REPORT ON
GEOTECHNICAL INVESTIGATION
1583 CORMACK CRESCENT
MISSISSAUGA, ONTARIO

REPORT NO.: 4553-17-G-ELM-B (R2)
REPORT DATE: JANUARY 14, 2020

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1.0 INTRODUCTION

Toronto Inspection Ltd. carried out a geotechnical investigation in June 2017, for the proposed residential development at a property located at 1583 Cormack Crescent, Mississauga, Ontario (hereinafter described as "the Site"). The report of our findings and recommendations for the design and construction of the proposed structures was presented in the Geotechnical Investigation Report No.: 4553-17-G-ELM-B, dated December 8, 2017.

The report has been revised based on data obtained at the borehole locations by ***Toronto Inspection Ltd.***, and a review of the following two drawings, provided by the client for reference.

- A Site Plan, Drawing No.: SP100-OPTION 1, prepared by RN Design Ltd., dated January 8, 2019, received via an email on April 25, 2019.
- A Grading Plan, Drawing No.: GR-1, prepared by Schaeffers Consulting Engineers, dated May 6, 2019, received via an email on May 6, 2019.

The recommendations for the design and construction of the residential development in the revised report are based on the subsoil and groundwater conditions at the Site, obtained at the borehole locations carried out under the supervision of ***Toronto Inspection Ltd.,*** and the information provided in the above documents. The revised report includes the geotechnical data / parameters for:

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

This report is provided on the basis of the above terms of reference and on an assumption that the design of structures 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.

This report supersedes the previous geotechnical investigation report and any verbal or written recommendations provided for the Site.

2.0 SITE CONDITION

The Site, approximately 0.86 Ha in area and near rectangle in shape, is located on the east side of Cormack Crescent (and Dixie Road), approximately 170m south of South Service Road (or approximately 190m south of QEW) in Mississauga, Ontario.

At the time of the investigation, the development of the Site consisted of a two-storey dwelling with a basement in the west portion and a single-storey school building without a basement in the central portion. A playground covered with vegetation and landscaped area was present to the east of the school building. A wooded lot was present in the east portion of the Site. Asphalt paved driveways and parking area were present in the west part of the Site, around the dwelling and between these two buildings. The site gradient was fairly flat, slightly dropping to the west and south.

3.0 INVESTIGATION PROCEDURE

The field work for the investigation was carried out on June 16, 2017, and consisted of drilling five sampled boreholes 17BH-1 to 17BH-5, in the landscaped areas, extending to depths of 3.8m to 6.1m from grade, terminating in the weathered shale. The locations of the boreholes are shown in appended Borehole Location Plan, Drawing No. 1.

The boreholes were advanced using a truck 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 regular intervals of 0.8m to a depth of 3.0m from grade and at 1.5m intervals thereafter, using a split spoon sampler in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs). 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.

Groundwater observations were made in the boreholes during and upon the completion of drilling. Boreholes 17BH-1 and 17BH-3 to 17BH-5 were also completed as monitoring wells for groundwater records.

The borehole locations, established in the field by our site personnel, are shown on the appended Borehole Location Plan, Drawing No. 1. The ground elevations, at the borehole locations, were determined using "TOP OF FLOOR SLAB", at the northeast entrance door of the school building, just south of the Gymnasium, as the temporary bench mark (TBM).

The geodetic elevation of 105.64m for the TBM was obtained from the Site Plan, Drawing No.: SP100-OPTION1, prepared by RN Design Ltd., dated January 8, 2019, 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 the Logs of Boreholes (Drawing Nos. 2 to 6) for details of field work, including soil classification, inferred stratigraphy, and groundwater observations in the boreholes.

The subsoil, below the topsoil and fill at the borehole locations, consisted of sand, sand and gravel, or clayey silt deposits, overlying a weathered shale. Brief descriptions of the subsurface materials, encountered at the borehole locations, are as follows:

4.1 Ground Surface

At the ground surface, topsoil, approximately 120mm to 300mm in thickness, was contacted at all borehole locations.

4.2 Fill

Underlying the topsoil at all borehole locations, a layer of fill was contacted. The fill consisted of sand, some sandy silt, with minor topsoil and rootlets, particularly at 17BH-3 location.

The fill extended to depths of approximately 0.9m from grade, at all boreholes, except at Borehole 17BH-3 location, where the depth of fill extended to a depth of 2.4m from grade.

4.3 Sand / Sand and Gravel

Sand / sand and gravel deposits were contacted below the fill at all borehole locations, at depths of 0.9m to 2.4m from grade. The sand deposit at 17BH-1, 17BH-2, 17BH-4 and 17BH-5 locations, generally fine to coarse grained, contained occasional layers of sandy silt, clayey silt, or sand and gravel.

The sand / sand and gravel deposits, at all borehole locations, extended to depths of 3.4m to 6.1m from grade.

Based on the Standard Penetration N-values, in the range of 6 to more than 100 blows for a penetration of 300mm, the relative density of the sand / sand and gravel deposits were loose to very dense.

The in-situ moisture content of the soil samples, retrieved from the silty sand / sand deposits, ranged from 7% to 24%, indicating moist to wet conditions.

Grain size analyses were conducted on selected soil samples, obtained from 17BH-1 (SS5 - at a depth of 3.0m), 17BH-3 (SS5 - at a depth of 3.0m), 17BH-4 (SS3 & SS5 - at depths of 1.8m and 3.0m) and 17BH-4 (SS4 - at a depth of 2.3m), using both mechanical sieves and hydrometer. The grain size distribution test results are shown on the appended Figure No. 1.

4.4 Clayey Silt

A clayey silt deposit was contacted below the sand deposit at borehole 17BH-5, at a depth of 3.4m from grade. The deposit contained some sandy silt, trace gravel and shale pieces, and extended to a depth of 3.8m from grade.

Based on the Standard Penetration N-value of 48 blows for a penetration of 300 mm, the consistency of the clayey silt deposit was hard.

The in-situ moisture content of the soil sample, retrieved from the clayey silt deposit, was 19%, indicating a moist condition.

4.5 Weathered Shale

Weathered shale was contacted below the sand, sand and gravel or clayey silt deposits at depths ranging from 3.8m to 6.1m from grade at all borehole locations. All the boreholes, 17BH-1 to 17BH-5, were terminated in the weathered shale, at depths of 3.8m to 6.1m from grade, where virtual refusal to augering was encountered at some of the boreholes. The weathered shale was stratified, with thin layers of clayey silt. The quality of the shale bedrock was not proven by coring below the virtual refusal depth.

Based on the Standard Penetration N-values of more than 100 blows for a penetration of 300mm, the consistency of the weathered shale was hard.

The in-situ moisture content of the soil samples retrieved from the weathered shale ranged from 7% to 17%, indicating moist conditions.

4.6 Groundwater

Free water was recorded in all open boreholes, at depths of 1.5m to 2.7m from grade, upon the completion of drilling. Cave-in was recorded in the open borehole 17BH-2, at a depth of 5.8m from grade.

