

**FOUNDATION INVESTIGATION 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

July 2, 2010
File: 19-1351-160

H:\19\1351\160 Mississauga BRT Detailed Design\Reports &
Memos\Structures\Noise Wall\BRT Noise Barrier Wall FIR
Final.doc

TABLE OF CONTENTS

PART 1 FACTUAL INFORMATION

1	INTRODUCTION	1
2	PROJECT AND SITE DESCRIPTION	1
3	SITE INVESTIGATION AND FIELD TESTING	2
4	LABORATORY TESTING	3
5	DESCRIPTION OF SUBSURFACE CONDITIONS	3
5.1	Topsoil	4
5.2	Silt, Clay and Shale Fill	4
5.3	Silty Clay Till.....	5
5.4	Silty Sand Till	6
5.5	Bedrock.....	6
5.6	Water Levels	7
6	MISCELLANEOUS.....	8

Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
Appendix C	Borehole Locations and Soil Strata Drawings

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

Geocres Number: 30M12-294

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 C. 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

Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
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 C. 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



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 ⁽¹⁾ '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



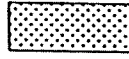


C_{pen} Shear Strength Determination by Pocket Penetrometer

- (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				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
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	20 40 60	20 40 60			
			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						

+ 3, x 3: 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
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.																	

+³, X³: 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 _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE								
								20 40 60 80 100									20 40 60		
156.2																			
0.0																			
0.1	ORGANICS, black peat: (100mm)																		
	Silty CLAY, sandy, trace shale fragments		1	SS	27														
	Very Stiff to Hard																		
	Brown		2	SS	43														
	(TILL)																		
	Limestone fragments		3	SS	50/ .100											5 22 54 19			
153.2																			
3.0	SHALE, highly weathered, thinly bedded, weak to very weak, with medium to very strong limestone interbeds		4	SS	50/ .125														
			1	NQ												RUN 1# TCR=95%, SCR=83%, RQD=17% UCS=50MPa(axi) UCS=132MPa(dia)			
			2	NQ												RUN 2# TCR=97%, SCR=92%, RQD=16% UCS=127MPa(dia)			
	Limestone layers (greater than 50mm)																		
	250mm at 5.8m																		
	125mm at 6.2m																		
	250mm at 7.6m																		
	Clay seams:																		
	75mm at 3.5m																		
	Rubble zone :																		
	50mm at 3.9m		3	NQ												RUN 3# TCR=95%, SCR=92%, RQD=43% UCS=72MPa(axi) UCS=167MPa(dia)			
	50mm at 4.4m																		
	Vertical joint at 3.2 to 3.3m and 5.3 to 5.4m		4	NQ												RUN 4# TCR=100%, SCR=96%, RQD=70%			
147.9																UCS=148MPa(dia)			
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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
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.													

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) 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 NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	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 _p w w _L			
151.0							20 40 60 80 100						
0.0	TOPSOIL: (175mm) Black		1	SS	3								
0.2	Silty CLAY, sandy, trace gravel Soft to Firm Brown (TILL)		2	SS	7								
			3	SS	7								
148.4	Occasional shale fragments		4	SS	54/								2 26 41 31
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								

+³, X³: 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 _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	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								20	40	60	80	100					
146.6	TOPSOIL: (250mm) Black		1	SS													
0.3	Silty CLAY, some sand, trace gravel, topsoil stained Very Stiff to Hard Brown (TILL)		2	SS	23									o			
	Occasional shale fragments		3	SS	40									o			
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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
155.6	Clayey SILT , and broken SHALE Stiff to Very Stiff Grey (FILL)															
0.0																
			1	SS	17											
			2	SS	13											
			3	SS	12											
152.3			4	SS	21											
3.4	END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL. MOVED TO BOREHOLE 09-023a.															

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
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							
0.2	Silty CLAY, sandy, trace gravel Very Stiff to Hard Brown (TILL)		1	SS	21		145							
			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.													

+³, X³: Numbers refer to
Sensitivity



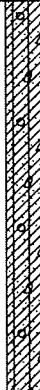
20
15 5
10 (%) STRAIN AT FAILURE

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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
155.1							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL x LAB VANE</div></div> <div><div>204060</div><div>W P W W L</div><div>WATER CONTENT (%)</div></div>							
0.0	Clayey SILT and broken SHALE Very Stiff to Hard Brown and Grey (FILL)						155							5 25 45 25
			1	SS	27		154							
			2	SS	75		153							
			3	SS	27		152							
			4	SS	48		151							
			5	SS	70		150							
	occasional rootlets and wood fibers	6	SS	30		149								
149.5							148							
5.6	Silty CLAY , trace sand and gravel, with organics Hard Dark Brown (FILL)		7	SS	32		147							
							146							
148.0							145							
7.2	Silty CLAY , sandy, trace gravel Hard Brown to Grey (TILL)		8	SS	35		144							
							143							
							142							
							141							
							140							
							139							
							138							
							137							
							136							
							135							
							134							
							133							
							132							
							131							
							130							
							129							
							128							
							127							
							126							
							125							
							124							
							123							
							122							
							121							
							120							
							119							
							118							
							117							
							116							
							115							
							114							
							113							
							112							
							111							
							110							
							109							
							108							
							107							
							106							
							105							
							104							
							103							
							102							
							101							
							100							
							99							
							98							
							97							
							96							
							95							
							94							
							93							
							92							
							91							
							90							
							89							
							88							
							87							
							86							
							85							
							84							
							83							
							82							
							81							
							80							
							79							
							78							
							77							
							76							
							75							
							74							
							73							
							72							
							71							
							70							
							69							
							68							
							67							
							66							
							65							
							64							
							63							
							62							
							61							
							60							
							59							
							58							
							57							
							56							
							55							
							54							
							53							
							52							
							51							
							50							
							49							
							48							
							47							
							46							
							45							
							44							
							43							
							42							
							41							
							40							
							39							
							38							
							37							
							36							
							35							
							34							
							33							
							32							
							31							
							30							
							29							
							28							
							27							
							26							
							25							
							24							
							23							
							22							
							21							
							20							
							19							
							18							
							17							
							16							
							15							
							14							
							13							
							12							
							11							
							10							
							9							
							8							
							7							
							6							
							5							
							4							
							3							
							2							
							1							
							0							

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

Continued Next Page

+³, X³: 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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
	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

+³, X³: Numbers refer to
Sensitivity


20
15 5
10 (%) STRAIN AT FAILURE

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 ³	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 _p w w _L					
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	▽	145								
							144								
							143								
	Grey						142								
							141								
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										

+³, X³: 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 ³	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					
147.4							20 40 60 80 100						
0.0	Sandy SILT, clayey and broken SHALE Brown Moist (FILL)												
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.												

