

**FOUNDATION INVESTIGATION REPORT  
NEW BRIDGE OVER NORTH SCHOMBERG RIVER  
FILL EMBANKMENTS AND SUCKER CREEK CULVERT  
HIGHWAY 400 AND LINE 5 INTERCHANGE RECONSTRUCTION  
BRADFORD WEST GWILLIMBURY, ONTARIO  
TBWG WP P13-03  
MTO GWP 2122-10-00**

**GEOCRES No. 31D-605**

**Report to**

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- Appendix D Sucker Creek culvert extension - Highway 400  
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Each of Appendices A to D includes:

- Record of Borehole Sheets
- Laboratory Test Results
- Drawings titled “Borehole Locations and Soil Strata”

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the design and reconstruction of the Highway 400 and Line 5 interchange in the Town of Bradford West Gwillimbury, Ontario. This report includes geotechnical recommendations for the following design components: new bridge structure at Sideroad 5, Sucker Creek culvert extensions, high fills at the new Ramps N-EW and ES.

The purpose of this investigation was to explore the subsurface conditions at the specific location of each of the proposed project component and, based on the data obtained, to provide borehole location plans and soil strata drawings with stratigraphic profiles and cross-sections (where required), records of boreholes, laboratory test results and written descriptions of the subsurface conditions. A model of the subsurface conditions was developed for the site based on the data obtained from the present investigation.

Thurber Engineering Ltd. (Thurber) carried out the investigation as a foundation sub-consultant to AECOM, ultimately for the Town of Bradford West Gwillimbury (TBWG).

**2 PROJECT AND SITE DESCRIPTION**

The site is located at the existing Highway 400 and Line 5 interchange; approximately 2.5 km south of Highway 400 and Simcoe Road 88 (former Highway 88) interchange in the Town of Bradford West Gwillimbury, Ontario.

This report presents subsurface data for the high fills and ancillary structures of the proposed interchange reconstruction. Foundation information of the main Highway 400 Line 5 underpass bridge and its immediate approaches are presented in Thurber report titled "Foundation Investigation Report, Highway 400 Line 5 Underpass and Interchange Reconstruction, Bradford West Gwillimbury, Ontario", TBWG WP P13-03, MTO GWP 2122-10-00, dated January 16, 2015.

Details of the major project components covered by this report are summarized in the following table.

Project Component	Location
New bridge	- Realigned Sideroad 5 over the North Schomberg River (approximately 700 m west of Highway 400)
High fill embankments (higher than 4.5 m)	- Line 5 (near Station 9+740) - Ramps N-EW, E-S and W-N (near Line 5)
Low embankments (lower than 4.5 m)	- Ramps S-EW and W-S, and Coffey Road
Sucker Creek culvert extension	- East and west extensions to Sucker Creek culvert under Highway 400 (approximately 450 m north of Line 5)

The lands surrounding the interchange are relatively flat and primarily used for agricultural purposes. The existing Sideroad 5 and Coffey Road run alongside Highway 400 at the southwest and southeast quadrants, respectively. The North Schomberg River meanders on the west side of Highway 400 and flows under the highway through a culvert to the north of Line 5. Within the project area, vegetation cover largely consists of grass with some shrubs and small trees along the highway and Line 5. On the west side of Highway 400, the land is relatively flat.

Within the area of the new bridge at the proposed realigned Sideroad 5, the land is relatively flat and covered with grass and shrubs, some residential dwellings are located approximately 150 m north of the Line 5 and Sideroad 5 crossing.

From published geological information, the site is located within the physiographic region known as the Schomberg Clay Plains which consists of deep deposits of stratified clay and silt overlying a drumlinized till plain. Depending on their sizes, the drumlins are completely or partially buried by the clays and silt deposits. The clay and silt deposits have average thicknesses of about 5 m although thicker deposits have also been identified.

### 3 SITE INVESTIGATION AND FIELD TESTING

Details of the site investigation and field testing for each project component are presented in Table 3.1. Some of the boreholes were supplemented by dynamic cone penetration testing (DCPT) conducted from the base of the sampled borehole and extended to practical refusal or adequate depth below the foundations.

**Table 3.1 – Borehole Designations and Details**

Design component	Date (2014)	Borehole	Sampled borehole termination depth* (m)	Sampled borehole termination elevation* (m)	Appendi x
<b>New Bridge</b>					
New bridge at realigned Sideroad 5 over the North Schomberg River	November 6, 7, 10, 27, 28, December 1	14-43, 14-44 14-45, 14-46 14-47, 14-48	9.4 to 15.7	203.4 to 212.0	A
<b>High Fills</b>					
High fill for Ramp N-EW (max. height 9.0 m)	January 29 and 30, October 27 to 30, December 4, 5 and 8	14-01, 14-05, 14-06, 14-07, 14-08, 14-09, 14-15, 14-52, 13-24, 13-25, 13-26	8.2 to 22.2	199.6 to 215.2	B
High fill for Ramp E-S (max. height 10.0 m)	October 23, 28, 29, November 3 and 4, December 2	14-11, 14-12, 14-14, 14-17, 14-18	10.2 to 22.2	199.9 to 211.1	B
High fill for Ramp W-N (max. height 6.0 m)	November 11	14-31	8.2	217.0	B
High fill for Line 5 (max. height 6.0 m)	November 18	14-23	8.2	215.2	B
High fill and culvert	October 23, 24, 29, 30, November 4 and 5	14-15, 14-16, 14-17, 14-51	12.6 to 20.1	202.1 to 208.9	B
High fill and culvert	October 27, 28, November 4, December 3	14-10, 14-12, 14-13	9.8 to 13.3	208.3 to 211.8	B
<b>Low Fills</b>					
Ramps S-EW and W-S, and Coffey Road (embankments less than 4.5 m high)	November 14, 17 and 19	14-32 14-38 14-42	6.7 to 8.2	217.6 to 219.5	C

Design component	Date (2014)	Borehole	Sampled Borehole termination depth* (m)	Sampled Borehole termination elevation* (m)	Appendix
<b>Culvert Extension</b>					
Sucker Creek Culvert extension under Highway 400	January 16, 31, October 28, November 24	14-01, 14-02, 14-03, 14-04	9.8 to 24.7	202.8 to 216.2	D

\* Borehole termination depths include termination depth of DCPT

The approximate locations of the boreholes drilled during the investigation are shown on the attached Borehole Locations and Soil Strata Drawings in Appendices A to D. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole Sheets in Appendices A to D.

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

During this investigation, track mounted D90, D56 and D6 drill rigs were used at this site. A truck-mounted drill rig was used for boreholes drilled on the existing Highway 400, Line 5 and Sideroad 5 platforms. A combination of solid and hollow-stem augers were used to advance the boreholes. Wash-boring methods with casing and tripod were employed at five borehole locations, where drill rig access was not possible, within the northwest quadrant of the Highway 400 and Line 5 interchange. Soils samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). The in situ shear strength of the soft to firm cohesive soils was also assessed using the MTO shear vane.

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 were observed in the open boreholes during and upon completion of the drilling operations. Standpipe piezometers consisting of a 19 mm diameter Schedule 40 PVC pipe with a 3.0 m long slotted screen, were installed and enclosed in filter sand in selected boreholes to permit longer term groundwater level monitoring. The completion details of the boreholes with piezometer installations are summarized in Table 3.2. Boreholes without piezometer installations were backfilled with bentonite holeplug and drill cuttings, except for Borehole 14-52 where methane gas was encountered during drilling (see Section 3.1 for details).

**Table 3.2 – Piezometer and Borehole Completion Details**

<b>Design Component</b>	<b>Borehole Number</b>	<b>Piezometer Tip Depth / Elevation (m)</b>	<b>Completion Details</b>
New bridge at realigned Sideroad 5 over the North Schomberg River	14-45	15.4/206.4	Backfilled with filter sand from 15.4 to 12.9m, bentonite holeplug from 12.9 to 6.7 m, then bentonite holeplug and auger cuttings from 6.7 m to ground surface.
	14-47	15.2/203.7	Backfilled with filter sand from 15.5 to 11.6 m, bentonite holeplug from 11.6 to 9.4m, bentonite holeplug and auger cuttings from 9.4 to 0.9 m, then bentonite holeplug to ground surface.
High fill for Ramp N-EW	14-01	9.1/213.4	Backfilled with filter sand from 9.8 to 5.8 m, bentonite holeplug from 5.8 to 4.0 m, bentonite holeplug and auger cuttings from 4.0 to 0.15 m, then cement to ground surface.
	14-06	9.1/213.6	Backfilled with filter sand from 9.1 to 6.7 m, bentonite holeplug from 6.7 m to ground surface.
	14-08	9.1/212.3	Backfilled with filter sand from 9.8 to 5.5 m, bentonite holeplug from 5.5 to 3.0 m, bentonite holeplug and auger cuttings from 3.0 to 0.15 m, then cement to ground surface.
	13-24	7.6/215.8	Backfilled with filter sand from 8.2 to 4.3 m, bentonite holeplug and auger cuttings from 4.3 m to ground surface.
	13/25	10.7/213.5	Backfilled with filter sand from 11.3 to 7.3 m, bentonite holeplug and auger cuttings from 7.3 m to ground surface.
	13-26	10.6/215.2	Backfilled with filter sand from 11.3 to 7.3 m, bentonite holeplug and auger cuttings from 7.3 m to ground surface.
High fill for Ramp W-N	14-31	7.6/217.7	Backfilled with filter sand from 8.2 to 3.9 m, bentonite holeplug and auger cuttings from 3.9 m to ground surface.
High fill and culvert	14-16	12.8/208.4	Backfilled with filter sand from 13.3 to 9.4 m, bentonite holeplug from 9.4 m to ground surface.
	14-17	12.5/209.0	Backfilled with filter sand from 13.3 to 8.9 m, bentonite holeplug from 8.9 to 5.2 m, then bentonite holeplug and auger cuttings to ground surface.
High fill and culvert	14-10	9.1/212.3	Backfilled with filter sand from 9.8 to 6.5 m, bentonite holeplug from 6.5 m to ground surface.



Design Component	Borehole Number	Piezometer Tip Depth / Elevation (m)	Completion Details
	14-13	9.4/212.4	<u>Deep Piezometer</u> Backfilled with filter sand from 9.8 to 5.8 m, bentonite holeplug and auger cuttings from 5.8 to 0.15 m, then cement to ground surface.
		3.0/218.5	<u>Shallow piezometer</u> Backfilled with filter sand from 3.6 to 1.4 m, bentonite holeplug and auger cuttings from 1.4 to 0.15 m, then cement to ground surface.
Sucker Creek Culvert extension (north of Line 5)	14-04	10.7/211.6	Backfilled with filter sand from 11.3 to 7.3 m, then bentonite holeplug and auger cuttings from 7.3 m to ground surface.

Once groundwater monitoring is completed, all piezometer installations will be decommissioned in accordance with Ministry of the Environment Regulation 903 and its Amendments (the water well regulation under the OWRA).

### 3.1 Methane Gas

The following summarizes factual information associated with the encountering and handling of methane gas in Borehole 14-52.

- On October 30, 2014, methane gas was encountered while conducting drilling operations in Borehole 14-52. This borehole is located approximately 50 m north of Line 5 and 125 m west of Highway 400 in an open field. As the drilling advanced to 18.1 m depth (Elevation 203.8 m) within the native silty clay, the drill rig was slightly shifted. While augers were being removed, water gushed out from the borehole and then settled down at 0.9 m depth. Bubbling sound was heard in the borehole and the augers were vibrating. Drilling operations were ceased with deployment of safety measures (e.g. shut off drill rig, advise fire department, use of gas mask) and gas monitoring commencing immediately.
- On October 31, a gas detector indicated that hydrogen sulphide gas (H<sub>2</sub>S) was emitting from the borehole. An area of approximately 9 m in radius surrounding the borehole and the drill rig was cordoned off.
- On November 1, methane gas (CH<sub>4</sub>) was detected with a concentration of 30,000ppm inside the borehole.
- On November 2, the methane readings were 40,000 ppm inside and 500 ppm outside of the borehole.

- On November 3, the augers in the ground were lifted up for about 0.9 m using a mechanical jack. Before the augers were lifted, the methane reading inside the borehole was 50,000 ppm and 1,000 ppm outside. As the augers were removed, the methane gas concentration inside the borehole dropped from 50,000 ppm to 30,000 ppm. Readings in the atmosphere above the borehole decreased from 1,000 ppm to 0 ppm.
- On November 4 and 5, the borehole was grouted and backfilled using pumped cement, concrete and peltonite. Methane readings decreased from 40,000 ppm to 1,200 ppm inside the borehole (as the level of grout rose) and from 1,200 ppm to below 600 ppm immediately above the borehole (after the grout reached ground surface). The methane readings above the borehole eventually dropped to 0 ppm.
- On November 6 and 7, methane readings remained at 0 ppm above the borehole.

It is noted that the local residents indicated that methane gas has occasionally been encountered in the existing wells in the vicinity and the sound of bubbling gas is not uncommon.

#### **4 LABORATORY TESTING**

All recovered soil samples were subjected to visual identification and to natural moisture content determination. At least 25% of the recovered soil samples were subjected to grain size distribution analysis. Atterberg Limits tests were carried out on selected samples of native silty clay and silty clay till to determine the plasticity characteristics. The results of the laboratory testing are summarized on the Record of Borehole sheets and also presented on the figures included in Appendices A to F.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets included in Appendices A to F. Details of the encountered soil stratigraphy are presented in these appendices and on the “Borehole Locations and Soil Strata” drawings also in Appendices A to F. An overall description of the stratigraphy for each design component is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the subsurface stratigraphy at the location of each of the project components consists of surficial topsoil, asphalt or fill overlying native silty clay. The silty clay is generally firm to very stiff within the upper 4 to 6 m, firm to soft to approximately 11 to 12 m depth, then becomes stiff to hard with depth. Very stiff to hard silty clay till was contacted below the silty clay. The till is underlain by a dense to very dense layer of sands and silts. The groundwater level within the cohesive deposits is at, or less than 2 m depth below, existing ground surface.

## **5.1 New Bridge at realigned Sideroad 5 over the North Schomberg River**

A total of six boreholes, numbered 14-43 to 14-48, were drilled near the location of the proposed bridge at the realigned Sideroad 5, located approximately 640 m west of Highway 400. Boreholes 14-44, 14-45, 14-47 and 14-48 were drilled at the proposed abutments, and Boreholes 14-43 and 14-46 at the proposed approach embankments. Records of boreholes, laboratory testing results and stratigraphic drawings are contained in Appendix A.

### **5.1.1 Topsoil**

Topsoil was encountered at ground surface in Boreholes 14-43, 14-45, 14-46 and 14-48, with a thickness varying from 25 to 125 mm.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

### **5.1.2 Silty clay**

A deposit of native silty clay was encountered below topsoil in Boreholes 14-43, 14-45, 14-46 and 14-48 and surficially in Boreholes 14-44 and 14-47. The silty clay contained trace sand and gravel and occasional roots and rootlets. It was generally brown to grey in colour. The thickness of the silty clay ranged from 5.7 to 8.7 m. The base of this deposit varied between 5.7 and 8.8 m depths (Elevations 212.9 to 214.8 m).

In situ vane testing in the silty clay indicated that the undrained shear strength typically ranges from 44 to 100 kPa. SPT 'N' values typically ranged from 3 to 15 blows per 0.3 m of penetration indicating a firm to stiff consistency. An SPT 'N' value of 19 blows per 0.3 m of penetration was measured in Borehole 14-46 indicating a very stiff zone near Elevation 220.8 m. The moisture contents ranged from 14% to 35%.

Samples of silty clay were subjected to gradation analysis and Atterberg Limits testing. Grain size distribution curves for samples of silty clay tested are presented on the Record of Borehole sheets and on Figures A1 and A2 in Appendix A. Atterberg Limit test results are presented on Figures A6 and A7 of Appendix A. The results of the laboratory test are summarized as follows:

<b>Soil Particles</b>	<b>Percentage (%)</b>
Gravel	0
Sand	0 to 13
Silt	45 to 68
Clay	32 to 53

Soil Particles	Percentage (%)
Liquid Limit	28 to 37
Plasticity Index	8 to 17

The results indicate that the silty clay typically has low to medium plasticity (CL to CI).

#### 5.1.3 Sandy silt, Sand and Silt to Silty Sand

A layer of sandy silt, sand and silt to silty sand containing trace gravel, trace to some clay and occasional clay pockets was contacted below the silty clay in all the boreholes, except in Borehole 14-46 at depths ranging from 5.7 to 8.8 m. The thickness of these cohesionless soils ranged from 3.0 to 6.2 m in Boreholes 14-44, 14-45 and 14-48. Boreholes 14-43 and 14-47 were terminated within the sand and silt layers at 9.4 and 15.5 m depths (Elevations 210.7 to 203.4 m), respectively. Where fully penetrated, the base of these soils were at 8.8 to 13.2 m depths (Elevations 211.7 to 208.5 m).

SPT 'N' values recorded in the sands and silts ranged from 18 blows for 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration indicating a compact to very dense condition.

The moisture contents generally ranged from 4% to 13%. Moisture contents of 20% were measured in Boreholes 14-44 and 14-48.

Samples of sandy silt, sand and silt, and silty sand were subjected to gradation analysis. Grain size distribution results are presented on the Record of Borehole sheets and on Figure A3 of Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 13
Sand	17 to 57
Silt	20 to 58
Clay	8 to 25

#### 5.1.4 Sand and Gravel

A layer of sand and gravel was encountered below the silty sand at 8.8 m depth in Borehole 14-44. The thickness of the sand and gravel layer was 1.4 m. The base of the layer was at 10.2 m depth (Elevation 210.3 m).

An SPT 'N' value recorded in the sand and gravel was 100 blows for less than 0.3 m of penetration indicating a very dense state.

The moisture content of the sand and gravel was 9%.

### 5.1.5 Silty Clay Till

Grey silty clay till containing some sand and trace to some gravel was contacted below the sands and silts at 10.2 m depth in Borehole 14-44, at 11.8 m depth in Borehole 14-45, below the silty clay at 8.5 m depth in Borehole 14-46, and at 13.2 m depth in Borehole 14-48. The thickness of the silty clay till was 2.0 m where fully penetrated in Borehole 14-44. The base of the silty clay till was at 12.2 m depth (Elevations 208.3 m) in Borehole 14-44. Boreholes 14-45, 14-46 and 14-48 were terminated within the silty clay till at 9.8 to 15.7 m depths (Elevation 206.0 to 212.0 m).

Where measured, SPT 'N' values were greater than 100 blows for less than 0.3 m of penetration indicating a hard consistency. An 'N' value of 23 blows per 0.3 m of penetration indicating a very stiff consistency was measured in the silty clay till in Borehole 14-46.

The measured moisture content of samples of the silty clay till ranged from 9% to 13%.

Two samples of the silty clay till were subjected to gradation analysis. Grain size distribution results are presented on the Record of Borehole sheets and on Figure A4 of Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	3 to 7
Sand	27 to 30
Silt	41 to 45
Clay	21 to 26

Glacial tills inherently contain cobbles and boulders.

### 5.1.6 Sand

A layer of sand containing trace silt and trace gravel was contacted below the silty clay till in Borehole 14-44 at 12.2 m depth. Boreholes 14-44 was terminated within the sand layer at 13.9 m depth (Elevation 206.6 m).

SPT 'N' values recorded in the sand were 100 blows for less than 0.3 m of penetration indicating very dense condition.

The measured moisture contents of samples of the sand were between 8% and 9%.

A sample of sand was subjected to gradation analysis. Grain size distribution curve for the sand sample tested is presented on the Record of Borehole sheets and on Figure A5 of Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	9
Sand	56
Silt	26
Clay	9

### 5.1.7 Groundwater Levels

Water levels were observed in the open boreholes upon completion of drilling operations. Standpipe piezometers were installed in two boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers along with the measurements recorded in the open boreholes upon completion of drilling are summarized in Table 5.1.

**Table 5.1 – Water Level Measurements**

Borehole Number	Date	Water Levels		Comment
		Depth (m)	Elevation (m)	
14-43	November 7, 2014	1.1	219.0	Open borehole
14-44	November 6, 2014	1.3	219.2	Open borehole
14-45	December 8, 2014	0.7	221.1	Piezometer
	January 6, 2015	0.9	220.9	Piezometer
14-46	November 27, 2014	2.6	219.2	Open borehole
14-47	December 8, 2014	0.9	218.0	Piezometer
	January 6, 2015	0.5	218.4	Piezometer
14-48	November 28, 2014	1.9	219.8	Open borehole

The piezometric readings indicate that water level at this site ranges from 0.5 to 0.9 m depths below ground surface (Elevations 218.4 to 220.9 m).

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

### 5.2 High Fills for Ramps N-EW, E-S and W-N, and Line 5 (near Station 9+740)

A total of twenty two boreholes (numbered 14-01, 14-05 to 14-18, 14-23, 13-24, 13-25, 13-26, 14-31, 14-51, 14-52) were drilled at the northwest quadrant of the Highway 400 and Line 5 interchange, where two ramps (high fills) and two new culverts are proposed. The high fills are approximately 9 to 10 m high. Selected boreholes were positioned along the alignments of Ramps N-EW and E-S, and Culverts 1E and 1H. Two of these boreholes were drilled along alignments of Ramp W-N and Line 5 (Station 9+740), respectively, where embankments are between 4.5 and 6.0 m high. Dynamic cone penetration testing

(DCPT) was conducted from the base of Boreholes 14-09 and 14-14 which extended to 22.2 m depth.

### 5.2.1 Topsoil

Topsoil was encountered surficially in all the boreholes drilled for the high fills and Culverts 1E and 1H, except in Boreholes 14-05 and 14-23. The topsoil thickness typically ranged from 150 to 800 mm, except in Boreholes 14-06, 14-14, 14-16 and 13-25 where the topsoil thickness varied from 25 to 100 mm.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

### 5.2.2 Fill

A layer of brown to grey silty clay fill with sand, trace to some gravel with occasional rootlets and wood fibres was contacted below the topsoil in Boreholes 13-25 and 13-26. The thickness of the silty clay fill was 2.8 to 2.9 m. A 0.6 m thick layer of brown clayey silt fill with sand, trace gravel was encountered below the topsoil in Borehole 13-24. A layer of brown sand fill containing trace gravel was encountered at ground surface in Borehole 14-23. The thickness of the sand fill was 1.1 m. The depth to the base of these fill deposits ranged between 0.8 and 3.0 m (Elevations 221.1 to 222.9 m).

SPT 'N' values recorded in the silty clay/clayey silt fill ranged from 8 to 20 blows per 0.3m penetration indicating a stiff to very stiff consistency. An SPT 'N' value in the sand fill was 9 blows per 0.3 m of penetration, indicating a loose state.

The measured moisture content of samples of the silty clay/clayey silt fill ranged from 14% to 24%. A moisture content in the sand fill was measured at 13%.

Samples of silty clay/clayey silt fill were subjected to gradation analysis and Atterberg Limits testing. Grain size distribution curves for samples of silty clay/clayey silt fill tested are presented on the Record of Borehole sheets and on Figure B1 in Appendix B. Atterberg Limit test results are presented on Figures B13 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 11
Sand	21 to 38
Silt	31 to 53
Clay	19 to 26

Soil Particles	Percentage (%)
Liquid Limit	38
Plasticity Index	16

The results indicate that the silty clay fill has a medium plasticity (CI).

### 5.2.3 Sand, Sandy Silt to Silty Sand

Layers of sand, sandy silt and silty sand containing trace gravel and clay were contacted below the topsoil or interbedded within the silty clay in Boreholes 14-05 to 14-11, 14-13, 14-15, 14-17, 14-23 and 14-51 at depths ranging from 0.6 to 2.4 m. Some clay to clayey zones were noted in Boreholes 14-13 and 14-15. Gravelly sand was noted in Boreholes 14-05, 14-09, 14-10 and 14-11. The thickness of the sands and silts ranged from 0.4 to 1.8 m. The depth to the base of these cohesionless soils ranges from 1.4 to 4.1 m (Elevations 217.3 to 220.8 m).

SPT 'N' values recorded in these layers ranged from 5 to 20 blows for 0.3 m penetration indicating loose to compact conditions.

The measured moisture contents of samples of the sands and silts ranged from 5 to 20%.

Two samples of sand and silt were subjected to gradation analysis testing. The results of these tests are summarized in the table below as well as on the Record of Borehole sheets included in Appendix B. Figure B2 in Appendix B presents the grain size distribution curves for these samples.

Soil Particles	Sand/Silt
Gravel	0
Sand	41 to 42
Silt	36 to 39
Clay	20 to 22

A pocket of clay encountered within the sand layer in Borehole 14-13 was tested for Atterberg Limits and the results indicated a plasticity index of 10% and a liquid limit of 25%. This clay has a low plasticity (CL). Test results are presented in Figure B14.

### 5.2.4 Sand and gravel

A 1.1 m thick layer of sand and gravel was contacted below the sand and silt at 1.4 m depth in Borehole 14-13. The depth to the base of this layer was 2.5 m (Elevation 219.0 m).

SPT 'N' value recorded in the sand and gravel was 35 blows for 0.3 m penetration, indicating a dense condition.

The measured moisture content in the sand and gravel was 6%.