On June 19, 2017, water levels, in the monitoring wells at 17BH-1 and 17BH-3 to 17BH-5, were documented at depths of 1.89m to 2.50m below the existing ground level. On June 28, 2017, water levels, in the monitoring wells at 17BH-1 and 17BH-3 to 17BH-5, were documented at depths of 2.05m to 2.79m below the existing ground level. The groundwater depths / elevations are shown in the following table.

BH/ Well Location	Well Depth	Groundwater Measured Depths / Elevations		
		Upon Completion	June 16, 2017	June 28, 2017
17BH-1	6.0m	2.5m / 102.65m	2.33m / 102.82m	2.79m / 102.36m
17BH-3	4.7m	2.0m / 103.48m	2.29m / 103.19m	2.05m / 103.43m
17BH-4	4.5m	1.5m / 104.20m	1.89m / 103.81m	2.13m / 103.57m
17BH-5	3.9m	2.5m / 102.93m	2.50m / 102.93m	2.49m / 102.94m

Based on the field observations and the moisture content profiles of the soil samples, obtained from the boreholes, it is our opinion that there is a continuous groundwater table at the Site, within the sand / sand and gravel deposits, below a depth of approximately 2.0m from grade. The documented groundwater elevations indicate a slight hydraulic gradient of approximately 0.5m from north to south.

5.0 RECOMMENDATIONS

We understand that the residential development at the Site will consist of 22 detached houses with basements, roads and related structures.

The following information was noted from the Grading Plan, Drawing No.: GR-1, prepared by Schaeffers Consulting Engineers, dated May 6, 2019, and the Site Plan, Drawing No.: SP100-OPTION 1, prepared by RN Design Ltd., dated January 8, 2019:

- The existing grade of the Site varies between elevations of 104.85m at the west end to 105.63m at the east end.
- The proposed Road, traversing the Site form east to west, will have finished grade at elevations varying from 104.77m at the west end to 105.22m at the east end, which are slightly lower than the existing grade elevations.
- The basement floor elevations of the proposed detached houses will vary from elevations of 103.14m at the west side to 104.45m at the east side, at depths of approximately 1.2m to 1.7m below the existing grade.

For the purpose of this revised report, the depths of the house foundations are assumed to be 0.3m lower than the proposed basement floor elevations, i.e. at elevations varying from 102.84m to 104.15m, at depths of approximately 1.5m to 2.0m below the existing grade.

Based on the borehole profiles, our comments and recommendations are as follow:

5.1 Site Preparation

The existing fill, contacted at the borehole locations, will not be suitable for foundations or slab-on-grade construction in its current state due to high moisture content and low competence. We recommend that the fill should be completely removed from the footprints of the residential houses, to a firm ground, within the proposed development.

After demolition of the existing buildings and removal of all debris and the existing asphalt pavement, the contractor must allow for removal of the topsoil, deleterious fill and material with high moisture and/or organic content, during the construction, from the residential house envelopes, including the pavement areas, as directed by a geotechnical engineer / technician from ***Toronto Inspection Ltd.***. Material of relatively high organic content will not be suitable for reuse within the building areas and will have to be disposed off-site or reused in landscaped areas, subject to approval by the landscape architect.

The depths of topsoil and the fill, shown on the Borehole Logs, are specific depths at the borehole locations only. Since the depths of the topsoil and the fill quality can vary considerably at the Site, the contractor must allow for removal of the topsoil and any deleterious fill or material with high moisture and/or organic content from the building envelopes, roads and driveways, at the time of construction.

Any topsoil or compressible fill material, with relatively high organic or moisture content, will have to be removed and disposed off-site or reused in areas where future settlement will be of little consequence.

New fill material to be used for uplifting the Site, if needed, should consist of organic free material and should be compacted, in lifts of 200mm, to at least 98% of its Standard Proctor maximum dry density.

On site excavated native soils or selected fill materials, to be used for site grading, should be organic free and maintained at or close to its optimum moisture content during placement and compaction. Any additional fill, placed on the Site, should be compacted in lifts not exceeding 200mm to at least 98% of its Standard Proctor maximum dry density (SPMDD).

5.2 Pipe Bedding

Based on the borehole information, the subsoil at service trench inverts will consist of sand / sand and gravel deposits at all boreholes, except at Borehole 17BH-3 location. Any unsuitable fill strata, below the invert level of the services, will have to be sub-excavated and replaced with organic free soil, compacted to at least 95% of its SPMDD.

The pipe bedding for the underground services, above the current static groundwater table, including catch basins and manholes should consist of OPSS Granular A, 20mm crusher run limestone, or an approved equivalent. The bedding should be compacted to 98% of its Standard Proctor maximum dry density (SPMDD).

We believe that free water will be encountered in the service trenches, below depths of 2.0m from grade. The bedding in the service trenches, below depths of 2.0m should consist of HL-6 stone or equivalent, provided that a geotextile filter fabric (Terrafix 270R or equivalent) is used to separate the stone bedding from the base and the sides of the excavation. The geotextile filter fabric must surround the clear stone bedding completely.

No excavation should be carried out below depths of 2.0m from the existing grade, without temporarily lowering the water table to a minimum of 0.5m below the proposed excavation depth. The installation of temporary dewatering system should be carried out by an experienced contractor and maintained until backfilling of the excavation is complete to above the water table.

5.3 House Foundations

We understand that the proposed development will consist of detached houses with basements. The founding levels of the footings are assumed to be 0.3m lower than the proposed basement floor elevations and at elevations of 102.84m to 104.15m, i.e. at depths of approximately 1.5m to 2.0m below the existing grade.

The highest static groundwater level, documented at the observation wells in June 2017, was at an elevation of 103.6m, at Borehole 17BH-4. These water levels are subject to seasonal fluctuations and could be higher during the wet seasons. We, therefore, recommend that the fluctuations in the static groundwater must be checked, before finalizing the founding depths of the houses, as it could have a significant impact on the proposed development.

The following recommendations are based on the static groundwater table elevations, documented in June 2017, and the subsoil conditions, encountered at the borehole locations.

With the current design data, obtained from the documents reviewed, it appears that most of the house foundations will be very close to or below the documented static groundwater table. Provision will, therefore, have to be made in the construction budget to temporarily lower the water table to a minimum of 0.5m below the lowest foundations. If the groundwater table is not lowered, it will lead to loosing of the non-cohesive sandy soil below the water table and thereby loss of the recommended bearing capacities.

The lowest founding elevations for spread or strip foundations, without dewatering, are provided in the following chart:

BH No.	Lowest Founding Elevation	Design Bearing Pressures*	
		Serviceability Limit State (SLS)	Ultimate Limit State (ULS)
17BH-1	102.5m	100 kPa	150 kPa
17BH-2	103.5m	100 kPa	150 kPa
17BH-4	103.7m	100 kPa	150 kPa
17BH-5	103.0m	100 kPa	150 kPa

*The recommended design bearing pressures are based on minimum foundation width of 600mm. The design bearing pressures for footings, founded below the groundwater table, will have to be reduced to 75 kPa at SLS and 110 kPa at ULS.

