

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
NOISE BARRIER WALLS  
MISSISSAUGA BUS RAPID TRANSIT (BRT) PROJECT  
MISSISSAUGA, ONTARIO**

**Geocres Number: 30M12-294**

**Report to**

**McCormick Rankin Corporation**

Thurber Engineering Ltd.  
2010 Winston Park Drive, Suite 103  
Oakville, Ontario  
L6H 5R7  
Phone: (905) 829 8666  
Fax: (905) 829 1166

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the proposed noise barrier walls to be constructed in connection with the Mississauga Bus Rapid Transit (BRT) project in Mississauga, Ontario. The proposed walls will be located to the east and west of Central Parkway along the south side of the busway, on the south side of Highway 403.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profiles, and written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and construction of the foundations for the proposed noise barrier walls.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation under their Sub-consultant Agreement for Project Number 7493.

**2 PROJECT AND SITE DESCRIPTION**

The BRT project involves a fully grade-separated, two-lane bus-only roadway located in the City of Mississauga, extending from the City Centre Station (Highway 403 at Hurontario Street) to the Renforth Drive Station (Renforth Drive at Eglinton Avenue). The total length is approximately 9.5 km.

The segment of the BRT at Central Parkway will run parallel to the south side of Highway 403 and include a bus station and grade separation structure at Central Parkway. A noise barrier wall will be installed from approximately 430 m west of the Central Parkway structure to approximately 260 m east of the station. At Central Parkway, the wall will be carried on the grade separation and station structures.

Currently the site is a vacant strip of land bordered on the north by Highway 403 and on the south by residential development. Vegetation consists mainly of tall grass and occasional shrubs.

The site is situated within the South Slope physiographic region. The geology generally comprises a till plain consisting of clayey silt to silty clay till (Halton Till) overlying bedrock at relatively shallow depth. The bedrock consists of grey shale, siltstone and limestone of the Georgian Bay Formation.

### **3 SITE INVESTIGATION AND FIELD TESTING**

Site investigation was carried out along the subject part of the BRT alignment between January 9, 2008 and July 10, 2009. The information from 15 boreholes drilled along or in close proximity to the wall alignment (borehole Nos. 07-06, 09-18 to 09-24A, 09-32, 09-33, 09-35 and 09-37) is included in this report. The boreholes were advanced to depths of 2.0 to 9.8 m, including coring of shale bedrock in one borehole.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendix D. The coordinates and elevations of the boreholes are given on the drawing and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

A combination of solid and hollow stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the underlying bedrock in borehole 09-19.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, visually examined the recovered samples, and transported them to Thurber's laboratory for further examination and testing.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in three boreholes to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.1.

**Table 3.1 – Borehole Completion Details**

<b>Borehole</b>	<b>Piezometer Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
07-06	6.1/152.7	Piezometer with 1.5 m slotted screen installed with sand filter to 3.6 m, bentonite from 3.6 m to ground surface.
09-18	None installed	Auger cuttings to ground surface.
09-19	8.3/147.9	Piezometer with 1.5 m slotted screen installed with sand filter to 2.7 m, bentonite from 2.7 m to ground surface.
09-20	None installed	Auger cuttings to ground surface.
09-21	None installed	Auger cuttings to ground surface.
09-22	2.0/144.9	Piezometer with 1.5 m slotted screen installed with sand filter to 0.5 m, bentonite from 0.5 m to ground surface.
09-23	None installed	Auger cuttings to ground surface.
09-23A	None installed	Bentonite to 1.7 m then auger cuttings to ground surface.
09-23B	None installed	Bentonite and auger cuttings to ground surface.
09-24A	None installed	Bentonite and auger cuttings to ground surface.
09-24	None installed	Bentonite to 2.7 m then auger cuttings to ground surface.
09-32	None installed	Bentonite and auger cuttings to ground surface.
09-33	None installed	Bentonite and auger cuttings to ground surface.
09-35	None installed	Bentonite and auger cuttings to ground surface.
09-37	None installed	Bentonite and auger cuttings to ground surface.

#### **4 LABORATORY TESTING**

All recovered soil samples were subjected to Visual Identification (VI) and rock samples to geological logging. At least 25% of the recovered samples of soil were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. Moisture content determinations were carried out on all soil samples. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory. Point load tests were carried out on selected samples of intact limestone interbeds upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. The results of the point load tests are shown on the borehole log.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil and rock stratigraphy are presented in this appendix and on the Borehole Locations and Soil Strata Drawings in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the soil stratigraphy encountered at this site comprises surficial topsoil or fill overlying native silty clay till, which is in turn underlain by weathered shale bedrock west of Central Parkway and silty sand till at the east end of the site. More detailed descriptions of the individual strata are presented below.

### 5.1 Topsoil

Topsoil or peaty organics were identified surficially in all but two of the boreholes. The topsoil thickness ranged from 75 to 250 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

### 5.2 Silt, Clay and Shale Fill

Fill consisting of silty clay, clayey silt and sandy silt mixed with broken shale was encountered in Boreholes 09-23, 09-23B, 09-024A, 09-33, 09-35 and 09-37 drilled on existing fill berms. This material may comprise excess excavated bedrock and include obstructions such as limestone slabs. The thickness of the fill layer ranged from 2.0 to 7.2 m, and the lower boundary was at Elevation 145.4 to 150.7 m. Borehole 09-23 encountered auger refusal in the fill at 3.4 m depth.

SPT 'N' values obtained in the fill ranged widely from 6 blows/0.3 m to 50 blows/0.05 m of penetration, reflecting the presence of firm zones and shale pieces, respectively. The 'N' values typically ranged from 20 to 75 blows/0.3 m (very stiff to hard).

The natural moisture contents of the fill samples generally ranged from 7 to 20%. Two values of 32% were obtained in samples from borehole 09-23B, possibly indicative of an organic component.

Grain size distribution curves for three samples tested are presented on the Record of Borehole sheets and on Figure B1 of Appendix B. Atterberg Limit test results are presented on Figure B5. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	4 to 6
Sand	25 to 31
Silt	41 to 46
Clay	22 to 25
Liquid Limit	37 to 41
Plastic Limit	20 to 22

The above results show that the clay/shale fill is typically of medium plasticity with a group symbol of CI.

### 5.3 Silty Clay Till

Native brown to grey silty clay till was contacted at depths of 2.0 to 7.2 m in the boreholes where fill was encountered and below the surficial topsoil layer in the remaining boreholes. The till is described as silty, some sand to sandy, trace to some gravel, and contains occasional cobbles and shale fragments.

Auger refusal was met in/below the clay till at depths of 2.0 to 4.7 m depth in six boreholes, and the lower boundary of the till was encountered at depths of 3.0 to 6.1 m in four boreholes. The thickness of the clay till at these locations ranged from 1.7 to 4.6 m. The remaining boreholes were terminated in the till at depths of 5.2 to 9.8 m, indicating a thickness of at least 2.6 to 5.1 m.

Based on SPT 'N' values typically ranging from 21 to 79 blows for 0.3 m of penetration, the silty clay till is described as very stiff to hard in consistency. SPT 'N' values ranging from 3 to 16 blows/0.3 m were obtained in four boreholes (boreholes 09-18, 09-20, 09-21 and 09-32) reflecting localized soft to very stiff zones. 'N' values of up to 50 blows/0.075 m of penetration were obtained in several boreholes, where shale or shale fragments were encountered.

The natural moisture content of the silty clay till ranged from 8 to 24%. Moisture contents of 29 and 32% were measured in two samples from borehole 09-32.

Grain size distribution curves for the clay till are presented on the Record of Borehole sheets and on Figures B2 and B3 of Appendix B. Atterberg Limit test results are presented on Figures B6 and B7 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 16
Sand	13 to 38
Silt	31 to 54
Clay	15 to 31
Liquid Limit	27 to 42
Plastic Limit	17 to 22

The above results show that the silty clay till is typically of low to medium plasticity with group symbols of CL-CI.

Glacial tills inherently contain cobbles and boulders and the lower part of the till may contain pieces and slabs of bedrock which may account for some high blow counts.

#### 5.4 Silty Sand Till

Brown to grey silty sand till was encountered at 6.1 and 5.8 m depth in boreholes 09-35 and 09-37 at the east end of the site. These boreholes were terminated in the till at 9.8 m depth, indicating a thickness of at least 3.7 and 4.0 m. Glacial tills inherently contain cobbles and boulders.

Based on SPT 'N' values ranging from 47 blows/0.3 m to 100 blows/0.125 m, the silty sand till is dense to very dense. Moisture contents ranged from 8 to 13%.

Grain size distribution curves for two samples tested are presented on the Record of Borehole sheets and on Figure B4 of Appendix B. Atterberg Limit test results from one sample are presented on Figure B8 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	3
Sand	53 to 54
Silt	28 to 33
Clay	11 to 15
Liquid Limit	21
Plastic Limit	13

The above results show that the silty sand till has slight to low plasticity with group symbols of ML to CL.

#### 5.5 Bedrock

Shale bedrock was encountered at 3.0 m depth in borehole 09-19 and proven by coring to a depth of 8.3 m. Bedrock was also encountered in borehole 07-06 at 3.0 m depth and this borehole was advanced to 6.1 m by augering. Auger refusal was encountered on probable bedrock at depths of 2.0 to 4.7 m in six additional boreholes. The depths and elevations of the bedrock/probable bedrock surface are summarized in Table 5.1.

**Table 5.1 – Depth and Elevation of Bedrock/Probable Bedrock**

Borehole	Depth to Bedrock (m)	Bedrock Surface Elevation (m)	Criteria
07-06	3.0	155.8	Augering/split spoon
09-18	2.0	156.3	Auger refusal
09-19	3.0	153.2	Cored
09-20	2.6	151.1	Auger refusal
09-21	2.6	148.4	Auger refusal
09-22	2.0	144.9	Auger refusal
09-23A	4.1	141.8	Auger refusal
09-24	4.7	140.4	Auger refusal



The shale recovered in the bedrock core was described as highly weathered and thinly bedded with hard limestone interbeds up to 250 mm in thickness. Total core recovery (TCR) ranged from 95 to 100%. RQD values ranged from 16 to 70%, indicating a very poor to fair rock quality. The fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 3 to 15.