### 5.2.5 Silty clay

An extensive deposit of native brown to grey silty clay containing trace to some sand, and occasionally with sand, trace gravel was encountered typically below topsoil and the surficial cohesionless soils in all boreholes, except for Borehole 14-05 where the silty clay was contacted at ground surface. The boreholes were terminated within the silty clay at depths ranging from 8.2 to 20.1 m (Elevations 202.1 to 215.2 m).

Immediately underlying the topsoil or exposed at ground surface, a silty clay layer up to 600mm in thickness is mixed with topsoil and roots, and has higher water contents and lower SPT 'N' values. This softer layer has likely resulted from previous farming activities and free-thaw effects.

Within the silty clay, a weathered crust in the order of 3 to 4 m thick, transitioning to a lightly over-consolidated zone of between 4 m to 10 m thick, was encountered in most of the boreholes. In Boreholes 14-01, 14-05 to 14-07, 13-23 to 13-26 and 14-31, the crust was apparently thicker and measured up to about 7 m. The silty clay generally becomes stiff to very stiff with depth below the lightly over-consolidated zone.

Within the weathered crust, the SPT 'N' values recorded in the silty clay typically ranged from 4 to 22 blows per 0.3 m of penetration indicating a firm to very stiff consistency. Field vane shear strengths measured in the crust in Borehole 14-01 ranged from 55 to 90 kPa. There were occasional soft zones at shallow depths as indicated by 'N' values of 3 blows.

In the underlying lightly over-consolidated zone, the SPT 'N' values generally varied from 1 to 8 blows per 0.3 m of penetration. In conjunction with field vane shear values generally ranging between 20 and 50 kPa, this zone has a soft to firm consistency. Occasional values up to 60 kPa indicate the presence of stiff layers.

The measured moisture content of samples of the silty clay ranged from 9% to 38%. A moisture content of 50% was measured in Borehole 14-06 at about 8 m depth.

Samples of silty clay were subjected to gradation analysis and Atterberg Limits testing. Grain size distribution curves for samples of silty clay tested are presented on the Record of Borehole sheets and on Figures B3 to B12 in Appendix B. Atterberg Limit test results are presented on Figures B15 to B21 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 5
Sand	0 to 40
Silt	26 to 72
Clay	21 to 59

Soil Particles	Percentage (%)
Liquid Limit	21 to 38
Plasticity Index	9 to 19

The results indicate that the silty clay typically has low plasticity (CL). Two samples of the silty clay from Borehole 13-24 and one sample from Borehole 13-25 showed medium plasticity (CI).

#### 5.2.6 Silt

A layer of grey silt containing trace sand and clay was contacted at 16.9 m depth in Borehole 14-14. The thickness of the silt layer was 1.4 m. The depth to the base of the silt was at 18.3 m (Elevation 203.8 m).

An SPT 'N' value of 14 blows per 0.3 m of penetration indicating a compact state was measured.

The measured moisture content of a sample of the silt was 22%.

#### 5.2.7 Groundwater Levels

Water levels were observed in the open boreholes upon completion of drilling operations. Standpipe piezometers were installed in twelve boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers along with the measurements recorded in the open boreholes upon completion of drilling are summarized in Table 5.2.

**Table 5.2 – Water Level Measurements**

Borehole Number	Date	Water Levels		Comment
		Depth (m)	Elevation (m)	
14-01	November 7, 2014	1.4	221.1	Piezometer
	December 8, 2014	1.2	221.3	Piezometer
	January 6, 2015	1.4	221.1	Piezometer
14-05	December 8, 2014	1.1	221.1	Open borehole
14-06	December 8, 2014	1.0	221.7	Piezometer
	January 6, 2015	1.0	221.7	Piezometer
14-07	December 4, 2014	1.6	220.0	Open borehole
14-08	November 7, 2014	2.5	219.0	Piezometer
	December 8, 2014	2.4	219.1	Piezometer
	January 6, 2015	2.7	218.8	Piezometer
14-09	October 29, 2014	2.1	219.7	Open borehole
14-10	December 8, 2014	1.4	220.0	Piezometer
	January 6, 2015	2.1	219.3	Piezometer
14-11	December 2, 2014	1.4	219.9	Open borehole
14-12	November 4, 2014	1.9	219.7	Open borehole

14-13	December 8, 2014	1.2*	220.3	Piezometer
	January 6, 2015	1.3*	220.2	Piezometer
14-14	December 8, 2014	1.2	220.3	Piezometer
	January 6, 2015	1.4	220.1	Piezometer
14-14	October 29, 2014	2.5	219.6	Open borehole
14-15	October 30, 2014	1.9	220.3	Open borehole
14-16	November 7, 2014	1.6	219.6	Piezometer
	December 8, 2014	1.4	219.8	Piezometer
	January 6, 2015	2.0	219.2	Piezometer
14-17	November 7, 2014	1.9	219.6	Piezometer
	December 8, 2014	1.7	219.8	Piezometer
	January 6, 2015	1.7	219.8	Piezometer
14-18	November 3, 2014	2.0	219.9	Open borehole
13-24	February 26, 2014	2.5	220.9	Piezometer
13-25	February 26, 2014	2.5	221.7	Piezometer
13-26	February 26, 2014	4.7	221.2	Piezometer
14-31	December 8, 2014	0.3	225.0	Piezometer
	January 6, 2015	0.4	224.9	Piezometer
14-51	October 24, 2014	1.7	219.8	Open borehole
14-52	October 30, 2014	1.0	220.9	Open borehole

\* Shallow piezometer

The piezometric readings indicate that the water level to the west of Highway 400 ranges from 1.0 to 2.7 m depth below ground surface (Elevations 218.8 to 221.7 m). On the east side of Highway 400, Borehole 14-31 recorded a water level very close to ground surface at 0.4 m depth, or Elevation 224.9 m.

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

### 5.3 Ramps S-EW and W-S, and Coffey Road - Fills lower than 4.5 m

Boreholes 14-32, 14-38 and 14-42 were drilled at selected locations within the alignments of the proposed Ramps S-EW and W-S, and Coffey Road (Station 10+890), respectively, where the embankments are lower than 4.5 m.

#### 5.3.1 Topsoil

Topsoil of 0.8 m in thickness was contacted surficially in Borehole 14-42.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

#### 5.3.2 Asphalt

Pavement structure consisting of asphalt overlying granular fill materials (road base) was encountered in Boreholes 14-32 and 14-38. The thickness of the asphalt was 25 to 100mm.

### 5.3.3 Fill

A layer of brown to dark brown sand fill containing some gravel to gravelly was contacted below the asphalt in Boreholes 14-32 and 14-38. The thickness of the sand fill was 0.8 and 1.1 m in Boreholes 14-32 and 14-38, respectively. The depth to the base of the sand fill was 0.9 to 1.1 m (Elevations 226.8 to 224.2 m).

An SPT 'N' value for the sand fill of 12 blows per 0.3 m indicated a compact condition.

Moisture contents measured in this fill ranged from 4% to 7%.

### 5.3.4 Sandy silt

A 0.6 m thick layer of native brown sandy silt was encountered below the sand fill at 0.9 m depth in Borehole 14-32. The depth to the base of the sandy silt was 1.5 m (Elevation 226.2 m).

An SPT 'N' value of 19 blows per 0.3 m of penetration was measured in the sandy silt indicating a compact condition.

A moisture content measured in the sandy silt was 19%.

### 5.3.5 Silty clay

Native brown to grey silty clay containing trace sand and gravel was encountered below the topsoil, sand fill and sandy silt layers. Cobbles were inferred in Borehole 14-42 near Elevation 220.4 m.

Boreholes 14-32, 14-38 and 14-42 were terminated within the silty clay at depths ranging from 6.7 to 8.2 m (Elevations 217.6 to 219.5 m).

SPT 'N' values recorded in the silty clay typically ranged from 11 to 27 blows per 0.3 m of penetration indicating a stiff to very stiff consistency. An SPT 'N' value of 49 blows per 0.3 m of penetration, indicating a hard consistency, was measured in Borehole 14-42 near Elevation 221 m. The measured moisture content ranged from 15% to 29%.

Samples of silty clay were subjected to gradation analysis and Atterberg Limits testing. Grain size distribution curves for samples of silty clay tested are presented on the Record of Borehole sheets and on Figure C1 of Appendix C. Atterberg Limit test results are presented on Figure C2 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0
Sand	0 to 4
Silt	55 to 63
Clay	37 to 45

Soil Particles	Percentage (%)
Liquid Limit	28 to 37
Plasticity Index	12 to 17

The results indicate that the silty clay typically has low plasticity (CL) with occasional zones of medium plasticity (CI).

#### 5.3.6 Groundwater Levels

The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.3. No piezometer was installed in any of these three boreholes.

**Table 5.3 – Water Level Measurements**

Borehole Number	Date	Water Levels		Comment
		Depth (m)	Elevation (m)	
14-38	November 17, 2014	1.9	223.4	Open borehole
14-42	November 14, 2014	3.4	220.9	Open borehole

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

#### 5.4 Sucker Creek Culvert Extension - Highway 400 north of Line 5

Four boreholes, numbered 14-01 to 14-04, were drilled near the culvert extension footprints at the west and east ends of the existing Sucker Creek Culvert. A dynamic cone penetration test was conducted in Borehole 14-02 which extended to 24.7 m depth (Elevation 202.8 m).

##### 5.4.1 Topsoil

Topsoil was encountered surficially in Boreholes 14-01 and 14-04, drilled at both ends of the culvert. The topsoil thickness was 800 mm and 125 mm on the west and east sides of the existing culvert, respectively.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

##### 5.4.2 Asphalt

Pavement structure consisting of asphalt overlying granular fill materials (road base) was encountered in Boreholes 14-02 and 14-03, drilled on the shoulders of Highway 400. The thickness of the asphalt was 75 to 125 mm.

### 5.4.3 Fill

A layer of granular fill consisting of brown sand and gravel, some silt, was encountered below the asphalt in Boreholes 14-02 and 14-03. The thickness of the granular fill was 1.1 m and 0.7 m in Boreholes 14-02 and 14-03, respectively.

A layer of brown silty clay fill containing trace to some sand and trace gravel was contacted below the sand and gravel fill at 0.8 m depth in Borehole 14-03. The thickness of the silty clay fill was 3.8 m. The depths to the base of the granular fill varied between 1.2 and 0.8 m (Elevations 226.3 and 226.7 m). The depth to the base of the silty clay fill was 4.6 m (Elevation 222.8 m).

SPT 'N' values recorded in the granular fill were 17 and 29 blows for 0.3 m penetration, indicating a compact condition. The SPT 'N' values of the silty clay fill ranged from 17 to 26 blows per 0.3 m of penetration indicating a very stiff consistency.

Moisture contents of the sand and gravel fill were 3% to 4%, and those measured for the silty clay fill were 7% to 21%.

One sample of the sand and gravel fill, and one sample of the silty clay fill, were subjected to laboratory gradation analysis.

Grain size distribution results for these tests are presented on the Record of Borehole sheets included in Appendix D and on Figures D1 and D2 of Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%) Granular Fill	Percentage (%) Silty Clay Fill
Gravel	39	0
Sand	50	0
Silt	-	48
Clay	-	52
Silt and Clay	11	-

A sample of the silty clay fill was tested for Atterberg Limits and the results revealed a plasticity index of 11% and a liquid limit of 26% indicating a low plasticity (CL). The results of the Atterberg Limits are presented in Figure D5 of Appendix D.

### 5.4.4 Silty Clay

A deposit of native brown to grey silty clay was encountered below the topsoil and fill. The silty clay typically contained trace gravel and trace to some sand, except in Borehole 14-02 where the clay contains a higher proportion of sand.

Borehole sampling was terminated within the silty clay at depths ranging from 9.8 m to 13.1 m (Elevations 211.0 to 216.2 m).

Within the upper crust, SPT 'N' values recorded in the silty clay typically ranged from 6 to 19 blows for 0.3 m of penetration indicating a firm to very stiff consistency. Below the crust, a firm to stiff zone was generally encountered as indicated by SPT 'N' values ranging from 4 to 9 blows per 0.3 m of penetration. In situ vane shear strengths in the silty clay ranged from 88 to 40 kPa. In Borehole 14-03, the silty clay was very stiff to stiff throughout the investigated depth.

The measured moisture contents of samples of the silty clay ranged from 9% to 26%. Moisture contents of 35% and 44% were measured at shallower depths in Borehole 14-04 indicating a layer of wet, softer clay just below the topsoil.

Samples of silty clay were subjected to gradation analysis and Atterberg Limits testing. Grain size distribution results are presented on the Record of Borehole sheets in Appendix D and on Figures D3 and D4. Atterberg Limit test results are presented on Figures D6 and D7 of Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 5
Sand	0 to 24
Silt	40 to 61
Clay	30 to 50

Soil Particles	Percentage (%)
Liquid Limit	22 to 34
Plasticity Index	11 to 15

The results indicate that the silty clay has low plasticity (CL).

#### 5.4.5 Groundwater Levels

Water levels were observed in the open boreholes upon completion of drilling operations. Standpipe piezometers were installed in two boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers along with measurements recorded in the open boreholes upon completion of drilling are summarized in Table 5.4.

**Table 5.4 – Water Level Measurements**

Borehole Number	Date	Water Levels		Comment
		Depth (m)	Elevation (m)	
14-01	November 7, 2013	1.4	221.1	Piezometer
	December 8, 2014	1.2	221.3	Piezometer
	January 6, 2015	1.4	221.1	Piezometer
14-02	November 24, 2014	5.9	221.6	Open borehole
14-03	January 16, 2014	9.4	218.1	Open borehole
14-04	January 21, 2014	1.3	221.0	Piezometer

The piezometric readings indicate that water level at this site ranges from 1.2 m to 1.4 m (Elevations 221.1 to 221.3 m) depth below ground surface.

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

## **6 MISCELLANEOUS**

Borehole locations were established in the field based on information provided by URS. The ground surface elevation and coordinates at all as-drilled borehole locations were established by Thurber upon completion of drilling. Underground utility clearances were obtained for the borehole locations prior to drilling.

Walker Drilling Inc. of Utopia, Ontario supplied track-mounted and truck-mounted drill rigs, as well as a portable rig mounted on a tripod, and conducted the drilling, sampling and in-situ testing operations.

The field investigation was supervised by Mr. George Azzopardi, C.E.T. and Ms. Eckie Siu of Thurber. Geotechnical laboratory testing was carried out in Thurber's Toronto Area laboratory.

Planning and co-ordination of the field program was conducted by Mr. Lukasz Gilarski, P.Eng. Overall direction of the program was provided by Mr. Sydney Pang, P.Eng. Interpretation of the data and preparation of this report was carried out by Mr. Sydney Pang, P.Eng. and Ms. R. Palomeque Reyna, P.Eng.

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



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## 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.

## **Appendix A**

### **New Bridge at Sideroad 5, over the North Schomberg River**

#### **Boreholes 14-43 to 14-48**

- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”

# RECORD OF BOREHOLE No 14-43

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 303.9 E 294 163.6 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.07 - 2014.11.07 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								20 40 60 80 100				w <sub>p</sub> w w <sub>L</sub>							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
220.1	GROUND SURFACE																		
0.0	TOPSOIL: (25mm)						220												
	Silty <b>CLAY</b> , trace sand, trace roots Firm to Soft Brown Moist		1	SS	6									○					
			2	SS	4		219							○					
	Grey Wet		3	SS	3									○				0 0 52 48	
217.9							218												
2.2	Stiff		4	SS	12		217							○					
			5	SS	12									○					
216.0							216												
4.1	Firm		6	SS	5		215							○					
214.4							214												
5.6			7	SS	10									○				0 0 61 39	
							213												
212.9							212							○					
7.2	Silty <b>SAND</b> , some clay, some gravel Compact Grey Moist		8	SS	29														
							211							○					
	Very Dense		9	SS	100/ 0.250													13 57 20 10	
210.7																			
9.4	END OF BOREHOLE AT 9.4m. WATER LEVEL IN OPEN BOREHOLE AT 1.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH																		

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-43

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 303.9 E 294 163.6 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.07 - 2014.11.07 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			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.													

# RECORD OF BOREHOLE No 14-44

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 297.2 E 294 173.4 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.06 - 2014.11.06 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>						
220.5	GROUND SURFACE																				
0.0	Silty <b>CLAY</b> , trace sand, occasional roots and rootlets Firm Brown Moist		1	SS	6								○								
			2	SS	4								○								
	Brown to Grey																				
			3	SS	7								○								
	Trace sand Grey Wet		4	SS	4								○								
			5	SS	4								○								
216.4																					
4.1	Stiff																				
			6	SS	8								○								
214.8																					
5.7	Silty <b>SAND</b> , some clay, trace gravel Compact Grey Wet		7	SS	22								○								
	Very Dense		8	SS	62/ 0.225								○								
211.7																					
8.8	<b>SAND</b> and <b>GRAVEL</b> Very Dense Grey Wet		9	SS	100/ 0.050								○								

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 14-44

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 297.2 E 294 173.4 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.06 - 2014.11.06 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			SHEAR STRENGTH kPa					W P      W      W L					
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE					WATER CONTENT (%)					
								20   40   60   80   100					20   40   60					
210.3	Continued From Previous Page		◊															
10.2	Silty <b>CLAY</b> , some sand, trace gravel Hard Grey Moist (TILL)						210											
			10	SS	103/ 0.275													
							209											
208.3																		
12.2	<b>SAND</b> , trace silt, trace gravel Very Dense Grey Wet		11	SS	100/ 0.075		208											
							207											
206.6			12	SS	111/ 0.200													
13.9	END OF BOREHOLE AT 13.9m. WATER LEVEL IN OPEN BOREHOLE AT 1.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																	

# RECORD OF BOREHOLE No 14-45

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 275.3 E 294 186.5 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.01 - 2014.12.01 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  <b>γ</b>  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					
221.8	GROUND SURFACE																		
0.0	TOPSOIL: (75mm)																		
0.1	Silty <b>CLAY</b> , trace sand, trace gravel, occasional roots and organics Firm to Stiff Dark Brown to Brown Moist		1	SS	6							○							
			2	SS	13							○							
			3	SS	15							○							
			4	SS	12							○							
	Grey Moist		5	SS	9							●	—					0   0   47   53	
										2.7 +									
			6	SS	6							○							
										2.4 +									
	Some sand Wet		7	SS	6							●	—					0   13   45   42	
	Wet to Moist		8	SS	14					2.0 +									
												○							
213.0	Sandy <b>SILT</b> , trace gravel Compact Grey Moist																		
8.8			9	SS	27							○							

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-45

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 275.3 E 294 186.5 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.01 - 2014.12.01 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
	Continued From Previous Page							20	40	60	80	100									
	Sandy <b>SILT</b> , trace gravel Very Dense Grey Moist  Occasional cobble		10	SS	83		211							○							
210.0							210														
11.8	Silty <b>CLAY</b> , with sand, trace gravel Hard Grey Moist (TILL)		11	SS	100/ 0.250		209							○							
			12	SS	103/ 0.250		208							○							
							207														
206.4			13	SS	113/ 0.200									○							
15.4	END OF BOREHOLE AT 15.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Dec 08/ 14      0.7      221.1 Jan 06/ 15      0.9      220.9																				

# RECORD OF BOREHOLE No 14-46

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 260.1 E 294 187.8 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.27 - 2014.11.27 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  <b>γ</b>  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      × LAB VANE				WATER CONTENT (%) W <sub>P</sub> W      W <sub>L</sub>				GR	SA	SI	CL	
221.8	GROUND SURFACE							20	40	60	80	100								
0.0 0.1	TOPSOIL: (100mm)																			
	Silty <b>CLAY</b> , trace sand, occasional roots		1	SS	10															
	Very Stiff to Stiff																			
	Dark Brown to Brown																			
	Moist																			
	Trace gravel		2	SS	19															
			3	SS	9															
219.6																				
2.2	Firm		4	SS	7													0   0   49   51		
218.8																				
3.0	Grey Moist		5	SS	8															
			6	SS	12													0   0   68   32		
216.1																				
5.6	Firm																			
			7	SS	5															
214.6																				
7.2																				
			8	SS	8													0   0   64   36		
213.3																				
8.5	Silty <b>CLAY</b> , some sand, trace gravel																			
	Very Stiff																			
	Grey																			
	Moist																			
	(TILL)																			
			9	SS	23															

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

# RECORD OF BOREHOLE No 14-47

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 289.9 E 294 160.9 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.10 - 2014.11.10 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  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											
218.9	GROUND SURFACE							<div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>WATER CONTENT (%)</div> <div>20 40 60</div>											
0.0	Silty <b>CLAY</b> , trace sand, occasional roots and rootlets Firm to Stiff Dark Brown Moist		1	SS	6		218												
			2	SS	4		217												
	Occasional wood fibres		3	SS	5		216												
	Grey		4	SS	10		215												
			5	SS	8		214												
							213												
							212												
							211												
213.2																			
5.7	Sandy <b>SILT</b> , some clay, occasional clay pockets Very Dense Grey Wet		7	SS	93		213												
							212												
	Moist		8	SS	98		211												
							210												
210.2																			
8.6	<b>SAND</b> and <b>SILT</b> , some clay, trace gravel Very Dense Grey Moist		9	SS	100/ 0.125														
208.9																			

Continued Next Page

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

# RECORD OF BOREHOLE No 14-47

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 289.9 E 294 160.9 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.10 - 2014.11.10 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							
								○ 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									
10.0	Continued From Previous Page														
	Sandy <b>SILT</b> , some clay, trace gravel Very Dense Grey Moist														
	Wet sand layer (125mm) at 10.9m		10	SS	127		208								
	Occasional sand layers		11	SS	118/ 0.200										
							206								
205.6															
13.3	Silty <b>SAND</b> , trace clay, trace gravel Very Dense Grey Moist		12	SS	100/ 0.125		205								
							204								
203.4			13	SS	103/ 0.225										
15.5	END OF BOREHOLE AT 15.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec 08/ 14 0.9 218.0 Jan 06/ 15 0.5 218.4														







ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 2/13/15

# RECORD OF BOREHOLE No 14-48

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 268.4 E 294 180.1 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.28 - 2014.11.28 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>P</sub> W      W <sub>L</sub>				GR	SA	SI	CL				
								20   40   60   80   100	○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE			WATER CONTENT (%)											
221.7	GROUND SURFACE							20	40	60	80	100											
0.0	TOPSOIL: (125mm)							20	40	60	80	100											
0.1	Silty <b>CLAY</b> , trace sand, occasional organics, occasional roots and rootlets Stiff Dark Brown to Brown Moist		1	SS	10		221																
			2	SS	12																		
			3	SS	15																	0	0
		Trace gravel							220														
	4			SS	11																		
	5			SS	8																		
	Grey Wet					219																	
							218																
						217																	
							216																
						215																	
							214																
						213																	
							212																
214.7																							
7.0	<b>SAND</b> and <b>SILT</b> , some clay, trace gravel Compact Grey Moist							214															
	Occasional inferred cobbles Very Dense						213																
						212																	

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE





# RECORD OF BOREHOLE No 14-48

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sideroad 5 Bridge N 4 881 268.4 E 294 180.1 ORIGINATED BY ES  
 HWY Sideroad 5 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.28 - 2014.11.28 CHECKED BY RPR

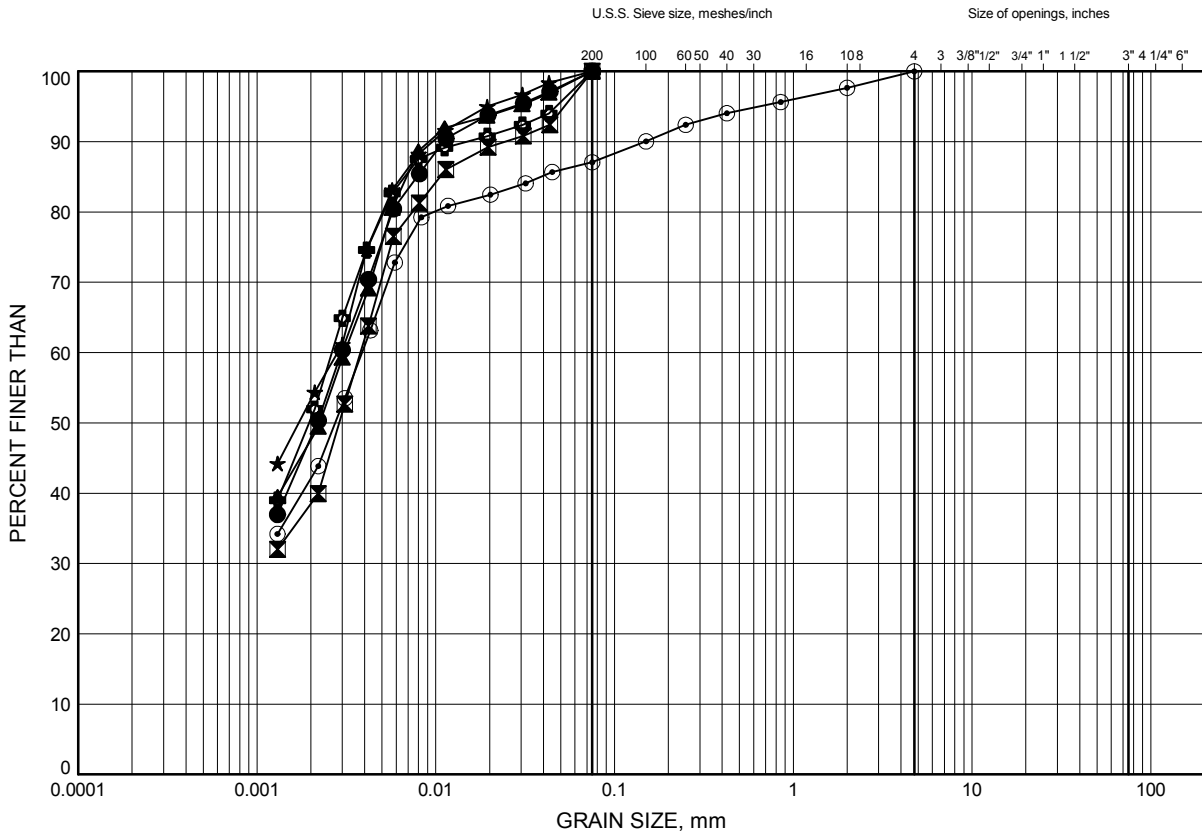
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								○ UNCONFINED      + FIELD VANE				w P      w      w L							
								● QUICK TRIAXIAL      × LAB VANE											
	Continued From Previous Page						20	40	60	80	100								
208.5	SAND and SILT, trace clay, trace gravel Very Dense Grey Moist					211													
			10	SS	124/ 0.200														
			11	SS	105/ 0.250														
13.2	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)  Occasional clay pockets					210													
206.0						209													
15.7	END OF BOREHOLE AT 15.5m. WATER LEVEL IN OPEN BOREHOLE AT 1.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.					208													
						207													

