

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGHWAY 404 EXTENSION  
FROM GREEN LANE TO QUEENSVILLE SIDEROAD  
HIGH FILLS AND DEEP CUTS AT  
27+775 – 27+875                      30+075 – 30+225  
30+975 – 31+100                      33+200 – 33+700  
QSR 9+550 – 9+750                      QSR 9+750 – 10+300  
REGION OF YORK  
G.W.P. 2109-05-00**

**GEOCRES Number: 31D-492**

**Report to**

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Appendix B	Deep Cut - Highway 404 extension, South of Mount Albert Road, Station 27+775 – 27+875, (Boreholes 08-15A to 08-17A)
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Appendix E	High Fill and Deep Cut - Queensville Sideroad, Station 9+550 – 10+300 (Boreholes 08-33 to 08-38, 08-38A, 08-33A, 08-39 to 08-47, 08-61, QSR4-1 to QSR4-5 and 301 to 303)
Appendix F	List of SPs and OPSS, and Suggested Text for Selected NSSP

Appendices A to E include:

- Record of Borehole Sheets
- Laboratory Test Results
- Site Photographs
- Slope Stability Output
- Drawing titled “Borehole Locations and Soil Strata”



**FOUNDATION INVESTIGATION AND DESIGN REPORT**  
**HIGH FILLS AND DEEP CUTS**  
**HIGHWAY 404 EXTENSION**  
**FROM GREEN LANE TO WOODBINE AVENUE/RAVENSHOE ROAD**  
**ONTARIO**  
**G.W.P. 2109-05-00**

**Geocres Number: 31D-492**

**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the locations of proposed high fills and deep cuts associated with the proposed extension of Highway 404 in the Regional Municipality of York, Ontario. The high fills and deep cuts included in this report are located between Green Lane and Queensville Sideroad (north side of Queensville Sideroad).

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the present investigation.

Thurber carried out the investigation as a sub-consultant to Philips Engineering / Hatch Mott MacDonald Joint Venture under the Ministry of Transportation Ontario (MTO) Agreement Number 2007-E-0027.

In the preparation of this report and in addition to the boreholes drilled under the current assignment, reference has been made to information on subsurface conditions contained in other foundation reports. The titles of these reports are listed as follows:

- Preliminary Foundation Investigation Report, Queensville Sideroad Underpass, Highway 404 Extension from Green Lane to Highway 12/48, Agreement No. 2005-A-000585, dated October 2006, prepared by Golder Associates. Report Reference No. 04-1111-016-3 (Reference 1).

- Foundation Investigation and Design Report, Queensville Sideroad Underpass, Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Road, Agreement No. 2007-E-0027, G.W.P. 2109-05-00, Geocres Number: 31D-449, dated August 27, 2009, prepared by Thurber. Report Reference No. 19-1605-96. (Reference 2).
- Foundation Investigation and Design Report, Doane Road Underpass, Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Road, Agreement No. 2007-E-0027, G.W.P. 2109-05-00, Geocres Number: 31D-483, dated September 9, 2009, prepared by Thurber. Report Reference No. 19-1605-96. (Reference 3).
- Draft Foundation and Investigation Report, Culverts, Highway 404 Extension from Green Lane to Woodbine Avenue/Ravenshoe Road, Agreement No. 2007-E-0027, G.W.P. 2109-05-00, Report Reference No. 19-1605-96. (Reference 4).

## 2 SITE DESCRIPTION

### 2.1 High Fill - Highway 404 extension, South of Doane Road, Station 30+075 – 30+225, (Boreholes 08-06 to 08-09)

The site is located approximately 750 m south of Doane Road and approximately 450 m west of Woodbine Avenue (York Regional Road 8) in the Town of East Gwillimbury in the Regional Municipality of York.

The south side of the site is currently a sod farm and towards the north the area becomes wooded with mature trees, shrubs and long grass. Mount Albert creek is located within the site flowing southerly. A flooded area was observed approximately 200 m north of the site. The water is backed up from a pond located to the northeast of the site. The pond is approximately 250 m long and 25 m wide.

Photographs of the site included in Appendix A show the general nature of the surrounding lands.

### 2.2 Deep Cut - Highway 404 extension, South of Mount Albert Road, Station 27+775 – 27+875, (Boreholes 08-15A to 08-017A)

The site is located approximately 1 km south of Mount Albert Road and approximately 200 m east of Colonel Wayling Boulevard in the Town of East Gwillimbury in the Regional Municipality of York.

The lands are currently agricultural to the north, east and south of the site. A residential subdivision occupies the west side of the site.

Photographs of the site included in Appendix B show the general nature of the surrounding lands.

**2.3 Deep Cut - Highway 404 extension, North of Doane Road  
Station 30+975 – 31+100, (Boreholes 08-18 to 08-21 and 08-48 to 08-55)**

The site is located approximately 50 m north of the existing Doane Road and approximately 900 m west of the intersection of Doane Road and Woodbine Avenue (York Regional Road 8), in the Town of East Gwillimbury in the Regional Municipality of York.

The lands are generally undeveloped and/or agricultural. Vegetation consists mainly of tall grass, shrubs and a few mature trees. There are farmsteads to the north and south of Doane Road.

Photographs of the site included in Appendix C show the general nature of the surrounding lands.

**2.4 Deep Cut - Highway 404 extension, North of Queensville Sideroad  
Station 33+200 – 33+700, (Boreholes 08-22 to 08-26)**

The site is located approximately 200 m north of the existing Queensville Sideroad and approximately 750 m west of the intersection of Queensville Sideroad and Woodbine Avenue (York Regional Road 8, in the Town of East Gwillimbury in the Regional Municipality of York.

The lands around the site are generally undeveloped and/or agricultural. Vegetation consists mainly of tall grass, shrubs and a few mature trees. There are farmsteads to the north and south of Queensville Sideroad.

Photographs of the site included in Appendix D show the general nature of the surrounding lands.

**2.5 High Fill and Deep Cut - Queensville Sideroad, Station 9+550 – 10+300  
(Boreholes 08-33 to 08-38, 08-38A, 08-33A, 08-39 to 08-47, 08-61, QSR4-1 to QSR4-5 and 301 to 303)**

The high fill and deep cut areas are located along the existing Queensville Sideroad, approximately 750 m west of the existing intersection of Queensville Road and Woodbine Avenue (York Regional Road 8), in the Town of East Gwillimbury, in the Regional Municipality of York.

Currently, the topography along Queensville Sideroad, within the site is a rolling/undulating terrain varying in elevation as follows:

Location	Station	Elevation	Grade (%)
West of site	9+350 to 9+625	270 to 284.9	5.4
	9+625 to 10+075	284.9 to 257.1	-6.2
Proposed Hwy 404 alignment & Queensville Sideroad intersection	10+000	259.1	-
East of site	10+075 to 10+280	257.1 to 264.5	3.6

The site is within a low point/valley and the natural ground surface within the valley has a relatively flat to gently rolling/undulating topography.

A small tributary of the Maskinonge River flows southerly through a CSP culvert under Queensville Sideroad.

The lands to the north and south of Queensville Sideroad are generally undeveloped and/or agricultural with a few farmsteads. Vegetation consists mainly of tall grass, shrubs and a few mature trees.

Photographs of the site included in Appendix E show the general nature of the surrounding lands.

The sites are located within the physiographic region known as The Peterborough Drumlin Field, characterized by drumlinized till. The till is typically sandy with shallow coverings of silt and fine sand.

### 3 SITE INVESTIGATION AND FIELD TESTING

During the present investigation, a total of twenty-nine (29) sampled boreholes were drilled for the proposed high fills and deep cuts identified within this section of the proposed Highway 404 extension. Twenty-two (22) boreholes drilled for proposed structures located in close proximity to the high fills and cuts have been incorporated in this report (References 1 to 4). A summary of the borehole designations employed at each site is provided in Table 3.1. The respective appendices including borehole logs, laboratory results, borehole location drawings, soil strata drawings and photographs are also provided in Table 3.1. The detailed subsurface soil and groundwater conditions encountered in the boreholes relevant to the high fill and deep cut locations included in References 1 to 4 are also included in the respective appendices. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole Sheets.

**Table 3.1 – Borehole Designations**

Location	Station	Fill or Cut	Borehole	Drilling date	Borehole Termination Depth (m)	Borehole Termination Elevation (m)	Appendix
<b>(1)</b> Hwy 404 extension/ Alignment (south of Doane Rd.)	30+075	F	08-06	August 25 and 26, 2009	5.2	254.7	A
	30+125		08-07		5.2	253.9	
	30+175		08-08		5.2	254.4	
	30+225		08-09		6.7	259.9	
<b>(2)</b> Hwy 404 extension/ Alignment (South of Mount Albert Rd.)	27+775	C	08-15A	July 30, 2009	10.8	279.7	B
	27+825		08-16A		10.8	278.8	
	27+875		08-17A		10.8	277.4	
<b>(3)</b> Hwy 404 extension/ Alignment (north of Doane Rd.)	30+975	C	08-18	January 29 and 30, 2009	7.7	259.3	C
	31+017		08-19		9.2	259.4	
	31+059		08-20		9.2	259.5	
	31+100		08-21		7.8	260.3	
Doane Road proposed underpass	30+950	C	08-48	October 20 to 24, 2008	7.9	257.8	
			08-49		9.3	256.8	
			08-50		9.4	255.0	
			08-51		12.3	251.3	
			08-52		9.5	252.8	
			08-53		10.8	251.4	
			08-54		12.3	248.7	
			08-55		9.3	252.4	
<b>(4)</b> Hwy 404 extension/ Alignment (north of Queensville Sideroad)	33+200	C	08-22	January 20 to 22, 2009	4.8	263.2	D
	33+250		08-23		13.9	260.1	
	33+300		08-24		16.8	259.5	
	33+350		08-25		19.9	258.0	
	33+400		08-26		19.8	258.4	

**Table 3.1 – Borehole Designations (Cont'd)**

Location	Station	Fill or Cut	Borehole	Drilling date	Borehole Termination Depth (m)	Borehole Termination Elevation (m)	Appendix
(5) Queensville Sideroad	9+550	C	08-61	July 15, 2008	15.3	269.6	E
	9+550		08-33	March 26, 2008	4.8	279.2	
	9+550		08-33A	July 14, 2008	15.3	270.9	
	9+700		08-34	March 25, 2008	6.4	275.0	
	9+750		08-35	March 26, 2008	6.3	271.3	
	9+800	F	08-36	March 25, 2008	7.8	265.7	
	9+840		08-37	March 24, 2008	9.2	260.9	
	9+880		08-38	March 24, 2008	10.8	256.1	
	10+100		08-38A	March 26, 2008	14.2	243.1	
	10+150		08-39	March 27, 2008	14.0	245.0	
	10+200		08-40	March 20, 2008	12.5	248.8	
	10+250		08-41	March 27, 2008	7.8	255.9	
	10+300		08-42	March 18, 2008	6.2	258.2	
Queensville Sideroad proposed underpass	33+000		08-43	March 28, 2008	4.7	259.2	
			08-44	March 28, 2008	12.3	246.8	
			08-45	April 3, 2008	21.4	236.9	
			08-46	March 18, 2008	23.1	233.6	
		08-47	March 12, 2008	27.7	229.7		
		301	June 11, 2004	15.7	241.8		
		301A	September 27 to 29, 2004	25.0	231.0		
		302		18.5	240.5		
		303		13.9	247.1		
Queensville Sideroad proposed culvert	10+088	QSR4-1	March 7, 2008	12.8	240.9		
	10+084	QSR4-2	March 7, 2008	11.3	243.6		
	10+080	QSR4-3	March 17, 2008	11.3	245.9		
	10+078	QSR4-4	February 25, 2009	11.3	244.2		
	10+075	QSR4-5		10.7	244.7		

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

Drilling was carried out using track mounted CME 75, CME 55 and D90 drill rigs. A combination of solid and hollow stem auger drilling techniques were used to advance the boreholes and samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipe with slotted screens were installed and enclosed in filter sand in selected boreholes to permit longer term groundwater level monitoring. Details of the piezometer installations and other borehole completion details are as shown in Table 3.2.

**Table 3.2 – Borehole Completion Details**

Location	Station	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
<b>(1)</b> Hwy 404 extension/ Alignment (south of Doane Rd.)	30+075	08-06	None installed	Borehole backfilled with holeplug to 0.9 m, then auger cuttings to 0.2 m and sod to the surface.
	30+125	08-07	5.2/253.9	Sand from 5.2 m to 3.3 m, holeplug from 3.3 m to 0.2 m, then sod to surface.
	30+175	08-08	None installed	Borehole backfilled with holeplug to surface.
	30+225	08-09	None installed	Borehole backfilled with holeplug to surface.
<b>(2)</b> Hwy 404 extension/ alignment (South of Mount Albert Rd.)	27+775	08-15A	None installed	Borehole backfilled with holeplug to 8.5 m, then auger cuttings to surface.
	27+825	08-16A	7.6/282.0	Sand from 7.6 m to 5.5 m, holeplug from 5.5 m to surface.
	27+875	08-17A	None installed	Borehole backfilled with holeplug to 8.7 m, then auger cuttings to surface.
<b>(3)</b> Hwy 404 extension/ Alignment (north of Doane Rd.)	30+975	08-18	None installed	Borehole backfilled with holeplug to 0.2 m, then auger cuttings to surface.
	31+017	08-19	9.1/259.5	Sand from 9.1 m to 7.3 m, holeplug from 7.3 m to 0.9 m, then auger cuttings surface.
	31+059	08-20	None installed	Borehole backfilled with holeplug to 1.5 m, then auger cuttings to surface.
	31+100	08-21	5.2/262.9	Sand from 5.2 m to 3.0 m, holeplug from 3.0 m to surface.
Doane Road proposed underpass	30+950	08-48	None installed	Borehole backfilled with holeplug to 0.07 m, then asphalt to surface.
		08-49	None installed	Borehole backfilled with holeplug to 0.05 m, then asphalt to surface.
		08-50	9.1/255.2	Sand from 9.1 m to 7.3 m, holeplug from 7.3 m to surface.
		08-51	8.1/255.5	Sand from 8.1 m to 5.8 m, holeplug from 5.8 m to 0.15 m, then concrete to surface.
		08-52	None installed	Borehole backfilled with holeplug to 3.0 m, then auger cuttings to surface.
		08-53	None installed	Borehole backfilled with holeplug to 0.07 m, then asphalt to surface.
		08-54	9.8/251.2	Sand from 9.8 m to 7.6 m, holeplug from 7.6 m to surface.
		08-55	None installed	Borehole backfilled with holeplug to 0.2 m, auger cuttings from 0.2 m to 0.05 m then asphalt to surface.



**Table 3.2 – Borehole Completion Details (Cont'd)**

Location	Station	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
<b>(4)</b> Hwy 404 extension/ Alignment (north of Queensville Sideroad)	33+200	08-22	None installed	Borehole backfilled with holeplug to 1.5 m, then auger cuttings to surface.
	33+250	08-23	13.7/260.2	Sand from 13.7 m to 11.9 m, holeplug from 11.9 m to surface.
	33+300	08-24	None installed	Borehole backfilled with holeplug to 2.4 m, then auger cuttings to surface.
	33+350	08-25	19.8/258.1	Sand from 19.8 m to 17.6 m, holeplug from 17.6 m to 3.0 m, then auger cuttings to surface.
	33+400	08-26	None installed	Borehole backfilled with holeplug to 2.7 m, then auger cuttings to surface.
<b>(5)</b> Queensville Sideroad	9+550	08-61	15.2/269.7	Sand from 15.2 m to 13.4 m, holeplug from 13.4 m to surface.
	9+550	08-33	None installed	Borehole backfilled with holeplug to surface.
	9+950	08-33A	15.2/271.0	Sand from 15.2 m to 13.4 m, holeplug from 13.4 m to surface.
	9+700	08-34	6.4/275.0	Sand from 6.4 m to 4.5 m, holeplug from 4.5 m to 0.6 m, then sand and gravel to 0.3 m, asphalt from 0.3 m surface.
	9+750	08-35	None installed	Borehole backfilled to surface with holeplug.
	9+800	08-36	7.8/265.7	Sand from 7.8 m to 5.9 m, holeplug from 5.9 m to 0.5 m, then sand and gravel to 0.3 m, asphalt from 0.3 m surface.
	9+840	08-37	None installed	Borehole backfilled with holeplug to surface.
	9+880	08-38	None installed	Borehole backfilled with holeplug to surface.
	10+100	08-38A	None installed	Borehole backfilled with holeplug to surface..
	10+150	08-39	14.0/245.0	Sand from 14.0 m to 12.1 m, holeplug from 12.1 m to 0.3 m, then flush mount installation.
	10+200	08-40	None installed	Holeplug to 0.1 m and then asphalt to surface.
	10+250	08-41	7.8/255.9	Sand from 7.8 m to 5.9 m, holeplug from 5.9 m to 0.3 m, asphalt from 0.3 m to surface.
	10+300	08-42	None installed	Borehole backfilled with holeplug to 0.1 m and then asphalt to surface.

**Table 3.2 – Borehole Completion Details (Cont'd)**

Location	Station	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
(5) Queensville Sideroad proposed underpass	33+000	08-43	None installed	Borehole backfilled to surface with holeplug.
		08-44	12.3/246.8	Sand from 12.3 m to 10.2 m. Borehole caved in from 10.2 m to 7.0 m, holeplug from 7.0 m to surface.
		08-45	21.4/236.9	Sand from 21.4 m to 19.6 m, holeplug from 19.6 m to 0.3 m then asphalt from 0.3 m to surface.
		08-46	None installed	Borehole backfilled with holeplug to surface.
		08-47	None installed	Borehole backfilled with holeplug to 0.2 m then asphalt to surface.
(5) Queensville Sideroad proposed culvert	10+088	QSR4-1	None installed	Borehole backfilled with holeplug to surface.
	10+084	QSR4-2	11.3/243.6	Sand from 11.3 m to 9.4 m, holeplug from 9.4 m to 0.6 then cuttings to surface.
	10+080	QSR4-3	None installed	Borehole backfilled with holeplug to 0.2 m then asphalt to surface.
	10+078	QSR4-4	10.7/244.7	Sand from 10.7 m to 8.5 m, holeplug from 9.4 m to surface.
	10+075	QSR4-5	None installed	Borehole backfilled with holeplug to 1.2 m then auger cuttings to surface.

#### 4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing are shown on the Record of Borehole sheets in the appendices as indicated in Table 3.1. The results of this testing program are shown on the Record of Borehole sheets in the respective appendices.

#### 5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendices A to E. Details of the encountered soil stratigraphy are presented in these sheets and on the “Borehole Locations and Soil Strata” and “Stratigraphic Sections” drawings in the respective appendices. An overall description

of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

### **5.1 High Fill - Highway 404 extension, South of Doane Road, Station 30+075 – 30+225, (Boreholes 08-06 to 08-09)**

In general, the soil stratigraphy encountered within this section consists of topsoil overlying a native layer of silt underlain by a deposit of silty clay. More detailed descriptions of the individual strata are presented below.

#### **5.1.1 Topsoil**

Topsoil was identified at the ground surface in Boreholes 08-06 to 08-09. The topsoil thickness generally ranged from 100 mm to 150 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

#### **5.1.2 Silt**

A 700-mm thick layer of native brown silt containing some sand and trace gravel was contacted below the topsoil in Borehole 08-09.

The depth to the base of the silt was 0.8 m (Elevation 265.9).

An SPT N-value measured in the silt was 3 blows per 0.3 m of penetration, indicating a very loose relative density. The moisture content of a silt sample was 22%.

#### **5.1.3 Silty Clay**

Native brown to grey silty clay containing trace sand and occasional rootlets was contacted below the topsoil in Boreholes 08-06 to 08-08 and below the silt in Borehole 08-09.

The boreholes were terminated within the silty clay at depths ranging from 5.2 m to 6.7 m (Elevations 253.9 to 259.9).

SPT N-values measured in the silty clay ranged from 4 to 31 blows per 0.3 m of penetration, indicating a soft to hard consistency. The deposit is generally stiff to very stiff. Moisture content ranged from 19% to 27%.

Grain size distribution curves for silty clay samples tested are presented on the Record of Borehole sheet and on Figures A1 and A2 of Appendix A. Atterberg Limit test results are presented on Figures A3 and A4 of Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	Silty Clay (%)
Gravel	0
Sand	0 to 5
Silt	46 to 79
Clay	21 to 51

Index Property	
Liquid Limit	22 to 48
Plastic Limit	18 to 21

The above results show that the silty clay is typically of low to medium plasticity with group symbols of CL-ML and CL-CI..

#### 5.1.4 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-07 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.1, along with the measurements in the boreholes upon completion of drilling.

**Table 5.1– Water Level Measurements**

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
08-06	August 25	5.0	254.9	Open borehole
08-07	August 25	3.9	255.2	Open borehole
	September 2	1.2	257.9	In piezometer
	September 21	1.2	257.9	In piezometer
08-09	August 26	5.5	261.1	Open borehole

The piezometric readings indicate that the groundwater level is near Elevation 257.9 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

#### 5.2 Deep Cut - Highway 404 extension, South of Mount Albert Road, Station 27+775 – 27+875, (Boreholes 08-15A to 08-17A)

In general, the soil stratigraphy encountered within this section consists of topsoil overlying a native layer of sand and an extensive deposit of sandy silt till. More detailed descriptions of the individual strata are presented below.

### 5.2.1 Topsoil

Topsoil was identified at ground surface in Boreholes 08-15A, 08-16A and 08-17A. The topsoil thickness generally ranged from 200 mm to 380 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

### 5.2.2 Sand

Native dark brown sand containing trace to some silt and occasional roots and rootlets was contacted below the topsoil in the boreholes. The thickness of the sand layer ranged between 120 mm and 200 mm.

The depth to the base of the sand ranged from 0.4 m to 0.5 m (Elevation 287.7 to 290.1).

SPT N-values recorded in the sand ranged from 5 to 7 blows per 0.3 m penetration indicating a loose relative density. Moisture content ranged from 21% to 28%.

### 5.2.3 Sandy Silt Till

An extensive deposit of brown to grey sandy silt till containing trace to some clay, trace gravel, occasional sand pockets and occasional cobbles was encountered below the sand layer at depths ranging from 0.4 m to 0.5 m (Elevation 287.7 to 290.1).

Boreholes were terminated within the sandy silt till at 10.8 m depth (Elevations 277.4 to 279.7).

SPT N-values ranged from 28 blows per 0.3 m of penetration to higher than 50 blows per 0.05 m of penetration, indicating a compact very dense relative density of the sandy silt till. The moisture content of samples from this deposit ranges from 8% to 18%.

Grain size distribution curves for sandy silt till samples tested are presented on the Record of Borehole sheet and on Figures B1 to B3 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	0 to 4
Sand	11 to 41
Silt	47 to 81
Clay	7 to 13

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts.

#### 5.2.4 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-16A to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.2, along with the measurements in the boreholes upon completion of drilling.

**Table 5.2 – Water Level Measurements**

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
08-15A	May 4	6.8	283.7	Open borehole
	July 30	5.9	284.6	Open borehole
08-16A	May 4	2.9	286.7	Open borehole
	May 15	1.2	288.4	In piezometer
	June 5	1.4	288.2	In piezometer
	July 10	1.7	287.9	In piezometer
	July 30	6.0	283.6	Open borehole
	September 21	3.2	286.4	In piezometer
08-17A	May 4	2.7	285.5	Open borehole
	July 30	5.5	282.7	Open borehole

The piezometric readings indicate that the groundwater level varies from Elevations 286.4 to 288.4.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

#### 5.3 Deep Cut - Highway 404 extension, North of Doane Road Station 30+975 – 31+100, (Boreholes 08-18 to 08-21 and 08-48 to 08-55)

In general, the soil stratigraphy encountered within this section consists of topsoil or pavement structure overlying silty sand fill and native layers of sand, sand and gravel, silty clay and deposits of sand and silt till. Asphalt/pavement structure was encountered at the surface in boreholes drilled on Doane Road. Fill was only contacted below the asphalt in boreholes drilled on Doane Road lanes/shoulders. More detailed descriptions of the individual strata are presented below.

##### 5.3.1 Topsoil

Topsoil was identified at ground surface in Boreholes 08-18 to 08-21, 08-50, 08-52 and 08-54. The topsoil thickness generally ranged from 430 mm to 600 mm in Boreholes 08-18 to 08-21 and 50 mm in Boreholes 08-50, 08-52 and 08-54. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

### 5.3.2 Pavement Structure

Pavement structure consisting of approximately 25 mm to 50 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in Boreholes 08-48, 08-49, 08-51, 08-53 and 08-55 drilled on existing Doane Road shoulders.

### 5.3.3 Fill

Fill was contacted below the pavement structure in Boreholes 08-48, 08-49, 08-51, 08-53 and 08-55. The fill generally consists of brown to dark brown sand and silty sand containing trace to some gravel, occasional cobbles and some silt. In Borehole 08-53, a layer of silty clay fill containing trace sand and occasional silt seams was contacted below the cohesionless fill at 0.8 m depth (Elevation 261.4). The thickness of the fill ranged from 0.55 m to 2.25 m.

The depth to the base of the fill varied from 0.6 to 2.3 (Elevations 260.4 to 265.5).

SPT N-values recorded in the cohesionless fill ranged from 13 to 37 blows per 0.3 m penetration indicating a loose to dense relative density. In Borehole 08-55, an SPT N-value of 73 blows per 0.3 m of penetration indicating a very dense relative density was measured below the asphalt layer.

In the silty clay fill layer, the SPT N-values were 7 and 12 blows per 0.3 m of penetration, indicating a firm to stiff consistency.

The moisture content of the fill ranged from 5% to 23%.

Grain size distribution curve for a sample of silty clay fill tested is presented on the Record of Borehole sheet and on Figure C1 of Appendix C. Atterberg Limit test results are presented on Figure C14 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	4
Silt	68
Clay	28

Index Property	(%)
Liquid Limit	27
Plastic Limit	16

The above results show that the silty clay fill is typically of low plasticity with a group symbol of CL.

#### 5.3.4 Silty Sand

A 200-mm thick layer of brown silty sand was contacted below the topsoil in Borehole 08-21.

An SPT N-value recorded in the silty sand was 8 blows per 0.3 m penetration indicating a loose relative density.

#### 5.3.5 Sand and Gravel

A layer of brown sand and gravel containing trace clay, trace silt and occasional cobbles was contacted within the sand and silt till at 1.5 m depth in Borehole 08-18. The thickness of the sand and gravel layer was 1.1 m.

The depth to the base of the sand and gravel layer was 2.6 m (Elevation 264.4).

SPT N-values of 85 and 105 blows per 0.3 m of penetration were measured within the sand and gravel layer, indicating a very dense relative density. The moisture contents were 6% and 14%.

A grain size distribution curve for a sand and gravel sample tested is presented on the Record of Borehole sheet and on Figure C2 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Gravel (%)
Gravel	41
Sand	47
Silt & Clay	12

#### 5.3.6 Silty Clay

Brown silty clay containing trace sand and trace gravel was contacted below the silty sand at 0.6 m (Elevation 267.5) in Borehole 08-21. The thickness of the silty clay was 2.2 m.

The depth to the base of the silty clay was 2.8 m (Elevation 265.3).

SPT N-values ranged from 11 to 21 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency. The moisture content of the silty clay samples ranged from 21% to 37%.

A grain size distribution curve for a silty clay sample tested is presented on the Record of Borehole sheet and on Figure C3 of Appendix C. Atterberg Limit test results are presented on Figure C15 of Appendix C. The results of the laboratory test are summarized as follows:



Soil Particles	Silty Clay (%)
Gravel	1
Sand	9
Silt	49
Clay	41

Index Property	
Liquid Limit	48
Plastic Limit	21

The above results show that the silty clay is typically of medium plasticity with a group symbol of CI.

### 5.3.7 Sand and Silt Till

Layers of native brown to grey sand and silt till containing trace to some clay, trace to some gravel and occasional cobbles were observed across the site in Boreholes 08-18 to 08-21 and 08-48 to 08-54 at depths and elevations as indicated in Table 5.3.

**Table 5.3 – Locations of Native Sand and Silt Till**

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-18	0.6 to 1.5	266.5 to 265.5	0.9
	2.6 to 7.7 (borehole termination depth)	264.4 to 259.3	At least 5.1
08-19	0.6 to 9.2 (borehole termination depth)	268.0 to 259.4	At least 8.6
08-20	0.5 to 9.2 (borehole termination depth)	268.2 to 259.5	At least 8.7
08-21	2.8 to 7.8	265.3 to 260.3	At least 5.0
08-48	0.8 to 2.4	264.9 to 263.2	1.6
08-49	0.6 to 3.0	265.5 to 263.0	2.4
08-50	0.05 to 2.1	264.3 to 262.2	2.1
08-51	2.3 to 12.3 (borehole termination depth)	261.4 to 251.3	At least 10.0
08-52	0.05 to 9.5 (borehole termination depth)	262.3 to 252.8	At least 9.5
08-53	1.8 to 10.8 (borehole termination depth)	260.4 to 251.4	At least 9.0
08-54	0.05 to 2.3	260.9 to 258.7	2.2
	5.6 to 12.3 (borehole termination depth)	255.4 to 248.7	At least 6.7

An 800-mm thick layer of sand was contacted at 5.5 m depth (Elevation 261.5) in Borehole 08-18.

Clayey zones were observed within the sand and silt till in Boreholes 08-19 and 08-20 near elevation 266.0 to 267.0.

A layer of silt was contacted in Borehole 08-21 near elevation 265.0.

Standard Penetration tests in the sand and silt till deposit gave SPT N-values ranging from 5 to 58 blows per 0.3 m of penetration, indicating a loose to very dense relative density. In Boreholes 08-18 to 08-21, an SPT N-value of 125 blows per 0.3 m of penetration and SPT N-values higher than 100 blows per 0.1 m of penetration were measured below approximate Elevations 264.0 to 265.0. Higher SPT N-values ranging from 83 blows per 0.3 m of penetration to 100 blows per 0.075 m of penetration were measured below 2.3 m depth (Elevation 261.4) in Borehole 08-51, below 3.4 m and 4.6 m depth (Elevations 259.0 and 257.5) in Boreholes 08-52 and 08-53 and below 7.6 m depth (Elevation 253.4) in Borehole 08-54.

The moisture content of samples from the sand and silt till deposit varies between 8% and 22%.

Grain size distribution curves for sand and silt till samples tested are presented on the Record of Borehole sheet and on Figures C4 to C7 of Appendix C. Grain size distribution curve for the silt sample is presented on the Record of Borehole sheet and on Figure C8 of Appendix C. Atterberg Limit test results of the clayey zones are presented on Figure C16 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Silt Till (%)	Silt (%)
Gravel	0 to 8	0
Sand	13 to 56	3
Silt	37 to 75	91
Clay	4 to 18	6

Index Property		
Liquid Limit	17 to 24	-
Plastic Limit	12 to 18	-

The above results show that the clayey zones in the sand and silt till are typically of low plasticity with group symbols of CL-ML.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts and resistance to augering.

### 5.3.8 Gravelly Sand

A layer of native brown gravelly sand containing some silt and clay was encountered in Borehole 08-48 at 2.4 m depth (Elevation 263.2). Cobbles were encountered within the gravelly sand layer at 3.5 m depth (Elevation 262.1). Thickness of the gravelly sand layer was 1.7 m.

The depth to the base of the gravelly sand was 4.1 m (Elevation 261.5).

SPT N-values measured in the gravelly sand were 35 and 50 blows per 0.3 m of penetration, indicating a dense relative density. Moisture contents ranged from 2% to 10%.

Grain size distribution curve for a gravelly sand sample tested is presented on the Record of Borehole sheets and on Figure C9 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Gravelly Sand (%)
Gravel	23
Sand	64
Silt & Clay	13

### 5.3.9 Clayey Silt Till

Native brown to grey clayey silt till containing trace of sand was contacted at 2.3 m depth (Elevation 258.7) in Borehole 08-054. Thickness of the clayey silt layer was 3.3 m.

The depth to the base of the clayey silt till was 5.6 m (Elevation 255.4).

SPT N-values measured in the clayey silt till were 14 to 26 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency. Moisture content ranged from 19% to 20%.

A grain size distribution curve for a clayey silt till sample tested is presented on the Record of Borehole sheet and on Figure C10 of Appendix C. Atterberg Limit test results are presented on Figure C17 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Clayey Silt Till (%)
Gravel	0
Sand	1
Silt	77
Clay	22

Index Property	
Liquid Limit	26
Plastic Limit	19

The above results show that the clayey silt till is typically of low plasticity with group symbols of ML-CL.

### 5.3.10 Silt Till

Layers of native brown to grey silt till containing some sand to sandy, trace to some clay, trace to some gravel and occasional cobbles were observed in Boreholes 08-48 to 08-50 and 08-55 at depths and elevations as indicated in Table 5.4.

**Table 5.4 – Locations of Native Silt Till**

<b>Borehole</b>	<b>Depth below existing ground surface (m)</b>	<b>Elevation (m)</b>	<b>Thickness (m)</b>
08-48	4.1 to 7.9 (borehole termination depth)	261.5 to 257.8	At least 3.8
08-49	3.0 to 9.3 (borehole termination depth)	263.0 to 256.8	At least 6.3
08-50	2.1 to 9.4 (borehole termination depth)	262.2 to 255.0	At least 7.3
08-55	1.1 to 9.3 (borehole termination depth)	260.5 to 252.4	At least 8.2

Layers of sand and silty sand were contacted within the silt till at 4.1 m depth (Elevations 262.0 and 260.3) in Boreholes 08-49 and 08-50.

Standard Penetration tests in this deposit gave SPT N-values ranging from 24 to 92 blows per 0.3 m of penetration, indicating a compact to very dense relative density. Locally in Borehole 08-55, loose conditions were measured at 1.5 m depth (Elevation 260.2). SPT N-values higher than 100 blows per 0.3 m of penetration, indicating a very dense relative density, were measured generally below 4.0 m depth (approximate Elevation 261.0) in Boreholes 08-48 to 08-50 and at 7.5 m depth (Elevation 254.2.) in Borehole 08-55.

The moisture content of samples from the sand and silt till deposit varies between 3% and 22%.

Grain size distribution curves for the silt till samples tested are presented on the Record of Borehole sheet and on Figures C11 and C12 of Appendix C. Grain size distribution curve for the layer of silty sand tested is presented on the Record of Borehole sheet and on Figure C13 of Appendix C. A sample of silt till containing some clay was tested for Atterberg Limits and the test results are presented on Figure C18 of Appendix C.

The results of the laboratory tests are summarized as follows:

<b>Soil Particles</b>	<b>Silt Till (%)</b>	<b>Silty Sand (%)</b>
Gravel	0 to 6	1
Sand	2 to 42	68
Silt	55 to 81	26
Clay	5 to 17	5

<b>Index Property</b>	<b>(%)</b>	
Liquid Limit	18	-
Plastic Limit	12	-

The above results show that the clayey zones in the silt till are typically of low plasticity with group symbols of CL-ML.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts.

### 5.3.11 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Five standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.5, along with the measurements in the boreholes upon completion of drilling.

**Table 5.5 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-18	January 29, 2009	6.3	260.7	Open borehole
08-19**	January 29, 2009	6.4	262.2	Open borehole
		-	-	In piezometer
08-21**	January 30, 2009	-	-	In piezometer
08-48	October 22, 2008	6.5	259.1	Open borehole
08-49	October 22, 2008	7.1	259.0	Open borehole
08-50	October 20, 2008	5.0	259.4	Open borehole
	October 24, 2008	4.4	260.0	In piezometer
	November 28, 2008	4.9	259.5	In piezometer
	February 6, 2009	0.1	264.3	In piezometer
	February 20, 2009	0.2*	264.6	In piezometer
	March 20, 2009	1.0	263.4	In piezometer
	April 22, 2009	1.1	263.3	In piezometer
	September 2, 2009	2.6	261.8	In piezometer
08-51	November 28, 2008	4.1	259.5	In piezometer
08-52	October 21, 2008	4.6	257.8	Open borehole
08-53	October 23, 2008	3.0	259.1	Open borehole
08-54	October 24, 2008	2.1	258.9	Open borehole
	November 28, 2008	3.7	257.3	In piezometer
	February 6, 2009	Ground surface	261.0	In piezometer
	February 20, 2009	0.4*	261.4	In piezometer
	March 20, 2009	0.7*	261.7	In piezometer
	April 22, 2009	0.6*	261.6	In piezometer
	September 2, 2009	0.6	260.4	In piezometer
08-55	October 22, 2008	4.2	257.5	Open borehole

\* Water level above ground surface (artesian condition)

\*\* Water level readings in piezometers have not been taken due to site access restriction.

The piezometric readings of the current investigation indicate that the groundwater level at the site is high and the water level decreases from west to east from Elevations 264.6 to 261.7 along Doane Road.

Water levels were observed approximately 0.2 m to 0.7 m above the existing ground surface (artesian conditions) during the later winter/early spring season in Boreholes 08-50 and 08-054, near Elevations 264.6 and 261.7, respectively.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

#### **5.4 Deep Cut - Highway 404 extension, North of Queensville Sideroad Station 33+200 – 33+700, (Boreholes 08-22 to 08-32)**

In general, the soil stratigraphy encountered within this section consists of topsoil overlying native layers of sandy silt and sand underlain by a deposit of sand and silt till. More detailed descriptions of the individual strata are presented below.

##### **5.4.1 Topsoil**

Topsoil was identified at ground surface in Boreholes 08-22 to 08-26, 08-31 and 08-32. The thickness of the topsoil ranged from 150 mm to 600 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities. Due to farming activities, the topsoil may have been mixed with native soils to depths deeper than 0.6 m as noted in Boreholes 08-24, 08-25 and 08-27 to 08-30.

##### **5.4.2 Sandy Silt**

Layers of native brown sandy silt mixed with topsoil were encountered below the topsoil in Boreholes 08-24 and 08-25. The sandy silt layers were 1.1 m and 0.3 m thick.

The depth to the base of the sandy silt was 1.5 m and 0.8 m (elevations 274.8 and 277.1) in Boreholes 08-24 and 08-25, respectively.

SPT N-values recorded in the sandy silt were 4 and 20 blows per 0.3 m penetration indicating a loose to compact relative density. Moisture contents were 12% to 18%.

##### **5.4.3 Sandy Silt Till**

Layers of native brown to grey sand and silt till containing some clay, trace gravel, sand pockets and occasional cobbles were encountered in the boreholes at depths and elevations as indicated in Table 5.6.

**Table 5.6 – Locations of Native Sand and Silt Till**

<b>Borehole</b>	<b>Depth below existing ground surface (m)</b>	<b>Elevation (m)</b>	<b>Thickness (m)</b>
08-22	0.6 to 4.8 (borehole termination depth)	267.4 to 263.2	At least 4.2

08-23	0.3 to 13.9 (borehole termination depth)	273.6 to 260.1	At least 13.6
08-24	1.5 to 13.1	274.8 to 263.2	11.6
	15.2 to 16.8 (borehole termination depth)	261.1 to 259.5	At least 1.6
08-25	0.8 to 14.5	277.1 to 263.4	13.7
	15.3 to 19.9 (borehole termination depth)	262.6 to 258.0	At least 4.6
08-26	0.8 to 19.8	277.4 to 258.4	19.0
08-27	0.4 to 12.3 (borehole termination depth)	273.4 to 261.5	At least 11.9
08-28	0.2 to 8.4	274.4 to 266.2	8.2
	13.3 to 15.3 (borehole termination depth)	261.3 to 259.2	At least 2.0
08-29	8.5 to 13.8	264.9 to 259.7	At least 5.3
08-30	0.8 to 4.1	270.8 to 267.4	3.3
	6.1 to 12.3	265.5 to 259.2	At least 6.2
08-31	1.1 to 1.6	267.4 to 267.0	0.5
08-32	0.8 to 1.9	265.5 to 264.4	1.1
	2.7 to 3.2	263.5 to 263.0	0.5

Layers of sand and layers of silt were encountered within the sand and silt till.

Standard Penetration tests in the sand and silt till deposit gave SPT N-values ranging from 12 to 112 blows per 0.3 m of penetration, indicating a compact to very dense relative density. SPT N-values higher than 100 blows per 0.075 m of penetration, indicating a very dense relative density, were encountered below 4.0 m depth in Boreholes 08-22 to 08-29.

The moisture content of samples from the sand and silt till deposit varies from 8% to 19%.

Grain size distribution curves for sand and silt till samples tested are presented on the Record of Borehole sheet and on Figures D1 to D3 of Appendix D. Grain size distribution curves for the silt samples are presented on the Record of Borehole sheets and on Figure D4 of Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Silt Till (%)
Gravel	0 to 5
Sand	1 to 65
Silt	61 to 90
Clay	4 to 14

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts and resistance to augering.

#### 5.4.4 Sand

A 300-mm thick layer of native brown sand was contacted below the topsoil in Borehole 08-26. The depth to the base of the sand layer was 0.8 m (Elevation 277.4). Grey sand layers containing some silt, trace clay and trace gravel were encountered within the sand and silt till in the boreholes at depths and elevations as indicated in Table 5.7.

**Table 5.7 – Locations of Native Sand**

<b>Borehole</b>	<b>Depth below existing ground surface (m)</b>	<b>Elevation (m)</b>	<b>Thickness (m)</b>
08-24	13.1 to 15.2	263.2 to 261.1	2.1
08-25	14.5 to 15.3	263.4 to 262.6	0.8
08-28	8.4 to 9.4	266.2 to 265.1	1.0
	10.1 to 13.3	264.5 to 261.3	3.2
08-29	6.4 to 8.5	267.0 to 264.9	2.1
08-30	4.1 to 6.1	267.4 to 265.5	2.0
08-31	1.1 to 1.6	267.4 to 267.0	0.5
08-32	1.9 to 2.7	264.3 to 263.5	0.8
	3.2 to 4.3	263.0 to 262.0	1.1

An SPT N-value recorded in the sand layer in Borehole 08-26 was 4 blows per 0.3 m penetration indicating a loose relative density. SPT N-values measured in the sand layer in Boreholes 08-24, 08-25, 08-28, 08-29, 08-30 were greater than 100 blows for less than 300 mm penetration indicating a very dense relative density. Moisture contents ranged from 8% to 19%.

#### **5.4.5 Water Levels**

Water levels were observed in the boreholes during and upon completion of drilling. Five standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.8, along with the measurements in the boreholes upon completion of drilling.



**Table 5.8 – Water Level Measurements**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-22	January 22, 2009	2.9	265.1	Open borehole
08-23	January 20, 2009	11.9	262.0	Open borehole
	February 6, 2009	6.1	267.8	In piezometer
	February 20, 2009	5.7	268.2	In piezometer
	March 20, 2009	5.8	268.1	In piezometer
	April 22, 2009	5.4	268.5	In piezometer
	May 15, 2009	5.8	268.1	In piezometer
	June 5, 2009	6.0	267.9	In piezometer
	July 10, 2009	6.1	267.8	In piezometer
	September 2, 2009	8.9	265.0	In piezometer
	September 21, 2009	8.2	265.7	In piezometer
08-24	January 21, 2009	10.6	265.7	Open borehole
08-25	January 21, 2009	12.2	267.5	Open borehole
	February 6, 2009	6.9	271.0	In piezometer
	February 20, 2009	6.0	271.9	In piezometer
	March 20, 2009	6.0	271.9	In piezometer
	April 22, 2009	5.7	272.2	In piezometer
	May 15, 2009	5.9	272.0	In piezometer
	June 5, 2009	6.1	271.8	In piezometer
	July 10, 2009	6.4	271.5	In piezometer
	September 2, 2009	13.3	264.6	In piezometer
	September 21, 2009	13.4	264.5	In piezometer
08-26	January 22, 2009	11.1	267.1	Open borehole
08-27	February 2, 2010	7.5	266.3	In piezometer
08-28	January 19, 2010	7.3	267.3	Open borehole
08-29	February 2, 2010	6.4	267.1	In piezometer
08-31	February 2, 2010	4.2	264.4	In piezometer

The piezometric readings indicate that the groundwater level varies from elevation 264.4 m to 272.2 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

**5.5 High Fill and Deep Cut, Queensville Sideroad, Station 9+550 – 10+300  
(Boreholes 08-61, 08-33 to 08-38, 08-38A, 08-33A, 08-39 to 08-47, QSR4-1 to  
QSR4-5 and 301 to 303)**

The soil stratigraphy encountered at the borehole locations typically consists of topsoil or pavement structure overlying fill of variable composition (silty clay/clayey silt, sand and gravel) overlying interbedded layers of native sand, clayey silt, and glacial till. Asphalt/pavement structure was encountered at the surface in boreholes drilled on the existing Queensville Sideroad lanes and shoulders. More detailed descriptions of the individual stratum are presented below.

**5.5.1 Topsoil**

Topsoil was identified at ground surface in Boreholes 08-33A and 08-61. The topsoil thickness was 150mm and 200 mm in Boreholes 08-33A and 08-61, respectively. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

**5.5.2 Pavement Structure**

Pavement structure consisting of approximately 125 mm to 200 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in boreholes drilled on the existing Queensville Sideroad lanes and shoulders.

**5.5.3 Fill**

Fill was contacted across the site in all the boreholes, except in Boreholes 08-61 and 08-33A. Fill was encountered below the pavement structure in Boreholes 08-33 to 08-42, 08-38A, 08-43, 08-45, 08-47 and QSR4-3 and surficially in Boreholes 08-44, 08-46, QSR4-1, QSR4-2, QSR4-4, QSR4-5 and 301 to 303.

The fill generally consists of intermixed layers of various soils:

- Dark brown silty clay/clayey silt containing trace sand, trace gravel, trace organics, topsoil and occasional rootlets.
- Dark brown gravelly sand.
- Brown sandy silt/silty sand containing trace to some clay, trace gravel and occasional organics.
- Brown sand and gravel containing trace to some silt.
- Brown silt containing some sand, some clay and trace gravel.
- Dark brown sand, containing some gravel and trace to some silt.

The thickness of the fill ranged from 0.6 m to 3.9 m.

The fill extended to depths ranging from 0.6 m to 4.2 m, Elevations 252.2 to 254.2 in Boreholes QSR41- to QSR4-5 and Elevations 253.0 to 282.5 in the remaining boreholes drilled along Queensville Sideroad.

SPT N-values recorded in the cohesionless fill ranged from 2 to 49 blows per 0.3 m penetration indicating a very loose to dense relative density. In general the fill is in a compact to dense state. In the clayey silt fill layer, the SPT N-values ranged from 1 to 16 blows per 0.3 m of penetration, indicating a very soft to very stiff consistency. The moisture content of the fill ranged from 2% to 39%.

Grain size distribution curves for the cohesionless fill samples tested are presented on the Record of Borehole sheets and on Figures E1 and E2 in Appendix E. The results of the laboratory tests are summarized as follows:

Soil	Gravelly Sand (%)	Silty Sand (%)	Sand (%)
Gravel	29 to 34	3 to 12	12
Sand	61 to 67	55 to 57	68
Silt	-	26 to 33	-
Clay	-	7	-
Silt & Clay	4 to 5	-	20

#### 5.5.4 Sand

Layers of native brown sand were encountered below the fill and topsoil in Boreholes 08-36, 08-44 and 08-61 at 1.7 m, 2.2 m and 0.2 m depth (Elevations 271.8, 256.9 and 284.7). The thickness of the sand layer ranges from 0.6 m to 1.3 m.

The depths to the base of the sand were 2.3 m, 3.0 m and 1.5 m (Elevations 271.2, 256.0 and 283.4) in Boreholes 08-36, 08-44 and 08-61, respectively.

SPT N-values measured in the sand ranged from 10 to 34 blows per 0.3 m of penetration, indicating a loose to dense relative density. An SPT N-value of 108 blows per 0.3 m of penetration was measured in Borehole 08-36, indicating a very dense relative density. Moisture contents ranged from 3% to 17%.

Grain size distribution curves for sand samples tested are presented on the Record of Borehole sheets and on Figure E3 in Appendix E. The results of the laboratory tests are summarized as follows:

Soil Particles	Sand (%)
Gravel	10 to 20
Sand	62 to 76
Silt	8
Clay	3
Silt & Clay	18 to 24

#### 5.5.5 Clayey Silt Till and Clayey Silt

Layers of native brown to grey clayey silt till and clayey silt containing trace sand to sandy and trace gravel were observed in the boreholes at depths and elevations as indicated in Table 5.9.

**Table 5.9 – Locations of Native Clayey Silt Till and Clayey Silt**

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-38A	2.3 to 5.6	255.0 to 251.7	3.3
	7.1 to 14.2 (borehole termination depth)	250.2 to 243.1	At least 7.1
08-39	2.3 to 7.0	256.7 to 251.9	4.7
08-40	3.0 to 8.4	258.3 to 252.9	5.4
08-41	2.3 to 4.0	261.4 to 259.7	1.7
08-42	1.1 to 4.1*	263.4 to 260.3*	3.0
08-46	7.2 to 10.3	249.5 to 246.4	3.1
	11.8 to 23.1 (borehole termination depth)	244.9 to 233.6	At least 11.3
08-47	4.4 to 21.8	253.0 to 235.6	17.4
301	2.2 to 3.7	255.3 to 253.8	1.5
	3.7 to 9.6	253.8 to 247.9	5.9
	11.6 to 15.7 (borehole termination depth)	245.9 to 241.8	At least 4.1
301A	12.2 to 25.0 (borehole termination depth)	243.8 to 231.0	At least 12.8
302	1.5 to 3.0	257.5 to 256.0	1.5

\*Clayey silt

SPT-N values measured in the clayey silt till and clayey silt layers ranged from 8 to 81 blows per 0.3 m of penetration, indicating a stiff to hard consistency. SPT N-values higher than 100 blows per 0.075 m of penetration, indicating a hard consistency were also measured within the clayey silt till. Moisture content ranged from 10% to 25%.

Grain size distribution curves for clayey silt till and clayey silt samples tested are presented on the Record of Borehole sheets and on Figures E4 to E7 in Appendix E. Atterberg Limit test results are presented on Figures E19 and E20 of Appendix E. Grain size distribution curves and Atterberg Limit tests results for clayey silt samples conducted during the

previous investigation are also presented in Appendix E. The results of the laboratory tests are summarized as follows:

Soil Particles	Clayey Silt Till and Clayey Silt (%)
Gravel	0 to 4
Sand	1 to 37
Silt	43 to 89
Clay	7 to 33

Index Property	(%)
Liquid Limit	18 to 28
Plastic Limit	10 to 19

The above results show that the clayey silt is typically of low plasticity with group symbols of ML-CL and CL.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts and resistance to augering.

#### 5.5.6 Sand and Silt Till

Layers of native brown sand and silt till containing trace clay to clayey, trace to some gravel and occasional cobbles were observed in some boreholes at various depths and elevations as indicated in Table 5.10.

**Table 5.10 – Locations of Native Sand and Silt Till**

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-61	1.5 to 8.7	283.4 to 276.2	7.2
08-33	1.5 to 4.8 (borehole termination depth)	282.5 to 279.2	At least 3.3
08-33A	0.2 to 4.1	286.0 to 282.1	3.9
08-34	1.5 to 6.4 (borehole termination depth)	279.8 to 275.0	At least 4.9
08-35	1.5 to 6.3 (borehole termination depth)	276.1 to 271.3	At least 4.8
08-36	2.3 to 7.8 (borehole termination depth)	271.2 to 265.7	At least 5.5
08-37	1.5 to 9.2 (borehole termination depth)	268.6 to 260.9	At least 7.7
08-38	1.5 to 10.8 (borehole termination depth)	265.3 to 256.1	At least 9.3
08-39	7.0 to 14.0 (borehole termination depth)	251.9 to 245.0	At least 7.0
08-40	8.4 to 12.5 (borehole termination depth)	252.9 to 248.8	At least 4.1
08-41	4.0 to 7.8 (borehole termination depth)	259.7 to 255.9	At least 3.8
08-42	4.1 to 6.2 (borehole termination depth)	260.3 to 258.2	At least 2.1
08-43	2.1 to 4.7 (borehole termination depth)	261.8 to 259.2	At least 2.6
08-44	3.0 to 12.3 (borehole termination depth)	256.0 to 246.8	At least 9.3
08-45	2.4 to 8.7 11.0 to 21.4 (borehole termination depth)	255.8 to 249.6 247.3 to 236.9	6.3 At least 10.4
08-46	2.9 to 7.2	253.8 to 249.5	4.3
302	3.0 to 18.5 (borehole termination depth)	256.0 to 240.5	At least 15.5

303	3.0 to 13.9 (borehole termination depth)	258.0 to 247.1	At least 10.9
QSR4-1	1.5 to 12.8 (borehole termination depth)	252.2 to 240.9	At least 11.3
QSR4-2	0.6 to 11.3 (borehole termination depth)	254.2 to 243.6	At least 10.7
QSR4-3	4.1 to 11.3 (borehole termination depth)	253.0 to 245.9	7.2
QSR4-4	2.1 to 11.3 (borehole termination depth)	253.3 to 244.2	9.2
QSR4-5	2.4 to 10.7 (borehole termination depth)	253.0 to 244.7	At least 8.3

Clayey zones and layers of silty sand were encountered within the sand and silt till.

In general, Standard Penetration tests in this deposit gave SPT N-values ranging from 30 blows per 0.3 m of penetration to greater than 100 blows for 0.10 m of penetration, indicating that the soil was in dense to very dense state. Occasional low SPT N-values were encountered in the deposit indicating loose to compact layers. The moisture content of samples from this deposit varies from 5% to 18%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheet and on Figures E8 to E15 of Appendix E. Atterberg Limit test results are presented on Figures E21 and E22 of Appendix E. Laboratory test results of previous investigation are presented in Appendix E. The results of the laboratory tests are summarized as follows:

Soil Particles	Sand and Silt Till
Gravel	0 to 32
Sand	18 to 69
Silt	24 to 74
Clay	5 to 36

Index Property	
Liquid Limit	18 to 23
Plastic Limit	10 to 21

The above results show that the clayey zones in the sand and silt till are typically of low plasticity with group symbols of CL-ML and two samples had a group symbol of CL.

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts and resistance to augering.

#### 5.5.7 Silt Till

Layers of native brown to grey silt till containing trace to some sand, some clay and trace gravel were encountered in three boreholes at depths and elevations as indicated in Table 5.11.

