REPORT ON
GEOTECHNICAL INVESTIGATION
2350 WOODGLADE BOULEVARD
PETERBOROUGH, ONTARIO

REPORT NO.: 5549W-21-GA
REPORT DATE: MAY 3, 2021 (REVISION 1)

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1.0 INTRODUCTION

Toronto Inspection Ltd. was retained by Henry Kortekaas & Associates Inc. to conduct a geotechnical investigation at a property located at 2350 Woodglade Boulevard in Peterborough, Ontario (hereinafter described as "the Site"). The retaining wall at the Site is proposed to be replaced.

The purpose of the investigation was to determine the subsoil and groundwater conditions affecting the design and construction of the new retaining wall. In particular, geotechnical data was to be provided for:

- General founding conditions
- Foundation design bearing pressures
- Construction recommendations
- Excavation recommendations
- Pavement recommendations

This report is provided on the basis of the above terms of reference and on an assumption that the design of the new retaining wall will be in accordance with the applicable building codes and standards. If there are any changes in the design features relevant to the geotechnical analysis, our office should be consulted to review the design and to confirm the recommendations and comments provided in the report.

2.0 SITE CONDITION

The Site is a 1.7± hectare property located on the east side of Woodglade Boulevard, approximately 100m north of Sherbrooke Street in Peterborough, Ontario.

At the time of the investigation, the Site is occupied by Ecole Catholique Secondaire, with a a one storey part two storey school building and paved driveways, parking areas and play areas on the north, west, south and part of the east side of the property. A segmental block retaining wall exists along the east and south sides of the property. The site gradient was generally flat, and was slightly to moderately sloping below the retaining wall on the east side.

The adjacent properties include treed vacant land to the north and east, sodded playing fields to the northeast and south, and residential dwelling across the road to the west.

3.0 INVESTIGATION PROCEDURE

The field work for the investigation was carried out on March 8, 9 and 16, 2021, and consisted of drilling ten sampled boreholes (21BH-1 to 21BH-10), extending to depths of between 3.5m and 8.1m from grade.

Boreholes 21BH-1, 21BH-2, 21BH-3, 21BH-8, 21BH-9 and 21BH-10 were drilled on the pavement above the retaining wall, and were advanced using a track mounted drill rig, equipped with continuous flight solid stem augers and sampling rods, supplied and operated by a specialist drilling contractor. Soil samples were retrieved from the boreholes at 0.76m intervals for the top 3.5m, and a 1.5m interval thereafter, using a split spoon sampler in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs).

Boreholes 21BH-4, 21BH-5, 21BH-6 and 21BH-7 were drilled near the toe of the retaining wall, and were advanced using a portable automatic hammer, equipped with continuous flight solid stem augers and sampling rods, supplied and operated by a specialist drilling contractor. Soil samples were retrieved from the boreholes at 0.76m intervals using a split spoon sampler also in conjunction with Standard Penetration Tests

The soil samples were identified and logged in the field and were carefully bagged for later visual identification and laboratory testing, including moisture content determination and grain size analysis.

Groundwater observations were made in the boreholes during and upon the completion of drilling. The groundwater observations are presented in the borehole logs.

The borehole locations, established in the field by our site personnel, are shown on the appended Borehole Location Plan, Drawing No. 1.

The ground elevation at the borehole locations was interpolated from the spot elevations shown on the "Topographic Survey of EEC Monseigneur-Jamot-Monavenir, #2350 Woodglade Boulevard, Block 32 Plan 45M-146 Peterborough, Ontario", prepared by Retz & Associates Inc., based on site survey completed on April 26, 2021, provided to our office by the Client.

4.0 SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Borehole Location Plan (Drawing No. 1) and Log of Boreholes (Drawing Nos. 2 to 11) for details of field work, including soil classification, inferred stratigraphy, and groundwater observations.

The subsoil, below the pavement and surficial topsoil at the borehole locations, consisted of granular fill, sandy silt fill, sand and sandy silt till deposits.

Brief descriptions of the subsurface materials, encountered at the borehole locations, are as follows:

4.1 Surface Course

A pavement was contacted at the ground surface at the location of boreholes 21BH-1, 21BH-2, 21BH-3, 21BH-9 and 21BH-10. The top of the boreholes were augered due to frozen ground, and the thickness of the asphalt could not be determined from the auger cuttings. Topsoil, 50mm to 3000mm in thickness, was contacted at the ground surface at the locations of boreholes 21BH-4, 21BH-5, 21BH-6, 21BH-7 and 21BH-8.

4.2 Granular Fill

Underlying the pavement and topsoil, a layer of granular fill was encountered at the locations of of boreholes 21BH-1, 21BH-2, 21BH-3, 21BH-8, 21BH-9 and 21BH-10. This fill consisted of brown gravelly sand. Geogrid reinforcement was encountered within the granular fill at the approximate depths shown in the borehole logs. The granular fill extended to depths of between 2.1m and 4.0m from grade at the borehole locations.

Based on the Standard Penetration N-values of 4 to 65 blows for a penetration of 300mm, the relative density of the granular fill loose to dense. The higher N-values at the top 1m of the granular fill was likely due to frozen soil.

The in-situ moisture content of the soil samples retrieved from the granular fill ranged from 3 % to 23%, indicating moist to wet conditions.

Grain size analyses were conducted on samples of the granular fill, retrieved from borehole 21BH-1 sample SS3 at a depth of 1.5m, borehole 21BH-2 sample SS3 at a

depth of 1.5m, borehole 21BH-3 sample SS4 at a depth of 2.3m, and borehole 21BH-10 sample SS2 at a depth of 0.8m, using mechanical sieves. The grain size distribution are shown on the appended Figure Nos. 1a to 1d, and reference to this indicates that, except for some excess fines, the granular fill samples tested meet the grading for OPSS Form 1010 granular specification of Granular 'B Type I'.

4.3 Silty Sand Fill

Underlying the topsoil at the locations of boreholes 21BH-4, 21BH-5, 21BH-6, 21BH-7 and 21BH-8, and underlying the granular fill at depths of 2.1m to 4.0m at the locations of boreholes 21BH-1, 21BH-2, 21BH-3, 21BH-9 and 21BH-10, a layer of silty sand fill was encountered . This fill contained some gravel and traces of topsoil in places, and extended to depth of between 1.0m and 5.5m from grade at the borehole locations.

Based on the Standard Penetration N-values of 9 to 46 blows for a penetration of 300mm, the relative density of the silty sand was loose to dense.

The in-situ moisture content of the soil samples retrieved from the silty sand fill ranged from 7% to 19%, indicating moist to wet conditions.

4.4 Sand

A deposit of sand was contacted below the silty sand fill at depths of between 1.0m and 5.5m from grade at the locations of boreholes 21BH-1, 21BH-2, 21BH-4, 21BH-6, 21BH-7, 21BH-9 and 21BH-10. This deposit consisted of fine grained sand with trace silt, or fine to medium grained sand with trace to some silt and gravel. Boreholes 21BH-1, 21BH-2, 21BH-4, 21BH-6, 21BH-6, 21BH-7, 21BH-9 and 21BH-10 were terminated in the sand deposit at depths of 3.5m to 8.1m from grade.

Based on the Standard Penetration N-values of 5 to 73 blows for a penetration of 300mm, the relative density of the sand deposit was loose to very dense.

The in-situ moisture content of the soil samples retrieved from the sand deposit ranged from 3% to 11%, indicating moist to very moist conditions.

A grain size analysis was conducted on a sample of the sand deposit, retrieved from borehole 21BH-4 sample SS3 at a depth of 1.5m, using both mechanical sieves and

hydrometer. The grain size distribution is shown on the appended Figure No. 2.