+³, ×³: 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 ³	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		20 40 60			
0.0								20 40 60 80 100		20 40 60			
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.												

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 γ kN/m ³	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.												

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

+³, x³: 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
152.8								20 40 60 80 100		W P W W L				
0.0	TOPSOIL: (100mm)		1	AS				○ UNCONFINED + FIELD VANE						
0.1	Silty CLAY, sandy, trace gravel, occasional cobbles, numerous shale pieces Very Stiff to Hard Grey (FILL)		1	SS	50/ .050		152	● QUICK TRIAXIAL × LAB VANE						
			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

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

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 γ kN/m ³	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					W _P	W	W _L		
	Continued From Previous Page							20	40	60	80	100	20	40	60		
	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

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

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		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
153.6														
0.0														
0.1	TOPSOIL: (100mm) Clayey SILT, sandy, trace gravel, with numerous shale pieces Firm to Hard Grey (FILL)		1	AS										
			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

+³, ×³: 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 γ kN/m ³	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

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

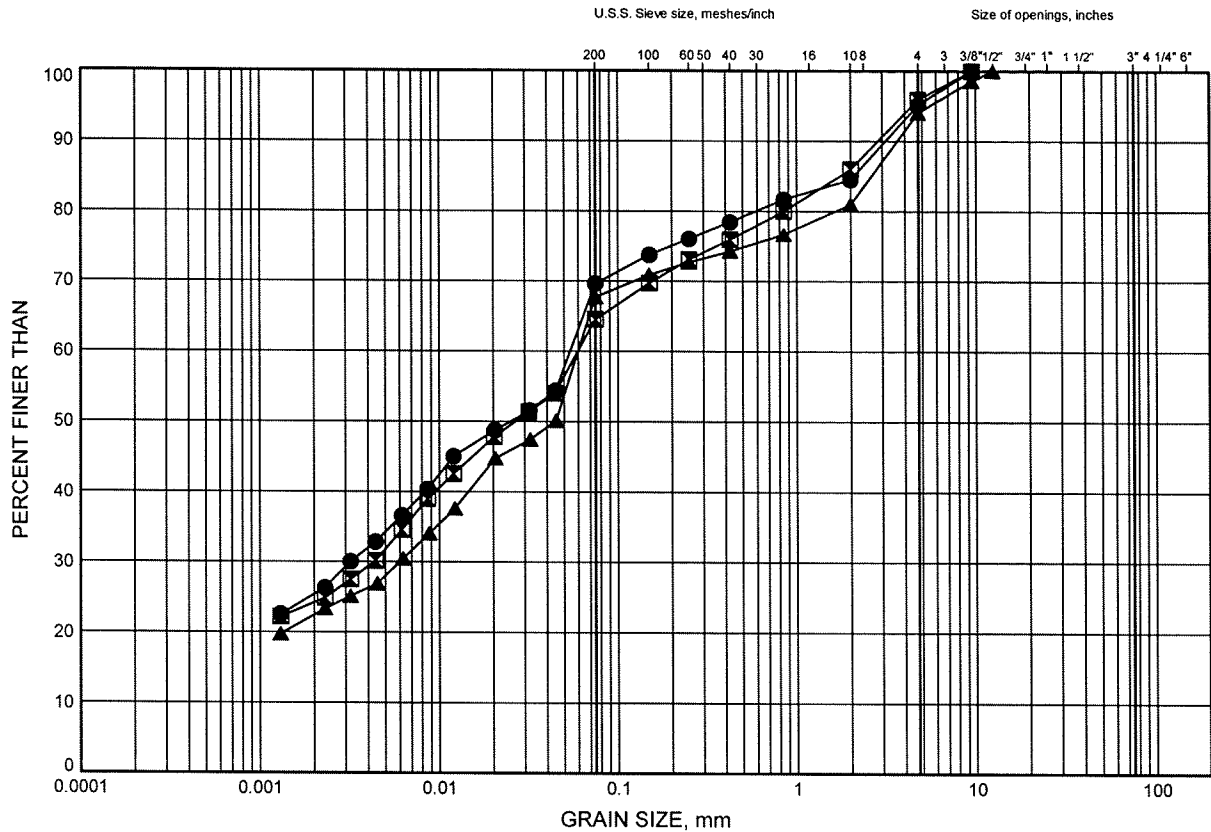
Appendix B

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

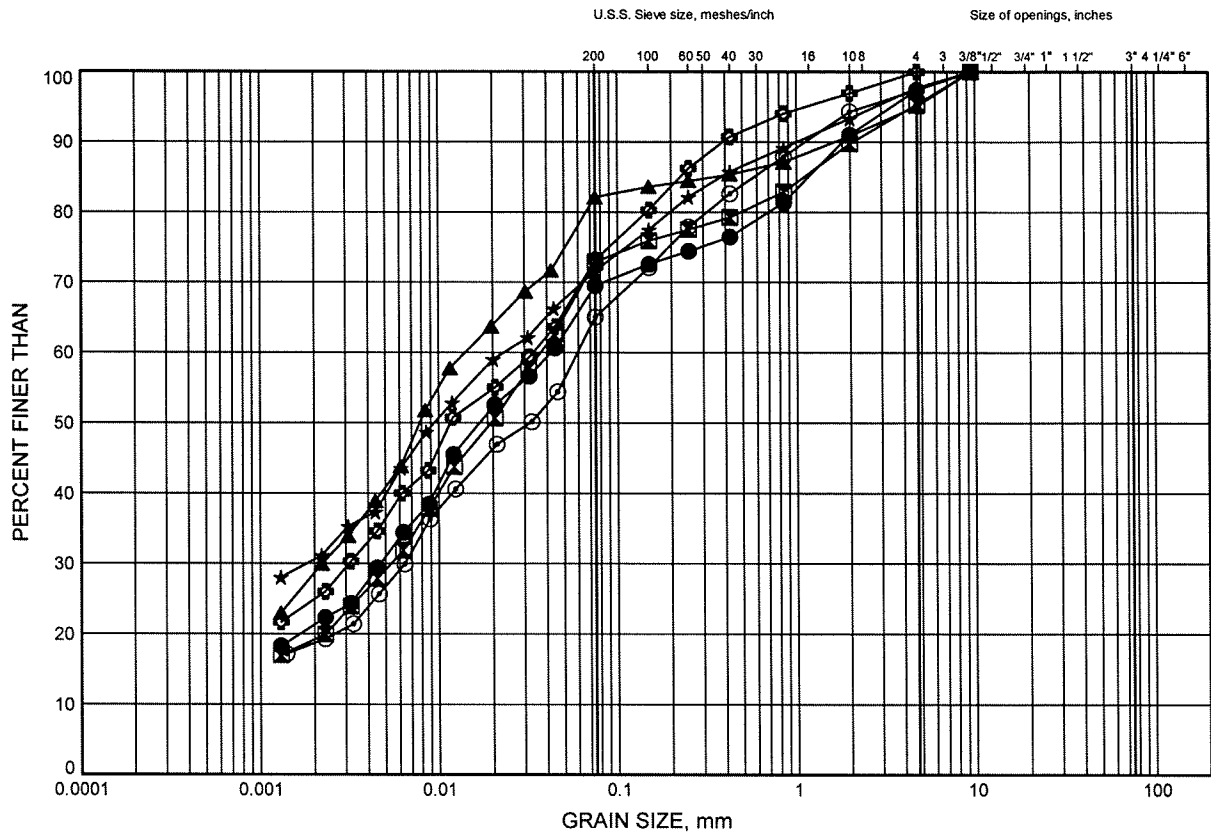


W.P.# 19-1351-160
