

REPORT ON
Updated Preliminary Geotechnical Investigation
118-132 Cross Avenue
Oakville, Ontario

PREPARED FOR:
Balbir Sanghera

PREPARED BY:
DS Consultants Ltd.

Project No: 25-315-100
Date: July 14, 2025



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1. INTRODUCTION

DS Consultants Ltd. (DS) was retained by Balbir Sanghera (The client) to undertake a preliminary geotechnical investigation for the proposed mixed-use development located at 118-132 Cross Avenue, Oakville, Ontario.

It is understood that the proposed development will be a high rise thirty-eight (38 storey) building, instead of 50 storey previously proposed, and five (5) storey podium with three (3) levels of underground parking/basement (and partial P4, Lower P3). The P3 finished floor slab will be at an Elevation of 93.23m and Lower P3 finished floor slab Elevation will be 90.43m.

The purpose of this preliminary geotechnical investigation was to determine the subsurface conditions at six (6) borehole locations (BH25-1 to BH25-6) which were drilled in the subject site was to determine the subsurface conditions at the borehole locations and from the findings in the boreholes make engineering recommendations for the following:

1. Foundations
2. Floor slabs and permanent drainage
3. Excavations and backfill
4. Earth pressures
5. Temporary Shoring System
6. Earthquake considerations

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for Balbir Sanghera and its architects and designers. Third party use of this report without DS Consultants Ltd. consent is prohibited.

2. FIELD AND LABORATORY WORK

Six boreholes (BH25-1 to BH25-6) were drilled at the subject site during the period of October 21 to October 22, 2025, to depths ranging from 2.1 to 11.1 m to shale bedrock or auger refusal.

Boreholes were drilled with hollow stem continuous flight auger and mud rotary equipment by a drilling sub-contractor under the direction and supervision of DS Consultants Limited personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the DS Consultants Ltd. laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples were tested for moisture contents. Grain size analyses were carried out on selected soil samples and gradation curves for grain size analyses are presented on **Drawing 9**.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Monitoring wells were installed in boreholes BH25-1, BH25-3, and BH25-5 for long-term groundwater level measurements.

The elevation surveying of the borehole locations was undertaken by DS personnel, using the differential GPS unit. It should be noted that the elevations at the as-drilled borehole/well locations were not provided by a professional surveyor and should be considered approximate. Contractors performing any work referenced to the borehole elevations should confirm the borehole elevations for their work.

3. SITE AND SUBSURFACE CONDITIONS

The borehole location plan is shown on **Drawing 1**. General notes on sample description are provided on **Drawing 1A**. The subsurface conditions in the boreholes are presented in the individual borehole logs **Drawings 2 to 7**. The subsurface conditions in the boreholes (by DS) are shown on **Drawing 8** and can be summarized in the following paragraphs.

3.1 Soil and Bedrock Conditions

Pavement/Organic Material/Fill:

Asphalt layer, varying from 50 to 75mm in thickness, was present at the surface at boreholes BH25-5 and BH25-6. Granular material consisting of crusher run limestone was encountered below the asphaltic concrete material in these boreholes. The thickness of granular material was measured 150 mm below the existing ground surface.

A layer of Organic material/topsoil, about 130 mm in thickness, was observed at the surface at Boreholes BH25-4 and BH25-3.

It should be noted that the thickness of the organics/topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site. Shallow hand-dug test-pits should be carried out to calculate the amount of topsoil at site accurately.

Fill material was found below the asphalt/organic layers at boreholes BH25-3 to BH25-6, at the surface, at the remaining boreholes BH25-1 and BH25-2 extending to depths ranging from 0.8 to 2.3 m below the ground surface. The fill material consisted of firm to very stiff clayey silt, and sandy silt from loose to compact state. It should be noted that borehole BH25-6 was terminated in fill material at an approximate depth of 2.1 m.

The fill layer contained organic clayey silt, trace to some of organics, rootlets, gravel, cobbles, rock fragments, shale fragments and wood pieces. The SPT 'N' values measured in fill materials ranged from 4 to 26 blows per 300 mm spoon penetration. The moisture content of this dark brown to brown fill layer varied from 9 to 28%.

The type/quantity and extent of the existing fill layer can be explored by further test pit investigation prior to excavations.

Clayey Silt (Till) Deposits:

A cohesive deposit of clayey silt, clayey silt till layer was found below the fill layers and non cohesive layer in boreholes (BH25-1, BH25-4 and BH25-5) at varying depths and to the underlying till/shale complex/shale bedrock, to approximate depths ranging from 1.0 to 6.0 m below ground surface in the boreholes. This deposit was found to have a stiff to hard consistency with measured SPT 'N' values ranging from 13 to over 50 blows per 300mm penetration. The clayey silt till deposits were brown to grey in colour and contained cobbles, boulders and trace to some of sand and gravel. The moisture content of this clayey till layer varied from 10 to 12%.

Grain size analyses of one clayey silt till soil sample (BH25-4/SS5) were conducted. The result is shown on **Drawings 9** with the following fractions:

Clay: 23%

Silt: 49%

Sand: 14%

Gravel: 14%

Sandy Silt/Silty Sand (Till):

Cohesionless deposit was encountered below fill or cohesive material in all boreholes at varying depths and except borehole BH25-6.

The sandy silt till/silty sand layers were extended to depths ranging from 0.8 to 4.7 m below existing grade and extended to the underlying till/shale complex except borehole BH25-6. The cohesionless material was present in a compact to very dense state, with measured SPT 'N' values ranging between 37 to over 50 blows per 300 mm of penetration.

Grain size analyses of three (3) soil sample from sandy soil (BH25-1/SS4, BH25-3/SS4 and BH25-5/SS3) was conducted, and the results are presented in **Drawing 9**, with the following fractions:

Clay: 8 to 14%
Silt: 41 to 48%
Sand: 19 to 56%
Gravel: 6 to 12%

Till/Shale Complex:

Below the sandy silt/silty sand till in two boreholes BH25-2 and BH25-3 sandy silt till shale complex was encountered and extended to the underlying found shale bedrock, to approximate depths ranging from 3.3 and 4.8 m below ground surface, respectively. The sandy silt till shale complex consisted of sandy silt till mixed with highly weathered shale. This deposit was found to have generally very dense in compactness, with measured SPT 'N' values to over 50 blows per 300 mm of penetration. The moisture content of this till/shale complex layer varied from 9 to 11%.