**Table 5.11 – Locations of Native Silt Till**

<b>Borehole</b>	<b>Depth below existing ground surface (m)</b>	<b>Elevation (m)</b>	<b>Thickness (m)</b>
08-33A	4.1 to 15.3 (borehole termination depth)	282.1 to 270.9	At least 11.2
08-47	21.8 to 27.7 (borehole termination depth)	235.6 to 229.7	At least 5.9
08-61	8.7 to 15.3 (borehole termination depth)	276.2 to 269.6	At least 6.6

SPT-N values measured in the silt till are higher than 100 blows per 0.1 m of penetration, indicating a very dense relative density. Moisture content ranged from 8% to 22%.

Grain size distribution curves for silt till samples tested are presented on the Record of Borehole sheets and on Figure E16 in Appendix E. The results of the laboratory tests are summarized as follows:

<b>Soil Particles</b>	<b>Silt Till (%)</b>
Gravel	0
Sand	2 to 24
Silt	68 to 92
Clay	6 to 18

Glacial tills inherently contain cobbles and boulders which may account for some high blow counts.

#### **5.5.8 Gravelly Sand**

A layer of grey gravelly sand was contacted in Borehole 08-45 at 8.7 m depth (Elevation 249.6), within the sand and silt till deposit.

This layer was 2.3 m thick. The depth to the base of the gravelly sand layer was 11.0 m (Elevation 247.3).

SPT-N values measured in the gravelly sand layer were 49 blows per 0.3 m of penetration and 100 blows per 0.1 m of penetration, indicating a dense to very dense relative density. The moisture content ranged from 9% to 11%.

Grain size distribution curves for two gravelly sand samples tested are presented on the Record of Borehole sheets and on Figure E17 of Appendix E. The results of the laboratory test are summarized as follows:

<b>Soil Particles</b>	<b>Gravelly Sand (%)</b>
Gravel	16 to 22
Sand	62 to 71
Silt & Clay	7 to 22

### 5.5.9 Silty Sand

Layers of native brown to grey silty sand were encountered within clayey silt till in Boreholes 08-46 and 301 and below the clayey silt in Borehole 303. Thickness of the silty sand layers ranged from 0.8 m to 2.0 m.

The depths to the base of the silty sand were 3.0 m, 11.6 m and 11.8 m (Elevations 258.0, 245.9 and 244.9) in Boreholes 303, 301 and 08-46, respectively.

SPT-N values measured in the silty sand ranged from 10 to 33 blows per 0.3 m of penetration, indicating a compact to dense relative density. Moisture content ranged from 10% to 18%.

Grain size distribution curve for a silty sand sample tested is presented on the Record of Borehole sheet and on Figure E18 of Appendix E. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	64
Silt	31
Clay	5

### 5.5.10 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in ten boreholes to monitor water levels after completion of drilling during the previous investigation. The water levels measured in the piezometers are summarized in Table 5.12, along with the measurements in the boreholes upon completion of drilling.



**Table 5.12 – Water Level Measurements**

Borehole	Station	Date	Water Level (m)		Comment
			Depth	Elevation	
08-61	9+550	July 16, 2008	9.6	275.3	In piezometer
		July 29, 2008	9.6	275.3	
		September 17, 2008	7.9	277.0	
		October 24, 2008	10.1	274.8	
		November 28, 2008	11.0	273.9	
		February 6, 2009	7.6	277.3	
		February 20, 2009	7.2	277.7	
		March 20, 2009	8.0	276.9	
		April 22, 2009	7.6	277.3	
		May 15, 2009	8.2	276.7	
		June 5, 2009	8.9	276.0	
		July 10, 2009	8.7	276.2	
		July 16, 2009	9.6	275.3	
		July 29, 2009	9.6	275.3	
		September 2, 2009	9.0	275.9	
		September 21, 2009	9.2	275.7	
08-33	9+550	March 26, 2008	Dry	-	Open borehole
08-33A	9+550	July, 16, 2008	8.6	277.6	In piezometer
		July 29, 2008	7.6	278.6	
		September 17, 2008	5.8	280.4	
		October 24, 2008	8.7	277.5	
		November 28, 2008	9.0	277.2	
		February 6, 2009	5.4	280.8	
		February 20, 2009	5.1	281.1	
		March 20, 2009	0.2*	286.4	
		April 22, 2009	4.8	281.4	
		May 15, 2009	5.3	280.9	
		June 5, 2009	6.0	280.2	
		July 10, 2009	5.8	280.4	
		July 16, 2009	8.5	277.7	
		July 29, 2009	7.6	278.6	
		September 2, 2009	6.9	279.3	
		September 21, 2009	7.2	279.0	
08-34	9+704	April 18, 2008	2.3	279.0	In piezometer
		April 21, 2008	2.2	279.1	
		June 30, 2008	2.0	279.3	
		July 29, 2008	1.6	279.7	
		September 17, 2008	1.4	279.9	
		November 28, 2008	1.7	279.6	
		July 29, 2009	1.6	279.7	
		September 21, 2009	3.7	277.6	
08-35	9+755	March 26, 2008	3.5	274.2	Open borehole

**Table 5.12 – Water Level Measurements (Cont'd)**

Borehole	Station	Date	Water Level (m)		Comment
			Depth	Elevation	
08-36	9+808	March 25, 2008	7.4	266.1	Open borehole
		April 18, 2008	3.4	270.1	In piezometer
		April 21, 2008	3.3	270.2	In piezometer
		June 30, 2008	1.7	271.8	In piezometer
		November 28, 2008	1.5	272.0	In piezometer
		July 29, 2009	1.3	272.2	In piezometer
		September 21, 2009	6.3	267.2	In piezometer
08-37	9+850	March 24, 2008	Dry	-	Open borehole
08-38	9+895	March 24, 2008	6.2	260.7	Open borehole
08-38-A	10+100	March 26, 2008	0.8	256.5	Open borehole
08-39	10+140	March 27, 2008	3.2	255.8	Open borehole
		April 18, 2008	2.0	257.0	In piezometer
		April 21, 2008	1.9	257.1	In piezometer
		June 30, 2008	2.8	256.2	In piezometer
		September 21, 2009	0.9	258.1	In piezometer
08-40	10+195	March 20, 2008	3.2	258.1	Open borehole

**Table 5.12 – Water Level Measurements (Cont'd)**

Borehole	Station	Date	Water Level (m)		Comment
			Depth	Elevation	
08-41	10+250	March 27, 2008	5.3	258.4	Open borehole
		April 18, 2008	3.3	260.4	In piezometer
		April 21, 2008	3.2	260.5	In piezometer
		June 30, 2008	2.1	261.6	In piezometer
		September 21, 2009	2.8	260.9	In piezometer
08-42	10+300	March 18, 2008	4.9	259.5	Open borehole
08-43	33+000	March 28, 2008	4.1	259.8	Open borehole
08-44		April 18, 2008	1.4	257.7	In piezometer
		June 30, 2008	2.1	257.0	
		July 29, 2008	1.9	257.2	
		October 24, 2008	1.1	258.0	
		March 20, 2009	0.5*	259.6*	
		April 22, 2009	0.5*	259.6*	
		May 15, 2009	0.5*	259.6*	
		June 5, 2009	0.1	259.0	
		July 10, 2009	2.1	257.0	
		July 16, 2009	Ground surface	259.1	
		July 29, 2009		257.9	
		September 21, 2009	0.5	258.6	
08-45		April 18, 2008	2.4	255.9	In piezometer
		April 21, 2008	2.4	255.9	
		September 21, 2009	0.1	258.2	
08-46		March 18, 2008	0.9	255.8	Open borehole
08-47		March 11, 2008	2.6	254.8	Open borehole
301**		June 11, 2004	4.9	252.6	Open borehole
301A**		September 28, 2004	2.7	253.3	In piezometer
		October 7, 2004	0.7*	256.7*	
302**		September 29, 2004	10.7	248.3	In piezometer
303**		September 29, 2004	9.1	251.9	Open borehole
QSR4-1	10+088	March 7, 2008	1.1	252.6	Open borehole

**Table 5.12 – Water Level Measurements (Cont'd)**

Borehole	Station	Date	Water Level (m)		Comment
			Depth	Elevation	
QSR4-2	10+084	March 20, 2008	3.3	251.6	In piezometer
		April 18, 2008	2.5	252.4	In piezometer
		June 30, 2008	1.0	253.9	In piezometer
		July 29, 2008	0.8	254.1	In piezometer
		October 24, 2008	0.9	254.0	In piezometer
		November 28, 2008	1.0	253.9	In piezometer
		February 6, 2009	0.9	254.0	In piezometer
		February 20, 2009	0.9	254.0	In piezometer
		March 20, 2009	0.8	254.1	In piezometer
		April 22, 2009	0.8	254.1	In piezometer
		May 15, 2009	0.9	254.0	In piezometer
		June 5, 2009	1.3	253.6	In piezometer
		July 29, 2009	0.1*	255.0	In piezometer
		August 5, 2009	1.0*	255.9	In piezometer
		September 2, 2009	0.5*	255.4	In piezometer
		September 21, 2009	0.3	254.6	In piezometer
QSR4-3	10+080	March 17, 2008	1.5	255.7	In open borehole
QSR4-4	10+078	February 25, 2008	0.8	254.6	In open borehole
		February 28, 2008	3.4	252.0	In piezometer
		March 7, 2008	3.0	252.4	In piezometer
		March 20, 2008	0.6	254.8	In piezometer
		April 18, 2008	Ground surface	255.4	In piezometer
		June 30, 2008	1.0	254.4	In piezometer
		July 10, 2009	0.8	254.6	In piezometer
		July 29, 2008	Ground surface	255.4	In piezometer
		August 5, 2009	0.8*	256.2	In piezometer
		September 2, 2009	0.9*	256.3	In piezometer
		September 21, 2009	0.8*	256.2	In piezometer
QSR4-5	10+075	February 25, 2008	0.8	254.6	In open borehole

\* Water level above ground surface (artesian condition)

\*\* Boreholes drilled during previous investigation, 2004.

The piezometric readings of the current investigation indicate that the groundwater level is high and the water level ranges from 248.3 to 286.4.

At the locations of Boreholes 08-33A, 08-44, QSR4-2 and QSR4-4 a relatively small artesian head was encountered at 0.2 m to 0.9m (Elevations 286.4 to 255.4) above the ground surface during late summer and spring.

Previous geotechnical investigation (Reference 1) indicates that a relatively low artesian head was encountered in Borehole 301A, where water level was measured at 0.7 m (Elevation 256.7) above the ground surface.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

## **6 MISCELLANEOUS**

Borehole locations were selected by Thurber Engineering Ltd. Surveyors from J. D. Barnes obtained the co-ordinates and the ground surface elevations at each borehole.

Thurber obtained utility clearances for the borehole locations prior to drilling.

DBW Drilling of Ajax, Ontario and Walker Drilling Ltd. from Utopia, Ontario supplied track mounted CME 75 and D90 drill rigs and conducted the drilling, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Ms. Eckie Siu and Mr. George Azzopardi of Thurber.

Laboratory testing was carried out by Thurber Engineering Ltd.

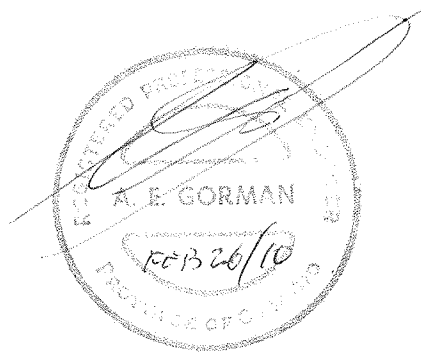
Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng., Mr. Weiss Medhawi, P.Eng. and Ms. R. Palomeque Reyna, P.Eng.

Interpretation of the data and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

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Review Principal

**FOUNDATION INVESTIGATION AND DESIGN REPORT**  
**HIGH FILLS AND DEEP CUTS**  
**HIGHWAY 404 EXTENSION**  
**FROM GREEN LANE TO WOODBINE AVENUE/RAVENSHOE ROAD**  
**ONTARIO**  
**G.W.P. 2109-05-00**

**Geocres Number: 31D-492**

**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7 GENERAL**

This report presents interpretation of the foundation data in the factual report and presents geotechnical design recommendations for the design of high fill embankments and deep cuts identified along a proposed section of Highway 404 extension from Green Lane to Woodbine Avenue/Ravenshoe Road (north of Queensville Sideroad) in the Regional Municipality of York, Ontario. This section of the project consists of approximately 3.6 km of new highway. High fills and deep cuts are identified as those greater than 4.5 m in height or depth.

Fill embankment within this section ranged from 0.5 m to 12.0 m in height and cuts ranged from 0.5 m to 12.0 m in depth. Embankments of 4.5 m or greater in height and permanent cuts of 4.5 m depth or deeper were identified at Stations 27+775 to 27+875, 30+075 to 30+225, 27+775 to 27+875, 30+975 to 31+100, 33+200 to 33+700, 9+550 to 9+700, and 9+800 to 10+250.

Information related to the deep cuts and high fills is presented in Table 1. The factual data relating to each cut or fill that is summarized in the table includes:

- Alignment and station
- The length and the maximum depth or height
- The relevant borehole references
- Summarized stratigraphy and groundwater levels

Where specific analysis has been conducted, the following information is also provided:

- Settlement and compression of the fill embankments.
- Slope stability analysis

Where a berm is required in accordance with OPSD 202.010, this is indicated in Table 1 under the heading “Berm Req.”.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained during the course of the present investigation. Factual data obtained during previous investigations is also referenced where appropriate.

In general the stratigraphy identified along the cut and fill areas consisted primarily of topsoil or pavement structure overlying fill of variable composition (silty clay/clayey silt, silty sand and sand and gravel) overlying interbedded layers of native compact to very dense cohesionless soils (sand, gravelly sand and silty sand, extensive deposits of sand and silt till and silt till) and firm to hard cohesive soils (clayey silt and clayey silt till). Clayey zones, sand pockets and occasional cobbles were observed within the sand and silt till and clayey silt till deposits. Fill was only contacted below the pavement structures in the boreholes drilled along Doane Road and Queensville Sideroad lanes and shoulders.

Groundwater levels measured in the piezometers are indicated in Table 5.11.

The project information, including plans and profiles, utilized for the preparation of this report was provided by Hatch Mott MacDonald.

## **8 ENGINEERING ANALYSIS METHODOLOGY**

The purpose of the investigation was to explore the soils and groundwater conditions at each deep cut and high fill along the proposed highway extension section, and based on the data obtained, to provide geotechnical recommendations for design and construction of the high fill embankments and deep cuts. Assessment of the global stability of the high fill embankments and cut slope geometries in various material types has been conducted. Settlements analysis was also carried out for the high fill embankments. For each section of the deep cut or high fill, the soil profile and properties were evaluated and the analysis was based on a combination of properties considered to provide a conservative representation of the site.

Major factors governing high fill embankment and deep cut design that have been taken into account for this project include the following:

- Proposed embankment or cut geometry (height, slope angle, footprint, berms etc.).
- Embankment material type (earthfill, Select Subgrade Material (SSM), granulars) or materials exposed in the cut.
- Extent and thickness of topsoil, organics and loose soils within the proposed embankment footprints.
- Thickness and engineering properties of foundation soils.
- Depth to competent layer (hard or dense soils).
- Groundwater conditions.



- The need to maintain embankment or cut stability during all stages of construction and in the long term.
- The maximum permissible settlements during embankment construction and after construction.

For the purpose of preparing geotechnical design recommendations, a number of assumptions have been made that are consistent MTO with standard highway design practices. The assessment has been carried out using the following assumptions:

- Deep cuts will be constructed with side slopes not exceeding 2H:1V.
- Where a cut in earth exceeds 6 m deep, a 2 m wide, mid-depth bench is required.
- Drainage will be provided along the highway that will also serve to drain the cut.
- High fills will be constructed with side slopes not steeper than 2H:1V.
- Topsoil, peat or other deleterious material will be stripped prior to constructing a high fill.
- Where an earth fill is greater than 8 m high, a 2 m wide, mid height berm is required (10 m height for rock fill).
- The high fills will be constructed using select subgrade material (SSM) or granular fill.

A stability analysis has been conducted for each site. For the purpose of embankment and cut slope stability analyses, the commercially available slope stability program GSLOPE developed by Mitre Software Inc. was used. The Bishop's simplified method for stability analysis was employed. The stability of the embankments was also checked under seismic loading assuming an acceleration of 0.08g.

For global stability a minimum Factor of Safety (F.S.) of 1.3 is considered appropriate for end of construction conditions. For seismic analysis, a Factor of Safety of 1.0 is considered acceptable.

Immediate foundation settlements due to compression of the soils have been estimated based on the methods described in the CHBDC, 2006 Commentary Section C6.6.3.6. Settlement analysis was carried out using stresses calculated for two-dimensional embankment loading configurations on an elastic foundation. Input parameters were developed based on correlations between SPT N-values measured at the site and elastic parameters.

The effects of compression of the fill materials used to construct the embankment were also taken into account.

## 9 HIGH FILLS

### 9.1 Stability Analysis Results

The analyses and assessment of the high fill sections indicate that embankment fills up to 12.0 m high that are likely to be constructed on the foundation soils within this section of Highway 404 extension will be stable at side slopes not steeper than 2H:1V if constructed using Select Subgrade Material (SSM) or granular fill.

This assessment is supported by the results of stability analysis carried out for the maximum height of fill in each site. The computed factors of safety are as shown in Table 1 immediately following the text of this report. The factors of safety ranged from 1.3 to 1.5 under normal static condition and from 1.0 to 1.3 under seismic loading. Slope stability computation outputs are included in the respective appendix for each embankment.

A factor of safety of 1.0 under seismic conditions is considered to be acceptable on the foundation soils encountered at this site. If this condition develops, the anticipated consequence is minor slumping of the side slopes and some minor spreading of the embankment.

### 9.2 Settlement Analysis

Table 1 shows the total settlement expected in the embankment as the sum of settlement in the foundation soils due to the load imposed by the fill plus the compression within the fill itself. It has been assumed that the embankment will compress by an amount equal to 0.5% of the total height of the fill during construction.

Elastic settlement of the foundation soils will occur as the new fill is placed and will be essentially completed during construction. Post-construction foundation settlement is expected to be negligible for compact to very dense cohesionless soils and very stiff to hard cohesive soils at this site.

Table 1 following the text of this report presents the estimated embankment settlements (foundation settlement and embankment compression) at each proposed high fill areas, assuming that granular materials or SSM are used as fill.

The ranges for different types of settlements are summarized as follows:

	<b>Settlement (mm)</b>
Foundation settlement	45 to 55
Embankment compression	25 to 60
<b>Total foundation settlement and embankment compression</b>	<b>70 to 115</b>

### **9.3 Embankment Design and Construction**

Based on the design information currently available and results of the analysis discussed above, the following recommendations are provided for high fill embankment design:

- Topsoil and organics must be removed from the footprints of the new embankments prior to placement of fill.
- Granular materials or SSM is recommended for construction of embankments in this project.
- No frozen material shall be used in embankment construction
- All embankments must be designed for a side slope not steeper than 2H : 1V.
- Where earth fill embankments are higher than 8 m, 2 m wide mid-height berms must be incorporated in the design.
- Paving must be delayed for a minimum period of 3 months between completion of fill placement and commencement of paving to accommodate embankment settlement and compression
- The constructed geometry of the embankment and the quantity estimates must include an allowance for the estimated settlements.
- Embankment construction must be carried out in accordance with Special Provision No. 206S03 “Amendment to OPSS 206, December 1993” dated July 2007. The embankment material should consist of Select Subgrade Material (SSM) in compliance with Special Provision No. 110F13, “Amendment to OPSS 1010, July 2007” March 2004.
- All new embankment fill must be placed in accordance with Special Provision No. 105S10 “Amendment to OPSS 501, February 1996” dated November 2004.
- Where new embankment fill is placed against existing embankment slopes or on a sloping ground surface, the existing slope must be benched in accordance with OPSD 208.010.
- Vegetation cover must be established on all exposed earth slopes to protect against surficial erosion in accordance with OPSS 572.

## **10 DEEP CUTS**

Based on the stratigraphy encountered at the sites, the soils at the bases of the deep cuts are described in Table 1.

### **10.1 Stability Analysis Results**

Deep cuts to a maximum depth of 12.0 m are required at some locations to construct the Highway 404 extension alignment. Assessment of the global stability of the cut sections

has indicated that the proposed cuts if constructed with side slopes not steeper than 2H:1V, will be safe in the soils encountered in the course of the investigation.

This assessment is supported by the results of analysis carried out for deep cuts, with the computed factors of safety shown in Table 1. The factors of safety ranged from 1.3 to 1.4 under normal static condition and from 1.0 to 1.1 under seismic loading.

Slope stability computation outputs are included in the respective appendix for each embankment.

## **10.2 Deep Cut Design**

Based on the design information currently available and the results of the analysis discussed above, the following design recommendations are provided for deep cut design:

- Deep cuts must be designed with side slopes no steeper than 2H:1V.
- For cuts deeper than 6 m, a 2 m wide, mid-height bench must be incorporated in the design. The bench is required throughout the length where the depth of cut exceeds 6.0 m.
- Adequate drainage of the cut must be provided (see discussion below).
- Vegetation cover must be established on all exposed earth slopes to protect against surficial erosion in accordance with Special Provision 572S01.

## **10.3 Cut Drainage**

Table 10.1 shows the cut locations where groundwater levels were measured above the base of the cut within the cohesionless soils.

**Table 10.1 – Summary of Cut locations with groundwater above the cut base**

Alignment/ Roadway	Approx Station	Length (m)	Depth of Cut (m)	Base of cut elevation	Ground water depth (m)	Highest noted Ground water elevation	Borehole	Appendix
(2) Highway 404 extension, South of Mount Albert Road	27+775 – 27+875	100	2.5 to 5.0	286.0 to 283.5	1.2	288.4	08-16A	B
(3) Highway 404 extension, North of Doane Road	30+975 – 31+100	125	4.0 to 6.0	262.0 to 262.5	0.2*	264.6	08-50	C
(4) Highway 404 extension, North of Queensville Sideroad	33+200 – 33+700	500	0.5 to 12.0	262.0 to 266.0	5.7	272.2	08-25	D
(5) Queensville Sideroad	9+550 – 9+750	200	0.5 to 9.0	277.0 to 278.0	7.2 0.2* 1.4	277.7 286.4 279.9	08-61 08-33A 08-34	E

\* Water levels were observed above the existing ground surface (artesian conditions) during the later winter/early spring season.

### 10.3.1 Construction Drainage

Groundwater seepage will occur into the cut as excavation proceeds. It is expected that seepage will be gradual and will not impede excavation, but the water will accumulate in the low points in the excavation. Accordingly, temporary drainage of the cuts must be provided to maintain a relatively dry, stable excavation and to allow work to continue in the dry.

It is the responsibility of the contractor to maintain a stable excavation and to control groundwater and surface run-off. The design of any control systems required is the responsibility of the contractor. However, suitable systems that might be considered include a combination of some or all of the following:

1. Starting the cuts from the lowest point and excavating the remainder of the cuts from that point and utilizing gravity drainage.
2. Temporary drainage ditches.
3. Pumping from sumps excavated at intervals in the base of the cut.

The rate of seepage is expected to decrease over time as the local groundwater table is drawn down. However, some continuing seepage is expected in the long term and permanent drainage must be provided.

### **10.3.2 Permanent Drainage**

Permanent drainage of the cut slope is required to remove groundwater seeping from the cut slopes and from the subgrade. Roadside ditches are expected to provide an adequate level of permanent drainage. An interceptor ditch should be provided at the top of the cut as per OPSD 200.020. General site drainage should be by gravity towards an outlet at a lower elevation.

Where cut excavation extends below the measured groundwater levels in cohesionless soils, more positive measures to provide permanent slope drainage and mitigate surficial instability are recommended. Measures may include provision of subdrains positioned along the toe of slope and/or along the rear of the mid-slope bench, as well as gravel sheeting or rip-rap lined channels down the slope. All subdrains must be sloped on a positive grade to an outlet or pumping chamber.

In the cut sections identified in Table 10.1, the base of the cut will lie below the prevailing groundwater level and there is a risk of groundwater seepage of surface soil sloughing in these areas. It is recommended that the Contract including a provisional quantity item for 3,000 m<sup>2</sup> gravel sheeting.

Gravel sheeting must only be placed to the extents directed by the Contract Administrator, based on an observational approach after final grading of the cut sections. Suggested wording for a NSSP is included in Appendix F.

A hydrogeology study has been conducted for these sites, which is reported under separate cover. This report recommends the following:

1. A permit to take water (PTTW) should be obtained for this project.
2. A monitoring program is recommended for the local domestic wells in the vicinity of the highway construction. This monitoring program is recommended for before,

during and after highway construction. Details of the monitoring program are given in the hydrogeology report.

It should be noted that artesian conditions were encountered at Stations 30+950 and 33+000 along the proposed Highway 404 extension and at Stations 9+550 and 10+080 along Queensville Sideroad. During construction of the cuts if an artesian condition was encountered in a cut base, such area should be provided with a filter blanket to prevent erosion of fines.

#### **10.4 Construction Considerations**

Excavation for cut slope construction should be carried out in accordance with OPSS 206 as amended by the most recent Special Provision (SP 206S03).

The till deposits in many of the cut sections are typically very dense/hard and often contain cobbles and boulders. Excavation in these deposits may be arduous and will require use of heavy duty excavators or dozers. Selection of the method of excavation must remain the responsibility of the contractor however and be based on his equipment, experience and interpretation of the site conditions.

The drainage/unwatering system design must take account of all MOE/MNR requirements regarding, among other things, permit to take water, discharging water and the turbidity of the discharge.

The above recommendations for cuts and fills are consistent with the recommendations for nearby or adjacent structures at Doane Road and Queensville Sideroad.

#### **10.5 Roadway Protection**

If roadway protection is required during cut and fill construction at Doane Road and Queensville Sideroad, an item titled "Protection System" as per SP 105S19 must be included in the contract documents. It is recommended that Performance Level 2 as per Clause 539.04.02.01 and the alignment of the shoring be specified for this site.

The design of roadway protection should be the responsibility of the Contractor. However, one option that is considered to be suitable for use as temporary shoring at these sites is a soldier pile and lagging wall. All shoring systems must be designed by a Professional Engineer experienced in such designs.

### **11 SEISMIC CONSIDERATIONS**

#### **11.1 Seismic Design Parameters**

The following seismic parameters should be used for design:

- Velocity Related Seismic Zone 1

- Zonal Velocity Ratio 0.05
- Acceleration Related Seismic Zone 1
- Zonal Acceleration Ratio 0.05
- Peak Horizontal Acceleration 0.08

The soil profile type at this site has been classified as Type II. Therefore, according to Table 4.4 of the CHBDC, a Site Coefficient “S” (ground motion amplification factor) of 1.2 should be used in seismic design.

### **11.2 Liquefaction Potential**

Based on the observed stratigraphy and groundwater conditions, the potential for liquefaction of the high fills and deep cut slopes at this site under a seismic event is low.

## **12 CONSTRUCTION CONCERNS**

Potential construction concerns include, but are not necessarily limited to:

### **1. Excavation difficulties.**

Cobbles and boulders should be expected within the till layers during excavation. Provision must be made for the removal of cobbles and boulders.

The contract documents must contain a NSSP or other warning to alert the Contractor to this possibility and alert him to the fact that the provision of suitable equipment must be included in his bid. Some suggested wording is included in Appendix F.

### **2. Control of groundwater seepage during construction and permanent drainage in deep cut sections.**

The Contractor must be alerted to the expected seepage into the excavation during the course of construction. Groundwater control and permanent drainage should be designed prior to excavation of cut sections.

### **3. Construction supervision.**

The Contract Administrator (CA) should employ experienced geotechnical staff to observe activities related to embankment construction and advise the CA on construction concerns or issues related to embankment stability or settlement.

Inspection and confirmation that all topsoil and organic material within the proposed embankment footprints are sub-excavated and replaced with approved backfill.



### 13 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Geotechnical Engineer



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Senior Foundations Engineer



Report reviewed by:  
P.K. Chatterji, P.Eng., Ph.D.  
Review Principal

**Table 1**  
**SUMMARY OF EMBANKMENT AND CUT HEIGHTS, SUBSURFACE CONDITIONS, SLOPE STABILITY ANALYSIS AND SETTLEMENT ANALYSIS**

Alignment/ Roadway	Approx. Station	Length (m)	Depth of Cut (m)	Height of Fill (m)	Base of cut elevation	Borehole	Soil Stratigraphy	Highest Groundwater depth/ elev. (m)	Slope Stability Analysis				Settlement Analysis			Appendix
							Soil Type – Depth to the base of soil layer (m)		Factor of Safety				Settlement Foundation (mm)	Embankment Compression (mm)	Total (mm)	
									Static condition	Seismic = 0.08g	Berm Req.	Figure				
(1) Highway 404 extension, South of Doane Road	30+075 – 30+225	150	-	4.0 to 4.5	-	08-6 to 08-9	0.1 – 0.15 Topsoil 0.1 – 6.7 Soft to hard silty clay	1.2/ 257.9	1.5	1.3	N	1 2	50 to 55	25	75 to 80	A
(2) Highway 404 extension, South of Mount Albert Road	27+775 – 27+875	100	2.5 to 5.0	-	286.0 to 283.5	08-15A to 08-017A	0.2 – 0.38 Topsoil 0.2 – 0.5 Loose Sand 0.5 – 10.8 Compact to very dense sand and silt till	1.2 to 3.2/ 288.4 to 286.4	1.3	1.0	N	1 2	-	-	-	B
(3) Highway 404 extension, North of Doane Road	30+975 – 31+100	125	4.0 to 6.0	-	262.0 to 262.5	08-18 to 08-21 and 08-48 to 08- 55	0.05 – 0.5 Topsoil 0.02 – 0.5 Pavement structure 0.6 – 2.3 Loose to dense/firm to stiff fill (various soils) 0.6 Loose silty sand 2.6 Very dense sand and gravel 2.8 Stiff to very stiff silty clay 1.5 – 12.3 Loose to very dense sand and silt till 4.1 Dense gravelly sand 5.6 Stiff to very stiff clayey silt till 7.9 – 9.3 Compact to very dense silt till	0.2 *to 0.7*/ 264.6 to 261.7	1.3	1.0	N	1 2	-	-	-	C
(4) Highway 404 extension, North of Queensville Sideroad	33+200 – 33+700	500	0.5 to 12.0	-	262.0 to 266.0	08-22 to 08-26	0.3 – 0.6 Topsoil 0.8 – 1.5 Loose to compact sandy silt 4.8 – 19.9 Compact to very dense sand and silt till 15.3 Loose to very dense sand	5.7/ 272.2	1.3	1.0	Y	1 2	-	-	-	D

\* Artesian conditions, water level above ground surface

Table 1 (Cont'd)

SUMMARY OF EMBANKMENT AND CUT HEIGHTS, SUBSURFACE CONDITIONS, SLOPE STABILITY ANALYSIS AND SETTLEMENT ANALYSIS

\* Artesian conditions, water level above ground surface

Alignment/ Roadway	Approx. Station	Length (m)	Depth of Cut (m)	Height of Fill (m)	Base of cut elevation	Borehole	Soil Stratigraphy		Highest Groundwat er depth/ elev. (m)	Slope Stability Analysis				Settlement Analysis			Appendix
							Soil Type – Depth to the base of soil layer (m)			Factor of Safety				Settlement Foundation (mm)	Embankment Compression (mm)	Total (mm)	
										Static conditi on	Seismic = 0.08g	Berm Req.	Figure				
(5)  Queensville Sideroad	9+550 – 9+750	200	0.5 to 9.0	-	277.0 to 278.0	08-33 to 08-35, 08-33A and 08-61	0.12 – 0.2 Topsoil 0.17 Pavement structure 1.5 Compact to dense fill 1.5 Loose to compact sand 4.8 – 15.3 Loose to very dense sand and silt till 15.3 Very dense silt till	0.2*/ 286.4	1.3	1.1	Y	1 2	-	-	-	E	
	9+750 – 10+300	550	-	0.5 to 12.0	-	08-36 to 08-38, 08-38A 08-39 to 08-47, 301 to 303, and QSR4-1 to QSR4-5	0.17 Pavement structure 0.6 – 3.9 Very loose to dense/ Very soft to very stiff fill 2.3 – 3.0 Loose to very dense sand 3.0 – 25.0 Firm to hard clayey silt till and clayey silt 4.1 – 21.4 Compact to very dense sand and silt till 15.3 – 27.7 Very dense silt till 11.0 Dense to very dense gravelly sand 11.8 Compact to dense silty sand	0.5* to 1.0*/ 255.9 to 259.6	1.3	1.2	Y	3 4	45 to 50	60	105 to 110		

## **Appendix A**

**High Fills - Highway 404 extension, South of Doane Road,  
Station 30+075 – 30+225  
(Boreholes 08-06 to 08-09)**

**Record of Borehole Sheets  
Laboratory Test Results  
Site Photographs  
Slope Stability Output  
Drawing titled “Borehole Locations and Soil Strata”**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

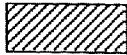




 Water Level  
 C<sub>pen</sub> Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

# RECORD OF BOREHOLE No 08-06

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 886 409.42 E 310 829.42 ORIGINATED BY GA  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.08.25 - 2009.08.25 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
259.9								20	40	60	80	100		
0.0	TOPSOIL: (100mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
0.1	Silty CLAY, trace sand, occasional rootlets Soft to Hard Brown		1	SS	4			WATER CONTENT (%)						
			2	SS	23		259							0 3 46 51
			3	SS	30		258							
			4	SS	19		257							
			5	SS	21		256							0 0 58 42
	Grey		6	SS	31	▽	255							0 0 75 25
254.7														
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 5.0m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.9m, THEN AUGER CUTTINGS TO 0.2m, AND SOD TO THE SURFACE.													



# RECORD OF BOREHOLE No 08-07

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 886 453.78 E 310 806.32 ORIGINATED BY GA  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.08.25 - 2009.08.25 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 (%)							
259.1							20	40	60	80	100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
0.0	TOPSOIL: (125mm)											W <sub>P</sub>	W	W <sub>L</sub>	
0.1	Silty CLAY, trace sand, occasional iron oxide staining Firm to Very Stiff Brown		1	SS	5										
			2	SS	17										
			3	SS	16										0 1 49 50
	Brown to Grey		4	SS	22										
			5	SS	20										0 0 62 38
			6	SS	24										
253.9	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 3.9m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
5.2	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.09.02 1.2 257.9 2009.09.21 1.2 257.9														

+ 3, X 3: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-08

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 886 497.64 E 310 782.46 ORIGINATED BY GA  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.08.26 - 2009.08.26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
258.6								20	40	60	80	100		
0.0	TOPSOIL: (150mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
0.2	Silty CLAY, occasional rootlets Firm to Very Stiff Brown		1	SS	5		258							
			2	SS	6									
			3	SS	6		257							
			4	SS	23		256							0 0 52 48
			5	SS	19		255							0 0 52 48
			6	SS	15		254							
253.4														
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.													

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-09

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 886 542.54 E 310 753.11 ORIGINATED BY GA  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.08.26 - 2009.08.26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
257.9														
0.0	TOPSOIL: (100mm)													
0.1	SILT, some sand, trace gravel Very Loose Brown Damp		1	SS	3									
257.1														
0.8	Silty CLAY, trace sand, occasional iron oxide staining Stiff to Very Stiff Brown		2	SS	8		257							
			3	SS	29		256							0 5 54 41
			4	SS	17		255							
			5	SS	25		254							
			6	SS	26		253							0 0 61 39
			7	SS	18		252							0 0 79 21
251.2	Grey													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND WATER LEVEL AT 5.5m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.													

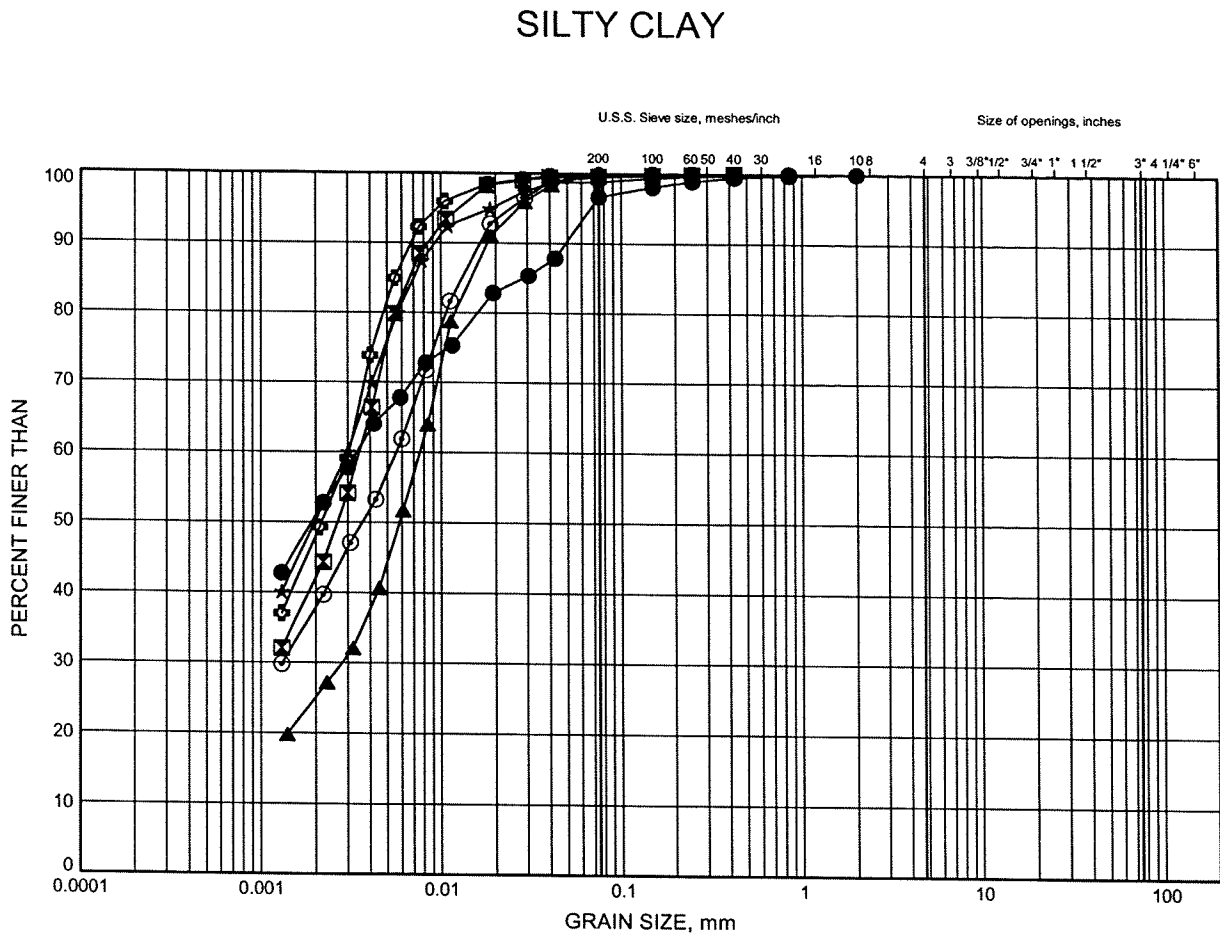
+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE A1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-06	1.07	258.86
⊠	08-06	3.35	256.58
▲	08-06	4.88	255.05
★	08-07	1.83	257.25
⊙	08-07	3.35	255.73
⊕	08-08	2.59	256.01

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/16/09

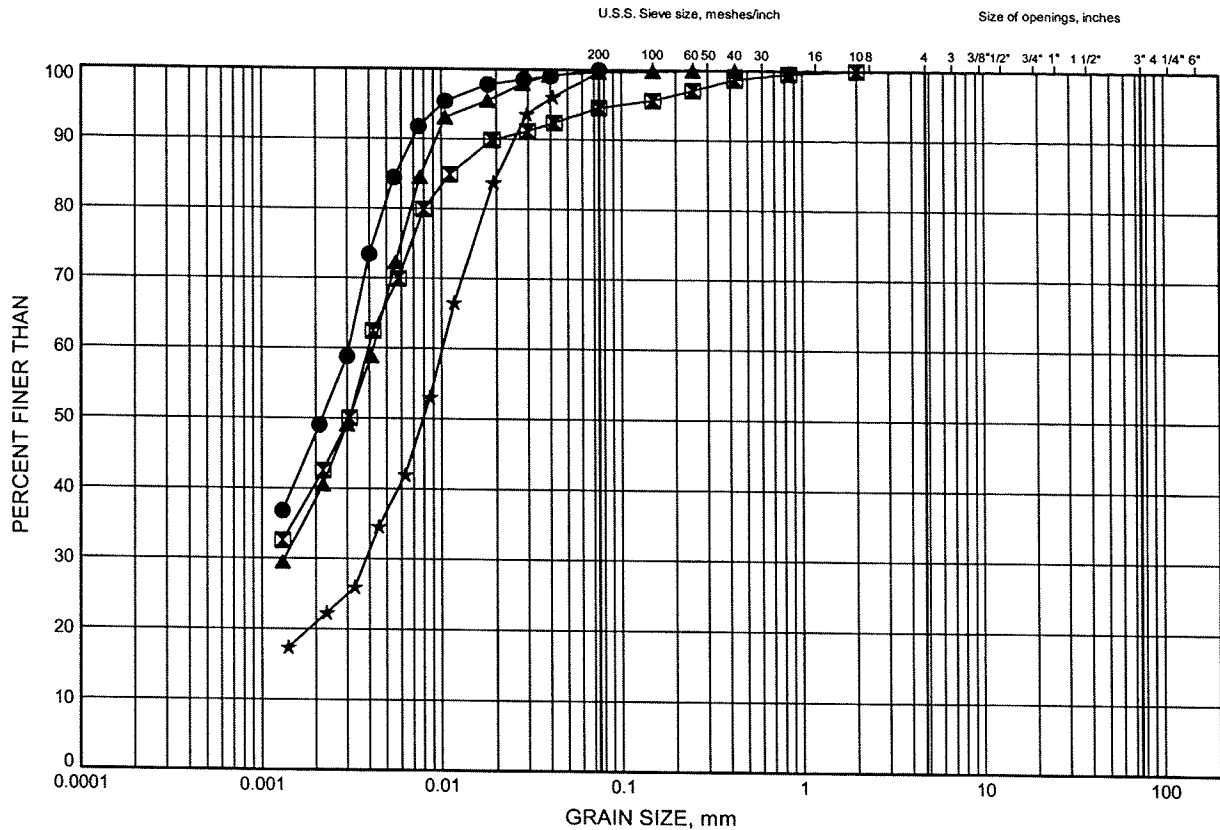
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE A2

## SILTY CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-08	3.35	255.25
⊠	08-09	1.83	256.07
▲	08-09	3.35	254.55
★	08-09	4.88	253.02

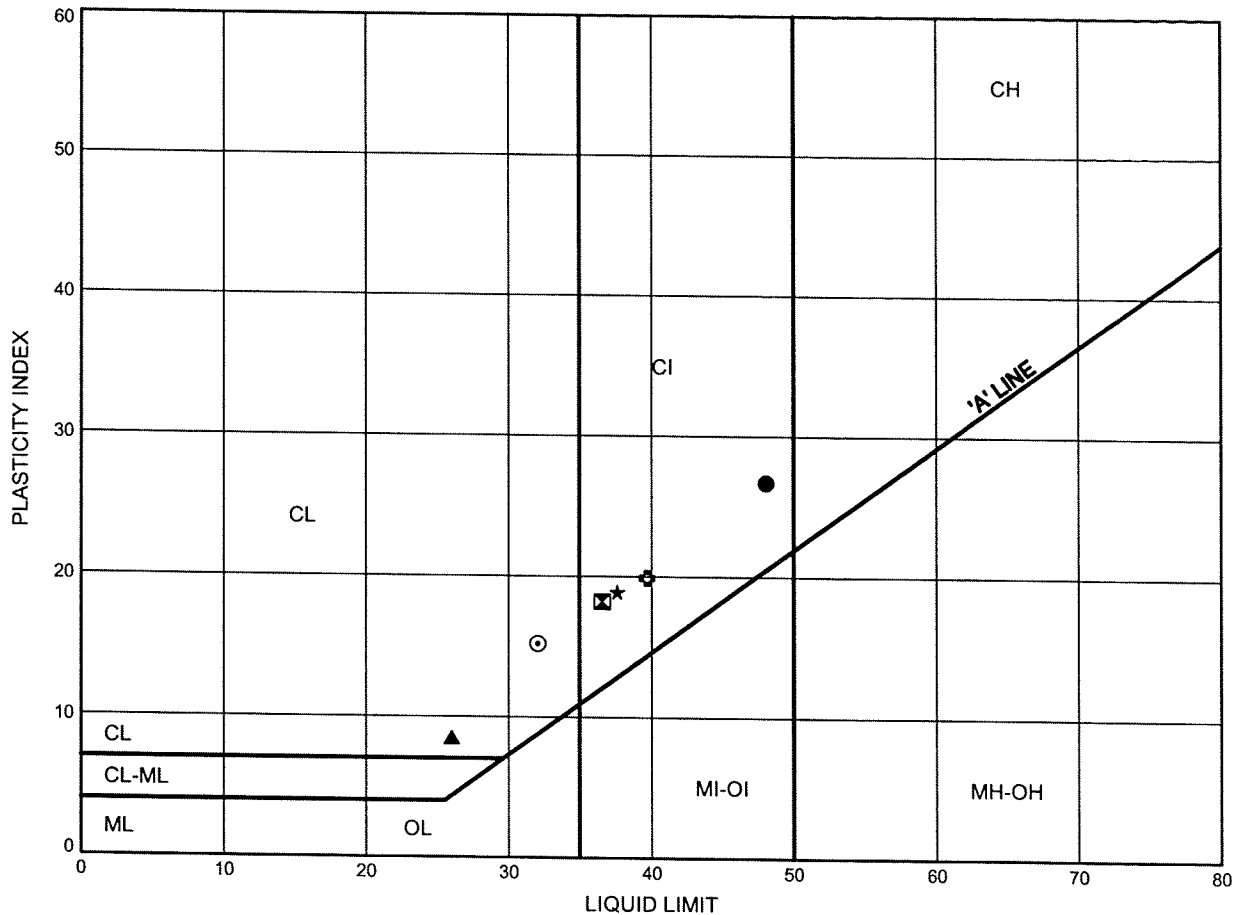


W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE A3

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-06	1.07	258.86
⊠	08-06	3.35	256.58
▲	08-06	4.88	255.05
★	08-07	1.83	257.25
⊙	08-07	3.35	255.73
⊛	08-08	2.59	256.01

Date October 2009  
 Project 2109-05-00

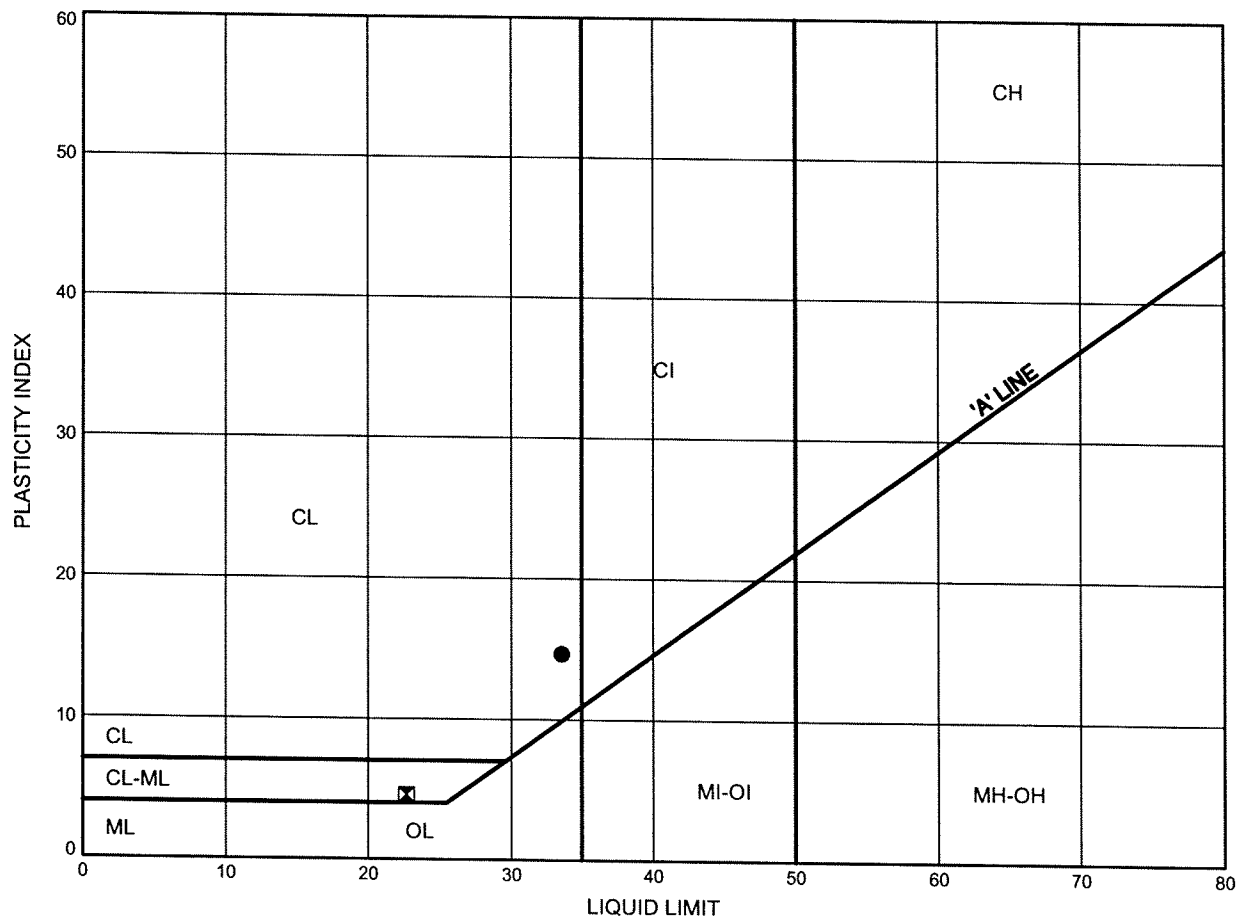


Prep'd AN  
 Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE A4

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-09	3.35	254.55
⊠	08-09	4.88	253.02

Date October 2009  
 Project 2109-05-00



Prep'd AN  
 Chkd. RPR



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

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**Photograph** – View looking at Boreholes 08-06 and 08-07



**Photograph** – View looking at south side of the site, Borehole 08-06



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** – View looking north at Borehole 08-08



**Photograph** – View looking north at Borehole 08-09

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 High Fill Embankment  
 September 24, 2009  
 Stations 30+075 to 30+225  
 Height: 5 m - Long Term

	Gamma	C	Phi	Piezo
	kN/m3	kPa	deg	Surf.
Earth Fill	21	0	30	1
Silty clay	20	0	27	1

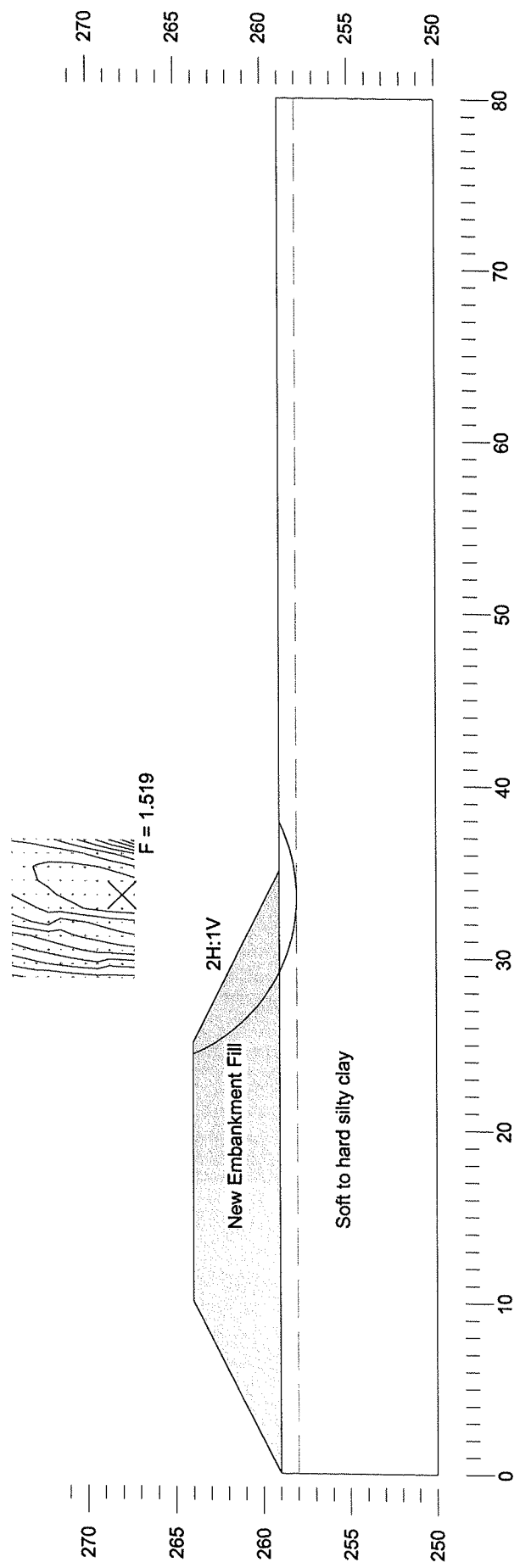


FIGURE 1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 High Fill Embankment  
 September 24, 2009  
 Stations 30+075 to 30+225  
 Height: 5 m - Short Term

Earth Fill	Gamma C	Phi	Piezo
Silty clay	kN/m <sup>3</sup>	deg	Surf.
	21	30	1
	20	0	1