Prepared By MFA
Checked By MRA

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

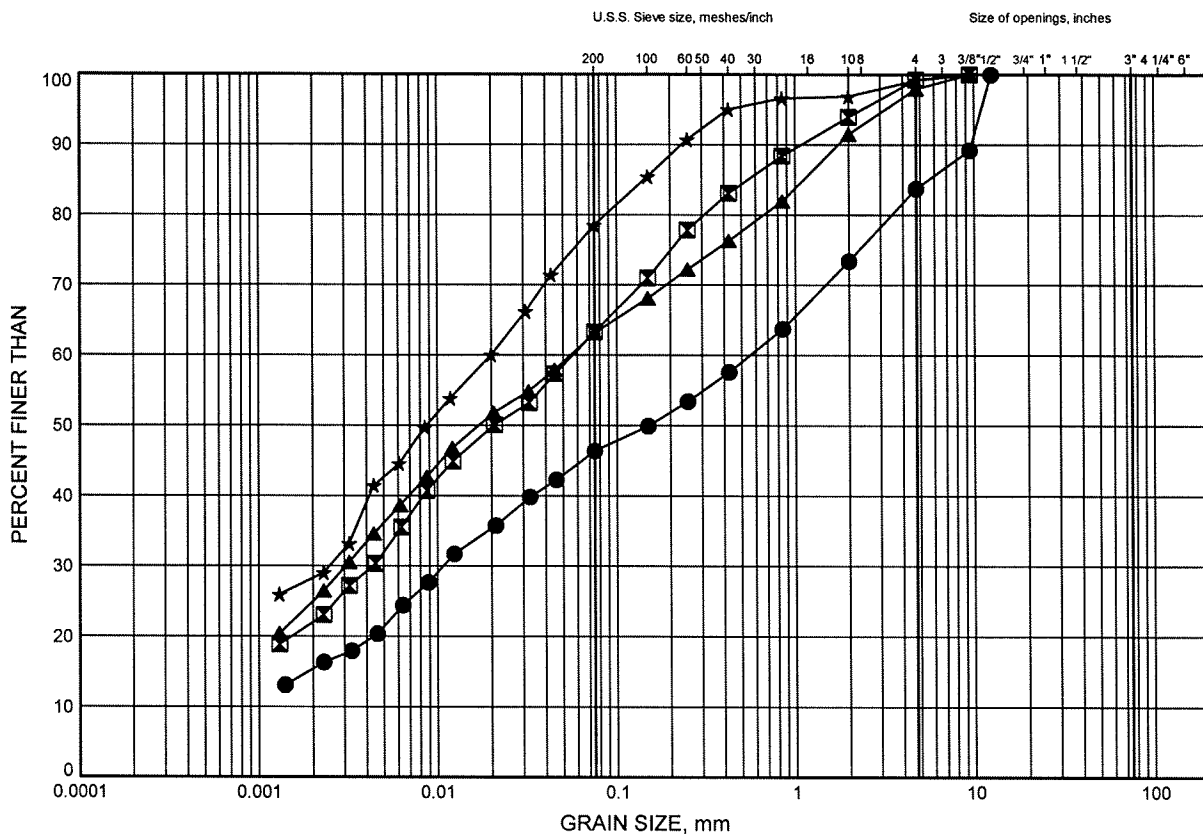


W.P.# 19-1351-160
Prepared By MFA
Checked By MRA

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

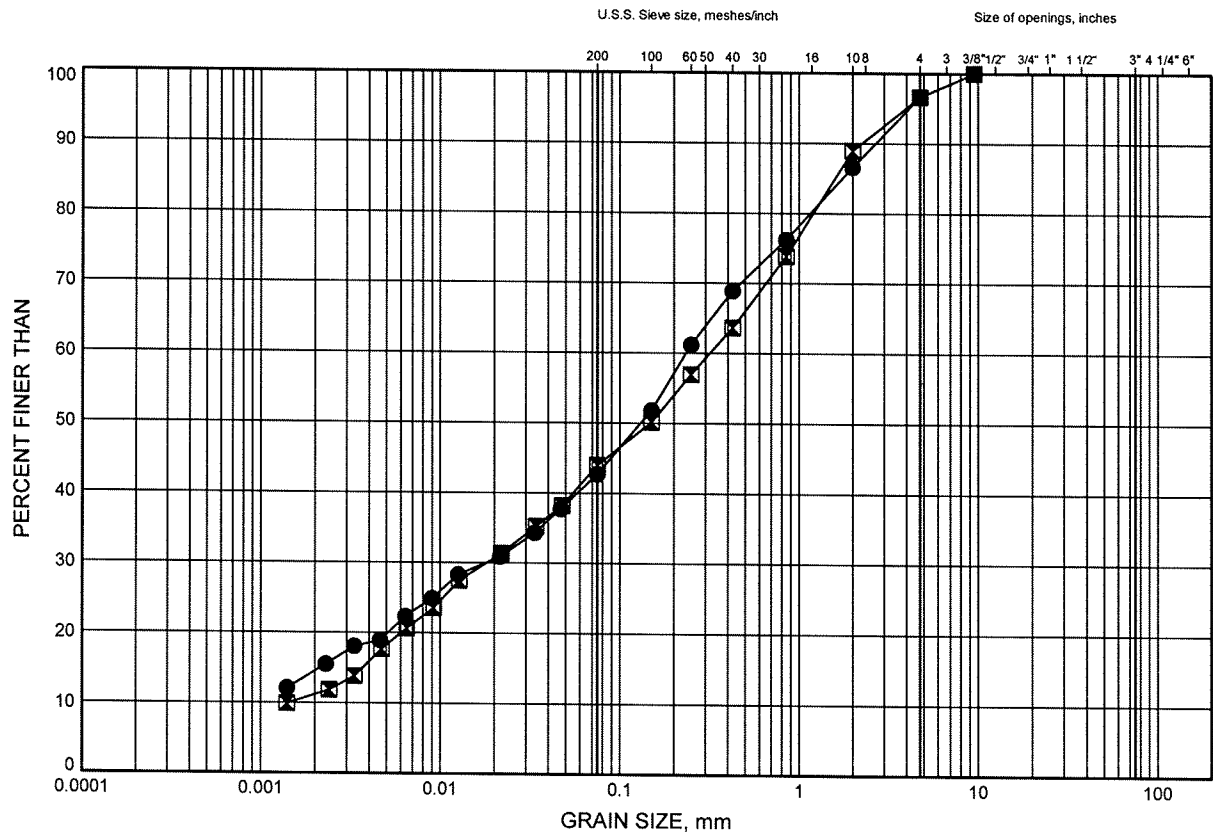


W.P.# 19-1351-160
Prepared By MFA
Checked By MRA

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

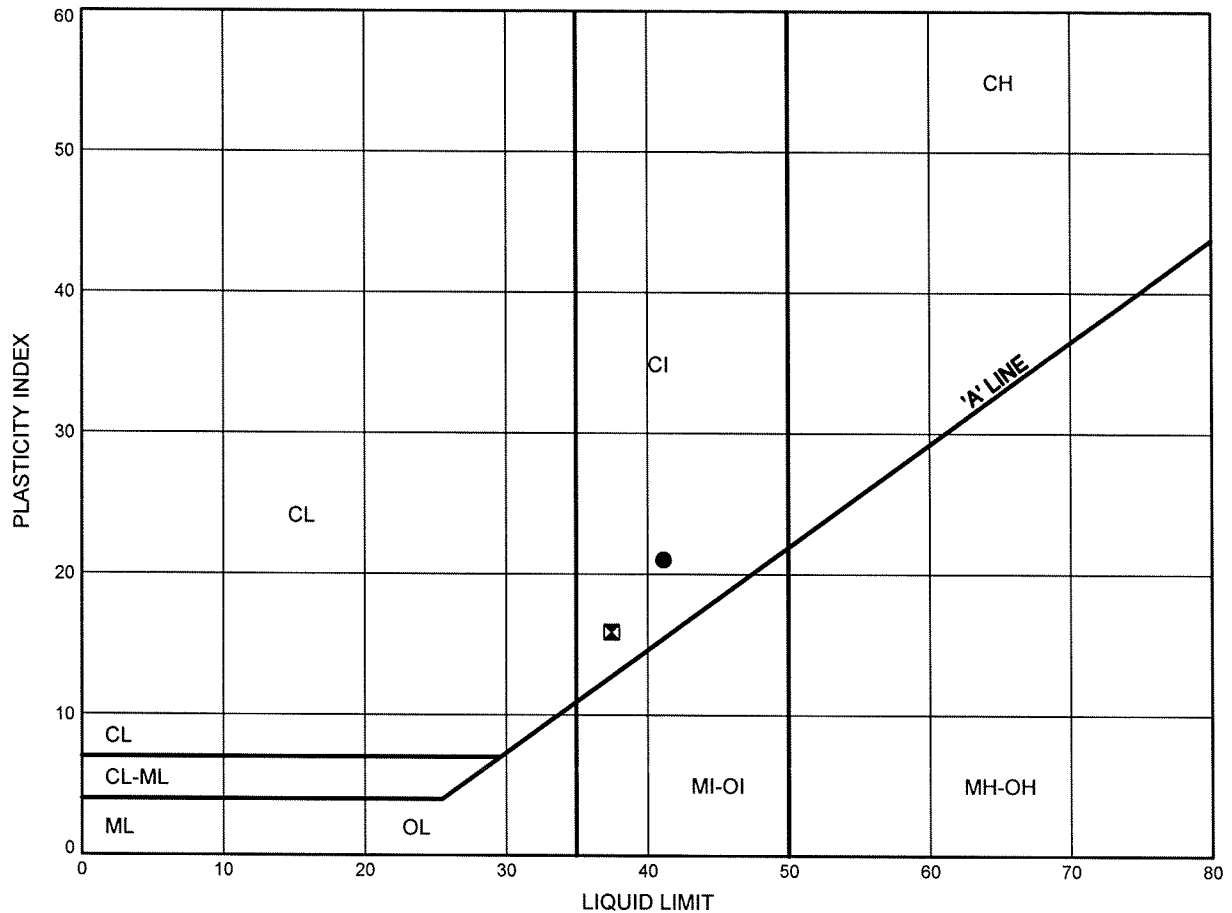


W.P.# 19-1351-160
Prepared By MFA
Checked By MRA

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

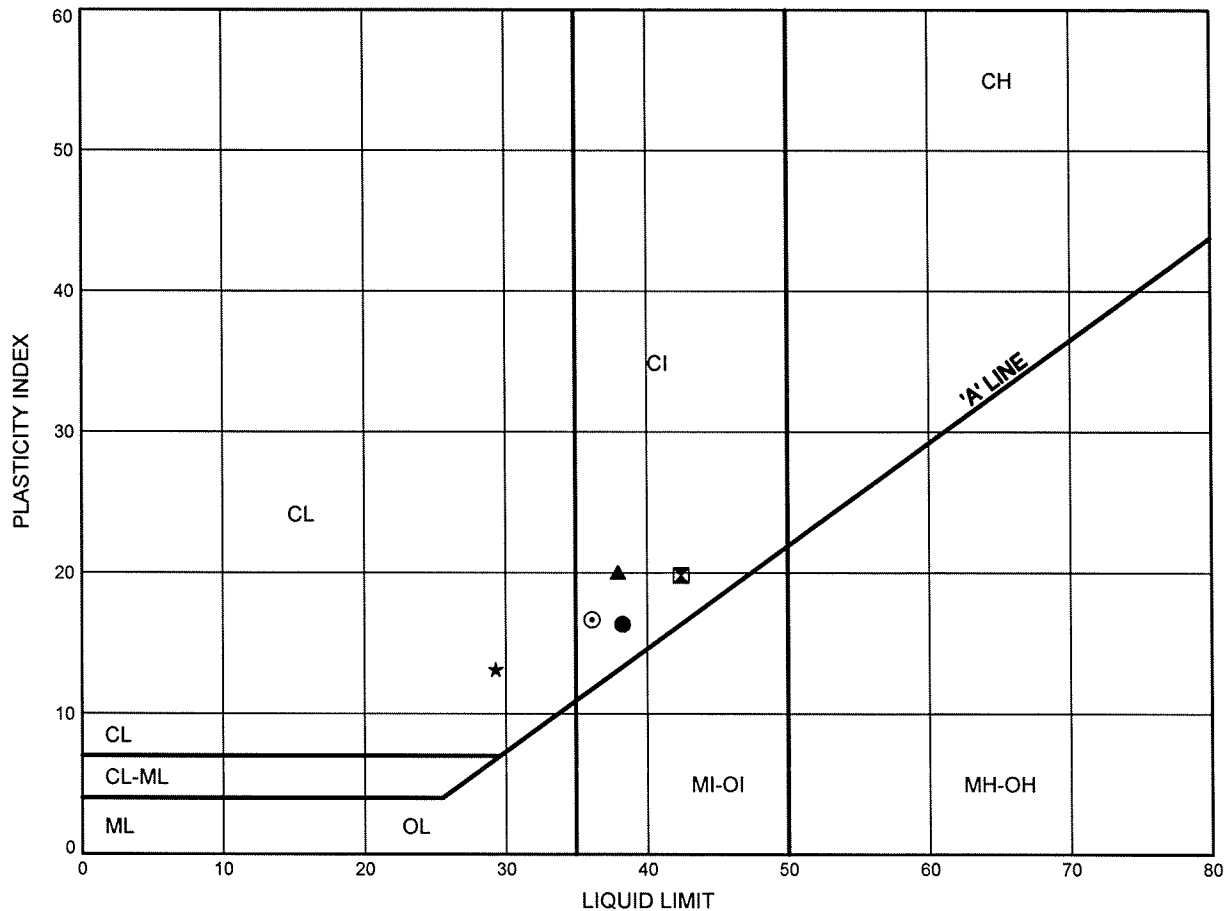


Prep'd MFA
 Chkd. MRA

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

