

**Golder Associates Ltd.**

2390 Argentia Road  
Mississauga, Ontario, Canada L5N 5Z7  
Telephone: (905) 567-4444  
Fax: (905) 567-6561



**FOUNDATION INVESTIGATION  
AND DESIGN REPORT  
PROPOSED RETAINING WALLS  
QEW WIDENING  
FROM THIRD LINE TO 1 KM EAST OF TRAGALGAR ROAD  
OAKVILLE, ONTARIO  
G.W.P 189-00-01**

Submitted to:

URS Canada Inc.  
75 Commerce Valley Drive East  
Markham, Ontario  
L3T 7N9

**GEOCRES No. 30M5-260**

**DISTRIBUTION:**

- 5 Copies - Ministry of Transportation, Ontario,  
Downsview, Ontario (Central Region)
- 1 Copy - Ministry of Transportation, Ontario,  
Downsview, Ontario (Foundation Section)
- 2 Copies - URS Canada Inc.  
Markham, Ontario
- 2 Copies - Golder Associates Ltd.  
Mississauga, Ontario

September 2009

011-1128-4 RW



## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
 <b>PART A - FOUNDATION INVESTIGATION REPORT</b>	
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION .....	1
3.0 INVESTIGATION PROCEDURES .....	2
4.0 SITE GEOLOGY AND STRATIGRAPHY .....	3
4.1 Regional Geological .....	3
4.2 Subsurface Conditions.....	3
4.2.1 Asphalt .....	4
4.2.2 Fill .....	4
4.2.3 Clayey Silt to Silty Clay .....	5
4.2.4 Silty Sand and Gravel Till .....	5
4.2.5 Clayey Silt Till .....	6
4.2.6 Clayey Silt Residual Soil.....	6
4.2.7 Bedrock .....	7
4.3 Groundwater Conditions .....	7
5.0 CLOSURE .....	8

In Order  
Following  
Page 8

Lists of Abbreviations and Symbols

Records of Boreholes Sheets

F7, H7, W1 and W2, W4 and W5, W9, W11 and W12, W14 to W16, W18 to W40

Drawings 1 to 7

Figures 1 to 11

Appendices A to C

## LIST OF DRAWINGS

Drawing 1	QEW Retaining Walls – From Third Line to 1 km East of Trafalgar Road Borehole Locations
Drawing 2	QEW Retaining Walls – From Third Line to 1 km East of Trafalgar Road Borehole Locations
Drawing 3	QEW Retaining Wall 1– Soil Strata
Drawing 4	QEW Retaining Walls 2, 3 and 4 – Soil Strata
Drawing 5	QEW Retaining Wall 5 – Soil Strata
Drawing 6	QEW Retaining Wall 6 – Soil Strata
Drawing 7	QEW Retaining Walls 7 and 8 – Soil Strata

**LIST OF FIGURES**

Figure 1	Grain Size Distribution – Clayey Silt to Silty Sand (Fill)
Figure 2	Plasticity Chart – Clayey Silt (Fill)
Figure 3	Grain Size Distribution – Clayey Silt to Silty Clay
Figure 4	Plasticity Chart – Silty Clay
Figure 5	Grain Size Distribution – Silty Sand and Gravel (Till)
Figure 6	Grain Size Distribution – Sandy Silt
Figure 7	Grain Size Distribution – Clayey Silt (Till)
Figure 8	Plasticity Chart – Clayey Silt (Till)
Figure 9	Grain Size Distribution – Clayey Silt (Residual Soil)
Figure 10	Plasticity Chart – Clayey Silt (Residual Soil)
Figure 11	Plasticity Chart – Shale Bedrock

**LIST OF APPENDICES**

Appendix A	Records of Borehole 1 to 3 and 6 to 8, 1975 Investigation by MTO
Appendix B	Record of Borehole BH1, 1999 Investigation by Golder Associates
Appendix C	Records of Borehole BH05-1 to BH05-3, 2005 Investigation by Golder Associates

September 2009

011-1128-4 RW

**PART A**  
**FOUNDATION INVESTIGATION REPORT**  
**PROPOSED RETAINING WALLS**

**QEW WIDENING**  
**FROM THIRD LINE TO 1 KM EAST OF TRAFALGAR ROAD**  
**OAKVILLE, ONTARIO**  
**G.W.P 189-00-01**

**Golder Associates**

## 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by URS Canada Inc. (URS) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out a foundation investigation for the detail design of the proposed Retaining Walls along the Queen Elizabeth Way (QEW) between Third Line and 1 km east of Trafalgar Road in Oakville, Ontario. This work forms part of the overall project which includes widening of the QEW, twinning of the Sixteen Mile Creek bridge structure, replacement of the Fourth Line bridge, construction of new high mast light poles and culvert extensions.

This report addresses the foundation investigation of the alignment of proposed retaining walls along the QEW from about Third Line to 1 km east of Trafalgar Road. Foundation investigations were carried out by Golder in 2006/2007 as part of the overall scope of work for the widening of the QEW. For this report, borehole data from the current investigation have been supplemented with information from the following previous geotechnical investigations:

- *Foundation Investigation Report for W.P. 125-66-02 & 03, Site 10-275, QEW District 4, Dorval Drive Underpass, 0.4 mile West of Kerr St. Interchange*, dated 1975. Geocres No. 30M5-101.
- *Geotechnical Investigation – Proposed Watermain Replacement, Oakville, Ontario*, by Golder Associates Ltd., dated November 1999. Report No. 991-1174. \*\*
- *Geotechnical Investigation, North Service Road Watermain Relocation Project (Phase 3), Sixth Line to East of Trafalgar Road, Oakville, Ontario*, prepared by Golder Associates Ltd., dated December 2005. Report No. 04-1111-012B-1. \*\*

\*\* *Permission obtained from the Regional Municipality of Halton to use the geotechnical data.*

The terms of reference for the scope of work are outlined in Golder's proposal P01-1104, dated March 2000, that forms part of the Consultant's Agreement (Number 2005-A-000219) for this project. A digital file of the General Arrangement plan showing the extent and location of the proposed retaining walls was provided to Golder by URS in December 2006.

## 2.0 SITE DESCRIPTION

The project study area extends along the QEW from Third Line to approximately 1 km east of Trafalgar Road in the Town of Oakville. The existing QEW road grade in this area varies from about Elevation 106 m in the vicinity of Trafalgar Road to Elevation 115 m in the vicinity of Dorval Drive and then to Elevation 110 m between Fourth Line and Third Line. It appears that the roadway was constructed generally at the level of the original ground with very little cut or

fill except perhaps adjacent to Dorval Drive. In this area, the original ground surface rises to the north to about Elevation 120 m immediately north of the interchange ramps and there appears to have been some cutting and some filling during the bridge and ramp construction.

### **3.0 INVESTIGATION PROCEDURES**

The borehole investigation program was carried out along the QEW between December 12, 2006 and December 22, 2006, during which time thirty-three boreholes (Boreholes W1 and W2, W4 and W5, W9, W11 and W12, W14 to W16 and W18 to W40) were advanced along the alignments of the proposed retaining walls. In addition, Boreholes F7 and H7 advanced as part of the overall QEW widening have also been incorporated into this report for the proposed retaining walls. The locations of the boreholes are shown on the attached Drawings 1 and 2.

The borehole investigation was carried out using a truck-mounted CME 75 drill rig, supplied and operated by Geo-Environmental Drilling Ltd. of Milton, Ontario. The boreholes were advanced through the overburden using 100 mm outside diameter (O.D.) continuous flight solid stem augers. Soil samples were obtained at 0.76 m and 1.5 m intervals of depth, using 50 mm outer diameter split-spoon samplers driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures.

The boreholes were advanced to depths ranging from 2.5 m to 7.7 m below the existing ground surface. The water level in the open boreholes was observed throughout the drilling operations, and standpipe piezometers were installed in Boreholes W9, W11, W20, W25 and W35 to permit monitoring of the groundwater level at the site. Details of the piezometer installation are shown on the relevant borehole records. Where no piezometer was installed, the boreholes were backfilled using bentonite pellets in accordance with the requirements of Ontario Regulation 903. The water level information upon completion of drilling is presented on the Record of Borehole sheets that follow the text of this report.

The field work was supervised throughout by a member of Golder's technical staff, who located the boreholes, arranged for the clearance of underground service locations, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory classification testing on selected soil samples which includes water contents, Atterberg limits and grain size distributions. All of the laboratory tests were carried out to MTO and/or ASTM Standards as appropriate.

The as-drilled borehole locations and ground surface elevations were measured by Golder relative to survey stakes established in the field by Callon Dietz Inc. The borehole positions are in terms

of MTM NAD83 northing and easting coordinates; this information together with the ground surface elevation (referenced to geodetic datum) are presented on the Records of Borehole sheets that follow the text of this report and on Drawings 1 and 2.

The coordinates (northing and easting) of boreholes from previous investigations have been converted to the MTM NAD83 system, including the boreholes put down for the investigation of the watermain replacement/relocation which were converted from the Region of Halton coordinate system.

## **4.0 SITE GEOLOGY AND STRATIGRAPHY**

### **4.1 Regional Geological**

The site is located in the physiographic region known as the Iroquois Plain. The Iroquois Plain is generally composed of shallow deposits of sand and till covering portions between Hamilton and Toronto<sup>1</sup>. The surface topography slopes down gradually and fairly uniformly towards Lake Ontario. The overburden in the general area of the site consists of a shallow cover of clayey silt till and residual soil which is underlain by bedrock comprised of red shale of the Queenston Formation.

### **4.2 Subsurface Conditions**

The detailed subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced during the current investigations, together with the results of the laboratory tests carried out on selected soil samples, are given on the attached Record of Borehole sheets and on Figures 1 to 10 following the text of this report. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests (SPTs). These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations. The inferred soil stratigraphy based on the results of the boreholes are shown on Drawings 3 through 7.

In addition to the current borehole investigation results, use has been made of seven boreholes put down during previous investigations in this area as referenced in Section 1.0 and as noted below. The locations of these boreholes are also shown on Drawings 1 and 2.

- Boreholes 1 to 3, 6 to 8: *1975 Foundation Investigation Report*. Geocres No. 30M5-101.

---

<sup>1</sup> Chapman, L.J. and Putnam, D.F., 1984. The Physiography of Southern Ontario, 3<sup>rd</sup> Edition (Ontario Geological Survey, Special Volume 2). Ontario Ministry of Natural Resources.

- Borehole BH1: 1999 *Geotechnical Investigation* by Golder Associates Ltd. Report No. 991-1174.
- Boreholes BH05-1 to BH05-3: 2005 *Geotechnical Investigation*, by Golder Associates Ltd. Report No. 04-1111-012B-1.

In general, the subsoils at the site consist of a layer of asphalt and road base granular fill, underlain by fill materials of varying composition. The fill is typically underlain by clayey silt till, silty sand and gravel till and/or clayey silt residual soil, and shale bedrock of the Queenston Formation.

#### **4.2.1 Asphalt**

The boreholes put down through the existing roadway/shoulder (Boreholes W1 and W2, W4, W11 and W12, W14, W18 to W34, W36, W39 and W40) penetrated between 60 mm and 200 mm of asphalt pavement.

#### **4.2.2 Fill**

A 0.3 m to 2.8 m thick layer of fill of varying composition was encountered either immediately below the asphalt pavement or at ground surface in all of the boreholes except at Borehole W9 where it was encountered below 0.2 m thick layer of topsoil. The base of the fill extends to between Elevation 104.0 m and Elevation 113.6 m. The fill consists of a upper layer of sand and gravel containing trace to some silt and trace organics, to silty sand containing trace to some gravel and brick fragments, and/or sandy silt containing trace gravel and organics. In Boreholes H7, W9, W11, W12, W14, W18, W19, W21, W22, W36 and W39, the sand and gravel and sandy silt fill was underlain by a 0.4 m to 1.5 m thick layer of clayey silt fill. Interlayers of sand and gravel and clayey silt were encountered in Boreholes W11 and W12.

The measured Standard Penetration Test (SPT) 'N' values within the sand and gravel to sandy silt fill typically ranged between 4 and 74 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The measured SPT 'N' values within the clayey silt fill typically ranged between 4 and 26 blow per 0.3 m of penetration, and as high as 50 blows per 0.13 m of penetration, indicating a soft to hard consistency.

Measured water contents of selected samples of the fill ranged between 3 percent and 22 percent, with the higher water content values measured in the cohesive fill deposits.



Grain size distribution analyses were carried out on a sample of the silty sand fill and a sample of the clayey silt fill and the test results are presented on Figure 1. Atterberg limits testing carried out on two samples of clayey silt fill yielded liquid limits of 28 percent and 31 percent, plastic limits of 18 percent and 20 percent, corresponding plasticity indices of 10 percent and 11 percent, indicating a clayey silt of low plasticity. The test results are plotted on a plasticity chart on Figure 2.

#### **4.2.3 Clayey Silt to Silty Clay**

A 0.7 m to 0.9 m thick clayey silt to silty clay deposit containing trace sand and gravel and occasional shale fragments was encountered underlying the fill materials in Boreholes W15, W16, W37 and W38. The surface of the clayey deposit was encountered between Elevation 105.5 m and Elevation 110.6 m.

The Standard Penetration Test (SPT) 'N' values measured within the clayey deposit ranged between 12 and 47 blows 0.3 m of penetration, with values as high as 60 blows per 0.23 m of penetration, indicating a hard consistency.

Measured water contents of selected samples of clayey deposit ranged between 13 percent and 20 percent. Grain Size distribution analysis was carried out on a sample of clayey silt to silty clay and the test results are presented on Figure 3.

Laboratory tests on a sample of silty clay yielded a water content of about 17 percent, a liquid limit of 47 percent, a plastic limit of 24 percent, corresponding to a plasticity index of 23 percent. The Atterberg limits test results presented on Figure 4 classify this material as a silty clay of medium plasticity.

#### **4.2.4 Silty Sand and Gravel Till**

A 2.0 m to 4.7 m thick deposit of silty sand and gravel till containing trace to some clay was encountered underlying the sand and gravel fill in Boreholes W29, W30, W32 and W33 and underlying clayey silt till in Borehole W31. Cobbles and boulders were noted with the till deposit. The surface of the silty sand and gravel deposit was encountered between Elevation 110.1 m and Elevation 113.6 m.

The Standard Penetration Test (SPT) 'N' values measured within the silty sand and gravel deposit ranged between 4 and 90 blows 0.3 m of penetration with values as high as 50 blows per 0.05 m of penetration, indicating a loose to very dense relative density. Measured water contents of selected samples of the silty sand and gravel till ranged between 3 percent and 17 percent.

In Borehole W4, a 0.7 m thick layer of sandy silt containing trace to some clay and rock fragments was penetrated between the clayey silt till and underlying shale bedrock. The measured Standard Penetration Test (SPT) 'N' value within the sandy silt deposit was 50 blows per 0.1 m of penetration, indicating a very dense consistency. Laboratory testing on one sample of sandy silt yielded a water content of about 5 percent.

The grain size distribution analysis on a sample of the silty sand and gravel till and a sample of the sandy silt are presented on Figure 5 and Figure 6, respectively.

#### **4.2.5 Clayey Silt Till**

A 0.4 m to 2.3 m thick deposit of clayey silt till in places grading to a silty clay till containing trace to some sand and trace gravel was encountered in Boreholes W1, W2, W4, W5, W9, W12, W21 to W28, W31, W34, W39 and W40 overlying sandy silt, clayey silt residual soil and/or the shale bedrock. The surface of the till deposit was encountered between Elevation 104.0 m and Elevation 112.3 m in these boreholes.

Measured SPT 'N' values within the till ranged from 18 to 75 blows per 0.3 m of penetration, indicating a very stiff to hard consistency.

Measured water contents from samples of the clayey silt till ranged between 6 percent and 48 percent. Grain size distribution analysis was carried out on one selected samples of the till and the result is presented on Figure 7. Atterberg limits testing carried out on samples measured liquid limits between 27 percent and 32 percent, plastic limits between 18 percent and 21 percent, and corresponding plasticity indices between 9 percent and 11 percent. The test results, which are presented on Figure 8, classify the till as a clayey silt of low plasticity.

#### **4.2.6 Clayey Silt Residual Soil**

About 0.4 m to 1.5 m thick layer of clayey silt residual soil containing trace to some sand and trace gravel was encountered underlying the fill material and/or the clayey silt till deposit in Boreholes H7, W2, W18, W20, W32 and W34 to W38. Cobbles were encountered at the base of the residual soil layer immediately overlying bedrock in Borehole W32. The surface of the clayey silt residual soil deposit was encountered between Elevation 104.8 m and Elevation 109.2 m in these boreholes.

Measured SPT 'N' values within the clayey silt residual soil deposit ranged from 6 and 58 blows per 0.3 m of penetration, with values as high as and 50 blows per 0.07 m of penetration, indicating a very stiff to hard consistency.

Measured water contents of selected samples of the clayey silt residual soil ranged between 8 percent and 17 percent. Grain size distribution analysis was carried out on one sample of the clayey silt residual soil and the result is presented on Figure 8. Atterberg limits testing carried out on two samples yielded liquid limits of 36 percent and 25 percent, plastic limits of 21 percent and 17 percent, with corresponding plasticity indices of 7 percent and 15 percent. The test results, which are presented on Figure 10, classify the residual soil as a clayey silt of low to medium plasticity.

#### **4.2.7 Bedrock**

Shale bedrock was encountered in all boreholes underlying the fill materials, clayey silt, clayey silt till, silty sand and gravel till, sandy silt and clayey silt residual soil between Elevation 103.4 m and Elevation 110.8 m. Hard limestone/siltstone interbeds were present within the shale bedrock during augering and are noted on the Record of Borehole sheets.

The boreholes were advanced into the shale bedrock by augering and split spoon sampling; SPT 'N' values recorded were generally greater than 50 blows per 0.1 m of penetration.

Measured water contents of samples of the shale bedrock ranged between 1 percent and 10 percent. Atterberg limits testing was carried out on a sample of the shale bedrock, as presented on Figure 11, yielded a liquid limit of 36 percent and a plastic limit of 24 percent, corresponding to a plasticity index of 12 percent, indicating that the shale bedrock breaks down to a clayey silt of low to medium plasticity.

