CONTRACT NO. 2011-3003

G.W.P. 131-98-00

FOUNDATION INVESTIGATION REPORT

FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS

Ministry Of Transportation

Ontario

April 2011

FOUNDATION INVESTIGATION

Fischer-Hallman Road S-E Ramp Retaining Walls
Widening of Highway 7/8
From 1.9 km West of Fischer-Hallman Road Interchange
Easterly to 0.8 km East of Courtland Avenue Interchange
Kitchener
GWP 131-98-00
Ministry of Transportation, Ontario - West Region

Submitted to:
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REPORT

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Report Number: 08-1132-084-1-R16
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Table of Contents

1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations as part of the detail design work for GWP 131-98-00, the reconstruction and widening of Highway 7/8. This report presents the results of the foundation investigation carried out for the proposed Fischer-Hallman Road S-E ramp retaining walls located in the southeast quadrant of the Fischer-Hallman Road Interchange.

The purpose of the foundation investigation is to determine the subsurface conditions at the locations of the proposed work by drilling boreholes and carrying out in situ testing and laboratory testing on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal, Golder Associates' proposal P81-3002 dated April 8, 2008, our letters dated July 21 and 22, 2008 and our revised scope of work letter dated April 13, 2010. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated July 4, 2008.

Dillon provided Golder Associates with draft design information for the retaining walls, presented in plan and cross-section, in digital format.

2.0 SITE DESCRIPTION

2.1 General

The Highway 7/8 project area is located in the south-central portion of Kitchener, Ontario. The overall project limits extend from 1.9 kilometres (km) west of Fischer-Hallman Road easterly to 0.8 km east of Courtland Avenue. The location of the project is shown on the Key Plan, Figure 1.

This section of Highway 7/8 is currently a four lane divided highway oriented generally east-west. Overpass structures at Westmount Road, Homer Watson Boulevard, Ottawa Street South and Courtland Avenue East, one underpass structure at Fischer-Hallman Road and an overhead structure at the Canadian National Rail (CNR) tracks are situated within the project limits.

Land use adjacent to this site is typically urban residential north of Highway 7/8 with predominantly industrial, commercial, institutional and residential areas to the south.

The proposed retaining walls will extend from the following approximate limits along the Fischer-Hallman S-E Ramp: 10+076 Lt to 10+271 Lt and 10+070 Rt to 10+120 Rt. The topography in the vicinity of the retaining wall generally slopes downwards along the alignment of the ramp from Fischer-Hallman Road to Highway 7/8. The ground surface elevation along the S-E ramp ranges from about 350 metres at Fischer-Hallman Road to about 343 metres at the east end of the ramp adjacent to Highway 7/8.

2.2 Site Geology

This project lies within the physiographic region of southwestern Ontario known as the Waterloo Hills[1]. The soils generally consist of sandy hills; some consist of sandy till while others are kames or kame moraines, with outwash sands deposited in the valleys. Adjoining the sandy hills is the Grand River spillway system comprised of alluvial terraces of sand and gravel.

Based on the Ministry of Natural Resources Map P.2559 entitled “Quaternary Geology, Stratford Area, Southern Ontario”, the site lies in an area of primarily Maryhill clayey till.

The Geologic Survey of Canada Map 1263A entitled “Geology, Toronto-Windsor Area, Ontario” indicates that the subcropping bedrock in the area of site is dolomite and mudstone of the Salina formation of Upper Silurian age. Based on the Ministry of Natural Resources Map P.168 entitled “Bedrock Topography Series, Stratford, Southern Ontario”, the bedrock surface along the proposed alignment of the Fischer-Hallman S-E ramp subcrops at about elevation 259 to 265 metres or some 80 to 85 metres below ground surface.

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

3.0 INVESTIGATION PROCEDURES

The foundation investigation for this component of the project was carried out between May 12 and June 8, 2010 during which time eight (8) boreholes, numbered 805 to 812, were drilled along the Fischer-Hallman Road S-E ramp between approximately Stations 10+020 and 10+290. The borehole locations are shown on Drawing 1.

The boreholes were advanced to depths of 9.6 to 12.7 metres at or within the immediate vicinity of the proposed retaining walls.

The subsurface conditions along the ramp are presented in profile on Drawing 1.

The table below summarizes the borehole locations, ground surface elevations at the borehole locations and the borehole depths:

Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
	Northing	Easting	(m)	(m)
805	4 809 296	222 748	344.73	9.60
806	4 809 312	222 776	345.35	9.60
807	4 809 343	222 813	342.58	9.60
808	4 809 362	222 850	342.89	9.60
809	4 809 376	222 877	343.20	9.60
810	4 809 396	222 914	343.56	9.60
811	4 809 224	222 763	350.34	10.36
812	4 809 255	222 737	350.05	12.65

The drilling was carried out using track mounted CME 45 and truck mounted CME 55 power augers supplied and operated by specialist drilling contractors. In the boreholes, samples of the overburden were obtained at 0.75 and 1.5 metre intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. The samplers used in the investigations limit the maximum particle size that can be sampled and tested to about 40 millimetres. Therefore, particles or objects that may exist within the soils that are larger than this dimension will not be sampled or represented in the grain size distributions. Larger particle sizes, including cobbles and boulders, are known to be present in the glacial till deposits as discussed in the text of this report.

Groundwater conditions were observed throughout the drilling operations and a summary of the groundwater level measurements in the boreholes is provided in Section 4.2. Following completion of drilling and sampling, the boreholes were backfilled in accordance with current Ontario Ministry of Transportation (MTO) procedures and Ontario Regulation 372/07.

The field work was monitored on a full-time basis by experienced members of our engineering staff who located the boreholes in the field, monitored the drilling, sampling and in situ testing operations, logged the boreholes and surveyed the borehole locations and elevations. The samples were identified in the field, placed in labelled containers and transported to our London laboratory for further examination and testing. Index and classification tests, consisting of water content determinations, grain size distribution analyses and Atterberg limits determinations, were carried out on selected samples. The results of the testing are shown on the Record of Borehole sheets and in Appendix A.

4.0 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the in situ and laboratory testing carried out on selected samples, are given on the attached Record of Borehole sheets following the text of this report and in Appendix A. The stratigraphic boundaries shown on the Record of Borehole sheets and stratigraphic profiles are inferred from non-continuous sampling and observations of drilling resistance and may represent transitions between soil types rather than exact planes of geological change. Subsurface conditions will vary between and beyond the borehole locations.

The boreholes drilled at the site generally encountered highly variable ground conditions, ranging from surficial topsoil and / or variable layers of fill underlain by layers of clayey silt till, clayey silt, silty sand, sandy silt, sand and gravel and sand.

The borehole locations are shown on Drawing 1. The detailed subsurface conditions encountered in the boreholes are provided on the Record of Borehole sheets and are summarized below.

4.1.1 Pavements

Asphaltic concrete was encountered from the ground surface in boreholes 811 and 812. The asphalt layers were 230 and 180 millimetres thick in boreholes 811 and 812, respectively.

Granular base and subbase materials were encountered underlying the asphaltic concrete in boreholes 811 and 812. The granular roadbase layers were 0.5 and 1.2 metres in boreholes 811 and 812, respectively. It should be noted that cobbles were noted when drilling through the granular subbase in borehole 812.

4.1.2 Topsoil

Topsoil layers were encountered at the ground surface in boreholes 805 through 810. Topsoil was also encountered within and beneath the fill in borehole 811 at elevations 347.9 and 345.9 metres, respectively. The surficial topsoil layers ranged from 130 to 200 millimetres. The buried topsoil layers in borehole 811 were about 0.5 to 0.9 metres thick.

The buried topsoil layers had N values, as determined in the standard penetration testing, of 7 and 28 blows per 0.3 metres indicating a loose to compact condition. The water contents were 13 to 20 per cent. Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

4.1.3 Fill

Fill was encountered underlying pavement structure or topsoil in boreholes 806, 810, 811 and 812 from elevations 343.4 to 349.6 metres. In boreholes 806 and 810, the fill typically consisted of clayey silt. The fill in boreholes 811 and 812 generally consisted of granular fill with layers of cohesive fill. The granular fill generally consisted of sand and gravel, silt and sandy silt. The thickness of the fill ranged from 1.2 to 3.8 metres.

The granular fill was very loose to dense with N values of 2 to 48 blows per 0.3 metres and water contents ranging from 2 to 25 per cent.

The N values in the soft to hard cohesive fill were 2 to 35 blows per 0.3 metres. The water contents ranged from 11 to 13 per cent. The cohesive fill is of low plasticity based on an Atterberg limits determination carried out on a sample of clayey silt fill with a plastic limit, a liquid limit and a plasticity index of 12, 22 and 10 per cent, respectively. These data are shown on Figure A-8 in Appendix A.

The results of the grain size testing carried out on samples of the fill are presented on Figure A-1.