4.5 Silty Sand Till

A deposit of silty sand till was contacted below the silty sand fill at depths of 3.2m to 5.5m from grade at the locations of boreholes 21BH-3, 21BH-5 and 21BH-8. This deposit consisted of a brown, heterogeneous mixture of sand, silt, some gravel, trace clay. Boreholes 21BH-3, 21BH-5 and 21BH-8 were terminated in the silty sand till deposit at depths of 3.8m to 6.6m from grade.

Based on the Standard Penetration N-values of 30 to 73 blows for a penetration of 300mm, the relative density of the silty sand till was dense to very dense.

The in-situ moisture content of the soil samples retrieved from the silty sand till deposit ranged from 6% to 16%, indicating moist to very conditions.

4.6 Groundwater

No free water surface was encountered in any of the boreholes. On completion of drilling, boreholes 21BH-8 and 21BH-9 caved in near the bottom of the boreholes at depths of 3.7m and 5.8m from grade. The remaining boreholes were dry and open to the full depth on completion of drilling.

Based on the findings during the investigation, and the moisture content profiles of the soil samples, it is our opinion that there is no continuous or discontinuous groundwater table within the depths investigated at the borehole locations. Perched water conditions may occur within the silty sand fill and on top of the silty sand till deposit.

5.0 RECOMMENDATIONS

Drawing No. 6 " Typical Section Gravity Wall", Drawing No. 7 "Typical Section Reinforced Wall", and Drawing No. 8 "Typical Sections and Components", prepared by Chung & Vander Doelen Engineering Ltd. dated July 21, 2016 shows that the retaining wall design consisted of Stoneterra precast blocks with geogrid reinforced granular backfill for the reinforced wall and unreinforced granular backfill for the gravity wall. It is unkown if the as built retaining wall system was constructed according to the design. There is a chain link fence with a steel frame at the top of the wall, then a curb, then a driveway. There is a storm water system and associated catch basin and manholes under the driveway. A hydro vault exists on a platform above the retaining wall in the middle of the site.

It is understood that the existing retaining wall will be removed and replaced with a new wall, and that the fence, pavement, curbs and storm water system will be reinstated. At the time of this report, it is unknown what the design of the replacement retaining wall will be, and if the hydro vault will be reinstated at the same location.

Based on the subsoils encountered at the borehole locations, our comments and recommendations for the design and construction of the development are as follows:

5.1 Site Preparation

The existing fence, curbs, pavement, and the retaining wall, including all segmental blocks, granular backfill, geogrid reinforcement, and any granular base and weeping tiles should be removed to a firm ground from within the footprint of the new retaining wall system. It is likely that the hydro vault will be in the way of the new wall installation and, therefore, the vault, its foundation and all wirings and appurtenances should also be removed. The storm sewers and other buried services which will be in the way of the construction should also be removed. The contractor must also allow for the removal of any deleterious fill and materials with high moisture and/or organic content, if encountered during the construction, as directed by a geotechnical engineer / technician from ***Toronto Inspection Ltd .***

Most of the excavated granular backfill will likely be suitable for reuse as the reinforced backfill for the replacement wall, depending on the design specifications. Care should, therefore, be taken during excavation to ensure that the granular backfill is not mixed with unsuitable material and that all of the geogrid and other foreign materials are removed. A suitable area should be set aside to stockpile the granular fill to be re-used.

The exposed subgrade should be inspected and proof-rolled under the supervision of a geotechnical engineer / technician from ***Toronto Inspection Ltd.*** The subgrade to be inspected should extend at least 1m from the front facing of the new wall and at least 0.3m from the back end of the lowermost geogrid. Any soft or wet areas identified within this area should be sub-excavated and replaced with engineered fill. The material proposed for engineered fill should be pre-approved by a geotechnical engineer / technician from ***Toronto Inspection Ltd***. If the fill material is wet, it should be allowed to dry to within 2% of its optimum moisture value prior to placement. The backfill should be placed in loose lifts not exceeding 200mm and compacted, using heavy compaction equipment, to at least 100% of its Standard Proctor maximum dry density (SPMDD). The Guidelines for Engineered Fill, shown in Appendix A, provides some of the conditions that must be satisfied for fill to be classified as engineered fill.

Any excavated topsoil and deleterious fill materials, will have to be disposed off-site or reused in landscaped areas, subject to approval by the landscape architect.

5.2 Retaining Wall Foundation

The borehole findings indicate the existing wall was founded on the silty sand fill. It is anticipated that the replacement wall will be founded also on the existing silty sand fill. Based on the findings at the locations of boreholes 21BH-1, 21BH-2, 21BH-3, 21BH-4 and 21BH-9, the silty sand fill is generally compact. However, the findings at the locations of boreholes 21BH-5, 24BH-6, 21BH-7, 21BH-8 and 21BH-10 indicate that portions of the silty sand fill are loose to marginally compact. The loose and marginally compact fill under the retaining wall system should be re-engineered, or removed and replaced with engineered fill, as discussed in the site preparation works in Section 5.1.

Following the site preparation works, the foundation subgrade of the new retaining wall will be composed of the existing compact or re-engineered silty sand fill or new engineered fill, and retaining wall system can be designed using the following bearing pressures:

- 150 kPa at Serviceability Limit State (SLS)
- 225 kPa at Factored Ultimate Limit State (ULS)

If a higher bearing pressure is required, then the retaining wall may have to be founded on the compact to dense native sand or silty sand till.

It is noted that if a concrete wall is to be adopted, then it will have to be founded at a depth of at least 1.2m from finished grade for frost protection.

It should be noted that the above recommendations for the foundations have been analyzed by ***Toronto Inspection Ltd.*** from the information obtained at the borehole locations. The bearing material, the interpretation between the boreholes and the recommendations of this report must be checked through field inspection provided by ***Toronto Inspection Ltd***. to validate the information for use during construction.

5.3 Earthquake Consideration

Based on the 2015 National Building Code of Canada (NBC) "seismic hazard calculator" the peak ground acceleration (PGA) for the Site with a probability of 2% in 50 years is 0.08g. The 2% in 50 years probability corresponds to a return period of approximately 2,500 years, and is consistent with the seismic probability used for building design in the current version of the Ontario Building Code.

It is noted that in Drawing No. 9 "Drawing Notes" of the existing retaining wall design drawings, the seismic design PGA was 0.062g. It appears that this value was based on the 2010 version of the NBC.

5.4 Retaining Wall Design

The new retaining wall should be designed by the retaining wall supplier or contractor. The retaining wall system should be designed against toppling, sliding, overturning, shear failure and bearing capacity failure with industry accepted factors of safety. ***Toronto Inspection Ltd.*** can assist in the global stability analysis, if required.

The lateral earth pressure on the retaining wall may be computed using the following equation:

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

where
- P = Lateral earth pressure — kPa
- K = Lateral earth pressure coefficient
- γ = Bulk unit weight of the soil — kN/m^3
- H = Depth of the wall below the finish grade — m
- q = Surcharge loads adjacent to the basement wall — kPa

The equation assumes that a permanent free draining system will be provided to prevent the buildup of hydrostatic pressure behind the wall.

5.5 Excavation and Site Services

All excavations should comply with the Ontario Occupational Health and Safety Act. The granular fill, silty sand fill, and sand can be classified as Type 3 soil and the silty sand till can be classified as Type 2 soil. Any excavation in the granular fill, the silty sand fill, and the sand should be sloped back to a safe angle of 45° or flatter. Excavations of more than 1.2m in height in the silty sand till should be sloped back to a safe angle of 45°.

The pipe bedding for underground services, including any catch basins and manholes, should consist of OPSS Granular A, 20mm crusher run limestone, or equivalent, compacted to 98% SPMDD.

