

Geocres No:

30M11-218

2009-0012



DRAFT

**FOUNDATION INVESTIGATION REPORT
HIGHWAY 401/HIGHWAY 27 OVERPASS
EASTBOUND LANES – EAST ABUTMENT
TORONTO, ONTARIO**

Prepared for

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January 13, 2003

DST File Number: MG02-077

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1.0 INTRODUCTION

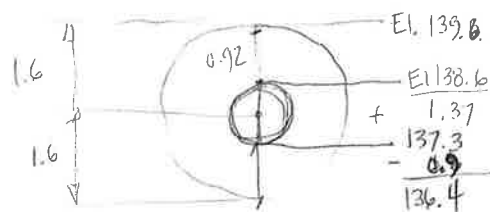
This report presents the results of a foundation investigation study that was completed by DST Consulting Engineers (DST) at the location of the east abutment of the eastbound lanes of the proposed new Highway 401/Highway 27 overpass structure. The investigation was undertaken at the request of the Foundation Design Branch of the MTO and is subject to the attached Statement of Limitations of Appendix A.

2.0 SITE AND PROJECT DESCRIPTION

The site of the investigation works is located in the general footprint area of the south or eastbound lane portion of the east abutment of the proposed new Highway 401/Highway 27 overpass that is located within the general Highway 401/Highway 427 interchange. As part of the proposed new overpass structure a new replacement abutment is proposed consisting of a series of pile supported piers and an approximately 6 m wide Retained Soil System (RSS) retaining wall to be supplied by Reinforced Earth (RE) to retain the earth backfill of the approach embankment.

At the time the present investigation was carried out in late December 2002, the general Stage 1 limits of the east abutment had been sub-excavated to approximate elevation 144.0 m, including the demolition of the south portion of the east abutment of the original overpass structure. In addition, the limits of proposed Pile Cap # 9 had been sub-excavated to approximate elevation 141.5 m in advance of pile installation. However, the existing buried footings of the original structure were not sub-excavated and accordingly, a number of former buried footings elements are known to be present in the area.

Furthermore, as shown on Drawing # 1 a Metro Toronto sanitary trunk sewer is known to pass below the proposed footing area in an oblique fashion to the proposed abutment. More specifically, based on information presented on Sheet 504 of MTO Contract No. 2002-2000, the sewer in question has an internal diameter of 1,372 mm and is encased with concrete to an external diameter of 3,200 mm. The invert elevation of the sewer is reported to be about 137.3 m, with a corresponding top elevation of the surrounding concrete of about 138.9 m. Elevation 138.9 m is some 4.25 m below the base of the proposed RSS wall (elevation 143.15 m) and some 2.6 m below the underside of the bridge pier supports (elevation 141.5 m).



Reco levelling pad

143.0
139.6
3.4

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Inspection of the aforementioned Pile Cap # 9 excavation completed by DST revealed the obvious presence of elements of a former timber shoring system and the presence of obvious fill materials within the south, east and west limits of the excavation leading to the conclusion that the underlying sewer had been installed in an open cut trench. Accordingly, it is understood that the primary intent of the present investigation was to obtain data on the conditions of the soil backfill within the former trench.

Other key features of the site at the time of the investigation are as follows:

- Soldier pile and wood lagging temporary retaining wall along the north edge of the Stage 1 construction limits to provide support to the existing earth backfill located behind the existing east abutment to the north.
- Steeply inclined earth cut slope to the rear or east side of the abutment excavation that was completed through the former approach embankment to the now demolished bridge.
- Steeply inclined earth cut slope to the south side of the abutment excavation through the existing flagging stone paved spill through approach embankment of the east abutment of the Highway 401 East to Hwy 427 South ramp.