The unconfined compressive strength of the limestone interbeds assessed from Point Load testing ranged from 50 to 167 MPa, indicating a strong to very strong rock. The results are shown on the Record of Borehole sheets in Appendix A.

Point load tests were possible only on the limestone interbed samples as the more typical weathered shale cores tended to split along bedding planes and were not suitable for testing. Based on point load and unconfined compression testing carried out on shale cores from other areas of the BRT project, the shale strength ranges from about 3 to 30 MPa, indicating a very weak to medium strong rock.

## 5.6 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in three boreholes to monitor water levels after completion of drilling. The water levels observed upon completion of drilling and measured in the piezometers are summarized in Table 5.2.

**Table 5.2 – Measured Groundwater Levels**

Borehole	Date	Water Level		Comment
		Depth (m)	Elevation (m)	
07-06	27-Feb-08	6.2	152.6	In piezometer
	16-Apr-08	5.3	153.5	
09-18	05-Apr-09	0.6	157.7	Upon completion
09-19	16-Apr-09	4.6	151.6	In piezometer
	05-May-09	4.4	151.8	
	21-May-09	4.7	151.5	
09-22	19-Apr-09	0.9	145.9	In piezometer
	05-May-09	0.6	146.2	
	21-May-09	0.6	146.2	
09-23A	06-Apr-09	2.3	143.7	Upon completion
09-24	06-Apr-09	1.5	143.6	Upon completion
09-35	01-Apr-09	8.8	144.0	Upon completion
09-37	02-Apr-09	7.3	146.3	Upon completion

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

## 6 MISCELLANEOUS

Borehole locations and ground surface elevations were supplied to Thurber by McCormick Rankin Corporation.

The drilling and sampling equipment was supplied and operated by DBW Drilling of Ajax, Ontario and Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario. The fieldwork was supervised on a full time basis by Ms. Eckie Siu, Mr. Will Ball, Mr. Luke Gilarski and Mr. Stephane Loranger of Thurber Engineering Ltd. under the direction of Mr. Mark Farrant, P. Eng., and Mr. Murray Anderson, P.Eng.

Laboratory testing was carried out at Thurber's laboratory in Oakville, Ontario.

Overall supervision of the field program was conducted by Mr. Murray R. Anderson, P.Eng. and Mr. M. Farrant, P. Eng. Interpretation of the data and preparation of the report were carried out by Mr. Murray R. Anderson, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

THURBER ENGINEERING LTD.

Murray R. Anderson, P.Eng., M.Eng.  
Senior Foundations Engineer



P.K. Chatterji, P.Eng., Ph.D.  
Review Principal



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**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 INTRODUCTION**

This report presents interpretation of the geotechnical data in the factual report and presents geotechnical parameters for design of the noise barrier wall foundations.

The segment of the BRT at Central Parkway will run parallel to the south side of Highway 403 and include a bus station and grade separation structure at Central Parkway. A noise barrier wall will be installed from approximately 430 m west of the Central Parkway structure to approximately 260 m east of the station. At Central Parkway, the wall will be carried on the grade separation and station structures.

The bottom of the wall will follow the existing ground surface from the west limit to approximately 260 m west of Central Parkway (falling from approximate elevation 157.7 to 151.8 m), then follow the BRT shoulder grade easterly to the Central Parkway structure (from elevation 151.8 to 150.5 m). East of Central Parkway, the bottom of the wall will follow the BRT grade, ranging from approximate elevation 149.7 m adjacent to the station to elevation 148.8 m near the east limit.

**7.1 Foundation Design Parameters**

Conventional post foundation design comprising a single augered caisson (drilled shaft) is considered appropriate for support of noise barrier walls on this project. Caisson construction is expected to be carried out primarily within new busway embankment fill, firm to hard clay till, and potentially into the underlying shale bedrock at the west limit.

The geotechnical parameters recommended for design of the post foundations are presented in Table 7.1 at the end of the text. Resistance within the upper 1.2 m below final grade should be neglected in the foundation design to account for frost effects and potential surficial disturbance.

The geotechnical parameters for design of post foundations in embankment fill will depend upon the type of soil used to construct the embankment. For embankments constructed using compacted on-site clay till, an unconfined compressive strength,  $q_u$  of 100 kPa is recommended. For imported cohesionless fill (Granular B Type 1 or similar), the following parameters are recommended: friction angle =  $30^\circ$ ,  $n_h = 3.0 \text{ MN/m}^3$ , unit weight =  $20 \text{ kN/m}^3$ .

The full lateral resistance should only be assumed where the width of soil in front of the caisson is equal to or greater than approximately four times the diameter of the caisson. Where a downward sloping ground surface exists in front of the caisson, the lateral passive resistance should be reduced during design. For sloping ground closer to the caisson face than four caisson diameters, the magnitude of the mobilized passive resistance can be estimated using the following reduction factors:

**Table 7.2 Slope Reduction Factors**

<b>Slope Inclination</b>	<b>Passive Resistance Reduction Factor</b>
2H : 1V	0.60
2.5H : 1V	0.65
3H : 1V	0.70
4H : 1V	0.75

## **7.2 Caisson Installation**

Caisson installation should generally be carried out in accordance with OPSS 903.

There is a high probability that the fill and till soils contain shale and limestone slabs/fragments, and possibly cobbles and boulders, that must be penetrated or removed during caisson/post excavation. Installation equipment must be capable of penetrating the fill, till and shale, and of dislodging and removing the potential cobbles and boulders.

Further, the equipment must be capable of penetrating strong to very strong limestone interbeds in the shale if foundations extend into bedrock. Rock coring or breaking equipment may be required.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for wall foundation supports at this site. Suggested wording for this NSSP is provided in Appendix C.

Groundwater was observed during drilling or measured in piezometers in a number of the boreholes. In general, the clay till and shale are expected to have a low permeability and therefore groundwater is not expected to impact post installation operations. Unwatering, if necessary, should be possible using sump pumps. Temporary liners should be available to support the caisson sidewalls and provide seepage cut-off where required.

Foundation installation should be monitored to verify that the soil conditions encountered during construction are consistent with the design assumptions in this report. Further, it should be confirmed that the base and sidewalls of the excavation are clean of loose and soft materials prior to pouring of concrete.

### 7.3 Construction Concerns

Potential construction concerns include, but are not necessarily limited to:

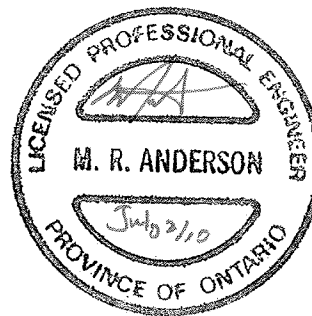
- The fill and till soils may contain shale and limestone slabs/fragments, and possibly cobbles and boulders, that must be penetrated or removed during caisson/post excavation.
- The shale surface may vary between and beyond the borehole locations, and additional depth of augering within the bedrock may be required.
- The shale contains hard interbeds of limestone and calcareous shale that may slow production and/or require the use of coring or rock breaking equipment to penetrate.
- Seepage may be experienced from the fill, seams in the till or fractures in the shale bedrock.

## 8 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Murray R. Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Murray R. Anderson, P.Eng., M.Eng.  
Senior Foundations Engineer



P.K. Chatterji, P.Eng., Ph.D.  
Review Principal



**Table 7.1 - Noise Barrier Wall Foundation Design Parameters**

Bus Rapid Transit (BRT) Project - East Section

City Of Mississauga

Borehole Number	Subsurface Stratigraphy			Foundation Design Parameters				
	Material	Depth* (m)	Elevation (m)	q <sub>u</sub> <sup>**</sup> (kPa)	φ (deg.)	n <sub>h</sub> (MN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	Groundwater Depth/Elev. (m)
09-18	Silty clay till, hard Shale	1.2 – 2.0 Below 2.0	157.1 – 156.3 Below 156.3	200 250	- -	- -	- -	-
09-19	Silty clay till, very stiff to hard Shale	1.2 – 3.0 Below 3.0	155.0 – 153.2 Below 153.2	200 250	- -	- -	- -	4.7/151.5
09-20	Silty clay till, hard Shale	1.2 – 2.6 Below 2.6	152.4 – 151.0 Below 151.0	200 250	- -	- -	- -	-
09-21	New embankment fill (see text) Silty clay till, firm Shale	- 0.2 – 2.6 Below 2.6	150.8 – 148.4 Below 148.4	75 250	- -	- -	- -	-
09-22	New embankment fill (see text) Silty clay till, very stiff to hard Shale	- 0.3 – 2.0 Below 2.0	146.5 – 144.8 Below 144.8	200 250	- -	- -	- -	0.6/146.2
09-23B	Silt/Shale fill Silty clay till, hard	5.5 – 7.2 7.2 – 9.8	149.6 – 147.9 147.9 – 145.4	75 200	- -	- -	- -	-
09-24A	New embankment fill (see text) Silt/Shale fill Silty clay till, hard	- 0.0 – 2.0 2.0 – 5.2	147.3 – 145.4 145.4 – 142.2	50 200	- -	- -	- -	-
09-24	New embankment fill (see text) Silty clay till, very stiff to hard Shale	- 0.2 – 4.7 Below 4.7	144.9 – 140.4 Below 140.4	200 250	- -	- -	- -	1.5/143.6

Notes: \* Depth below existing ground at borehole.

Ignore resistance in upper 1.2 m below finished grade due to frost effects.

\*\* Shear strength ( $c_u$ ) = unconfined compressive strength ( $q_u$ ) / 2.

Table 7.1 – Noise Barrier Wall Foundation Design Parameters

Bus Rapid Transit (BRT) Project - East Section

City Of Mississauga

Borehole Number	Subsurface Stratigraphy			Foundation Design Parameters				
	Material	Depth* (m)	Elevation (m)	q <sub>u</sub> ** (kPa)	φ (deg.)	n <sub>h</sub> (MN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	Groundwater Depth/Elev. (m)
09-32	Silty clay till, stiff to hard	1.2 – 5.2	149.0 – 145.0	150	-	-	-	-
09-33	Silt/Clay fill	3.9 – 5.5	149.3 – 147.7	50	-	-	-	-
	Silty clay till, very stiff	5.5 – 8.2	147.7 – 145.0	200	-	-	-	-
09-35	Silty clay till, hard	5.2 – 6.1	147.6 – 146.7	200	-	-	-	8.8/144.0
	Silty sand till, very dense	6.1 – 8.8	146.7 – 144.0	-	35	10	21	
		8.8 - 9.8	144.0 - 143.0	-	35	7	11	
09-37	Clayey silt fill	0.1 – 2.9	153.5 – 150.7	50	-	-	-	7.3/146.3
	Silty clay till, very stiff to hard	2.9 – 5.8	150.7 – 147.8	200	-	-	-	
	Silty sand till, dense/very dense	5.8 – 7.3	147.8 – 146.3	-	35	10	21	
		7.3 – 9.8	146.3 - 143.8	-	35	7	11	

Notes: \* Depth below existing ground at borehole.