5.6 Pavement Construction

Following the site preparation recommended in Section 5.1 and the construction of the new retaining wall system, the subgrade of the paved areas will likely consist of granular fill or compact silty sand fill. The following minimum pavement designs are recommended:

Pavement Structure		Light Duty Pavement	Heavy Duty Pavement
Asphaltic Concrete:	**OPSS HL3 or equivalent**	**65mm**	**45mm**
	OPSS HL8 or equivalent	**-**	**60mm**
Base:	**OPSS Granular A or 20mm crusher-run**	**150mm**	**150mm**
Sub-base:	**OPSS Granular B or 50mm crusher-run**	**200mm**	**300mm**

The granular base and sub-base should be compacted to a minimum of 100% SPMDD. The asphaltic concrete should be compacted to at least 96% Marshall density.

For concrete walkways, the design for a light duty pavement may be used, with the HL3 being replaced by 200mm thick concrete with wire reinforcement.

6.0 GENERAL STATEMENT OF LIMITATION

The comments and recommendations presented in this report are based on the subsoil and ground water conditions encountered at the borehole locations indicated in the borehole location plan, and are intended for the guidance of the design engineer. Although we consider this report to be representative of the subsurface conditions at the subject property, the soil and the ground water conditions between and beyond the borehole locations may differ from those encountered at the time of our investigation and may become apparent during construction. Any contractor bidding on, or undertaking the works, should decide on their own investigation and interpretations of the groundwater and the soil conditions between the borehole locations.

Any use and / or the interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third parties. The responsibility of ***Toronto Inspection Ltd.*** is limited to the accurate interpretation of the soil and ground water conditions prevailing in the locations investigated and accepts no responsibility for the loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

Any legal actions arising directly or indirectly from this work and/or ***Toronto Inspection Ltd.'s*** performance of the services shall be filed no longer than two years from the date of ***Toronto Inspection Ltd.'s*** substantial completion of the services. ***Toronto Inspection Ltd.*** shall not be responsible to the client for lost revenues, loss of profits, cost of content, claims of customers, or other special indirect, consequential or punitive damages.

To the fullest extent permitted by law, the client's maximum aggregate recovery against ***Toronto Inspection Ltd.***, its directors, employees, sub-contractors and representatives, for any and all claims by clients for all causes including, but not limited to, claims of breach of contract, breach of warranty and /or negligence, shall be the amount of the fee paid to ***Toronto Inspection Ltd.*** for its professional services rendered under the agreement with respect to the particular site which is the subject of the claim by the client.

Yours very truly,
TORONTO INSPECTION LTD.

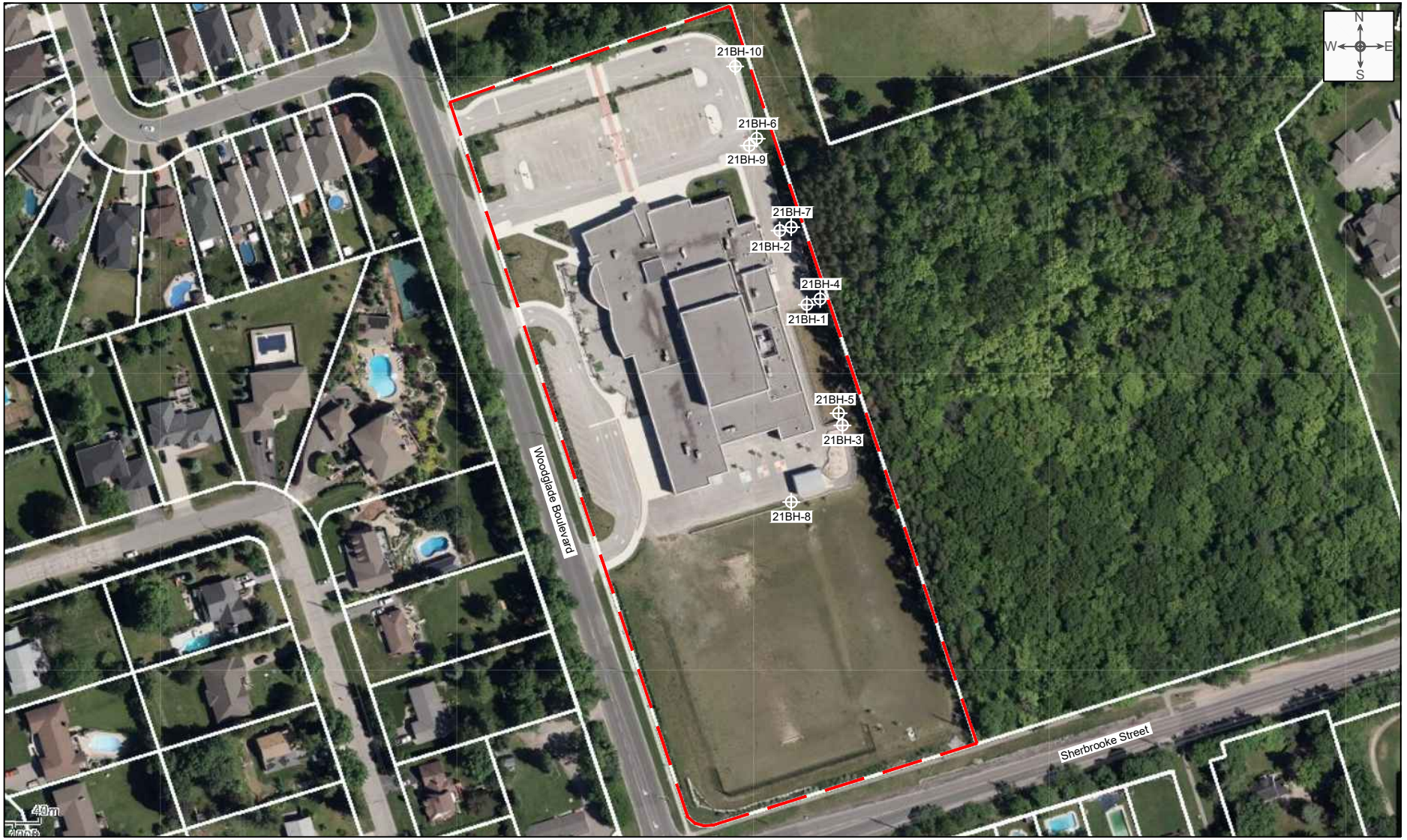
LICENSED PROFESSIONAL ENGINEER
R. T. QUIAMBAO
100080555
May 3, 2021
PROVINCE OF ONTARIO

Rene Quiambao, P.Eng.
Senior Engineer

Toronto Inspection Ltd.

Drawings

Borehole Location Plan
Borehole Logs



LEGEND:

Borehole Location

Site Boundary

Source: City of Peterborough Interactive Map

NOT TO SCALE

TorontoInspection LTD
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TITLE:	Borehole Location Plan		
LOCATION:	2350 Woodglade Boulevard, Peterborough, Ontario		
PROJECT NO. 5549W-21-GA	DATE : March 2021	DRAWING NO: 1	

