Azure Group

A SOIL INVESTIGATION FOR PROPOSED MIXED USE BUILDINGS

141-153 PLAINS ROAD WEST

BURLINGTON, ONTARIO

PREPARED FOR: **2781798 ONTARIO LTD. C/O AAA ARCHITECTS INC.**
2121 ARGENTIA ROAD
MISSISSAUGA, ONTARIO
L5N 2X4

PROJECT NO. **2207-005**

DATE: **JANUARY 20, 2023**

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TABLE OF CONTENTS

1.0 INTRODUCTION……....4
2.0 SITE AND PROJECT DESCRIPTION……....5
3.0 SCOPE OF WORK……...6
4.0 FIELD WORK…….…6
5.0 SUBSURFACE CONDITIONS……...8
5.1 Asphalt pavement……..8
5.2 Topsoil.....8
5.3 Fill Soil.....…….....…8
5.4 Native Soils…….....……9
5.5 Groundwater.....10
6.0 DISCUSSION AND RECOMMENDATIONS…….....10
6.1 Introduction.....10
6.2 Site Preparation (Site Grading, Cut and Fill).....…….....11
6.3 Foundation Recommendation.....12
6.4 Earthquake Considerations.....14
6.5 Excavation and Groundwater Control.....14
6.6 Lateral Earth Pressure.....……..….15
6.7 Shoring the Excavated Walls.…….....16
6.8 Elevator Pit.....20
6.9 Floor Slab on Grade……..…20
6.10 Floor Slab on Underground Level…….21
6.11 Suitability of Site Material for Reuse…….. 22
6.12 Recommendation for Sewer Bedding and Trench Backfilling…….…22
6.13 Foundation Walls Backfilling ……...23
6.14 Winter Construction…….…..23
6.15 Pavement Design for Asphalt Concrete…….24
7.0 LIMITATIONS OF REPORT…….....31

TABLES

Table 1: Summary of Subsurface Conditions……..…….....10
Table 2: Recommended Bearing Capacities.....…….....13
Table 3: Soil Type and Slope Ratio.....15
Table 4: Recommended Soil Parameters.....16
Table 5: Pavement Structure for the Driveways and Parking Areas.....26
Table 6: Compaction Recommendation for Pavement Layers……..26

ENCLOSURES

Site and Borehole Locations Plan	Figure 1, 2
Borehole Logs	Figures 3 to 11
Grain Size Distribution Graphs	Figures 12 to 16

1.0 INTRODUCTION

Azure Group Inc. (Azure) was retained by Dr. Laith Al-Dabbagh of 2381798 Ontario Ltd. (the Client) c/o AAA Architects Inc. to prepare a geotechnical investigation for the proposed development at 141-153 Plains Road in Burlington, Ontario (hereinafter referred to as the "Site"). The work carried out for this investigation was completed in general accordance with Azure's proposal (Azure Proposal No. P2202003 dated October 7, 2022. Authorization to proceed with this investigation was received on November 1, 2022 from Dr. Laith Al-Dabbagh of 2381798 Ontario Ltd. The geotechnical investigation was completed concurrently with hydrogeological and environmental investigations. The results of those investigations are provided under a separate cover.

The purpose of the geotechnical investigation was to determine the subsurface soil and groundwater conditions at the Site by means of nine (9) boreholes to provide geotechnical parameters and recommendations for the design and construction of the proposed buildings, underground utilities, driveways and parking areas. The scope of the geotechnical investigation did not include environmental sampling and testing.

This report has been prepared for Dr. Laith Al- Dabbagh (the Client) specifically and solely for the proposed development of the Site based on the intended layout and the proposed facilities provided at the time of preparing this report. Third party use of this report is prohibited without written consent of Azure Group Inc.

2.0 SITE AND PROJECT DESCRIPTION

Proposed Site encompasses properties 141 to 153 Plains Road in Burlington, Ontario.
The properties are located at the northwest corner of Plains Road and Howard Road in Burlington. The Site is approximately 800 m north of Lake Ontario and 750 m south of Highway 403. Grindstone Creek is approximately 310 m northwest of the Site.
The Site surrounded by residential and commercial buildings.

Currently, the site is occupied by two residential buildings at lots 147 and 153 Plains Road West and two storey mixed use residential/commercial building at 141 Plains Road West.

The topography of the Site slopes gently toward the south with elevation difference of approximately 600 mm at the ground surface of the boreholes.

The project considers the construction of eleven (11) storey buildings with two (2) underground levels with the associated driveways, parking lots and underground utilities.

The finished floor elevation of the building, structural loads, underground utilities invert depths, etc., are not available at this time. However, we anticipate that the finished floor of the building is ±0.3 m above the existing ground surface. Details of the Site are shown in Figure 1 and 2.
The depth of the two underground levels as provided by AAA Architects, Drawing A401 is 6.12 m below the finished floor elevation. The total depth of underground levels will be between 6 m and 7 m below the existing ground surface. Additional three (3) m will be added to depth of the underground levels in the event of three underground levels will be considered (i.e., 9 m to 10.0 m)

3.0 SCOPE OF WORK

The geotechnical scope of work included the following:

- Advancing nine (9) boreholes "BH1 to BH9". The location of the boreholes is shown in Figure 1 attached to this report;
- All boreholes were drilled within the footprint of the buildings to depths ranging between 3 m to 15 m;
- Install 50 mm diameter monitoring wells at the location of BH1, BH2, BH4 and BH5 to an approximate depth of 14.6 m;
- Conducted Standard Penetration Tests "SPT" and Cone Penetration Test "CPT";
- Conducted a limited laboratory tests on selected soil samples obtained from the boreholes for soil classification, and moisture content;
- Prepared a geotechnical report with comments and recommendations regarding:
    - Site preparation Site Grading, Cut and Fill,
    - Appropriate foundation depth, types, bearing capacity, settlement, and seismic classification,
    - Slab on grade,
    - General excavation and backfilling requirements,
    - Lateral earth pressure,
    - Temporary excavations in accordance with latest edition of the Occupational Health and Safety Act (OHSA), and Regulations 213/91,
    - Sewer bedding and cover,
    - Suitability of the existing materials for backfilling, and,
    - Pavement recommendations along the investigated area.

4.0 FIELD WORK

Prior to undertaking the drilling operation, the site was cleared of buried underground utilities at the borehole locations. A private locating contractor was retained to identify the position of any privately owned electrical cables or piping that could be present but not identified by Ontario One Call (Public Utilities Locator).

The field work for this investigation was carried out between November 3 and 17, 2022. The investigation consisted of drilling nine (9) "BH1 to BH9" to depths ranging between 3.0 m and 14.6 m. Four of which were installed with monitoring wells (boreholes BH1, BH2, BH4 and BH5) to a depth of 14.6 m.

The location of the boreholes and monitoring wells is shown on the attached Figure 1.

The ground surface elevation of each borehole was surveyed relative to a Manhole that exists in front of the Dentistry sign. The elevation of the fire hydrant was assumed to be 102.64 m. The location of the fire hydrant is shown in Fig. 2

All boreholes were advanced using a track-mounted CME-55 drilling rig with 100 mm diameter continuous flight open/solid-stem auger under the full-time supervision of a geotechnical engineer from Azure.

The subsurface strata were sampled at regular intervals of 0.75 m depth for the first 3 m and at 1.5 m interval for the remaining depth, or continuous auguring using a split-spoon sampler while performing the Standard Penetration Test (SPT) as detailed in the ASTM D1586. The number of blows of the 63.4 kg hammer required to drive the spoon 0.3 m (12 inches) into the soil was the SPT "N" value of the soil. The "N" value provides an approximate measure of the consistency of cohesive soils or the relative density in non-cohesive (cohesionless) soils.

The field tests were supplemented by laboratory analysis. Following completion of the drilling operation, representative soil samples were taken to an accredited laboratory for final visual assessment, classification and testing. The soil samples were tested and classified in general accordance with the Unified Soil Classification System (USCS), ASTM 2487, Ontario Ministry of Transportation, Soil Classification System.

The soil samples recovered during the investigation will be stored for a period of 30 days after which they will be discarded unless further instructions are received from the Client. All boreholes were backfilled with soil cuttings and bentonite.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes are shown on the borehole records provided in Figures 3 to 11. The borehole records include soil stratification at the borehole locations with detailed soil descriptions and selected physical properties for each stratum encountered. Variations in the soil stratification may occur and should be expected between borehole locations and elsewhere on the site. Furthermore, since the internal diameter of the Spoon used in the Standard Penetration Test (SPT) is 38 mm which is less than the maximum size of the gravel (75 mm), the grain size test results and soil classification may not reflect the entire gravel size fraction.