### **4.3 Groundwater Conditions**

The water levels in the boreholes were noted during and upon completion of drilling operations; typically, the open boreholes were dry upon completion of drilling. Standpipe piezometers were installed in Boreholes W9, W11, W20, W25 and W35 to permit monitoring of the groundwater levels at the site. Details of the piezometer installations are shown on the Record of Borehole sheets following the text of the report. Typically the water levels measured in the piezometers vary from about 1.9 m to 3.0 m below ground surface. It should be noted that it was not possible to take a water level reading in piezometer W11 due on February 13, 2007 to the frozen conditions in the tubing. The water levels measured in the piezometers are summarised below:

<i><b>Borehole No.</b></i>	<i><b>Ground Surface Elevation</b></i>	<i><b>Depth to Water Level</b></i>	<i><b>Groundwater Elevation</b></i>	<i><b>Date of Measurement</b></i>
W9	107.3 m	2.1 m	105.2 m	February 13, 2007
W11	113.8 m	Frozen		February 13, 2007
W20	110.0 m	3.0 m	107.0 m	February 13, 2007


<i>Borehole No.</i>	<i>Ground Surface Elevation</i>	<i>Depth to Water Level</i>	<i>Groundwater Elevation</i>	<i>Date of Measurement</i>
W25	111.0 m	2.4 m	108.6 m	February 13, 2007
W35	106.0 m	1.9 m	104.1 m	February 13, 2007

The groundwater level is generally close to the overburden/bedrock surface and tends to slope downward both toward the south as well as toward the Sixteen Mile Creek valley. It should be noted that groundwater levels in the area are subject to seasonal fluctuations and precipitation events and may also be affected by housing development and buried services along the QEW right-of-way.


## 5.0 CLOSURE

The field technician supervising the drilling program was Mr. Chris Radway, CET. This report was prepared by Ms. Nikol Kochmanová, EIT, and Mr. Christopher Ng, P.Eng., an intermediate geotechnical engineer, both with Golder Associates Ltd.; the technical aspects were reviewed by Ms. Anne Poschmann, P.Eng, a Principal with Golder Associates Ltd. Mr. Jorge Costa, P.Eng., a Designated MTO Contact for Golder Associates Ltd., conducted a quality control review of the report.

### GOLDER ASSOCIATES LTD.

  
Christopher Ng, P.Eng.  
Geotechnical Engineer



  
Anne S. Poschmann, P.Eng.  
Principal

  
Jorge M.A. Costa, P.Eng.  
Principal, Designated MTO Contact



NK/CN/ASP/JMAC/al

N:\Active\2001\1100\011-1128\Reporting\Retaining Walls\Final\011-1128 FINAL 07Mar13 Retaining Walls.doc

## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

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

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

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

#### Consistency

	$c_u, s_u$	kPa	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

#### 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 cm<sup>2</sup> 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 <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	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 <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	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

$\pi$	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

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\epsilon$	linear strain
$\epsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	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
$\gamma'$	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
$\sigma'_p$	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

$\tau_p, \tau_r$	peak and residual shear strength
$\phi'$	effective angle of internal friction
$\delta$	angle of interface friction
$\mu$	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  $\rho$ . Unit weight symbol is  $\gamma$  where  $\gamma = \rho g$  (i.e. mass density x acceleration due to gravity)

PROJECT 011-1128			RECORD OF BOREHOLE No F7			1 OF 1 METRIC												
G.W.P. 189-00-01			LOCATION N 4810992.0 ; E 287842.0			ORIGINATED BY SB												
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY SEP												
DATUM Geodetic			DATE November 29, 2001			CHECKED BY ASP												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ		
110.1	GROUND SURFACE							20 40 60 80 100										
109.5	TOPSOIL Silty clay (FILL) Brown																	
109.5	Weathered, red-brown and grey SHALE BEDROCK (Queenston Formation) with occasional limestone siltstone layers		1	SS	86/25													
109.5			2	SS	50/13													
108.5	Augers grinding at depths of 1.2 m and 2.3 m for 25 mm.																	
107.5			3	SS	50/08													
106.5	Augers grinding at depths of 3.6 m and 4.0 m for 50 mm.																	
105.5	END OF BOREHOLE		4	SS	50/08													
105.5	Notes: 1. Water level in open borehole at a depth of 1.7 m (Elev.108.4 m) upon completion of drilling.																	

PROJECT 011-1128			RECORD OF BOREHOLE No H7			1 OF 1 METRIC												
G.W.P. 189-00-01			LOCATION N 4811344.0 ; E 288142.0			ORIGINATED BY ANB												
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY SEP												
DATUM Geodetic			DATE December 14, 2001			CHECKED BY ASP												
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100	20 40 60 80 100	20 40 60 80 100						10 20 30	10 20 30	10 20 30
112.2 0.0	GROUND SURFACE ASPHALT		1	AS														
	Crushed gravel (FILL) Brown																	
111.4 0.8	Silty sand, trace gravel (FILL) Brown Moist		2	SS	11													
	Clayey silt, trace to some sand, trace gravel (FILL) Stiff to very stiff Brown to red-brown Moist		3	SS	16													
110.1 2.1	CLAYEY SILT, trace sand to some shale fragments (Residual Soil) Firm to stiff Red-brown Moist		4	SS	6													
			5	SS	10													
108.2 4.0	SHALE BEDROCK (Queenston Formation) with occasional grey limestone/siltstone fragments Red-brown and grey		6	SS	50/05													
			7	SS	50/02													
			8	SS	50/02													
104.6 7.6	END OF BOREHOLE		9	SS	50/02													
Notes: 1. Borehole caved at a depth of 3.6 m upon completion of drilling. 2. Water level in open borehole at a depth of 3.3 m (Elev.108.9 m) upon completion of drilling.																		

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09



PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W1</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813284.1 ; E 289704.1</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 14, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT   LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20	40	60	80	100			W <sub>p</sub>	W	W <sub>L</sub>
106.3	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel, trace silt (FILL) Compact		1	SS	19												
105.6	Reddish brown Moist																
0.7	CLAYEY SILT, some to trace sand, trace gravel, containing sand seams (TILL) Very stiff to hard Reddish brown to grey, mottled Moist		2	SS	22												
			3	SS	33												
103.9	Grinding of augers noted at a depth of 2.29 m		4	SS	50/0.08												
2.4	SHALE BEDROCK Reddish to grey		5	SS	50/0.13												
101.7																	
4.6	END OF BOREHOLE		6	SS	50/0.05												
	Notes:  1. Open borehole dry upon completion of drilling.																

<b>PROJECT</b> 011-1128		<b>RECORD OF BOREHOLE No W2</b>		1 OF 1 <b>METRIC</b>	
<b>G.W.P.</b> 189-00-01		<b>LOCATION</b> N 4813211.6 ; E 289661.9		<b>ORIGINATED BY</b> CR	
<b>DIST</b> 4 HWY QEW		<b>BOREHOLE TYPE</b> CME 75, 100mm O.D. Solid Stem Auger		<b>COMPILED BY</b> NK	
<b>DATUM</b> Geodetic		<b>DATE</b> December 14, 2006		<b>CHECKED BY</b> CN	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								<div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div><div></div><div></div></div>		
106.6	GROUND SURFACE													
0.0	ASPHALT		1	SS	11									
0.2	Sand and gravel, some silt (FILL)													
105.9	Compact Reddish brown													
0.7	Moist		2	SS	33									
	SILTY CLAY, trace to some sand, some gravel (TILL)													
105.1	Stiff		3	SS	72/0.20									
	Reddish brown, grey, mottled													
104.7	Moist													
1.9	CLAYEY SILT, some sand, trace gravel (Residual Soil)		4	SS	50/0.13									
	Hard													
	Reddish-brown, mottled													
	Moist													
	SHALE BEDROCK		5	SS	50/0.08									
	Reddish brown													
	Grinding of augers noted from depths 3.20 m to 3.25 m, 3.81 m to 3.88 m and 4.26 m to 4.29 m													
101.9														
4.7	END OF BOREHOLE		6	SS	50/0.10									
	Notes:  1. Water level in open borehole at a depth of 4.3 m (Elev. 102.3 m) upon completion of drilling.													





MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W4</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813098.4 ; E 289571.9</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 14, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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	100	W <sub>p</sub>	W	W <sub>L</sub>						
108.8	GROUND SURFACE																				
0.0	ASPHALT		1	SS	9																
0.2	Silty sand, trace to some gravel, contains brick fragments (FILL) Loose																				
107.9	Brown to dark brown Moist		2	SS	36																
0.9	CLAYEY SILT, trace sand, trace gravel, contains cobbles (TILL)																				
107.3	Hard		3	SS	50/0.10																
1.5	Moist																				
106.6	SANDY SILT, trace to some clay, contains rock fragments																				
2.2	Very dense Brown Moist		4	SS	50/0.08																
	Grinding of augers noted at depths of 1.82 m to 1.98 m and 2.13 m to 2.18 m		5	SS	50/0.13																
	SHALE BEDROCK Reddish brown																				
	Grinding of augers noted at a depth of 2.89 m																				
104.2	END OF BOREHOLE		6	SS	50/0.05																
4.6	Notes:  1. Open borehole dry upon completion of drilling.																				

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W5</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813038.0 ; E 289523.3</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 12, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  w <sub>p</sub>	NATURAL MOISTURE CONTENT  w	LIQUID LIMIT  w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	× REMOULDED									
107.5	GROUND SURFACE																			
0.0	Silty sand and gravel (FILL) Loose to compact Brown Moist		1	SS	5															
106.4			2	SS	10															
106.1	Sandy silt, trace gravel, contains topsoil (FILL) Compact																			
1.4	Brown to dark brown Moist to wet		3	SS	50															
105.6	CLAYEY SILT, trace sand, trace gravel (TILL) Hard																			
1.9	Reddish brown to grey, mottled Moist to wet		4	SS	55/0.13															
105.0	SHALE BEDROCK Reddish brown																			
2.5	Grinding of augers noted at depths 1.98 to 2.08 m END OF BOREHOLE																			
	Notes:  1. Water level in open borehole at a depth of 1.8 m (perched) during drilling.  2. Water level in open borehole at a depth of 1.8 m (Elev. 105.7 m) upon completion of drilling.																			

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09







PROJECT 011-1128			RECORD OF BOREHOLE No W9			1 OF 1 METRIC												
G.W.P. 189-00-01			LOCATION N 4812803.2; E 289325.0			ORIGINATED BY CR												
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK												
DATUM Geodetic			DATE December 12, 2006			CHECKED BY CN												
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ				
107.3 0.0	GROUND SURFACE TOPSOIL		1	SS	8		107											
106.8 0.6	Sandy silt, trace gravel, trace organics (FILL) Loose Brown Moist Clayey silt, trace to some sand, some gravel, contains topsoil (FILL) Firm Brown Moist to wet		2	SS	7		106											
105.1 2.2	CLAYEY SILT, some sand, some gravel, contains cobbles (TILL) Hard Reddish brown Wet		3	SS	50/0.13		105											
104.1 3.2	SHALE BEDROCK Reddish brown		4	SS	46		104											
102.5 4.8	Grinding of augers noted at depths 4.57 m to 4.65 m Auger refusal at a depth of 4.78 m END OF BOREHOLE		5	SS	55/0.08		103											
	Notes:  1. Water level in open borehole at a depth of 1.5 m during drilling.  2. Water level in open borehole at a depth of 2.1 m (Elev. 105.2 m) upon completion of drilling.  3. Water level in piezometer at a depth of 2.1 m (Elev. 105.2 m) on February 13, 2007.		6	SS	50/0.08													

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT		RECORD OF BOREHOLE				No W11		1 OF 1		METRIC						
G.W.P. 189-00-01		LOCATION		N 4811415.8 ; E 288196.7				ORIGINATED BY CR								
DIST 4 HWY QEW		BOREHOLE TYPE		CME 75, 100mm O.D. Solid Stem Auger				COMPILED BY NK								
DATUM Geodetic		DATE		December 19, 2006				CHECKED BY CN								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
113.8 0.0	GROUND SURFACE ASPHALT						20	40	60	80	100					
113.3 0.5	Sand and gravel (FILL) Compact Brown Moist		1	SS	33											
112.3 1.5	Clayey silt, some sand, contains topsoil (FILL) Firm Reddish brown Wet		2	SS	6											
111.5 2.3	Silty sand, trace to some gravel (FILL) Loose Reddish brown Wet		3	SS	4											
110.8 3.0	Clayey silt, some sand, some gravel (FILL) Very stiff Brown to reddish brown Wet		4	SS	18											
	SHALE BEDROCK Reddish brown to grey, contains limestone inclusions		5	SS	50/0.1											
			6	SS	50/0.07											
107.7 6.2	END OF BOREHOLE		7	SS	50/0.06											
Notes: 1. Water level in open borehole at a depth of 0.8 m (perched) during of drilling. 2. Water level in open borehole at a depth of 0.8 m (Elev. 113.0 m) upon completion of drilling. 3. Tubing frozen on February 13, 2007.																

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W12</b>			1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4811376.0 ; E 288165.0</u>		ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>		DATE <u>December 19, 2006</u>		CHECKED BY <u>CN</u>		









  

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE "N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>				
112.7 0.0	GROUND SURFACE ASPHALT												
112.2 0.5	Sand and Gravel, (FILL) Compact Brown Moist		1	SS	27								
111.2 1.5	Clayey silt, with gravel, some sand, some cobbles (FILL) Very stiff Dark brown Moist		2	SS	26								
110.6 2.5	Silty sand, some clay, some gravel (FILL) Stiff Reddish brown Moist		3	SS	9								
110.2 2.5	CLAYEY SILT, some sand, trace gravel, contains cobbles (TILL) Stiff Reddish brown Moist		4	SS	65/0.29								
108.1 4.6	SHALE BEDROCK Grey to reddish brown		5	SS	50/0.07								
108.1 4.6	END OF BOREHOLE		6	SS	50/0.05								
Notes: 1. Open borehole dry upon completion of drilling.													

PROJECT		RECORD OF BOREHOLE				No W14		1 OF 1		METRIC						
G.W.P. 189-00-01		LOCATION		N 4811278.5 ; E 288084.8				ORIGINATED BY CR								
DIST 4 HWY QEW		BOREHOLE TYPE		CME 75, 100mm O.D. Solid Stem Auger				COMPILED BY NK								
DATUM Geodetic		DATE		December 19, 2006				CHECKED BY CN								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 × REMOULDED								
111.5	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel (FILL) Compact Brown Moist		1	SS	22		111									
			2	SS	9											
110.1							110									
1.4	Clayey silt, some sand, some gravel, contains topsoil (FILL) Very stiff to hard Brown to dark-brown Moist		3	SS	17											
			4A	SS	43		109									
108.9	SHALE BEDROCK, occasional limestone inclusions Grey to reddish brown		4B													
2.6			5	SS	50/0.07		108									
	Grinding of augers noted at depths 3.96 m, 4.06 m, 4.47 and 4.87 m		6	SS	50/0.07		107									
							106									
105.4	Grinding of augers noted at depths 5.64 m and 5.79 m															
6.2	END OF BOREHOLE		7	SS	50/0.08											
	Notes:  1. Water level in open borehole at a depth of 2.3 m (perched) during drilling.  2. Open borehole dry upon completion of drilling.															



PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W15</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4811217.7 ; E 288034.7</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 19, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT   LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	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   x REMOULDED								
110.9	GROUND SURFACE						20	40	60	80	100					
0.0	Sand and Gravel, (FILL) Compact Brown Moist		1	SS	20											
110.4	CLAYEY SILT, trace sand Hard Reddish brown, mottled Moist		2	SS	47											
109.5	SHALE BEDROCK Grey to reddish brown		3	SS	50/0.11											
1.4			4	SS	50/0.13											
			5	SS	50/0.07											
																
																
106.3	END OF BOREHOLE		6	SS	50/0.05											
4.6	Notes:  1. Open borehole dry upon completion of drilling.															

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W16</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4811151.7 ; E 287984.2</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 19, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE "N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED				WATER CONTENT (%) 10 20 30 W <sub>p</sub> — W — W <sub>L</sub>				
111.1	GROUND SURFACE														
0.0	Sand and gravel (FILL)		1	SS	16										
110.6	Compact Brown Moist														
0.5	CLAYEY SILT to SILTY CLAY, trace sand		2	SS	33										
109.7	Hard Reddish brown to grey Moist		3	SS	50/0.13										
1.4	SHALE BEDROCK, occasional limestone inclusions Grey to reddish brown		4	SS	50/0.13										
			5	SS	71/0.25										
	Grinding of augers noted at depths 4.11 m to 4.26 m depth														
106.5			6	SS	50/0.08										
4.7	END OF BOREHOLE														
Notes: 1. Water level in open borehole at a depth of 2.7 m (Elev. 108.4 m) upon completion of drilling.															

PROJECT 011-1128			RECORD OF BOREHOLE No W18			1 OF 1 METRIC							
G.W.P. 189-00-01			LOCATION N 4810943.8 ; E 287813.3			ORIGINATED BY CR							
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK							
DATUM Geodetic			DATE December 17, 2006			CHECKED BY CN							
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
110.4	GROUND SURFACE												
0.0	ASPHALT		1	SS	35								
0.2	Sand and gravel (FILL)												
0.6	Compact Brown Moist		2	SS	12								
109.8	Clayey silt, trace to some sand, trace gravel, contains topsoil (FILL)												
109.0	Very stiff to stiff												
1.4	Reddish brown, grey, mottled Moist		3	SS	71/0.29								
108.3	CLAYEY SILT, trace to some sand, trace gravel (Residual Soil)												
2.1	Hard Reddish brown Moist		4	SS	50/0.13								
	SHALE BEDROCK												
	Reddish brown		5	SS	50/0.08								
105.7	END OF BOREHOLE		6	SS	50/0.08								
4.7	Notes: 1. Water level in open borehole at a depth of 2.7 m during drilling. 2. Water level in open borehole at a depth of 2.7 m (Elev. 107.7 m) upon completion of drilling.												


PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W19</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4810904.9 ; E 287778.8</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 17, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT   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 (%)				
								20   40   60   80   100	W <sub>p</sub>	W	W <sub>L</sub>			
							○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED							
110.5	GROUND SURFACE													
0.0	ASPHALT													
0.2	Sand and gravel (FILL) Compact to loose		1	SS	18									
109.7	Brown													
0.8	Moist													
	Clayey silt to silty clay, contains topsoil (FILL) Firm to stiff Reddish brown, grey, mottled		2	SS	7									
	Moist													
			3	SS	12									
108.2														
2.3	SHALE BEDROCK, contains limestone inclusions Reddish brown to grey		4	SS	50/0.08									
			5	SS	50/0.15									
105.8	Grinding of augers noted at a depth of 4.27 m													
4.7	END OF BOREHOLE		6	SS	50/0.08									
	Notes:  1. Open borehole dry upon completion of drilling.													

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT 011-1128			RECORD OF BOREHOLE No W20			1 OF 1 METRIC													
G.W.P. 189-00-01			LOCATION N 4810742.6 ; E 287646.8			ORIGINATED BY CR													
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK													
DATUM Geodetic			DATE December 18, 2006			CHECKED BY CN													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ					
110.0	GROUND SURFACE							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	W <sub>p</sub> — W — W <sub>L</sub>	10 20 30	kN/m <sup>3</sup>	GR SA SI CL					
0.0	ASPHALT								● QUICK TRIAXIAL	× REMOULDED									
109.5	Sand and gravel (FILL) Compact Brown Moist		1	SS	23														
0.8	Silty sand, trace clay, some gravel (FILL) Compact Brown Moist		2	SS	19		109												
			3	SS	81/0.23														
107.7	CLAYEY SILT, trace sand, contains shale fragments below 1.52 m (Residual Soil) Very stiff to hard Grey-reddish brown, mottled Moist		4	SS	50/0.05		108												
2.3	SHALE BEDROCK contains limestone inclusions Reddish brown to grey		5	SS	50/0.05		107												
	Grinding of augers noted at depths of 2.74 m to 2.79 m						106												
			6	SS	50/0.08		105												
	Grinding of augers noted at depths of 4.72 m, 5.18 m, 5.64 m and 5.79 m						104												
			7	SS	50/0.06		103												
102.4	END OF BOREHOLE																		
7.6	Notes:  1. Water level in open borehole at a depth of 3.4 m (perched) during drilling.  2. Water level in open borehole at a depth of 4.6 m (Elev. 105.4 m) upon completion of drilling.  3. Water level in piezometer at a depth of 3.0 m depth (Elev. 107.0 m) on February 13, 2007.																		

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT 011-1128			RECORD OF BOREHOLE No W21			1 OF 1 METRIC					
G.W.P. 189-00-01			LOCATION N 4810709.7 ; E 287616.7			ORIGINATED BY CR					
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK					
DATUM Geodetic			DATE December 18, 2006			CHECKED BY CN					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W    LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
109.8	GROUND SURFACE										
0.0	ASPHALT										
109.4	Sand and gravel (FILL)		1	SS	20	▽					
0.4	Compact Brown Moist CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to hard Grey to reddish brown Moist		2	SS	9		109				
			3	SS	34		108				
107.6	SHALE BEDROCK contains limestone inclusions Brown to grey		4	SS	90/0.23		107				
2.2			5	SS	50/0.08		106				
	Grinding of augers noted at depths of 3.81 m to 3.84 m and 3.96 m										
105.2	END OF BOREHOLE		6	SS	50/0.08						
4.7	Notes: 1. Water level in open borehole at a depth of 0.5 m (perched) during drilling. 2. Water level in open borehole at a depth of 0.5 m (Elev. 109.3 m) upon completion of drilling.										

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W22</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4810674.5 ; E 287584.4</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 17, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE "N" VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W   W <sub>L</sub>	10 20 30			
109.7	GROUND SURFACE				▽								
0.0	ASPHALT												
	Sand and gravel (FILL) Compact Brown Moist		1	SS 14									
108.9													
0.8	Clayey silt, some sand, some gravel (FILL) Stiff Reddish brown, mottled Moist		2	SS 14									
	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to hard Reddish brown to grey, mottled Moist		3	SS 44									
107.4			4	SS 50/0.13									
2.3	Grinding of augers noted at a depth of 2.29 m SHALE BEDROCK contains limestone inclusions Reddish brown to grey Moist		5	SS 50/0.10									
			6	SS 50/0.07									
105.0	Grinding of augers noted at a depth of 3.81 m		7	SS 50/0.07									
4.7	END OF BOREHOLE												
Notes: 1. Water level in open borehole at a depth of 0.5 m (perched) during drilling. 2. Water level in open borehole at a depth of 0.5 m (Elev. 109.2 m) upon completion of drilling.													

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W23</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4811095.8 ; E 288003.9</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 20, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 × REMOULDED						
109.4	GROUND SURFACE												
0.0	ASPHALT												
0.1	Sand and gravel (FILL)		1	SS 25									
0.6	Compact Grey-brown Moist												
0.8			2	SS 75/0.25									
1.1	CLAYEY SILT, some sand, trace gravel (TILL) Hard Reddish brown Moist												
	SHALE BEDROCK Reddish brown		3	SS 78/0.28									
			4	SS 50/0.13									
	Grinding of augers noted at a depth of 3.05 m		5	SS 50/0.13									
	Grinding of augers noted at a depth of 3.96 m												
104.7			6	SS 50/0.10									
4.7	END OF BOREHOLE												
Notes: 1. Open borehole dry upon completion of drilling.													



PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W24</b>				1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4811151.2; E 288049.9</u>		ORIGINATED BY <u>CR</u>			
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>			
DATUM <u>Geodetic</u>		DATE <u>December 20, 2006</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 × REMOULDED						
110.4	GROUND SURFACE												
0.0	ASPHALT												
109.9	Sand and gravel (FILL) Compact Brown		1	SS 24									
0.5	Moist CLAYEY SILT, some sand, trace gravel (TILL) Very stiff		2	SS 24									
108.9	Reddish brown Moist		3	SS 50/0.13									
1.5	SHALE BEDROCK, contains limestone inclusions Reddish brown to grey		4	SS 50/0.13									
	Grinding of augers noted at depths of 3.20 m to 3.25 m and 3.51		5	SS 50/0.13									
	Grinding of augers noted at a depth of 3.96 m												
105.8	END OF BOREHOLE		6	SS 50/0.08									
4.7	Notes:  1. Open borehole dry upon completion of drilling.												

PROJECT		RECORD OF BOREHOLE		No W25		1 OF 1		METRIC											
G.W.P.		LOCATION		N 4811210.8 ; E 288097.5		ORIGINATED BY		CR											
DIST		HWY		BOREHOLE TYPE		CME 75, 100mm O.D. Solid Stem Auger		COMPILED BY											
DATUM		DATE		December 21, 2006		CHECKED BY		CN											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa			WATER CONTENT (%)			γ					
111.0	GROUND SURFACE		1	SS	50/0.13			20 40 60 80 100	20 40 60 80 100	10 20 30									
0.0	ASPHALT																		
0.2	Sand and gravel, trace silt, zones of clayey silt, contains cobbles (FILL)																		
110.4	Compact to loose																		
0.6	Brown Moist CLAYEY SILT, some sand, trace gravel, contains shale fragments (TILL)		2	SS	18		110												
	Firm to very stiff Reddish brown Moist		3	SS	9		109												
	Cobbles encountered at 0.41 m to 0.61 m, 0.76 m to 1.37 m depth		4	SS	4														
108.3	SHALE BEDROCK, contains limestone inclusions Reddish brown to grey		5	SS	50/0.13		108												
2.7	Grinding of augers noted at depths of 3.66 m, 3.81 m and 3.96 m						107												
106.3	END OF BOREHOLE		6	SS	50/0.13														
4.7	Notes: 1. Water level in open borehole at a depth of 0.8 m during drilling. 2. Open borehole dry upon completion of drilling. 3. Water level in piezometer at a depth of 2.4 m (Elev. 108.6 m) on February 13, 2007																		

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W26</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4811270.5 ; E 288147.2</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 21, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
							20 40 60 80 100		20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
111.3	GROUND SURFACE													
0.0	ASPHALT													
0.1	Sand and gravel (FILL)		1	SS	30									
110.7	Dense Brown													
0.6	Moist CLAYEY SILT, trace sand, trace gravel (TILL)		2	SS	13									
109.8	Stiff Reddish brown													
1.5	Moist SHALE BEDROCK, contains limestone inclusions		3	SS	75/0.28									
	Grey to reddish brown		4	SS	50/0.13									
			5	SS	50/0.14									
106.7	END OF BOREHOLE		6	SS	50/0.08									
4.7	Notes:  1. Open borehole dry upon completion of drilling.													

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W27</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4811323.6 ; E 288190.2</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 21, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	"N" VALUES			SHEAR STRENGTH kPa						
						○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED							
111.7	GROUND SURFACE												
0.0	ASPHALT												
111.2	Sand and gravel, trace silt (FILL)		1	SS 20									
0.5	Compact Brown Moist												
110.3	CLAYEY SILT, some sand, trace gravel (TILL)		2	SS 34									
1.4	Hard Reddish brown Moist		3	SS 50/0.13									
	SHALE BEDROCK, contains limestone inclusions												
	Grey to reddish-brown		4	SS 50/0.15									
	Grinding of augers noted at depths of 2.74 m and 2.89 m												
			5	SS 50/0.08									
	Grinding of augers noted at depths of 3.35 m and 3.51 m depth												
107.0	END OF BOREHOLE		6	SS 50/0.10									
4.7	Notes: 1. Open borehole dry upon completion of drilling.												

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W28</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4811384.0 ; E 288240.1</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 21, 2006</u>		CHECKED BY <u>CN</u>	

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 (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
112.1	GROUND SURFACE							20	40	60	80	100	10	20	30		
0.0	ASPHALT																
0.2	Sand and gravel (FILL) Very dense Brown		1	SS	74												
111.3	Moist		2	SS	81/0.25												
0.8	CLAYEY SILT, some sand, some gravel, contains shale fragments (TILL) Firm to hard Reddish brown Moist		3	SS	21												
	Cobbles encountered at depths 0.91 m to 1.22 m and 1.98 m to 2.13 m		4	SS	7												
109.1	SHALE BEDROCK, contains limestone inclusions Reddish brown		5	SS	50/0.15												
3.0	Grinding of augers noted at depths of 3.66 m and 4.11 m																
107.4	END OF BOREHOLE		6	SS	50/0.1												
4.7	Notes:  1. Water level in open borehole at a depth of 1.8 m (perched) during drilling.  2. Open borehole dry upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE		No W29		1 OF 1		METRIC							
G.W.P. 189-00-01		LOCATION		N 4811442.2 ; E 288288.7		ORIGINATED BY		CR							
DIST 4 HWY QEW		BOREHOLE TYPE		CME 75, 100mm O.D. Solid Stem Auger		COMPILED BY		NK							
DATUM Geodetic		DATE		December 21, 2006		CHECKED BY		CN							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
112.9	GROUND SURFACE														
0.0	ASPHALT														
0.2	Sand and gravel, contains clay pockets, contains occasional cobbles (FILL)		1	SS	42										
112.1	Dense to very dense Brown Moist		2	SS	50/0.15										
0.8	Silty SAND AND GRAVEL, trace clay, trace gravel, contains shale fragments (TILL)														
	Dense to very dense Brown Moist		3	SS	33										
110.1	Cobbles encountered at depths 0.91 m to 1.22 m, 1.98 m to 2.13 m and 2.29 m to 2.89 m		4	SS	4										
2.8	SHAILE BEDROCK, contains limestone inclusions Grey		5	SS	75/0.25										
108.3															
4.7	END OF BOREHOLE		6	SS	50/0.08										
Notes: 1. Water level in open borehole at a depth of 3.05 m (perched) during drilling. 2. Open borehole dry upon completion of drilling.															

PROJECT 011-1128			RECORD OF BOREHOLE No W30			1 OF 1 METRIC													
G.W.P. 189-00-01			LOCATION N 4811495.8 ; E 288334.1			ORIGINATED BY CR													
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK													
DATUM Geodetic			DATE December 21, 2006			CHECKED BY CN													
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)			
112.8	GROUND SURFACE						20	40	60	80	100								
0.0	ASPHALT																		
0.2	Sand and gravel (FILL)		1	SS	32														
112.2	Dense																		
0.6	Brown																		
	Moist																		
	Silty SAND AND GRAVEL, trace to some clay, contains shale fragments (TILL)		2	SS	31														
	Loose to dense																		
	Brown to reddish brown		3	SS	8														
	Moist																		
	Cobbles encountered at depths of 1.22 m to 1.37 m, 1.52 m to 2.13 m and 2.28 m to 2.89 m		4	SS	5											26	42	23	9
109.3			5	SS	7														
3.5	SHALE BEDROCK, contains limestone inclusions																		
	Reddish brown to grey																		
	Grinding of augers noted at depths of 4.72 m and 4.88 m		6	SS	50/0.02														
106.7																			
6.2	END OF BOREHOLE		7	SS	50/0.05														
	Notes:																		
	1. Water level in open borehole at a depth of 2.3 m (perched) during drilling.																		
	2. Open borehole dry upon completion of drilling.																		

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT 011-1128			RECORD OF BOREHOLE No W31			1 OF 1 METRIC										
G.W.P. 189-00-01			LOCATION N 4811557.1 ; E 288388.5			ORIGINATED BY CR										
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK										
DATUM Geodetic			DATE December 21, 2006			CHECKED BY CN										
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)
113.1	GROUND SURFACE						20	40	60	80	100					
0.0	ASPHALT															
0.2	Sand and gravel, some silt, occasional cobbles (FILL)		1	SS	55											
112.3	Very dense															
0.8	Brown Moist		2	SS	18											
	CLAYEY SILT, some sand, some gravel, occasional cobbles (TILL)															
	Very stiff to hard		3	SS	22											
	Brown to reddish brown															
	Moist															
	Cobbles encountered at depths of 1.98 m to 2.44 m, 2.29 m to 2.89 m, 3.05 m to 3.1 m		4	SS	50/0.15											
110.1																
3.1	Silty SAND AND GRAVEL, trace clay, occasional cobbles (TILL)		5	SS	90											
	Very dense															
	Brown															
	Moist															
108.8	Cobbles encountered at depths of 3.1 m to 3.5 m															
4.3	SHALE BEDROCK		6	SS	50/0.05											
	Reddish brown															
	Grinding of augers noted at depths of 4.57 m to 4.78 m															
106.9																
6.2	END OF BOREHOLE		7	SS	50/0.05											
	Notes:  1. Water level in open borehole at a depth of 4.3 m during drilling.  2. Water level in open borehole at a depth of 4.9 m (Elev. 108.2 m) upon completion of drilling.															



PROJECT 011-1128			RECORD OF BOREHOLE No W32			1 OF 1 METRIC													
G.W.P. 189-00-01			LOCATION N 4811615.5 ; E 288440.3			ORIGINATED BY CR													
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK													
DATUM Geodetic			DATE December 22, 2006			CHECKED BY CN													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>			γ					
113.7	GROUND SURFACE							20 40 60 80 100											
0.0	ASPHALT																		
0.2	Sand and gravel (FILL) Very dense Brown Moist		1	SS	51		113												
112.9	Silty SAND AND GRAVEL, trace clay, occasional cobbles and boulders (TILL) Very dense Brown to reddish brown Moist		2	SS	50		112												
0.8	Encountered cobbles at depths of 1.07 m to 1.22 m, 1.52 m to 2.13 m, 2.28 m to 2.3 m, 2.3 m to 2.89 m, 3.35 m to 3.51 m and 3.76 m to 3.96 m		3	SS	58		111												
			4	SS	50/0.05		110												
			5	SS	34		109												
109.7	CLAYEY SILT, trace to some sand, some gravel (Residual Soil) Very stiff Reddish brown Moist		6	SS	24		108												
108.7	Encountered cobbles at depths of 4.57 m to 5.0 m																		
5.0	SHALE BEDROCK Grey to reddish brown																		
107.6	END OF BOREHOLE		7	SS	50/0.07														
6.2	Notes: 1. Open borehole dry upon completion of drilling.																		

PROJECT 011-1128		RECORD OF BOREHOLE No W33				1 OF 1 METRIC										
G.W.P. 189-00-01		LOCATION N 4811645.1 ; E 288469.2		ORIGINATED BY CR												
DIST 4 HWY QEW		BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger		COMPILED BY NK												
DATUM Geodetic		DATE December 22, 2006		CHECKED BY CN												
SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)	
114.4	GROUND SURFACE						20	40	60	80	100					
0.0	ASPHALT															
0.2	Sand and gravel, trace clay, contains clayey silt pockets, contains cobbles (FILL)		1	SS	20											
113.6	Compact Brown to reddish brown Moist		2	SS	50/0.15											
0.8	Silty SAND AND GRAVEL, trace clay, occasional cobbles (TILL) Compact to very dense Brown Moist		3	SS	60											
	Encountered cobbles at depths of 1.07 m to 1.37 m, 1.52 m to 2.13 m, 1.98 m to 2.29 m and 2.29 m to 2.82 m		4	SS	71											
	Grinding of augers noted at depths of 3.65 m to 3.96 m		5	SS	90											
	Grinding of augers noted at depths of 4.27 m to 4.42 m		6	SS	17											
108.9	SHALE BEDROCK Gray to reddish brown Moist															
5.5	Grinding of augers noted at a depth of 5.64 m		7	SS	50/0.13											
106.7	END OF BOREHOLE		8	SS	50/0.08											
7.7	Notes: 1. Open borehole dry upon completion of drilling.															

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W34</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4813711.4 ; E 290128.5</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 15, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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    × REMOULDED				WATER CONTENT (%)						
						20	40	60	80	100	10	20	30			
107.0	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel, trace silt (FILL)		1	SS	16						○					
0.6	Compact Brown Moist															
106.2																
0.8	CLAYEY SILT, some sand, trace gravel (TILL)		2	SS	18											
105.5	Very stiff															
1.5	Reddish brown to grey, mottled Moist		3	SS	39							○			4 5 63 28	
104.9	CLAYEY SILT, some sand (Residual Soil)															
2.1	Hard Reddish brown Moist		4	SS	50/0.13											
	SHALE BEDROCK contains limestone inclusions															
	Reddish brown to grey		5	SS	50/0.07											
	Grinding of augers noted at depths of 2.13 m to 2.29 m, 2.29 m to 2.57 m, 2.89 m to 3.05 m, 3.20 m to 3.25 m, 3.96 m, 4.11 m, 4.47 m		6	SS	50/0.13						○					
103																
102.3																
4.7	END OF BOREHOLE		7	SS	50/0.15											
Notes:																
1. Water level in open borehole at a depth of 3.1 m during drilling.																
2. Water level in open borehole at a depth of 4.4 m (Elev. 102.6 m) upon completion of drilling.																