Project No. 5549W-21-GA

Log of Borehole 21BH-1

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

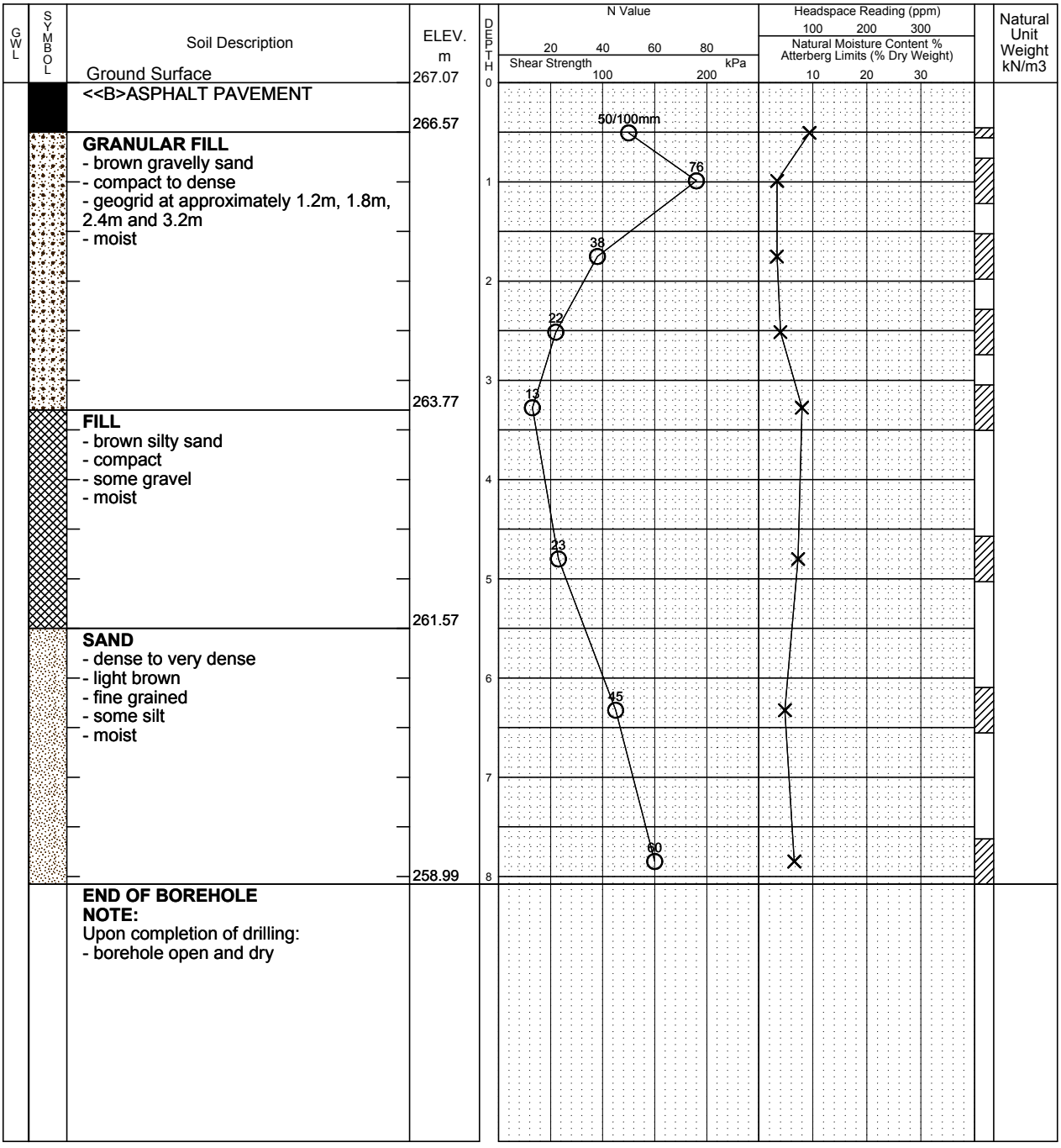
Date Drilled: 3/8/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



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NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

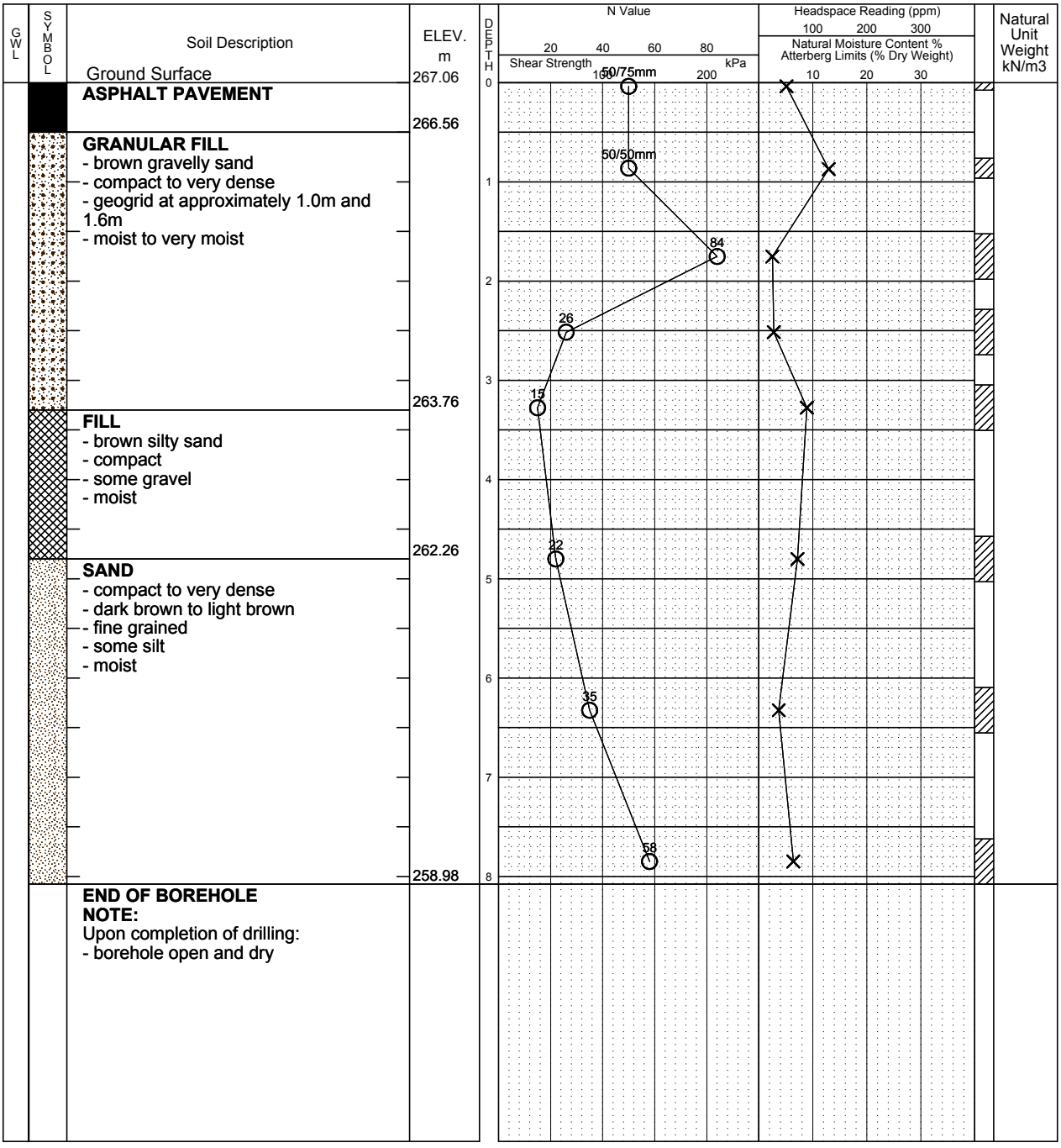
Date Drilled: 3/8/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



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NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-3

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/8/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	267.17	0
		ASPHALT PAVEMENT	266.67	
		GRANULAR FILL - brown gravelly sand - loose to very dense - geogrid at approximately 1.8m and 3.2m - moist		1
				2
				3
			263.17	4
		FILL - brown silty sand - compact - some gravel, trace topsoil - very moist to wet		5
			261.67	
		SILTY SAND TILL - very dense - brown - some gravel, trace clay - moist		6
			260.62	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
50/75mm
50/150mm
65
8
4
27
65

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

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NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/9/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	263.10	0
		TOPSOIL - 75mm topsoil thickness	263.03	
		FILL - brown silty sand - dense - some gravel, trace topsoil - moist to very moist	262.10	1
		SAND - compact to dense - light brown - fine grained - some silt - moist		2
				3
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry	259.60	