In general, the subsurface conditions encountered at the borehole locations consisted of asphalt pavement, topsoil, fill/possible fill and native soils.
The following sections describe the materials encountered at the location of the boreholes.

5.1 Asphalt Pavement

Asphalt pavement was encountered at the location of BH1, BH2, BH3 and BH6. The thickness of the asphalt varies from 75 mm to 120 mm with average thickness of 100 mm.

5.2 Topsoil

Topsoil was encountered at the location of boreholes BH4, BH5 and BH7 to BH9. The average thickness of the topsoil was ±140 mm. It should be noted that the thickness of the topsoil at the borehole locations may not represent the entire Site. Therefore, it should not be considered in estimating the total quantity of the topsoil. The topsoil encountered was dark brown in color indicating a considerable amount of roots and humus. Topsoil in general, is unstable and compressive under loads, therefore, it should not be used for engineering purposes.

5.3 Fill/Possible Fill

Fill was encountered below the topsoil or the pavement structure. The fill consists of very loose to compact dark brown sand/silty sand trace gravel, clay and organics and cobbles. The sandy fill extended to an approximate depth ranging between 0.6 m and 1 m below the existing ground

surface. Silt clay/clayey silt fill was encountered below the sandy fill at the location of BH5, BH6 and BH9 extended to an approximate depth of 5 m below the existing ground surface.

5.4 Native Soils

Native soils were encountered below the fill at the location of all boreholes. The native soil consists of sand/ silty sand, trace gravel/boulders at the location of all boreholes.

Based on the N values obtained from the Standard Penetration Test "SPT", the relative density of the sandy soil was loose to dense. "N" higher than 50 was obtained at several boreholes and depths. The high "N" number may be attributed to the presence of boulders at the tested depth. On the other hand, the low "N" values may be attributed to the sloughing and caving of the sandy soil during drilling operations.

A layer of stiff to very stiff silty clay/clay silt was encountered at the location of boreholes BH1, BH6 at depths 4.5 m and 4.0 m respectively. Very soft clayey silt was encountered at the location of BH5 at depth 3.5 m. The approximate thickness of the clayey soil was 1.0 m.

The moisture content of the soil varies from 4.02% to 30.38% with an average of 9.6%. Grain size analysis was carried out on representative soil samples. indicated the following:

Gravel	Average 5.21% (Ranging between 0.4% and 19.11%)
Sand	Average 68.69% (Ranging between 4.89% and 91.29%)
Silt and Clay	Average 26.10% (Ranging between 7.11 and 93.81%)

Summary of the materials encountered at the location of the boreholes is provided in the boring logs drawing 3 to 11.

5.5 Groundwater

Four (4) monitoring wells were installed at the location of BH1, BH2, BH4 and BH5 to a depth of 14.0 m below the existing ground surface. The length of the screen is 3.05 m (10').

Upon completion of the drilling operation and/or monitoring wells installation groundwater was encountered at depths deeper than 14 m at several borehole locations.

Upon completion of the drilling operation and/or monitoring wells installation, groundwater was measured at several borehole locations at depths ranging between 12.8 m and 13.8 m below the existing ground surface. As of November 21, 2022, the measured groundwater table in the monitoring wells ranged between 13.0 m to 13.7 m.

It should be noted that the natural groundwater table is likely to vary throughout the year, depending on the amount of precipitation, runoff, evaporation, and percolation in the area.

Summary of subsurface condition and groundwater table is provided in Table 1.

Table 1: Summary of Subsurface Conditions

BH No.	G. S. E.	BH Depth	M.W Depth	Groundwater Table	
				Nov. 21, 2022	Dec. ////, 2022
BH (MW)1	103.13 m	14.6 m	14.60 m	13.16 m	
BH(MW)2	102.74 m	14.6 m	14.60 m	13.0 m	
BH3	102.85 m	14.6 m	-	-	
BH(MW)4	102.83 m	14.0 m	13.93 m	13.37 m	
BH(MW)5	103.31 m	14.6 m	14.6 m	13.7 m	
BH6	103.33 m	6.7 m	-	-	
BH7	103.11 m	14.2 m	-	-	
BH8	102.93 m	14.2 m	-	-	
BH9	103.22 m	14.0 m	-	-	

G. S. E = Ground Surface Elevation
G. W. T = Ground Water Table
NM = Not measured

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 Introduction

Based on the information obtained from the investigation, the following comments are provided with respect to the proposed scope of development:

- The proposed development considers the construction eleven (11) storey buildings with two underground levels (possible three underground levels),
- The topography of the Site is considerably level, with surface elevation difference of approximately 0.6 m throughout the Site. Earthwork (cut and fill) may be required for the Site to achieve the final grade,

- The finished elevation of slab-on-existing ground surface (outside the building footprint) was not available at the time of preparing this report. However, we anticipate that the elevation of the finished slab will be at ±0.3 m above the existing ground surface,
- The anticipated footings depth of the two underground levels will be in the range of 6 and 7 m,
- Shallow (spread and continuous footings), raft, and pile foundations may be used to support the building loads,
- For frost protection, the recommended minimum depth of the footing should be not less than 1.2 m below the existing grade; and
- Temporary shoring may be required to maintain the stability of the excavation.

The following sections contain recommendations for building construction based on the materials encountered in the boreholes:

6.2 Site Preparation (Site Grading, Cut and Fill)

The following recommendations may be considered for the site grading and preparation:

- Cut and fill operation may be required to achieve the final grades,
- The topsoil, asphalt pavement, the fill and the soft/loose soils should be removed from areas of the proposed development,
- The exposed ground surface should be inspected and thoroughly proof rolled in the presence of a qualified geotechnical engineer. The purpose of the proof-roll is to locate areas of unsuitably loose or soft subgrade and to uniformly compact the surface. In clayey soils, proof-rolling should be performed with a loaded tandem axle dump truck, rubber-tired loader, or other suitable piece of pneumatic-tired construction equipment. In granular soils, proof-rolling should be performed with a heavy (minimum 10 tones) self-propelled vibratory roller. The proof-rolling should consist of a minimum of six passes per unit area and should be tested to ensure that areas exhibiting more than 15 mm deflection or any soft, wet or deleterious materials identified at the time of proof rolling should be sub-excavated and replaced with a suitable and/or approved drier materials. The exposed surface after the

proof rolling should be compacted to at least 100% of the materials Standard Proctor Maximum Dry Density (SPMDD),

- Following the subgrade preparation, fill materials may be placed on the exposed surface
- Materials placed to raise the final grade or replace the excavated materials during proof rolling should be placed in 150 mm thick lifts in the loose condition and uniformly compacted to minimum of 100% of the materials SPMDD,
- The filling and compacting should continue until the final elevation of the subgrade and/or foundation level is achieved,
- During the placement of structural fill, all frozen materials should be removed prior to placing additional layers of materials,
- Imported fill materials for use in the development on the site must meet all applicable municipal, provincial, and federal guidelines as well as regulations associated with environmental characterization of the materials. The materials should also be examined and approved by a qualified geotechnical engineer,
- We do not recommend construction to be carried out in wet or inclement weather,
- Furthermore, the outside ground surface should be graded to direct run-off water away from the proposed development.

6.3 Foundation Recommendation

For two underground levels, the footings will extend to depths ranging between 6 m and 7 m. Compact to dense sandy soils were encountered below a depth of 6 m. Based on the available soil conditions, conventional spread and continuous footings supported on the native soils are considered suitable for the proposed building foundations.

6.3.1 Conventional Spread and Strip Footings

6.3.1.1 Footings on Native Soil

For conventional spread or continuous footings constructed on the exiting native soils at a depth of ≥6.0 m and maximum settlement of 25 mm, the recommended factored Ultimate Limit State (ULS) and the Serviceability Limit State (SLS) to be used for the design of the proposed footings are summarized in Table 2.

Table 2: Recommended Bearing Capacity for Footings at a Depth of 6 to 7 m

Footing width	SLS kPa	ULS kPa	Settlement
≤1.2 m	240	360	25 mm
±1.5 m	220	310	25 mm
±2.0 m	210	305	25 mm
±2.5 m	200	300	25 mm

6.3.1.2 Footing on the Engineered Fill

Conventional spread or continuous footings may also be constructed on the prepared engineered fill soil (Section 6.2) provided that the engineered fill is constructed on the native soil. For foundations constructed on the engineered fill, the recommended factored Ultimate Limit State (ULS) and the Serviceability Limit State (SLS) to be used for the design of the proposed footings are 150 kPa and 100 kPa, respectively.