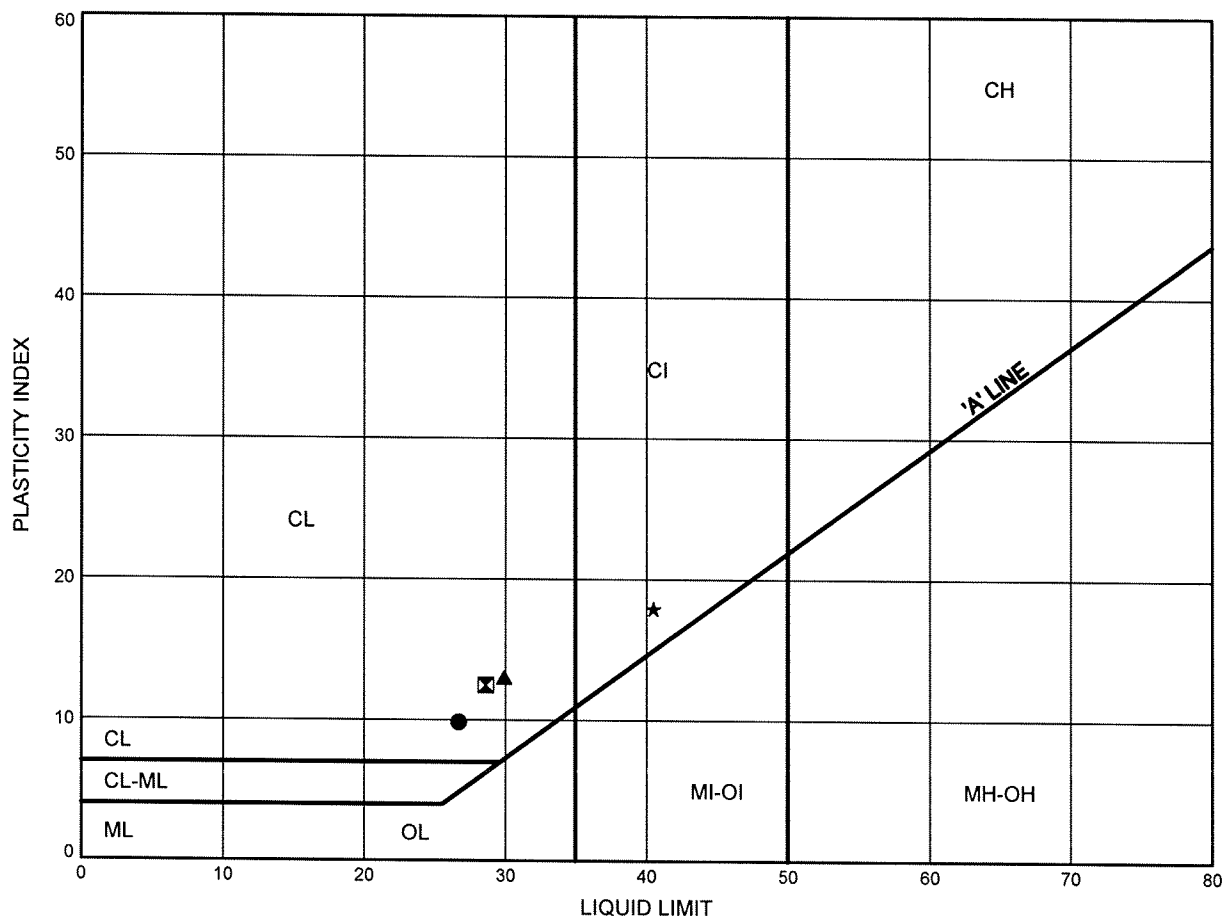


Prep'd MFA
 Chkd. MRA

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

THURBALT 1160(MTO).GPJ 3/22/10

Date March 2010
 Project 19-1351-160

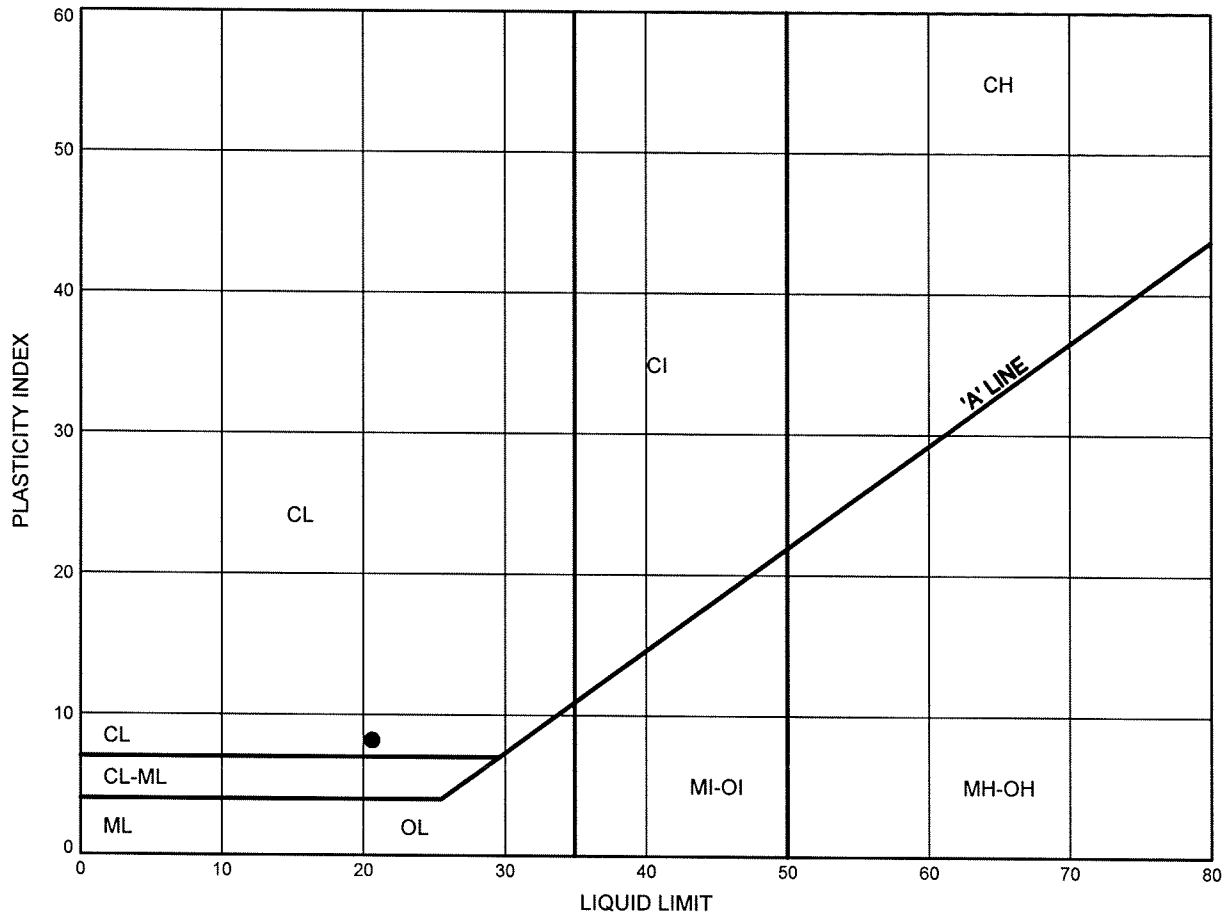


Prep'd MFA
 Chkd. MRA

Mississauga BRT East
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

Silty Sand Till



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

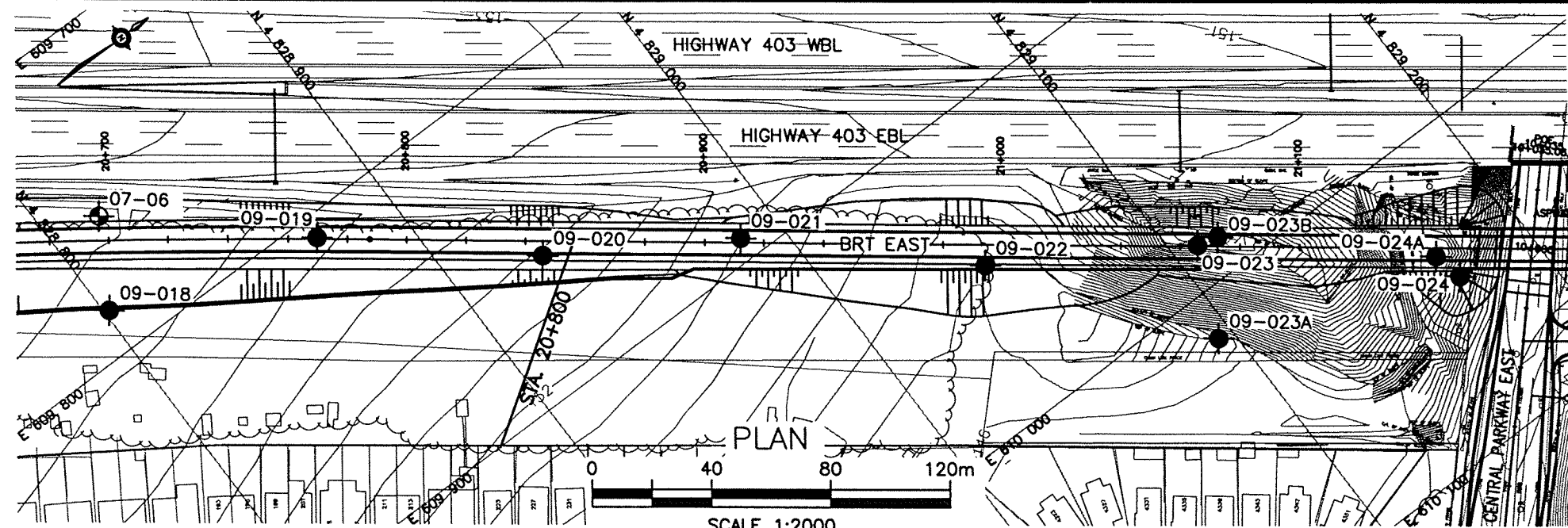
Date March 2010
 Project 19-1351-160



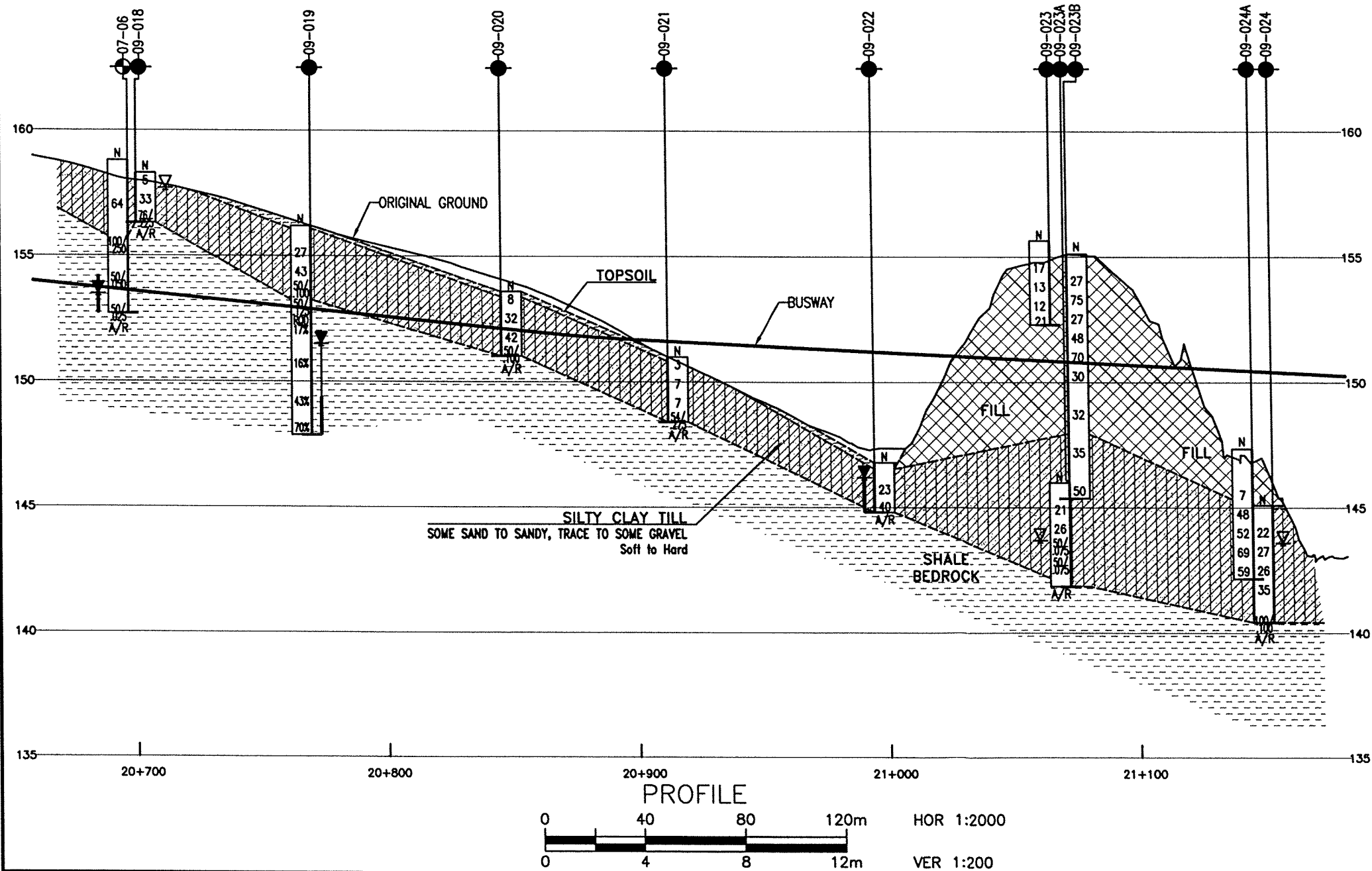
Prep'd MFA
 Chkd. MRA

Appendix C

Borehole Locations and Soil Strata Drawings