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W35</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813772.1 ; E 290171.4</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 15, 2006</u>		CHECKED BY <u>CN</u>	





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 (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
106.0	GROUND SURFACE													
0.0	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	16									
105.3														
0.7	CLAYEY SILT, trace sand, trace gravel (Residual Soil) Very stiff to hard Reddish brown to grey Moist		2	SS	24									
			3	SS	58									
103.8														
2.2	SHALE BEDROCK contains limestone inclusions Reddish brown to grey  Grinding of augers noted at depths of 2.20 m to 2.90m, 3.35 m to 3.51 m, 3.66 m to 3.76 m, 4.27 m to 4.37 m, 4.57 m to 4.57 m		4	SS	50/0.13									
			5	SS	50/0.13									
101.4														
4.6	END OF BOREHOLE  Notes:  1. Water level in open borehole at a depth of 1.5 m during drilling.  2. Water level in open borehole at a depth of 1.5 m (Elev. 104.5 m) upon completion of drilling.  3. Water level in piezometer at a depth of 1.9 m (Elev. 104.1 m) on February 13, 2007.		6	SS	50/0.09									

PROJECT <u>011-1128</u>			<b>RECORD OF BOREHOLE No W36</b>			1 OF 1 <b>METRIC</b>		
G.W.P. <u>189-00-01</u>			LOCATION <u>N 4813830.8 ; E 290214.4</u>			ORIGINATED BY <u>CR</u>		
DIST <u>4</u> HWY <u>QEW</u>			BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>			COMPILED BY <u>NK</u>		
DATUM <u>Geodetic</u>			DATE <u>December 15, 2006</u>			CHECKED BY <u>CN</u>		

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 × REMOULDED		WATER CONTENT (%) W <sub>p</sub> — W — W <sub>L</sub>				
106.3	GROUND SURFACE												
0.0	ASPHALT												
0.2	Sand and gravel, trace silt (FILL)		1	SS	15								
105.6	Compact Brown												
0.7	Moist												
104.9	Clayey silt, some sand, trace gravel, trace organics (FILL)		2	SS	26								
1.4	Very stiff												
104.4	Reddish brown to grey		3	SS	50/0.13								
1.9	Moist												
	CLAYEY SILT, some sand, trace gravel (Residual Soil)												
	Hard		4	SS	50/0.08								
	Reddish brown to grey												
	Moist												
	SHALE BEDROCK, contains limestone inclusions		5	SS	50/0.08								
	Reddish brown to grey												
	Grinding of augers noted at depths of 1.88 m to 1.98 m, 2.13 m, 2.29 m to 2.46 m, 2.84 m, 2.95 m to 2.99 m, 3.96 m to 4.06 m and 4.42 m to 4.47 m												
101.7													
4.6	END OF BOREHOLE		6	SS	50/0.02								
Notes: 1. Water level in open borehole at a depth of 2.4 m during drilling. 2. Water level in open borehole at depth of 2.5 m (Elev. 103.8 m) upon completion of drilling.													

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W37</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813890.6 ; E 290260.4</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 15, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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   × REMOULDED		WATER CONTENT (%) W <sub>p</sub> W   W <sub>L</sub>				
106.2	GROUND SURFACE													
0.0	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	21									
105.5														
0.7	SILTY CLAY, some sand Stiff Reddish brown to grey, mottled Moist		2	SS	12									
104.8														
1.4	CLAYEY SILT, some sand, trace gravel (Residual Soil) Hard Reddish brown to grey, mottled Moist		3	SS	40									
104.1														
2.1	SHALE BEDROCK contains limestone inclusions Grey to reddish brown		4	SS	50/0.1									
	Grinding of augers noted at depths of 2.13 m to 2.18 m		5	SS	50/0.07									
	Grinding of augers noted at depths of 2.59 m to 2.64 m, 2.79 m to 2.89 m, and 3.66 m to 3.71 m													
	Grinding of augers noted at depths of 4.27 m to 4.37 m													
101.5														
4.7	END OF BOREHOLE													
	Notes:  1. Water level in open borehole at a depth of 2.6 m during drilling.  2. Water level in open borehole at a depth of 2.4 m (Elev. 103.8 m) upon completion of drilling.													

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09

PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W38</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4813957.8 ; E 290313.0</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 15, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								20   40   60   80   100						
								○ UNCONFINED   + FIELD VANE						
								● QUICK TRIAXIAL   × REMOULDED						
106.1	GROUND SURFACE													
0.0	Silty sand and gravel, contains clayey silt pockets, asphalt fragments (FILL)		1	SS	17									
105.8	Compact Brown Moist		2	SS	60/0.23									
105.0	CLAYEY SILT, some sand Hard Reddish brown-gray mottled Moist		3	SS	50/0.07									
1.1	CLAYEY SILT, trace sand, some to trace gravel (Residual Soil) Hard Reddish brown Moist		4	SS	50/0.07									
104.0	SHALE BEDROCK, contains limestone inclusions Reddish brown to grey		5	SS	50/0.13									
2.1	Grinding of augers noted at depths of 3.35 m to 3.43 m, 3.86 m to 3.94 m, 3.96 m to 4.01 m and 4.11 m													
101.5	END OF BOREHOLE		6	SS	50/0.04									
4.6	Notes:  1. Water level in open borehole at a depth of 2.4 m during drilling.  2. Water level in open borehole at a depth of 4.5 m (Elev. 101.6 m) upon completion of drilling.													

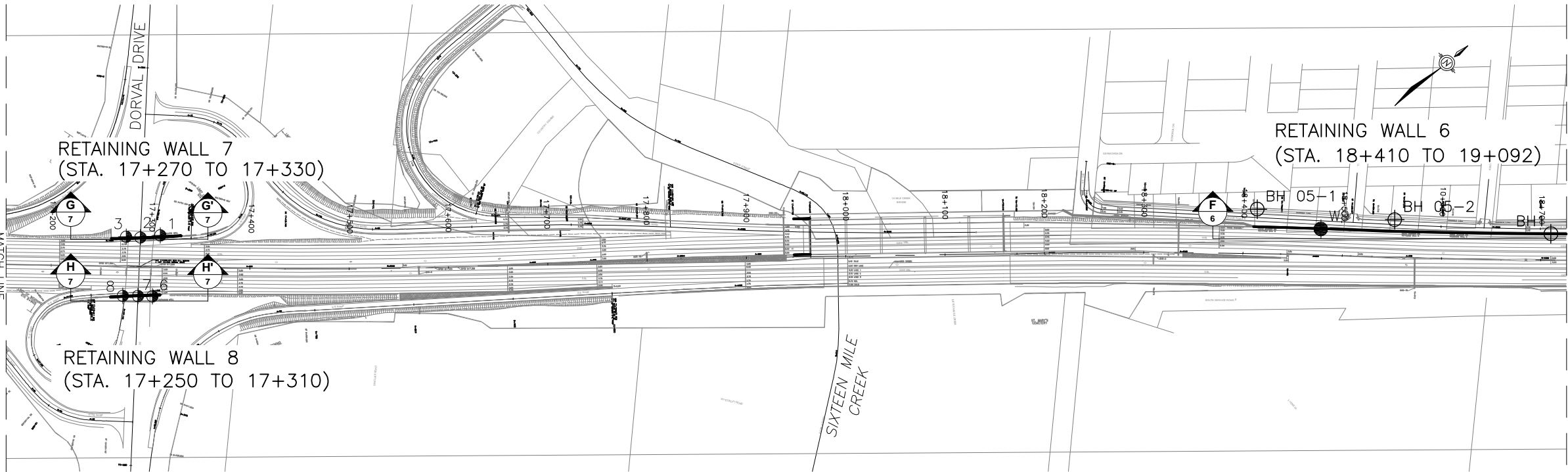
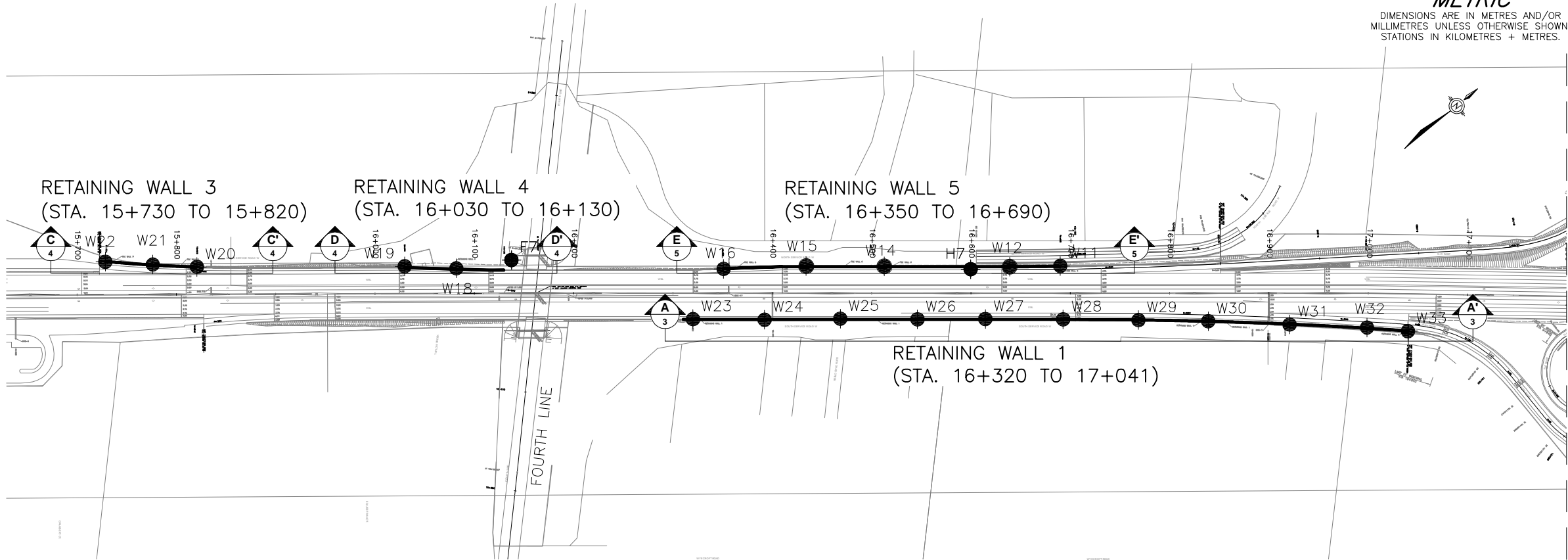
PROJECT 011-1128			RECORD OF BOREHOLE No W39			1 OF 1 METRIC										
G.W.P. 189-00-01			LOCATION N 4814013.0 ; E 290357.6			ORIGINATED BY CR										
DIST 4 HWY QEW			BOREHOLE TYPE CME 75, 100mm O.D. Solid Stem Auger			COMPILED BY NK										
DATUM Geodetic			DATE December 20, 2006			CHECKED BY CN										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 × REMOULDED								
106.2	GROUND SURFACE															
0.0	ASPHALT															
0.2	Sand and gravel, some silt (FILL) Dense to compact Brown Moist		1	SS	36											
			2	SS	13											
104.8																
1.4	Clayey silt to silty clay, trace gravel (FILL) Stiff Reddish brown to grey, mottled Moist		3	SS	14											
104.0																
2.2	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Moist		4	SS	49											
103.4																
2.8	SHAILE BEDROCK, contains limestone inclusions Grey  Grinding of augers noted at depths of 3.51 m to 3.66 m, 3.96 m to 4.06 m and 4.32 m to 4.42 m		5	SS	50/0.15											
			6	SS	50/0.07											
100.0																
6.2	END OF BOREHOLE		7	SS	50/0.05											
	Notes:  1. Water level in open borehole at a depth of 4.0 m during drilling.  2. Water level in open borehole at a depth of 3.3 m (Elev. 102.9 m) upon completion of drilling.															



PROJECT <u>011-1128</u>		<b>RECORD OF BOREHOLE No W40</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>189-00-01</u>		LOCATION <u>N 4814057.8 ; E 290391.4</u>		ORIGINATED BY <u>CR</u>	
DIST <u>4</u> HWY <u>QEW</u>		BOREHOLE TYPE <u>CME 75, 100mm O.D. Solid Stem Auger</u>		COMPILED BY <u>NK</u>	
DATUM <u>Geodetic</u>		DATE <u>December 20, 2006</u>		CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20   40   60   80   100	W <sub>p</sub> W   W <sub>L</sub>						
						○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED									
106.5 0.0	GROUND SURFACE ASPHALT		1	SS	19		106								
106.0 0.6	Sand and gravel (FILL) Compact Brown Moist		2	SS	14										
105.1 1.4	Clayey silt to silty clay, some sand, contains sand pockets (FILL) Stiff Reddish brown to grey Moist		3	SS	60										
104.3 2.2	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Moist		4	SS	50/0.15										
	SHALE BEDROCK, contains limestone inclusions Grey		5	SS	50/0.08										
102.7 3.8	Grinding of augers noted at depths of 2.74 m to 2.89 m, 2.95 m to 2.99 m, 3.2 m to 3.30 m, 3.40 m to 3.50 m and 3.61 m to 3.81 m END OF BOREHOLE		6	SS	50/0.04										
Notes:  1. Open borehole dry upon completion of drilling.															

MIS-MTO 001 011-1128.GPJ GAL-MISS.GDT 21/9/09



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

CONT No.  
GWP No. 189-00-01

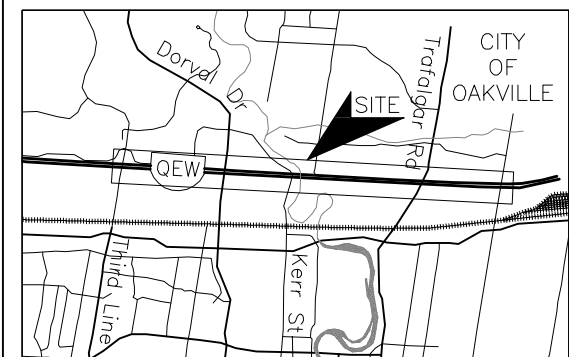
RETAINING WALLS  
QEW WIDENING FROM THIRD LINE TO  
1 KM EAST OF TRAFALGAR ROAD  
BOREHOLE LOCATIONS



SHEET



**Golder Associates Ltd.**  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE  
800 0 800 m

LEGEND

- Borehole - Current Investigation
- Borehole - Previous Golder Investigation
- Borehole - Previous Investigation by Others

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
BH1	107.0	4812979.5	289475.4
BH 05-1	107.3	4812766.4	289268.9
BH 05-2	107.5	4812866.8	289364.8
F7	110.1	4810992.0	287842.0
H7	112.2	4811344.0	288142.0
W9	107.3	4812803.2	289325.0
W11	113.8	4811415.8	288196.7
W12	112.7	4811376.0	288165.0
W14	111.5	4811278.5	288084.8
W15	110.9	4811217.7	288034.7
W16	111.1	4811151.7	287984.2
W18	110.4	4810943.8	287813.3
W19	110.5	4810904.9	287778.8
W20	110.0	4810742.6	287646.8
W21	109.8	4810709.7	287616.7
W22	109.7	4810674.5	287584.4
W23	109.4	4811095.8	288003.9
W24	110.4	4811151.2	288049.9
W25	111.0	4811210.8	288097.5
W26	111.3	4811270.5	288147.2
W27	111.7	4811323.6	288190.2
W28	112.1	4811384.0	288240.1
W29	112.9	4811442.2	288288.7
W30	112.8	4811495.8	288334.1
W31	113.1	4811557.1	288388.5
W32	113.7	4811615.5	288440.3
W33	114.4	4811645.1	288469.2
1	115.7	4811895.1	288589.8
2	115.7	4811878.2	288578.7
3	115.8	4811867.5	288569.0
6	114.5	4811850.1	288632.2
7	114.5	4811839.1	288622.8
8	114.6	4811827.2	288612.8

NOTES

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

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing file no. QEW-EL-LS-MTO-60% and QEW Plan, received on December 20, 2006.

NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY. QEW	PROJECT NO. 011-1128		DIST.
SUBM'D. NK	CHKD. CN	DATE: MAR 2007	SITE:
DRAWN: MSM	CHKD. ASP	APPD. JMAC	DWG. 1

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

CONT No.  
GWP No. 189-00-01



RETAINING WALLS  
QEW WIDENING FROM THIRD LINE TO  
1 KM EAST OF TRAFALGAR ROAD  
BOREHOLE LOCATIONS

SHEET



**Golder Associates Ltd.**  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE  
800 0 800 m

LEGEND

- Borehole - Current Investigation
- ⊕ Borehole - Previous Golder Investigation

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
BH1	107.0	4812979.5	289475.4
BH 05-3	107.0	4813177.3	289609.9
W1	106.3	4813284.1	289704.1
W2	106.6	4813211.6	289661.9
W4	108.8	4813098.4	289571.9
W5	107.5	4813038.0	289523.3
W34	107.0	4813711.4	290128.5
W35	106.0	4813772.1	290171.4
W36	106.3	4813830.8	290214.4
W37	106.2	4813890.6	290260.4
W38	106.1	4813957.8	290313.0
W39	106.2	4814013.0	290357.6
W40	106.5	4814057.8	290391.4

NOTES

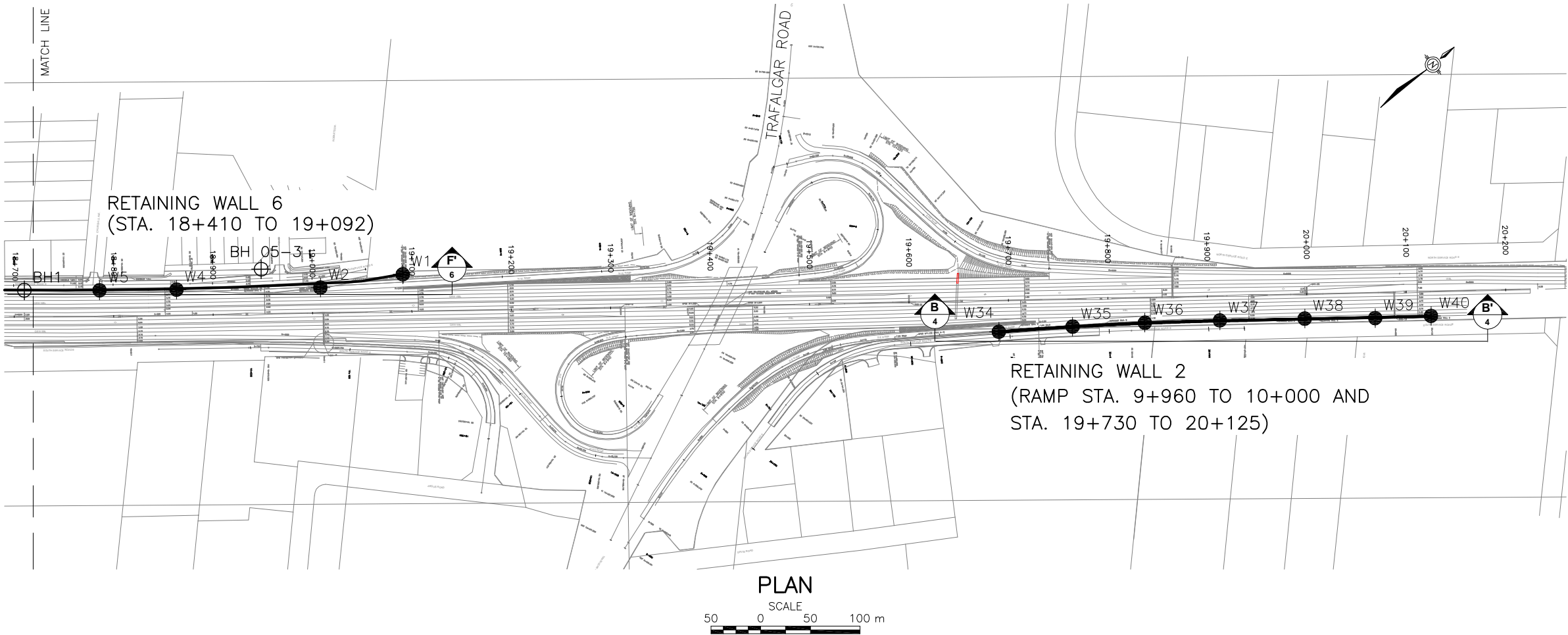
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by URS, drawing file no. QEW-EL-LS-MT0-60% and QEW Plan, received on December 20, 2006.

NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY. QEW	PROJECT NO. 011-1128		DIST.
SUBM'D. NK	CHKD. CN	DATE: MAR 2007	SITE:
DRAWN: MSM	CHKD. ASP	APPD. JMAC	DWG. 2

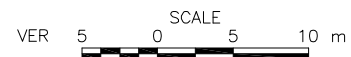


PLAN

SCALE  
50 0 50 100 m

SHEET

NO.		DATE		BY		REVISION	
Geocres No. 30M5-260							
HWY. QEW				PROJECT NO. 011-1128			DIST.
SUBM'D. NK		CHKD. CN		DATE: MAR 2007			SITE:
DRAWN: MSM		CHKD. ASP		APPD. JMAG			DWG. 3



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

CONT No.  
GWP No. 189-00-01

RETAINING WALLS 2, 3 AND 4  
RW2 (RAMP STA. 9+960 TO 10+000 AND  
STA. 19+730 TO 20+125)  
RW3 (STA. 15+730 TO 15+820)  
RW4 (STA. 16+030 TO 16+130)  
SOIL STRATA

SHEET



**Golder Associates Ltd.**  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN  
SCALE  
800 0 800 m

## LEGEND

- Borehole - Current Investigation
- Seal
- Piezometer
- Standard Penetration Test Value
- Blows/0.3m unless otherwise stated  
(Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on Feb. 13, 2007
- WL upon completion of drilling

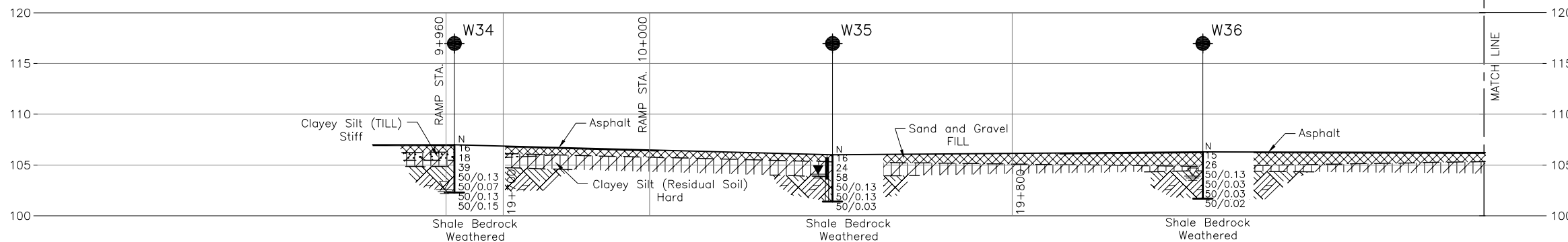
No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
F7	110.1	4810992.0	287842.0
W18	110.4	4810943.8	287813.3
W19	110.5	4810904.9	287778.8
W20	110.0	4810742.6	287646.8
W21	109.8	4810709.7	287616.7
W22	109.7	4810674.5	287584.4
W34	107.0	4813711.4	290128.5
W35	106.0	4813772.1	290171.4
W36	106.3	4813830.8	290214.4
W37	106.2	4813890.6	290260.4
W38	106.1	4813957.8	290313.0
W39	106.2	4814013.0	290357.6
W40	106.5	4814057.8	290391.4

## NOTES

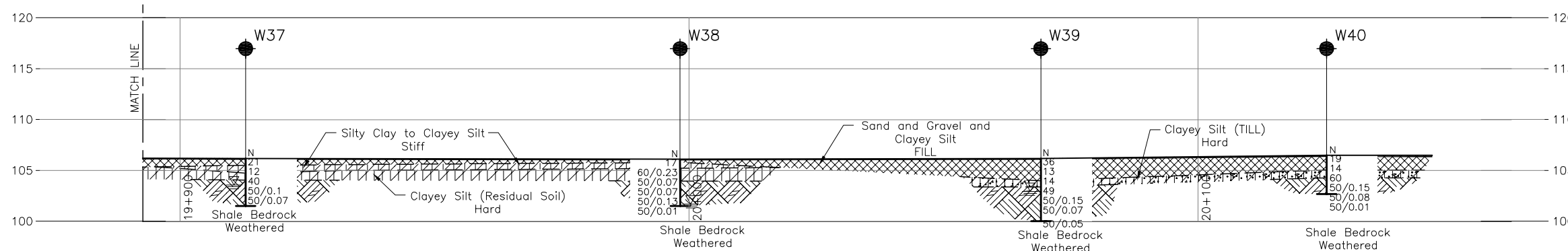
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

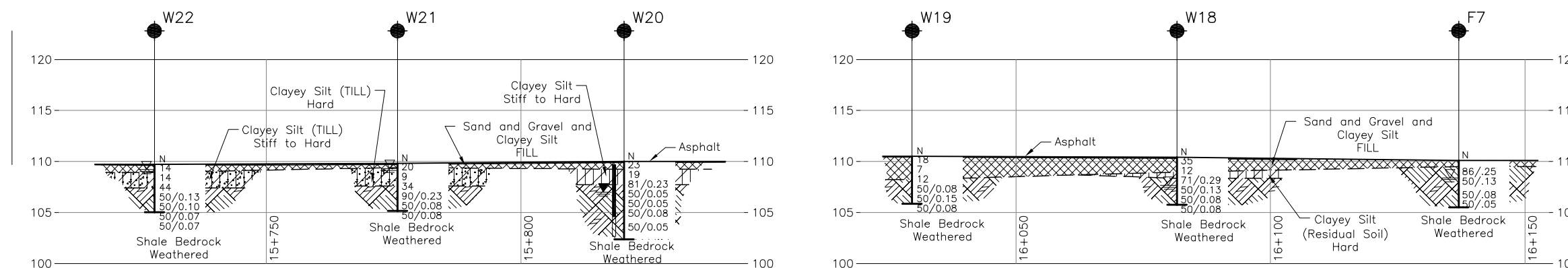
NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY. QEW	PROJECT NO. 011-1128		DIST.
SUBM'D. NK	CHKD. CN	DATE: MAR 2007	SITE:
DRAWN: MSM	CHKD. ASP	APPD. JMAC	DWG. 4



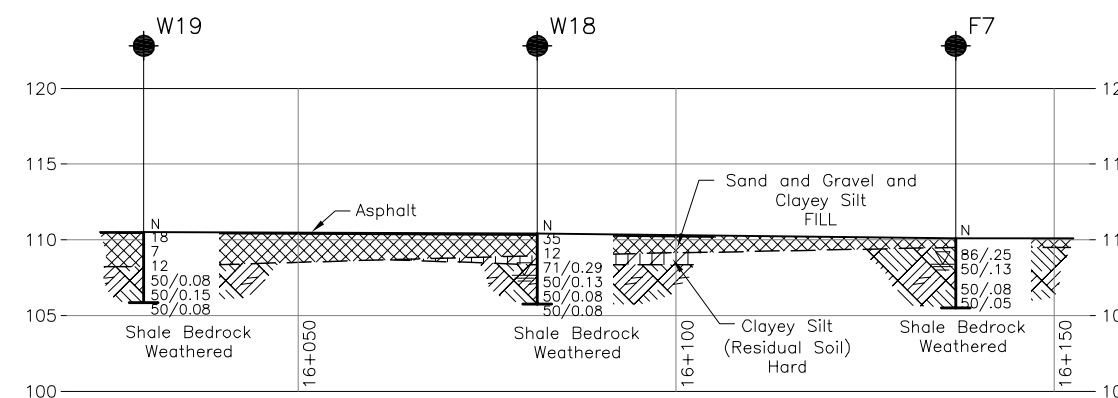
PROFILE B-B' - RETAINING WALL 2



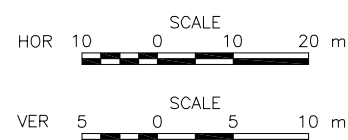
PROFILE B-B' - RETAINING WALL 2 (CONTINUED)



PROFILE C-C' - RETAINING WALL 3



PROFILE D-D' - RETAINING WALL 4



## REFERENCE

Base plans provided in digital format by URS, drawing file no.  
QEW-EL-LS-MTO-60% and QEW Plan, received on December 20, 2006.



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

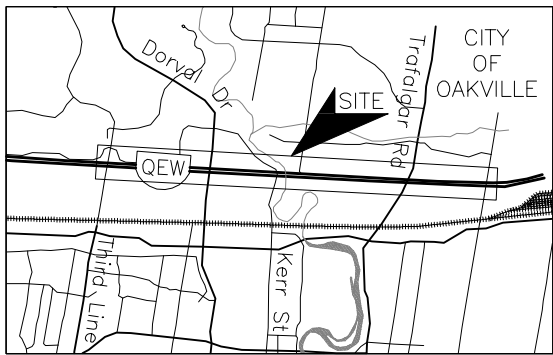
CONT No.  
GWP No. 189-00-01

RETAINING WALL 5  
(STA. 16+350 TO 16+690)  
SOIL STRATA

SHEET



Golder Associates Ltd.  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN  
SCALE  
0 800 m

LEGEND

- Borehole - Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated  
(Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on Feb. 13, 2007
- WL upon completion of drilling

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
H7	112.2	4811344.0	288142.0
W11	113.8	4811415.8	288196.7
W12	112.7	4811376.0	288165.0
W14	111.5	4811278.5	288084.8
W15	110.9	4811217.7	288034.7
W16	111.1	4811151.7	287984.2

NOTES

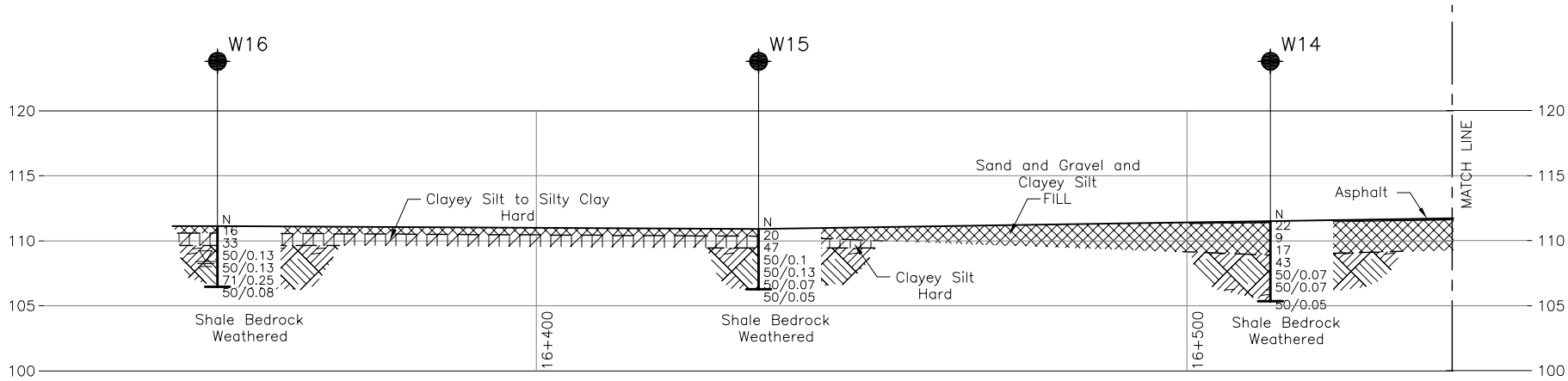
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

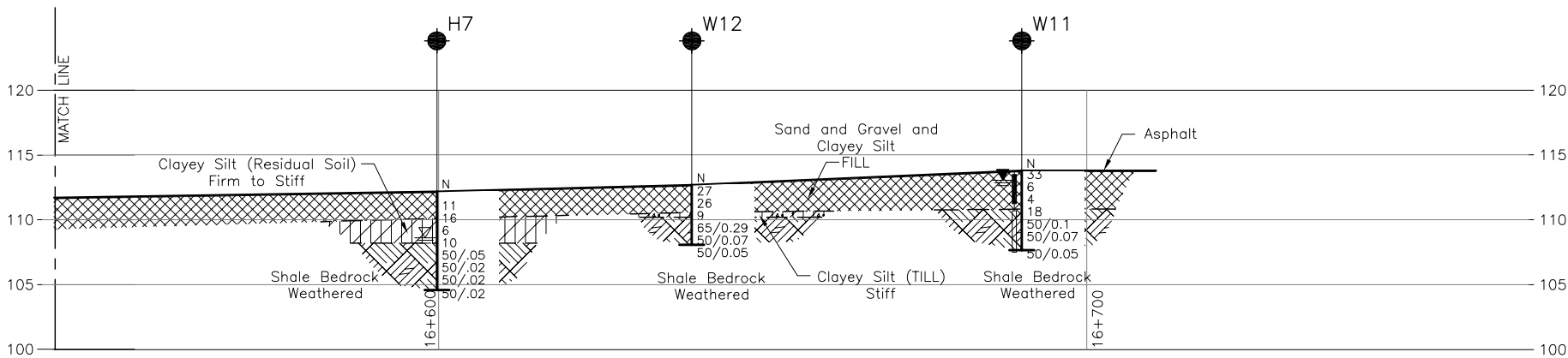
REFERENCE

Base plans provided in digital format by URS, drawing file no. QEW-EL-LS-MT0-60% and QEW Plan, received on December 20, 2006.

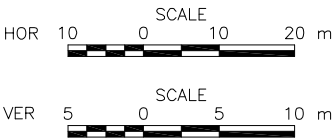
NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY.	QEW	PROJECT NO.	011-1128
SUBM'D.	NK	CHKD.	CN
DATE:	MAR 2007	SITE:	
DRAWN:	MSM	CHKD.	ASP
APPD.	JMAC	DWG.	5



PROFILE E-E' - RETAINING WALL 5



PROFILE E-E' - RETAINING WALL 5 (CONTINUED)



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

CONT No.  
GWP No. 189-00-01

RETAINING WALL 6  
(STA. 18+410 TO 19+092)  
SOIL STRATA

SHEET



**Golder Associates Ltd.**  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN  
SCALE  
800 0 800 m

LEGEND

- Borehole - Current Investigation
- Borehole - Previous Golder Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on Feb. 13, 2007
- WL upon completion of drilling

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
BH1	107.0	4812979.5	289475.4
BH 05-1	107.3	4812766.4	289268.9
BH 05-2	107.5	4812866.8	289364.8
BH 05-3	107.0	4813177.3	289609.9
W1	106.3	4813284.1	289704.1
W2	106.6	4813211.6	289661.9
W4	108.8	4813098.4	289571.9
W5	107.5	4813038.0	289523.3
W9	107.3	4812803.2	289325.0

NOTES

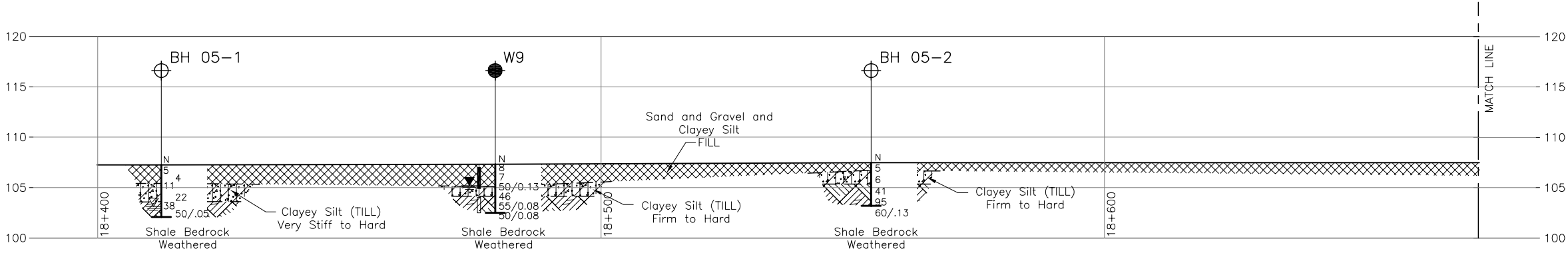
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

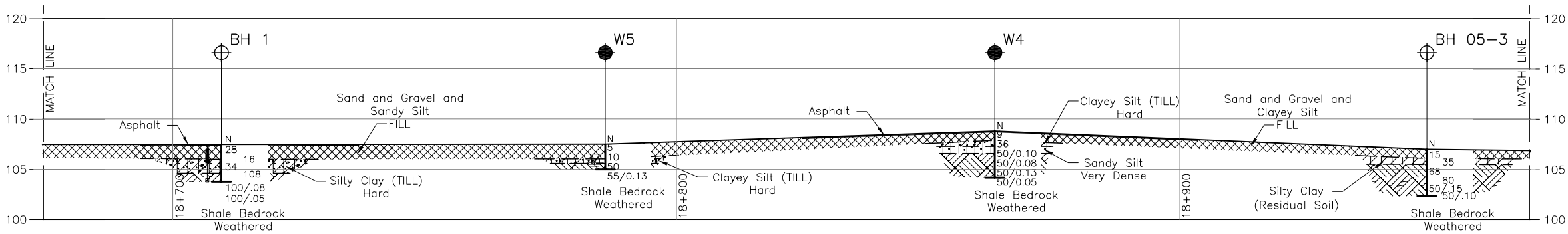
REFERENCE

Base plans provided in digital format by URS, drawing file no. QEW-EL-LS-MT0-60% and QEW Plan, received on December 20, 2006.

