

# **Triple Crown Line Development Inc.**

Geotechnical Investigation Proposed Residential Development Airport Road and Cranston Drive Caledon East, Ontario

Project Number BRM-00235186-D0

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# 1. Introduction

This report presents the results of a geotechnical investigation carried out for a proposed residential development on the east side of Airport Road and straddling the intersection with Cranston Drive in Caledon East, Ontario. The site occupies an area of approximately 44 hectares (~110 acres). The work was authorized by Mr. Jordan Archer of Triple Crown Line Development Inc.

The project involves the design and construction of single family residential dwellings together with the necessary municipal infrastructure such as roads, sewers, water and other services and a potential stormwater management pond.

The purpose of the geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site and, based on this information, to provide an engineering report with geotechnical recommendations pertaining to the design and construction of the proposed residential development.

The comments and recommendations given in this report are based on the assumption that the abovedescribed design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.



# 2. Site Description

The Site occupies an area east of Airport Road, north of the farmland located at address 15521 Airport Road, and south of the commercial plaza located at 15771 Airport Road, in Caledon East, Ontario, as shown on Figure 1. The Site is irregular in shape and occupies an area of approximately 44 hectares (~110 acres).

The majority of the Site consists of an open field, largely covered in soya bean plants. The north, east, and southeast boundaries of the property consist of a tree-line, which extends into a forested area in the southeast corner of the property. In general, the Site property and surrounding area appeared to rise from south to north, though the topography was found to undulate significantly across the Site. The south-central and east sides of the property slope sharply downward toward unnamed streams in valley lands which flow into Innis Lake southeast of the Site. The property comprises mainly farmland and is currently developed with two (2) residential dwellings and nine (9) major outbuildings.



# 3. Fieldwork

The field work comprised drilling of sixty-three (63) sampled boreholes designated Boreholes 1 to 27, 29, 31 to 36, 38 to 47 and 49 to 67. It should be noted that Boreholes 28, 30, 37 and 48 were eliminated from the program by the Client. Boreholes 1 to 4, 66 and 67 were drilled in the valley lands near the toes of slopes located at the south and east boundaries of the site. 50 mm diameter monitoring wells were installed in Boreholes 2, 6, 7, 20, 23, 25, 36, 39, 41, 56, 59, 61, 66 and 67. Nested configurations comprising deep and shallow monitoring wells were installed at locations of Boreholes 8, 18, 47, 51 and 64. The deep and shallow monitoring well logs were assigned the suffixes D and S respectively, following the borehole numbers. The fieldwork was carried out between April 26 and May 17, 2017. The sixty-three (63) sampled boreholes were drilled to depths of approximately 6 to 18 m below existing grades at the approximate locations shown on the attached Borehole Location Plan (Drawing No. 1).

The boreholes were advanced using continuous flight solid stem auger equipment owned and operated by a specialist drilling contractor. In each borehole, samples were recovered using conventional split spoon equipment in conjunction with the standard penetration test method.

Water levels were observed in the open boreholes during the course of the fieldwork and in monitoring wells as described earlier for subsequent groundwater level measurement, testing and sampling for hydrogeological purposes.

The fieldwork was supervised throughout by an **exp** Services Inc. (**exp**) geotechnical technologist who directed the drilling and sampling operations, prepared borehole logs, made groundwater observations during and upon completion of drilling, and processed the recovered samples. In the laboratory, the samples were classified as to their olfactory, visual and textural characteristics. Natural moisture content and density tests were carried out for selected recovered samples, with results presented on the Log of Borehole sheets.

The locations of the boreholes were established in the field by Holding Jones Vanderveen Inc., Ontario Land Surveyors, who were retained by the Client. The top of borehole elevations (Geodetic) were provided to **exp** by Holding Jones Vanderveen Inc. through the Client.



# 4. Laboratory Testing

✤ BH45 SS5

The laboratory testing program comprised the following:

- Moisture content and unit weight determination on selected recovered soil samples, with results presented on the Log of Borehole sheets.
- Grain Size Analysis on the following four (4) selected soil samples:

Borehole 45 - 3.1 - 3.5 m depth

*	BH 23 SS2	Borehole 23 – 0.8 to 1.2 m depth
*	BH 39 SS2	Borehole 39 – 0.8 – 1.2 m depth
*	BH2 SS7	Borehole 2 – 6.1 – 6.5 m depth



# 5. Subsurface Conditions

# 5.1 Soil

The detailed profiles encountered in each borehole and the results of laboratory moisture content and unit weight are indicated on the attached borehole logs. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones, for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Description" preceding the borehole logs are an integral part of and should be read in conjunction with this report.

The stratigraphy encountered at the site, as revealed in the boreholes, generally comprised surficial topsoil and ploughed soil, fill and native deposits of sandy silt till, clayey silt till, silty sand, clayey silt, peat and sand and gravel.

A brief description of the soil profiles follows.

## Topsoil / Ploughed Soil

A surficial layer of topsoil 75 to 450 mm thick was encountered in all Boreholes. However, given use of the property for agricultural purposes disturbed (ploughed) soil should be expected to typical ploughing depths of up to 600 to 800 mm.

It should be noted that topsoil and disturbed (ploughed) soil measurements were carried out at the borehole locations only and could differ at other locations on the site. Consequently, topsoil and disturbed (ploughed) soil quantities should not be established from the information provided at the borehole locations. If required, a more detailed test pit program should be carried out to more accurately quantify the amount of topsoil and disturbed (ploughed) soil to be removed for construction purposes.

#### Fill

Fill underlies the topsoil in Boreholes 1, 7, 9 to 11, 15 to 17, 23 to 27, 31 to 33, 36, 38, 43 to 46, 49 to 52, 56 to 58, 60, 61 and 65. Fill was not encountered in Boreholes 66 and 67 drilled at the toes of the slopes off the south-central and northeastern portions of the property. The fill extends to depths of approximately 1.0 to 4.1 m (~Elevation 292.5 to 310.2 m). Typically the thickness of fill ranged from approximately 1.0 to 2.2 m except in Boreholes 10, 27, 43 and 58 where the fill extends to approximately 4.1 m depth. The fill typically comprises various combinations of brown sand, sandy silt and clayey silt



with trace gravel. Locally, topsoil stained pockets, rock fragments and rootlets were observed in the fill. Moisture contents in the fill ranged from approximately 10 to 27 %.

#### Native Soils

The native soils were intersected below the topsoil or fill at all borehole locations. The native soils comprise sand, silty sand, clayey silt, clayey silt till, sandy silt till, sand and gravel and peat and exist in various thicknesses, sequences, degrees of compactness and consistencies depending on location. Moisture contents in the native soils were recorded as follows:

- Sand/Silty Sand approximately 3 to 23 %
- Clayey Silt approximately 13 to 24 %
- Clayey Silt Till approximately 11 to 26 %
- Sandy Silt Till approximately 6 to 26 %
- Sand and Gravel approximately 10 to 12 %
- Peat approximately 270 and 450 %

#### Peat

Peat was encountered locally in Boreholes 16 and 24 in the southeastern portion of the site. Locations, depths below grade and elevations where peat was noted are summarized in the following table.

Borehole No.	Depth Interval below Grade (m)	Elevation Interval (m)
16	1.0 – 2.5	292.4 – 293.7
24	2.1 – 4.0	291.5 – 293.7

#### Table 1: Peat Summary

#### Wet Sand

Wet sand was interpreted to be present in boreholes in the northern and southern thirds of the site. Locations, depths below grade and elevations where wet sand was noted are summarized in the following table.



Borehole No.	Depth Interval below Grade (m)	Elevation Interval (m)
3	5.6 – 7.1	293.9 – 295.4
4	5.0 – 6.6 (end of borehole)	290.1 – 291.7
7	8.5 – 10.2	283.7 – 285.4
11	5.6 - 6.2	295.2 – 295.8
14	0.5 – 2.2	292.7 – 294.4
16	2.5 – 4.1	290.8 – 292.4
24	4.0 - 4.8	290.7 – 291.5
25	2.9 - 4.0	299.6 – 300.7
43	4.0 – 5.6	300.8 - 302.4
44	4.1 – 7.0	301.2 - 304.1
45	2.2 - 5.6	303.2 - 306.6
46	1.4 – 4.0	303.1 – 305.7
51	5.6 – 10.2	299.8 - 304.4
52	4.0 – 8.1 (end of borehole)	302.5 - 306.6
53	4.1 – 7.2	303.5 – 306.6
55	1.4 – 4.1	305.0 – 307.7
60	4.8 - 8.7	301.3 – 305.2
62	0.2 – 4.0	303.2 - 307.0
63	7.1 – 8.6	304.0 – 305.5
64	7.0 – 8.6	303.7 – 305.3
65	4.0 – 5.6	306.0 – 307.6

#### Table 2: Wet Sand Summary

Seasonal variations in the interpreted wet sand intervals should be anticipated.



# 5.2 Groundwater

Groundwater conditions were observed in the open boreholes during the course of the fieldwork and in the monitoring wells installed at nineteen (19) selected borehole locations for subsequent groundwater measurements.

Upon completion of drilling, free water was detected at depths of approximately 0.1 to 12.2 m in Boreholes 7, 8D, 18D, 19, 24 to 46, 47D, 49, 51D, 52 to 55, 57, 58, 60 and 66. All other boreholes were dry upon completion of drilling. A summary of groundwater observations in the monitoring wells is presented in the following table.

Borehole No.	Elapsed Time	Water Level (m)	Elevation (m)
2*	After 22 Days	8.8	293.3
6	After 17 days	7.6	290.4
7	After 15 Days	8.2	285.7
8D	After 11 Days	10.5	284.7
8S	After 11 Days	Dry	
18D	After 11 Days	11.3	291.4
18S	After 11 Days	5.8	296.9
20	After 10 Days	5.8	294.3
23	After 11 Days	Dry	
25	After 23 days	2.9	300.7
36	After 17 Days	5.8	297.2
39	After 17 days	6.0	298.7
41	After 10 Days	2.1	302.1
47D	After 8 Days	10.4	293.0
47S	After 8 Days	Dry	
51D	After 4 Days	9.5	300.5
51S	After 4 Days	5.9	304.1
56	After 11 Days	Dry	

## Table 3: Groundwater Level Readings



Borehole No.	Elapsed Time	Water Level (m)	Elevation (m)
59	After 8 Days	Dry	
61	After 3 days	Dry	
64D	After 2 Days	12.1	300.2
64S	After 2 Days	Dry	
66*	After 16 Days	-0.6 (above grade)	284.1
67*	After 9 days	Dry	

# \* Located at toe of slope.

Based on the information observed in the boreholes, the groundwater originates from the wet silty sand and the more pervious seams within the glacial sandy silt till.

The groundwater elevations reflect the conditions at the time of the investigation. Groundwater elevations are subject to seasonal fluctuations.

The monitoring wells were installed in general accordance with the Ontario Water Resources Act-R.R.O. 1990, Regulation 903 – Amended to O. Reg. 128/03 by CSD, by a licensed well contractor. When the use of the monitoring wells is no longer required, they must be decommissioned in accordance with the procedure outlined in the Ontario Water Resources Act – R.R.O. 1990, Regulation 903 – Amended to O. Reg. 128/03.



# 6. Engineering Discussion and Recommendations

# 6.1 General

The project involves the design and construction of single family residential dwellings together with the necessary municipal infrastructure such as roads, sewers, water and other services and a potential stormwater management pond.

The following subsections provide geotechnical engineering guidelines for the design and construction of the proposed residential development.

# 6.2 Site Grading

Final site grades have not been established at the time of this investigation. However, in view of the relief of approximately 18 m measured at the borehole locations excluding those in the valley lands, it is anticipated that regrading (cut and fill operations) will be carried out. The following procedures are recommended for the construction of structural fill for building lots and pavement areas, where required.

- All vegetation, topsoil, disturbed (ploughed) soil, loose fill, peat, loose native soil, gravel pavement structure and building floor slabs/foundations should be removed from proposed building and pavement areas. Any existing septic tile field should also be removed. Potable water wells and all monitoring wells installed for this investigation should be properly decommissioned.
- The exposed subgrade surface should be proofrolled with a heavy roller and examined by a geotechnical engineer from exp. Any soft or loose spots encountered during the process should be subexcavated and replaced with approved on-site or imported materials, compacted to 100 % standard Proctor maximum dry density (SPMDD).
- Low areas can then be brought up to final subgrade level with approved on-site or imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD within building areas ("engineered fill") and 95% SPMDD to within 600 mm of final subgrade level and 98% SPMDD for the upper 600 mm in pavement areas. The moisture content of the fill to be placed should be at or near its optimum moisture content in order to assure the specified densities can be achieved with reasonable compactive effort. Some of the on-site soils, particularly from the lower elevations, will require partial drying before they can be properly compacted. Any organic or excessively wet or otherwise deleterious material should not be used for backfilling purposes.



- Fill and cut slopes should not be steeper than two horizontal to one vertical and should be protected from surface erosion.
- All imported borrow fill material from local sources should be free from organic material and foreign objects (i.e. trees, roots, debris, etc.) and should be tested geotechnically by exp prior to transport to the site. In addition, the chemical quality of the borrow fill material should be assessed by exp in accordance with applicable soil criteria listed in the Ministry of the Environment and Climate Change Standards (Ontario Regulation 153), dated April 15, 2011.
- All excavation, backfilling and compaction operations should be monitored on a full-time basis by qualified geotechnical staff to approve materials and to confirm that the specified degrees of compaction have been obtained.

# 6.3 Site Servicing

## 6.3.1 Watermain and Sewer Installation

## 6.3.1.1 Open Cut Excavation

The sewer and watermain invert levels have not yet been determined at the time of investigation, but based on the specified borehole depths, they are expected to extend to the typical depths of approximately 6 m below existing grades at the southern portion of the site and up to approximately 10 m below existing grades on the north portion of the site. Based on the results of the investigation, excavation will generally be carried out within the fills and into the native deposits of sandy silt till, clayey silt till and silty sand.

Subject to groundwater control measures discussed in the following sub-section, excavation may be carried out in open cuts using conventional equipment. Side slopes of temporary excavation must conform to the Occupational Health and Safety Act (OHSA) and local regulations. Within the meaning of OHSA, the fills and sandy silt till deposit where wet, are classified as Type 3 soil. The silty sand, where wet is classified as Type 4 soil. The compact sandy silt till and silty sand above the groundwater table are classified as Type 2 soils. In areas where localized seepage of groundwater is encountered it may be necessary to flatten the side slopes. Locally, due to spatial restrictions, vertical trenching may be required. It is our opinion that steeper temporary slopes may be permitted if a trench box is utilized, subject to on-site inspection.

It should also be noted that occasional boulders were noted within the till deposits and their presence may influence the progress of excavation. Consequently, provisions should be made in the contract documents to cover any delays caused by boulder obstructions.



## 6.3.1.2 Groundwater Control

Given the recorded groundwater conditions and the anticipated depths of installations of services, positive groundwater control measures such as well points or eductor wells will be required to facilitate construction particularly in the northern and southern one-thirds of the site. Such groundwater control measures will be required where excavation below the groundwater table in the silty sand encountered at the site as summarized in Section 5 of this report, is to be carried out. The groundwater level should be lowered to at least 0.5 m below service trench base elevations and maintenance hole structures prior to construction and be maintained until backfill above the groundwater table has been completed. Any residual localized seepage of groundwater into the trenches can be handled using conventional sump pumping techniques. Grain Size Analyses of representative samples of the subsurface soils to assist with design of the groundwater control measures are compiled in Appendix A.

Above the groundwater table, seepage into the trenches is expected to primarily originate from perched conditions in the fill and wet sand seams and layers in the sandy silt till and clayey silt till deposits. The quantity of water from these sources will vary depending upon the extent and thickness of individual wet seams and layers. It should be recognized that groundwater levels are also influenced by the effects of precipitation as well as seasonal fluctuations. It is our opinion that the seepage produced by these sources can be handled using conventional sump pumping in conjunction with oversized excavations.

#### 6.3.1.3 Pipe Bedding

It is anticipated that the sewer and watermain pipes will be founded on competent native soils or on engineered fill. Provided adequate groundwater control measures are implemented, no bearing capacity problems are envisaged.

In general, the pipe bedding may consist of a minimum thickness of 150 mm of compacted OPSS Granular "A" material. Where wet conditions are encountered, the pipe bedding may comprise 150 mm of 19 mm clear stone or HL-6 stone material. However, the clear stone or HL-6 stone bedding must be completely wrapped in a geotextile filter fabric to prevent the migration of fines from the surrounding soils, which may result in settlement of the pipes. The chosen geotextile should be compatible with the existing soils on site. It is anticipated Terrafix 270R or similar should suffice.

The base of the excavations in the competent compact to very dense soils should remain stable provided excavations are not left open for extended periods of time and the work is done in accordance with good construction practice.



The bedding material should be placed in 150 mm lifts and compacted to at least 98% SPMDD. Particular attention should be given to ensure material placed beneath the bottom quadrants of the pipe is adequately compacted. Compaction is not required for clear stone or HL-6 stone bedding.

Pipe cover material should consist of fine sand which can be more readily compacted with light equipment to avoid damaging the pipes. The cover material should be placed in 150 mm lifts, compacted to 98% SPMDD and extend to 300 mm above the top of the pipe.

#### 6.3.1.4 Backfilling Operations

The existing native soils which are not contaminated with topsoil and other obviously unsuitable material may be reused as trench backfill if the moisture contents are within 2% of their optimum values. In this regard, portions of the excavated native soils as identified in Section 5.1 and the majority of the fill soils would be wet and will require drying for proper compaction.

Excavated topsoil and peat should not be used for trench backfilling purposes. These materials may be used in landscaping areas. Any organic or excessively wet or otherwise deleterious material should not be used for backfill purposes. Any shortfall of suitable on-site excavated material can be made up with imported clean approved fill or granular material, OPSS Granular 'B' or equivalent.

In general, the on-site native soils are not free draining and therefore should not be used where this characteristic is required, or in confined areas. Imported granular material conforming to OPSS Granular 'B' would also be suitable for these purposes.

In areas where substantial cutting and filling is required, the compaction of the fill should be monitored on a full-time basis by qualified geotechnical personnel.

All backfilling and compaction operations must be closely examined by qualified geotechnical personnel to confirm that uniform compaction to specification requirements is achieved, especially in the vicinity of sewer maintenance holes and catchbasins, near the ends of compaction runs, and in all areas that are not readily accessible to compaction equipment, etc. All backfilling should be placed in maximum 300 mm horizontal lifts and uniformly compacted to 95% SPMDD. Within the upper 600 mm of road subgrade, the fill material should be compacted to at least 98% SPMDD. Smaller lifts may be required depending on the size of compaction equipment used by the contractor and the moisture content of fill at the time of construction.

To minimize potential problems, backfilling operations should follow closely after excavation so that only minimal length of trench slope is exposed. This will minimize wetting of the subgrade material. Should



construction extend to the winter season, particular attention should be given to ensure that frozen material is not used as backfill.

# 6.3.2 Pavement Design and Construction

The pavement subgrade is expected to comprise native sandy silt till, sand, clayey silt till and compacted engineered fill. Grain Size Analyses of representative near surface soils used to assist in assessment of frost susceptibility are compiled in Appendix A. Based on estimated CBR values, the frost susceptibility of the anticipated subgrade materials, expected traffic loading, and assuming adequate drainage, the following minimum pavement structure component thicknesses specified by the Town of Caledon (Table 3) are considered satisfactory. Other thickness combinations can be used provided the Granular Base Equivalency (GBE) is maintained and any minimum component thickness specified by the Town of Caledon is met.

Pavement Layer	Compaction Requirements	Local Roadway	Collector Roadway	Driveway
Asphaltic Concrete (OPSS 310)	Minimum 92 % MRD	40 mm HL3 65 mm HL8	40 mm HL3 90 mm HL8	65 mm HL3 (placed in 2 lifts)
OPSS Granular A Base (OPSS 1010)	100% SPMDD*	150 mm	150 mm	150 mm
OPSS Granular B Subbase (OPSS 1010)	100% SPMDD*	300 mm	450 mm	-

#### Table 4: Recommended Pavement Structure Thicknesses

\* Denotes standard Proctor maximum dry density, ASTM-D698

The foregoing design assumes construction is carried out during dry periods and the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is experienced, additional thickness of subbase course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free



of depressions and sloped to provide effective surface drainage toward catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

Additional comments on the construction of proposed roadways are as follows:

- As part of the subgrade preparation, proposed roadways should be stripped of topsoil and other obviously unsuitable material. Soft or spongy subgrade areas identified during proofrolling should be subexcavated and replaced with suitable approved backfill. Fill required to raise the grades to design elevations should be organic-free and at a moisture content which will permit compaction to 98% SPMDD. The final subgrade surface should be properly shaped and crowned.
- 2. The location and extent of subdrainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading. In view of the silty nature of the subgrade soils, we recommend subdrains be installed on both sides of the roadways at least 300 m below the granular subbase. This will ensure no water collects in the granular courses which could result in pre-mature pavement failure during the spring thaw.
- 3. To minimize problems of differential movement between the pavement and catchbasins/sewer maintenance holes due to frost action, backfill around these structures should consist of free-draining granular material. The granular material should be compacted to 98% SPMDD with a small tamper to avoid damaging the structures. In addition, catchbasins should be perforated just above the drain and the holes screened with filter cloth.
- 4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc. may be required, especially if construction is carried out during unfavorable weather.

