

FOUNDATION INVESTIGATION REPORT

BREAKAWAY SIGNS

CONTRACT NO. 2006-3039

HIGHWAY 403

Ministry of Transportation



Golder Associates Ltd.

309 Exeter Road, Unit #1
London, Ontario, Canada N6L 1C1
Telephone: (519) 652-0099
Fax: (519) 652-6299



**FOUNDATION INVESTIGATION REPORT
BREAKAWAY SIGNS
HIGHWAY 403
GWP 3322-04-00, AGREEMENT NO. 3004-A-0023
MINISTRY OF TRANSPORTATION – SOUTHWESTERN REGION**

Submitted to:

Dillon Consulting Limited
P.O. Box 426, Terminal B
495 Richmond Street
London, Ontario
N6A 4W7

DISTRIBUTION:

8 Copies - Dillon Consulting Limited
2 Copies - Golder Associates Ltd.

July 10, 2006

06-1130-047
Geocres No. 40P1-94



TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
FOUNDATION INVESTIGATION REPORT	
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	2
3.0 INVESTIGATION PROCEDURES.....	3
4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY.....	4
4.1 Geology	4
4.2 Site Stratigraphy.....	4
4.2.1 Pavement Structure	5
4.2.2 Fill.....	5
4.2.3 Silty Clay	5
4.2.4 Silt	6
4.2.5 Clayey Silt	6
4.3 Groundwater Conditions.....	6
5.0 MISCELLANEOUS.....	8

In Order
Following
Page 8

LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORDS OF BOREHOLES

FIGURE 1 - Site Location Map

DRAWING 1 - Borehole Location Plan

APPENDIX A – Results of Laboratory Testing

**FOUNDATION INVESTIGATION REPORT
BREAKAWAY SIGNS
HIGHWAY 403
GWP 3322-04-00, AGREEMENT NUMBER 3004-A-0023
MINISTRY OF TRANSPORTATION – SOUTHWESTERN REGION**

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out a foundation investigation relating to the reconstruction of Highway 403 under GWP 3322-04-00 which extends from 1.0 kilometres west of Garden Avenue to the boundary between the City of Brantford and the City of Hamilton. This section of Highway 403 is some 11.8 kilometres in length.

The purpose of the foundation investigation was to determine the subsurface conditions at the proposed breakaway sign locations. The terms of reference for the scope of work are outlined in Golder's Total Project Management (TPM) proposal P61-3037, dated February 15, 2006. The work was carried out in accordance with our Quality Control of TPM Services Plan, GWP 3322-04-00, Agreement No. 3004-E-0023, dated March 17, 2006.

Dillon provided Golder with design drawings showing the locations of the proposed breakaway signs.

2.0 SITE DESCRIPTION

The project area is located on the east side of the City of Brantford in the geographic Township of Brantford, County of Brant, Ontario as shown on the Site Location Map, Figure 1. The breakaway signs will be installed between the western project limit at Highway 403, Station 9+615, and Station 13+600. Project GWP 3322-04-00 extends from 1 kilometre west of Garden Avenue to the boundaries of the Cities of Brantford and Hamilton. The project chainage extends from Station 9+615 to 18+630.

Highway 403 within the project area is currently a four lane divided freeway with a depressed grass median. The surrounding land is generally flat to gently rolling and mainly consists of agricultural fields. Based on a survey of the boreholes, elevations in the project area range between 205 and 215 metres with elevations generally decreasing easterly towards Fairchild Creek.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out on April 6, 2006. Seven boreholes were drilled at the locations indicated on the Location Plan, Drawing 1. The boreholes were 3.7 to 5.0 metres deep. The boreholes were drilled between the edge of the roadway pavement and the sign locations since the actual locations are on slopes which are inaccessible to conventional drilling equipment. The encountered subsurface conditions are shown in detail on the Record of Borehole sheets.

The borehole locations, ground surface elevations and borehole depths are summarized as follows:

BOREHOLE	STATION	BOREHOLE LOCATION		GROUND SURFACE ELEVATION (m)	BOREHOLE DEPTH (m)
		NORTHING (m)	EASTING (m)		
1	10+300	4 781 054.6	246 483.8	214.59	3.66
2	11+750	4 781 106.2	247 933.0	209.42	5.03
3	13+525	4 781 299.8	249 685.0	208.68	5.03
4	13+228	4 781 214.9	249 402.8	205.45	5.03
5	12+325	4 781 158.5	248 506.8	210.35	5.03
6	12+025	4 781 149.3	248 207.0	212.07	5.03
7	11+045	4 781 131.7	247 227.1	210.39	3.66

The investigation was carried out using a truck mounted CME 45 drill rig supplied and operated by Aardvark Drilling. Samples of the overburden were obtained at suitable intervals of depth using 50 millimetre outside diameter split-spoon samplers in accordance with the Standard Penetration Test (SPT) procedures. Groundwater conditions were observed in the open boreholes throughout the drilling operations. The boreholes were backfilled using MTO recommended procedures and as required by Ontario Regulation 903 (amended by Ontario Regulation 128/03).

The field work was supervised on a full-time basis by members of our engineering staff who located the boreholes in the field, obtained utility locates, directed the drilling, sampling and in-situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labeled containers and transported to our laboratory in London, Ontario for further examination. Index and classification tests, consisting of grain size analyses, water content and Atterberg limits determinations, were carried out on selected samples. The results of the field and laboratory testing are given on the Record of Borehole sheets and in Appendix A.

