

**FOUNDATION INVESTIGATION AND DESIGN REPORT
WINDSOR SOUTH
COMMERCIAL VEHICLE INSPECTION STATION
HIGHWAY 401 RECONSTRUCTION
GWP 63-00-00, AGREEMENT NO. 3004-E-0006
MINISTRY OF TRANSPORTATION - SOUTHWESTERN REGION**

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February 7, 2006

05-1130-031-1-8
Geocres No. 40J2-77

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LIST OF ABBREVIATIONS

LIST OF SYMBOLS

RECORDS OF BOREHOLES

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PART A

**FOUNDATION INVESTIGATION REPORT
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundations engineering services as part of the detail design work for the section of Highway 401 described by GWP 63-00-00. This section of Highway 401 is some 9.9 kilometres in length and extends from 2.5 kilometres east of Essex Road 27 easterly to 1.2 kilometres west of Highway 77 in the Townships of Rochester and Tilbury West, County of Essex, Ontario.

The purpose of this portion of the foundation investigation was to determine the subsurface conditions for the improvements proposed for the Windsor south commercial vehicle inspection station (CVIS) by drilling boreholes, carrying out in-situ tests and laboratory tests on selected samples. The terms of reference for the scope of work are outlined in the MTO's request for proposal, Golder Associates proposal P41-3106, dated December 24, 2004. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering Detail Design Services dated March 9, 2005 and our letter dated August 19, 2005.

2.0 SITE DESCRIPTION

2.1 General

GWP 63-00-00 comprises the reconstruction and widening of some 9.9 kilometres of Highway 401 extending from 2.5 kilometres east of Essex Road 27 in the Township of Rochester easterly to 1.2 kilometres west of Highway 77 in the Township of Tilbury West, County of Essex, Ontario. The location of the project is shown on the Key Plan, Figure 1. The project chainage extends from Highway 401 Station 13+000, Township of Rochester to Station 12+700, Township of Tilbury West.

This section of Highway 401 is currently a four lane divided freeway with a depressed grass median. In each direction, two 3.35 metre wide lanes with 3.58 metre outer shoulders and 4.57 metre wide inner shoulders are present.

The topography in the area of the site is generally flat. The areas outside of the Highway 401 paved surfaces are well vegetated with grasses. The primary land use in the area is agricultural with some residential areas along French Line Road.

The general arrangement of the exiting truck inspection station is shown on Drawing 1.

2.2 Site Geology

The project lies within the Essex Clay Plain, a subregion of the physiographic region of southern Ontario known as the St. Clair Clay Plains, identified in "The Physiography of Southern Ontario" by Chapman and Putnam (1984). The clay plain is described as a till plain that has been smoothed by shallow deposits of lacustrine clay which settled in the depressions of the till. The prevailing soil type is reportedly the Brookston clay.

Based on the Ontario Department of Mines and Northern Affairs Preliminary Maps P.749 and P.750 entitled "Quaternary Geology of the Windsor-Essex Area" Western and Eastern Parts, respectively, the project area is reportedly located in predominantly clayey silt till.

Based on the available bedrock geology mapping, the subcropping bedrock consists of limestone of the Dundee formation of Middle Devonian age.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out on August 11 and 12, 2005 at which time twelve boreholes were drilled at the locations indicated on Drawing 1.

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

<u>BOREHOLE</u>	<u>LOCATIONS (m)</u>		<u>GROUND SURFACE</u>	<u>BOREHOLE DEPTH</u>
	<u>Northing</u>	<u>Easting</u>	<u>ELEVATION</u> (m)	
301	4677869	275812	187.87	5.03
302	4677873	275817	187.90	5.03
303	4677831	276273	187.91	6.55
304	4677830	276345	187.72	6.55
305	4677804	276299	187.76	6.55
306	4677787	276275	187.42	5.03
307	4677787	276264	187.28	5.03
308	4677807	276246	187.52	6.55
309	4677804	276203	187.28	6.55
310	4677803	276228	187.31	6.55
311	4677789	276227	186.99	6.55
312	4677790	276202	187.02	6.55

The locations of the boreholes are shown on the attached Record of Borehole sheets and on Drawing 1.

The boreholes were advanced using an all terrain vehicle mounted power auger supplied and operated by a specialist drilling contractor. Samples of the overburden were obtained at suitable intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures. Groundwater conditions were observed in the boreholes throughout the drilling operations. All of the boreholes were backfilled in accordance with current regulations and MTO recommended procedures.

The field work was supervised on a full-time basis by experienced members of our engineering staff who arranged for underground utility locates, directed the drilling, sampling and in situ testing operations, logged the boreholes and cared for the samples obtained. The soil samples were identified in the field, placed in labeled containers and transported to Golder Associates' London laboratory for further examination and routine 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 field and laboratory testing are given on the Record of Borehole sheets and in Appendix A.

Where required, temporary traffic control was provided in accordance with the Ontario Traffic Manual, Book 7, dated March 2001.

4.0 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the results of the in situ and laboratory testing are provided 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 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. Further, the subsurface conditions may vary significantly between and beyond the borehole locations.

In summary, the boreholes drilled for the CVIS improvements encountered surficial topsoil or the existing pavements and fill materials overlying silty clay till. Localized areas of clayey silt till and silty clay were also encountered.

A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized in the following sections.

4.1.1 Topsoil

A layer of surficial topsoil about 0.1 metres thick was encountered at ground surface in borehole 303.

4.1.2 Pavement Structure

The pavement structures associated with the existing CVIS were encountered in all of the boreholes, except borehole 303. The pavements consisted of asphalt, granular base and sandy granular subbase, except in borehole 304 which was advanced in a shoulder area and asphalt was not present, and in boreholes 306, 309, 310 and 312 where the pavements consisted of asphalt, concrete and granular subbase. The total pavement structure thicknesses ranged from 0.7 to 1.5 metres with an average thickness of about 1.2 metres. The granular subbase had N values, as determined in the standard penetration testing, of 6 to 35 blows per 0.3 metres and in situ water contents of 8 to 12 per cent.

A grain size distribution curve for a sample of the granular subbase recovered from the standard penetration testing is provided on Figure A-1.

4.1.3 Clayey Fill

Beneath the surficial topsoil in borehole 303 and beneath the pavement structure in boreholes 302, 304, 305 and 308, firm to very stiff clayey fill materials were encountered. The clayey fill layers were 0.4 to 3.2 metres thick at the borehole locations. These fill materials had N values of 6 to 16 blows per 0.3 metres with in situ water contents of 15 to 36 per cent and an average water content of about 21 per cent. The clayey fill had corresponding plastic and liquid limits of 16 and 37 per cent, respectively, based on a single Atterberg limits determination. The Atterberg limits data are provided on Figure A-6 and indicate an inorganic clay of intermediate plasticity.

A grain size distribution curve for a sample of the clayey fill recovered from the standard penetration testing is provided on Figure A-2.

4.1.4 Silty Clay

Beneath the fill in boreholes 305 and 308 at elevations 186.4 and 186.0 metres, respectively, layers of silty clay were encountered. The silty clay layers were 0.8 and 0.6 metres thick in boreholes 305 and 308. The silty clay had N values of 8 to 9 blows per 0.3 metres with natural water contents of 20 to 21 per cent.

4.1.5 Clayey Silt Till

Stiff to hard clayey silt till was encountered beneath the pavement structure in borehole 311 at elevation 185.6 metres. The clayey silt till was 1.5 metres thick at the borehole location. The clayey silt till had N values of 8 and 45 blows per 0.3 metres with natural water contents of 10 to 20 per cent. The clayey silt till had corresponding plastic and liquid limits of 12 and 22 per cent, respectively, based on a single Atterberg limits determination. The Atterberg limits data are provided on Figure A-6 and indicate an inorganic clay of low plasticity.

