



December 2011

FOUNDATION INVESTIGATION AND DESIGN REPORT

Triage Canopy
Putnam South Commercial Vehicle Inspection Facility
GWP 4100-04-00

Submitted to:

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REPORT



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Table of Contents

PART A - FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	2
2.1 Site Geology	2
3.0 INVESTIGATION PROCEDURES	3
4.0 SUBSURFACE CONDITIONS.....	4
4.1 General.....	4
4.2 Soil Conditions.....	4
4.2.1 Topsoil	4
4.2.2 Clayey Silt Till	4
4.2.3 Silt.....	5
4.2.4 Sandy Silt Till	5
4.2.5 Sand.....	5
4.3 Groundwater Conditions	5
5.0 MISCELLANEOUS	6

PART B - FOUNDATION DESIGN REPORT

6.0 ENGINEERING RECOMMENDATIONS.....	7
6.1 General.....	7
6.2 Foundations.....	7
6.2.1 Engineered Fill	8
6.3 Resistance to Lateral Loads	8
6.3.1 Spread Footings.....	8
6.3.2 Caissons	8
6.4 Slab-on-Grade	9
6.5 Excavations	9
6.6 Groundwater.....	9
7.0 MISCELLANEOUS	11



FOUNDATION INVESTIGATION AND DESIGN REPORT TRIAGE CANOPY, GWP 4100-04-00

LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORD OF BOREHOLE SHEETS

FIGURE 1 - Key Plan

DRAWING 1 - Borehole Locations and Soil Strata

APPENDICES

APPENDIX A

Laboratory Test Data



PART A
FOUNDATION INVESTIGATION REPORT
TRIAGE CANOPY
PUTNAM SOUTH CVIF
GWP 4100-04-00



1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of Coco Paving Inc. to carry out foundation investigations as part of the design-build work for GWP 4100-04-00. The project consists of the detail design and construction of the new Commercial Vehicle Inspection Facilities (CVIF) at the Putnam north and south sites. This report addresses the new triage canopy to be constructed at the Putnam south site. The location of the site is shown on the Key Plan, Figure 1.

The purpose of the foundation investigation was to determine the subsurface conditions at the location of the new triage canopy 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 Golder Associates' letter dated June 14, 2011.

Dillon provided Golder Associates with preliminary drawings for this project in digital format.



2.0 SITE DESCRIPTION

The Putnam South CVIF is located immediately south of Highway 401 about 1.5 kilometres west of the Highway 401/Putnam Road interchange as shown on the Key Plan, Figure 1. Currently, a primary scale lane is oriented parallel to Highway 401 with the scale and existing inspection building located in the eastern portion of the site. South of the scale lane, a “race track” configured, asphalt surfaced parking/inspection area is present. A raised sewage disposal system is located immediately east of the inspection area.

The existing truck inspection station is located at the crest of a moraine in the generally rolling regional topography. The lands in the existing truck inspection station have been constructed on variable thicknesses of fill materials to create a relatively level area. The station entrance ramp rises to the east and the exit ramp declines to the east similar to the adjacent Highway 401.

The topography in the area of the site ranges from about elevation 282 metres near the bullnose of the entrance ramp to about elevation 291 metres in the inspection area.

The adjacent land use is rural agricultural.

2.1 Site Geology

The site is located within the physiographic region of Southwestern Ontario¹ known as the Stratford Till Plain which is a product of the Huron ice lobe. Throughout the area, the till is a fairly uniform, brown calcareous silty clay.

¹ Chapman and Putnam, 1985, The Physiography of Southern Ontario, 3rd Edition, Ontario Geological Series



3.0 INVESTIGATION PROCEDURES

The field work for this component of the investigation was carried out on September 19, 2011 during which time two boreholes (boreholes 7 and 8) were drilled at the approximate locations shown on Drawing 1. The table below provides the borehole locations, ground surface elevations at the borehole locations and the depths of the boreholes.

Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
	Northing	Easting	(m)	(m)
7	4,760,301	429,631	287.34	8.08
8	4,760,288	429,632	286.64	8.08

It should be noted that ten boreholes (numbered 1 to 10, inclusive) were drilled for the various CVIF components and the results are provided in the associated Foundation Investigation and Design Reports. Boreholes 7 and 8 are relevant to the new triage canopy.

The investigation was carried out using an all terrain vehicle mounted CME 750 power auger supplied and operated by a specialist drilling contractor. In each borehole, samples of the overburden were obtained at 0.75 metre intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. The boreholes were terminated about 8.1 metres below the existing pavement or ground surface.

Groundwater conditions in the boreholes were observed throughout the drilling operations and a piezometer was installed in borehole 8. Following completion of drilling and sampling, the boreholes were backfilled in accordance with current MTO procedures and Ontario Regulation 903, as amended.

The field work was monitored on a full-time basis by an experienced member 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 their locations. 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 General

The detailed subsurface soil and groundwater conditions encountered in boreholes, together with the results of the in situ testing and the 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 the profiles on Drawing 1 are inferred from non-continuous samples and observations of drilling resistance and, therefore, may represent transitions between soil types rather than exact planes of geological change. Further, the subsurface conditions will vary between and beyond the borehole locations.