4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

4.1 Geology

This project lies within the physiographic region of southwestern Ontario known as the Norfolk Sand Plain¹. Near the area of the site, the Horseshoe Moraines intersect the sand plain. In the area of the site, a discontinuous veneer of surficial sandy soil deposited in glacial Lakes Whittlesey and Warren overlies extensive deposits of stratified clays and silts associated with the Haldimand Clay Plain.

Based on the Ontario Department of Mines and Northern Affairs Map 2241 entitled “Granular Deposits of the Brantford Area” dated 1972, the soils at the site consist of glaciolacustrine deep water sediments, mainly Lake Warren and younger. These are predominantly stratified to varved silts and clays with minor sand and are locally overlain by a veneer of sand.

Bedrock in the area of the site is considered to consist of shale and dolomite belonging to the Salina Formation of Upper Silurian Age. Bedrock surface topographical mapping and information from the MTO Geocres system indicates that the bedrock surface in the area of the site ranges between approximately elevations 170 to 187 metres or about 19 to 45 metres below the existing ground surface.

4.2 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes together with the results of the field and laboratory testing are shown on the Record of Borehole sheets and in Appendix A. The stratigraphic boundaries shown on the borehole sheets are inferred from non-continuous sampling and, therefore, may represent transitions between soil types rather than exact planes of geological change. Subsurface conditions will vary between and beyond the borehole locations.

The locations and elevations of the boreholes are shown on the attached Drawing 1. A detailed description of the subsurface conditions encountered in each borehole for this investigation is provided on the Record of Borehole sheets and is summarized in the following sections. In general, the subsurface conditions were relatively uniform along the length of the project and consisted of surficial fill overlying stratified deposits of silty clay, clayey silt and silt.

¹ L.J. Chapman and D.F. Putnam: The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 1984.

4.2.1 Pavement Structure

A 100 millimetre thick layer of asphalt was encountered at the surface of borehole 6.

Granular base materials associated with the shoulders of the pavement structure were found at the ground surface in boreholes 3, 5 and 7 and beneath the asphalt at elevation 212.0 metres in borehole 6. The thickness of the granular base layers ranged from 240 to 300 millimetres.

The granular base materials were underlain by layers of granular subbase 310 to 430 millimetres thick. The granular subbase layers were found from elevations 208.4 to 211.7 metres.

4.2.2 Fill

Fill materials were encountered at the ground surface in boreholes 1, 2 and 4 and beneath the granular roadbase materials from elevation 211.3 metres in borehole 6.

The fill layers at the ground surface in boreholes 1, 2 and 4 were comprised of sand and gravel fill and were 0.9 to 1.1 metres thick. The sand and gravel fill is compact with N values ranging between 12 and 29 blows per 0.3 metres and an average water content of 7 per cent.

The fill layer in borehole 6 was 2.1 metres thick and consisted of silty clay with trace amounts of topsoil and gravel. N values in the silty clay fill ranged from 14 to 28 blows per 0.3 metres with water contents of 18 to 23 per cent.

4.2.3 Silty Clay

Silty clay was intercepted beneath the fill in boreholes 1, 2 and 4 from elevations 204.5 to 213.5 metres, the granular roadbase materials in borehole 3 from elevation 208.0 metres, the silt in boreholes 2 and 5 from elevations 205.2 and 206.2 metres, respectively, and the clayey silt in borehole 7 from elevation 208.3 metres. Where fully penetrated, the silty clay layers are 1.4 to 1.8 metres thick. Boreholes 1, 2, 4, 5 and 7 were terminated in silty clay layers after exploring them for some 0.8 to 4.2 metres.

The grain size distribution curves for samples of silty clay recovered from the standard penetration testing are provided on Figure A-1.

The silty clay is firm to very stiff but generally stiff based on N values of 6 to 22 blows per 0.3 metres with an average of 13 blows per 0.3 metres. The estimated undrained shear strength is 90 kilopascals. The silty clay is a low to intermediate plasticity, inorganic clay based on three Atterberg limits determinations. The Atterberg limits data are shown on the Plasticity Chart, Figure A-4. The average plastic and liquid limits were 19 and 36 per cent, respectively, and the

average plasticity index was 17 per cent. Water contents of 17 to 34 per cent were measured in the silty clay. The estimated bulk unit weight of the silty clay is 20 kilonewtons per cubic metre.

4.2.4 Silt

Layers of silt were encountered beneath the silty clay in borehole 2 from elevation 206.5 metres and below the granular roadbase layers in borehole 5 from elevation 209.8 metres. The silt layers were 1.4 metres thick in borehole 2 and 3.6 metres thick in borehole 5.

The grain size distribution curve for a sample of silt with some clay recovered from the standard penetration testing is provided on Figure A-2.

The silt has an estimated angle of internal friction of 30 degrees and an estimated bulk unit weight of 19 kilonewtons per cubic metre.

Standard penetration test N values of 9 to 29 blows per 0.3 metres were measured in the silt layers. Water contents in the silt varied between 22 and 31 per cent.