6.3.1.3 Foundation Notes

The following notes should be considered in the design and construction of the spread and strip footings:

- The above recommendations apply to the actual borehole locations. Variations in soil profile and properties may be present between the borehole locations. Should significant variations evident during construction, it may be necessary to re-evaluate the recommendations of this report,
- Footing excavations should be inspected and approved by **Azure geotechnical engineers** during construction. All soft/loose, wet frozen or disturbed material should be removed, and compacted using vibrator compactor,
- The exposed subgrade should be immediately covered with 50 mm of lean to minimize/eliminate soil disturbance,
- For frost protection, footings should be constructed at a depth of not less than 1.2 m below the grade,
- Surface/rainwater should not be allowed in the excavated footings,
- The above bearing capacities must be reviewed by our office, once the finished floor elevation of the building has been established,

- The total and differential settlement for footings constructed on the native sandy soil and/or the engineered fill are expected to be less than 25 mm and 15 mm respectively,
- The minimum footing size, footing thickness, excavation size and other footing requirements should be designed in accordance with the requirements detailed in the latest edition of the Ontario Building Code "OBC",
- Footings constructed at different levels should be constructed so that the higher foundations are set behind a line sloping at an angle of 7V: 10H and drawn from the near edge of the lower footing,
- For overturning considerations of spread or continuous foundations, the maximum soil pressure at the toe of the foundations should not exceed the maximum net allowable soil pressure.

6.4 Earthquake Considerations

The 2012 Ontario Building Code (OBC) Subsection 4.1.8 stipulates that a structure should be designed to meet the requirements of the Earthquake Load Effects. The Site Classification for the Seismic Site Response (Table 4.1.8.4. A) is determined from the average Standard Penetration Resistance (N60) and the soil undrained shear strength (Su).

Based on the average soil conditions below the existing ground surface and as per 2012 OBC. Table 4.1.8.4A, the site classification for seismic site response is considered as **Site Class D.** The site classification is only for design consideration. For the possibility of obtaining higher Site Class, e.g. Site Class **C**, Shear wave tests should be considered.

6.5 Excavation

- It is anticipated that shallow footings will be constructed at a depth of ≥6 m below the existing ground surface
- Temporary excavations for footings or underground services must be carried out in accordance with latest edition of the Occupational Health and Safety Act (OHSA),
- According to OHSA, if excavation is deeper than 1.2 m, the excavated sides should be sloped. The slope of the sides depends on the type of the excavation materials.
- Table 3 stipulates maximum slope excavation for various soil types,

Table 3- Soil Type and Slope Ratio

Soil Type	Base of Slope	Maximum Slope Identification
1	Within 1.2 meters of bottom of trench	1H: 1V
2	Within 1.2 meters of bottom of trench	1H: 1V
3	From bottom of trench	1H: 1V
4	From bottom of trench	3H: 1V

- Native sandy soils were encountered at the location of all boreholes. The native soil may be classified as Type 3,
- Excavation of side slopes should be protected from exposure to precipitation and associated ground surface run-off and should be inspected regularly for signs of instability. If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions,
  - Excavation of the overburden soil should be relatively straightforward using conventional equipment,
  - It should be noted that the above recommendations are based on the actual boreholes locations. Should any contaminated materials be encountered beyond the location of the boreholes, it may be necessary to revise the above recommendations.

6.6 Lateral Earth Pressure

Walls and/or bracing supporting soil should be designed and constructed to resist lateral earth pressure imposed by the soil and hydrostatic pressure. For walls that are designed to allow rotation, active earth pressure may be used for design. For rigidly tied walls, the at-test earth pressure should be used for design. The lateral earth pressure, p, in kPa, acting on a unit element of the shoring system at any depth h, in meters, below the surface of the retained soil, may be estimated from the following equation:

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

The above equation considers the hydrostatic pressure in determining the lateral pressure on the wall if continuous wall drains are not provided.

A perimeter drainage system may be constructed to prevent the build-up of any hydrostatic pressure behind the wall. In this case, the following equation is recommended:

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

Where:

γ = the soil unit weight

K = Lateral earth pressure coefficient

K_o = earth pressure coefficient at rest, if wall movement cannot be permitted

K_a = active earth pressure coefficient, if moderate wall movement can be permitted,

K_p = passive earth pressure coefficient

q = is the surcharge load adjacent to the shoring wall

ϕ = is the angle of internal friction of the soil

A summary of the soil parameters is provided in the following Table 4.

Table 4 – Recommended Soil Parameters

Soil Parameters	**ϕ**	**γ(kN/m3)**	**K_a**	**K_o**	**K_p**
Loose Sand/silty sand	28	18	0.36	0.53	2.8
Compact sand/silty sand	30	19	0.33	0.5	3.0
Dense sand/silty sand	33	20	0.30	0.45	3.33

6.7 Shoring the Excavated Walls

If the underground excavation extends to the property boundaries, temporary shoring will be required. The following provides our recommendation for the design and construction of the temporary shoring:

1) The shoring system should be designed in accordance with the latest edition of the Canadian Foundation Engineering Manual (CFEM),
2) The design of the temporary shoring system must take into account the presence of underground utilities and services below the adjacent streets as well as proximity of the foundations of the existing structures of adjacent sites, both of which must be protected against lateral or downward movement. If services and/or foundations of adjacent structures are present within the active zone behind the shoring system, appropriate parameters must be considered to avoid any harmful movements,
3) Monitoring the horizontal movement at the top of the shoring is recommended. Monitoring recommendation is discussed in Section **6.7.5.**
4) The temporary shoring may consist of caisson walls and/or soldier piles and a wooden lagging system. The latter is recommended for this project,
5) Boulders may encounter during caisson and/or soldier pile installation.

The following sections discuss the type of applicable shoring system:

6.7.1 Caisson Wall

1) The caisson wall may be constructed by drilling individual caissons along the excavated sides,
2) We recommend that the caissons extend 300 mm below the base of excavation,
3) We recommend that liners be used in sandy soil,
4) Soldier piles may be installed in some of the drilled holes as recommended by the shoring engineer,
5) The holes should be filled with concrete using a Tremie pipe or equivalent method. The concrete strength must be specified by the shoring designer,
6) The walls of the excavation should be supported by either post-tensioned anchors or tiebacks drilled and grouted into the soil around the excavation by struts. Tiebacks and/or anchors are discussed in section 6.7.3 of this report,
7) If permission to extend anchors into the adjacent properties subsoil is not granted, internal bracing, such as using struts and/or rakers, are other options for supporting the shoring,
8) If rakers are to be used to support the shoring system, they should be designed by the shoring consultant. The raker footings should be designed in accordance with the design principles for foundations subject to inclined loading. The Raker foundation should be constructed at a depth of not less than 0.50 m below the excavated surface of the underground level. The allowable bearing capacity of the raker foundation should be not more than 100 kPa at the depth of the building foundations. Footings and the foundation material of the rakers should be protected from freezing or deterioration. The rakers should be installed in trenches such that the lateral movement of the retaining wall is limited to an acceptable amount,
9) Similar lateral earth pressure and soil parameters recommended in Section 6.6, may be used for the design of the shoring system,
10) For the design of shoring system rectangular pressure distribution envelope may be considered,
11) The shoring system should be designed by a local design professional experienced in the type of system being proposed,

12) The underground walls should be constructed independent of the caisson walls.

6.7.2 Soldier Piles and Wooden Lagging

1) Temporary shoring may also consist of soldier piles and wooden lagging,
2) The soldier piles should be installed in pre-augered holes extended below the deepest excavation. The depth below the deepest excavation must be specified by a shoring designer,
3) The shoring system should be supported by anchors, tie back, or rakers as discussed in the construction of the caisson walls (Section 6.7.1),
4) The soil parameters recommended in the design of the soldier piles and wooden lagging system can be found in Section 6.6 of this report,
5) The backfilled materials between the shoring system and the excavated sides should be free draining materials, in order to minimize the effect of hydrostatic pressure on the shoring system. Otherwise, the hydrostatic pressure should be added to the lateral earth pressure acting on the system,
6) We recommend the use of geotextile filter cloth on the exposed surface of the lagging boards to prevent/minimize the loss of the soil through the spaces between the boards.