In general, the boreholes encountered the surficial topsoil and fill materials overlying clayey silt till which is underlain by layers of silt, sand, sandy silt and sandy silt till.

4.2 Soil Conditions

4.2.1 Topsoil

Layers of topsoil about 0.1 metres thick were encountered at the ground surface in boreholes 7 and 8.

4.2.2 Clayey Silt Till

Beneath the surficial topsoil, very stiff to hard clayey silt till was encountered between about elevation 286.5 and 287.2 metres. The clayey silt till was about 4.3 metres thick in borehole 7 and about 2.8 metres thick in borehole 8. The clayey silt till had N values, as determined in the standard penetration testing, of 26 to 61 blows per 0.3 metres with water contents of 14 to 22 per cent. The clayey silt till had average plastic and liquid limits of about 16 and 31 per cent, respectively, based on two Atterberg limits determinations. The Atterberg limits data are provided on Figure A-4.

Grain size distribution curves for samples of the clayey silt till recovered from the standard penetration testing are provided on Figure A-1. Although not specifically encountered in the boreholes, cobbles and boulders should be expected in the clayey silt till.



4.2.3 Silt

Layers of compact to very dense silt were encountered beneath the clayey silt till in borehole 8 at about elevation 283.7 metres and beneath the sands at about elevation 279.6 metres. The upper silt was about 1.5 metres thick. Borehole 8 was terminated in the lower silt after exploring it for about 1.1 metres. The silt layers had N values of 26 to 63 blows per 0.3 metres with water contents of about 18 to 23 per cent.

Grain size distribution curves for samples of the silt recovered from the standard penetration testing are provided on Figure A-2.

4.2.4 Sandy Silt Till

Beneath the clayey silt till, borehole 7 encountered a layer of dense to very dense sandy silt till at about elevation 282.9 metres. Borehole 8 encountered a dense to very dense layer of sandy silt till beneath the silt at about elevation 282.2 metres. The sandy silt till layers were about 1.5 metres thick. The sandy silt till had N values of 37 to 70 blows per 0.3 metres with water contents of about 14 to 16 per cent.

Although not specifically encountered in the boreholes, cobbles and boulders should be expected in the sandy silt till.

4.2.5 Sand

Layers of very dense sand were encountered beneath the sandy silt till in both of the boreholes at about elevations 280.7 to 281.4 metres. Borehole 7 was terminated in the sand after exploring it for about 2.1 metres. In borehole 8, the sand was about 1.1 metres thick. The sands had N values of 61 to 91 blows per 0.3 metres with water contents of about 4 to 9 per cent.

A grain size distribution curve for a sample of sand recovered from the standard penetration testing is provided on Figure A-3.

4.3 Groundwater Conditions

Boreholes 7 and 8 remained dry during drilling on September 19, 2011. A piezometer was installed in borehole 8 to monitor the groundwater levels. On September 30, 2011, the piezometer was dry to elevation 278.9 metres.

The inferred long term groundwater level is below about elevation 279 metres. Groundwater levels should be expected to fluctuate seasonally and in response to significant precipitation events.



5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Lantech Drilling Services Inc., an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Dan Babcock, P.Eng. under the direction of Mr. Michael E. Beadle, P.Eng.. 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 Mr. Michael E. Beadle, 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.

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PART B
FOUNDATION DESIGN REPORT
NEW TRIAGE CANOPY
PUTNAM SOUTH CVIF
GWP 4100-04-00



6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides recommendations based on our interpretation of the factual information obtained during the investigation and is intended for the guidance of the design engineer. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

6.2 Foundations

Based on the information available, the pavements in the area of the triage canopy will be at about elevation 291 metres, or some 3.5 to 4 metres above current grade at the borehole locations. As a result, and based on the results of the investigation, the proposed triage canopy can be founded on conventional spread and/or strip footing bearing on the clayey silt till or on an engineered fill constructed on the native clayey silt till at or below elevation 286.5 metres. Foundations constructed in this manner may be designed using a factored geotechnical resistance at Ultimate Limit States (ULS) of 400 kilopascals and a geotechnical resistance at Serviceability Limit States (SLS) of 250 kilopascals. The SLS criterion is for 25 millimetres of total settlement based on a minimum 1.0 metre footing width. Resistance to uplift should be based on a groundwater level at the ground surface.

Alternatively, the canopy foundations could be constructed on drilled, cast in place piles (caissons). Caissons at least 0.76 metres in diameter extending at least one diameter into the clayey silt till can be designed using a factored geotechnical resistance at ULS of 600 kilopascals and a geotechnical resistance at SLS of 400 kilopascals. All caisson excavations should be inspected by the geotechnical engineer prior to pouring concrete.

All exposed founding surfaces should be inspected by the geotechnical engineer prior to pouring concrete. It is preferable that the final 0.5 metres of excavation be carried out while the geotechnical engineer is on site.

If the footings cannot be poured the same day as the excavation, a 75 millimetre thick lean concrete working slab should be provided in the base of the excavation immediately following inspection by the geotechnical engineer.

At least 1.2 metres of soil cover or thermal equivalent should be provided over the footings.

The soils at the site are not considered to be aggressive to concrete. As a result, normal GU (formerly Type 10) cement can be used.

For seismic site response, Site Class C is appropriate.



