Geotechnical Investigation
Proposed Residential Development
1839 Four Mile Creek Road
Niagara-On-The-Lake, Ontario

Project No.:
NT25108

Submitted To:
Harvest Heights
657 East West Line
Niagara-On-The-Lake, Ontario
L0S 1J0

Attention:
Mr. Josh Bice

Prepared By:
Niagara Testing and Inspection Ltd.
3300 Merrittville Hwy, Unit 5
Thorold, Ontario L2V 4Y6
t: 289-438-2249

Date Submitted:
August 27, 2025

TABLE OF CONTENTS

Page

LIST OF APPENDICES

1.0 INTRODUCTION

Niagara Testing and Inspection Ltd. (NTIL) has been retained by Harvest Heights (the 'Client') to carry out a geotechnical investigation for the proposed residential development to be constructed at 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario.

It is understood that the proposed development would consist of a twenty-nine (29) unit three-storey residential apartment building, with a half-storey underground parking level, including new asphaltic concrete paved parking areas, concrete curbs/sidewalks, and underground utility installations. The proposed finished floor elevation of the underground parking garage level is approximately 86.17 metres, as shown on Upper Canada Consultants' Preliminary Grading Plan, File No.: 22150, Dwg. No. 22150-SGP, Rev. 0, dated 2025-08-20. The proposed underside of footing is expected to be approximately 0.45 to 0.55 metres below the finished floor elevation of the underground garage level, yet to be determined by the structural engineer. Future revisions to this report may be required once the final design is provided.

The purpose of this investigation was to determine the subsurface soil and groundwater conditions at the site by advancing five (5) boreholes and installing four (4) groundwater monitoring wells, and based on an assessment of the factual borehole data, provide an engineering report containing design and construction recommendations of foundations, the excavation conditions and groundwater control, backfilling recommendations, pavement structure design and related earthworks from a geotechnical point-of-view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, then this office must be consulted to review the new design with respect to the results of this investigation.

2.0 FIELD WORK

A total of five (5) sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. Boreholes were advanced using a track-mounted drilling rig implementing solid stem continuous flight auger equipment on July 21st, 2025. The field work was carried out under the direction and supervision of a staff member of NTIL, who logged the boreholes in the field, observed the subsurface sampling, and monitored the groundwater conditions. Boreholes were advanced to depths between 5.08 and 12.62 m below ground surface, along with the installation of four (4) groundwater monitoring wells. On completion of drilling, boreholes were backfilled in general accordance with Ontario Regulation 903.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with ASTM Specification D1586. After general field examination of soils, including pocket penetrometer tests in cohesive soils, the soil samples were preserved and transported to the soil laboratory. Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Borehole Log Nos. 1 to 5, Appendix A, inclusive following the text of this report.

The boreholes were located in the field and the ground surface elevations at the borehole locations were referenced to a temporary benchmark by representatives of NTIL. The temporary benchmark is described as the top of catch basin cover located on Four Mile Creek Road, at the northwest corner of the site, see attached Drawing No. 1, Borehole Location Plan. The temporary benchmark was assigned geodetic Elevation 87.56 metres, as shown on Upper Canada Consultants' Preliminary Grading Plan, Dwg. No. 22150-SGP, Rev. 0, dated 2025-06-13.

A summary of the borehole geodetic locations and corresponding elevations are shown in the following table:

Borehole No.	Location	Location [NAD83 UTM Coordinates] ±3m		Surface Elevation [Temporary Benchmark]	Borehole Depth / Elevation [MBGS / M]
		Easting	Northing	[Meters]	[MBGS / M]
BH-1	Three-Storey Apartment Building	652324	4788193	87.66	5.08 / 82.58
BH-2		652372	4788196	88.17	5.18 / 82.99
BH-3		652320	4788171	87.53	5.18 / 82.35
BH-4		652375	4788176	87.89	5.18 / 82.71
BH-5		652340	4788193	87.89	12.62 / 75.26

3.0 LABORATORY TESING

Soil samples obtained from the in-situ tests were examined in the field and subsequently brought to our laboratory for visual, tactile, and olfactory classifications to confirm field classification. Moisture content determination of all retrieved samples occurred.

In addition, four (4) grain size distribution analysis test was carried out on representative soil samples to establish the physical and engineering properties. Laboratory test results are presented on Figure No. 1 to 4, Grain Size Distribution, inclusive, in Appendix B.

4.0 EXISTING SITE CONDITIONS

The subject site is located at 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario. For descriptive purposes in this report Four Mile Creek Road has been assigned a north to south alignment. The site is bounded by Four Mile Creek Road to the west, residential properties to the north and south, and by agricultural vineyard to the east.

The site was formerly a residential property with a single storey dwelling and detached two-car garage, located centrally within the site. At the time of the geotechnical investigation, the residential dwelling and detached garage had been previously removed, and the site was currently vacant with only the asphaltic concrete driveway remaining and mature trees spread across the site. Historically, before the property was converted to a residential lot, the site was used for agricultural purposes. The site is relatively flat with a gentle slope towards the western limit of the site.

5.0 GEOLOGICAL SETTING

Map 2496, Quaternary Geology of the Niagara-Welland Area, published by the Ministry of Natural Resources (1984), indicates that the surficial soils generally consist of glaciolacustrine nearshore and deltaic sand and silt.

Based on *Map 2344, Paleozoic Geology of the Niagara Area*, published by the Ontario Division of Mines (1976), the bedrock in the area consists of red shale of the Queenston Formation.

6.0 SUBSURFACE CONDITIONS

6.1 General

The detailed subsurface conditions encountered in the five (5) boreholes advanced as part of this geotechnical investigation are shown on the Borehole Log Sheets, Appendix A, inclusive. The borehole locations are indicated on the Borehole Location Plan, Drawing No. 1.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

6.2 Topsoil

Topsoil was encountered at the ground surface at all borehole locations, with the exception of Borehole No. 5, with measured thicknesses between 100 and 150 mm.

6.3 Granular Material

Granular material consisting of varying percentages of sand and gravel was encountered at the ground surface at Borehole No. 5, with measured thickness of about 200 mm. The material is associated with excavation backfill from the demolition of the former residential dwelling.

6.4 Clayey Silt

The topsoil and granular material at the borehole locations were underlain by clayey silt deposits extending to maximum investigated borehole depths of about 12.62 metres below existing ground surface (mbgs). The upper level of the clayey silt is described as having a ‘reworked’ appearance, expected to be from possible limited site grading operations, agricultural ploughing, and yearly freeze/thaw cycles.

In general, the ‘reworked’ upper clayey silt contained some sand with traces of gravel and rootlets, extending to depths of between 0.76 and 1.68 mbgs. The lower undisturbed native clayey silt generally contained trace to some amounts of sand, and trace fine gravel, and had a till-like appearance. The clayey silt was generally brown in colour, transitioning to grey at depths of about 2.44 to 3.05 mbgs.

A reddish-brown clayey silt, possible weathered shale, layer was encountered at a depth of about 11.73 mbgs in Borehole No. 5 and extended to maximum investigated depths.

The SPT "N"-value measured within the cohesive deposit ranged from 9 to greater than 50 blows per 300 mm of penetration with depth. Undrained shear strength measured on slightly disturbed SPT samples using a pocket penetrometer ranged from 100 to greater than 225 kPa with depth. Based on the above test results, the native clayey silt layer is considered to have a very stiff to hard consistency.

Natural moisture content was measured between 9% and 20%, and the plasticity was generally observed at dryer than plastic (DTPL).

Four (4) grain size analysis tests were conducted on select samples of the stratum as summarized in the table below. The results of this testing are included in Appendix B.

Borehole and Sample No.	Sample Depth (m)	Grain Size Distribution (%)			
		Gravel	Sand	Silt	Clay
BH-1 SS-3	1.52 – 2.13	0	9.1	71.8	19.1
BH-2 SS-5	3.05 – 3.66	2.7	21.1	55.2	21.0
BH-3 SS-6	4.57 – 5.18	4.4	14.6	66.4	14.6
BH-4 SS-4	2.29 – 2.90	4.8	18.8	51.6	24.8

6.5 Groundwater

Groundwater conditions were monitored during and following completion of borehole sampling. Upon completion all boreholes contained no free water, with the exception of Borehole No. 5. Monitoring wells were installed in Borehole Nos. 1, 2, 3, and 4, inclusive.

The retrieved samples were generally noted to become grey in colour below depths of about 2.44± to 3.05± m below grade, which may be indicative of the long-term groundwater level at the site.

Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (i.e., spring thaw and late fall) and lower levels occurring during dry weather.

The table below summarizes the recorded water level readings in the monitoring wells.