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

4.1.6 Silty Clay Till

Beneath the pavement structure, clayey fill materials, clayey silt till and/or silty clay, all of the boreholes encountered stiff to hard silty clay till. The surface of the silty clay till was encountered between elevation 184.1 and 186.5 metres. All of the boreholes were terminated in the silty clay till after exploring it for 3.2 to 5.6 metres. The silty clay till had N values of 8 to 47 blows per 0.3 metres with natural water contents of 11 to 22 per cent and an average of 17 per cent. The silty clay till had corresponding average plastic and liquid limits of 17 and 36 per cent,

respectively, based on eleven Atterberg limits determinations. The Atterberg limits data are provided on Figure A-6 and indicate an inorganic clay of low to intermediate plasticity.

Grain size distribution curves for samples of the silty clay till recovered from the standard penetration testing are provided on Figures A-4 and A-5.

4.2 Groundwater Conditions

Groundwater conditions were observed in the boreholes during drilling. All of the boreholes were dry during drilling. This information is summarized below:

<u>BOREHOLE</u>	<u>GROUND SURFACE ELEVATION</u> (m)	<u>ENCOUNTERED GROUNDWATER ELEVATION</u> (m)
301	187.87	Dry
302	187.90	Dry
303	187.91	Dry
304	187.72	Dry
305	187.76	Dry
306	187.42	Dry
307	187.28	Dry
308	187.52	Dry
309	187.28	Dry
310	187.31	Dry
311	186.99	Dry
312	187.02	Dry

Based on the conditions encountered in the boreholes, it is considered that the long term groundwater level is at approximately elevation 184 metres. Seasonal variation in the groundwater level should be expected.

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. Michael Arthur and Mr. Dan Babcock 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 Mr. Michael E. Beadle, P. Eng. under the direction of the Project Manager, 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
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HIGHWAY 401 RECONSTRUCTION
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6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides our recommendations on the foundation aspects of the design of the proposed Windsor south commercial vehicle inspection station (CVIS). The recommendations are based on our interpretation of the factual information obtained during the investigation. It should be noted that the interpretation and recommendations are intended for use only by 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.

It is understood that the improvements to the CVIS will include a new weigh-in-motion scale, a new static scale, a new inspection canopy and a new triage canopy. The locations of these structures are shown in plan on Drawing 1. Based on the information provided, conventional shallow foundations are proposed for all new structures.

6.2 Foundations

The subsurface conditions encountered in the boreholes drilled for this investigation typically consist of the existing pavement structures and fill overlying silty clay till. Silty clay and clayey silt till was also encountered in some areas.

Based on our understanding of the foundation requirements and the information provided, the proposed new structures may be founded as described below:

<u>STRUCTURE</u>	<u>RELEVANT BOREHOLES</u>	<u>FOUNDING ELEVATION (m)</u>	<u>FOUNDING SOILS</u>	<u>GEOTECHNICAL RESISTANCE (kPa)</u>	
				<u>Factored ULS</u>	<u>SLS</u>
Weigh-in Motion Scale	301, 302	186.0	Silty clay till	225	150
Inspection Canopy	303, 304, 306, 308	186.5	Silty clay till	300	200
			Engineered fill	300	200
Static Scale	306, 307	185.0	Silty clay till	300	200
Triage Canopy	309, 310, 311, 312	185.5	Silty clay till	185	125

SLS geotechnical resistances are based on a 1 metre wide strip footings or 1.5 metre wide spread footings.

The proposed foundation excavations should penetrate all of the existing fill materials and be terminated in the stiff to hard silty clay till at or below the founding elevations provided in the table above.

Engineered fill should be constructed on a competent, undisturbed subgrade and should consist of Granular A materials placed in maximum 300 millimetre thick loose lifts and compacted. The engineered fill should extend laterally beyond the outside edges of the footings by at least 1 metre plus the thickness of fill. Full time geotechnical inspections and testing should be carried out during subgrade preparation and engineered fill construction.

Alternatively, the canopies could be supported on drilled, cast in place concrete piles (caissons) with a minimum diameter of 1.0 metre. Caissons socketed at least 2 metres into the undisturbed silty clay till may be designed with a factored geotechnical resistance at ULS of 450 kilopascals and a geotechnical resistance at SLS of 300 kilopascals. Founding elevations of approximately 183 metres are anticipated for the canopies. Temporary liners will be required for final cleaning and inspection of the caissons.

6.2.1 Resistance to Lateral Forces

Resistance to lateral forces/sliding resistance between the concrete spread footings and the subsoil should be calculated in accordance with Section 6.7.5 of the CHBDC. Assuming that the founding soils are not softened/disturbed during excavation and footing construction, the following angle of friction between the concrete and the founding soils, and corresponding coefficient of friction, $\tan \delta$, may be used:

Footings on silty clay till	angle of friction	28°
	$\tan \delta$	0.53

6.2.2 Frost Protection

All footings should be provided with a minimum of 1.2 metres of earth cover for frost protection purposes.

6.2.3 Construction Considerations

The founding soils are susceptible to softening upon exposure to water and the placement of a 75 millimetre thick working slab of lean concrete will be required at the base of the excavation for the footing area. The prepared excavation base should be inspected by qualified geotechnical personnel prior to placing the working slab. It is recommended that the footing excavation be carried out such that the final 0.5 metres of excavation is completed with the geotechnical

personnel on site and that the working slab be placed immediately after the footing excavation is inspected.

6.3 Lateral Earth Pressures

The lateral pressures acting on the foundation walls will depend on the type and method of placement of the backfill materials, on the nature of the soils behind the backfill, on the freedom of lateral movement of the walls, and on the drainage conditions behind the walls. The following recommendations are made concerning the design of the foundation walls, in accordance with the CHBDC:

- Select, free-draining granular fill meeting the specifications of Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B with less than 5 per cent passing the 200 sieve should be used as backfill behind the abutments and walls. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill. Other aspects of the abutment granular backfill requirements with respect to subdrains should be in accordance with OPSD 3501.00.
- A compaction surcharge equal to 12 kPa should be included in the lateral earth pressures for the structural design of the foundation wall, in accordance with CHBDC Figure 6.9.3. Compaction equipment should be used in accordance with OPSS 501.06.
- The granular fill may be placed either in a zone with a width equal to at least 1.2 metres behind the back of the stem (Case i from Commentary on CHBDC Figure C6.9.1(I) or within the wedge-shaped zone defined by a line drawn at 1.5 horizontal to 1 vertical extending up and back from the rear face of the footing (Case ii from Commentary on CHBDC Figure C6.9.1(I)).
- For Case i, the pressures are based on the existing materials and the following parameters (unfactored) may be assumed for granular fill:

Soil unit weight:	21 kN/m ³
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Coefficients of lateral earth pressure:	
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Active, K_a	0.33
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At rest, K_o	0.50
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- For Case ii, the pressures are based on the granular fill as placed and the following parameters (unfactored) may be assumed:

	<u>GRANULAR A</u>	<u>GRANULAR B</u> (Type III)
Soil unit weight:	22 kN/m ³	21 kN/m ³
Coefficients of lateral earth pressure:		
Active, K_a	0.27	0.31
At rest, K_o	0.43	0.47

- If the wall support and superstructure allow lateral yielding of the stem, active earth pressures may be used in the geotechnical design of the structure. If the wall support does not allow lateral yielding, at rest earth pressures should be assumed for geotechnical design.

It should be noted that the above design parameters assume level backfill and ground surface behind the wall.