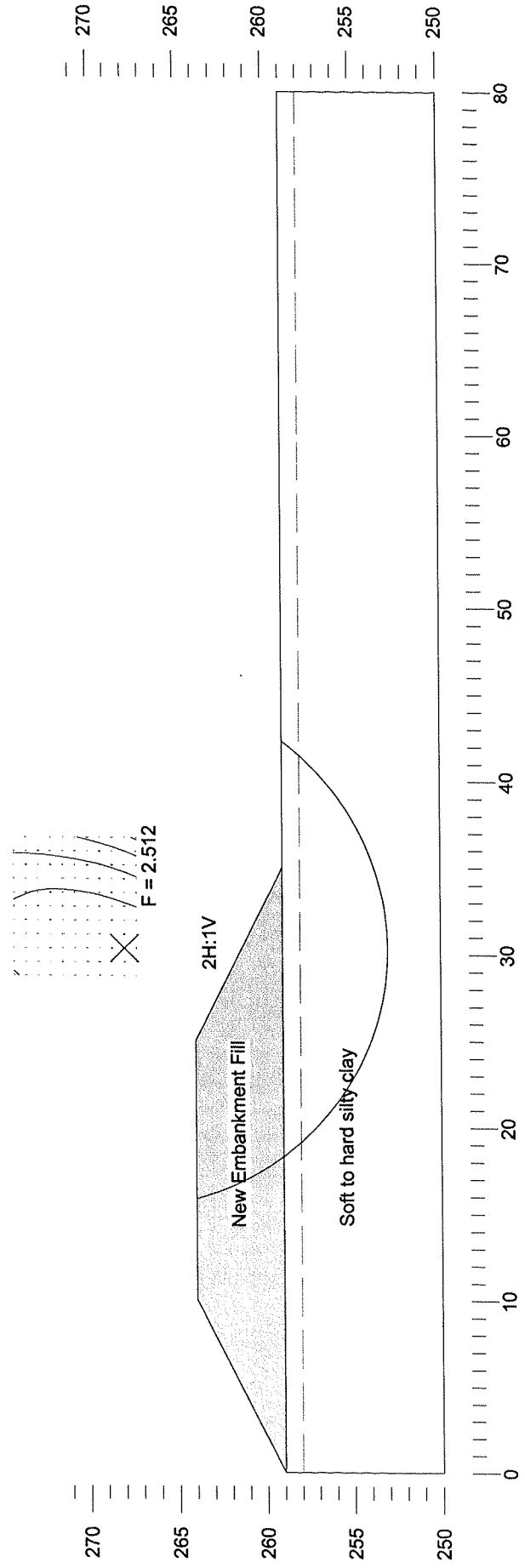


FIGURE 1A

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 High Fill Embankment  
 September 24, 2009  
 Stations 30+075 to 30+225  
 Height: 5 m - Seismic

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Earth Fill	21	30	1
Silty clay	20	27	1

Seismic coefficient = 0.08

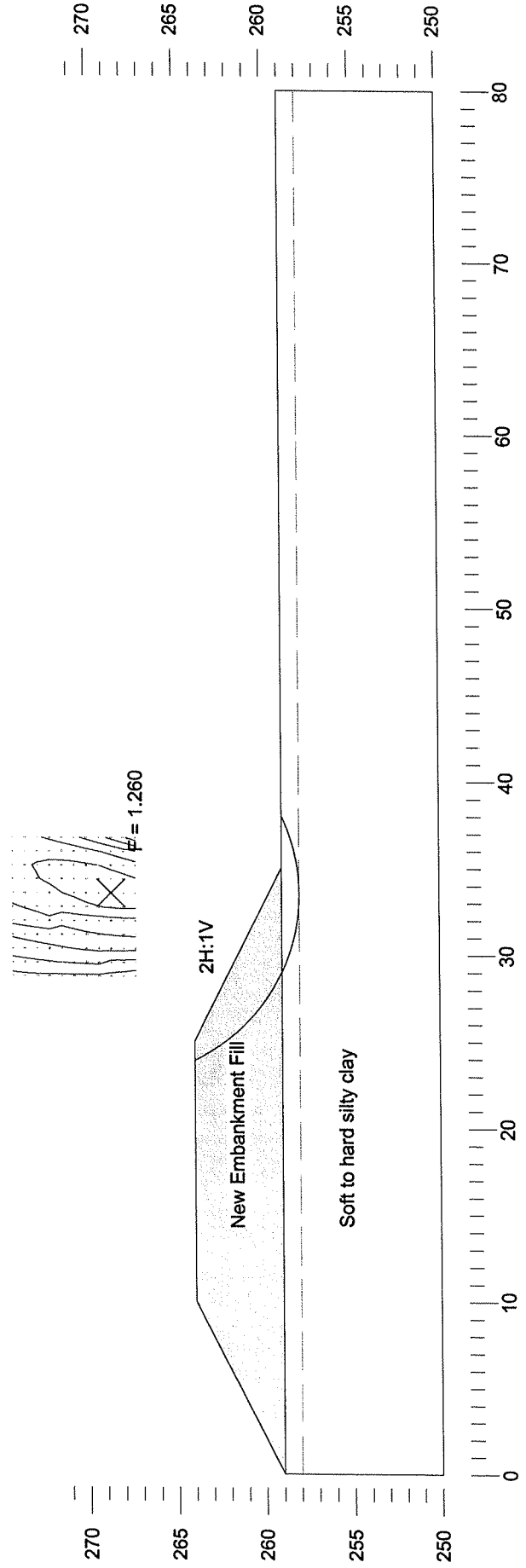


FIGURE 2

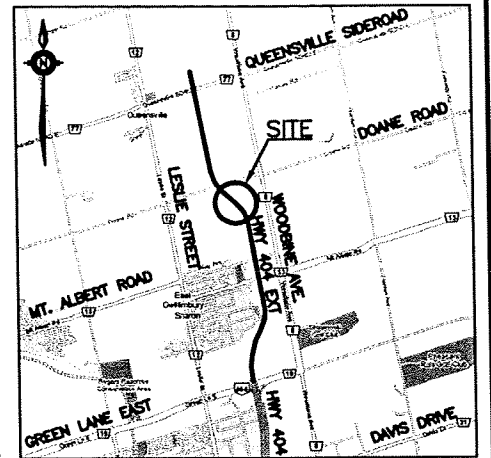


METRIC






DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 2109-05-00

HIGHWAY 404 EXTENSION HIGH FILL SOUTH OF DOANE ROAD STATIONS 30+075 TO 30+225 BOREHOLE LOCATIONS AND SOIL STRATA	
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KEYPLAN  
LEGEND

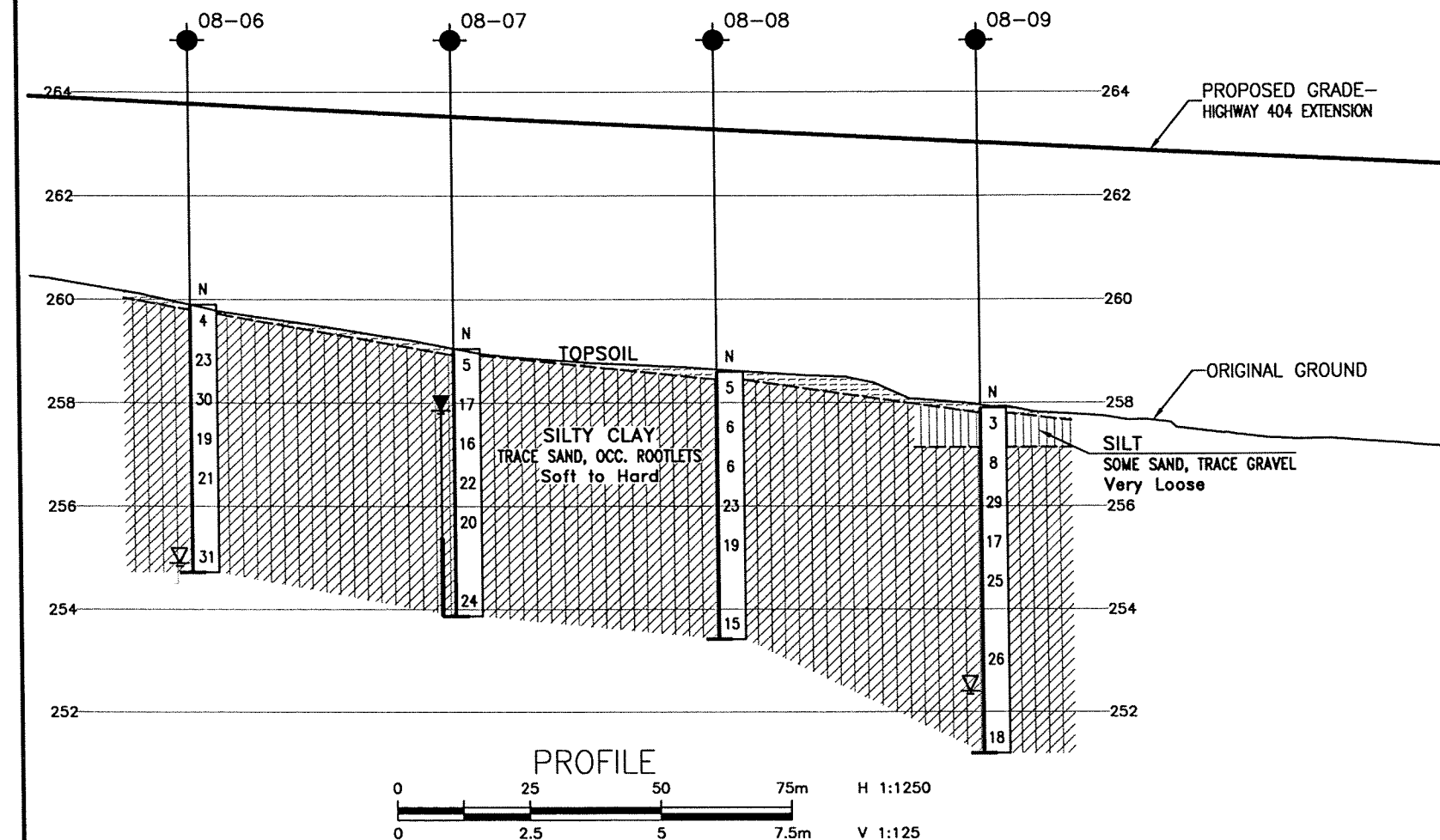
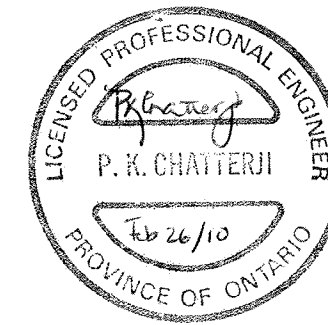
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

[illegible]

**-NOTES-**

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 31D-492**



**Appendix B**

**Deep Cut - Highway 404 extension, South of Mount Albert Road  
Station 27+775 – 27+875  
(Boreholes 08-15A to 08-17A)**

**Record of Borehole Sheets  
Laboratory Test Results  
Site Photographs  
Slope Stability Output  
Drawing titled “Borehole Locations and Soil Strata”**

# RECORD OF BOREHOLE No 08-15A

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 884 166.95 E 311 038.81 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.07.30 - 2009.07.30 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL			
290.5							20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	TOPSOIL: (200mm)						40	80	120	160	200				
290.4	SAND, trace to some silt, occasional roots and rootlets Loose Dark Brown Damp		1	SS	6										
0.4	Sandy SILT, trace gravel, trace clay, occasional sand pockets, occasional cobbles Dense to Very Dense Brown Damp (TILL)		2	SS	34										1 39 51 9
			3	SS	70										1 34 56 9
			4	SS	100/ 0.275										
	Occasional sand pockets		5	SS	50/ 0.125										1 39 51 9
			6	SS	50/ 0.100										2 31 58 9
			7	SS	50/ 0.100										3 36 52 9
	Light Brown to Grey Wet		8	SS	100/ 0.075										4 29 58 9
	Occasional sand pockets		9	SS	105/ 0.150										
	Grey														

Continued Next Page

+<sup>3</sup> . X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-15A

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 884 166.95 E 311 038.81 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.07.30 - 2009.07.30 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE 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>		
							40 80 120 160 200							
	Continued From Previous Page													
279.7	Sandy SILT, trace clay, trace gravel, occasional cobbles Very Dense Grey Wet (TILL)		10	SS	100/		280							
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 10.4m AND WATER LEVEL AT 6.8m UPON COMPLETION OF DRILLING IN MAY 2009. WATER LEVEL AT 5.9m UPON COMPLETION OF DRILLING IN JULY 2009. BOREHOLE BACKFILLED WITH HOLEPLUG TO 8.5m, THEN AUGER CUTTINGS TO SURFACE.				0.100									

ONTMT4S 0596.GPJ 10/20/09



**METRIC**

ORIGINATED BY ES

COMPILED BY AN

CHECKED BY RPR

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 08-16A

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 884 213.73 E 311 056.48 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.07.30 - 2009.07.30 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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 x LAB VANE					WATER CONTENT (%) W <sub>p</sub> W W <sub>L</sub>				
	Continued From Previous Page																
278.8	Sandy SILT, trace clay Very Dense Grey Damp (TILL)		10	SS	100/		279										
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 10.1m AND WATER LEVEL AT 2.9m UPON COMPLETION OF DRILLING IN MAY 2009. WATER LEVEL AT 6.0m UPON COMPLETION OF DRILLING IN JULY 2009. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEVATION(m) 2009.05.15 1.2 288.4 2009.06.05 1.4 288.2 2009.07.10 1.7 287.9 2009.09.21 3.2 286.4				0.125												

# RECORD OF BOREHOLE No 08-17A

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 884 260.87 E 311 073.13 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.07.30 - 2009.07.30 CHECKED BY RPR

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100							
								40 80 120 160 200							
									○ UNCONFINED    + FIELD VANE						
									● QUICK TRIAXIAL    x LAB VANE						
288.2															
0.0	TOPSOIL: (380mm)														
287.8			1	SS	5		288								
287.4	SAND, some silt, occasional root and rootlets Loose Dark Brown Moist		2	SS	57									1	30 58 11
0.5	Sandy SILT, some clay, trace gravel, occasional sand pockets, occasional cobbles Very Dense to Dense Brown Moist (TILL)		3	SS	32		287							3	41 47 9
	Very Dense Damp		4	SS	71		286								
			5	SS	79/ 0.275		285							1	20 70 9
			6	SS	50/ 0.125		284								
			7	SS	50/ 0.100		283								
			8	SS	100/ 0.150		282							2	29 61 8
	Grey Wet		9	SS	100/ 0.150		281								
							280								
							279							0	11 81 8

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-17A

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 884 260.87 E 311 073.13 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.07.30 - 2009.07.30 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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								
								20 40 60 80 100								
Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%)				
277.4	Sandy SILT, trace gravel Very Dense Grey Damp (TILL)		10	SS	100/		278									
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 9.9m AND WATER LEVEL AT 2.7m UPON COMPLETION OF DRILLING IN MAY 2009. WATER LEVEL AT 5.5m UPON COMPLETION OF DRILLING IN JULY 2009. BOREHOLE BACKFILLED WITH HOLEPLUG TO 8.7m THEN AUGER CUTTINGS TO SURFACE.				0.125											

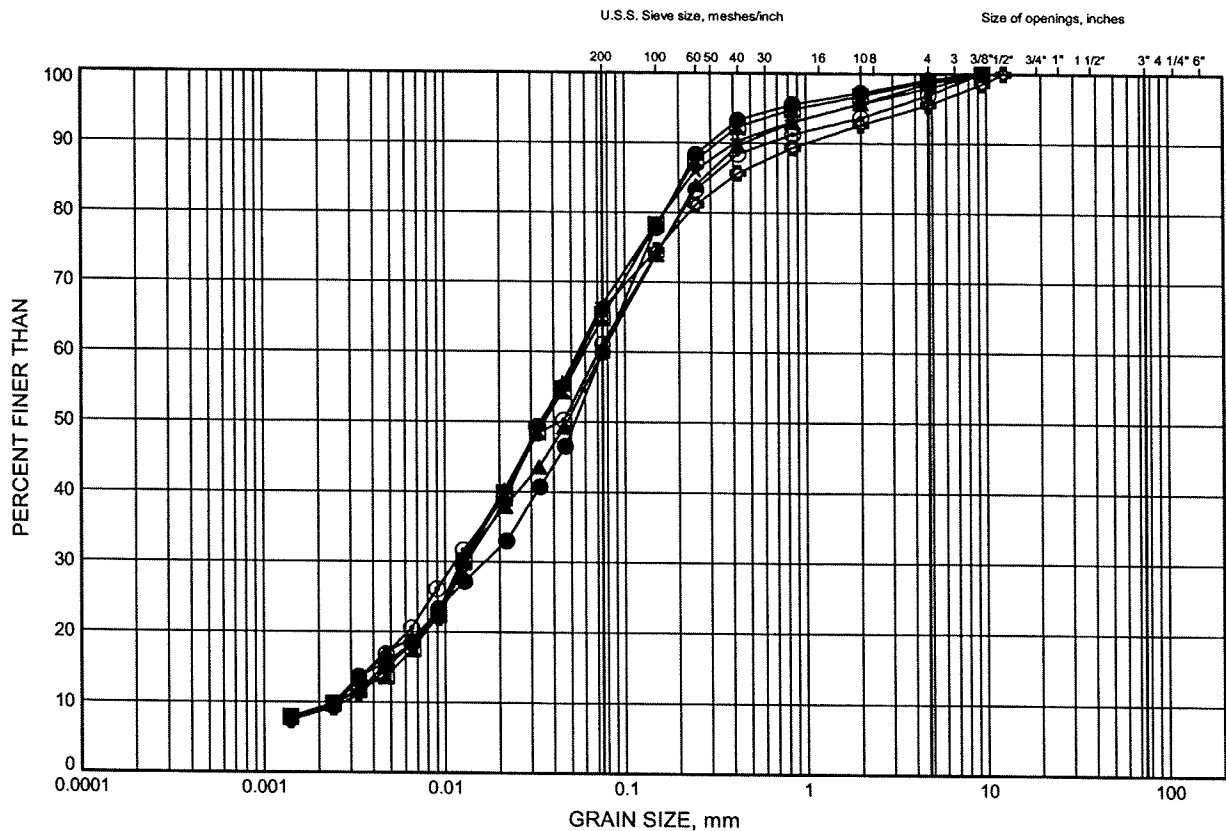
+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10  
(%) STRAIN AT FAILURE

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B1

## SANDY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-15A	1.07	289.43
■	08-15A	1.75	288.75
▲	08-15A	3.26	287.24
★	08-15A	4.70	285.80
⊙	08-15A	6.17	284.33
⊕	08-15A	7.66	282.84

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/5/09

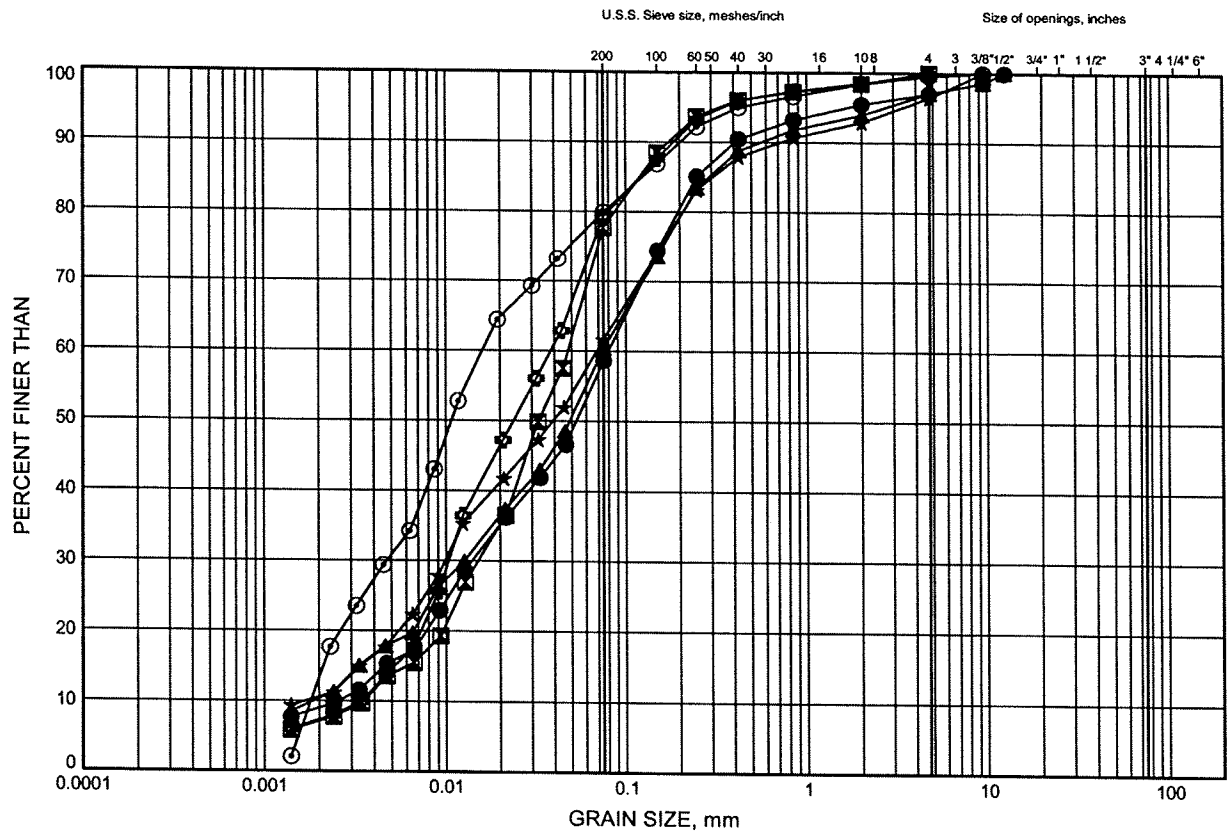
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B2

## SANDY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-16A	0.99	288.61
⊠	08-16A	1.83	287.77
▲	08-16A	2.59	287.01
★	08-16A	4.65	284.95
⊙	08-16A	4.76	284.84
⊕	08-16A	9.21	280.39

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/5/09

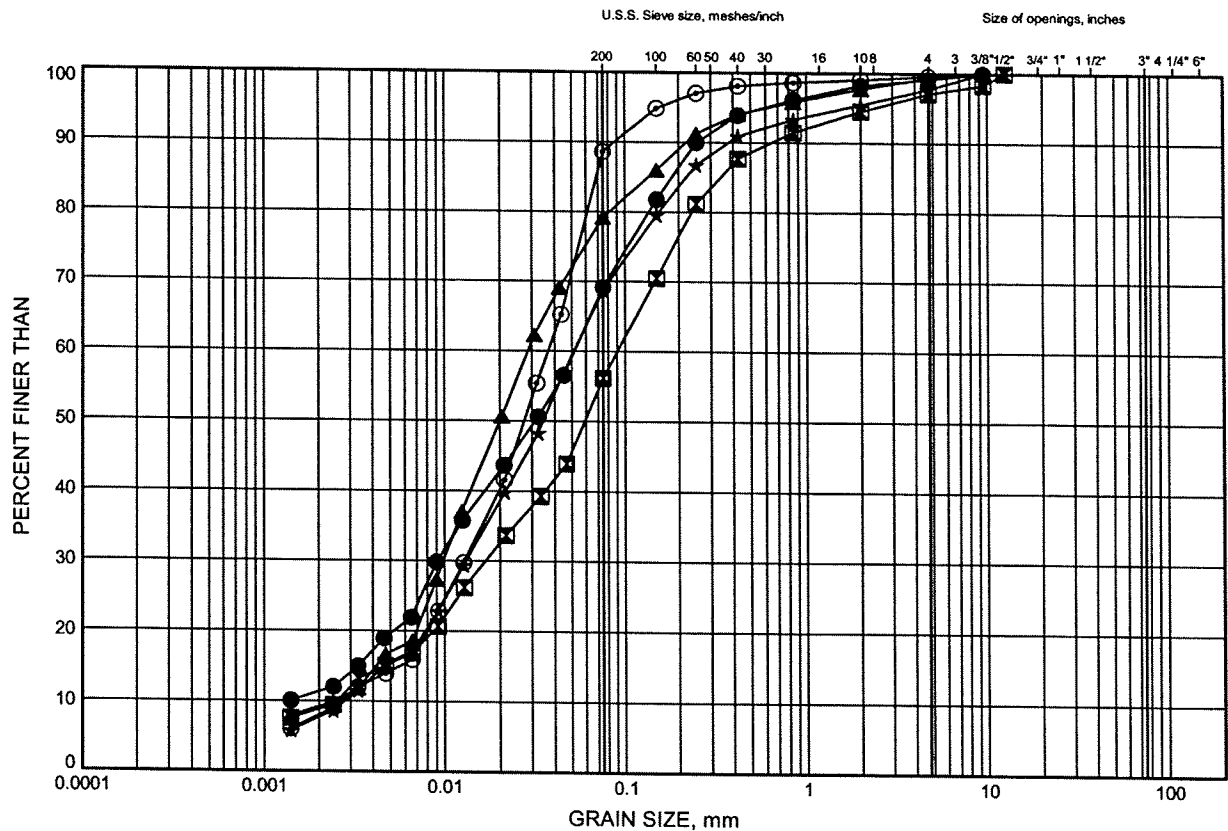
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE B3

## SANDY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-17A	0.99	287.21
⊠	08-17A	1.83	286.37
▲	08-17A	3.35	284.85
★	08-17A	6.22	281.98
⊙	08-17A	9.22	278.98

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/5/09

W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....





High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

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**Photograph**— View looking north, Borehole 08-15A (photograph taken in May 2009)



**Photograph** – View looking south, Borehole 08-15A, (photograph taken in July 2009)



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** – View looking south, Borehole 08-16A (photograph taken in May 2009)



**Photograph** – View looking south, Borehole 08-16A, (photograph taken in July 2009)



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** – View looking south, Borehole 08-17A, (photograph taken in July 2009)

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 27+775 to 27+875  
 Depth: 5 m

	Gamma C	Phi	Piezo
	kN/m <sup>3</sup>	deg	Surf.
Sandy Silt Till	20	32	1
Sandy Silt Till	21	35	1

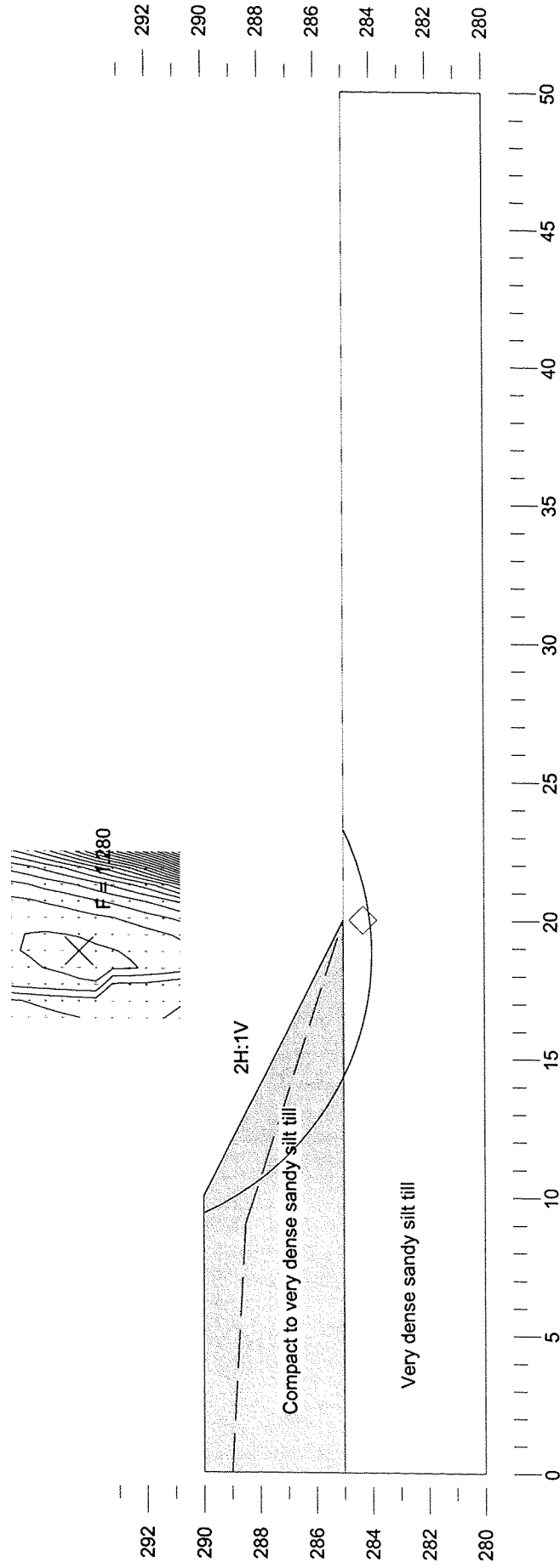


FIGURE 1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 September 24, 2009  
 Stations 27+775 to 27+875  
 Depth: 5 m - Seismic

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Sandy Silt Till	20	32	1
Sandy Silt Till	21	35	1

Seismic coefficient = 0.08

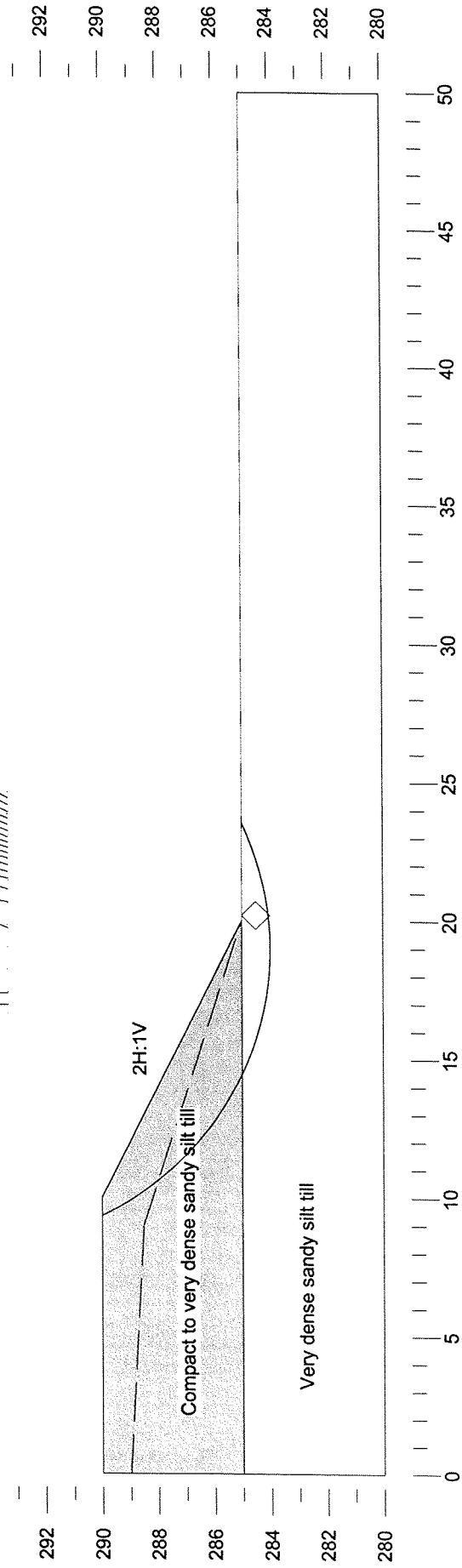
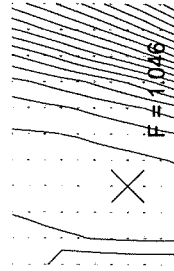


FIGURE 2



## **Appendix C**

**Deep Cut - Highway 404 extension, North of Doane Road  
Station 30+975 – 31+100  
(Boreholes 08-18 to 08-21 and 08-48 to 08-55)**

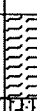

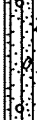
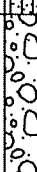



**Record of Borehole Sheets  
Laboratory Test Results  
Site Photographs  
Slope Stability Output  
Drawing titled “Borehole Locations and Soil Strata”**

RECORD OF BOREHOLE No 08-18

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 887 157.90 E 310 330.89 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.01.29 - 2009.01.29 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
							20 40 60 80 100	WATER CONTENT (%)						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w <sub>p</sub> w w <sub>L</sub>						
267.0	TOPSOIL, trace sand, occasional roots Compact Dark Brown (550mm)		1	SS	16		267						41 47 12 (SI+CL)	
266.5														
0.6	SAND and SILT Dense Brown Moist (TILL)		2	SS	44		266							
265.5														
1.5	SAND and GRAVEL, trace silt, trace clay, occasional cobbles Very Dense Brown Moist		3	SS	105		265							
264.4														
2.6	SAND and SILT, trace to some clay, trace gravel Very Dense Brown Moist (TILL) Occasional oxidized staining		4	SS	85		264							
					5	SS	115/ 0.225	263						
					6	SS	100/ 0.125	262						0 21 65 14
	Layer of sand (800mm)		7	SS	125	261							2 56 37 5	
259.3	Occasional grey sand seams		8	SS	100/ 0.100		260						3 37 51 9	
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND WATER LEVEL AT 6.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.20m, THEN AUGER CUTTINGS TO SURFACE.													

ONTMT4S 0596.GPJ 10/5/09

# RECORD OF BOREHOLE No 08-19

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 887 193.45 E 310 308.52

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2009.01.29 - 2009.01.29

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
268.6							20	40	60	80	100		
0.0	TOPSOIL, trace sand, trace silt, occasional roots Compact Dark Brown (600mm)		1	SS	11								
268.0													
0.6	SAND and SILT, some clay, trace gravel, occasional oxidized staining Compact to Dense Brown Moist (TILL)		2	SS	16								
	Clayey zone		3	SS	11								
	Occasional cobbles		4	SS	36								
	Very Dense		5	SS	105/ 0.275								
			6	SS	100/ 0.125								
			7	SS	100/ 0.075								
			8	SS	100/ 0.100								
259.4			9	SS	100/ 0.075								
9.2	END OF BOREHOLE AT 9.2m. BOREHOLE OPEN AND WATER LEVEL AT 6.4m UPON COMPLETION OF DRILLING. Piezometer installation consists of												

Continued Next Page

+<sup>3</sup> X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S 0596.GPJ 9/23/09





# RECORD OF BOREHOLE No 08-20

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 887 229.37 E 310 286.75 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.29 - 2009.01.29 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 (%)	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w				LIQUID LIMIT w <sub>L</sub>
268.7							20	40	60	80	100	20	40	60	GR SA SI CL
0.0	TOPSOIL, trace sand, trace silt, occasional roots Loose Dark Brown (550mm)		1	SS	9								○		
268.2													○		
0.5	SAND and SILT, some clay, trace gravel, occasional oxidized staining Compact to Dense Brown Moist (TILL)		2	SS	21								○		
													○		0 13 75 12
	Clayey zone		3	SS	20								○		
													○		
			4	SS	37								○		
													○		
			5	SS	30								○		1 27 58 14
	Very Dense												○		
			6	SS	108/ 0.275								○		
													○		
			7	SS	100/ 0.125								○		
													○		
			8	SS	100/ 0.125								○		6 38 45 11
													○		
			9	SS	100/ 0.100								○		
259.5	END OF BOREHOLE AT 9.2m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 1.5m, THEN AUGER												○		
9.2															

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (% STRAIN AT FAILURE)

ONTMT4S 0596.GPJ 10/5/09

# RECORD OF BOREHOLE No 08-20

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 887 229.37 E 310 286.75 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.29 - 2009.01.29 CHECKED BY RPR

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	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No 08-21

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 887 264.78 E 310 266.08 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.30 - 2009.01.30 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			
268.1								20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		
0.0	TOPSOIL, trace silt, occasional roots Loose Dark Brown (430mm)		1	SS	8			20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>		
267.7											
267.4											
0.6	Silty SAND, trace clay Loose Brown Moist		2	SS	12						1 9 49 41
	Silty CLAY, trace sand, trace gravel, occasional oxidized staining Stiff to Very Stiff Brown		3	SS	11						
			4	SS	21						
265.3											
2.8	SAND and SILT, trace gravel, trace to some clay, occasional oxidized staining Compact to Very Dense Brown Damp to Moist (TILL) Layer of silt at 3.0m		5	SS	24						0 3 91 6
			6	SS	103/ 0.275						
			7	SS	100/ 0.150						0 34 56 10
			8	SS	100/ 0.150						
260.3											
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE OPEN TO 5.2m UPON COMPLETION OF DRILLING. Piezometer installation consists of 24mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m)										

ONTMT4S 0596.GPJ 10/5/09

# RECORD OF BOREHOLE No 08-48

1 OF 1

METRIC

G.W.P. 2109-05-00

LOCATION Doane Rd. N 4 887 093.56 E 310 301.81

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.10.22 - 2008.10.22

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  7 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
265.6	ASPHALT (50mm)						20	40	60	80	100									
0.0	SAND, some silt to silty, some gravel Compact Brown to Dark Brown Moist (FILL)		1	SS	13															
264.9																				
0.8	SAND and SILT, some clay, trace gravel, occasional oxide staining Loose to Compact Brown Moist (TILL)		2	SS	8															
			3	SS	13															
263.2																				
2.4	Gravelly SAND, some silt, some clay Dense Brown Moist		4	SS	35															
			5	SS	50															
	Cobbles at 3.5m																			
261.5																				
4.1	SILT, some sand to sandy Very Dense Grey Wet (TILL)		6	SS	140															
			7	SS	180/ .275															
257.8			8	SS	185/ .250															
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN AND WATER LEVEL AT 6.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.07m THEN ASPHALT TO SURFACE.																			

+ 3 x 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-49

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 108.93 E 310 311.68  
 HWY 404 BOREHOLE TYPE Solid Stem Augers ORIGINATED BY ES  
 DATUM Geodetic DATE 2008.10.22 - 2008.10.22 COMPILED BY AN  
 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 (%)					
266.1							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
8.8	ASPHALT (25mm)												
265.5	SAND, some gravel Compact Brown Moist (FILL)		1	SS	23								
0.6	SAND and SILT, some clay, trace gravel, occasional oxidize staining Compact to Dense Brown Moist (TILL)		2	SS	25								1 35 52 12
			3	SS	28								
			4	SS	33								
263.0													
3.0	SILT, some sand, trace clay, occasional cobbles, occasional oxide staining Compact to Very Dense Brown Moist (TILL)  Layer of sand (800mm) Wet  Brown to Grey   Some sand		5	SS	24								0 2 81 17
			6	SS	135								0 39 56 5
			7	SS	188/ .275								0 19 73 8
			8	SS	100/ .150								
256.8			9	SS	100/ .125								
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE OPEN TO 8.2m AND WATER LEVEL AT 7.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH												

ONTMT4S 0596.GPJ 8/26/09

Continued Next Page

+ 3, X 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-49

2 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION

Doane Rd. N 4 887 108.93 E 310 311.68

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE

Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE

2008.10.22 - 2008.10.22

CHECKED BY RPR

## SOIL PROFILE

## SAMPLES

## GROUND WATER CONDITIONS

## ELEVATION SCALE

## 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 x LAB VANE

WATER CONTENT (%)

γ

GR SA SI CL

Continued From Previous Page  
HOLEPLUG TO 0.05m THEN  
ASPHALT TO SURFACE.

ONTMT4S 0596.GPJ 8/26/09

+ 3 . x 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

**METRIC**

CHECKED BY RPR

+ 3, X 3: Numbers refer to Sensitivity



# RECORD OF BOREHOLE No 08-50

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 090.43 E 310 327.05 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.20 - 2008.10.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	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			20	40	60	80	100					
Continued From Previous Page																	
Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.10.24 4.4 260.0 2008.11.28 4.9 259.5 2009.02.06 0.1 264.3 2009.02.20 0.2* 264.6 2009.03.20 1.0 263.4 2009.04.22 1.1 263.3 2009.09.02 2.6 261.8  * (above ground surface)																	

## METRIC

CHECKED BY RPR

+ 3 x 3 Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-51

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 113.65 E 310 353.28  
 HWY 404 BOREHOLE TYPE Solid Stem Augers ORIGINATED BY ES  
 DATUM Geodetic DATE 2008.10.23 - 2008.10.23 COMPILED BY AN  
 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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						
	Continued From Previous Page							20 40 60 80 100						
								O UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL X LAB VANE						
								40 80 120 160 200						
								W P W L						
								WATER CONTENT (%)						
								20 40 60						
251.3	SAND and SILT, trace gravel. occasional sand pockets Very Dense Gray (TILL)		10	SS	1000	.75	253							
							252							
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE OPEN TO 8.1m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.11.28 4.1 259.5		11	SS	1000	.100								

# RECORD OF BOREHOLE No 08-52

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION Doane Rd. N 4 887 100.05 E 310 368.44

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.10.20 - 2008.10.21

CHECKED BY RPR

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			20	40					
262.4	TOPSOIL (50mm)													
262	SAND and SILT, trace to some clay, trace gravel, occasional rootlets, occasional oxide staining Loose Dark Brown to Brown Moist (TILL)		1	SS	10									
261	Compact Grey		2	SS	5									3 34 51 13
260	Dense Brown to Grey Wet		3	SS	12									
259	Occasional cobbles Very Dense		4	SS	41									0 48 48 5
258	Brown to Grey		5	SS	96									
257			6	SS	100/ .125									
256			7	SS	100/ .125									
255			8	SS	100/ .125									
254			9	SS	175/ 250									1 33 57 9
252.8	END OF BOREHOLE AT 9.5m. WATER LEVEL AT 4.6m UPON COMPLETION OF DRILLING.													

Continued Next Page

ONTMT4S 0596.GPJ 8/26/09

+ 3 X 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-52

2 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION

Doane Rd. N 4 887 100.05 E 310 368.44

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE

Hollow Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE

2008.10.20 - 2008.10.21

CHECKED BY RPR

## SOIL PROFILE

## SAMPLES

## GROUND WATER

## CONDITIONS

## ELEVATION SCALE

## DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL X LAB VANE

PLASTIC LIMIT

NATURAL MOISTURE CONTENT

LIQUID LIMIT

W<sub>p</sub>

W

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

GROUND WATER

CONDITIONS

ELEVATION SCALE

DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL X LAB VANE

PLASTIC LIMIT

NATURAL MOISTURE CONTENT

LIQUID LIMIT

W<sub>p</sub>

W

W<sub>L</sub>

WATER CONTENT (%)

UNIT WEIGHT

γ

kN/m<sup>3</sup>

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Continued From Previous Page  
BOREHOLE BACKFILLED WITH HOLEPLUG TO 3.0m THEN AUGER CUTTINGS TO SURFACE.

ONTMT4S 0596.GPJ 8/26/09

+ 3 X 3

Numbers refer to Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-53

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION Doane Rd. N 4 887 127.36 E 310 398.80

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.10.23 - 2008.10.23

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
262.1							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		GR SA SI CL			
0.8	ASPHALT (50mm)														
261.4	SAND, some gravel, some silt to silty Compact Brown to Dark Brown Moist (FILL)		1	SS	25										
0.8															
260.4	Silty CLAY, trace sand, occasional silt seams, occasional oxide staining Firm to Stiff Brown (FILL)		2	SS	12										
1.8	SAND and SILT, trace to some clay, trace gravel, occasional sand seams Loose to Compact Brown to Grey Moist (TILL)		3	SS	7							0 4 68 28			
			4	SS	10										
			5	SS	14							6 36 45 13			
	Very Dense		6	SS	97										
	Occasional sand pockets		7	SS	100/ .175							4 33 53 9			
	Layer of fine sand (500mm) Occasional cobbles		8	SS	178/ .225										
	Grey														
			9	SS	100/ .100							4 40 48 8			

Continued Next Page

Continued Next Page

+<sup>3</sup> . X<sup>3</sup> Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-53

2 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION Doane Rd. N 4 887 127.36 E 310 398.80

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.10.23 - 2008.10.23

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	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 (%)					
	Continued From Previous Page													
251.4	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100		252							
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 4.8m AND WATER LEVEL AT 3.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.07m THEN ASPHALT TO SURFACE.				.100									

+ 3 x 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-54

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION Doane Rd. N 4 887 112.68 E 310 413.77 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2008.10.21 - 2008.10.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE ELEVATION	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 (%)					
261.0	TOPSOIL (50mm)		1	SS	8		261							
	SAND and SILT, trace clay, occasional oxide staining Loose Dark Brown to Brown Moist (TILL)		2	SS	9		260							
			3	SS	7		259							
258.7	Clayey SILT, trace sand Stiff to Very Stiff Brown to Grey (TILL)		4	SS	14		258							0 1 77 22
			5	SS	26		257							
			6	SS	14		256							
255.4	SAND and SILT, trace gravel, trace clay Dense to Very Dense Grey Moist (TILL)		7	SS	34		255							
	Possible boulder at 7.3m. Layer of fine sand (400mm).		8	SS	158/ .125		254							8 41 44 7
			9	SS	100/ .150		253							
							252							

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-54

2 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION Doane Rd. N 4 887 112.68 E 310 413.77

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.10.21 - 2008.10.24

CHECKED BY RPR

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
	Continued From Previous Page															
	SILT, some sand, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100											3 17 65 15
248.7					.100											
249																
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE OPEN TO 9.7m AND WATER LEVEL AT 2.1m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.11.28 3.7 257.3 2009.02.06 0.0 261.0 2009.02.20 0.4* 261.4 2009.03.20 0.7* 261.7 2009.04.22 0.6* 261.6 2009.09.02 0.6 260.4  * (above ground surface)		11	SS	100											

+ 3 . X 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-55

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION

Doane Rd. N 4 887 131.71 E 310 424.00

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE

2008.10.22 - 2008.10.22

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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		PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>				
261.7						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) 40 80 120 160 200				
0.0	ASPHALT (50mm)		1	SS	73									
260.5	SAND, some gravel, some silt to silty, occasional oxide staining Compact to Very Dense Brown Moist (FILL)		2	SS	19									
1.1	SILT, some clay, some sand, occasional oxide staining Loose to Compact Brown Moist (TILL)		3	SS	8									
	Occasional coarse sand pockets		4	SS	15									0 13 74 13
			5	SS	18									1 42 45 12
			6	SS	18									
	Sandy Grey		7	SS	19									6 25 55 15
	Occasional cobbles Very Dense		8	SS	118									
252.4			9	SS	100/									
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE OPEN AND WATER LEVEL AT 4.2m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH				150									
Continued Next Page														

Continued Next Page

+ 3 . × 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## 2 OF 2

**METRIC**

LOCATION

Doane Rd. N 4 887 131.71 E 310 424.00

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE

### Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE

2008.10.22 - 2008.10.22

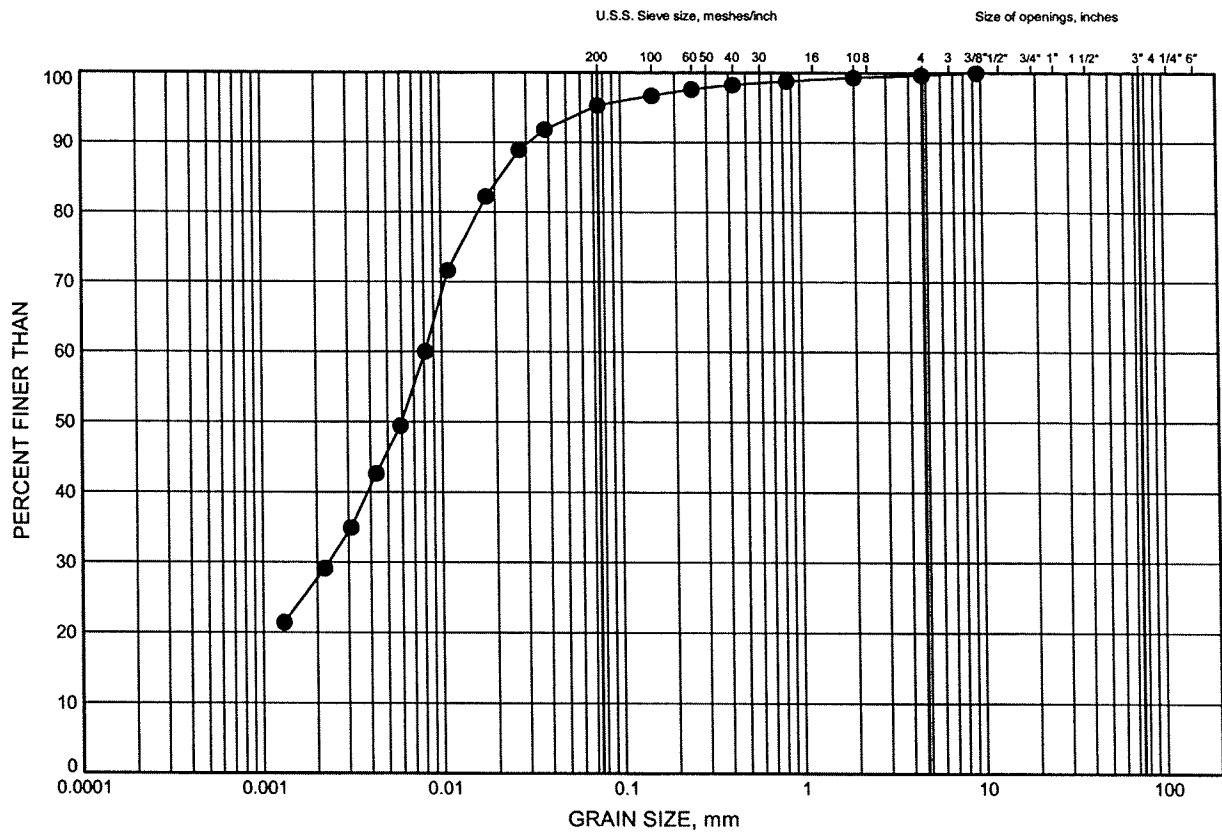
CHECKED BY RPR

[illegible]

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C1

## SILTY CLAY FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-53	1.83	260.31

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

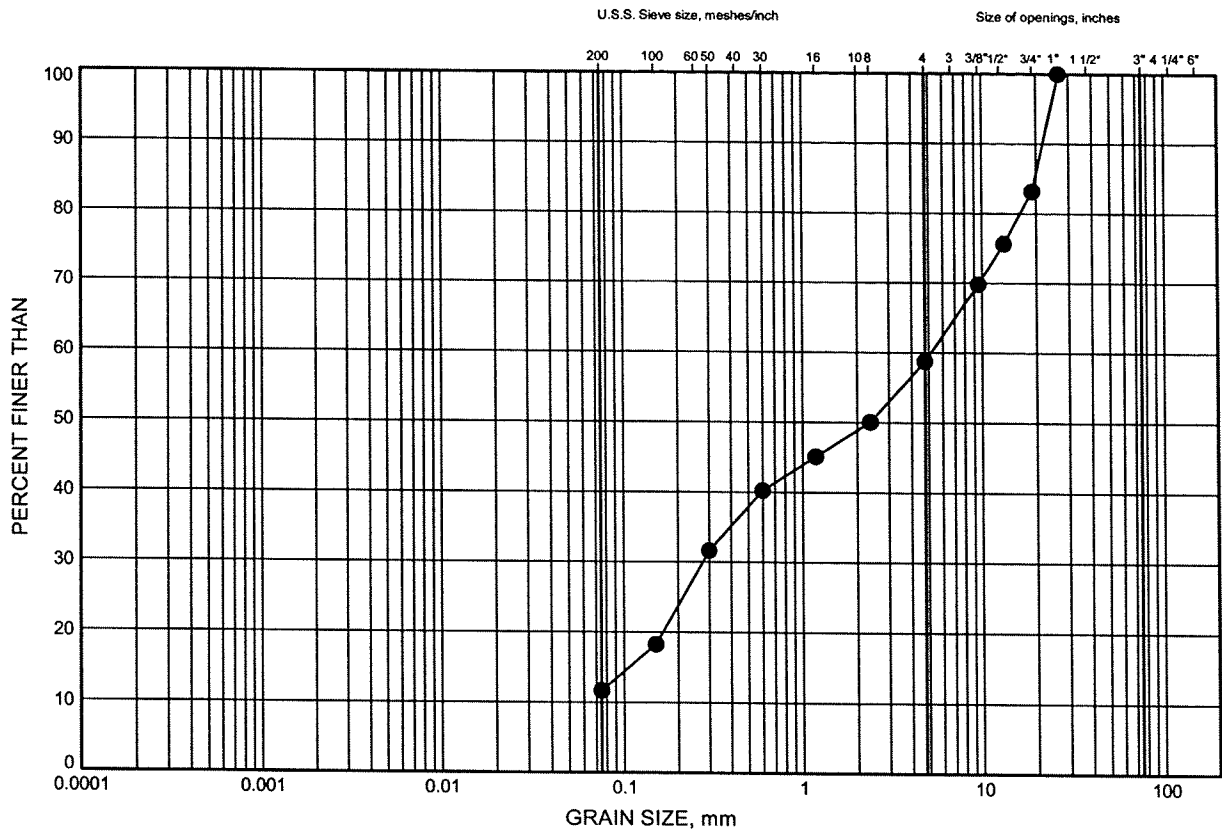
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C2

## SAND & GRAVEL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-18	1.68	265.33

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

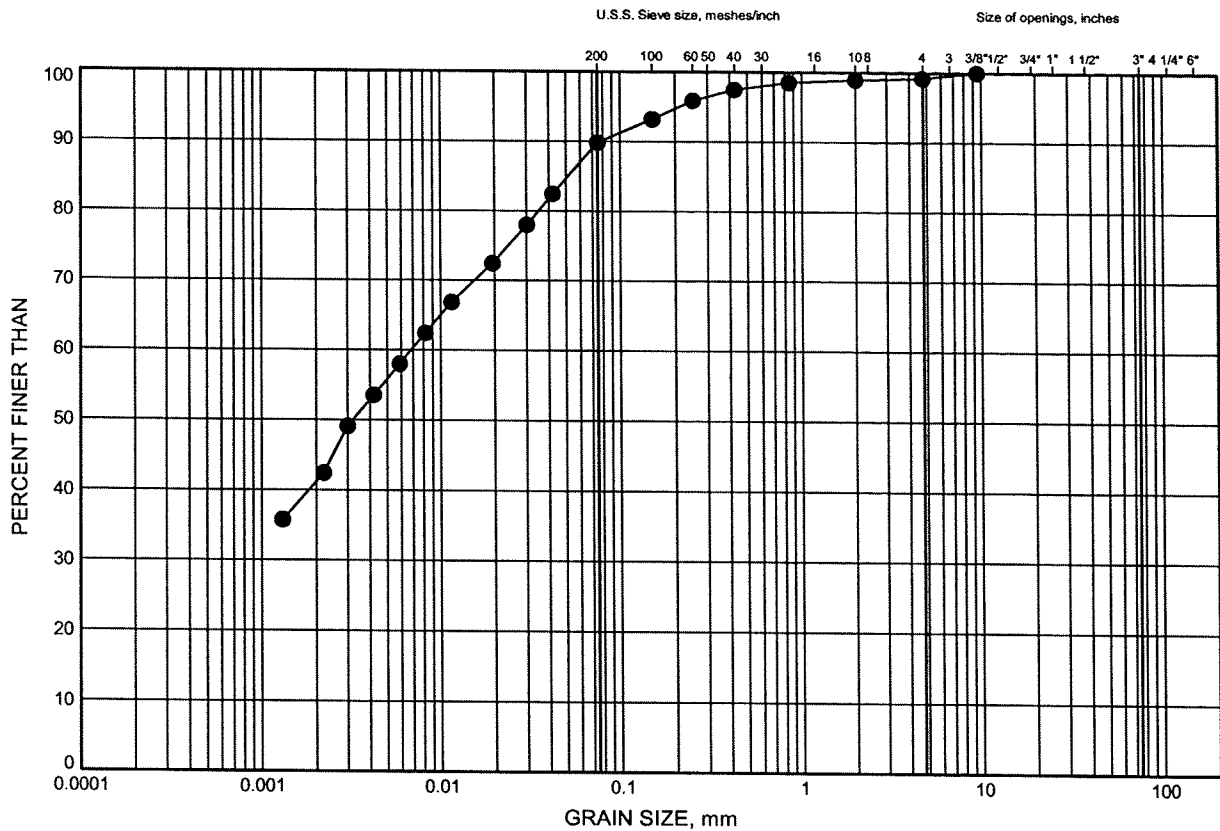
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C3

## SILTY CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-21	1.07	267.03

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

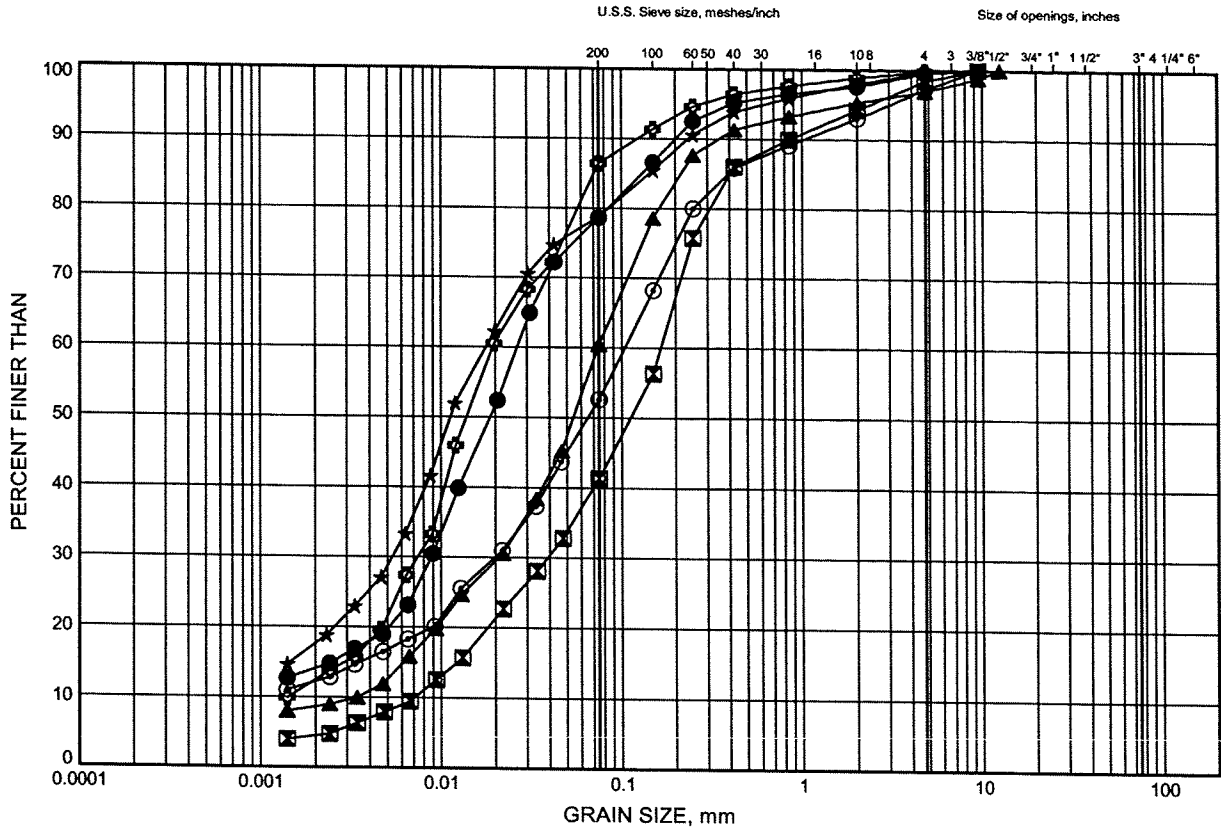
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C4

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-18	4.64	262.37
⊠	08-18	6.22	260.79
▲	08-18	7.67	259.34
★	08-19	2.51	266.09
⊙	08-19	6.13	262.47
⊕	08-20	1.75	266.95

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

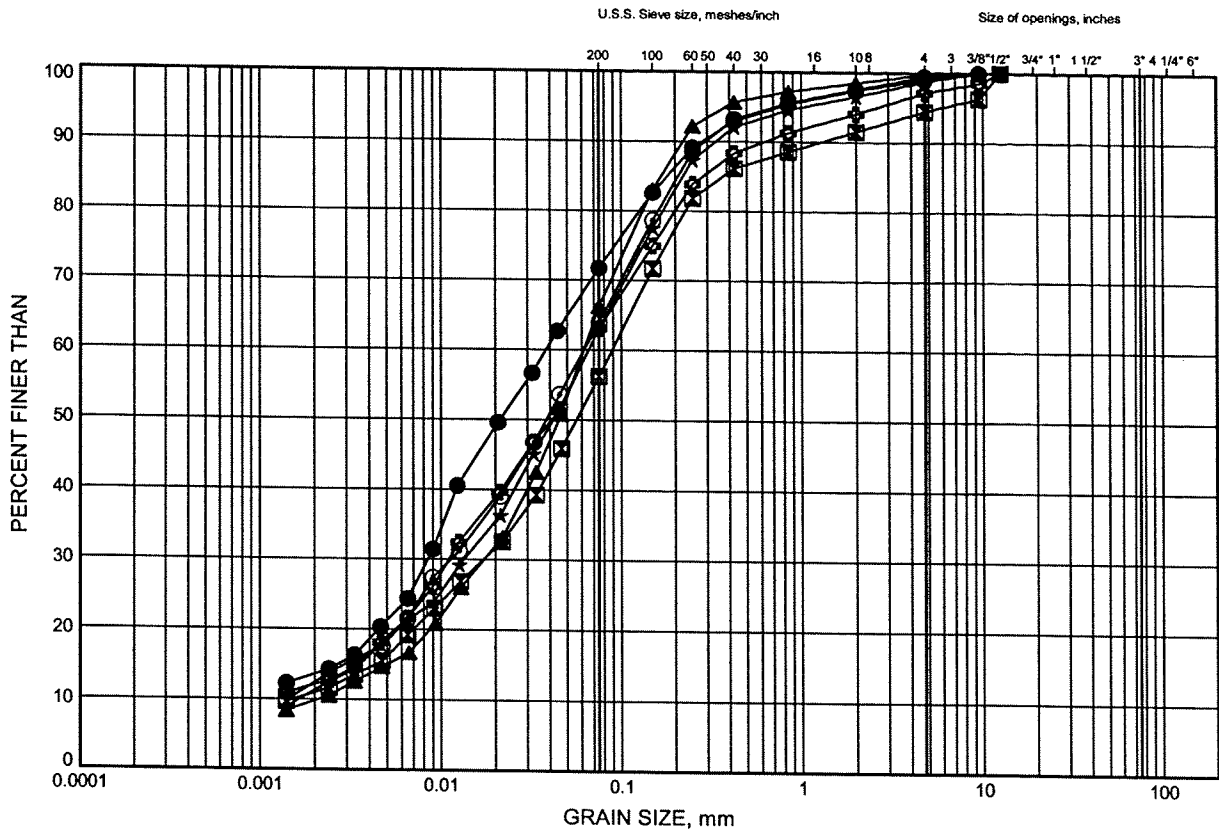
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C5

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-20	3.28	265.42
⊠	08-20	7.68	261.02
▲	08-21	6.17	261.93
★	08-48	1.83	263.80
⊙	08-49	1.07	265.02
⊕	08-51	2.59	261.05

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....