Shale Bedrock:

The shale bedrock of Georgian Bay Formation was encountered in all boreholes except BH25-6, at approximate depths ranging from 4.6 to 5.9 m below the existing grade, corresponding to approximate Elevations varying from 98.0 to 97.1 m.

Shale bedrock was proven by rock coring in three boreholes BH25-1, BH25-3, and BH25-5. Photographs of general bedrock of cores and general comments on bedrock in Toronto area are attached in Appendix A. The depth and elevation of the shale bedrock surface in the boreholes are listed on Table 1.

Table 1: Depth and Elevation of Shale Bedrock Surface

Borehole No.	Borehole Elevation (m)	Depth of Shale Bedrock Surface below Existing Ground (m)	Approximate Elevation of Shale Bedrock Surface (m)	Notes
BH25-1	103.0	5.9	97.1	Bedrock was cored to 9.6 m
BH25-2	102.7	4.7	98.0	Augered to approximate 5.4 m
BH25-3	102.8	4.8	98.0	Bedrock was cored to 9.6 m
BH25-4	103.2	6.0	97.2	Augered to approximate 6.3 m
BH25-5	102.6	4.6	98.0	Bedrock was cored to 11.1 m

Depth to shale bedrock varies across the site. Therefore, it must be confirmed during general excavations.

Because of the method of drilling and sampling, the surface elevations of the bedrock can be different than indicated on the borehole logs. With augering, the auger may penetrate some of the more weathered shale and the coring may therefore begin below the bedrock surface. Commonly the overburden overlying the shale contains slabs of limestone which would give a false indication of the bedrock level. Similarly, the depth of weathering cannot be determined accurately due to the presence of limestone layers.

Total Core Recovery (TCR): The total core recovery indicates the total length of rock core recovered, expressed as a percentage of the actual length of the core run. The total core recovery in the core hole (by DS) ranged from 76 to 100%. Generally, less core recovery was experienced only near the surface of the rock, where the formation is slightly weathered and was almost full as depth increased.

Solid Core Recovery (SCR): The solid core recovery is the total length of solid, full diameter rock core that was recovered, expressed as a percentage of the length of the core run. Solid core recovery ranged from 30 to 86% and also appears to generally improve with depth. The SCR index was generally influenced by the orientations of the fractures. SCR was low when fractures oblique to the borehole axis were intercepted.

Rock Quality Designation (RQD): The rock quality designation index is obtained by measuring the total length of recovered rock core pieces which are longer than 100 mm and expressing their sum total length as a percentage of the length of the core run. RQD is a function of the frequency of joints, bedding plane partings and fractures in the rock core.

While the use of double tube core barrels provided reasonably good protection of the core during drilling and core retrieval, the fissile nature of the shale greatly influences the RQD values of the rock cores. Consequently, it is believed that the RQD values recorded underestimate the rock quality classification of the laminated fissile shale. The recorded RQD values in the core (by DS) ranged from 0 to 72 percent which also improved with depth.

Hard Layers: Based on the visual examination of the rock cores, an attempt was made to identify and record the thickness and percentages of the relatively harder siltstone and limestone layers. The percentage of the “hard layers” per core run ranges between 5 and 16%. The thickness of these layers varied but was generally less than 130 mm, however, thicker layers to be as much as 750 to 900 mm have been observed at other sites in GTA. The layers are actually lenses and they can vary significantly in thickness over short distance. Encountering such thick layers should be anticipated. It is also common to encounter closely spaced groupings of thin strong limestone/siltstone layers which individually may only be 25 to 50 mm thick but collectively can be 1m in thickness.

Methane Gas: Although not detected during drilling at this site, methane gas is expected in the bedrock as indicated in **Appendix A**. Appropriate care and monitoring is essential in all confined bedrock excavations.

3.2 Groundwater Conditions

Stabilized groundwater levels measured in the monitoring wells (installed by DS) are provided below on Table 2.

Table 2: Groundwater Levels Observed in Boreholes

BH No.	Date of Drilling	Date of Observation	Borehole Elevation (m)	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH25-1	Oct. 22, 2025	Nov. 6, 2025	103.0	4.9	98.1
BH25-3	Oct. 22, 2025	Nov. 6, 2025	102.8	5.6	97.2
BH25-5	Oct. 21, 2025	Nov. 6, 2025	102.6	3.7	98.9

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

Therefore, reference is made to the hydrogeology study report prepared by DS for this project for further details on the extent and the conditions of the groundwater, as well as the recommended groundwater control.

4. FOUNDATIONS

It is understood that the proposed development will be a high rise thirty-eight (38 storey) building, instead of 50 storey previously proposed, and five (5) storey podium with three (3) levels of underground parking/basement (and partial P4, Lower P3). The P3 finished floor slab will be at an Elevation of 93.23m and Lower P3 finished floor slab Elevation will be 90.43m.

Subject to design grades and depth of shale bedrock, the proposed building with three (3 levels of basements and lower P3 partial basement can be supported by conventional spread and strip footings or raft founded on shale bedrock. Footings founded in sound shale bedrock at least 1.5m below the bedrock surface can be designed for an bearing capacity values of 5 MPa (at SLS) and 7.5 MPa (at ULS).

It should be noted that, if it is not feasible to adopt underfloor and perimeter drainage, the structures will need to be designed as a tank structure (watertight), considering the hydrostatic uplift pressure on the slab and walls. The entire basement (slab and walls) should be waterproofed.

Foundations designed to the specified bearing capacity at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

Where it is necessary to place footings on bedrock at different levels, the upper footing must be founded below an imaginary 1 horizontal to 1 vertical line (1H:1V in sound bedrock) 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.

The shale bedrock weathers rapidly between wetting and drying cycles. In view of this, it is suggested that a lean concrete mat slab be placed immediately after the excavation is complete to keep the shale intact, unless the footings are cast immediately after excavating.

It should be noted that the recommended bearing capacities have been calculated by DS Consultants Ltd. from the borehole information for the preliminary 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 DS Consultants Ltd. to validate the information for use during the construction stage.