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

Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE A1

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-43	1.83	218.25
⊠	14-43	6.40	213.68
▲	14-44	2.59	217.90
★	14-45	3.35	218.48
⊙	14-45	6.40	215.43
⊕	14-46	2.59	219.19

Date February 2015  
W.P. P-13-03

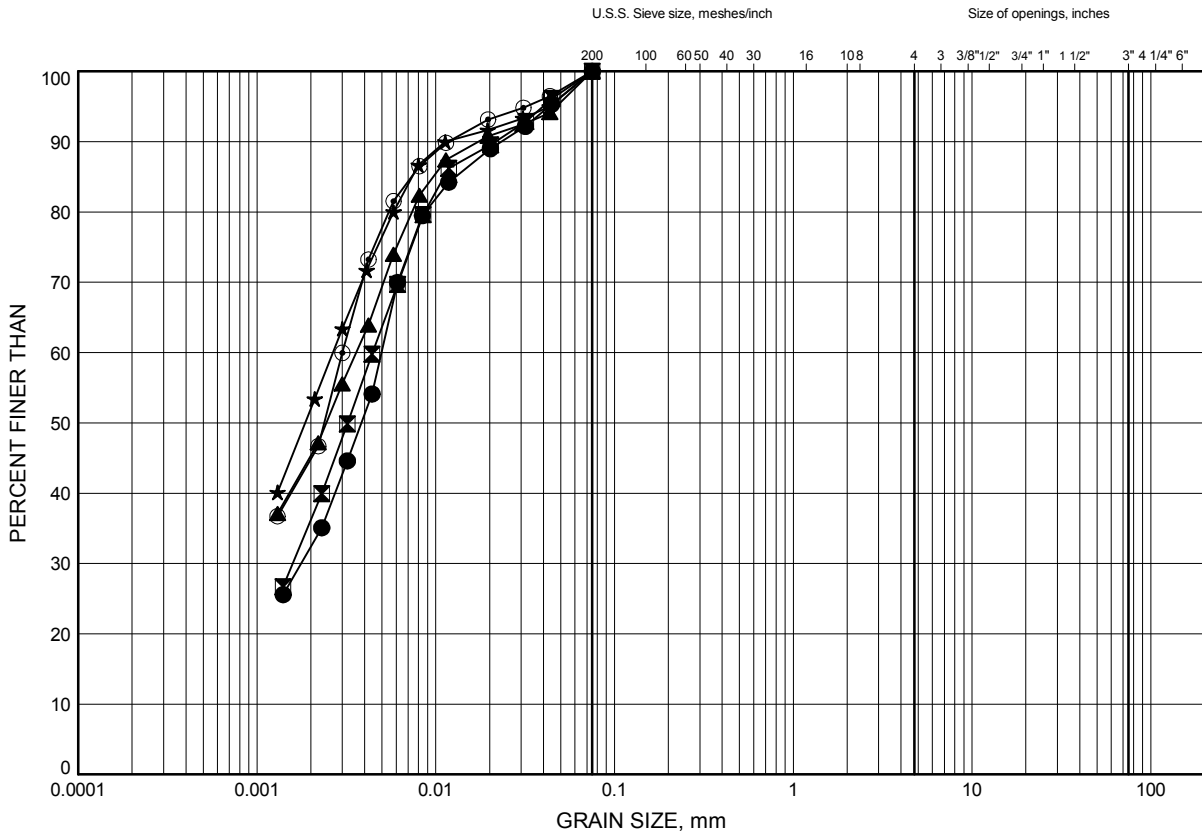


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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

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)
●	14-46	4.88	216.90
⊠	14-46	7.92	213.85
▲	14-47	1.07	217.79
★	14-48	1.83	219.89
⊙	14-48	6.40	215.32

Date February 2015  
W.P. P-13-03

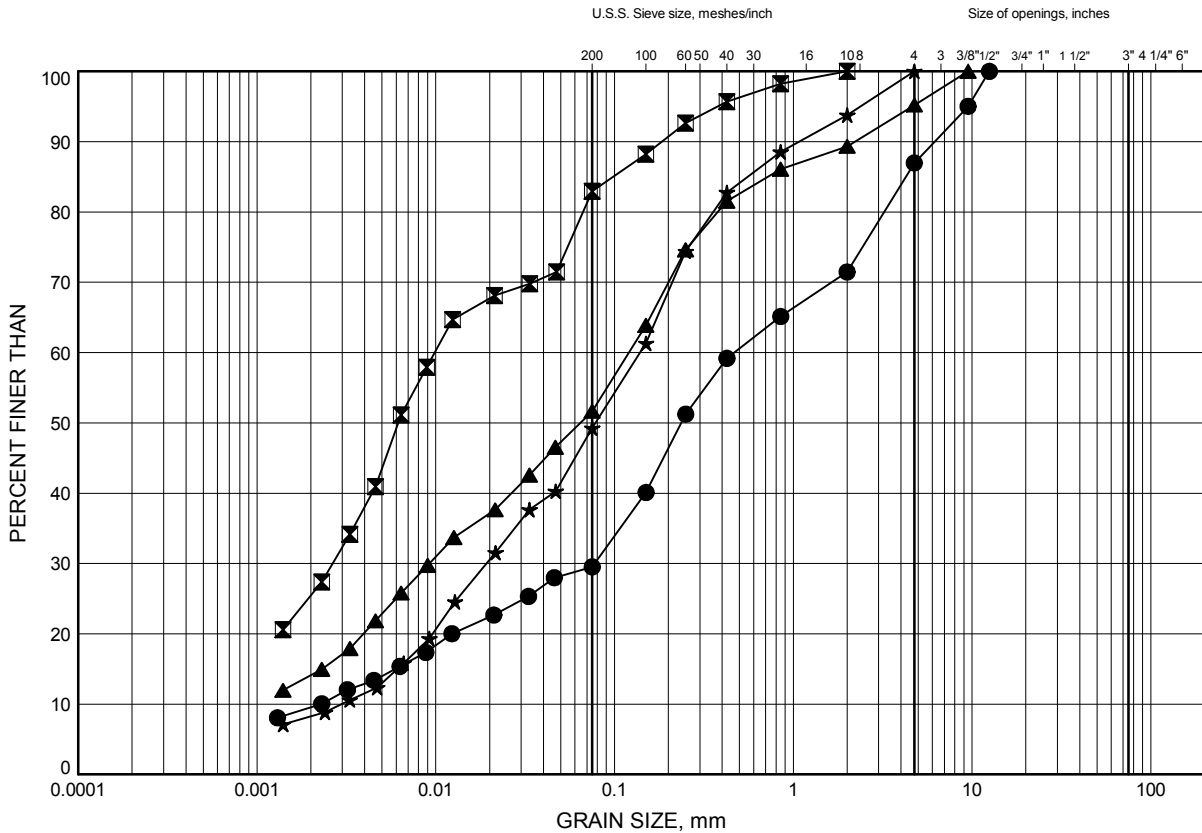


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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE A3

**SILTY SAND/SAND & SILT/SANDY SILT**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-43	9.27	210.81
⊠	14-47	6.40	212.45
▲	14-47	9.45	209.40
★	14-48	10.97	210.75

Date February 2015  
W.P. P-13-03

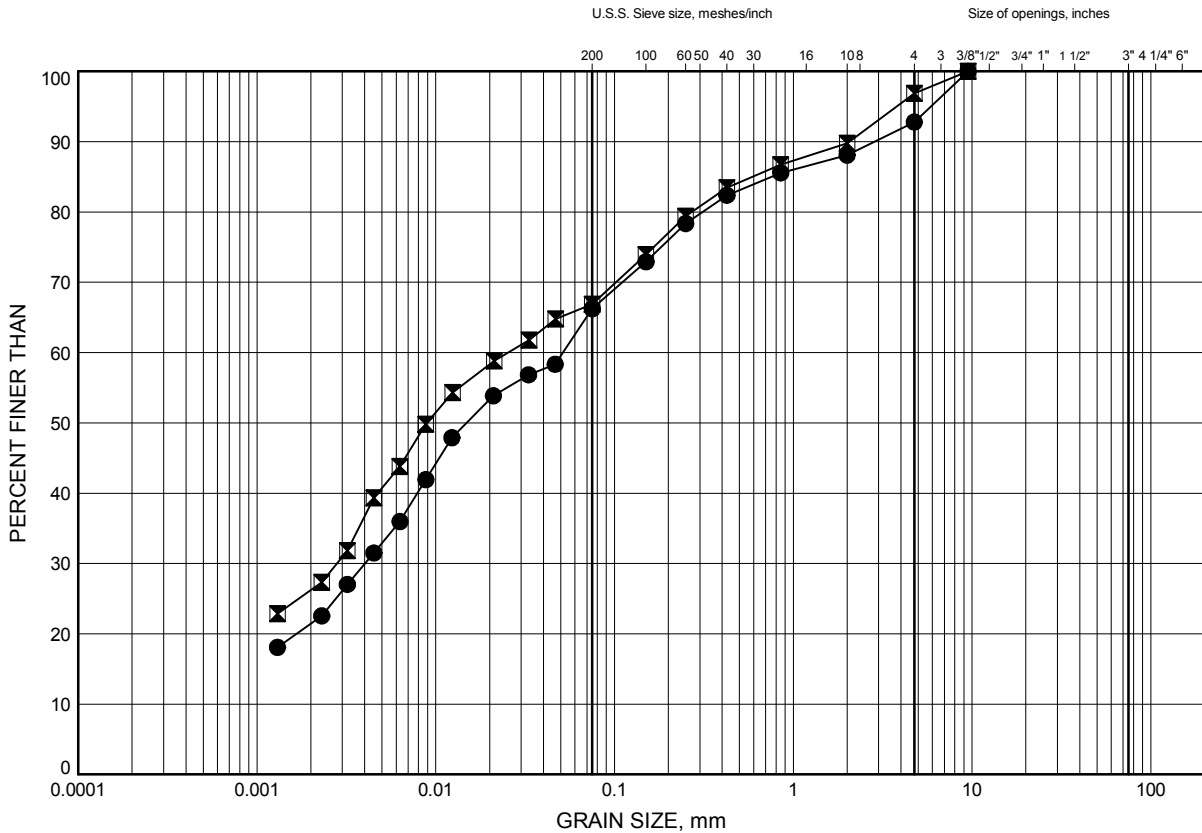


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**GRAIN SIZE DISTRIBUTION**

FIGURE A4

**SILTY CLAY TILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-45	12.50	209.34
⊠	14-48	13.83	207.89

Date February 2015  
W.P. P-13-03

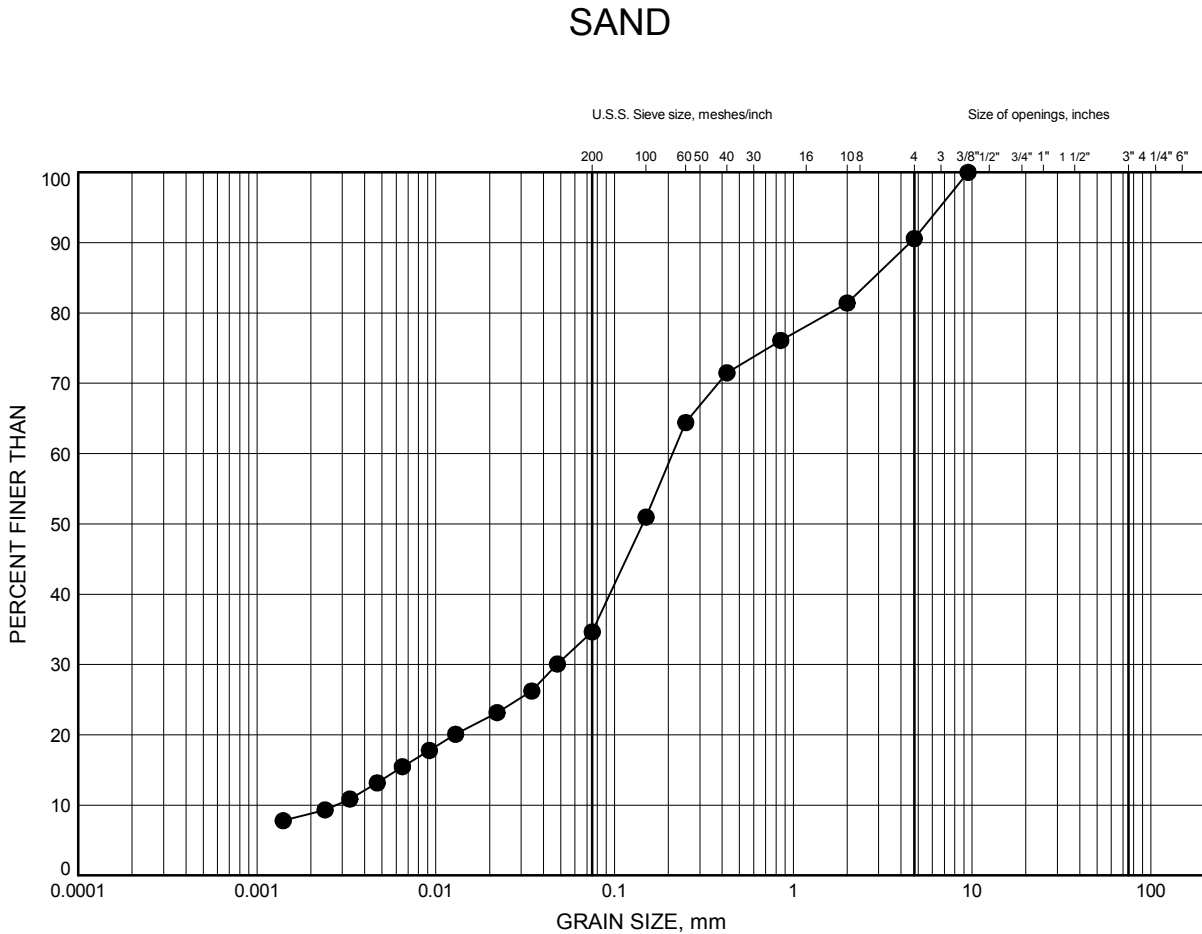


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Foundation Engineering, Hwy. 400 and 5th Line

# GRAIN SIZE DISTRIBUTION

FIGURE A5



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-47	14.02	204.83

Date February 2015  
W.P. P-13-03

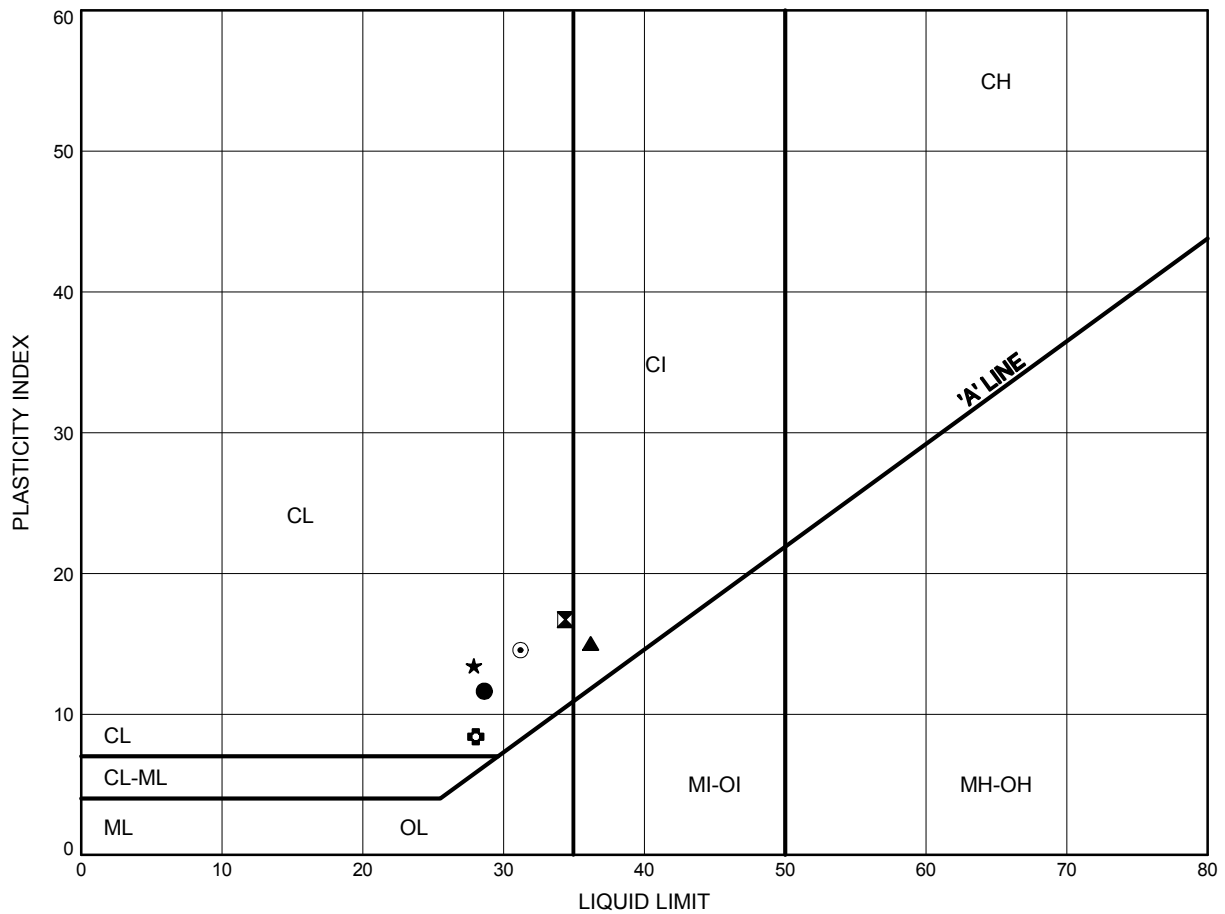


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Foundation Engineering, Hwy. 400 and 5th Line  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE A6

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-43	6.40	213.68
⊠	14-44	2.59	217.90
▲	14-45	3.35	218.48
★	14-45	6.40	215.43
⊙	14-46	2.59	219.19
⊕	14-46	4.88	216.90

Date February 2015  
 W.P. P-13-03

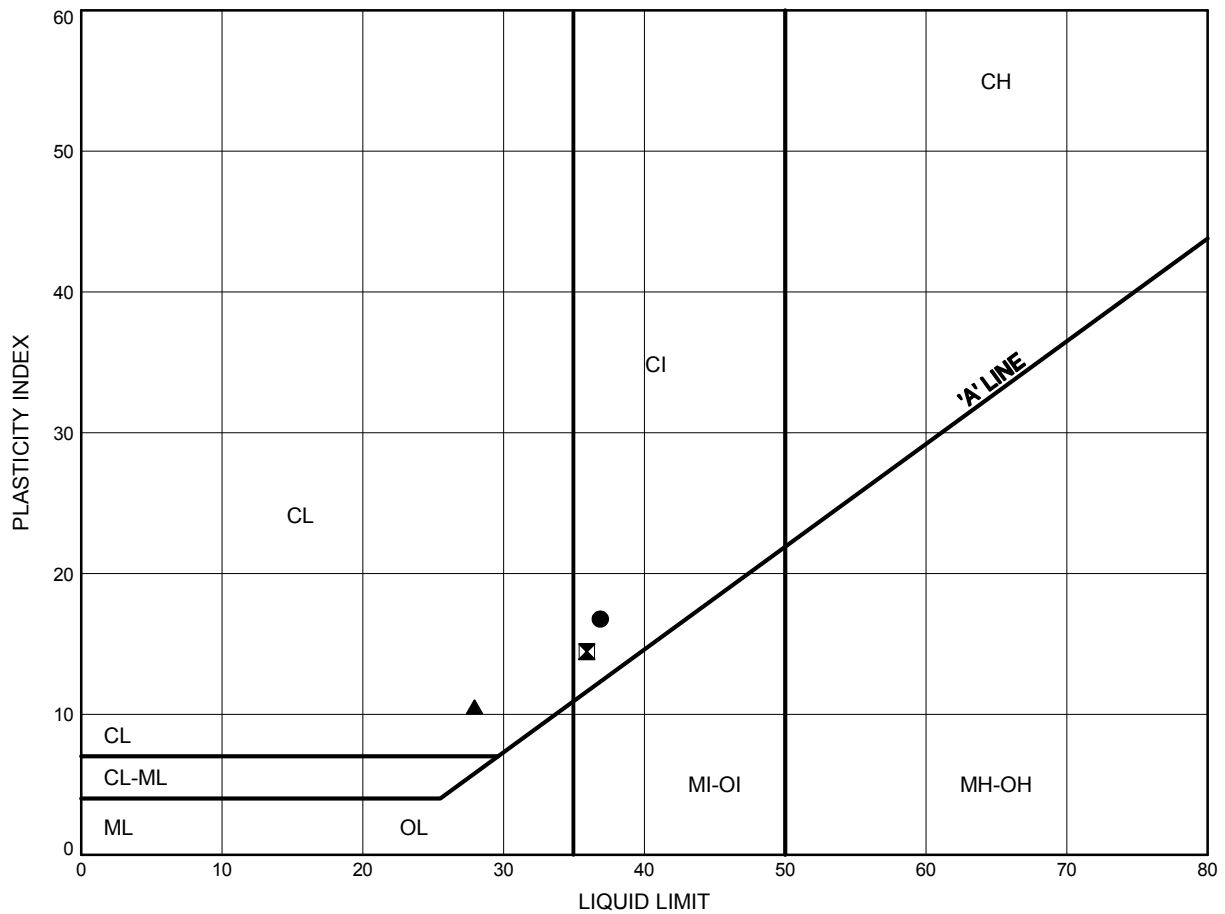


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Foundation Engineering, Hwy. 400 and 5th Line  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE A7

**SILTY CLAY**



**LEGEND**

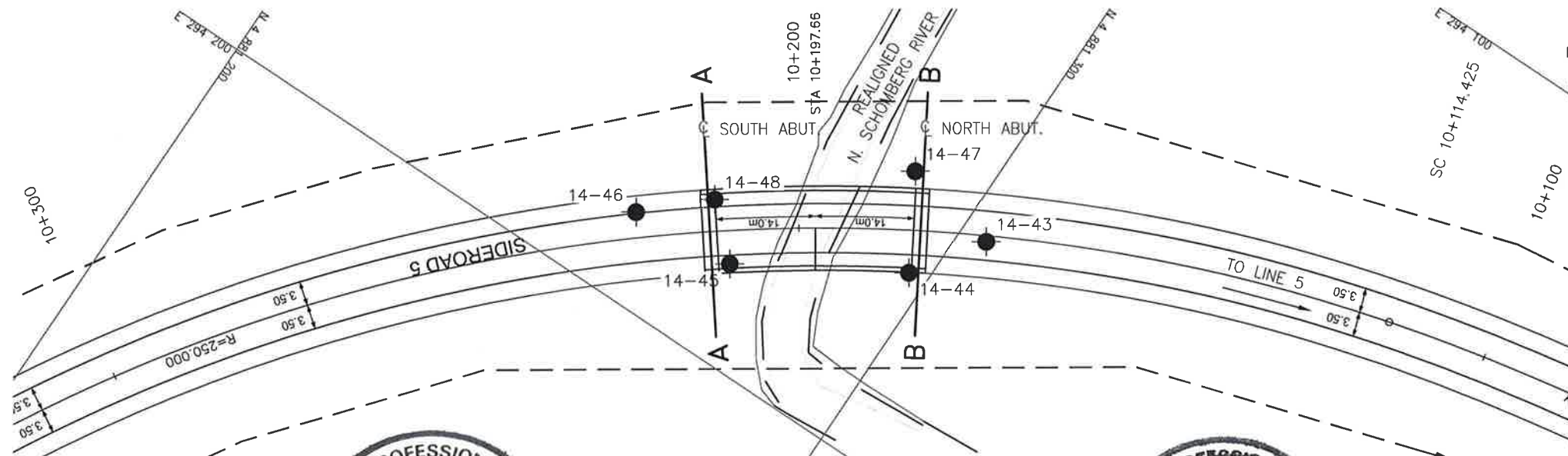
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-47	1.07	217.79
⊠	14-48	1.83	219.89
▲	14-48	6.40	215.32