Footings at and in the vicinity of 17BH-3 location will have to be taken through the fill and founded in the native sand and gravel deposit, at or below an elevation of 103.0m from grade. The water table at 17BH-3 location was documented at an elevation of 103.4m and will have to be lowered to below the recommended founding elevation for the duration of the construction.

The total and differential settlement of footings, founded in the native soil strata, and designed for the above recommended bearing pressure at the serviceability limit state, will not exceed 25mm and 20mm, respectively.

All the perimeter wall footings and footings exposed to freeze and thaw cycles should be founded at a minimum depth of 1.2 m below the outside grade.

Since all the boreholes were drilled in the landscaped areas, we recommend that additional boreholes should be drilled in the existing pavement and building areas to delineate the subsoil conditions.

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.

5.4 Floor Slab Construction

The ground floor slab or the basement floor slab of the houses can be designed and constructed as conventional slab-on-grade.

The subgrade for slab-on-grade construction will have to be proof-rolled, under the supervision of a soils engineer from ***Toronto Inspection Ltd.***, prior to placement of the granular base. Any compressible, loose, or weak spots, identified in the subgrade during proof-rolling, should be sub-excavated to the competent soil strata. Fill to the subgrade, above the footing elevations, should consist of organic free soils, approved by the geotechnical engineer, and compacted in lifts not exceeding 200mm to a minimum of 98% of its Standard Proctor maximum dry density (SPMDD).

A granular base course, consisting of at least 150 mm of 20mm clear stone or equivalent, should be provided below the concrete floor as a moisture barrier.

Provisions should be made to install sub-floor drainage systems under slab-on-grades which are at or close to the documented water elevations, to maintain the groundwater levels below the slab in the event of rise in the water level during the west seasons. The final decision on the sub-floor drain requirements should be made after the seasonal fluctuations of the groundwater table at the Site have been determined.

Below the groundwater table, the slab-on-grade will have to be designed as a structural slab, designed to withstand the uplift pressures.

5.5 Earthquake Consideration

The Ontario Building Code requires that all buildings be designed to resist earthquake forces. In accordance with Table 4.1.8.4.A of the Ontario Building Code, the site classification for the Seismic Site Response is Class D (stiff soil).

The acceleration and velocity based site coefficients, Fa and Fv, should conform to Tables 4.1.8.4.B and 4.1.8.4.C. These values should be reviewed by the Structural Engineer.

5.6 Excavation and Backfill

The open-cut excavations for service trenches and house foundations should comply with the Ontario Occupational Health and Safety Act. Any excavation in soils, up to a depth of 2.0m below grade, should be sloped back to a safe angle of less than 45 degrees. The sand deposit is TYPE 3 soil.

We do not anticipate any serious groundwater problems in shallow excavations at the Site, up to a depth of 2.0m below grade. Localized seepage of water from wet sand deposit can be drained to sump pits and removed by pumping from sumps.

No excavation should be carried out at the Site, below the groundwater table, without lowering the groundwater table to a minimum of 0.5m below the proposed excavation depth.

The in-situ moisture contents in the native deposits were estimated to be close to or higher than their optimum moisture contents. In our opinion, some of the on-site material will have to be dried to the dry side of its optimum moisture content before re-use as backfill for trenches. If the weather conditions are not favourable for drying of the soils with higher moisture content, these soils should only be used for backfilling the areas where any future settlement will be of little consequence.

Backfill around manholes and narrow trenches in the pavement area should consist of imported granular material and should be compacted using a vibratory equipment. In addition, catch basins and manholes should be perforated just above the drain level and the holes should be screened with a filter fabric. This will help in draining the pavement structure as well as alleviate the problem of differential movement of manholes due to frost action.

5.7 Lateral Earth Pressure

Where subsurface walls will retain unbalanced loads, the lateral earth pressure in the overburden may be computed using the following equation, for part of the structure above the water table, up to a depth of 1.5m below grade:

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

where	P = Lateral earth pressure	kPa
	K = Lateral earth pressure coefficient	0.4
	γ = Bulk unit weight of the soil	21.0 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 next to the wall. The drainage system should include a free-draining granular backfill or a drainage membrane placed against the concrete wall, together with an effective perimeter weeping tile drainage system at the wall base. The weeping tile should consist of a minimum 100mm diameter perforated pipe, surrounded by a geotextile filter fabric (OPSS 405) and installed on a positive grade leading to a frost free sump or outlet.

5.8 Permanent Perimeter Drainage

For an open cut excavation at the locations of full or partial basements, the recommended permanent perimeter drainage system is shown on Figure No. 1.

If seepage of water is observed from the wet sand deposit below the slab-on-grade level, at the time of construction, a subfloor weeper system will have to be installed.

The part of the structure, below the groundwater table, will have to be designed as a water tight structure, unless the groundwater table is lowered, on a permanent basis, to at least 0.5m below the slab-on-grade level.

5.9 Pavement Construction

After site grading and before the placement of granular bases for pavement construction, the subgrade should be proofrolled with a heavy roller to identify the presence of soft spots. Any soft pockets, revealed by that process, should be sub-excavated and replaced with an approved local or imported fill. The backfill should be compacted to 98% of SPMDD.

The thicknesses of road pavement are highly depending on the subgrade conditions. The following pavement design is based on an assumption that the subgrade soils for the roads will consist of organic free on-site mixture of sand, sandy silt or clayey silt, depending on the depth of excavation for the underground services within the road.

According to the comments of Development Engineering Review from City of Mississauga, dated December 8, 2019, the current Condominium road standards should be followed. Therefore, the following minimum pavement thicknesses are recommended:

		Private Roadway	**Driveway**
Asphaltic Concrete:	OPSS HL3	40 mm	25 mm
	OPSS HL8	65 mm	50 mm
Base course - OPSS Granular A or equivalent		200 mm	150 mm
Sub-base - OPSS Granular B or equivalent		250 mm	-

The pavement thicknesses recommended above are based on the assumption that the construction would be carried out in the dry season and that the subgrade is stable, without excessive movement during proof rolling. If excessive movements are noticed, additional granular sub-base thickness will be necessary.

For roads to be conveyed to the city, the municipality road design criteria must be followed.

Continuous perforated plastic longitudinal sub-drains should be installed on a positive gradient on both sides of the roadway, between catch basins and manholes to prevent the build-up of water in the roadway's and the parking lot's granular base courses. The subdrain pipes should be surrounded by a geotextile filter fabric as per Ontario Provincial Specifications Standard (OPSS 405). The sub-drains should be at least 300 mm below the subgrade level. Backfill above the drain should comprise of free draining sub-base material.

Granular bases should be compacted to 100% of Standard Proctor maximum dry density. Asphaltic concrete should be placed and compacted to at least 96% Marshall density.

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 plans, 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 / test pit 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, lost 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
S. WANG
100131918
Jan 14, 2020
PROVINCE OF ONTARIO

David S. Wang, P.Eng.
Senior Engineer

Upkar S. Sappal, P.Eng.
Principal Engineer

Toronto Inspection Ltd.