5. FLOOR SLAB AND PERMANENT DRAINAGE

The basement floor will extend below groundwater table. Feasibility studies of permanent underfloor drainage and perimeter drainage must be carried out in the hydrogeological investigation, to estimate seepage rates into the permanent drainage systems.

If it is not feasible to install permanent underfloor and perimeter drainages, tanked basement structures with waterproofing will be required.

Subject to design grades, the P3/Lower P3 floor slab will be on bedrock and can be cast as slab-on-grade provided a 200 mm layer of clear crushed stone (19 mm maximum size) is placed between the underside of the floor slab and the exposed bedrock surface.

If it is feasible to install perimeter and underfloor drainage, a perimeter and underfloor drainage system will be required with three levels of basement and Lower P3 Basement. Typical drainage and backfill recommendations are illustrated on **Drawings 10 and 11** for shored excavation system.

In addition, the elevator pits should be designed as a water-tight structures and should be fully waterproofed to avoid any water leaks.

6. EARTH AND GROUNDWATER PRESSURES

The lateral earth pressures acting on the basement and retaining walls can be calculated from the following expressions:

The design of basement walls can incorporate the conventional design in the overburden using the earth pressure coefficient $K_1=0.50$. In the rock, the earth pressure coefficient K can be reduced to $K_2=0.20$.

The lateral earth/rock pressure acting at any depth on basement walls can be calculated as follows:

In soil: $p = K_1 (\gamma_1 h_1 + q)$

In rock: $p = K_2 (\gamma_1 H_1 + q + \gamma_2 h_2)$

where p = lateral earth pressure in kPa acting at depth h_1 or h_2

K_1 = earth pressure coefficient $K_1=0.50$ for overburden soil

K_2 = earth pressure coefficient $K_2=0.20$ for rock

γ_1 = unit weight of overburden soil assuming 21 kN/m³

γ_2	=	unit weight of rock assuming 24 kN/m ³
h_1	=	depth in overburden soil below ground surface
H_1	=	thickness of soil above rock
h_2	=	depth in rock (depth below rock surface)
q	=	value of surcharge in kPa

The above expression assumes that the perimeter drainage system prevents the buildup of any hydrostatic pressure behind the wall. If water is not drained by underfloor and perimeter drainage, then the wall should be designed for hydrostatic pressure. If the foundation wall is poured against the caisson wall, then the foundation wall as well as the caisson wall should be designed for hydrostatic pressure.

7. EXCAVATIONS AND BACKFILL

Excavations in overburden can be carried out with heavy hydraulic backhoe. Excavation of the overburden will be relatively straightforward; however, obstructions and boulder should be expected. Excavation of the shale can be carried out using heaviest available single tooth ripper equipment. The limestone beds may be frequent and may overly the shale bedrock surface at some locations. It may be necessary at some locations to utilize jackhammer type equipment to “open” the limestone layers for the ripper.

DS completed a hydrogeological study at the subject site and more comments regarding the type and extent of groundwater control required were addressed in the hydrogeology report.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the overburden soil can be classified as Type 3 Soil above the groundwater table and Type 4 Soil below the groundwater table.

Large obstructions in the fill material and boulders in till are anticipated. Provisions must be made in the excavation contract for the removal of large obstructions in the fill materials, boulders in till and hard layers in the shale bedrock.

Based on borehole information, the existing fill materials are considered unsuitable for re-use as backfill material as it contains organics and other debris. Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

8. TEMPORARY SHORING

It is understood that the proposed excavations may be supported by a temporary shoring system consisting of timber lagging and soldier piles. A tightly braced caisson wall may be required to support adjacent structures. The requirement for caisson walls is given on **Drawing 12**.

The shoring system must be designed in accordance with the 4th Edition of the Canadian Foundation Engineering Manual. The soil parameters estimated to be applicable for this design are as follows:

- 1) Earth Pressure Coefficient for shoring:
 - (a) where movement must be minimal $K=0.45$
 - (b) where minor movement ($.002H$) can be tolerated $K=0.30$
 - (c) passive earth pressure for soldier piles (unfactored) $K_p=5.0$ for sound shale bedrock.
- 2) For stability check
 - $\phi = 30^\circ$
 - $C = 0$
 - $\gamma = 21 \text{ kN/m}^3$
 - surcharge is to be determined by shoring contractor.
- 3) For rock anchors

An allowable bond stress of 600 kPa (90 psi) can be used in sound shale bedrock for the design of anchors.

An allowable bond value of 600 kPa is suggested for anchors in sound rock; However, this value depends on anchor installation methods and grouting procedures. Gravity poured concrete can result in low bond values while pressure grouted anchors will give higher values and produce a more satisfactory anchor.

The soldier piles should be installed in pre-augered holes taken below the deepest adjacent excavation. The holes should be filled with concrete below the excavation level and half bag mix above the base of the excavation. The concrete strength must be specified by the shoring designer. Temporary liners will be required to help prevent the alluvial deposits or fill from caving during the installation period.

The top anchor must not be placed lower than 3.0 metres below the top of level ground surface. The contractor must decide the anchor capacity and confirm its availability. All anchors must be tested as indicated in the Canadian Foundation Engineering Manual, 4th edition.

Adhesion on the buried caisson shaft or behind the shoring system must be neglected when designing this shoring system.

Movement of the shoring system is inevitable. Vertical movements will result from the vertical load on the soldier piles resulting from the inclined tiebacks and inward horizontal movement results from earth and water pressures. 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 to 0.25% of the shoring height.

To ensure that movements of the shoring are within an acceptable range, monitoring must be carried out. Vertical and horizontal targets on the soldier piles 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 will enable directions to be given to improve the shoring.

9. EARTHQUAKE CONSIDERATIONS

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2024, the subject site for the proposed building with three levels of basement and Lower P3 partial basement in sound shale bedrock can be classified as 'Class B' for seismic site response, provided that field seismic Shear Wave Velocity Testing (SWVT) is to be carried out to confirm the 'class B' classification and to provide additional seismic design information for the structural engineer.

10. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Ltd. should 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, DS Consultants Ltd. will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for Balbir Sanghera. The material in it reflects our best judgment in light of the information available to DS Consultants Ltd. at the time of preparation. Unless otherwise agreed in writing by DS Consultants Ltd, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the borehole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

DS Consultants Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken because of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

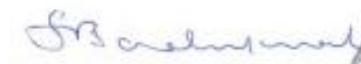
**Yours Very Truly,
DS CONSULTANTS LTD.**




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Drawings



Legend

- Borehole
- Borehole With Monitoring Well



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Client:

BALBIR SANGHERA

Project: GEOTECHNICAL INVESTIGATION
118-132 Cross Avenue, Oakville, ON

Title: **BOREHOLE LOCATION PLAN**



Size:
8.5 x 11

Approved By: L.M

Drawn By: K.T

Date: December 2025

Rev:
0

Scale: As Shown

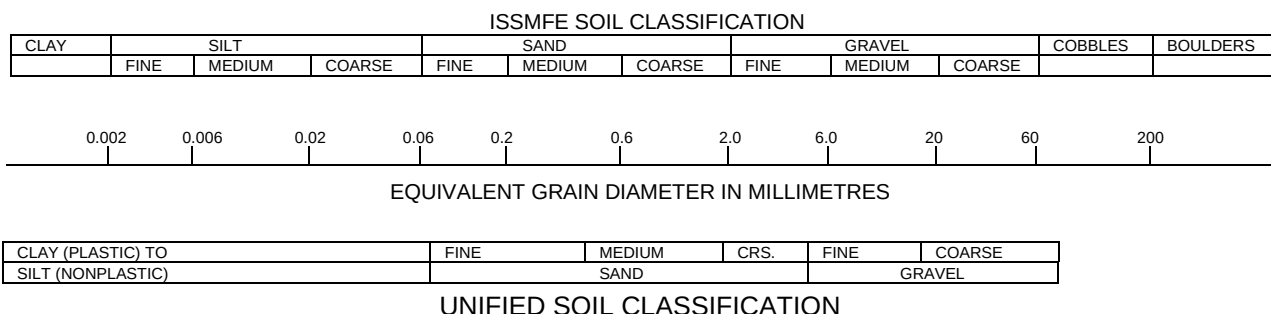
Project No.: 25-315-100

Drawing No.: **1**

Image/Map Source: Google Satellite Image

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



2. **Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.
3. **Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

PROJECT: Geotechnical Investigation
CLIENT: Balbir Sanghera
PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4812114 E 606339.8

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200mm
Date: Oct-22-2025
REF. NO.: 25-315-100
ENCL NO.: 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN (C _u) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)										WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE & Sensitivity	× LAB VANE	20							40	60	80
103.0																	GR SA SI CL			
0.0	FILL: clayey silt, trace rootlets, trace rock fragments, piece of shale, brown, moist, firm to very stiff		1	SS	4															
			2	SS	4															
101.3	CLAYEY SILT TILL: sandy, trace gravel, trace cobble/boulder, brown, moist, very stiff		3	SS	26															
100.7	SANDY SILT TILL: trace to some clay, trace to some gravel, cobbles/boulders, brown, moist, dense to very dense trace shale fragments at 3.1m		4	SS	47												12 19 48 11			
2.3			5	SS	54															
98.4	CLAYEY SILT TILL: trace sand, trace gravel, grey, moist, hard		6	SS	50/ 30mm															
97.1	SHALE BEDROCK: Georgian Bay Formation, grey, weathered		7	SS	50/ 50mm															
96.9	TCR=85%, SCR=40%, RQD=0%		R1	RC																
96.4	Hard layer=8%, Maximum hard layer thickness=25mm																			
6.6	TCR=96%, SCR=72%, RQD=55%		R2	RC																
	Hard layer=8%, Maximum hard layer thickness=50mm																			
94.9	TCR=96%, SCR=86%, RQD=72%																			
8.1	Hard layer=15%, Maximum hard layer thickness=130mm		R3	RC																
93.4	END OF BOREHOLE:																			
9.6	Notes: 1) 50mm dia. monitoring well installed upon completion. 2) Water Level Readings: Date: Water Level(mbgl): Nov 6, 2025 4.9																			

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure

DS SOIL LOG-2021-FINAL 25-315-100 GEO.GPJ DS.GDT 25-12-1

PROJECT: Geotechnical Investigation
CLIENT: Balbir Sanghera
PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4812100.1 E 606349.8

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200mm
Date: Oct-22-2025
REF. NO.: 25-315-100
ENCL NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (C _u) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							
102.7								20 40 60 80 100							GR SA SI CL
0.0	FILL: organic clayey silt, trace rootlets, trace rock fragments, gravel, dark brown, moist, stiff		1	SS	11										
101.9															
0.8	FILL: clayey silt, trace sand, trace gravel, brown, moist to very moist, firm to stiff trace cobble/boulder at 1.0 m		2	SS	10										
			3	SS	4										
100.4															
2.3	SANDY SILT TILL: some clay, trace gravel, brown, moist, very dense		4	SS	52										
99.4															
3.3	SANDY SILT TILL/SHALE COMPLEX: trace clay, trace gravel, brown to reddish brown, moist, very dense		5	SS	56										
98.0															
4.7	SHALE BEDROCK: Georgian Bay Formation, grey, weathered		6	SS	50/ 30mm										
97.3															
5.4	END OF BOREHOLE: Notes: 1) Auger refusal at 5.4m.		7	SS	50/ 50mm										

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure



PROJECT: Geotechnical Investigation

CLIENT: Balbir Sanghera

PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON

DATUM: Geodetic

BH LOCATION: See Drawing 1 N 4812084.7 E 606330.4

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200mm

Date: Oct-22-2025

REF. NO.: 25-315-100

ENCL NO.: 4

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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W. L. 97.2 m
Nov 06, 2025

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH
NOTES+ 3 , × 3 : Numbers refer
to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation
CLIENT: Balbir Sanghera
PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4812073.7 E 606294.4

DRILLING DATA
Method: Hollow Stem Auger
Diameter: 200mm
Date: Oct-22-2025
REF. NO.: 25-315-100
ENCL NO.: 5