Date February 2015  
 W.P. P-13-03

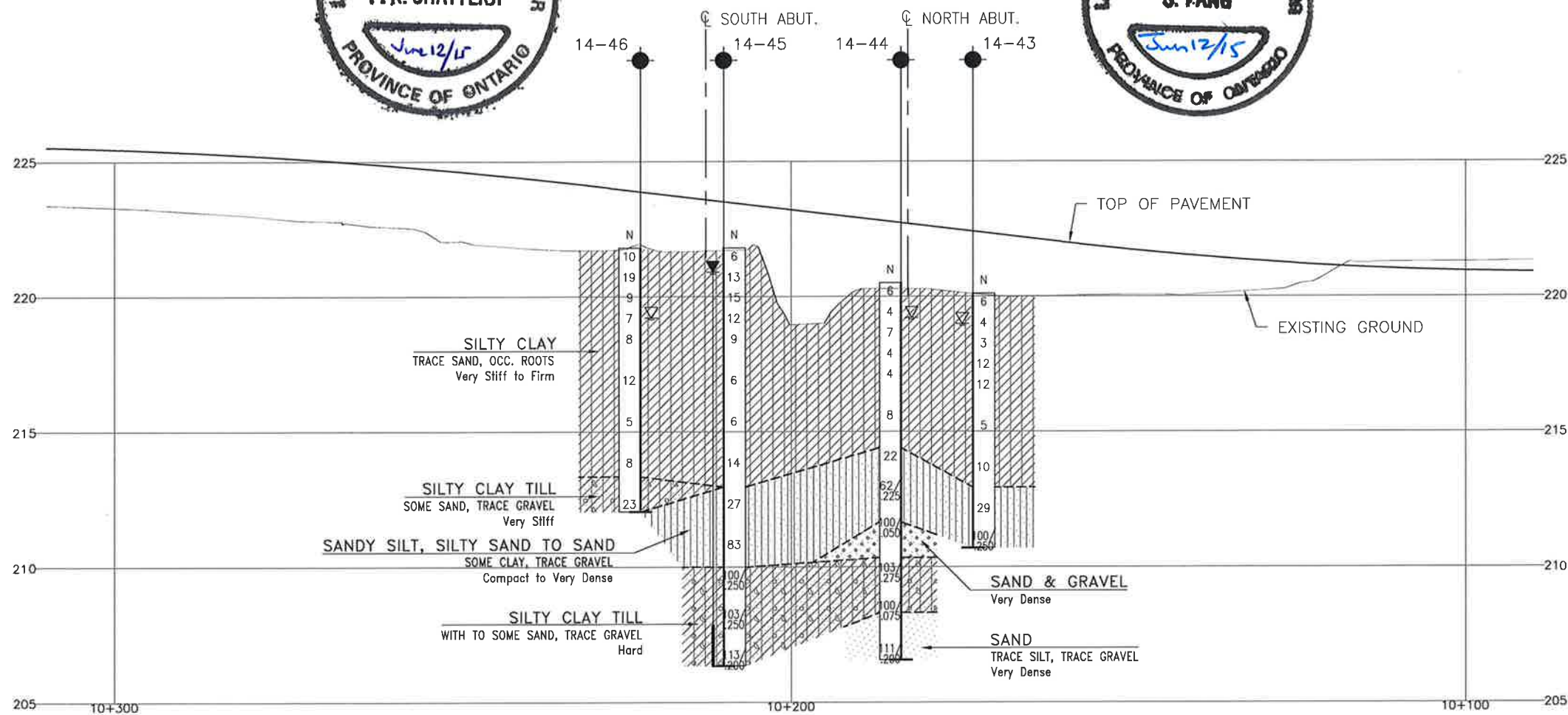


Prep'd AN  
 Chkd. RPR





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



PROFILE ALONG C SIDEROAD 5

CONT No  
WP No P13-03

HIGHWAY 400 & LINE 5  
SIDEROAD 5  
NEW BRIDGE  
BOREHOLE LOCATIONS AND SOIL STRATA

**AECOM**



THURBER ENGINEERING LTD.



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
14-43	220.1	4 881 303.9	294 163.6
14-44	220.5	4 881 297.2	294 173.4
14-45	221.8	4 881 275.3	294 186.5
14-46	221.8	4 881 260.1	294 187.8
14-47	218.9	4 881 289.9	294 160.9
14-48	221.7	4 881 268.4	294 180.1

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-605

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			DATE JUN 2015
			STRUCT
			DWG 1A

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

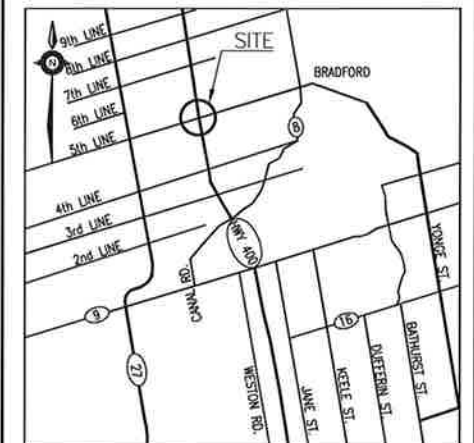
CONT No  
WP No P13-03

HIGHWAY 400 & LINE 5  
SIDEROAD 5  
NEW BRIDGE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








**THURBER ENGINEERING LTD.**



## KEYPLAN

### LEGEND

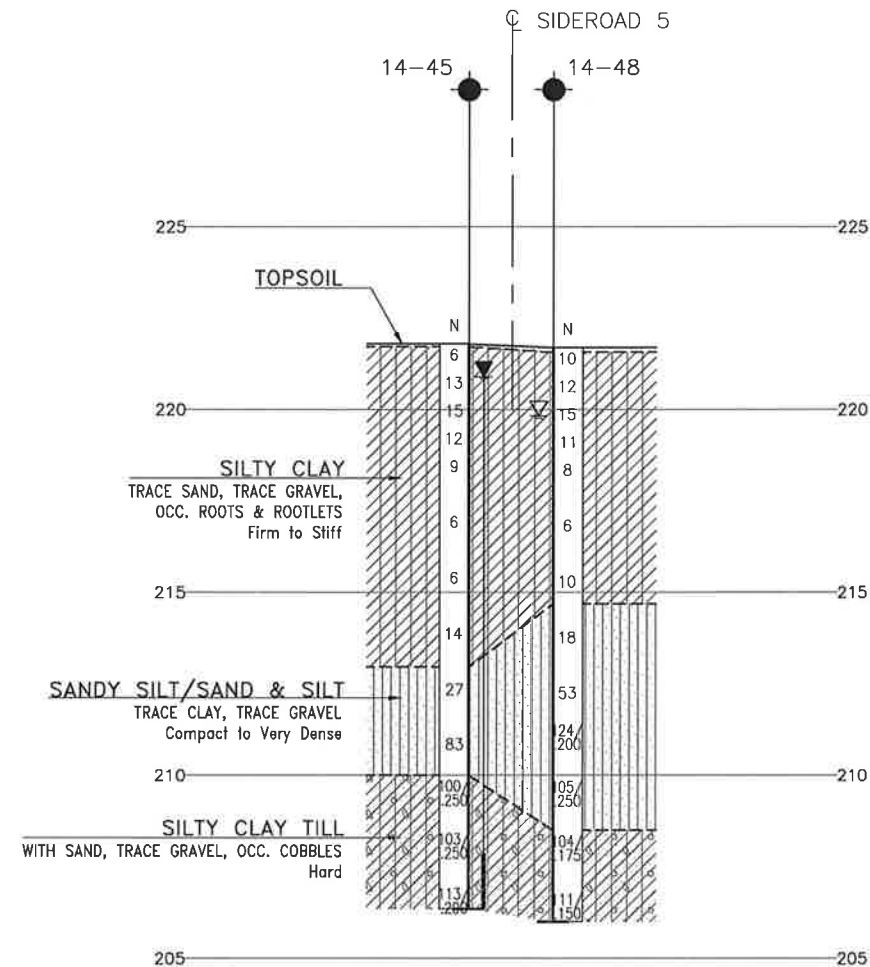
- |   |                                       |
|---|---------------------------------------|
|  | Borehole                              |
|  | Borehole and Cone                     |
| N   | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)     |
| PH  | Pressure, Hydraulic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

NO	ELEVATION	NORTHING	EASTING
14-43	220.1	4 881 303.9	294 163.6
14-44	220.5	4 881 297.2	294 173.4
14-45	221.8	4 881 275.3	294 186.5
14-46	221.8	4 881 260.1	294 187.8
14-47	218.9	4 881 289.9	294 160.9
14-48	221.7	4 881 268.4	294 180.1

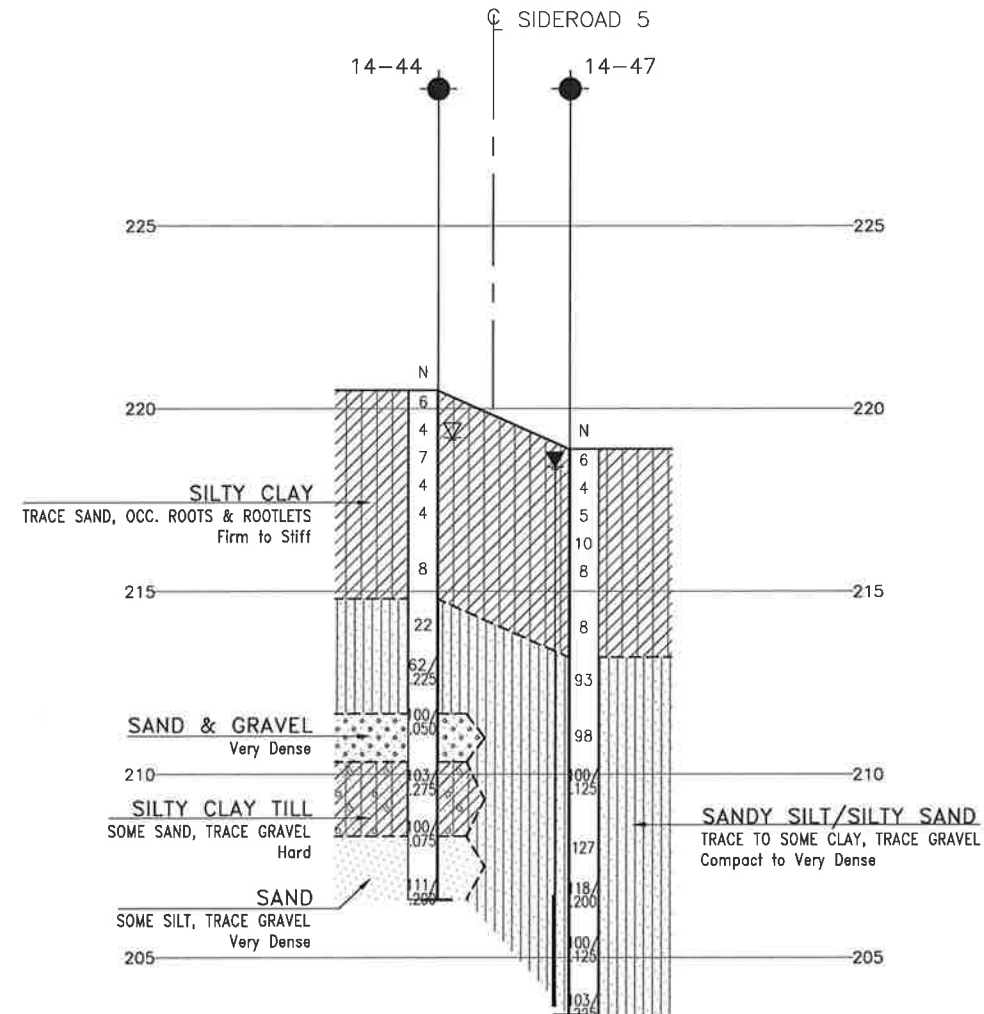
-NOTES-

- 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-605**



SECTION ALONG A-A  
(SOUTH ABUT.)



SECTION ALONG B-B  
(NORTH ABUT.)



REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	RPR	CHK	PKC	CODE		LOAD		DATE	JUN 2015
DRAWN	AN	CHK	RPR	SITE		STRUCT		DWG	2A

## **Appendix B**

### **High Fill for Ramps N-EW, E-S and W-N and Line 5 (station 9+740)**

**Boreholes 14-01, 13-05 to 14-18, 14-23, 13-24, 13-25, 13-26, 14-31, 14-51, 14-52**

- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”

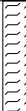






# RECORD OF BOREHOLE No 14-01

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 058.1 E 294 691.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.28 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								20	40	60	80	100	W <sub>P</sub>	W					
222.5	GROUND SURFACE																		
0.0	<b>TOPSOIL</b> , occasional roots and rootlets Loose Dark Brown Moist		1	SS	6														
221.7																			
0.8	Silty <b>CLAY</b> , trace sand, trace gravel, occasional rootlets Firm to Stiff Brown to Grey Moist		2	SS	6													0   9   61   30	
	Occasional sand seams		3	SS	7				2.6 +										
220.3																			
2.2	Stiff Grey		4	SS	13														
			5	SS	10				2.8 +										
			6	SS	9				2.3 +									0   7   47   46	
			7	SS	9				2.2 +										
215.3																			
7.2	Firm		8	SS	9				2.4 +									0   6   55   39	
			9	SS	8				2.2 +										
212.7																			
9.8	END OF BOREHOLE AT 9.8m.																		

Continued Next Page

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

# RECORD OF BOREHOLE No 14-01

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 058.1 E 294 691.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.28 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 $\gamma$ 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																
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Nov 07/ 14      1.4      221.1 Dec 08/ 14      1.2      221.3 Jan 06/ 15      1.4      221.1  NOTE: Field vane shear values were measured in a separate hole located adjacent to the original sampled borehole.																

# RECORD OF BOREHOLE No 14-05

1 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp N-EW N 4 882 039.1 E 294 709.1 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.08 - 2014.12.08 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
222.2	GROUND SURFACE							20 40 60 80 100							
0.0	Silty <b>CLAY</b> , trace sand, trace gravel, occasional organics, occasional roots Firm Dark Brown to Brown Moist		1	SS	6	▽	222								0 5 54 41
			2	SS	7		221								
			3	SS	5										
220.1							220								
2.1	Gravelly <b>SAND</b>														
219.7	Loose Brown		4	SS	5										
2.5	Wet														
	Silty <b>CLAY</b> , trace to some sand, trace gravel, occasional black sand layer Firm to Very Stiff Grey Moist		5	SS	17		219								
							218								
			6	SS	7		217								0 0 56 44
			7	SS	12		216								
	Stiff Wet						215								
			8	SS	10		214								
			9	SS	10		213								0 10 43 47
212.4															
9.8	END OF BOREHOLE AT 9.8m.														

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

## METRIC

[illegible]

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

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 2/13/15



RECORD OF BOREHOLE No 14-06

2 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp N-EW N 4 881 939.3 E 294 702.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.05 - 2014.12.05 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 $\gamma$ 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																
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Dec 08/ 14      1.0      221.7 Jan 06/ 15      1.0      221.7																

## METRIC

[illegible]

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

## METRIC

[illegible]

# RECORD OF BOREHOLE No 14-08

1 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp N-EW N 4 881 803.1 E 294 648.2 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.27 - 2014.10.27 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100		20 40 60					
221.5	GROUND SURFACE													
0.0	TOPSOIL: (175mm)													
0.2	Silty <b>CLAY</b> , trace sand, occasional organics, occasional rootlets Stiff Brown Moist		1	SS	8									
			2	SS	9								0 8 50 42	
			3	SS	9									
219.4														
2.0	<b>SAND</b> , trace silt, trace gravel Loose Grey Wet													
219.0			4	SS	10									
2.5	Silty <b>CLAY</b> , trace sand Stiff Grey Moist													
			5	SS	12								0 6 49 45	
			6	SS	11									
215.8														
5.6	Firm		7	SS	5									
			8	SS	6									
			9	SS	7								0 0 66 34	
211.7														
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

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

# RECORD OF BOREHOLE No 14-08

2 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp N-EW N 4 881 803.1 E 294 648.2 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.27 - 2014.10.27 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Nov 07/ 14      2.5      219.0 Dec 08/ 14      2.4      219.1 Jan 06/ 15      2.7      218.8																

# RECORD OF BOREHOLE No 14-09

1 OF 3

METRIC

W.P. P-13-03 LOCATION Highfill/Ramp N-EW N 4 881 757.0 E 294 628.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.29 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
221.8	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (175mm)							20	40	60	80	100					
0.2	Silty <b>CLAY</b> , trace to some sand, mixed with organics, occasional roots and rootlets Firm to Stiff Brown to Grey		1	SS	7		221										
			2	SS	13												
	Occasional sand seams, occasional oxide staining		3	SS	9		220										0 7 72 21
219.6																	
2.2	Gravelly <b>SAND</b> Compact Brown Wet		4	SS	15		219										
219.1																	
2.7	Silty <b>CLAY</b> , trace to some sand, trace gravel Stiff Grey Moist		5	SS	15		218										
			6	SS	14		217										
216.2							216										
5.6	Firm Wet		7	SS	7		215										0 11 50 39
			8	SS	7		214										
							213										
			9	SS	5		212										

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-09

2 OF 3

METRIC

W.P. P-13-03 LOCATION Highfill/Ramp N-EW N 4 881 757.0 E 294 628.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.29 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
	Continued From Previous Page							20   40   60   80   100	○ UNCONFINED      + FIELD VANE	W <sub>P</sub> W      W <sub>L</sub>			
	Silty <b>CLAY</b> , trace sand Firm to Stiff Grey Wet							20   40   60   80   100	● QUICK TRIAXIAL      × LAB VANE				
208.5													
13.3	Very Stiff												
207.0													
14.8													
			</										

Continued Next Page

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

20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-09

3 OF 3

METRIC

W.P. P-13-03 LOCATION Highfill/Ramp N-EW N 4 881 757.0 E 294 628.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.29 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
199.6							201							
22.2	END OF BOREHOLE AT 22.2m UPON DCPT REFUSAL. WATER LEVEL AT 2.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.						200							



# RECORD OF BOREHOLE No 14-10

1 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1H N 4 881 817.1 E 294 699.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.03 - 2014.12.03 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						
221.4	GROUND SURFACE							20 40 60 80 100						
0.0	<b>TOPSOIL</b> , occasional roots and rootlets Compact Dark Brown Moist		1	SS	10		221							
220.7														
0.7	Silty <b>CLAY</b> , trace sand, trace gravel, occasional organics Firm Brown to Grey Moist		2	SS	7		220							
			3	SS	4									
219.0							219							
2.4	Gravelly <b>SAND</b> Compact Brown Wet		4	SS	20									
			5	SS	13		218							
217.3														
4.1	Silty <b>CLAY</b> , trace sand Firm Grey Wet		6	SS	8		217							
							216							
			7	SS	6		215							
							214							
			8	SS	4		213							
							212							
211.6			9	SS	4									
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

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

# RECORD OF BOREHOLE No 14-10

2 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1H N 4 881 817.1 E 294 699.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.03 - 2014.12.03 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 $\gamma$ 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																
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Dec 08/ 14      1.4      220.0 Jan 06/ 15      2.1      219.3																

# RECORD OF BOREHOLE No 14-11

1 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp E-S N 4 881 784.6 E 294 730.4 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.02 - 2014.12.02 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  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
221.3	GROUND SURFACE					▽							GR   SA   SI   CL		
0.0	<b>TOPSOIL</b> , clayey, occasional roots Loose Dark Brown Moist		1	SS	4		221								
220.6															
0.8	Silty <b>CLAY</b> , mixed with organics, some sand, trace gravel Firm Brown Moist  Occasional roots and rootlets Dark Brown		2	SS	6		220								
			3	SS	4										
219.1															
2.2	Gravelly <b>SAND</b> Compact Grey Wet		4	SS	16		219								
218.6															
2.7	Silty <b>CLAY</b> , trace sand Firm to Stiff Grey Moist		5	SS	8		218								
217.2															
4.1	Very Stiff		6	SS	22	217									
215.7															
5.6	Wet		7	SS	6	215									
								</							

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-11

2 OF 2

METRIC

W.P. P-13-03 LOCATION Ramp E-S N 4 881 784.6 E 294 730.4 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Wash Boring/Tripod COMPILED BY AN  
 DATUM Geodetic DATE 2014.12.02 - 2014.12.02 CHECKED BY RPR

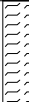

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
211.1																	
10.2	END OF BOREHOLE AT 10.2m. WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

# RECORD OF BOREHOLE No 14-12

1 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1H/Ramp E-S N 4 881 789.8 E 294 692.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.04 - 2014.11.04 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  <b>γ</b>  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>	SHEAR STRENGTH kPa					WATER CONTENT (%)			GR	SA	SI	CL	
										○ UNCONFINED      + FIELD VANE												
										● QUICK TRIAXIAL      × LAB VANE												
221.6	GROUND SURFACE																					
0.0	<b>TOPSOIL</b> , occasional roots and rootlets Loose Dark Brown Moist		1	SS	7		221															
220.9																						
0.7	Silty <b>CLAY</b> , trace sand, occasional rootlets Soft Brown Moist		2	SS	3		220															
220.2																						
1.4	Stiff to Very Stiff		3	SS	11		219															
	Grey Wet		4	SS	15		218															
			5	SS	12		217															
			6	SS	18		216															
			7	SS	10		215															
214.4																						
7.2	Soft to Firm																					
			8	SS	2	214																
			9	SS	6	213																

Continued Next Page

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

## METRIC

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	20 40 60 80 100	W P W W L	WATER CONTENT (%)		
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
	Silty <b>CLAY</b> Firm Grey Wet						2.6 +						
			10	SS	5								0 0 65 35
			11	SS	7		2.3 +						
208.3 13.3	END OF BOREHOLE AT 13.3m. WATER LEVEL AT 1.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.						2.5						

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

# RECORD OF BOREHOLE No 14-13

1 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1H N 4 881 762.5 E 294 697.8 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.27 - 2014.10.28 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
221.5	GROUND SURFACE							20	40	60	80	100						
0.0	<b>TOPSOIL</b> , occasional roots and rootlets Loose Dark Brown Moist		1	SS	5		221											
220.9																		
0.7	<b>SAND</b> and <b>SILT</b> , some clay to clayey, pockets of clay Loose Brown Moist		2	SS	6		220											0 42 36 22
220.1																		
1.4	<b>SAND</b> and <b>GRAVEL</b> Dense Brown Wet		3	SS	35		219											
219.0																		
2.5	Silty <b>CLAY</b> , trace to some sand, trace gravel Stiff to Very Stiff Grey Moist		4	SS	9		218											0 15 50 35
			5	SS	22		217											
			6	SS	16		216											
215.9							215											
5.6	Firm to Soft Wet		7	SS	5		214											0 0 46 54
			8	SS	3		213											
			9	SS	5		212											
211.8																		
9.8	END OF BOREHOLE AT 9.8m.																	