Ignore resistance in upper 1.2 m below finished grade due to frost effects.

\*\* Shear strength ( $c_u$ ) = unconfined compressive strength ( $q_u$ ) / 2.

## **Appendix A**

### **Record of Borehole Sheets**



## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight		RC Rock Core
			SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level






$C_{pen}$  Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT              Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. $(W_L < 30\%)$ .
		CI	Inorganic clays of medium plasticity, silty clays. $(30\% < W_L < 50\%)$ .
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

RECORD OF BOREHOLE No 07-06

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 828 818.0 E 609 758.0 ORIGINATED BY SM  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2008.01.09 - 2008.01.09 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
158.8 0.0 0.1	TOPSOIL: (100mm)  Silty, sandy CLAY, trace gravel, occasional shale fragments Hard Greenish Grey (TILL)(CI)							20 40 60 80 100		W P	W	W L		
			1	SS	64		158							
							157							3 28 48 21
155.8 3.0	Weathered SHALE, occasional limestone layers, grey		2	SS	100/ 250		156							
							155							
			3	SS	50/ .050		154							
152.7 6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.02.27 6.2 152.6 2008.04.16 5.3 153.5		4	SS	60/ .025		153							

+<sup>3</sup> . ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 09-018

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 828 801.7 E 609 785.3 ORIGINATED BY ES  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.05 - 2009.04.05 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE							PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)		
158.3								20	40	60	80	100					
0.0	TOPSOIL: (150mm)							20	40	60	80	100					
0.2	Silty CLAY, some sand, trace gravel Firm to Hard Grey (TILL)		1	SS	5		158										
			2	SS	33		157										
	Occasional shale fragments		3	SS	76/ 225												
156.3																	
2.0	END OF BOREHOLE AT 2.0m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 0.6m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity






20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 09-019

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 828 872.4 E 609 807.3 ORIGINATED BY SL  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers / NQ Coring COMPILED BY AN  
 DATUM DATE 2009.04.02 - 2009.04.02 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
156.2								○ UNCONFINED    + FIELD VANE							
0.0								● QUICK TRIAXIAL    × LAB VANE							
0.1	<b>ORGANICS</b> , black peat: (100mm)														
	Silty <b>CLAY</b> , sandy, trace shale fragments		1	SS	27										
	Very Stiff to Hard														
	Brown (TILL)		2	SS	43										
	Limestone fragments		3	SS	50/ .100									5 22 54 19	
153.2															
3.0	<b>SHALE</b> , highly weathered, thinly bedded, weak to very weak, with medium to very strong limestone interbeds		4	SS	50/ .125										
			1	NQ									FI	RUN 1# TCR=95%, SCR=83%, RQD=17% UCS=50MPa(axi) UCS=132MPa(dia)	
													6		
													7		
													4		
													6		
													8	RUN 2# TCR=97%, SCR=92%, RQD=16% UCS=127MPa(dia)	
			2	NQ									15		
													12		
													8		
													5		
	Limestone layers (greater than 50mm)												11	RUN 3# TCR=95%, SCR=92%, RQD=43% UCS=72MPa(axi) UCS=167MPa(dia)	
	250mm at 5.8m												3		
	125mm at 6.2m												4		
	250mm at 7.6m												6		
	Clay seams:		3	NQ									4		
	75mm at 3.5m												6		
	Rubble zone :												4		
	50mm at 3.9m												4		
	50mm at 4.4m		4	NQ									4	RUN 4# TCR=100%, SCR=96%, RQD=70% UCS=148MPa(dia)	
147.9															
8.3	END OF BOREHOLE AT 8.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE        DEPTH (m)    ELEV. (m) 2009.04.16    4.6            151.6 2009.05.05    4.4            151.8 2009.05.21    4.7            151.5														All point load tests conducted on limestone interbeds.

+ 3 . X 3 : Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 1160(MTO).GPJ 3/26/10

# RECORD OF BOREHOLE No 09-020

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 828 929.8 E 609 857.4 ORIGINATED BY ES  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
153.6								20	40	60	80	100				
0.0	TOPSOIL: (200mm)															
0.2	Silty CLAY, some sand, trace gravel Stiff to Hard Brown (TILL)		1	SS	8		153									
			2	SS	32											
			3	SS	42		152									
			4	SS	50/											
151.1	Occasional shale fragments															
2.6	END OF BOREHOLE AT 2.6m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.															

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-021

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 828 986.6 E 609 892.5 ORIGINATED BY ES  
HWY 403 / BRT BOREHOLE TYPE Solid Stem augers COMPILED BY AN  
DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE								
151.0								20	40	60	80	100				
0.0	TOPSOIL: (175mm) Black		1	SS	3		151									
0.2	Silty CLAY, sandy, trace gravel Soft to Firm Brown (TILL)		2	SS	7		150									
			3	SS	7		149									2 26 41 31
148.4	Occasional shale fragments		4	SS	54/											
2.6	END OF BOREHOLE AT 2.6m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				275											

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 09-022

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 046.9 E 609 948.7 ORIGINATED BY ES  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
146.8								20	40	60	80	100					
0.0	TOPSOIL: (250mm)							20	40	60	80	100					
146.6	Black		1	SS													
0.3	Silty CLAY, some sand, trace gravel, topsoil stained Very Stiff to Hard Brown (TILL)																
			2	SS	23												
	Occasional shale fragments		3	SS	40												
144.9																	
2.0	END OF BOREHOLE AT 2.0m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT SURFACE UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.04.16 0.9 145.9 2009.05.05 0.6 146.2 2009.05.21 0.6 146.2																

+ 3, X 3: Numbers refer to  
Sensitivity


20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-023

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 108.3 E 609 986.1 ORIGINATED BY ES  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
155.6	Clayey <b>SILT</b> , and broken <b>SHALE</b> Stiff to Very Stiff Grey (FILL)							20	40	60	80	100									
0.0			1	SS	17		155														
			2	SS	13		154														
			3	SS	12		153														
152.3			4	SS	21																
3.4			END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL. MOVED TO BOREHOLE 09-023a.																		

# RECORD OF BOREHOLE No 09-023A

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 094.9 E 610 015.1 ORIGINATED BY ES  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
146.0								20 40 60 80 100				
0.0	TOPSOIL, trace roots Dark Brown						146	○ UNCONFINED + FIELD VANE				
0.2	Silty CLAY, sandy, trace gravel Very Stiff to Hard Brown (TILL)		1	SS	21		145	● QUICK TRIAXIAL × LAB VANE				
			2	SS	26		144					
			3	SS	50/ .075		143					
	Occasional shale fragments Grey		4	SS	50/ .075		142					
141.8												
4.1	END OF BOREHOLE AT 4.1m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 2.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 1.7m THEN CUTTINGS TO SURFACE.											

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity



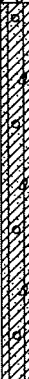
20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-023B

1 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 115.4 E 609 987.9 ORIGINATED BY LG  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.07.10 - 2009.07.10 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
155.1								20 40 60 80 100					
0.0	Clayey <b>SILT</b> and broken <b>SHALE</b> Very Stiff to Hard Brown and Grey (FILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
			1	SS	27				20 40 60 80 100				
			2	SS	75				20 40 60 80 100				
			3	SS	27				20 40 60 80 100				
			4	SS	48				20 40 60 80 100				
	occasional rootlets and wood fibers		5	SS	70				20 40 60 80 100				
			6	SS	30				20 40 60 80 100				
149.5								20 40 60 80 100					
5.6	Silty <b>CLAY</b> , trace sand and gravel, with organics Hard Dark Brown (FILL)		7	SS	32			20 40 60 80 100					
									20 40 60 80 100				
148.0								20 40 60 80 100					
7.2	Silty <b>CLAY</b> , sandy, trace gravel Hard Brown to Grey (TILL)		8	SS	35			20 40 60 80 100					
									20 40 60 80 100				
			9	SS	50			20 40 60 80 100					
145.4								20 40 60 80 100					
9.8	END OF BOREHOLE AT 9.7m.							20 40 60 80 100					

ONTMT4S 1160(MTO),GPJ 3/26/10

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-023B

2 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 115.4 E 609 987.9 ORIGINATED BY LG  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.07.10 - 2009.07.10 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
	BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																


ONTMT4S 1160(MTO),GPJ 3/26/10

RECORD OF BOREHOLE No 09-024

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 172.3 E 610 046.9 ORIGINATED BY ES  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.04.06 - 2009.04.06 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE		WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>					
145.1								20   40   60   80   100							
0.0	TOPSOIL (130mm)							20   40   60   80   100							
0.1	Silty CLAY, some sand to sandy, some gravel Very Stiff to Hard Brown (TILL)		1	SS	22	▽									
			2	SS	27										
			3	SS	26										
	Grey		4	SS	35										
140.4			5	SS	100/										
4.7	END OF BOREHOLE AT 4.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 2.7m THEN CUTTINGS TO SURFACE.				.100										

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 09-024A

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 169.9 E 610 036.8 ORIGINATED BY LG  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.07.09 - 2009.07.09 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
147.4								20 40 60 80 100						
0.0	Sandy SILT, clayey and broken SHALE Brown Moist (FILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
145.4			1	SS	7									
2.0	Silty CLAY, sandy, trace gravel Hard Brown to Grey (TILL)		2	SS	48									
			3	SS	52									
			4	SS	69									
	Grey		5	SS	59									
142.2														
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-032

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 277.8 E 610 118.5 ORIGINATED BY WB  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.03.30 - 2009.03.30 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT		UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P                      W                      W L			
150.2								20   40   60   80   100					
0.0								20   40   60   80   100					
0.1	TOPSOIL: (100mm)		1	AS			150						
	Silty CLAY, some sand to sandy, trace gravel, occasional cobbles Stiff to Hard Grey (TILL)		1	SS	31		149						
			2	SS	30		148						
			3	SS	16		147						
			4	SS	13		146						
			5	SS	53								
145.0													
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.												