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3.0 INVESTIGATION METHODOLOGY AND RESULTS

The investigation aspects of the project consisted of drilling a total of two boreholes at the locations shown on the attached Drawing # 1. Borehole locations were indicated to DST by the site superintendent of Graham Bros. Construction Limited (Graham) based on prior discussions between Graham and the MTO Foundation Design Branch and was initially intended to be over the centre-line of the existing sewer and at a location towards the rear of the footprint area of the proposed RSS wall. However, based on survey data for the as-drilled boreholes as completed by Shiu Geomatics Limited, Mississauga, Ontario as presented on the borehole logs of Appendix B and on Drawing # 1, actual drilled locations appear to have been close to the east and west lateral limits of the existing sewer.

The boreholes were drilled to depths of 8.1 m (BH02-100) and 9.3 m (BH02-101) on December 19, 2002, using a bombardier mounted conventional soils exploration drill rig turning 150mm diameter solid stem augers and working under the full time supervision of a DST engineer in training. During drilling, Standard Penetration Tests (SPT) and associated split spoon soil sampling was undertaken at 0.76 m intervals of depth. A log of encountered soil conditions within each borehole, together with the results and locations of all in-situ tests are provided in the attached Appendix B.

In addition to noting groundwater conditions during and upon completion of drilling, standpipe piezometers were installed in both boreholes. Subsequent to their installation, a stabilized set of water level readings was retrieved on January 10, 2003 some 3 weeks after the piezometers were installed. A record of piezometer installation details and subsequent water level measurements are presented on the borehole logs of Appendix B.

Soil samples collected from the boreholes were transferred to DST's laboratory in Mississauga for re-examination by a senior engineer and scheduling of laboratory tests to be completed at DST's Thunder Bay soil laboratory. Laboratory testing consisted of determination of the water content on each retrieved sample and laboratory grain size analyses on a total of five (5) samples and Atterberg limit soil plasticity tests on a further three (3) samples. The results of the water content tests and a summary of the grain size and Atterberg Limit data is presented on the borehole logs of Appendix B. Complete grain size curves are presented in Appendix C with Atterberg Limit data presented on the soil plasticity charts of Appendix D.

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4.0 SUBSURFACE CONDITIONS

The soil conditions encountered at the locations of Boreholes BH02-100 and 101, consist primarily of clayey silt fill materials that extend to a depth of at least 8.1 m (elevation 136.6 m) at BH02-100 and to a depth of 7.8 m (elevation 136.9 m) at BH02-101, where it is underlain by weathered shale bedrock. The shale bedrock is also expected to be present a short distance below the maximum investigated depth of BH02-100, although this was not confirmed due to concerns with damage that could result to the drill rig by augering through the wood shoring that was present at depth within BH02-100.

The fill material consists primarily of reworked clayey silt till. The results of five (5) grain size distribution analyses completed on samples of the fill are presented on Figure C1 of Appendix C and indicate the following material fractions: gravel 2 to 24 %; sand 26 to 37 %; silt 33 to 59 %; clay 6 to 12 %.

However, some cobbles and wood pieces and occasional thin topsoil layers were noted within the fill. In addition, the lowermost 1.5 m of BH02-100 is assumed to have been completed along the vertical edge of a former shoring system as evidenced by the presence of a “half round” of pressure treated timber being retrieved within the split spoon soil sampler. The results of three (3) Atterberg limit determinations on samples of the fill are presented on Figure D1 of Appendix D and indicate that the material to be of low plasticity.

Measured SPT ‘N’ values within the clayey silt fill vary between 5 and 73 indicating quite variable conditions. However, most of the SPT ‘N’ values vary from 5 to about 15, indicating a predominantly firm to stiff consistency. SPT ‘N’ values within the underlying weathered shale were greater than the equivalent of 100 blows per 300 mm, indicating “sound” conditions.

Measured groundwater levels within the piezometers some 3 weeks after installation indicate fairly consistent levels of 141.4 m and 141.3 m respectively within BH02-100 and BH02-101. However, it should be noted that this represents a fairly short term observation period and may be subject to annual and/or seasonal variation.