Borehole No.	Ground Surface Elevation (m)	Date	Water Level Below Existing Ground Surface (mbgs)	Water Level Elevation (m)	Water Level Depth Below Garage FF Elevation of 86.17 m (m)
1 (Monitoring Well)	87.66	21-Jul-25*	Dry	--	--
		28-Jul-25	2.26	85.4	0.77
		05-Aug-25	2.31	85.35	0.82
2 (Monitoring Well)	88.17	21-Jul-25*	Dry	--	--
		28-Jul-25	2.26	85.91	0.26
		05-Aug-25	2.52	85.65	0.52
3 (Monitoring Well)	87.53	21-Jul-25*	Dry	--	--
		28-Jul-25	2.9	84.63	1.54
		05-Aug-25	2.6	84.93	1.24
4 (Monitoring Well)	87.89	21-Jul-25*	Dry	--	--
		28-Jul-25	4.41	83.48	2.69
		05-Aug-25	4.35	83.54	2.63
5	87.66	21-Jul-25*	7.62	80.27	5.90

*Water level measurement taken upon drilling completion, water level not anticipated to be fully stabilized.

7.0 DISCUSSION AND RECOMMENDATIONS

7.1 General

It is understood that the proposed development would consist of a twenty-nine (29) unit three-storey residential apartment building, with a half-storey underground parking level, including new asphaltic concrete paved parking areas, concrete curbs/sidewalks, and underground utility installations. The proposed finished floor elevation of the underground parking garage level is approximately 86.17 metres, as shown on Upper Canada Consultants' Preliminary Grading Plan, File No.: 22150, Dwg. No. 22150-SGP, Rev. 0, dated 2025-08-20. The proposed underside of footing is expected to be approximately 0.45 to 0.55 metres below the finished floor elevation of the underground garage level, yet to be determined by the structural engineer.

In general, the topsoil, granular material, and 'reworked' soils were underlain by a clayey silt deposit extending to maximum explored depths of about 5.08 to 12.62 mbgs. The 'reworked' upper clayey silt contained some sand with traces of gravel and rootlets, extending to depths of between 0.76 and 1.68 mbgs. The lower undisturbed native clayey silt generally contained trace to some amounts of sand, and trace fine gravel, and had a till-like appearance and is considered to have a very stiff to hard consistency.

The retrieved samples were generally noted to become grey below depths between 2.44± to 3.05± m below grade, corresponding to elevations between 85.3± to 84.8± m, which may be indicative of the long-term groundwater level at the site. Monitoring wells were installed in Borehole Nos. 1 to 4, inclusive, with water levels readings taken approximately 2.31± to 4.35± m below grade, corresponding to elevations between 85.35± to 83.54± m. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

7.2 Footing Foundations

It is understood that the proposed finished floor elevation of the underground parking garage level is approximately 86.17 metres, as shown on Upper Canada Consultants' Preliminary Grading Plan, File No.: 22150, Dwg. No. 22150-SGP, Rev. 0, dated 2025-08-20.

The native clayey silt deposits, below any topsoil, fill and reworked soils, are capable of supporting the loads typically associated with residential construction on conventional spread footings. Increased fill depths, if encountered, especially in the area of the former site buildings, may required the foundations to be extended to the underlying native soils, the foundation excavation could be advanced within a 'slot' trench [excavation width slightly wider than the footing] to the competent native soils and then backfilled with a 10 MPa lean-mix concrete product to the design underside footing level.

The following table summarizes the recommended geotechnical reactions at the Serviceability Limit State (SLS) and factored geotechnical resistances at the Ultimate Limit State (ULS) for the clayey silt deposits. It should be noted that the established design parameters have been determined for the design stage only.

Subsurface conditions can vary over relatively short distances, and the subsurface conditions revealed at the test locations may not be representative of subsurface conditions across the site. Therefore, it is imperative that a soils engineer be retained from this office during construction to examine the exposed sub-soil quality and condition, and to allow changes to be made in the event that subsurface conditions

differ from the conditions identified at the borehole locations.

Location	Proposed Founding Elevations		Founding Stratum	Foundation Design Resistance	
	Founding Depth (mbgs)	Elevation Range (m)		SLS (kPa)	ULS (kPa)
At-grade	1.5 – 2.0	86.3 – 85.8	Clayey Silt	200	300
Basement	2.5 – 3.5	85.3 – 84.3	Clayey Silt	250	375

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The majority of the settlements will take place during construction and the first loading cycle of the building.

The following table summarizes the highest founding level and elevation for the at-grade footing option at each borehole location:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	87.66	1.2	86.46
2	88.17	1.2	86.97
3	87.53	1.2	86.33
4	87.89	1.2	86.69
5	87.89	1.2	86.69

In addition, the footings should be founded below any existing fill materials, building foundations and utility trenches, on competent native undisturbed soils. Spacing between adjacent footing steps should not be steeper than 10 Horizontal to 7 Vertical.

The maximum total and differential settlements of footings designed to the above recommended soil bearing pressure are expected to be less than 25 and 20 mm, respectively, and these are considered tolerable for the structure being contemplated.

It is noted that the support conditions afforded by the founding soils are not typically uniform across the site, nor are the loads on the various foundation elements. In this regard it is recommended that all footings and foundation walls be provided with nominal steel reinforcement. Such nominal reinforcement would typically consist of two continuous 15M bars in the footings and a similar two 15M bars approximately 300 millimetres from the top of the foundation walls. The reinforcing bars should be bent to reinforce around corners and window openings, provided with sufficient overlap, and tied at splice locations. The provision of such nominal reinforcing steel is considered good practice as it will work to

limit any cracking of foundation walls, reducing the potential need for costly post construction repairs. The reinforcement will also aid the foundation walls in resisting the lateral forces associated with the often early backfill typical in residential construction.

The founding soils should be in an undisturbed state, and the footing bases should be hand cleaned of any loose or disturbed material immediately before the placement of concrete.

It is recommended that a lean concrete mat ('mud' slab) be placed over approved footing subgrade in wet to saturated areas to prevent further disturbance to the bearing soils resulting from construction activities.

7.3 Building Drainage

All basement foundation walls should be suitable damp proofed [with a 'dimple' drainage blanket] and provided with a perimeter drainage tile system. The perimeter weeping tile should consist of a 100-millimetre diameter perforated plastic pipe, encased in a geofabric sock, covered with a minimum of 200 millimetres of 20-millimetre clear crushed stone, in turn encased in a heavy geofabric. The weeping tile system would ideally outlet to a gravity sewer connection. This would eliminate the potential for frequently operating sump pumps for lots at lower founding elevations relative to the static groundwater level. Where a sump pit system is required, it is recommended that an 'over-sized' sump pit be provided to reduce the frequency of pump operation. The outlet should be fitted with suitable back-flow prevention valves.

7.4 Frost Protection and Insulation

The estimated frost penetration depth at the site is 1.2 metres, as such, all exterior footings and footings in unheated areas placed on native soils should be situated at 1.2 metres below ground surface to provide adequate insulation against frost heaving. Alternatively, insulation equivalent to a soil cover can be used to raise the frost line. If shallower embedment is needed, expanded polystyrene (EPS) insulation or equivalent can be designed to prevent frost action. If the insulation material is expected to take any load, the design engineer should check the product specification(s) from the manufacture and ensure the selected product(s) satisfy the expected loading conditions.

If construction is undertaken during the winter months, foundation subgrade must be protected from freezing.

7.5 Floor Slab Construction

The floor slabs may be constructed using conventional slab-on-grade techniques on a prepared subgrade. The exposed subgrade surface should then be well compacted in the presence of a representative of Niagara Testing and Inspection Ltd., using a smooth drum compactor. Any soft 'spots' delineated during this work must be sub-excavated and replaced with quality backfill material compacted to 100 percent of its standard Proctor maximum dry density. Imported granular fill is preferred due to its relative insensitivity to weather conditions, its relative ease in achieving the required degree of compaction and its quick response to applied stresses.

As with all concrete floor slabs, there is a tendency for the floor slabs to crack. The slab thickness, concrete

mix design, amount of steel and/or fibre reinforcement and/or wire mesh placed into the concrete slab, if any, will there be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend a minimum of 1/3 the thickness of the slab.

Based on in-situ soil conditions, it is recommended to establish the concrete floor slab on a minimum 300 mm thick layer of Granular 'A' (OPSS 1010) compacted to 100% SPMDD. Alternatively, a moisture barrier will be required under the floor slabs such a 10-mil polyethylene or thicker vapour barrier sheet, or the placement of at least 200 millimetres of well-compacted 20-millimetre clear crushed stone. At a minimum, the moisture barrier material should contain no more than 10 percent passing the No. 4 sieve.

Curing of the slab-on-grade must be carefully specified to ensure that slab curl is minimised. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

It is also important that the concrete mix design provide a limiting water/cement ratio and total cement content, which will mitigate moisture related problems with low permeance floor coverings, such as debonding of vinyl and ceramic tile. It is equally important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage cracking and curling of the slab.