6.2.1 Engineered Fill

Following careful stripping of the surficial topsoil and inspection by the geotechnical engineer, the engineered fill should be constructed using compacted Granular A placed in maximum 300 millimetre thick loose lifts. The engineered fill should extend beyond the footprint of the triage canopy footings by 1 metre plus the thickness of the fill required beneath the footings. Full time geotechnical inspections and materials testing will be required during construction of any engineered fill.

Care will be required to carefully bench the fill into adjacent native materials, as required, in accordance with Ontario Provincial Standard Drawing (OPSD) 208.010.

6.3 Resistance to Lateral Loads

6.3.1 Spread Footings

Resistance to lateral forces/sliding resistance between the concrete spread footings and the subsoil should be calculated in accordance with the Ontario Building Code. Assuming that the founding soils are not softened/disturbed during excavation and footing construction, the following unfactored angle of friction between the concrete and the founding soils, and corresponding unfactored coefficient of friction, $\tan \delta$, may be used:

	<u>Angle of Friction</u> (degrees)	<u>$\tan \delta$</u>
Footings on clayey silt till	30	0.58
Footings on Granular A engineered fill	32	0.62

6.3.2 Caissons

The lateral resistance of the cohesive soils along the shaft is represented by a constant distribution with depth and given by $9c_u B$ where c_u is the undrained shear strength in kilopascals and B is the shaft diameter in metres. The unfactored lateral force resisted by a shaft of length L (in metres) is given by:

$$P = 9 c_u B (L - 1.5B)$$

The above equation is based on the assumption that the lateral geotechnical resistance acts over a width equal to 3 times the shaft diameter. Also, large deformations (lateral movement) would be required to fully mobilize lateral shaft resistance. A resistance factor of 0.5 should be applied to obtain the factored lateral resistance at ULS.

The passive resistance in front of the caisson within the upper 1.2 metres below the ground surface should be neglected in the design of the foundation to account for frost action.



Where an undrained shear strength, c_u , is provided, the undrained capacity of the caisson should be checked to determine whether the drained or undrained case will govern. In this case, the lateral resistance for the length of the caisson within cohesive soil should be calculated assuming an unfactored passive lateral pressure distribution varying linearly from $2 c_u$ at the surface to $9 c_u$ at a depth of three pile diameters and beyond acting over the actual width of the caisson. A resistance factor of 0.5 should be applied to this calculated lateral resistance in order to obtain the factored lateral geotechnical resistance.

The following may be used for design of the caissons:

Soil Type	Undrained Shear Strength, C_u (kPa)
Clayey Silt Till	200

6.4 Slab-on-Grade

It is understood that a slab-on-grade will be constructed beneath the canopy. The slab-on-grade will be supported on either engineered fill or earth fill, depending on the foundation alternative selected.

The subgrade for the slab-on-grade should be proofrolled under the direction of the geotechnical engineer and any softened areas subexcavated and replaced with compacted Granular A. Should earth fill be used to bring the slab to subgrade level, 500 millimetres of compacted Granular A should be provided beneath the slab. Alternatively, if a granular engineered fill is used, the slab can be placed directly on the fill materials. For design purposes, a modulus of subgrade reaction of 80 megapascals per metre (MPa/m) may be used for the design of slabs constructed on engineered fill or Granular A as described above. The minimum slab thickness should be consistent with the adjacent rigid pavement design.

Appropriate load transfer devices should be used. Further, sawcut crack control joints should be provided at regular intervals. The slab should be kept structurally separate from the foundation elements.

6.5 Excavations

No significant excavations are anticipated for this work. However, cobbles and boulders should be expected in the till strata should excavations be required or if caissons are chosen for the foundation option. Further, a temporary steel liner will be required to permit cleaning and inspection of the base(s) of the caisson(s).

6.6 Groundwater

It is anticipated that groundwater control, when required, can be adequately handled using appropriate sized and filtered sumps.



FOUNDATION INVESTIGATION AND DESIGN REPORT TRIAGE CANOPY, GWP 4100-04-00

Surface water should be directed away from the open cut excavations.



7.0 MISCELLANEOUS

This report was prepared by Mr. Michael E. Beadle, 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.

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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

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

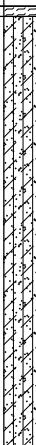

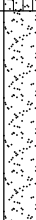
- Notes:**
- 1 $\tau = c' + \sigma' \tan \phi'$
 - 2 shear strength = (compressive strength)/2
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

PROJECT 11-1132-0082
W.P. 4100-04-00 LOCATION N 4760301.0 ; E 429631.0 ORIGINATED BY DB
DIST HWY 401 BOREHOLE TYPE POWER AUGER, SOLID STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE September 19, 2011 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	WATER CONTENT (%)						
287.34	GROUND SURFACE						20	40	60	80	100							
0.10	TOPSOIL, silty Black CLAYEY SILT TILL, trace sand, trace gravel Hard Brown																	
			1	SS	36													
			2	SS	47													
			3	SS	61													
			4	SS	40													
			5	SS	50													
282.92	SANDY SILT TILL, some clay, some gravel Dense to very dense Brown																	
4.42																		
			6	SS	64													
			7	SS	43													
281.40	SAND, some silt Very dense Brown																	
5.94																		
					8	SS	91											
			9	SS	82													
			10	SS	65													
279.26	END OF BOREHOLE																	
8.08	Borehole dry during drilling on September 19, 2011.																	