4.1.4 Silt

Layers of silt were encountered in borehole 811 beneath the fill and topsoil layers at elevation 345.5 metres and below a clayey silt layer at elevation 344.4 metres. The upper and lower silt layers were 0.6 and 0.8 metres thick respectively.

The upper silt layer was inferred to be loose based on the N value of 9 blows per 0.3 metres. The lower silt layer was compact with an N value of 13 blows per 0.3 metres.

4.1.5 Sandy Silt

Layers of sandy silt were encountered in boreholes 806, 808, 809, 810 and 812 between elevations 336.9 and 344.9 metres. The sandy silt layers were found underlying the fill, clayey silt and silty sand and within the clayey silt and were about 0.8 to 4.6 metres thick.

The N values for the sandy silt ranged from 10 to 50 blows per 0.3 metres. The water contents were about 7 to 16 per cent. An Atterberg limits determination carried out on a sample of the sandy silt indicated plastic and liquid limits of 13 and 17 per cent, respectively, and a plasticity index of 4 per cent indicating a silt of low plasticity. These data are provided on Figure A-8.

The results of grain size analyses conducted on samples of the sandy silt obtained during standard penetration testing are presented on Figure A-2.

4.1.6 Clayey Silt

Layers of clayey silt were encountered in boreholes 805 through 810 from elevations 334.7 to 344.9 metres. The clayey silt layers were found underlying the surficial topsoil in boreholes 805, 808 and 809, underlying the fill in boreholes 806 and 810 and underlying the lower sand in borehole 807. In boreholes 805, 808, 809 and 810, the clayey silt was interlayered with silty fine sand and sandy silt. Silty sand and sand seams were also observed in the clayey silt layers in all of the boreholes with the exception of borehole 810. The thickness of the clayey silt layers ranged from 0.5 to 5.3 metres. Boreholes 807 and 808 were terminated in the clayey silt after exploring it for 1.4 to 2.1 metres.

The firm to very stiff clayey silt had N values of 6 to 27 blows per 0.3 metres. Water contents in the clayey silt ranged from 13 to 17 per cent. The clayey silt is of low plasticity based on plastic limits, liquid limits and plasticity indices ranging from 11 to 15, 18 to 25 and 7 to 12 per cent, respectively. These data are provided on Figure A-8.

The results of the grain size testing conducted on selected clayey silt samples obtained during the standard penetration testing are presented on Figure A-3.

4.1.7 Clayey Silt Till

Clayey silt till was encountered in borehole 811 beneath layers of silt and clayey silt at elevation 343.6 metres.

The very stiff clayey silt till had N values of 15 to 17 blows per 0.3 metres. A water content of 14 per cent was measured for a sample of the clayey silt till. The Atterberg limits testing indicated that the clayey silt till is of low plasticity. The plastic limit, liquid limit and plasticity index for a clayey silt till sample were 13, 21 and 9 per cent, respectively. These data are shown on Figure A-8.

The results of the grain size testing conducted on a sample of the clayey silt till obtained during standard penetration testing is presented on Figure A-4. Although not specifically encountered in the boreholes, cobbles and boulders should be anticipated in the clayey silt till.

4.1.8 Sand and Gravel

A 2.0 metre thick layer of dense sand and gravel was encountered beneath the sandy silt in borehole 812 at elevation 343.0 metres. Cobbles were noted during drilling in the sand and gravel.

The sand and gravel had an N value 43 blows per 0.3 metres and water content of 3 per cent. A grain size distribution curve for a sand and gravel sample recovered from the standard penetration testing is presented on Figure A-5.

4.1.9 Silty Sand

Layers of loose to very dense silty sand and silty fine sand were encountered in boreholes 805, 806, 807, 808, 809 and 812 from elevations 337.1 to 342.5 metres. The silty sand was encountered underlying topsoil, clayey silt, sandy silt and sand and gravel. In boreholes 805, 807 and 808, the silty sand was interlayered with clayey silt and sand layers. Where fully penetrated, the silty sand layers were 0.4 to 2.8 metres thick. Boreholes 805, 806, 809 and 812 were terminated in the silty sand after exploring it for 1.4 to 5.2 metres.

The silty sand had N values of 5 to 59 blows per 0.3 metres with water contents of 5 to 17 per cent.

The results of grain size testing conducted on samples of the silty sand obtained during standard penetration testing are presented on Figure A-6.

4.1.10 Sandy Silt Till

Sandy silt till was encountered beneath clayey silt till at elevation 340.6 metres in borehole 811. This borehole was terminated in sandy silt till after exploring it for some 0.6 metres.

The sandy silt till was compact with an N value of 12 blows per 0.3 metres.

4.1.11 Sand

Layers of compact to dense sand were found within or underlying sandy silt and silty sand layers in boreholes 807 and 810 at elevations 339.7 and 334.6 metres, respectively. The sand layers in borehole 807 were 1.7 and 0.8 metres thick. Borehole 810 was terminated in sand after exploring it for 0.6 metres.

N values in the sand layers ranged from 26 to 37 blows per 0.3 metres with a water content of 18 per cent. A grain size distribution curve for a sample of the sand obtained during standard penetration testing is presented on Figure A-7.

4.2 Groundwater Conditions

The groundwater conditions in the boreholes were observed during and upon completion of drilling. The groundwater conditions are noted on the Record of Borehole sheets and are summarized in the following text and table.

Borehole	Ground Surface Elevation	Encountered Groundwater Level	
		Depth	Elevation
	(m)	(m)	(m)
805	344.73	Dry	Below 335.5
806	345.35	Dry	Below 336.0
807	342.58	2.9	339.7
808	342.89	3.3	339.6
809	343.20	Dry	Below 334.0
810	343.56	Dry	-
811	350.34	5.1	345.2
812	350.05	Dry	Below 337.5

During the field work, groundwater was encountered between elevation 339.6 and 345.2 metres in boreholes 807, 808 and 811. The remaining boreholes were dry. Of the dry boreholes, grey soils were intercepted only in borehole 810.

Groundwater levels along the Fischer-Hallman Road S-E Ramp alignment are variable. The inferred groundwater levels at the site are as follows:

- Station 10+000 to 10+040 Fischer-Hallman Road S-E Ramp – below elevation 345 metres
- Station 10+040 to 10+150 Fischer-Hallman Road S-E Ramp – below elevation 336 metres
- Station 10+150 to 10+225 Fischer-Hallman Road S-E Ramp – elevation 340 metres
- Station 10+225 to 10+300 Fischer-Hallman Road S-E Ramp – below elevation 334 metres

The inferred groundwater levels are based on the encountered groundwater levels and the colour change from brown to grey.

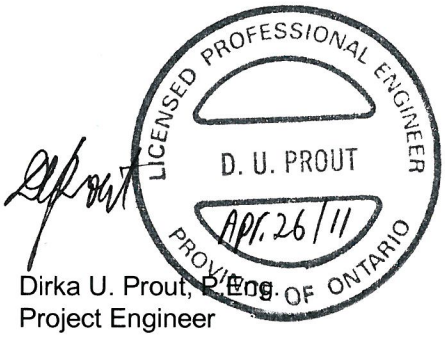
The above noted groundwater levels are not necessarily considered to be representative of the long-term, stabilized groundwater conditions as the readings were taken for a short duration only. The groundwater levels are expected to fluctuate due to climatic and seasonal variations.

5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Aardvark Drilling Ltd., who is an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Mathew Riopelle and Mr. Matthew Rhody under the direction of Mr. David J. Mitchell.

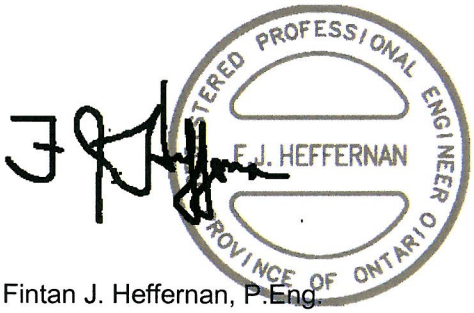
The laboratory testing was carried out at Golder Associates' London laboratory under the direction of Mr. Chris M. Sewell. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing Types C and D aggregates. This report was prepared by the Project Engineer, Ms. Dirka U. Prout, P.Eng., under the direction of the Team Leader, Mr. Philip R. Bedell, P.Eng. This report was reviewed by Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

GOLDER ASSOCIATES LTD.



Dirka U. Prout, P.Eng.
Project Engineer

Philip R. Bedell, P.Eng.
Senior Consultant



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

DUP/PRB/FJH/cr/ly

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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

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.)

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, 60º 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 cm^2 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.