7.6 Earthquake Considerations

In accordance with The Ontario Building Code 2024 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

Based on the anticipated condition of the underlying soil encountered at the borehole locations, the site can be classified as a Site Class D – Stiff Soil as per OBC Table 4.1.8.4.-B. The conducting of site specific shear wave velocity testing may allow for the property to be classified as a Class C - Very Dense Soil and Soft Rock.

The seismic data obtained from the 2020 National Building Code of Canada Seismic Hazard Tool, which provides values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1 of Division B of the NBC 2020, for project site located in the Town of Niagara-On-The-Lake are as follows.

Location	Sa[0.2]	Sa[0.5]	Sa[1.0]	Sa[2.0]	Sa[5.0]	Sa[10.0]	PGA	PGV
1839 Four Mile Creek Road, NOTL	0.447	0.353	0.197	0.0897	0.0231	0.00704	0.284	0.233

The structural engineer responsible for the project should review the earthquake loads and effects.

7.7 Excavations and Groundwater Control

Trenching and excavation can be carried out using conventional open cut procedures. The excavations will generally extend through the surficial topsoil, reworked materials and into the native clayey silt. A maximum excavation depth of about 2.0 m is assumed for the purposes of this report.

Above the groundwater table, the native stiff to very stiff clayey silt soils are generally considered to be Type 2 Soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 2 Soils are expected to remain stable during the construction period provided side slopes are cut to 1H : 1V from within 1.2 m of the base of the excavation. Sidewalls in the lower 1.2 m may be cut vertical.

Groundwater levels were measured in the open boreholes during and upon completion of drilling operations, no free water was encountered, with the exception of Borehole No. 5 where non-static groundwater was observed at approximately 7.62 m below grade. Monitoring wells were installed in Borehole Nos. 1 to 4, inclusive. The water level in the monitoring wells generally ranged from 2.31± to 4.35± m below grade, corresponding to elevations between 85.35± to 83.54± m. The retrieved samples were generally noted to become grey in colour below depths of about 2.44± to 3.05± m below grade, which may be indicative of the long-term groundwater level at the site. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

The proposed finished floor elevation of the underground parking garage level is approximately 86.17 metres, with the expected proposed underside of footing to be approximately 0.45 to 0.55 metres below the finished floor elevation of the underground garage level, corresponding to elevations between 85.72 to 85.62 metres, yet to be determined by the structural engineer.

The water levels within the boreholes are expected to be close but remain below the elevation of excavation, approximately 85.72 to 85.62 metres, at all locations within the proposed building, and is not expected to have a major impact on construction methods or building design.

During excavation for the underground parking garage and foundations, minor groundwater seepage should be expected from surface runoff and more permeable seams within the upper reworked deposits. However, due to the conditions of the subsoils, uncontrollable groundwater flows are not expected to be encountered for footing foundation construction. Subsurface seepage and surface water runoff into the excavations may be handled by conventional ‘dewatering’ techniques, such as filtered sump pumping techniques, as and where required, extensive dewatering of the site is not anticipated. More water should be expected when connections are made with existing services. Surface water should be directed away from the excavations.

Given the current groundwater levels and the proximity to the anticipated depth of excavation, further hydrogeological studies may be required and can be completed at the detailed design stage once the exact footing elevations are determined by the design team. In the event that subsurface conditions differ from the conditions identified at the borehole locations or building designs change, then additional investigation and reporting may be required.

7.8 Backfill Considerations

The majority of the excavated material will consist of topsoil, reworked soils, and the native clayey silt, as encountered in the boreholes and described above. Select portions of the fill and reworked materials may be used for backfilling purposes, however, it is best assessed in the field at the time of construction. Unsuitable excavated fill material, if encountered, may be used in non-settlement sensitive areas, such as landscaping areas. The native cohesive materials are generally considered suitable for use as service trench backfill and engineered fill, provided they can be effectively moisture conditions to within 3 percent of standard Proctor optimum moisture content. Some moisture conditioning may be required depending upon the weather conditions at the time of construction.
The clayey silt encountered in the borings is sensitive to moisture absorption and will become practically impossible to compact using conventional compaction equipment if it becomes 'wet' during extended periods of precipitation. After a period of heavy precipitation, any near-surface softened material should be allowed to dry or be removed from the fill surface and discarded. The on-site soils are considered to be frost susceptible and have the potential to 'heave' because of freezing. The on-site soils are not considered to be free-draining and should not be used where this characteristic is required.

It is noted that the use of a free draining granular fill material, such as an Ontario Provincial Standard Specification [OPSS] Granular 'B' product, is generally preferred for use a backfill against foundation walls. Such materials are more readily compacted in restricted access areas, are less sensitive to moisture conditions and generally provide more positive support to interior and exterior floor slabs and pavements.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long-term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic, and therefore impacting roadway construction. If the soil is well 'dry' of its optimum value, it will appear to be very strong when compacted but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. The cohesive soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to their standard Proctor optimum value. It is therefore very important that the placement moisture content of the backfill soils be within 3 percent of its standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill should have its moisture content within 3 percent of its optimum moisture content and meet the necessary environmental guidelines. We would recommend that all sub-excavated areas of the site remediation work be backfilled with a well graded granular product compacted to 100 percent of its standard Proctor density.

The backfilling and compaction operations should be monitored by a representative of Niagara Testing and Inspection Ltd. to monitor uniform compaction of the backfill material to project specification requirements. Service trench and foundation wall backfill should be compacted to a minimum of 98 percent of the material's standard Proctor density. The upper one metre should be compacted to 100 percent. The backfill should be placed in loose lifts not exceeding 300 millimetres and should be compacted with sufficient compaction equipment that will not significantly disturb the native soils below. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

7.9 Lateral Earth Pressure

The unbalanced foundation walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. Based on a well-compacted and drained backfill soil, soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The horizontal pressure 'P', at a depth 'H', may be estimated using the following:

$$P = K (\gamma H + q)$$

where:

P =	Lateral earth pressure	kPa
K =	earth pressure coefficient	
γ =	unit weight	kN/m^3
H =	unbalanced height of wall	m
q =	surcharge load, if present, plus 15 kPa due to heavy compaction equipment	kPa

Suggested material properties and parameters are presented in the table below.

Material	Bulk Unit Weight (kN/m^3)	Angle of Internal Friction [°]	Active Earth Coefficient [K_a]	Passive Earth Coefficient [K_p]	At Rest Earth Coefficient [K_o]
Granular "A"	22	35	0.27	3.7	0.43
Granular "B" Type I	21	32	0.31	3.3	0.47
Silty Clay / Clayey Silt	20	28	0.36	2.77	0.53
Silt	20	30	0.33	3.77	0.50

*If below groundwater level and no drainage system provided, effective unit weight [$\gamma' = \gamma - \gamma_w$] and hydrostatic pressure should be considered

It is recommended that granular material [i.e., Granular "A" or Granular "B" as per OPSS 1010] be used as a backfill behind foundation walls [if any]. The granular material will facilitate drainage to a perimeter drainage system to reduce hydrostatic pressure acting on the walls [if below groundwater]. Heavy compaction equipment should not be used for wall backfill. Adequate slope of the surface layer should be maintained to drain any runoff away from the building to designated locations [i.e., manholes and catch basins].

7.10 Manholes, Catch Basins, and Thrust Blocks

With the manholes, catch basins, valve chambers, etc. founded on the native cohesive deposits, assuming all founding surfaces are carefully prepared to remove all loose and disturbed material, the bearing surfaces will be practically non-yielding under the anticipated loads. Proper preparation of the founding soils will therefore accentuate the protrusion of these structures above the pavement surface if compaction of the fill around these structures is not adequate, causing settlement of the surrounding paved surfaces. Conversely, the pavement surfaces may rise above the valve chambers under frost action. To alleviate the potential for these types of differential movements, free-draining, non-frost susceptible material should be provided as backfill around the structures located within any paved limits and compacted to 100% of its standard Proctor maximum dry density. A geofabric separator should be provided between the free draining material and the on-site fine-grained soils to prevent intrusion of fines.

The thrust blocks in the native fine granular may be sized as recommended by the applicable Ontario Provincial Standard Specification [OPSS]. A design allowable bearing pressure of 100 kPa [~2000 psf] may conservatively be used in the design of thrust blocks. Any backfill required behind the blocks should be granular and should be compacted to 100% of their standard Proctor density.