N Value: 34, 46, 28, 43, 41

Shear Strength: 20 40 60 80 kPa; 100 200

Headspace Reading (ppm): 100 200 300

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/9/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	265.30	0
		TOPSOIL - 150mm topsoil thickness	265.15	
		FILL - brown silty sand - loose to compact - some gravel, trace topsoil - moist to wet		1
				2
			262.10	3
		SILTY SAND TILL - dense to very dense - brown - topsoil with organics at the top - some gravel, trace clay - moist to very moist		4
			260.27	5
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3

N Value: 9, 15, 12, 25, 48, 73

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-6

Dwg No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/9/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (kPa)	Headspace Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Natural Unit Weight kN/m3
		Ground Surface	264.30	0			
		TOPSOIL - 50mm topsoil thickness	264.25				
		FILL - brown silty sand - loose to compact - some gravel - topsoil at the bottom - moist to wet	262.90	1	10 9		
		SAND - loose - brown to light brown - fine to medium grained - some silt - trace to some gravel - moist		2	9 7		
				3	6		
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry	260.79				

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-7

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/9/21

Drill Type: Geoprobe

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	263.50	0
		TOPSOIL - 50mm topsoil thickness	263.45	
		FILL - brown silty sand - compact - some gravel - moist		1
			261.80	
		SAND - loose to compact - brown to light brown - fine grained - some silt, rootlets at 2.5m - moist		2
				3
			259.99	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3

N Value: 10, 17, 11, 5, 26

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-8

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/16/21

Drill Type: Ram Sounder

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	266.89	0
		TOPSOIL - 300mm topsoil thickness	266.59	
		GRANULAR FILL - brown gravelly sand - loose to very dense - geogrid at approximately 0.75m - moist to wet		1
			264.79	2
		FILL - brown silty sand - compact - some gravel - some topsoil and organics at the top - moist	263.69	3
		SILTY SAND TILL - dense, brown - some gravel, trace clay - very moist	263.08	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - cave-in at 3.7m		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

N Value: 27, 7, 11, 13, 30

Natural Unit Weight kN/m3

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-9

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

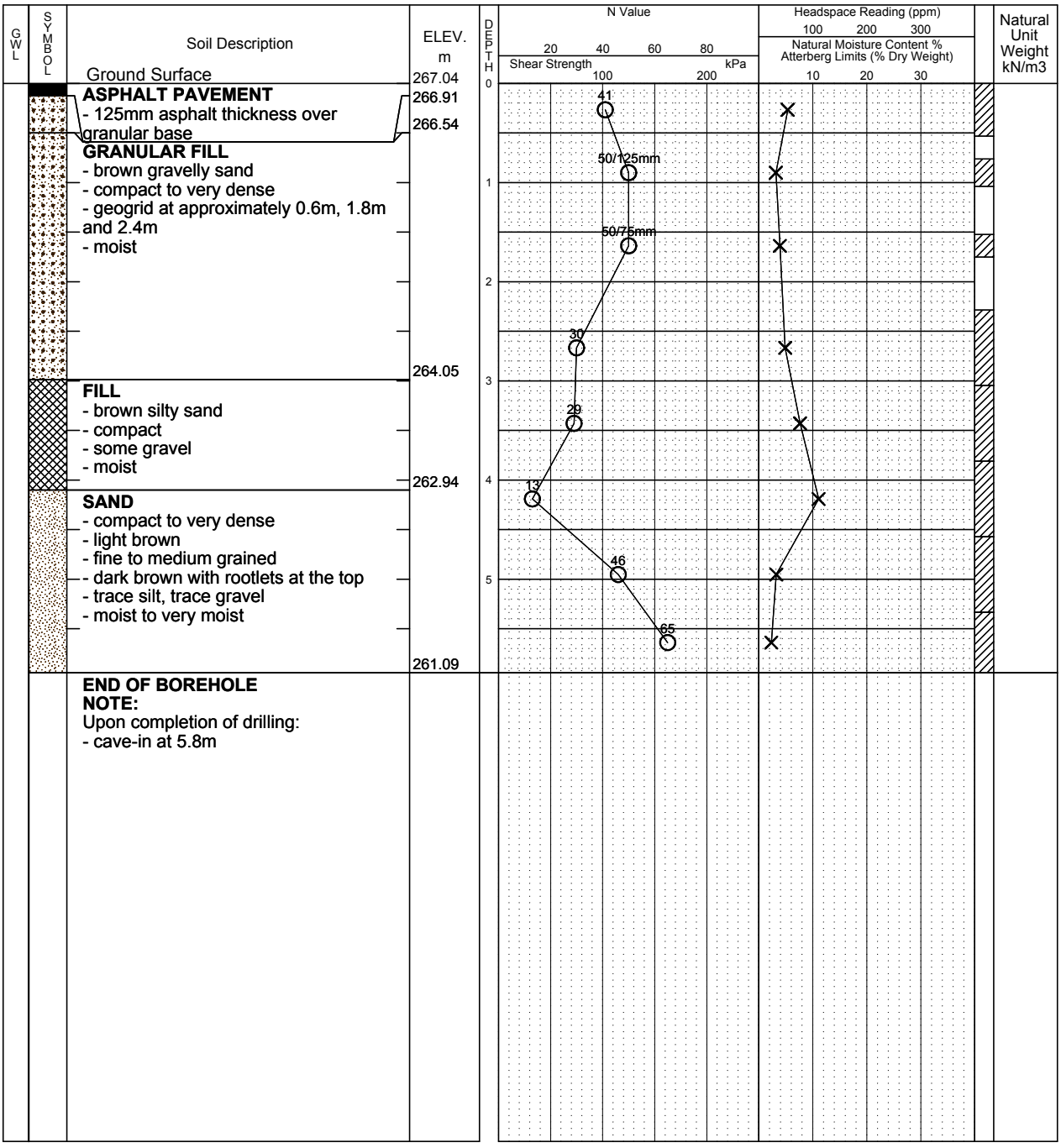
Date Drilled: 3/16/21

Drill Type: Ram Sounder

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5549W-21-GA

Log of Borehole 21BH-10

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 2350 Woodglade Boulevard, Peterborough, Ontario

Date Drilled: 3/16/21

Drill Type: Ram Sounder

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	267.40
		CONCRETE PAVEMENT - 150mm concrete thickness over granular base	267.25 267.00
		GRANULAR FILL - brown gravelly sand - compact to dense - moist	
			264.80
		FILL - brown silty sand - compact - some gravel - some topsoil and organics at the top - moist	263.60
		SAND - loose to compact - brown - well graded at the top - fine to medium grained at the bottom - trace to some gravel - moist	262.06
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - borehole open and dry	

DEPTH (m): 0, 1, 2, 3, 4, 5

N Value: 20, 39, 22, 21, 10, 9, 24

Shear Strength (kPa): 20 40 60 80 | 100 200

Headspace Reading (ppm): 100 200 300

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

LGBE3 5549W-21-GA.GPJ 5/4/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Figures

Grain Size Distribution

Grain Size Distribution - Granular 'B Type I'