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

PROJECT 11-1132-0082

W.P. 4100-04-00

LOCATION N 4760288.0 ; E 429632.2

ORIGINATED BY DB

DIST HWY 401

BOREHOLE TYPE POWER AUGER, SOLID STEM

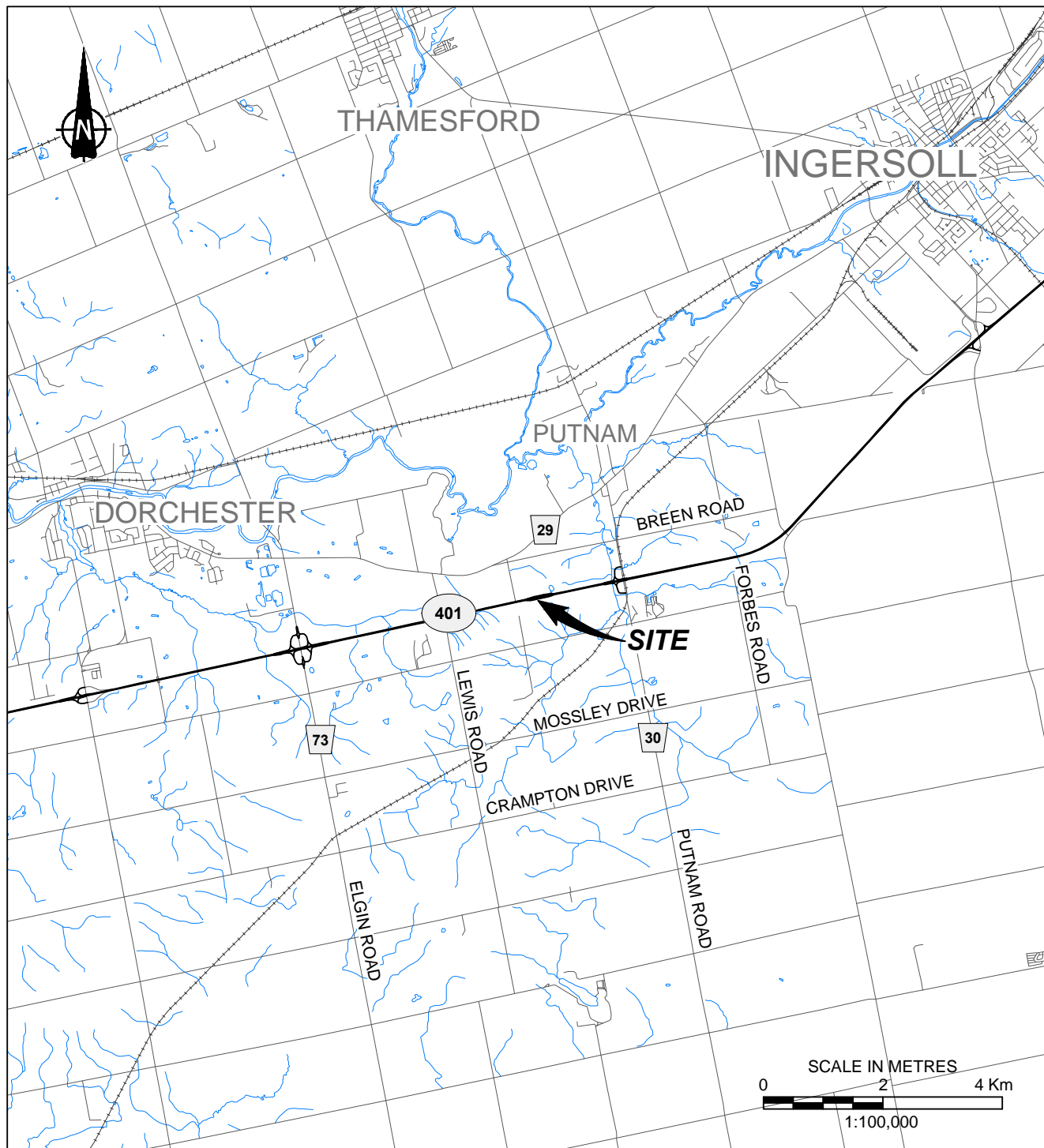
COMPILED BY WDF/LMK

DATUM GEODETIC

DATE September 19, 2011

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	WATER CONTENT (%)					
286.64	GROUND SURFACE						20	40	60	80	100						
0.10	TOPSOIL, silty Black CLAYEY SILT TILL, trace sand, trace gravel Very stiff to hard Brown		1	SS	33								○				
			2	SS	26								○				
			3	SS	40								○			1 11 42 36	
283.74	SILT, some clay, trace sand Compact Brown		4	SS	26								○			0 1 79 20	
282.98	SILT, trace sand Dense Brown		5	SS	34								○				
282.22	SANDY SILT TILL, trace gravel Dense to very dense Brown		6	SS	37												
			7	SS	70								○				
280.70	SAND, trace silt Very dense Brown		8	SS	61												
279.63	SILT, trace sand Very dense Brown		9	SS	63								○			1 5 81 13	
278.56	END OF BOREHOLE																
8.08	Borehole dry during drilling on September 19, 2011. Piezometer dry on September 30, 2011.																



REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2008.4.

NOTES

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

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

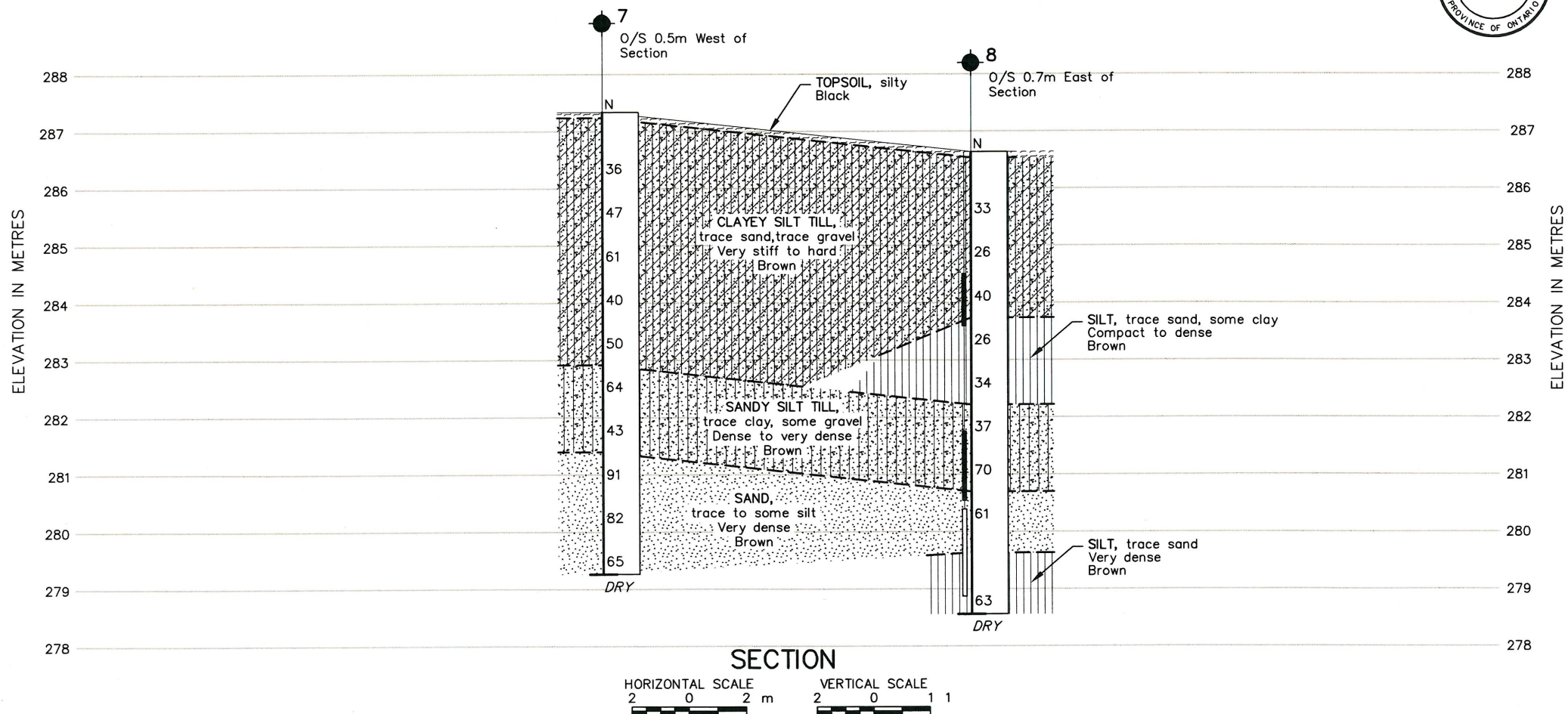
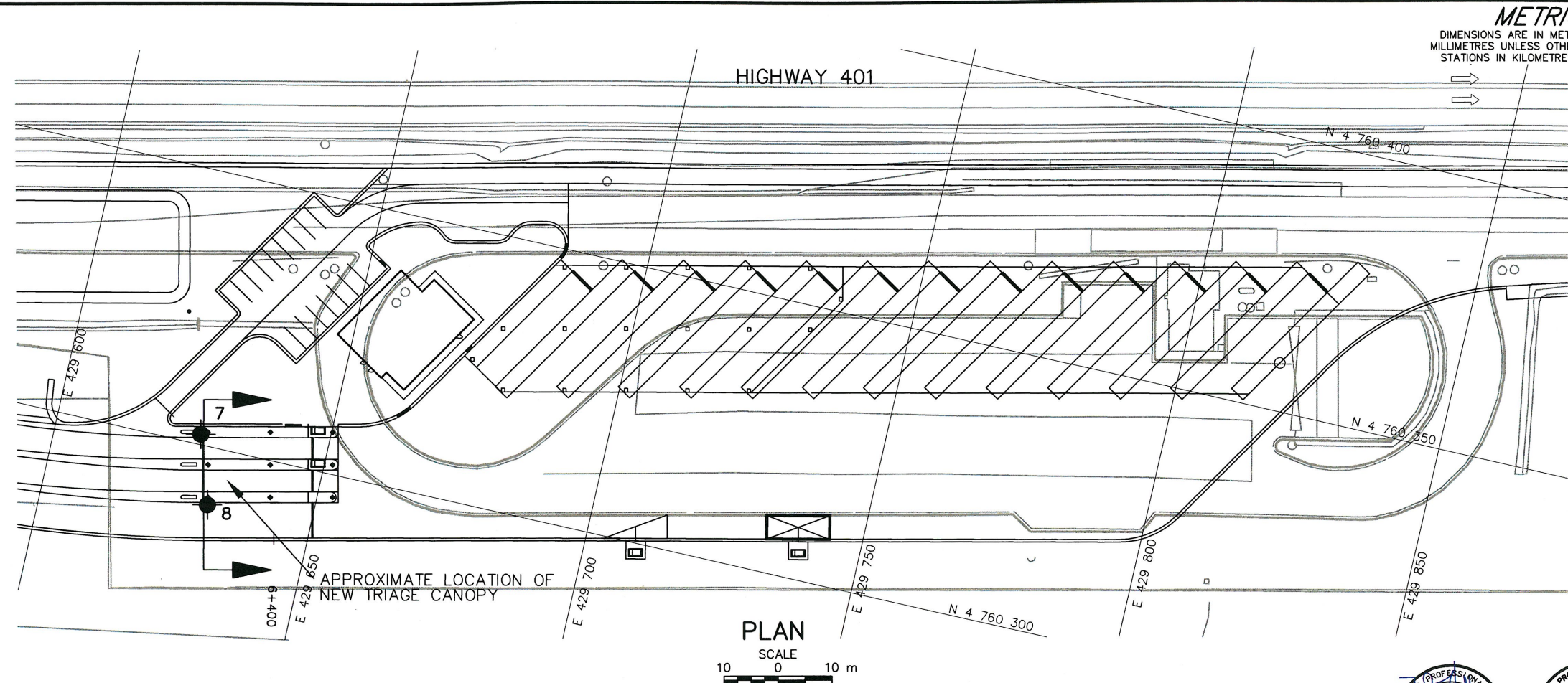
FOUNDATION INVESTIGATION
NEW TRIAGE CANOPY
PUTNAM SOUTH CVIF, GWP 4100-04-00