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 09-033

1 OF 1

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 362.3 E 610 172.7 ORIGINATED BY WB  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.03.30 - 2009.04.01 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
153.2								20 40 60 80 100					
0.0	TOPSOIL: (75mm)		1	AS			153						
0.1	Clayey SILT, some gravel, occasional cobbles, possible broken shale Compact Grey (FILL)		1	SS	22		152						
			2	SS	50/ .100								
151.0							151						
2.1	Silty CLAY, some sand, some gravel, with limestone fragments Very Stiff to Hard Grey (FILL)		3	SS	54		150						
			4	SS	20		149						
			5	SS	34		148						
147.7							147						
5.5	Silty CLAY, some sand, some gravel, trace rootlets, occasional cobbles Very Stiff Grey (TILL)		6	SS	79		146						
			7	SS	22		145						
145.0							144						
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.						143						

ONTMT-4S 116Q(MTO).GPJ 3/26/10

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-035

1 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 438.4 E 610 238.6 ORIGINATED BY WB  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.04.01 - 2009.04.01 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
152.8								20 40 60 80 100		w <sub>P</sub> w w <sub>L</sub>				
0.0								○ UNCONFINED + FIELD VANE						
0.1	TOPSOIL: (100mm)		1	AS				● QUICK TRIAXIAL × LAB VANE						
	Silty CLAY, sandy, trace gravel, occasional cobbles, numerous shale pieces Very Stiff to Hard Grey (FILL)		1	SS	50/ .050		152			○				
			2	SS	50/ .075		151			○				
			3	SS	36		150			○				4 31 41 24
			4	SS	27		149			○				
148.7							148			○				
4.1	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		5	SS	36		147			○				
146.7							146							
6.1	Silty SAND, some clay, trace gravel Very Dense Brown to Grey (TILL)		6	SS	71		145			○				3 54 28 15
			7	SS	50/ .075		144			○				
			8	SS	110					○				
143.1														
9.8	END OF BOREHOLE AT 9.7m.													

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 1160(MTO), GPJ 3/26/10

RECORD OF BOREHOLE No 09-035

2 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 438.4 E 610 238.6 ORIGINATED BY WB  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.01 - 2009.04.01 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%) W <sub>P</sub> W W <sub>L</sub>				
	Continued From Previous Page																
	BOREHOLE OPEN AND WATER LEVEL AT 8.8m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

ONTMT4S 1160(MTO).GPJ 3/26/10

RECORD OF BOREHOLE No 09-037

1 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 517.1 E 610 299.7 ORIGINATED BY WB  
HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM DATE 2009.04.02 - 2009.04.02 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
153.6												
0.0	TOPSOIL: (100mm)		1	AS								
0.1	Clayey SILT, sandy, trace gravel, with numerous shale pieces Firm to Hard Grey (FILL)											
			1	SS	6							
			2	SS	40							
			3	SS	50/ .150							
150.7												
2.9	Silty CLAY, some sand, trace gravel Very Stiff to Hard Brown to Grey (TILL)		4	SS	33							
			5	SS	25							
147.8												
5.8	Silty SAND, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		6	SS	49							
			7	SS	47							
			8	SS	100/ .125							
	Grey											
143.8												
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 1160(MTO) GPJ 3/26/10

RECORD OF BOREHOLE No 09-037

2 OF 2

METRIC

G.W.P. 19-1351-160 LOCATION N 4 829 517.1 E 610 299.7 ORIGINATED BY WB  
 HWY 403 / BRT BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM DATE 2009.04.02 - 2009.04.02 CHECKED BY MA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE				WATER CONTENT (%) W P W W L				
	Continued From Previous Page															
	BOREHOLE OPEN AND WATER LEVEL AT 7.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.															

ONTMT4S 1160(MTO).GPJ 3/26/10

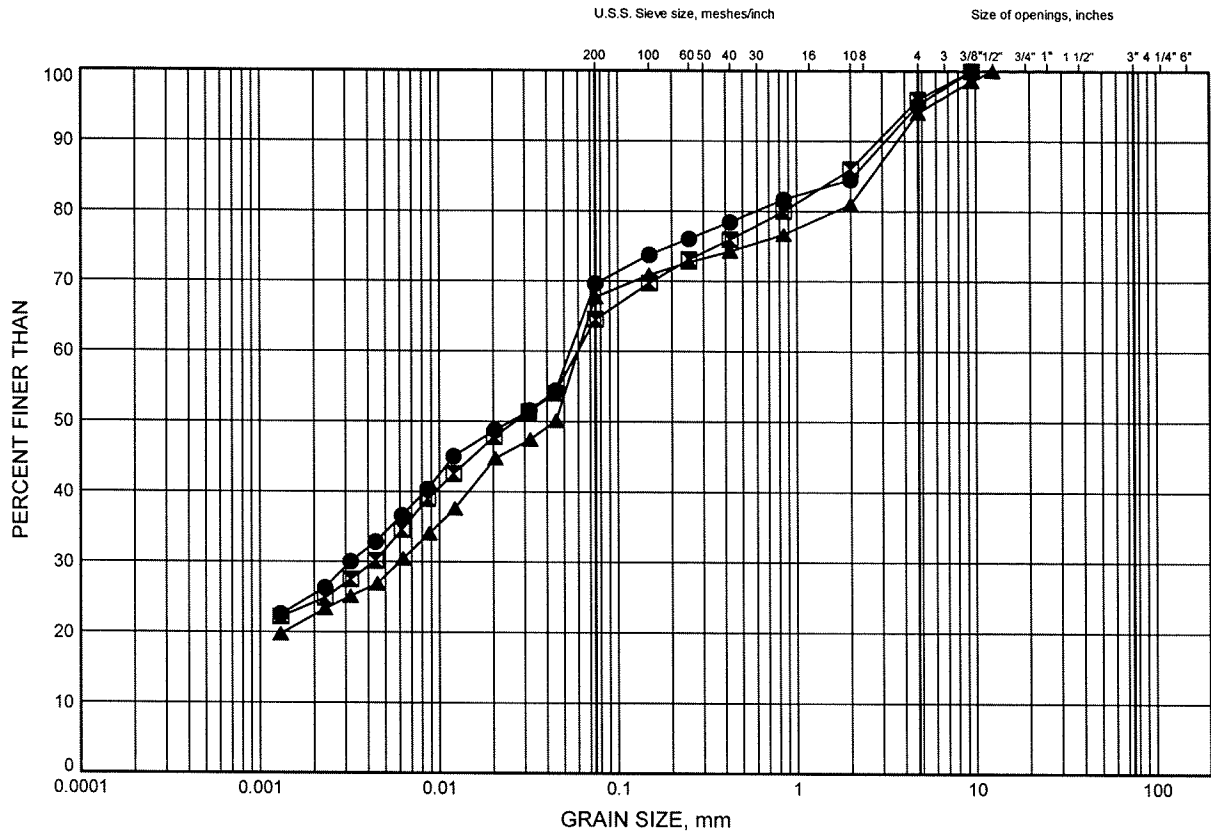
## **Appendix B**

### **Laboratory Test Results**

# Mississauga BRT East GRAIN SIZE DISTRIBUTION

FIGURE B1

## Silt, Clay and Shale Fill



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-023B	2.59	152.54
⊠	09-035	2.59	150.21
▲	09-037	2.50	151.05

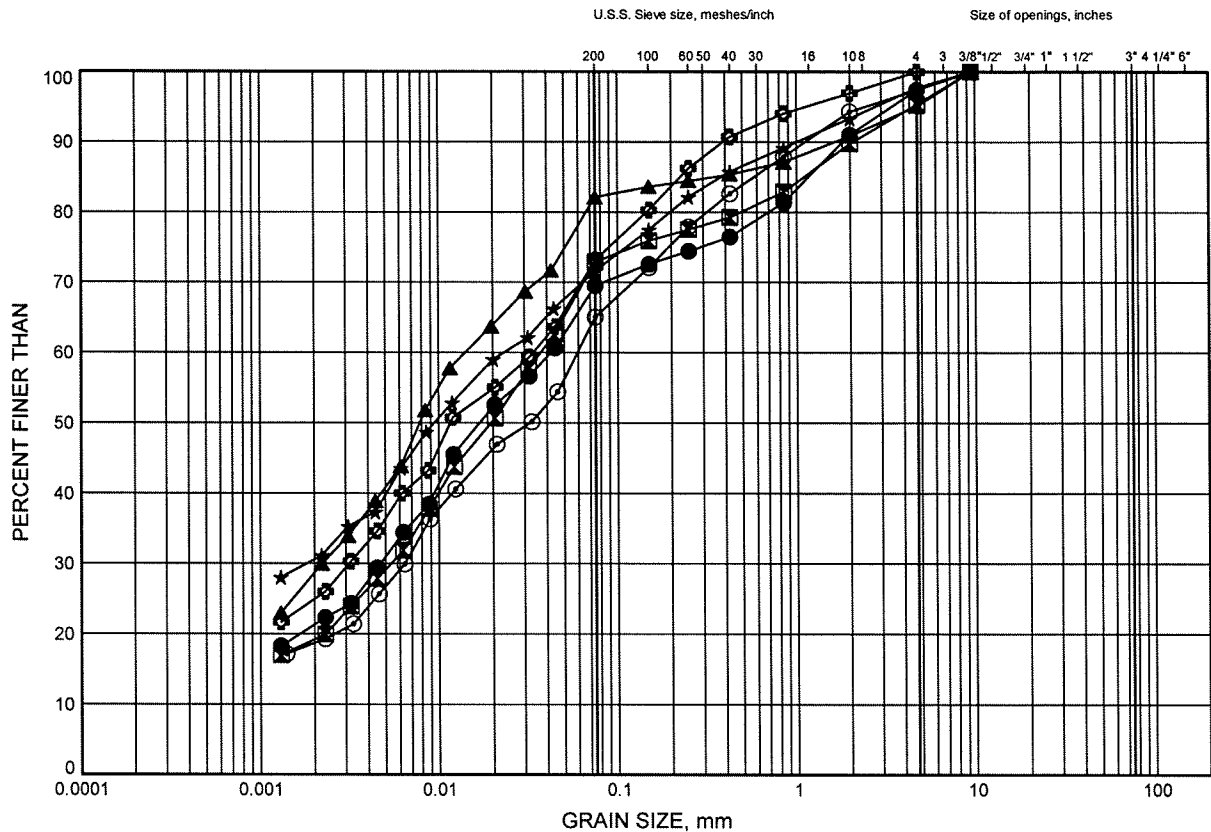


W.P.# 19-1351-160  
Prepared By MFA  
Checked By MRA

# Mississauga BRT East GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty Clay Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	07-06	1.75	157.05
⊠	09-019	2.41	153.78
▲	09-020	1.83	151.80
★	09-021	1.83	149.18
⊙	09-023A	1.83	144.14
⊕	09-023B	7.92	147.20