4.2.5 Clayey Silt

Clayey silt was encountered beneath the silty clay in borehole 3 from elevation 206.6 metres, beneath the fill layers in borehole 6 from elevation 209.2 metres and beneath the granular layers in borehole 7 from 209.7 metres. Boreholes 3 and 6 were terminated in clayey silt.

The grain size distribution curves for samples of clayey silt recovered from the standard penetration testing are provided on Figure A-3.

The clayey silt is firm to hard but generally very stiff based on N values of 7 to 38 blows per 0.3 metres with an average N value of 17 blows per 0.3 metres. The estimated undrained shear strength is 115 kilopascals. The clayey silt is a low plasticity, inorganic clay based on three Atterberg limits determinations. The average plastic and liquid limits were 20 and 29 per cent, respectively, and the average plasticity index was 9 per cent. The Atterberg limits data are shown on the Plasticity Chart, Figure A-4. Water contents of 14 to 32 per cent were measured in the clayey silt. The clayey silt has an estimated bulk unit weight of 20 kilonewtons per cubic metre.

4.3 Groundwater Conditions

Groundwater conditions were observed in the boreholes during and upon completion of drilling and sampling. Most of the boreholes were dry during drilling. Groundwater was encountered in boreholes 3 and 5 at depths of 4.6 and 2.9 metres below ground surface or at elevations 204.1 and 207.5 metres, respectively. Details of the groundwater conditions encountered at the borehole locations are summarized in the table below:

BOREHOLE	GROUND SURFACE ELEVATION (m)	ENCOUNTERED GROUNDWATER ELEVATION (m)
1	214.59	Dry
2	209.42	Dry
3	208.68	204.11
4	205.45	Dry
5	210.35	207.45
6	212.07	Dry
7	210.39	Dry

The groundwater levels are expected to fluctuate seasonally and are expected to be higher during periods of sustained precipitation or during spring melt conditions.

5.0 MISCELLANEOUS

The investigation was carried out using equipment supplied and operated by Aardvark Drilling (Aardvark). Aardvark is an Ontario Ministry of Environment licensed well contractor. Field operations were supervised by Mr. David J. Mitchell. All routine laboratory testing was conducted at Golder's London laboratory which is an accredited participant in the MTO's Soil and Aggregate Proficiency program and is certified for full quality testing of Types C and D Aggregates by the Canadian Council of Independent Laboratories.

This report was written by Ms. Dirka U. Prout, P. Eng., a geotechnical engineer, under the direction of the Project Manager, Mr. Philip R. Bedell, P. Eng., a Principal with Golder Associates Ltd. The report was reviewed by Mr. Fintan J. Heffernan, P. Eng., the Designated MTO Contact and Quality Control Auditor.

GOLDER ASSOCIATES LTD.

Dirka U. Prout, P. Eng.

Philip R. Bedell, P. Eng.
Principal

Fintan J. Heffernan, P. Eng.
Designated MTO Contact

DUP/PRB/FJH/cr
n:\active\2006\1130 - geotechnical\1130-000\06-1130-047 dillon - gwp 3322-04-00 - hwy 403\reports\july 10 06 - (final) prelim fdn inv report - breakaway signs.doc

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.)

Consistency

	<u>kPa</u>	<u>psf</u>
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

(b) Cohesive Soils

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. General

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity index $= (w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

- Notes:**
- 1 $\tau = c' + \sigma' \tan \phi'$
 - 2 shear strength = (compressive strength)/2
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

PROJECT 06-1130-047 LOCATION N 4781054.6 ; E 246483.8 ORIGINATED BY DJM
G.W.P. 3322-04-00 DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY _____

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										
214.59	GROUND SURFACE							20	40	60	80	100						
0.00	FILL, sand and gravel, some silt Compact Brown						214											
213.52			1	SS	12													
1.07	SILTY CLAY, trace sand, silt partings Stiff to Very Stiff Brown becoming grey below about elev. 211.7m						213								○			
			2	SS	16													
							212									○		
			3	SS	12													
			4	SS	8													
210.93							211									○		
3.66	END OF BOREHOLE																	
	Borehole dry during drilling Apr. 6, 2006.																	

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

PROJECT 06-1130-047
G.W.P. 3322-04-00 LOCATION N 4781106.2 ; E 247933.0 ORIGINATED BY DJM
DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY

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													
209.42	GROUND SURFACE							20	40	60	80	100									
0.00	FILL, sand and gravel, trace silt Compact Grey						209														
208.35			1	SS	16									○							
1.07	SILTY CLAY, trace topsoil to elev. 207.3m, silt partings below elev. 207.3m Stiff to Very Stiff Brown						208								○						
			2	SS	19											○					
			3	SS	11		207														
206.52																					
2.90	SILT, with silty clay layers Compact Brown						206									○					
			4	SS	12																
205.15																					
4.27	SILTY CLAY, with silt partings Firm Grey						205														
204.39			5	SS	6											○					
5.03	END OF BOREHOLE																				
	Borehole dry during drilling Apr. 6, 2006.																				