6.4 Excavations and Temporary Cut Slopes

Excavations for spread footings will extend through the existing fill materials and will encounter clayey silt, clayey silt till and silty clay till. Based on the subsurface conditions encountered in the boreholes, it is not likely that excavations will encounter groundwater. Temporary open cut slopes should be maintained no steeper than 1 horizontal to 1 vertical but may need to be locally flattened in the fill materials.

Some surficial water seepage into the excavations should be expected, and will be heavier during periods of sustained precipitation. Pumping from well filtered sumps located at the base of the excavations may be required to provide groundwater control during foundation construction. Sumps should be maintained outside of the actual footing limits. Surface water runoff should be directed away from the excavations at all times. The appropriate Non Standard Special Provision (NSSP) should be included in the contract documents.

Where space is restricted and will not permit open cuts, a temporary roadway protection support system should be installed to support the sides of the excavation and permit the use of vertical cuts. The temporary support system could consist of soldier piles and lagging where the H-piles would be driven to a suitable depth and horizontal lagging installed as the excavation proceeds or driven steel sheet piling. Support to the system could be in the form of struts and walers in the case of footing excavations or rakers and anchors in the case of roadway protection.

The temporary excavation support system should be designed and constructed in accordance with MTO's Special Provision 539S01. The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in SP 539S01.

All excavations should be carried out in accordance with the guidelines outlined in the latest edition of the Ontario Occupational Health and Safety Act and Regulations For Construction Projects. The surficial topsoil and fill materials at this site would be classified as Type 3 soils and the underlying native cohesive soils would be classified as Type 2 soils.

7.0 MISCELLANEOUS

This report was prepared by Mr. Michael E. Beadle, P.Eng. under the direction of the Project Manager, 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 $= (\text{compressive strength})/2$
 - * density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 301		1 OF 1 METRIC	
G.W.P. <u>63-00-00</u>		LOCATION <u>N 4677869.2 ; E 275811.7</u>		ORIGINATED BY <u>M.A.</u>	
DIST <u>1</u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>		COMPILED BY <u>WDF</u>	
DATUM <u>GEODETIC</u>		DATE <u>August 11, 2005</u>		CHECKED BY _____	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m³	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						w _p w w _L				
187.87	PAVEMENT SURFACE																	
0.00	ASPHALT																	
0.23	FILL, Granular Base																	
0.40	FILL, sand, fine to medium, trace silt, trace gravel Compact Brown		1	SS	20													
186.50																		
1.37	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 183.5m		2	SS	11													
			3	SS	13													
			4	SS	27													
			5	SS	37													
182.84			6	SS	18													
5.03	END OF BOREHOLE																	
	Borehole dry during drilling August 11, 2005																	

ON_MTO 05-1130-031-1-T.GPJ ON_MOT.GDT 27/06

PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 302		1 OF 1		METRIC	
G.W.P. <u>63-00-00</u>		LOCATION <u>N 4677873.3 ; E 275817.0</u>		ORIGINATED BY <u>M.A.</u>			
DIST <u>1</u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>		COMPILED BY <u>WDF</u>			
DATUM <u>GEODETIC</u>		DATE <u>August 11, 2005</u>		CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	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					w _p w w _L				
187.90	PAVEMENT SURFACE						20	40	60	80	100						
0.00	ASPHALT																
0.15	FILL, Granular Base																
0.30	FILL, sand, fine to medium, trace silt, trace gravel Loose																
186.92	Brown		1	SS	7								○				
0.98	FILL, silty clay, trace to some sand, some topsoil, trace gravel Stiff													○			
186.07	Brown and black		2	SS	11										○		
1.83	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown														○		
															○		
			3	SS	12										○		
															○		
															○		
			4	SS	32										○		
															○		
															○		
			5	SS	37										○		
															○		
															○		
182.87	END OF BOREHOLE		6	SS	20										○		
5.03	END OF BOREHOLE																
	Borehole dry during drilling August 11, 2005																


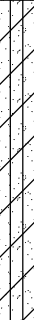
ON_MTO 05-1130-031-1-T.GPJ ON_MOT.GDT 27/06

RECORD OF BOREHOLE No 303

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS LOCATION N 4677830.9 ; E 276272.5 ORIGINATED BY M.A.
G.W.P. 63-00-00 DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS COMPILED BY WDF
DATUM GEODETIC DATE August 11, 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						
187.91	GROUND SURFACE																
0.09	TOPSOIL , clayey Black FILL , silty clay, trace to some sand, trace gravel Stiff Brown and grey		1	SS	9								○				
			2	SS	8								├─○─┤			0 27 37 36	
			3	SS	10								○				
184.62			4	SS	16								○	○			
3.29	SILTY CLAY , trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 184.3m		5	SS	31								○├─┤			0 17 44 39	
			6	SS	20								○				
			7	SS	15								○				
181.36			8	SS	17								○				
6.55	END OF BOREHOLE Borehole dry during drilling August 11, 2005																

RECORD OF BOREHOLE No 304

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS LOCATION N 4677830.1 ; E 276344.5 ORIGINATED BY M.A.
G.W.P. 63-00-00 DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS COMPILED BY WDF
DATUM GEODETIC DATE August 11, 2005 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
187.72	GROUND SURFACE							20 40 60 80 100		W _P	W	W _L	kN/m ³	GR SA SI CL
0.00	FILL, Granular Base							20 40 60 80 100						
0.23	FILL, sand, fine to medium, trace silt						187							
186.81	Loose Brown													
0.91	FILL, silty clay, trace sand, trace gravel, trace topsoil		1	SS	6									
	Firm Grey													
			2	SS	6		186							
185.59														
2.13	SILTY CLAY, trace to some sand, trace gravel (TILL)													
	Stiff to Hard		3	SS	9		185							0 17 44 39
	Brown to grey at elev. 184.1m													
			4	SS	32		184							
			5	SS	25		183							0 18 45 37
			6	SS	15		182							
			7	SS	9									
			8	SS	8									
181.17														
6.55	END OF BOREHOLE													
	Borehole dry during drilling August 11, 2005													

RECORD OF BOREHOLE No 305

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS
G.W.P. 63-00-00 LOCATION N 4677804.3 ; E 276299.0 ORIGINATED BY M.A.
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS COMPILED BY WDF
DATUM GEODETIC DATE August 11, 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									
								WATER CONTENT (%)									
187.76	PAVEMENT SURFACE						20	40	60	80	100	10	20	30			
0.00	ASPHALT																
0.12	FILL, Granular Base																
0.30	FILL, sand, fine to medium, trace silt, trace gravel																
187.06	Brown																
0.70	FILL, silty clay, trace sand, trace topsoil		1	SS	8								○				
186.39	Firm																
1.37	Brown																
	SILTY CLAY, some sand		2	SS	8								○			0 44 23 33	
	Stiff																
185.63	Brown																
2.13	SILTY CLAY, trace to some sand, trace gravel (TILL)		3	SS	16								○				
	Stiff to Hard																
	Brown to grey at elev. 183.4m		4	SS	27								○				
			5	SS	31								○				
			6	SS	14								○				
			7	SS	11								○				
			8	SS	9												
181.21	END OF BOREHOLE																
6.55	Borehole dry during drilling August 11, 2005																

PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 306		1 OF 1 METRIC	
G.W.P. <u>63-00-00</u>		LOCATION <u>N 4677786.8 ; E 276275.1</u>		ORIGINATED BY <u>M.A.</u>	
DIST <u>1</u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>		COMPILED BY <u>WDF</u>	
DATUM <u>GEODETIC</u>		DATE <u>August 11, 2005</u>		CHECKED BY _____	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
187.42		PAVEMENT SURFACE																			
0.09		ASPHALT																			
0.30		CONCRETE																			
		FILL, sand, fine to medium, trace silt, trace gravel Dense Brown																			
186.05																					
1.37		SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 183.8m																			
182.39		END OF BOREHOLE																			
5.03		Borehole dry during drilling August 11, 2005																			