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

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
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

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
v	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 = σ'_p/σ'_{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 δ
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)

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 805

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809296.0 ;E 222748.0
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 12, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
344.73	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.18	Black CLAYEY SILT, trace sand, trace gravel, with silty sand seams Firm to very stiff Brown		1	SS	6		344				
			2	SS	14		343				
			3	SS	16		342				0 15 60 25
			4	SS	15						
			5	SS	8		341				
340.16											
4.57	SILTY FINE SAND, trace gravel Loose Brown		6	SS	5		340				
339.70											
5.03	CLAYEY SILT, trace gravel, with sand seams Stiff Brown		7	SS	11		339				0 48 38 14
338.79											
5.94	SILTY FINE SAND, trace clay Loose to compact Brown		8	SS	8		338				
337.64			9	SS	15						
7.09	CLAYEY SILT Very stiff Brown to grey										
7.32	SILTY SAND, trace clay Dense to very dense Brown		10	SS	34		337				0 54 40 6
			11	SS	38		336				
335.13			12	SS	59						
9.60	END OF BOREHOLE Borehole dry during drilling on May 12, 2010.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

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London, Ontario

RECORD OF BOREHOLE No 806

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
LOCATION N 4809312.0 ;E 222776.0
ORIGINATED BY MR
DIST HWY 7/8
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
COMPILED BY WDF/LMK
DATUM GEODETIC
DATE May 12, 2010
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
345.35	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.15	Black FILL, silt, some sand, trace clay, with topsoil Very Loose Brown		1	SS	2		345		○ at w		
343.98											
1.37	FILL, clayey silt, some sand, with topsoil Firm Brown		2	SS	6		344		w_P – ○ – w_L		0 32 48 20
343.22											
2.13	CLAYEY SILT, some sand, trace gravel, with sand seams Stiff to very stiff Brown		3	SS	14		343				
			4	SS	24		342				
			5	SS	11				w_P – ○ – w_L		0 22 56 22
			6	SS	11		341				
			7	SS	18		340				
			8	SS	16		339		○ at w		1 29 51 19
			9	SS	14						
337.88							338				
7.47	SANDY SILT Dense Brown		10	SS	50				○ at w_P		0 41 52 7
337.12											
8.23	SILTY FINE SAND Dense to very dense Brown		11	SS	49		337				
			12	SS	53		336				
335.75											
9.60	END OF BOREHOLE Borehole dry during drilling on May 12, 2010.										

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

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 807

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809343.0 ;E 222813.0
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 12, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
342.58	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.13	Black SILTY FINE SAND, trace to some clay, trace gravel Dense Brown		1	SS	32		342				
			2	SS	32		341		○		0 59 31 10
			3	SS	36		340				
339.68						▽					
2.90	SAND, some silt, trace clay Compact Brown		4	SS	26		339				
			5	SS	26				○		0 86 11 3
338.01							338				
4.57	SILTY FINE SAND, trace to some clay Compact Brown		6	SS	25						
			7	SS	22		337				
			8	SS	25				○		0 61 29 10
335.87							336				
6.71	SAND, fine to medium, trace silt Compact Brown		9	SS	28						
335.11							335				
7.47	CLAYEY SILT, with silty sand seams Very stiff Grey		10	SS	21						
			11	SS	21		334				
332.98			12	SS	24		333				
9.60	END OF BOREHOLE Groundwater encountered at about elev. 339.7m during drilling on May 12, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 808

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809361.5 ;E 222849.5
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 17, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
342.89	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.20	Black CLAYEY SILT, some sand, trace gravel, with silty sand layers Very stiff Brown turning grey at about elev. 339.8m		1	SS	17		342				
			2	SS	15		341				
			3	SS	18						0 27 53 20
339.63			4	SS	26	▽	340				
3.26	SILTY SAND										
339.23	Compact Brown										
3.66	SANDY SILT, some clay, trace gravel Compact Grey		5	SS	10		339				
			6	SS	22		338				1 27 58 14
			7	SS	28						
			8	SS	21		337				
			9	SS	26		336				
			10	SS	19		335				
334.66											
8.23	CLAYEY SILT, trace silty sand seams, trace gravel Stiff to very stiff Grey		11	SS	11		334				
333.29			12	SS	17						
9.60	END OF BOREHOLE Groundwater encountered at about elev. 339.6m during drilling on May 17, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 809

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809375.5 ;E 222877.0
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 17, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
343.20	GROUND SURFACE										
0.00	TOPSOIL, silty						343				
0.15	Black CLAYEY SILT, with sand seams, trace gravel Stiff to very stiff Brown		1	SS	13						
							342				
			2	SS	23				⊖		0 17 54 29
341.07											
2.13	SANDY SILT, trace clay, trace gravel Compact Brown		3	SS	17		341				
			4	SS	11		340				
339.54											
3.66	CLAYEY SILT, with sand seams, trace gravel Very stiff Brown		5	SS	27						
338.78							339				
4.42	SILTY FINE SAND, trace gravel, trace clay Compact to dense Brown		6	SS	34				○		1 60 39 0
			7	SS	29		338				
			8	SS	30		337				
			9	SS	32				○		0 60 37 3
			10	SS	38		336				
			11	SS	35		335				
			12	SS	32		334				
333.60											
9.60	END OF BOREHOLE Borehole dry during drilling on May 17, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 810

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809396.0 ;E 222913.5
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE May 17, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
343.56	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.18	Black FILL, clayey silt, with topsoil, trace gravel Stiff Brown and black		1	SS	8		343				
342.19											
1.37	CLAYEY SILT, some sand, trace gravel Stiff to very stiff Brown		2	SS	12		342		○		1 11 63 25
			3	SS	16		341				
340.66											
2.90	SANDY SILT, some clay, trace gravel Compact Brown		4	SS	14		340				
			5	SS	19						
			6	SS	16		339		○		1 36 49 14
338.38											
5.18	CLAYEY SILT, trace sand, trace gravel Very stiff Grey		7	SS	19		338				
			8	SS	17		337				
336.85											
6.71	SANDY SILT, trace to some clay, trace gravel Compact Brown		9	SS	19				○		2 32 53 13
			10	SS	13		336				
			11	SS	10		335				
334.57											
8.99	SAND, fine to medium, trace silt Dense Brown		12	SS	37						
333.96							334				
9.60	END OF BOREHOLE Borehole dry during drilling on May 17, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 811

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST HWY 7/8
DATUM GEODETIC

LOCATION N 4809223.6 ;E 222763.0
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE June 2, 2010

ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
350.34	ROAD SURFACE										
0.00	ASPHALT						350				
0.23	FILL, sand and gravel, crushed										
0.40 / 349.61	Brown										
	FILL, sand and gravel										
0.73	Brown		1	SS	35						
	FILL, clayey silt, some sand, trace gravel						349				
348.97											
1.37	Hard										
	Brown		2	SS	48						
	FILL, sand and gravel, some silt										
348.21	Dense										
2.13 / 347.90	Brown						348				
	FILL, clayey silt, trace sand		3	SS	7						
2.44	Firm										
	Brown										
	TOPSOIL, silty										
	Loose to compact		4	SS	28						
346.99	Brown						347				
3.35	FILL, sand and gravel, some silt, trace clay										
	Loose to compact		5	SS	9						45 29 19 7
345.92											
4.42	TOPSOIL, silty						346				
	Loose		6	SS	9						
345.46	Brown and black										
4.88	SILT, some sand, trace clay					▽					
	Loose						345				
344.85	Brown and grey		7	SS	8						
5.49	CLAYEY SILT, trace sand										
344.40	Stiff										
5.94	Brown and grey						344				
	SILT, some clay, trace sand		8	SS	13						
	Compact										
343.63	Brown										
6.71	CLAYEY SILT TILL, some sand, trace gravel		9	SS	15		343				1 18 57 24
	Very stiff										
	Grey		10	SS	16						
							342				
			11	SS	17						
			12	SS	15		341				
340.59											
9.75	SANDY SILT TILL, some clay, trace gravel		13	SS	12						
	Compact										
339.98	Grey						340				
10.36	END OF BOREHOLE										
	Groundwater encountered at about elev. 345.2m during drilling on June 2, 2010.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 812

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00
DIST _____ HWY 7/8
DATUM GEODETIC