7.11 Pavement Considerations

The parking and access driveway areas should be stripped of all unsuitable materials. The exposed subgrade should be proof-rolled with 3 to 4 passes of a loaded tandem truck in the presence of a representative of Niagara Testing and Inspection Ltd., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this, or any other means must be sub-excavated and replaced with suitable backfill material. Alternatively, the soft areas may be repaired by the placement of coarse aggregate, such as 50-millimetre clear crushed stone. The need for sub-excavations of a softened subgrade will be reduced if construction is undertaken during periods of dry weather and careful attention is paid to the compaction operations. The fill placed over shallow utilities cuts into or across the street must also be compacted to 100% of its standard Proctor maximum dry density.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved area.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimising the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as typically experienced during the Fall and Spring months, it should be anticipated that the additional subgrade preparation would be required, such as the provision of a Granular B sub-base coarse material. It is also important that the sub-base and base coarse granular layers of the pavement structure be placed as soon after exposure and preparation of the subgrade level as practical.

The suggested pavement structures outlined below are based on subgrade parameters estimated based on visual and tactile examinations of the on-site soils and experience. The outlined pavement structure may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

Pavement Layer	Light Duty Pavement Structure	Heavy Duty Pavement Structure
Asphaltic Concrete [Compaction of 92 % to 96.5 % of MRD*]	HL3-HS – 65 mm	HL3-HS – 40 mm HL8-HS – 75 mm
OPSS Granular Material	350 mm plus of Granular "A" Base to design grade or an inspected subgrade or Granular "A" Base – 150 mm Granular "B" Type II Sub-Base Course – 200 mm	450 mm plus of Granular "A" Base to design grade or an inspected subgrade Or Granular "A" Base – 150 mm Granular "B" Type II Sub-Base Course – 300 mm

*MRD: Maximum Relative Density

This design is considered adequate, provided that the subgrade has been prepared as specified and is good and firm before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. The granular sub-base and base courses and asphaltic concrete layers should be compacted to OPSS or the Town of Niagara-On-The-Lake's requirements. A programme of in-place density testing must be carried out to monitor that compaction requirements are being met. If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. We note that this pavement structure is not to be considered as a construction roadway design.

8.0 CLOSURE

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the five (5) borehole locations. Contractors placing bids of undertaking this project should carry out due diligence in order to verify the results of this investigation and to determine how the subsurface conditions will affect their operations.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarifications as to the contents of this document, then please do not hesitate to contact the undersigned.

Yours very truly,
Niagara Testing and Inspection Ltd.

Dwayne Neill, P.Eng.
Project Engineer

Appendix A

Drawings & Borehole Logs

NTiL
NIAGARA TESTING AND INSPECTION LTD.

LEGEND

- BH-1 — Borehole with Monitoring Well Location
- BH-5 — Borehole Location
- TBM — Temporary Benchmark
  Cathch basin on Four Mile Creek Road, at northwest corner of site, Elev. 87.56 m.
- Site Boundary
- Approximate proposed building location.

NTiL
NIAGARA TESTING AND INSPECTION LTD.

CLIENT:
HARVEST HEIGHTS

PROJECT:
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
1839 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

TITLE:
BOREHOLE LOCATION PLAN

DRAWN BY: DN

CHECKED BY: DN

DATE: AUGUST 2025

PROJECT NO: NT25108

SCALE: AS SHOWN

NO:
DRAWING 1

REFERENCE: BASE MAP PROVIDED BY NIAGARA NAVIGATOR, https://maps-beta.niagararegion.ca/Navigator/
NOTE: FOR ILLUSTRATION PURPOSES ONLY, ALL LOCATIONS APPROXIMATE.

Soil Abbreviations and Explanation of Borehole Logs

TERMINOLOGY DESCRIBING COMMON SOIL TYPES:

Topsoil	-	mixture of soil and humus capable of supporting vegetation
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	soil materials identified as being placed anthropologically

CLASSIFICATION (UNIFIED SYSTEM)

Clay	<0.002mm		
Silt	0.002 to .075mm		
Sand	0.075 to 4.75mm		
		Fine	0.075 to 0.425 mm
		Medium	0.425 to 2.0 mm
		Coarse	2.0 to 4.75 mm
Gravel	4.75 to 75mm		
		Fine	4.75 to 19 mm
		Coarse	19 to 75 mm
Cobbles	75 to 300mm		
Boulders	>300mm		

TERMINOLOGY

Soil Composition	**% by Weight**
"traces"	<10%
"some"(eg. some silt)	10-20%
Adjective (eg. sandy)	20-35%
"and"(eg. sand and gravel)	35-50%

Standard Penetration Resistance (SPT): Standard Penetration Resistance ('N' Values) refers to the number of blows required to advance a standard (ASTM D1586) 51 mm Ø (2 inch) split-spoon sampler by the use of a free falling, 63.5 Kg (140lbs) hammer. The number of blows from the drop weight is recorded for every 15 cm (6 inches). The hammer is dropped from a distance of 0.76m (30 inches) providing 474.5 Joules per blow. When the sampler is driven a total of 45 cm (18 inches) into the soil, the standard penetration index ('N' Value) is the total number of blows for the last 30 cm (12 inches).

Dynamic Cone Penetration Resistance (DCPT): Dynamic Cone Penetration Resistance is similar to a SPT with the 474.5 Joule/blow impulse provided by the free falling hammer where the split-spoon sampler is replaced by a 51 mm Ø, 60˚ conical point and the number of blows is recorded continuously for every 30 cm (12 inches).

COHESIVE SOILS CONSISTENCY

	(kPa)	**(P.S.F.)**	**Nominal 'N' Value**
Very Soft	<12	<250	0-2
Soft	12-25	250-500	2-4
Firm	25-50	500-1000	4-8
Stiff	50-100	1000-2000	8-15
Very Stiff	100-200	2000-4000	15-30
Hard	>200	>4000	>30

RELATIVE DENSITY OF COHESIONLESS SOIL

	'N' Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

MOISTURE CONDITIONS:

Cohesive Soil
DTPL- Drier than plastic limit
APL- About plastic limit
WTPL- Wetter than plastic limit
MWTPL- Much wetter than plastic limit

Cohesionless Soil
Damp
Moist
Wet
Saturated

SAMPLE TYPES AND ADDITIONAL FIELD TESTS

SS	Split Spoon Sample (obtained from SPT)	**GS**	Grab Sample	**PP**	Pocket Penetrometer
		BS	Bulk Sample	**FV**	Field Vane
AS	Auger Sample	**TW**	Thin Wall Sample or Shelby Tube	**DMT**	Flat Plate Dilatometer

LABORATORY TESTS

SG	Specific Gravity	**S**	Sieve Analysis	**W**	Water Content
H	Hydrometer	**P**	Field Permeability	**K**	Lab Permeability
W_p	Plastic Limit	**W_l**	Liquid Limit	**I_p**	Plasticity Index
GSA	Grain Size Analysis	**C**	Consolidation	**UNC**	Unconfined compression

NTiL
NIAGARA TESTING & INSPECTION LTD.

MODIFIED* UNIFIED SOIL CLASSIFICATION SYSTEM

*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army. Vol. 1, March 1953) modified slightly so that an inorganic clay of "medium plasticity" is recognized.

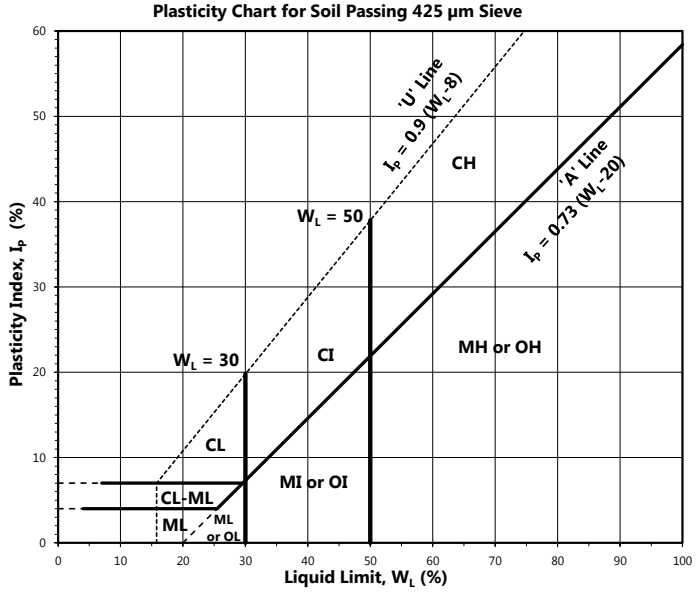
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SLTS & CLAYS BELOW "A" LINE	W_L < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", e.g. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGH ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SOIL COMPONENTS

FRACTION	U.S STANDARD SIEVE SIZE			DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	19 mm	35 - 50	AND
	FINE	19 mm	4.75 mm	20 - 35	Y/EY
SAND	COARSE	4.75 mm	2.00 mm	10 - 20	SOME
	MEDIUM	2.00 mm	425 µm	1 - 10	TRACE
	FINE	425 µm	75 µm		
FINES (SILT AND CLAY BASED ON PLASTICITY)		75 µm			

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED:	NOT ROUNDED:
COBBLES 75 mm to 300 mm	ROCK FRAGMENTS > 75 mm
BOULDERS > 300 mm	ROCKS > 0.76 CUBIC METRE IN VOLUME



Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

www.ntil.ca

NIAGARA TESTING AND INSPECTION LTD.