RECORD OF BOREHOLE No 307

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS
G.W.P. 63-00-00 LOCATION N 4677787.3 ; E 276264.1 ORIGINATED BY M.A.
DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS COMPILED BY WDF
DATUM GEODETIC DATE August 12, 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													
187.28	PAVEMENT SURFACE							20	40	60	80	100							
0.00	ASPHALT																		
0.12	FILL, Granular Base																		
186.83																			
0.45	FILL, sand, fine to medium, trace silt, trace gravel Dense Brown		1	SS	35									○					
185.91																			
1.37	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey		2	SS	15									○					
			3	SS	25									←———→			0 18 43 39		
			4	SS	35									○					
			5	SS	25									○					
														○					
182.25	END OF BOREHOLE		6	SS	20									○					
5.03	Borehole dry during drilling August 12, 2005																		

RECORD OF BOREHOLE No 308

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS LOCATION N 4677807.4 ; E 276246.4 ORIGINATED BY M.A.
G.W.P. 63-00-00 DIST 1 HWY 401 BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS COMPILED BY WDF
DATUM GEODETIC DATE August 12, 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									
								WATER CONTENT (%)									
187.52	PAVEMENT SURFACE						20	40	60	80	100	10	20	30			
0.00	ASPHALT																
0.12	FILL, Granular Base																
187.12																	
0.40	FILL, sand, fine, trace silt, trace gravel Compact Brown		1	SS	18												
186.39																	
1.13	FILL, silty clay, some sand, trace gravel Stiff Grey		2	SS	9												
186.00																	
1.52	SILTY CLAY, trace sand Stiff Brown																
185.39																	
2.13	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 183.9m		3	SS	25												
			4	SS	30												
			5	SS	28												
			6	SS	16												
			7	SS	13												
			8	SS	9												
180.97	END OF BOREHOLE																
6.55	Borehole dry during drilling August 12, 2005																

PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 309		1 OF 1		METRIC	
G.W.P. <u>63-00-00</u>		LOCATION <u>N 4677803.6 ; E 276202.5</u>		ORIGINATED BY <u>M.A.</u>			
DIST <u>1</u> HWY <u>401</u>		BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>		COMPILED BY <u>WDF</u>			
DATUM <u>GEODETIC</u>		DATE <u>August 12, 2005</u>		CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	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					w _p w w _L				
187.28	PAVEMENT SURFACE						20	40	60	80	100						
0.09	ASPHALT																
0.30	CONCRETE																
	FILL, sand, trace silt, trace gravel																
	Compact																
186.30	Brown		1	SS	15								○				
0.98	SILTY CLAY, trace to some sand, trace gravel (TILL)													○			
	Stiff to Hard		2	SS	24									○			
	Brown to grey at elev. 183.7m																
			3	SS	35									○			
			4	SS	23									○			
			5	SS	18									○			
			6	SS	14												
			7	SS	13												
			8	SS	11												
180.73	END OF BOREHOLE																
6.55	Borehole dry during drilling August 12, 2005																

RECORD OF BOREHOLE No 310

1 OF 1

METRIC

PROJECT 05-1130-031-1-TIS

G.W.P. 63-00-00

LOCATION N 4677802.5 ; E 276227.5

ORIGINATED BY M.A.

DIST 1 HWY 401

BOREHOLE TYPE POWER AUGER/HOLLOW STEM AUGERS

COMPILED BY WDF

DATUM GEODETIC

DATE August 12, 2005

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L			WATER CONTENT (%)		
187.31	PAVEMENT SURFACE							20	40	60	80	100					
0.09	ASPHALT																
0.30	CONCRETE																
186.25	FILL, sand, fine to medium, trace silt, trace gravel Compact Brown		1	SS	13												
1.06	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 184.4m		2	SS	11												1 21 40 38
			3	SS	35												
			4	SS	34												
			5	SS	24												4 19 43 34
			6	SS	16												
			7	SS	13												
			8	SS	12												
180.76	END OF BOREHOLE																
6.55	Borehole dry during drilling August 12, 2005																

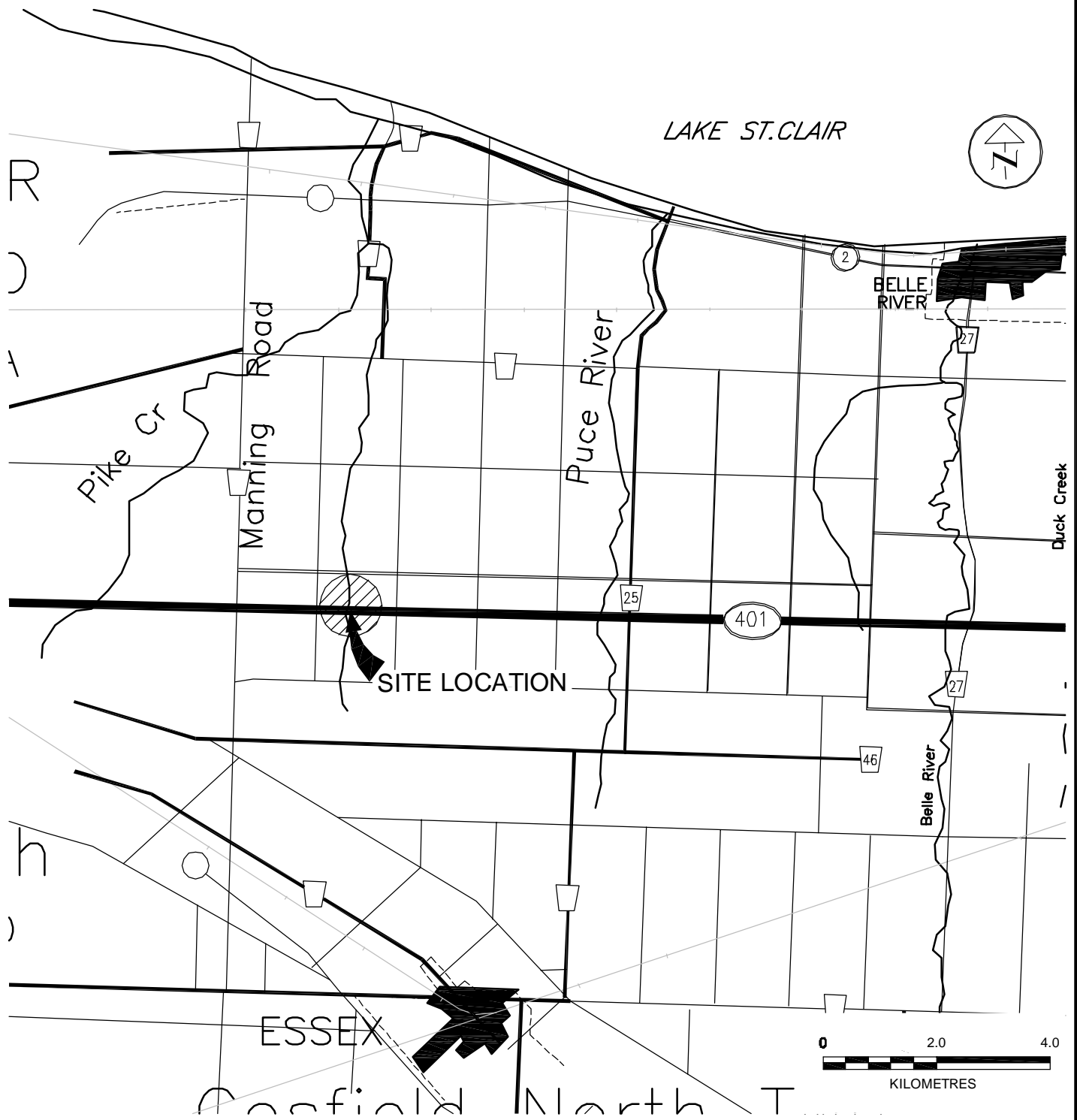
PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 311		1 OF 1	METRIC
G.W.P. <u>63-00-00</u>	LOCATION <u>N 4677788.5 ; E 276226.7</u>	ORIGINATED BY <u>M.A.</u>			
DIST <u>1</u> HWY <u>401</u>	BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>	COMPILED BY <u>WDF</u>			
DATUM <u>GEODETIC</u>	DATE <u>August 12, 2005</u>	CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	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	20	40	60	80	100	w _p	w		
186.99	PAVEMENT SURFACE																
0.00	ASPHALT																
0.12	FILL, Granular Base																
0.24	FILL, sand, fine to medium, trace silt, trace gravel Compact Brown		1	SS	15												
185.62	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to Hard Brown		2	SS	8												
1.37			3	SS	45												
184.09			4	SS	33												
2.90	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 183.4m		5	SS	21												
			6	SS	14												
			7	SS	14												
			8	SS	9												
180.44	END OF BOREHOLE																
6.55	Borehole dry during drilling August 12, 2005																