6.7.3 Tiebacks or Anchors

1) The walls of the excavation should be supported by either post-tensioned anchors or tiebacks drilled and grouted into the soil around the excavation,
2) Liners should be used in constructing the anchors or tie backs in sandy soils,
3) The anchors/tie backs may extend to the adjacent properties and roads subsoil,
4) Permission will be required from the owners of the adjacent properties to install the anchors/tie backs,
5) The anchors/tie backs must extend to a length in the soil recommended by Canadian Foundation Manual. A minimum length of 2.5 m beyond the line of 45^{o} drawn from the base of the excavation is recommended,
6) The anchors/tie backs bond depends on the soil property, installation method and grouting properties. For gravity poured concrete, an allowable bond pressure of 40 kPa to 50 kPa is

suggested for the compact to dense silty sand/sandy silt soils. A higher bond pressure may be obtained if a pressurized method of grout installation is used,

7) All anchors should be tested as indicated in the Canadian Foundation Engineering Manual (CFEM). At least two (2) anchors in each level should be tested to 200% of the design load in accordance with the current edition of the CFEM in order to verify the capacity of the anchors/tie backs. The design of the working anchors/tie backs should then be modified based on the test results, where necessary. All remaining anchors should be installed following similar procedures and proof tested to 1.33 times the design load.

6.7.4 Lateral Earth Pressure on the Shoring

The recommendations and soil parameters provided in Section 6.6 of this report may be adopted in estimating the lateral earth pressure "P" acting on a unit element of the shoring system at any depth below the surface of the retained.

For the design of the shoring system, a rectangular pressure distribution envelope may be considered, and The shoring system should be designed by a local design professional experienced in the type of system being proposed.

6.7.5 Shoring System Movement (Vertical and Horizontal)

Vertical and horizontal movement of the shoring system is inevitable. The vertical movement will result from the vertical component of the inclined anchor or tie back and surface settlement. The horizontal movement will result from the lateral earth pressure and water pressure. The magnitude of these movements may be minimized/eliminated by proper construction practices. The vertical and horizontal movement will be in the range of 0.1H% to 0.25%H%. However, the actual shoring movement should be determined by the shoring consultant.

Monitoring the vertical and horizontal movement of the shoring system using an inclinometer incorporated in the soldier piles and/or using a total station with targets attached on the soldier piles are recommended to ensure that the movements are within the acceptable range.

Initial readings of these devices should be conducted prior to any excavation activities.

Based on our experience of monitoring the movement using either inclinometer and/or total station with targets, we recommend the measurements be carried out on a weekly basis on the early stages

of underground construction and then every other week until the completion of the underground levels and backfilling beyond the underground wall.

Monitoring records should be provided continuously to Azure Team and shoring consultants.

We should also be informed immediately for any movement exceeding the recommended limit.

6.8 Elevator Pit

We anticipate that the elevator pit may be constructed at a depth of ±2.0 m below the finished lower level (P2) of the underground parking.

The pit should be designed and constructed as a water-tight structure..

6.9 Floor Slab on Grade

Floor slab-on-grade may be required for the development. Floor slab may be constructed on engineered fill or on the native soil. The following recommendations are for floor slab constructed on the existing ground surface:

- Prior to any slab on grade construction, the topsoil, all loose/soft and debris material should be removed. the Thickness of the layer to be removed should be not less than 500 mm,
- The subsurface of the exposed subgrade after the removal of the top layer should be inspected and compacted to at least 98% of the material standard Proctor Maximum Dry Density “SPMDD”, and proof rolled with a loaded tandem truck. Proof rolling is discussed in Section 6.2.
- Materials placed to raise the final grade and compaction of the added layer, is discussed in Section 6.2,
- A moisture barrier (capillary moisture barrier) should be placed between the underside of the floor slab and exposed soil. It is recommended that the moisture barrier consist of a minimum 150 mm thick layer of Ontario Provincial Standard Specification (OPSS) Granular “A” or 19 mm clear crushed stone compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD),
- The ground surface adjacent to the building should be graded to direct run-off water away from the buildings.

6.10 Floor Slab for Underground Level

For buildings constructed with underground levels and supported on conventional footings (spread and strip), the underground floor slab will mainly be constructed as a conventional slab-on-grade on the existing native soil. The anticipated depth of the underground slab on grade will be in the range of 6 to 7 m.

The following is recommended for the slab-on-grade construction:

1) All loose/soft soils should be removed, and the exposed surface should be compacted,
2) A moisture barrier should be placed between the underside of the floor slab and exposed native soil. It is recommended that the moisture barrier consist of a minimum 250 mm thick layer of Ontario Provincial Standard Specification (OPSS) Granular "A" or 19 mm clear crushed stone compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD),
3) The floor slab should be constructed independently of any structural members; e.g., load bearing walls and/or columns,
4) Saw cuts should be provided along column lines and closer centers as required, and
5) To protect unheated areas and the entrance of the underground parking against frost heave, we recommend the installation of 50 mm thick Styrofoam or equivalent below the slab on grade.

6.11 Suitability of Site Material for Reuse

The native soils are considered suitable for backfilling the trenches provided that the moisture content is within the optimum content of 2%, and these activities are not undertaken in wet or freezing conditions. However, these materials are not suitable for reuse as new base/subbase materials below the pavement. Deleterious material, if any, should be removed prior to reuse on site. The use of these materials is subject to a geotechnical engineer approval.

6.12 Recommendation for Sewer Bedding and Trench Backfilling

- Pipe bedding and backfill material specifications and compaction criteria for water and sewer services should be in accordance with the pipe designer's recommendations and/or local municipal requirements,

- The subgrade of the sewer should consist of sound native soil, or properly compacted fill materials free of organic and/or deleterious materials. If the bottom of the trench at the required pipe grade is found to be unstable or include organics materials, the unsuitable materials should be removed and replaced with approved materials prior to any pipe installation,
- The exposed trench bottom shall be compacted to a minimum of 95% of the materials Standard Proctor Maximum Dry Density (SPMDD). OPSS Granular B is recommended for backfilling the excavated trench. The backfilling operation should be carried out in lifts not exceeding 150 mm in the loose state compacted to 98% of the materials SPMDD,
- Sandy layer of minimum thickness of 50 mm should be placed below the sewers as a leveling pad. The leveling pad will make the pipe foundation more rigid, reduce the detrimental effect of differential settlement and provide a working platform to facilitate the construction of the sewers. The leveling pad should spread the full width of the trench bottom,
- After preparation of the trench base, a pipe bedding of a minimum thickness of 150 mm shall be placed using crushed stone or crushed gravel, meeting OPSS Granular "A" material compacted to 98% of the materials SPMDD,
- All trench excavations shall be backfilled immediately after the sewers are laid. The backfilling operation should be carried out on both sides of the sewer and shall be manually compacted simultaneously. At no time shall the levels of each side differ by more than 100 mm un-compacted. Approved granular materials should be used for backfilling. The granular materials should extend to a minimum of 300 mm above the top of the pipe. Backfill materials shall be placed in uniform layers not exceeding 150 mm in thickness for the full width of the trench and compacted manually,
- Backfilling above the 300 mm should be placed in uniform thickness of 150 mm compacted to 98% of the materials SPMDD to eliminate the possibility of settlement, pipe misalignment, or damage to the joints,
- Granular materials may be used as backfill materials. The site materials encountered below the topsoil or the ground surface may also be used provided that the materials are free from organics and other deleterious materials,
- Backfill materials shall be placed to a minimum of 900 mm above the crown of the sewer before any power operated tractor or rolling equipment are used for compaction.

- Water lines installed outside of heated areas should be provided with a minimum of 1.5-meter soil cover or equivalent for frost protection,
- In normal sewer construction, the problem of road settlement largely occurs adjacent to manholes or catch basins. In areas which are inaccessible to heavy compaction equipment, additional compactive effort with smaller equipment is warranted,
- Fill materials imported to the site must meet all applicable municipal, provincial, and federal guidelines and regulations associated with environmental characterization of the material. The materials preparation and compaction of bedding layer, the pipe installation should be in accordance with the current revision of OPSS 1010, OPSS 401, OPSS 501, OPSS410, OPSD 902.032, OPSD 803.030 and OPSD 803.031.

6.13 Foundation Walls Backfilling

All foundations and foundation trenches should be backfilled with granular materials. The backfilled materials should be compacted in 150 mm thick loose lifts to a minimum of 95% of the materials SPMDD using plate vibrator compactor. The backfilling process should be carried out on both sides of the walls simultaneously.