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In summary, based on the soil conditions encountered with BH02-100 and 101, it is concluded that the soil conditions within the immediate limits of the sewer trench and a large majority of the footprint area of the proposed RSS wall, consist primarily of firm to stiff clayey silt fill to a depth of about 8 m where it is underlain by weathered shale bedrock. Presumably, native soils are located beyond the lateral limits of the sewer trench backfill. However, the nature and strength characteristics of the adjacent native soils was not investigated as part of this investigation.

5.0 CLOSURE

We trust that this report is sufficient for your present requirements. Should you have any questions or require clarification on any matter, please do not hesitate to contact us.

DST CONSULTING ENGINEERS INC.



Jacek Strakowski, M.Eng.
Engineer in Training



Ivan Corbett, P.Eng.
Senior Geotechnical Engineer

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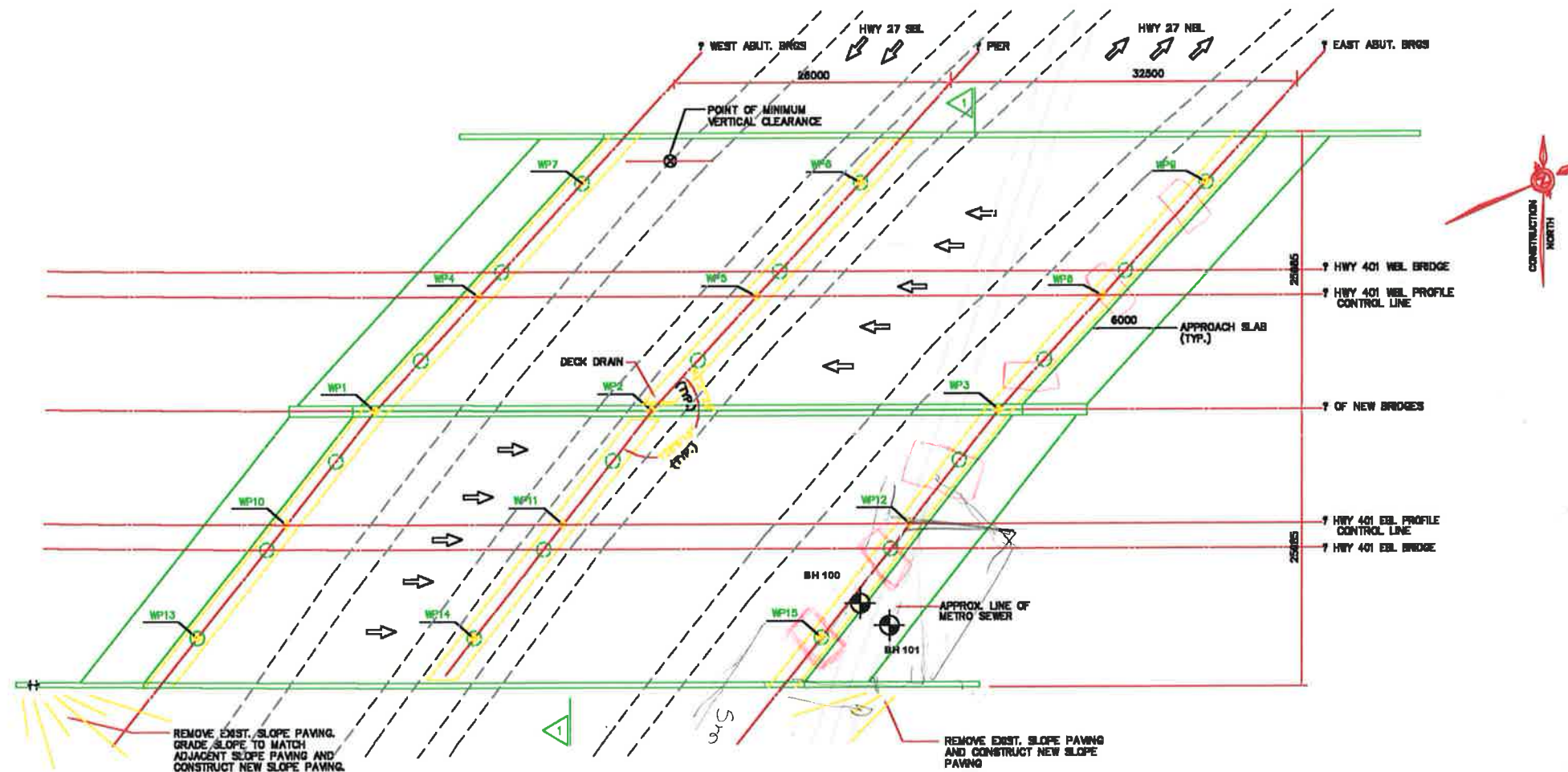
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