LOCATION N 4809254.8 ;E 222736.6
BOREHOLE TYPE POWER AUGER / HOLLOW STEM
DATE June 8, 2010

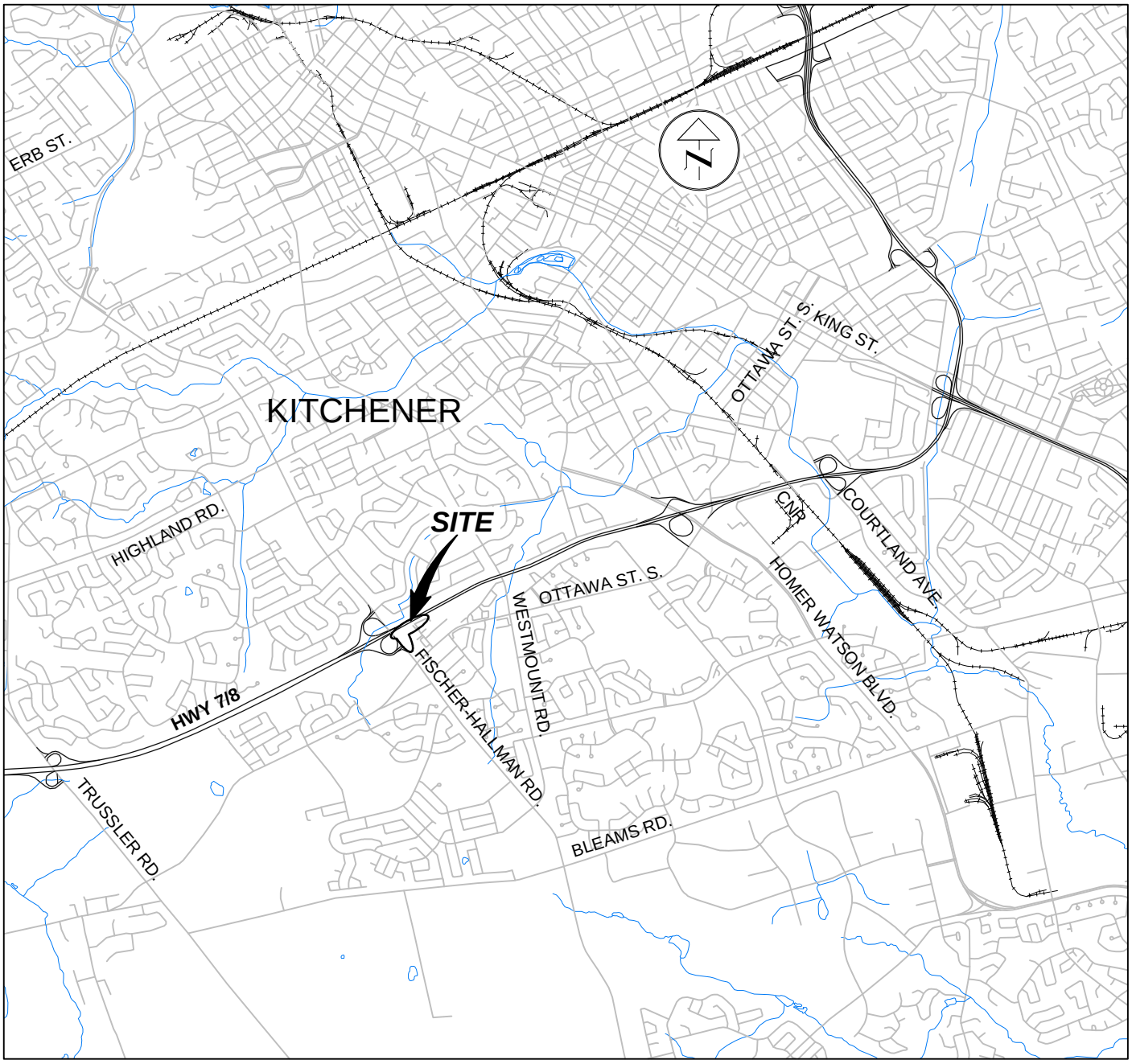
ORIGINATED BY MR
COMPILED BY WDF/LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
350.05	ROAD SURFACE						350				
0.00	ASPHALT										
0.18	FILL, sand and gravel, crushed										
0.38	Brown FILL, sand and gravel, some silt with cobbles Dense Brown		1	SS	31		349		○		
348.68											
1.37	FILL, sandy silt, trace to some clay, trace gravel, with topsoil layers at about elev. 346.1m Loose to compact Brown		2	SS	19		348		○		
			3	SS	8				○		
			4	SS	11		347		○		4 28 51 17
			5	SS	14		346		○		
			6	SS	9				○		
344.87							345				
5.18	SANDY SILT, trace clay Compact Brown		7	SS	15				○		
			8	SS	18		344		○		
343.04							343				
7.01	SAND AND GRAVEL, with cobbles, trace silt, trace clay Dense Brown		9	SS	43		342		○		42 48 7 3
341.06											
8.99	SILTY FINE SAND, trace clay, trace gravel Compact to dense Brown		10	SS	19		341				
			11	SS	32		340		○		1 58 36 5
							339				
337.40			12	SS	42		338				
12.65	END OF BOREHOLE Borehole dry during drilling on June 8, 2010.										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 26/01/11



SCALE IN METRES

0 1000 2000

1:50000

REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2005.4.

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE

KEY PLAN

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-084-1		FILE No.	0811320841-F16001
			SCALE	AS SHOWN REV.
CADD	WF/AG/LK	Feb. 18/11		
CHECK				

FIGURE 1

Drawing file: 0811320841-F16001.DWG Feb 18, 2011 - 2:30pm

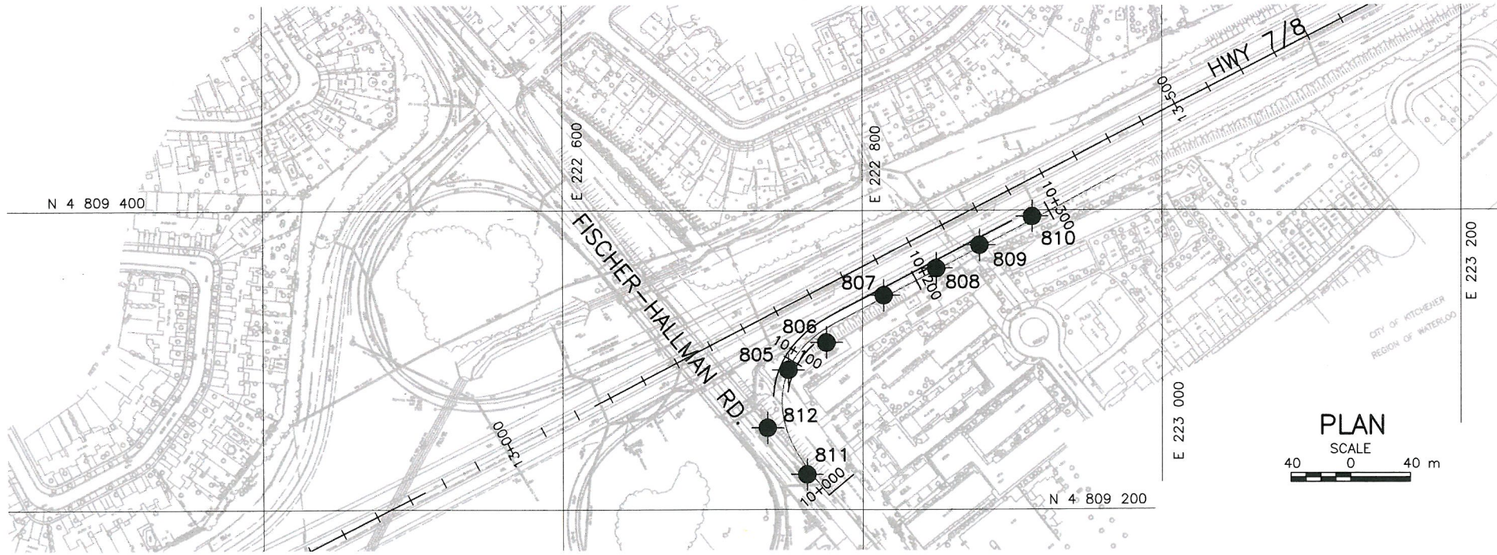
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 131-98-00

SHEET

FISCHER-HALLMAN ROAD, S-E RAMP/RETAINING WALLS
WIDENING OF HIGHWAY 7/8
BOREHOLE LOCATIONS AND SOIL STRATA

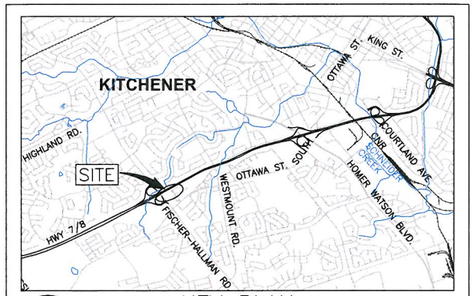
Golder Associates Ltd.
LONDON, ONTARIO, CANADA