ON_MTO 05-1130-031-1-T.GPJ ON_MOT.GDT 27/06

PROJECT <u>05-1130-031-1-TIS</u>		RECORD OF BOREHOLE No 312		1 OF 1	METRIC
G.W.P. <u>63-00-00</u>	LOCATION <u>N 4677789.6 ; E 276201.9</u>	ORIGINATED BY <u>M.A.</u>			
DIST <u>1</u> HWY <u>401</u>	BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM AUGERS</u>	COMPILED BY <u>WDF</u>			
DATUM <u>GEODETIC</u>	DATE <u>August 12, 2005</u>	CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
													20	40	60						80
187.02	PAVEMENT SURFACE																				
0.09	ASPHALT																				
0.30	CONCRETE																				
	FILL, sand, fine to medium, trace silt, trace gravel Compact Brown		1	SS	25													4	80	12	4
185.50																					
1.52	SILTY CLAY, trace to some sand, trace gravel (TILL) Stiff to Hard Brown to grey at elev. 184.1m		2	SS	18																
			3	SS	47																
			4	SS	24													0	16	48	36
			5	SS	17																
			6	SS	15																
			7	SS	15																
			8	SS	14																
180.47																					
6.55	END OF BOREHOLE Borehole dry during drilling August 12, 2005																				



PROJECT			
WINDSOR SOUTH COMMERCIAL VEHICLE INSPECTION STATION			
WP 63-00-00			
HIGHWAY 401 RECONSTRUCTION			
TITLE			
KEY PLAN			
PROJECT No.		FILE No.	
05-1130-031-1-8		051130031-1-8F001	
SCALE		AS SHOWN	REV. 0
GADD		DCH	Sept. 15/05
CHECK			
FIGURE 1			



1 = 1 metric D size dwg 22" x 34" 11" x 17" plot half scale

F:\ENR\05130031-1-80001.dwg

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

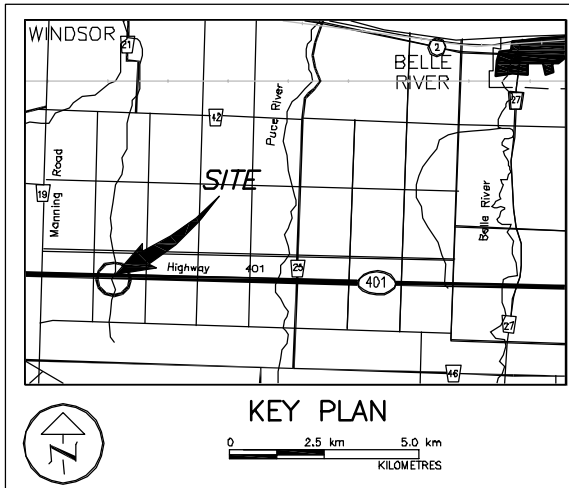
DIST 1
CONT. No.
WP No. 3100-00-01

SHEET

WINDSOR SOUTH COMMERCIAL
VEHICLE INSPECTION STATION
BOREHOLE LOCATIONS



Golder Associates Ltd.
LONDON, ONTARIO, CANADA



LEGEND			
Borehole (Current Investigation - Golder Associates)			
No.	ELEVATION (metres)	CO-ORDINATES	
		NORTH	EAST
301	187.87	4 677 869.2	275 811.7
302	187.90	4 677 873.3	275 817.0
303	187.91	4 677 830.9	276 272.5
304	187.72	4 677 830.1	276 344.5
305	187.76	4 677 804.3	276 299.0
306	187.42	4 677 786.8	276 275.1
307	187.28	4 677 787.3	276 264.1
308	187.52	4 677 807.4	276 246.4
309	187.28	4 677 803.6	276 202.5
310	187.31	4 677 802.5	276 227.5
311	186.99	4 677 788.5	276 226.7
312	187.02	4 677 789.6	276 201.9

NOTES

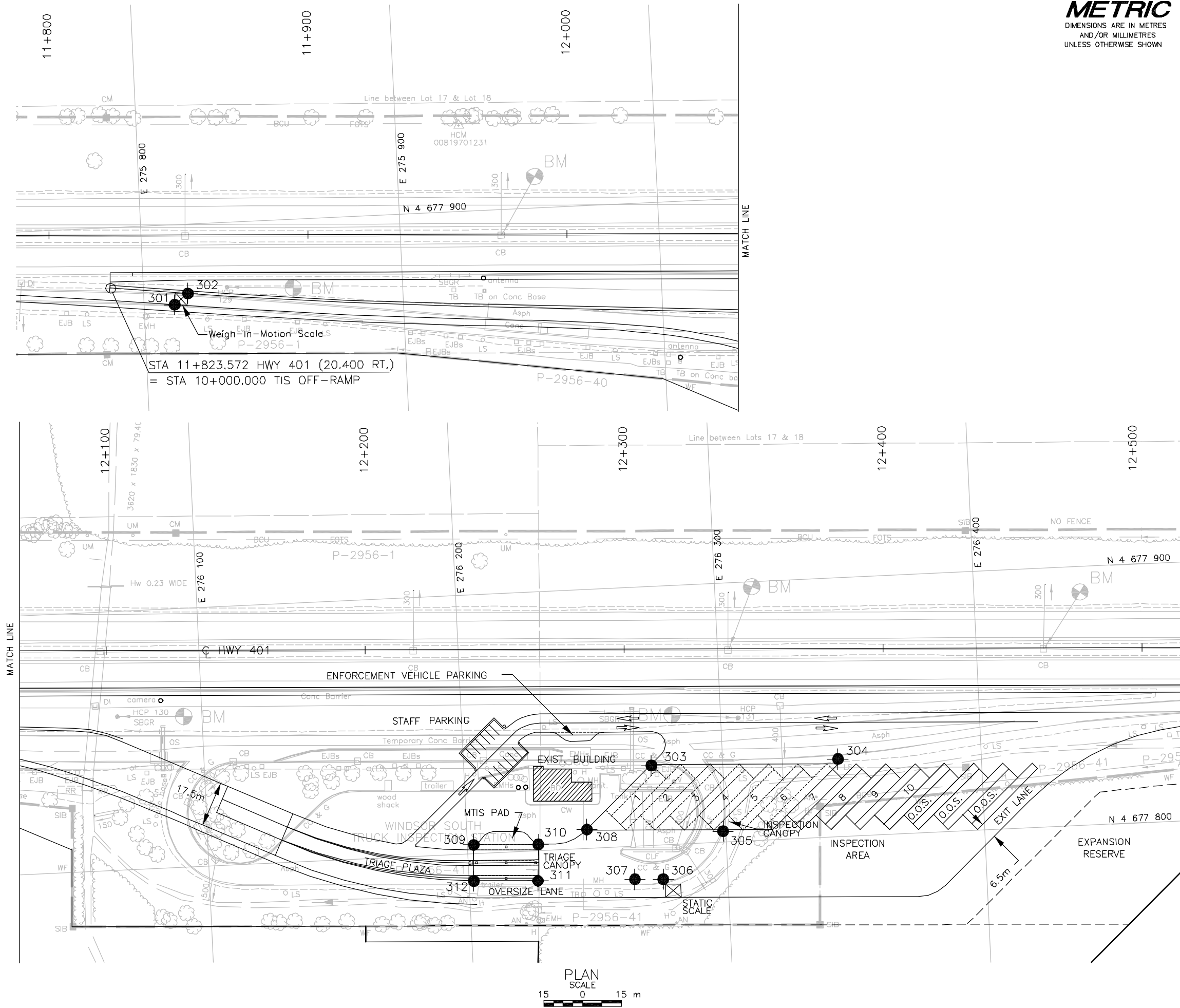
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