TITLE

KEY PLAN



PROJECT No. 11-1132-0082			FILE No. 1111320082-2000-F02001	
CADD	DCH/AMG	NOV. 16/11	SCALE	AS SHOWN
CHECK				REV.
			FIGURE 1	



CONT No.
WP No. 4100-04-00

NEW TRIAGE CANOPY
HIGHWAY 401/PUTNAM SOUTH CVIF
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
LONDON, ONTARIO, CANADA

SHEET

KEY PLAN
SCALE IN KILOMETRES
0 2.5 5.0

LEGEND

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

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.

REFERENCE

Base plans provided in digital format by Dillon Consulting

NO.	DATE	BY	REVISION

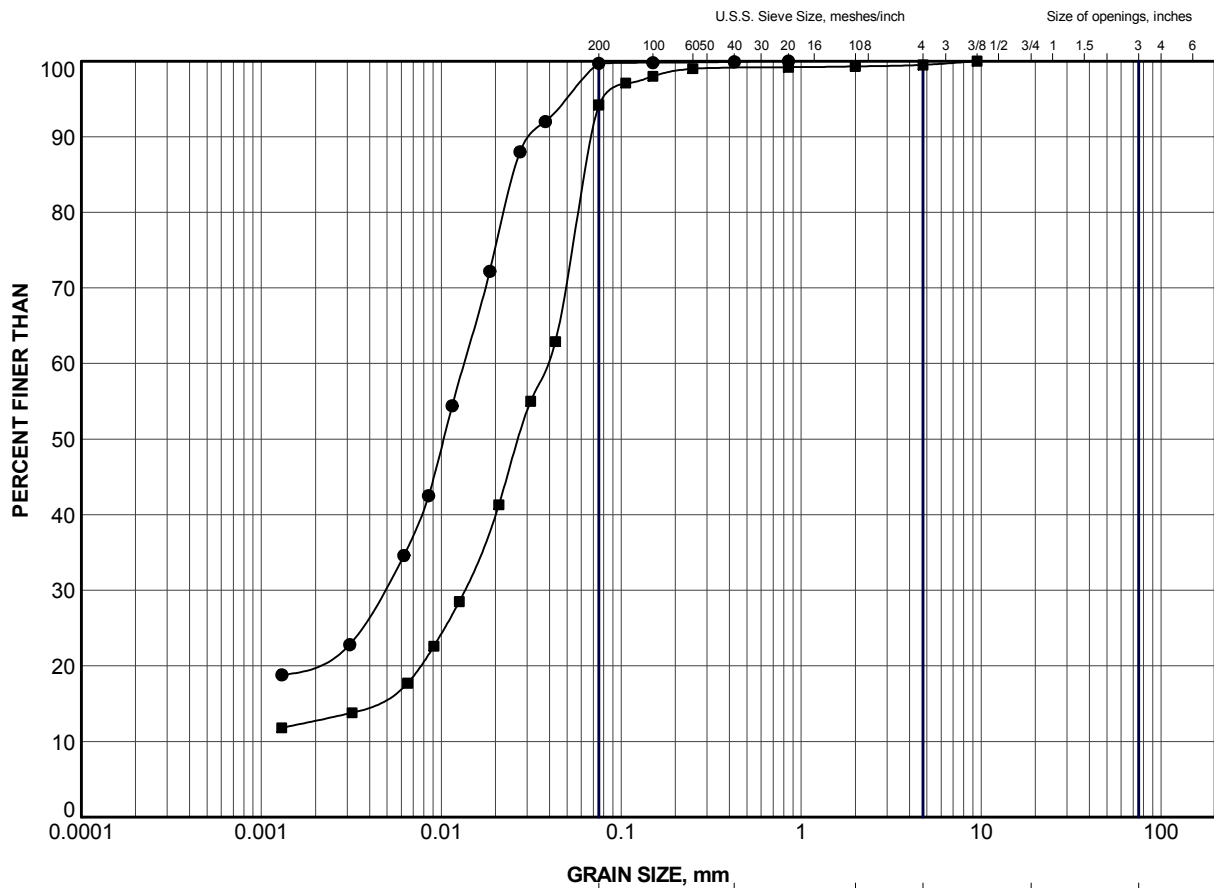