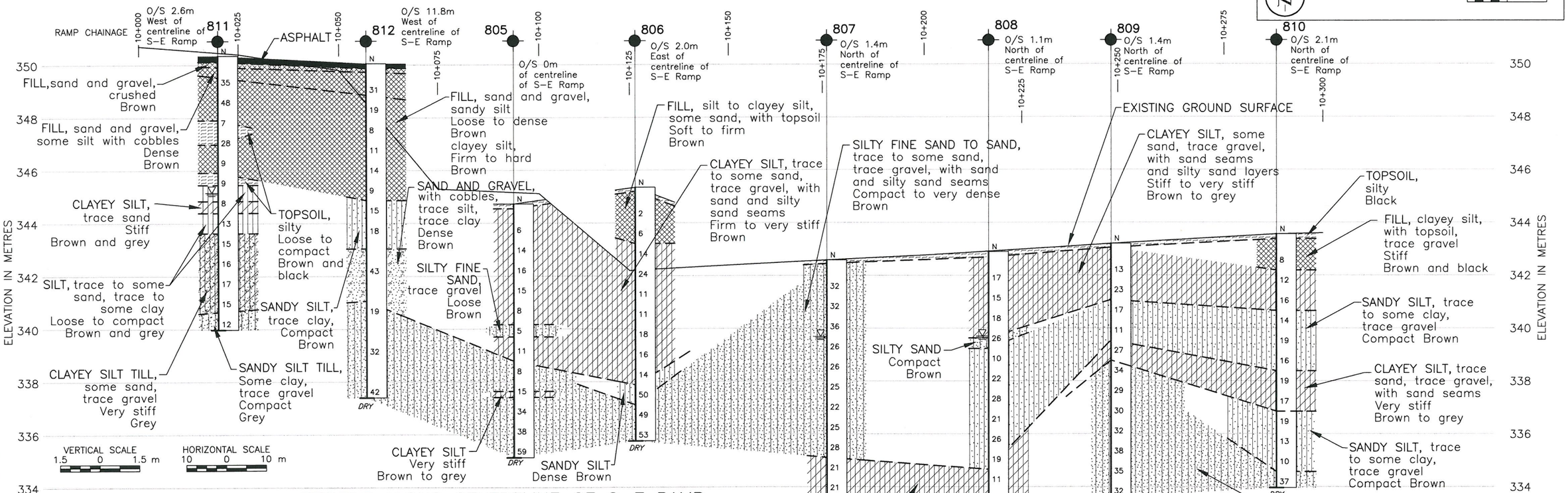
PLAN
SCALE
40 0 40 m

LICENSED PROFESSIONAL ENGINEER
D.U. PROUT
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
F.J. HEFFERNAN
PROVINCE OF ONTARIO



KEY PLAN
SCALE IN KILOMETRES 0 1 2



PROFILE ALONG CENTRELINE OF S-E RAMP

LEGEND

●	Borehole – Current Investigation
N	Standard Penetration Test Value
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
▽	WL encountered during drilling
DRY	Borehole dry during drilling

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10) NORTHING	EASTING
805	344.73	4 809 296.0	222 748.0
806	345.35	4 809 312.0	222 776.0
807	342.58	4 809 343.0	222 813.0
808	342.89	4 809 361.5	222 849.5
809	343.20	4 809 375.5	222 877.0
810	343.56	4 809 396.0	222 913.5
811	350.34	4 809 223.6	222 763.0
812	350.05	4 809 254.8	222 736.6

NOTES

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

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

Stratigraphy has been simplified for clarity. Please refer to Record of Boreholes for further details.

REFERENCE

Base plans provided in digital format by Dillon Consulting Limited.

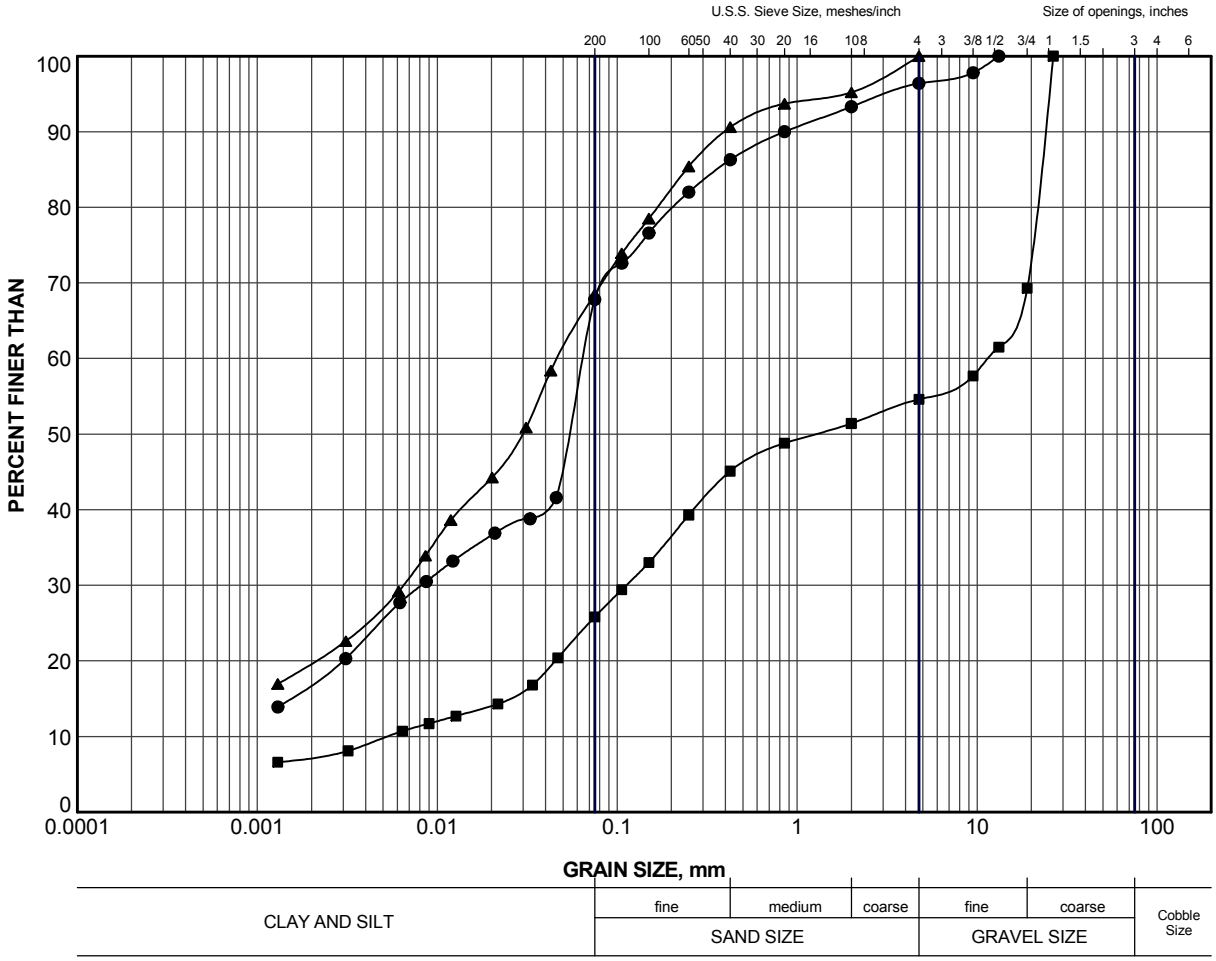
NO.	DATE	BY	REVISION

Geocres No. 40P7-62

HWY. 7/8	PROJECT NO. 08-1132-084-1		DIST.
SUBM'D. ML	CHKD.	DATE: Feb. 18/11	SITE:
DRAWN: WF/LK/AG	CHKD.	APPD.	DWG. 1

APPENDIX A

Laboratory Test Data



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
NON-COHESIVE			
■	811	5	346.3
●	812	4	346.8
COHESIVE			
▲	806	2	343.6

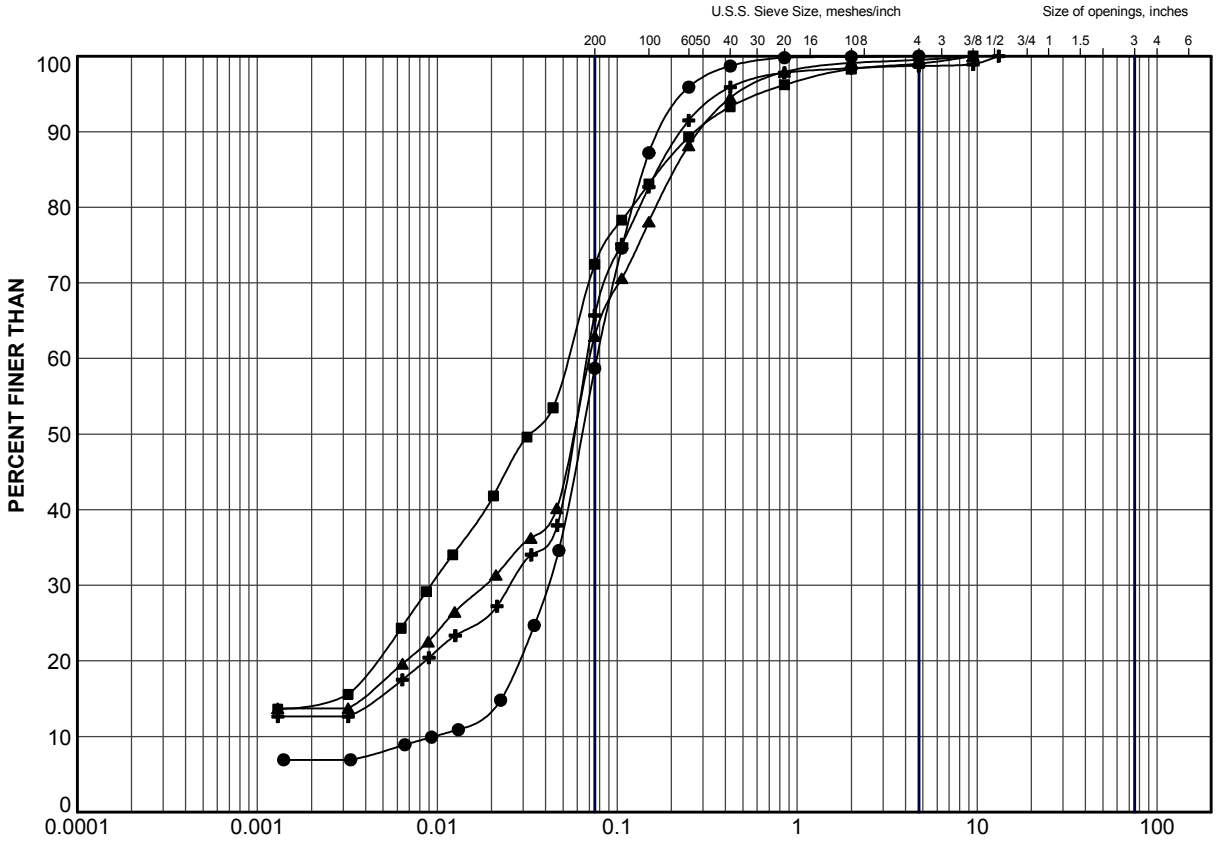
PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE
GRAIN SIZE DISTRIBUTION
FILL