PLATE No PLATE
CONT No2002-2000
WP No 47-99-00
HIGHWAY 401/27 OVERPASS
RSS WALL - EAST ABUTMENT
METRO SEWER BACKFILL INVESTIGATION
BORE HOLE LOCATIONS



SHEET

DST



PLAN

SCALE



Wall height ~ 6m at about face
Wingwall max height : 8.6m

LEGEND



No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
BH 100	144.852	4 837 478.2	298 587.0
BH 101	144.828	4 837 478.0	298 589.9

NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

Rev.	DATE	BY	DESCRIPTION
GEOCRES No			
HIGHWAY No. 401 & 27			DIST 6
SUBM'D IC	CHECKED IC	DATE JAN. 13, 2003	SITE
DRAWN SL	CHECKED	APPROVED IC	DWG 1

APPENDIX A

STATEMENT OF LIMITATIONS

LIMITATIONS OF REPORT

Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation.

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

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APPENDIX B

BOREHOLE LOGS

RECORD OF BOREHOLE No BH02-100

1 OF 2

METRIC

W.P. 47-99-00 LOCATION 4,837,476.2 N; 298,567.0 E ORIGINATED BY JS
DIST 6 HWY 401/27 BOREHOLE TYPE Solid Stem Auger COMPILED BY JS
DATUM Geodetic DATE 19/12/2002 CHECKED BY IC

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							
144.7 0.0	FILL - CLAYEY SILT, trace to some gravel, trace sand, stiff to very stiff, brown		1	SS	10										
			2	SS	10									2 26 59 12	
			3a	SS	21										
142.7 1.9	FILL - CLAYEY SILT, some sand and gravel, occasional cobbles, very stiff to stiff, grey		3b	SS											
			4	SS	12										
141.8 2.9	FILL - CLAYEY SILT, some sand and gravel, occasional cobbles, firm, grey		5	SS	7										
140.7 4.0	TOPSOIL - sandy, loose, black		6a	SS											
140.9	FILL - CLAYEY SILT, some sand and gravel, firm, grey <i>Backfill</i>		6b	SS	7										
					6c	SS									
			7	SS	6									7 33 50 9	
			8	SS	5										

2 SS wall Fdn.

Top of concrete sewer.

Backfill

ON MOT MG02-077.GPJ ON MOT.GDT 13/1/03

Continued Next Page

+ 3, X 3, Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH02-100

2 OF 2

METRIC

W.P. 47-99-00 LOCATION 4,837,476.2 N; 298,567.0 E ORIGINATED BY JS
 DIST 6 HWY 401/27 BOREHOLE TYPE Solid Stem Auger COMPILED BY JS
 DATUM Geodetic DATE 19/12/2002 CHECKED BY IC

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
138.0	WOOD AND GRAVEL - Assumed edge of former shoring system. Note: SPT's artificially high due to driving through old wood shoring.		9	SS	52											
6.6			10	SS	68											
			11	SS	57											
137																
136.6	END OF BOREHOLE AT 8.08 m DUE TO CONCERNS WITH AUGERING THROUGH THE EXISTING WOOD SHORING. BOREHOLE OPEN UPON COMPLETION OF DRILLING. STANDPIPE PIEZOMETER INSTALLED TO DEPTH OF 7.92 m. WATER LEVEL MEASURED AT ELEVATION 141.9 m UPON INSTALLATION. WATER LEVEL MEASURED AT ELEVATION 141.4 m ON JAN 10, 2003.															
8.1																