Continued Next Page

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

# RECORD OF BOREHOLE No 14-13

2 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1H N 4 881 762.5 E 294 697.8 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.27 - 2014.10.28 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 (%) GR SA SI CL																
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																									
	Continued From Previous Page																																
	<p>WATER LEVEL AT 1.7m UPON COMPLETION.</p> <p>Piezometers installation consists of two 19mm diameter Schedule 40 PVC pipes with a 1.52m and 3.05m slotted screen.</p> <p>NOTE: A separate hole was drilled for installing the shallow piezometer.</p> <p>WATER LEVEL READINGS (DEEP PIEZOMETER):</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>Dec 08/ 14</td> <td>1.2</td> <td>220.3</td> </tr> <tr> <td>Jan 06/ 15</td> <td>1.4</td> <td>220.1</td> </tr> </tbody> </table> <p>WATER LEVEL READINGS (SHALLOW PIEZOMETER):</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>Dec 08/ 14</td> <td>1.2</td> <td>220.3</td> </tr> <tr> <td>Jan 06/ 15</td> <td>1.3</td> <td>220.2</td> </tr> </tbody> </table>	DATE	DEPTH (m)	ELEV. (m)	Dec 08/ 14	1.2	220.3	Jan 06/ 15	1.4	220.1	DATE	DEPTH (m)	ELEV. (m)	Dec 08/ 14	1.2	220.3	Jan 06/ 15	1.3	220.2														
DATE	DEPTH (m)	ELEV. (m)																															
Dec 08/ 14	1.2	220.3																															
Jan 06/ 15	1.4	220.1																															
DATE	DEPTH (m)	ELEV. (m)																															
Dec 08/ 14	1.2	220.3																															
Jan 06/ 15	1.3	220.2																															

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 2/13/15



# RECORD OF BOREHOLE No 14-14

1 OF 3

METRIC

W.P. P-13-03 LOCATION Ramp E-S N 4 881 762.4 E 294 658.9 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.29 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  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										
222.1	GROUND SURFACE							20 40 60 80 100										
0.0	<b>TOPSOIL:</b> (100mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
0.1	Silty <b>CLAY</b> , trace to some sand, occasional organics, occasional roots and rootlets Firm to Soft Brown and Grey Moist		1	SS	6		222											
			2	SS	9		221										0 8 63 29	
	Trace gravel, occasional sand layer		3	SS	3													
219.9							220											
2.2	Stiff to Very Stiff Grey		4	SS	14		219											
			5	SS	22		218											
			6	SS	15		217										0 0 57 43	
							216											
216.5							215											
5.6	Firm to Soft Wet		7	SS	4		214											
			8	SS	2		213										0 0 61 39	
			9	SS	3													

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-14

2 OF 3

METRIC

W.P. P-13-03 LOCATION Ramp E-S N 4 881 762.4 E 294 658.9 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.29 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			SHEAR STRENGTH kPa									WATER CONTENT (%)		GR	SA	SI	CL
								○ UNCONFINED    + FIELD VANE	● QUICK TRIAXIAL    × LAB VANE													
	Continued From Previous Page						20	40	60	80	100	20	40	60	kN/m <sup>3</sup>							
	Silty <b>CLAY</b> , trace sand, trace gravel Firm Grey Wet						212	2.9														
			10	SS	5		211															
							210	2.5														
			11	SS	6		209															
							208	2.8														
			12	SS	5		207															
							206	2.5														
			13	SS	6		205															
							204															
							203															
205.2																						
16.9	<b>SILT</b> , trace sand, trace clay Compact Grey Wet		14	SS	14		205															
203.8							204															
18.3	Silty <b>CLAY</b> , some sand Stiff Grey Wet		15	SS	14																	
203.2																						
18.9	End of sampling at 18.9m and start of DCPT																					

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity  
 20  
15  
10  
5  
0  
10 20 30 40 50 60 70 80 90 100 (%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2012TEMPLATE(MTO).GDT 2/13/15

# RECORD OF BOREHOLE No 14-14

3 OF 3

METRIC

W.P. P-13-03 LOCATION Ramp E-S N 4 881 762.4 E 294 658.9 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Dynamic Cone Penetration Test COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.29 CHECKED BY RPR

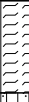



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page						202	20	40	60	80	100		
							201							
							200							
199.9	22.2													
	END OF BOREHOLE AT 22.2m UPON DCPT REFUSAL. WATER LEVEL AT 2.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.													

# RECORD OF BOREHOLE No 14-15

1 OF 3

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp E-S N 4 881 704.9 E 294 627.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.30 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				WATER CONTENT (%)							
								○ UNCONFINED      + FIELD VANE				W P      W      W L							
								● QUICK TRIAXIAL      × LAB VANE											
222.2	GROUND SURFACE						20	40	60	80	100								
0.0	TOPSOIL, trace roots and rootlets, trace sand Loose Dark Brown Moist		1	SS	5		222												
221.6																			
0.6																			
	SAND and SILT, some clay Compact Brown Moist		2	SS	11		221										0   41   39   20		
220.8																			
1.4	Silty CLAY, trace sand, trace gravel Stiff Grey Moist		3	SS	10		220												
			4	SS	15	219													
			5	SS	15	218													
			6	SS	9	217										0   7   52   41			
							</												

Continued Next Page

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




20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-15

2 OF 3

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp E-S N 4 881 704.9 E 294 627.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.30 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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								20   40   60   80   100	○ UNCONFINED      + FIELD VANE	W <sub>P</sub> W      W <sub>L</sub>									
Continued From Previous Page								20   40   60   80   100	● QUICK TRIAXIAL      × LAB VANE										
	Silty <b>CLAY</b> Firm to Stiff Grey Wet						212	2.5											
			10	SS	5		211												
			11	SS	5		210												
			12	SS	7		209												
			13	SS	6		208												
	Trace sand		14	SS	7		206	4.0											
			15	SS	9		205												
	Some sand, trace gravel Moist							2.5											
	Sandv																		
			16	SS	50/		204												
							203												
											</								

Continued Next Page

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

# RECORD OF BOREHOLE No 14-15

3 OF 3

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp E-S N 4 881 704.9 E 294 627.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.29 - 2014.10.30 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 (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE							
						● QUICK TRIAXIAL	×	LAB VANE			WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
202.1	Continued From Previous Page	✓✓			0.100												
20.1	END OF BOREHOLE AT 20.1m. WATER LEVEL AT 1.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No 14-16

1 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp N-EW N 4 881 695.2 E 294 599.3 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.04 - 2014.11.05 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100						
221.2	GROUND SURFACE																
0.0	TOPSOIL: (25mm)																
	Silty CLAY, trace sand, occasional roots, occasional organics		1	SS	8												
	Stiff to Firm																
	Brown to Dark Brown		2	SS	7												
	Moist																
219.8																	
1.4	Very Stiff																
	Brown to Grey		3	SS	16												
	Moist																
			4	SS	16												
			5	SS	17												
217.1																	
4.1	Firm to Soft																
	Grey		6	SS	8												
	Wet																
			7	SS	5												
			8	SS	3												
			9	SS	2												

Continued Next Page

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

# RECORD OF BOREHOLE No 14-16

2 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp N-EW N 4 881 695.2 E 294 599.3 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.04 - 2014.11.05 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 $\gamma$ 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 × LAB VANE	WATER CONTENT (%)								
	Continued From Previous Page																
	Silty <b>CLAY</b> Soft to Firm Grey Wet		10	SS	2		211	3.0									
							210										
							209	2.4									
			11	SS	4		208	2.6									
207.9																	
13.3	END OF BOREHOLE AT 13.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Nov 07/ 14      1.6      219.6 Dec 08/ 14      1.4      219.8 Jan 06/ 15      2.0      219.2																



# RECORD OF BOREHOLE No 14-17

1 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp E-S N 4 881 714.1 E 294 655.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.23 - 2014.10.23 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									
								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>									
221.5	GROUND SURFACE																
0.0	<b>TOPSOIL</b> , some sand, occasional roots and rootlets Loose Dark Brown Moist		1	SS	4		221										
221.0																	
0.6	Sandy <b>SILT</b> , occasional sand seams Loose Brown Moist		2	SS	7												
220.1																	
1.4	<b>SAND</b> , trace silt Compact Brown Wet		3	SS	13		220										
219.2																	
2.3	Silty <b>CLAY</b> , trace to some sand Stiff to Very Stiff Grey Moist		4	SS	13		219						0	7	53	40	
	Trace gravel		5	SS	19		218										
	Wet		6	SS	9		217										
215.9							216										
5.6	Firm		7	SS	7		215							0	0	55	45
214.3																	
7.2	Soft		8	SS	3		214										
212.8							213										
8.7			9	SS	6		212										

Continued Next Page

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

# RECORD OF BOREHOLE No 14-17

2 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1E/Ramp E-S N 4 881 714.1 E 294 655.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.23 - 2014.10.23 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20	40	60	80					
	Continued From Previous Page																
	Silty <b>CLAY</b> , occasional sand seams Firm Grey Wet		10	SS	6		211										
							210										
			11	SS	7		209									0 8 45 47	
208.2								3.6									
13.3	END OF BOREHOLE AT 13.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov 07/ 14 1.9 219.6 Dec 08/ 14 1.7 219.8 Jan 06/ 15 1.7 219.8																

## METRIC

[illegible]

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

# RECORD OF BOREHOLE No 14-18

2 OF 2

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp E-S N 4 881 681.1 E 294 688.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.03 - 2014.11.03 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			SHEAR STRENGTH kPa				WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page															
	Silty <b>CLAY</b> , trace sand, occasional silt seams Firm Grey Wet		10	SS	7			1.8								
								2.9								
			11	SS	6											
208.6																
13.3	END OF BOREHOLE AT 13.3m. WATER LEVEL AT 2.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.							2.3								

# RECORD OF BOREHOLE No 14-23

1 OF 1

METRIC

W.P. P-13-03 LOCATION High Fill/Line 5 N 4 881 603.2 E 294 549.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.18 - 2014.11.18 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  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							PLASTIC LIMIT w <sub>P</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub> WATER CONTENT (%)		
223.4	GROUND SURFACE							20	40	60	80	100					
0.0	<b>SAND</b> , trace gravel Loose Brown Moist (FILL)		1	GS			223							○			
222.3			1	SS	9									○			
1.1	Silty <b>CLAY</b> , some sand, trace gravel Stiff Brown Moist		2	SS	11		222							○			
221.2																	
2.2	<b>SAND</b> , some gravel, trace clay Compact Brown Moist		3	SS	19		221							○			
220.6																	
2.8	Silty <b>CLAY</b> , trace sand, trace gravel Stiff to Very Stiff Brown to Grey Moist		4	SS	14		220							○	1		0 0 47 53
							219										
			5	SS	15		218							○			
			6	SS	15		217							○	1		0 8 56 36
							216										
			7	SS	14									○			
215.2																	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-24

1 OF 1

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp N-EW N 4 881 617.8 E 294 596.3 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.30 - 2014.01.30 CHECKED BY KY

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					
223.4	GROUND SURFACE												
0.0	TOPSOIL: (150 mm)												
0.2	Clayey <b>SILT</b> , with sand, trace gravel, occasional rootlets Stiff Brown		1	SS	9		223						9 38 34 19
222.6	Moist (FILL)												
0.8	Silty <b>CLAY</b> , trace sand Stiff to Very Stiff Brown Moist		2	SS	8		222						
			3	SS	12								
			4	SS	16		221						
			5	SS	14		220						0 0 41 59
			6	SS	17		219						
			7	SS	13								0 0 54 46
							218						
	Grey Wet		8	SS	13		217						
							216						
	Firm		9	SS	7								
215.2													
8.2	END OF BOREHOLE AT 8.2 m. BOREHOLE OPEN TO 8.2 m AND WATER LEVEL AT 8.2m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen.  WATER LEVEL READINGS: DATE        DEPTH (m)    ELEV. (m) Feb 26/ 14     2.5        220.9												

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-25

1 OF 2

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp N-EW N 4 881 628.3 E 294 649.5 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

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 × LAB VANE									
224.2	GROUND SURFACE					20	40	60	80	100	20	40	60				
0.0	<b>TOPSOIL:</b> (50 mm)		1	SS	20												
	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)		2	SS	12											6 35 36 23	
			3	SS	9												
	Occasional rootlets Grey		4	SS	8											0 21 53 26	
221.1																	
3.0	Silty <b>CLAY</b> , trace sand, trace gravel Firm to Stiff Grey Moist		5	SS	6												
			6	SS	9												
219.7																	
4.5	Very Stiff		7	SS	20												
218.5																	
5.6			8	SS	15											0 0 46 54	
			9	SS	14												
			10	SS	12												

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 13-25

2 OF 2

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp N-EW N 4 881 628.3 E 294 649.5 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

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 × LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
	Silty <b>CLAY</b> Firm Grey Wet		11	SS	7		214										
212.9							213									0 0 44 56	
11.3	END OF BOREHOLE AT 11.3 m. BOREHOLE OPEN TO 10.6 m AND WATER LEVEL AT 7.1 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Feb 26/ 14 2.5 221.7																






# RECORD OF BOREHOLE No 13-26

1 OF 2

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp N-EW N 4 881 634.1 E 294 689.2 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
225.9	GROUND SURFACE							20 40 60 80 100							
0.0	TOPSOIL: (175 mm)							20 40 60 80 100							
0.2	Silty <b>CLAY</b> , with sand, trace to some gravel, occasional rootlets Stiff to Very Stiff Brown Moist (FILL)		1	SS	17		225								
			2	SS	12										
			3	SS	14		224								11 38 31 20
			4	SS	16										
222.9							223								
3.0	Silty <b>CLAY</b> , with sand, trace gravel, occasional rootlets Stiff Grey Moist		5	SS	10										
			6	SS	8		222							3 31 38 28	
			7	SS	13		221								
220.3															
5.6	Very Stiff		8	SS	17		220								
							219								
218.7															
7.2	Firm		9	SS	13		218								
							217								
			10	SS	9									0 12 50 38	
							216								

Continued Next Page

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

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# RECORD OF BOREHOLE No 13-26

2 OF 2

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp N-EW N 4 881 634.1 E 294 689.2 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.29 - 2014.01.29 CHECKED BY KY

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 × LAB VANE					WATER CONTENT (%)					
							20	40	60	80	100	20	40	60			
	Continued From Previous Page																
214.6	Silty <b>CLAY</b> , some sand Firm Grey Wet		11	SS	9												
11.3	END OF BOREHOLE AT 11.3 m. BOREHOLE OPEN TO 10.6 m AND WATER LEVEL AT 7.8 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Feb 26/ 14      4.7      221.2																

# RECORD OF BOREHOLE No 14-31

1 OF 1

METRIC

W.P. P-13-03 LOCATION High Fill/Ramp W-N N 4 881 690.8 E 294 937.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.11 - 2014.11.11 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100						
225.3	GROUND SURFACE																
0.0	<b>TOPSOIL</b> , occasional roots Firm Dark Brown Moist		1	SS	6												
224.7																	
0.6	Silty <b>CLAY</b> , trace sand, trace gravel Firm Brown Moist		2	SS	7												
223.8																	
1.4	Very Stiff		3	SS	17												
			4	SS	17												
			5	SS	19												
			6	SS	17												
	Grey		7	SS	19												
			8	SS	18												
217.0																	
8.2	END OF BOREHOLE AT 8.2m Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Dec 08/ 14 0.3 225.0 Jan 06/ 15 0.4 224.9																


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

# RECORD OF BOREHOLE No 14-51

2 OF 2

METRIC

W.P. P-13-03 LOCATION Culvert 1E N 4 881 727.4 E 294 691.7 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.24 - 2014.10.24 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 (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE								
	Continued From Previous Page							20	40	60	80	100				
208.9	Silty <b>CLAY</b> Stiff Grey Wet						211									0   4   49   47
			10	SS	8		210			2.9						
			11	SS	7		209							○		
12.6	END OF BOREHOLE AT 12.6m. WATER LEVEL AT 1.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.															

# RECORD OF BOREHOLE No 14-52

1 OF 2

METRIC

W.P. P-13-03 LOCATION High Fills/Ramp N-EW N 4 881 660.4 E 294 648.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.30 - 2014.10.30 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				WATER CONTENT (%)							
								20   40   60   80   100	○ UNCONFINED   + FIELD VANE	● QUICK TRIAXIAL   × LAB VANE	W <sub>P</sub> W   W <sub>L</sub>								
221.9	GROUND SURFACE																		
0.0	TOPSOIL, some clay, occasional roots and rootlets		1	SS	6		221												
221.4	Loose Dark Brown Moist																		
0.6	Silty CLAY, with sand, occasional roots		2	SS	3														
	Soft to Firm Brown Moist																		
	Occasional sand layer		3	SS	7				220										
219.7																			
2.2	Stiff Brown to Grey Moist		4	SS	9				219										
			5	SS	12				218										
			6	SS	8				217										
216.3																			
5.6	Firm Grey Wet		7	SS	4		216												
							215												
			8	SS	4		214										0   0   52   48		
							213												
			9	SS	6														
							212												

Continued Next Page

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

## METRIC

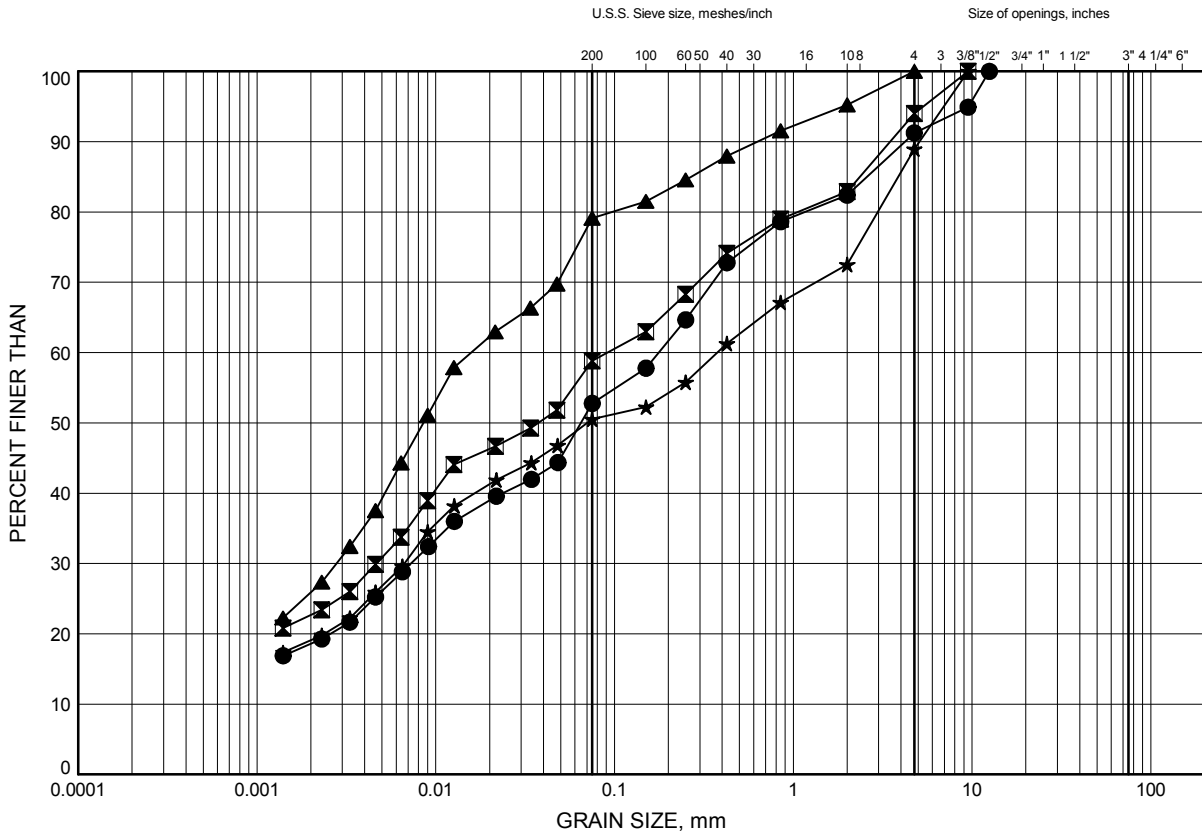
[illegible]

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

Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE B1

**CLAYEY SILT/SILTY CLAY FILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-24	0.30	223.08
⊠	13-25	1.07	223.09
▲	13-25	2.59	221.56
★	13-26	1.83	224.08

Date February 2015  
W.P. P-13-03

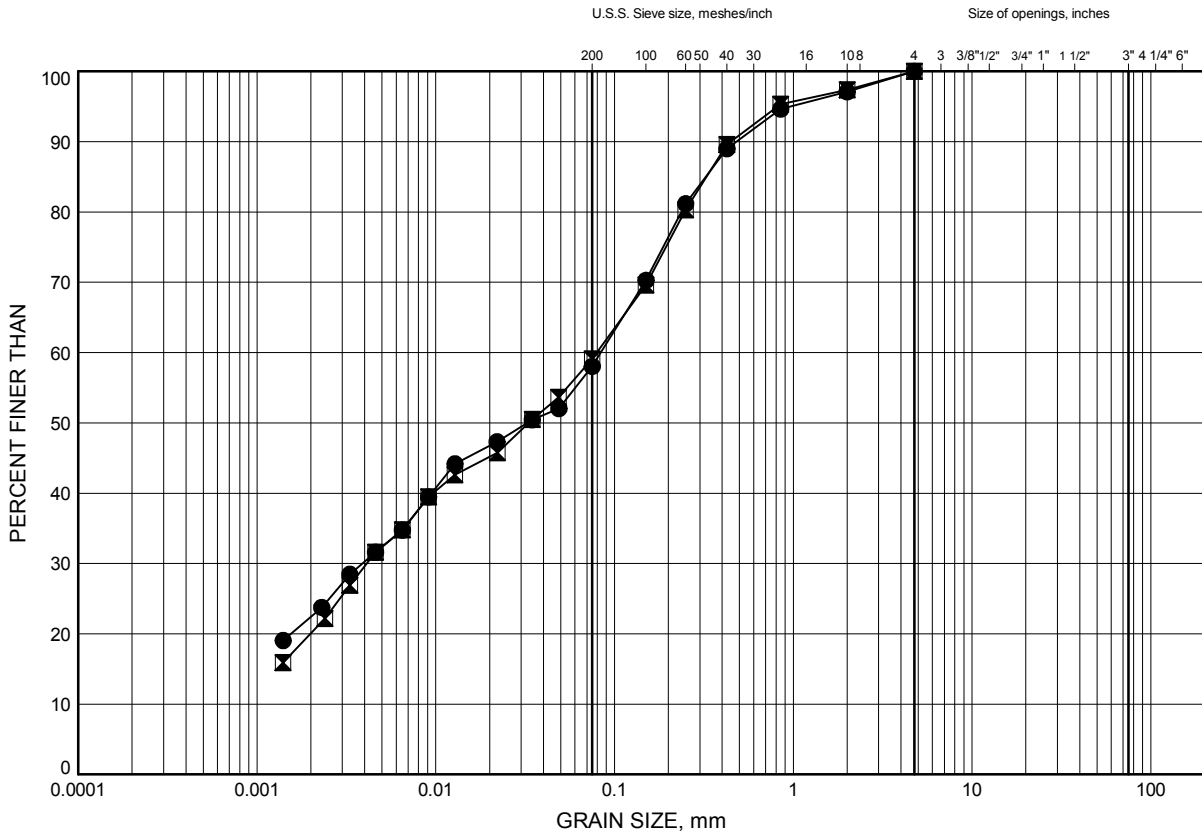


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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE B2

**SAND & SILT**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-13	1.07	220.48
⊗	14-15	1.07	221.13

Date February 2015  
W.P. P-13-03



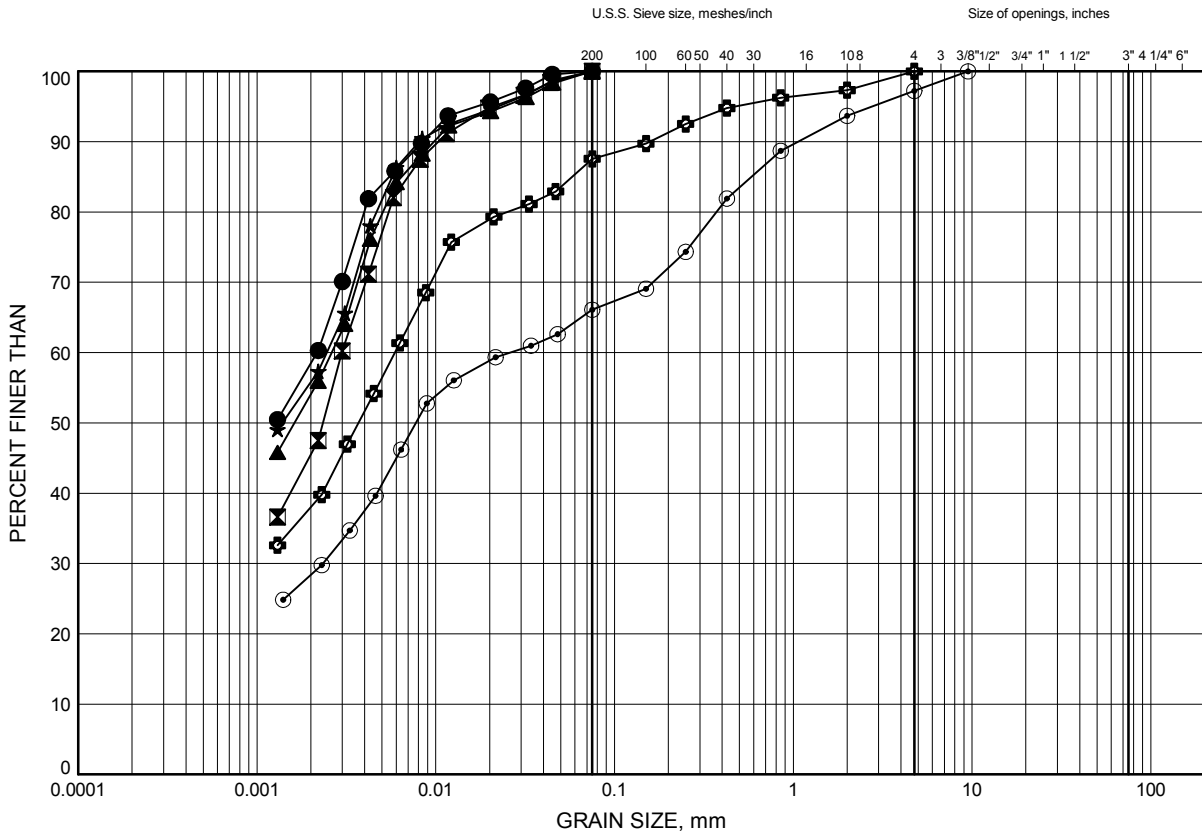
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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE B3

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-24	3.35	220.03
⊠	13-24	4.88	218.50
▲	13-25	6.40	217.75
★	13-25	10.97	213.18
⊙	13-26	4.11	221.80
⊕	13-26	9.45	216.46