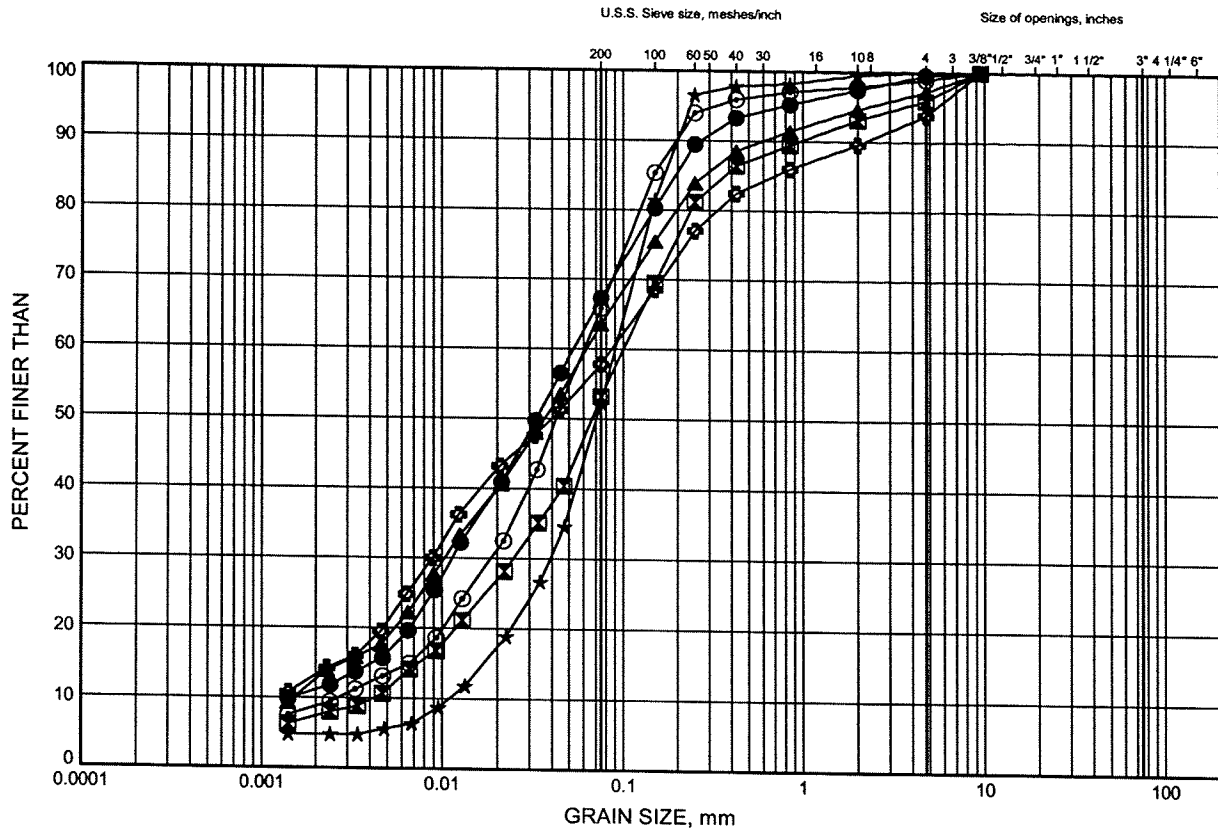




# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C6

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-51	6.17	257.47
⊠	08-51	9.18	254.46
▲	08-52	1.07	261.31
★	08-52	2.59	259.79
⊙	08-52	9.35	253.03
⊕	08-53	3.47	258.67

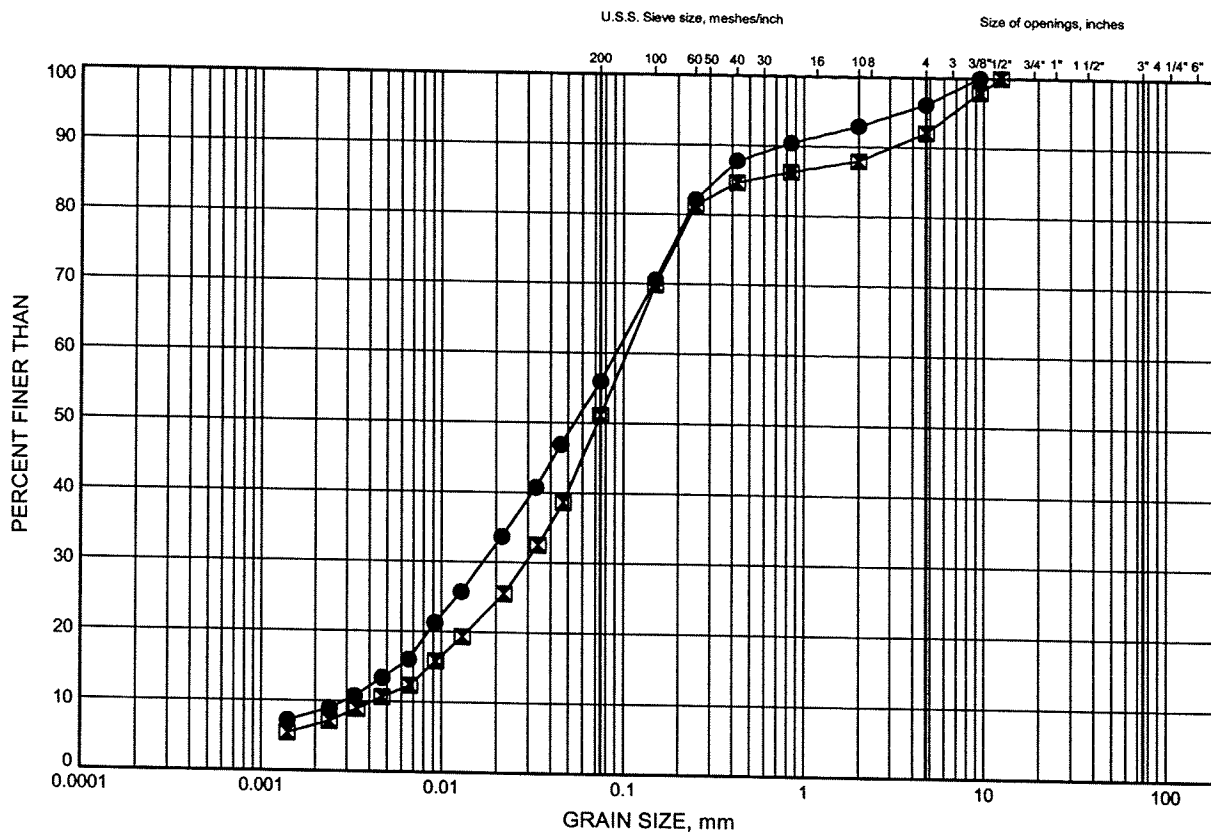


W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C7

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-53	9.26	252.88
◻	08-54	7.83	253.17

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

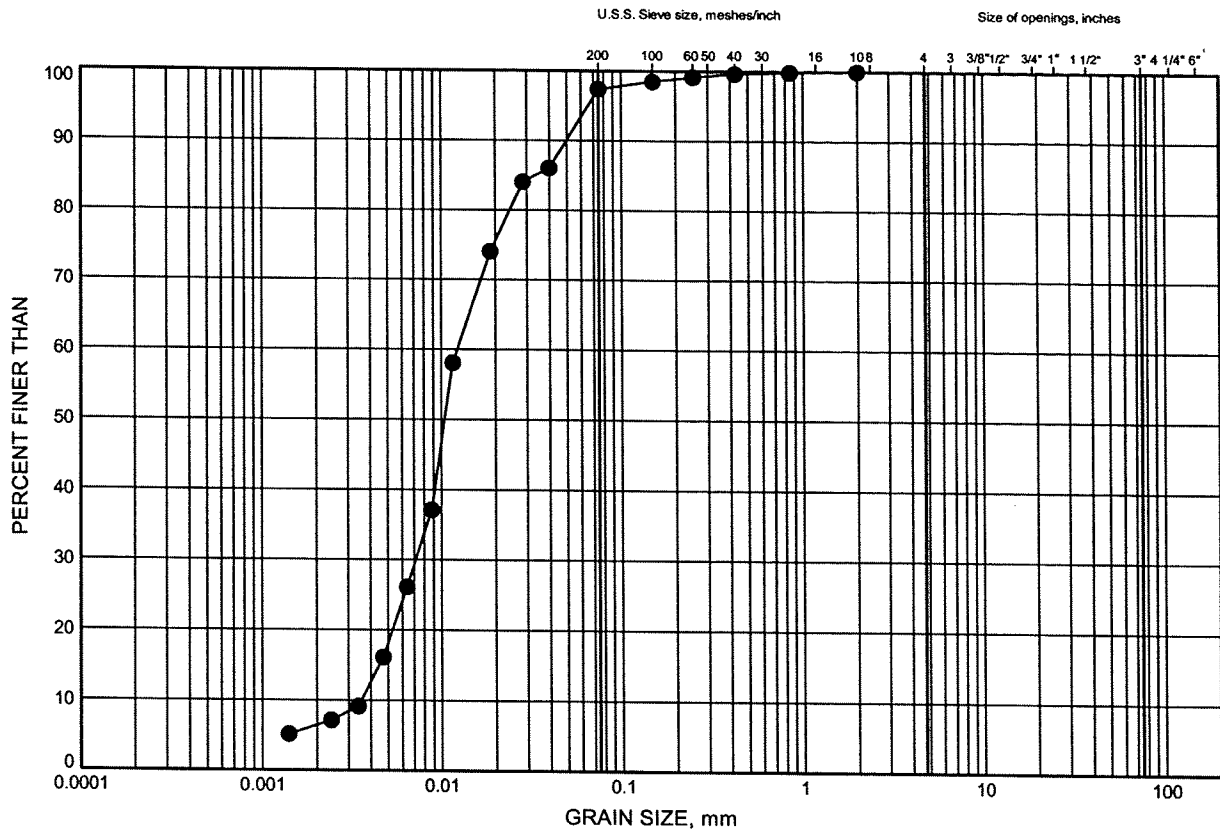
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C8

## SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-21	3.28	264.82

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

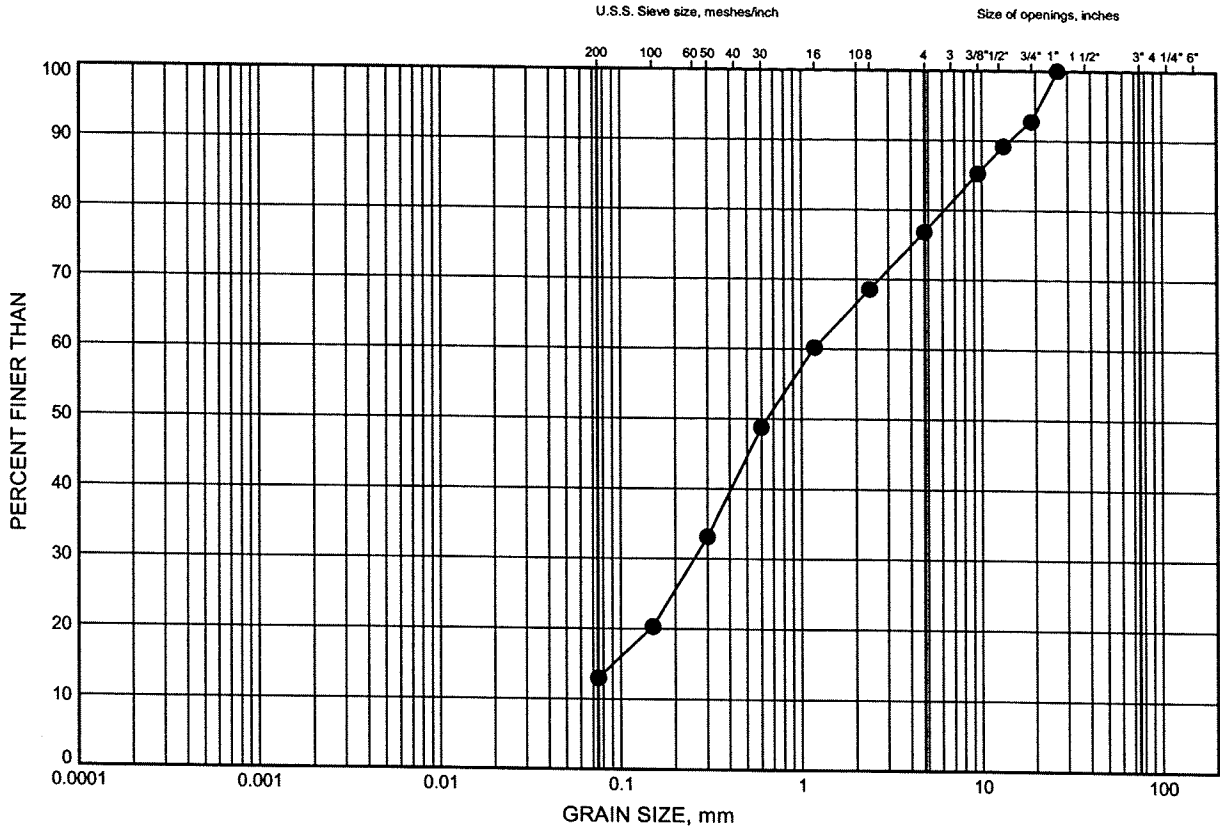
W.P.# .2109-05:00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C9

## GRAVELLY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

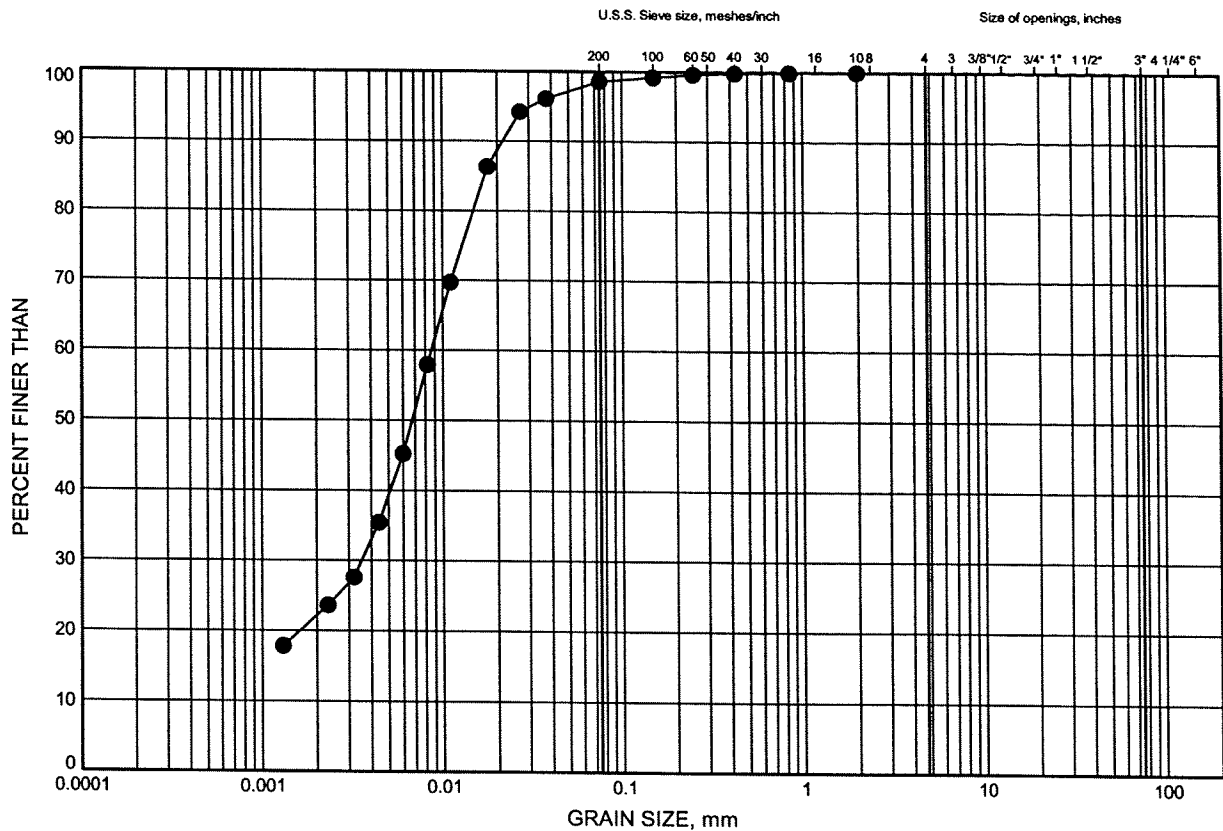
### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-48	3.35	262.28

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C10

## CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-54	2.59	258.41

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

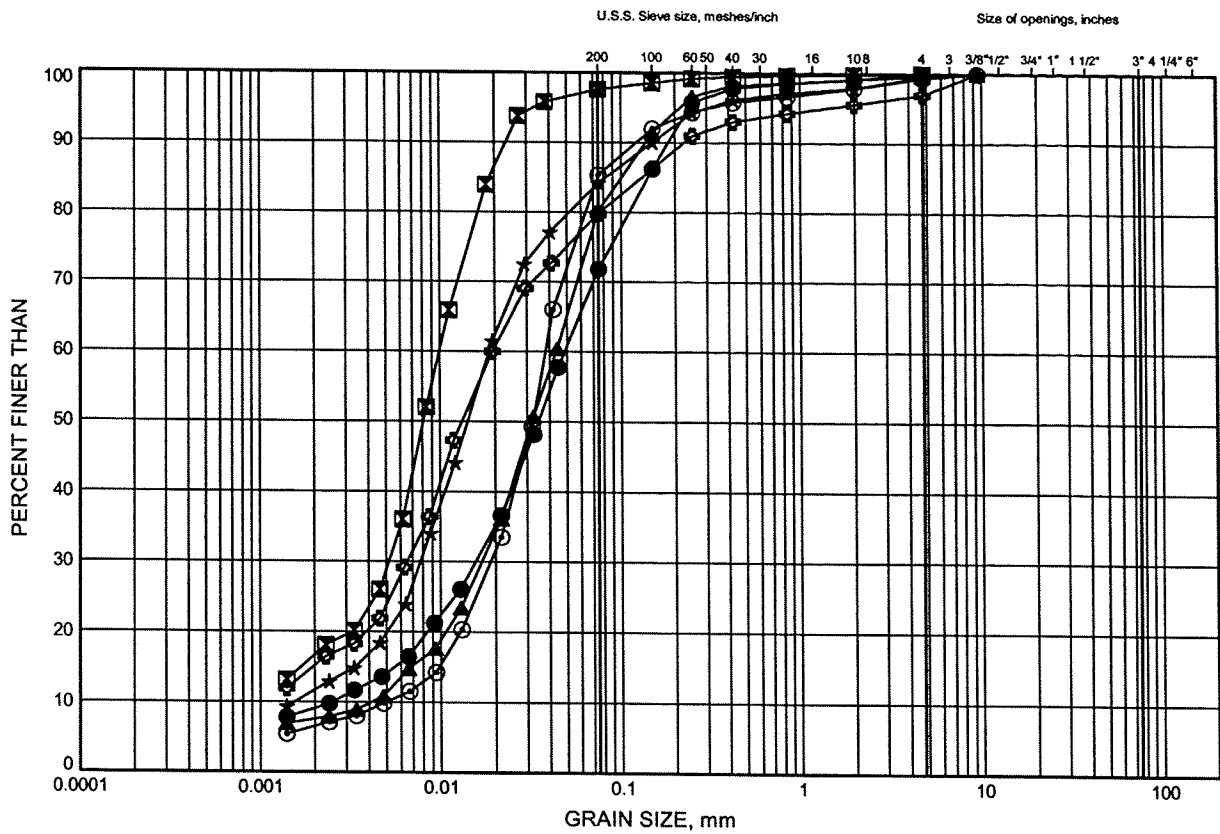
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C11

## SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-48	6.23	259.40
⊠	08-49	3.35	262.74
▲	08-49	6.40	259.69
★	08-50	2.59	261.79
⊙	08-50	6.29	258.09
⊕	08-54	10.72	250.28

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

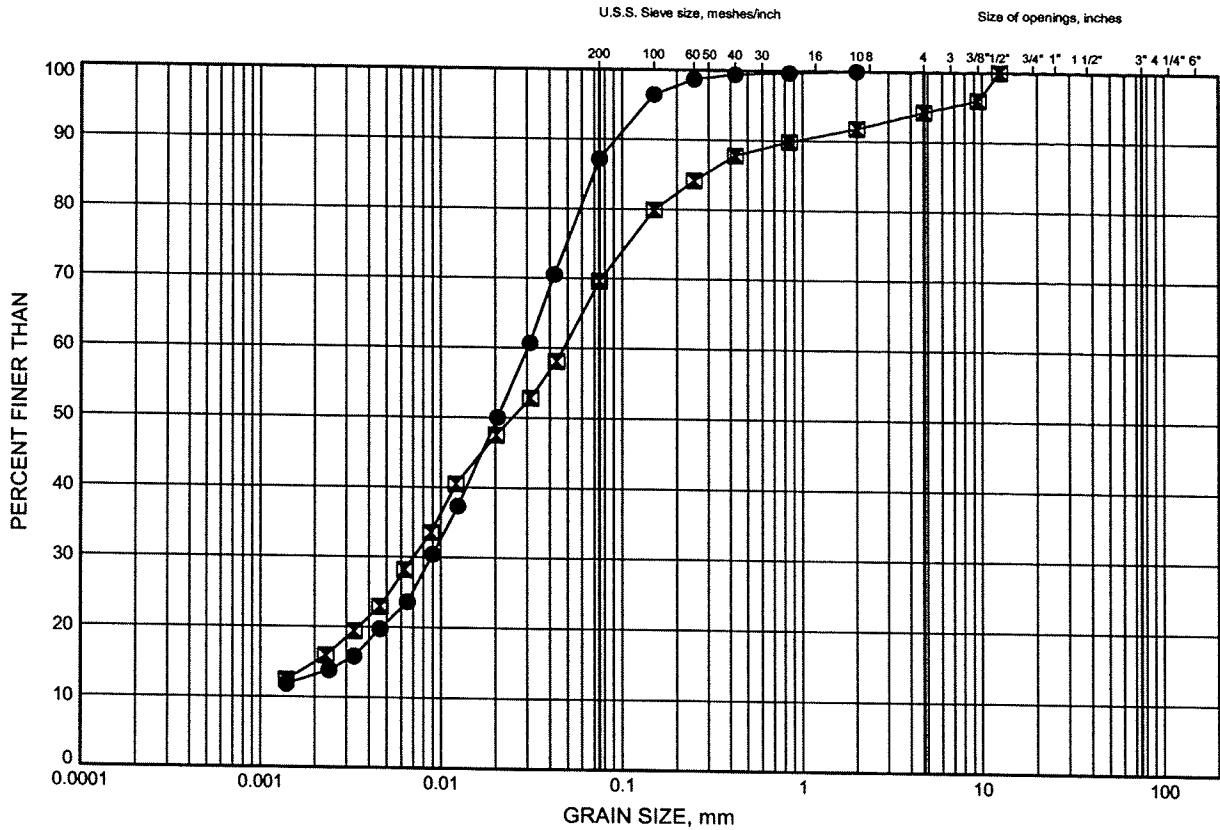
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C12

## SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-55	1.83	259.84
◻	08-55	6.40	255.27

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

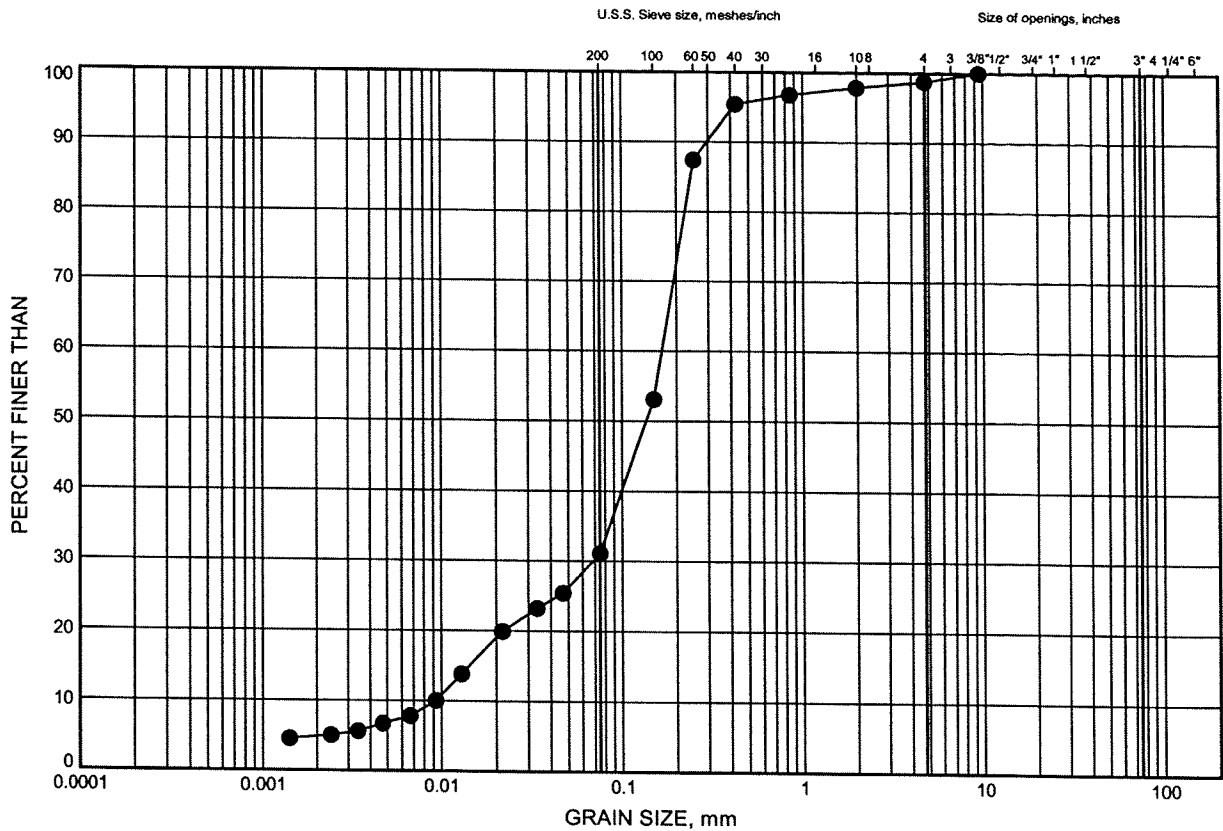
W.P.# 2109-05:00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE C13

## SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-50	4.62	259.76

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR

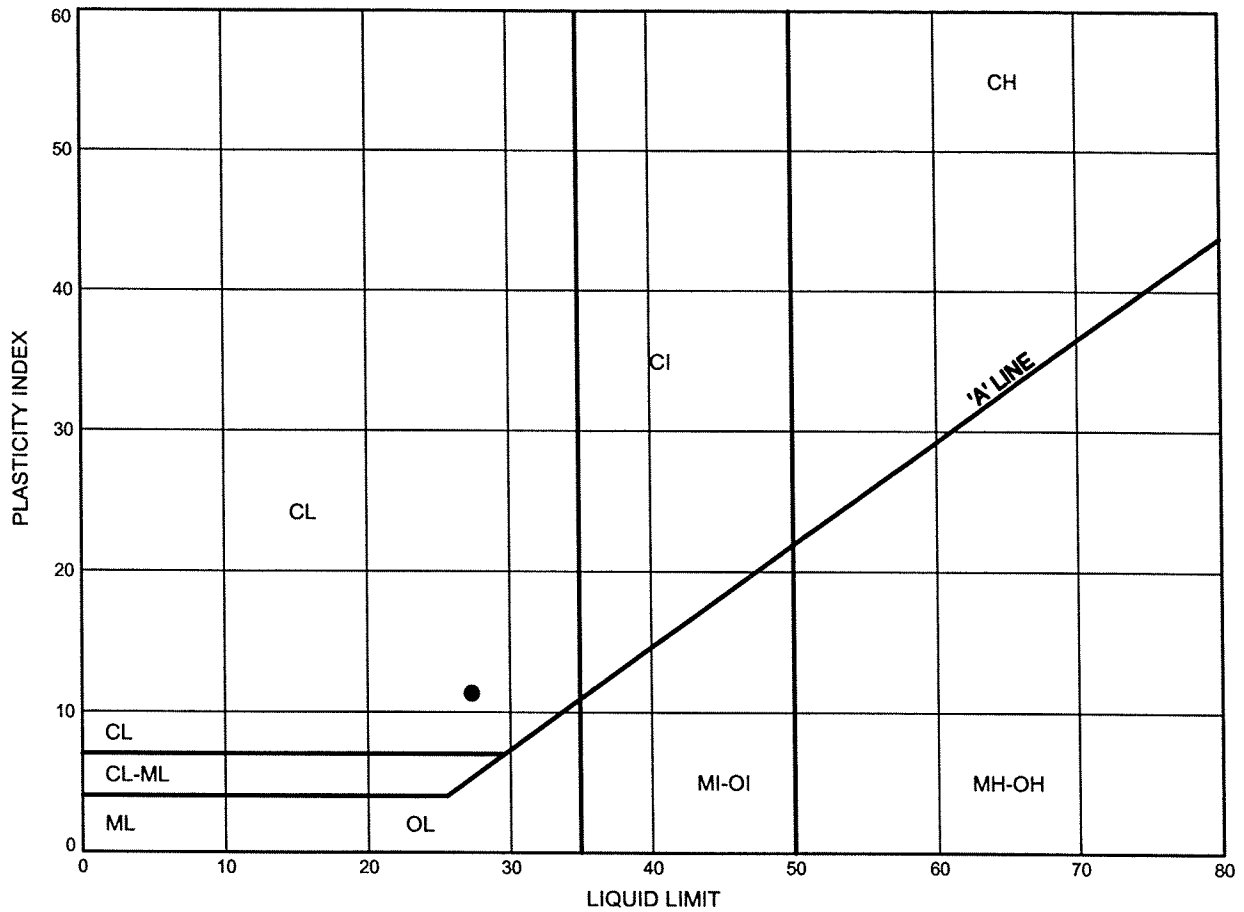




# Hwy 404 Extension ATTERBERG LIMITS TEST RESULTS

FIGURE C14

## SILTY CLAY FILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-53	1.83	260.31

Date September 2009

Project 2109-05-00



Prep'd AN

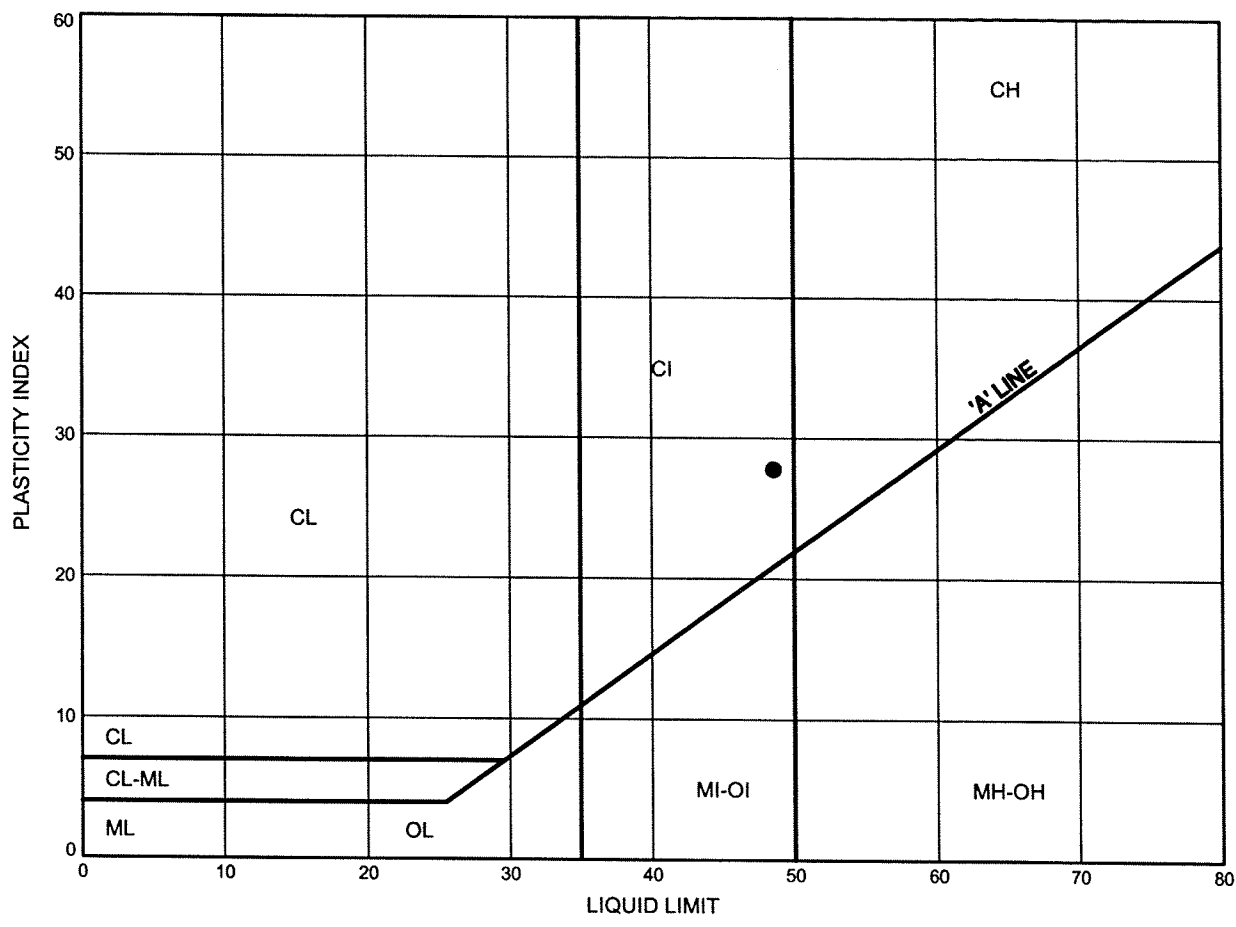
Chkd. RPR

Hwy 404 Extension

# ATTERBERG LIMITS TEST RESULTS

FIGURE C15

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-21	1.07	267.03

THURBALT 0596.GPJ 9/24/09

Date September 2009  
Project 2109-05-00

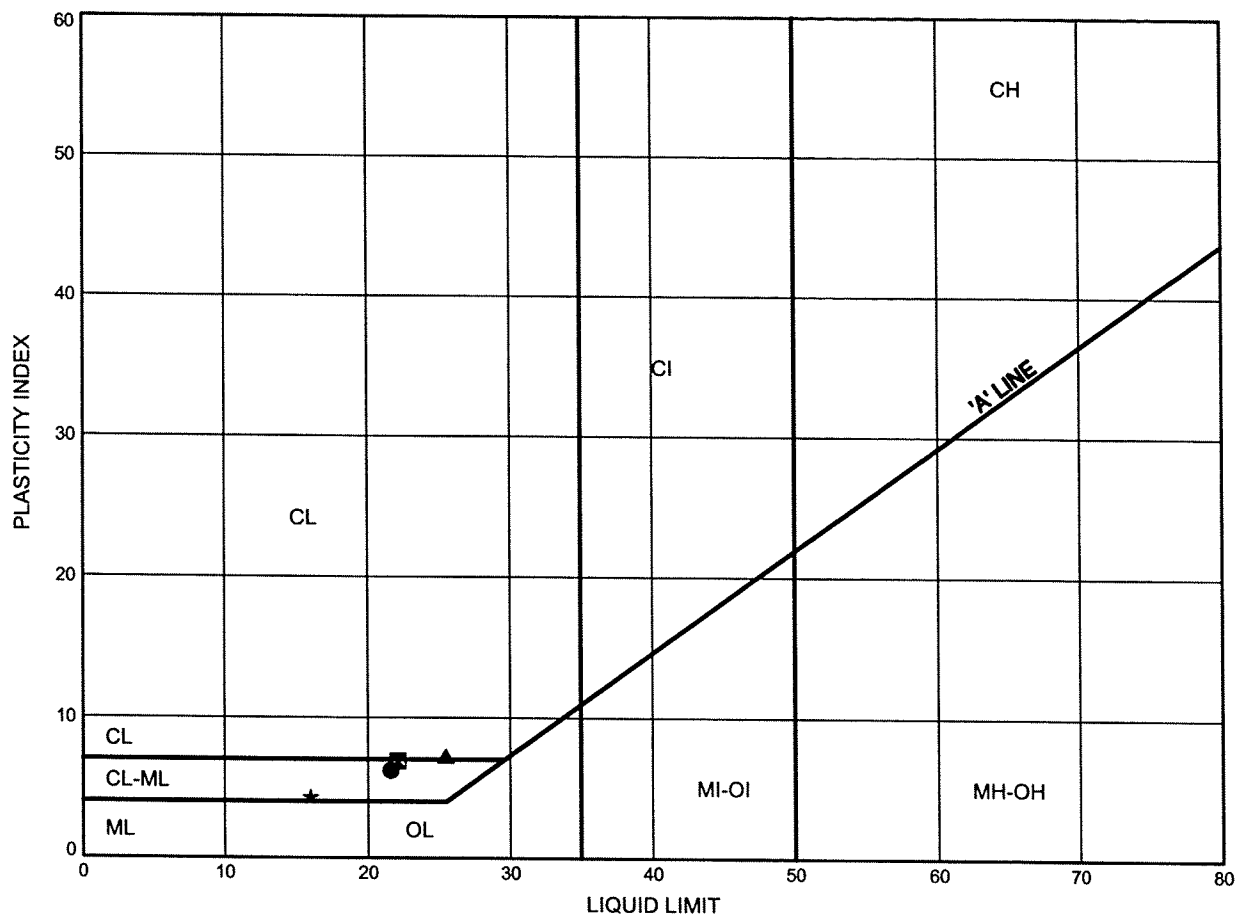


Prep'd AN  
Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C16

**SAND & SILT TILL (Clayey Zones)**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-19	2.51	266.09
☒	08-20	1.75	266.95
▲	08-21	3.28	264.82
★	08-53	3.54	258.60

Date September 2009

Project 2109-05-00



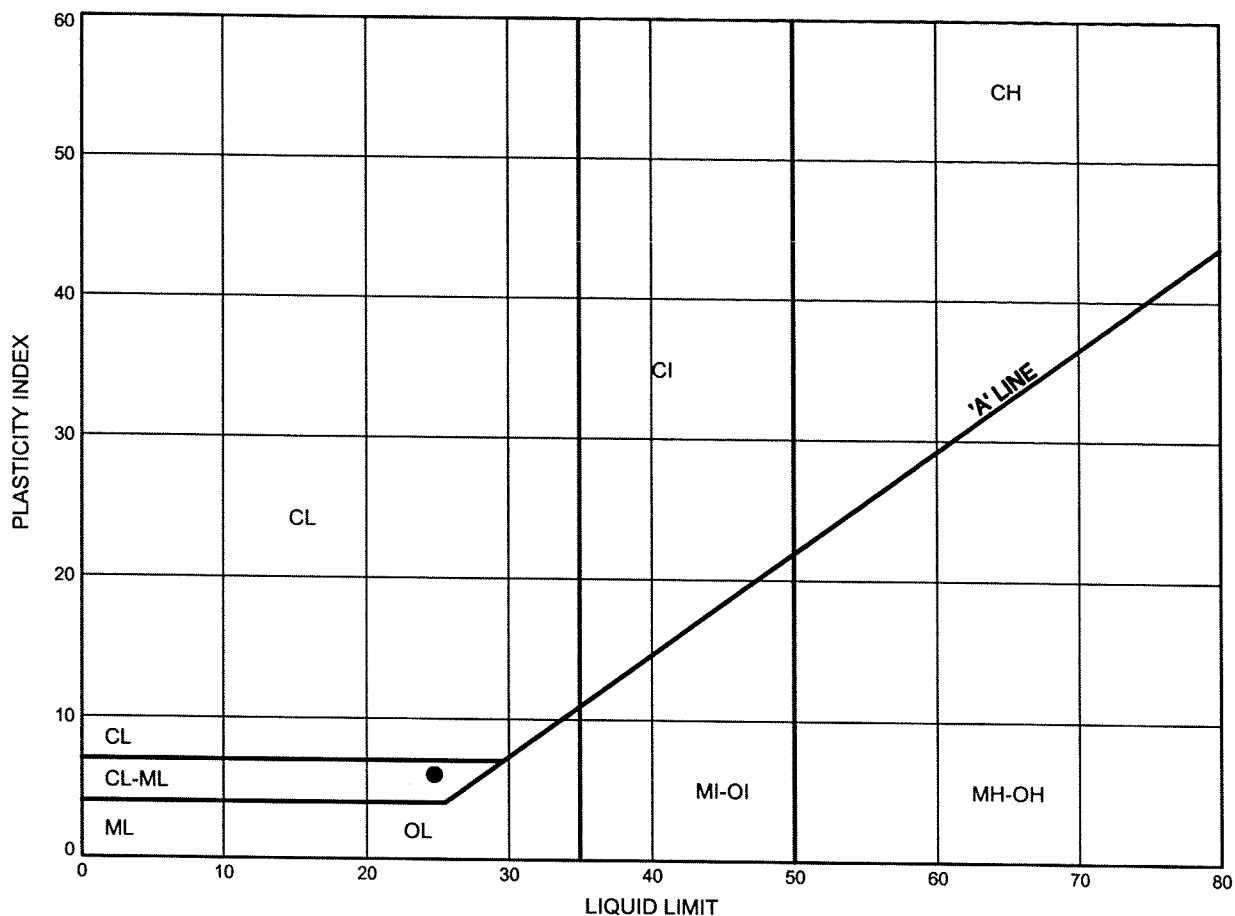
Prep'd AN

Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C17

**CLAYEY SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-54	2.59	258.41

THURBALT 0596.GPJ 10/5/09

Date October 2009  
 Project 2109-05-00

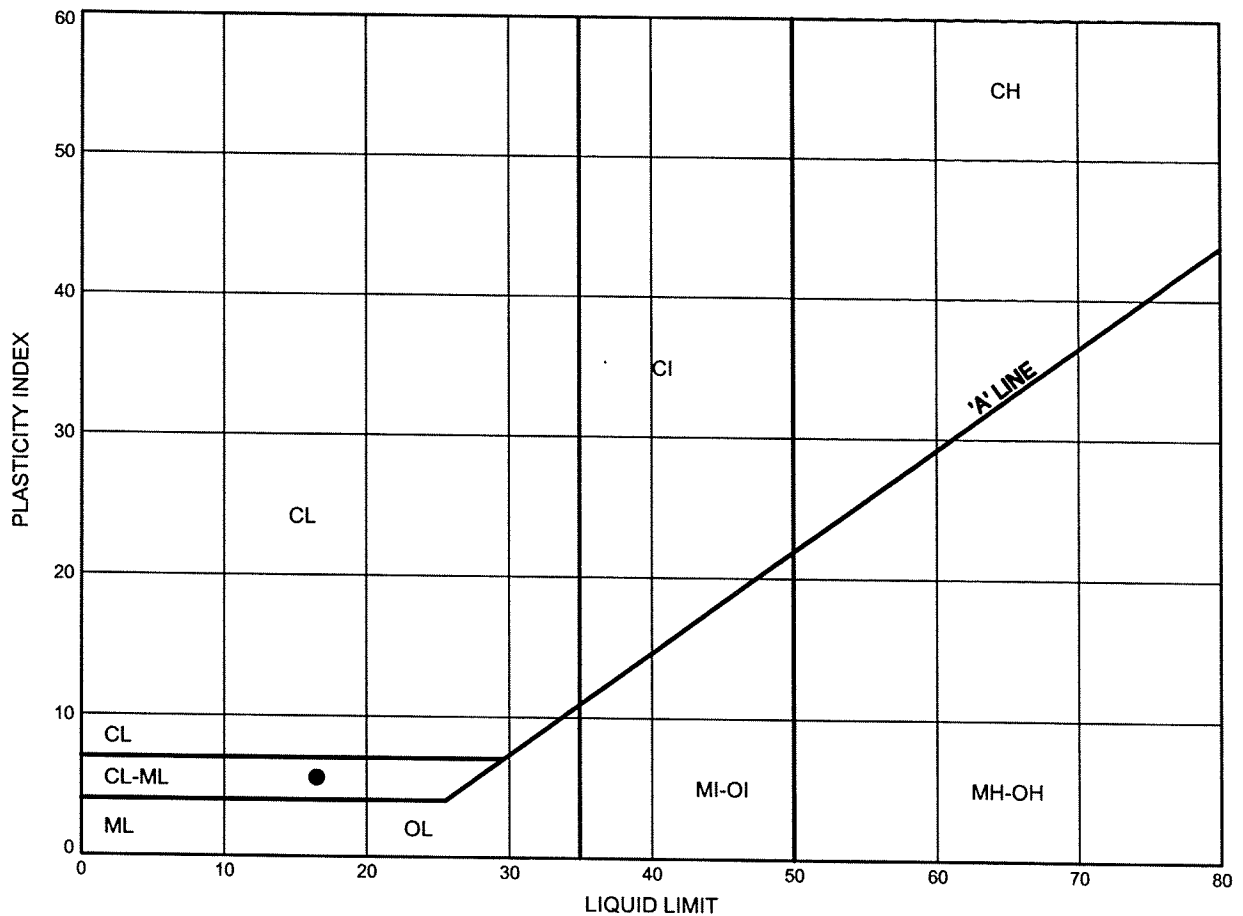


Prep'd AN  
 Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE C18

**SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-55	6.40	255.27

Date October 2009  
 Project 2109-05-00



Prep'd AN  
 Chkd. RPR

High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph 1** – View looking north of Doane Road

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 30+975 to 31+100  
 Depth: 6 m

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Sandy Silt Till	20	31	1
Sand/Silt Till	21	35	1