6.14 Winter Construction

When construction is undertaken during periods of inclement weather, or when freeze-thaw effects are a concern, the backfilling procedures should consider the following comments:

- The preferred backfill material during periods of inclement weather is OPSS Granular B Type 1,
- Areas of intended backfill should be clearly identified in the field prior to commencing the work,
- Fill placement should be inspected by qualified field personnel under the supervision of a geotechnical engineer,
- Imported materials that contain ice, snow, or any frozen materials should not be accepted for use,
- Overnight frost penetration into the existing subgrade or the fill layer should be prevented by using insulation blankets. Alternatively, the frozen fill can be removed prior to placing

subsequent lifts. Approaches such as breaking the frost in-situ is not considered acceptable, and,

- During periods of cold, where ambient temperature is -5◦ or less, placement of engineered fill should stop and the existing fill materials should be protected from freezing.

6.15 Pavement Design for Asphalt Concrete

Flexible asphalt pavement is recommended for the parking areas and site access roads. Flexible pavement consists of a prepared roadbed (subgrade) underlying layers of subbase, base, and surface courses (pavement structure).

Prior to pavement structure construction, we recommend the pavement subgrade should be prepared as noted below:

Pavement Subgrade: Pavement subgrade can consist of the engineered fill or the native soils encountered at the site. The topsoil and the underlying fill soil to a depth of not less than 500 mm below the existing ground surface should be removed. Any soft, lose or unstable materials should also be removed. The exposed surface should be compacted to at least 98% of the SPMDD and proof-rolled with a loaded tandem truck as discussed in section 7.2.
Sub-grade up-fill should be compacted to at least 98% of the SPMDD, at or below the optimum moisture content (OMC) in lifts not exceeding 150 mm in thickness. Any materials that has moisture content higher than 3% of its OMC should be dried out.

The granular sub-base: The granular sub-base is the portion of the flexible pavement structure between the roadbed (subgrade) and the base course, and is used to increase the structural capacity, raise pavement layers above the frost line, or provide a levelling course for the placement of base layers. Granular "B" may be used for sub-base construction. The sub-base layer should be placed on the prepared subgrade.

Granular Base: the granular base is the portion of the pavement structure immediately beneath the surface course. It is constructed with high quality aggregates. The base materials consist of 100% aggregate materials. These materials consist of durable particles of gravel and sand or

crushed rock, crushed gravel and sand. Recycled aggregates may also be used for base construction. Geotechnical engineer should be consulted prior the use of the recycled materials.

The production, gradation and placement of granular materials (base and sub-base) shall be in accordance with applicable OPSS requirements. The granular base and sub-base layers should be compacted to at least 100% of the SPMDD.

In the extreme cases, such as during the wet season, the top 600 mm of the subgrade may have to be replaced by compacted granular material in order to compensate for the inadequate strength of the wet sub-grade.

Pavement Surface: the surface course of a flexible pavement structure consists of a mixture of mineral aggregates and bituminous materials placed as the upper course and usually constructed on a base course. The pavement surface must be constructed to a higher standard than other layers in the pavement structure. The materials most commonly used for pavement surfacing are the asphalt/bituminous mixtures.

The recommended pavement structures are provided in Table 5.

Table 5: Pavement Structure for the Driveways and Parking Areas

Description	Heavy duty	Materials
Asphalt Surface Course (HL3)	40 mm	Hot Mix Asphalt
Asphalt Base Course (HL8)	60 mm	Hot Mix Asphalt
Granular Base	150 mm	19 mm CRL or Granular A
Granular Sub-Base Course	200 mm	50 mm Crushed Limestone or Granular B

CRL = Crusher Run Limestone

The recommended compaction level for each layer is provided in Table 6.

Table 6: Compaction Recommendation for Pavement Layers

Pavement Layer	Compaction Level
Asphalt Surface Course (HL3)	92.0 -96.5% MRD
Asphalt Base Course (HL8)	92.0 – 96.5% MRD
OPSS Granular “A” or 20 mm CRL (Granular Base)	100% SPMDD
OPSS Granular “B” Type II or 50 mm CRL (Granular Sub-base)	100% SPMDD

MRD = Marshall Relative Density

SPMDD = Standard Proctor Maximum Dry Density

Notes

1. The pavement surface and subgrade should be graded to direct run-off water away from the roadway, parking areas and associated infrastructure.

2. We recommend the installation of sub-drains pipes along the perimeter of the pavement and throughout low areas to prevent infiltration and accumulation of surface run-off water in the pavement structure. The sub-drain pipes should be placed parallel to each other and sloped downward toward the adjacent areas or swells,
3. Construction trucks and equipment should be kept off the newly constructed parking area and driveways before the placement of asphalt layer.

The discussion and recommendations as presented represent the best judgment of the inspector based on the visual observations of the accessible property elements of the Site and adjacent properties observed. Should additional information become available, Azure Group Inc. requests that this information be brought to our attention so that we may reassess the conclusions presented herein.

Respectfully Submitted,

AZURE GROUP INC.

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7.0 LIMITATIONS OF REPORT

This report was prepared by Azure Group Inc. (Azure) for the account of Dr. Laith Al-Dabbagh (the Client) and for review by its designated agents and financial institutions and government agencies. The material in it reflects the judgement of Mr. Ahmed Al-Temimi, M.Sc., P.Eng. QP(ESA), in light of the information available to it at the time of preparation.

The report may not be relied upon by any other person or entity without the express written consent of Azure and the Client. Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Azure accepts no responsibility for damages, if any, suffered by any party as a result of decisions made or actions based on this report.

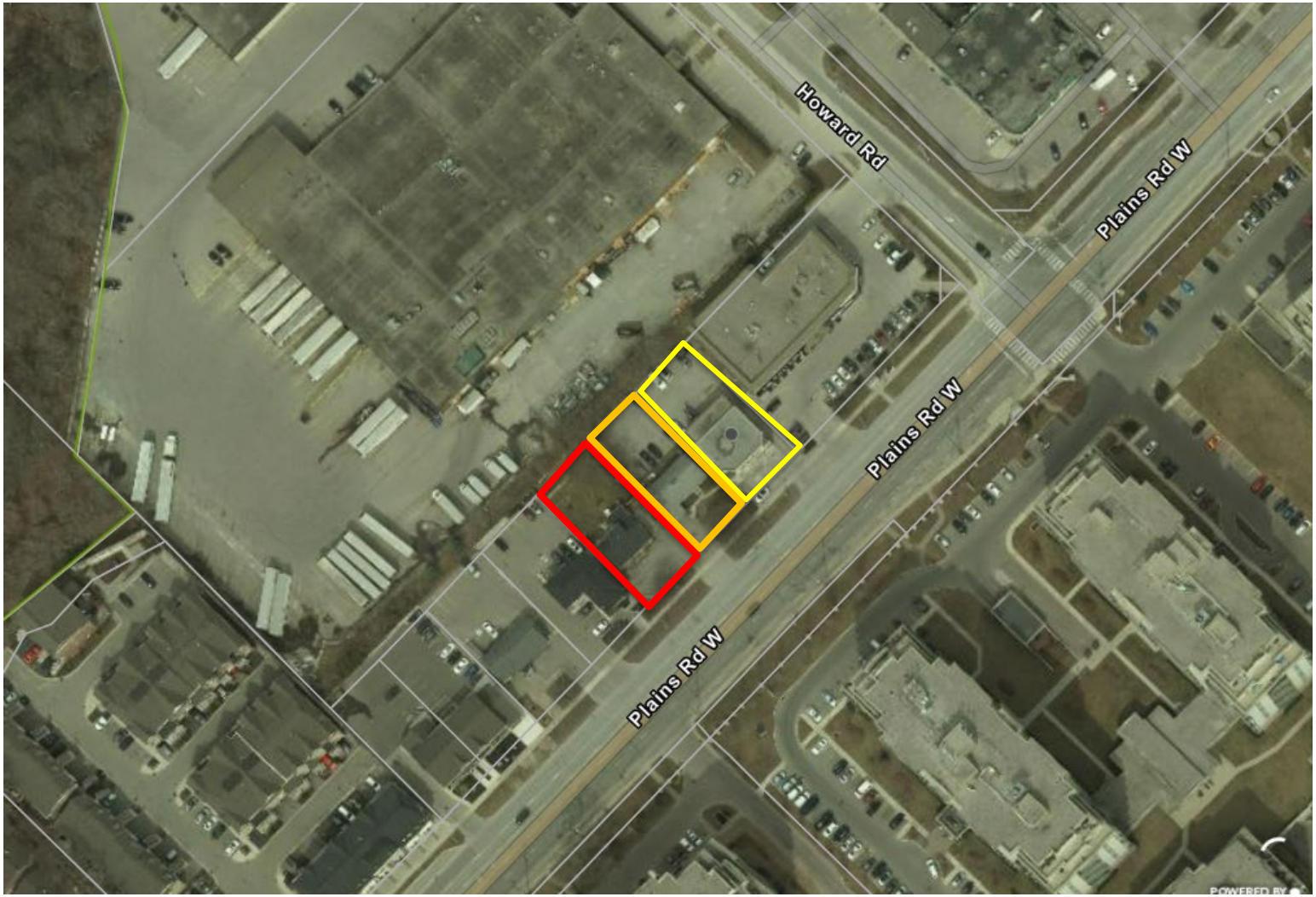
One must understand that the mandate of Azure is to obtain readily available past and present information pertinent to the subject site for a Geotechnical Investigation only. No other warranty or representation, expressed or implied, as to the accuracy of the information is included or intended by this investigation. Azure makes no other representation whatsoever, including those concerning the legal significance of its findings or as to the other legal matters addressed incidentally in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time; thus the Client should review such issues with appropriate legal counsel.