Date February 2015  
W.P. P-13-03

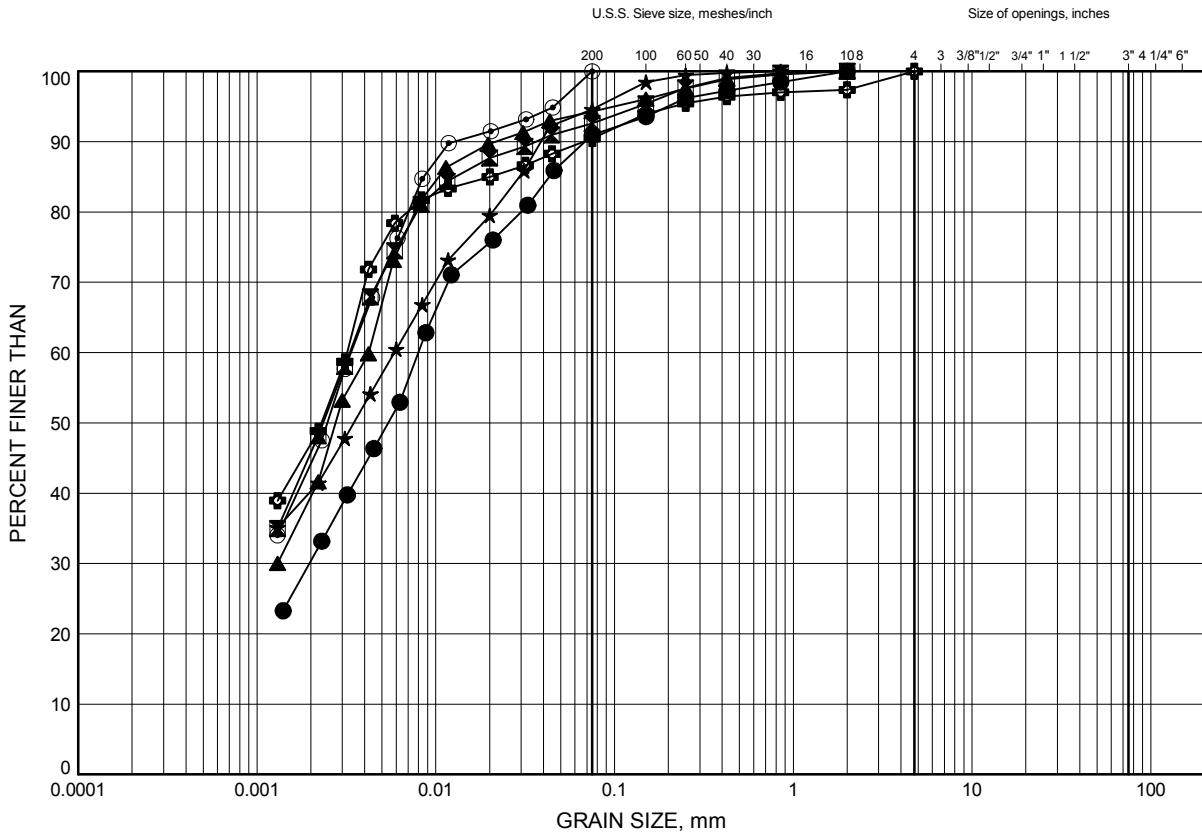


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**GRAIN SIZE DISTRIBUTION**

FIGURE B4

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-01	1.07	221.43
⊠	14-01	4.88	217.62
▲	14-01	7.92	214.58
★	14-05	1.07	221.12
⊙	14-05	4.88	217.31
⊕	14-05	9.45	212.73

Date February 2015  
W.P. P-13-03

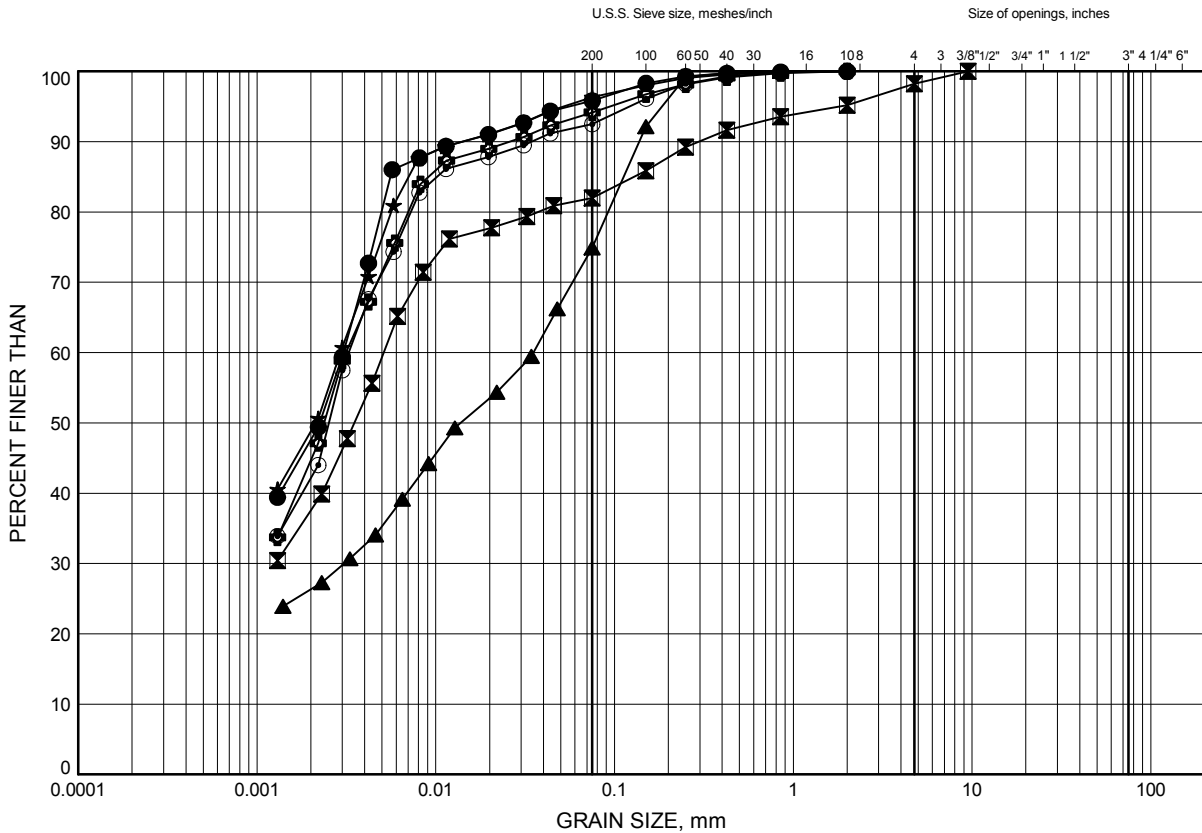


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**GRAIN SIZE DISTRIBUTION**

FIGURE B5

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-06	3.35	219.31
⊠	14-06	7.92	214.73
▲	14-07	1.07	220.56
★	14-07	4.88	216.75
⊙	14-08	1.07	220.39
⊕	14-08	3.35	218.10

Date February 2015  
W.P. P-13-03

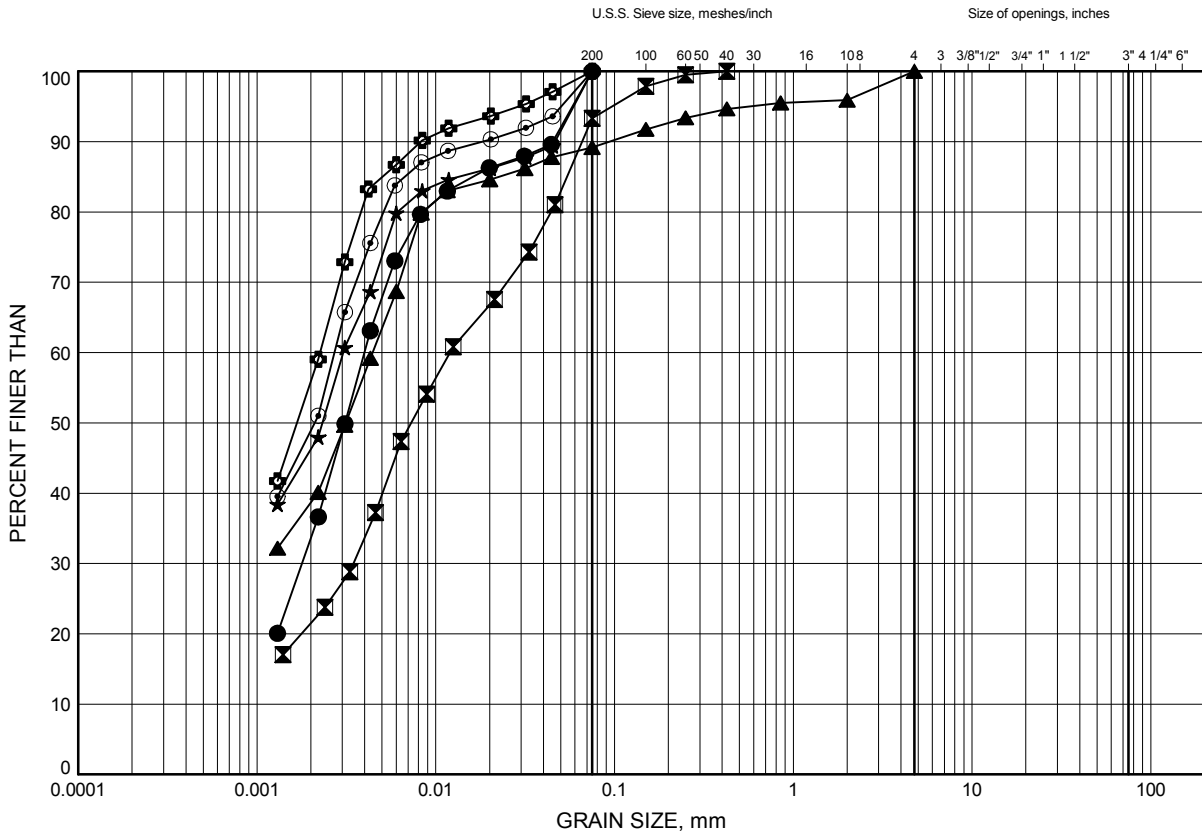


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**GRAIN SIZE DISTRIBUTION**

FIGURE B6

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-08	9.45	212.01
⊠	14-09	1.83	219.97
▲	14-09	6.40	215.40
★	14-09	10.97	210.83
⊙	14-09	14.02	207.78
⊕	14-10	1.83	219.55

Date February 2015  
W.P. P-13-03

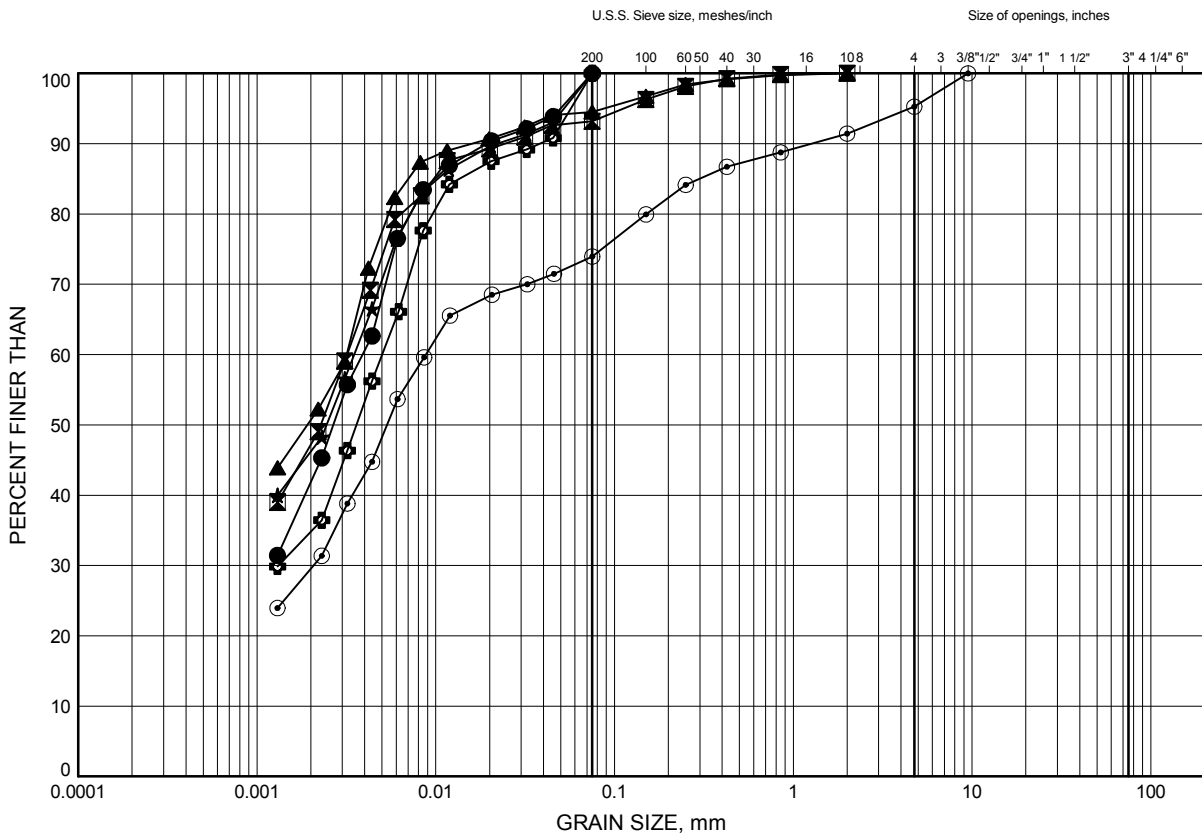


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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE B7

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-10	9.45	211.93
⊠	14-11	3.35	217.99
▲	14-11	6.40	214.94
★	14-12	2.59	219.01
⊙	14-12	6.40	215.20
⊕	14-12	10.97	210.63

Date February 2015  
W.P. P-13-03

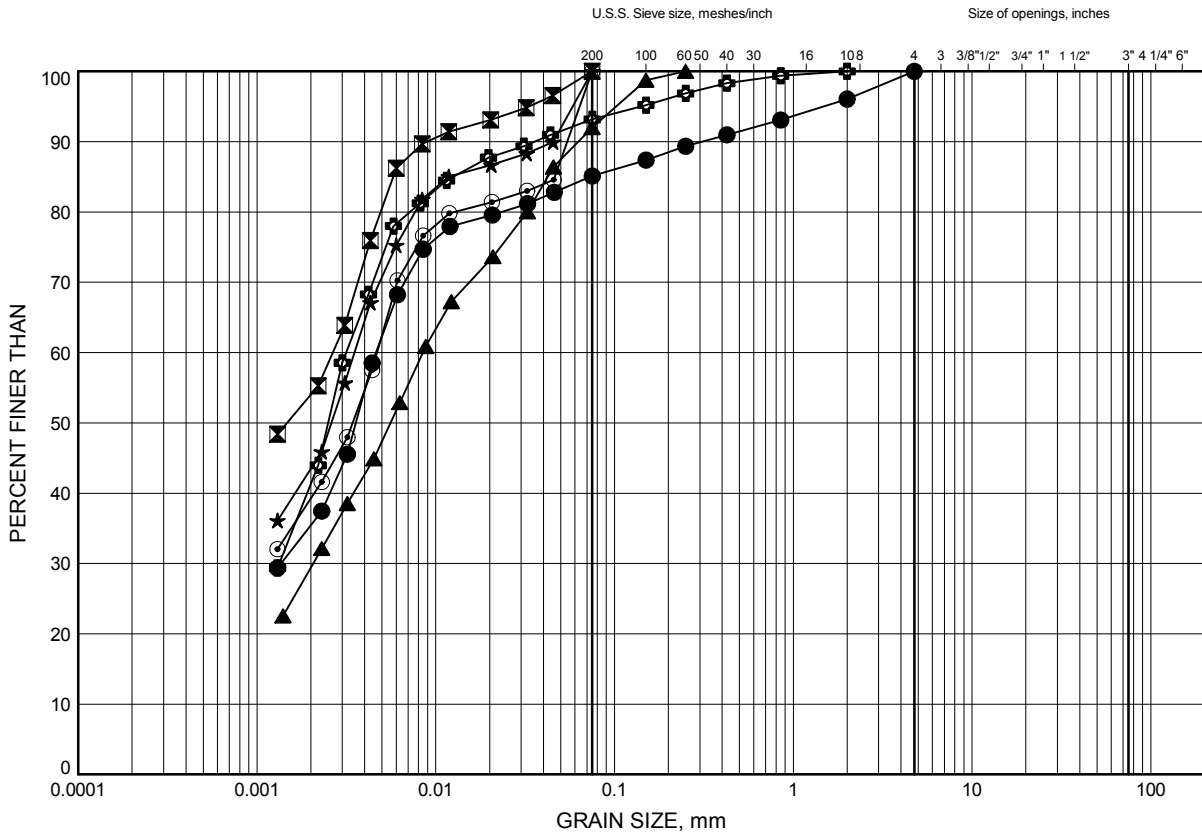


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Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE B8

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-13	3.35	218.19
⊠	14-13	7.92	213.62
▲	14-14	1.07	221.03
★	14-14	4.88	217.22
⊙	14-14	9.45	212.65
⊕	14-15	4.88	217.32

Date February 2015  
W.P. P-13-03

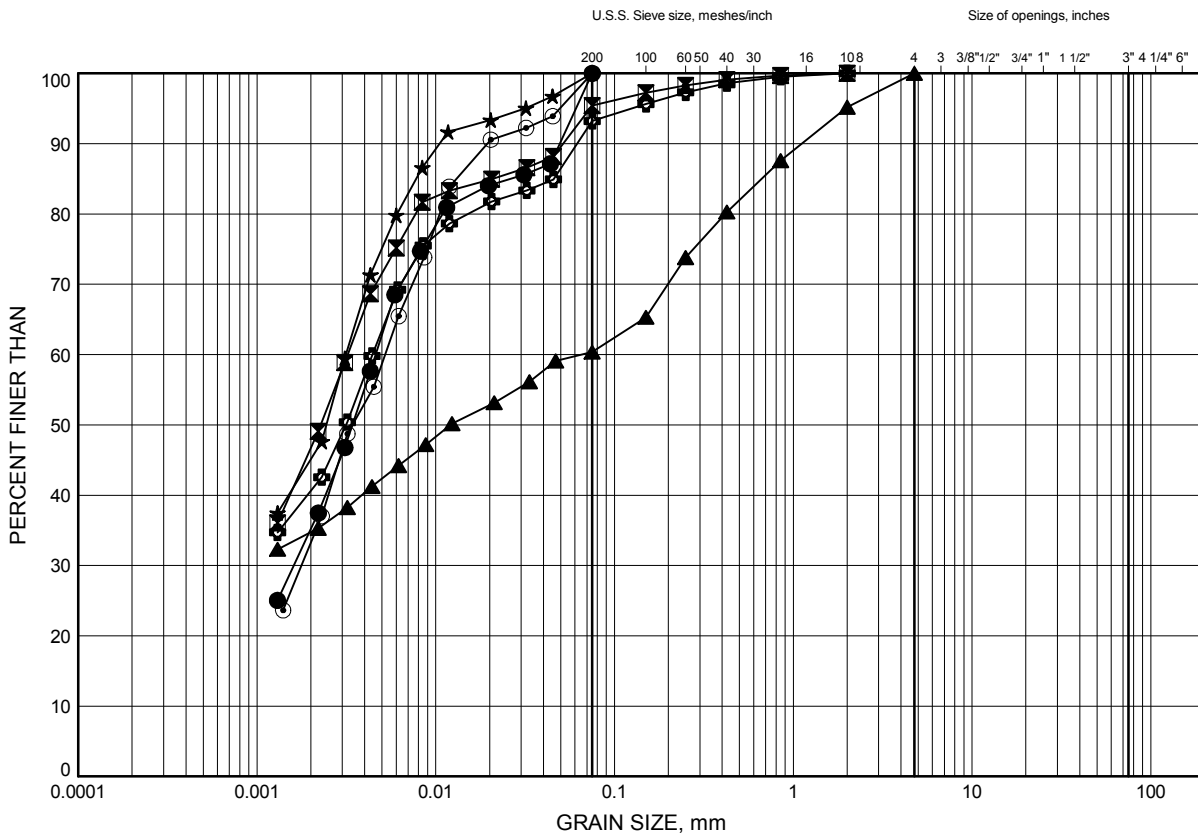


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**GRAIN SIZE DISTRIBUTION**

FIGURE B9

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-15	9.45	212.75
⊠	14-15	18.59	203.61
▲	14-15	19.89	202.31
★	14-16	3.35	217.86
⊙	14-16	10.97	210.24
⊕	14-17	2.59	218.92

Date February 2015  
W.P. P-13-03

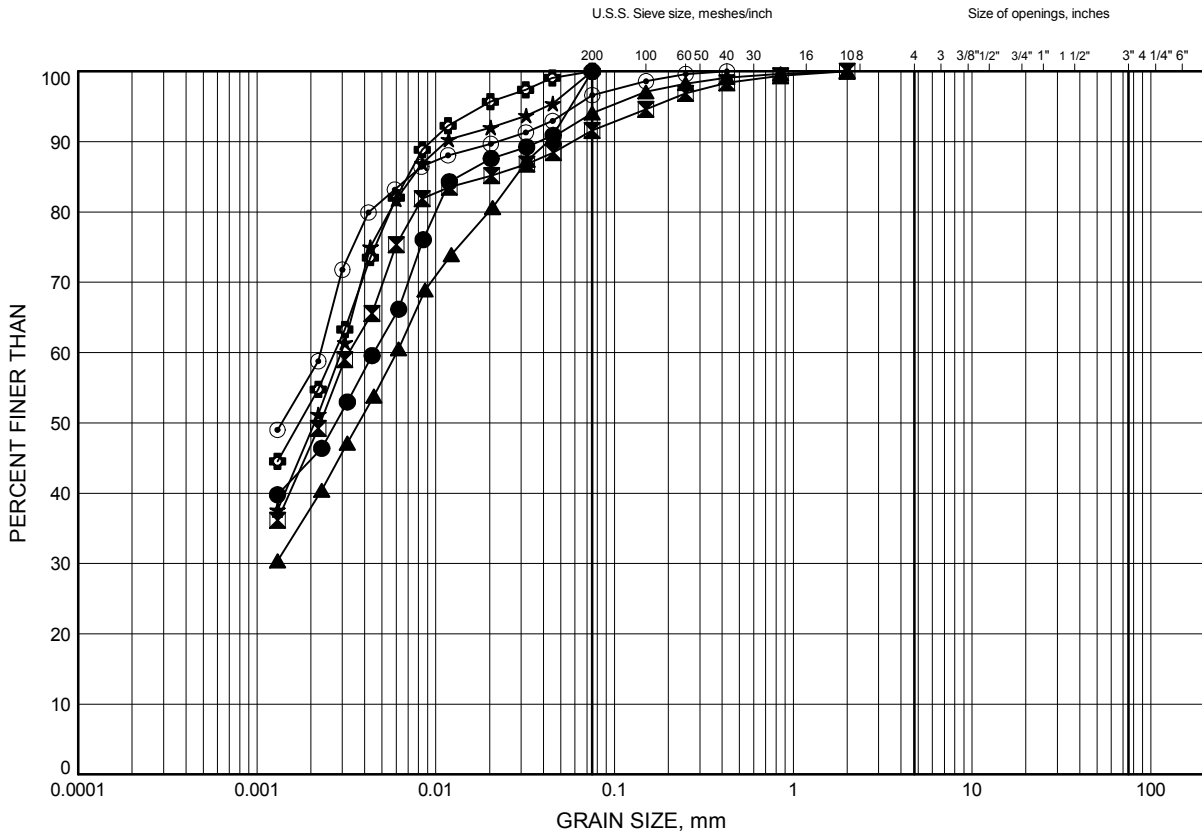


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**GRAIN SIZE DISTRIBUTION**

FIGURE B10

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-17	6.40	215.11
⊠	14-17	12.50	209.01
▲	14-18	1.07	220.83
★	14-18	4.88	217.02
⊙	14-18	12.50	209.40
⊕	14-23	3.35	220.06