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-084-1		FILE No.	0811320841-F160A1
			SCALE	N/A REV.
DRAWN	LMK	Feb. 18/11		
CHECK			**FIGURE A-1**	

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	806	10	337.5
■	808	6	338.1
▲	810	6	338.8
✚	810	9	336.5

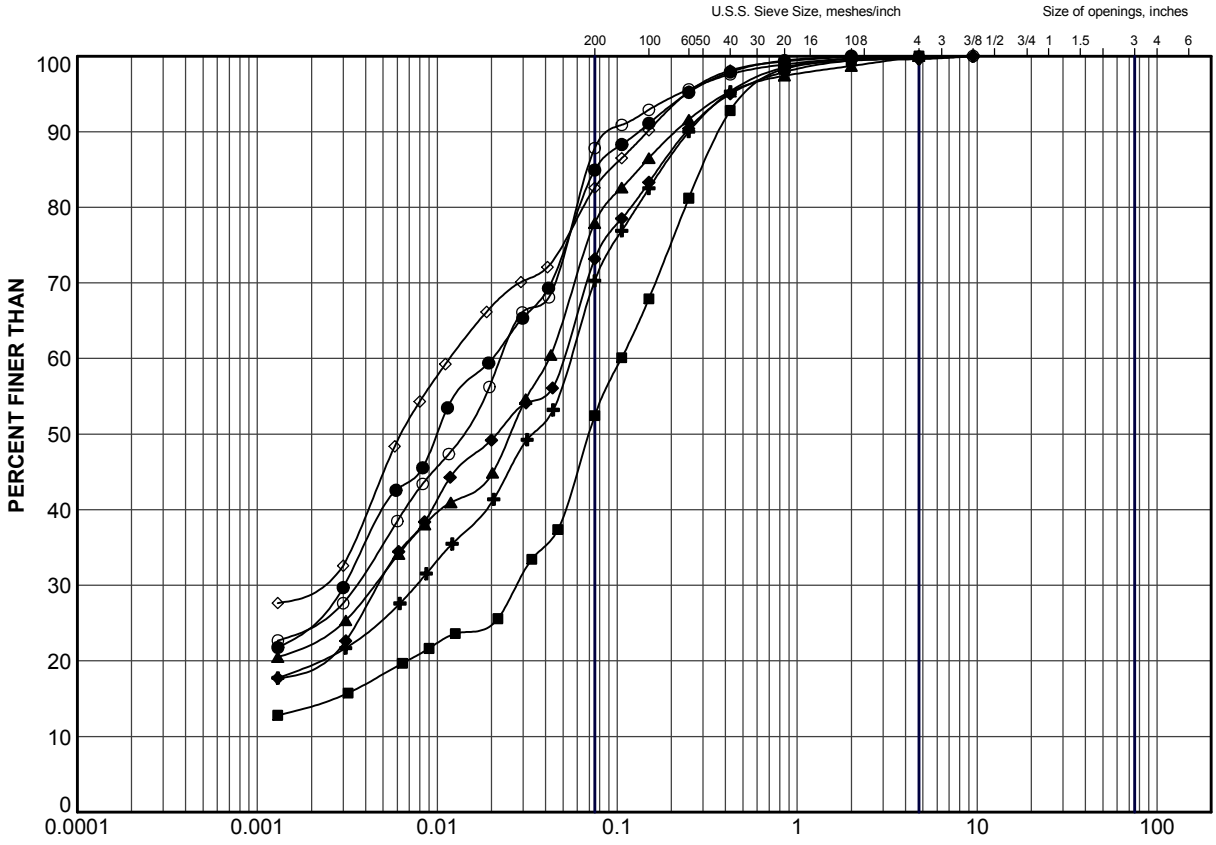
PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE
GRAIN SIZE DISTRIBUTION
SANDY SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F160A2
			SCALE	N/A
DRAWN	AG/LMK	Feb. 18/11	REV.	
CHECK			**FIGURE**	**A-2**

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	805	3	342.2
■	805	7	339.2
▲	806	5	341.3
✚	806	8	339.0
◆	808	3	340.4
◇	809	2	341.5
○	810	2	341.8

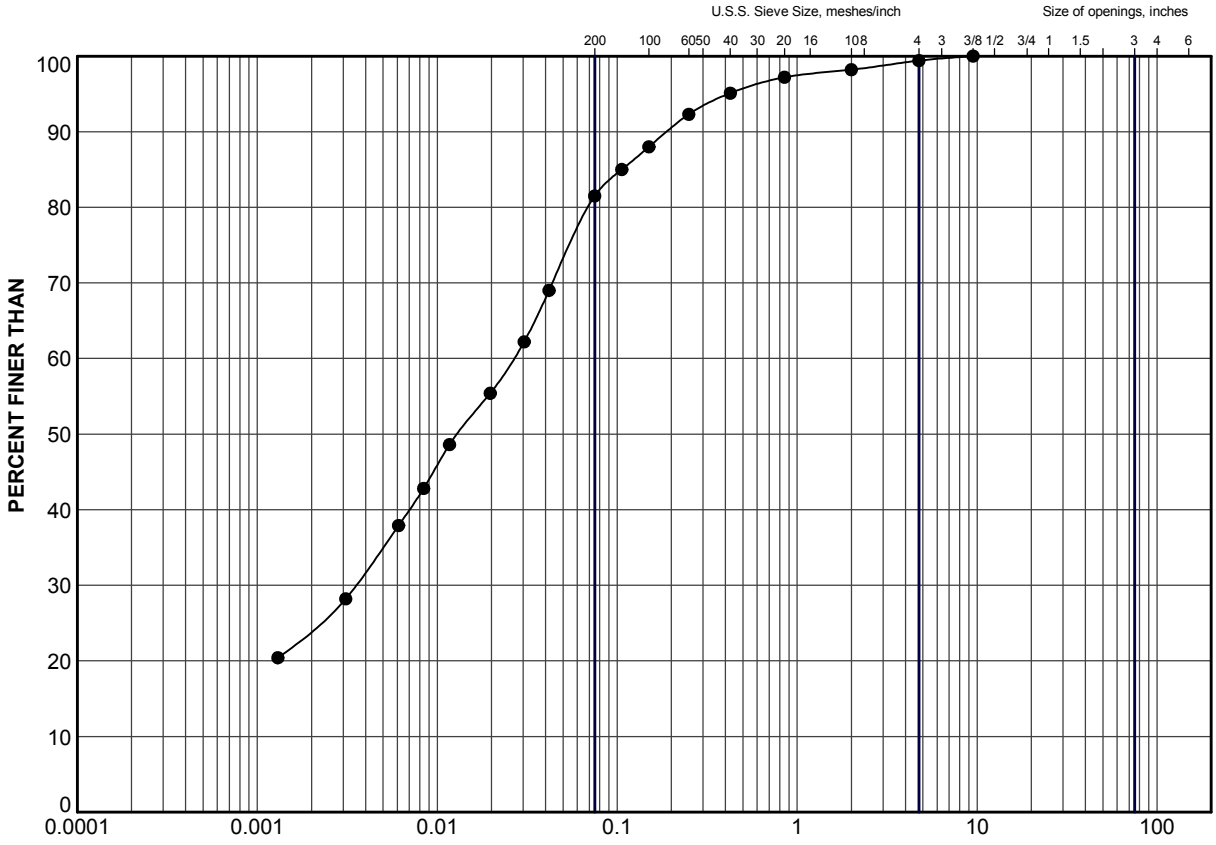
PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE
GRAIN SIZE DISTRIBUTION
CLAYEY SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F160A3
			SCALE	N/A REV.
DRAWN	AG/LMK	Feb. 18/11		
CHECK			**FIGURE A-3**	