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



+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

PROJECT 06-1130-047
G.W.P. 3322-04-00 LOCATION N 4781214.9 ; E 249402.8 ORIGINATED BY DJM
DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY

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											
205.45	GROUND SURFACE						20	40	60	80	100								
0.00	FILL, sand and gravel Compact Brown																		
204.54	SILTY CLAY, with silt layers Stiff to Very Stiff Brown becoming grey below about elev. 201.0m		1	SS	21								○						
0.91														○					
			2	SS	20										○				
																○			
			3	SS	10												○		
																		○	
			4	SS	12											○			
																	○		
200.42	END OF BOREHOLE		5	SS	9														
5.03	Borehole dry during drilling Apr. 6, 2006.																		

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

PROJECT 06-1130-047 LOCATION N 4781158.5 ; E 248506.8 ORIGINATED BY DJM
G.W.P. 3322-04-00 DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY _____

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 (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)				GR	SA
210.35	GROUND SURFACE					▽	210										0	0	72	28		
0.00	FILL, Granular Base																					
0.24	FILL, Granular Subbase																					
209.80																						
0.55	SILT, some clay Loose to Compact Grey		1	SS	29																	
		2	SS	9																		
		3	SS	14																		
			4	SS	9				207													
206.24							206															
4.11	SILTY CLAY, with silt partings Stiff Grey		5	SS	8																	
205.32																						
5.03	END OF BOREHOLE																					
	Groundwater encountered at elev. 207.45m during drilling Apr. 6, 2006.																					

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

PROJECT 06-1130-047 G.W.P. 3322-04-00 LOCATION N 4781149.3 ; E 248207.0 ORIGINATED BY DJM
DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY

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			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE													
212.07	GROUND SURFACE							20	40	60	80	100					GR	SA	SI	CL	
0.10	ASPHALT																				
211.69	FILL, Granular Base																				
0.38	FILL, Granular Subbase																				
211.31																					
0.76	FILL, silty clay mixed with silt, trace topsoil, trace gravel Stiff to very Stiff Brown		1	SS	28		211								○						
			2	SS	17		210								○						
			3	SS	14											○					
209.17																					
2.90	CLAYEY SILT, with silt layers Firm to Very Stiff Brown		4	SS	23		209								○	┌───┐		0	3	64	33
							208														
			5	SS	7																
207.04	END OF BOREHOLE																				
5.03	Borehole dry during drilling Apr. 6, 2006.																				