# 6.4 Residential Dwelling Construction

## 6.4.1 Foundation Considerations

Soil conditions on the site are considered suitable for construction of single family dwellings. Since final site grades have not yet been established, two (2) foundation schemes are being presented for consideration; namely footings on native soils and footings on engineered fill.



#### 6.4.1.1 Footings on Native Soil

The proposed structures may be supported on conventional spread and strip footings founded on the compact sandy silt till, stiff to hard clayey silt till or compact silty sand, below all existing topsoil, fill, peat and loose soils. Footings founded on the native sandy silt till, clayey silt till or silty sand may be designed for a Geotechnical Reaction of 150 kPa at Serviceability Limit States (SLS), subject to adequate groundwater control and inspection during construction. The factored Geotechnical Resistance at Ultimate Limit States (ULS) is 225 kPa. At isolated locations where weaker native soils were encountered, reduced Geotechnical Reaction at SLS and corresponding factored Geotechnical Resistance of basements it is anticipated that founding levels would be at or below approximately 2.5 m depth. The following Table 4 shows the highest elevations at the borehole locations where the above mentioned geotechnical reactions/resistances can be applied.

## Table 5: Highest Elevation at Borehole Locations Where Recommended Geotechnical Reactions/Resistances Can Be Applied

Borehole No.	Footing SLS 150 kPa / ULS 225 kPa ~ Elevation (Depth Below Existing Grade (m))	
5	298.8 (2.5)	
6	295.5 (2.5)	
7	291.4 (2.5)	
8	292.7 (2.5)	
9	299.9 (2.5)	
10*	297.2 (5.0)	
11	294.0 (2.5)	
12	298.9 (2.5)	
13	294.9 (2.5)	
14	292.4 (2.5)	
15	297.0 (2.5)	
16**	291.4 (3.5)	
17	300.3 (2.5)	
18	300.2 (2.5)	



# Table 5 (Continued): Highest Elevation at Borehole Locations WhereRecommended Geotechnical Reactions/Resistances Can Be Applied

Borehole No.	Footing SLS 150 kPa / ULS 225 kPa ~ Elevation (Depth Below Existing Grade (m))
19	297.8 (2.5)
20	297.6 (2.5)
21***	295.3 (3.5)
22	300.7 (2.5)
23	299.3 (2.5)
24**	290.5 (5.0)
25	301.1 (2.5)
26	300.9 (2.5)
27*	297.4 (4.5)
29	300.2 (2.5)
31	298.2 (2.5)
32	299.9 (2.5)
33	299.4 (2.5)
34	301.3 (2.5)
35	300.6 (2.5)
36	300.5 (2.5)
38	301.9 (2.5)
39	302.2 (2.5)
40	302.2 (2.5)
41	301.9 (2.5)
42	300.9 (2.5)
43*	301.9 (4.5)
44	305.7 (2.5)
45	306.3 (2.5)



# Table 5 (Continued): Highest Elevation at Borehole Locations Where Recommended Geotechnical Reactions/Resistances Can Be Applied

Borehole No.	Footing SLS 150 kPa / ULS 225 kPa ~ Elevation (Depth Below Existing Grade (m))		
46***	304.6 (2.5)		
47	300.9 (2.5)		
49	303.6 (2.5)		
50	306.7 (2.5)		
51	307.5 (2.5)		
52	308.1 (2.5)		
53	308.2 (2.5)		
54	308.7 (2.5)		
55	306.6 (2.5)		
56	303.4 (2.5)		
57	305.8 (2.5)		
58*	303.9 (4.5)		
59	306.9 (2.5)		
60	307.5 (2.5)		
61	304.1 (2.5)		
62	304.7 (2.5)		
63	310.1 (2.5)		
64	309.8 (2.5)		
65	309.1 (2.5)		

Notes: \* Deep Fill

\*\* Peat

\*\*\* 75 kPa (SLS)/110 kPa (ULS)



### 6.4.1.2 Engineered Fill

The proposed structures may also be supported on footings founded on engineered fill developed over the competent sandy silt till, clayey silt till or silty sand and designed for a Geotechnical Reaction of 150 kPa at SLS and factored Geotechnical Resistance of 225 kPa at ULS. If engineered fill is constructed in the vicinities of Boreholes 21 and 46, the Geotechnical Reaction at SLS and factored Geotechnical Resistance at ULS should be lowered to 75 kPa and 110 kPa, respectively. The engineered fill should be constructed to above the level of the garage footings for the single family dwellings.

The engineered fill should be constructed by removing all topsoil, topsoil-stained soil, fill and peat down to the competent native subgrade. The engineered fill should extend at least 3 m beyond the outside edge of exterior footings. The required extent of engineered fill should be determined based on a known fixed location for the structures and adherence to the conditions outlined above. The boundaries of the engineered fill should be laid out by a surveyor in consultation with qualified engineering staff.

As mentioned in the 'Site Grading' subsection, the exposed subgrade surface should be proof-rolled and examined by qualified geotechnical personnel prior to placement of engineered fill. Any loose or soft areas detected during proofrolling should be removed and replaced with approved material compacted to 100% SPMDD. The areas can then be brought up to design subgrade level with approved on-site or imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD. Some of the on-site soils will require partial drying before they can be compacted to 100% SMPDD.

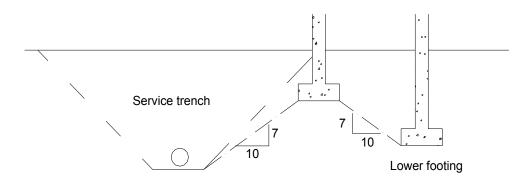
The engineered fill construction should be monitored on a full-time basis by qualified geotechnical personnel to examine and approve backfill materials, to evaluate placement operations, and to verify the specified degree of compaction is being achieved uniformly throughout the fill.

It is recommended that nominal reinforcing steel be installed in the footings and foundation walls of structures supported on engineered fill to minimize cracking from differential settlement. The basement walls should be reinforced continuously with 2-15M bars above the footings and below the window sill. If the basement walls are made from concrete blocks, equivalent top and bottom reinforcing should be provided as designed by a structural engineer.

#### 6.4.1.3 Foundations General

Footings which are to be placed at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing. This concept should also be applied to excavations for new foundations in relation to existing footings or underground services. This concept is illustrated in the following sketch:





FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements.

The on-site soils are susceptible to disturbance. It is therefore recommended that a concrete skim coat be placed over the founding surface as soon as possible after approval to protect it from disturbance from construction traffic.

The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations, are expected to be less than 25 mm and 20 mm, respectively.

It should be noted that the recommended bearing capacities have been calculated by **exp** from the borehole information for the design stage only. The investigation and comments are necessarily ongoing as new information on underground conditions becomes available. For example, it should be appreciated that modifications to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason, this office should be retained to review final foundation drawings and to examine footing conditions.

# 6.4.2 Excavation and Groundwater Control

Excavation for single family dwellings with a basement will extend to about 2 to 2.5 m below finished grade. Where excavations will be undertaken below the groundwater table, the groundwater must be



lowered to at least 0.5 m below foundation base elevations prior to construction and be maintained until permanent perimeter and underfloor drainage systems for the structures as may be required, have been installed and commissioned. Subject to implementation of proper groundwater control measures where required, excavation should be relatively straightforward and must be carried out in accordance with the latest edition of the OHSA and local regulations. For preliminary guidance, side slopes of one vertical to one horizontal may be used, subject to geotechnical inspection. Where loose soil is encountered, it may be necessary to locally flatten the side slopes.

Even with implementation of proper groundwater control measures as required, residual groundwater seepage from trapped pockets in the fill and native soils into the excavation(s) should be anticipated during construction. It should be possible to control and remove residual seepage water entering the excavation(s), using conventional construction dewatering techniques, i.e., pumping from sumps.

It should be noted boulders frequently occur in till deposits and their presence may influence the progress of excavation. Consequently, provisions should be made in the contract documents to cover any delays caused by the presence of boulders.

# 6.4.3 Floor Slab Construction and Permanent Drainage

The floor slab may be constructed as a slab-on-grade on a properly prepared subgrade (i.e., on native undisturbed soils or engineered fill). In this regard, all topsoil, fill and other obviously unsuitable material should be removed from the entire underfloor area and the exposed subgrade thoroughly proofrolled. Any soft spots detected should be sub-excavated and the area brought up to design grades using approved clean fill in the manner described in the "Site Grading" section of this report.

A 200 mm layer of 19 mm clear stone should be placed between the prepared subgrade and the floor slab to serve as a moisture barrier.

It is recommended that the foundation walls be covered with a bituminous damp-proofing spray and a drainage sheet. In addition, a weeping tile surrounded with 300 mm of 19 mm clear stone and wrapped with a filter cloth should be installed around the perimeter of the basement and connected to a frost free outlet.

In areas where the subgrade consists of wet/saturated soil (below the groundwater table) or where persistent groundwater seepage is encountered during excavation, underfloor subdrains should also be installed. The subdrains should consist of 100 mm diameter perforated pipe surrounded by 150 mm of 19 mm clear stone all wrapped in Terrafix 270R or equivalent. The drainage system should lead to frost



free sumps or outlets from which the water can be removed. The need for underfloor subdrains should be further assessed upon basement excavation.

## 6.4.4 Earth Pressure on Subsurface Walls

The lateral earth pressure acting on subsurface walls (i.e., basement walls) may be calculated from the following equation:

where:

- p = the pressure in kPa acting against any subsurface wall at depth, h, below the ground surface;
  - k = the earth pressure coefficient considered to be appropriate for the subsurface walls, for this case, 0.4;
  - $\gamma$  = the bulk unit weight of the backfill, use 22.5 kN/m<sup>3</sup>;
  - h = the depth in m below the ground surface at which the pressure, p, is to be computed; and,
  - q = the value of any adjacent surcharge in kPa which may be acting close to the wall.

The above expression assumes an effective perimeter tile drain system will be incorporated to prevent the build-up of hydrostatic pressure behind the subsurface wall. All subsurface walls should be waterproofed. To minimize infiltration of surface water, the upper 600 mm of backfill should comprise compacted relatively impervious material sloped away from the structure.

# 6.4.5 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

## 6.4.5.1 Subsoil Conditions

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 of OBC 2012. The subsoil consisted of topsoil, fill, compact to very dense sandy silt till, compact to very dense silty sand and stiff to hard clayey silt till. The foundations will be founded on the competent native



soil or on engineered fill. The reported N-values for the soil below the anticipated floor slab level ranged from 5 to 50 for 80 mm.

There have been no shear wave velocity measurements carried out at this site and therefore, N-values will be used to determine the site classification.

#### 6.4.5.2 Depth of Boreholes

Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2012 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The boreholes at this site were advanced to depths of about 6.6 to 15.7 m. Shale bedrock was not contacted within the depths of investigation.

#### 6.4.5.3 Site Classification

Based on the soil conditions, the Site Class for this site is "D" as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.



# 7. Stormwater Management Pond

A potential stormwater management pond is being considered for the southwestern corner of the site. Based on a supplied drawing, it was noted that the base elevation of the pond is set at approximate Elevation 295.0 m.

Boreholes drilled in the area of the potential stormwater management pond encountered loose to very dense sandy silt till over loose to very dense silty sand. A stabilized groundwater level of ~293.3 m was recorded in the monitoring well installed in Borehole 2 during the course of this investigation. At this elevation, the subsurface soil comprises dense silty sand. It should be noted that the fieldwork was carried out during the spring thaw when the groundwater level is likely at its highest with fluctuations of approximately 1 m.

Based on the results of the boreholes it is **exp's** opinion that construction of a stormwater management pond in this area is feasible. The material at the base and sides of the pond will primarily comprise sandy silt till and silty fine sand. It is anticipated that the sandy silt till will exhibit coefficients of hydraulic conductivity in the order of 10<sup>-5</sup> to 10<sup>-6</sup> cm/sec which is considered relatively low. The silty fine sand is expected to exhibit coefficients of hydraulic conductivity in the order of 10<sup>-5</sup> cm/sec which is considered noderate. As such it is recommended that a liner be incorporated into the pond design to mitigate infiltration of surrounding groundwater into the pond and exfiltration of stormwater to the surrounding soils. The pond base is above the observed groundwater level and should not pose the risk of base heave when emptied for cleaning.

The supplied drawing indicates sides of the pond being sloped between 3 Horizontal:1 Vertical and 5 Horizontal:1 Vertical which is acceptable. The pond slopes should be vegetated to prevent surface erosion. Where wet sand is encountered, a layer of armour stone with filter cloth backing should be placed on the slope face to prevent sloughing. It is suggested that a layer of rip-rap be placed at the base of the pond to serve as a marker during cleaning.

More detailed comments can be provided once the design specifications of the pond have been finalized.



# 8. General Comments

**Exp** should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, **exp** will assume no responsibility for interpretation of the recommendations in the report.

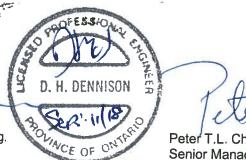
The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, **exp** should be contacted to assess the situation, and additional testing and reporting may be required. **Exp** has qualified personnel to provide assistance in regards to future geotechnical and environmental issues related to this property.

Yours truly,

Exp Services Inc.

David Dennison, P.Eng. Senior Engineer Geotechnical Division

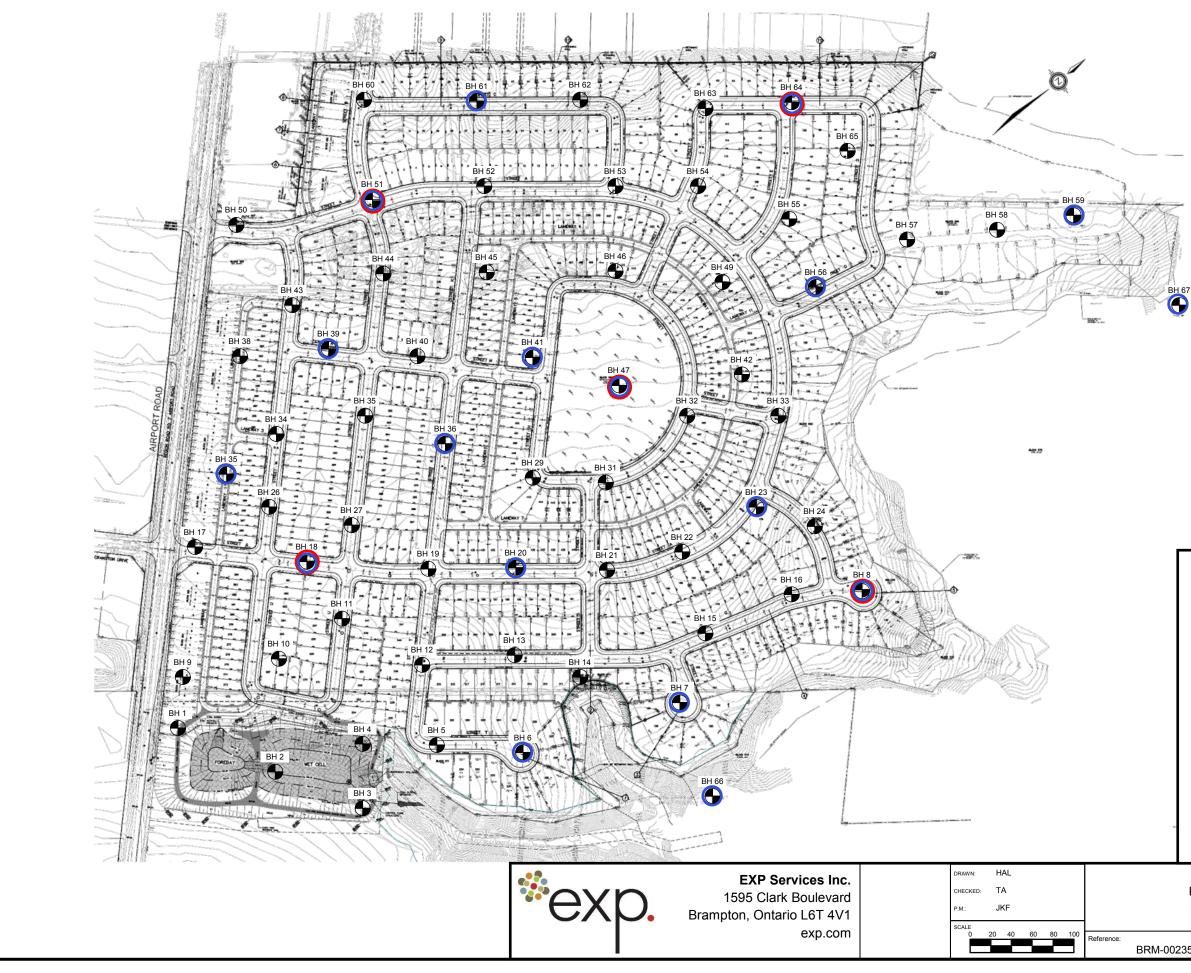


Peter T.L. Chan, P. Eng. Senior Manager, Central Ontario Geotechnical Services

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Drawings: Borehole Location Plan Notes on Sample Description Borehole Logs







Borehole

Monitoring Well

Nested Monitoring Wells

# Note:

Caledon East, Ontario

rence:		Drawing:
	BRM-00235186-D0	

1

# Notes on Sample Descriptions and Soil Types

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** also follow the same system. Others may use different classification systems; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

				ISSM	IFE SOIL	CLASSIF	ICATIC	DN				
CLAY	AY SILT			SAND			GRAVEL	COBBLES	BOULDERS			
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								÷				
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	EQUIVALENT GRAIN DIAMETER IN MILLIMETERS											
CLAY (I	PLASTIC) TO	)		FINE	М	EDIUM	COARSE	FINE	COARSE			
SILT (N	ONPLASTIC	)			SA	AND		GR	AVEL			

UNIFIED SOIL CLASSIFICATION

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

till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

4. Excerpt from "OHSA Regulations for Construction Projects," Part III, Section 226:

#### • Soil Types

Type 1 Soil

- a) is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
- b) has a low natural moisture content and a high degree of internal strength;
- c) has no signs of water seepage; and
- d) can be excavated only by mechanical equipment.

#### Type 2 Soil

- a) is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
- b) has a low to medium natural moisture content and a medium degree of internal strength; and
- c) has a damp appearance after it is excavated.

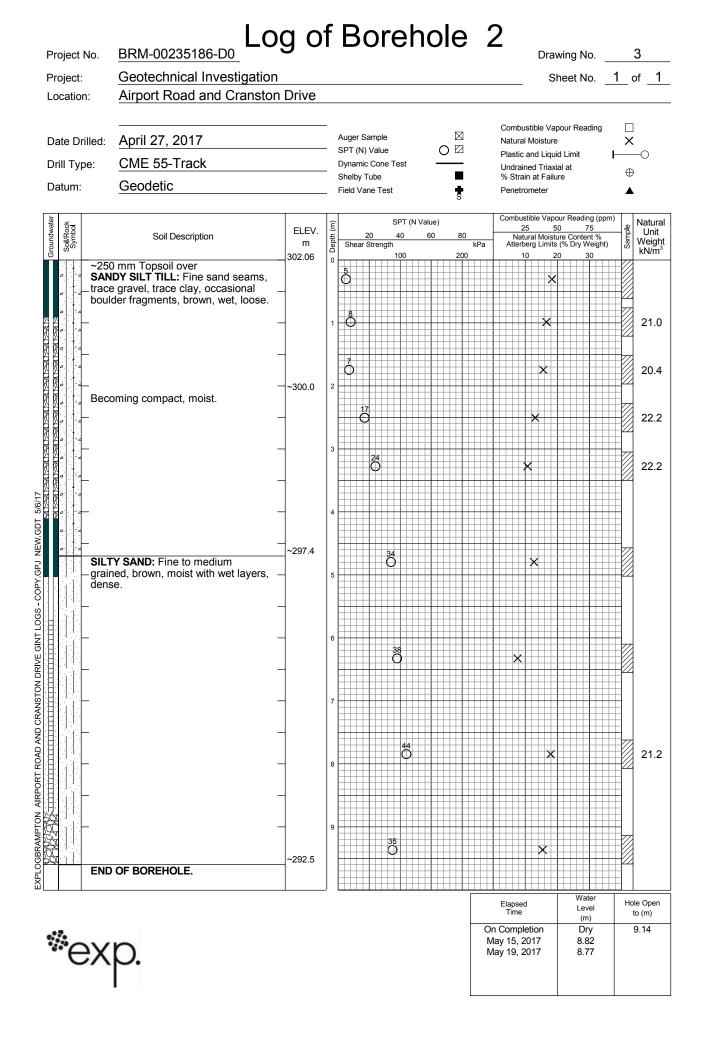
Type 3 Soil

- a) is stiff to firm and compact to loose in consistency or is previously excavated soil;
- b) exhibits signs of surface cracking;
- c) exhibits signs of water seepage;
- d) if it is dry, may run easily into a well-defined conical pile; and
- e) has a low degree of internal strength.