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	811	9	343.3

PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

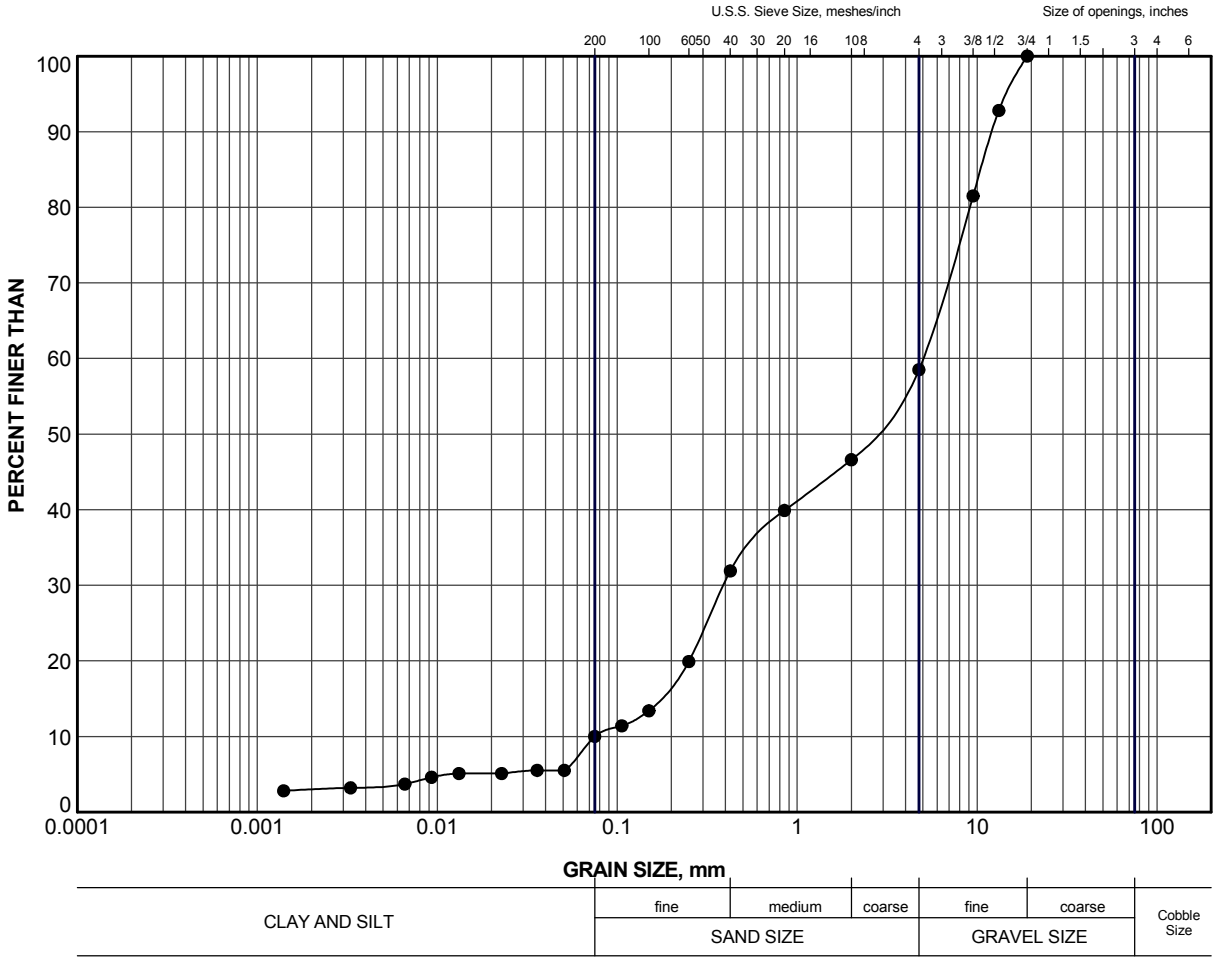
TITLE
GRAIN SIZE DISTRIBUTION
CLAYEY SILT TILL

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F160A4
			SCALE	N/A
DRAWN	LK/AG	Feb. 18/11	REV.	
CHECK				

FIGURE A-4

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	812	9	342.2

PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

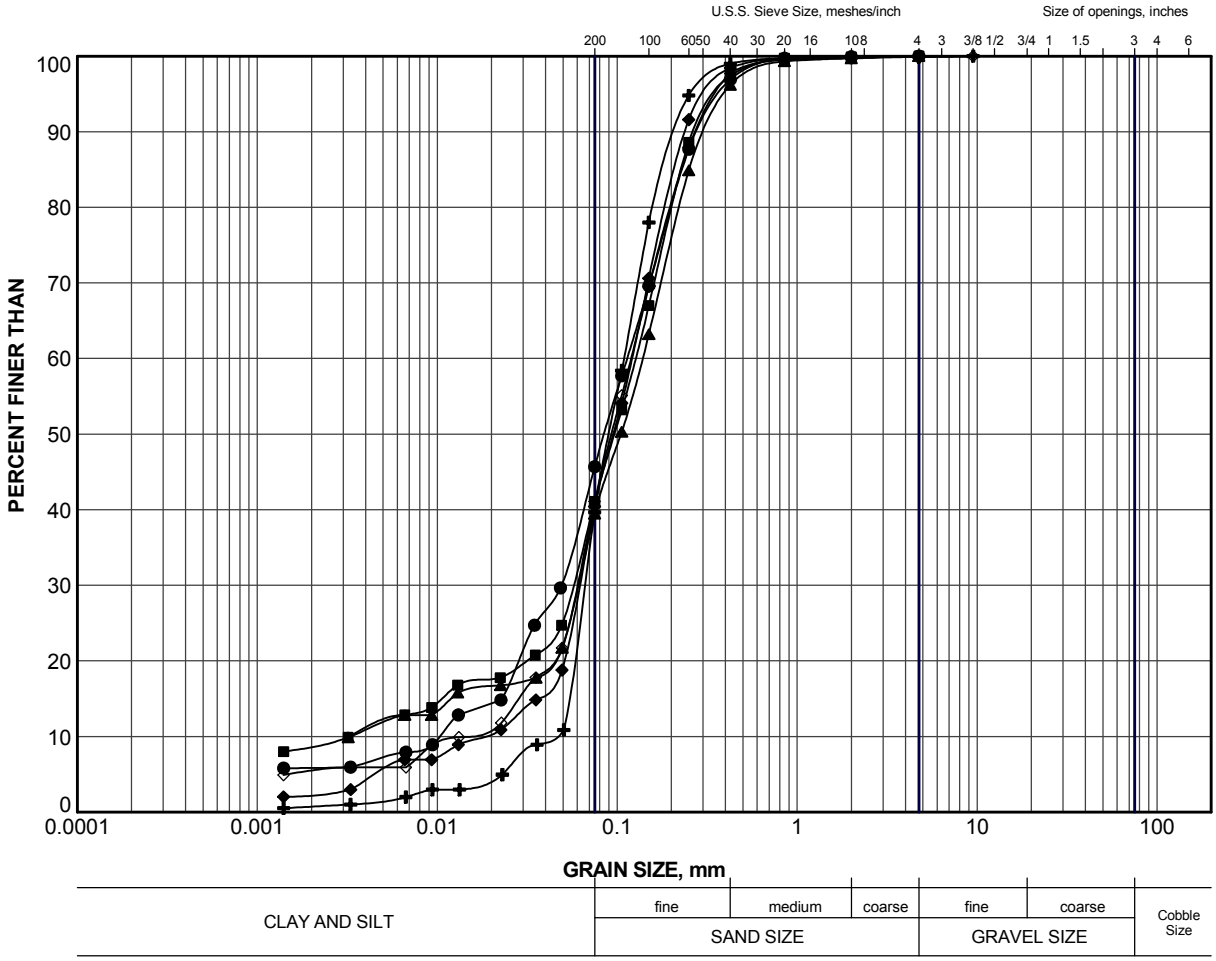
TITLE
GRAIN SIZE DISTRIBUTION
SAND AND GRAVEL

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F160A5
			SCALE	N/A
DRAWN	LK/AG	Feb. 18/11	REV.	
CHECK				

FIGURE A-5

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	805	10	336.9
■	807	2	340.8
▲	807	8	336.3
✚	809	6	338.4
◆	809	9	336.1
◇	812	11	339.2