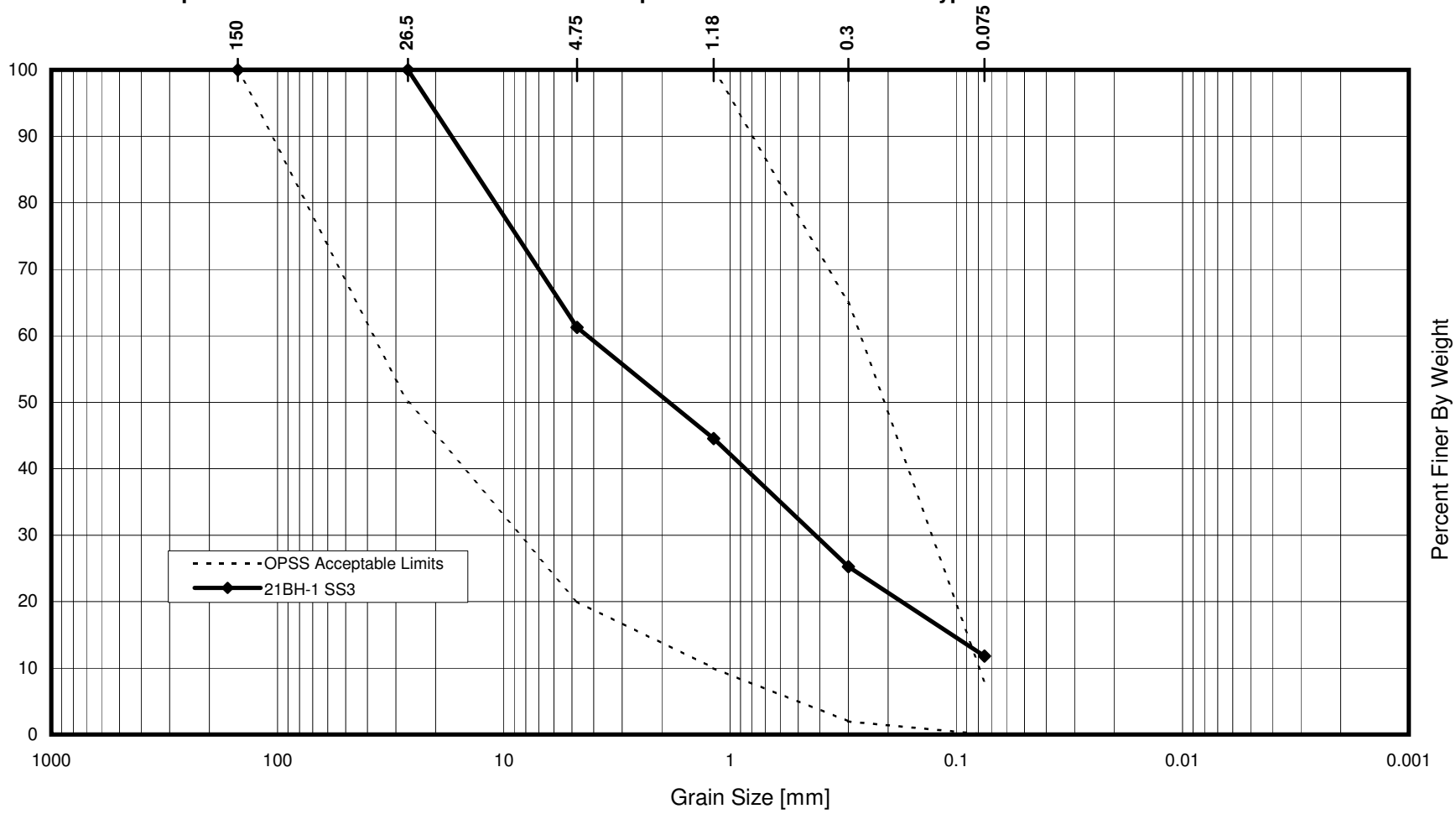
Project : 5549W-21-GA

Figure No. 1a

Location : 2350 Woodglade Boulevard, Peterborough,ON

Sample Description : Borehole 21BH-1 Sample SS3

The sample meets the OPSS FORM 1010 Granular Specification of Granular 'B Type I'.



Grain Size Distribution - Granular 'B Type I'

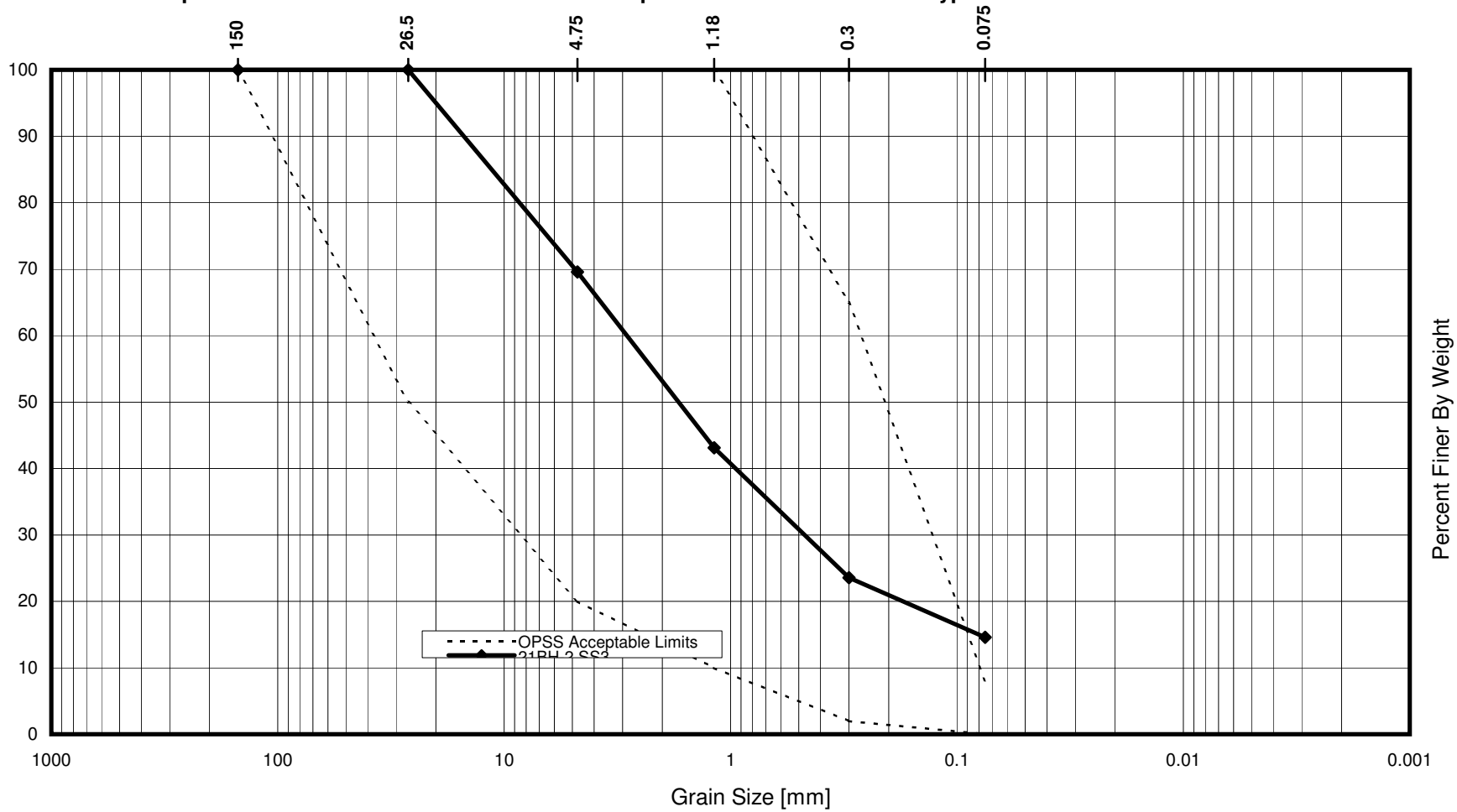
Project : 5549W-21-GA

Figure No. 1b

Location : 2350 Woodglade Boulevard, Peterborough,ON

Sample Description : Borehole 21BH-2 Sample SS3

The sample meets the OPSS FORM 1010 Granular Specification of Granular 'B Type I'.