Date February 2015  
W.P. P-13-03



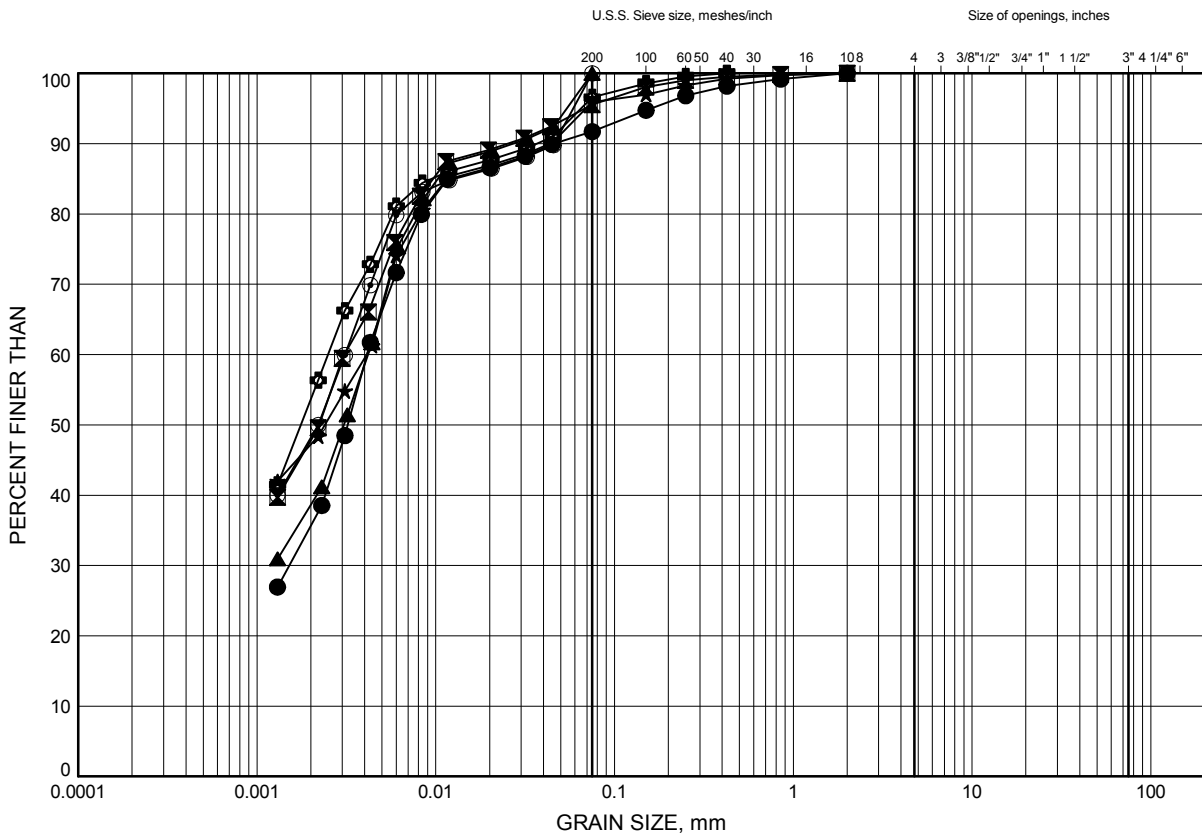
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**GRAIN SIZE DISTRIBUTION**

FIGURE B11

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-23	6.40	217.01
⊠	14-51	3.35	218.15
▲	14-51	7.92	213.58
★	14-51	10.97	210.53
⊙	14-52	7.92	214.01
⊕	14-52	14.02	207.92

Date February 2015  
W.P. P-13-03

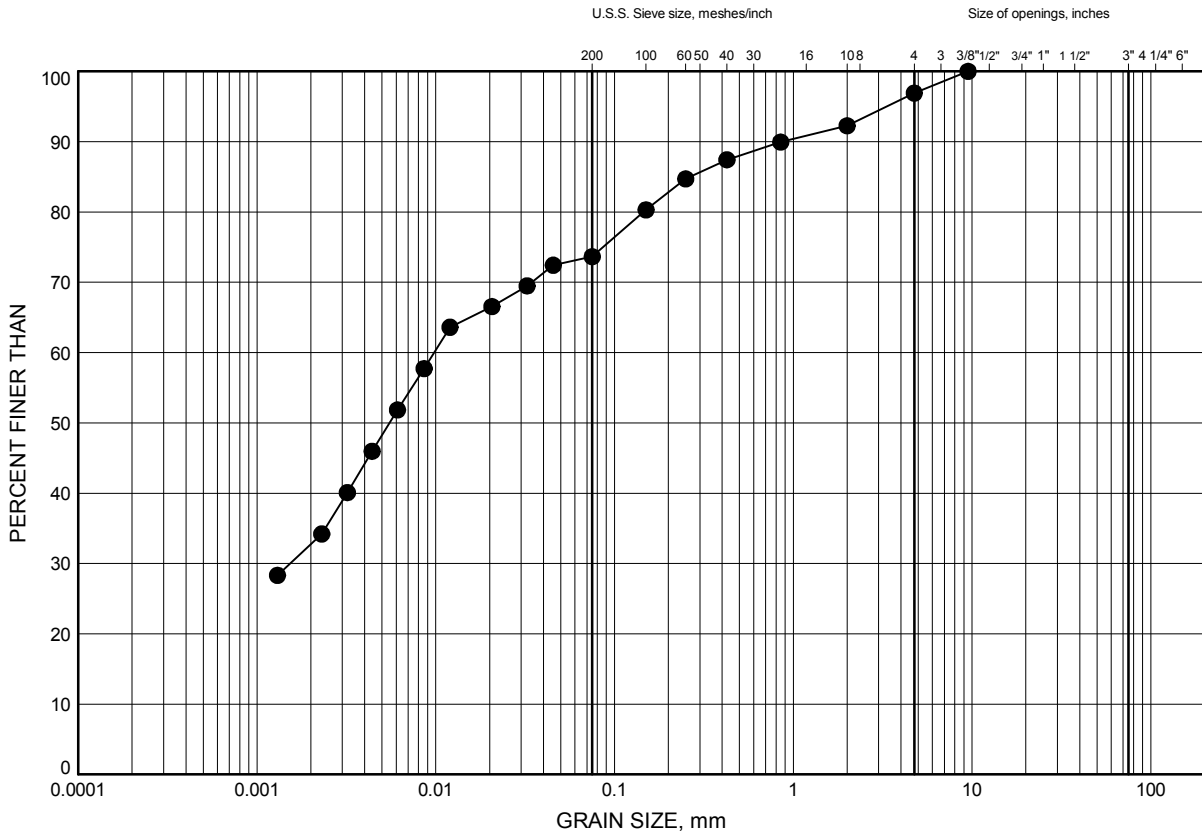


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**GRAIN SIZE DISTRIBUTION**

FIGURE B12

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-52	17.07	204.87

Date February 2015  
W.P. P-13-03

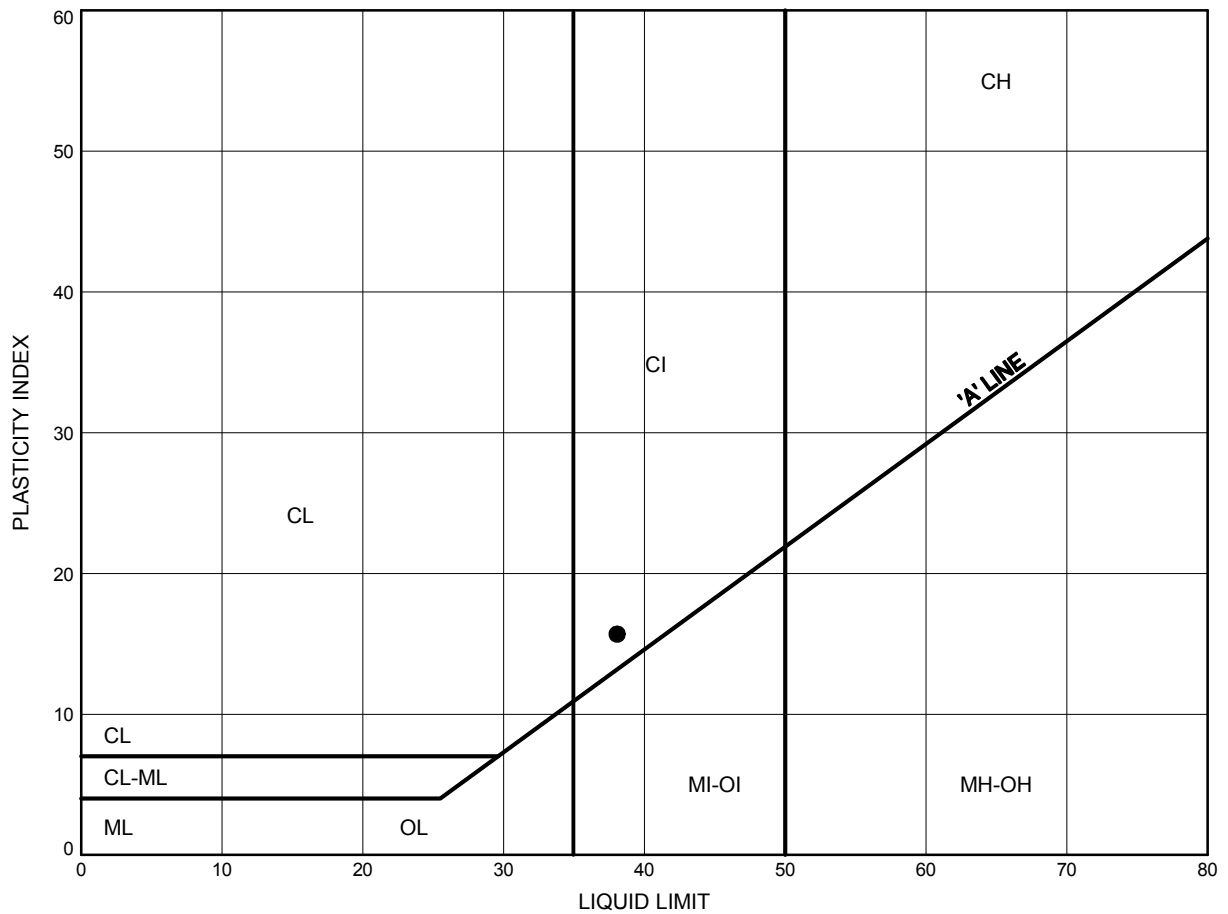


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B13

**SILTY CLAY FILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-25	2.59	221.56

Date February 2015  
W.P. P-13-03

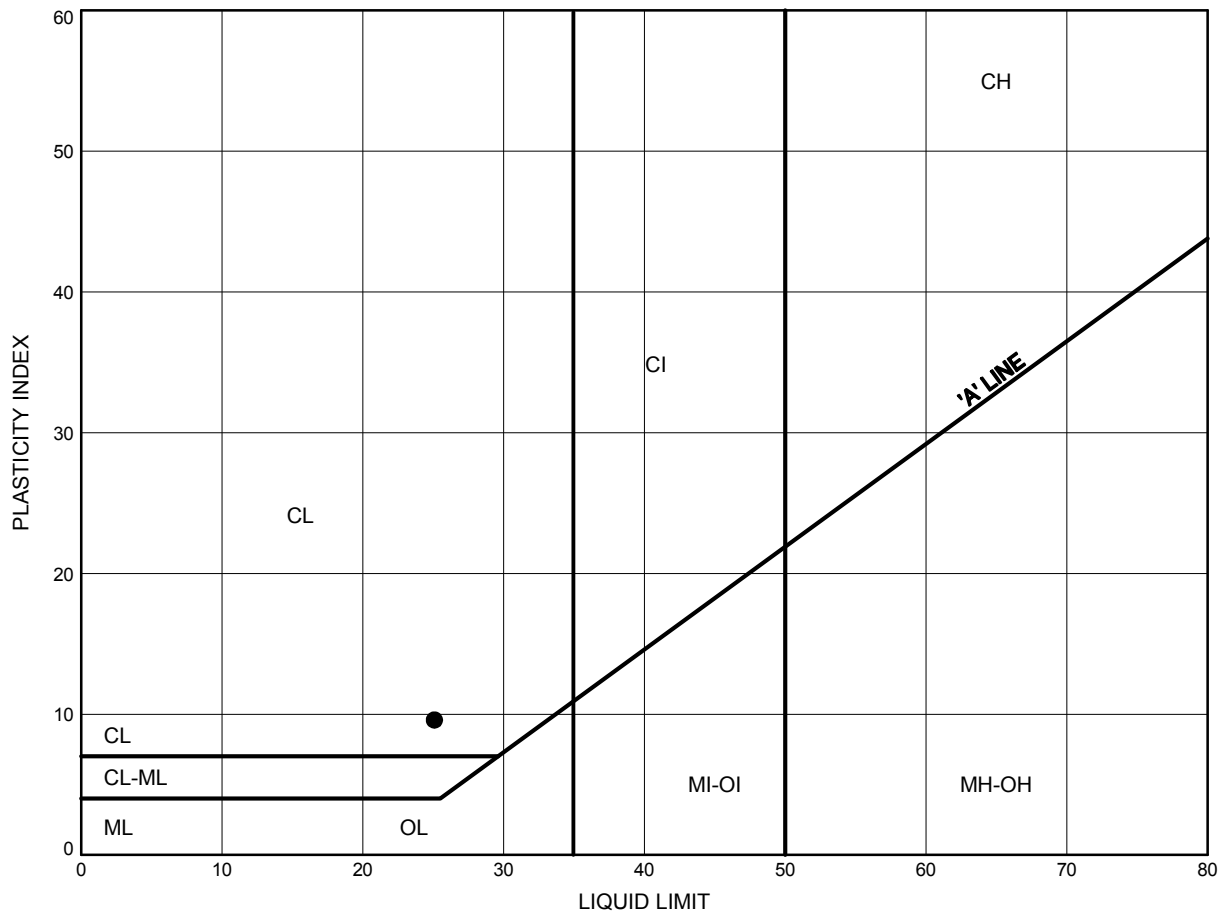


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B14

**SILTY/CLAYEY SAND**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-13	1.07	220.48

Date February 2015  
 W.P. P-13-03

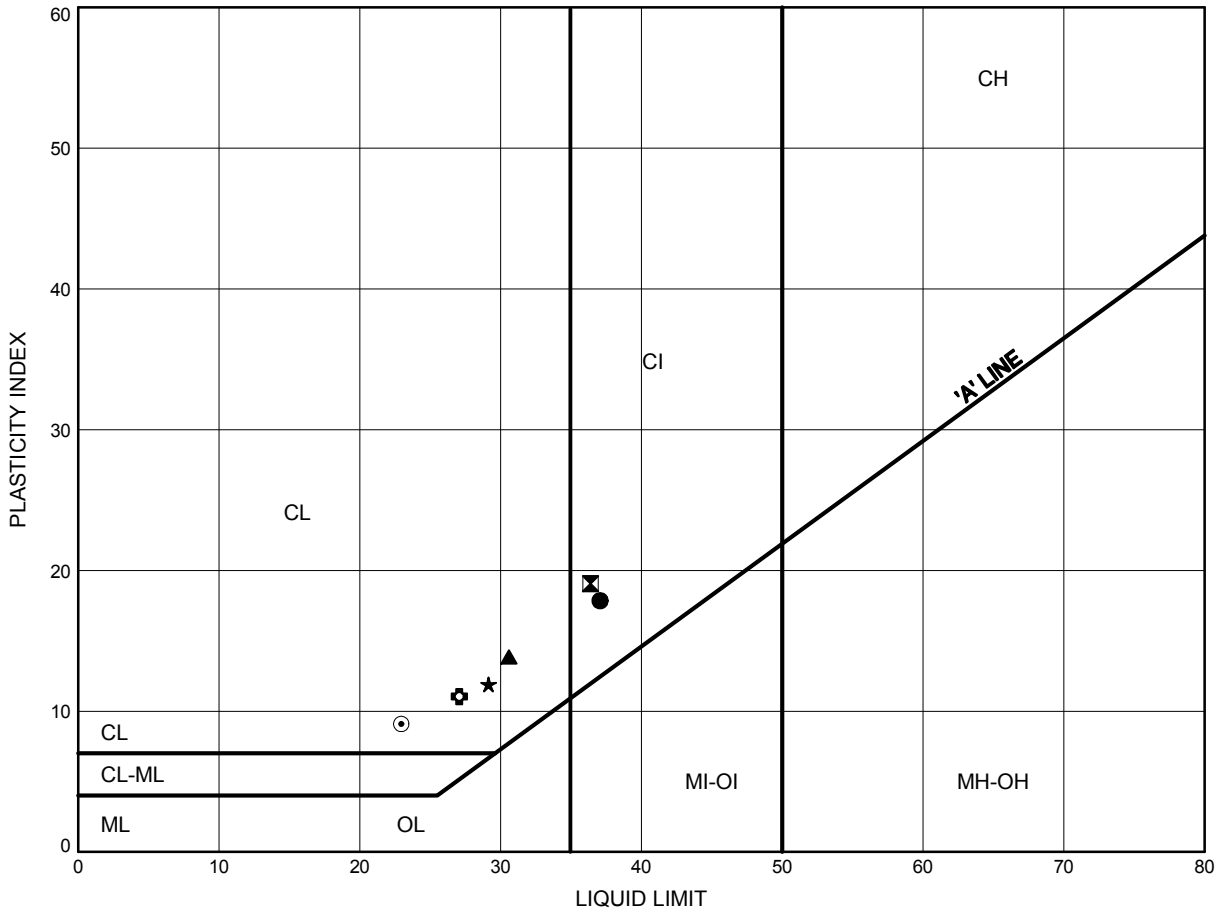


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B15

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-24	3.35	220.03
⊠	13-24	4.88	218.50
▲	13-25	6.40	217.75
★	13-25	10.97	213.18
⊙	13-26	9.45	216.46
⊕	14-01	4.88	217.62

Date February 2015  
W.P. P-13-03

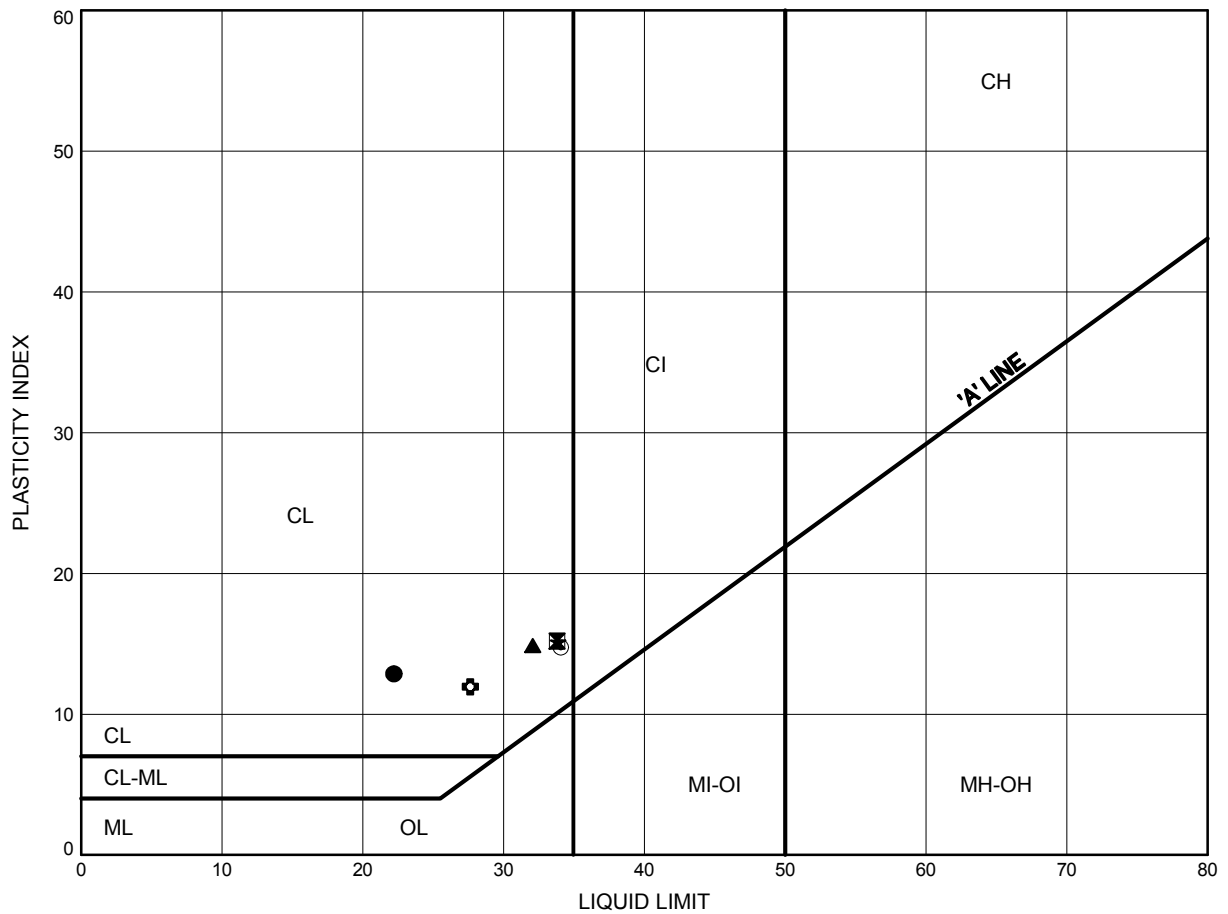


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B16

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-01	7.92	214.58
⊠	14-05	9.45	212.73
▲	14-06	3.35	219.31
★	14-06	7.92	214.73
⊙	14-07	4.88	216.75
⊕	14-08	1.07	220.39

Date February 2015  
 W.P. P-13-03

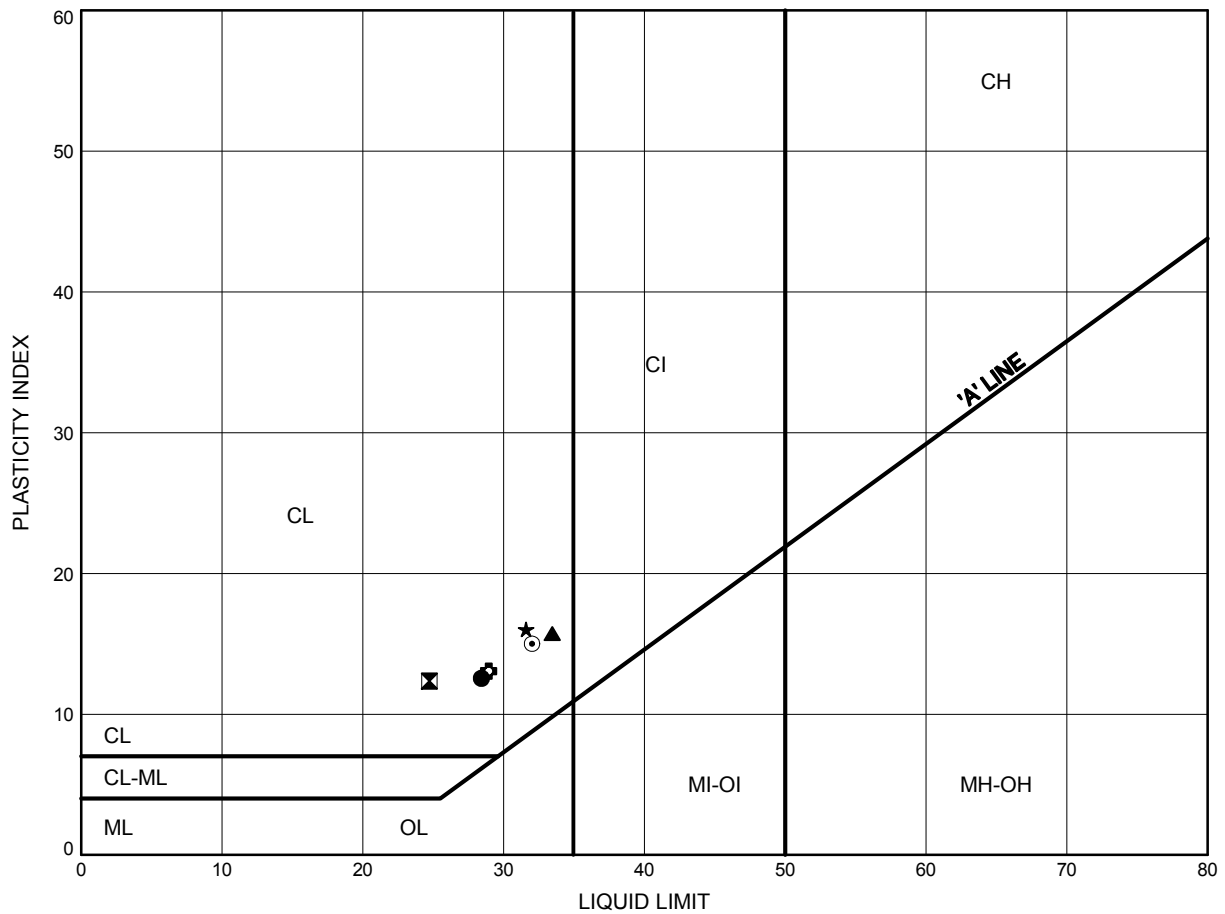


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B17

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-08	3.35	218.10
⊠	14-09	10.97	210.83
▲	14-09	14.02	207.78
★	14-10	1.83	219.55
⊙	14-11	3.35	217.99
⊕	14-11	6.40	214.94