SCALE 1:2000



HOR 1:2000

VER 1:200

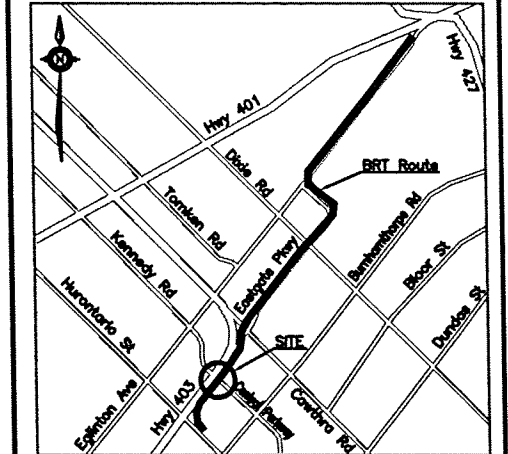
METRIC

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



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 |

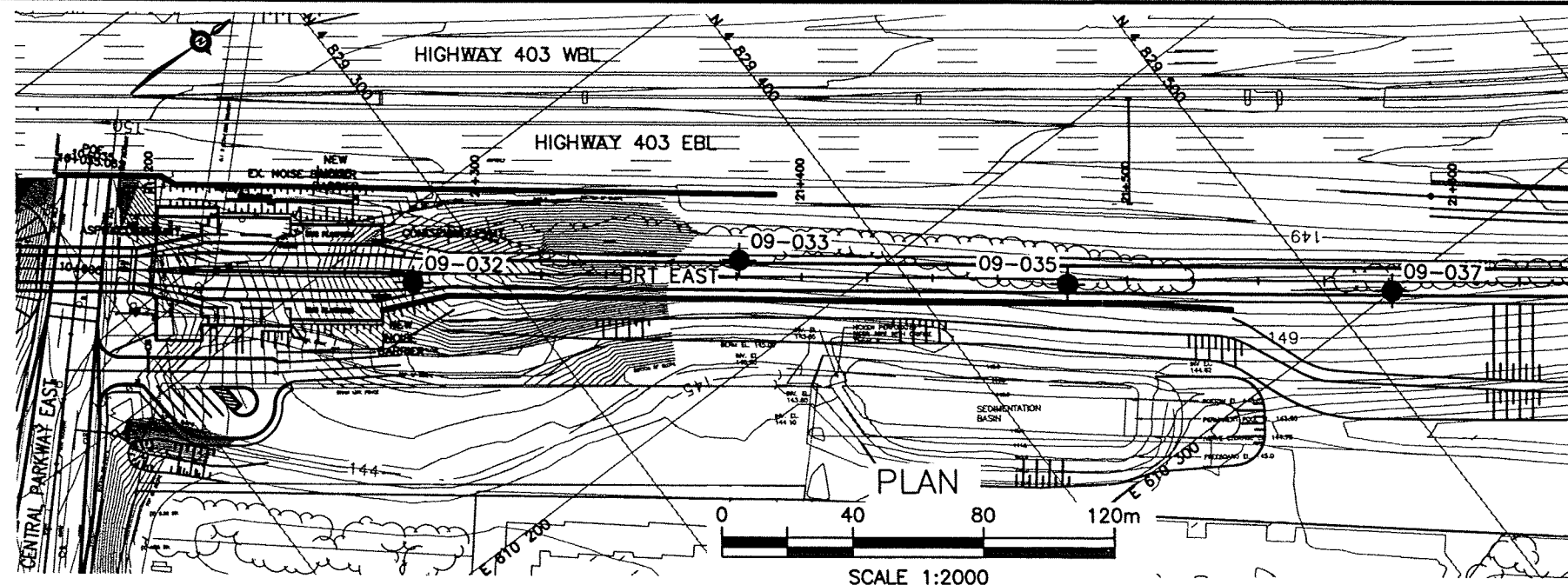
NO	ELEVATION	NORTHING	EASTING
07-06	158.8	4 828 818.0	609 758.0
09-018	158.3	4 828 801.7	609 785.3
09-019	156.2	4 828 872.4	609 807.3
09-020	153.6	4 828 929.8	609 857.4
09-021	151.0	4 828 986.6	609 892.5
09-022	146.8	4 829 046.9	609 948.7
09-023	155.6	4 829 108.3	609 986.1
09-023A	146.0	4 829 094.9	610 015.1
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