Type 4 Soil

- a) is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
- b) runs easily or flows, unless it is completely supported before excavating procedures;
- c) has almost no internal strength;
- d) is wet or muddy; and
- e) exerts substantial fluid pressure on its supporting system. O. Reg. 213/91, s. 226.

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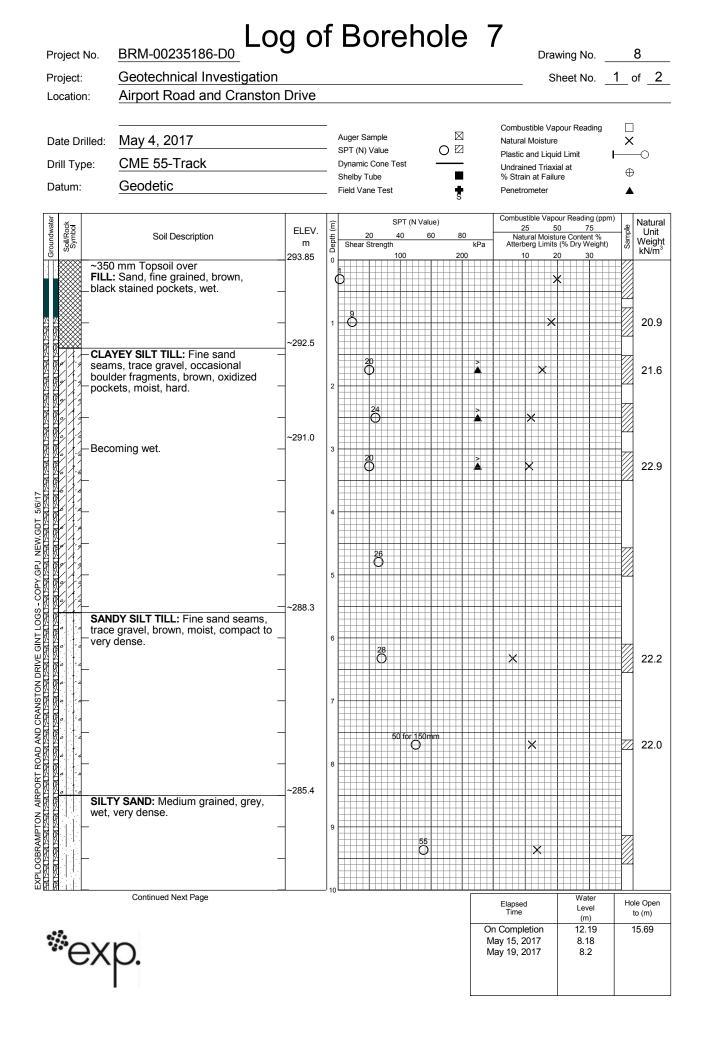


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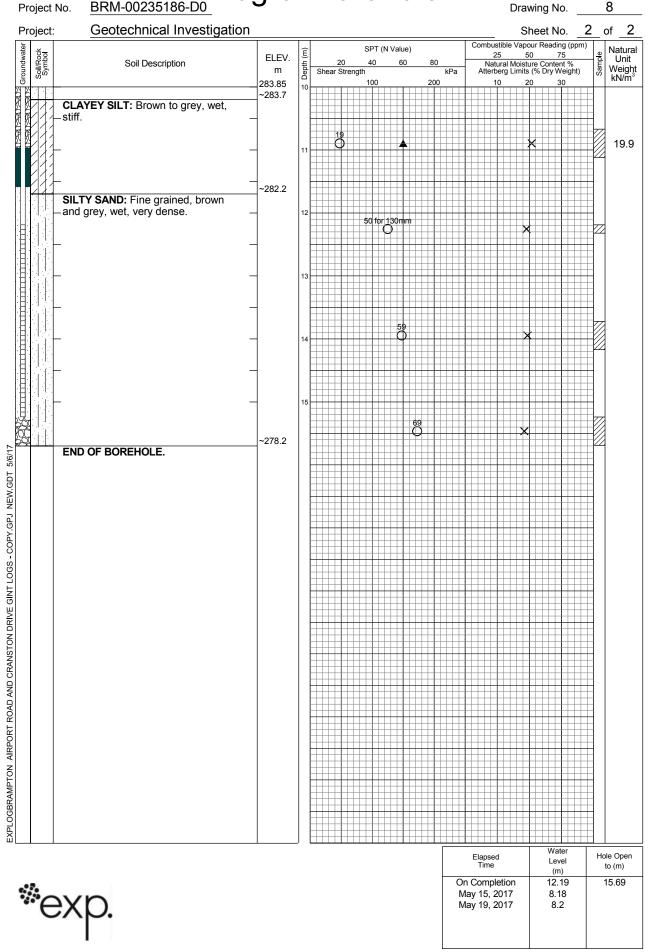
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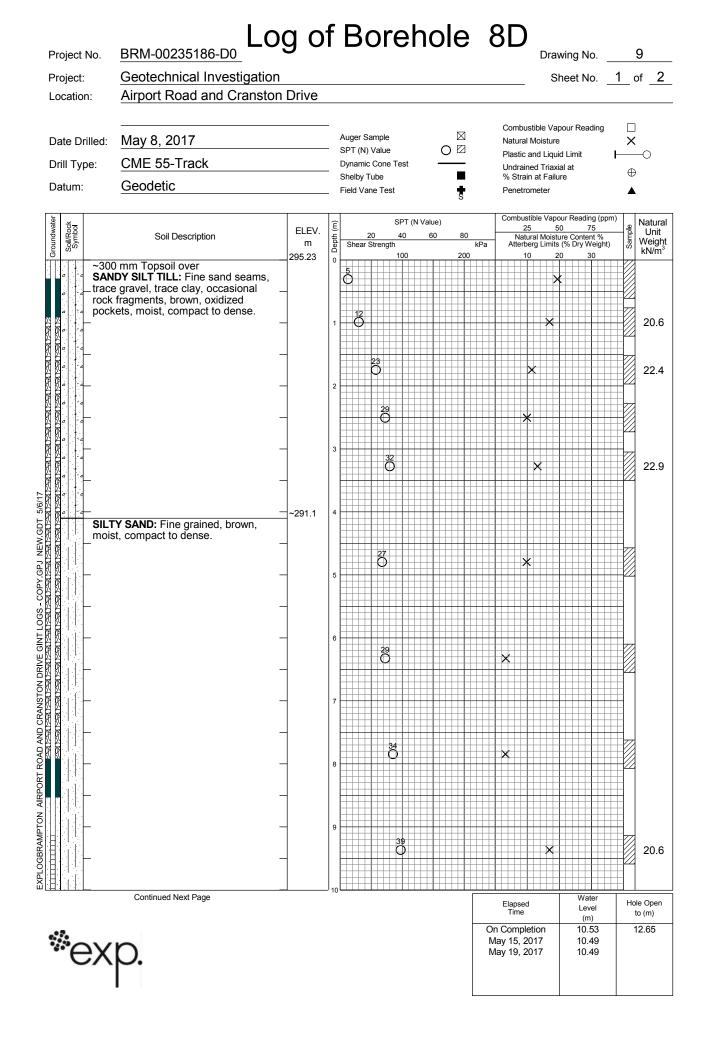
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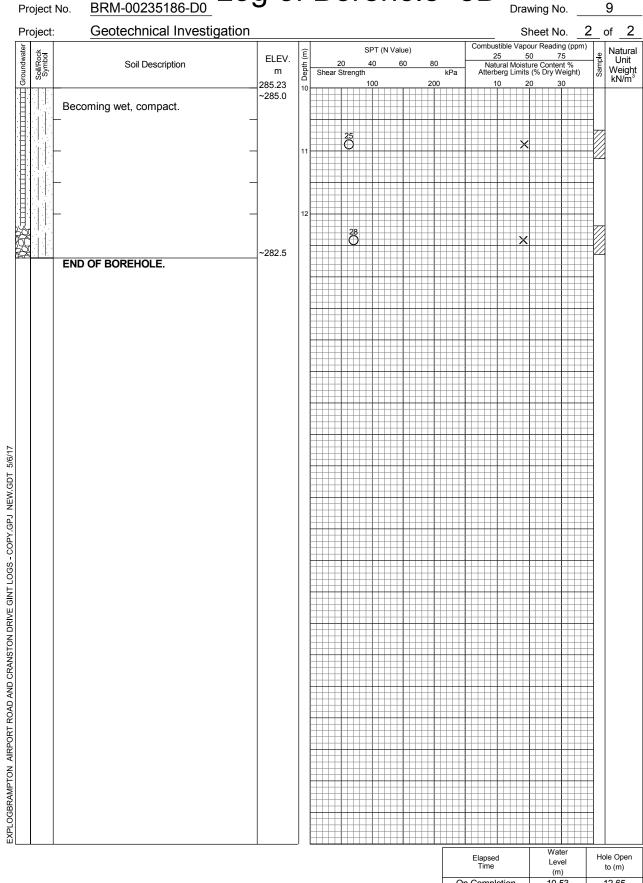
## Log of Borehole 7

BRM-00235186-D0





## BRM-00235186-D0 Log of Borehole 8D Drawing No.





Elapsed Time	Water Level (m)	Hole Open to (m)
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May 19, 2017	10.49	

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oject: ocation:	Geotechnical Investigation Airport Road and Cransto						S	heet No.	<u>1</u> (	of <u>1</u>
						C	ombustible Va	nour Reading		1
ate Drilled:	April 26, 2017			Auger Sample SPT (N) Value		Ν	atural Moisture	)	×	
rill Type:	CME 55-Track		_	Dynamic Cone Test Shelby Tube		U	ndrained Triax	ial at	$\oplus$	0
atum:	Geodetic		_	Field Vane Test	S		enetrometer			
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	Shear Strength	60 80 kP		25 5 Natural Moisti Atterberg Limits	our Reading (ppm) 0 75 ure Content % 5 (% Dry Weight)	Sample	Natur Unit Weigł kN/m
~22 FIL	25 mm Topsoil over L: Silty sand to sandy silt, trace vel, clayey silt pockets, brown,	302.38	0		200					KIVII
moi	ist.	_	1	Ô			×			21.
		~300.5		ō.				×		18.
frac	NDY SILT TILL: Fine sand seams, ce gravel, occasional boulder gments, brown, oxidized fissures, ist, compact.		2	13 O			- ×			21.
0 6 0 6		_	3	15 O			×			
0 e			4							
o q		_		22						
	TY SAND: Fine to medium ined, scattered gravel, brown,	_~297.3	5	0			×			22.
mo			6							
ENI	D OF BOREHOLE.	~295.8					*			
			'			E	lapsed Time	Water Level (m)		ble Oper to (m)
*ex						On Co	ompletion	Dry		5.79

oject No.	BRM-00235186-D0	3 -		Boreh		Dra	awing No.		11
oject:	Geotechnical Investigation					:	Sheet No.	<u>1</u>	of
ocation:	Airport Road and Cranston	Drive							
			_	Auger Sample	$\boxtimes$		apour Reading		
ate Drilled:	April 27, 2017 CME 55-Track		_	SPT (N) Value	0	Natural Moistu Plastic and Liq		X	-0
rill Type: atum:	Geodetic		-	Dynamic Cone Test Shelby Tube		Undrained Tria % Strain at Fa		$\oplus$	•
atum.			-	Field Vane Test	s	Penetrometer			
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Val 20 40 6 Shear Strength	60 80 kF	25 Natural Moi Pa Atterberg Limi	pour Reading (ppm) 50 75 sture Content % its (% Dry Weight)	Sample	Natu Un Weig kN/r
~150	) mm Topsoil over : Sandy silt, trace gravel, trace scattered rock fragments, brown, . st.	302.16	0	100			20 30 X		19
				ů Č		×			21
	· · · · · · · · · · · · · · · · · · ·	-	2	28		*			22
Laye	er of dark brown silt, sand and el.	~299.0	3	6		×			
	DY SILT TILL: Fine sand seams layers, trace gravel, moist, loose ense.	~298.1	4						
ρ			5	Ô		*			22
0 e		_	6	39		*			
END	OF BOREHOLE.	_~295.6							
						Elapsed Time	Water Level (m)		le Op to (m)
ех					F	On Completion	Dry		5.79

	Geotechnical Investigation					Sheet	t No. <u>1</u>	(	of
-			_	Auger Sample		ustible Vapour I	Reading		
_	April 27, 2017 CME 55-Track		_	SPT (N) Value O	Plasti	al Moisture c and Liquid Lim	iit 📙	×	-0
	Geodetic		_	Shelby Tube	% Str	iined Triaxial at ain at Failure rometer		0	
-			-	S				_	
Soil/Rock Symbol	Soil Description	ELEV. m 301.41	o Depth (m)	SPT (N Value)           20         40         60         80           Shear Strength         100         200	kPa Atter	ustible Vapour Re 25 50 atural Moisture Co berg Limits (% D 10 20	75	Sample	Natu Ur Wei kN/
💥 FILL: S	nm Topsoil over Sandy silt to clayey silt, trace brown, moist to wet.		U	<b>Č</b>		×			
_		~300.0	1	ð		×			21
trace g	<b>/ SILT TILL:</b> Fine sand seams, ravel, occasional shale and r fragments, brown, moist, ct to very dense.		2	23 O		×			21
		_		26 O		*			21
		_	3	39 O		×			22
<i>a</i>		_	4						
0 0 0 0		_		51					20
			5						20
Becom	ing wet.	-~295.8							
moist,		~295.2 ~294.8	6	46 O		×			
END O	F BOREHOLE.								
I			_1 1		Elapse	ed	Water Level		le Op to (m)
exp					On Comp		(m) Dry		5.94

oject No.	BRM-00235186-D0							ving No.		13
oject: ocation:	Geotechnical Investigation Airport Road and Cranstor						_ Sł	neet No	<u> </u> (	of _
			_						_	
ate Drilled:	April 27, 2017			Auger Sample SPT (N) Value		Natu	Iral Moisture		⊔ ×	
rill Type:	CME 55-Track		_	Dynamic Cone Test		Und	tic and Liquid rained Triaxia	al at	•	-0 ,
atum:	Geodetic			Shelby Tube Field Vane Test	s		train at Failu etrometer	le		
ž <u>o</u>		ELEV.	(m)	SPT (N Val	ue)	Com	bustible Vapo 25 50	ur Reading (ppm) ) 75	e	Nat
Soil/Rock Symbol	Soil Description		Depth (m	20 40 6 Shear Strength 100	80 80 kF 200	Pa Att	Vatural Moistu erberg Limits 10 20	re Content % (% Dry Weight)	Sample	U We kN
SAN	) mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams,		0	5 O			×		0	
	e gravel, occasional boulder ements, brown, moist, compact.	-							4	1
		_	1	10 Ö			×			22
2 C										
0 0				16 O			×			2
o a o a		1	2							
e     − Sanc	d and gravel layer ~225 mm thick.	~298.9		Č.			<b>*</b>			2
		_	3							1
a				Č.			×			2
0 0		~297.4								
Find	sand layers.		4							
o a		-		27						
0 a		_	5	Ö			*		4	2
0 a_		~295.8								
	Y SAND: Fine grained, brown,									
			6	35			×			2
END	OF BOREHOLE.	~294.8							4	
										1
										1
										1
						Elap	sed	Water Level		le O
*ex					$\vdash$	On Corr		(m) Dry		to (m 5.94

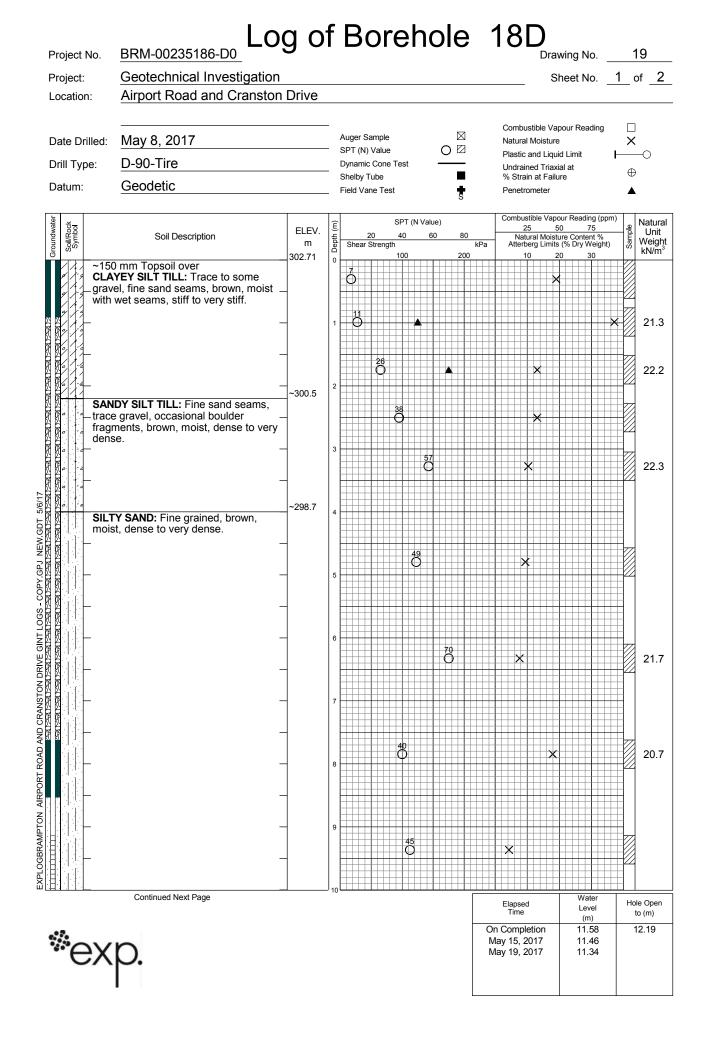
oject:		Geotechnical Investigation	า				Sheet No.	1 -	h
oject.		Airport Road and Cranston					Sheet No		<u>ר</u>
				_		Combust	ible Vapour Reading		
ate Dri	illed:	May 2, 2017			Auger Sample 🛛 SPT (N) Value O	Natural N		×	
ill Typ	e:	CME 55-Track		-	Dynamic Cone Test Shelby Tube	Undraine	d Triaxial at at Failure	•	
atum:		Geodetic		-	Field Vane Test S	Penetron		<b></b>	
Soil/Rock Symbol		Soil Description	ELEV. m 297.44	Depth (m)	100 200	25	ble Vapour Reading (pp 50 75 al Moisture Content % g Limits (% Dry Weight) 20 30	<u>e</u>	Nat U We kN
	FILL _grave	) mm Topsoil over : Sandy silt to clayey silt, trace el, brown, topsoil stained pockets, t to wet.		1			× .		21
o   c	-trace	<b>DY SILT TILL:</b> Fine sand seams, gravel, trace clay, brown, moist, se to very dense.	~295.2 	2		;	*		2
ρ c 2 c	- - SILT	<b>Y SAND:</b> Fine grained, silt	~293.3	4	3	*			22
	sean dens	ns, brown, moist, dense to very	_	5	50 for 130mm	*			
	END	OF BOREHOLE.	~290.8	6	44 ©		×		2′
				_		Elapsed	Water		le Op
έ						Time On Complet	(m)		to (m)

oject No. oject:	BRM-00235186-D0 Geotechnical Investigation						Drawing N Sheet N			5 of _
ocation:	Airport Road and Cranstor	n Drive								
ate Drilled:	May 2, 2017			Auger Sample			istible Vapour Re I Moisture	ading	$\square$	
ill Type:	CME 55-Track		_	SPT (N) Value Dynamic Cone Test		Undrai	and Liquid Limit ned Triaxial at	ŀ	•	-0
atum:	Geodetic			Shelby Tube Field Vane Test	s		in at Failure ometer		▲	
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N 20 40 Shear Strength	60 80	Na kPa Atter	ural Moisture Cont berg Limits (% Dry	75 ent % Weight)	Sample	Nat U We kN
~450 <b>SAN</b> _trace	0 mm Topsoil over I <b>D:</b> Medium to coarse grained, e gravel, brown, wet, loose to	294.85	0	3 3	200			30		
com _	pact.	_	1	Ô			×			
		-		18			x			
sear	YEY SILT TILL: Fine sand ns, trace gravel, brown, wet, stiff	~292.7	2	29 C			*			
	ery stiff.	_	3				×			
		~290.9	4							
Beco	oming grey, wet.	_	-	15						
		_	5	Ö			×			2
	<b>DY SILT TILL:</b> Medium grained seams, trace gravel, brown, wet,	~289.3 	6							
0 4	OF BOREHOLE.	~288.3					×			
ex						Elapse Time	d Le	ater evel m)		e O o (m

roject No.	BRM-00235186-D0	_						Drawing			16
roject: ocation:	Geotechnical Investigation Airport Road and Cransto							Sheet	No	1	of _1
	May 2, 2017		- A	uger Sample		$\boxtimes$		tible Vapour R	Reading		]
oate Drilled: Drill Type:	<u>May 3, 2017</u> CME 55-Track		- s	PT (N) Value ynamic Cone Te	act	0 🛛		nd Liquid Limi	it	×	—O
)atum:	Geodetic		s	helby Tube eld Vane Test	551			ed Triaxial at at Failure		¢	)
			_ ''			S					<b>`</b>
Symbol	Soil Description	ELEV. m 299.46		20 4 Shear Strength	PT (N Val 40 (	ue) 60 80 kF 200	25	ble Vapour Rea 50 al Moisture Co rg Limits (% Dr 20	75	Sample	Natura Unit Weigł kN/m
~250 FILL	0 mm Topsoil over .: Sandy silt to clayey silt, trace lets, trace gravel, brown, moist.	299.40	0	5				×			
-		_	>50  1	o for 12" O				*			20.1
		_		Ô				×			20.2
	IDY SILT TILL: Fine sand seams, e gravel, occasional boulder	~297.3	2	26				×			22.3
fraq	ments, brown, oxidized partings, st, compact to dense.	_	3		45						
р р г с		_			0		*				
0 6 0 6			4								
o e		_	5					×			22.
e e Beco	oming wet, compact.	-~293.9									
0 4 0 4		~292.9	6	22 O				×			21.9
END	) OF BOREHOLE.										
							Elapsed		Water Level		ble Oper to (m)
*ex						$\vdash$	On Complet	tion	(m) 6.10		6.55

