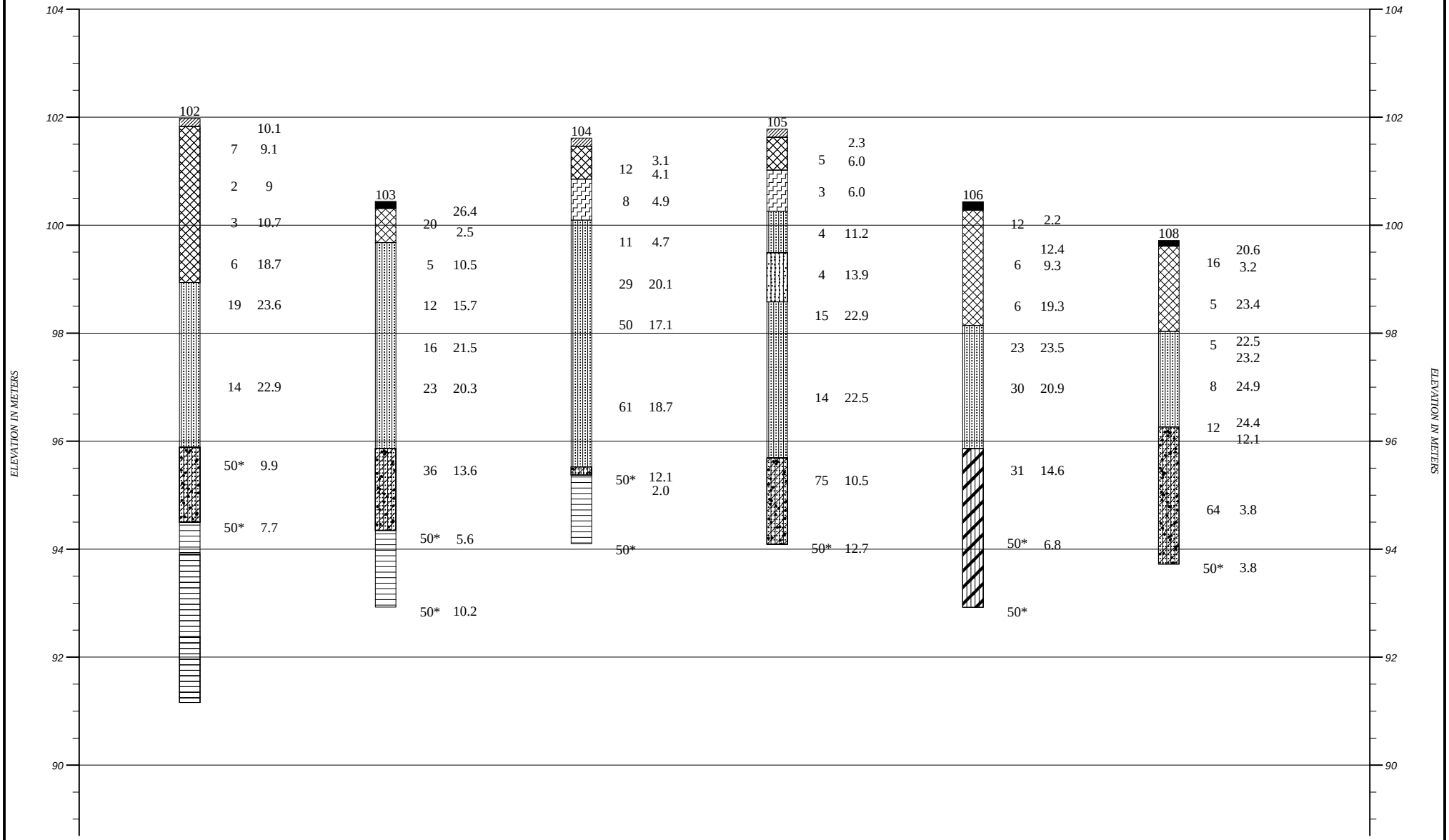
	SS - SPLIT SPOON
	AS - AUGER SAMPLE
	ST - SHELBY TUBE
	CS - CORE SAMPLE
	STABILIZED WATER LEVEL
	CAVED AT
"N"	BLOWS / 0.3 M
M.C.	NATURAL MOISTURE CONTENT (%)
O.V.M	ORGANIC VAPOUR MONITOR
P.L.	PLASTIC LIMIT (%)
L.L.	LIQUID LIMIT (%)