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



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

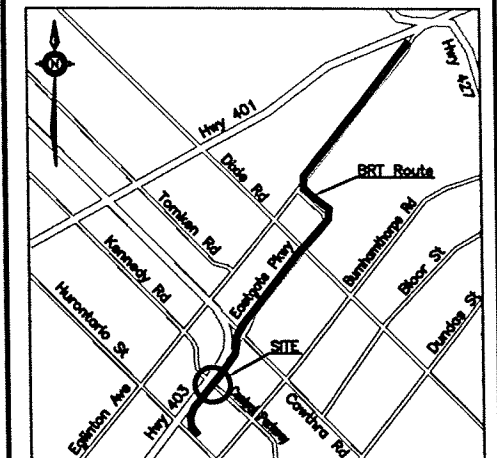
S	CONT No
	GWP No

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

MRC **McCORMICK RANKIN**
CORPORATION








THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

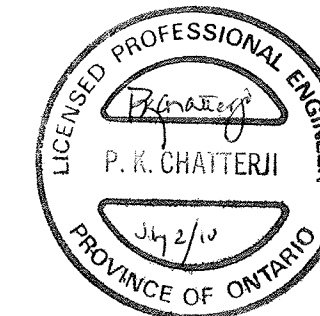
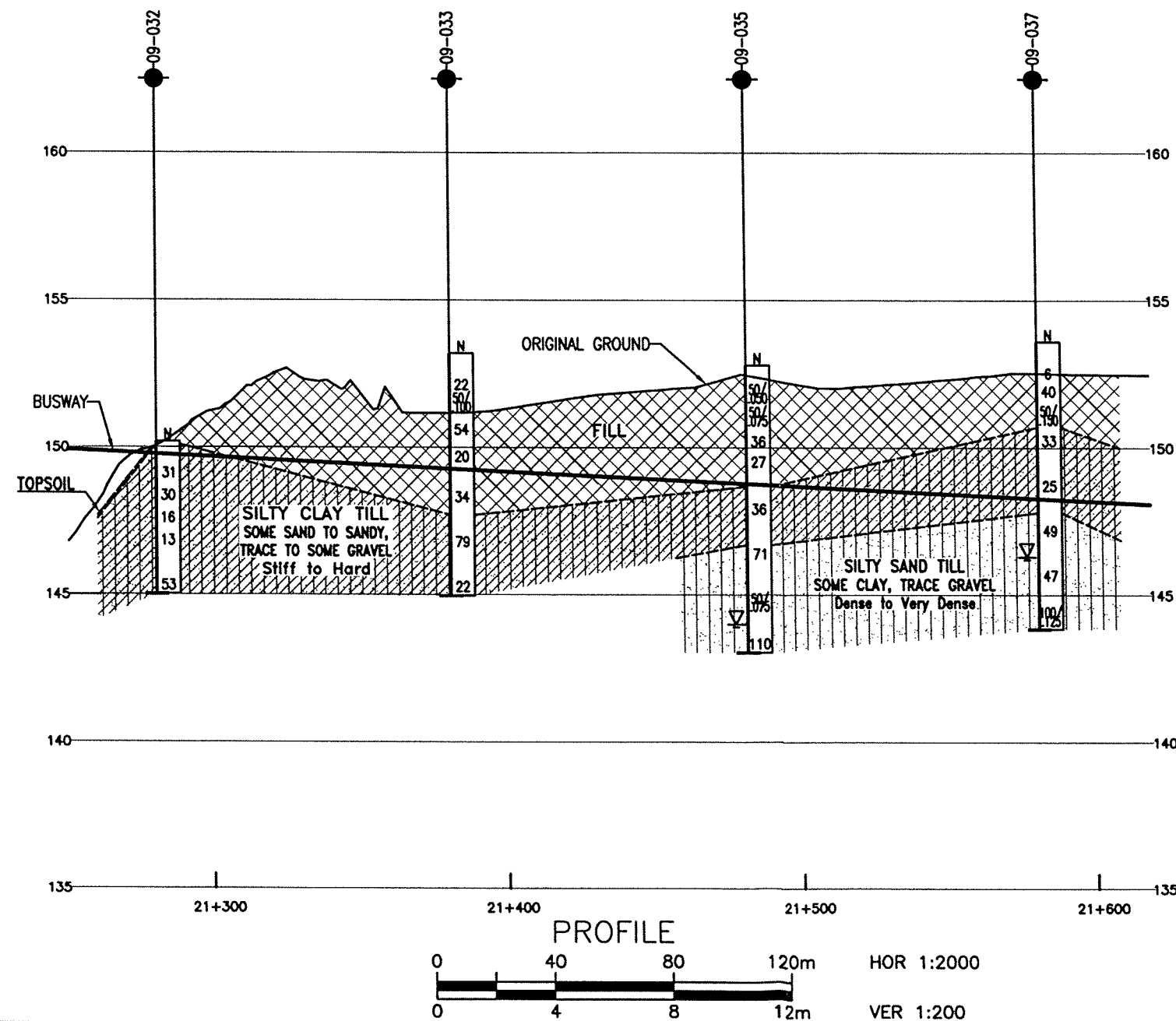
	Present Borehole Location
	Previous Borehole Location
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[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

[illegible]