+ 3, X 3: Numbers refer to 0 3% STRAIN AT FAILURE
Sensitivity

RECORD OF BOREHOLE No BH02-101

1 OF 2

METRIC

W.P. 47-99-00 LOCATION 4,837,478.0 N; 298,569.9 E ORIGINATED BY JS
DIST 6 HWY 401/27 BOREHOLE TYPE Solid Stem Auger COMPILED BY JS
DATUM Geodetic DATE 19/12/2002 CHECKED BY IC

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 ○ UNCONFINED + FIELD VANE □ QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%)
144.6 0.0	FILL - CLAYEY SILT, some sand and gravel, firm to hard, brown		1	SS	7										
			2	SS	8									6 27 55 12	
			3	SS	30										
142.5 2.1	FILL - CLAYEY SILT, some sand and gravel, stiff, grey		4a	SS	9										
141.9 2.7	FILL - CLAYEY SILT, some organics, black, (Possible Topsoil)		4b	SS											
141.7 2.9	FILL - CLAYEY SILT, some sand and gravel, occasional cobbles, stiff, grey		5a	SS	8										
141.1 3.5	FILL - CLAYEY SILT, some sand and gravel, occasional cobbles, hard, grey		5b	SS											
			6	SS	46									7 36 48 8	
			7	SS	73										
139.6 5.0	FILL - CLAYEY SILT, some sand and gravel, occasional cobbles, some wood pieces, stiff, grey		8	SS	15										

ON_MOT MG02-077.GPJ ON_MOT.GDT 13/1/03

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Base of RSS Wall

Top of Sailer

RECORD OF BOREHOLE No BH02-101

2 OF 2

METRIC

W.P. 47-99-00 LOCATION 4,837,478.0 N; 298,569.9 E ORIGINATED BY JS
DIST 6 HWY 401/27 BOREHOLE TYPE Solid Stem Auger COMPILED BY JS
DATUM Geodetic DATE 19/12/2002 CHECKED BY IC

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
			9	SS	9											
			10	SS	11											
			11a	SS												
136.9 7.8	WEATHERED SHALE		11b	SS	80											
			12	SS	60											
			13	SS	50											
135.4 9.3	END OF BOREHOLE AT 9.27 m. BOREHOLE OPEN UPON COMPLETION OF DRILLING. STANDPIPE PIEZOMETER INSTALLED TO DEPTH OF 7.62 m. WATER LEVEL MEASURED AT ELEVATION 141.9 m UPON INSTALLATION. WATER LEVEL MEASURED AT ELEVATION 141.3 m ON JAN 10, 2003.															