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)		W _p		W		W _L				
103.2								20 40 60 80 100										GR SA SI CL
100.9	TOPSOIL: 130mm		1	SS	5		103											
	FILL: sandy silt, topsoil inclusion, trace rootlets, trace gravel, trace wood piece, trace organics, dark brown, moist, loose to compact cobbles at 0.8m		2	SS	13		102											
			3	SS	16		101											
100.9	SANDY SILT TILL: some clay, trace gravel, occasional cobble, brown, moist, dense		4	SS	41		100											
100.1	CLAYEY SILT TILL: some sand, trace to some gravel, shale fragments inclusions, trace cobble/boulder, brown to grey, moist, hard		5	SS	34		99											14 14 49 23
	grey at 4.6m		6	SS	32		98											
97.2	SHALE BEDROCK: Georgian Bay Formation, grey, weathered		7	SS	50/25mm		97											
6.3	END OF BOREHOLE: Notes: 1) Borehole dry at the bottom upon completion.																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation
CLIENT: Balbir Sanghera
PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4812051.5 E 606316.1

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Oct-21-2025
REF. NO.: 25-315-100
ENCL NO.: 6

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)										WATER CONTENT (%)		
○ UNCONFINED + FIELD VANE & Sensitivity																				
● QUICK TRIAXIAL × LAB VANE																				
102.6							20	40	60	80	100	10	20	30						
100.2	ASPHALT: 50mm		1	SS	4								○							
	GRANULAR BASE: crusher run limestone, 150mm																			
101.6	FILL: clayey silt, trace rootlets, trace gravel, some sand, rock fragments, brown, moist, firm to stiff		2	SS	13								○							
101.1	CLAYEY SILT TILL: sandy, trace gravel, brown, moist, stiff		3	SS	55								○			9	36	41	14	
1.5	SANDY SILT TILL: trace to some clay, trace gravel, cobbles/boulders, brown to reddish brown, moist, very dense no recovery due cobble/boulder at 2.3m		4	SS	50/50mm															
			5	SS	55								○							

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure

DS SOIL LOG-2021-FINAL 25-315-100 GEO.GPJ DS.GDT 25-12-1



PROJECT: Geotechnical Investigation

CLIENT: Balbir Sanghera

PROJECT LOCATION: 118-132 Cross Avenue, Oakville, ON

DATUM: Geodetic

BH LOCATION: See Drawing 1 N 4812107.5 E 606329.7

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200mm

Date: Oct-21-2025

REF. NO.: 25-315-100

ENCL NO.: 7

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN (C _u) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)									
103.2	ASPHALT: 75mm GRANULAR BASE: crusher run limestone, 150mm FILL: clayey silt, trace organics, boulders/cobbles, dark grey, moist, firm to very stiff trace shale pieces organic clayey silt at 1.5m		1	SS	14		103										
103.0			2	SS	7												
102.9			3	SS	17												
101.1			END OF BOREHOLE:														

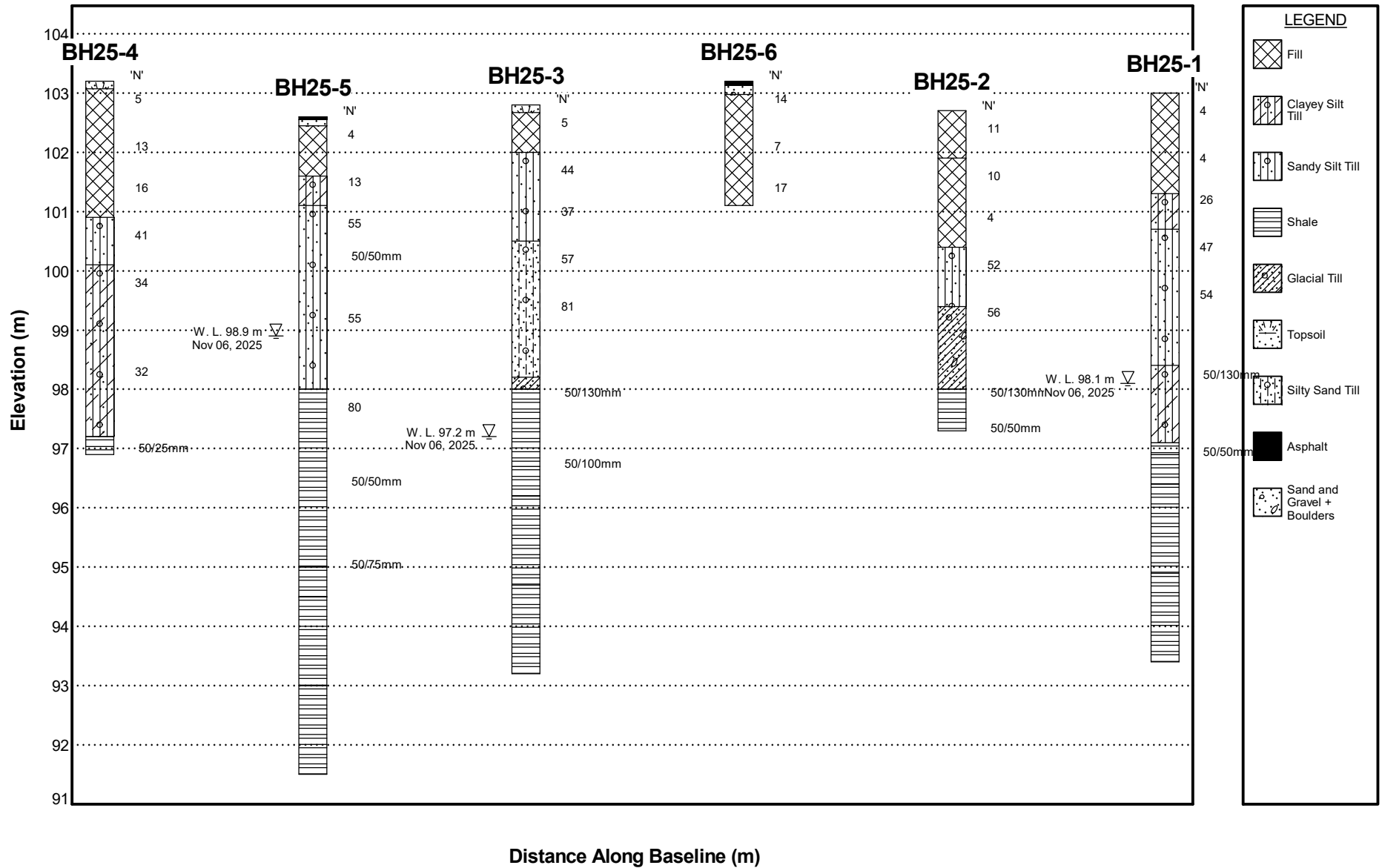
GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure



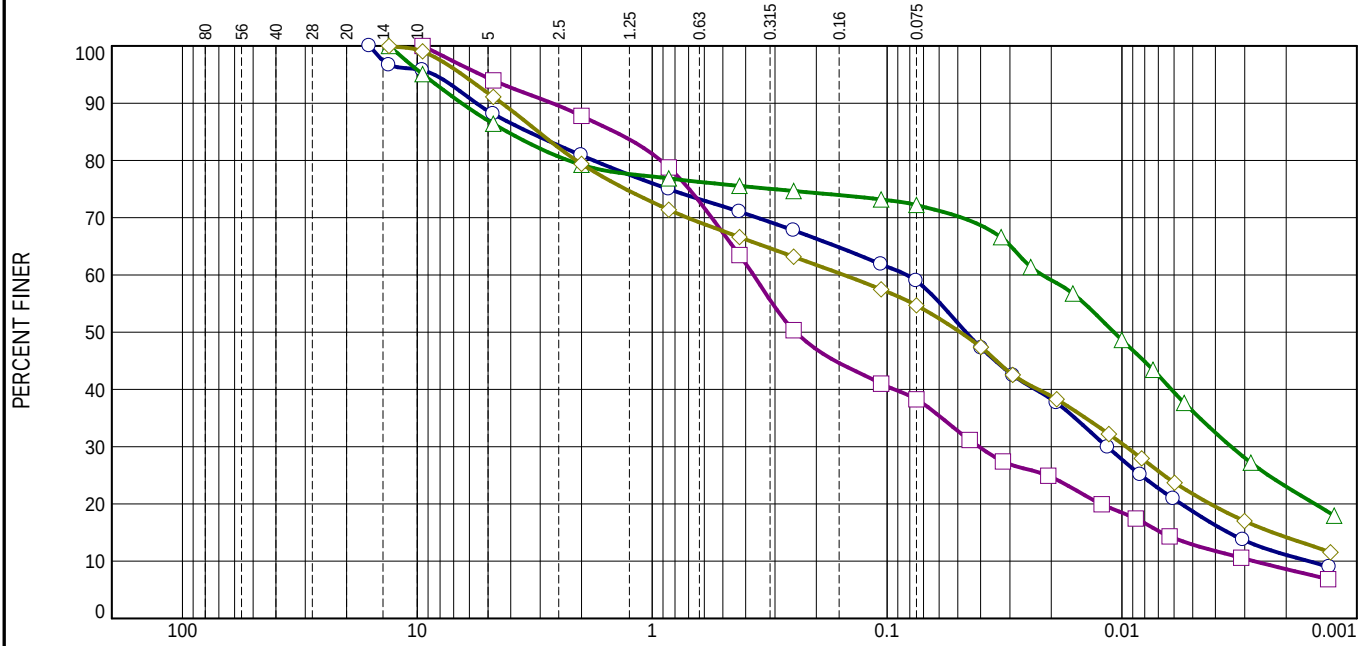
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Geotechnical ♦ Environmental ♦ Materials ♦ Hydrogeology

Generalized Sub-surface Profile (NTS)

DRAWING NO.	8
JOB NO.	25-315-100
DATE	November, 2025

Particle Size Distribution Report

ASTM D422



GRAIN SIZE - mm.										
	% +75mm	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt		Clay	
○	0.0	0.0	11.9	7.2	9.9	12.1	47.8		11.1	
□	0.0	0.0	6.0	6.2	24.3	25.2	29.7		8.6	
△	0.0	0.0	13.6	7.2	3.6	3.4	49.2		23.0	
◇	0.0	0.0	8.9	11.7	12.8	11.9	40.5		14.2	

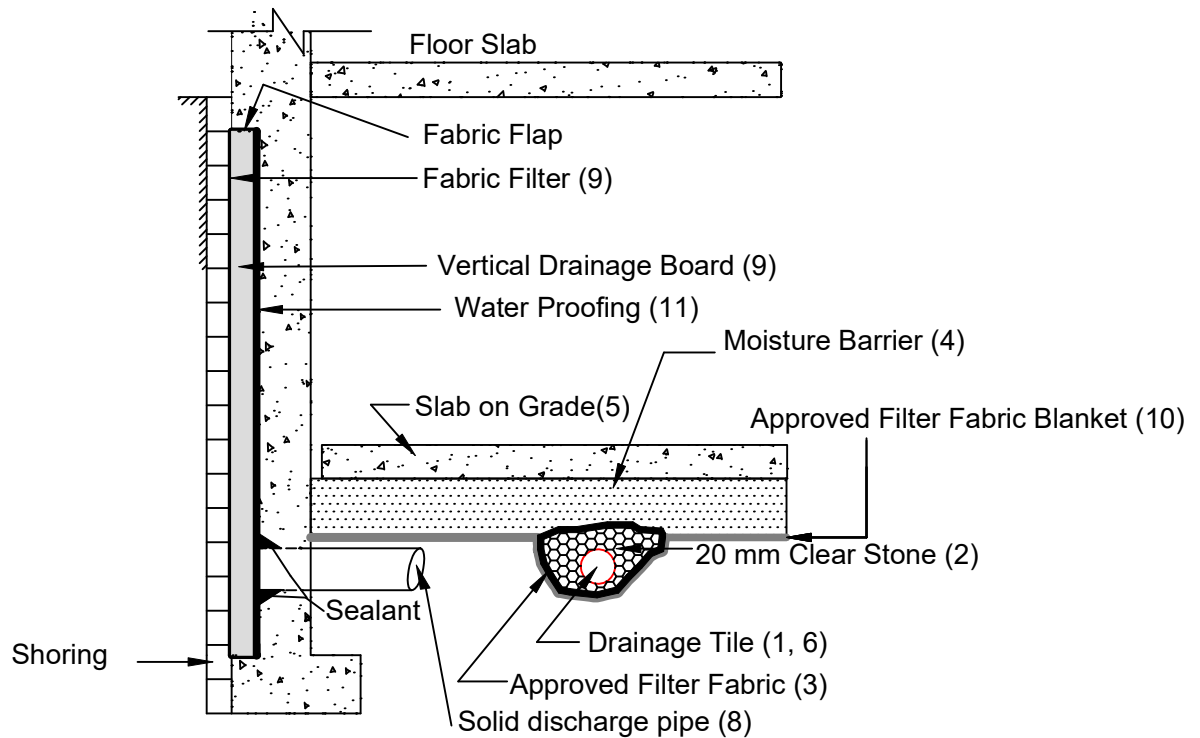
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○			3.3655	0.0824	0.0461	0.0116	0.0035	0.0016	1.02	51.59
□			1.4430	0.3705	0.2450	0.0406	0.0068	0.0027	1.62	135.26
△			4.1336	0.0219	0.0108	0.0034				
◇			3.0525	0.1528	0.0488	0.0096	0.0023			