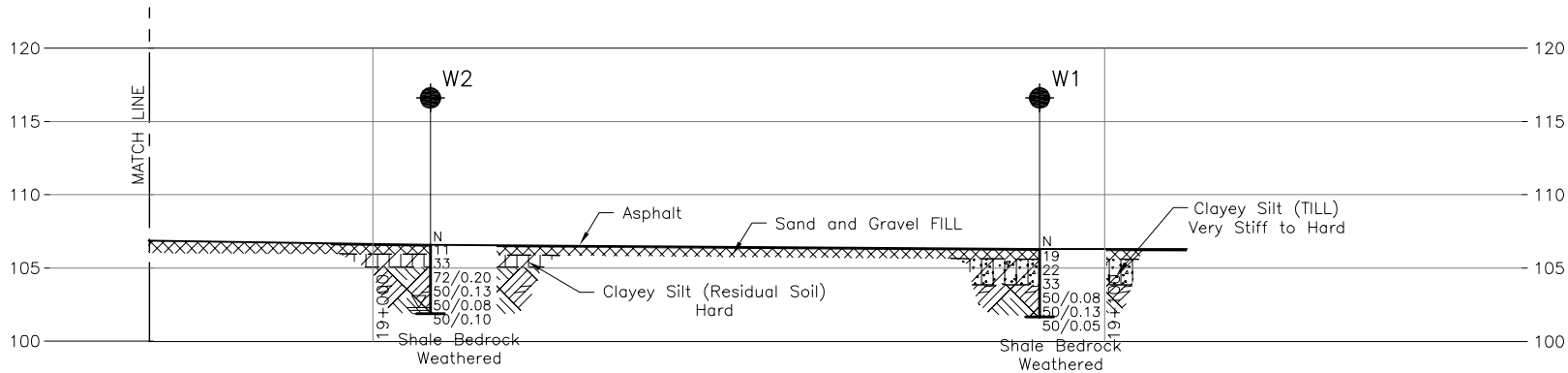
NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY. QEW	PROJECT NO. 011-1128		DIST.
SUBM'D. NK	CHKD. CN	DATE: MAR 2007	SITE:
DRAWN: MSM	CHKD. ASP	APPD. JMAC	DWG. 6



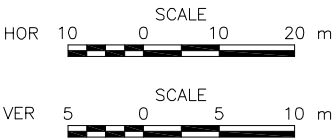
PROFILE F-F' - RETAINING WALL 6



PROFILE F-F' - RETAINING WALL 6 (CONTINUED)



PROFILE F-F' - RETAINING WALL 6 (CONTINUED)



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

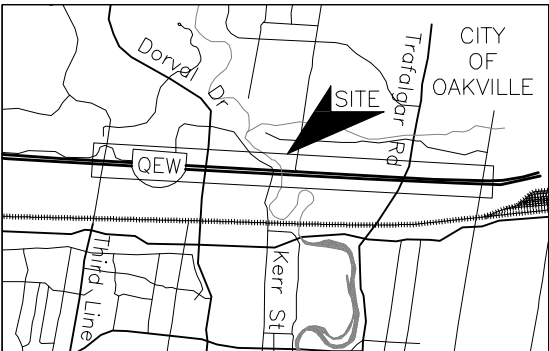
CONT No.  
GWP No. 189-00-01

RETAINING WALLS 7 AND 8  
RW7 (STA. 17+270 TO 17+330)  
RW8 (STA. 17+250 TO 17+310)  
SOIL STRATA

SHEET



Golder Associates Ltd.  
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE  
0 800 m

LEGEND

- Borehole - Previous Investigation by Others
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated  
(Std. Pen. Test, 475 j/blow)
- 90% Rock Quality Designation (RQD)

No.	ELEVATION	CO-ORDINATES	
		NORTHING	EASTING
1	115.7	4811895.1	288589.8
2	115.7	4811878.2	288578.7
3	115.8	4811867.5	288569.0
6	114.5	4811850.1	288632.2
7	114.5	4811839.1	288622.8
8	114.6	4811827.2	288612.8

NOTES

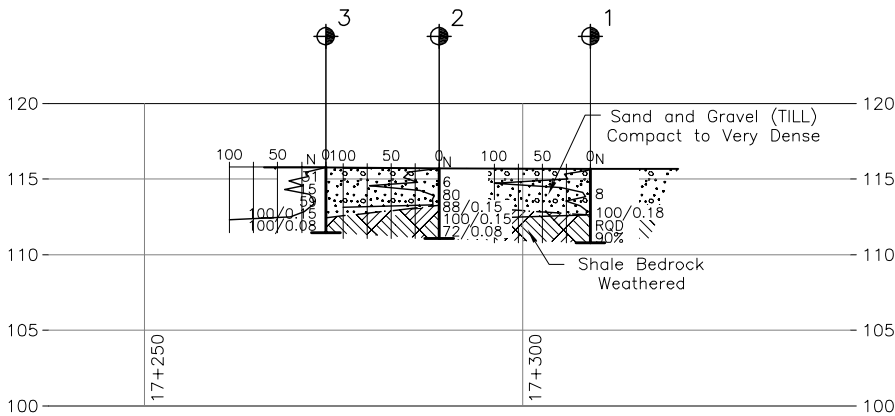
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

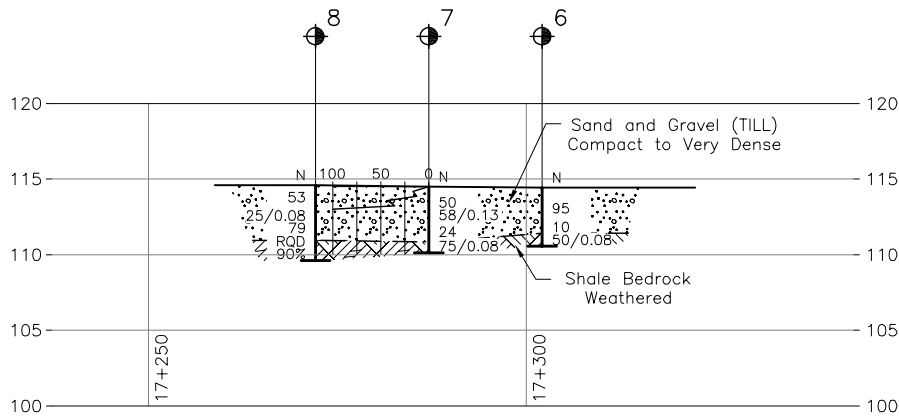
REFERENCE

Base plans provided in digital format by URS, drawing file no. QEW-EL-LS-MT0-60% and QEW Plan, received on December 20, 2006.

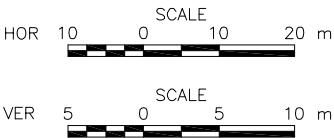
NO.	DATE	BY	REVISION
Geocres No. 30M5-260			
HWY.	QEW	PROJECT NO.	011-1128
SUBM'D.	NK	CHKD.	CN
DATE:	MAR 2007	SITE:	
DRAWN:	MSM	CHKD.	ASP
APPD.	JMAC	DWG.	7



PROFILE G-G' - RETAINING WALL 7

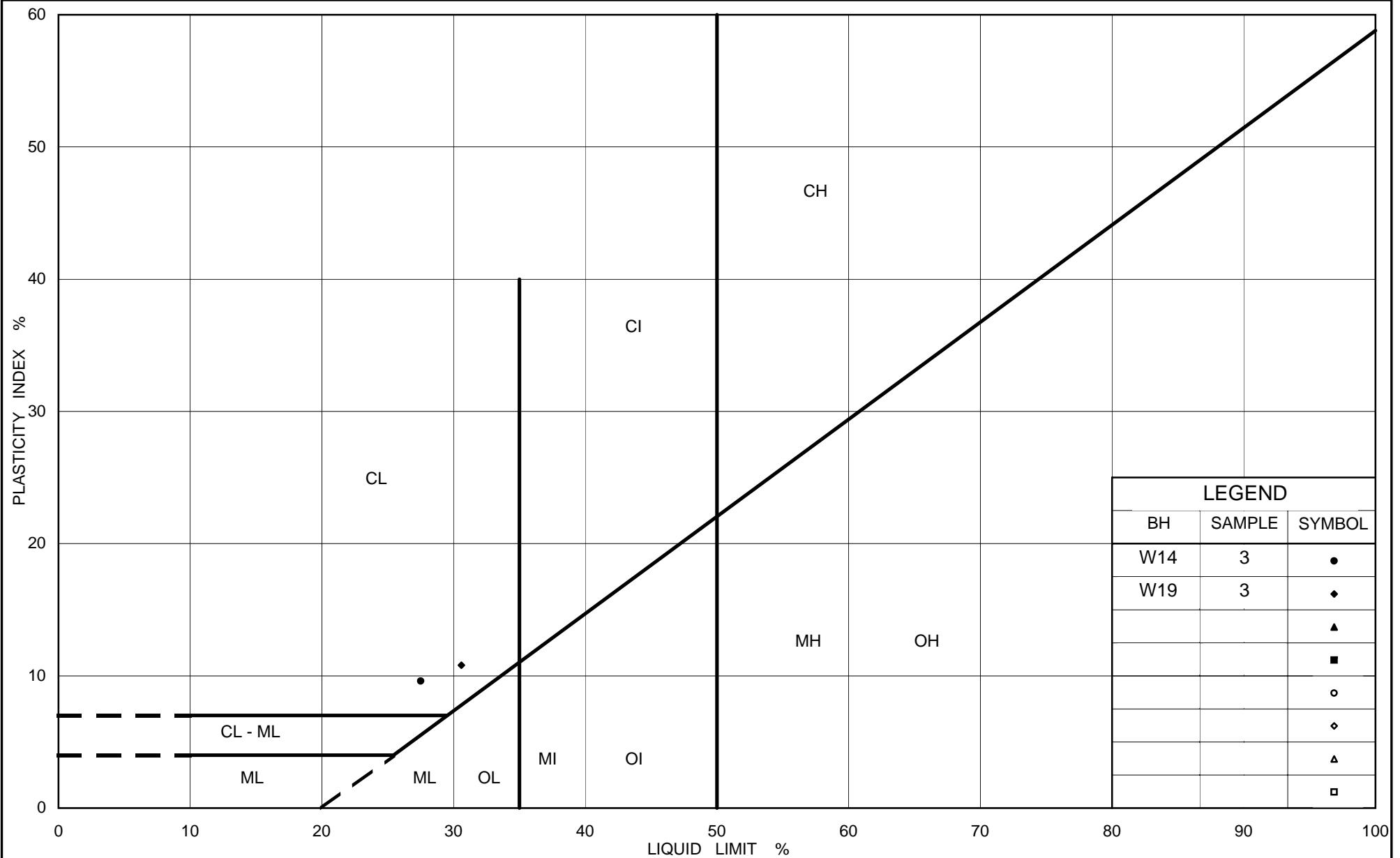


PROFILE H-H' - RETAINING WALL 8









Ministry of Transportation

Ontario

## PLASTICITY CHART

### Clayey Silt (Fill)

Figure No. 2

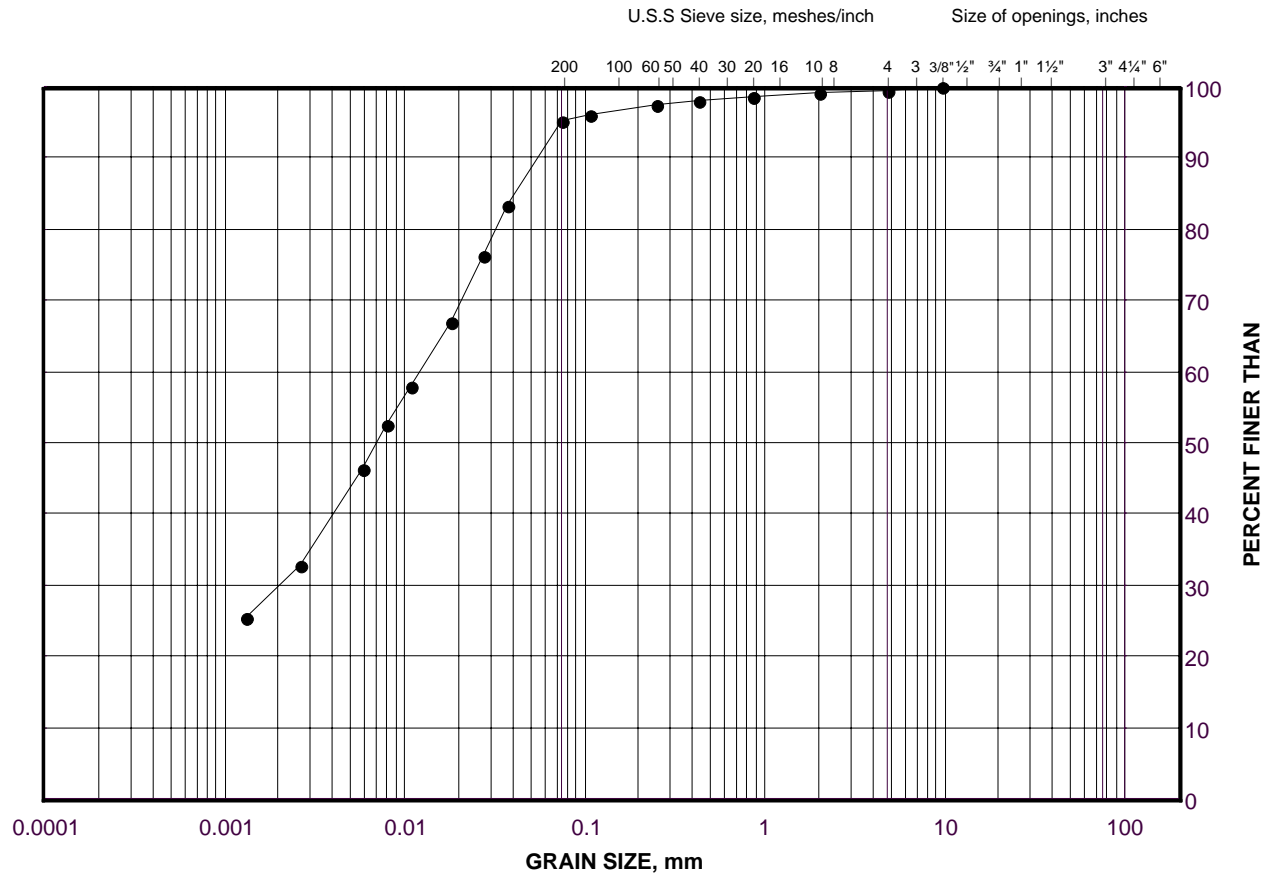
Project No. 011-1128

Checked By:

# GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE 3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

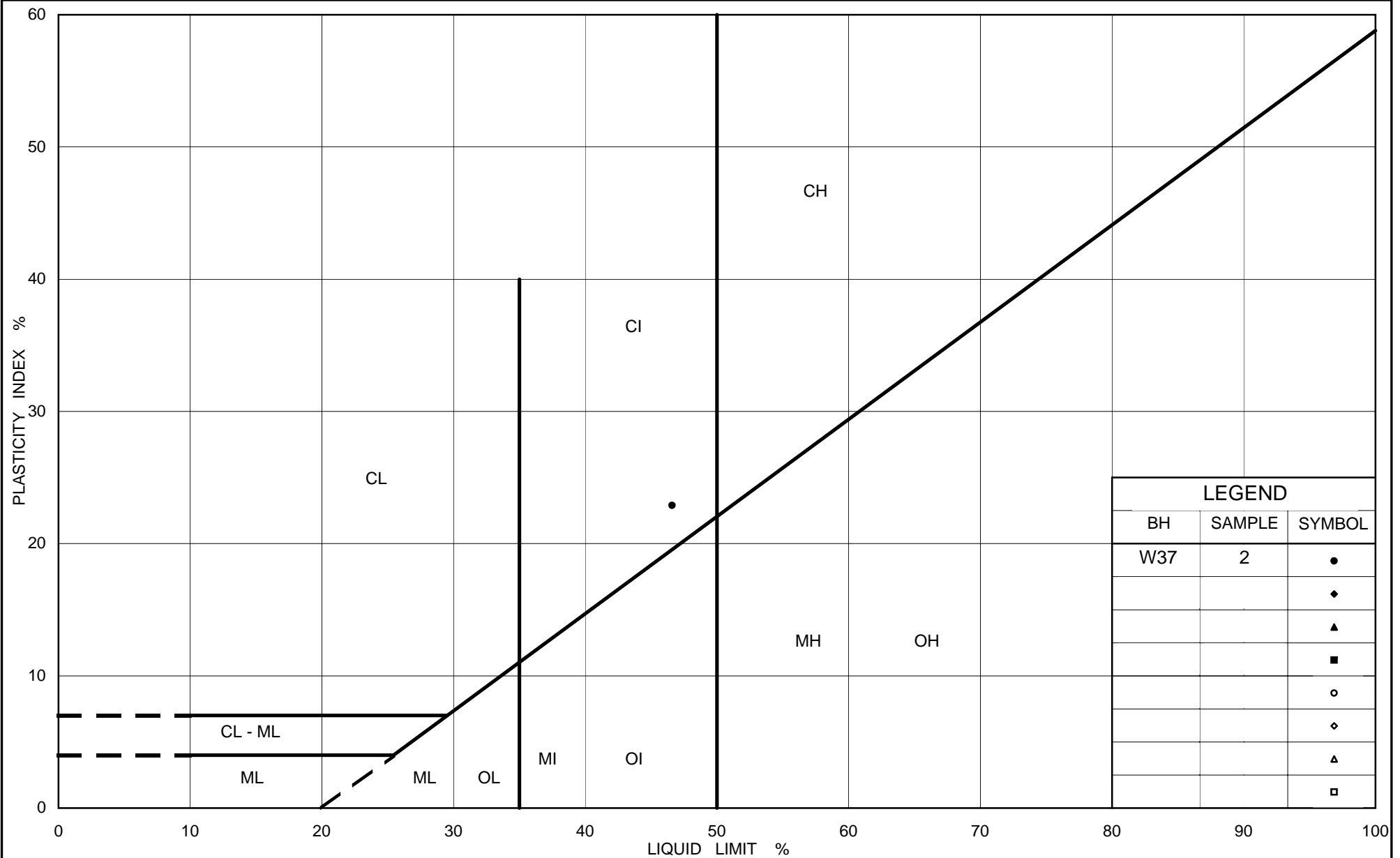
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	W16	2	110.0