It should be noted that the information supplied in this report is not be sufficient to obtain approval for disposal of excess soil or materials generated during construction. The geotechnical site characterization is a limited sampling of a site and it does not include any chemical testing. Some of the information presented in this report was provided through existing documents and by third parties. Although attempts were made, whenever possible, to obtain a minimum of two confirmatory sources of information, Azure in certain instances has been required to assume that this information provided is accurate. Due to the nature of the investigation and the limited data available, Azure cannot warrant against undiscovered geotechnical liabilities. No other warranty or representation, either expressed or implied, is included or intended in this report.

APPENDIX A

FIGURES

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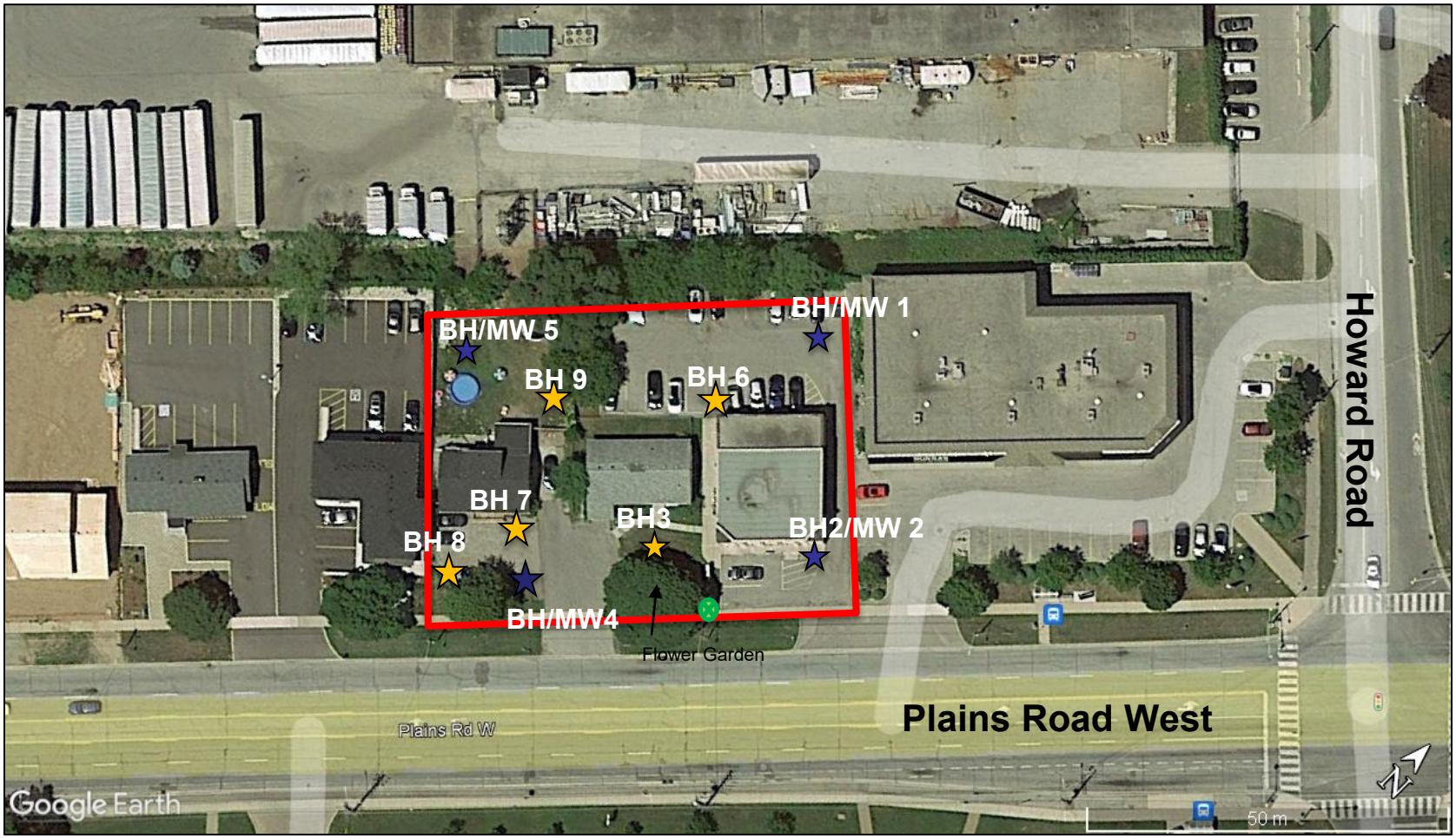
Approximate Location of the Subject Property
141 Plains Rd W, Burlington

Approximate Location of the Subject Property
147 Plains Rd W, Burlington

Approximate Location of the Subject Property
153 Plains Rd W, Burlington

Source: Burlington Interactive map - 2022

Title	Project	Project No.	Scale	Date	Drawing No.
Subject Property Location Plan	141-153 Plains Road West, Burlington, Ontario	2209-004	As shown	January 20, 2023	1



Approximate Location of the Subject Property

Approximate Location of the Boreholes

Approximate Location of the Monitoring Wells

Approximate Location of the Benchmark Manhole

Source: Burlington Interactive map - 2022

Title	Project	Project No.	Scale	Date	Drawing No.
Borehole Location Plan	141-153 Plains Road West, Burlington, Ontario	2209-004	As shown	January 20, 2023	1

APPENDIX B

BOREHOLE LOGS

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AZURE GROUP **DRAWING NO. 2**

JOB NUMBER 209-004 **BH(MW)1**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 16, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 16, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 102.74 m	G.W. Depth: 13.42 m	G.W. Elevation: 89.32 m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	102.7	100 mm Asphalt	CS	1	20			
		Compact dark brown Silty Sand trace cobble,						
0.75	102.1	Very loose Silty Sand	CS	2	4			
1.50	101.3	Compact Silty Sand below 1.5 m	CS	3	15			
2.25	100.6		CS	4	15			
3.0	99.7		CS	5				
4.6	98.3	Stiff to very stiff reddish brown Silty clay below 4.5 m	CS	6				
6.1	96.7	Compact Sand trace gravels below 5.5 m	CS	7				
7.6	95.2		CS	8				
9.2	93.6		CS	9				
10.7	92.1	Dense SAND	CS	10				
12.2	90.6	Very dense SAND below 12 m (boulders at the tip of the spoon)	CS	11	80			
							13.42	
13.7	89.1		CS	12	30			
15.2	87.5	Loose SAND	CS	13	7			

EOB

AZURE GROUP **DRAWING NO. 3**

JOB NUMBER 209-004 **BH(MW)2**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 16, 2022	Time:	Sheet 1	of 1
Finished/Date	Nov. 16, 2022	Time:		
Azure Rep: Amit Pal		Auger Type: 150 mm Open		
G. S. El: 102.74 m	G.W. Depth: 13.0 m	G.W. Elevation: 89.7 m	Time:	

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	102.7	120 mm Asphalt	CS	1	9			
		Looe to very loose brown Sand with cobbles and gravel,						
0.75	102.0		CS	2	3			
1.50	101.2	Compact SAND, below 1.5 m, moist to wet	CS	3	15			
2.25	100.5		CS	4				
3.0	99.7		CS	5				
4.6	98.24		CS	6				
6.1	96.6		CS	7				
7.6	95.1		CS	8				
9.2	93.5		CS	9				
10.7	90.5	Compact to dense SAND, below 7.6 m,	CS	10	29			
12.2	89.0		CS	11				
							13.0	
13.7	87.5		CS	12				
15.2	86.0		CS	13				