Drawings

Borehole Location Plan
Borehole Logs

LEGEND:

Borehole / Monitoring Well Location

Test Pit Location

Temporary Benchmark (TBM, Outside of Building Entrance Door)

NOT TO SCALE

TorontoInspection LTD.
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TITLE:	Borehole / Monitoring Well (and Test Pit) Location Plan
LOCATION:	1583 Cormack Crescent, Mississauga, Ontario

PROJECT NO.	DATE :	DRAWING NO.
4553-17-G-ELM-B	May, 2019	1

Project No. 4553-17-G-ELM-B

Log of Borehole 17BH-1

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1583 Cormack Crescent, Mississauga, Ontario

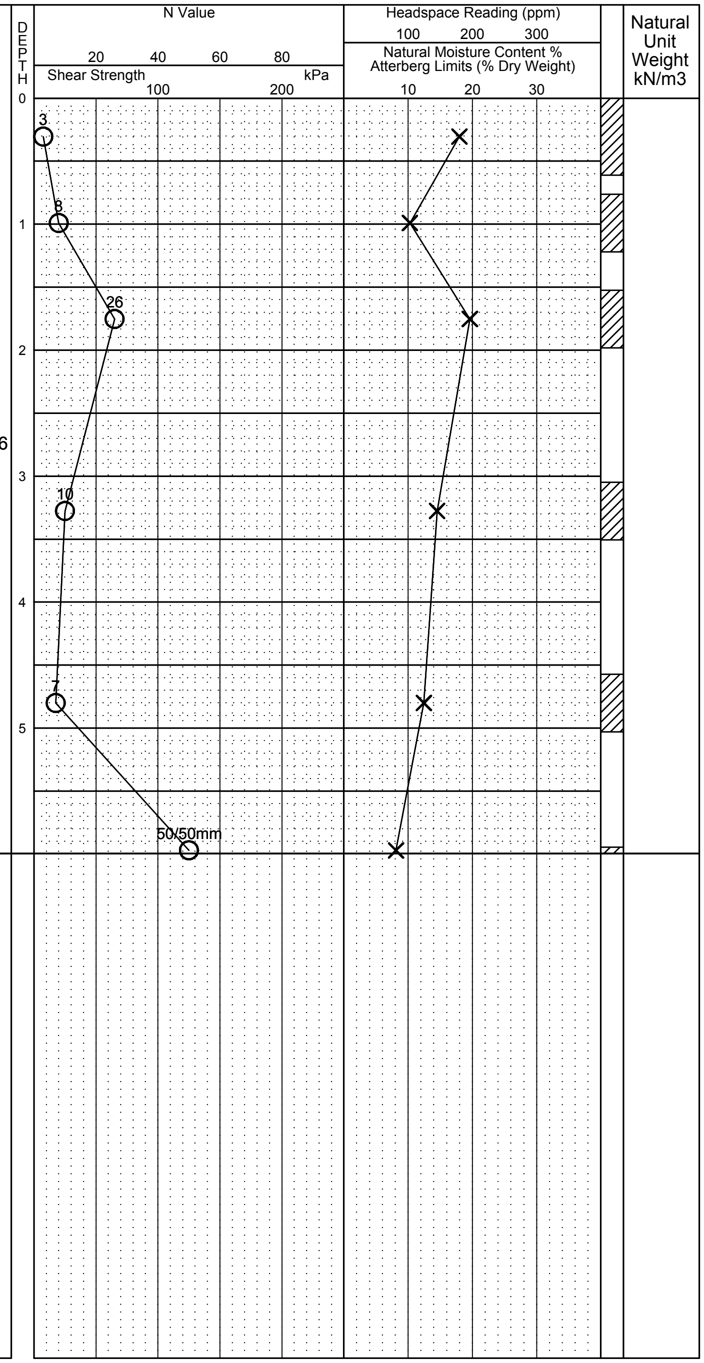
Date Drilled: 6/16/17

Drill Type: Truck Mounted Drill Rig

Datum: Geodetic

Legend	Symbol
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	▲

Soil Description	ELEV. m
Ground Surface	105.15
TOPSOIL	105.02
FILL - dark brown to brown sand - minor rootlets - moist	104.24
SAND - loose to compact - brown, grey below 3.0m - fine to coarse grained - layers of sandy silt at 1.5m - trace silt to 2.3m - some gravel below 2.3m - a layer of clayey silt at 5.7m - moist to wet	102.36 (water level) 99.28
WEATHERED SHALE - hard, grey - stratified, thin layers of clayey silt - moist	99.15
END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.5m	



LGBE3 4553-17-G-ELM-B(R).GPJ 5/7/19

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)
June 19, 2017	2.33m	
June 28, 2017	2.79m	

Log of Borehole 17BH-2

Project No. 4553-17-G-ELM-B

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1583 Cormack Crescent, Mississauga, Ontario

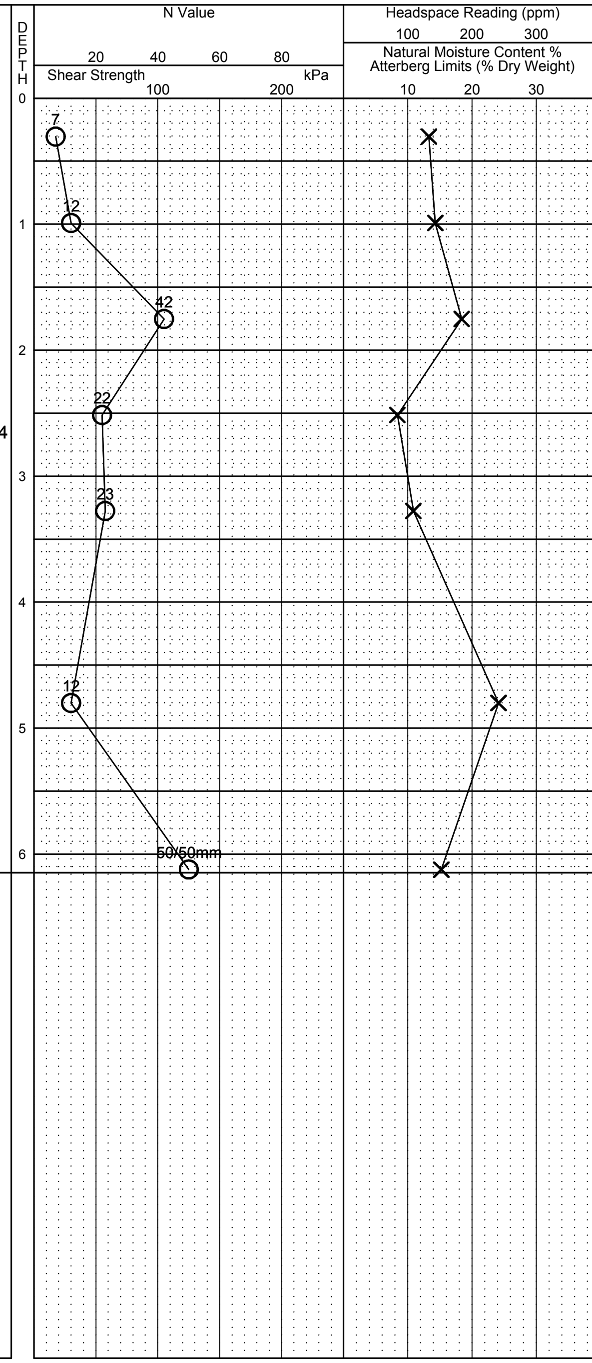
Date Drilled: 6/16/17

Drill Type: Truck Mounted Drill Rig

Datum: Geodetic

Legend:
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Headspace Reading (ppm)
- Natural Moisture
- Plastic and Liquid Limit
- Unconfined Compression % Strain at Failure
- Penetrometer