Project Number: 011-1128

Checked By: \_\_\_\_\_

**Golder Associates**

Date: 09-Mar-07



Ministry of Transportation

Ontario

# PLASTICITY CHART Silty Clay

Figure No. 4

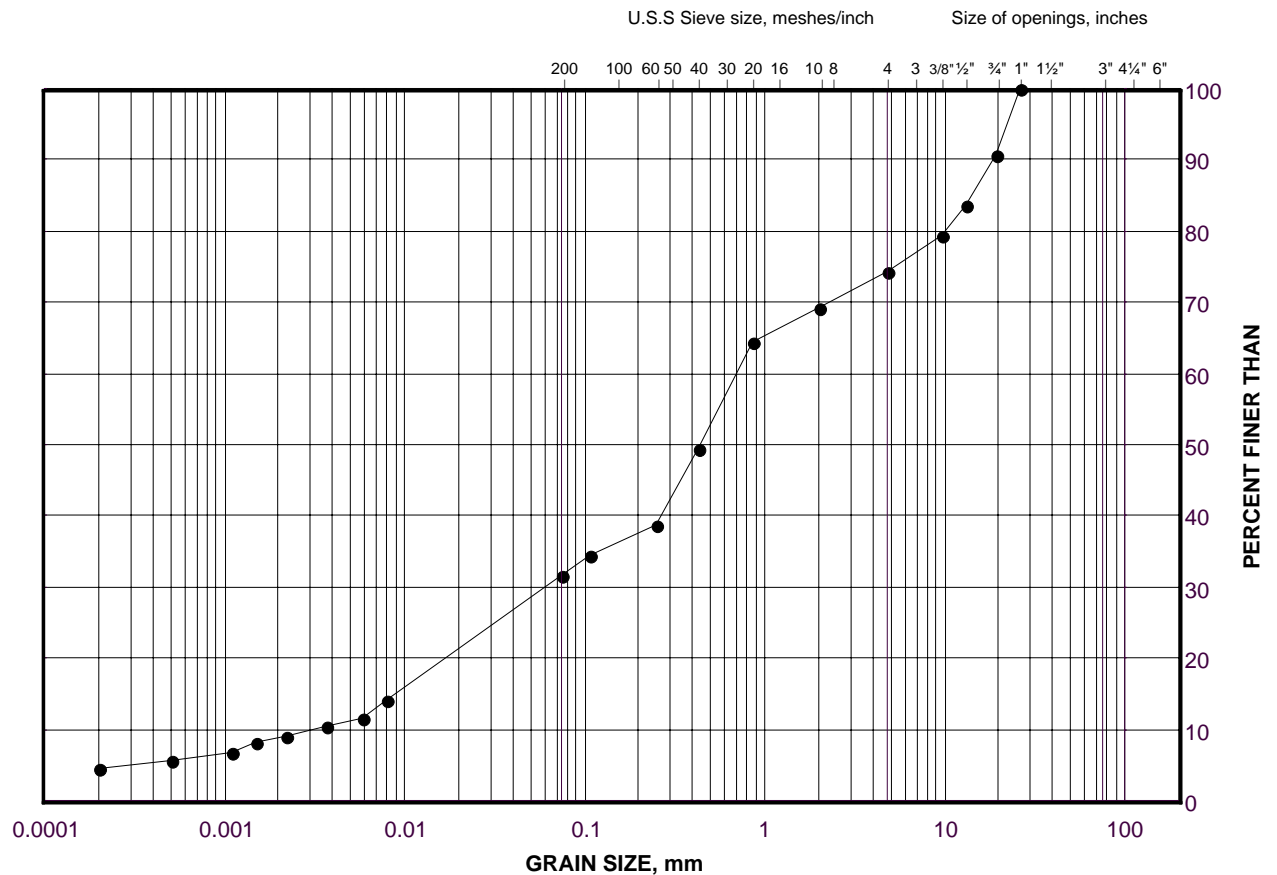
Project No. 011-1128

Checked By:

# GRAIN SIZE DISTRIBUTION

Silty Sand and Gravel (Till)

FIGURE 5



SILT AND CLAY SIZES			FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED			SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	W30	4	110.2

Project Number: 011-1128

Checked By: \_\_\_\_\_

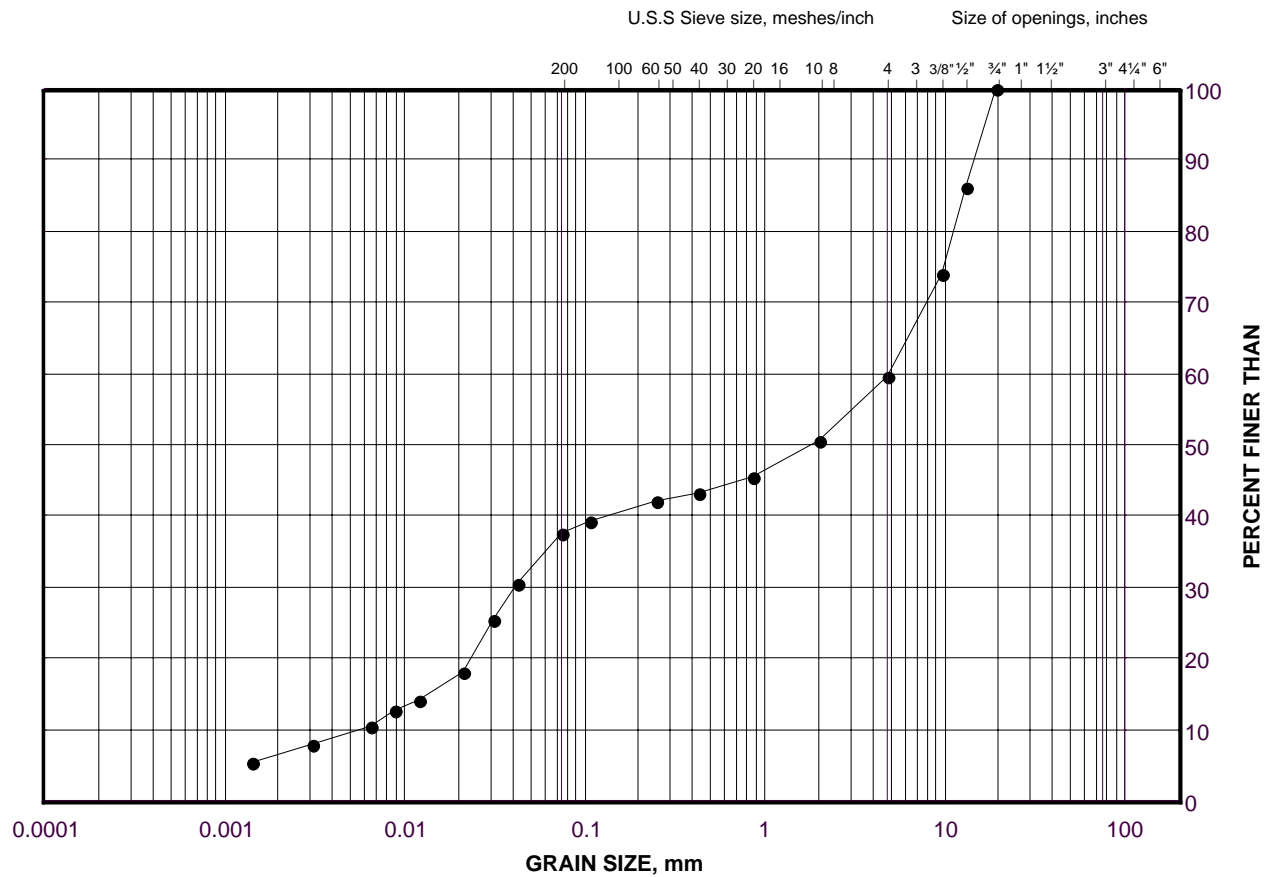
**Golder Associates**

Date: 09-Mar-07

# GRAIN SIZE DISTRIBUTION

Sandy Silt

FIGURE 6



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	W4	3	107.2

Project Number: 011-1128

Checked By: \_\_\_\_\_

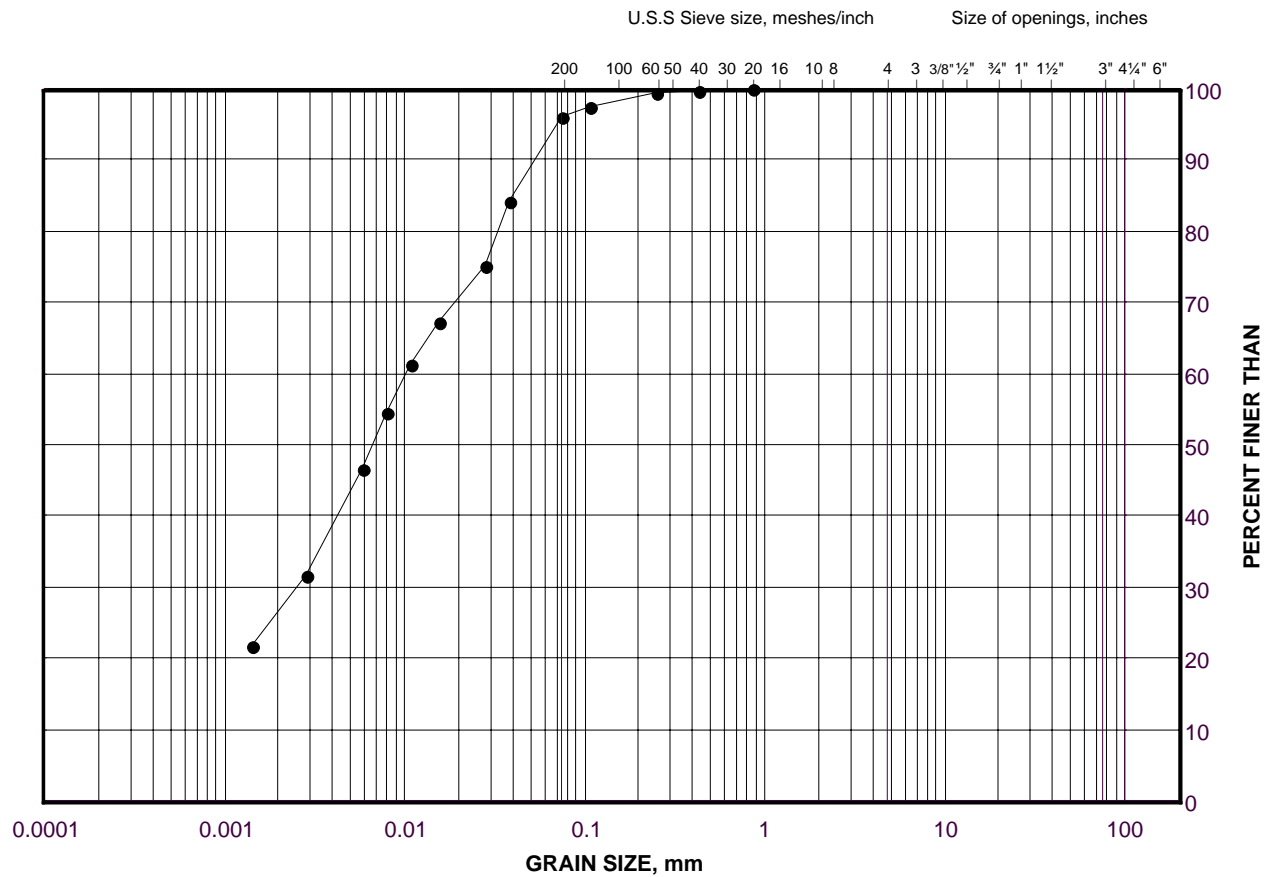
**Golder Associates**

Date: 09-Mar-07

# GRAIN SIZE DISTRIBUTION

Clayey Silt (Till)

FIGURE 7



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

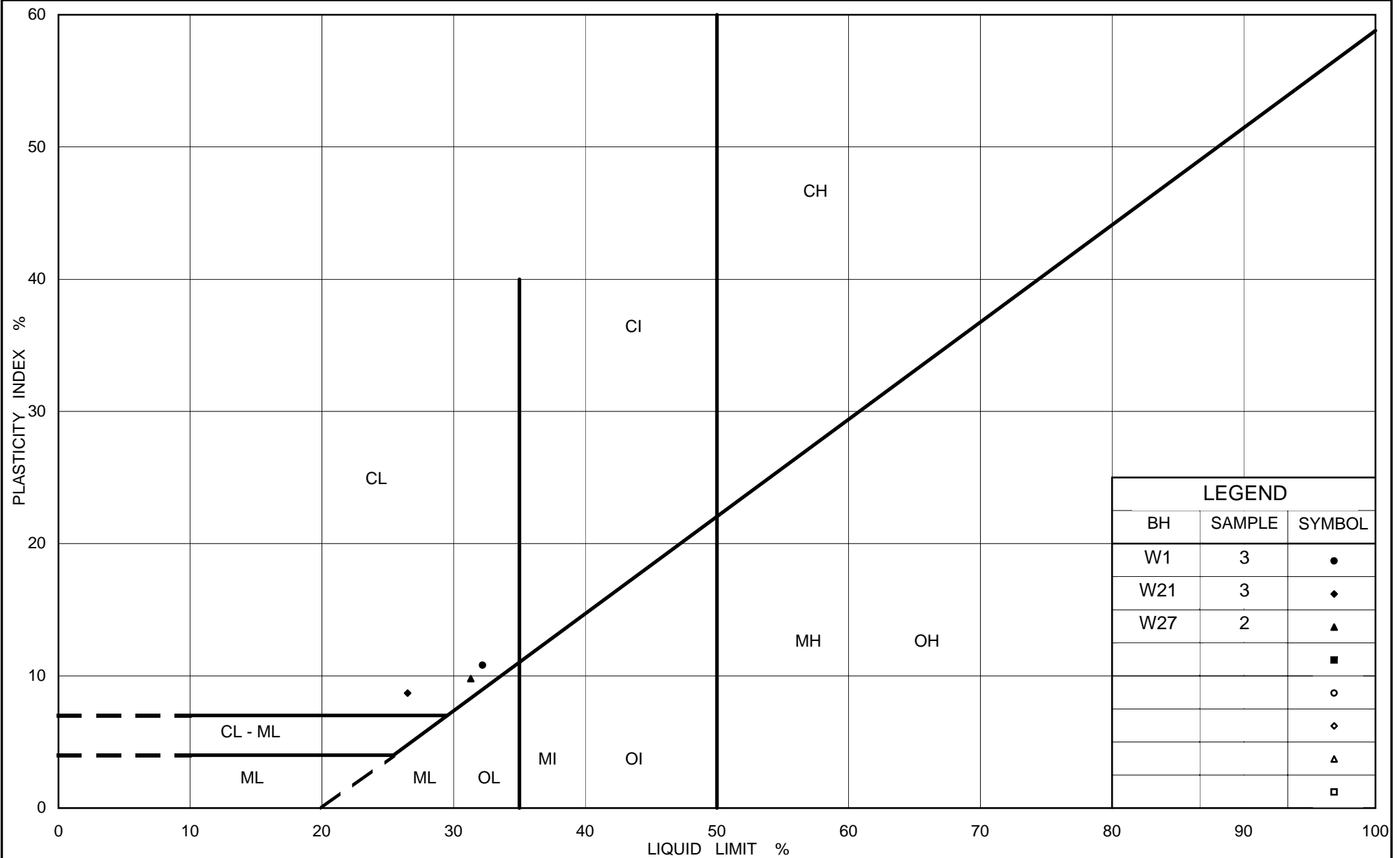
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	W27	2	110.6