EOB

AZURE GROUP **DRAWING NO. 4**

JOB NUMBER 209-004 **BH(MW)3**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 17, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 17, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 102.85 m	G.W. Depth: m	G.W. Elevation: m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	102.9	75 mm Asphalt	CS	1	10			
		Loose dark brown Sand trace to some cobbles and gravel						
0.75	102.2		CS	2	6			
1.50	101.4	Compact Sand below 1.5 m below 1.5 m	CS	3	15			
2.25	100.7		CS	4				
3.0	99.9		CS	5				
4.6	98.3		CS	6				
6.1	96.8	Dense SAND trace gravels (some cobbles) below 5 m	CS	7	33			
7.6	95.3		CS	8				

EOB

AZURE GROUP **DRAWING NO. 5**

JOB NUMBER 209-004 **BH(MW)4**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 16, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 16, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 102.83 m	G.W. Depth: 12.8 m	G.W. Elevation: 90.03 m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	102.83	150 mm Topsoil	SS	1	8			
		Loose to very loose Sand trace gravels and organics						
0.75	102.1		SS	2	2			
1.50	101.3	Dense SAND trace clay and gravel, moist to dry	SS	3	3			
2.25	100.6	Loose grey SAND, moist to wet	SS	4	7			
3.0	99.8	Loose grey SAND, wet	SS	5	9			
4.6	98.3	Dense SAND trace clay below 4 m, wet	SS	6	48			
6.1	96.7	Very dense below 6 m (possible cobbles)	SS	7	80			
7.6	95.2	Dense below 7 m	SS	8	43			
9.2	93.6	Compact below 9 m	SS	9	10			
10.7	92.1		CS	10				
12.2	90.6	Compact Sand below 12 m	CS	11	19			
							12.8	
13.7	89.1		CS	12				
15.2	87.6		CS	13				

EOB

AZURE GROUP **DRAWING NO. 6**

JOB NUMBER 209-004 **BH(MW)5**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 16, 2022	Time:	Sheet 1	of 1
Finished/Date	Nov. 16, 2022	Time:		
Azure Rep: Amit Pal		Auger Type: 150 mm Open		
G. S. El: 103.31 m	G.W. Depth: 13.4 m	G.W. Elevation: 89.91 m	Time:	

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	103.1	125 mm Topsoil	SS	1	6			
		Loose to very loose Sand trace gravel,						
0.75	102.4		SS	2	3			
1.50	101.6	Dense SAND trace to some gravel, moist to dry	SS	3	39			
2.25	100.9	Very dense below 2.0 m	SS	4	66			
3.0	100.1	Dense below 3.0 m	SS	5	31			
4.6	98.5	Very loose SILT/Soft to very soft clayey SILT below 4.0 m	SS	6	4			
6.1	97.0	Dense below 6 m	SS	7	32			
7.6	95.5		SS	8	32			
9.2	93.9	Dense below 9 m	SS	9	32			
10.7	92.4		CS	10				
12.2	90.9		CS	11				
13.7	89.4		CS	12			13.4	
15.2	87.9		CS	13				

EOB

AZURE GROUP **DRAWING NO. 7**

JOB NUMBER 209-004 **BH6**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 16, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 16, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 103.33 m	G.W. Depth: m	G.W. Elevation: m	Time:

Depth	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	103.3	100 Asphaltil	CS	1	10			
		Fill: Loose to Compact Sand/Silty Sand trace gravels						
0.75	102.6	Fill: Loose grey SAND, moist to wet	CS	2	10			
1.50	101.8	Fill: Compact Sand and gravel below 1.5	CS	3	18			
2.25	101.1		CS	4				
		Fill: Stiff to very stiff Silty Clay/Clayey Silt below 3 m						
3.0	100.3		CS	5	16			
		Compact SAND trace to some gravel below 4 m						
4.6	98.7		CS	6	16			
6.1	97.2	Very Loose grey SAND below 6.0 m,	CS	7	3			

EOB

AZURE GROUP **DRAWING NO. 8**

JOB NUMBER 209-004 **BH7**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa) | *G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content*

Temperature: 5°C

Started/Date	Nov. 14, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 14, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 103.104 m	G.W. Depth: 13.7 m	G.W. Elevation: 89.4 m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	103.1	Topsoil	SS	1	10			
		Fill: Loose brown Sand with some gravel,						
0.75	102.4	Very loose below 0.7 m	SS	2	2			
1.50	101.6	Compact SAND trace gravel, moist to dry	SS	3	22			
2.25	100.9	Compact to loose SAND trace gravel	SS	4	10			
3.0	100.1	Loose SAND	SS	5	8			
4.6	98.5	Dense SAND trace to some gravel below 4 m	SS	6	39			
6.1	97.0	Dense below 6 m (caved)	SS	7	47			
7.6	95.5		SS	8				
9.2	93.9		SS	9				
10.7	92.4	Compact SAND trace cobbles below 10 m	SS	10	11			
12.2	90.9	Compact below 12 m	SS	11	17			
13.7	89.4	Compact below 13 m	SS	12	18		13.7	
15.2	87.9		SS	13				

EOB

AZURE GROUP **DRAWING NO. 9**

JOB NUMBER 209-004 **BH8**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa)	G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content

Temperature: 5°C

Started/Date	Nov. 14, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 14, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 102.93 m	G.W. Depth: m	G.W. Elevation: m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	102.9	Topsoil	CS	1	5			
		Fill: loose to very loose dark brown Sand						
0.75	102.2	Fill: Very loose below 0.7 m	CS	2	1			
1.50	101.4	Loose SAND below 1.5 m	CS	3	6			
2.25	100.7	Very loose below 2.2 m	CS	4	3			
3.0	99.9	Very loose below 3 m	CS	5	2			
4.6	98.3	Dense SAND below 4 m	CS	6	32			
6.1	96.7	Very dense SAND trace shale fragments	CS	7	80			
7.6	95.3		CS	8	80			

EOB

AZURE GROUP **DRAWING NO. 10**

JOB NUMBER 209-004 **BH9**

PROJECT LOCATION: 141-153 Plains Road West, Burlington, Ontario

Client: Black Creek Group

C_u = Shear Strength (kPa) | *G%= Gravel, S% = Sand, F% = Fines (Silt and Clay), M = Moisture Content*

Temperature: 5°C

Started/Date	Nov. 14, 2022	Time:	Sheet 1 of 1
Finished/Date	Nov. 14, 2022	Time:	
Azure Rep: Amit Pal		Auger Type: 150 mm Open	
G. S. El: 103.22 m	G.W. Depth: m	G.W. Elevation: m	Time:

Depth (m)	Elev. (m)	Soil Description	Type	No	N	C_u (kPa)	G.W.T	Remark
0	103.2	Topsoil	SS	1	8			
		Fill: Loose Sand trace gravel and organics						
0.75	102.4		SS	2	6			
1.50	101.6	Loose SAND trace gravel	SS	3	6			
2.25	100.9	Compact SAND trace gravel	SS	4	23			
3.0	100.1	Compact SAND trace to some gravel	SS	5	28			
4.6	98.5	Compact SILT/Stiff CLAYEY SILT trace clay below 3 m, wet	SS	6	11			
6.1	97.0	Dense SAND trace to some gravel below 6 m	SS	7	38			
7.6	95.5	Very dense SAND (Possible boulder)	SS	8	74			
9.2	94.0	Loose to compact SAND trace to some gravels	CPT		8			
9.5	93.7		CPT		11			
9.8	93.4		CPT		14			
10.1	93.1		CPT		6			
10.4	92.8		CPT		10			
10.7	92.5		CPT		13			
11.0	92.2		CPT		13			
11.3	91.9		CPT		12			
11.6	91.6		CPT		5			
11.9	91.3		CPT		6			
12.2	91.0		CPT		6			
12.5	90.7		CPT					