GWL	Soil Description	ELEV. m
	Ground Surface	105.44
	TOPSOIL	105.29
	FILL - dark brown to brown sand - minor rootlets - moist	104.53
	SAND - compact to dense - brown, grey below 2.3m - fine to coarse grained - trace to some silt to 2.4m - sand and gravel below 2.4m - layers of clayey silt at 4.5m - moist to wet	
▼		102.74
		99.34
	WEATHERED SHALE - hard, grey - stratified - moist	99.29
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.7m - cave-in at 5.8m	



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. 4553-17-G-ELM-B

Log of Borehole 17BH-3

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1583 Cormack Crescent, Mississauga, Ontario

Date Drilled: 6/16/17

Drill Type: Truck Mounted Drill Rig

Datum: Geodetic

Legend		Legend	
Auger Sample	⊠	Headspace Reading (ppm)	●
SPT (N) Value	○ ◪	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

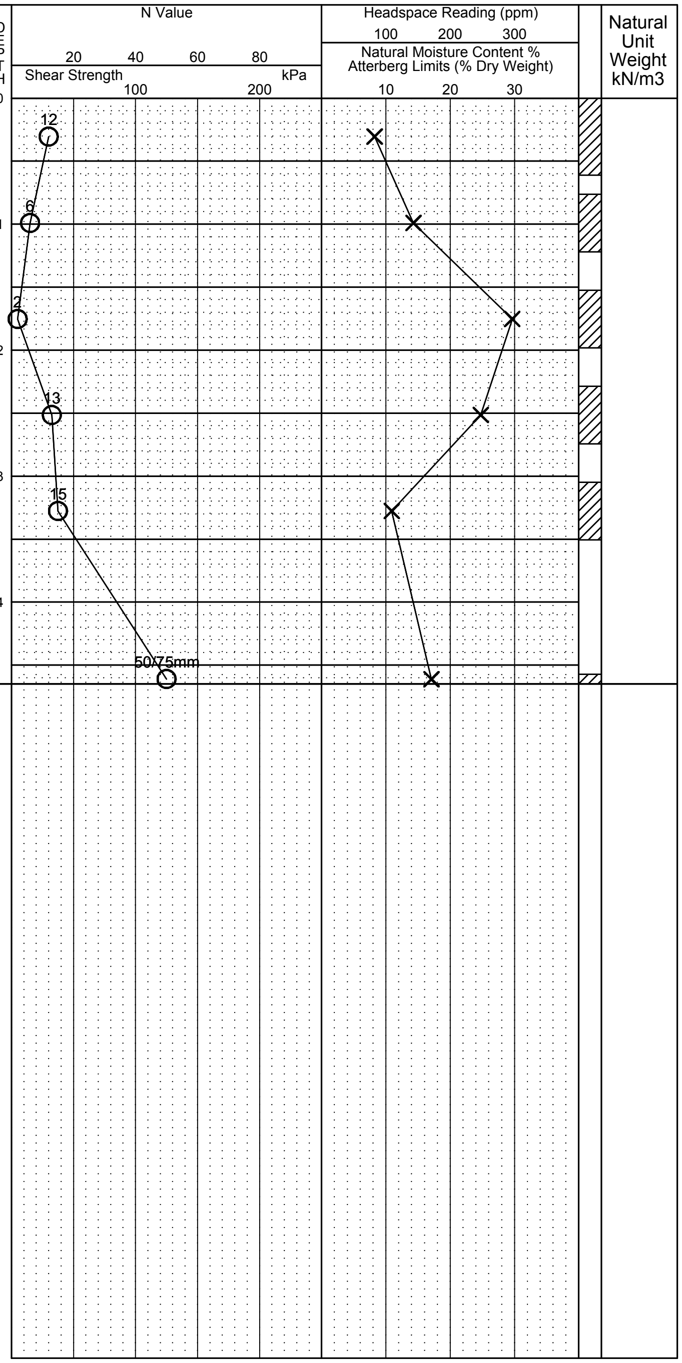
Soil Description	ELEV. m	DEPTH (m)
Ground Surface	105.48	0
TOPSOIL	105.17	
FILL - brown sandy silt - dark brown silty sand and topsoil at 0.6m to 2.4m - moist to wet	103.43	1, 2
SAND AND GRAVEL - compact, grey - a layer of clayey silt at 4.5m - wet	103.04 100.86	3, 4
WEATHRED SHALE - hard, grey - stratified, some clayey silt - moist	100.83	

END OF BOREHOLE

NOTE:

Upon completion of drilling:

- refusal to augering at 4.6m
- water level at 2.0m



LGBE3 4553-17-G-ELM-B(R).GPJ 5/7/19

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)
June 19, 2017	2.29m	
June 28, 2017	2.05m	