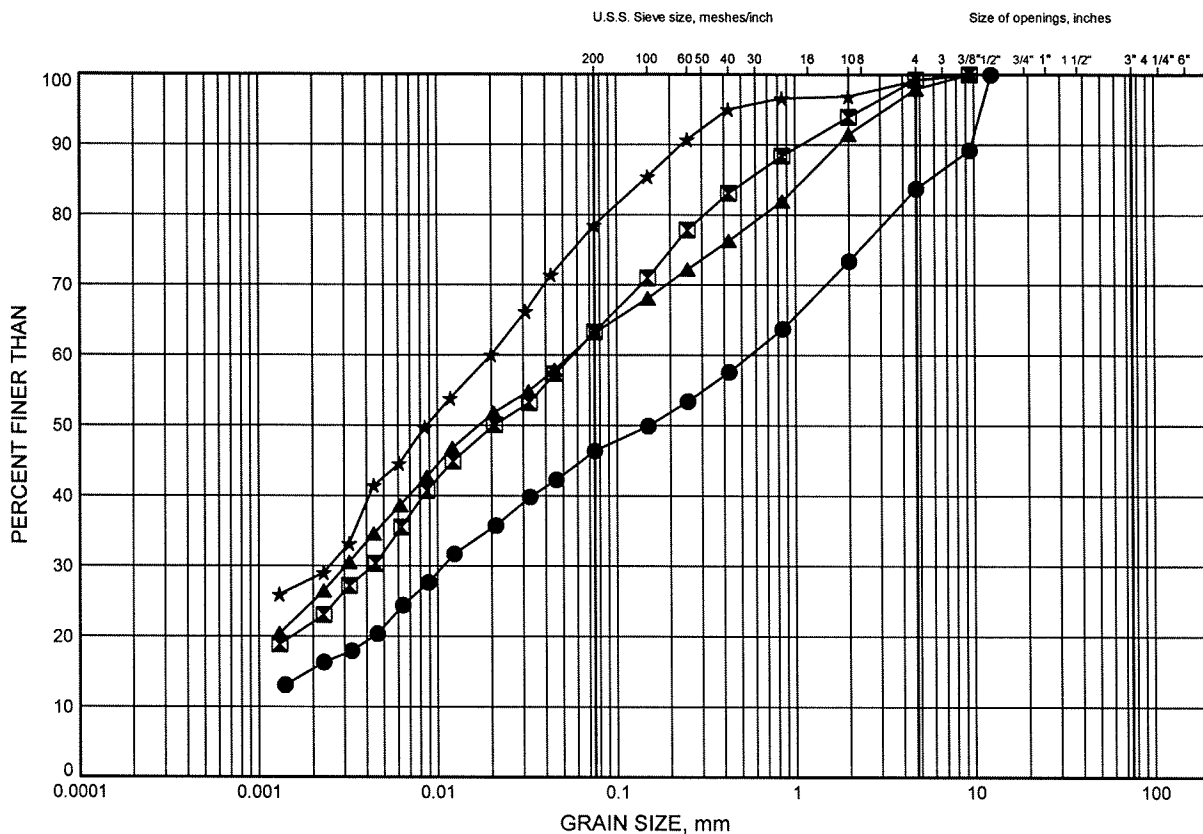
W.P.# 19-1351-160.....  
Prepared By MFA.....  
Checked By MRA.....



# Mississauga BRT East GRAIN SIZE DISTRIBUTION

FIGURE B3

## Silty Clay Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-024	3.35	141.76
◻	09-024A	3.35	144.05
▲	09-024A	4.88	142.52
★	09-032	3.35	146.86



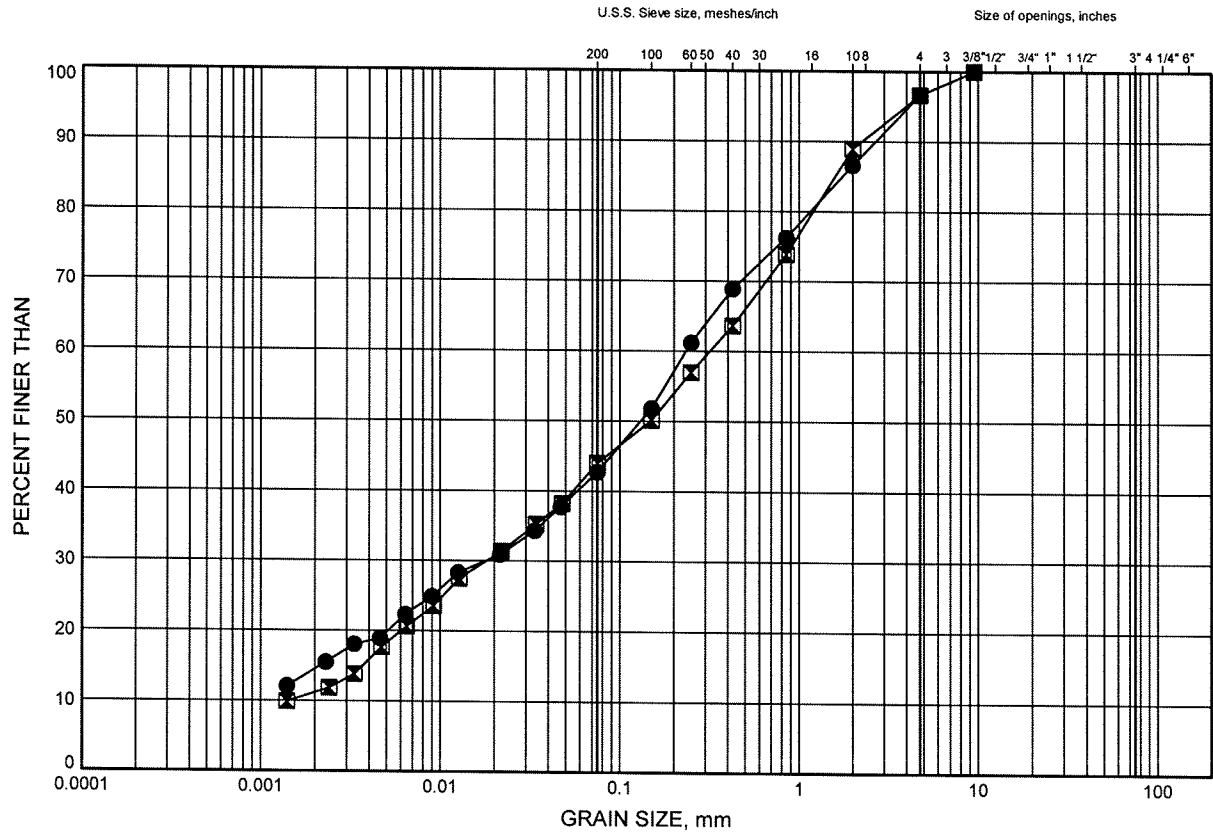
THURBER

W.P.# 19-1351-160.....  
Prepared By MFA.....  
Checked By MRA.....

Mississauga BRT East  
GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty Sand Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-035	7.73	145.07
■	09-037	7.92	145.63

GRAIN SIZE DISTRIBUTION - THURBER 1160(MTO), GPJ 3/22/10

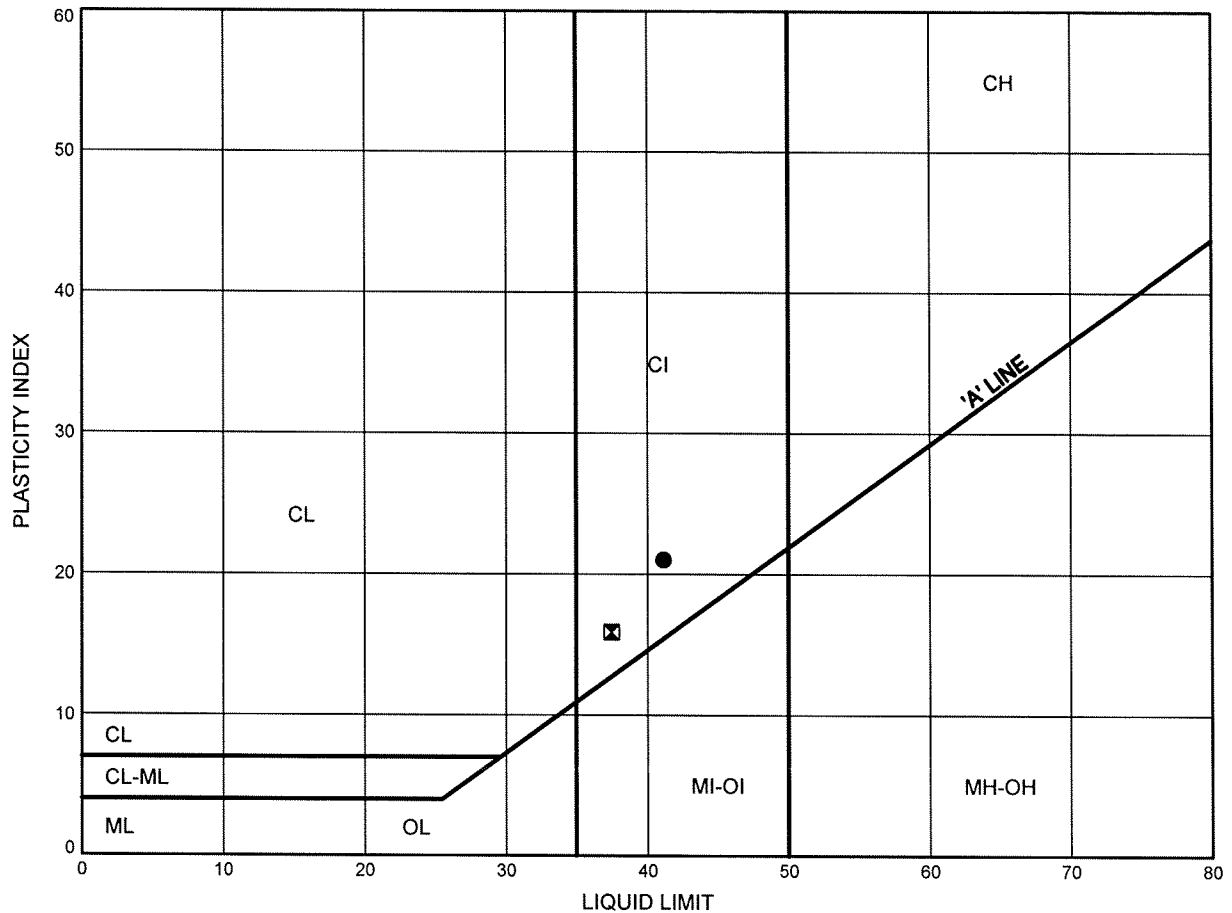
W.P.# 19-1351-160.....  
Prepared By MFA.....  
Checked By MRA.....