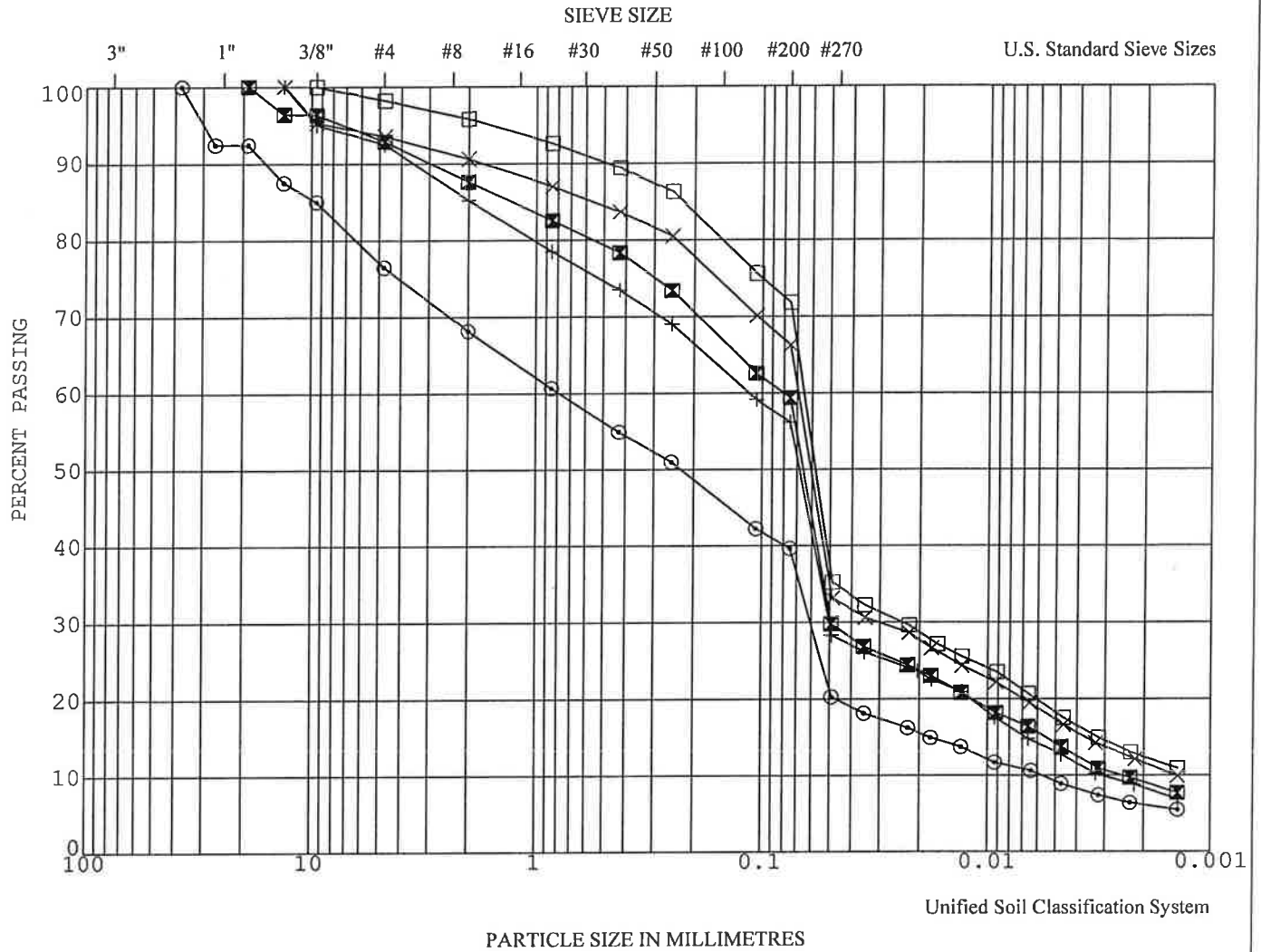
+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

APPENDIX C

LABORATORY GRAIN SIZE DATA

GRAIN SIZE ANALYSIS CLAYEY SILT FILL



COB'L	GRAVEL		SAND			SILT & CLAY
	Coarse	Fine	Coarse	Medium	Fine	

LEGEND:

□	Sample BH02-100	Depth (m) 0.99
■	Sample BH02-100	Depth (m) 4.80
×	Sample BH02-101	Depth (m) 0.99
+	Sample BH02-101	Depth (m) 4.04
○	Sample BH02-101	Depth (m) 7.09