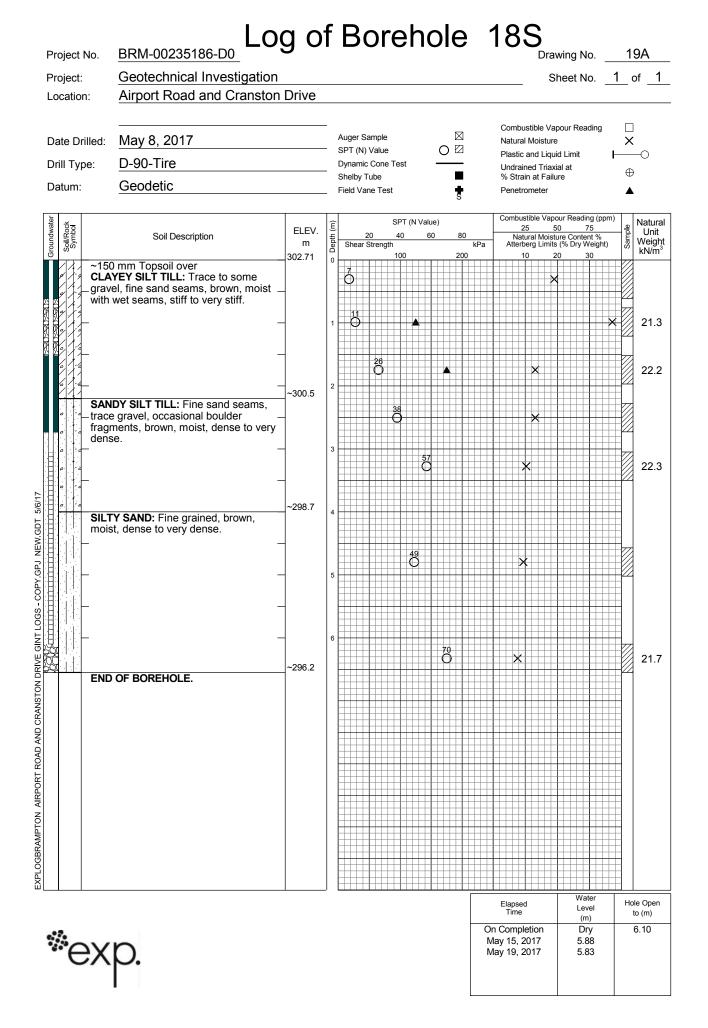
roject No. roject: ocation:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranstor								awing No	
ate Drilled:	May 3, 2017			Auger Sample				Combustible Va Natural Moistur		×
rill Type:	CME 55-Track		_	SPT (N) Value				Plastic and Liqu Undrained Triax	xial at	—O ⊕
atum:	Geodetic			Shelby Tube Field Vane Te	st	Š		% Strain at Fail Penetrometer	ure	▲
Soil/Rock Symbol	Soil Description	ELEV. m 294.92	o Depth (m)	20 Shear Streng	SPT (N 40 th 100	Value) 60 80 200	kPa	25 Natural Mois Atterberg Limit	bour Reading (ppm) 50 75 ture Content % s (% Dry Weight) 20 30	) al Unit Weigh kN/m
FIL	0 mm Topsoil over L: Clayey silt, trace gravel, brown rey, oxidized pockets, moist.	_		5				*		
	AT: Fibrous decayed vegetation, od fragments, black, wet, very se.	~293.9	10	Ó 1					×	10.1
	TY SAND: Fine grained, clayey	~292.4	2							¥ 10.3
	and gravel layers, grey, wet, loose.		3	°.					×	
<b>CL</b>	AYEY SILT TILL: Silt seams, trace vel, grey, moist, stiff to hard.	~290.8	4							
		_	5					*		22.0
ENI	D OF BOREHOLE.	~288.6	6		50 for 1	50mm )		×		
1			_1					Elapsed Time	Water Level (m)	Hole Open to (m)
<sup>*</sup> ex	5						Or	Completion	(m) Dry	6.25

•	BRM-00235186-D0					Drawing No.		18
	Geotechnical Investigation Airport Road and Cransto					Sheet No.		OT _
			_	Auger Sample		stible Vapour Readin	-	
	April 26, 2017		-	SPT (N) Value	Naturai	Moisture and Liquid Limit	, ⊢	<b>&lt;</b> —0
	CME 55-Track Geodetic		_	Dynamic Cone Test Shelby Tube		ed Triaxial at n at Failure	e	Ð
itum:	Geodelic		-	Field Vane Test	Penetro	ometer	4	•
Soil/Rock Symbol	Soil Description	ELEV. m 302.81	Depth (m)	100 20	) 2: Natu kPa Atterb	ral Moisture Content of erg Limits (% Dry Weig	4	Nat U We kN
FILL:	mm Topsoil over Sandy silt to clayey silt, trace I, brown, moist.		0	Ô		*		
	SANDY SILT TILL: Fine sand seams, trace gravel, trace clay, occasional		1	ð		*		1
trace (			2	15 O		×		2
o d 0 d				29 Č	*******	<pre></pre>		2
		_	3	28 O	×			2
Becor	ning dense.	_~298.8	4					
			5	43 O		*		2:
	<b>' SAND:</b> Fine grained, brown,	~297.2						
	, very dense. DF BOREHOLE.	~296.5	6	50 for 150mm		×		2
I		I	_1		Elapseo	Water Level		lole O to (m
exp					On Comple	(m)		6.04



## Log of Borehole 18D BRM-00235186-D0 Project No.

Becoming wet, compact.       -201.0       -201.1       Becoming wet, compact.       -201.1       -201.1       -201.1       -201.1       -201.1<	Project:	Geotechnical Investig		Ê			SP	T (N Va	lue)	 	Co	mbus	stible	Vapo	ur Read	ding (ppm	1)	of
END OF BOREHOLE.	Soil/Rock Symbol	Soil Description		0 Depth (m)	Shea	20 r Stren	gth		60	kPa	4						Samp	Ur Wei kN/
Elanood Water Hole On			- 	11														
											Ela	apsed						lole Op to (m)



·	IM-00235186-D0	•		Boreh	_	Dr	awing No		20
	otechnical Investigation						Sheet No	1	of _
ocation: <u>Air</u>	port Road and Cranstor	Drive							
ate Drilled: Ap	ril 27, 2017			Auger Sample		Combustible V Natural Moistu	/apour Reading ire	×	-
	/IE 55-Track			SPT (N) Value Dynamic Cone Test	0 🛛	Plastic and Lic Undrained Tria	•		-0
atum: Ge	odetic			Shelby Tube Field Vane Test	■ <del>★</del>	% Strain at Fa Penetrometer	ilure	∉	•
~				SPT (N	/alue)	Combustible Va	pour Reading (ppn	n)	Natu
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m	20 40 Shear Strength	60 80	25 Natural Moi Pa Atterberg Lim	50 75 sture Content % its (% Dry Weight)	Sample	Un Weig kN/i
~200 mm	Topsoil over	300.26	0	100	200	10	20 30		KIN/
trace grav	<b>ILT TILL:</b> Fine sand seams, vel, occasional boulder s, brown oxidized pockets	-		0			×		
and silt p	artings, moist, compact.		1			×			22
0 C									
0 0		-		d Ö		×			
o		-	2						
0 0 0		_				×			21
a			3						
0			Ū	26 O		×			22
o c		-							
a	· · · · · · · · · · · · · · · · · · ·	-	4						
8 a		_							
0 a			5	29 Ö		×			22
0									
Becoming	g wet, dense.	~294.7							
e e		-	6	42					
0 10		~293.7		Ő			×		21
END OF E	BOREHOLE.								
						<b>F</b> ' '	Water		ble Ope
						Elapsed Time	Level (m)		to (m)
*exp						On Completion	5.03		5.79

roject No. roject:	BRM-00235186-D0 Geotechnical Investigation						awing No Sheet No	21 1_ of
ocation:	Airport Road and Cranston	n Drive						
ate Drilled:	May 9, 2017		_	Auger Sample	$\boxtimes$	Combustible V Natural Moistu	apour Reading re	□ ×
rill Type:	CME 55-Track			SPT (N) Value Dynamic Cone Test	0 🛛	Plastic and Liq Undrained Tria	· -	C
atum:	Geodetic			Shelby Tube Field Vane Test	s	% Strain at Fai Penetrometer	lure	⊕
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value 20 40 60 Shear Strength		25	pour Reading (ppm) 50 75 sture Content % its (% Dry Weight)	
~250	0 mm Topsoil over	300.12	0	100	200	10	20 30	<sup>07</sup> kN
_ trace	<b>IDY SILT TILL:</b> Fine sand seams, e gravel, trace clay, occasional der fragments, brown, moist, loose	_		Ó			×	
	ense.		1	Å .		×		
р р с								
o a				22 O		× .		
0 a 0 a		-	2					
o a		-				<b>×</b>		
		_	3	21				
a a				Ö		×		
e e								
SILT	Y SAND: Fine grained, brown,	~296.0	4					
	st, dense.	-		37				
		-	5			*		
의 것이 같이다는		_						
			6					
				46 O		×		
END	OF BOREHOLE.	~293.5						
							Water	
						Elapsed Time	Level (m)	Hole O to (m
*ex	5					On Completion May 15, 2017	Dry 5.85	6.10

oject: cation:	Geotechnical Investigation Airport Road and Cranstor						Shee	et No	1_ of
te Drilled: Il Type: tum:	May 9, 2017 CME 55-Track Geodetic		_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test		Natural Plastic a Undrain	tible Vapour Moisture Ind Liquid Lir ed Triaxial at I at Failure meter	nit l	× ()
ypogun/so volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions volutions voluti	Soil Description ) mm Topsoil over I <b>DY SILT TILL:</b> Trace gravel,	ELEV. m 298.77	o Depth (m)	SPT (N 20 40 Shear Strength 100	S Value) 60 80 kP 200	25	50 ral Moisture C rg Limits (% [	teading (ppm) 75 Content % Dry Weight) 30	A M M
brow	<b>Y SAND:</b> Stratified, fine grained, <i>n</i> , moist, loose to very loose.		1	5 0 4			×		
		_	3	ð 0		*			
	oming cemented, compact.	 ~293.2	5			>	<		
END	OF BOREHOLE.	~292.2		Ö			×		
ex						Elapsed Time		Water Level (m) Dry	Hole to (

oject No.	BRM-00235186-D0						Drawin		23
oject: cation:	Geotechnical Investigation Airport Road and Cranstor						_ Shee	et No.	
			_		_	Comb	oustible Vapour	Reading	
ate Drilled:	May 9, 2017			Auger Sample SPT (N) Value			al Moisture c and Liquid Lir	mit	<b>X</b>
ill Type:	CME 55-Track		_	Dynamic Cone Test Shelby Tube		Undra	ained Triaxial at ain at Failure		•
atum:	Geodetic		_	Field Vane Test	S	Pene	rometer		
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N 20 40 Shear Strength	60 80		ustible Vapour R 25 50 atural Moisture C rberg Limits (% I	75	W gamble W gamble
~300	) mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams,	303.22	0	100	200		10 20	30	<sup>60</sup> kl
_	e gravel, occasional boulder nents, brown, moist, compact to	_		0			×		
dens			1	10 O			×		
р с р с									4
0 a	Becoming wet.			45 O			×		
			2						
							- ×		
o   a			3						
a				26 O			×		
a a		-							
<i>а</i> а-	-	~299.1	4						
	<b>Y SAND:</b> Fine grained, brown, t, compact.	_							
							×		
			5						
		_	6						
		~296.6		26 O			×		
END	OF BOREHOLE.								
						Elaps Time	ed e	Water Level (m)	Hole C to (I
ex					F	On Com	oletion	5.49	6.1

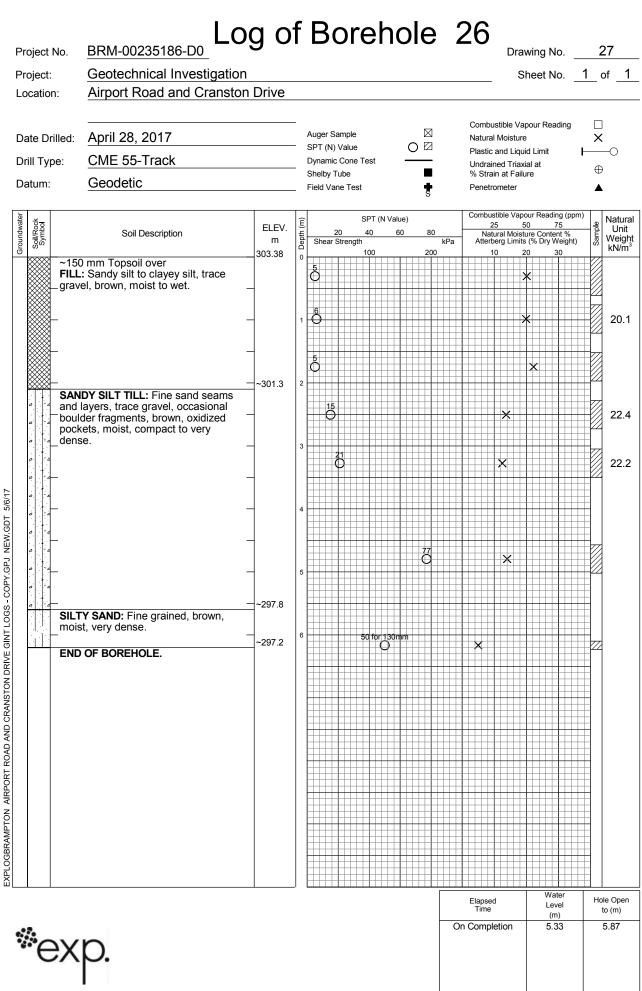
roject No.	BRIVI-00233160-D0	-		Bore	_	-			ving No.		24
roject: ocation:	Geotechnical Investigation Airport Road and Cranstor							Sh	neet No.	<u>1</u> c	of <u>1</u>
ate Drilled:	May 8, 2017		_	Auger Sample				istible Vap I Moisture	our Reading	×	
rill Type:	CME 55-Track			SPT (N) Value Dynamic Cone Tes				and Liquid ned Triaxia		⊢	-0
atum:	Geodetic		_	Shelby Tube Field Vane Test		s		in at Failur ometer	e	⊕	
Soil/Rock Symbol	Soil Description	ELEV.	(m) L	SP <sup>-</sup> 20 40	Г (N Value) 60	80	2	5 50		Sample (I	Natura Unit
		m 301.81	<ul> <li>Depth (m)</li> </ul>	Shear Strength		kPa 200	Attert	org Limits	re Content % (% Dry Weight) ) 30	San	Weigh kN/m
FILL:	) mm Topsoil over : Sandy silt to clayey silt, trace el, brown to dark brown, moist.		0	5 O				>	<		
		_	1	¢				*			
	DY SILT TILL: Fine sand seams,	~300.4		14							
f trace	e gravel, trace clay, brown, moist, pact to dense.		2	Ö				×			22.1
ο ο		_		37 O				×			22.4
	Y SAND: Fine grained, brown,	~298.9	3	501	or 150mm						
i i mois	t, dense to very dense.	_									
		_	4								
			5		50 O		×				
			6								
		~295.2		38 O			×				
END	OF BOREHOLE.	~295.2									
			_				Elapse	d	Water		le Open
							Time On Compl		Level (m) Dry	t	to (m) 6.10
*ex	n						May 15, 2 May 19, 2	2017	Dry Dry Dry	'	0.10

	0235186-D0 nnical Investigation	g o									Dia	wing N heet N	_		25 of
	Road and Cranstor												10	<u> </u>	<u> </u>
ate Drilled: May 8,	2017		_	Auger	Sample	9		D	_		ustible Va Il Moisture		ading		]
ill Type: CME 55			_		N) Valu nic Con			0 8	2 -	Plastic	and Liqu	id Limit		É	—0
atum: <u>Geodet</u>			_	Shelb	y Tube /ane Te			ļ	8 •	% Stra	ain at Failu rometer			€	•
šo o		ELEV.	Ĵ			SPT (	N Value	e)	,		stible Vap		ng (ppn 75		Natu
Soul/Rock Symbol So	il Description	295.53	Depth (m)	She	20 ar Streng	40 gth 100	60		30 kPa :00	Nat Atter	tural Moist berg Limits	ure Conte s (% Dry V	ent % Veight) 30	Sample	Un Weig kN/i
~300 mm Tops FILL: Clayey sil black decayed v	bil over t, trace gravel, trace /egetation, brown, wet.		1											43	4
PEAT: Fibrous of wood fragments	decayed vegetation, s, black, wet, very	~293.4 	2	0 0										35	18 .9
<u> </u>		~291.5	4	3 O											.2
CLAYEY SILT 1	<b>ILL:</b> Trace gravel, f.	~290.7 	5	Ō								×			
END OF BOREI	HOLE.	~288.9	6	C C							×				22
			_							Elapse	d	Wa Le (n			ble Op to (m)

erp.

Project No. Project:	bject No. BRIVI-00235186-D0 bject: Geotechnical Investigation		T	Bol	en	ole	25	Drawing No. Sheet No.		26 of _1_
Location: Date Drilled: Drill Type: Datum:	Airport Road and Cranston April 26, 2017 CME 55-Track Geodetic	Drive		Auger Sample SPT (N) Value Dynamic Cone Shelby Tube Field Vane Te:	Test		Natural Mo	l Liquid Limit Triaxial at t Failure	× 	<b>.</b> 0
Groundwater Soil/Rock Symbol	Soil Description	ELEV. m 303.63	Depth (m)			60 80	25 Natural	e Vapour Reading (pp 50 75 Moisture Content % Limits (% Dry Weight 20 30		Natural Unit Weight kN/m <sup>3</sup>
FILL	5 mm Topsoil over : Silt to clayey silt, trace gravel, /n, moist to wet	-	1	ð ð				× ×		21.8
	DY SILT TILL: Trace gravel, isional boulder fragments, brown, it, compact.	~301.5	2	27 Ŏ			×			
grav	Y SAND: Medium grained, trace – el, brown, wet, compact. –		3					×		
SAN trace frage dens	<b>DY SILT TILL:</b> Fine sand seams, e gravel, occasional boulder ments, brown, moist, dense to very_ se. –	_~299.6	4		45 ©		*			22.4
END	OF BOREHOLE.	~297.0	6			75	×			22.9
*ex			_				Elapsed Time	Water Level (m)		ole Open to (m)

erp.