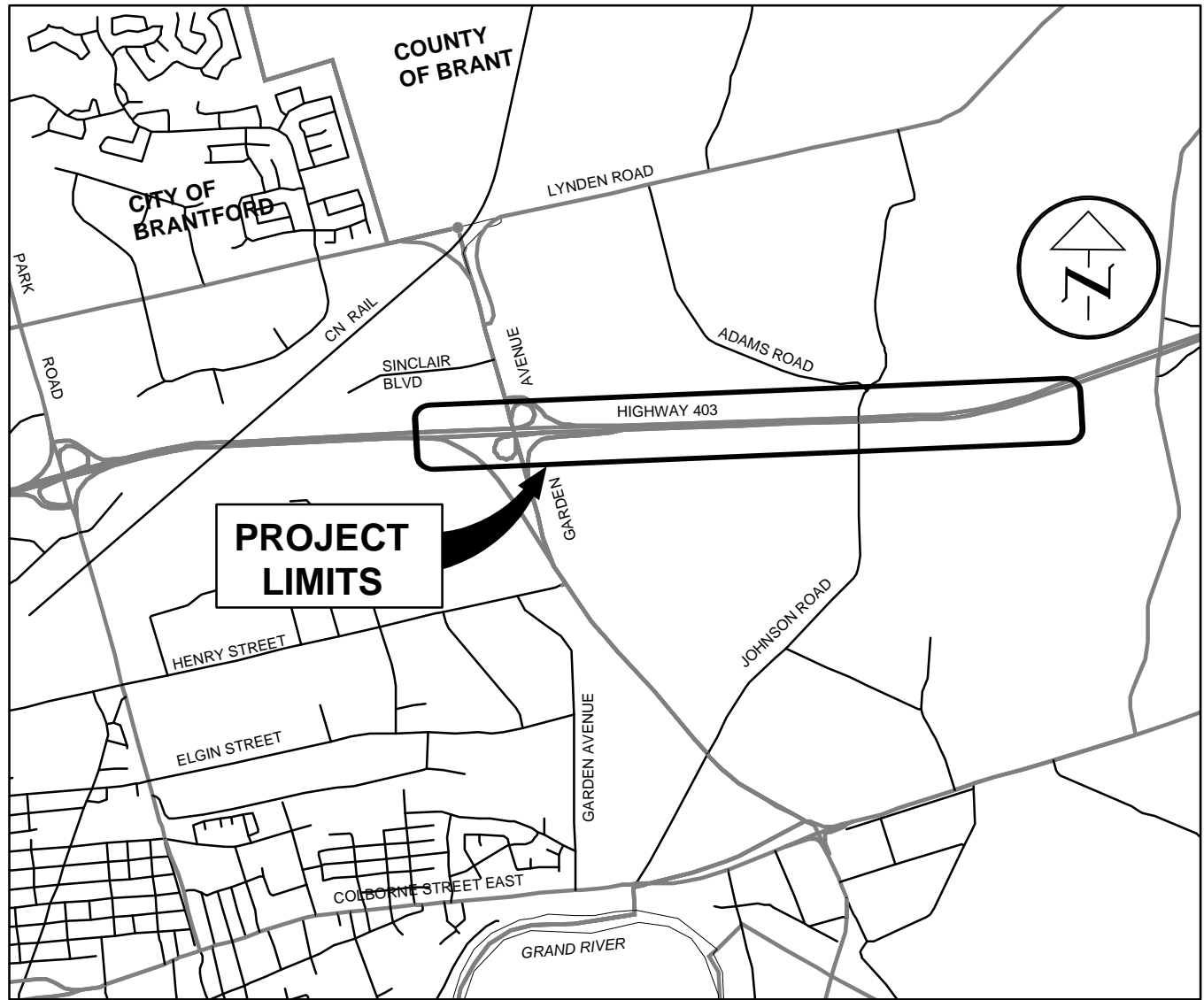
RECORD OF BOREHOLE No 7

1 OF 1

METRIC

PROJECT 06-1130-047 G.W.P. 3322-04-00 LOCATION N 4781131.7 ; E 247227.1 ORIGINATED BY DJM
DIST HWY 403 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE April 6, 2005 CHECKED BY

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									
210.39	GROUND SURFACE							20	40	60	80	100								
0.00	FILL, Granular Base																			
210.09																				
0.30	FILL, Granular Subbase																			
209.69																				
0.70	CLAYEY SILT, Very stiff to Hard Grey		1	SS	38									○						
			2	SS	23										┌─○─┐		0 0 69 31			
208.29																				
2.10	SILTY CLAY, Firm Grey		3	SS	8										○					
			4	SS	7											○				
206.73																				
3.66	END OF BOREHOLE																			
	Borehole dry during drilling Apr. 6, 2006.																			



PROJECT		BREAKAWAY SIGNS HIGHWAY 403 GWP 3322-04-00	
TITLE		SITE LOCATION MAP	
 Golder Associates LONDON, ONTARIO		PROJECT No. 06-1130-047	FILE No. 061130047F001
		CADD WDF MAY 01/06	SCALE AS SHOWN REV. 0
		CHECK	FIGURE 1

PLOT DATE: July 10, 2006
FILENAME: N:\civ\w\2006\1130 - Geotechnical\1130-006\06-1130-047 - HWY 403\Drafting\AutoCAD Files\061130410001.DWG

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

DIST 1 HWY 403
CONT. No.
GWP No. 3322-04-00

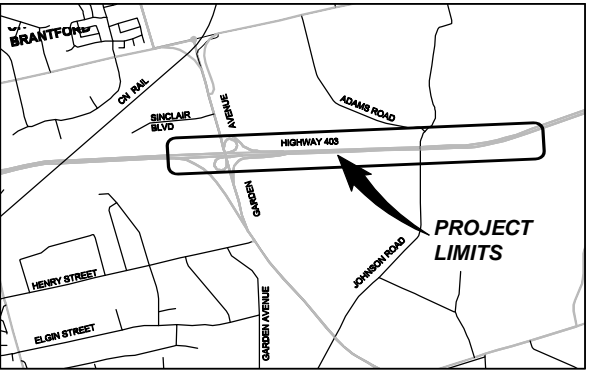


BREAKAWAY SIGNS
BOREHOLE LOCATIONS

SHEET



Golder Associates Ltd.
LONDON, ONTARIO, CANADA



KEY PLAN

LEGEND

Borehole

No.	ELEVATION (metres)	CO-ORDINATES (NAD 83, MTM ZONE 10)	
		NORTH	EAST
1	214.59	4 781 054.6	246 483.8
2	209.42	4 781 106.2	247 933.0
3	208.68	4 781 299.8	249 685.0
4	205.45	4 781 214.9	249 402.8
5	210.35	4 781 158.5	248 506.8
6	212.07	4 781 149.3	248 207.0
7	210.39	4 781 131.7	247 227.1

NOTES

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

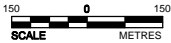
This drawing is for subsurface information only. The proposed structure details are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents

REFERENCE

DRAWINGS SUPPLIED BY DILLON CONSULTING LIMITED
CONT No 2006-3039 WP No 3322-04-00
NEW CONSTRUCTION HIGHWAY 403



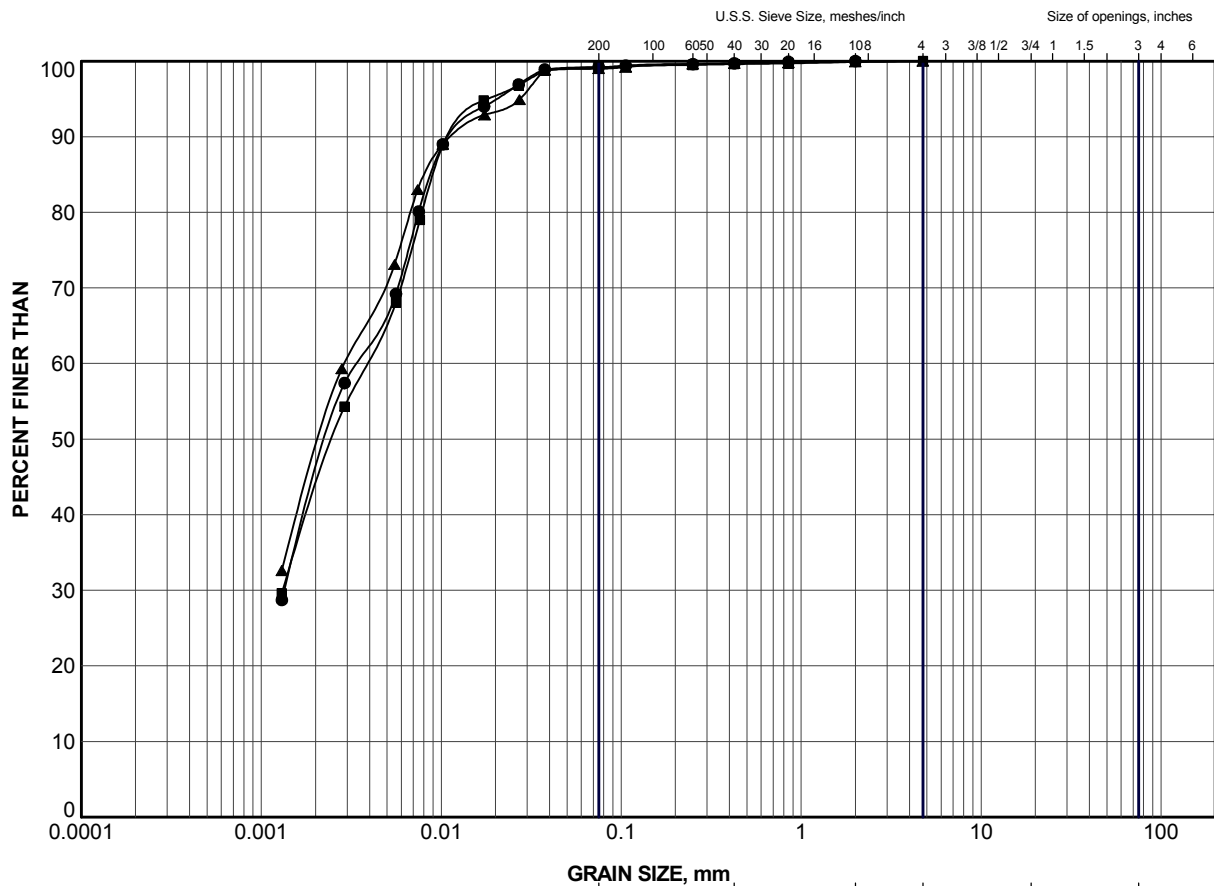
PLAN



NO.	DATE	BY	REVISION	
Geocres No. 40P1-94				
HWY. No. 403		PROJECT NO.: 06-1130-047		
SUBM'D. DUP		CHKD. DUP	DATE: MAY 01/06	
DRAWN: WDF		CHKD.	APPD.	DWG. 1