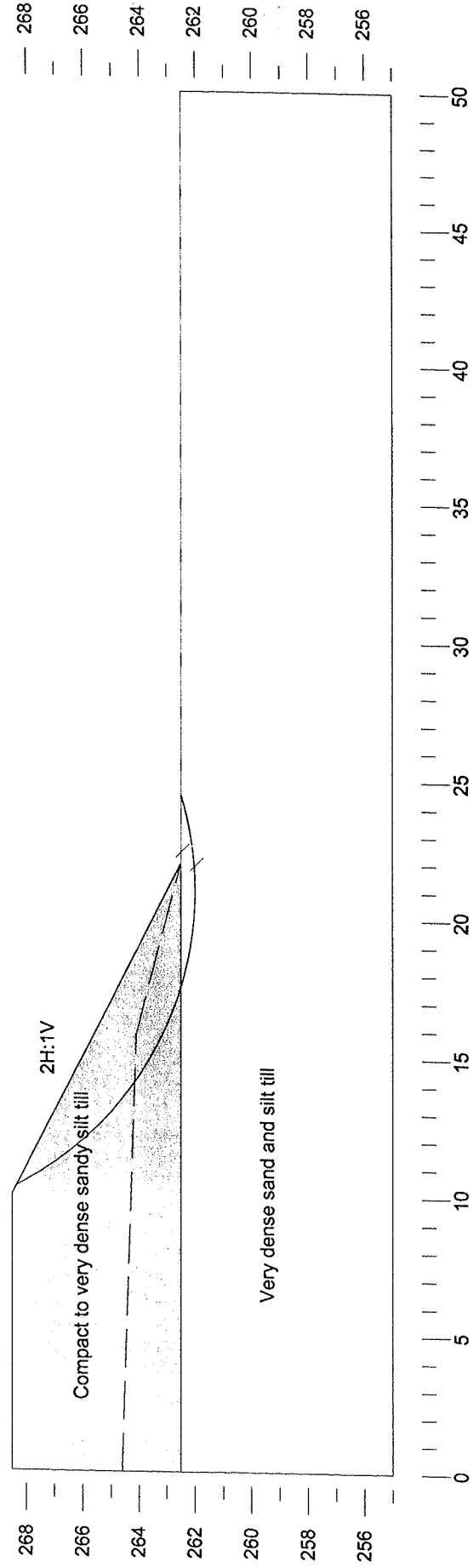
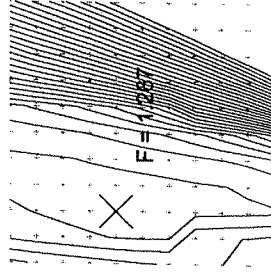


FIGURE 1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 30+975 to 31+100  
 Depth: 6 m - Seismic

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Sandy Silt Till	20	31	1
Sand/Silt Till	21	35	1

Seismic coefficient = 0.08

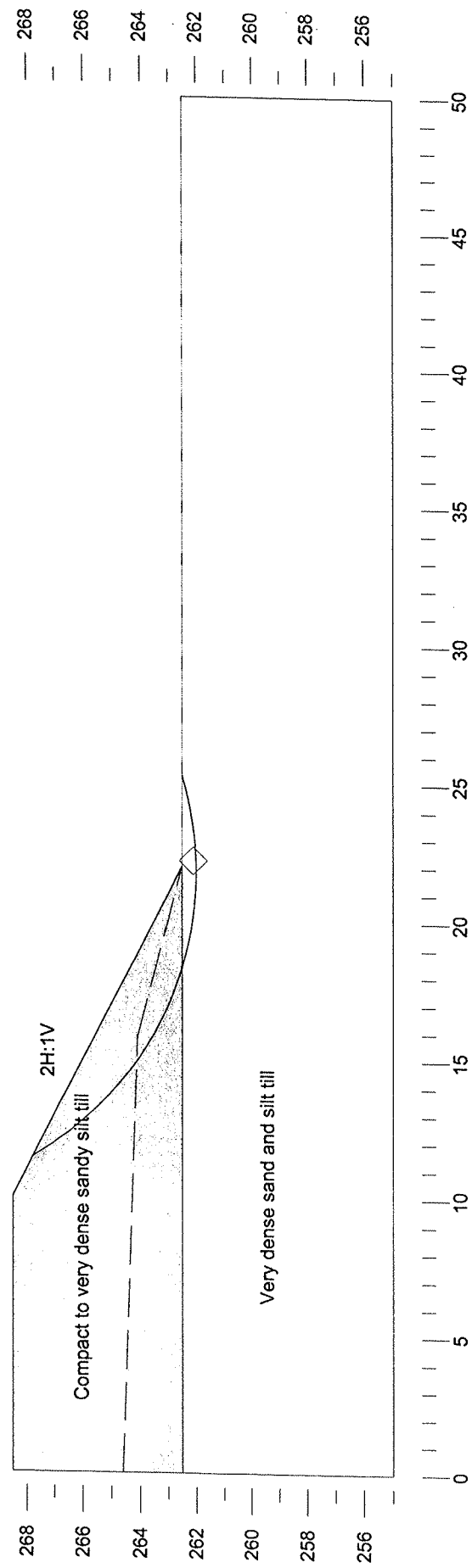
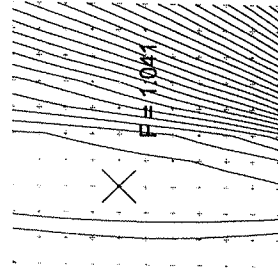


FIGURE 2



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

DOANE ROAD

HIGHWAY 404 EXTENSION

08-48, 08-49, 08-50, 08-51, 08-52, 08-53, 08-54, 08-55, 08-18, 08-19, 08-20, 08-21

00+000, 00+100, 00+200, 00+300, 00+400, 00+500, 00+600, 00+700, 00+800, 00+900, 00+1000, 00+1100, 00+1200, 00+1300, 00+1400, 00+1500, 00+1600, 00+1700, 00+1800, 00+1900, 00+2000, 00+2100, 00+2200, 00+2300, 00+2400, 00+2500, 00+2600, 00+2700, 00+2800, 00+2900, 00+3000, 00+3100, 00+3200, 00+3300, 00+3400, 00+3500, 00+3600, 00+3700, 00+3800, 00+3900, 00+4000, 00+4100, 00+4200, 00+4300, 00+4400, 00+4500, 00+4600, 00+4700, 00+4800, 00+4900, 00+5000, 00+5100, 00+5200, 00+5300, 00+5400, 00+5500, 00+5600, 00+5700, 00+5800, 00+5900, 00+6000, 00+6100, 00+6200, 00+6300, 00+6400, 00+6500, 00+6600, 00+6700, 00+6800, 00+6900, 00+7000, 00+7100, 00+7200, 00+7300, 00+7400, 00+7500, 00+7600, 00+7700, 00+7800, 00+7900, 00+8000, 00+8100, 00+8200, 00+8300, 00+8400, 00+8500, 00+8600, 00+8700, 00+8800, 00+8900, 00+9000, 00+9100, 00+9200, 00+9300, 00+9400, 00+9500, 00+9600, 00+9700, 00+9800, 00+9900, 00+10000

PLAN

0 20 40 60m

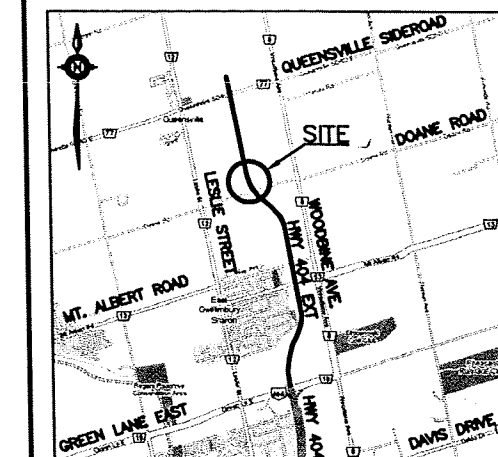
SCALE 1:1000

LICENSED PROFESSIONAL ENGINEER  
S.M. SATHER  
Feb 26/10  
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER  
P. K. CHATTERJI  
Feb 26/10  
PROVINCE OF ONTARIO








SHEET



## KEYPLAN

### LEGEND

- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

NO	ELEVATION	NORTHING	EASTING
08-18	267.0	4 887 157.9	310 330.9
08-19	268.6	4 887 193.4	310 308.5
08-20	268.7	4 887 229.4	310 286.7
08-21	268.1	4 887 264.8	310 266.1
08-48	265.6	4 887 093.6	310 301.8
08-49	266.1	4 887 108.9	310 311.7
08-50	264.4	4 887 090.4	310 327.1
08-51	263.6	4 887 113.7	310 353.3
08-52	262.4	4 887 100.1	310 368.4
08-53	262.1	4 887 127.4	310 398.8
08-54	261.0	4 887 112.7	310 413.8
08-55	261.7	4 887 131.7	310 424.0

**-NOTES-**

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 31D-492**

[illegible]

FILENAME: D:\Drafting\19\1605\96\ted0596-BoreholePlan.dwg  
DATE: 2010-1-29  
TIME: 1:29pm





**Appendix D**

**Deep Cut - Highway 404 extension, North of Queensville Sideroad  
Station 33+200 – 33+700  
(Boreholes 08-22 to 08-32)**

**Record of Borehole Sheets  
Laboratory Test Results  
Site Photographs  
Slope Stability Output  
Drawing titled “Borehole Locations and Soil Strata”**

# RECORD OF BOREHOLE No 08-22

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 288.21 E 309 746.91 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.22 - 2009.01.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
268.0	TOPSOIL, occasional roots and organics Dark Brown (600mm)		1	SS	6		268							
267.4														
0.6	SAND and SILT, trace gravel, trace clay Brown Compact Wet (TILL)		2	SS	17		267							
			3	SS	21		266							
	sand pockets		4	SS	28		265							5 53 37 5
	Very Dense		5	SS	102/ 0.250		264							0 39 53 8
	Layer of fine sand (600mm)		6	SS	100/ 0.150									0 40 53 7
263.2	Grey		7	SS	137/ 0.200									
4.8	END OF BOREHOLE AT 4.8m. BOREHOLE OPEN AND WATER LEVEL AT 2.9m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 1.5m, THEN AUGER CUTTINGS TO SURFACE.													

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-23

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 889 337.37 E 309 737.75

ORIGINATED BY GA

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.01.20 - 2009.01.20

CHECKED BY RPR

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	20	40	60						80
273.9																
0.0	TOPSOIL (300mm)		1	SS	14											
273.6																
0.3	SAND and SILT, some clay, trace gravel Compact to Very Dense Brown Moist (TILL)		2	SS	31											
			3	SS	43										1	36 52 11
			4	SS	55											
			5	SS	51											
			6	SS	100/ 0.150										5	38 46 11
			7	SS	100/ 0.150											
	Occasional oxidized staining		8	SS	107/ 0.150										0	34 55 11
			9	SS	115/ 0.150											
	Moist to Wet															

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-23

2 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 889 337.37 E 309 737.75

ORIGINATED BY GA

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.01.20 - 2009.01.20

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
	SAND and SILT, trace to some clay, trace gravel Very Dense Brown Wet (TILL)		10	SS	152/												
					0.150												
			11	SS	107/												
260.1			12	SS	126/												
13.9	END OF BOREHOLE AT 13.9m. BOREHOLE OPEN AND WATER LEVEL AT 11.9m UPON COMPLETION OF DRILLING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
	WATER LEVEL READINGS:																
	DATE DEPTH (m) ELEV. (m)																
	2009.02.06 6.1 267.8																
	2009.02.20 5.7 268.2																
	2009.03.20 5.8 268.1																
	2009.04.22 5.4 268.5																
	2009.05.15 5.8 268.1																
	2009.06.05 6.0 267.9																
	2009.07.10 6.1 267.8																
	2009.09.02 8.9 265.0																
	2009.09.21 8.2 265.7																

+<sup>3</sup>.X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-24

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 386.52 E 309 728.60 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.01.21 - 2009.01.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
276.3														
0.0	TOPSOIL (430mm)		1	SS	4		276							
275.9														
0.4	Sandy SILT, mixed with topsoil Loose to Compact Brown Moist		2	SS	20		275							
274.8														
1.5	SAND and SILT, some clay, trace gravel Compact to Very Dense Brown Moist (TILL)  occasional cobbles Moist   occasional sand pockets		3	SS	27		274							2 44 43 11
			4	SS	65		273							3 40 46 11
			5	SS	83/ 0.250		272							
			6	SS	100/ 0.150		271							
			7	SS	100/ 0.125		270							1 33 52 14
			8	SS	144/ 0.250		269							
			9	SS	100/ 0.125		268							
							267							

Continued Next Page

+<sup>3</sup> X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



**METRIC**

ORIGINATED BY ES

COMPILED BY AN

CHECKED BY RPR

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 08-25

1 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 435.67 E 309 719.44 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.01.21 - 2009.01.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	120 140 160 180 200	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
277.9	TOPSOIL, organics, trace roots													
0.0	Loose		1	SS	4									
277.4	Dark Brown													
0.5	(500mm)													
277.1	Sandy SILT, mixed with topsoil													
0.8	Loose		2	SS	41		277							2 46 41 11
	Brown													
	Moist													
	SAND and SILT, some clay, trace													
	gravel, occasional sand pockets													
	Dense to Very Dense		3	SS	42		276							
	Brown													
	Moist													
	(TILL)													
			4	SS	66									
							275							
	Occasional sand seams, occasional silt		5	SS	61									1 40 48 11
	seams													
							274							
			6	SS	100/									
					0.125		273							
			7	SS	100/		272							
					0.100									
							271							
	Occasional oxidized staining		8	SS	100/		270							
	Brown to Grey				0.100									
							269							
			9	SS	100/									
	Layer of silt				0.100		268							0 17 70 13

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-25

2 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 435.67 E 309 719.44 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2009.01.21 - 2009.01.21 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%)					
							40	80	120	160	200	
												GR SA SI CL
	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100/ 0.075	267						
						266						
			11	SS	100/ 0.050	265						
						264						
			12	SS	100/ 0.125	264						0 65 31 4
263.4												
14.5	SAND, fine grained, some silt, trace gravel, trace clay Very Dense Grey Moist					263						
262.6			13	SS	100/ 0.125	262						2 86 12 (SI+CL)
15.3	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)					261						
			14	SS	100/ 0.075	260						
						259						
			15	SS	100/ 0.100	259						
			16	SS	100/ 0.075	259						
258.0												
19.9												

Continued Next Page

+<sup>3</sup> X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-25

3 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 435.67 E 309 719.44 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.21 - 2009.01.21 CHECKED BY RPR

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 (%)																													
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W <sub>p</sub>	W			W <sub>L</sub>																												
	Continued From Previous Page					0.050																																							
	END OF BOREHOLE AT 19.9m. BOREHOLE OPEN AND WATER LEVEL AT 12.2m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr><td>2009.02.06</td><td>6.9</td><td>271.0</td></tr> <tr><td>2009.02.20</td><td>6.0</td><td>271.9</td></tr> <tr><td>2009.03.20</td><td>6.0</td><td>271.9</td></tr> <tr><td>2009.04.22</td><td>5.7</td><td>272.2</td></tr> <tr><td>2009.05.15</td><td>5.9</td><td>272.0</td></tr> <tr><td>2009.06.05</td><td>6.1</td><td>271.8</td></tr> <tr><td>2009.07.10</td><td>6.4</td><td>271.5</td></tr> <tr><td>2009.09.02</td><td>13.3</td><td>264.6</td></tr> <tr><td>2009.09.21</td><td>13.4</td><td>264.5</td></tr> </tbody> </table>	DATE	DEPTH (m)	ELEV. (m)	2009.02.06	6.9	271.0	2009.02.20	6.0	271.9	2009.03.20	6.0	271.9	2009.04.22	5.7	272.2	2009.05.15	5.9	272.0	2009.06.05	6.1	271.8	2009.07.10	6.4	271.5	2009.09.02	13.3	264.6	2009.09.21	13.4	264.5														
DATE	DEPTH (m)	ELEV. (m)																																											
2009.02.06	6.9	271.0																																											
2009.02.20	6.0	271.9																																											
2009.03.20	6.0	271.9																																											
2009.04.22	5.7	272.2																																											
2009.05.15	5.9	272.0																																											
2009.06.05	6.1	271.8																																											
2009.07.10	6.4	271.5																																											
2009.09.02	13.3	264.6																																											
2009.09.21	13.4	264.5																																											

# RECORD OF BOREHOLE No 08-26

1 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 484.83 E 309 710.29 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.22 - 2009.01.22 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
278.2													
0.0	TOPSOIL, organics												
277.7	Loose		1	SS	4								
0.5	Dark Brown												
277.4	(450mm)												
0.8	SAND, trace gravel												
	Loose		2	SS	33								
	Brown												
	Moist												
	SAND and SILT, some clay, trace												
	gravel, occasional cobbles												
	Dense to Compact												
	Brown		3	SS	21								3 34 52 11
	Moist												
	(TILL)												
	Very Dense												
			4	SS	52								
			5	SS	112								
			6	SS	100/								
					0.075								
	Layer of silt												
	Very Dense		7	SS	100/								0 18 78 4
					0.150								
	Layer of sand (600mm)												
			8	SS	115/								1 67 28 6
					0.225								
	Layer of silt												
	Occasional clay seams, occasional		9	SS	100/								0 5 82 13
	oxidized staining				0.125								
	Brown to Grey												

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-26

2 OF 3

METRIC

G.W.P. 2109-05-00

LOCATION N 4 889 484.83 E 309 710.29

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2009.01.22 - 2009.01.22

CHECKED BY RPR

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	W <sub>P</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
	SAND and SILT, some clay, trace gravel, occasional oxidized staining Very Dense Brown to Grey Moist		10	SS	100/	0.100											
	Layer of sand		11	SS	100/	0.100											
	Grey		12	SS	100/	0.100											
			13	SS	100/	0.075											
			14	SS	100/	0.075											
			15	SS	100/	0.050											
258.4	END OF BOREHOLE AT 19.8m.		16	SS	100/												
19.8																	

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 0596.GPJ 10/16/09

RECORD OF BOREHOLE No 08-26

3 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 484.83 E 309 710.29 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.01.22 - 2009.01.22 CHECKED BY RPR

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	w <sub>p</sub>	w		
	Continued From Previous Page					0.025										
	BOREHOLE OPEN AND WATER LEVEL AT 11.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 2.7m, THEN AUGER CUTTINGS TO SURFACE.															

ONTM14S 0596.GPJ 10/16/09





RECORD OF BOREHOLE No 08-27

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 534.0 E 309 701.1, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.18 - 2010.01.18 CHECKED BY TH

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
							WATER CONTENT (%) 20 40 60 80 100						
261.5	SAND and SILT, trace clay, trace gravel Very Dense Grey Damp (TILL)		10	SS	100/	0.100							
262													
12.3	END OF BOREHOLE AT 12.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.02.02 7.5 266.3		11	SS	100/	0.075							

# RECORD OF BOREHOLE No 08-28

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 583.1 E 309 692.0, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

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									
274.6								20	40	60	80	100					
0.0	<b>ORGANICS</b> Loose Dark Brown Damp (225mm)  <b>SAND and SILT</b> , trace clay Loose to Very Dense Brown Damp (TILL)		1	SS	5		274										
0.2			2	SS	32		273										0 40 53 7
			3	SS	34		272										0 26 67 7
			4	SS	62		271										
			5	SS	105/ 0.275		270										
			6	SS	101		269										
			7	SS	112/ 0.250		268										
			8	SS	116/ 0.225		267										
266.2								266									
8.4	<b>SAND</b> , some gravel Very Dense Brown Moist						265										
265.1			9	SS	124												
9.4	<b>SAND and SILT</b> , trace gravel Very Dense Brown																

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-28

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 583.1 E 309 692.0, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							W <sub>p</sub> W W <sub>L</sub>		
264.5 10.1	Continued From Previous Page  Moist (TILL)  SAND, some silt, trace gravel Very Dense Brown Moist		10	SS	105/ 0.250	264											
							263										
				11	SS	100/ 0.125	262										
261.3 13.3	SAND and SILT, trace gravel Very Dense Grey Damp (TILL)			12	SS	100/ 0.150	261										
							260										
259.2 15.3	END OF BOREHOLE AT 15.3m. BOREHOLE OPEN AND WATER LEVEL AT 7.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 11.8m, THEN CUTTINGS TO SURFACE.		13	SS	100/ 0.100												

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity  
20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-29

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 632.3 E 309 682.8, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
273.5							20 40 60 80 100					
0.0	<b>ORGANICS</b>											
273.1	Loose		1	SS	4							
0.4	Dark Brown											
	Damp											
	Sandy <b>SILT</b> , trace clay											
	Compact to Very Dense											
	Brown		2	SS	21							
	Damp											
	(TILL)											
			3	SS	23							0 1 90 9
			4	SS	75							
			5	SS	122							0 24 67 9
			6	SS	100/ 0.150							
			7	SS	104/ 0.250							
267.0	<b>SAND</b> , some silt, trace gravel											
6.4	Very Dense											
	Brown		8	SS	129/ 0.225							
	Moist											
264.9	<b>SAND</b> and <b>SILT</b> , trace clay, trace gravel											
8.5	Very Dense		9	SS	100/ 0.125							
	Grey											
	Damp											
	(TILL)											

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

**METRIC**

G.W.P. 2109-05-00 LOCATION N 4 889 632.3 E 309 682.8, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES

HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

[illegible]

# RECORD OF BOREHOLE No 08-30

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 681.4 E 309 673.3, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
271.6							20 40 60 80 100						
0.0	<b>ORGANICS</b> Loose Dark Brown Damp		1	SS	5								
271.1													
0.4													
270.8	<b>SAND and SILT</b> , trace clay, trace roots and rootlets Loose Brown Damp		2	SS	12								
0.8													
	<b>SAND and SILT</b> , trace clay, trace gravel Compact to Dense Brown Damp (TILL) Sand pockets Very Dense		3	SS	32								0 27 66 7
			4	SS	69								
			5	SS	121/ 0.225								
267.4													
4.1	<b>SAND</b> , fine grained, trace gravel Very Dense Brown Moist		6	SS	107								1 83 16 (SI+CL)
265.5													
6.1	<b>SAND and SILT</b> , trace clay, trace gravel Very Dense Brown Damp (TILL)		7	SS	100/ 0.125								
			8	SS	100/ 0.100								
			9	SS	100/ 0.125								

Continued Next Page

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-30

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 681.4 E 309 673.3, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.19 - 2010.01.19 CHECKED BY TH

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 X LAB VANE					W <sub>P</sub> W W <sub>L</sub> 20 40 60					
	Continued From Previous Page															
	SAND and SILT, trace clay, trace gravel Very Dense Grey Damp (TILL)		10	SS	100/	0.125										
259.2																
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 11.8m, THEN CUTTINGS TO SURFACE.		11	SS	100/	0.125										

# RECORD OF BOREHOLE No 08-31

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 730.6 E 309 664.5, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.20 - 2010.01.20 CHECKED BY TH

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    x LAB VANE								
268.6								20	40	60	80	100				
0.0	TOPSOIL: (150mm)															
0.2	SAND AND SILT, some clay, trace roots and rootlets Very Loose Dark Brown Damp		1	SS	3		268						○			
267.4			2	SS	11								○			
1.1	SAND, fine grained, trace gravel Compact Brown Damp						267						○			
267.0			3	SS	24								○			
1.6	Sandy SILT, trace clay, trace gravel Compact to Very Dense Brown Damp (TILL)		4	SS	26		266						○			0 23 68 9
			5	SS	117/ 0.250		265						○			
			6	SS	100/ 0.150		264						○			1 31 61 7
			7	SS	100/ 0.150		263						○			
			8	SS	100/ 0.125		262									
260.8							261						○			
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND WATER LEVEL AT 5.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2010.02.02      4.2      264.4															

ONTMT4S 0596.GPJ 2/3/10



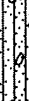
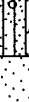

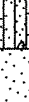



# RECORD OF BOREHOLE No 08-32

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 779.6 E 309 655.4, DEEP CUT NORTH OF QUEENVILLE SIDE RD. ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2010.01.20 - 2010.01.20 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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						
266.2								20	40	60	80	100		
0.0	TOPSOIL: (175mm)						266							
0.2	SAND and SILT, some clay, trace roots and rootlets Loose Dark Brown Damp		1	SS	4									
265.5														
0.8	SAND and SILT, trace clay, trace gravel Compact to Dense Brown Damp (TILL)		2	SS	22		265							
264.3														
1.9	SAND, fine grained Dense Brown Damp		3	SS	49		264							
263.5														
2.7	SAND and SILT, trace clay, trace gravel Dense Brown Damp (TILL)		4	SS	36		263							
263.0														
3.2	SAND, fine grained, trace gravel Very Dense Brown Damp		5	SS	80		262							
262.0														
4.3	Sandy SILT, trace clay, trace gravel Very Dense Brown Damp (TILL)		6	SS	107/ 0.250		261							
260.0														
6.2	END OF BOREHOLE AT 6.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 4.3m, THEN CUTTINGS TO SURFACE.		7	SS	100/ 0.150									

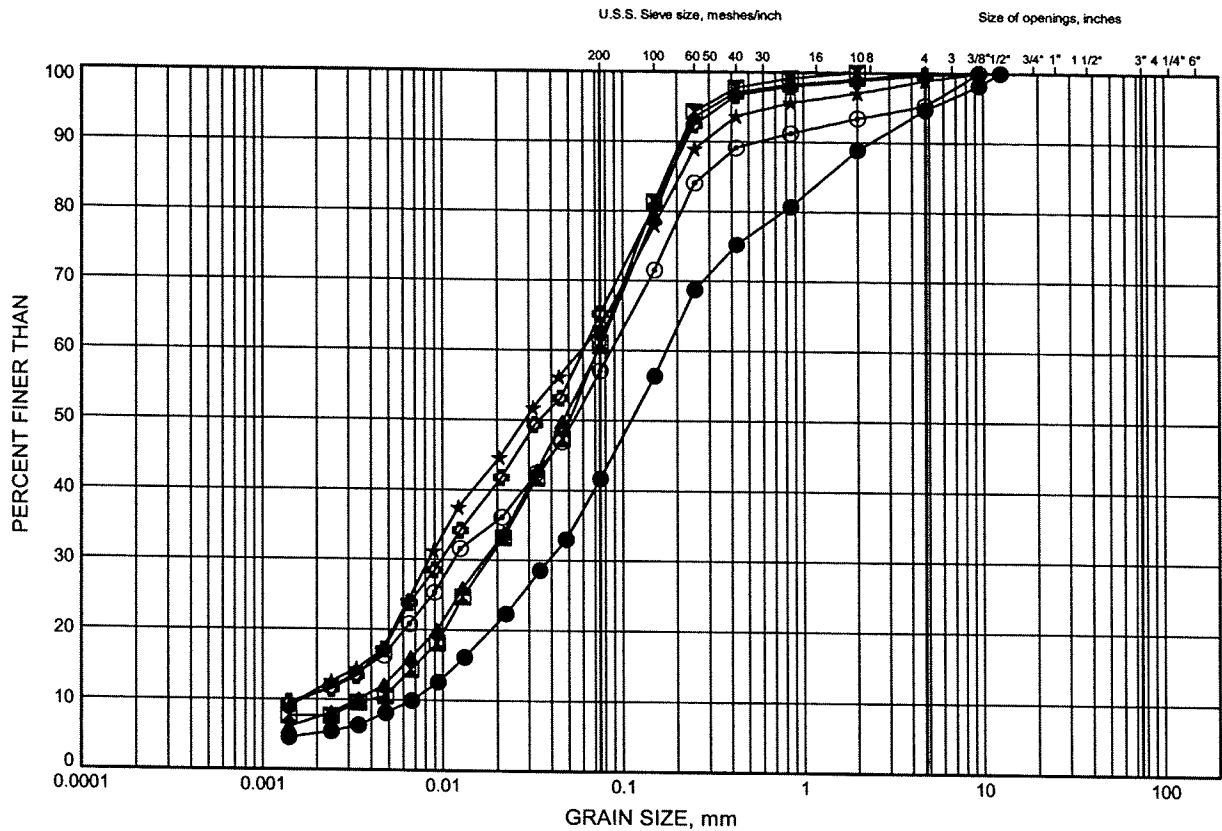
+<sup>3</sup> X<sup>3</sup>: Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D1

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-22	2.51	265.50
⊠	08-22	3.25	264.76
▲	08-22	3.89	264.12
★	08-23	1.83	272.11
⊙	08-23	4.65	269.29
⊕	08-23	7.70	266.24

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/23/09

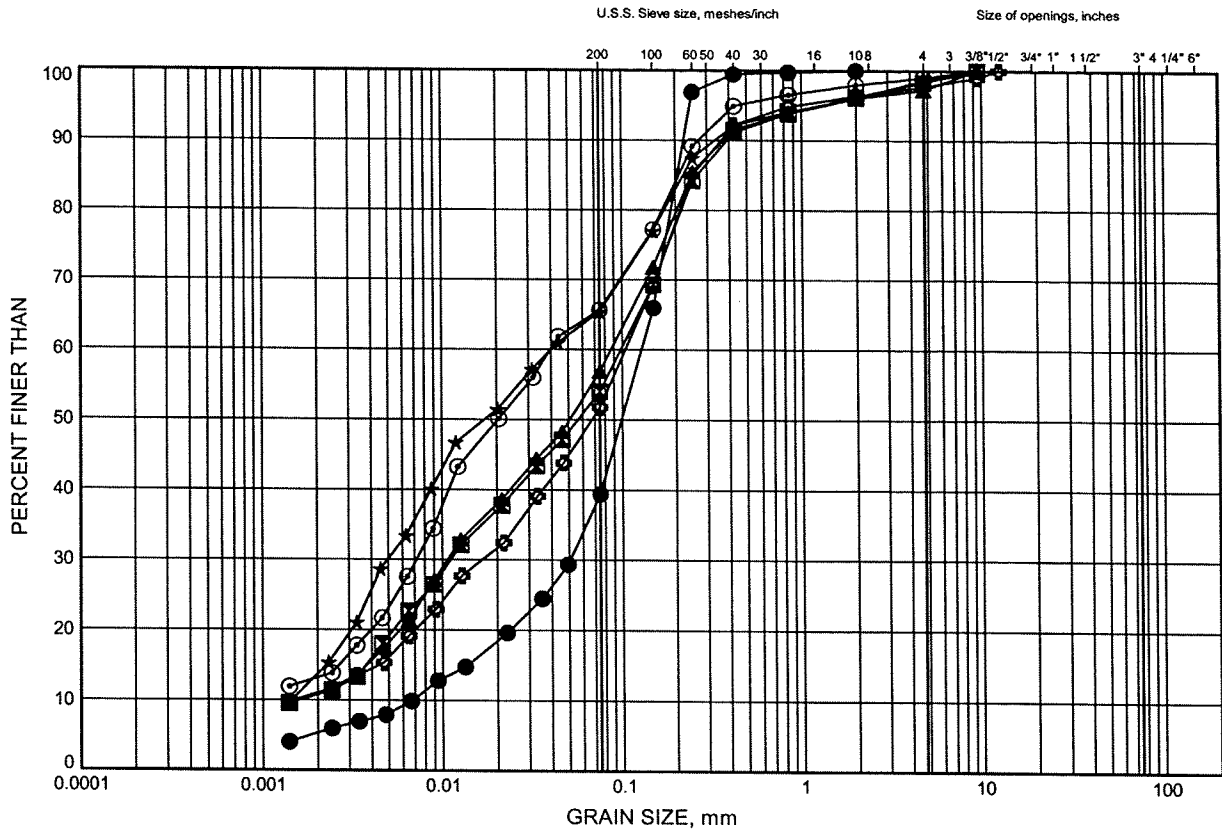
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D2

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-23	12.27	261.67
⊠	08-24	2.51	273.79
▲	08-24	3.25	273.05
★	08-24	6.16	270.14
⊙	08-24	10.72	265.58
⊕	08-25	0.99	276.91

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/16/09

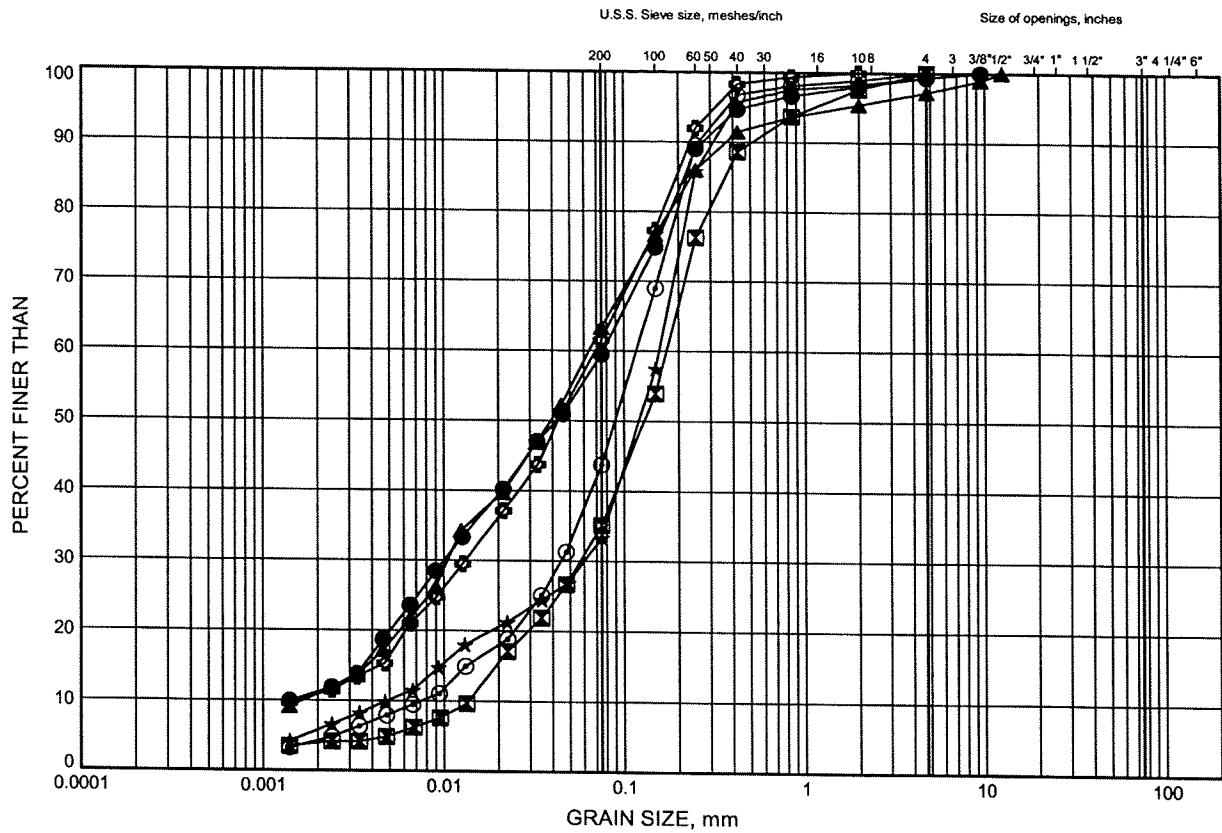
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D3

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-25	3.28	274.62
⊠	08-25	13.78	264.12
▲	08-26	1.75	276.45
★	08-26	7.70	270.50
⊙	08-26	13.76	264.44
⊕	08-26	18.31	259.89

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/16/09

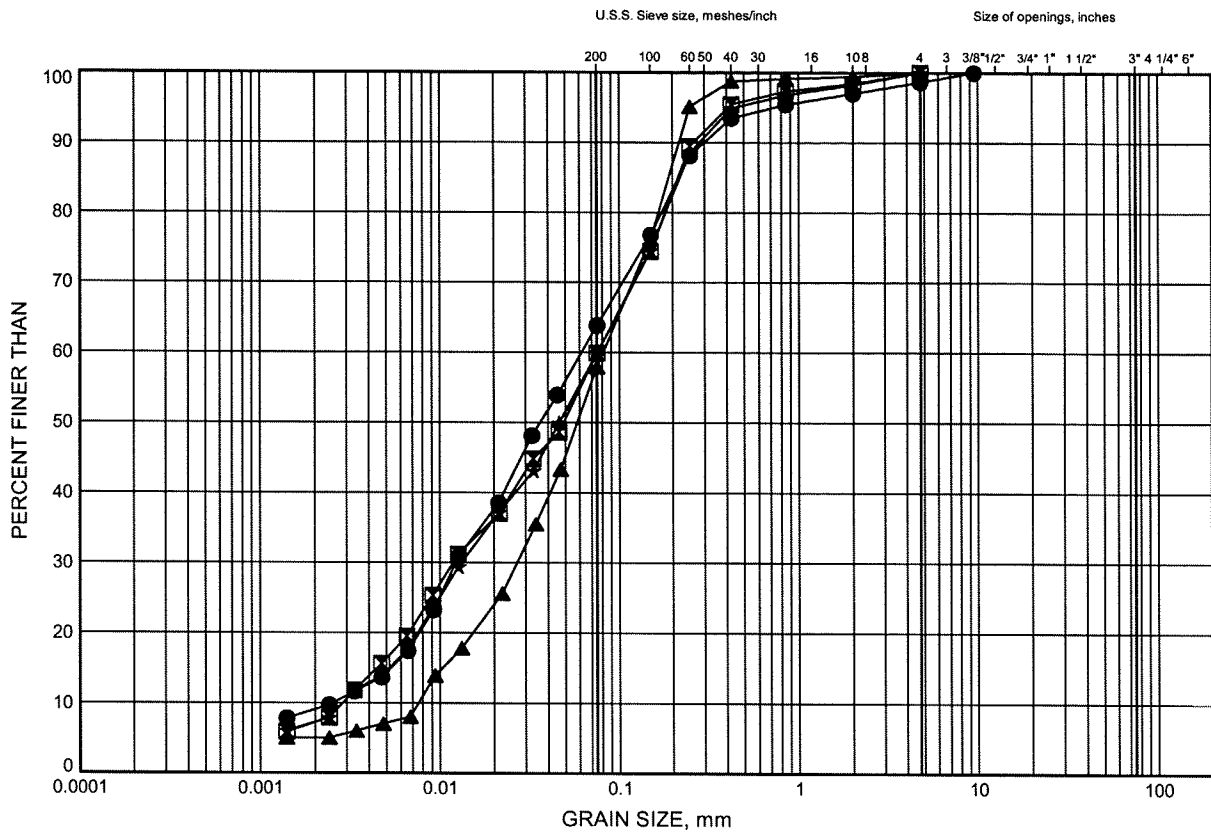
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D4

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

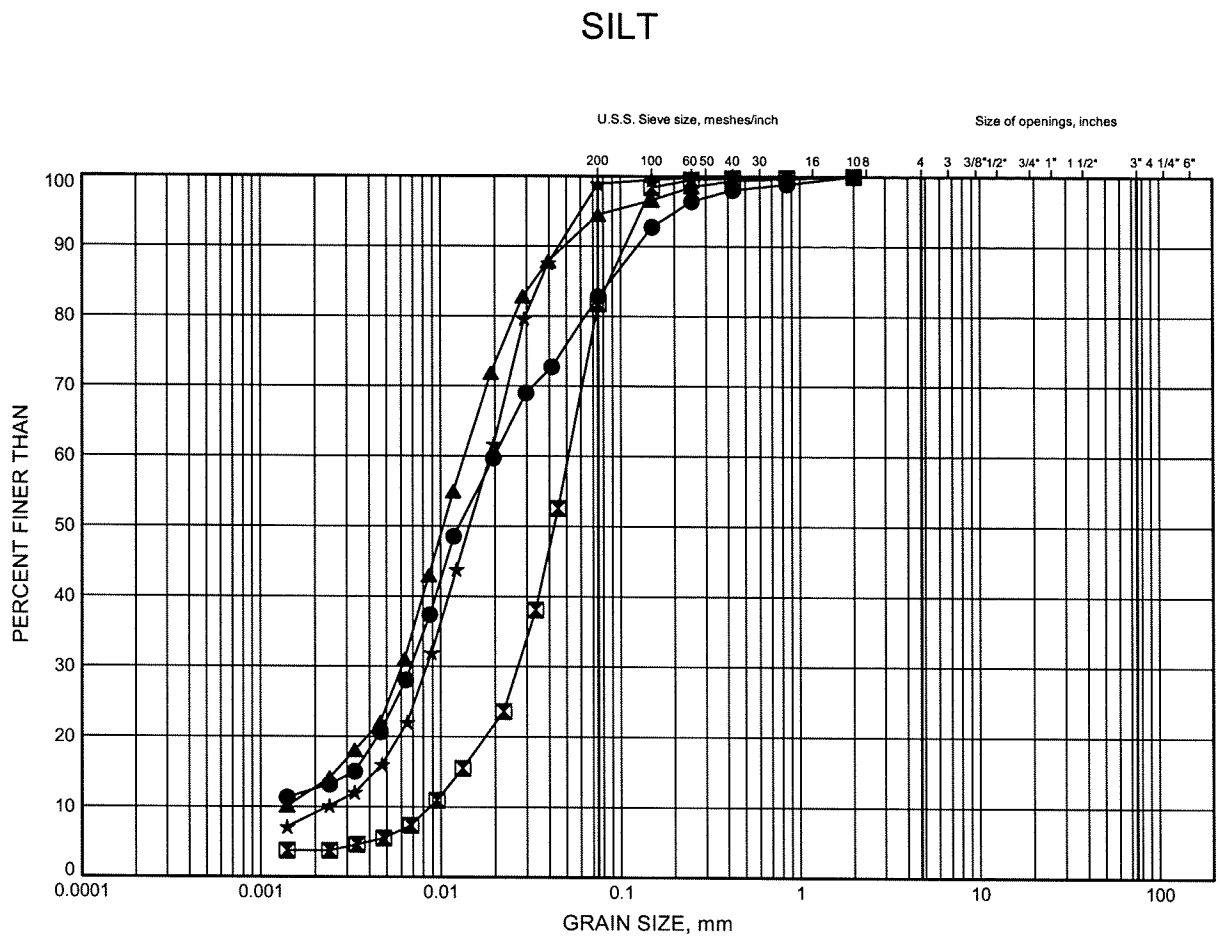
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-27	1.07	272.72
■	08-27	2.59	271.20
▲	08-27	7.74	266.05
★	08-28	1.07	273.50



W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By TH.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D5



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

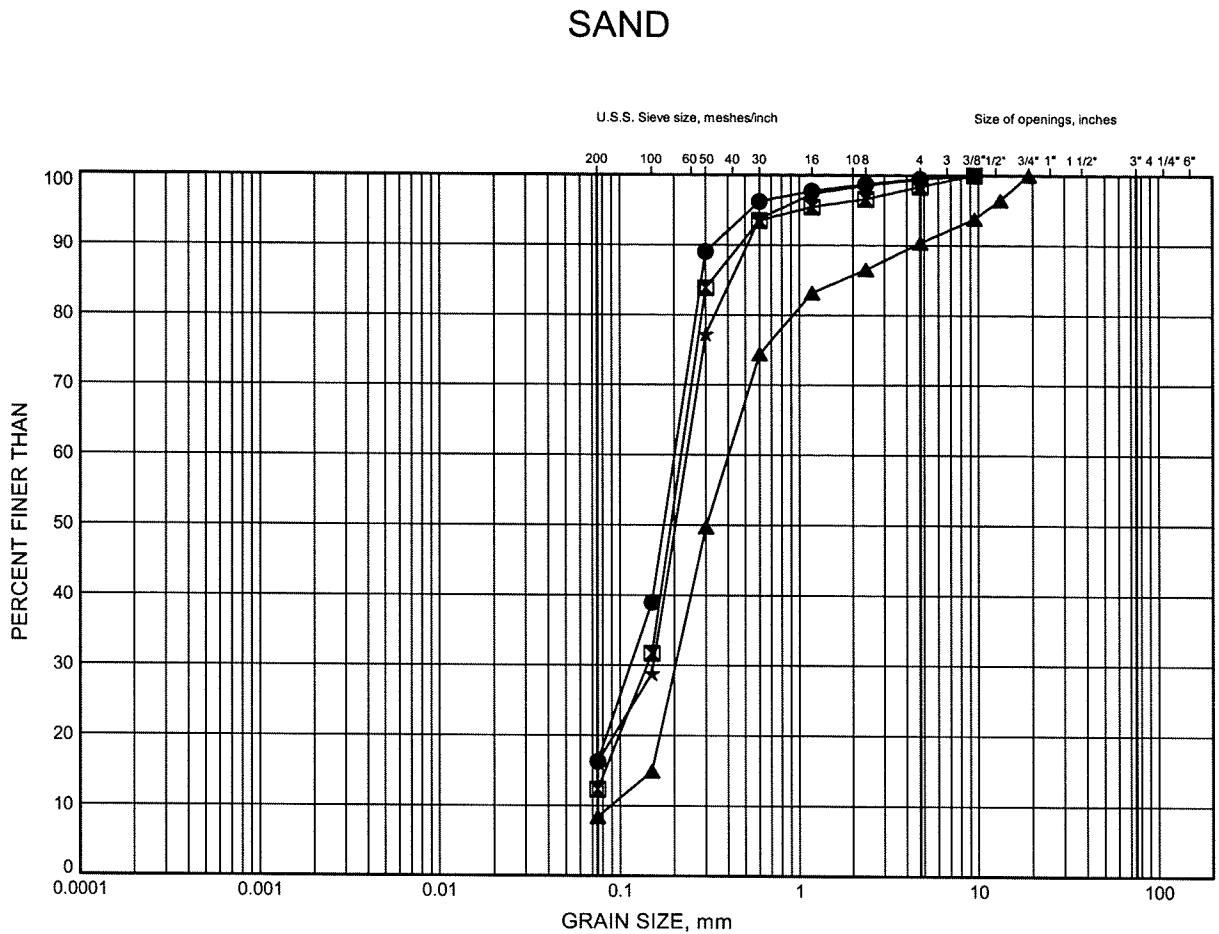
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-25	9.19	268.71
⊠	08-26	6.17	272.03
▲	08-26	9.21	268.99
★	08-29	1.83	271.64



W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By TH.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE D6



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-24	13.75	262.55
⊠	08-25	15.28	262.62
▲	08-28	9.30	265.27
★	08-30	4.80	266.76



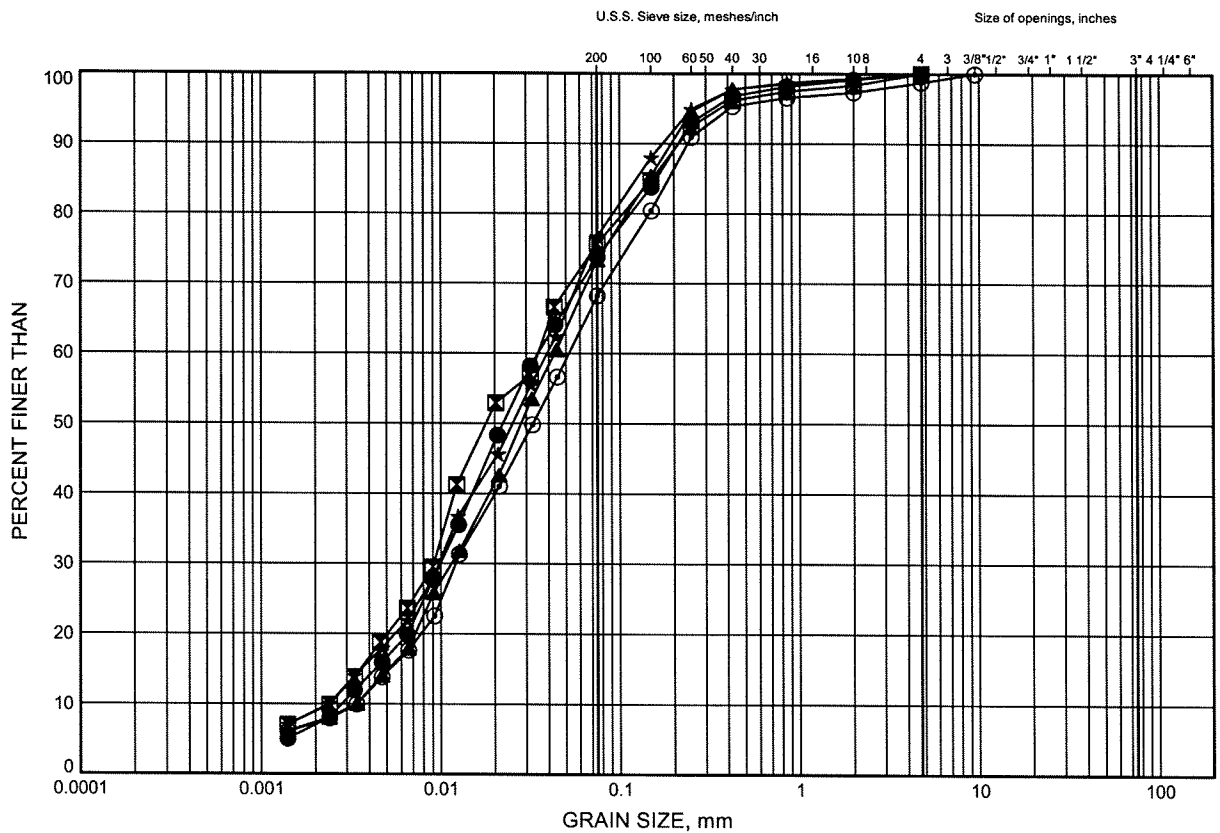
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By TH.....

# Hwy 404 Extension

## GRAIN SIZE DISTRIBUTION

FIGURE D7

### SANDY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-28	2.59	271.98
⊠	08-29	3.28	270.19
▲	08-30	1.83	269.73
★	08-31	2.59	266.00
⊙	08-31	4.65	263.94

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 2/5/10

W.P.# 2109-05-00.....  
 Prepared By AN.....  
 Checked By TH.....