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

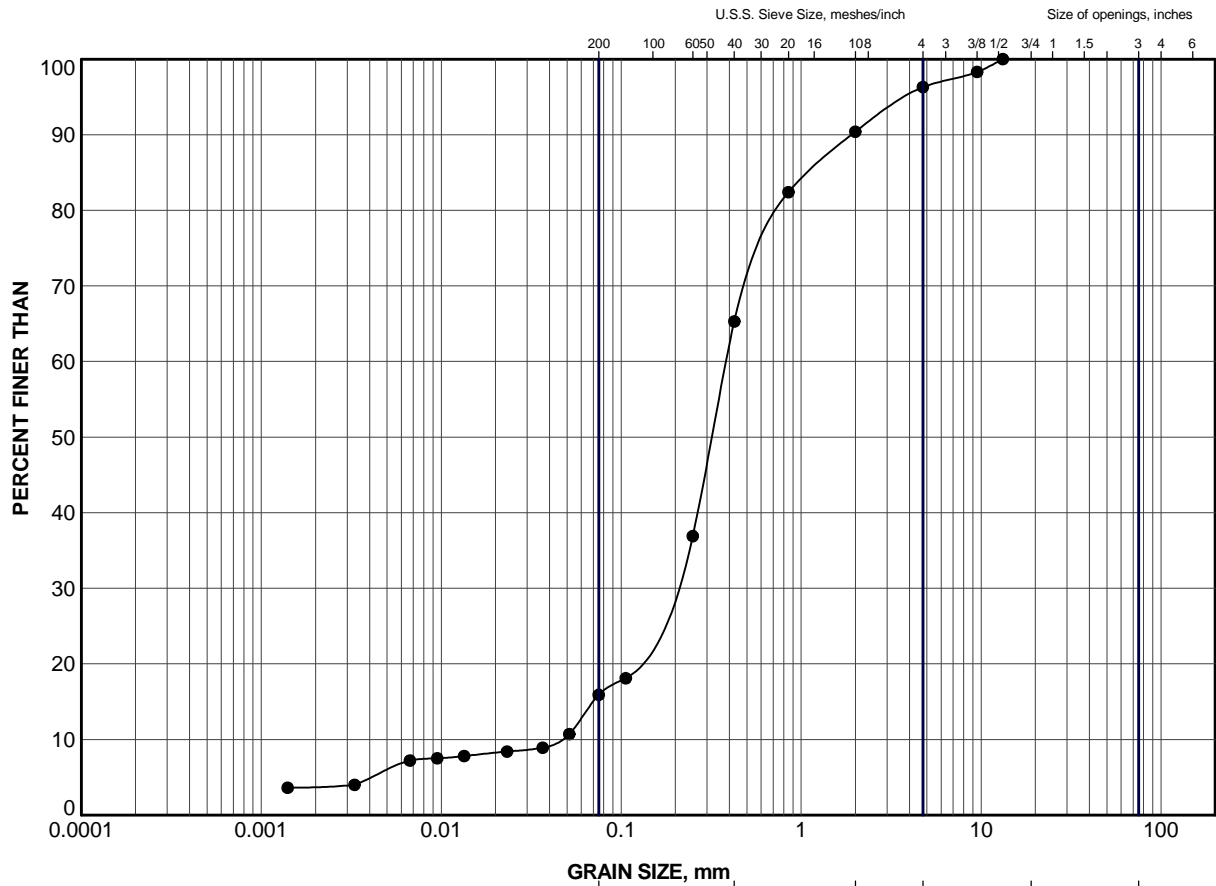
REFERENCE : DRAWING BY DILLON CONSULTING
ENTITLED: Windsor South CVIF
SITE No. :
DATED: SEPT 2005

NO.	DATE	BY	REVISION
40J2-75			
HWY. No.	401	PROJECT NO.:	05-1130-031-1-8
SUBM'D.	-	CHKD.	DATE: SEPT 16/05
DRAWN:	WDF	CHKD.	MEB
APPD.		DWG.	1




APPENDIX A

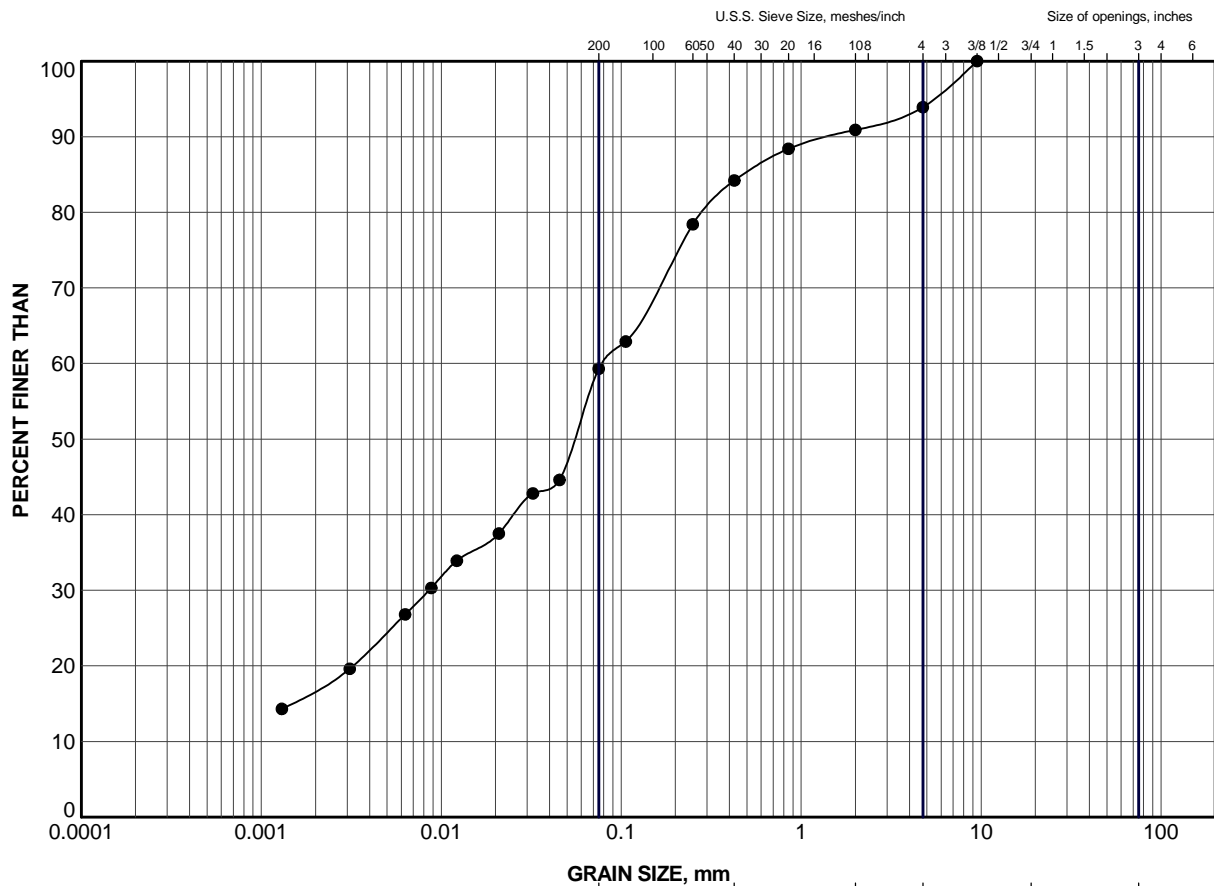
LABORATORY TEST DATA (FIGURES A-1 TO A-6)