MODIFIED USCS

Note 1: Soils are classified and described according to their engineering properties and behaviour.
Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual (4th Edition, Canadian Geotechnical Society, 2006.)

Rev Date: May 23, 2024

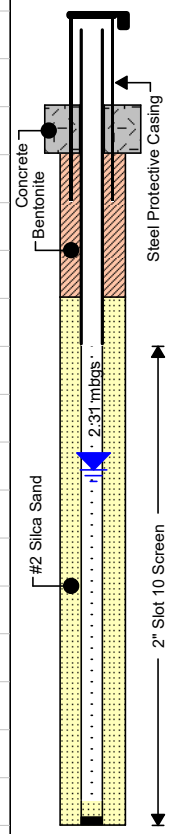
RECORD OF BOREHOLE: BH-1

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652324 E, 4788193 N

SHEET 1 of 1
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

SOIL PROFILE			SAMPLES					FIELD TESTING	LAB TESTING		
LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)	DEPTH SCALE ft / m	SPT (N) 20 40 60 80 / SHEAR STRENGTH (kPa) 50 100 150 200	MOISTURE CONTENT (%) 10 20 30 40	WELL INSTALLATION	COMMENTS and ADDITIONAL LAB TESTING
	87.66	Ground Surface									Top of Well Pipe - 0.69 m above ground surface
	0.00	**150 mm Topsoil** rootlets and organics									
		Clayey Silt Reworked brown some sand, trace gravel and rootlets stiff dtpl	SS	1	4,5,5,7			10	9.5		
			SS	2	7,7,5,8			12	13.2		
	86.14										
	1.52	**Clayey Silt** brown till-like trace sand and fine gravel very stiff dtpl	SS	3	7,9,12,14			21	>225 12.6		**Grain Size Distribution: BH-1 SS-3** Gravel: 0% Sand: 9.1% Silt: 71.8% Clay: 19.1%
			SS	4	6,8,11,15			19	>225 15.4		
	84.61										
	3.05	**Clayey Silt** grey till-like some fine to medium gravel trace sand and shale fragments very stiff to hard dtpl	SS	5	7,10,11,15			21	>225 12.8		
			SS	6	15,27,35, 50/50mm			62	>225 15.9		
	82.58										
	5.08	End of Borehole									



Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: Dry
SECONDARY WATER LEVEL: 2.31 mbgs
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: August 5, 2025

LOGGED: DN
COMPILED: DN
CHECKED: DN

Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

Note: This borehole log has been prepared for Geotechnical purposes and does not necessarily contain information suitable for an Environmentall assessment of the subsurface conditions. Borehole details as presented, do not constitute a through understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer.

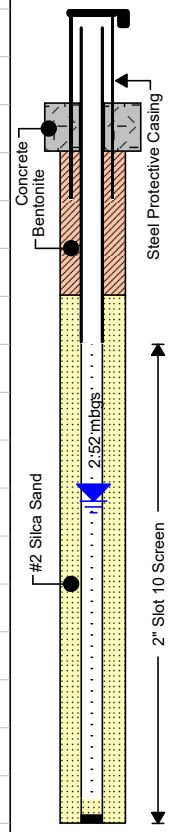
RECORD OF BOREHOLE: BH-2

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652372 E, 4788196 N

SHEET 1 of 1
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

SOIL PROFILE			SAMPLES					FIELD TESTING	LAB TESTING		
LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)	DEPTH SCALE ft / m	SPT (N) 20 40 60 80 / SHEAR STRENGTH (kPa) 50 100 150 200	MOISTURE CONTENT (%) 10 20 30 40	WELL INSTALLATION	COMMENTS and ADDITIONAL LAB TESTING
	88.17	Ground Surface									Top of Well Pipe - 0.75 m above ground surface
	0.00	**100 mm Topsoil** rootlets and organics									
		Clayey Silt Reworked brown some sand, trace gravel and rootlets firm to stiff dtpl	SS	1	2,3,5,6			8	7.3		
	87.41										
	0.76	**Clayey Silt** brown till-like some sand and trace fine gravel stiff to very stiff dtpl	SS	2	5,7,9,11			16	>225 14.1		
			SS	3	5,8,11,12			19	>225 14.3		
	85.58		SS	4	3,4,5,5			9	>225 15.3		
	2.59	**Clayey Silt** grey till-like some sand trace fine to medium gravel stiff to hard dtpl	SS	5	4,5,7,8			12	>225 12.1		**Grain Size Distribution: BH-2 SS-5** Gravel: 2.7% Sand: 21.1% Silt: 55.2% Clay: 21.0%
			SS	6	15,14,22,23			36	>225 16.1		
	82.99										
	5.18	End of Borehole									



Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: Dry
SECONDARY WATER LEVEL: 2.52 mbgs
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: August 5, 2025

LOGGED: DN
COMPILED: DN
CHECKED: DN

Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

RECORD OF BOREHOLE: BH-3

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652320 E, 4788171 N

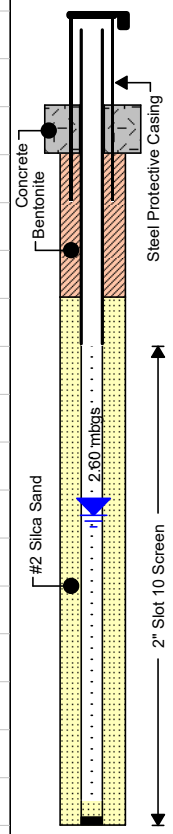
SHEET 1 of 1
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)
	87.53	Ground Surface				
	0.00	**100 mm Topsoil** rootlets and organics				
		Clayey Silt Reworked brown some sand, trace gravel and rootlets stiff dtpl	SS	1	5,6,5,5	
			SS	2	4,5,5,5	
	86.01					
	1.52	**Clayey Silt** brown till-like some sand and trace fine gravel very stiff dtpl	SS	3	5,7,10,11	
	85.09					
	2.44	**Clayey Silt** grey till-like some sand trace fine to medium gravel very stiff to hard dtpl	SS	4	4,11,12,12	
			SS	5	5,8,16,21	
			SS	6	6,23,33,28	
	82.35					
	5.18	End of Borehole				

DEPTH SCALE ft / m

FIELD TESTING: SPT (N) 20 40 60 80; SHEAR STRENGTH (kPa) 50 100 150 200

LAB TESTING: MOISTURE CONTENT (%) 10 20 30 40



Top of Well Pipe - 0.83 m above ground surface

Grain Size Distribution: BH-3 SS-6
Gravel: 4.4%
Sand: 14.6%
Silt: 66.4%
Clay: 14.6%

Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: Dry
SECONDARY WATER LEVEL: 2.60 mbgs
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: August 5, 2025

LOGGED: DN
COMPILED: DN
CHECKED: DN

Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

Note: This borehole log has been prepared for Geotechnical purposes and does not necessarily contain information suitable for an Environmentall assessment of the subsurface conditions. Borehole details as presented, do not constitute a through understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer.

RECORD OF BOREHOLE: BH-4

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652375 E, 4788176 N

SHEET 1 of 1
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

SOIL PROFILE			SAMPLES					FIELD TESTING	LAB TESTING		
LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)	DEPTH SCALE ft / m	SPT (N) 20 40 60 80 / SHEAR STRENGTH (kPa) 50 100 150 200	MOISTURE CONTENT (%) 10 20 30 40	WELL INSTALLATION	COMMENTS and ADDITIONAL LAB TESTING
	87.89	Ground Surface									Top of Well Pipe - 0.72 m above ground surface
	0.00	**125 mm Topsoil** rootlets and organics									
		Clayey Silt Reworked brown some sand, trace gravel and rootlets firm to stiff dtpl	SS	1	4,3,3,4			6	15.1		
			SS	2	3,3,5,9			8	15.3		
	86.21										
	1.68	**Clayey Silt** brown till-like some sand and trace fine gravel very stiff to hard dtpl	SS	3	13,19,19,22			38	>225 11.6		
			SS	4	8,11,14,13			25	>225 13.1		
	84.84										
	3.05	**Clayey Silt** grey till-like some sand trace fine to medium gravel very stiff dtpl	SS	5	3,5,8,9			13 100	11.0		
			SS	6	7,9,10,10			19	>225 12.0		
	82.71										
	5.18	End of Borehole									

ft m
0.0 0.0
1.0 1.0
2.0
3.0 1.0
4.0
5.0
6.0 2.0
7.0
8.0
9.0
10.0 3.0
11.0
12.0
13.0 4.0
14.0
15.0
16.0 5.0
17.0
18.0
19.0
20.0 6.0
21.0
22.0
23.0 7.0