Mississauga BRT East  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B5

Silt, Clay and Shale Fill



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-023B	2.59	152.54
⊠	09-035	2.59	150.21

Date March 2010  
 Project 19-1351-160

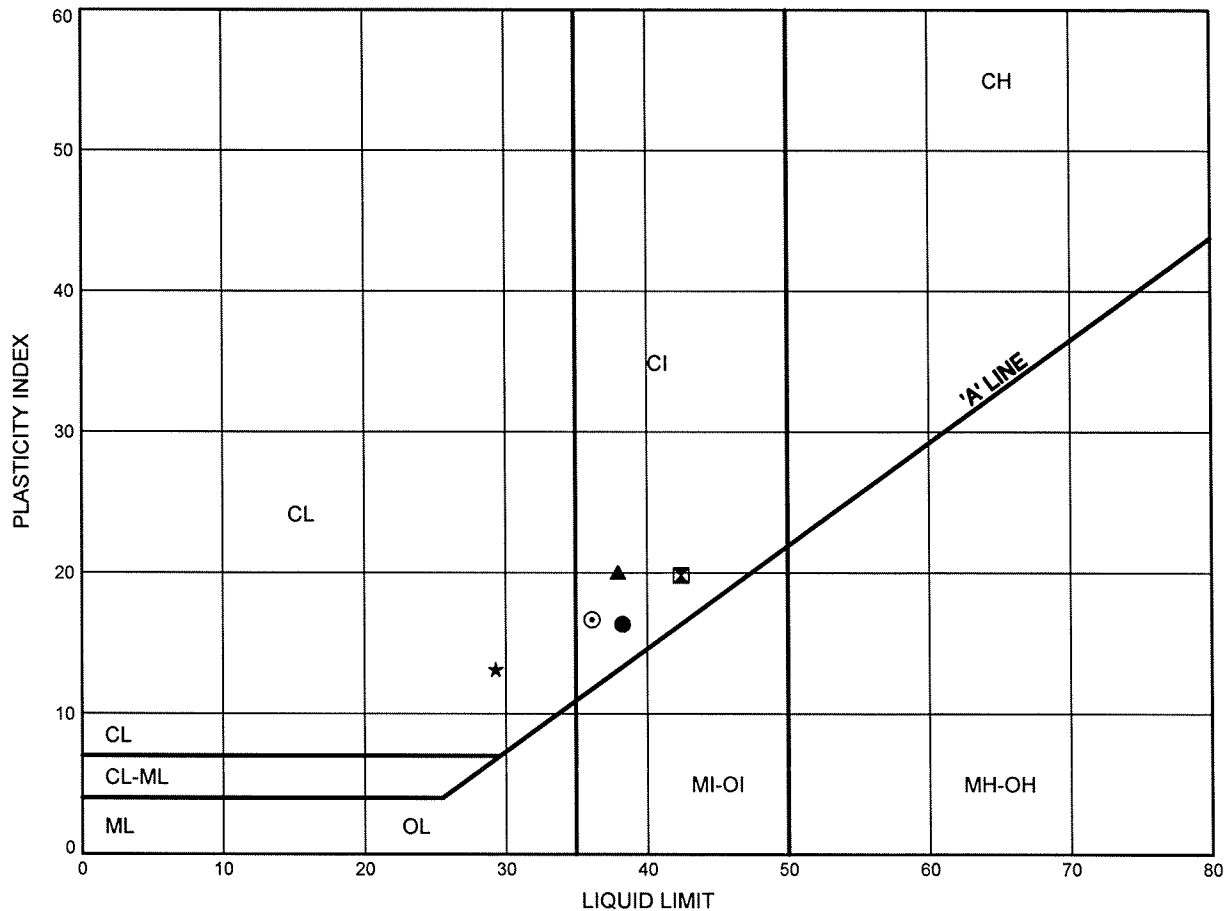


Prep'd MFA  
 Chkd. MRA

Mississauga BRT East  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B6

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	07-06	1.75	157.05
⊠	09-020	1.83	151.80
▲	09-021	1.83	149.18
★	09-023A	1.83	144.14
⊙	09-023B	7.92	147.20

Date March 2010  
 Project 19-1351-160

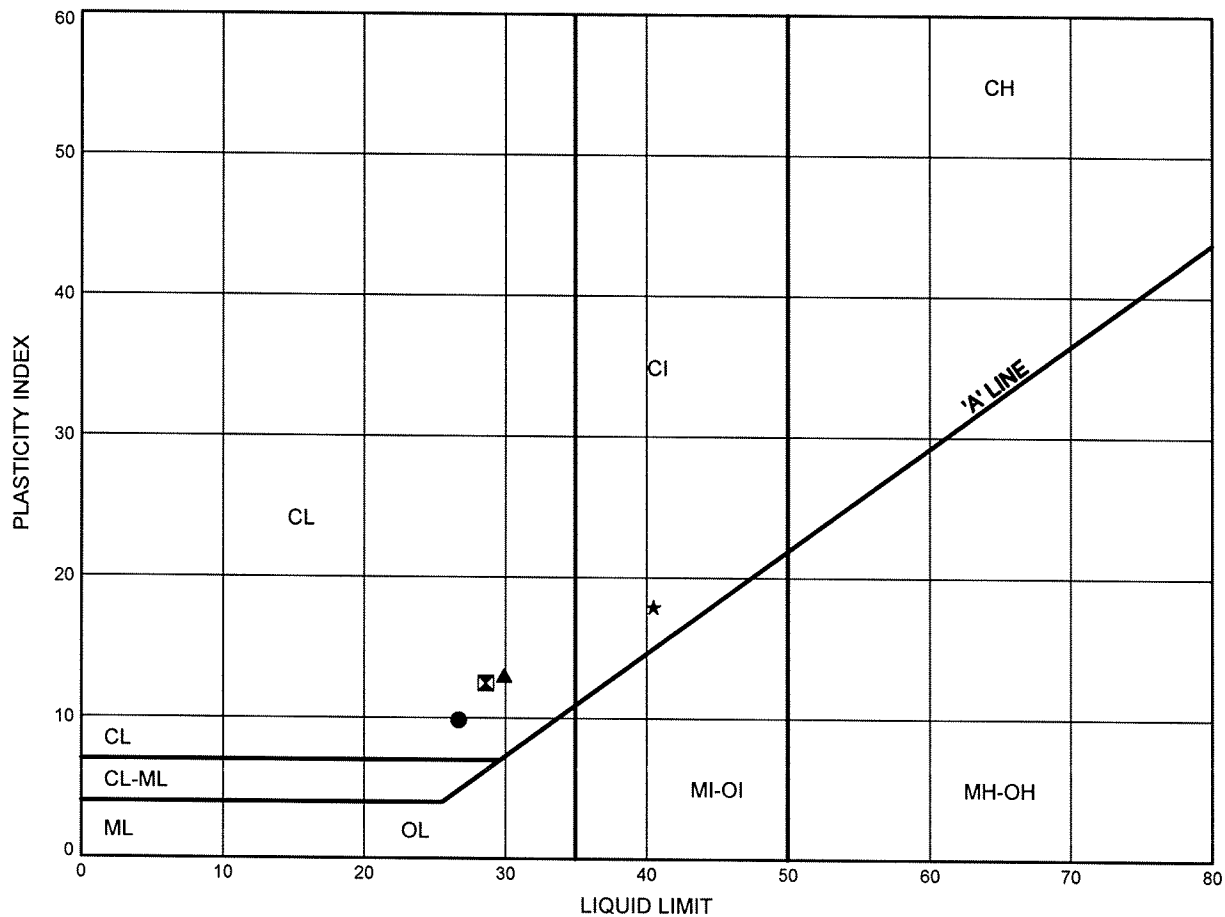


Prep'd MFA  
 Chkd. MRA

Mississauga BRT East  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B7

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-024	3.35	141.76
⊠	09-024A	3.35	144.00
▲	09-024A	4.88	142.47
★	09-032	3.35	146.86