Material Description	USCS	AASHTO
○ Sandy silt till, some clay, some gravel		
□ Silty sand, trace clay, trace gravel		
△ Clayey silt till, some sand, some gravel		
◇ Sandy silt till, some clay, trace gravel		

Project No. 25-315-100 Client: Balbir Sanghera Project: 118-132 Cross Avenue, Oakville, ON ○ Location: BH25-1 SS4 Sample Number: VM-7229 □ Location: BH25-3 SS4 Sample Number: VM-7229 △ Location: BH25-4 SS5 Sample Number: VM-7229 ◇ Location: BH25-5 SS3 Sample Number: VM-7229	Remarks: ○ F.M.=1.51 □ F.M.=1.64 △ F.M.=1.36 ◇ F.M.=1.61
 DS CONSULTANTS LTD. Geotechnical ♦ Environmental ♦ Materials ♦ Hydrogeology 	

Figure 9

Tested By: Helen/Nisha Checked By: Kirupa



EXTERIOR FOOTING

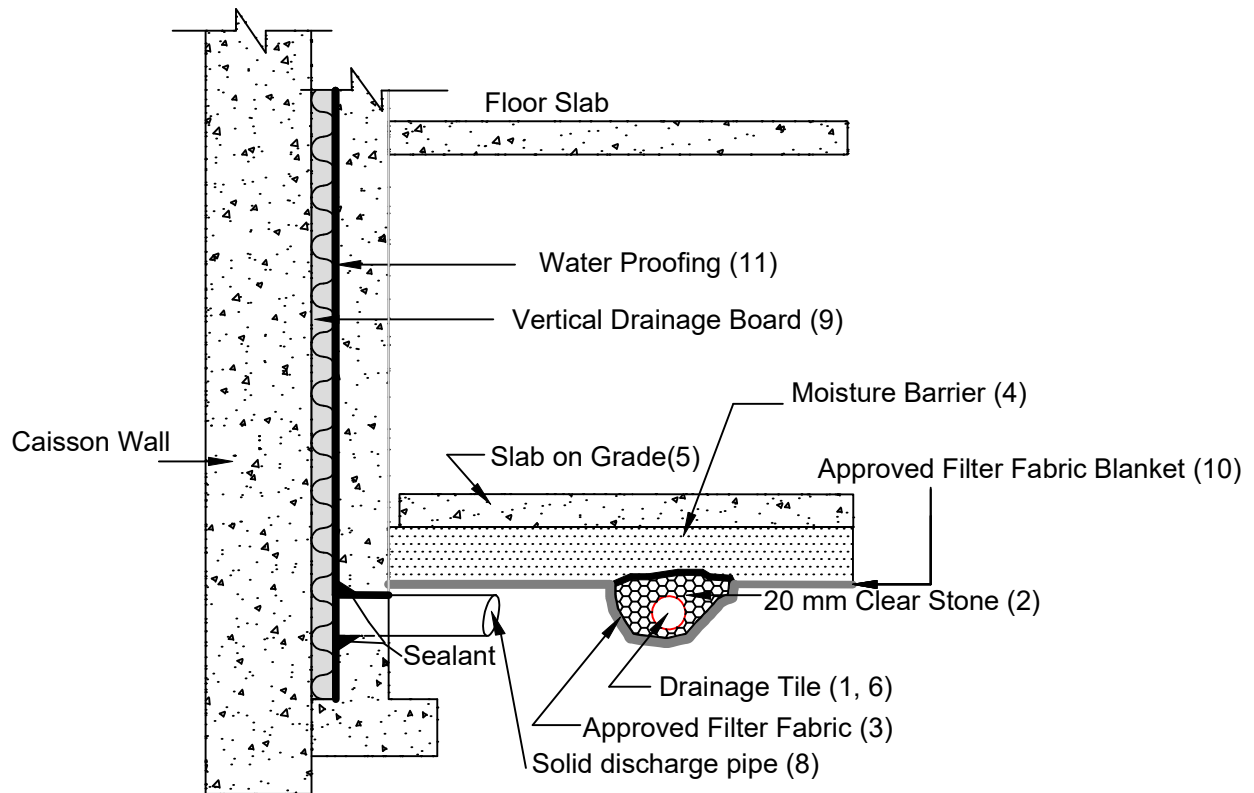
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place 100 mm (4 inches) of stone below drain.
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solid piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minimum of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS

Shored Basement wall with Underfloor Drainage System

(not to scale)



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place 100 mm (4 inches) of stone below drain.
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the soldier piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or equivalent with filter cloth should be continuous from bottom to 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