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	312	1	186.0


PROJECT			
WINDSOR SOUTH COMMER. VEHICLE INSP.STATION WP 63-00-00 HWY 401 RECONSTRUCTION			
TITLE			
GRAIN SIZE DISTRIBUTION FILL, sand			
PROJECT No. 05-1130-031-1-TIS		FILE No. 05-1130-031-1-TIS.GPJ	
DRAWN	WDF	Sep 09/05	SCALE N/A REV.
CHECK			
 Golder Associates LONDON, ONTARIO		FIGURE A-1	

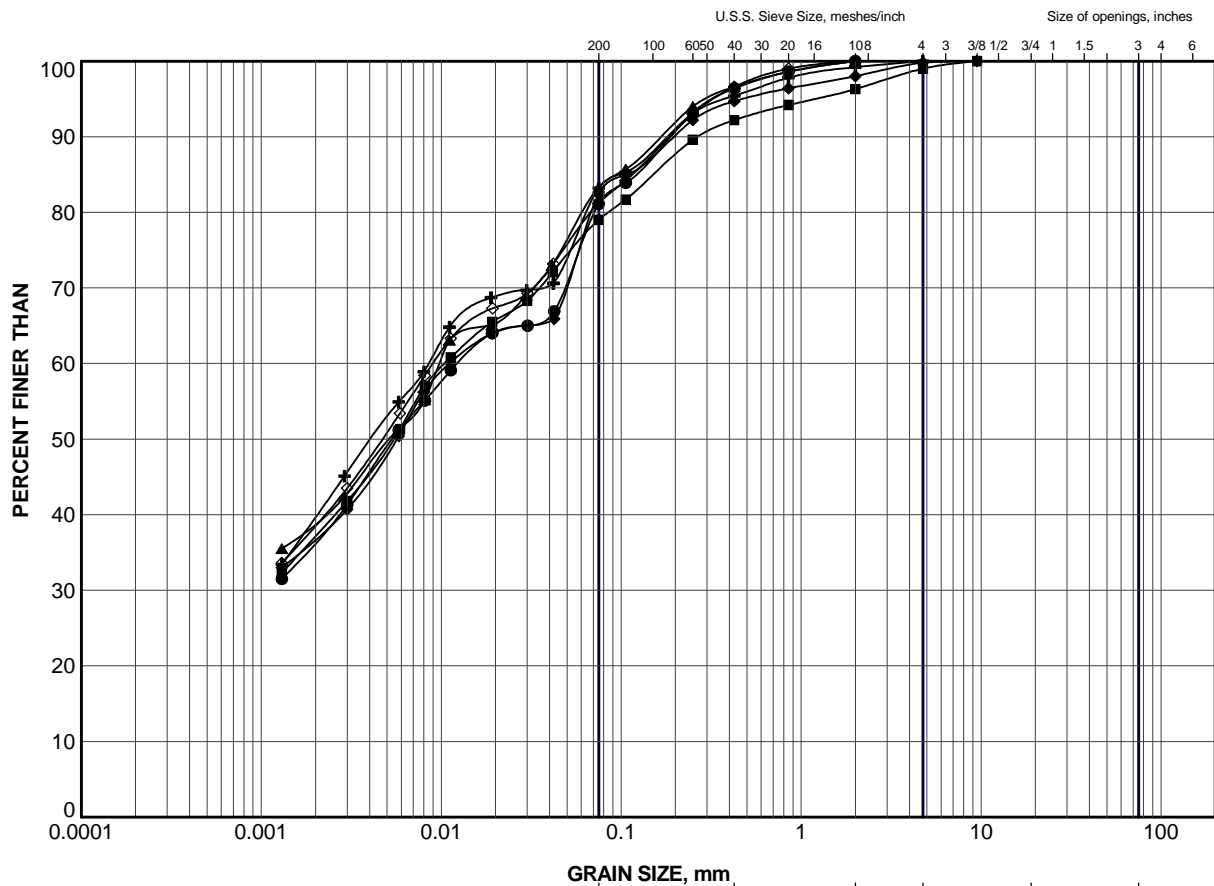


GRAVEL SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	311	3	184.5


PROJECT WINDSOR SOUTH COMMER. VEHICLE INSP.STATION WP 63-00-00 HWY 401 RECONSTRUCTION			
TITLE GRAIN SIZE DISTRIBUTION CLAYEY SILT TILL			
 Golder Associates LONDON, ONTARIO	PROJECT No. 05-1130-031-1-TIS		FILE No. 05-1130-031-1-TIS.GPJ
	DRAWN	WDF	Sep 09/05
	CHECK		
	SCALE N/A		REV.
FIGURE A-3			