Date March 2010  
 Project 19-1351-160

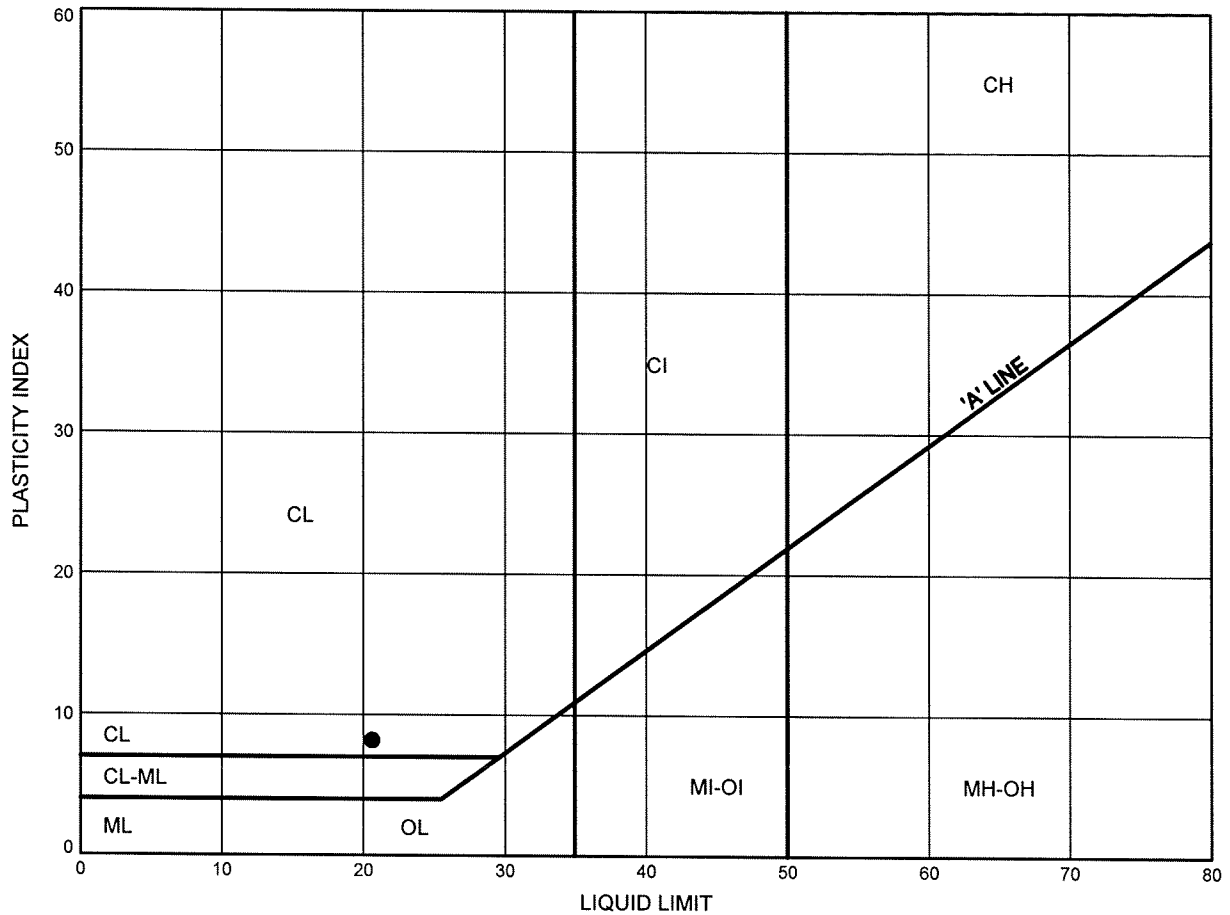


Prep'd MFA  
 Chkd. MRA

Mississauga BRT East  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B8

Silty Sand Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-035	7.73	145.07

Date March 2010  
 Project 19-1351-160



Prep'd MFA  
 Chkd. MRA

## **Appendix C**

### **List of SPs and OPSS**

### **Suggested Text for Selected NSSP**

**1. List of Special Provisions and OPSS Documents Referenced in this Report**

- OPSS 903

**2. Suggested Text for NSSP on “Augered Caisson Construction for Noise Barrier Wall Foundations”**

Shale pieces, cobbles, boulders and limestone fragments may be encountered within the glacial till deposits or within the existing fill berms on site. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions. Arduous excavation may be experienced in the hard and very dense till materials.

The shale bedrock contains hard limestone interbeds. Augering through the shale and hard interbeds may be difficult. As such, rock coring or breaking equipment should be available on site to assist in drilling of caisson sockets in rock.

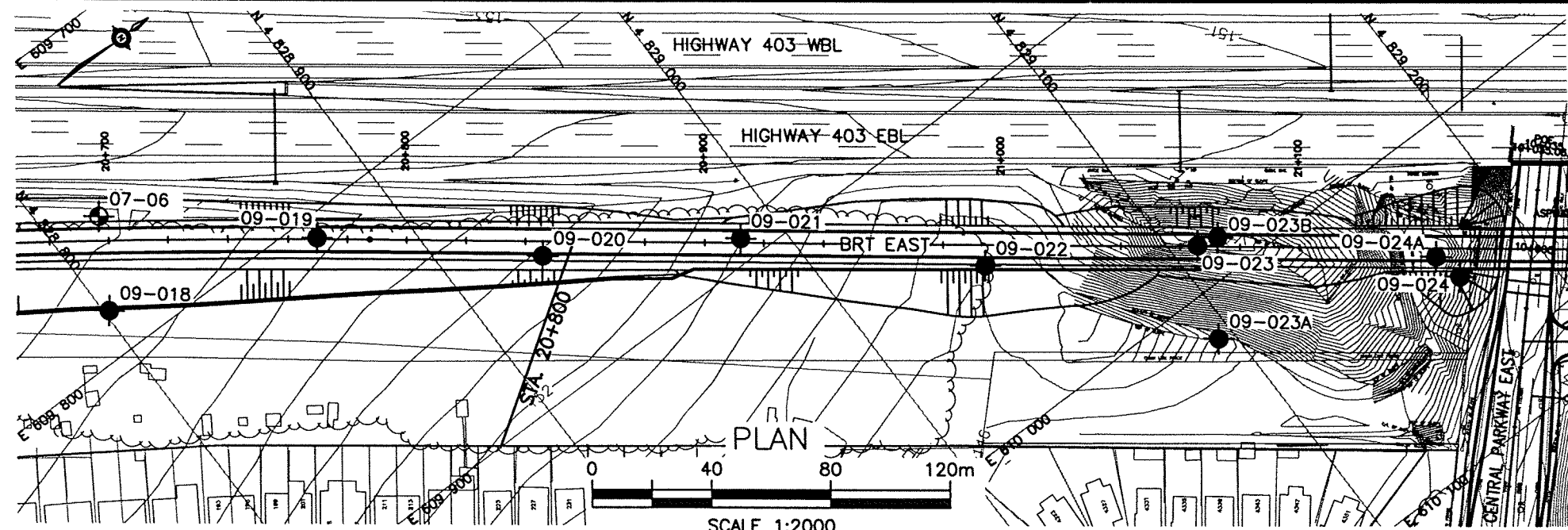
The depth to the top of the bedrock may vary between and beyond that defined at the borehole locations.

The Contractor is responsible for constructing the noise barrier wall foundations without disturbing the material at the sides or bases of the foundations.

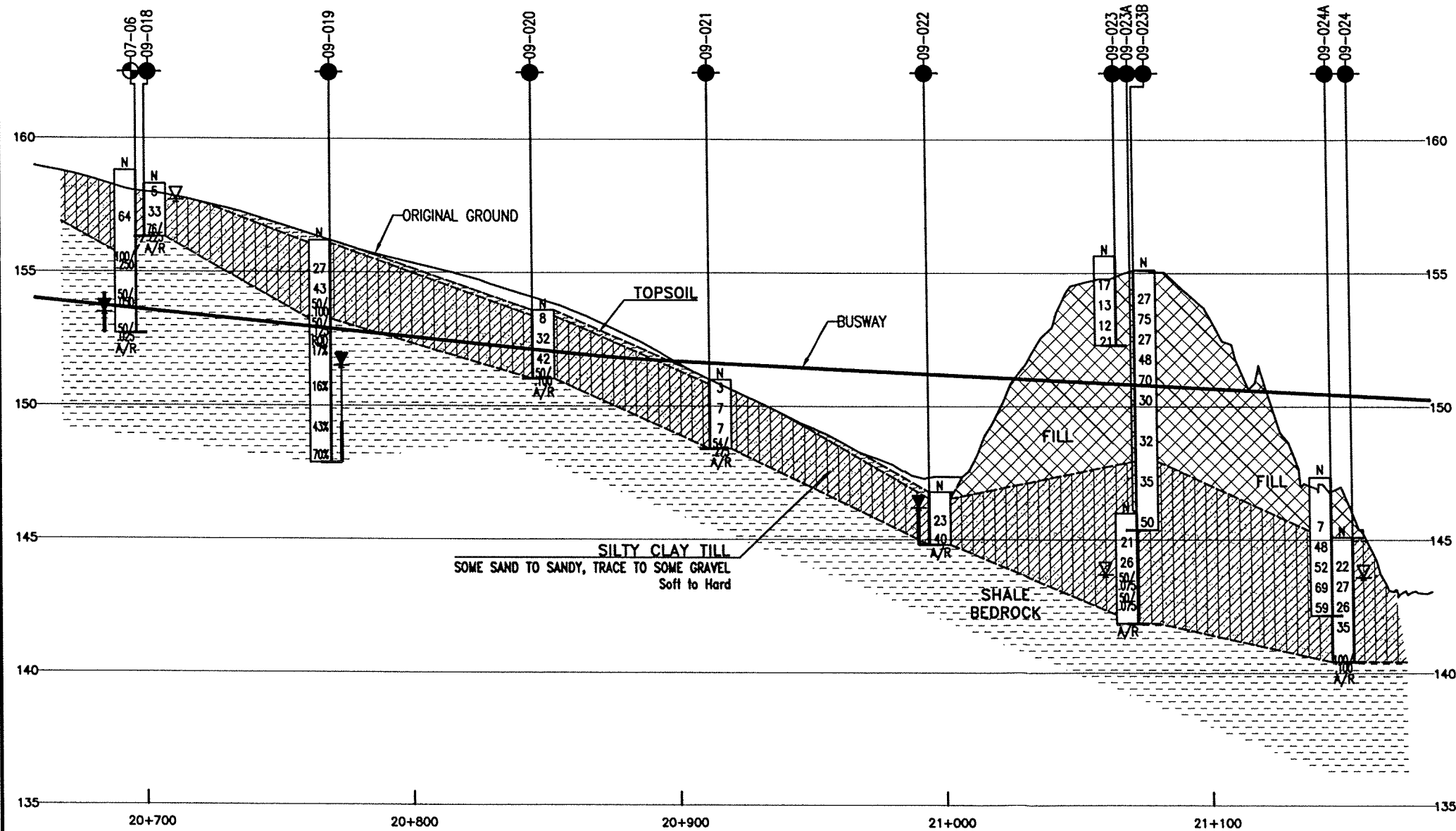


## **Appendix D**

### **Borehole Locations and Soil Strata Drawings**



SCALE 1:2000



## PROFILE

HOR 1:2000

VER 1:200

**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

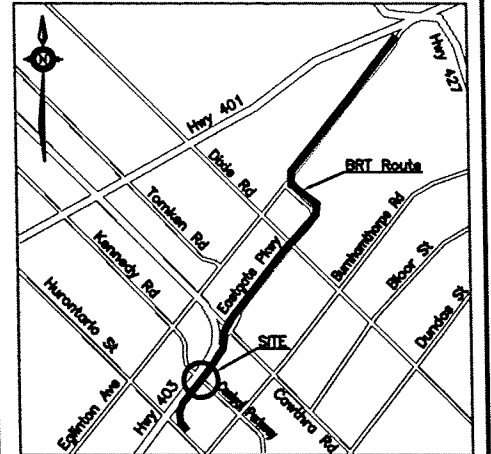
CONT No  
GWP No

MISSISSAUGA BRT EAST  
DETAILED DESIGN  
NOISE BARRIER WALL  
BOREHOLE LOCATIONS AND SOIL STRATA

**MRC** **McCORMICK RANKIN**  
**CORPORATION**








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## KEYPLAN

## LEGEND

- |   |                                       |
|---|---------------------------------------|
|  | Present Borehole Location             |
|  | Previous Borehole Location            |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