ELEV./ DEPTH (m)	WELL/ PIEZO. DETAIL	SYMBOLS, SAMPLERS TEST DATA	DESCRIPTION	Moisture Content	STANDARD PENETRATION TESTS: BLOW COUNTS	STANDARD PENETRATION TESTS: "N" VALUE	ELEV./ DEPTH (m)
99 / 0			TOPSOIL - 100 mm	20.6			
		1	FILL - silty sand , trace gravel, trace rootlets, trace organic, reddish brown to brown, moist	3.2	2-8-8-10	16	
		2		23.4	2-2-3-4	5	
97.5 / 1.5			- some organic, brownish black, wet				
		3		22.5	2-2-3-4	5	
			SILTY SAND - brown, loose, wet	23.2			
		1					
		4	- dark brown	24.9	3-3-5-8	8	
96 / 3							
		5		24.4	4-5-7-11	12	
			SILTY CLAY TILL - trace gravel, brown, stiff to hard, moist	12.1			
94.5 / 4.5			- trace shale fragments				
		6		3.8	20-28-36-42	64	
93 / 6		7	- inferred limestone cap	3.8	50*/5	50*	
			END OF BOREHOLE upon AUGER REFUSAL at DEPTH of 5.99 m				
91.5 / 7.5							
90 / 9							
88.5 / 10.5							

P.L.-L.L. M.C. "N" Value
20 40 60 80

Notes: 50*/5 denotes 50 plus blows for 5 cm of sampler penetration

This information pertains only to this borehole and should not be interpreted as being indicative of the site.



Plan View

Strata symbols

- Pavement
- Fill
- Silty sand
- Silty clay till
- Shale
- Topsoil
- Possible fill
- Sandy silt
- Silty clay

SOLA ENGINEERING INC.

CONCEPTUAL SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY
VERTICAL SCALE: 1"=100'	

Proposed Residential Development

PROJECT NO. 10269

Enclosure 8

KEY TO SYMBOLS

ENCLOSURE 9

Symbol	Description
Strata symbols	
	**Pavement**
	**Silty sand**
	**Silty clay till**
	**Shale**
	**Topsoil**

Symbol	Description
	**Fill**
	**Possible fill**
	**Sandy silt**
	**Silty clay**
Misc. Symbols	
	Natural Moisture Content
	**Drill Refusal**
	**Cave Depth**

Notes:

Terms describing RELATIVE DENSITY, based on Standard Penetration Test "N"-Value for COURSE GRAINED soils (major portion retained on No. 200 sieve).

DESCRIPTIVE TERM ["N"-Value (blows/0.3m), Relative Density (%)]

- **Very Loose [less than 4, less than 15]**
- **Loose [4 to 10, 15 to 35]**
- **Compact or Medium [10 to 30, 35 to 65]**
- **Dense [30 to 50, 65 to 85]**
- **Very Dense [greater than 50, greater than 85]**

Terms describing CONSISTENCY, based on Standard Penetration Test "N"-Value for FINE GRAINED soils (major portion passing No. 200 sieve)

DESCRIPTIVE TERM [Unconfined Compressive Strength (kPa), "N"-Value (blows/0.3m)]

Very Soft [less than 25, less than 2]
Soft [25 to 50, 2 to 4]
Firm [50 to 100, 4 to 8]
Stiff [100 to 200, 8 to 15]
Very Stiff [200 to 400, 15 to 30]
Hard [greater than 400, greater than 30]

KEY TO SYMBOLS

Symbol **Description**

Soil Samplers



Description not given for: "AS"