APPENDIX A


RESULTS OF LABORATORY TESTING

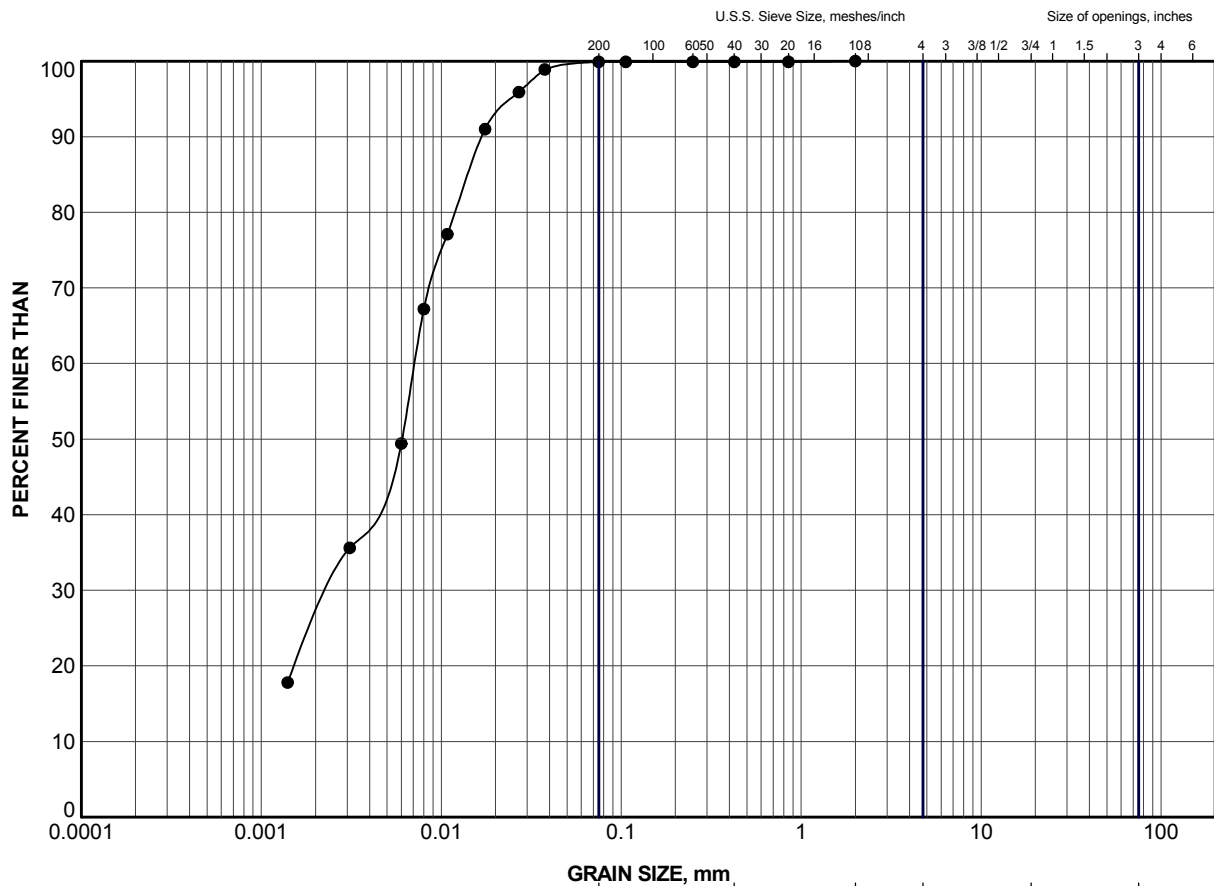


GRAVEL SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	1	3	212.1
■	2	3	206.9
▲	4	4	202.1

PROJECT				BREAKAWAY SIGNS HIGHWAY 403 GWP 3322-04-00			
TITLE				GRAIN SIZE DISTRIBUTION SILTY CLAY			
PROJECT No.		06-1130-047		FILE No.		061130047.GPJ	
DRAWN		WDF		SCALE		N/A	
CHECK				REV.			
 Golder Associates LONDON, ONTARIO				Apr 27/06 FIGURE A-1			

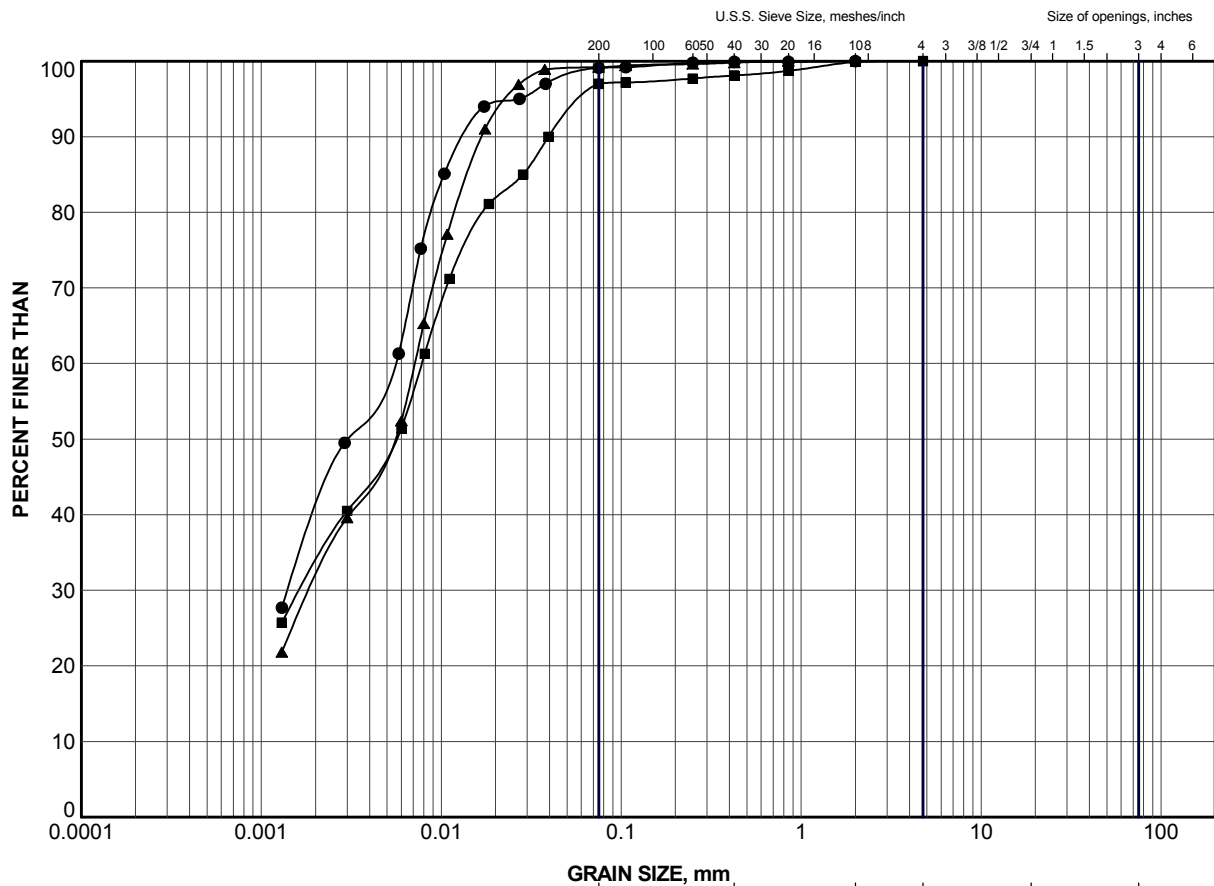


GRAVEL SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	5	4	207.0


PROJECT				BREAKAWAY SIGNS HIGHWAY 403 GWP 3322-04-00			
TITLE				GRAIN SIZE DISTRIBUTION SILT, some clay			
PROJECT No.		06-1130-047		FILE No.		061130047.GPJ	
DRAWN		WDF		SCALE		N/A	
CHECK				REV.			
Golder Associates LONDON, ONTARIO		Apr 27/06		FIGURE A-2			