Grain Size Distribution - Granular 'B Type I'

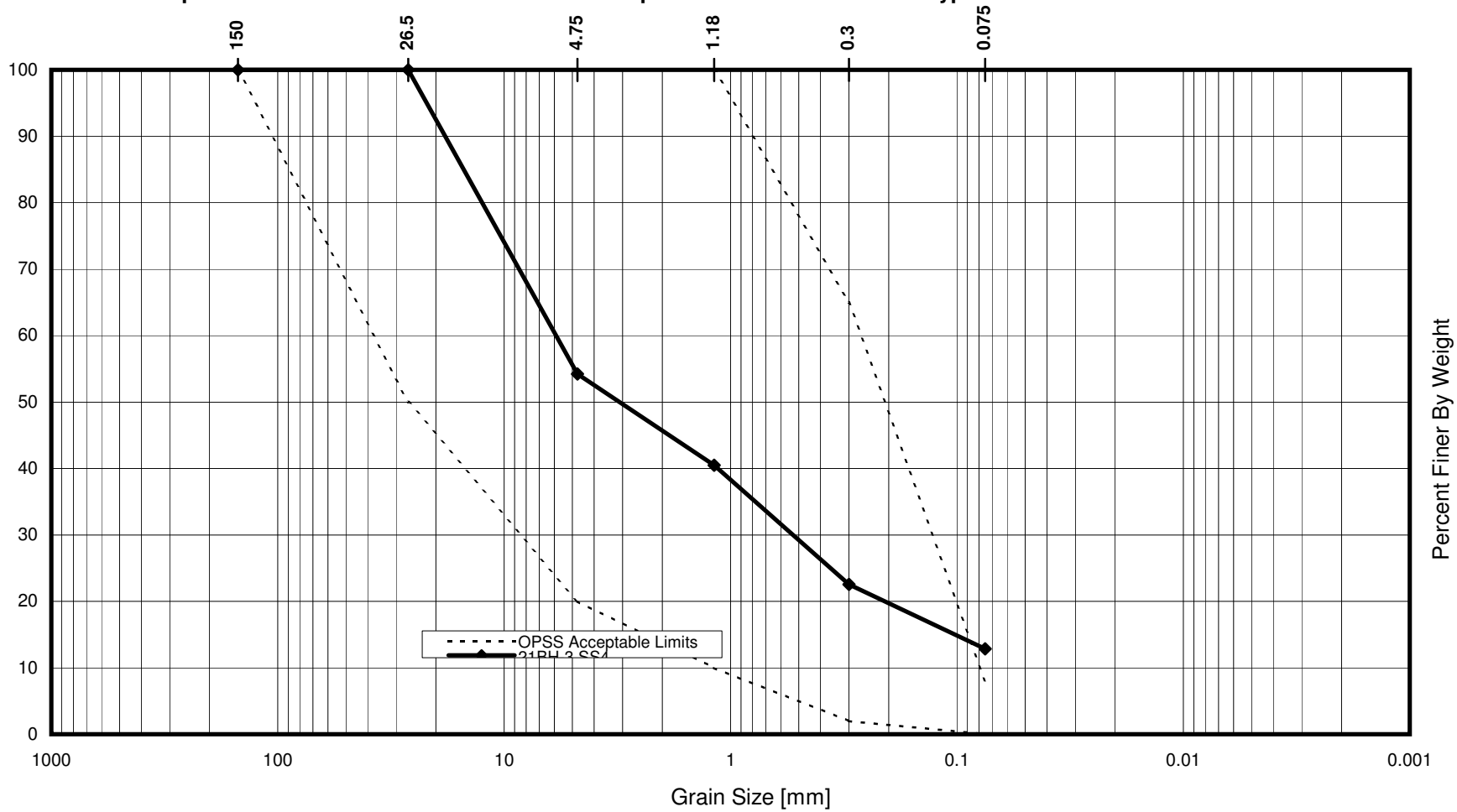
Project : 5549W-21-GA

Figure No. 1c

Location : 2350 Woodglade Boulevard, Peterborough,ON

Sample Description : Borehole 21BH-3 Sample SS4

The sample meets the OPSS FORM 1010 Granular Specification of Granular 'B Type I'.



Grain Size Distribution - Granular 'B Type I'