·	RIVI-00235186-D0	-	-	Bo	-	-		-		-		wing N	-		28
-	eotechnical Investigation irport Road and Cranstor										S	heet N	10.	1	of _
<u> </u>															
ate Drilled: M	lay 2, 2017			Auger Sampl			0			Combus Natural I			ading		_ ≺
rill Type: D	-90-Tire		_	SPT (N) Valu Dynamic Cor			-			Plastic a Undraine	ed Triaxi	al at		F	—0 ∌
atum: <u>G</u>	eodetic		_	Shelby Tube Field Vane Te	est			<b>.</b>		% Strain Penetror		ire		1	▲
<u>*</u> _			Ê		SPT	(N Valu	ıe)			Combust					Nat
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m	20 Shear Stren	40 gth	6	0		kPa	25 Natur Atterbe	5 al Moistu rg Limits	0 ure Cont (% Dry	75 ent % Weight	) (Sample	We kN
💥 ~150 mi	m Topsoil over	301.92	0	8	100			200		10	2	0	30		
gravel, s	ayey silt, trace to some sand pockets, brown, moist to	_		0							×				
			1	11 Ö							×				
			ľ												4
				ő							×				1
× -		_	2												4.
				Ô								×			
															2
			3	4 Ó								×			
	_														4
		~297.9	4												
grained,	AND: Fine to medium widely scattered rock														
	its, brown, moist, very dense.								98	×					
		-	5												4
		_													
시 한다. 1944년 - 1944년 -															
			6					85 C		×					
END OF	BOREHOLE.	~295.3													2
			_					<u>   </u> 		Elapsed			ater		Hole O
										Time	tion	(	evel m)		to (m
exp	<b>`</b>								Ur	n Comple	uUN	2	.13		5.18

roject No.	BRM-00235186-D0	0		Bore			Die	wing No.		30
	Geotechnical Investigation						5	Sheet No	<u> </u>	of
ocation:	Airport Road and Cranston	Drive								
- ate Drilled: 【	May 9, 2017		_	Auger Sample	$\boxtimes$		Combustible Va Natural Moistur		×	
-	CME 55-Track			SPT (N) Value Dynamic Cone Tes	t <u>O 🛛</u>		Plastic and Liqu Undrained Tria:	uid Limit	<b>—</b>	-0
-	Geodetic			Shelby Tube Field Vane Test			% Strain at Fail Penetrometer		⊕ ▲	•
-		1			5			oour Reading (ppr		
Soil/Rock Symbol	Soil Description	ELEV.	Depth (m)	20 40	「 (N Value) 60 80		25	50 75 ture Content % s (% Dry Weight)	<u>e</u>	Natu Un Weig
	nm Topsoil over	302.68	o De	Shear Strength 100	200	kPa )		20 30	ıı V	kN/
	EY SILT TILL: Fine sand			Ô				*		
	r fragments, brown, wet, stiff to			9						
		-	1	Ŏ	<b>A</b>			*		
		_		18						
			2	Ó			×			
			-	18						
				0			*			
		-	3	33		<b>,</b>				
r/:g_				Ö		À	×			
		~298.7								
	<b>Y SILT TILL:</b> Fine sand seams, pravel, brown, wet, very dense.	230.7	4							
	·····, ····, ····, ····, ····, ····, ····, ····, ····, ····, ·····	_			57					
o		_	5		Ċ		*			
o a o a										
SILTY	SAND: Fine grained, stratified, moist, dense.	~297.1								
	inoisi, dense.	-	6	32						
		~296.1		32 O			*			
END O	F BOREHOLE.									
							Elapsed Time	Water Level (m)		le Op to (m)

Project No. Project: Location:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cransto		f	Bc	ore	eh	ol	e	3	81		wing N heet N			32 of <u>1</u>
Date Drilled: Drill Type: Datum:	May 9, 2017 CME 55-Track Geodetic			Auger San SPT (N) V Dynamic C Shelby Tul Field Vane	alue Cone Te be	est	0			Natural Plastic Undrair	stible Va Moisture and Liqui ned Triaxi n at Failu ometer	d Limit al at	ding 	□ × ⊕	-0
Groundwater Soil/Rock Symbol	Soil Description	ELEV. m 300.71	Depth (m)	20 Shear Str	rength	PT (N Va 10 00	lue) 60	80 kF 200		2	ural Moisti erg Limits	0 7 ure Conte (% Dry V	75	Sample	Natural Unit Weight kN/m <sup>3</sup>
	<ul> <li>D mm Topsoil over</li> <li>Clayey silt to sandy silt, trace el, brown, wet.</li> <li>YEY SILT TILL: Fine sand ns, trace gravel, brown, moist, stiff to hard.</li> <li>Y SAND: Fine grained, silt ns, brown, moist, dense.</li> </ul>		0 1 2 3 4 5					> ▲			× ×	× · · · · · · · · · · · · · · · · · · ·			
	OF BOREHOLE.	~294.1	6								×				
*ex	p.									Elapsec Time		Wa Lev (m 1.8	vel 1)	t	le Open to (m) 3.96

oject No. oject:	BRM-00235186-D0 Geotechnical Investigation						Drawii She	et No.		33 of
ocation:	Airport Road and Cranstor						. 0110	-	<u> </u>	
			_		$\boxtimes$	Comb	ustible Vapou	ur Reading		]
ate Drilled:	May 9, 2017		_	Auger Sample SPT (N) Value	ΟØ		al Moisture c and Liquid L	.imit	× —	: —0
ill Type:	CME 55-Track		_	Dynamic Cone Test Shelby Tube			ined Triaxial a ain at Failure	at	€	¢
atum:	Geodetic		-	Field Vane Test	S	Penet	rometer			۱.
Soil/Rock Symbol	Soil Description	ELEV. m 302.35	Depth (m)	SPT (N Va 20 40 Shear Strength 100	60 80		Istible Vapour 25 50 tural Moisture berg Limits (% 10 20	75	e	Nat U We kN
💥 FILL	0 mm Topsoil over : Silty sand changing to clayey trace gravel, brown and grey, wet.		0	6			×			
	YEY SILT TILL: Fine sand and	~301.0	1	Ô			*			
silt s	der fragments, brown and grey, ized partings, moist, stiff to hard.	_	2	<b>D</b>			×			
		-	3				*			
		_	5	23 O			×			
Beco	oming grey.	~298.4	4							
9 / 9 / / 9 / / 9 / 4 / 9 / 4 / 9		_	5				*			
	IDY SILT TILL: Fine sand seams, e gravel, grey, moist, compact.	_~296.8								
	OF BOREHOLE.	~295.8	6	25 O			<			
	of Bonehole.									
					F			Water		<u> </u>
ex						Elapse Time On Comp		Level (m) Dry		ole Op to (m 6.10

oject: ocation:	BRM-00235186-D0 Geotechnical Investigatio Airport Road and Cransto								ing No eet No	1	of _
ate Drilled: rill Type: atum:	May 9, 2017 CME 55-Track Geodetic		_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test			Natural Plastic a Undrain	Moisture and Liquid ed Triaxial n at Failure	at	×	<b>&lt;</b> —0
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N V 20 40 Shear Strength	60 80	kPa	25 Natu Atterbe	50 ral Moisture erg Limits (9	r Reading (ppm 75 e Content % % Dry Weight)	Sample (	Nat UI We kN
~25	0 mm Topsoil over : Sandy silt to clayey silt, trace rel, brown, wet.	301.89	0		200			20	30		
e sanc	IDY SILT TILL: Fine sand seams, d and gravel layers, trace gravel, vn, moist, compact.	~300.8 	1	3 0 9				× -			
ο : α φ : α φ : α		_	2					×			
a a a		_	3					×			
	oming grey, occasional boulder ments.	_~297.9	4								
0 0 0 0 0 0			5	15 O				*			
0		_	6	15 O							
END	OF BOREHOLE.	~295.3									
			_				Elapsed Time		Water Level (m)		ole O to (m

roject:	Geotechnical Investigation										Dra	wing Sheet	No No		35 of _	
	Airport Road and Cranstor	n Drive								Comb	oustible Va	apour R	Reading		]	
	Type: CME 55-Track			Auger S SPT (N			Ċ	⊠ C			al Moistur c and Liqu		it	× ⊢	( 	
rill Type:			_	Dynami Shelby		e Test	-			Undra	ined Triax ain at Fail	cial at			)	
atum:	Geodetic			Field Va		st		s		Penel	trometer					
ž <u>e</u>		ELEV.	(E)			SPT (N	Value)				ustible Vap 25	50	75	1)	Natu	
Soil/Rock Symbol	Soil Description		Depth	Shear	20 Streng	40 th 100	60	20	kPa	Na Atte	atural Mois rberg Limit	ture Co s (% Dr 20	ntent % y Weight) 30	Sample	Ur Wei kN/	
~250	mm Topsoil over DY SILT TILL: Fine sand seams	303.76	0	5 0								Ĭ				
	ayers, trace gravel, occasional er fragments, brown, moist,	_														
- comp	act to dense.	_	1	10 O							×					
0 6 0 6															1	
o   e		-		12 O							×				22	
o		_	2													
<i>0</i>				13							×				22	
o c																
a -		_	3			34										
a a		_				<u>э</u>					×					
e e																
а 'а р. с		_	4													
0 a		_				41										
o   c		_	5			0					×					
0 0																
	SAND: Fine grained, trace	_~298.2														
	l and shale fragments, brown, , very dense.	~297.6	6			50 for 1	50mm				×					
END	OF BOREHOLE.														1	
													Nater			

<sup>®</sup>exp.

roject No.	BRIVI-00235186-D0	g o			-		-							Dra	wing	-		36
roject:	Geotechnical Investigation													_ \$	heet	No.	1	of _
ocation:	All port Road and Granston	I DIIVE																
ate Drilled:	May 2, 2017		_	Auger	r Sam	ole					3			oustible Va al Moisture	•	eading		
rill Type:	D-90-Tire		_	SPT ( Dynar	N) Va		Test		_	) E	2		Plasti	c and Liqu	id Limit		ŕ	_0
atum:	Geodetic		_	Shelb	y Tube	e							% Str	ained Triax ain at Fail			θ	€
			_	Field	vane	rest				ę	S		Pene	trometer			4	•
Pock	Sail Description	ELEV.	(m) (		20	:	SPT 40	(N Va	alue) 60		80	_		ustible Vap	50	75		Nati
Soil/Rock Symbol	Soil Description		o Depth (m	100				kPa 200			Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30				San	Wei kN/		
SAN	) mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams,	303.11		ő														
trace	e gravel, scattered clayey silt ns, brown, wet, loose to dense.	-																
• •		_	1	ð											×			2
o d D d																		1
o 6		-				7								×				20
o		_	2															
ð ¢							41											2
							Υ											2
		-	3			34	1											
a   a		_				С								×				22
0 0		~299.1																
	oming grey, occasional boulder nents.		4															
	nenta.	_																
0 0					C C	; ;								×				22
o 'a			5															1
Becc	oming very dense.	~297.6																
		_	6				50 fo	or <u>1</u> 00	) ) mm									
END	OF BOREHOLE.	~296.9						0						×				2
LI			!	<u> </u>							Ē		Elaps	ed	1	/ater .evel	Н	ole Op

\*exp.

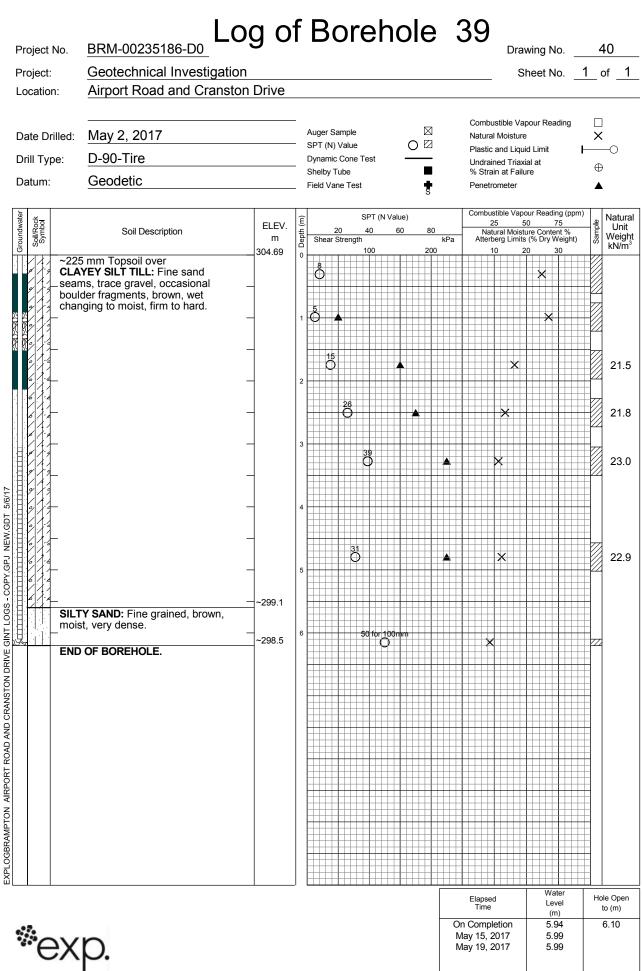
 
 Elapsed Time
 Water Level (m)
 Hole Open to (m)

 On Completion
 0.91
 0.91

Project No. Project: Location:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranstor	1	• 	Boreh			Drawing No Sheet No		37 of _1
Date Drilled: Drill Type: Datum:	May 2, 2017 D-90-Tire Geodetic		_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test		Natural Plastic a Undrain	stible Vapour Reading Moisture and Liquid Limit ed Triaxial at a tf Failure meter	×	<b>(</b> 0
Symbol Symbol Symbol Symbol	Soil Description	ELEV. m 303.04	o Depth (m)	SPT (N 1 20 40 Shear Strength 100	Value) 60 80 200	25 Natu	ral Moisture Content % erg Limits (% Dry Weight)	Sample	Natura Unit Weigł kN/m
FILL grave	: Clayey silt, some sand, trace el, brown, wet. <b>DY SILT TILL:</b> Fine sand seams, e gravel, trace clay, brown, moist, pact to very dense.	~301.6	1	0 4 0 14			× × ×		22.0
		_	3	35 0			×		21.9
	<b>Y SAND:</b> Fine to medium led, brown, moist, very dense.	~297.4	5			100 ©	×		21.
	OF BOREHOLE.	~296.4	6		65 O	×			
<sup>*</sup> ex	p.		_1			Elapsed Time On Comple May 15, 20 May 19, 20	5.88		ble Ope to (m) 5.64

	1-00233160-D0	_	-	Boreh		Dra	awing No.		39
-	technical Investigation					:	Sheet No	1	of _
ocation: <u>Airp</u> e	ort Road and Cranstor	Drive							
ate Drilled: April	26, 2017		-	Auger Sample	$\boxtimes$	Combustible V Natural Moistu	apour Reading	×	-
	55-Track		_	SPT (N) Value Dynamic Cone Test		Plastic and Liq	uid Limit	⊢	0
,	detic		-	Shelby Tube		Undrained Tria % Strain at Fa		€	)
<u> </u>			_	Field Vane Test	S	Penetrometer		-	•
Soil/Rock Symbol	Soil Description	ELEV.	h (m)	SPT (N Va	lue) 60 80	25	pour Reading (ppm 50 75	Sample (	Natu Un
	·	m 304.43	o Depth (m	Shear Strength 100	kPa 200	Atterberg Limi	sture Content % its (% Dry Weight) 20 30	San	Wei kN/i
~200 mm T FILL: Sand	silt, trace gravel, trace			4 0			*		
clay, rock fr	agments, brown, moist to	-							
××-		_	1	Ô.		×			22
				Å.		×			22
	T TILL: Fine sand seams,	~302.3	2						
<ul> <li>trace grave</li> </ul>	, occasional boulder brown, moist, compact.	_							22
p a			3	25		×			22
2 / a		-							
		_	4						
o 'a o 'a									
0 ' A		~299.6		20					21
Black sand	pockets and oxidized	_	5	Ψ					21
		~208.8							
Becoming c	lense.	~298.8							
o o		-	6	41					
2. C		~297.8		C C		×			22
END OF BC	OREHOLE.								
		1	_1			Elapsed	Water		l ble Op
exp.						Time	(m) 5.03		to (m) 5.79

Υ.



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C/	1	J.
	- I.	

oject No. <u>BRM-00235186-D(</u> oject: Geotechnical Inves	<u> </u>	2	Borehole		Drawing	_		11
oject: <u>Geotechnical Inves</u> ocation: <u>Airport Road and (</u>					Sneet	No	<u> </u>	ינ
				Co	mbustible Vapour F	Reading		
ate Drilled: April 28, 2017		_	Auger Sample 🛛 🖂 SPT (N) Value 🔿	Nat	tural Moisture	-	. ×	
rill Type: <u>CME 55-Track</u>		_	Dynamic Cone Test Shelby Tube	Un	stic and Liquid Lim drained Triaxial at Strain at Failure	π		-0
atum: <u>Geodetic</u>		_	Field Vane Test		netrometer		▲	
Soil Description	ELEV. m	Depth (m)	20 40 60 80 Shear Strength		nbustible Vapour Re 25 50 Natural Moisture Co tterberg Limits (% Dr	75 ntent % y Weight)	Sample	Natu Un Weig kN/r
~250 mm Topsoil over SANDY SILT TILL: Fine sand trace gravel, occasional bould fragments, brown, moist, com	der _	0			10 20			21
Becoming dense.	~300.7	3	23 O		×			22
SILTY SAND: Fine grained, s seams, brown, moist, very de		5	00.0. <u>1</u> =0		×			
END OF BOREHOLE.								
		_		Ela		Water Level		le Op

exp.

roject No.	BRM-00233180-D0	og o					Drawii	ng No		2
roject:	Geotechnical Investigatio						She	et No.	<u>1</u> c	of
ocation:	Airport Road and Cransto	n Drive								
ate Drilled:	May 9, 2017		-	Auger Sample	$\boxtimes$		nbustible Vapou ural Moisture	ır Reading		
rill Type:	CME 55-Track			SPT (N) Value Dynamic Cone Test	0 🛛		stic and Liquid L Irained Triaxial a			-0
atum:	Geodetic			Shelby Tube Field Vane Test	∎ ŧ		Strain at Failure netrometer		⊕	
×			-	SPT (N	I Value)	Con	bustible Vapour			Natu
Soil/Rock Symbol	Soil Description	ELEV. m 304.21	Depth (m	20 40 Shear Strength 100	<u>60 80</u> 200	kPa At	25 50 Natural Moisture terberg Limits (% 10 20	75 Content % Dry Weight) 30	Sample	Ur Wei kN/
CLA	) mm Topsoil over YEY SILT TILL: Fine sand		0	ð			×			
	ns, trace gravel, brown, moist to stiff to very stiff.	-								
		-	1				×			
		_		16						
		_	2	Ő			×			
6/6				24						
				$\mathbf{O}$			- <b>X</b>		4	
		-	3	24 O			×			
		-								
Bec	oming grey, wet, stiff.	_~300.2	4							
		_								
			-	10 Ö			×			
			5							
		-								
		-	6							
		~297.6		0			×		Ø	
END	OF BOREHOLE.									
						Elaj Ti	osed me	Water Level		le Op o (m)
*ex						On Cor May 1	npletion	(m) 1.67 1.82		6.10

roject No. roject: ocation:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cransto				wing No heet No1	43 of
ocation: Pate Drilled: prill Type: patum:			Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test Sher Strength 1 1 1 1 1 1 1 1 1 1 1 1 1	Combustible Va Natural Moisture Plastic and Liqu Undrained Triax % Strain at Failt Penetrometer Combustible Vap 25 5 Natural Moist kPa Atterberg Limits	pour Reading e id Limit – ial at	or
END	OF BOREHOLE.	~296.8		Elapsed	Water	Hole Ope

۱p.

roject: ocation: ate Drilled: rill Type: atum:	Geotechnical Investigation Airport Road and Cranston April 28, 2017 CME 55-Track Geodetic		– Auger Sample – SPT (N) Value		Combustible Vapour Read	o. <u>1</u> of
rill Type: atum:	CME 55-Track				Combustible Vapour Read	ting
rill Type: atum:	CME 55-Track				Mark and Markets and	V
atum:			Dynamic Cone Test	0 🛛	Natural Moisture Plastic and Liquid Limit	× ⊷
Soil/Rock			_ Shelby Tube _ Field Vane Test		Undrained Triaxial at % Strain at Failure Penetrometer	<b>⊕</b>
~200		1		5	Combustible Vapour Readin	
~200	Soil Description	ELEV. m	E SPT (N) E 20 40 Shear Strength	60 80 kPa	25 50 7 Natural Moisture Conter Atterberg Limits (% Dry W	/5 0 Un nt % /eight) Weight
FILL:	mm Topsoil over : Silty sand, fine to medium ed, brown, reddish brown and moist with wet zones.	306.39			10 20 3	
-		_	2		×	
_		_			× ×	
		_	3 0 0		×	
SILT wet, d	Y SAND: Fine grained, brown, compact.	~302.4	4			
		-	5		*	
	DY SILT TILL: Fine sand seams,	_~300.8				
• • trace	gravel, brown, moist, compact.	~299.8			×	21
END	OF BOREHOLE.					
					Wat	er
*ex					Elapsed Time (m On Completion 0.0	rel to (m)