High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

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**Photograph** – View looking north, Borehole 08-22



**Photograph** – View looking south, Borehole 08-24



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** – View looking north, Borehole 08-25



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** – View looking north, Borehole 08-26

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 33+200 to 33+700  
 Depth: 12 m

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Sand/Silt Till	20	32	1
Sand/Silt Till	21	35	1

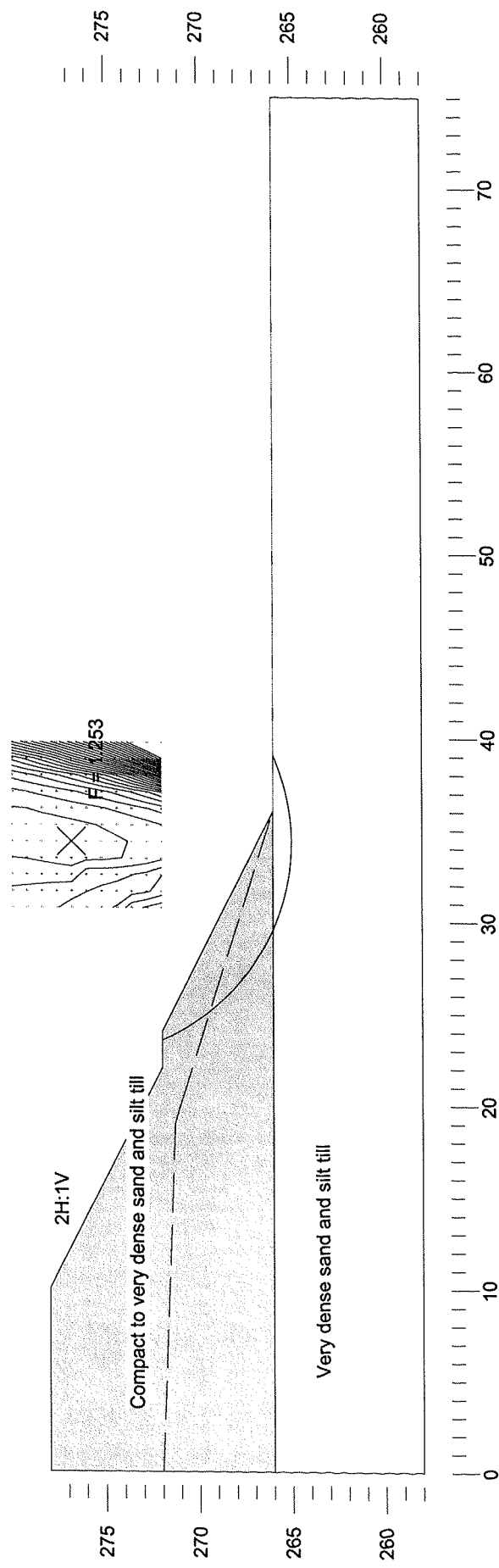


FIGURE 1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 33+200 to 33+700  
 Depth: 12 m - Seismic

	Gamma C	Phi	Piezo
	kN/m <sup>3</sup>	deg	Surf.
Sand/Silt Till	20	32	1
Sand/Silt Till	21	35	1

Seismic coefficient = 0.08

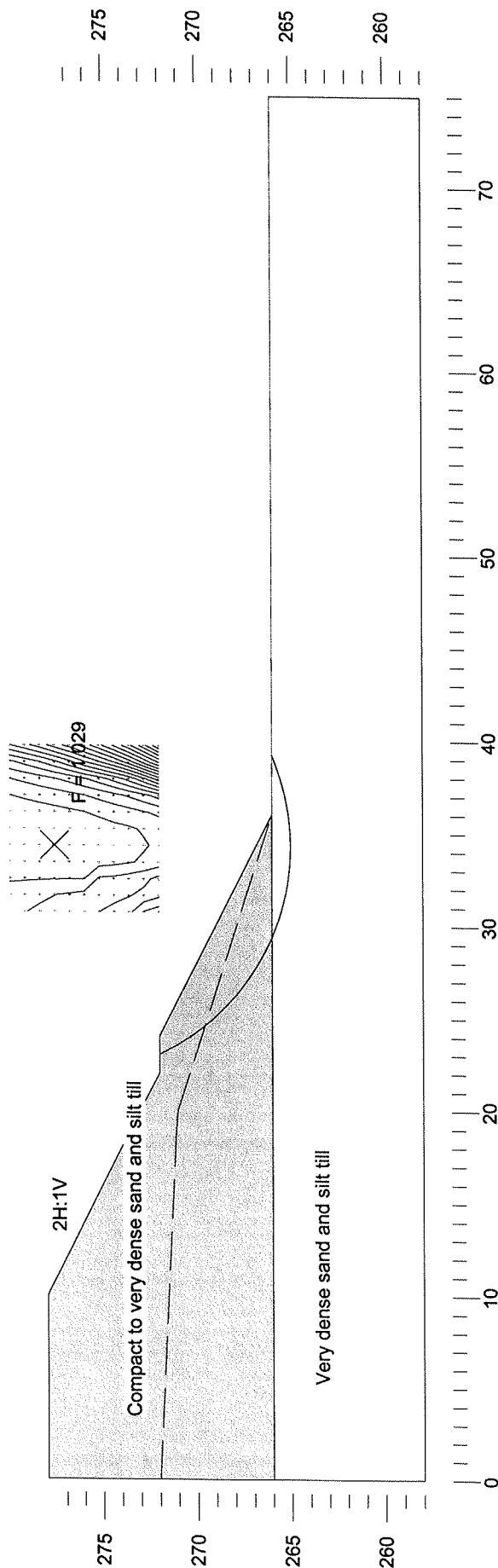
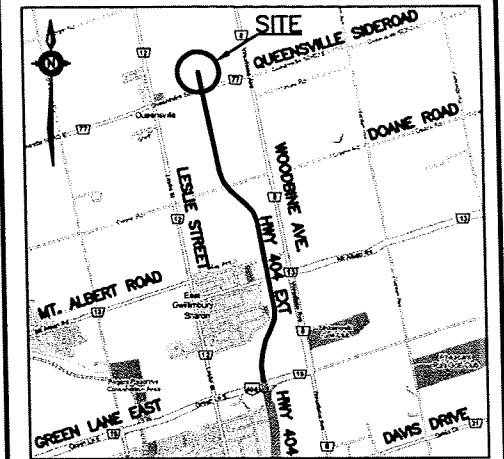







FIGURE 2





KEYPLAN  
LEGEND

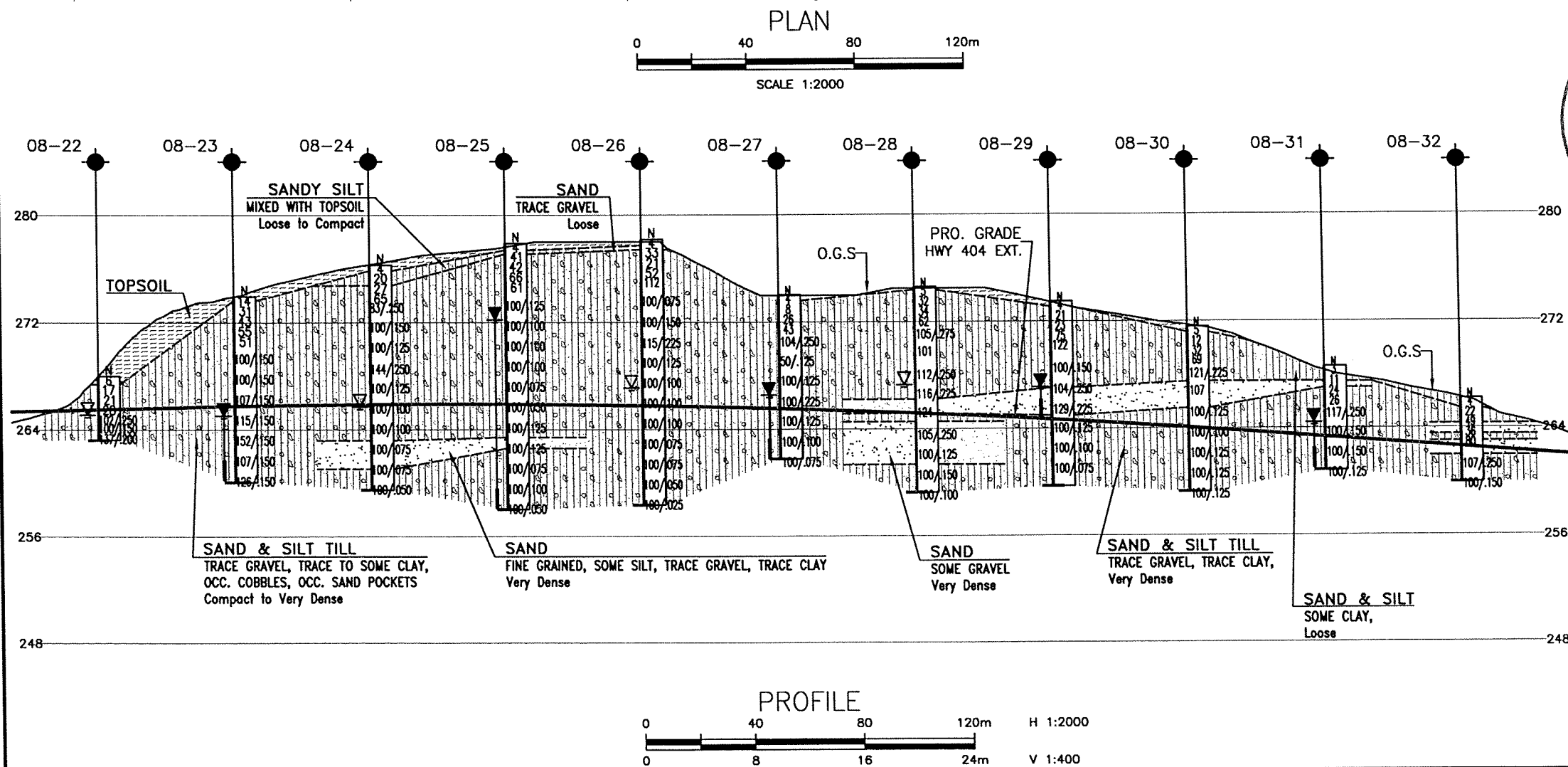
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic                   |
|  | Water Level                           |
|  | Head Artesian Water                   |
|  | Piezometer                            |
| 90%   | Rock Quality Designation (RQD)        |
| A/R   | Auger Refusal                         |

NO	ELEVATION	NORTHING	EASTING
08-22	268.0	4 889 288.2	309 746.9
08-23	273.9	4 889 337.4	309 737.8
08-24	276.3	4 889 386.5	309 728.6
08-25	277.9	4 889 435.7	309 719.4
08-26	278.2	4 889 484.8	309 710.3
08-27	273.8	4 889 534.0	309 701.1
08-28	274.6	4 889 583.1	309 692.0
08-29	273.5	4 889 632.3	309 682.8
08-30	271.6	4 889 681.4	309 673.7
08-31	286.6	4 889 730.6	309 664.5
08-32	266.2	4 889 779.6	309 655.4

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 31D-492**



REVISIONS							
	DATE	BY	DESCRIPTION				
DESIGN	RPR	CHK	PKC	CODE	LOAD	DATE MAR. 2010	
DRAWN	MFA	CHK	AEF	SITE	STRUCT	DWG	

## **Appendix E**

**High Fill and Deep Cut - Queensville Sideroad, Station 9+550 – 10+300  
(Boreholes 08-61, 08-33 to 08-38, 08-38A, 08-33A, 08-39 to 08-47, QSR4-1 to  
QSR4-5 and 301 to 303)**

**Record of Borehole Sheets**

**Laboratory Test Results**

**Site Photographs**

**Slope Stability Output**

**Drawing titled “Borehole Locations and Soil Strata”**

# RECORD OF BOREHOLE No 08-61

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 888 955.8 E 309 342.6

ORIGINATED BY GA

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY WM

DATUM Geodetic

DATE 2008.07.15 - 2008.07.15

CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 × LAB VANE					
284.9							20 40 60 80 100						
0.0	TOPSOIL: (200mm)												
0.2	SAND, some gravel, trace silt, trace clay Loose to Compact Brown Moist		1	SS	10								
			2	SS	20								
283.4													
1.5	SAND and SILT, trace gravel, trace to some clay Very Dense Brown Moist (TILL)		3	SS	50/ .150								
			4	SS	111								
	Fine grained sand layer		5	SS	102/ .150								
			6	SS	132								
			7	SS	107								
			8	SS	103/ .150								

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-61

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 888 955.8 E 309 342.6 ORIGINATED BY GA  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.07.15 - 2008.07.15 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 X LAB VANE 20 40 60 80 100 40 80 120 160 200							WATER CONTENT (%) W P W W L 20 40 60																																																
Continued From Previous Page																																																															
	SILT, trace sand, some clay, occasional iron oxide staining Very Dense Brown to grey Moist (TILL)		10	SS	111/ .150		274								0 2 80 18																																																
			11	SS	114/ .150		273																																																								
			12	SS	126/ .150		272																																																								
			13	SS	50/ .075		271																																																								
269.6							270																																																								
15.3	END OF BOREHOLE AT 15.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH(m)</th> <th>ELEV.(m)</th> </tr> </thead> <tbody> <tr><td>2008.07.16</td><td>9.6</td><td>275.3</td></tr> <tr><td>2008.07.29</td><td>9.6</td><td>275.3</td></tr> <tr><td>2008.09.17</td><td>7.9</td><td>277.0</td></tr> <tr><td>2008.10.24</td><td>10.1</td><td>274.8</td></tr> <tr><td>2008.11.28</td><td>11.0</td><td>273.9</td></tr> <tr><td>2009.02.06</td><td>7.6</td><td>277.3</td></tr> <tr><td>2009.02.20</td><td>7.2</td><td>277.7</td></tr> <tr><td>2009.03.20</td><td>8.0</td><td>276.9</td></tr> <tr><td>2009.04.22</td><td>7.6</td><td>277.3</td></tr> <tr><td>2009.05.15</td><td>8.2</td><td>276.7</td></tr> <tr><td>2009.06.05</td><td>8.9</td><td>276.0</td></tr> <tr><td>2009.07.10</td><td>8.7</td><td>276.2</td></tr> <tr><td>2009.07.16</td><td>9.6</td><td>275.3</td></tr> <tr><td>2009.07.29</td><td>9.6</td><td>275.3</td></tr> <tr><td>2009.09.02</td><td>9.0</td><td>275.9</td></tr> <tr><td>2009.09.21</td><td>9.2</td><td>275.7</td></tr> </tbody> </table>	DATE	DEPTH(m)	ELEV.(m)	2008.07.16	9.6	275.3	2008.07.29	9.6	275.3	2008.09.17	7.9	277.0	2008.10.24	10.1	274.8	2008.11.28	11.0	273.9	2009.02.06	7.6	277.3	2009.02.20	7.2	277.7	2009.03.20	8.0	276.9	2009.04.22	7.6	277.3	2009.05.15	8.2	276.7	2009.06.05	8.9	276.0	2009.07.10	8.7	276.2	2009.07.16	9.6	275.3	2009.07.29	9.6	275.3	2009.09.02	9.0	275.9	2009.09.21	9.2	275.7											
DATE	DEPTH(m)	ELEV.(m)																																																													
2008.07.16	9.6	275.3																																																													
2008.07.29	9.6	275.3																																																													
2008.09.17	7.9	277.0																																																													
2008.10.24	10.1	274.8																																																													
2008.11.28	11.0	273.9																																																													
2009.02.06	7.6	277.3																																																													
2009.02.20	7.2	277.7																																																													
2009.03.20	8.0	276.9																																																													
2009.04.22	7.6	277.3																																																													
2009.05.15	8.2	276.7																																																													
2009.06.05	8.9	276.0																																																													
2009.07.10	8.7	276.2																																																													
2009.07.16	9.6	275.3																																																													
2009.07.29	9.6	275.3																																																													
2009.09.02	9.0	275.9																																																													
2009.09.21	9.2	275.7																																																													

ONTMT4S 0596.GPJ 10/20/09

# RECORD OF BOREHOLE No 08-33

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 888 970.79 E 309 452.49, Station 9+650, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.26 - 2008.03.26 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE						PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)
284.0								20	40	60	80	100		
0.0	ASPHALT: (175mm)						284							
0.2	SAND and GRAVEL, some silt Brown Moist (FILL)													
283.1														
0.9	Silty SAND, trace gravel, trace clay Dense Brown Moist (FILL)		1	SS	46		283							
282.5														
1.5	SAND and SILT, fine grained, trace gravel, trace clay Dense to Very Dense Brown Moist (TILL)		2	SS	33		282							1 55 35 9
			3	SS	45		281							
			4	SS	175		280							
	Auger grinding from 3.3m to 3.6m													
279.2			5	SS	100/									0 44 48 8
4.8	END OF BOREHOLE AT 4.8m. BOREHOLE OPEN TO 4.8m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.				0.150									

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-33A

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 888 987.30 E 309 440.20, Station 9+650

ORIGINATED BY GA

HWY 404

BOREHOLE TYPE Solid Stem Augers

COMPILED BY WM

DATUM Geodetic

DATE 2008.07.14 - 2008.07.14

CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 × LAB VANE							
286.2							20 40 60 80 100								
0.0	TOPSOIL: (150mm)														
0.2	SAND and SILT, trace gravel, trace to some clay Loose to Very Dense Brown Moist (TILL)		1	SS	8										
			2	SS	45										
			3	SS	58										
			4	SS	92										
			5	SS	152										
282.1	SILT, some sand, some clay, trace gravel Very Dense Brown Moist to Wet (TILL)		6	SS	135/ .150										
4.1			7	SS	126/ .150										
			8	SS	100/ .150										
			9	SS	124/ .150										

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-33A

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 888 987.30 E 309 440.20, Station 9+650 ORIGINATED BY GA  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.07.14 - 2008.07.14 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
	SILT, some clay, trace sand Very Dense Brown Moist to Wet (TILL)		10	SS	113/ .150		276							0 9 74 17
							275							
				11	SS	114/ .150		274						
							273							
				12	SS	121/ .150		272						
270.9			13	SS	100/ .100		271							
15.3	END OF BOREHOLE AT 15.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH(m)      ELEV.(m) 2008.07.16      8.6      277.6 2008.07.29      7.6      278.6 2008.09.17      5.8      280.4 2008.10.24      8.7      277.5 2008.11.28      9.0      277.2 2009.02.06      5.4      280.8 2009.02.20      5.1      281.1 2009.03.20      0.2*      286.4 2009.04.22      4.8      281.4 2009.05.15      5.3      280.9 2009.06.05      6.0      280.2 2009.07.10      5.8      280.4 2009.07.16      8.5      277.7 2009.07.29      7.6      278.6 2009.09.02      6.9      279.3 2009.09.21      7.2      279.0 * (above ground surface)													

ONTMT4S 0596.GPJ 9/24/09

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-34

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 888 985.68 E 309 500.23, Station 9+700, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.25 - 2008.03.25 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
281.3								20 40 60 80 100						
0.0	ASPHALT: (125mm)													
0.1	SAND and GRAVEL, trace silt Brown Moist (FILL)						281							
280.6														
0.8	Silty SAND, trace to some gravel Compact Brown Moist (FILL)		1	SS	27		280							
279.8														
1.5	SAND and SILT, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		2	SS	36		279							2 47 41 10
			3	SS	82									
			4	SS	120		278							
							277							
			5	SS	100/ 150									1 33 53 13
							276							
275.0			6	SS	100/ 125									
6.4	END OF BOREHOLE AT 6.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.04.18 2.3 279.0 2008.04.21 2.2 279.1 2008.06.30 2.0 279.3 2008.07.29 1.6 279.7 2008.09.17 1.4 279.9 2008.11.28 1.7 279.6 2009.07.29 1.6 279.7 2009.09.21 3.7 277.6													

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity 20 15 10 (% STRAIN AT FAILURE

**METRIC**

ORIGINATED BY ES

COMPILED BY WM

CHECKED BY            AEG

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

### METRIC

ORIGINATED BY ES

COMPILED BY WM

CHECKED BY AEG

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-37

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 027.35 E 309 633.88, Station 9+840, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.24 - 2008.03.24 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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	× LAB VANE			W <sub>p</sub>	W	W <sub>L</sub>
270.1							20	40	60	80	100					
0.0	ASPHALT: (125mm)															
0.1	SAND and GRAVEL, trace silt Brown Moist (FILL)															
269.4																
0.8	Silty SAND, trace clay, trace gravel Dense Brown Moist (FILL)		1	SS	34											
268.6																
1.5	SAND and SILT, trace gravel, trace to some clay Dense to Very Dense Brown Moist (TILL) Cobbles at 1.9m Auger grinding at 2.1m to 2.3m		2	SS	92											
			3	SS	38										2 44 45 9	
			4	SS	100/ .075										2 31 56 11	
			5	SS	100/ .125											
			6	SS	100/ .100										1 32 55 12	
			7	SS	100/ .125											
			8	SS	100/ .125											
260.9																
9.2	END OF BOREHOLE AT 9.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLE PLUG TO SURFACE.															

ONTMT4S 0596.GPJ 9/24/09

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE





# RECORD OF BOREHOLE No 08-38

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 039.26 E 309 672.07, Station 9+880, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.24 - 2008.03.24 CHECKED BY AEG

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					WATER CONTENT (%)			
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					W P W W L 20 40 60					
	Continued From Previous Page															
256.1	SAND and SILT, some clay, trace gravel Very Dense Brown Moist (TILL)		9	SS	100/											1 29 57 13
10.8	END OF BOREHOLE AT 10.8m. BOREHOLE OPEN TO 10.4m AND WATER LEVEL AT 6.2m ON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.				.100											

ONTMT4S 0596.GPJ 9/24/09

# RECORD OF BOREHOLE No 08-38A

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 109.70 E 309 883.40, Station 10+100, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.26 - 2008.03.26 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
257.3							20 40 60 80 100	○ UNCONFINED + FIELD VANE	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	ASPHALT: (200mm)							● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)			
0.2	SAND, some gravel, trace silt Dark Brown Moist (FILL)						40 80 120 160 200		20 40 60			
256.4												
0.9	Silty CLAY, trace sand, trace gravel, occasional oxide lenses Firm Brown (FILL)		1	SS	6							
			2	SS	6							
255.0												
2.3	Clayey SILT, trace to some sand, trace gravel Very Stiff to Hard Brown (TILL)		3	SS	26							
			4	SS	36							
			5	SS	20							
251.7												
5.6	Sandy SILT, some clay, trace gravel Compact Grey Wet Auger grinding at 5.9m to 6.1m		6	SS	17							
250.2												
7.1	Clayey SILT, sandy, trace gravel Very Stiff Grey (TILL)		7	SS	25							
			8	SS	27							

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-38A

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 109.70 E 309 883.40, Station 10+100, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.26 - 2008.03.26 CHECKED BY AEG

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE					
	Continued From Previous Page						20	40	60	80	100					
	Clayey SILT, sandy, trace gravel Very Stiff to Stiff Grey (TILL)		9	SS	12											
			10	SS	17											
	Becoming Hard		11	SS	32											
243.1																0 31 53 16
14.2	END OF BOREHOLE AT 14.2m. BOREHOLE OPEN TO 3.1m AND WATER LEVEL AT 0.8m ON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.															

+<sup>3</sup> . X<sup>3</sup> : Numbers refer to  
Sensitivity

20  
15 5  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-39

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 119.64 E 309 929.82, Station 10+150, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.27 - 2008.03.27 CHECKED BY AEG

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	UNCONFINED	FIELD VANE					
259.0	0.0	ASPHALT: (200mm)					259								
0.2		SAND, some gravel, trace to some silt Dark Brown Moist (FILL)													
257.9	1.0	SILT, some clay, trace sand, trace gravel Compact Brown Moist (FILL)	1	SS	17		258								
			2	SS	15										
256.7	2.3	Clayey SILT, some sand to sandy, trace gravel, occasional oxide lenses Very Stiff to Hard Brown (TILL)	3	SS	23		257								
			4	SS	26		256								
							255								
			5	SS	20		254								
							253								
			6	SS	25		252								
251.9	7.0	SAND and SILT, some clay, trace gravel Compact to Very Dense Grey Moist (TILL)	7	SS	36		251								
							250								
			8	SS	100/ .125										

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-39

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 119.64 E 309 929.82, Station 10+150, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.27 - 2008.03.27 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL) Layer of very loose silty sand (1.0m)		9	SS	2			○ UNCONFINED + FIELD VANE					1 69 24 6	
								● QUICK TRIAXIAL x LAB VANE						
								WATER CONTENT (%)						
				10	SS	100/ .125			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
									W <sub>P</sub> W W <sub>L</sub>					
245.0			11	SS	100/ .100									
14.0	END OF BOREHOLE AT 14.1m. WATER LEVEL AT 3.2m ON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.04.18 2.0 257.0 2008.04.21 1.9 257.1 2008.06.30 2.8 256.2 2009.09.21 0.9 258.1													

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-40

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 134.53 E 309 977.56, Station 10+200, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.20 - 2008.03.20 CHECKED BY AEG

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 X LAB VANE								
261.3								20	40	60	80	100				
0.0	ASPHALT: (125mm)															
0.1	SAND and GRAVEL, trace to some silt Brown Moist (FILL)						261									
260.4																
0.9	SILT, some clay, trace to some sand, trace gravel Loose to Compact Brown Moist (FILL)		1	SS	20		260									
			2	SS	8											
258.7			3	SS	9		259									
2.6	SAND, some gravel, trace silt Loose Brown Moist (FILL)															
258.3			4	SS	26		258									2 37 51 10
3.0	Clayey SILT, sandy, trace gravel Very Stiff to Hard Grey (TILL)															
			5	SS	23		257									
			6	SS	27		256									
			7	SS	100/		255									1 29 54 16
					.075		254									
252.9							253									
8.4	SAND and SILT, trace clay, trace gravel Very Dense Grey Moist (TILL)		8	SS	100/		252									
					.075											

Continued Next Page

+<sup>3</sup> . X<sup>3</sup> : Numbers refer to  
Sensitivity 20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-40

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 134.53 E 309 977.56, Station 10+200, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.20 - 2008.03.20 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
	Continued From Previous Page													
	SAND and SILT, trace clay, trace gravel Very Dense Grey Moist (TILL)													
			9	SS	100/ .050									
248.8			10	SS	100/ .125									
12.5	END OF BOREHOLE AT 12.5m. BOREHOLE OPEN TO 11.3m AND WATER LEVEL AT 3.2m ON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m, THEN ASPHALT TO SURFACE.													



# RECORD OF BOREHOLE No 08-41

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 149.41 E 310 025.29, Station 10+250, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.27 - 2008.03.27 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
263.7								20 40 60 80 100					
0.0	ASPHALT: (150mm)							○ UNCONFINED + FIELD VANE					
0.2	Gravelly SAND, trace silt Dark Brown Moist (FILL)							● QUICK TRIAXIAL x LAB VANE					
262.9								40 80 120 160 200					
0.8	Clayey SILT, some sand, trace gravel Stiff to Very Stiff Brown (FILL)		1	SS	16		263						29 67 4 (SI+CL)
			2	SS	9		262						
261.4							261						1 24 56 19
2.3	Clayey SILT, sandy, trace gravel, occasional oxide staining Very Stiff Brown (TILL)		3	SS	20		260						
			4	SS	29		259						
259.7							258						
4.0	SAND and SILT, trace gravel, trace clay, occasional oxide staining Very Dense Brown Moist (TILL)		5	SS	100/ .150		257						1 41 50 8
			6	SS	100/ .125								
255.9			7	SS	100/ .150		256						
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE OPEN AND WATER LEVEL AT 5.3m ON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.04.18 3.3 260.40 2008.04.21 3.2 260.50 2008.06.30 2.1 261.60 2009.09.21 2.8 260.90												

+<sup>3</sup> x<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-42

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 164.30 E 310 073.02, Station 10+300, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.18 - 2008.03.18 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 (%)						
264.4							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
0.0	ASPHALT (125mm)						○ UNCONFINED + FIELD VANE	W <sub>P</sub>	W	W <sub>L</sub>				
0.1	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)						● QUICK TRIAXIAL x LAB VANE							
263.4			1	SS	29		40 80 120 160 200					12 68 20 (SI+CL)		
1.1	Clayey SILT, sandy, trace gravel, trace rootlets, occasional black staining Stiff to Very Stiff Brown		2	SS	13							0 32 52 16		
			3	SS	8									
			4	SS	10									
	Auger grinding on possible cobble at 3.56 to 3.66m													
260.3														
4.1	SAND and SILT, trace clay Very Dense Brown Moist (TILL)		5	SS	141/ .300							0 47 45 8		
258.2			6	SS	100/ .125									
6.2	END OF BOREHOLE AT 6.2m BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.													

+<sup>3</sup> . X<sup>3</sup>: Numbers refer to  
Sensitivity



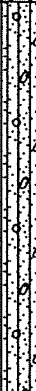
20  
15 5  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-43

1 OF 1

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 051.2 E 309 710.3, Station 9+920, Left Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.28 - 2008.03.28 CHECKED BY AEG

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    x LAB VANE								
263.9								20	40	60	80	100				
0.0	ASPHALT: (200mm)															
0.2	SAND, some gravel, trace to some silt															
263.1	Dark Brown															
0.8	Moist (FILL)															
	Silty SAND, some gravel, trace clay		1	SS	41		263									
	Dense to Compact															
	Brown															
	Moist (FILL)	2	SS	16		262										
261.8																
2.1	SAND and SILT, trace gravel, trace clay															
	Compact to Very Dense															
	Brown		3	SS	24		261									
	Moist (TILL)															
			4	SS	37		260									
259.2																
4.7	END OF BOREHOLE AT 4.7m. BOREHOLE OPEN AND WATER LEVEL AT 4.1m ON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.		5	SS	100/ .125											

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-44

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 053.5 E 309 751.4, Station 9+960, 10m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.28 - 2008.04.02 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20	40	60	80			100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w
						○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      x LAB VANE				WATER CONTENT (%) 20      40      60						
259.1																
0.0	Clayey <b>SILT</b> , mixed with topsoil, trace sand, trace rootlets Soft Dark Brown (FILL)		1	SS	2		259									
258.6																
0.5																
	Silty <b>SAND</b> , trace clay, trace gravel, occasional oxides staining Compact Brown Moist (FILL)		2	SS	15		258									
256.9			3	SS	13											
	<b>SAND</b> , trace silt, trace gravel Dense Brown Moist		4	SS	34		257									
2.2																
256.0																
3.0	<b>SAND and SILT</b> , trace clay, trace gravel Dense Brown Moist (TILL)		5	SS	33		256									
					6	SS	41		255							
	Very Dense Grey		7	SS	31		254									
			8	SS	57		253									
													</			

Continued Next Page

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

ORIGINATED BY ES

COMPILED BY WM

CHECKED BY AEG

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-45

1 OF 3

METRIC

G.W.P. 2109-05-00

LOCATION N 4 889 070.2 E 309 788.1, Station 10+000, 5m Rt

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY WM

DATUM Geodetic

DATE 2008.04.03 - 2008.04.03

CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w		
258.3							SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE			WATER CONTENT (%) 20 40 60		
0.0	ASPHALT: (125mm)						40 80 120 160 200					GR SA SI CL
0.1	SAND, some gravel, trace to some silt Dark Brown to Brown Compact Moist (FILL)		1	SS	25							
	fine grained Loose		2	SS	6							
255.8			3	SS	9							
2.4	SAND and SILT, some clay, occasional oxide staining Loose Brown (TILL)		4	SS	9							0 41 46 13
	Compact Grey		5	SS	16							
			6	SS	21							
			7	SS	58							0 33 52 15
249.6			8	SS	100/ .100							16 62 22 (SI+CL)
8.7	Gravelly SAND, medium to coarse grained, trace silt, trace clay Very Dense Grey Wet											

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+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15-5  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-45

2 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 070.2 E 309 788.1, Station 10+000, 5m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.04.03 - 2008.04.03 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
	Continued From Previous Page							20 40 60 80 100					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
								WATER CONTENT (%)					
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
								w <sub>p</sub> w w <sub>L</sub>					
								20 40 60					
247.3	Gravelly SAND, medium to coarse grained, trace silt, trace clay Dense Grey Wet		9	SS	49		248						22 71 7
11.0	SAND and SILT, trace gravel, trace to some clay Compact to Very Dense Grey Moist (TILL)												(SI+CL)
							247						
			10	SS	30		246						
							245						
			11	SS	61		244						
							243						0 29 54 17
			12	SS	22		242						
							241						
			13	SS	14		240						
							239						
	occasional cobbles Very Dense		14	SS	84								
			15	SS	100/								2 47 39 12

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+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15-5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-45

3 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 070.2 E 309 788.1, Station 10+000, 5m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.04.03 - 2008.04.03 CHECKED BY AEG

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>				
	Continued From Previous Page				.125												
	SAND and SILT, some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)																
236.9																	
21.4	END OF BOREHOLE AT 21.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		16	SS	100												
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.04.18 2.4 255.9 2008.04.21 2.4 255.9 2009.09.21 0.1 258.2				.125												

ONTMT4S 0596.GPJ 10/5/09



# RECORD OF BOREHOLE No 08-46

1 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 096.4 E 309 821.8, Station 10+060, 10m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.17 - 2008.03.18 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)							
								20 40 60 80 100														
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE														
256.7	SAND, medium to coarse grained, some gravel, some silt, trace rootlets Loose to Compact Dark Brown Moist (FILL)		1	SS	5																	
			2	SS	19																	
254.7			3	SS	6																	
2.0	Silty SAND, some gravel, occasional wood fibres Loose Brown Moist (FILL)		4	SS	7																	
253.8																						
2.9	SAND and SILT, some clay, trace gravel, occasional oxide staining Compact Brown to Grey Moist (TILL)		5	SS	10																	
					6	SS	22															
	Dense to Very Dense		7	SS	120																	
249.5	Clayey SILT, sandy Hard Grey (TILL)		8	SS	77																	
7.2																						
			9	SS	45																	

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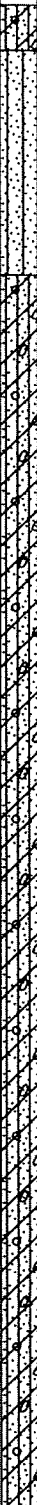
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-46

2 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 096.4 E 309 821.8, Station 10+060, 10m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.17 - 2008.03.18 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-46

3 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 096.4 E 309 821.8, Station 10+060, 10m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.17 - 2008.03.18 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)									
											W <sub>P</sub>	W	W <sub>L</sub>							
											40	80	120	160	200	20	40	60		
	Continued From Previous Page																			
	Clayey SILT, sandy, trace gravel Hard Grey (TILL)		16	SS	35															
233.6			17	SS	149/															
23.1	END OF BOREHOLE AT 23.1m. BOREHOLE OPEN TO 5.2m AND WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.				.275															

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

**METRIC**

CHECKED BY AEG

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

**METRIC**

CHECKED BY AEG

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 08-47

3 OF 3

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 092.8 E 309 843.9, Station 10+040, Right Shoulder ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.11 - 2008.03.12 CHECKED BY AEG

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
	Continued From Previous Page													
235.6	Clayey SILT, trace to some sand Hard Grey (TILL)		16	SS	36									0 11 70 19
21.8	SILT, trace sand, trace gravel, trace clay Very Dense Grey Moist (TILL)													
			17	SS	100/ .100									
			18	SS	100/ .100									0 2 92 6
			19	SS	100/ .140									
229.7			20	SS	100/ .100									
27.7	END OF BOREHOLE AT 27.7m. BOREHOLE OPEN AND WATER LEVEL AT 2.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.2m THEN ASPHALT TO SURFACE.													

ONTMT4S 0596.GPJ 9/24/09

# RECORD OF BOREHOLE No QSR4-1

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 148.9 E 309 855.8, Station 10+088, 50m Lt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.07 - 2008.03.07 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								20 40 60 80 100		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
253.7															
0.0	Silty CLAY, trace sand, trace gravel, trace organics and topsoil Firm Dark Brown (FILL)		1	SS	4		253								
			2	SS	5										
252.2															
1.5	SAND and SILT, some clay to clayey, trace gravel, occasional oxide staining Loose to Dense Brown Moist (TILL)		3	SS	8		252								
			4	SS	16		251							1 25 54 20	
			5	SS	42		250								
	Grey		6	SS	34		249								
							248								
			7	SS	25		247							1 40 44 15	
	Wet		8	SS	24		246								
							245								
	Very Dense Moist		9	SS	73		244								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10


(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-1

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 148.9 E 309 855.8, Station 10+088, 50m Lt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.07 - 2008.03.07 CHECKED BY AEG

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											
								20	40	60	80	100						WATER CONTENT (%) 20 40 60	
Continued From Previous Page																			
	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	100/ .150		243											1 22 60 17	
240.9				11	SS	82													
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 12.8m AND WATER LEVEL AT 1.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																		

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



## METRIC

CHECKED BY AEG

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-2

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 123.9 E 309 859.4, Station 10+084, 25m Lt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.07 - 2008.03.07 CHECKED BY AEG

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	x	LAB VANE							
								20	40	60	80	100					

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-3

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 098.8 E 309 863.0, Station 10+080, centreline ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.17 - 2008.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
257.2														
0.0	ASPHALT: (150mm)													
0.2	Gravelly SAND Dense Dark Brown Dry (FILL)		1	SS	46		257							
256.1			2	SS	19		256							
1.1	Sandy SILT, some clay, trace gravel Very Loose to Compact Brown Wet (FILL)		3a	SS	2		255							
255.3			3b	SS			255							
1.8	Silty CLAY, some sand, trace gravel, some organics and topsoil Soft to Firm Brown (FILL)		4	SS	4		254							
	occasional wood fibres		5	SS	6		253							
253.0			6	SS	11		252							
4.1	SAND and SILT, some clay to clayey, trace gravel, occasional oxide staining Compact Grey Moist (TILL)		7	SS	19		251							1 23 55 21
	Very Dense		8	SS	74		250							7 48 35 10
			9	SS	84		249							
							248							

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-3

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 098.8 E 309 863.0, Station 10+080, centreline ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.03.17 - 2008.03.17 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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			20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
245.9	SAND and SILT, some clay, trace gravel Dense Grey (TILL)		10	SS	38		247									1 33 48 18	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 6.7m AND WATER LEVEL AT 1.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.2m THEN ASPHALT TO SURFACE.						246										

ONTMT4S 0596.GPJ 10/5/09

# RECORD OF BOREHOLE No QSR4-4

1 OF 2

METRIC

G.W.P. 2109-05-00

LOCATION N 4 889 074.3 E 309 868.5, Station 10+078, 25m Rt

ORIGINATED BY ES

HWY 404

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY WM

DATUM Geodetic

DATE 2008.02.25 - 2008.02.25

CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	40 80 120 160 200	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)	20 40 60		
255.4	Silty CLAY, mixed with topsoil, trace sand, occasional rootlets Very soft to firm Brown Moist (FILL)  occasional wood fibres		1	SS	1									
			2	SS	4									
			3	SS	4									
253.3	SAND and SILT, some clay, trace gravel Compact to Dense Grey Moist (TILL)		4	SS	32									
			5	SS	15									
			6	SS	18									
			7	SS	37									
			8	SS	26									
			9	SS	14									

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-4

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 074.3 E 309 868.5, Station 10+078, 25m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.02.25 - 2008.02.25 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 X LAB VANE						
	Continued From Previous Page						20 40 60 80 100							
							40 80 120 160 200							

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-5

1 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 049.6 E 309 873.1, Station 10+075, 50m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.02.25 - 2008.02.25 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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				
255.4	Clayey SILT, mixed with topsoil, trace sand, occasional rootlets Soft to Stiff Brown (FILL)		1	SS	2		20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0							255	○ UNCONFINED + FIELD VANE	W P W W L			
254.8								● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)			
0.6	Sandy SILT, some clay Loose to Compact Brown Moist (FILL)		2	SS	4		40 80 120 160 200	20 40 60				
							254					
			3	SS	8							
253.0	SAND and SILT, some clay to clayey, trace gravel, occasional oxide staining Compact Grey (TILL)		4	SS	20			253				
2.4												
			5	SS	11		252					
										0 20 58 22		
			6	SS	12		251					
										2 18 44 36		

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No QSR4-5

2 OF 2

METRIC

G.W.P. 2109-05-00 LOCATION N 4 889 049.6 E 309 873.1, Station 10+075, 50m Rt ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.02.25 - 2008.02.25 CHECKED BY AEG

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									
	Continued From Previous Page							20	40	60	80	100					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	x	LAB VANE							
								WATER CONTENT (%)									
								40	80	120	160	200		20	40	60	
244.7	SAND and SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		10	SS	1000		245										
10.7	END OF BOREHOLE AT 10.7m. BOREHOLE OPEN AND WATER LEVEL AT 0.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 1.2m THEN AUGER CUTTINGS TO SURFACE.				.075												

+<sup>3</sup> . x<sup>3</sup> : Numbers refer to  
Sensitivity 20  
15-5  
10 (%) STRAIN AT FAILURE



MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

Continued Next Page

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT 04-1111-016 RECORD OF BOREHOLE No BH 301A 1 OF 2 METRIC  
W.P. \_\_\_\_\_ LOCATION N 4889107.0 ; E 309821.9 ORIGINATED BY PKS  
DIST Central HWY 404 BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers COMPILED BY DD  
DATUM Geodetic DATE SEPTEMBER 27, 28, 2004 CHECKED BY LCC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w <sub>p</sub> — w — w <sub>L</sub>	WATER CONTENT (%) 10 20 30	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								
256.0	GROUND SURFACE												
0.0	Augered from 0.0 m to 12.2 m depth without sampling. Refer to Record of Borehole 301 for subsurface conditions over this interval.												
							255						
							254						
							253						
							252						
							251						
							250						
							249						
							248						
							247						
							246						
							245						
243.8							244						
12.2	Clayey Silt, some sand, trace gravel (TILL) Stiff to hard Grey Moist to wet		1	SS	32		243						
			2	SS	11		242						

MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

Continued Next Page

+<sup>3</sup> . X<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-016</u>		<b>RECORD OF BOREHOLE No BH 301A</b>		2 OF 2 <b>METRIC</b>	
W.P. _____		LOCATION <u>N 4889107.0 :E 309821.9</u>		ORIGINATED BY <u>PKS</u>	
DIST <u>Central</u> HWY <u>404</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>DD</u>	
DATUM <u>Geodetic</u>		DATE <u>SEPTEMBER 27, 28, 2004</u>		CHECKED BY <u>LCC</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 (%)							
								$\circ$ UNCONFINED $\bullet$ QUICK TRIAXIAL	$+$ FIELD VANE $\times$ REMOULDED	$w_p$	$w$	$w_L$					
	--- CONTINUED FROM PREVIOUS PAGE ---					20	40	60	80	100	10	20	30				
238.9	Clayey Silt, some sand, trace gravel (TILL) Stiff to hard Grey Moist to wet		3	SS	12												
17.1	Interlayered Clayey Silt, trace sand, and Silt, trace clay and sand, containing clay seams Hard/Very dense Grey Moist to wet		4	SS	59												
			5	SS	100												
			6	SS	121												
			7	SS	108												
		8	SS	100/18													

MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

PROJECT 04-1111-016

# RECORD OF BOREHOLE No BH 302

1 OF 2 METRIC

W.P.

LOCATION

N 4889084.1 ; E 309781.5

ORIGINATED BY PKS

DIST Central HWY 404

BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers

COMPILED BY DD

DATUM Geodetic

DATE

SEPTEMBER 28, 2004

CHECKED BY LCC

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 (%)				
259.0	GROUND SURFACE						20 40 60 80 100													
0.0	Topsoil		1	SS	6	258								3 21 43 33						
0.1	Silty sand (FILL) Loose Brown Moist																			
258.3	Clayey silt, some sand, trace gravel, trace asphalt fragments (FILL) Firm Dark brown Moist		2	SS	6															
0.7																				
257.5	Clayey Silt, some sand, trace gravel Stiff Mottled brown Moist	3	SS	10	257										3 21 43 33					
1.5																				
		4	SS	9																
256.0																				
3.0	Sand and Silt, trace gravel, trace clay, containing lenses/interlayers of sand and gravel (TILL) Compact to very dense Brown to grey Moist	5	SS	14			256										2 38 53 7			
		6	SS	23																
		7	SS	23																
		8	SS	32				255											2 38 53 7	
		9	SS	38		254												2 38 53 7		
		10	SS	39	253											2 38 53 7				
		11	SS	39			252										2 38 53 7			
		12	SS	74				251											2 38 53 7	
		13	SS	81	250										2 38 53 7					
												</								

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

MIS-MTO 001 041111018AAMTO.GPJ GAL-MISS.GDT 26/4/06

PROJECT <u>04-1111-016</u>		<b>RECORD OF BOREHOLE No BH 302</b>				2 OF 2 <b>METRIC</b>	
W.P. _____		LOCATION <u>N 4889084.1 ; E 309781.5</u>				ORIGINATED BY <u>PKS</u>	
DIST <u>Central</u> HWY <u>404</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>				COMPILED BY <u>DD</u>	
DATUM <u>Geodetic</u>		DATE <u>SEPTEMBER 28, 2004</u>				CHECKED BY <u>LCC</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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
	--- CONTINUED FROM PREVIOUS PAGE ---																			
	Sand and Silt, trace gravel, trace clay, containing lenses/interlayers of sand and gravel (TILL) Compact to very dense Brown to grey Moist	[Strat Plot]	14	SS	102												1 34 54 11			
			15	SS	100/23															
240.5																				
243																				
242																				
241																				
18.5	End of Borehole		16	SS	100/16															
	Note:  Water level in piezometer measured at 10.7 m depth (Elevation 248.3 m) on September 29, 2004.																			

MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

PROJECT 04-1111-016

# RECORD OF BOREHOLE No BH 303

1 OF 1 METRIC

W.P. \_\_\_\_\_

LOCATION N 4889071.0; E 309743.7

ORIGINATED BY PKS

DIST Central HWY 404

BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers

COMPILED BY DD

DATUM Geodetic

DATE SEPTEMBER 29, 2004

CHECKED BY LCC

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								10 20 30				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED												
261.0	GROUND SURFACE																			
0.0	Silty Sand, some organics (FILL) Very loose to loose Brown Moist		1	SS	4															
			2	SS	6															
259.5							260													
1.5	Clayey Silt, some sand, trace gravel, trace organics Stiff Brown		3	SS	11															
258.8	Moist						259													
2.2	Silty Sand, trace clay, trace gravel, trace organics Dense Brown		4	SS	33															
258.0	Moist						258													
3.0	Sand and Silt, trace clay, some gravel (TILL) Dense to very dense Brown, becoming grey below 9.1 m depth Moist to wet below 3.7 m depth		5	SS	36															
			6	SS	33		257													
			7	SS	40															
							256													
			8	SS	67															
							255													
							254													
			9	SS	100/23															
							253													
			10	SS	100/23															
							252													
							251													
			11	SS	100/13		250													
							249													
			12	SS	100/18															
							248													
247.1	End of Borehole		13	SS	100/15															
13.9																				
	Note: Water level at 9.1 m depth (Elevation 250.9 m) upon completion of drilling.																			

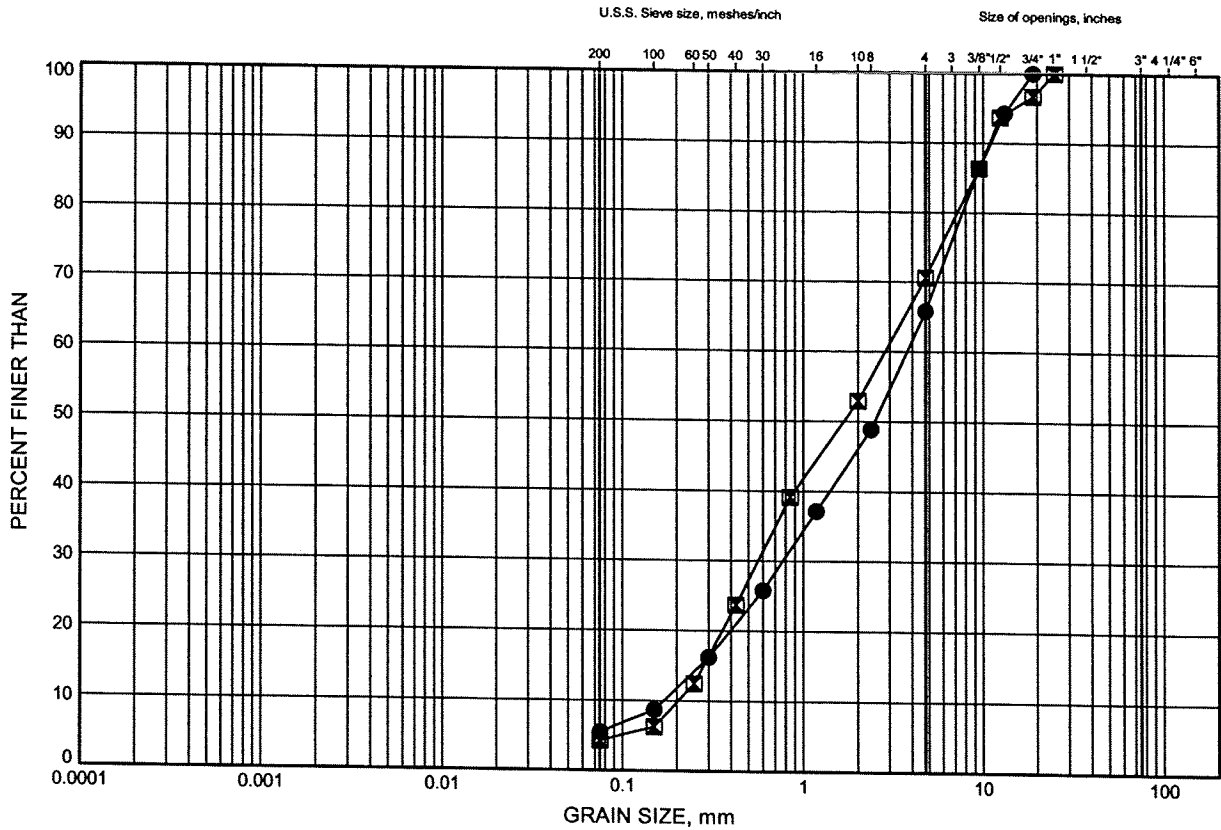
MIS-MTO 001 041111016AAMTO.GPJ GAL-MISS.GDT 26/4/06

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E1

## GRAVELLY SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-35	0.46	277.19
◻	08-41	0.46	263.24

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....

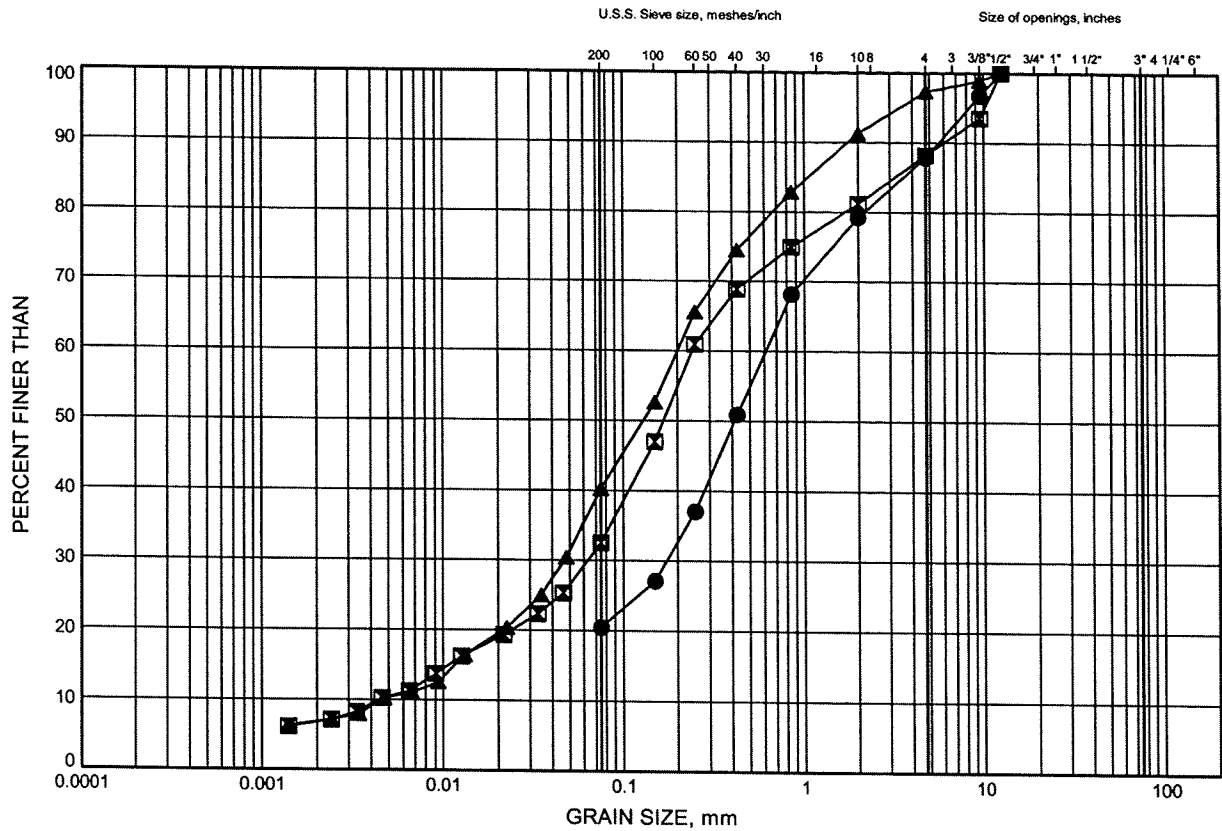




# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E2

## SILTY SAND FILL & SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-42	0.91	263.53
⊠	08-43	0.99	262.87
▲	08-47	2.82	254.56

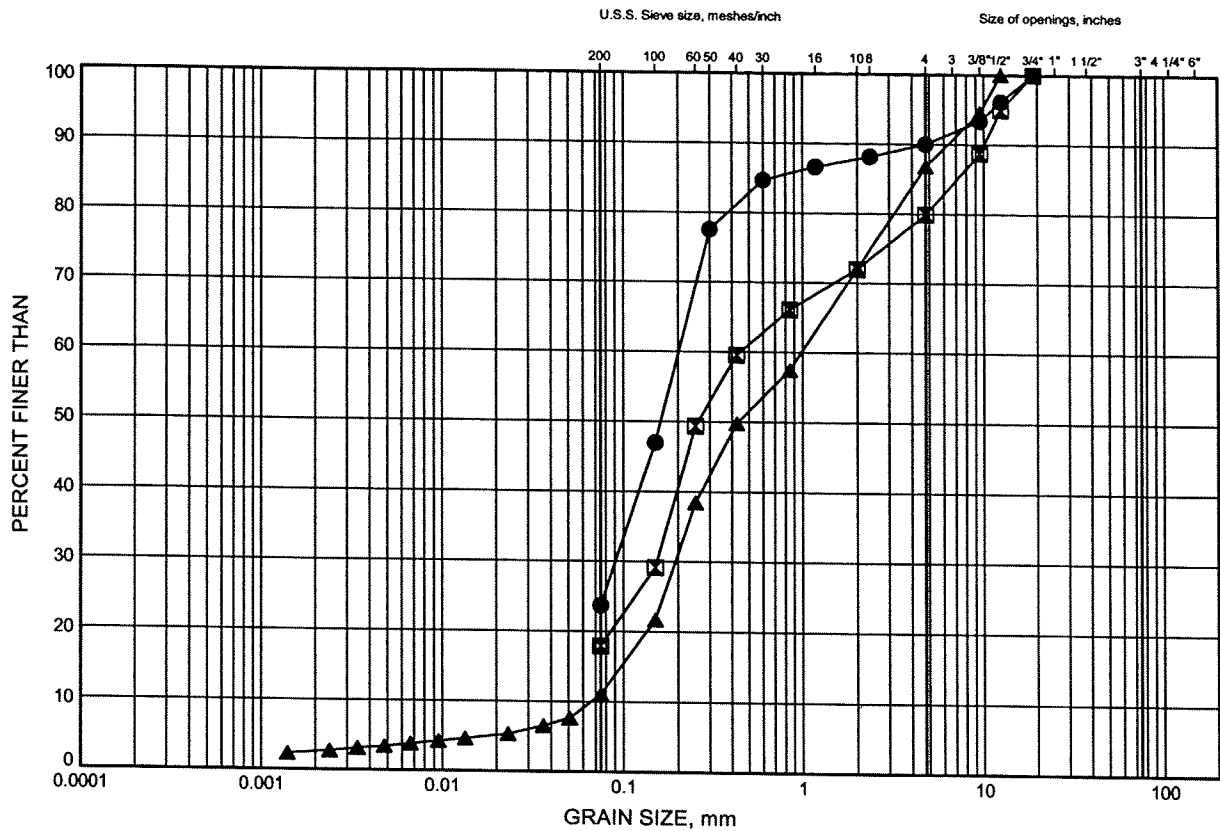


W.P.# 2109:05:00.....  
Prepared By AN.....  
Checked By RPR.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E3

## SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-36	1.75	271.73
◻	08-44	2.51	256.58
▲	08-61	1.07	283.83

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

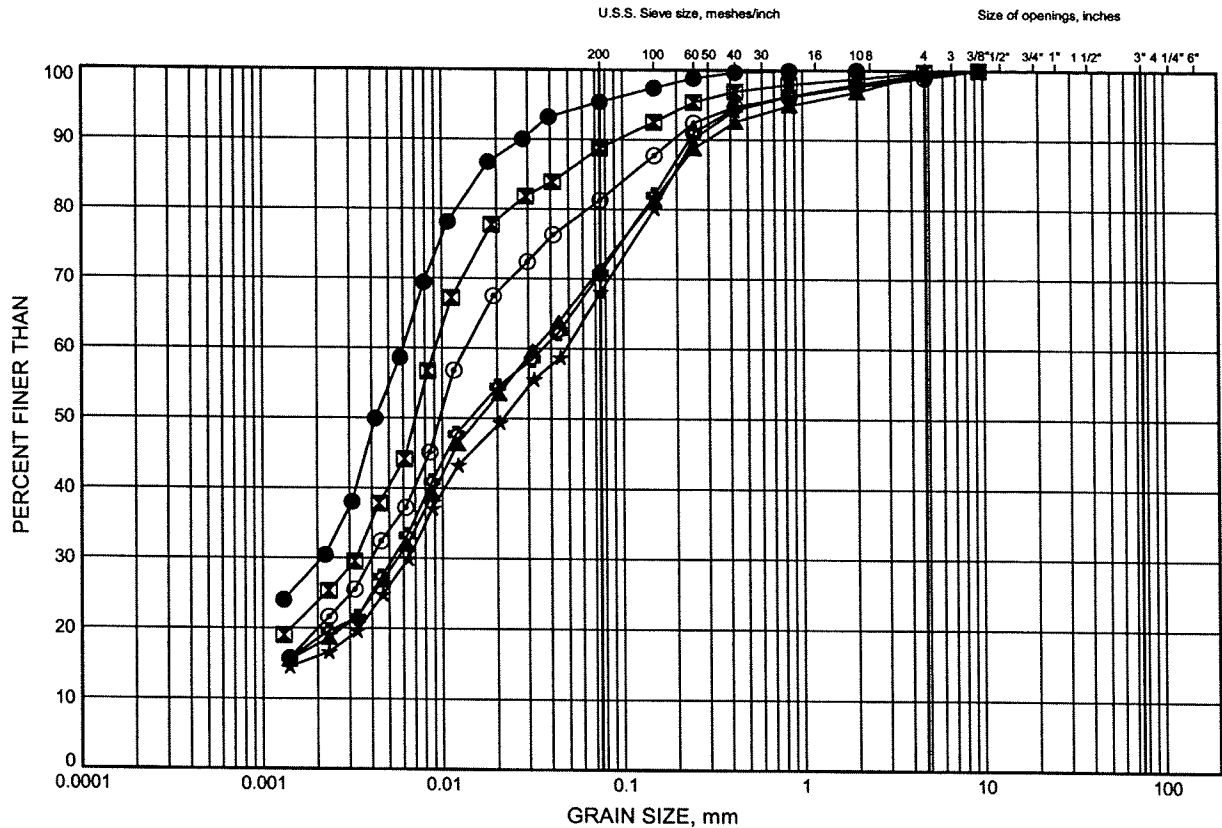
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E4