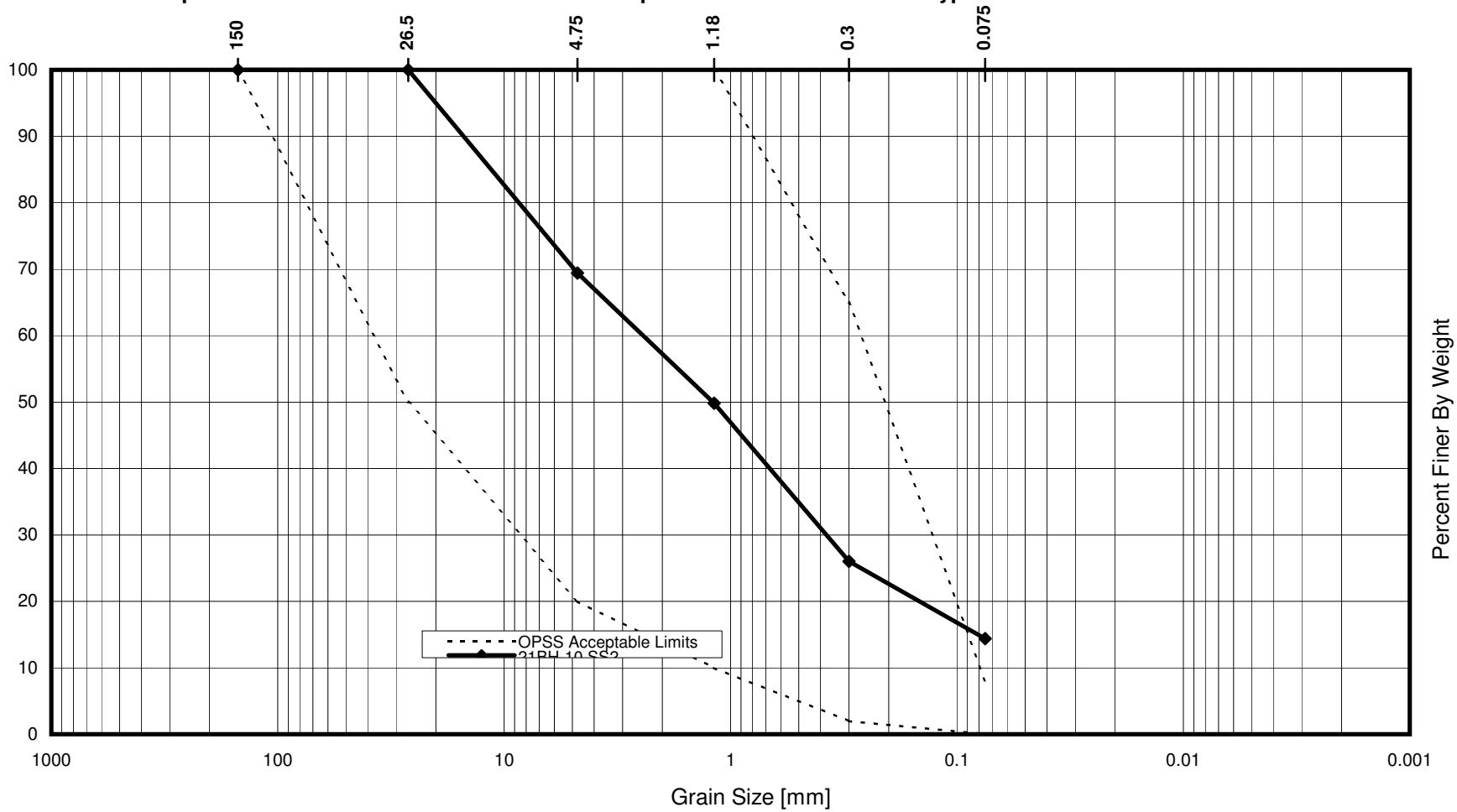
Project : 5549W-21-GA

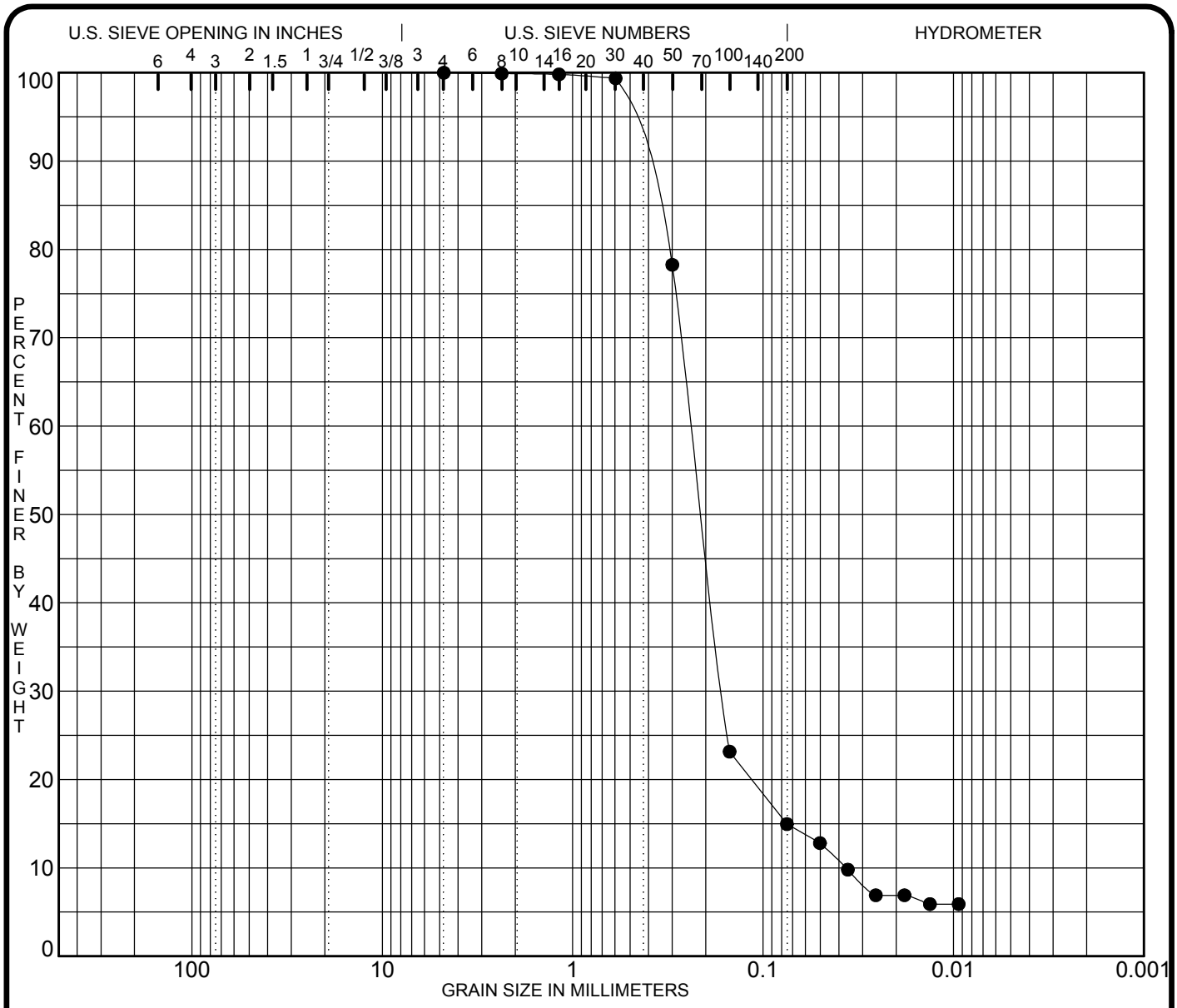
Figure No. 1d

Location : 2350 Woodglade Boulevard, Peterborough,ON

Sample Description : Borehole 21BH-10 Sample SS2

The sample meets the OPSS FORM 1010 Granular Specification of Granular 'B Type I'.





COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● **21BH-4**	**1.5**						**3.05**	**6.5**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **21BH-4**	**1.5**	**4.75**	**0.24**	**0.163**	**0.0367**	**0.0**	**85.0**	**15.0**	

PROJECT **Geotechnical Investigation - 2350 Woodglade Boulevard, Peterborough, Ontario**

JOB NO. **5549W-21-GA**

DATE **3/25/21**

GRADATION CURVES

Figure No.2

Toronto Inspection Ltd.

Appendix A

Guidelines for Engineered Fill

GUIDELINES FOR ENGINEERED FILL

The information presented in this guideline is intended for general guidance only. Site specific and prevailing weather conditions may require modification of the material(s) to be used and the compaction standards or procedures changed. The site preparation and the material(s) to be used must be discussed and procedures agreed with ***Toronto Inspection Ltd.*** prior to the start of the earthworks and must be subjected to on going review during construction.

For fill to be classified as engineered fill, suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Areal Extent

The engineered fill must extend beyond the envelope of the structure to be supported. The minimum extent should be 2.0m beyond the envelope in all directions at the foundation level, including the loading dock pad and the front sidewalk, and sloping downwards to the sub-grade at 45°. Once the envelope is set, the structure cannot be moved out of the envelope without consultation with ***Toronto Inspection Ltd.*** Similarly, no excavation should encroach on the engineered fill envelope without consultation with ***Toronto Inspection Ltd.***

2. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor. During construction. it is necessary to have qualified surveyors providing control stations on the three-dimensional extent of the engineered fill.

3. Subsurface Preparation

Prior to placement of the engineered fill, the sub-grade must be prepared to the satisfaction of ***Toronto Inspection Ltd.*** All deleterious material must be removed and in some cases excavation of native mineral soils may also be required. Particular attention must be paid to wet sub-grade and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching will be necessary and natural drainage paths must not be blocked.

4. Suitable Fill Material

All material to be used as fill must be approved by ***Toronto Inspection Ltd.*** Such approval will be influenced by weather factors. External sources of fill material must be sampled, tested and approved prior to material being hauled to the job site.

5. Trial Test Section

In advance of the construction of the engineered fill pad, the contractor should conduct a trial test section. The compaction criterion will be assessed for the backfill material to be used, using specified lift thicknesses and number of passes for the compaction equipment proposed by the contractor. To achieve a uniform degree of compaction of each layer, the lift thickness of loose

material, prior to start of compaction, must not exceed 200mm (8 inches). Additional trial test section(s) may be required throughout the course of the project to reflect changes in material sources, the moisture content of the material and the weather conditions.

6. Degree of Compaction

The minimum degree of compaction for the engineered fill should not be less than 100% of the Standard Proctor maximum dry density, or 95% of the Modified Proctor maximum dry density, to the level at or above 0.3m from proposed footing founding level. Each layer must be tested and approved by this office before the next layer is placed.

7. Inspection and Testing

Uniform and thorough compaction is crucial to the performance of the fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be done with full time inspection and to the satisfaction of ***Toronto Inspection Ltd.*** All founding surfaces must be inspected and approved by ***Toronto Inspection Ltd.*** prior to placement of concrete.

8. Protection of Fill

Fills are generally more susceptible to the effects of weather than are natural soils. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where inadequate protection had been provided, it may be necessary to provide deeper founding level for footings or to strip and re-compact some of the filled layers.

9. Limitations

The engineered fill is subjected to the following limitations:

i. Proper drainage must be maintained at all times within the engineered fill pad.
ii. If the engineered fill is left in place during the winter months, adequate protection must be provided against frost penetration to the proposed footing depths.
iii. If the engineered fill depth exceeds 5m below the foundation depth, the construction of the foundations might have to be delayed for a period of 1 year after placement, depending on the type of fill material used.
iv. Strip footings and foundation walls founded on engineered fill must be reinforced continuously with a minimum of two 15mm steel bars with at least 1m of overlap.