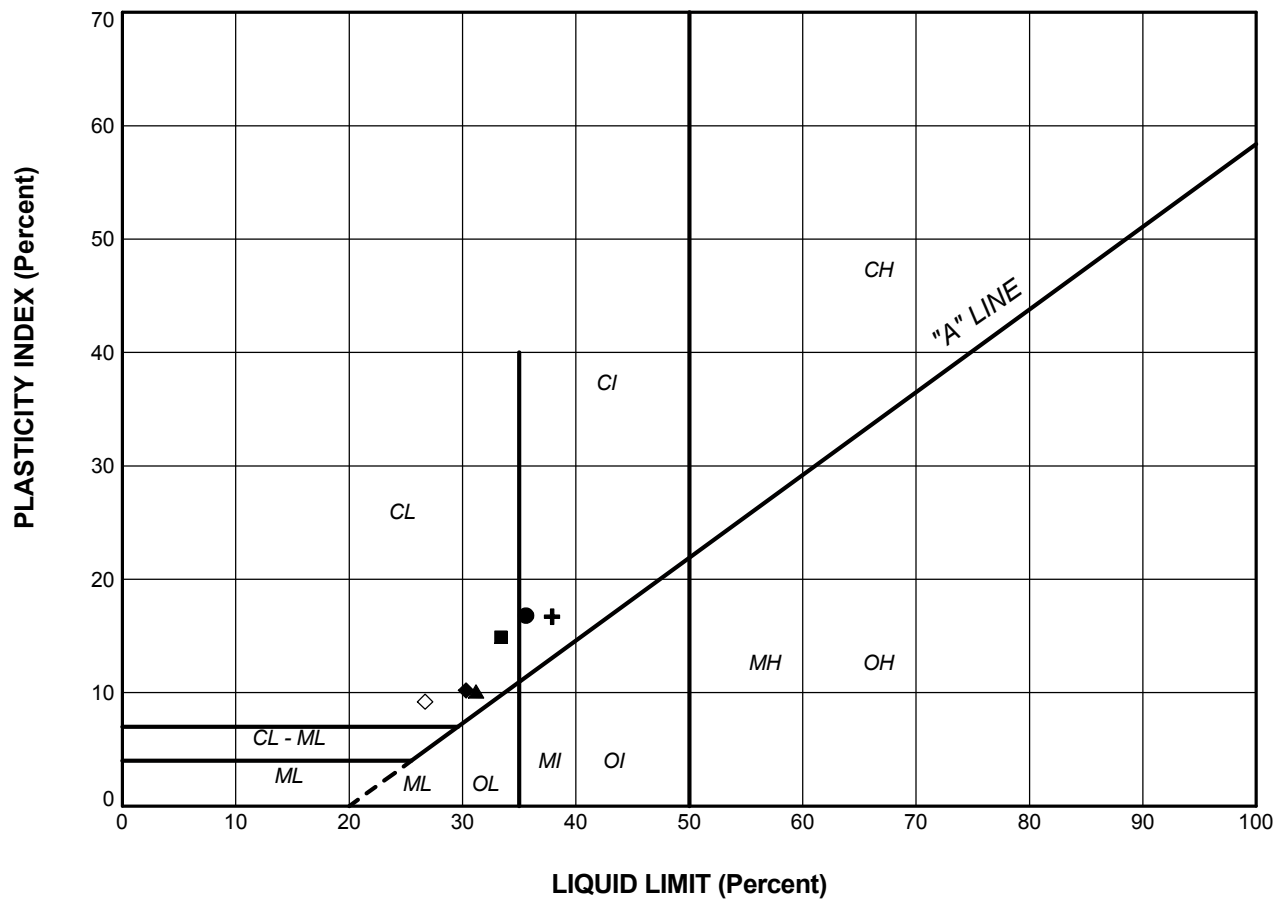


GRAVEL SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	3	4	205.3
■	6	4	208.7
▲	7	2	208.6

PROJECT		BREAKAWAY SIGNS HIGHWAY 403 GWP 3322-04-00			
TITLE		GRAIN SIZE DISTRIBUTION CLAYEY SILT			
PROJECT No.		06-1130-047		FILE No. 061130047.GPJ	
DRAWN		WDF		Apr 27/06	
CHECK					
SCALE		N/A		REV.	
 Golder Associates LONDON, ONTARIO		FIGURE A-3			



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
SILTY CLAY					
●	1	3	35.6	18.8	16.8
■	2	3	33.4	18.5	14.9
+	4	4	37.9	21.2	16.7
CLAYEY SILT					
▲	3	4	31.2	21.1	10.1
◆	6	4	30.3	20.1	10.2
◇	7	2	26.7	17.5	9.2

PROJECT		BREAKAWAY SIGNS HIGHWAY 403 GWP 3322-04-00	
TITLE		PLASTICITY CHART	
PROJECT No. 06-1130-047		FILE No. 061130047.GPJ	
DRAWN	WDF	May 01/06	SCALE N/A REV.
CHECK			
 Golder Associates LONDON, ONTARIO		FIGURE A-4	