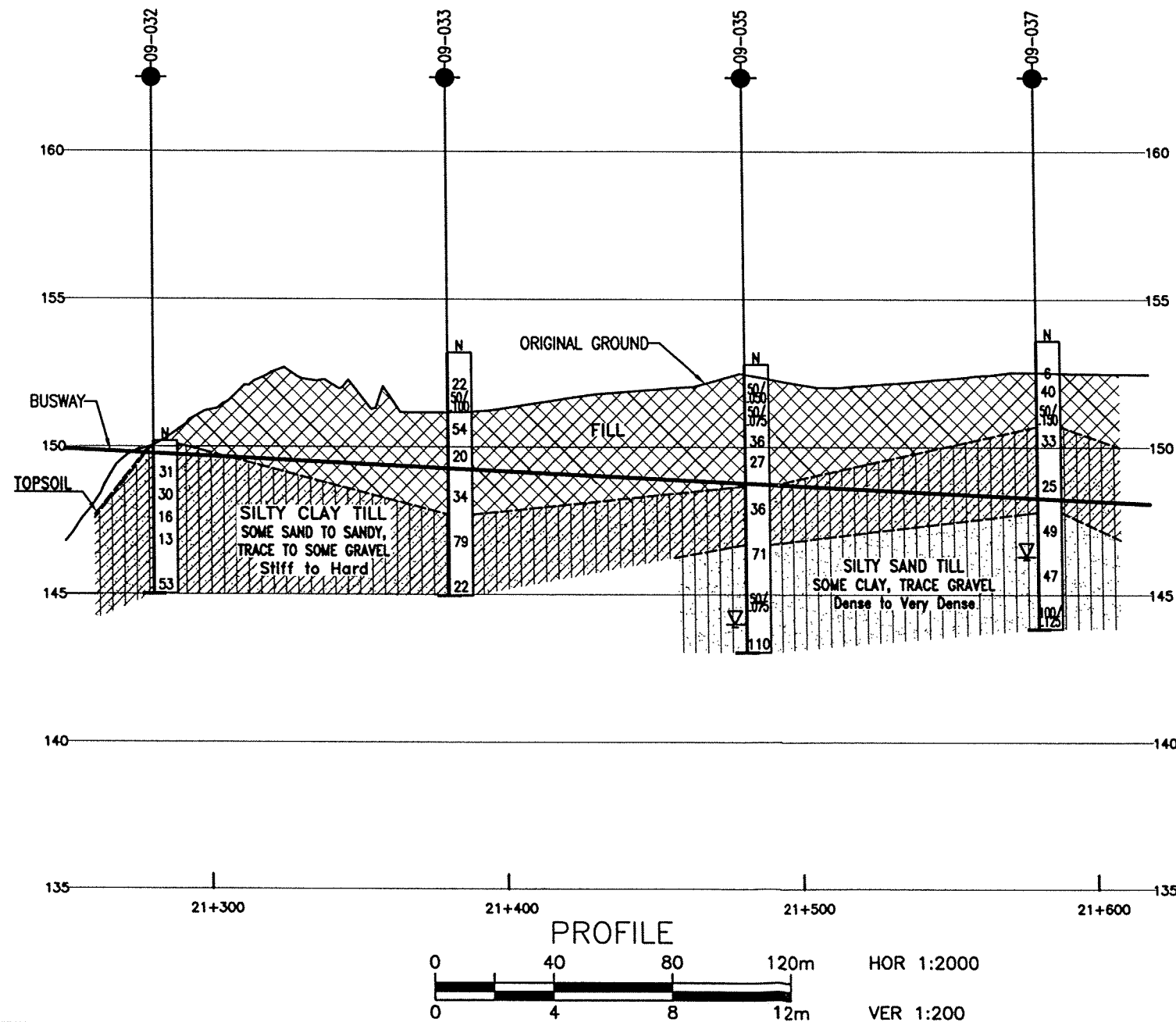
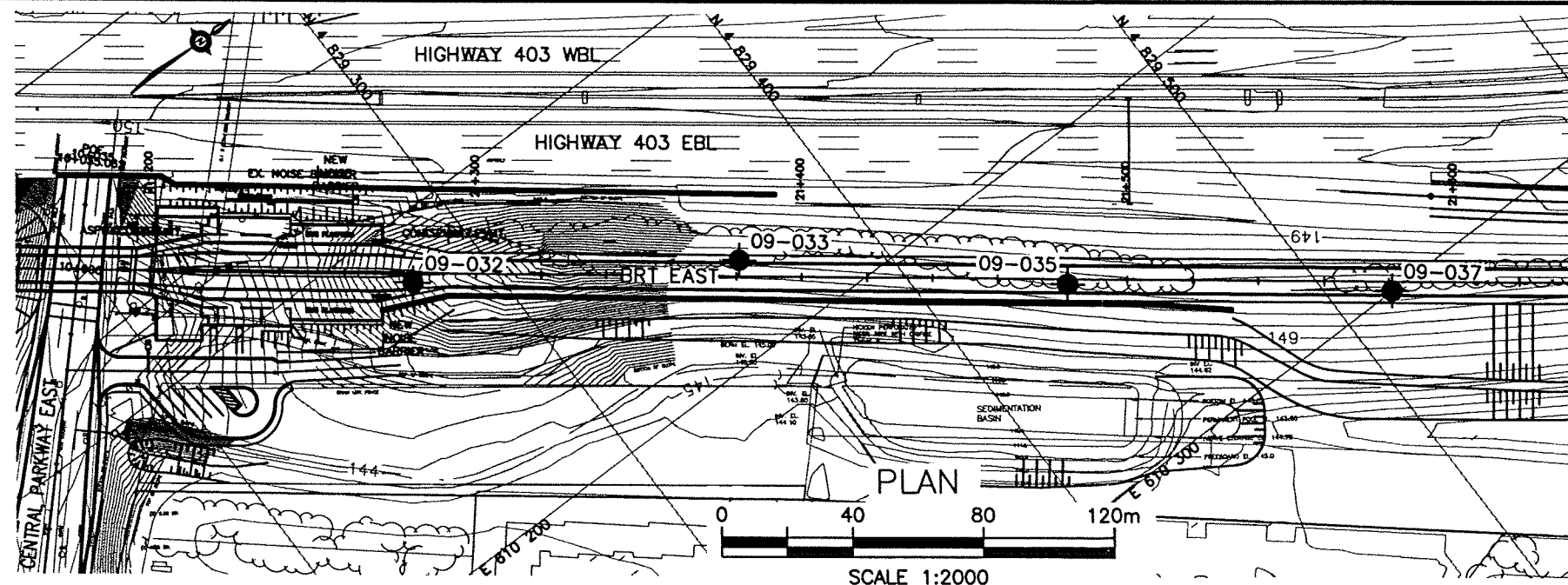
NO	ELEVATION	NORTHING	EASTING
07-06	158.8	4 828 818.0	609 758.0
09-01B	158.3	4 828 801.7	609 785.3
09-019	156.2	4 828 872.4	609 807.3
09-020	153.6	4 828 929.8	609 857.4
09-021	151.0	4 828 986.6	609 892.5
09-022	146.8	4 829 046.9	609 948.7
09-023	155.6	4 829 108.3	609 986.1
09-023A	146.0	4 829 094.9	610 015.1
09-023B	155.1	4 829 115.4	609 987.9
09-024	145.1	4 829 172.3	610 046.9
09-024A	147.4	4 829 169.9	610 036.8

**-NOTES-**

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 30M12-294**

REV	DATE				BY				DESCRIPTION
	1	2	3	4	1	2	3	4	
DESIGN	MRA	CHK	AEQ	CODE	LOAD				DATE JUN. 2010
DRAWN	MFA	CHK	PKC	SITE	STRUCT				DWG 1



**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

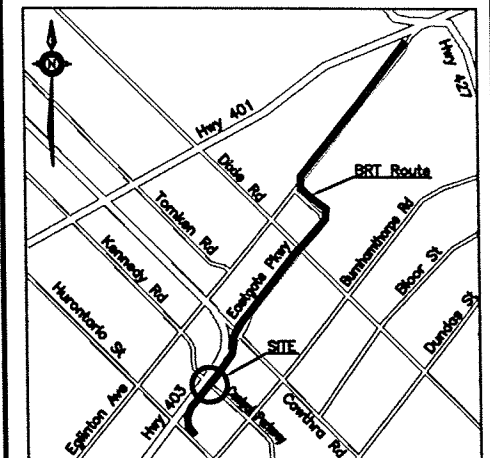
CONT No  
GWP No

MISSISSAUGA BRT EAST  
DETAILED DESIGN  
NOISE BARRIER WALL  
BOREHOLE LOCATIONS AND SOIL STRATA

**MRC** **McCORMICK RANKIN**  
**CORPORATION**








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## KEYPLAN

## LEGEND

- |   |                                       |
|---|---------------------------------------|
|  | Present Borehole Location             |
|  | Previous Borehole Location            |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

[illegible]

**-NOTES-**

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 30M12-294**

REVISIONS							
	DATE	BY	DESCRIPTION				
DESIGN	MRA	CHK AEG	CODE	LOAD	DATE	JUN. 2010	
DRAWN	MFA	CHK PKC	SITE	STRUCT	DWG	2	