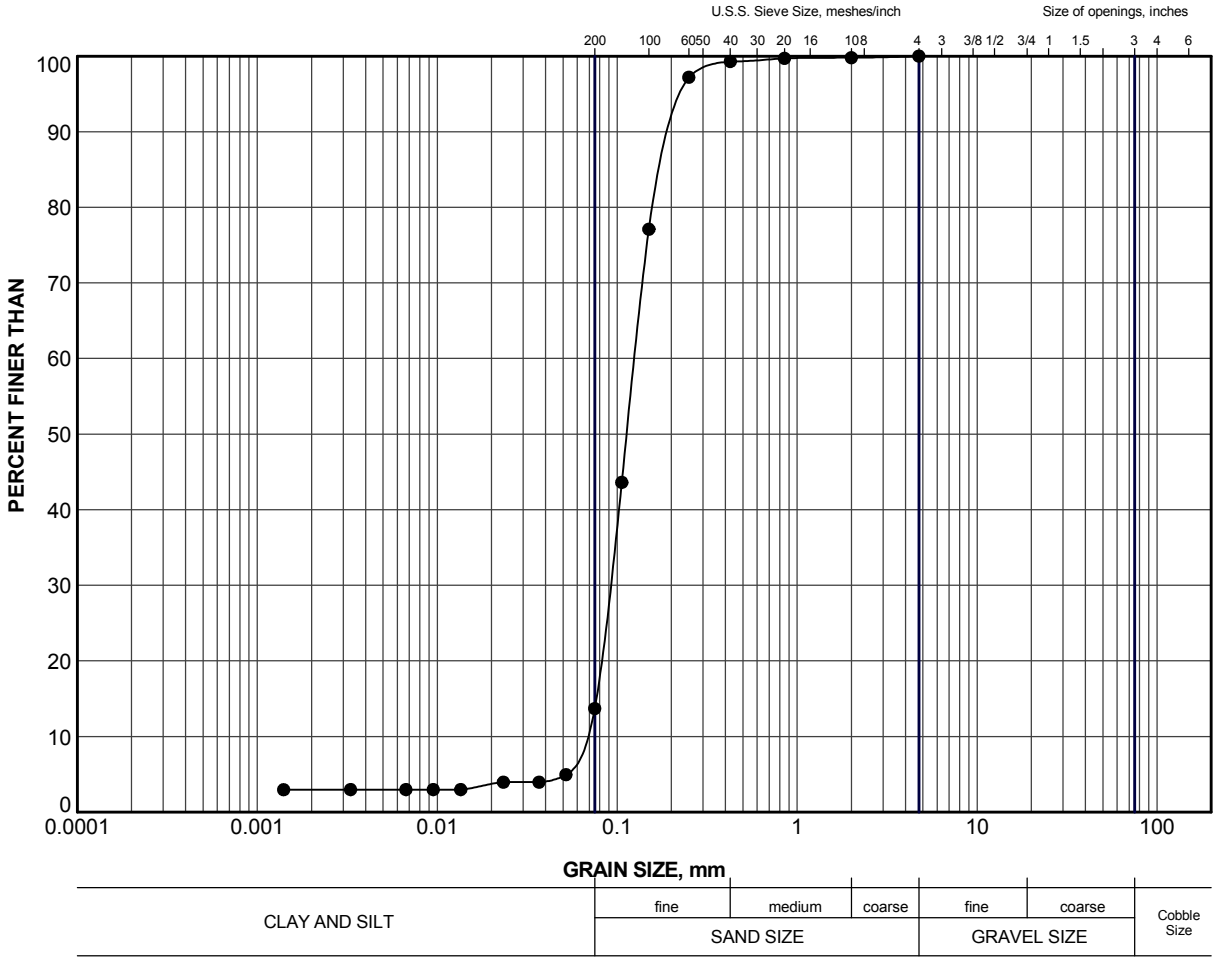
PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE
GRAIN SIZE DISTRIBUTION
SILTY SAND

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-084-1		FILE No.	0811320841-F160A6
			SCALE	N/A REV.
DRAWN	AG/LMK	Feb. 18/11		
CHECK			**FIGURE A-6**	

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	807	5	338.5

PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

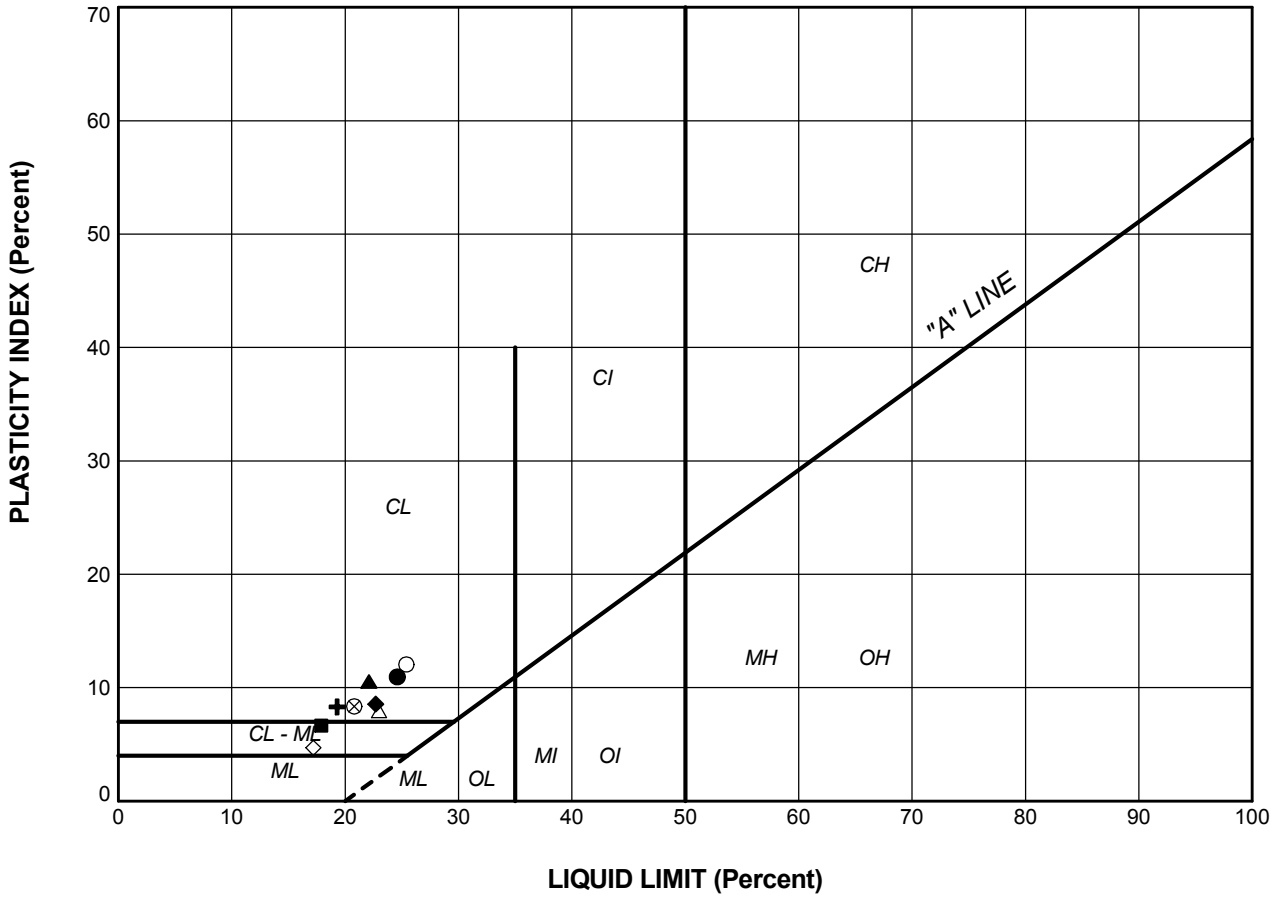
TITLE
GRAIN SIZE DISTRIBUTION
SAND

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-084-1	FILE No.	0811320841-F160A7
			SCALE	N/A
DRAWN	AG/LMK	Feb. 18/11	REV.	
CHECK				

FIGURE A-7

LDN_MTO_NEW GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
FILL-COHESIVE					
▲	806	2	22.1	11.6	10.6
CLAYEY SILT TILL					
⊗	811	9	20.8	12.5	8.4
CLAYEY SILT					
●	805	3	24.6	13.7	11.0
■	805	7	17.9	11.3	6.7
✚	806	5	19.3	11.0	8.3
◆	808	3	22.7	14.2	8.6
○	809	2	25.4	13.4	12.1
△	810	2	23.0	15.1	8.0
SANDY SILT					
◇	808	7	17.2	12.5	4.7

PROJECT
FISCHER-HALLMAN ROAD S-E RAMP RETAINING WALLS
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE
PLASTICITY CHART

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-084-1		FILE No.	0811320841-F160A8	
			SCALE	N/A	REV.
DRAWN	LMK	Feb. 18/11			
CHECK			**FIGURE A-8**		

MTO_PI GLDR_LDN.GDT

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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