Geocres No. 40115-32

HWY.	401	PROJECT NO.	11-1132-0082	DIST.
SUBM'D.	MB	CHKD.	DATE: Nov. 2/11	SITE:
DRAWN:	DCH	CHKD.	APPD.	DWG. 1



APPENDIX A


Laboratory Test Data

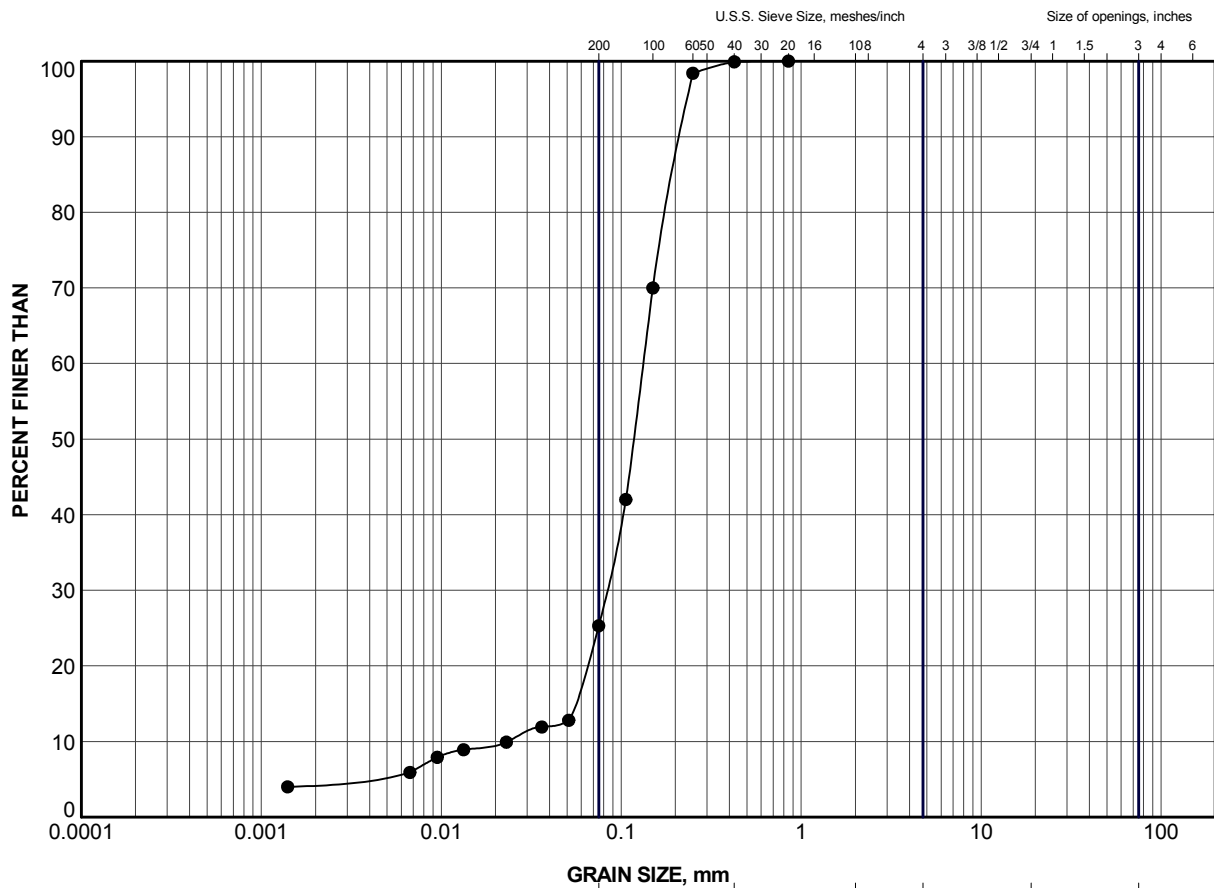


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	8	4	283.4
■	8	9	278.8


PROJECT				FOUNDATION INVESTIGATION NEW TRIAGE CANOPY PUTNAM SOUTH CVIF GWP 4100-04-00			
TITLE				GRAIN SIZE DISTRIBUTION SILT			
PROJECT No.		11-1132-0082		FILE No		11320082-2000-F020A2	
DRAWN		DCH		SCALE		N/A	
CHECK		Nov 10/11		REV.			
 Golder Associates LONDON, ONTARIO				FIGURE A-2			