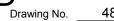
Location: <u>Airport Road and Cranston Drive</u> Date Drilled: <u>May 8, 2017</u> Drill Type: <u>CME 75-Marcoka</u> Datum: <u>Geodetic</u> Sol Description FILL: Sandy silt to silty sand, trace clay, brown, moist to wet. SilLTY SAND: Fine grained, brown, moist, compact. Sol Description FILL: Sandy silt to silty sand, trace 		ject I	NO.	BRM-00235186-D0											D		ing N			45
Date Drilled: May 8, 2017 Drill Type: CME 75-Marcoka Datum: Geodetic Soil Description Table Joint to Well Soil Description Soil D		-	n:	Geotechnical Investigation Airport Road and Cranstor											-	Sh	eet N	lo	1_	of <u>1</u>
Date Drilled:       May 8, 2017       Auger Sample       Image: Sample <td></td> <td></td> <td></td> <td></td> <td></td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>.,</td> <td></td> <td></td> <td>_</td> <td></td>						_										.,			_	
Drait Type: CME 75-Marooka Geodetic Datum: Geodetic Datum: Geodetic Sol Description FILE: Sand sitt a sitt y sand, trace -clay, brown, moist to wet. 	Dat	te Dri	illed:	May 8, 2017			-							Natur	al Moist	ure		ading		
Datum:       Geodetic       Pettometer       Pettometer         30       Soil Description       ELEV. m       0       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00       00	Dril	I Тур	e:	CME 75-Marooka		_	Dynami	c Con		t	-	 _		Undra	ained Tr	iaxial	l at		Œ	-0 ,
Barton         ELEV.         Construction	Dat	tum:		Geodetic					st			S					e			
SILTY SAND: Fine grained, brown, moist to dense	Sroundwater	Soil/Rock Symbol		Soil Description	m	Depth (m)	Shear		40 th	·		 ŀ	:Pa		25 atural Mo rberg Lir	50 Distur nits (	e Conte % Dry V	75 ent % Veight)	Sample	Natura Unit Weigh kN/m
SILTY SAND: Fine grained, brown, moist, compact to dense. 			FILL	: Sandy silt to silty sand, trace	308.19	0	ð					200								
SANDY SILT TILL: Fine sand seams, race gravel, brown, moist, dense. SANDY SILT TILL: Fine sand seams, race gravel, brown, moist, dense. END OF BOREHOLE. -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -3	*****		_		_	1	¢.									×				19.9
SANDY SILT TILL: Fine sand seams, Trace gravel, brown, moist, dense. END OF BOREHOLE. SANDY SILT TILL: Fine sand seams, Trace gravel, brown, moist, dense. -300.1 SANDY SILT TILL: Fine sand seams, -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 			-		-		Ô								×					21.9
Becoming wet, compact. 	XXX ·				~306.0	2			39 O						*					21.6
Becoming wet, compact.	•		-		-	3		25							×					
Becoming wet, compact.			_			4														
	•		Becc -	oming wet, compact.	_		14													
-301.2 -301.2 -301.2 -301.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1 -300.1			-		-	5	C									×				21.5
-301.2 SANDY SILT TILL: Fine sand seams, trace gravel, brown, moist, dense. -300.1 END OF BOREHOLE. -300.1 Value			_			6														
SANDY SILT TILL: Fine sand seams, trace gravel, brown, moist, dense.	•		-		-			O O								×				
-300.1 C X X X X X X X X X X X X X X X X X X					~301.2	7														
			END	OF BOREHOLE.	~300.1				37 O						×					22.3
Elapsed Water Hole																				
Elapsed Hole																	Wa	iter		
(m)														Elaps Time			(n	n)		to (m)

Project No. Project: Location:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranston			Boreh			Dra	wing No		46 of <u>1</u>
Date Drilled: Drill Type: Datum:	May 8, 2017 CME 75-Marooka Geodetic		_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test			Combustible Va Natural Moistur Plastic and Liqu Undrained Triax % Strain at Failu Penetrometer	e iid Limit iial at	× ÷	-0
Groundwater Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N V 20 40 Shear Strength	/alue) 60 80	kPa	25	our Reading (ppm) 50 75 ture Content % s (% Dry Weight)	Sample	Natura Unit Weight
- 150 FILL - clay, mois - - - - - - - - - - - - - - - - - - -	Y SAND: Fine to medium ed, brown, grey seams, wet, brown, grey seams, wet, brown, grey seams, wet, brown, grey seams, wet, broact.	308.82 ~306.6  ~303.2	□ 0 1 2 3 4 5							kN/m <sup>3</sup>
grave	el, brown, wet, stiff.	~302.2	6	12 0						20.3
*ex	p.	<u> </u>	_			 On	Elapsed Time Completion	Water Level (m) 2.89		ble Open to (m) 2.89

oject: ocatio		Geotechnical Investigation Airport Road and Cranstor														She	et N	0	<u>1</u>	of _
ate Di	rilled:	May 8, 2017			Auger					~				Combu: Natural			ır Rea	iding	$\square$	
rill Ty	pe:	CME 75-Marooka		_	SPT (N Dynam	ic Co	ne Te	est		_			ι	Plastic a Jndrain	ed Tria	ixial a		ļ		O
atum:		Geodetic			Shelby Field V						s			% Straii Penetro		ilure				
Soil/Rock Symbol		Soil Description	ELEV. m 307.10	Depth (m)	Shea	20 r Strei	4 ngth	PT (N 10 00	l Valu 61		80	kPa		25	5 ral Mois erg Limi	50	Conte Dry V	ng (ppm 75 nt % Veight) 30	Sample	Nat Ui We kN
	FILL	) mm Topsoil over : Silty sand, clayey silt pockets, n to dark brown, moist.		0	5 0										, 	20				
		<b>Y SAND:</b> Fine grained, stratified, n, wet, loose.	~305.7 	1	0 0											×				
			_	2	7										×					
			_	3	°										×					
0 0	and I	<b>DY SILT TILL:</b> Fine sand seams layers, trace gravel, brown, moist, pact to very dense.	~303.1 	4	12															
0 0 0 0	_		_	5											×					
0 0 0 0 0 0	_		_	6								85 O		×						
			_	7																
a 4	END	OF BOREHOLE.	~299.0										98 0	x						
													E	lapsed Time			Wa Lev (m	vel		ole Op to (m

roject No. roject: ocation:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranstor								awing No Sheet No	(	of _2
rill Type: atum:	May 11, 2017 CME 55 - Rubber Track Geodetic		- s - c	uger Sample PT (N) Value ynamic Cone helby Tube eld Vane Tes				Combustible V Natural Moistu Plastic and Liq Undrained Tria % Strain at Fa Penetrometer	re uid Limit - xial at	□ × €	O
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	20 Shear Strengtl		lue) 60 80	) kPa	25	pour Reading (ppm) 50 75 sture Content % ts (% Dry Weight)	Sample	Natur Unit Weigl kN/m
230 CLA sean bould	) mm Topsoil over YEY SILT TILL: Fine sand ns, trace gravel, occasional der fragments, brown, oxidized ns and fissures, moist, hard.	303.35	1				>				9 22. 22.
		-	2	19			>		×		22.
	oming grey, shale fragments, wet.	~299.4	4	O Č				×			23.
0 c SAN 0 c Iayer	<b>D AND GRAVEL:</b> Clayey silt rs, brown, moist, very dense.	~297.8	6			72 O		×			
O O O SAN trace	DY SILT TILL: Fine sand seams, e gravel, trace clay, occasional der fragments, brown, moist, se.	~296.3	7		47 O			×			
e e Becc	oming grey, compact.	~294.7	9	29 O				×			23
0 0	Continued Next Page		10					Elapsed	Water	Hc	ble Ope
ех	p.						N	Time n Completion lay 15, 2017 lay 19, 2017	(m) 11.73 10.14 10.44		to (m) 11.89

## Project No. BRM-00235186-D0 Log of Borehole 47D Trawing No. 48



roject:		ELEV.	(u				(N V	alue)				mbus 2	5	Vap	our R	eadin 7	g (p	pm)	TI	of Natu Uni
Soil/Rock Symbol	Soil Description	m	Depth (m)	Shea	20 r Stren			60		Pa	,	Natı Atterb	ural I erg I	Moist Limit	ure C s (% [	onter Dry W	nt % ′eigh	t)	Sample	Weig kN/r
	SILTY SAND: Fine grained, brown, moist, very dense.	293.35 ~293.3 	10			100			2				0		20	3	0			1111/1
	_		11										×							
	_ Becoming wet, dense. _	~291.7	12																	
	END OF BOREHOLE.	~290.7				ő								>	<				0	
												apsec Fime				Wat Lev (m	el )		1	le Ope to (m)
е	exp.									Μ	lay <sup>·</sup>	omple 15, 2 19, 2	2017	7		11.7 10.1 10.4	14		1	11.89

roject No.					hole					8A
roject: ocation:	Geotechnical Investigation Airport Road and Cranstor						\$	Sheet No1	_ 0	of <u>1</u>
ate Drilled:	May 11, 2017		-	er Sample			Combustible V Natural Moistu	′apour Reading ire	$\mathbf{x}$	
rill Type:	CME 55- Rubber Track		Dyn	<sup>-</sup> (N) Value amic Cone Test			Plastic and Liq Undrained Tria	axial at	•	-0
atum:	Geodetic			lby Tube d Vane Test	∎ \$		% Strain at Fai Penetrometer	lure	▲	
Soil/Rock Symbol	Soil Description	ELEV.	Depth (m)	20 40	(N Value) 60 80		25 Natural Mois	pour Reading (ppm) 50 75 sture Content %	Sample	Natur Unit Weig
	0 mm Topsoil over	m 303.35		near Strength 100	200	kPa	Atterberg Limi	its (% Dry Weight) 20 30	s V	kN/m
CLA	YEY SILT TILL: Fine sand ns, trace gravel, occasional		ð				×			
boul	der fragments, brown, oxidized ns and fissures, moist, hard.			11		>			59.	9
		-	1	Э		<b>A</b>			*	22
		-		22		>				
		_	2				× ×		4	22
				19		>				22
						<b>A</b>			1	22.
		-	3	19		>				23
8 / 9		-		9		-				20
	oming grey, shale fragments, wet.	~299.4	4							
Deci	Sining grey, shale fragments, wet.									
				25 O		À	×			
6 . 4		-	5							
SAN	D AND GRAVEL: Clayey silt	~297.8							-	
	rs, brown, moist, very dense.	_	6							
0.0		~296.8			72 O		×			
END	OF BOREHOLE.									
								Water		
							Elapsed Time	Water Level (m)		le Ope to (m)
ex							n Completion /lay 15, 2017	Dry 3.93	(	6.10

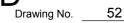
roject: ocation:	Geotechnical Investigation Airport Road and Cranston	Drive						Sheet N	lo	1_ (	of _
ate Drilled:	May 8, 2017			Auger Sample SPT (N) Value			Combustible Natural Moist	ure	ading	$\square$	-
rill Type:	CME 75-Marooka		_	Dynamic Cone Test Shelby Tube			Plastic and L Undrained Tr % Strain at F	iaxial at	ł	•	-0 ,
atum:	Geodetic			Field Vane Test	S		Penetromete				
Soil/Rock Symbol	Soil Description	ELEV. m 306.06	Depth (m)	SPT (N 20 40 Shear Strength 100	Value) 60 80 200	kPa	Combustible V 25 Natural Me Atterberg Lin 10	50	75	Sample	Natu Ur Wei kN/
FILL:	mm Topsoil over : Clayey silt to sandy silt, trace el, brown, wet.		0	5 O 4				*			
seam	- YEY SILT TILL: Fine sand - is, trace gravel, occasional gravel ets, brown, moist, firm to very	~304.7	1	0 4 0				×			
		_	2	<b>Ö</b>				*			
	-	-	3	0	<b>A</b>		×				
SAN	DY SILT TILL: Fine sand seams, gravel, brown, moist, compact.	~302.0	4	23 Ö			*				
0	- - Y SAND: Medium grained,	~299.9	6			91 O	×				
widel	ly scattered gravel, brown, moist, dense/ OF BOREHOLE.	~299.5									
ex	n					On	Elapsed Time	Wa Le (n 2.	vel n)	t	to (m

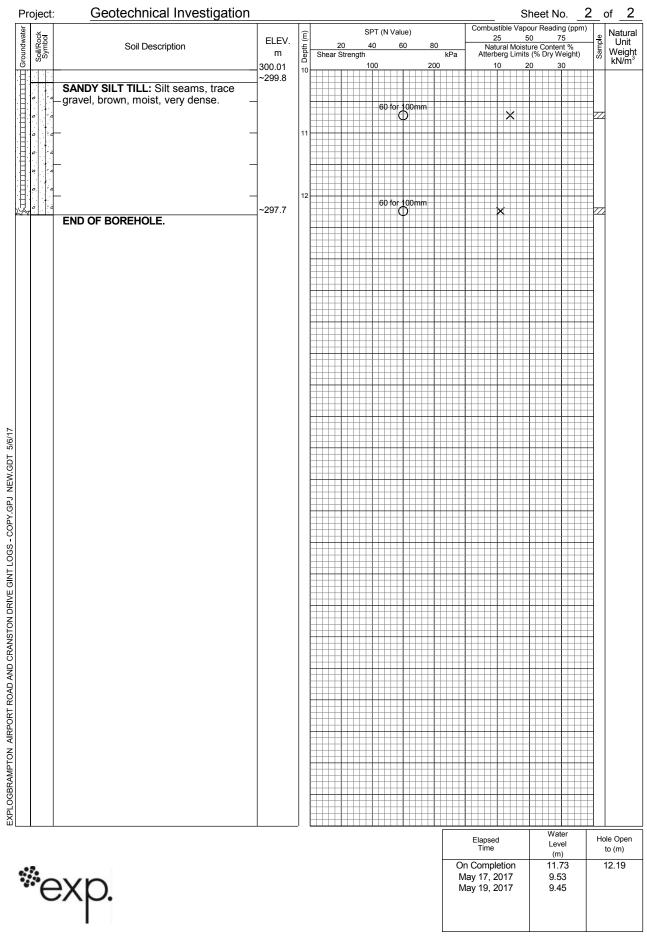
oject: ocation:	Geotechnical Investigation Airport Road and Cranstor						S	heet No.	<u>1</u> (	of _1
ate Drilled:	May 8, 2017			Auger Sample			Combustible Va Natural Moistur	-	$\square$	
rill Type:	CME 75-Marooka			SPT (N) Value Dynamic Cone Test			Plastic and Liqu Undrained Triax			-0
atum:	Geodetic			Shelby Tube Field Vane Test	ŝ		% Strain at Fail Penetrometer	ure	⊕	
Soil/Rock Symbol	Soil Description	ELEV.	Depth (m)	SPT (N Value 20 40 60 Shear Strength 100		kPa	25 Natural Mois Atterberg Limit	our Reading (ppm) 50 75 ture Content % s (% Dry Weight) 20 30	Sample	Natura Unit Weigh kN/m
FILL	) mm Topsoil over : Sandy silt to clayey silt, trace el, brown to dark brown, moist.	309.19	0	4 O				× · · ·		
• trace	<b>DY SILT TILL:</b> Fine sand seams, e gravel, sand and gravel layer, /n, moist, loose.	~308.2	1	- Č			×			
	Y SAND: Fine grained, widely	~307.1	2	¢			×			
scatt	tered gravel, brown, moist, dense ery dense.		3				*			
		_	3	56			×			
		_	4							
		_	5	30 O			×			
	eased silt content, becoming wet, e.	~303.6	6							
END	OF BOREHOLE.	~302.6		Ô			×			
			_				Elapsed	Water Level		le Ope
						On	Time Completion	(m) Dry		to (m) 5.72

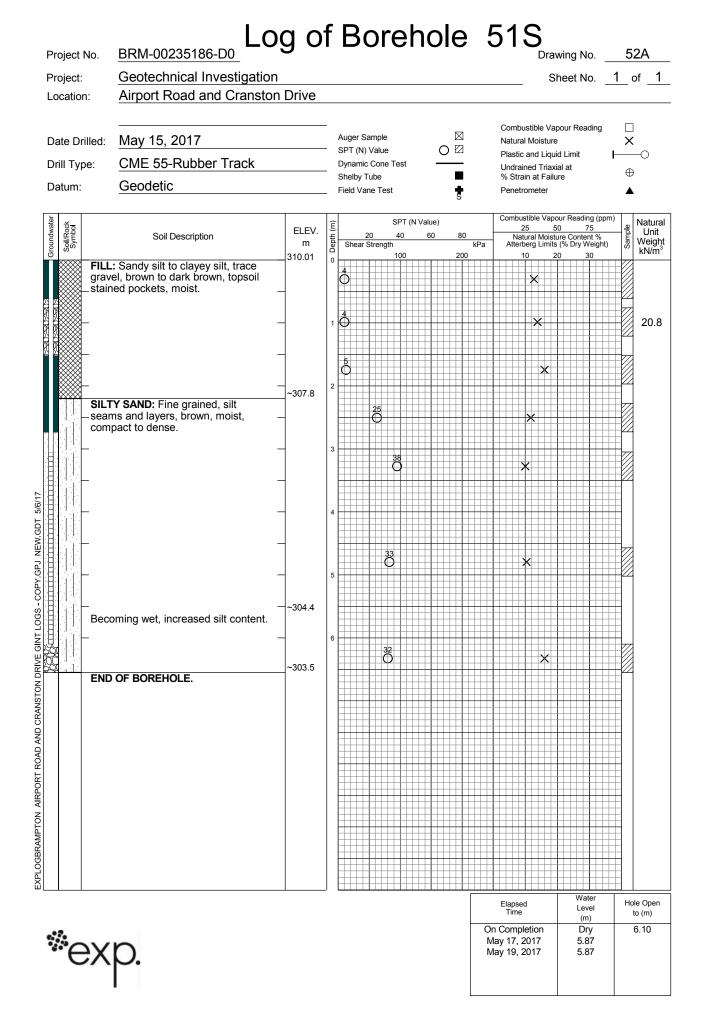
oject: ocation:	Geotechnical Investigation Airport Road and Cranstor												_	Sh	eet No	o1	_ (	of _2
ate Drilled:	May 15, 2017			Auger					-					ble Vapo oisture	ur Read	ding	□ ×	
ill Type:	CME 55 - Rubber Track			SPT ( Dynar			est		0	Ø				d Liquid I Triaxial		F	•	-0
atum:	Geodetic			Shelby Field						s			train a etrom	at Failure eter	•		⊕	
Soil/Rock Symbol	Soil Description	ELEV. m 310.01	Depth (m)	She	20 ar Stre	4 ngth	PT (N 10 00	Value 60		80 200	kPa		25	le Vapou 50 I Moisture Limits ( <sup>6</sup> 20	7	5 nt % 'eight)	Sample	Natur Uni Weig kN/m
💥 grav	: Sandy silt to clayey silt, trace el, brown to dark brown, topsoil ed pockets, moist.		0	ð									-10 	<				
				4														00
		1	1	0														20.
		1		ð										×				
SILT	Y SAND: Fine grained, silt	~307.8	2		2	5												
sean	ns and layers, brown, moist, pact to dense.	-			Ĉ	>							×				Ø	
		-	3			38	}						×					
		-																
199 <u>-</u> 1995		-	4															
		-				33 O												
		-	5			0							×				8	
		~304.4																
	oming wet, increased silt content.	_	6															
		_				32 Ö								×				
			7															
			8			3 C	8							×				
		]	9		2! C	5								×				
			10															
	Continued Next Page		- 10									Elap Tir	osed ne		Wat Lev (m	el		le Ope to (m)
*ex	5										N	n Con lay 17 lay 19	, 201	7	11.7 9.5 9.4	73 3	1	2.19

## BRM-00235186-D0 Log of Borehole 51D

Project No.