January 2003

Reference No.: MG02-077

**HIGHWAY 401/27
Toronto, Ontario**

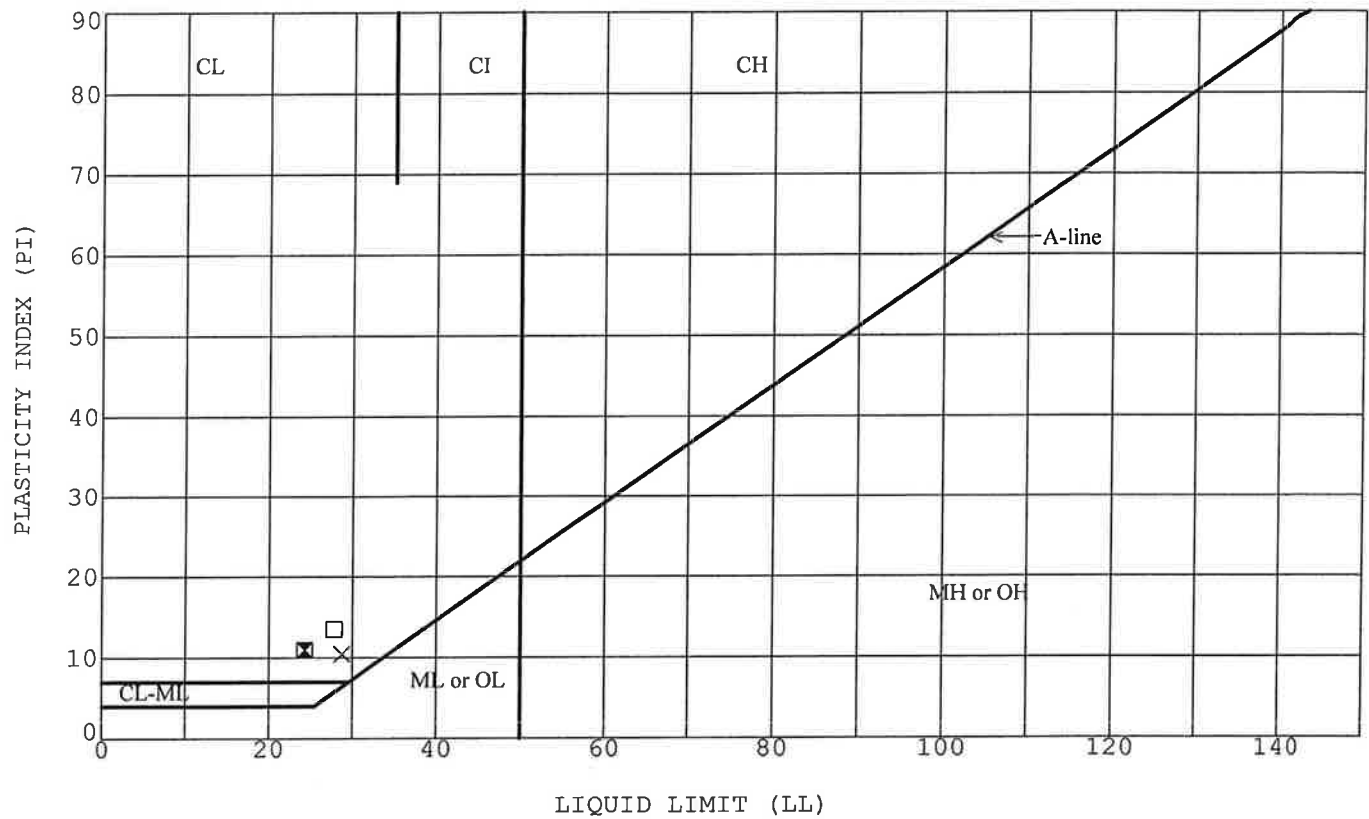
DST CONSULTING ENGINEERS INC.

Figure C1

APPENDIX D

SOIL PLASTICITY CHARTS

ATTERBERG LIMIT TEST RESULTS CLAYEY SILT FILL



LEGEND:

□	BOREHOLE BH02-100	DEPTH 0.99
■	BOREHOLE BH02-101	DEPTH 0.99
×	BOREHOLE BH02-101	DEPTH 7.09

W _L	W _P	PI	W
28	14	14	16
24	13	11	13
29	18	10	16

January 2003

Reference No.: MG02-077

HIGHWAY 401/27 - Toronto, Ontario

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Figure D1