WELL INSTALLATION: Concrete, Bentonite, Steel Protective Casing, #2 Silica Sand, 2" Slot 10 Screen, 4.35 mbgs

Grain Size Distribution: BH-4 SS-4
Gravel: 4.8%
Sand: 18.8%
Silt: 51.6%
Clay: 24.8%

Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: Dry
SECONDARY WATER LEVEL: 4.35 mbgs
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: August 5, 2025

LOGGED: DN
COMPILED: DN
CHECKED: DN

Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

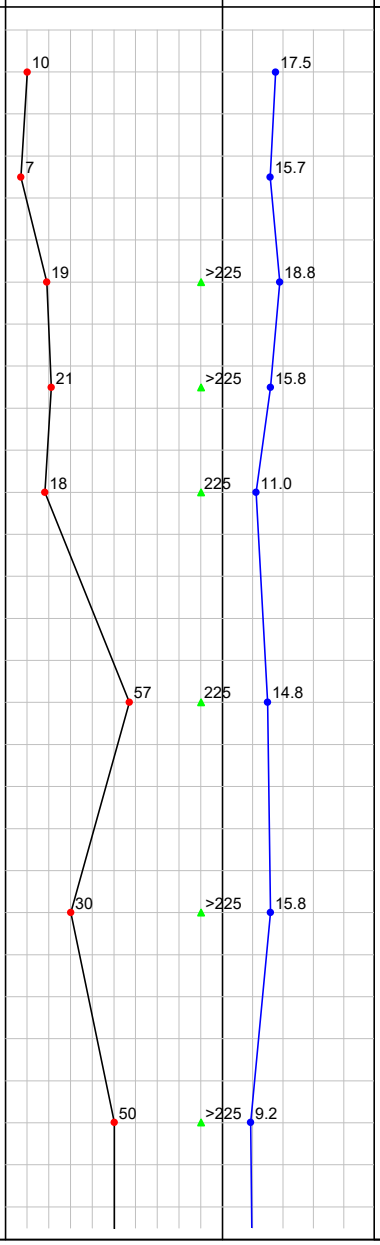
RECORD OF BOREHOLE: BH-5

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652340 E, 4788193 N

SHEET 1 of 2
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)
	87.89	Ground Surface				
	0.00 / 87.68	**200 mm Granular Material** Sand and Gravel excavation backfill from house demolition	SS	1	11,7,3,4	
	0.20	**Clayey Silt Reworked** brown some sand, trace gravel and rootlets firm dtpl	SS	2	3,3,4,5	
	86.37					
	1.52	**Clayey Silt** brown till-like some sand and trace fine gravel very stiff dtpl	SS	3	4,7,12,23	
			SS	4	7,10,11,13	
	84.84					
	3.05	**Clayey Silt** grey till-like some sand trace fine to medium gravel and shale fragments some wet sandy seams very stiff to hard dtpl	SS	5	7,11,7,9	
			SS	6	10,24,33,44	
			SS	7	11,13,17,35	
	81.18					
	6.71	occassional wet gravel layers	SS	8	13,22,28,30	



WELL INSTALLATION

COMMENTS and ADDITIONAL LAB TESTING

Borehole within vicinity of former site building, recently removed and backfilled.

Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: 7.62 mbgs
SECONDARY WATER LEVEL: NA
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: NA

LOGGED: DN
COMPILED: DN
CHECKED: DN

Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

Note: This borehole log has been prepared for Geotechnical purposes and does not necessarily contain information suitable for an Environmentall assessment of the subsurface conditions. Borehole details as presented, do not constitute a through understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer.

RECORD OF BOREHOLE: BH-5

PROJECT NO.: NT25108
PROJECT: Proposed Residential Development
LOCATION: 1839 Four Mile Creek Road, NOTL, ON
CLIENT: Harvest Heights

DRILLING COMPANY: Elite Drilling Services
DRILLING METHOD: 150 mm Solid Stem Augers
DRILL RIG: D-50 Track Mount
BOREHOLE COORDINATE (UTM): 652340 E, 4788193 N

SHEET 2 of 2
DATE STARTED: July 21, 2025
DATE COMPLETED: July 21, 2025
DATUM: Geodetic Benchmark

SOIL PROFILE			SAMPLES				DEPTH SCALE ft / m	FIELD TESTING	LAB TESTING	WELL INSTALLATION	COMMENTS and ADDITIONAL LAB TESTING
LITHOLOGY PLOT	ELEVATION (m / mbgs)	DESCRIPTION	TYPE	NUMBER	SPT 'N' VALUE	RECOVERY (%)		SPT (N) 20 40 60 80; SHEAR STRENGTH (kPa) 50 100 150 200	MOISTURE CONTENT (%) 10 20 30 40		
	76.15						29.0 / 9.0				
			SS	9	48, 50/125mm		30.0 / 31.0 / 32.0 / 10.0	>50 >225 10.0			
			SS	10	14,37, 50/150mm		33.0 / 34.0 / 35.0 / 36.0 / 11.0	>50 >225 12.7			
	11.73	**Clayey Silt** possible weathered shale some sand, gravel, and shale fragments hard dtpl					37.0 / 38.0 / 39.0 / 12.0				
	75.26		SS	11	18,23, 50/125mm		40.0 / 41.0 / 42.0 / 13.0	>50 >225 12.6			
	12.62	End of Borehole					43.0 / 44.0 / 45.0 / 46.0 / 14.0 / 47.0 / 48.0 / 49.0 / 15.0 / 50.0 / 51.0 / 52.0 / 16.0 / 53.0 / 54.0 / 55.0 / 56.0 / 17.0 / 57.0				

Groundwater Level Upon Completion:
Secondary Groundwater Level:

INITIAL WATER LEVEL: 7.62 mbgs
SECONDARY WATER LEVEL: NA
BOREHOLE CAVE UPON COMPLETION: Open

INITIAL WATER LEVEL DATE: July 21, 2025
SECONDARY WATER LEVEL DATE: NA

NTiL
NIAGARA TESTING AND INSPECTION LTD.

LOGGED: DN
COMPILED: DN
CHECKED: DN

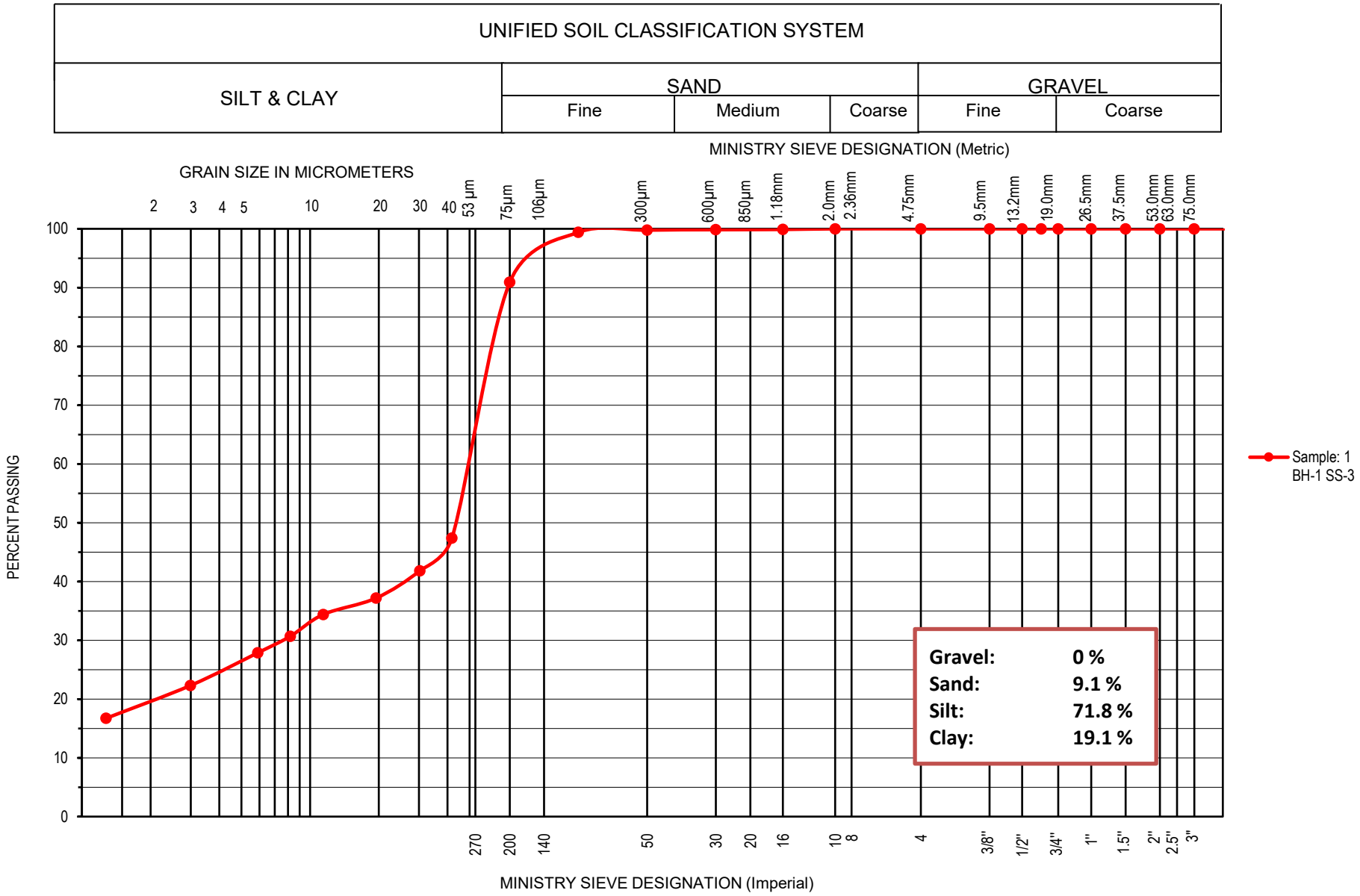
Niagara Testing and Inspection Ltd.
3300 Merrittville Highway, Unit 5
Thorold, Ontario, L2V 4Y6