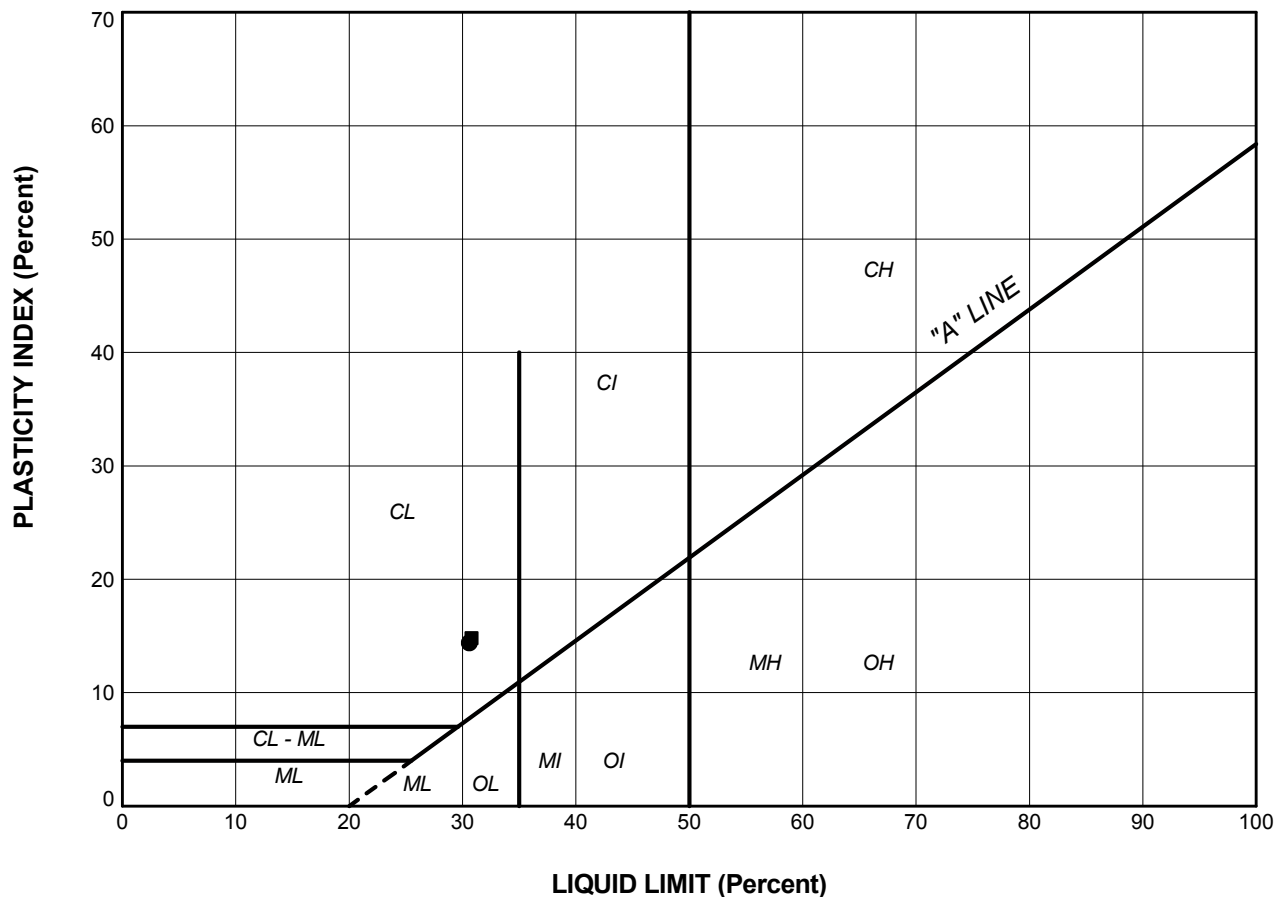


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	7	9	280.3

PROJECT	FOUNDATION INVESTIGATION NEW TRIAGE CANOPY PUTNAM SOUTH CVIF GWP 4100-04-00		
TITLE	GRAIN SIZE DISTRIBUTION SAND		
 Golder Associates LONDON, ONTARIO	PROJECT No.	11-1132-0082	FILE No. 1111320082-2000-F020A3
	DRAWN	DCH	Oct 24/11
	CHECK		
			FIGURE A-3




SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	7	3	30.6	16.2	14.4
■	8	3	30.8	16.0	14.8

CLAYEY SILT TILL

PROJECT		FOUNDATION INVESTIGATION NEW TRIAGE CANOPY PUTNAM SOUTH CVIF GWP 4100-04-00	
TITLE		PLASTICITY CHART	
PROJECT No. 11-1132-0082		FILE No. 1111320082-2000-F02004	
DRAWN	LMK	Nov 04/11	SCALE N/A REV.
CHECK			
 Golder Associates LONDON, ONTARIO		FIGURE A-4	

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