Split Spoon



Core Sample

Monitor Well Details

Flush-mount Cover



Pipe Riser



Bentonite Pellets



Silica sand, Blank PVC

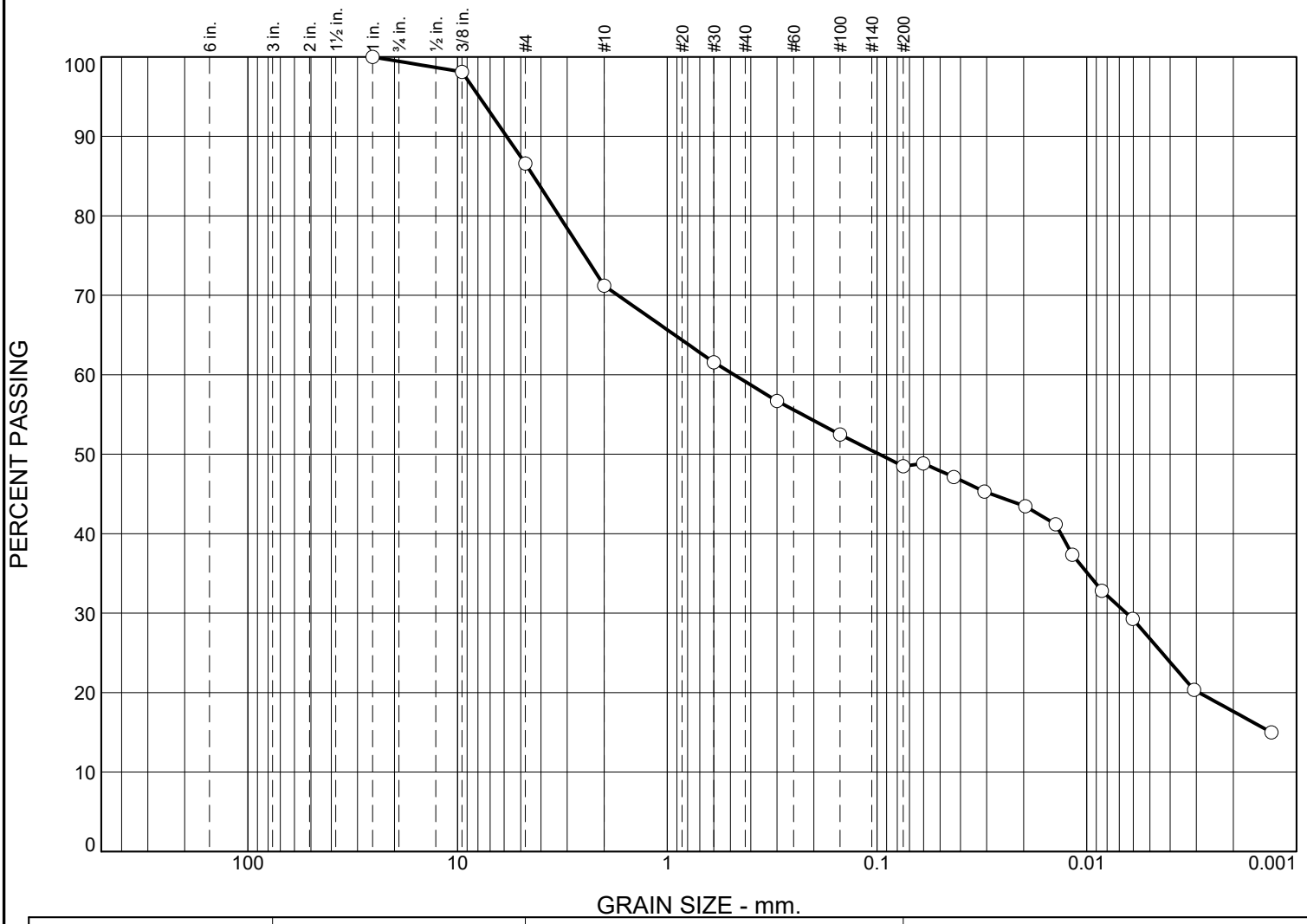


Slotted Pipe w/ Sand



Silica Sand, No Pipe (End Plug)

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0	1	12	16	12	11	48

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	24	13	4.3443	0.4800	0.0976	0.0065	0.0013			

	Material Description	USCS	AASHTO
○	SILTY CLAY TILL (VISUAL MANUAL) SILTY, CLAYEY SAND (LAB)	SC	A-6(2)

Project No. 10269 **Client:** Valour Capital Management

Project: Proposed Residential Development

○ **Location:** BH 105 **Depth:** 20'-22' **Sample Number:** 17-352

Remarks:

○ Sampled by:Harjot

Date: September 5, 2017

Report No: 2017-10923

SOLA ENGINEERING INC.

Enclosure 10