Project No. 4553-17-G-ELM-B

Log of Borehole 17BH-4

Dwg No. 5

Sheet No. 1 of 1

Project: Geotechnical Investigation

Location: 1583 Cormack Crescent, Mississauga, Ontario

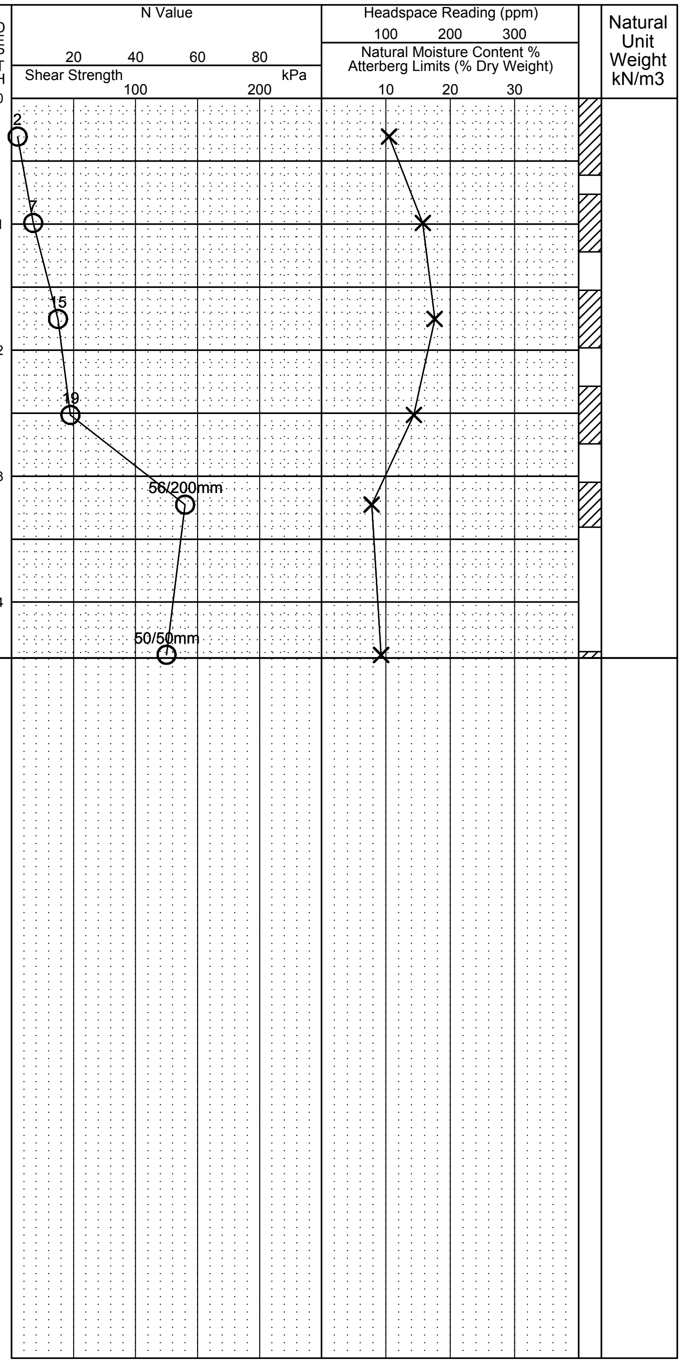
Date Drilled: 6/16/17

Drill Type: Truck Mounted Drill Rig

Datum: Geodetic

Legend	
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	105.70	0
		TOPSOIL	105.45	
		FILL - brown sand - moist	104.78	
		SAND - loose to very dense - brown, grey below 2.3m - fine to medium grained - trace to some silt - sand and gravel below 2.3m - pockets of thin layers of clayey silt below 2.3m - moist to wet	103.57	1, 2, 3, 4
			101.28	
		WEATHERED SHALE - hard, grey - stratified - moist	101.25	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - refusal to augering at 4.4m - water level at 1.5m		



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)
June 19, 2017	1.89m	
June 28, 2017	2.13m	

Project No. 4553-17-G-ELM-B

Log of Borehole 17BH-5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 1583 Cormack Crescent, Mississauga, Ontario

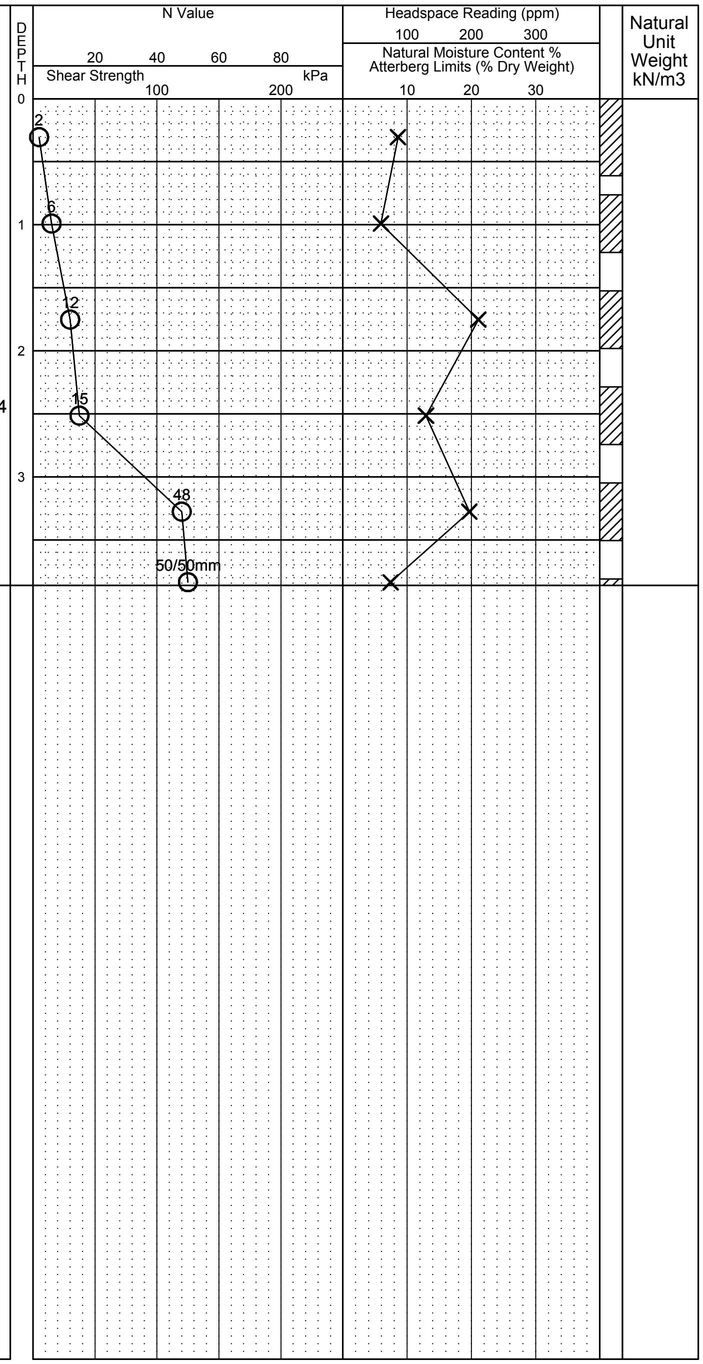
Date Drilled: 6/16/17

Drill Type: Truck Mounted Drill Rig

Datum: Geodetic

Legend	Symbol
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	▲

Soil Description	ELEV. m
Ground Surface	105.43
TOPSOIL	105.23
FILL - brown sand - moist	104.52
SAND - loose to compact - brown, grey below 2.3m - some sandy silt at 1.5m - sand and gravel below 2.3m - moist to wet	102.94 102.08
CLAYEY SILT - hard, grey - some sandy silt - trace gravel - shale pieces at 3.5m - moist	101.62
WEATHERED SHALE - hard, grey - stratified, thin layers of clayey silt - moist	101.57
END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.5m	