Project No. Project: Location:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranstor		f Boreh		Drav	ving No	53 1_of_1
Date Drilled: Drill Type: Datum:	May 12, 2017 CME 55 - Rubber Track Geodetic		Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test	60 80	Combustible Vap Natural Moisture Plastic and Liqui Undrained Triaxia % Strain at Failu Penetrometer Combustible Vapo 25 51 Natural Moistu	d Limit I al at re uur Reading (ppm) 0 75	
SAN	Soil Description     mm Topsoil over     Silty sand, trace gravel, trace     brown, wet.      DY SILT TILL: Fine sand seams,     gravel, occasional boulder     nents, brown, oxidized pockets,     t, compact.      Y SAND: Fine grained, stratified,     n, wet, compact.	m 310.64	2 16 3 20 4 100 4 100 100 100 100 100 1	kPa 200	Natural Moistu Atterberg Limits 10 20 X		Weigh kN/m 21.6
	OF BOREHOLE.		6 25 7 21 21 21 21 21 21 21 21 21 21		×	Water	
<sup>®</sup> ex	p.			0	Elapsed Time	Water Level (m) 6.25	Hole Ope to (m) 6.25

roject:		Geotechnical Investigation	ı					SI	heet No.	<u>1</u> (	of _
ocatio	n:	Airport Road and Cranstor	n Drive								
				_				Combustible Var	oour Reading		
ate Dr	illed:	May 12, 2017			Auger Sample SPT (N) Value			Natural Moisture	-	Х	
rill Typ	be:	CME 55 - Rubber Track		_	Dynamic Cone Test			Plastic and Liqui Undrained Triaxi	al at	Ð	-0 ,
atum:		Geodetic			Shelby Tube Field Vane Test			% Strain at Failu Penetrometer	Ire		
					SPT (N	(alue)		Combustible Vapo	our Reading (ppm)		Natu
Soil/Rock Symbol		Soil Description	ELEV. m	Depth (m		60 80	kPa	25 5 Natural Moistu Atterberg Limits	ure Content %	Sample	Uni
о С	~100	mm Topsoil over	310.73	0		200		10 2			kN/r
0 C	SAN	<b>DY SILT TILL:</b> Fine sand seams, gravel, trace clay, brown, moist,			Ô			×			
0 0	loose										
	_		_	1	Ô			- ×			22
0 0											
0 C	_		_		Ô			×			21
0 a			~308.6	2						4	
	SILT ceme	Y SAND: Fine grained, ented zones, brown, moist,			24						
	_comp		_		O			×			
	_		_	3							
					O O			×			
	_		_								
	_		~306.6	4							
	Beco	ming wet, increased silt content.									
			_		13						
	_		_	5					×		19
	– Beco	ming dense.	~305.1								
	_		_	6							
								×			
	_		-							-22	
	_		_	7							
		DY SILT TILL: Fine sand seams,	~303.5								
	trace- comp	gravel, trace clay, brown, wet, bact.	_		15						
a a	_		_	8	Ő			×	<		21
e e											
p e	- Beco	ming moist, very dense.	~302.1								
0 a	_	g, to y donoo.		9	50 for 8	0mm					
	END	OF BOREHOLE.	~301.5		SU for 8			×			22
								Elapsed Time	Water Level		ole Ope to (m)
2.							On	Completion	(m) Dry		7.32
6	Х	n									

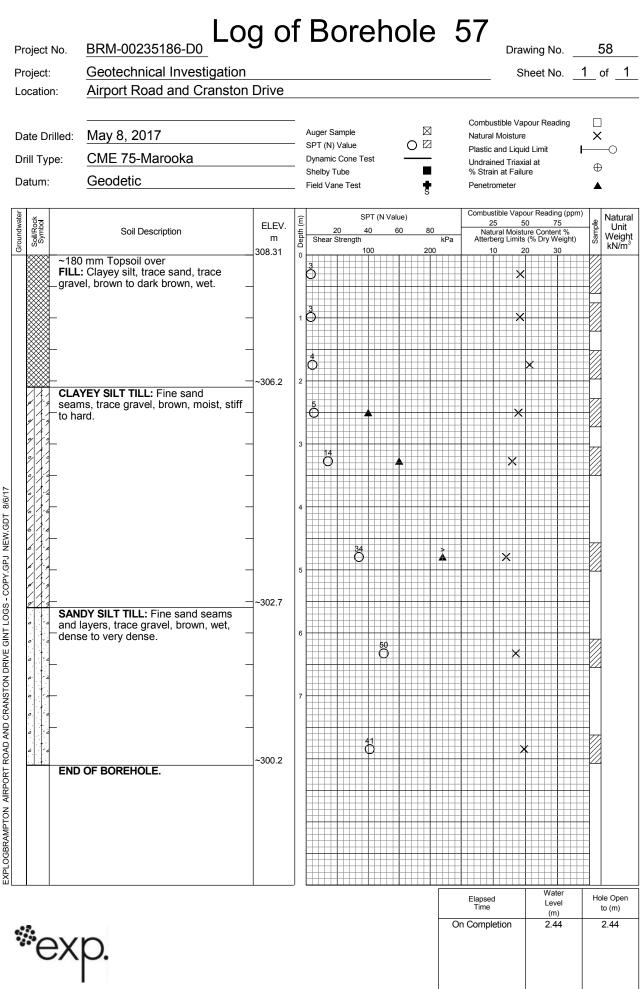
Project No. Project:	Geotechnical Investigation	1	f	Boreh	ole	54		ng No		2
Location:	Airport Road and Cranston	n Drive								
Date Drilled: Drill Type: Datum:	May 12, 2017 CME 55 - Rubber Track Geodetic		- : - :	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test		Natura Plastic Undra % Stra	ustible Vapo al Moisture c and Liquid iined Triaxial ain at Failure rometer	Limit -	□ × ⊕	
Groundwater Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N V 20 40 Shear Strength 100	60 80	kPa Atter	25 50	r Reading (ppm) 75 Content % 6 Dry Weight) 30	Natu Sample Wei kN/	nit ight
~180 SAN	) mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams, e gravel, brown, moist to wet, pact.		1	3 3 11			× ×		21	
silt – mois –	<b>Y SAND:</b> Fine grained, brown, t, dense.	~309.0 	2	6 35 0 40		*				
Construction of the second sec	<b>DY SILT TILL:</b> Fine sand seams layers, trace gravel, brown, moist, se to very dense.	~307.2	4	U	61 C		*		23	3.1
AND       CRANSTON DRIVE GINT LOGS - COPY GPU NEW GDT         and       and	sand layer.	  ~304.9 	6	41 Č			×			
AIRPORT ROAD AND CRA		-	8	50 for 13	Onim		×		7 22	2.8
EXPLOGBRAMPTON		_	9	50 for 10	Onhm		*			
*ex	Continued Next Page					Elapse Time On Comp	•	Water Level (m) 5.69	Hole Op to (m) 5.79	)

## Log of Borehole 54

Proje	ct: Geotechnical Investigat	tion													S	Sheet	: No		2	of _
ock .			Ê		20			N Va			0			25		oour Re 50	75	5	) ee	Natu
Soil/Rock	Soil Description	m	Depth (m	Shear	20 Strer	ngth	40		60	80	kF	°a	At	Natui tterbe 10		sture Co ts (% D 20	ontent ry We 30		Sample	Wei kN/
, 		301.23 1	10				00			20						20				<u> </u>
0			H																	
		~300.4				5		r 80r O	nm						×				z	2
	END OF BOREHOLE.		Ħ																	
			Ħ																	
			Ħ		+		#	Ħ			+						Ħ			
			Ħ								#									
			Ħ		$\parallel$			₿												
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			Ħ																	
			H					₿												
		I											Ela	psed			Wate		н	ole Op
												0-		psed me	tion		Leve (m)			to (m)
	exp.											Un	Cor	nple	แบท		5.69	2		5.79

Project No. Project: .ocation:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranston	Drive					wing No		56 of _1
Date Drilled: Drill Type: Datum:	May 12, 2017 CME 55 - Rubber Track Geodetic		_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test		Combustible Va Natural Moisture Plastic and Liqu Undrained Triax % Strain at Failu Penetrometer	id Limit	□ × ⊕	-0
Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N Value) 20 40 60 80 Shear Strength	kPa	25 5 Natural Moist Atterberg Limits	our Reading (ppm) 0 75 ure Content % (% Dry Weight)	Sample	Natura Unit Weigh
-Becc	Y SAND: Fine grained, brown, t, loose to compact.		0 1 2 3 4	100 200 5 0 13 0 16 0 19 0 19 0 19 0 19 0 19 0 19 0 10 10 10 10 10 10 10 10 10		10 2 X			
e trace	DY SILT TILL: Fine sand seams, gravel, brown, moist, compact to dense.	-	5 6 7	19 34 56 for 230mm		×			21.
END	OF BOREHOLE.	_~301.3				X			22.0
<sup>®</sup> ex			1			Elapsed Time	Water Level (m) 3.81	t	e Oper o (m) 4.27

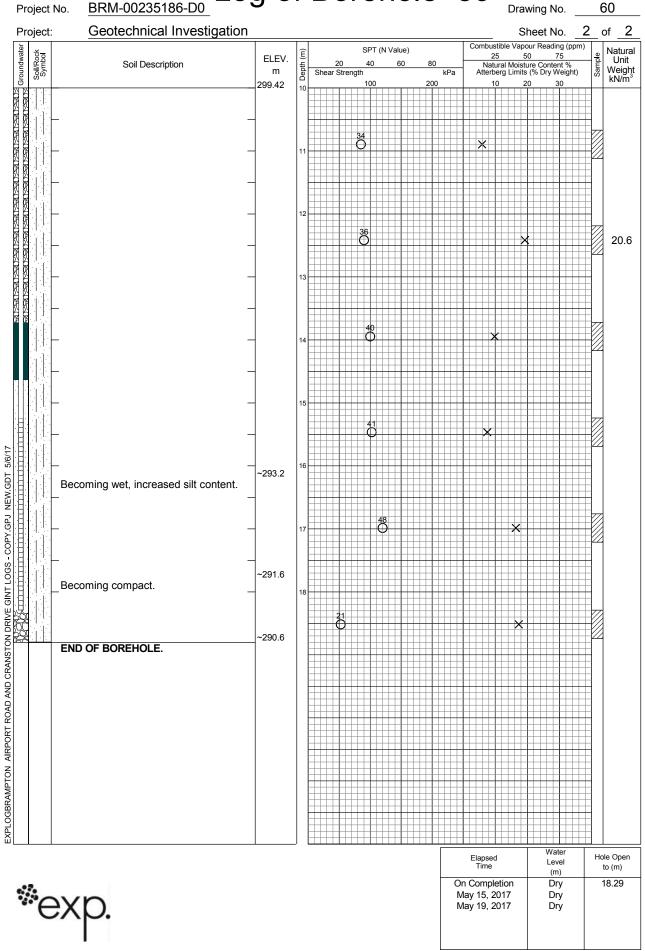
oject: ocation:	Geotechnical Investigation Airport Road and Cranston											Ś	Shee	et No	<u>1</u>	of _
ate Drilled:	May 8, 2017			Auger Sa SPT (N)				0			Natura	ustible V I Moistu and Liq	re	Reading	□ ×	
ill Type: atum:	CME 75-Marooka Geodetic		-	Dynamic Shelby T Field Va	ube				S		Undrai % Stra	ned Tria in at Fai ometer	ixial at	-	⊕	, ,
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	2 Shear S	20 Strengt	40	(N Valı 6	ue) i0		Pa	2	25	50	Reading (ppm) 75 Content % Dry Weight)	Sample	Nati Ur Wei kN/
~200 FILL:	mm Topsoil over : Clayey silt, trace sand, trace el, brown, wet.	305.93	0	ð ð								10 	20 X			KIN
seam	YEY SILT TILL: Fine sand ns, trace gravel, brown, moist,	~303.8	2	5 0 13								×				
	stiff changing to firm.	_	3	ů Č		*						×				
SANI trace	DY SILT TILL: Fine sand seams, gravel, brown, wet, very dense.	~301.9 	4				53					>				
siLT mois	<b>Y SAND:</b> Fine grained, brown, t, dense.	~300.3 	6													
END	OF BOREHOLE.	~299.3														
ex	n		_1	<u> </u>		<u> </u>				Ma	Elapse Time Compl ay 15, 2 ay 19, 2	etion 2017		Water Level (m) Dry Dry Dry Dry	t	ble Op to (m 5.94

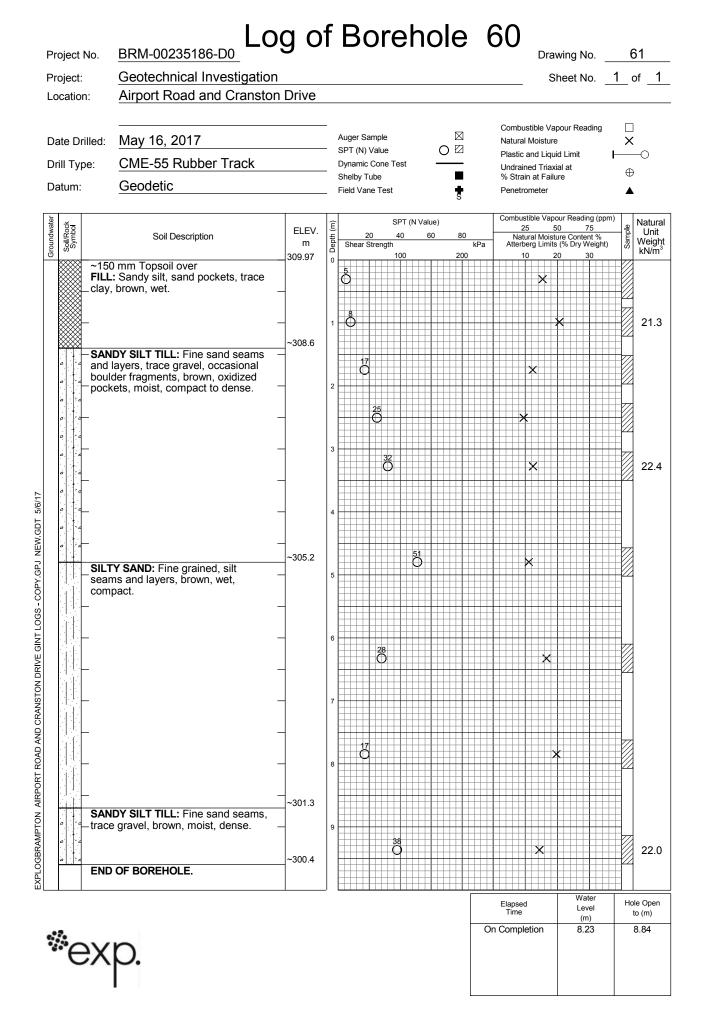


	Seotechnical Investigation											_	ę	Sheet	t No	1	of _1
 ate Drilled: N	Лау 8, 2017		-	Auger S	ample				$\boxtimes$				tible Va Moistur		Reading	□ ×	
	CME 75-Marooka		-	SPT (N) Dynamic	Value	9		С	) 🛛		Pla	stic a	nd Liqi	uid Lim	iit	$\vdash$	—0
	Geodetic		-	Shelby T Field Va	Гube				s		% 5	Strain	ed Tria: at Fai neter			€	•
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	Shear	20 Streng	40 th	(N Va	lue) 60	80	kPa		25 Natur tterbe	al Mois rg Limit	50 sture Co ts (% D	eading (ppm 75 ontent % ry Weight)	Sample (	Natur Unit Weig kN/m
🗱 🕅 FILL: S	am Topsoil over andy silt to clayey silt, trace brown, moist.	308.38	0	ð		100			20			10		20	30		
_			1	6									×				
		~306.2	2	ð									×				
	ing mainly sandy silt, trace brown, wet.	_		>										*			
		_	3	2 5										×			
SILTY S	SAND: Fine grained, brown, dense.	~304.3	4														
		_	5			Ö						*					
<b>SANDY</b> trace gr dense.	<b>SILT TILL:</b> Fine sand seams, ravel, trace clay, brown, moist,	~302.8	6			36											
<i>a a</i>		201.0	7			36 O						>	<				
SAND A	AND GRAVEL: Brown, wet, nse.	~301.3	'			50 fc	or 100	mm									
END OI	F BOREHOLE.						0										
											Elap	psed			Water Level	Но	ole Ope

oject No. oject:	BRM-00235186-D0 Geotechnical Investigation			oreh		D	rawing No Sheet No		60 of 2
cation:	Airport Road and Cranstor						_		
			_		5	Combustible	Vapour Reading		]
te Drilled:	May 10, 2017		-	<sup>·</sup> Sample N) Value		Natural Mois Plastic and L		× ⊢	: 
ill Type:	CME 75-Marooka		_	nic Cone Test y Tube		Undrained Tr % Strain at F		€	)
itum:	Geodetic		_ Field	/ane Test	S	Penetromete	r		L .
Soil/Rock Symbol	Soil Description	ELEV. m 309.42		SPT (N V 20 40 ar Strength 100	'alue) 60 80 kPa 200	25 Natural M	Vapour Reading (ppr 50 75 Disture Content % mits (% Dry Weight) 20 30	mple	Natu Ur Wei kN/
	) mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams		0 Ô			×			
occa	layers, trace gravel, trace clay, isional boulder fragments, brown,	-							
, a mois , a	st, compact to dense.	_	1	\$		×			22
		_							
			Ċ			×			22
			2	40					
,		_		Ő		×			2'
		~306.2	3	10					
	<b>Y SAND:</b> Fine grained, sandy silt rs, cemented zones, widely			Ð		×			
scat	tered gravel, brown, moist, dense.								
			4						
		_		43					
		_	5			×			
			6	43 O		~			
		_							
		_	7						
				45 O		×			22
			8						ł
		-							
		_	9						
				34 O		×			
	Continued Next Page		10			Elapsed	Water	Но	l ble Op
						Time On Completion	(m) Dry		to (m)
ex	n					May 15, 2017 May 19, 2017	Dry Dry		_,

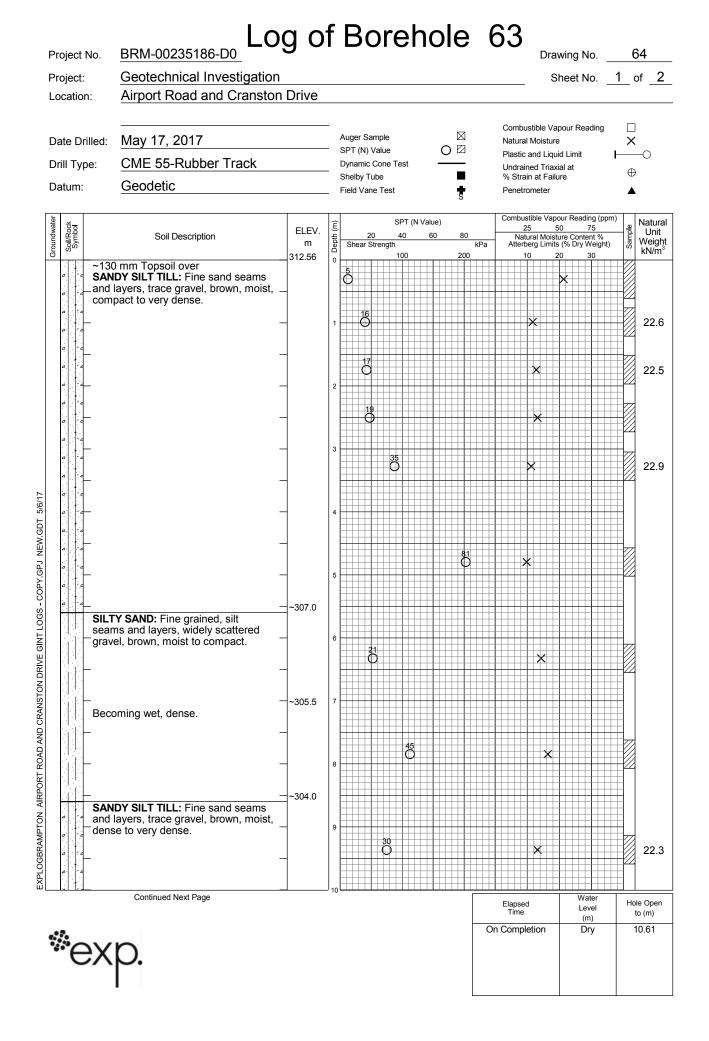
## Log of Borehole 59 Drawing No.