Note: This borehole log has been prepared for Geotechnical purposes and does not necessarily contain information suitable for an Environmentall assessment of the subsurface conditions. Borehole details as presented, do not constitute a through understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer.

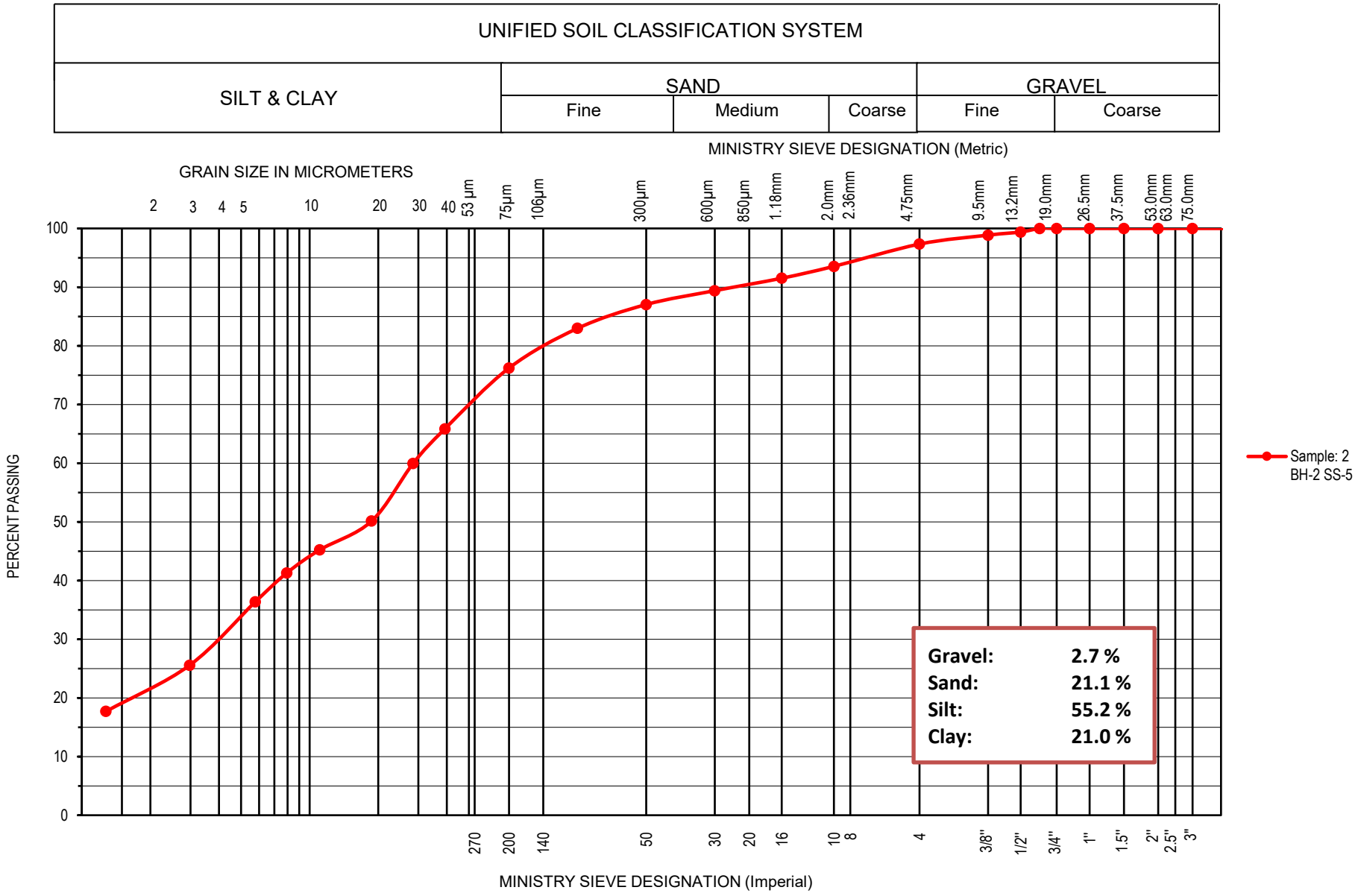
Appendix B

Laboratory Test Results

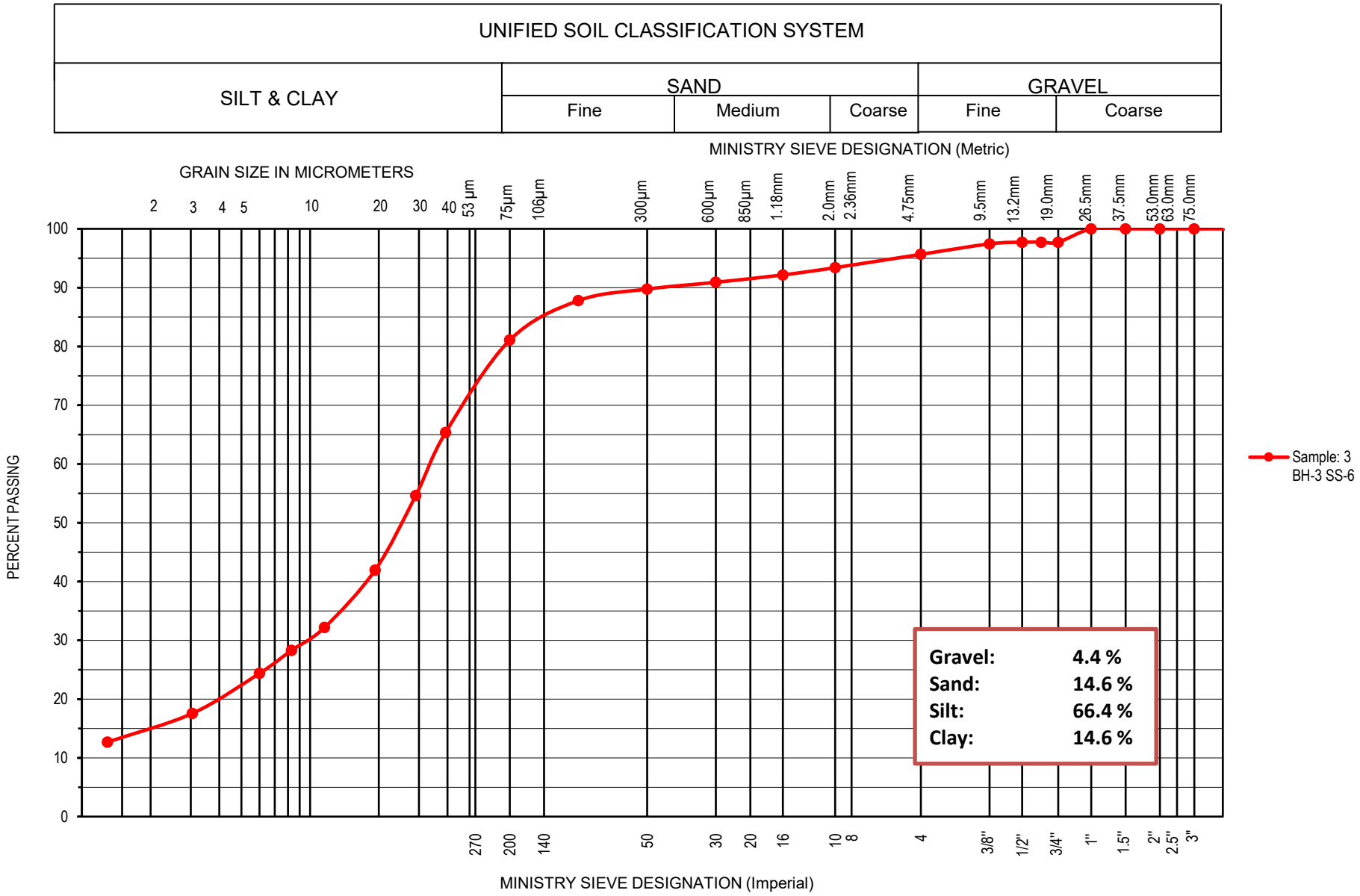
NTiL
NIAGARA TESTING AND INSPECTION LTD.