## CLAYEY SILT & CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-38A	2.51	254.79
⊠	08-38A	4.80	252.50
▲	08-38A	9.37	247.93
★	08-38A	13.94	243.36
⊙	08-39	2.51	256.44
⊕	08-39	6.32	252.63

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

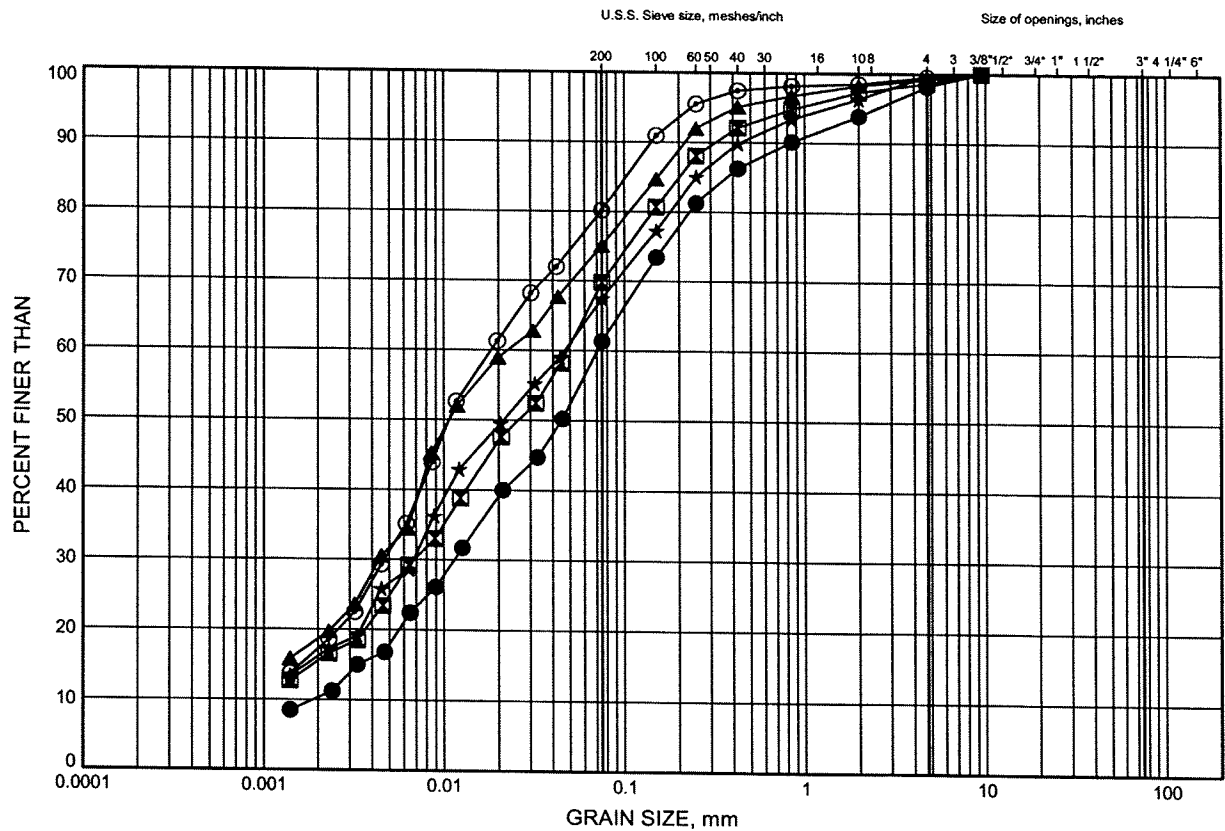
W.P.# 2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E5

## CLAYEY SILT & CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-40	3.28	258.03
⊠	08-40	6.40	254.91
▲	08-41	2.51	261.19
★	08-42	1.83	262.61
⊙	08-46	7.92	248.78

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 10/5/09

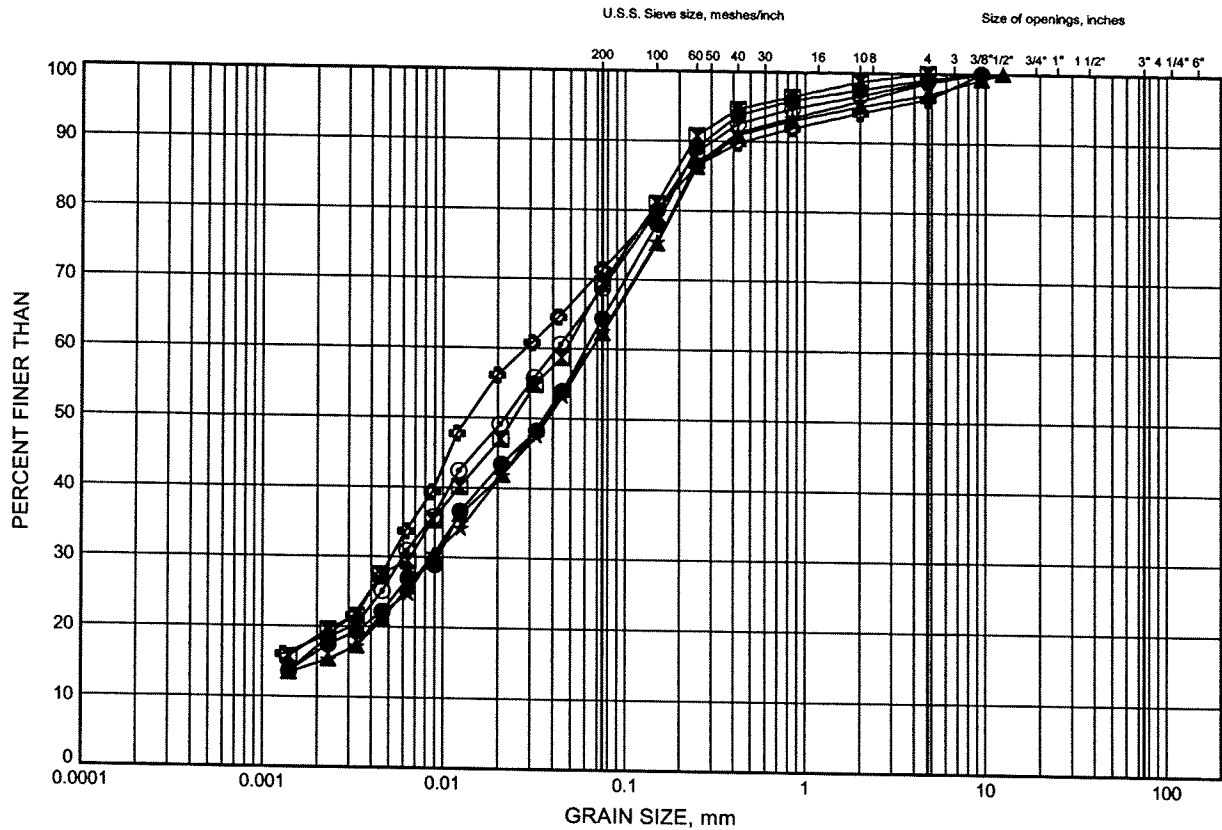
W.P.# .2109:05:00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E6

## CLAYEY SILT & CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-46	14.02	242.68
⊠	08-46	17.07	239.63
▲	08-46	18.52	238.18
★	08-46	20.12	236.58
⊙	08-47	6.32	251.06
⊕	08-47	7.92	249.46

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

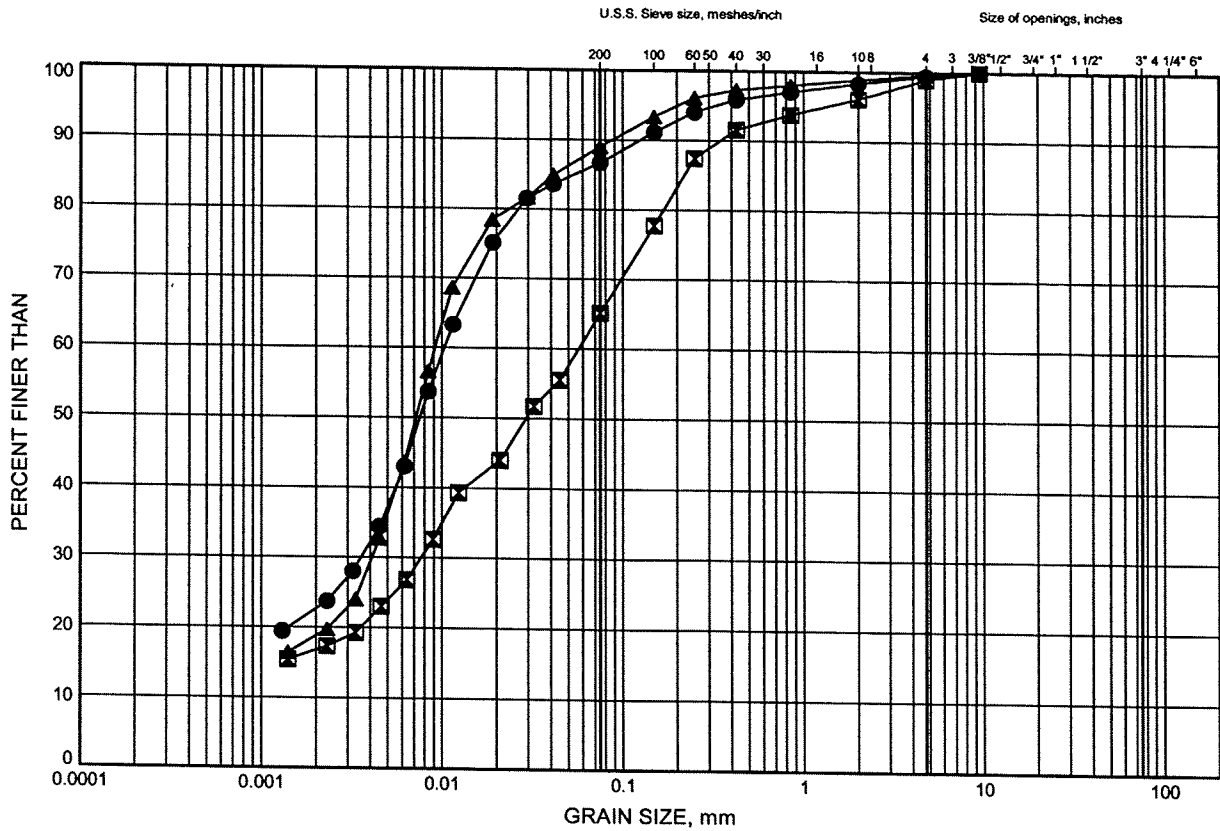
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E7

## CLAYEY SILT & CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-47	12.50	244.88
■	08-47	17.07	240.31
▲	08-47	20.12	237.26

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

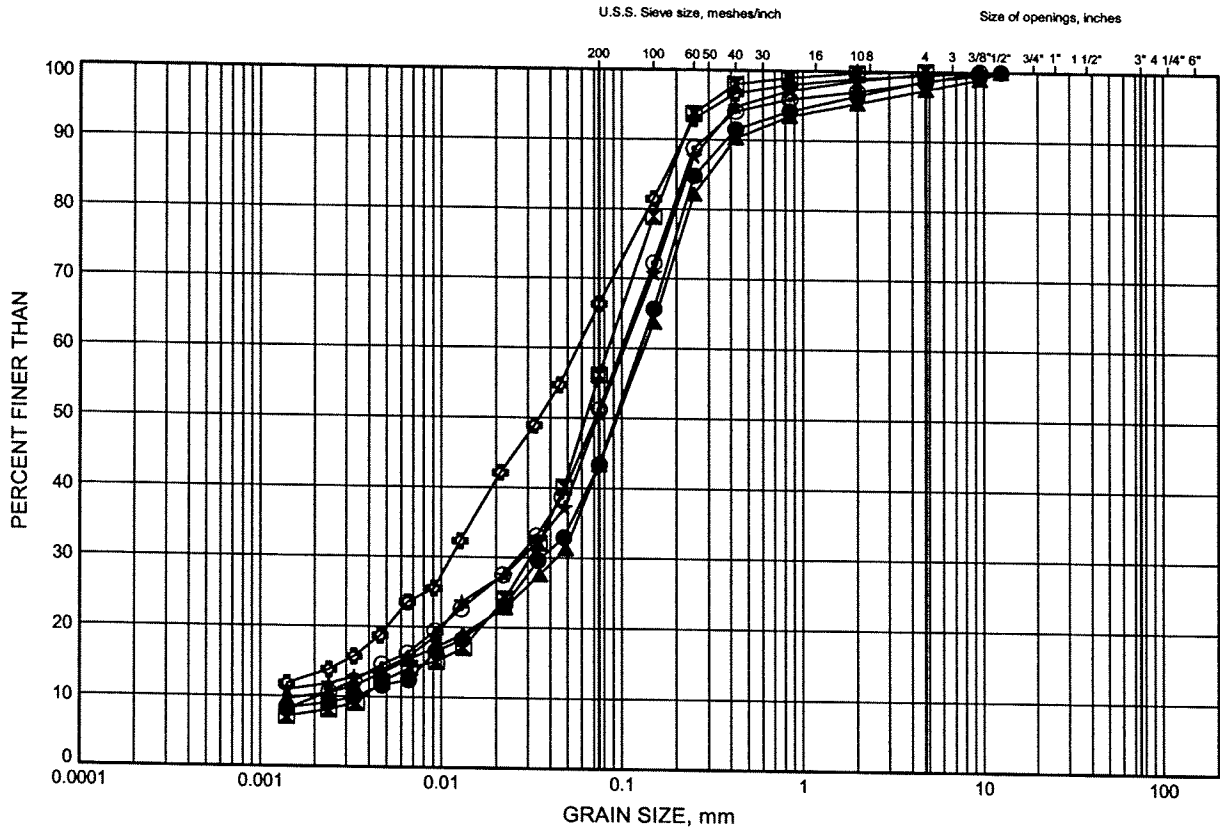
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E8

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-33	1.75	282.27
⊠	08-33	4.62	279.40
▲	08-33A	1.83	284.37
★	08-33A	3.35	282.85
⊙	08-34	2.51	278.82
⊕	08-34	4.80	276.53

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

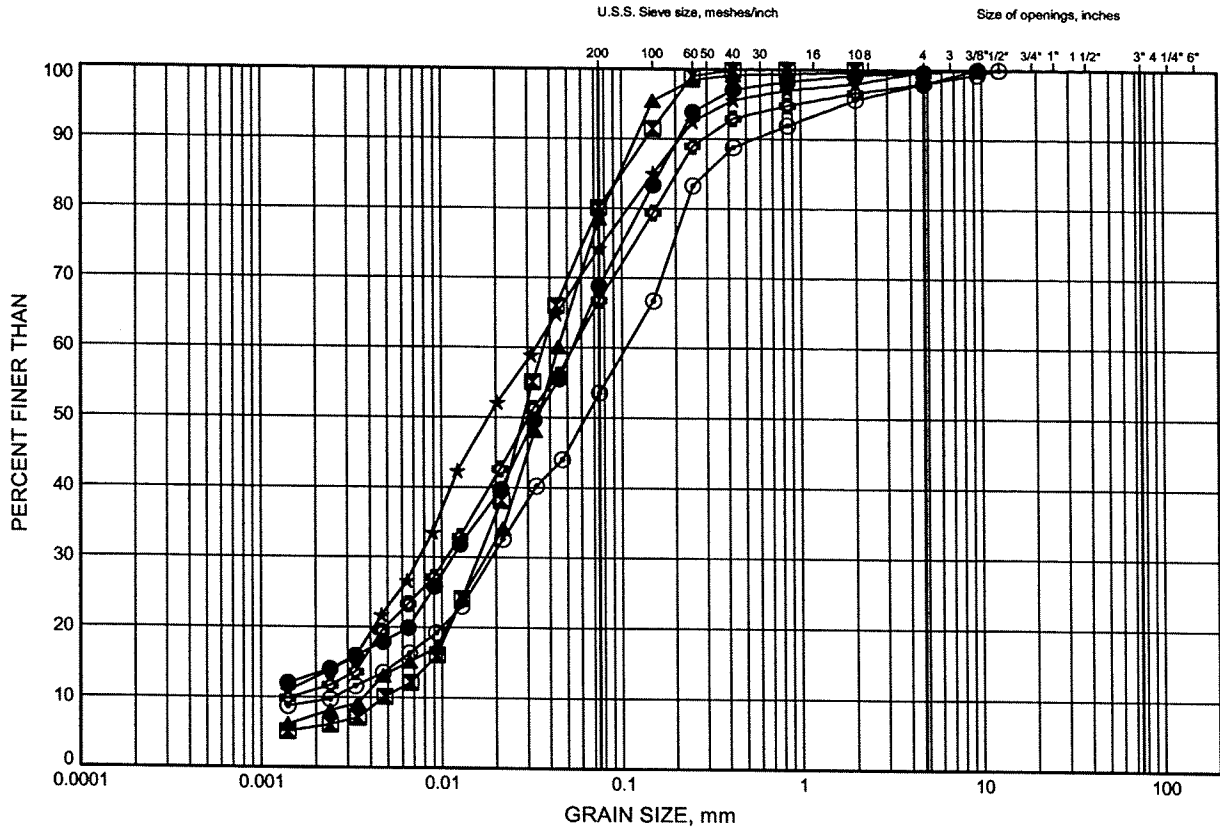
W.P.# .2109:05:00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E9

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-35	2.51	275.14
⊠	08-35	4.71	272.94
▲	08-36	3.12	270.36
★	08-36	6.14	267.34
⊙	08-37	2.51	267.62
⊕	08-37	3.26	266.87

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....

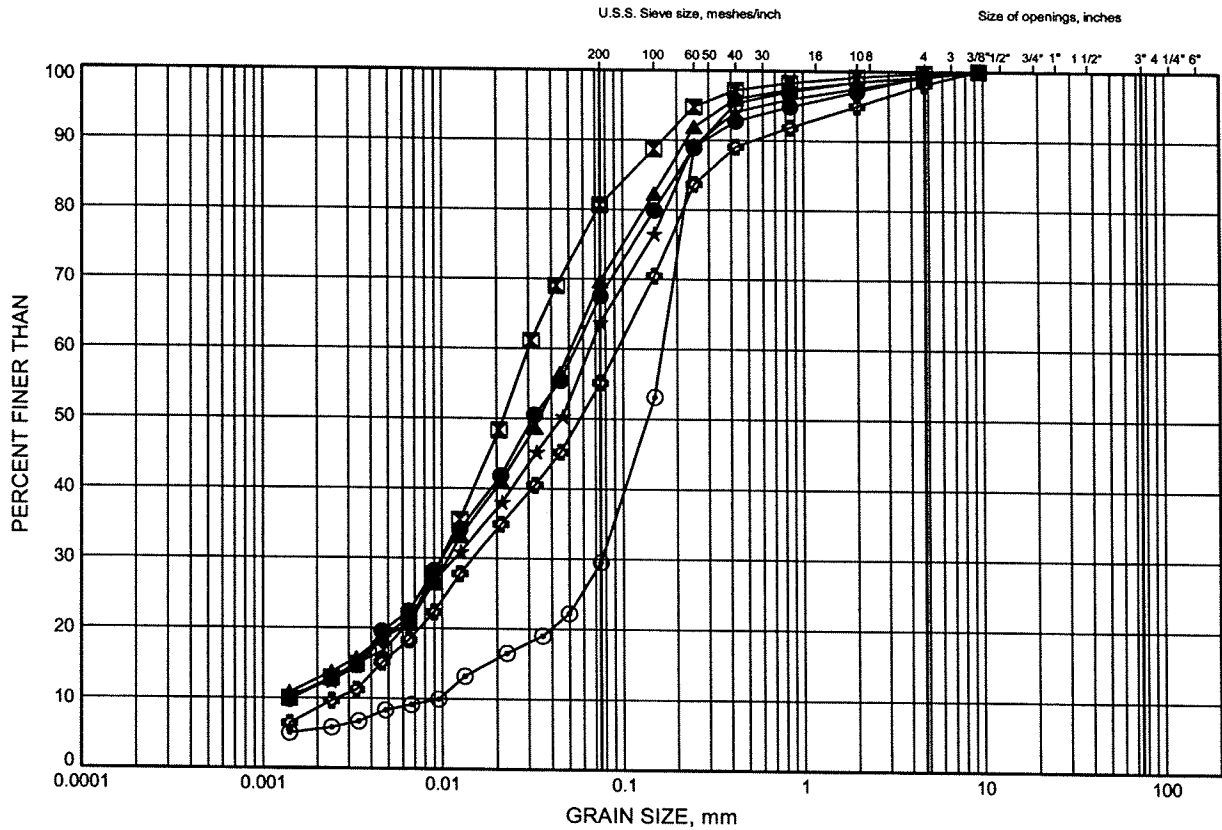




# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E10

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-37	6.14	263.99
⊠	08-38	2.51	264.34
▲	08-38	10.71	256.14
★	08-39	9.28	249.67
⊙	08-39	10.97	247.98
⊕	08-40	10.69	250.62

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

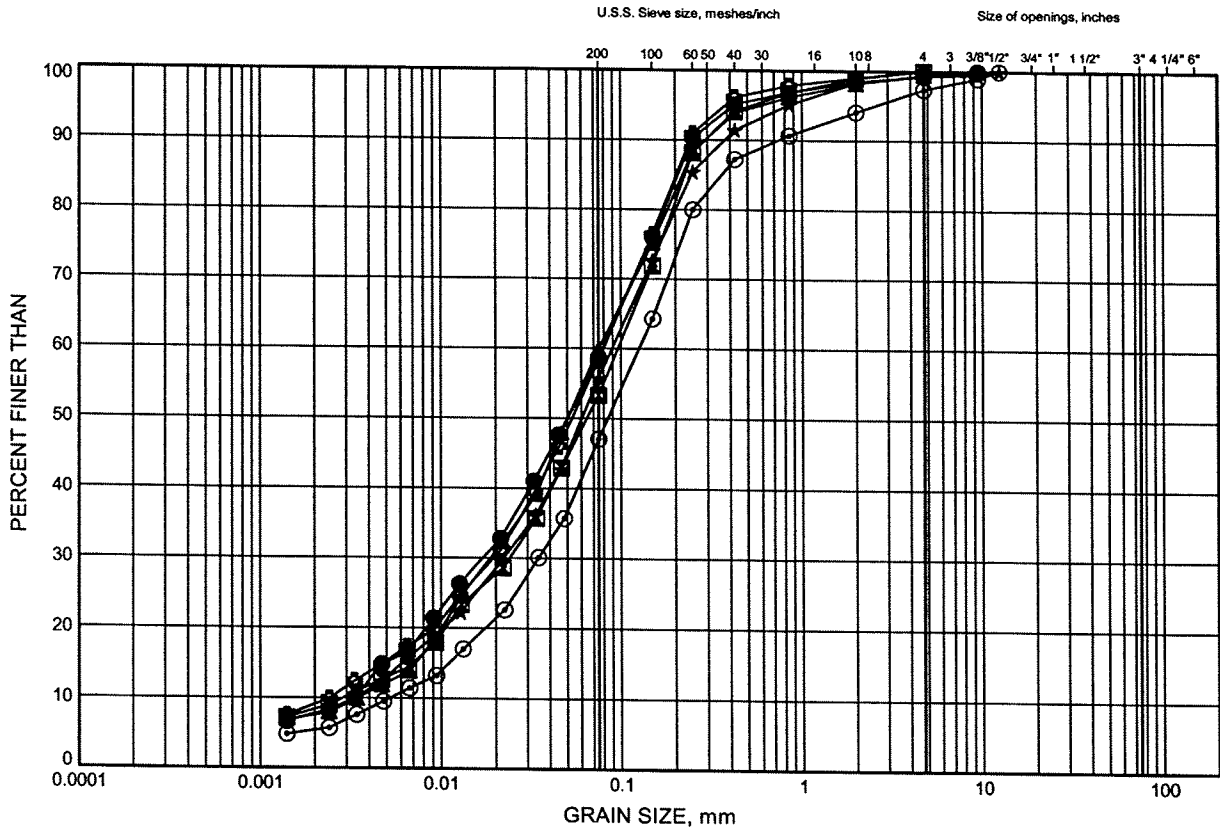
W.P.# 2109-05-00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E11

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-41	6.16	257.54
⊠	08-42	4.72	259.72
▲	08-43	3.28	260.58
★	08-44	4.80	254.29
⊙	08-44	7.85	251.24
⊕	08-44	10.73	248.36

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

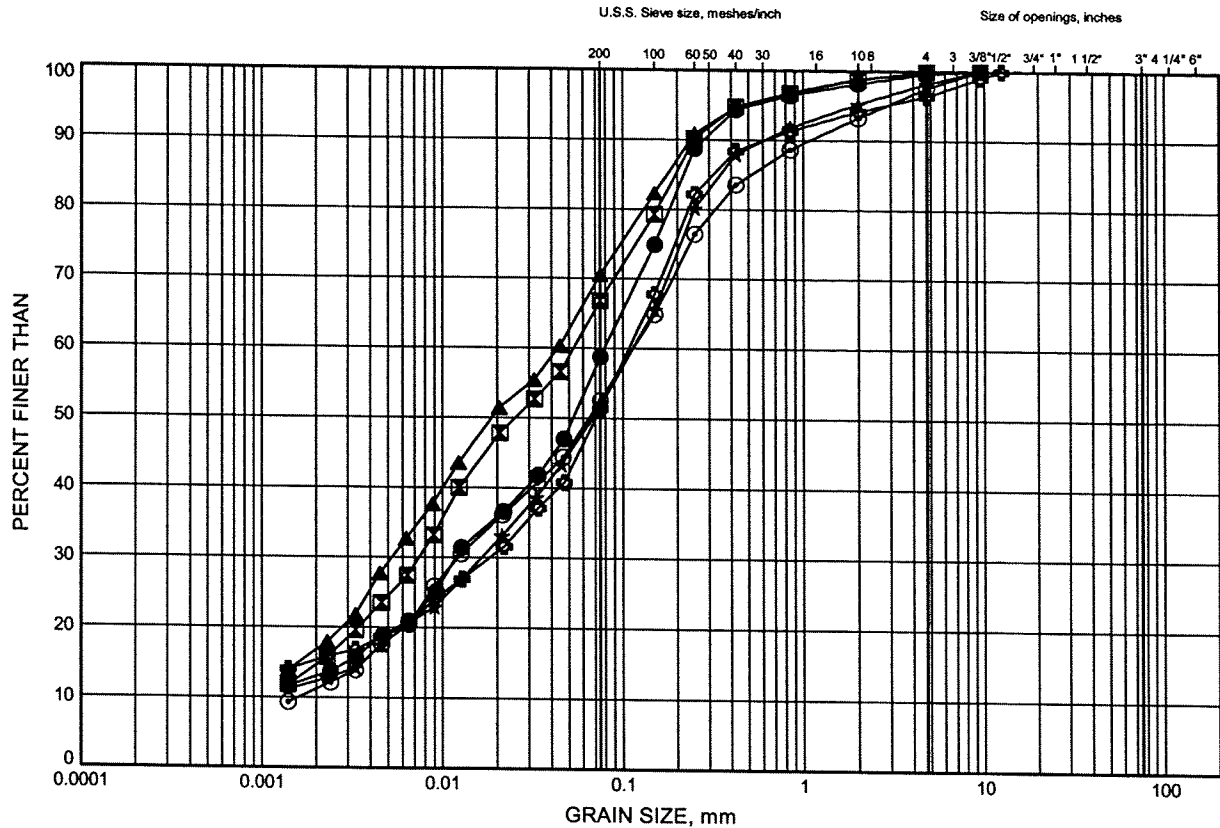
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Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E12

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-45	3.28	254.99
⊠	08-45	7.85	250.42
▲	08-45	15.47	242.80
★	08-45	19.87	238.40
⊙	08-46	4.88	251.82
⊕	08-61	2.44	282.46

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

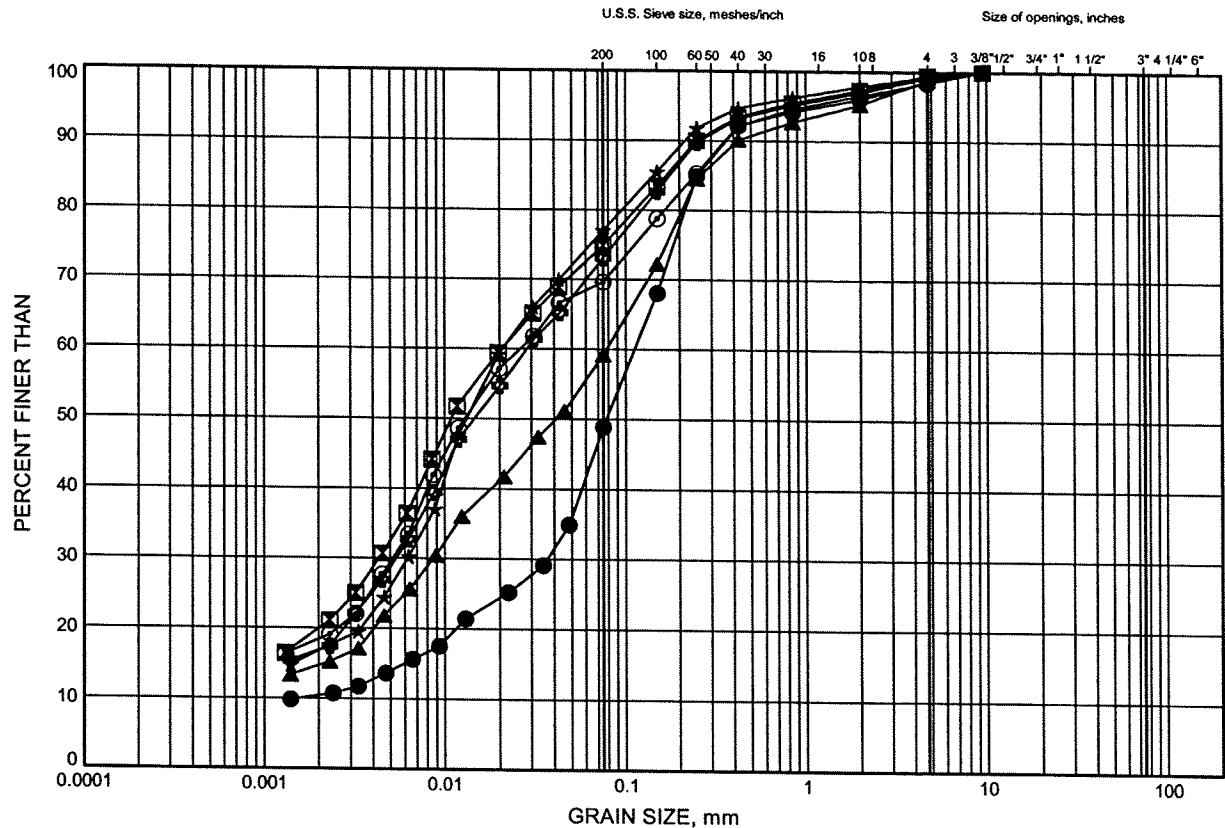
W.P.# 2109-05:00.....  
Prepared By AN.....  
Checked By RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E13

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-61	6.40	278.50
⊠	QSR4-1	2.59	251.15
▲	QSR4-1	6.40	247.34
★	QSR4-1	10.90	242.84
⊙	QSR4-2	2.59	252.26
⊛	QSR4-2	6.40	248.45

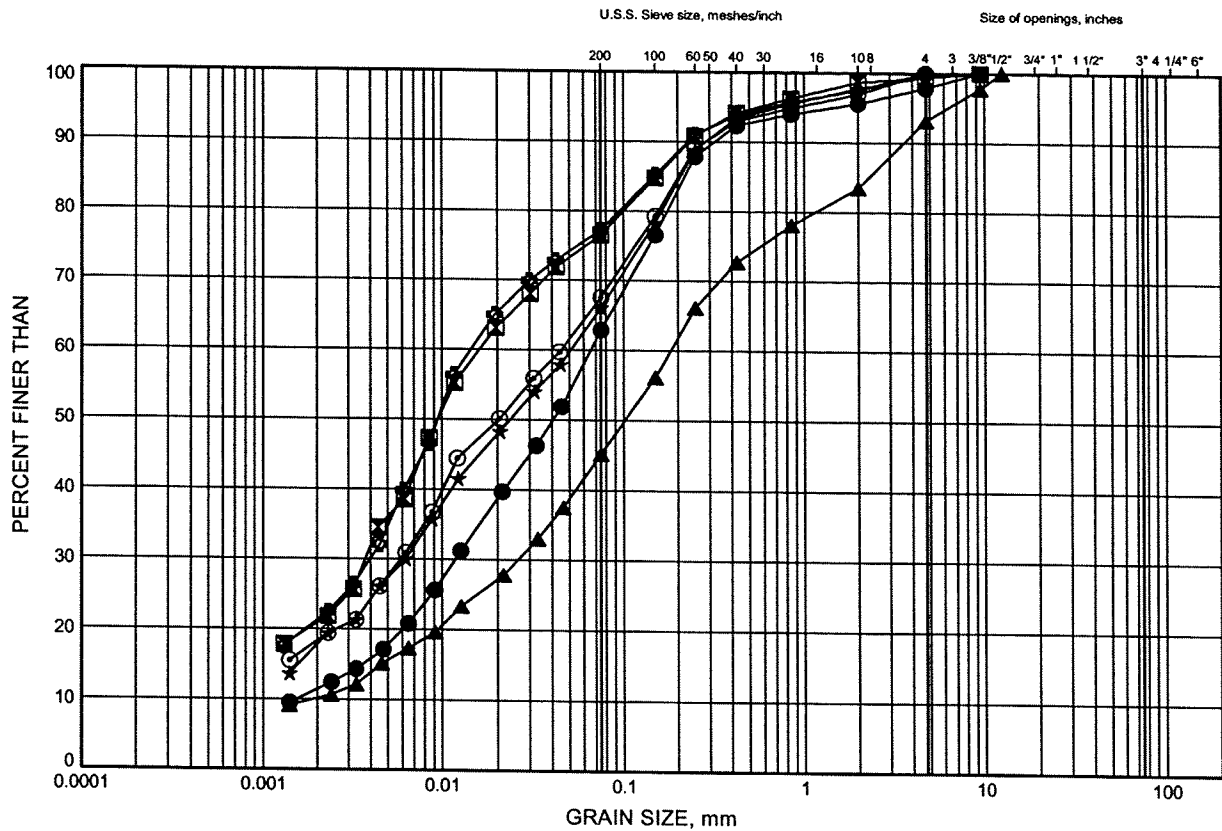


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Prepared By .AN.....  
Checked By .RPR.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E14

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	QSR4-2	9.45	245.40
⊠	QSR4-3	4.88	252.27
▲	QSR4-3	7.92	249.23
★	QSR4-3	10.97	246.18
⊙	QSR4-4	3.35	252.08
⊕	QSR4-4	7.92	247.51

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

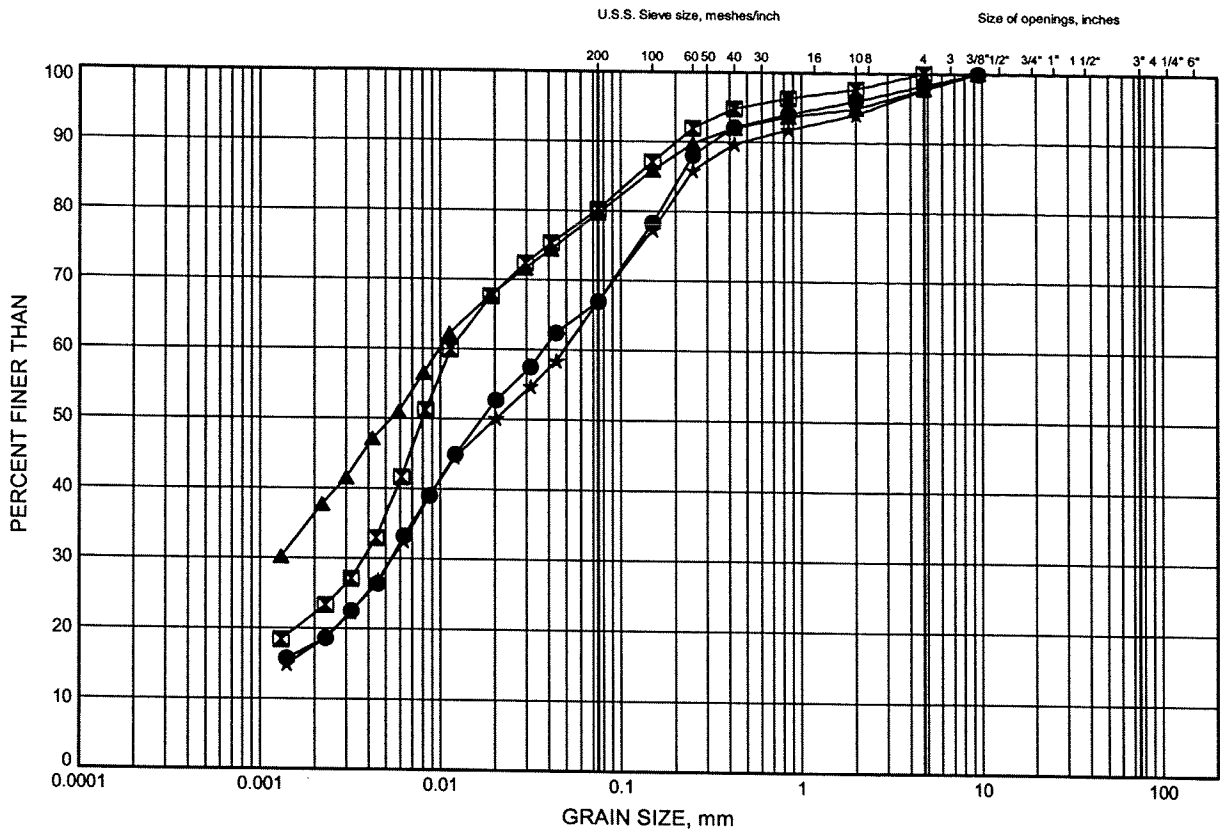
W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E15

## SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	QSR4-4	10.97	244.46
☒	QSR4-5	3.35	252.08
▲	QSR4-5	4.88	250.55
★	QSR4-5	9.45	245.98

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

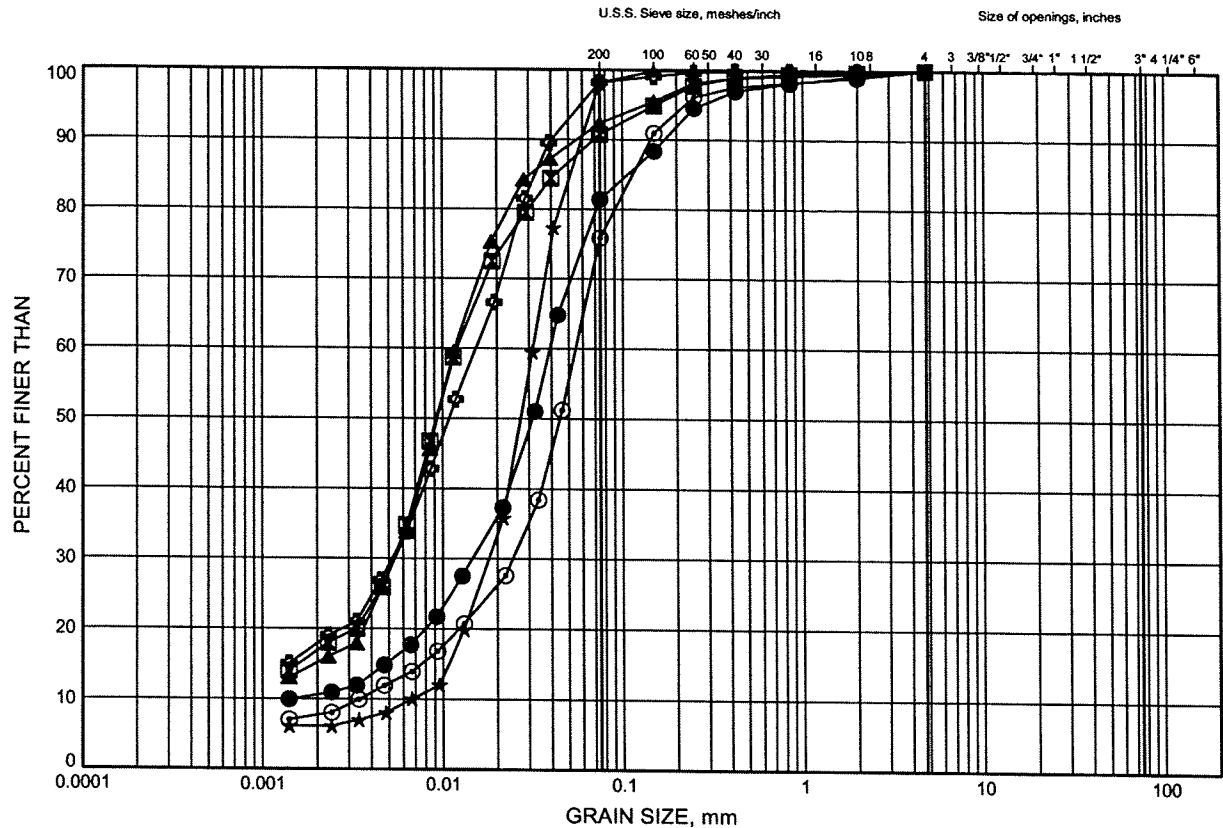
W.P.# 2109-05-00  
Prepared By AN  
Checked By RPR



# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E16

## SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-33A	6.40	279.80
⊠	08-33A	10.97	275.23
▲	08-33A	14.02	272.18
★	08-47	24.52	232.86
⊙	08-61	9.45	275.45
⊕	08-61	10.97	273.93

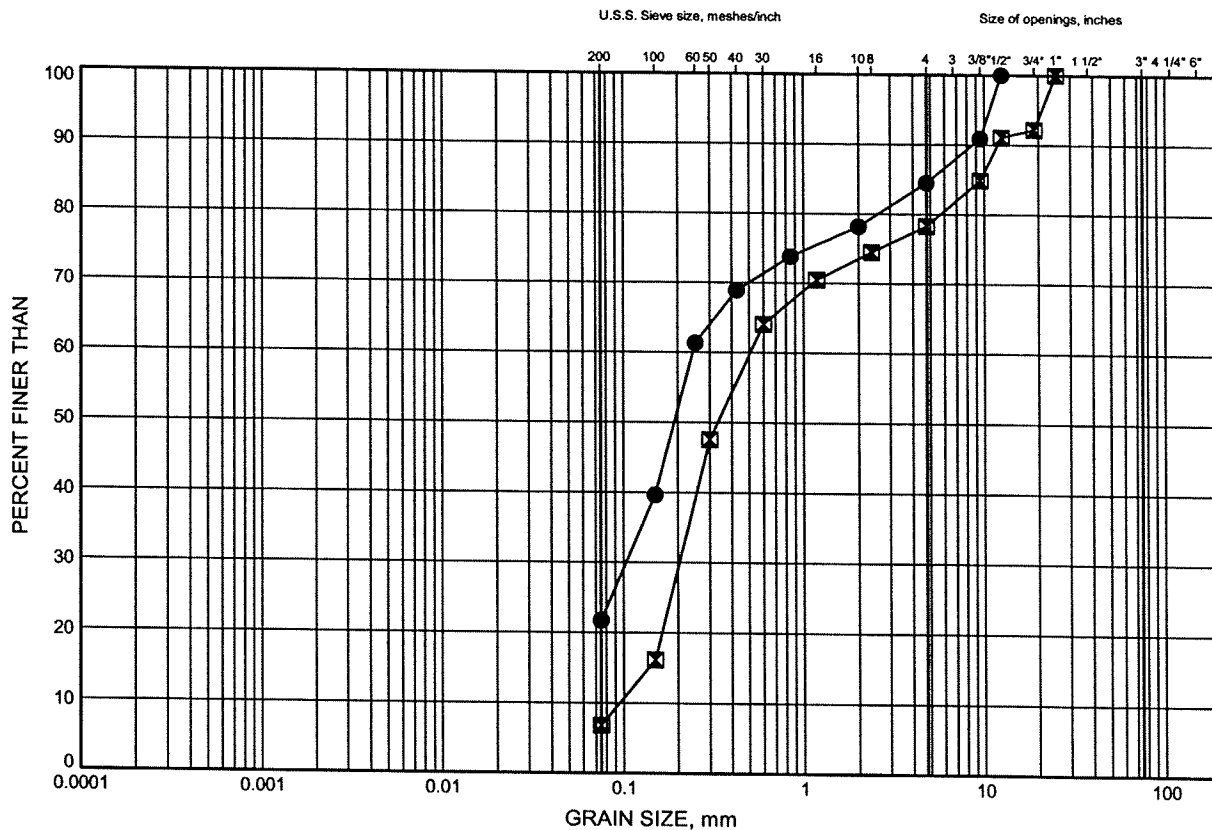


W.P.# .2109:05-00.....  
Prepared By .AN.....  
Checked By .RPR.....

# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E17

## GRAVELLY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-45	9.27	249.00
⊠	08-45	10.79	247.48

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

W.P.# .2109-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....

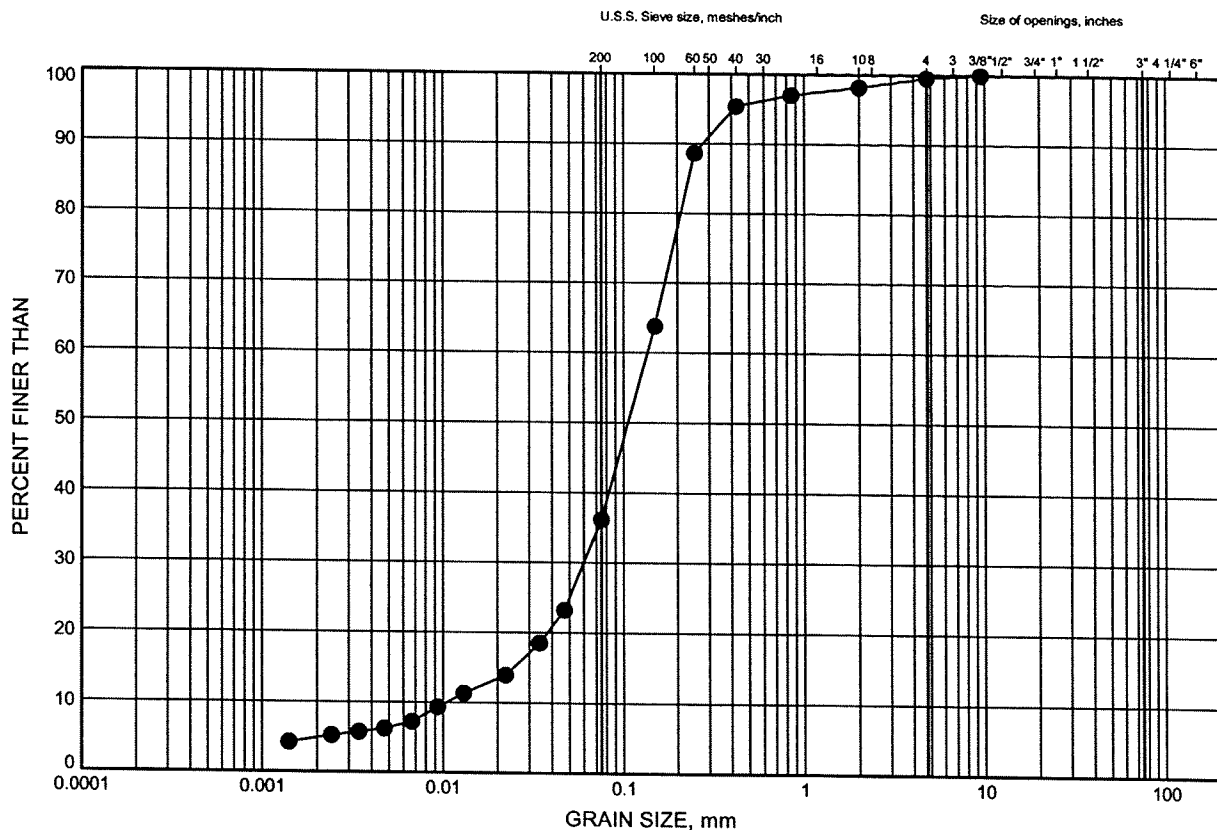




# Hwy 404 Extension GRAIN SIZE DISTRIBUTION

FIGURE E18

## SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-46	10.97	245.73

GRAIN SIZE DISTRIBUTION - THURBER 0596.GPJ 9/24/09

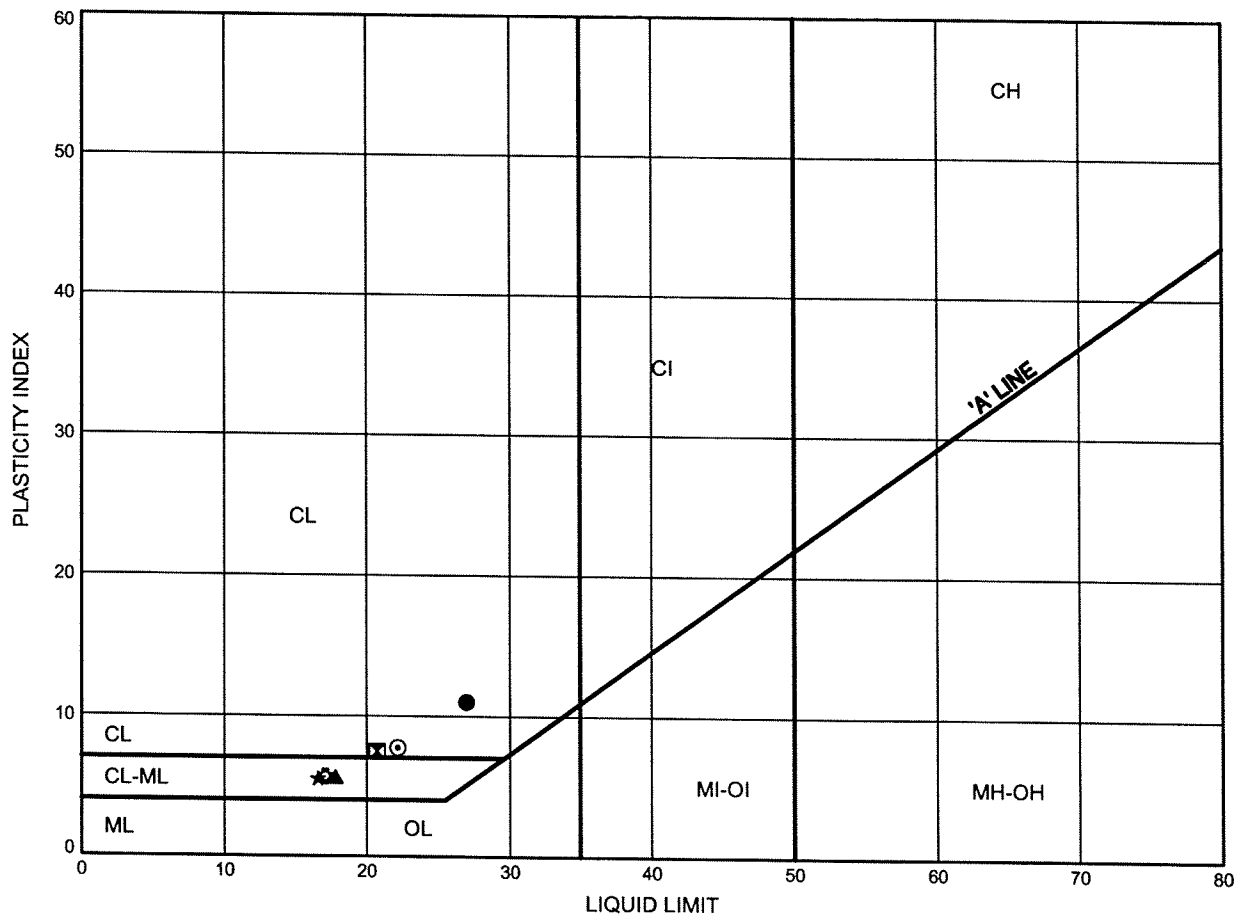
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Prepared By AN.....  
Checked By RPR.....



Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE E19

**CLAYEY SILT & CLAYEY SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-38A	2.51	254.79
⊠	08-38A	4.80	252.50
▲	08-38A	9.37	247.93
★	08-38A	13.94	243.36
⊙	08-39	2.51	256.44
⊕	08-39	6.32	252.63

Date October 2009

Project 2109-05-00



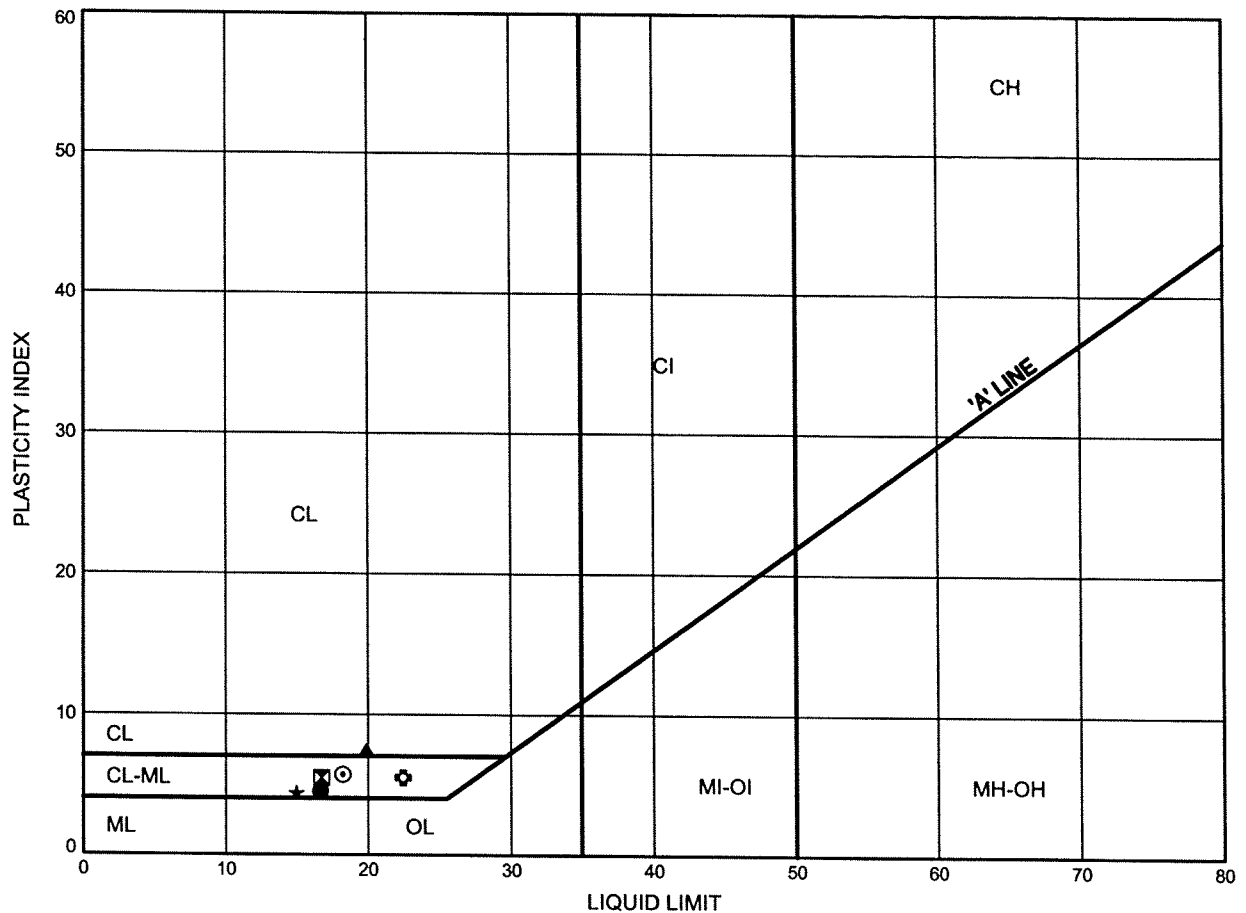
Prep'd AN

Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE E20

**CLAYEY SILT & CLAYEY SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-40	3.28	258.03
⊠	08-40	6.40	254.91
▲	08-41	2.51	261.19
★	08-46	17.07	239.63
⊙	08-47	7.92	249.46
⊛	08-47	20.12	237.26

Date September 2009

Project 2109-05-00



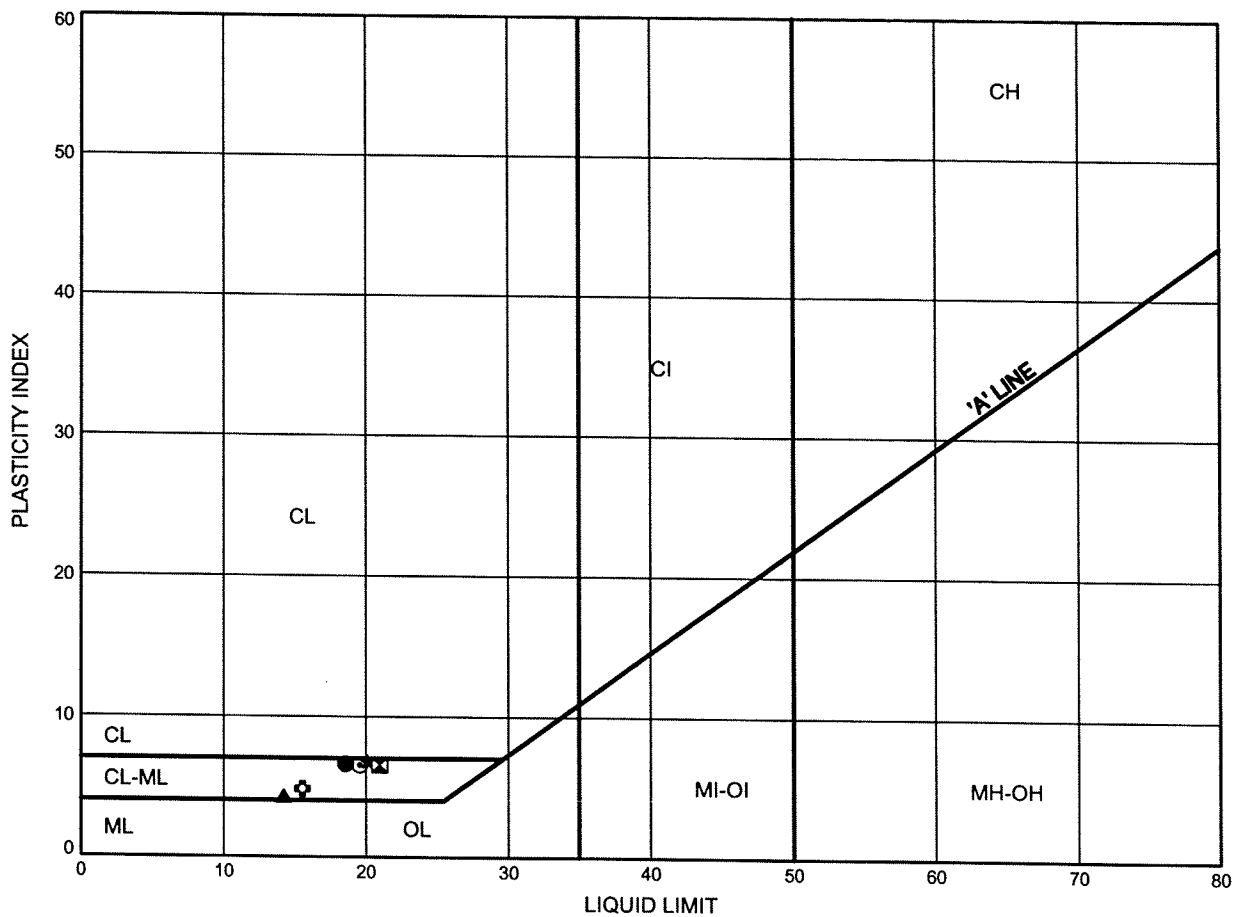
Prep'd AN

Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE E21

**SAND & SILT TILL (Clayey Zones)**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-45	15.47	242.80
⊠	QSR4-1	2.59	251.15
▲	QSR4-1	6.40	247.34
★	QSR4-2	2.59	252.26
⊙	QSR4-3	4.88	252.27
⊕	QSR4-3	10.97	246.18

THURBALT 0596.GPJ 10/5/09

Date October 2009  
 Project 2109-05-00

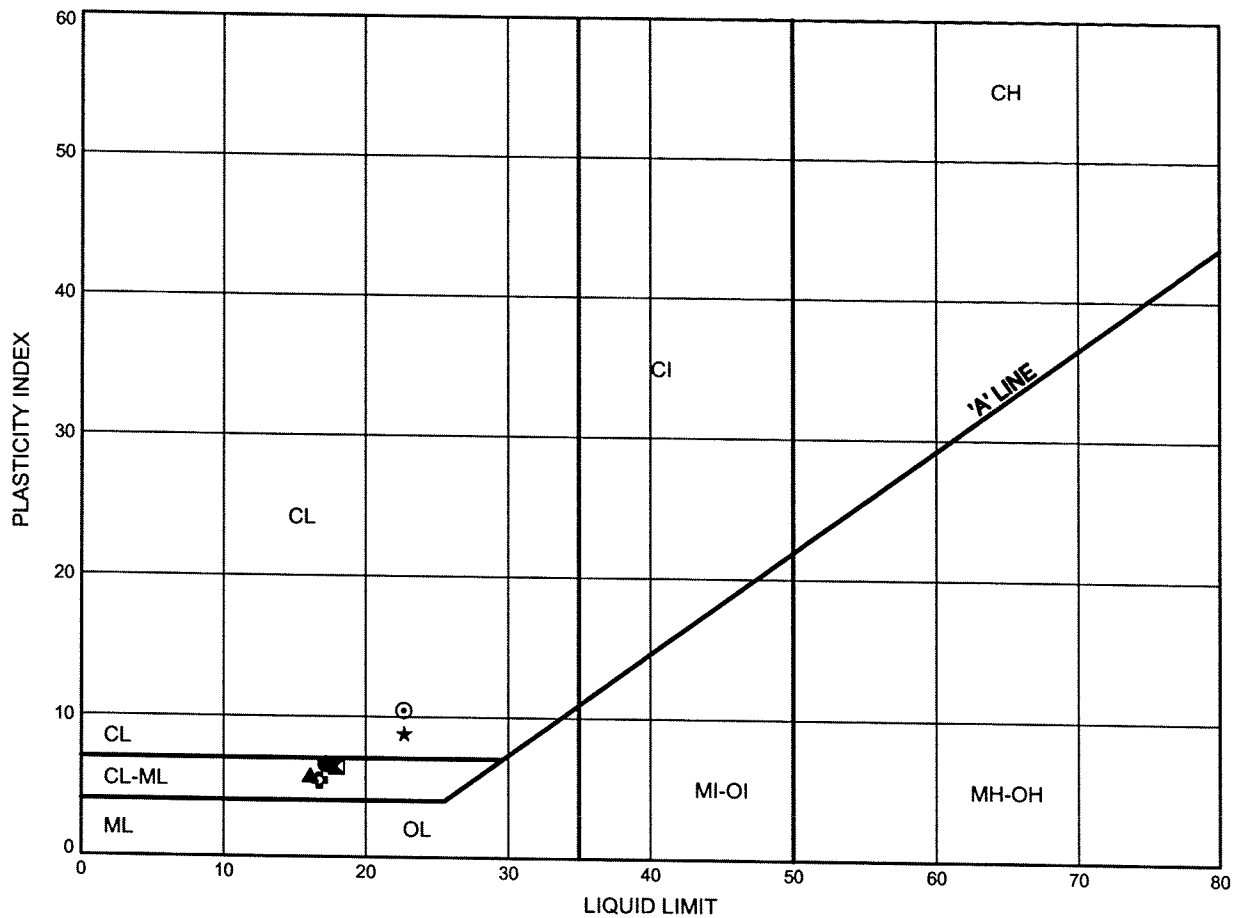


Prep'd AN  
 Chkd. RPR

Hwy 404 Extension  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE E22

**SAND & SILT TILL (Clayey Zones)**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	QSR4-4	3.35	252.08
⊠	QSR4-4	7.92	247.51
▲	QSR4-4	10.97	244.46
★	QSR4-5	3.35	252.08
⊙	QSR4-5	4.88	250.55
⊕	QSR4-5	9.45	245.98

THURBALT 0596.GPJ 10/5/09

Date October 2009  
 Project 2109-05-00

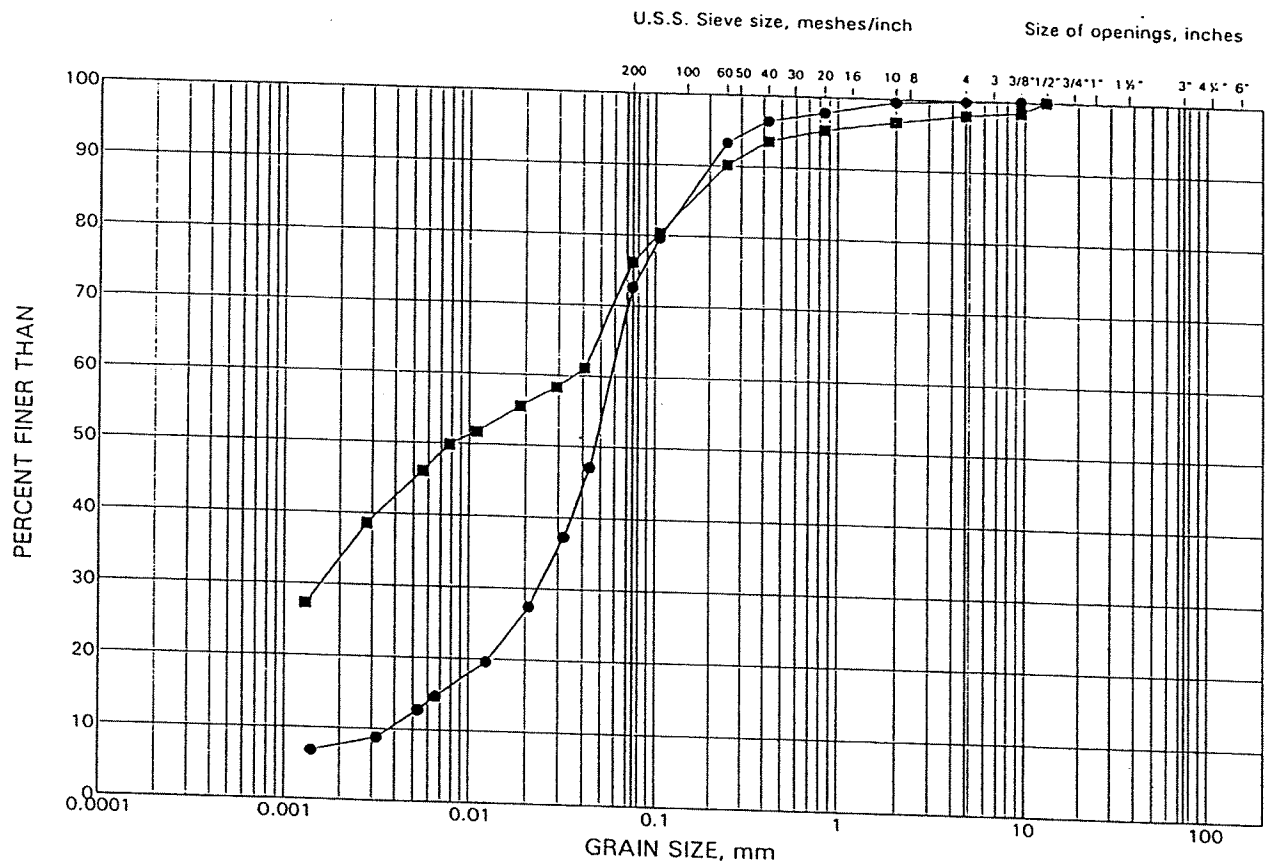


Prep'd AN  
 Chkd. RPR

# GRAIN SIZE DISTRIBUTION TEST RESULTS

## Surficial Clayey Silt

FIGURE 1



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

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	301	5	254.3
■	302	3	257.2

50

40

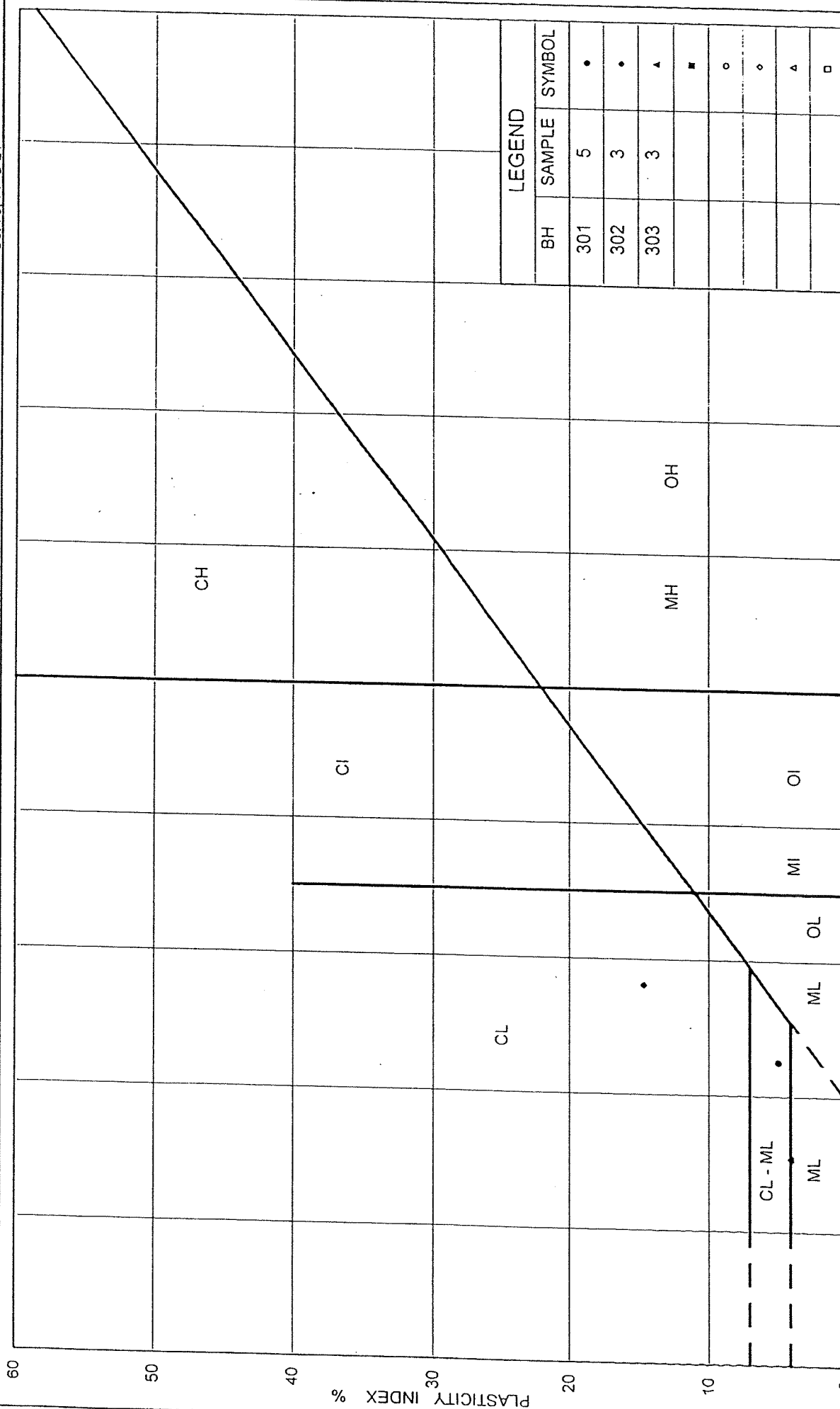
30



1

0

PLASTICITY INDEX %



10

70

H  
M

10

ML

10

IN

LIQUID LIMIT %  
50

90

88

02

69

50

40

30

20

10

0

### LEGEND

BH	SAMPLE	SYMBOL
----	--------	--------

301	5
-----	---

302	3
-----	---

303	3
-----	---

1000

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Ministry of Transportation



**FIG No. 2**

## PLASTICITY CHART

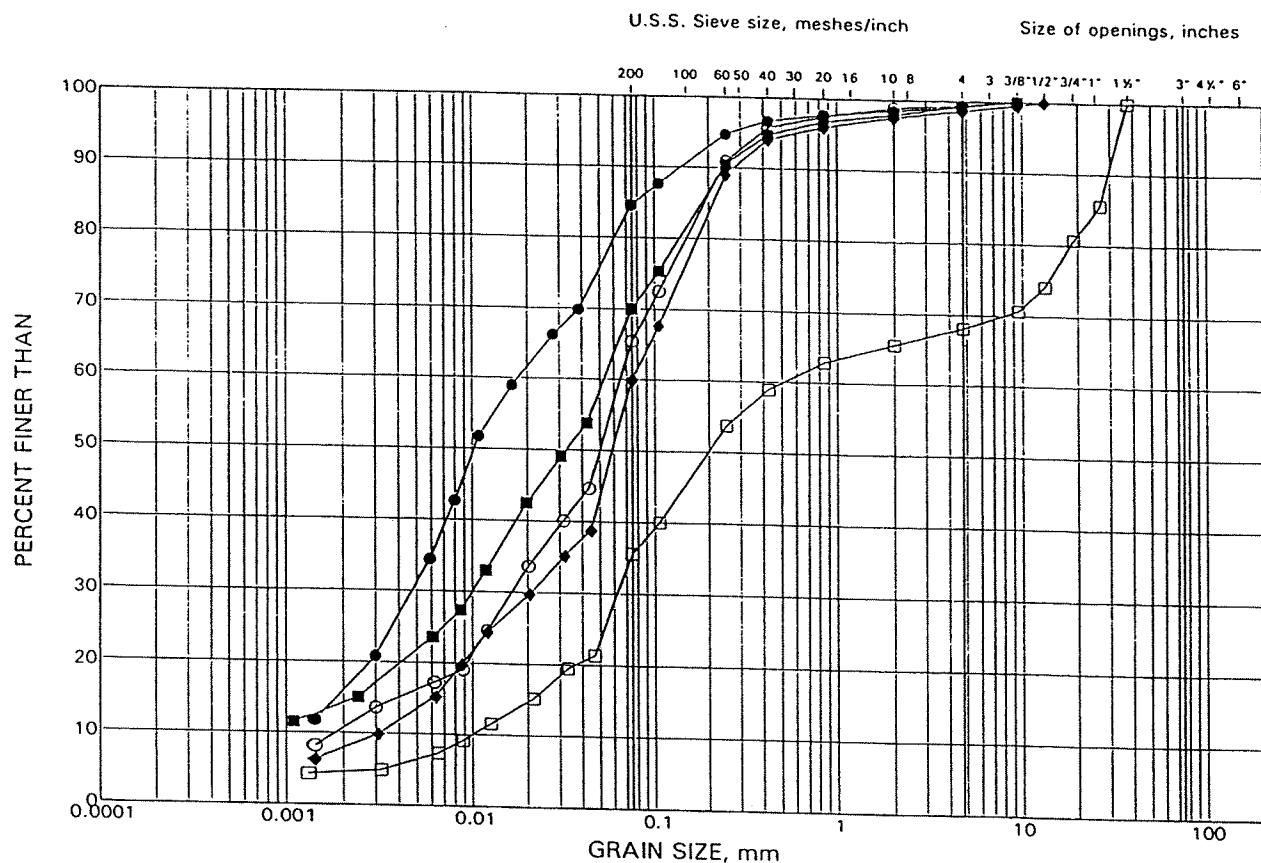
## Surficial Clayey Silt

Project No. 04-1111-016

# GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Till / Sand and Silt Till

FIGURE 3



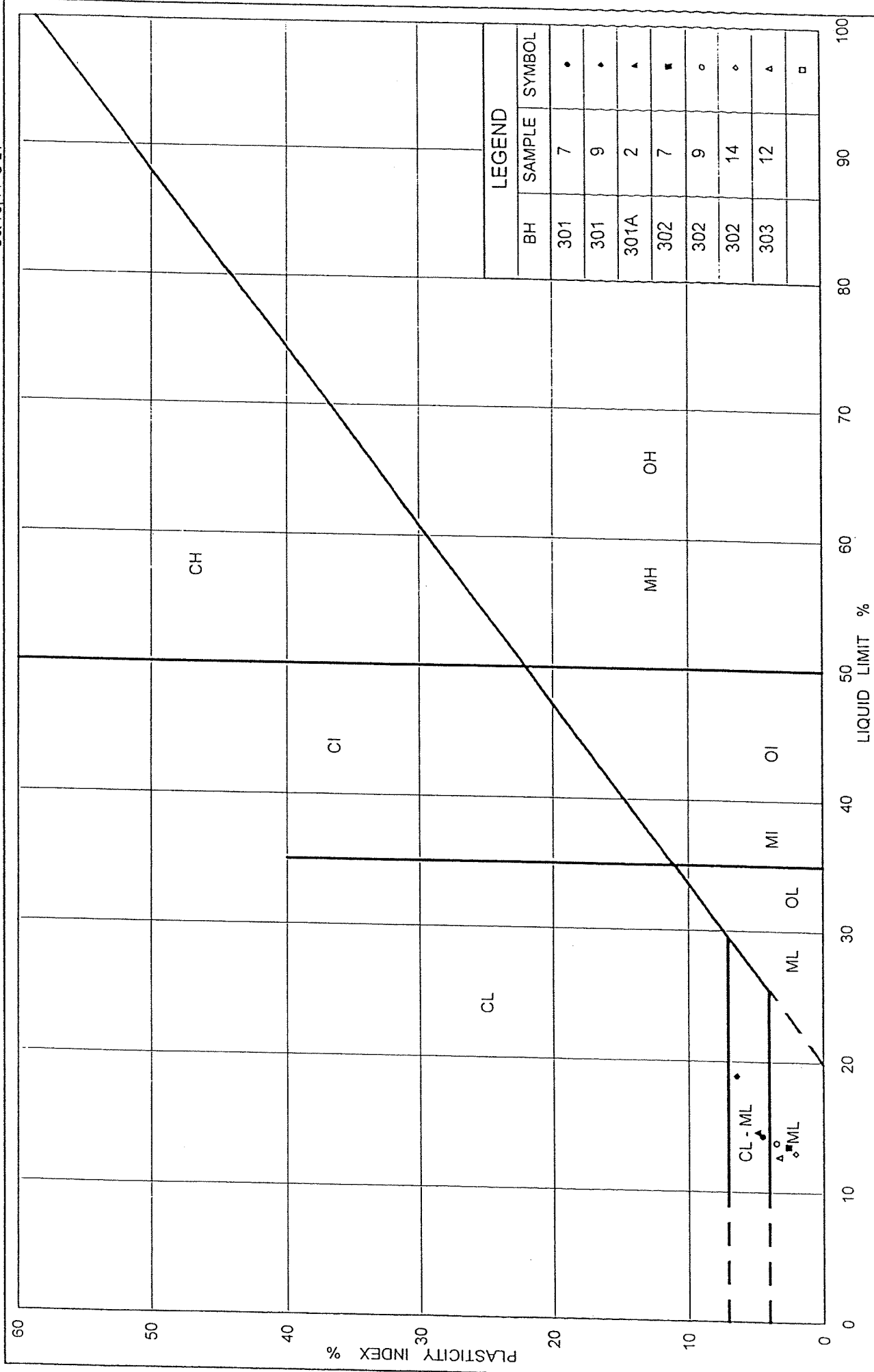
SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	301	9	249.6
■	301A	2	242.0
◆	302	9	251.1
○	302	14	243.5
□	303	7	256.2



Ocl 75, FF-S-21



# PLASTICITY CHART Clayey Silt Till / Sand and Silt Till

FIG No. 4

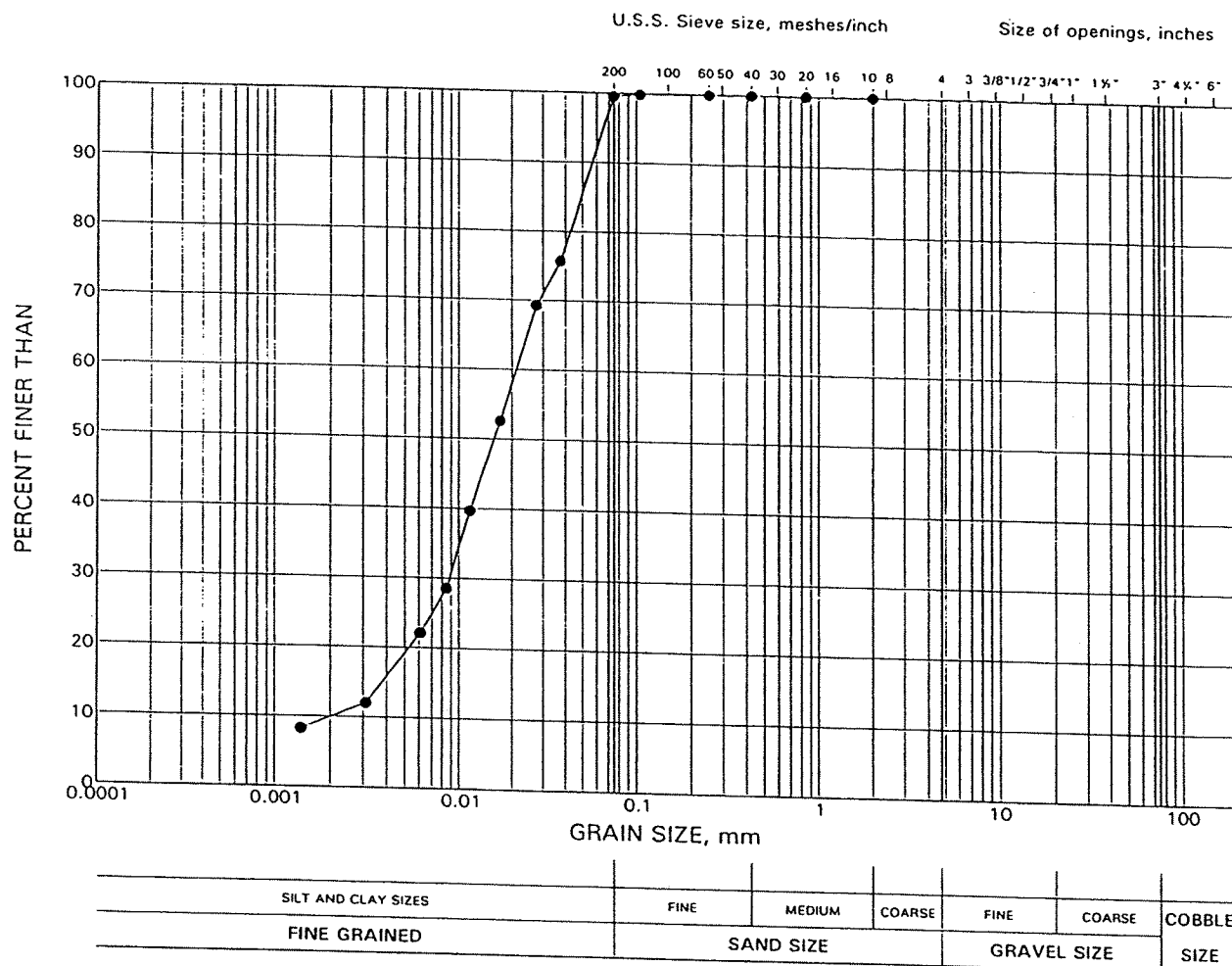
Project No. 04-1111-016



# GRAIN SIZE DISTRIBUTION TEST RESULT

Interlayered Clayey Silt and Silt

FIGURE 5



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	301A	7	234.5

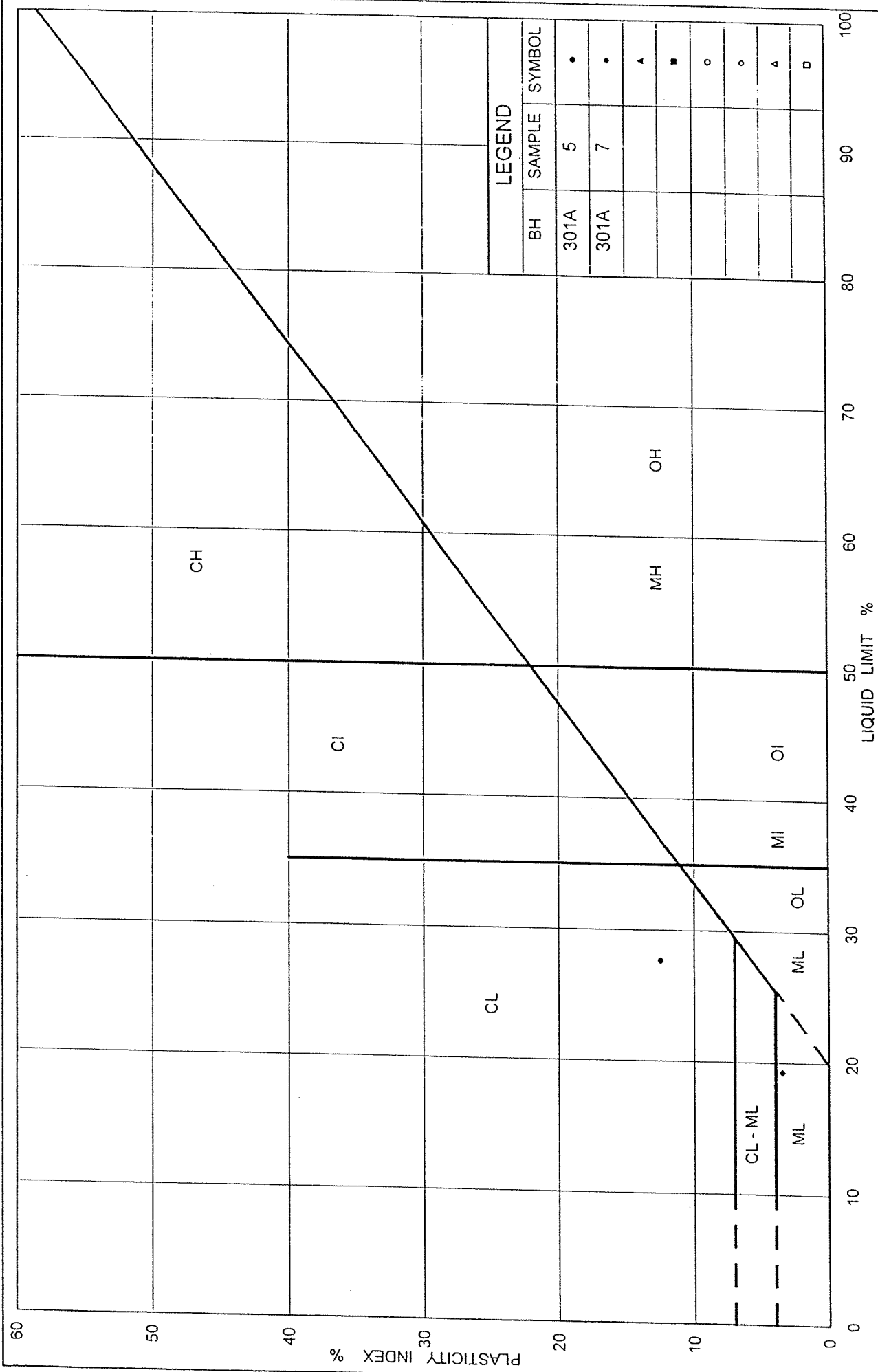
Date 11/2/2004

Project 04-1111-016

Golder Associates

Prepared by LG

Checked by *lpe*



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

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**Photograph** – View of the site looking north of Queensville Sideroad



**Photograph** – View of the site looking northwest of Queensville Sideroad



High Fills and Deep Cuts  
Highway 404 Extension from Green Lane to Queensville Sideroad

---



**Photograph** –Looking south of Queensville Sideroad



**Photograph** – Looking east along Queensville Sideroad

	Gamma	C	Phi	Piezo
	kN/m <sup>3</sup>	kPa	deg	Surf.
Sand/Silt Till	20	0	32	1
Sand/Silt Till	21	0	35	1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 September 24, 2009  
 Stations 9+550 to 9+750  
 Depth: 9 m

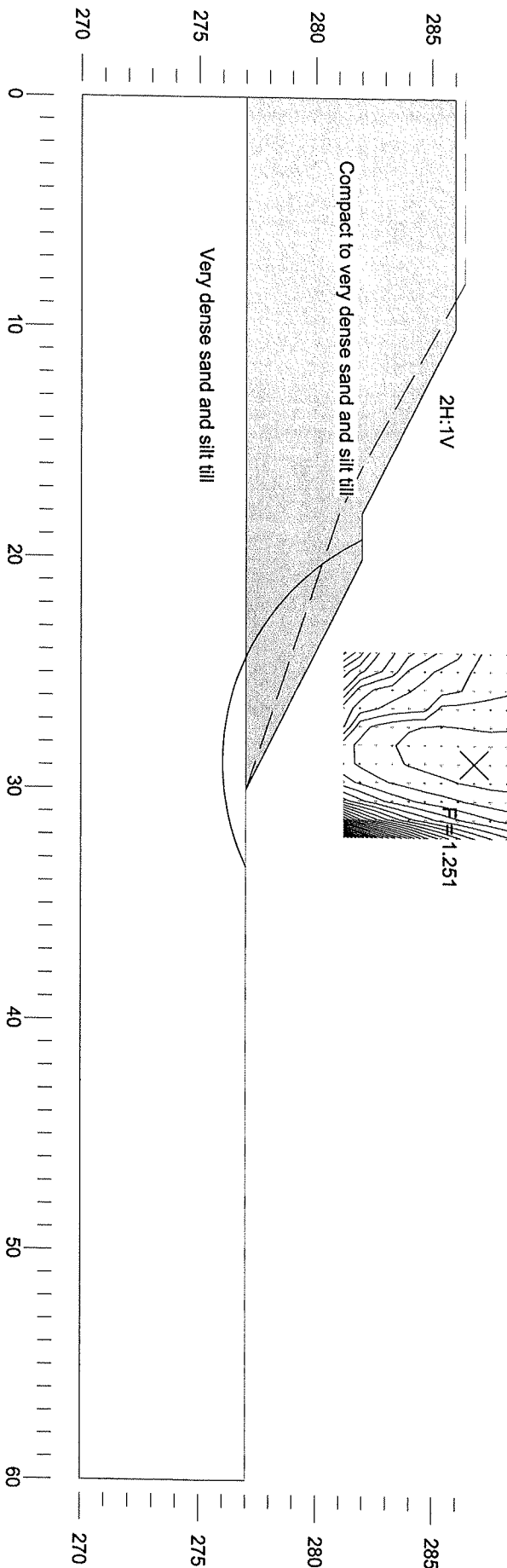


FIGURE 1

	Gamma	C	Phi	Piezo
	kN/m <sup>3</sup>	kPa	deg	Surf.
Sand/Silt Till	20	0	32	1
Sand/Silt Till	21	0	35	1

Seismic coefficient = 0.08

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 Deep Cut  
 October 19, 2009  
 Stations 9+550 to 9+750  
 Depth: 9 m - Seismic

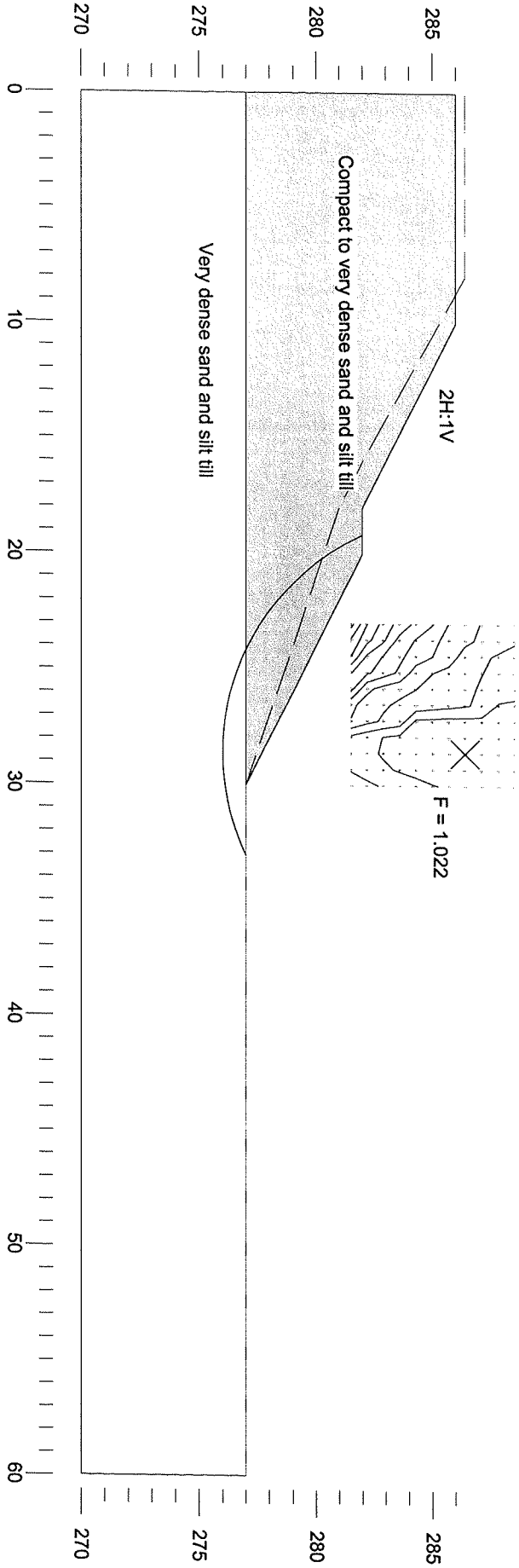


FIGURE 2

	Gamma C	Phi	Piezo
	kN/m <sup>3</sup>	kPa	deg
Earth Fill	21	0	30
Sand/Silt Till	21	0	33
			1

Thurber Engineering Ltd. - Toronto  
 19-1605-96 Highway 404 Extension  
 High Fill  
 September 29, 2009  
 Stations 9+750 to 10+075  
 Height: 12 m

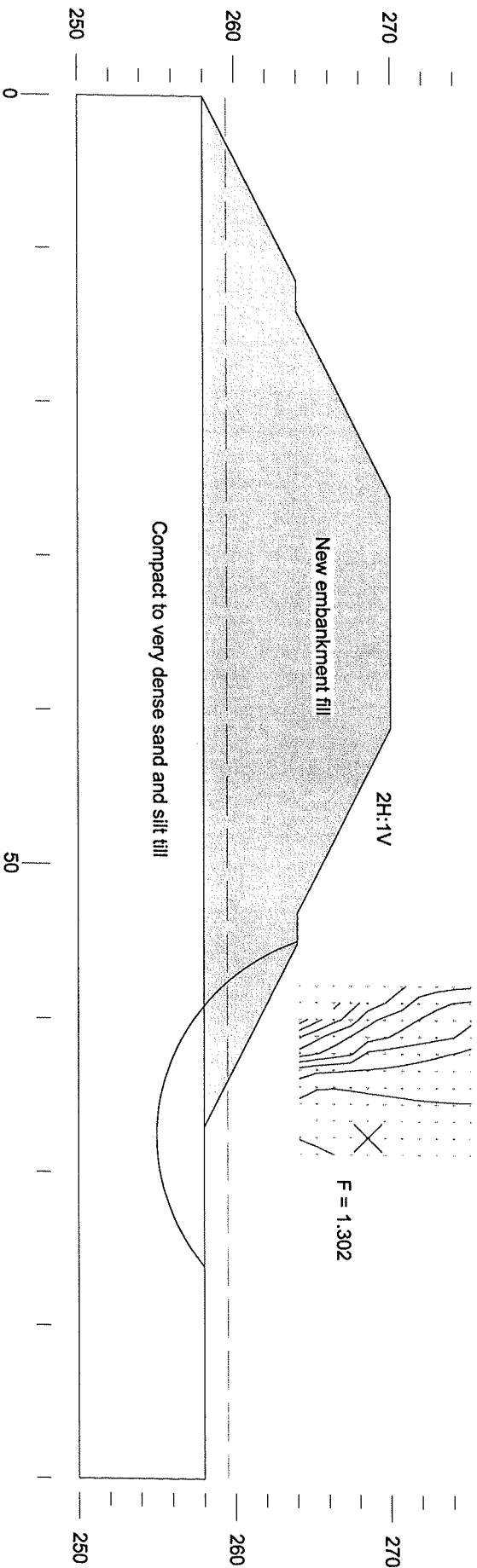


FIGURE 3



	Gamma	C	Phi	Piezo
	kN/m <sup>3</sup>	kPa	deg	Surf.
Earth Fill	21	0	30	1
Sand/Silt Till	21	0	33	1

Seismic coefficient = 0.08

Thurber Engineering Ltd. - Toronto  
19-1605-96 Highway 404 Extension  
High Fill  
September 29, 2009  
Stations 9+750 to 10+075  
Height: 12 m - Seismic

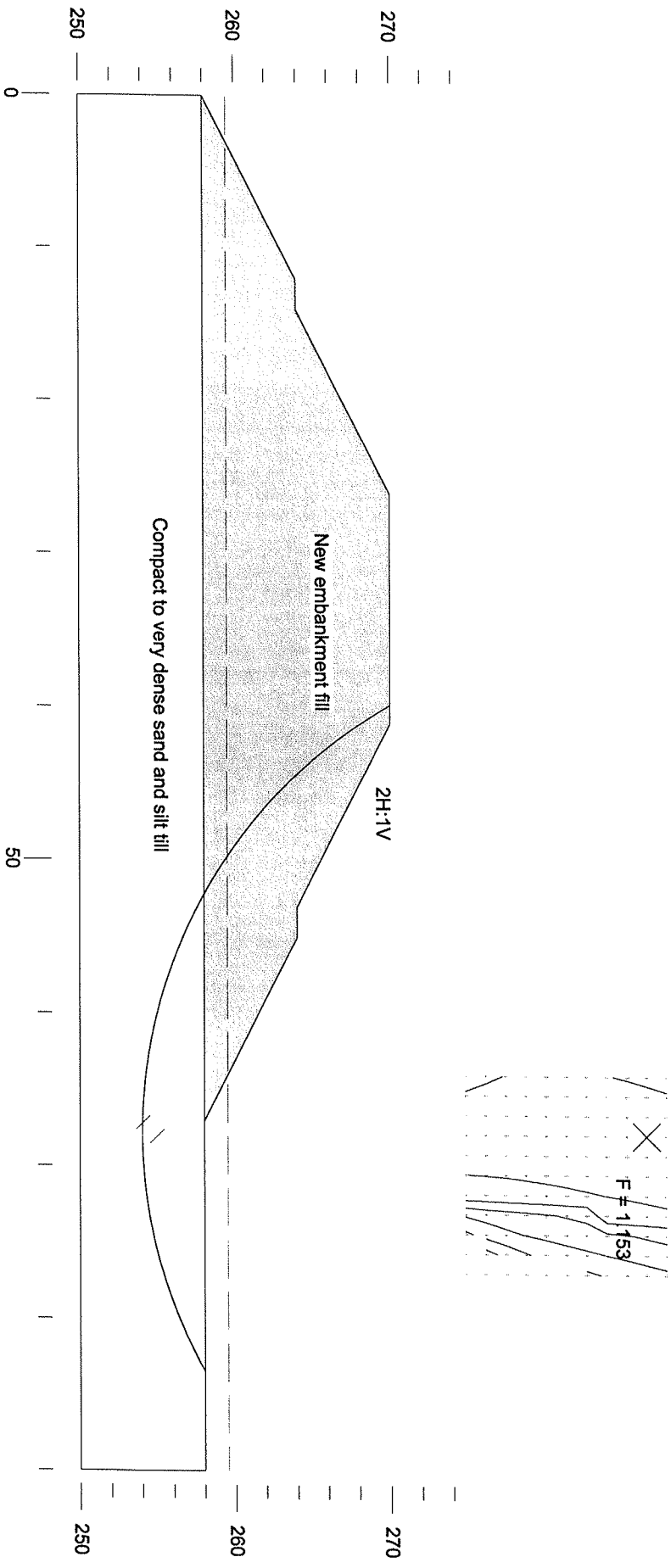
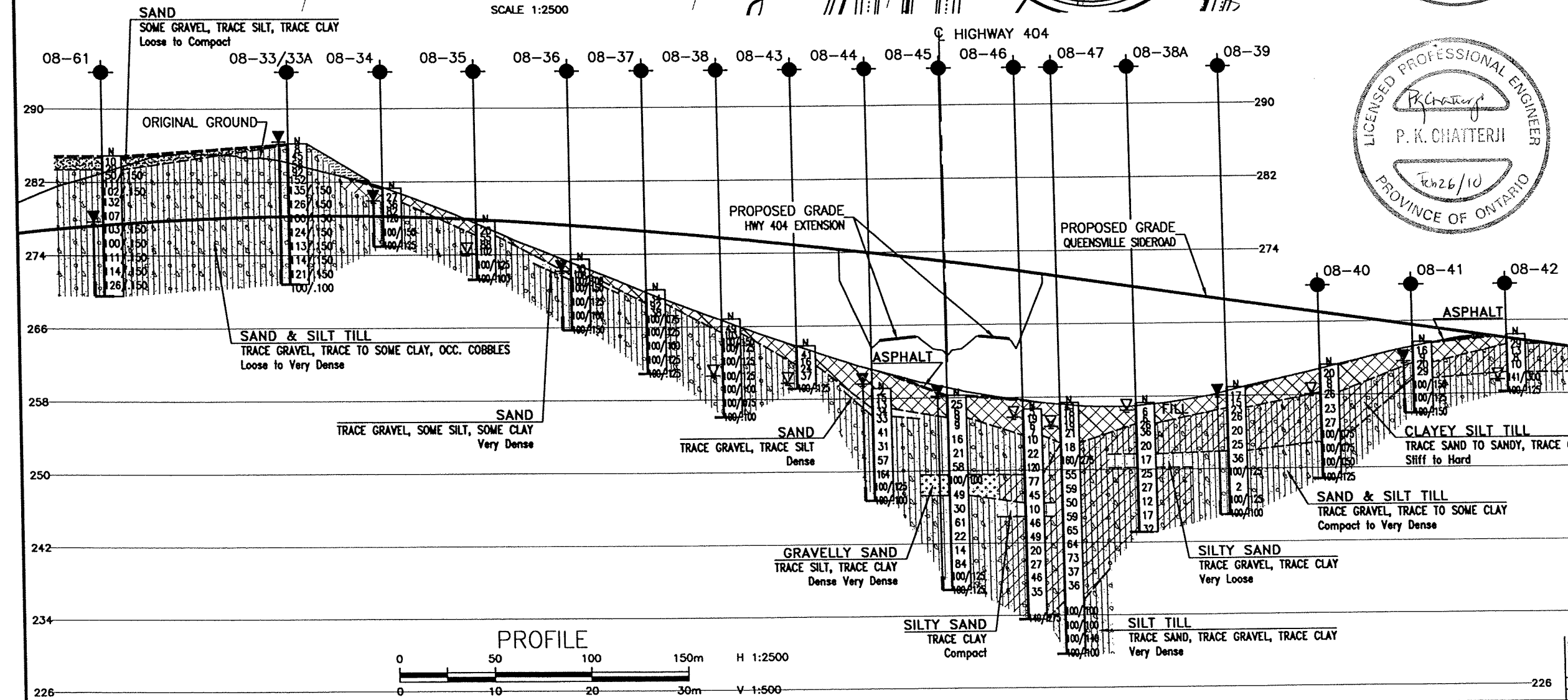
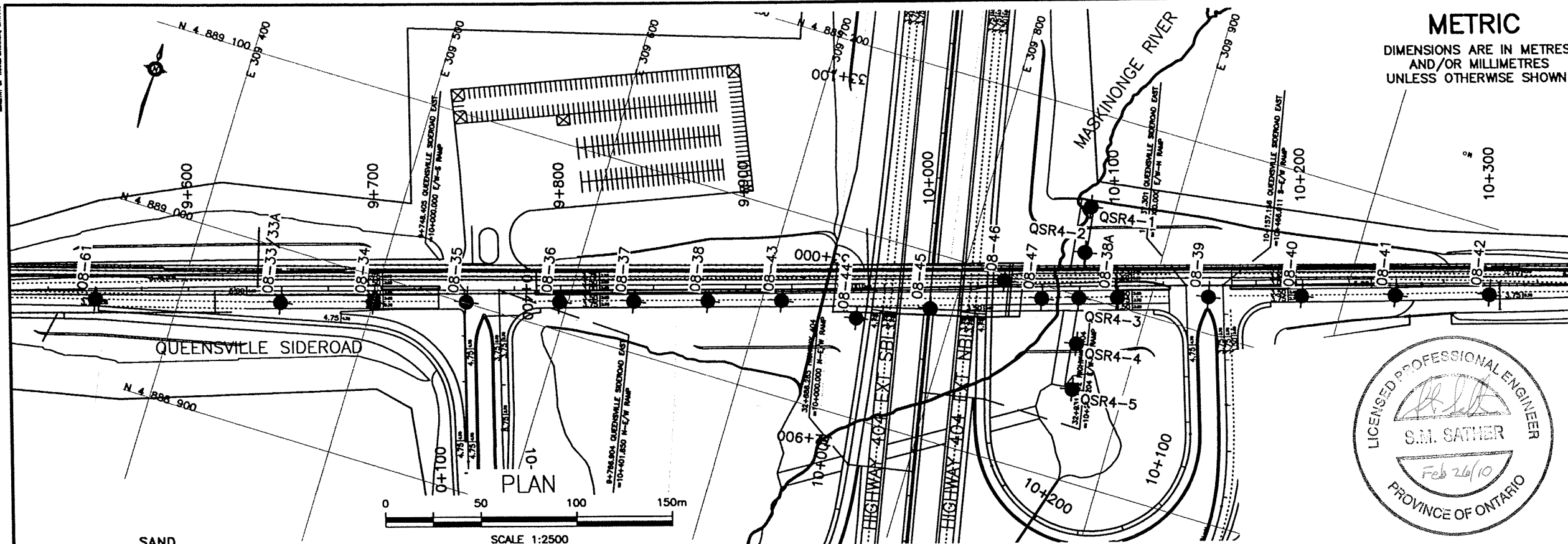


FIGURE 4



CONT No  
GWP No 2109-05-00

HIGHWAY 404 EXTENSION  
DEEP CUT ALONG QUEENSVILLE SIDEROAD  
STATIONS 9+550 TO 10+300  
BOREHOLE LOCATIONS AND SOIL STRATA

**THURBER ENGINEERING LTD.**  
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

**KEYPLAN**

**LEGEND**

- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-33/33A	284.0	4 888 970.8	309 452.5
08-34	281.3	4 888 985.7	309 500.2
08-35	277.7	4 889 000.6	309 548.0
08-36	273.5	4 889 015.4	309 595.7
08-37	270.1	4 889 027.4	309 633.9
08-38	266.9	4 889 039.3	309 672.1
08-38A	257.3	4 889 105.0	309 882.8
08-39	259.0	4 889 119.6	309 929.8
08-40	261.3	4 889 134.5	309 977.6
08-41	263.7	4 889 149.4	310 025.3
08-42	264.4	4 889 164.3	310 073.0
08-43	263.9	4 889 051.2	309 710.3
08-44	259.1	4 889 053.5	309 751.4
08-45	258.3	4 889 070.2	309 788.1
08-46	256.7	4 889 096.4	309 821.8
08-47	257.4	4 889 092.8	309 843.9
08-61	284.9	4 888 943.1	309 357.2

**-NOTES-**

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

**GEOCRES No. 31D-492**

DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC
DRAWN	MFA	CHK AEG

DATE MAR. 2010

**LICENSED PROFESSIONAL ENGINEER**  
S.M. SATHER  
Feb 26/10  
PROVINCE OF ONTARIO

**LICENSED PROFESSIONAL ENGINEER**  
P.K. CHATTERJI  
Feb 26/10  
PROVINCE OF ONTARIO

## **Appendix F**

### **List of SPs and OPSS**

#### **Suggested Text for Selected NSSP**

**1. List of Special Provisions and OPSS Documents Referenced in this Report**

- OPSS 1010
- Special Provision No. 110F13
- OPSS 501
- OPSS 511
- SP 206S03
- Special Provision 572S01
- SSP 105S10
- OPSD 208.010
- SP 105S19

OPSS 206, as amended by Special Provision “Amendment to OPSS 206, December 1993”, dated November 2002.

**2. Suggested text for a NSSP on Excavation within the very dense/hard tills.**

Cobbles and boulders should be expected within the sand and silt till, silt till and silty clay till layers. Accordingly, excavation of the lower zones of the till may be difficult.

**3. Suggested text for NSSP relating to gravel sheeting.**

The Contractor’s attention is drawn to the fact that the base of some cut sections will lie below the groundwater level. In these sections, gravel sheeting may be required to control groundwater seepage and surface soil sloughing.

Gravel sheeting shall be placed in accordance with the requirements of OPSS 511.

Gravel sheeting shall only be placed to the extent directed by the Contract Administrator.