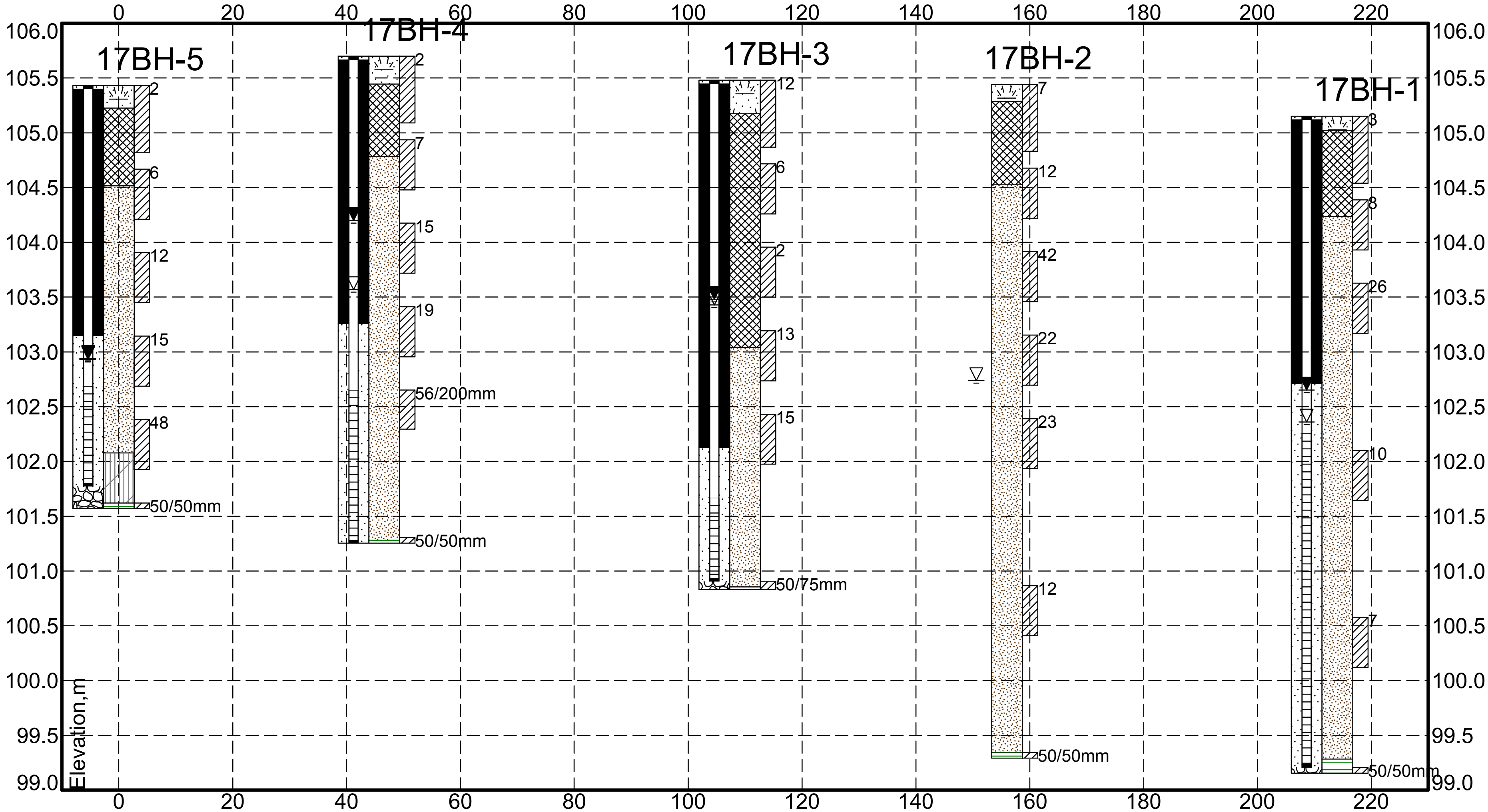


LGBE3 4553-17-G-ELM-B(R).GPJ 5/7/19

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)
June 19, 2017	2.50m	
June 28, 2017	2.49m	



Borehole No	Elev.	Depth
17BH-1	105.1	6.0
17BH-2	105.4	6.1
17BH-3	105.5	4.6
17BH-4	105.7	4.4
17BH-5	105.4	3.9

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SUBSURFACE STRATIGRAPHY

Section

Geotechnical Investigation

1583 Cormack Crescent, Mississauga, Ontario

PROJECT #	DATE	DRAWING
4553-17-G-ELM-B	May 19	7

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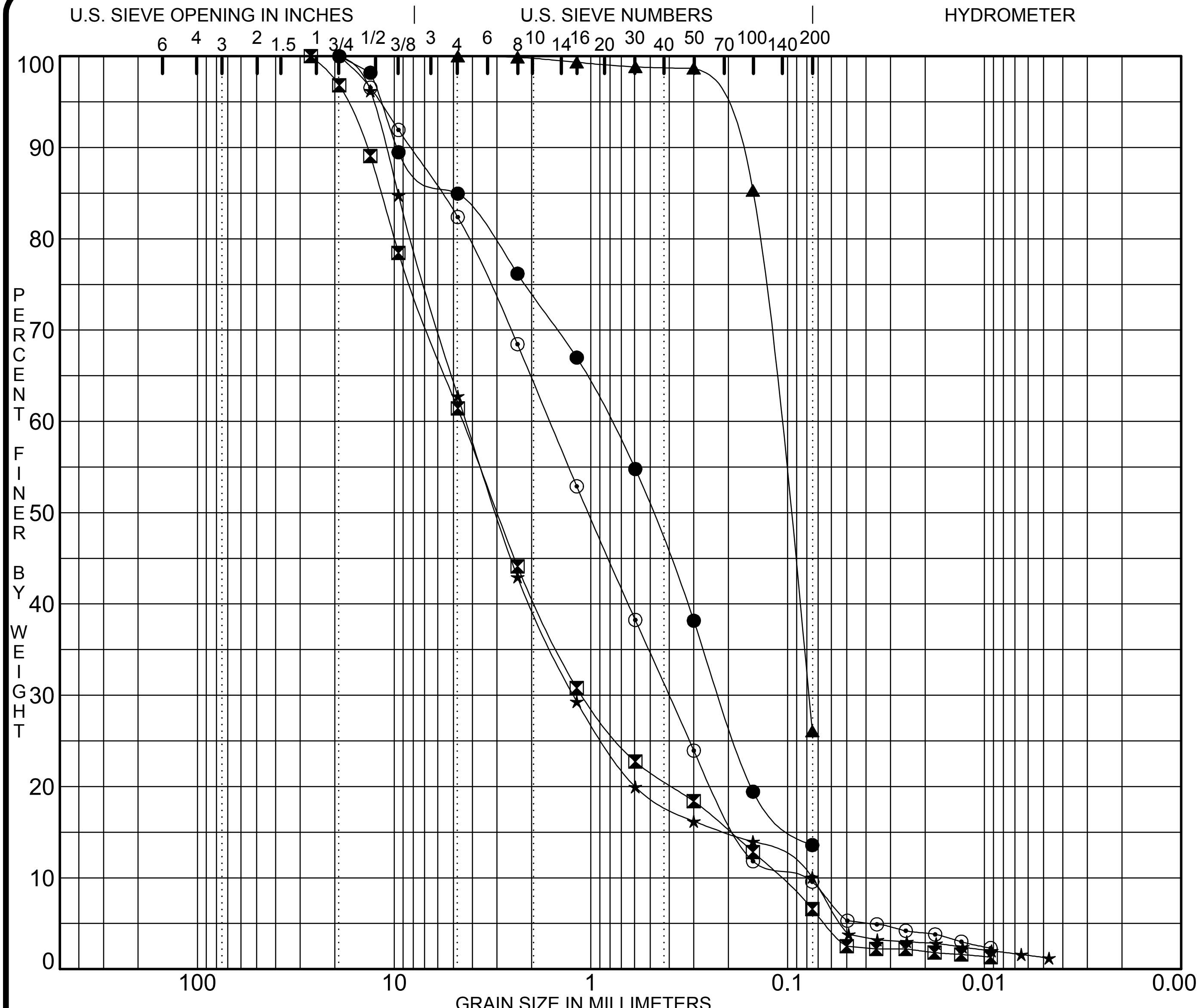
Figures