Project Number: 011-1128

Checked By: \_\_\_\_\_

**Golder Associates**

Date: 09-Mar-07



Ministry of Transportation

Ontario

## PLASTICITY CHART

### Clayey Silt (Till)

Figure No. 8

Project No. 011-1128

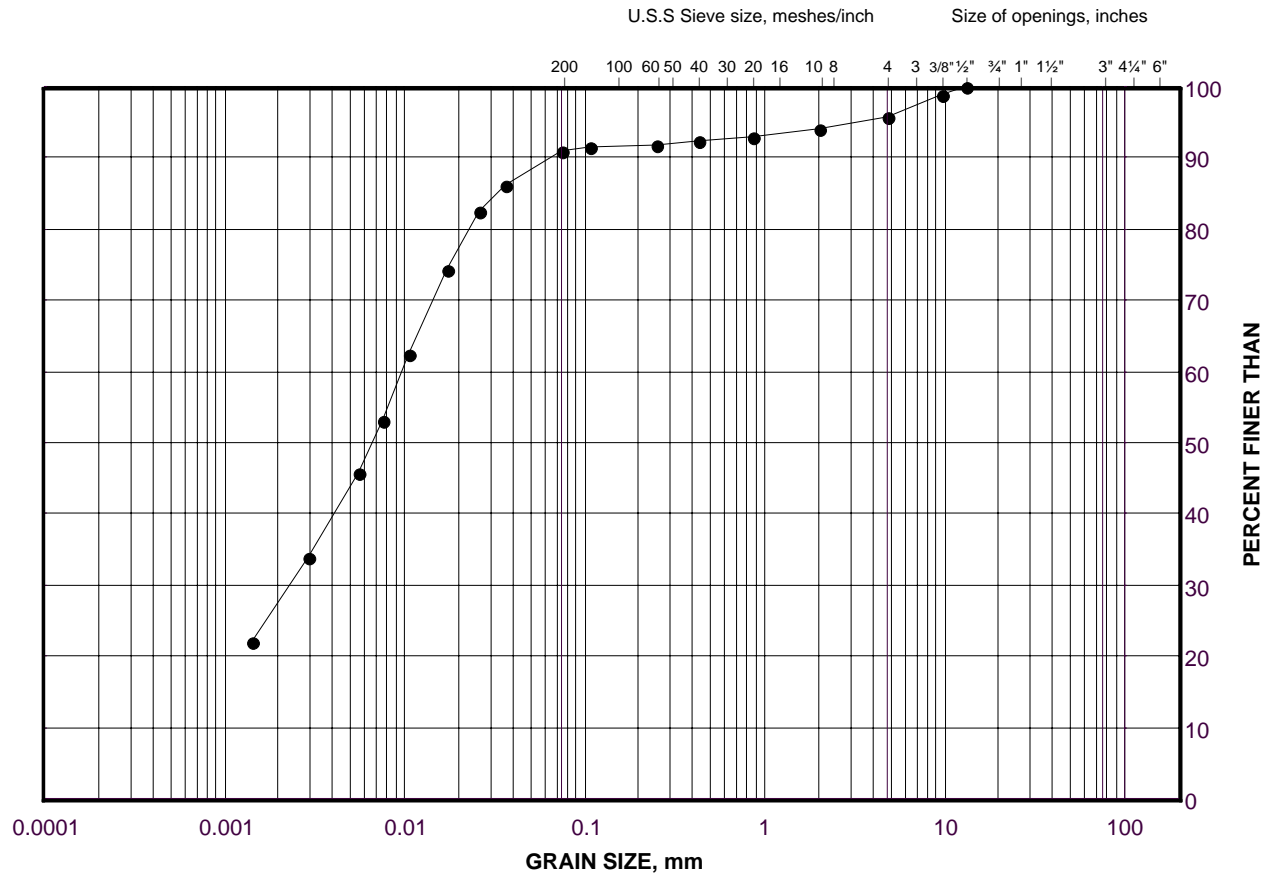
Checked By:



# GRAIN SIZE DISTRIBUTION

Clayey Silt (Residual Soil)

FIGURE 9



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

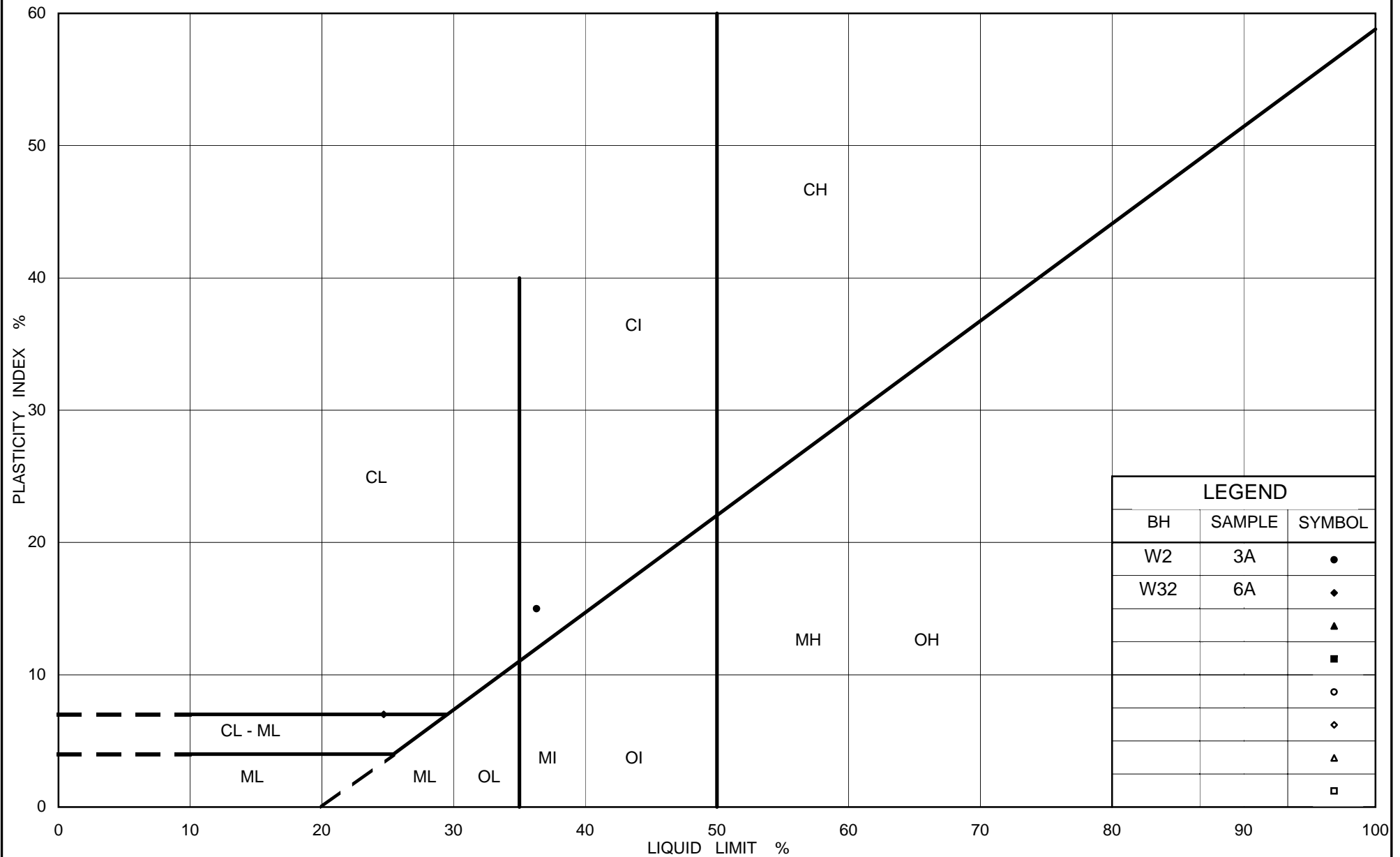
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	W34	3	105.2

Project Number: 011-1128

Checked By: \_\_\_\_\_

**Golder Associates**

Date: 06-Mar-07



Ministry of Transportation

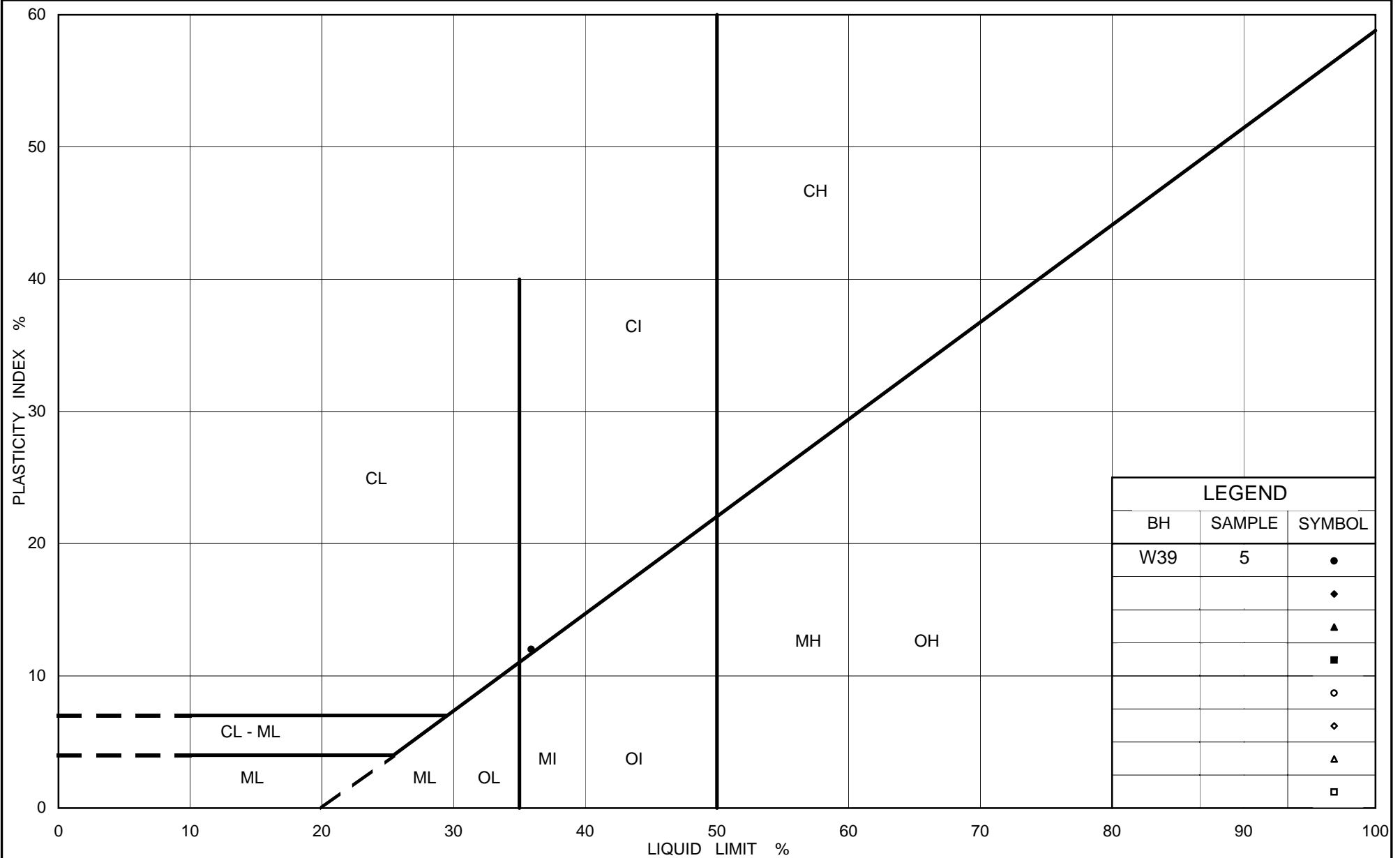
# PLASTICITY CHART Clayey Silt (Residual Soil)

Ontario

Figure No. 10

Project No. 011-1128

Checked By:



Ministry of Transportation

Ontario

## PLASTICITY CHART

### Shale Bedrock

Figure No. 11

Project No. 011-1128

Checked By:

## **APPENDIX A**

**RECORDS OF BOREHOLES 1 TO 3 AND 6 TO 8, 1975 INVESTIGATION BY MTO  
GEOCRES NO. 30M5-101**

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 125-66-02 LOCATION Co-ords. 786,312 N; 946,765 E. ORIGINATED BY PJS  
DIST 4 HWY QEW BORING DATE December 17, 1975 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BXL CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
379.5	Ground Level									
0.0	Sand & gravel with silt, trace of clay (Glacial Till)		1	SS	8					
369.5	Loose		2	SS	100	370				
10.0	(Red) Shale, severely to moderately weathered		3	BXL	90					
363.5										
16.0	End of Borehole					360				

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 125-66-02 LOCATION Co-ords. 786,271 N; 946,728 E. ORIGINATED BY PJS  
DIST 4 HWY QEW BORING DATE December 17, 1975 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
379.6	Ground Level															
0.0	Sand & gravel with silt, trace of clay (Glacial Till)		1	SS	6											
371.6	Loose		2	SS	80											
8.0	(Red) Shale, severely to moderately weathered		3	SS	8876	370										
364.4			4	SS	10076	6"										
15.2	End of Borehole		5	SS	7573	6"										
						360										

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 125-66-02 LOCATION Co-ords. 786,236 N; 946,700 E. ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE December 16, 1975 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ $W$ $W_L$	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
379.9	Ground Level									
0.0	Sand & gravel with silt, trace of clay (Glacial Till) Compact to Very Dense		1	SS	31					
8.5			2	SS	15					
368.9			3	SS	59					
11.0	Red Shale		4	SS	100	4"				
365.7			5	SS	100	3"				
14.2	End of Borehole									

20  
15  $\diamond$  5 % STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE No. 6

[illegible]

OFFICE REPORT ON SOIL EXPLORATION



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 125-66-02 LOCATION Co-ords. 786,145 N; 946,868 E. ORIGINATED BY PJS  
DIST 4 HWY QEW BORING DATE December 17, 1975 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	W' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
375.7	Ground Level															
0.0	Gravel & sand, some silt, trace of clay, numerous boulders (Glacial Till)		1	SS	50											
			2	SS	58.7	370										
363.7	Compact to Very Dense		3	SS	24											
12.0	(Red) Shale		4	SS	75.3											
361.3							No further progress with auger possible									
14.4	End of Borehole					360										

20  
15-5 % STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 125-66-02 LOCATION Co-ords. 786,108 N: 946,836 E. ORIGINATED BY PJS  
DIST 4 HWY QEW BORING DATE December 21, 1975 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BXL Core CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
376.0	Ground Level															
0.0	Gravel & sand, some silt, trace of clay, numerous boulders (Glacial Till) Very Dense		1	SS	53	370										
			2	SS	25/2	"										
36.0			3	SS	79											
12.0	(Red) Shale, severely to moderately weathered		4	BXL	90%	360										
359.6																
16.4	End of Borehole															

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

## **APPENDIX B**

### **RECORD OF BOREHOLE BH1, 1999 INVESTIGATION BY GOLDER ASSOCIATES**



## **APPENDIX C**

### **RECORDS OF BOREHOLES BH05-1 AND BH05-3, 2005 INVESTIGATION BY GOLDER ASSOCIATES**

PROJECT: 04-1111-012B

## RECORD OF BOREHOLE: BH 05-1

SHEET 1 OF 1

LOCATION: N 4812134.7 ; E 605832.4

BORING DATE: January 11, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT						
								20	40	60	80	10 <sup>-6</sup>	10 <sup>-5</sup>			10 <sup>-4</sup>	10 <sup>-3</sup>	nat V. + Q - ● rem V. ⊕ U - ○
								20	40	60	80	10	20	30	40			
0		GROUND SURFACE		107.25 0.00														
	Power Auger 108 mm O.D. Solid Stem Augers	Loose to compact, wet, reddish brown silty sand, trace to some gravel and clay (FILL)			1	50 DO	5											
1					2	50 DO	4											MH
					3	50 DO	11											
2					4	50 DO	22											
			Very stiff to hard, brown to red CLAYEY SILT, some sand, trace gravel (TILL)			5	50 DO	38									MH	
3																		
4		Weathered, red SHALE (Bedrock) contains limestone/siltstone interbeds																
				103.59 3.66														
5						50 DO	50/.05											
				102.07 5.18														
		END OF BOREHOLE AUGER REFUSAL																
		Note: 1. Water level in open borehole at 4.88 m depth upon completion of drilling operations.																
6																		
7																		
8																		
9																		
10																		

DEPTH SCALE

1 : 50



LOGGED: PKS

CHECKED: SLP

MISS BHS 041111012BAAGDR.GPJ GLDR CAN GDT 21/12/05 DD

PROJECT: 04-1111-012B

## RECORD OF BOREHOLE: BH 05-2

SHEET 1 OF 1




LOCATION: N 4812236.8 ;E 605926.5

BORING DATE: January 10, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	10 <sup>-6</sup>	10 <sup>-5</sup>			10 <sup>-4</sup>	10 <sup>-3</sup>
								nat V. + Q - ●	rem V. ⊗ U - ○								
								20	40	60	80	10	20	30	40		
0		GROUND SURFACE		107.47													
	Power Auger 108 mm O.D. Solid Stem Augers	Loose, wet, brown sand, some gravel, some silt, trace clay (FILL)		0.00	1	50 DO	5										
1		Firm to hard, moist, brown/red CLAYEY SILT, some sand, trace gravel and shale fragments (TILL/RESIDUAL SOIL)		106.71 0.76	2	50 DO	6										
2																	
3		Weathered, red SHALE (Bedrock) contains limestone/siltstone interbeds		105.34 2.13	4	50 DO	95										
4																	
5		END OF BOREHOLE AUGER REFUSAL		103.20 4.27													
		Note: 1. Open borehole dry upon completion of drilling operations.															
6																	
7																	
8																	
9																	
10																	

DEPTH SCALE

1 : 50



LOGGED: PKS

CHECKED: SLP

MISS BHS 041111012BAAGDR.GPJ GLDR\_CAN.GDT 21/12/05 DD

PROJECT: 04-1111-012B

## RECORD OF BOREHOLE: BH 05-3

SHEET 1 OF 1




LOCATION: N 4812551.5 ;E 606166.1

BORING DATE: January 10, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	10 <sup>-6</sup>	10 <sup>-5</sup>			10 <sup>-4</sup>	10 <sup>-3</sup>
		GROUND SURFACE		107.01													
0	Power Auger 108 mm O.D. Solid Stem Augers	Very stiff, moist, brown clayey silt, some sand, trace gravel (FILL)		0.00	1	50 DO	15										
1		Hard, red SILTY CLAY, trace sand, trace gravel and limestone fragments (RESIDUAL SOIL)		106.10	2	50 DO	35										
2		Weathered, red SHALE (Bedrock) contains limestone/siltstone interbeds		105.49	3	50 DO	66										
3																	
4																	
5		END OF BOREHOLE		102.34	6	50 DO	50/-10										
6		Note:  1. Open borehole dry upon completion of drilling operations.		4.87													
7																	
8																	
9																	
10																	

DEPTH SCALE

1:50



LOGGED: PKS

CHECKED: SLP

MISS BHS 041111012BAAGDR.GPJ GLDR CAN.GDT 21/12/05 DD