Project No. BRM-00235186-D0 Project: Geotechnical Investigation Location: Airport Road and Cranstor	1		Boreł			Drawing	g No et No		62 of <u>1</u>
Date Drilled: May 16, 2017 Drill Type: CME 55-Rubber Track Datum: Geodetic Soil Description ************************************	ELEV. m 306.60	_	Auger Sample SPT (N) Value Dynamic Cone Test Shelby Tube Field Vane Test 20 40 Shear Strength 100	Value) 60 80 201	Natu Plas Undi % St Pene Comt <u>kPa</u> Atte	bustible Vapour ral Moisture tic and Liquid Lin rained Triaxial at train at Failure etrometer 25 50 latural Moisture C erberg Limits (% D 10 20	nit  -	뤝	-O Natura Unit Weight kN/m <sup>3</sup>
FILL: Silty sand, trace clay, dark brown, wet.	- - - - - - - - - - - - - - - - - - -	2 3 4			,	× × ×			20.9
END OF BOREHOLE.	~300.0	5		70 Ö 71		*			
<u> </u>	•					sed	Water		e Open

Project No. Project:	Geotechnical Investigatio	n	f	Boreł	nole	62	Drawing No Sheet No	63 <u>1</u> of <u>1</u>
Location: Date Drilled:	Airport Road and Cransto May 16, 2017	n Drive		Auger Sample SPT (N) Value	O 🛛	Natural M	ble Vapour Reading loisture Id Liquid Limit	×
Drill Type: Datum:	CME 55- Rubber Track Geodetic		-	Dynamic Cone Test Shelby Tube Field Vane Test	S S	Undrained % Strain a Penetrom		⊕
Groundwater Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N 20 40 Shear Strength	60 80	25 Natura kPa Atterberg	le Vapour Reading (ppr 50 75 Il Moisture Content % g Limits (% Dry Weight) 20 30	<sup>1)</sup> <u>e</u> Unit Weight kN/m <sup>3</sup>
~200 SILT	0 mm Topsoil over T <b>Y SAND:</b> Fine grained, silt rs, brown, wet, compact.	307.21	0		200		× · · · · ·	
			1	11			×	
		_	2	13 Ö			*	
			3				*	
		-		14 O			×	
∃ and ≥ _ boul	IDY SILT TILL: Fine sand seams layers, trace gravel, occasional der fragments, brown, moist, se to very dense.		4	31			×	
민 티카이는		-	6		78	×		22.4
	<b>Y SAND:</b> Fine grained, ented zones, brown, moist, very se.	~300.1 	8		75 for 250r	nm ×		22.4
	OF BOREHOLE.	~297.6	9		79	×		
			_  {			Elapsed	Water Level	Hole Open to (m)
*ex	p.					On Completi	on Dry	3.05



# BRM-00235186-D0 Log of Borehole 63

з 30256 то 100 20 10 20 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20

oject No. oject: ocation:	BRM-00235186-D0 Geotechnical Investigation Airport Road and Cranstor										wing N heet N		6 	of _2
		1 Diric	_						Com	bustible Var	oour Rea	dina		
ate Drilled:	May 17, 2017			Auger Sample SPT (N) Value				8 2	Natu	iral Moisture tic and Liqui		L	×	
ill Type:	CME 55-Rubber Track		_	Dynamic Cone Shelby Tube	Test			-	Undr	rained Triaxi train at Failu	al at	ſ	$\oplus$	0
atum:	Geodetic			Field Vane Tes	st			s		etrometer				
Soil/Rock Symbol	Soil Description	ELEV. m 312.27	Depth (m)	20 Shear Strengt	40	(N Valu 6	0	80 kPa 200		Dustible Vapo 25 5 Jatural Moistu erberg Limits 10 2	0 7 ure Conte (% Dry V	75 nt %	Sample	Natu Uni Weig kN/n
~300	mm Topsoil over <b>DY SILT TILL:</b> Fine sand seams.		0	5 O										
	gravel, trace clay, occasional ler fragments, brown, moist,	-											4	
e le comp ⊢	pact.	_	1	14 O						×				22.
0 0 0 0														
o   a		1		14 Ö						×				22.
a		-	2										4	
o c				17						×				
0 0 0 0													14	
a a		-	3	18										22.
e		_											4	22.
o a		~308.3												
Beco	ming very dense.		4											
o		-				54								
o   a 		_	5			0				*			8	22.
0 0														
o   c		1												
ο ν ο ι ε		-	6					92 for <u>2</u> 80	)mm					
o   a		_								×			A	21.
o c o c		~305.3												
	Y SAND: Fine grained, silt is and layers, brown, wet,		7											
		-												
			8	Ö						×				
SANI	DY SILT TILL: Fine sand seams	~303.7												
and I	ayers, trace gravel, brown, moist, bact to very dense.	_	9											
0 . a	,			16 O						×				22.
0 0		7												
	Continued Next Page		_  <sub>10</sub>			+++-			Elaps		Wa			le Oper
									Tin	1e	Lev (m	1)	t	o (m)
*ex									n Com ⁄Iay 19	pletion . 2017	Dr 12.		1	2.19

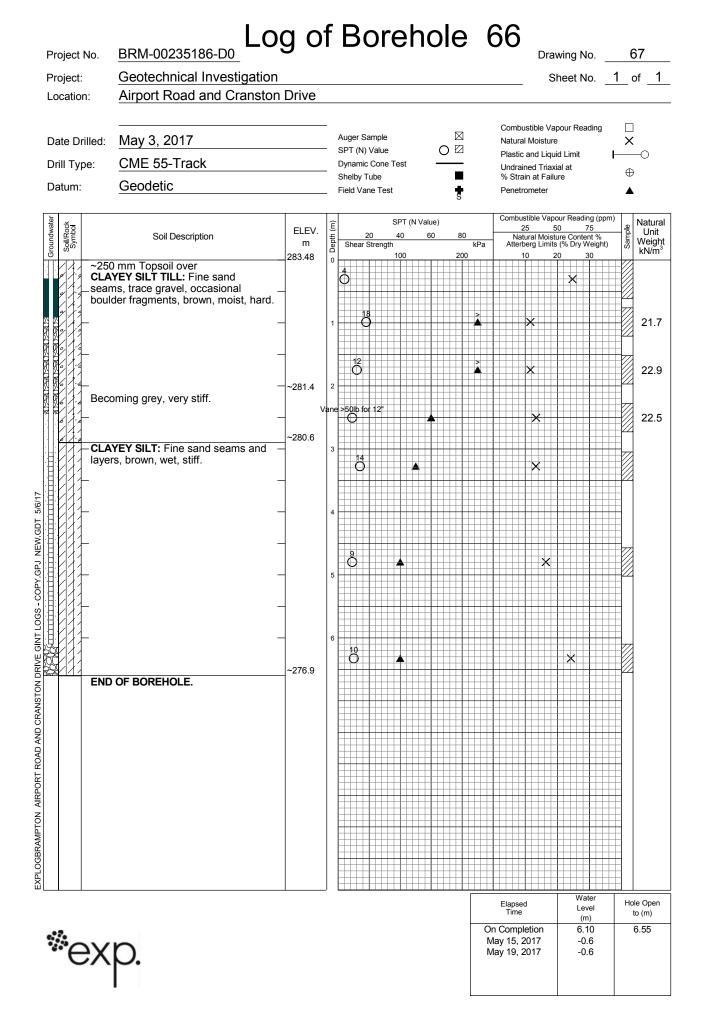
# BRM-00235186-D0 Log of Borehole 64D Drawing No.

1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	roject: <u>Geotechnical Investigation</u>		Ê		SP	Г (N Val	ue)				stible Vap	heet N	ng (ppm)		of Natu
	Soil Description		Depth (m)	20 Shear Strer	igth		60	k	Pa	Na Atter	tural Moist berg Limit	ure Conte s (% Dry V	nt % Veight)	Sample	Natu Uni Weig kN/r
		~300.0	11		50		h	84 Ö			×				
Elapsed Uvater Hole Ope Time Level to (m)													ter		

®exp.

				Boreh						5A
	Geotechnical Investigation Airport Road and Cranstor						SI	neet No	1	of _1
- ate Drilled:	May 17, 2017		_	Auger Sample		3	Combustible Va Natural Moisture	-	□ ×	-
-	CME 55-Rubber Track			SPT (N) Value Dynamic Cone Test	OB	2	Plastic and Liqui Undrained Triaxi	d Limit	É	—0
	Geodetic		_	Shelby Tube Field Vane Test			% Strain at Failu Penetrometer		€	•
Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)	SPT (N 20 40 Shear Strength 100	60	80 kPa 200	Combustible Vapo 25 5 Natural Moistu Atterberg Limits 10 2	0 75 ure Content % (% Dry Weight)	ample (u	Natur Uni Weig kN/n
SAND	nm Topsoil over <b>/ SILT TILL:</b> Fine sand seams, ravel, trace clay, occasional	312.27	0	5 Č			×			
	r fragments, brown, moist,		1	14 Ö			*			22.
		-		14						
o		-	2							22.
0 e 0 e		-		Č			*			
e			3	18 O			×			22
e Becom	ing very dense.	~308.3	4							
p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         p       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d       d         d				54						
		5				×			22	
	~305.9	6			92 for 280n				21	
LI		L	_!				Elapsed Time	Water Level (m)		ble Ope to (m)
*exp	-						Completion ay 19, 2017	Dry Dry		6.10

roject: ocation:	Geotechnical Investigation Airport Road and Cranstor													S	hee	t No.	1	of
ate Drilled: rill Type: atum:	May 11, 2017 CME 55 - Rubber Track Geodetic		_	Auger S SPT (N) Dynami Shelby	) Value c Cone Tube	e Tes	t	-	0			Natu Plas Und % S	ural I stic a raine train	Moistur and Liqu ed Triax n at Fail	e iid Lin kial at		∟ × ●	<b>(</b> —0
Symbol	Soil Description	ELEV.	Depth (m)		20	SP1 40	[ (N V	alue) 60	)	S 80		Com	bust 25	;	50	eading (ppm 75 ontent % Dry Weight)	Sample (	Natur
~165 FILL	5 mm Topsoil over : Clayey silt, trace gravel, brown ark brown, moist.	m 311.56	o Dep	Shear	Streng	100				200	kPa	Att	erbe		s (% E 20	Dry Weight) 30	Sa	Weig kN/r
-		~310.2	1	ð										;	<b>x</b>			19
and boul	DY SILT TILL: Fine sand seams layers, trace gravel, occasional der fragments, brown, moist, pact to dense.		2	Ö										×				21
ρ 2		_	3		23	5-								*				22
	SILTY SAND: Fine grained, brown, wet, dense.	~307.6	4											×				22
wet,	dense.	_	5			37 O									*			
	YEY SILT TILL: Fine sand ns, trace gravel, brown, moist,	~306.0	6															
		_			21 0						*			×				22
		_	7			32					>			~				
END	OF BOREHOLE.	~303.5																22
																Water		
ех	p.										0	Elap Tin n Corr	ne	tion		Level (m) Dry		to (m)



oject No. oject:	BRM-00235186-D0 Geotechnical Investigation	_	-	Boreh			Drav	ving No		58 of ^	
ocation:	Airport Road and Cransto						_ 01		<u> </u>		
				August Operation	$\boxtimes$	Com	ibustible Vap	oour Reading			
ate Drilled:	May 10, 2017			Auger Sample SPT (N) Value			iral Moisture tic and Liqui		× ⊢	-0	
rill Type: atum:	CME 75-Marooka Geodetic			Dynamic Cone Test Shelby Tube		% St	rained Triaxi train at Failu		$\oplus$		
				Field Vane Test	S	Pene	etrometer				
Soil/Rock Symbol	Soil Description	ELEV. m 296.43	Depth	100	/alue) 60 80 kF 200	N	25 5 Jatural Moistu	re Content % (% Dry Weight)	<sup>i)</sup> alu Natu Uni Weig kN/r		
🖉 🌾 CLA	0 mm Topsoil over YEY SILT TILL: Trace sand, e gravel, brown, moist, stiff to very		0	Š O			×				
		_	1	Ô			*			21	
			2	ð			×			21	
		_					× -			22	
		-	3	20 O			×			22	
	<b>FY SAND:</b> Fine grained, silt	~292.4	4								
sear	seams, widely scattered gravel, brown, moist, compact. -	,		17			×				
		-	5								
			6								
	OF BOREHOLE.	~289.8					×			1	
						Elaps	sed	Water Level (m)		le Ope to (m)	
*ex	10					On Com May 15		Dry Dry Dry		5.69	



Appendix A: Grain Size Analyses

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#### **Grain Size Analysis** & Hydrometer **Test Report ST08**

#### **Sample Test No.:** 268600-2

#### ort No · 1

#### Date Reported: <u>31-May-17</u>

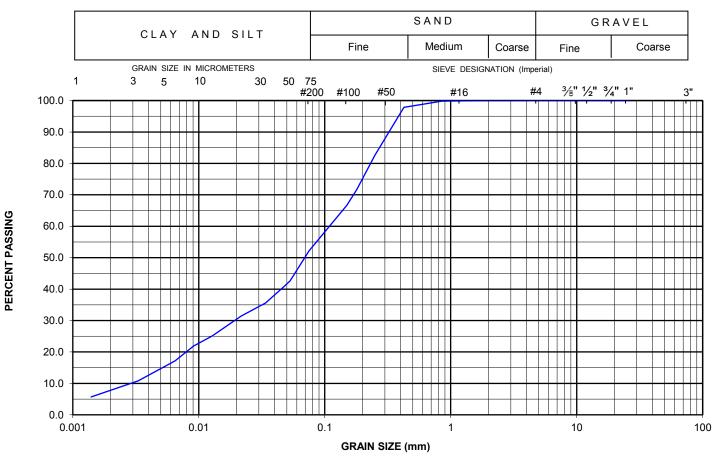
**Project No.:** brm-00235186-d0

Report No.	: <u>1</u>	_
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Project Name:	Airport Road and	Cranston Drive, Caledon East, ON
	(east side of Airpo	ort Rd., north and south of Cranston
Grain Size Proport		
Gravel (> 4.75mm):		
Sand (> 75μm, < 4.	75mm):	47.8
Silt (> 2μm), < 75μn	n):	44.9
Clay (< 2μm):		7.3
Total:		100.0
Sample Information	<u>n</u>	
Location:	<u>BH 2</u>	
Sample Method:	<u>SS</u>	
Sample No.:	<u>7</u>	
Depth:	<u>6.1 - 6.6m</u>	
Sample Description	n: <u>Sand and Silt, trac</u>	e Clay; Brown
Sampled By:	<u>D. P.</u>	
Sampling Date:	<u>4/27/2017</u>	
Date Received:	4/28/2017	
Client Sample ID:		
Comments:		

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0471	40.7
22.4	100.0	0.0339	35.6
19	100.0	0.0217	31.4
16	100.0	0.0128	25.1
13.2	100.0	0.0091	21.9
12.5	100.0	0.0065	17.2
9.5	100.0	0.0033	10.8
6.7	100.0	0.0014	5.7
4.75	100.0		
2	100.0		
0.85	99.8		
0.425	97.8		
0.25	82.6		
0.18	71.7		
0.15	66.7		
0.075	52.2		
0.053	42.6		

#### UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: David Dennison Approved By: Original Signed By

Date Approved: 31-May-17

Willie Rodych, Lab Supervisor

*ex	О.

## Grain Size Analysis & Hydrometer Test Report STO8

Sample Test No.: <u>269141-2</u>

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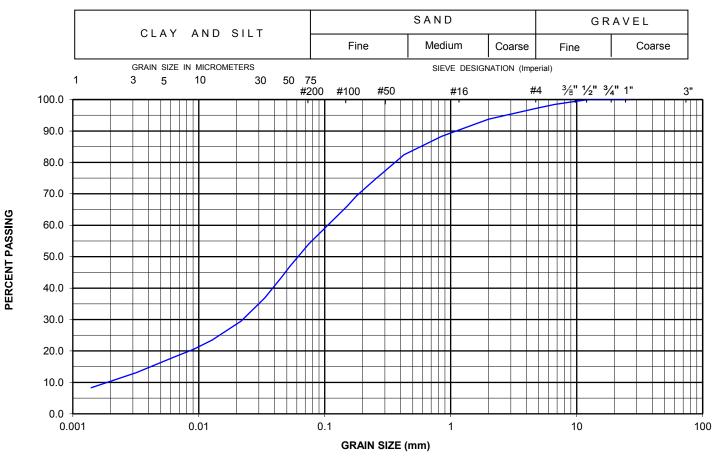
#### **Report No.:** <u>2</u>

Date Reported: <u>31-May-17</u>

Project No.:	brm-00235186-d0	
Project Name:	Airport Road and Cranston Drive, Caledon East, ON	
	(east side of Airport Rd., north and south of Cranstor	1
Grain Size Proporti	on (%)	
Gravel (> 4.75mm):	2.8	
Sand (> 75μm, < 4.7		
Silt (> 2μm), < 75μm	n): 44.2	
Clay (< 2μm):	9.9	
Total:	100.0	
Sample Information	<u>1</u>	
Location:	<u>BH 23</u>	
Sample Method:	$\frac{SS}{2}$	
Sample No.:	<u>2</u>	
Depth:	<u>0.8 - 1.2m</u>	
	: Silt and Sand, trace Clay and Gravel; Brown	
Sampled By:	<u>K. M.</u>	
Sampling Date:	<u>5/8/2017</u>	
Date Received:	<u>5/8/2017</u>	
Client Sample ID:		
Comments:		

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0462	43.8
22.4	100.0	0.0335	36.9
19	100.0	0.0217	29.5
16	100.0	0.0128	23.5
13.2	100.0	0.0091	20.5
12.5	100.0	0.0065	18.2
9.5	99.3	0.0032	13.1
6.7	98.5	0.0014	8.3
4.75	97.2		
2	93.7		
0.85	88.3		
0.425	82.4		
0.25	74.5		
0.18	69.5		
0.15	66.0		
0.075	54.1		
0.053	47.0		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: David Dennison Approved By: Original Signed By Willie Rodych, Lab Super Date Approved: 31-May-17

Willie Rodych, Lab Supervisor



## Grain Size Analysis & Hydrometer Test Report STO8

#### Sample Test No.: <u>268958-2</u>

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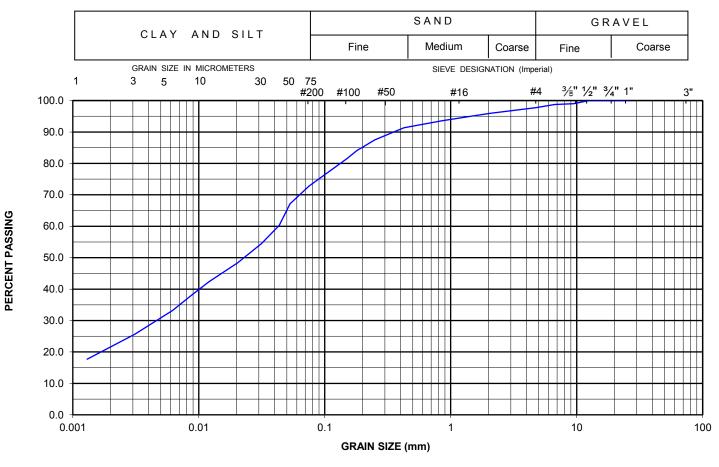
#### **Report No.:** <u>3</u>

Date Reported: <u>31-May-17</u>

Project No.:	brm-00235186-d0				
Project Name:	Airport Road and Cranston Drive, Caledon East, ON				
	(east side of Airport Rd., north and south of Cranston				
Grain Size Proportion (%)					
Gravel (> 4.75mm):		2.3			
Sand (> 75μm, < 4.7	'5mm):	25.0			
Silt (> 2μm), < 75μm	ı):	51.9			
Clay (< 2μm):		20.8			
Total:		100.0			
Sample Information	<u>1</u>				
Location:	<u>BH 39</u>				
Sample Method:	<u>SS</u> <u>2</u>				
Sample No.:	<u>2</u>				
Depth:	<u>0.8 - 1.2m</u>				
Sample Description: Clayey, Sandy Silt; trace Gravel; Brown					
Sampled By:	<u>K. M.</u>				
Sampling Date:	<u>5/1/2017</u>				
Date Received:	5/4/2017				
Client Sample ID:					
Comments:					

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0435	60.3
22.4	100.0	0.0315	54.5
19	100.0	0.0204	48.4
16	100.0	0.0120	42.3
13.2	100.0	0.0086	37.8
12.5	100.0	0.0062	33.2
9.5	99.0	0.0031	25.6
6.7	98.7	0.0013	17.7
4.75	97.7		
2	95.9		
0.85	93.5		
0.425	91.3		
0.25	87.5		
0.18	84.1		
0.15	81.5		
0.075	72.8		
0.053	67.1		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: David Dennison Approved By: Original Signed By Willie Rodych, Lab Supe Date Approved: 31-May-17

Willie Rodych, Lab Supervisor



#### **Grain Size Analysis** & Hydrometer **Test Report ST08**

#### Sample Test No.: 269168-2

Sample No.:

Sampled By:

Sampling Date:

Date Received:

Client Sample ID: Comments:

Depth:

#### **Report No.:** 4

#### Date Reported: 31-May-17

Project No.: brm-00235186-d0 Project Name: Airport Road and Cranston Drive, Caledon East, ON (east side of Airport Rd., north and south of Cranston Grain Size Proportion (%) Gravel (> 4.75mm): Sand (> 75µm, < 4.75mm): 25.6 Silt (> 2μm), < 75μm): 72.8 Clay (< 2µm): 1.6 Total: 100.0 Sample Information Location: BH 45 Sample Method: <u>SS</u>

5

3.0 - 3.5m Sample Description: Sandy Silt, trace Clay; Brown

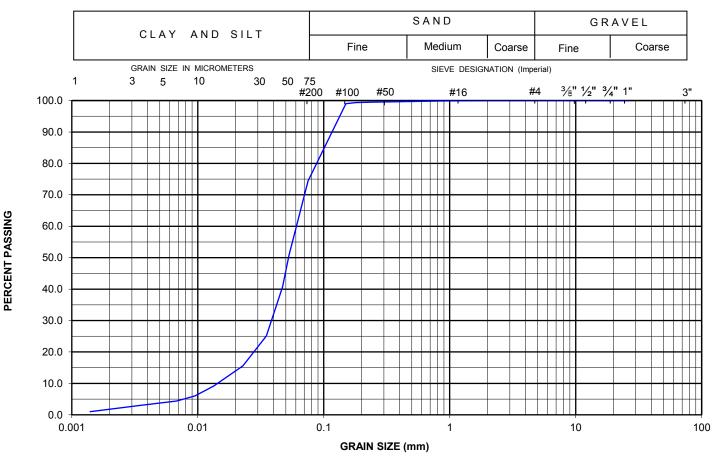
<u>K. M.</u>

5/8/2017

5/8/2017

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0471	40.7
22.4	100.0	0.0350	25.1
19	100.0	0.0228	15.6
16	100.0	0.0134	9.2
13.2	100.0	0.0095	6.0
12.5	100.0	0.0068	4.4
9.5	100.0	0.0033	2.9
6.7	100.0	0.0014	1.0
4.75	100.0		
2	100.0		
0.85	99.8		
0.425	99.7		
0.25	99.5		
0.18	99.3		
0.15	99.0		
0.075	74.4		
0.053	50.8		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: David Dennison Approved By: Original Signed By Willie Rodych, Lab Supervisor Date Approved: 31-May-17