EOB

APPENDIX C

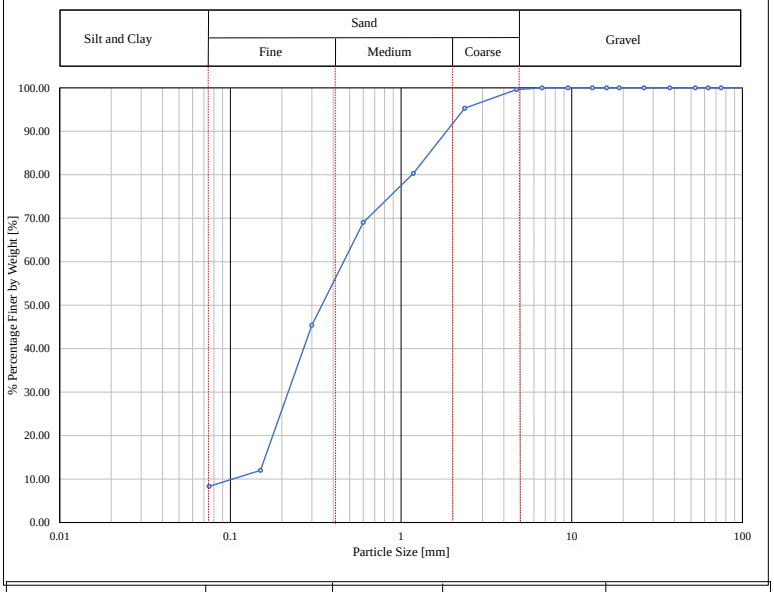
GRAIN SIZE DISTRIBUTION GRAPHS

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McINTOSH PERRY

JOB NO. CCC-213999-00
Lab No: **21393**

PROJECT : Azure Group-Laboratory Testing-Various Locations
LOCATION : 141-153-Plains Road West, Burlington
DATE : 09-12-2022

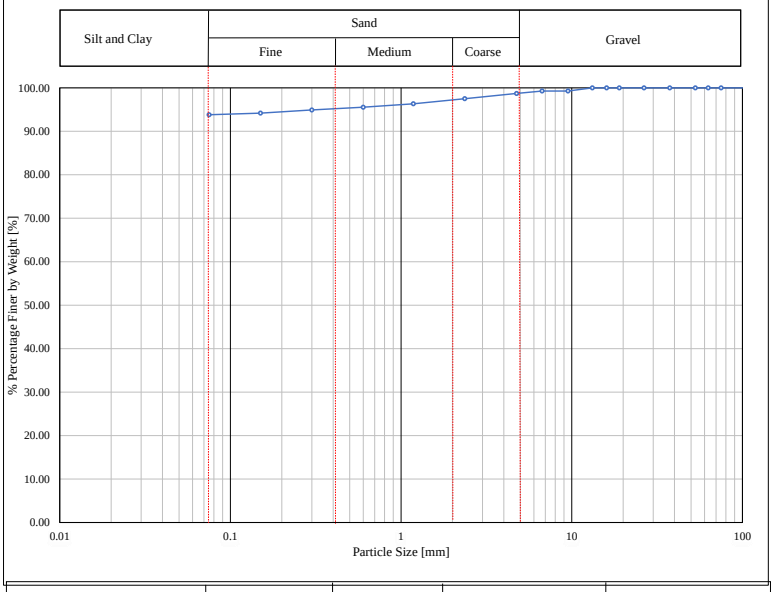


Sample	Percent Gravel [%]	Percent sand [%]	Percent Silt and Clay [%]	Moisture Content [%]
BH 4-13 -(24'-26')	0.40%	91.29%	8.31%	4.02%

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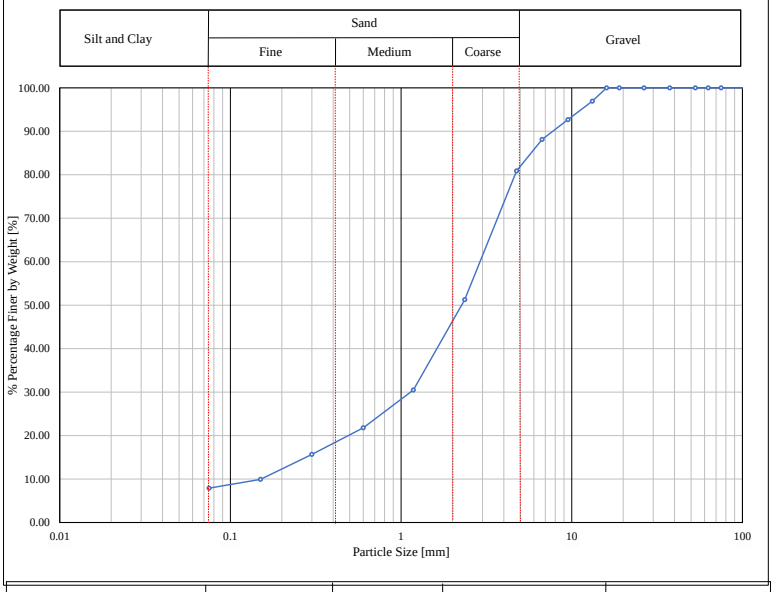


Sample	Percent Gravel [%]	Percent sand [%]	Percent Silt and Clay [%]	Moisture Content [%]
BH 6-9 (16'-18')	1.29%	4.89%	93.81%	30.38%

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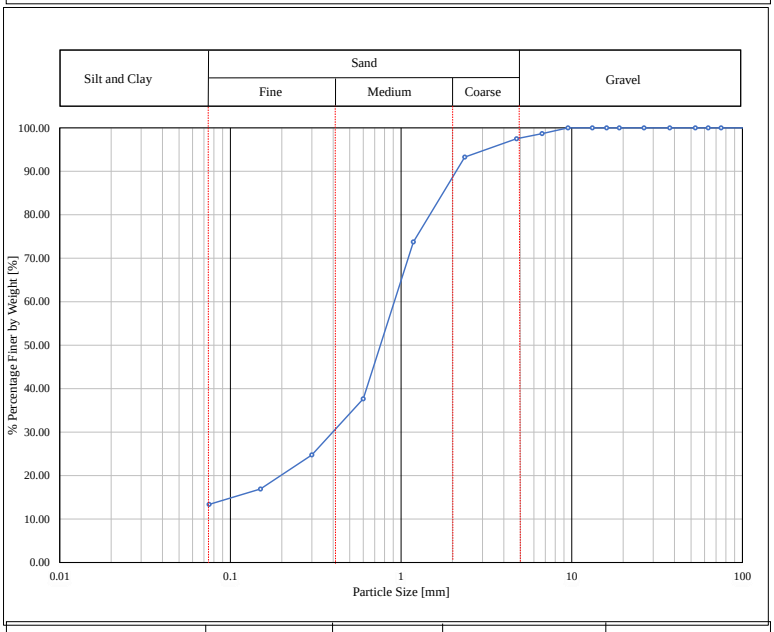


Sample	Percent Gravel [%]	Percent sand [%]	Percent Silt and Clay [%]	Moisture Content [%]
BH 7-7 -(20'-22')	19.11%	72.99%	7.90%	4.11%

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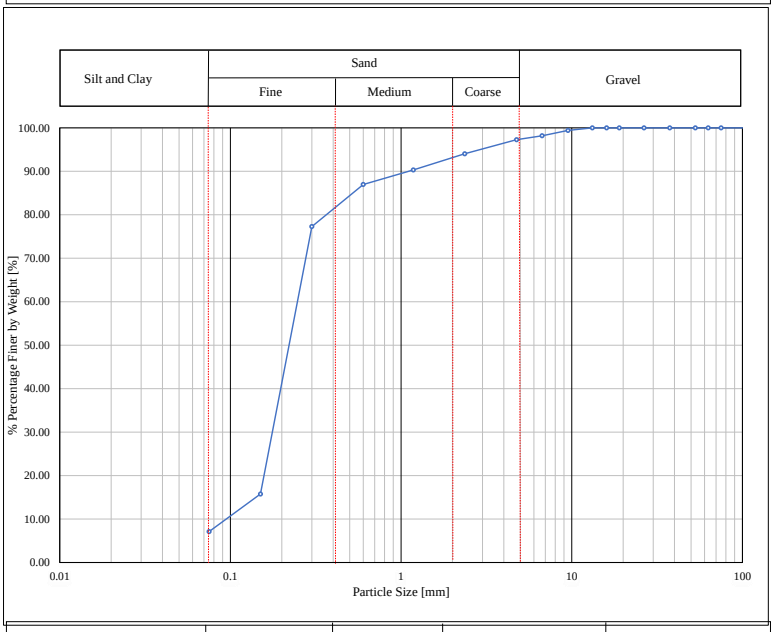


Sample	Percent Gravel [%]	Percent sand [%]	Percent Silt and Clay [%]	Moisture Content [%]
BH 8-10 -(18'-20')	2.51%	84.13%	13.36%	4.15%

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Sample	Percent Gravel [%]	Percent sand [%]	Percent Silt and Clay [%]	Moisture Content [%]
BH 9-8 (26'-28')	2.73%	90.17%	7.11%	5.33%