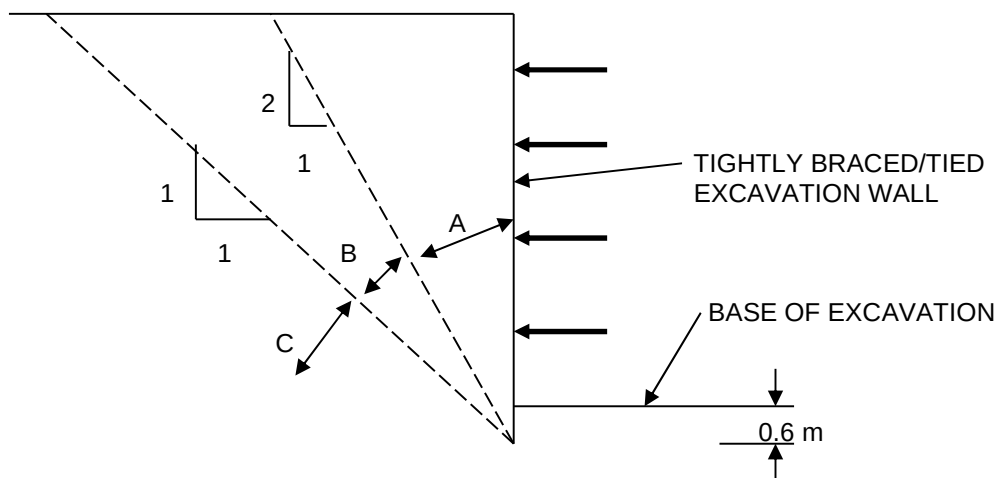
DRAINAGE RECOMMENDATIONS

Shored Basement wall with Underfloor Drainage System

(not to scale)

Guidelines for Underpinning in Soil and Excavation Support

Existing foundations located within Zone A normally require underpinning, especially for heavy structures. For some foundations in Zone A, it may be possible to eliminate underpinning and control foundation movement by tightly braced excavation walls, such as caisson walls.



- Zone A** Foundations located within this zone normally require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered
- Zone B** Foundations located within this zone normally do not require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered
- Zone C** Underpinning to structures is normally founded in this zone. Lateral pressure from underpinning is not normally considered

(Reference: Figure 26.27 from Canadian Foundation Engineering Manual, 4th Edition)

Appendix A

General Comments – Bedrock in Greater Toronto Area

The bedrock that makes spread footings or caissons a popular choice for high-rise foundation support is a shale or shale limestone composition. The highest member, the Queenston Formation, is generally found west of Toronto, while the Georgian Bay Formation underlies most of Metro Toronto, with the Collingwood Formation east of Toronto. The Queenston is, relatively speaking, the weaker of the three formations that are likely to support caissons or footings.

The Georgian Bay as well as the Queenston and Collingwood Formation are of Middle Ordovician Age. It is defined as the rock unit that overlies the bluish grey shales of the Collingwood Formation and is in turn overlain by the red shale of the Queenston Formation. The Georgian Bay Formation consists of bluish and grey shale with interbeds of sandstone, limestone and dolostone. Towards the west where the Georgian Bay formation underlies the Queenston Formation, the limestone content increases significantly and limestone and/or sandstone may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at some sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

The upper portion of the bedrock is commonly weathered for a depth of 600 to 1000 mm and within this weathered zone hard limestone layers or lenses are common. These hard limestone layers can result in contractual problems for augers, and can provide misleading bedrock elevations. Where the weathering is more extensive a shale till layer may be found above the bedrock. In the sound bedrock, the limestone, sandstone, dolostone is hard to very hard.

Stress relief features such as folds and faults are common in the bedrock. In these features, the rock is heavily fractured and sheared, and contains layers of shale rubble and clay. Weathering is much deeper than the surrounding rock in these features and often there is a lateral migration of the stress relief features resulting in sound unweathered bedrock overlying fractured and weather bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but the depth can vary from 4 to 5 m to in excess of 10 m. These features occur randomly.

The bedrock contains significant high locked in horizontal stresses. These stresses can impose significant loads on tunnel walls but the slower rate of construction for basements allows for a relaxation of these stresses and they are not normally a problem for basement construction.

Groundwater seepage below the top 1000 mm is generally small, however, at several locations in Toronto and Mississauga large quantities have been encountered.

Bedding joints in the bedrock are very close-to-close, smooth planar in the shale and rough planar in the limestone. Significant vertical jointing is common.

Where the bedrock was cored, a detailed description of the rock core is appended to the borehole log.

Design features related to the bedrock are discussed in other sections of this report, and these general comments must be considered with these comments.

Methane gas exists in the bedrock, normally below the top 1000 mm and more concentrated with depth. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly caissons and tunnels.

25-315-100

BH 25-1

R1: ~20' ~21'8"

R2: ~21'8" ~26'8"

R3: ~26'8" ~31'8"

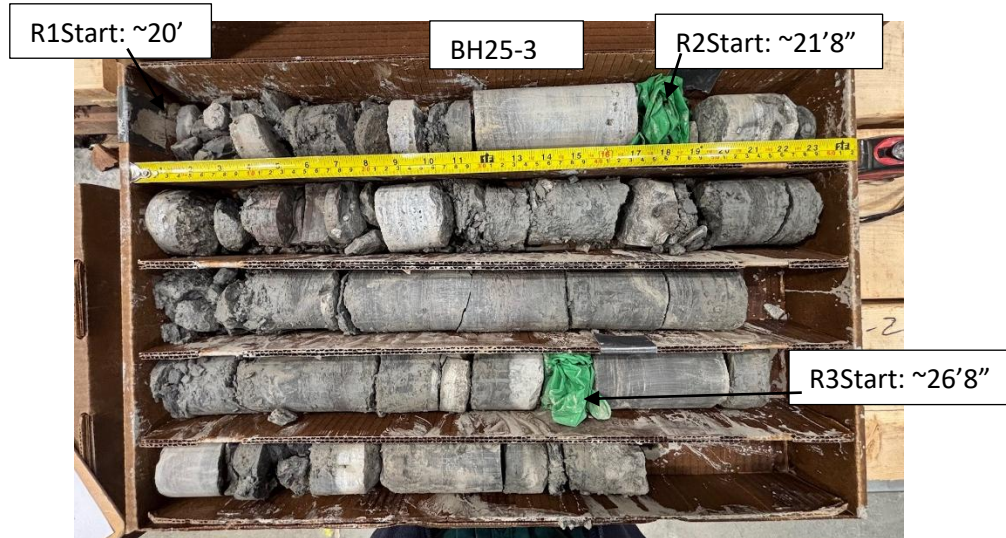


BH 25-3

R1: ~20' ~21'8"

R2: ~21'8" ~26'8"

R3: ~26'8" ~31'8"



25-315-100

BH 25-5

R1: ~25' ~26'8"

R2: ~26'8" ~31'8"

R3: ~31'8" ~36'8"