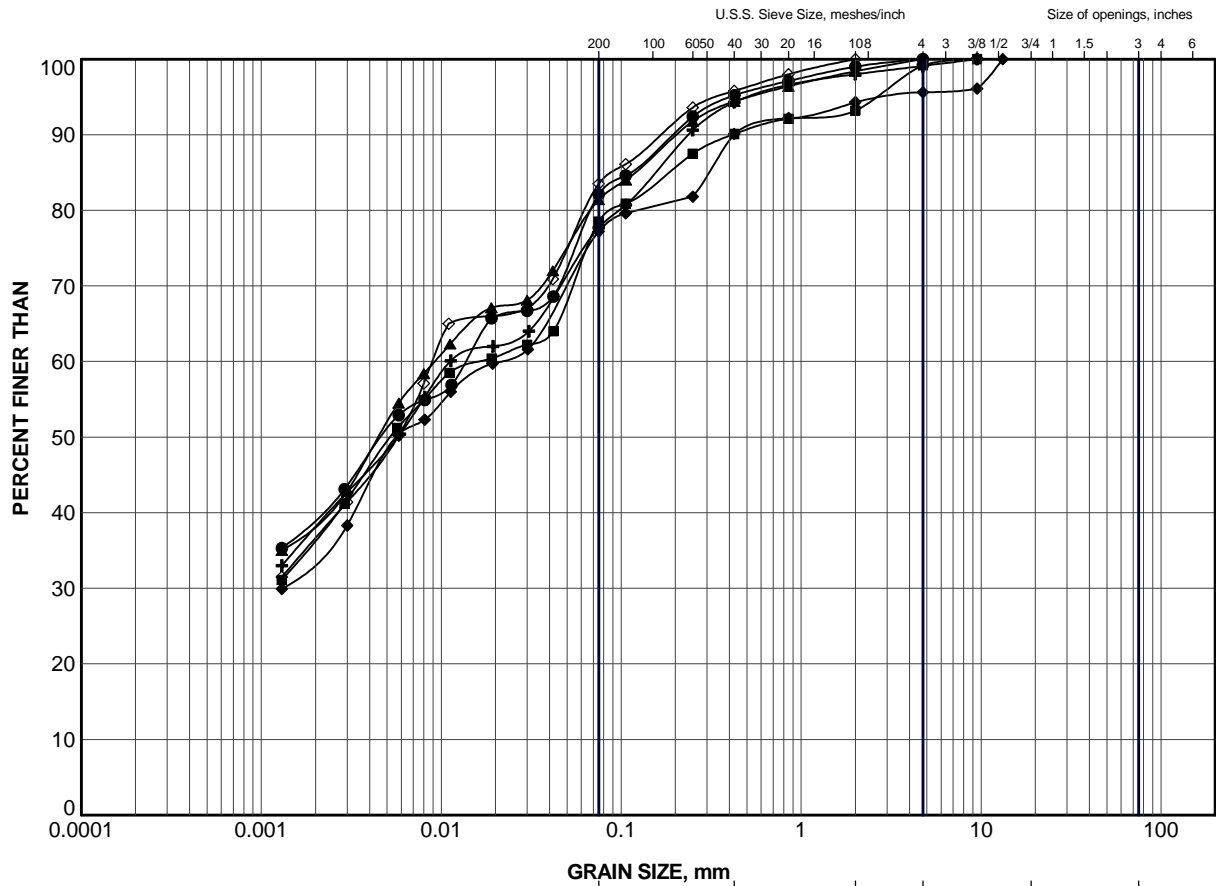


CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	301	3	185.4
■	302	4	184.6
▲	303	5	183.9
+	304	3	185.2
◆	304	6	182.9
◇	306	4	184.1

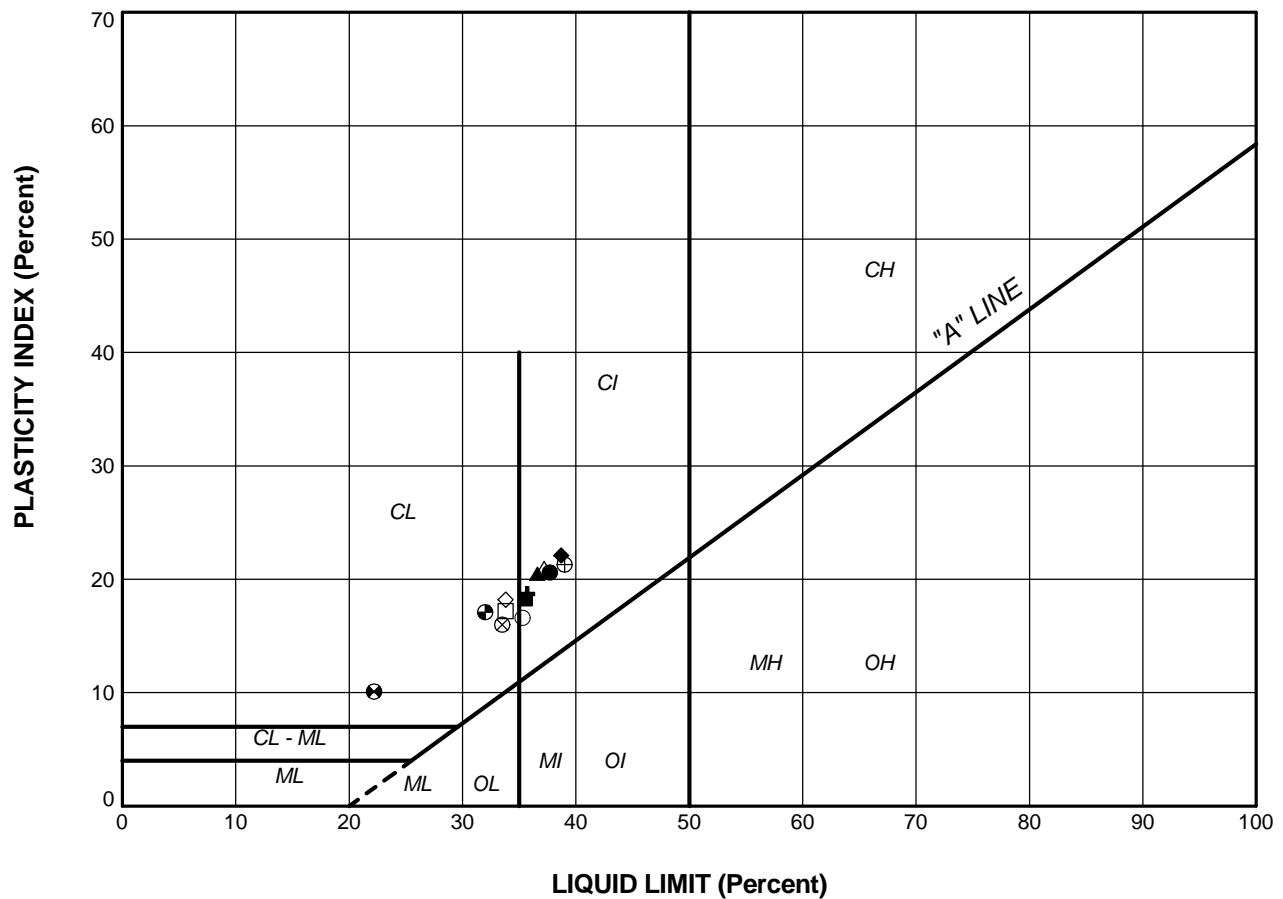
PROJECT			
WINDSOR SOUTH COMMER. VEHICLE INSP. STATION WP 63-00-00 HWY 401 RECONSTRUCTION			
TITLE			
GRAIN SIZE DISTRIBUTION SILTY CLAY TILL			
PROJECT No. 05-1130-031-1-TIS		FILE No. 05-1130-031-1-TIS.GPJ	
DRAWN	WDF	Sep 09/05	SCALE N/A REV.
CHECK			
 Golder Associates LONDON, ONTARIO		FIGURE A-4	



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	307	3	184.8
■	308	3	185.0
▲	309	6	182.5
+	310	2	185.6
◆	311	5	183.3
◇	312	4	183.7

PROJECT			
WINDSOR SOUTH COMMER. VEHICLE INSP. STATION WP 63-00-00 HWY 401 RECONSTRUCTION			
TITLE			
GRAIN SIZE DISTRIBUTION SILTY CLAY TILL			
PROJECT No. 05-1130-031-1-TIS		FILE No. 05-1130-031-1-T.GPJ	
SCALE		N/A	
DRAWN AG		Sep 15/05	
CHECK		Sep 15/05	
Golder Associates LONDON, ONTARIO		FIGURE A-5	




LEGEND

	SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
CLAYEY FILL	▲	303	2	36.6	16.1	20.5
SILTY CLAY TILL	●	301	3	37.7	17.1	20.6
	■	302	4	35.6	17.4	18.2
	+	303	5	35.7	17.0	18.7
	◆	304	3	38.7	16.6	22.1
	◇	304	6	33.8	15.6	18.2
	○	306	4	35.3	18.7	16.6
	△	307	3	37.2	16.2	21.0
	⊗	309	6	33.5	17.5	16.0
	⊕	310	2	39.0	17.7	21.3
	□	310	5	33.8	16.6	17.2
CLAYEY SILT TILL	⊙	311	3	22.2	12.1	10.1

PROJECT
WINDSOR SOUTH COMMER. VEHICLE INSP.STATION
WP 63-00-00
HWY 401 RECONSTRUCTION

TITLE
PLASTICITY CHART

	PROJECT No. 05-1130-031-1-TIS		FILE No. 05-1130-031-1-TIS.GPJ	
	DRAWN	Sep 09/05	SCALE	N/A
	CHECK		REV.	
			FIGURE A-6	