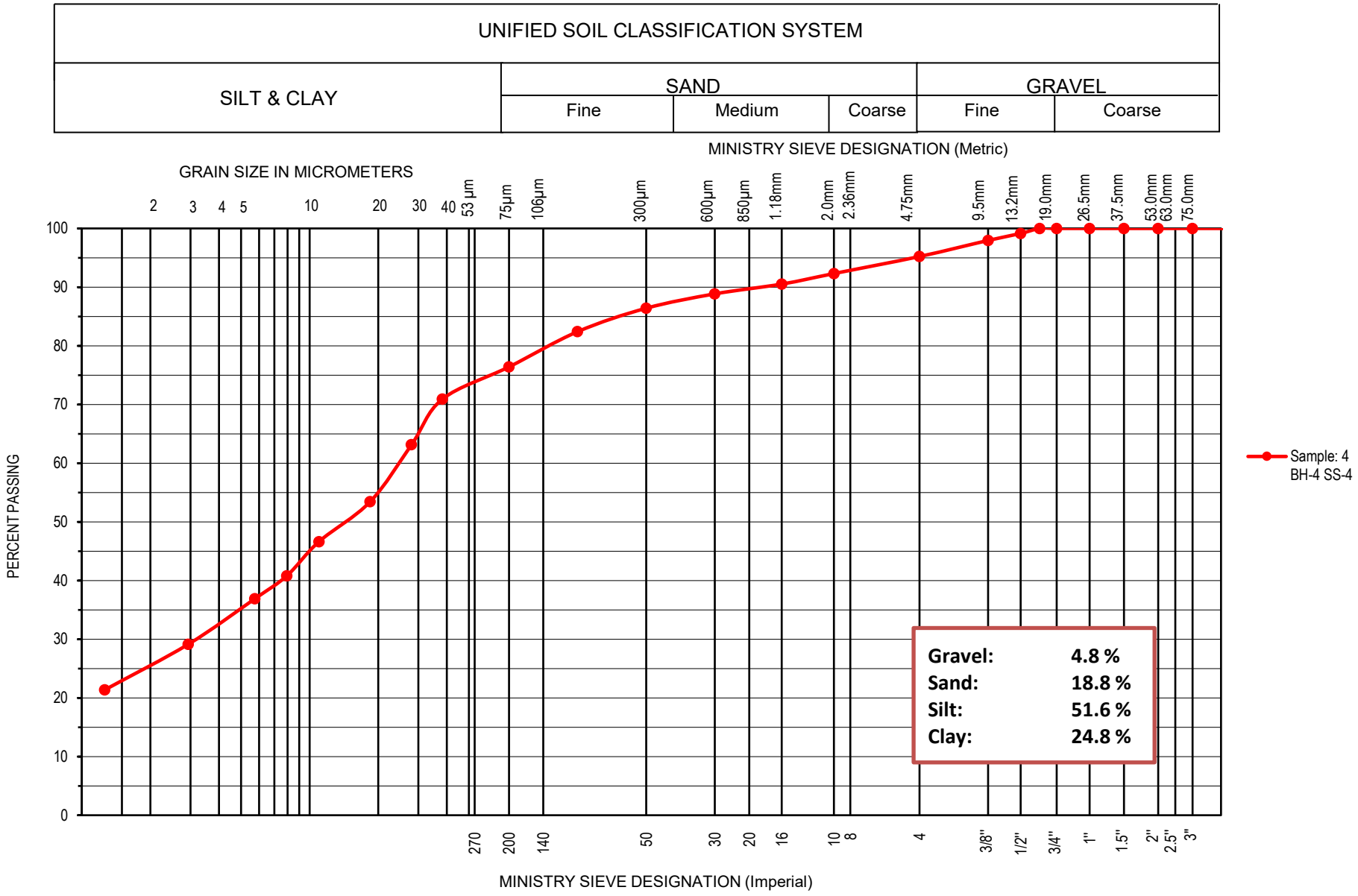
CLIENT **Harvest Heights**	PREPARED BY KC	PROJECT Sieve / Hydrometer Analysis 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario	DATE August 7, 2025
			PROJECT NO NT25108
Niagara Testing and Inspection Ltd. 3300 Merrittville Highway, Unit #5 Thorold, Ontario	CHECKED BY DN	TITLE Grain Size Distribution	FIGURE NO 1



CLIENT **Harvest Heights**	PREPARED BY KC	PROJECT Sieve / Hydrometer Analysis 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario	DATE August 7, 2025
			PROJECT NO NT25108
Niagara Testing and Inspection Ltd. 3300 Merrittville Highway, Unit #5 Thorold, Ontario	CHECKED BY DN	TITLE Grain Size Distribution	FIGURE NO 2



CLIENT **Harvest Heights**	PREPARED BY KC	PROJECT Sieve / Hydrometer Analysis 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario	DATE August 7, 2025
			PROJECT NO NT25108
Niagara Testing and Inspection Ltd. 3300 Merrittville Highway, Unit #5 Thorold, Ontario	CHECKED BY DN	TITLE Grain Size Distribution	FIGURE NO 3



CLIENT **Harvest Heights**	PREPARED BY KC	PROJECT Sieve / Hydrometer Analysis 1839 Four Mile Creek Road, Niagara-On-The-Lake, Ontario	DATE August 7, 2025
			PROJECT NO NT25108
Niagara Testing and Inspection Ltd. 3300 Merrittville Highway, Unit #5 Thorold, Ontario	CHECKED BY DN	TITLE Grain Size Distribution	FIGURE NO 4

Appendix C

Geotechnical Report Limitations

NTiL
NIAGARA TESTING AND INSPECTION LTD.

Limitations to Geotechnical Reports

The work performed in the preparation of this report and the conclusions presented herein are subject to the following:

a) The contract between Niagara Testing and Inspection Ltd. [NTIL] and the Client, including any subsequent written amendment or Change Order duly signed by the parties (hereinafter together referred as the "Contract").

b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by NTIL to the Client in connection to the Contract; and

c) The limitations stated herein.

1. **Standard of care:** NTIL has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of NTIL's profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.
2. **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by NTIL and to the topics specifically discussed in it, and is not applicable to any other aspects, areas, or locations.
3. **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: i) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions and qualifications/limitations set forth in this report.
4. **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter "Supplied Data"). NTIL cannot be held responsible for any loss or damage, of either a contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on Supplied Data.
5. **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by NTIL.
6. **No legal representations:** NTIL makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on 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 and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
7. **Decrease in property value:** NTIL shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
8. **No third-party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. NTIL does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this document, for use or consideration by any third party. NTIL accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report, or anything set out therein. including without limitation, any indirect, special, incidental, punitive, or consequential loss, liability, or damage of any kind.

9. **Assumptions**: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to NTIL changes made in the project, including but not limited to, details in the design, conditions, engineering, or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. NTIL shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.

10. **Time dependence**: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by NTIL to be contemplated by the Client at the commencement of NTIL's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by NTIL, and the conclusions of the report are amended or are validated in writing accordingly.

    Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes, or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.

    NTIL will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

11. **Limitations of visual inspections:** Where conclusions and recommendations are given based on a visual inspection conducted by NTIL, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in NTIL's opinion, for direct observation.

12. **Limitations of site investigations**: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

    Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.

    Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving, or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation, and snowmelt.

    During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended practice that NTIL be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained and to deal quickly with geotechnical considerations if they arise.

Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by NTIL is not provided during construction.

13. **Factors that may affect construction methods, costs, and scheduling**: The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc.

    Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.

14. **Groundwater and Dewatering**: NTIL will accept no responsibility for the effects of drainage and/or dewatering measures if NTIL has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.

15. **Environmental and Hazardous Materials Aspects**: Unless otherwise stated, the information contained in this report in no way reflects the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wildlife conditions, rare plants, or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention, or assessment of conditions that can contribute to moisture, mould, or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes.

16. **Sample Disposal**: NTIL will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with NTIL or a third party.

Niagara Testing and Inspection Ltd.
[NTIL]