Grain Size Distributions

Drainage System for Open Cut Excavation



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**17BH-1**	**3.0**							
⧗	**17BH-3**	**3.0**						**2.48**	**41.0**
▲	**17BH-4**	**1.8**							
★	**17BH-4**	**3.0**						**4.65**	**57.7**
⊙	**17BH-5**	**2.3**						**1.16**	**18.9**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**17BH-1**	**3.0**	**19.00**	**0.80**	**0.222**		**15.1**	**71.4**	**13.6**	
⧗	**17BH-3**	**3.0**	**26.50**	**4.49**	**1.103**	**0.1096**	**38.6**	**54.8**	**6.6**	
▲	**17BH-4**	**1.8**	**4.75**	**0.11**	**0.079**		**0.0**	**73.9**	**26.1**	
★	**17BH-4**	**3.0**	**19.00**	**4.31**	**1.223**	**0.0747**	**37.2**	**52.7**	**8.8**	**1.3**
⊙	**17BH-5**	**2.3**	**19.00**	**1.62**	**0.401**	**0.0855**	**17.6**	**72.8**	**9.6**	

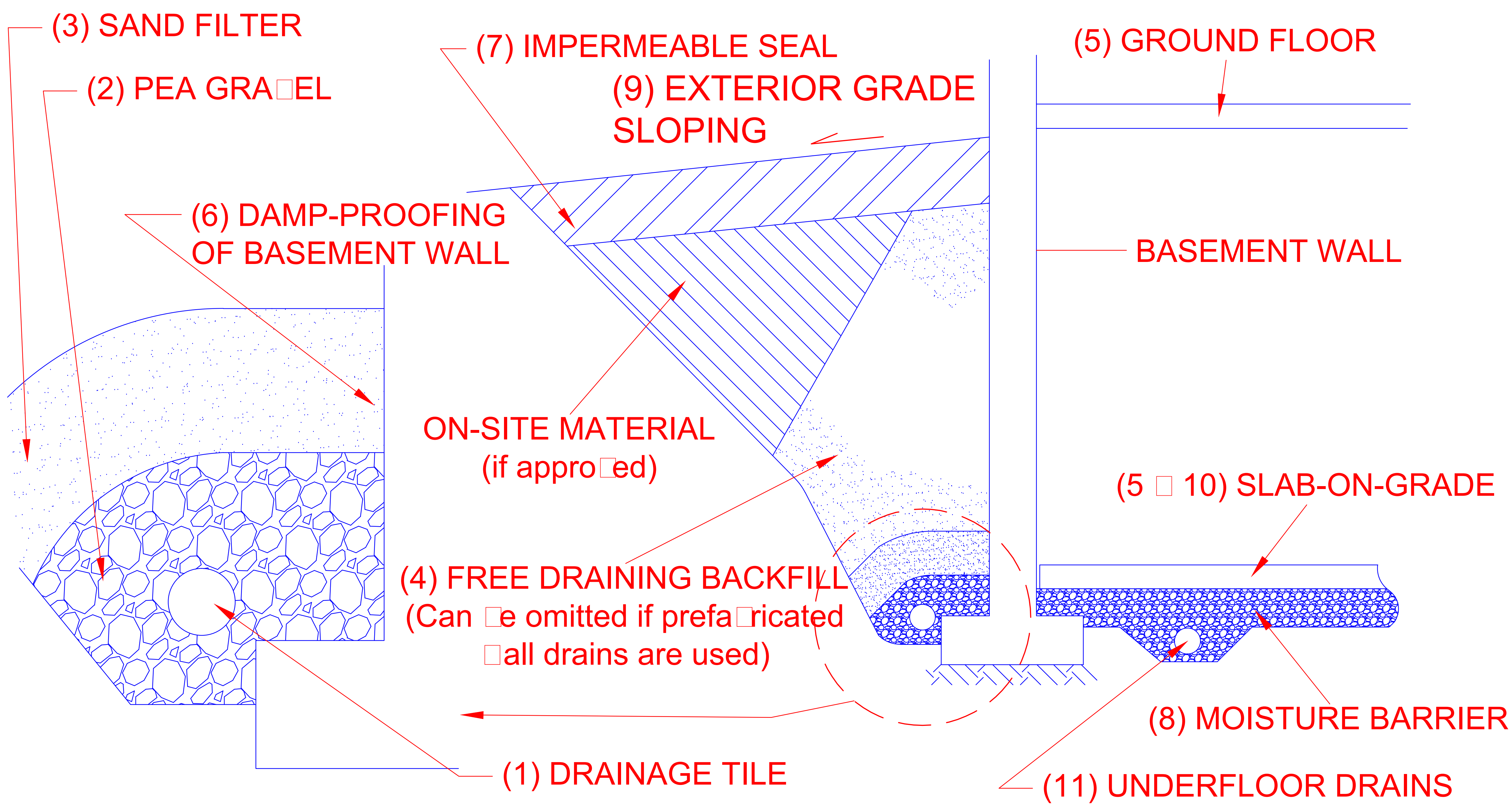
PROJECT **Geotechnical Investigation - 1583 Cormack Crescent, Mississauga, Ontario**

JOB NO. **4553-17-G-ELM-B**
DATE **7/30/17**

GRADATION CURVES

Toronto Inspection Ltd.

FIGURE NO. 1



Notes:

1. **Drainage tile**: consist of 100mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. invert to be at minimum of 150mm (6") below underside of basement floor level.
2. **Pea gravel**: at 150mm (6") on the top and sides of drain. If drain is not placed on footing, provide 100mm (4") of pea gravel below drain. The pea gravel may be replaced by 20mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270 R or equivalent.
3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.
4. **Free-draining backfill**: OPSS Granular B or equivalent, compacted to 93 to 95% (maximum) Standard Proctor Density. Do not ocmpact closer than 1.8m (6ft.) from wall with heavy equipment. This may be replaced by on site material if prefabicated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.
5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adequate bracing.
6. **Damp-proofing** of the basement wall is requred before backfilling.
7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free draining sand, the seal may be omitted.
8. **Moisture barrier**: consists of 20mm clear stone or compacted OPSS Granular A, or equivalent. The thickness of this layer to be 150mm (6") minimum.
9. **Exterior Grade**: slope away from basement wall on all the sides of the building.
10. **Slab-on-grade** should not be structurally connected to walls or foundations.
11. **Underfloor drains** * should be placed in parallel rows at 6-8m (20-25 ft.) centre, on 100mm (4") of pea gravel with 150mm (6") of pea gravel on top and sides. The invert should be at least 300mm (12") below the underside of the floor slab. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

* Underfloor drains can be deleted where not required.

NOT TO SCALE

Toronto Inspection LTD. GEO-ENVIRONMENTAL CONSULTANTS

TITLE: Suggested Backfill and Drainage System for Open Cut Excavation

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FIGURE NO. 2