Date February 2015  
W.P. P-13-03

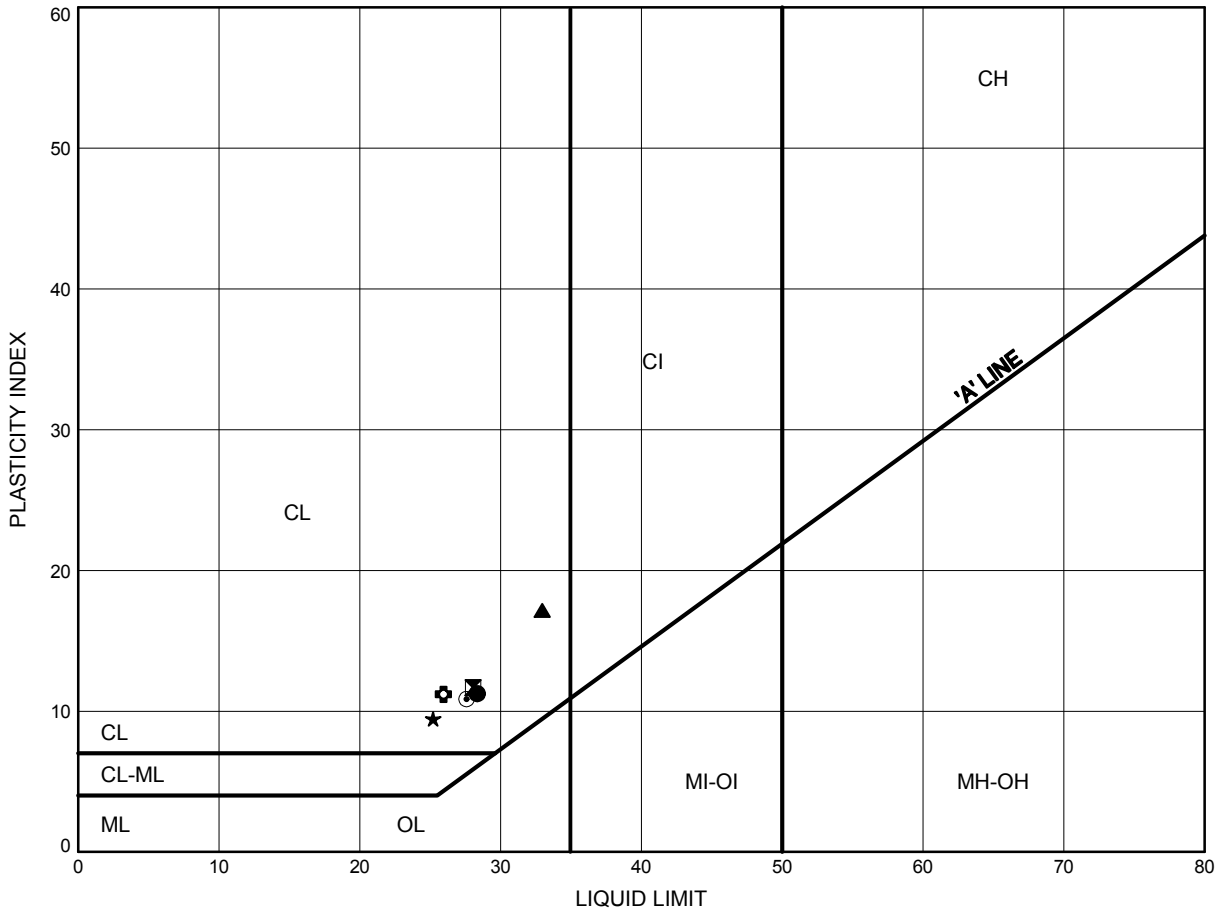


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B18

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-12	6.40	215.20
⊠	14-12	10.97	210.63
▲	14-13	7.92	213.62
★	14-14	1.07	221.03
⊙	14-14	4.88	217.22
⊕	14-14	9.45	212.65

Date February 2015  
W.P. P-13-03



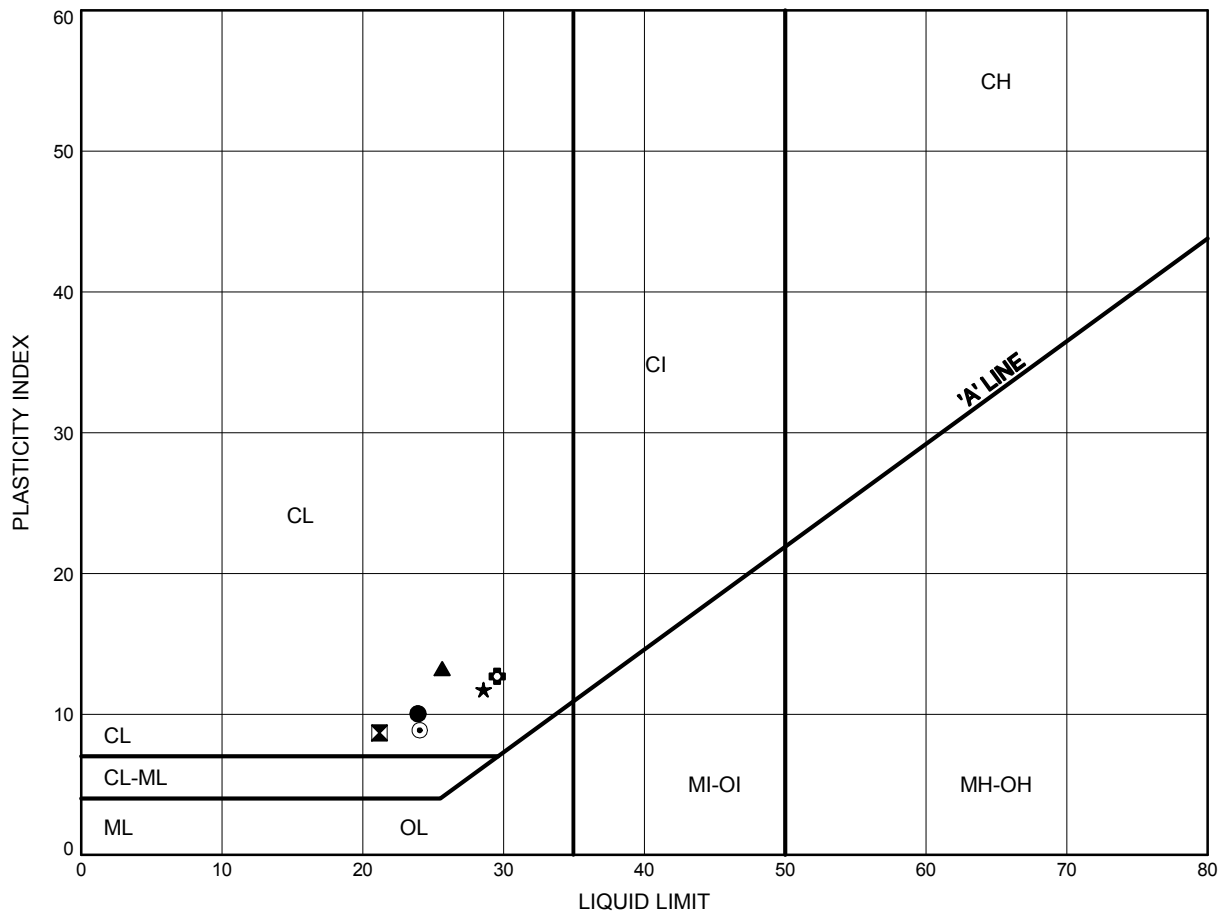
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Chkd. RPR



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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B19

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-15	4.88	217.32
⊠	14-15	9.45	212.75
▲	14-15	18.59	203.61
★	14-16	3.35	217.86
⊙	14-16	10.97	210.24
⊕	14-17	6.40	215.11

Date February 2015  
W.P. P-13-03

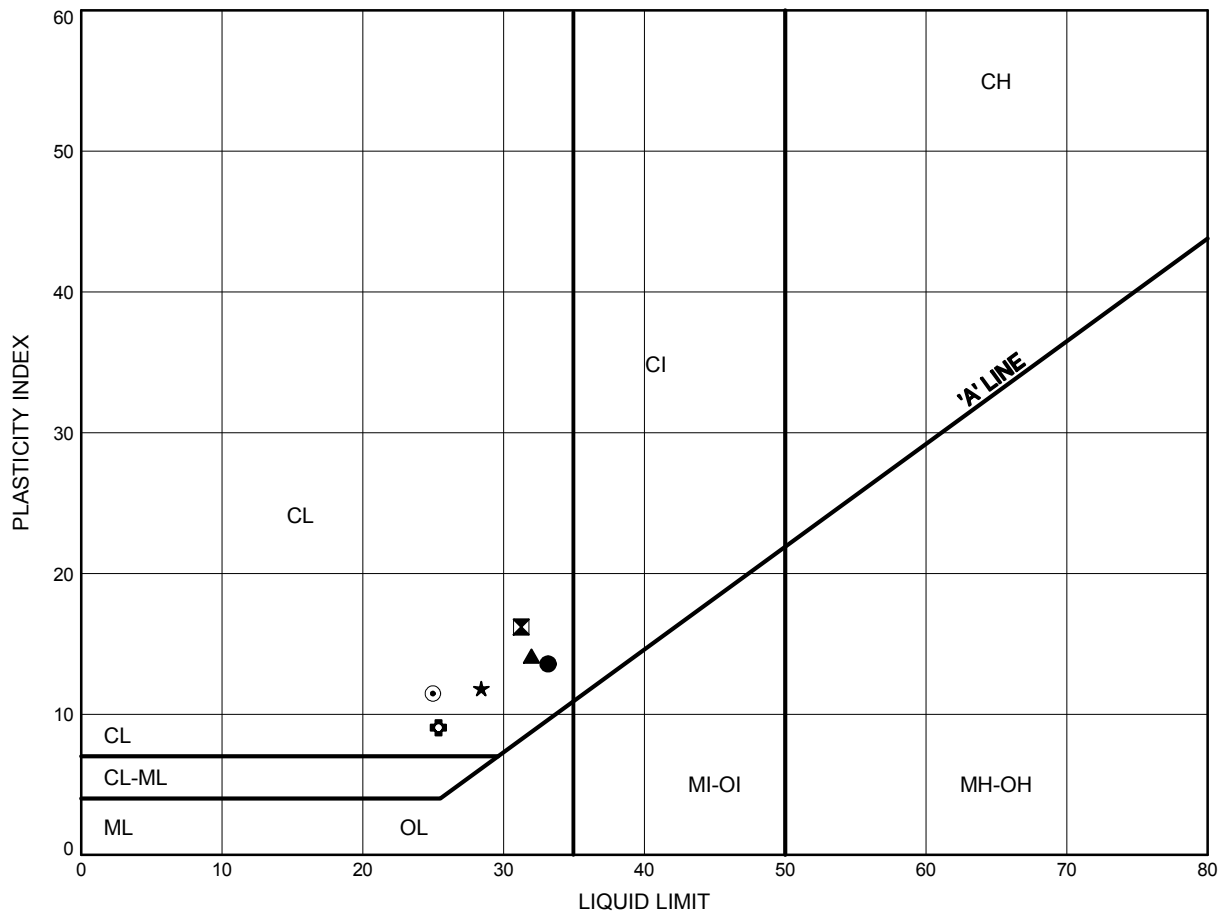


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B20

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-18	4.88	217.02
⊠	14-18	12.50	209.40
▲	14-23	3.35	220.06
★	14-23	6.40	217.01
⊙	14-51	7.92	213.58
⊕	14-51	10.97	210.53

Date February 2015  
 W.P. P-13-03

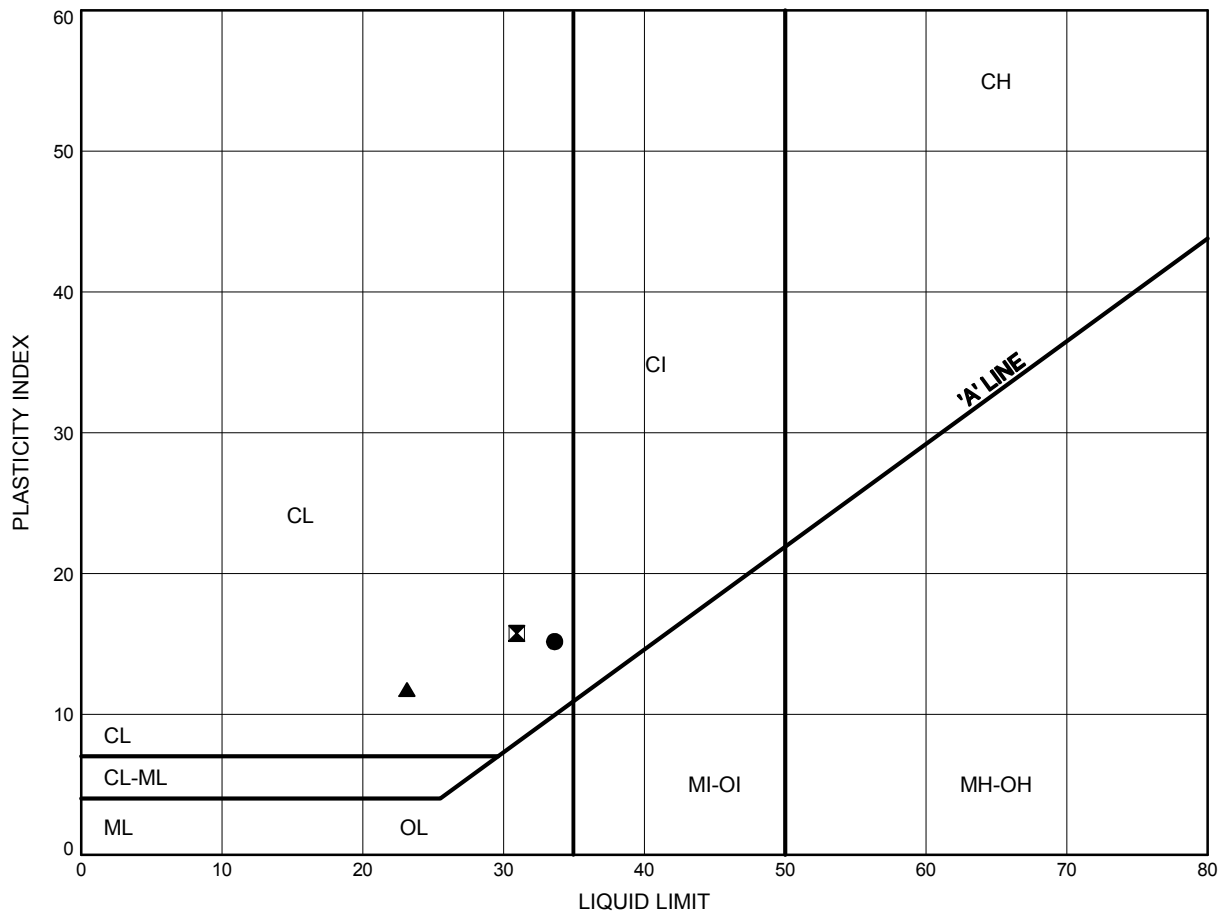


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE B21

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-52	7.92	214.01
⊠	14-52	14.02	207.92
▲	14-52	17.07	204.87

Date February 2015  
 W.P. P-13-03



Prep'd AN  
 Chkd. RPR



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

CONT No  
WP No P13-03

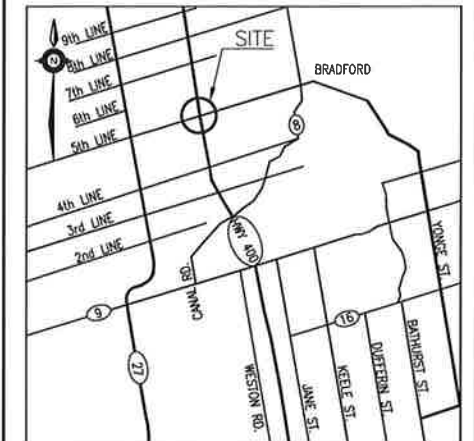
HIGHWAY 400 & LINE 5  
N-EW & E-S RAMPS  
HIGH FILLS  
BOREHOLE LOCATIONS PLAN

**AECOM**

**THURBER ENGINEERING LTD.**



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
- W Water Level
- ⊕ Head Artesian Water
- ⊕ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
13-24	223.4	4 881 617.8	294 596.3
13-25	224.2	4 881 628.3	294 649.5
13-26	225.9	4 881 634.1	294 689.2
14-01	222.5	4 882 058.1	294 691.5
14-02	227.5	4 882 047.5	294 728.5
14-03	227.5	4 882 057.7	294 754.1
14-04	222.3	4 882 070.2	294 799.2
14-05	222.2	4 882 039.1	294 709.1
14-06	222.7	4 881 939.3	294 702.6
14-07	221.6	4 881 857.5	294 677.9
14-08	221.5	4 881 803.1	294 648.2
14-09	221.8	4 881 757.0	294 628.6
14-10	221.4	4 881 817.1	294 699.6

**-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-605

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC	CODE
DRAWN	AN	CHK RPR	SITE
			STRUCT
			DWG 1B
			DATE JUN 2015



NO	ELEVATION	NORTHING	EASTING
14-11	221.3	4 881 784.6	294 730.4
14-12	221.6	4 881 789.8	294 692.0
14-13	221.5	4 881 762.5	294 697.8
14-14	222.1	4 881 762.4	294 658.9
14-15	222.2	4 881 704.9	294 627.0
14-16	221.2	4 881 695.2	294 599.3
14-17	221.5	4 881 714.1	294 655.5
14-18	221.9	4 881 681.1	294 688.6
14-23	223.4	4 881 603.2	294 549.6
14-31	225.3	4 881 690.8	294 937.0
14-51	221.5	4 881 727.4	294 691.7
14-52	221.9	4 881 660.4	294 648.5

PLAN





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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

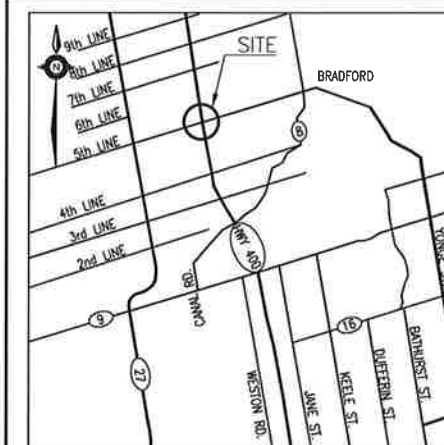
CONT No  
WP No P13-03

HIGHWAY 400 & LINE 5  
N-EW & E-S RAMPS  
HIGH FILLS  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








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## KEYPLAN

LEGEND

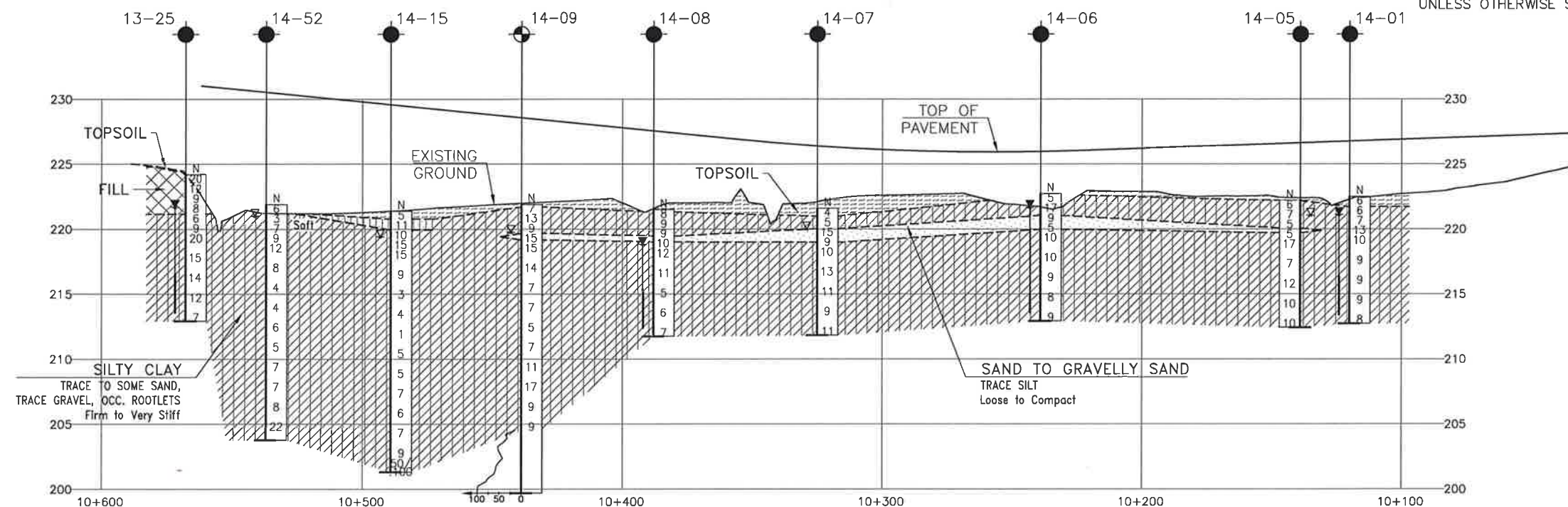
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
14-01	222.5	4 882 058.1	294 691.5
14-05	222.2	4 882 039.1	294 709.1
14-06	222.7	4 881 939.3	294 702.6
14-07	221.6	4 881 857.5	294 677.9
14-08	221.5	4 881 803.1	294 648.2
14-09	221.8	4 881 757.0	294 628.6
14-11	221.3	4 881 784.6	294 730.4
14-12	221.6	4 881 789.8	294 692.0
14-14	222.1	4 881 762.4	294 658.9
14-15	222.2	4 881 704.9	294 627.0
14-17	221.5	4 881 714.1	294 655.5
14-18	221.9	4 881 681.1	294 688.6
14-52	221.9	4 881 660.4	294 648.5

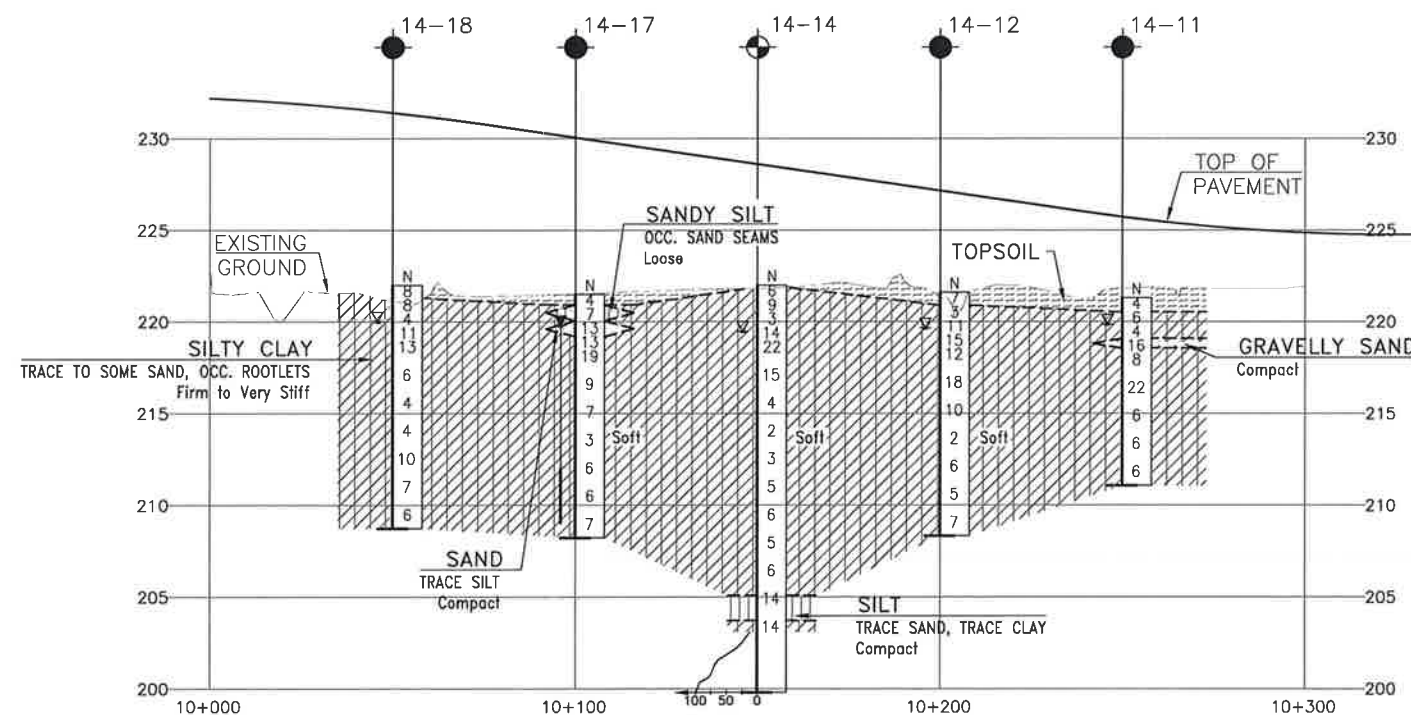
-NOTES-

- 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-605



PROFILE ALONG C RAMP N-EW



PROFILE ALONG C RAMP E-S



NO	ELEVATION	NORTHING	EASTING
13-25	224.2	4 881 628.3	294 649.5

[illegible]

FILENAME: H:\Drafting\19\4406\15\ted0615-BoreholePlan&Profile (HighFills).dwg

## **Appendix C**

### **Ramps S-EW and W-S and Coffey Rd. - Embankments less than 4.5 m high, Boreholes 14-32, 14-38 and 14-42**

- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”

# RECORD OF BOREHOLE No 14-32

1 OF 1

METRIC

W.P. P-13-03 LOCATION Ramp S-EW N 4 881 698.8 E 294 979.0 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.19 - 2014.11.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
227.7	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0	ASPHALT: (100mm)							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.1	SAND, some gravel to gravelly Brown Damp (FILL)		1	GS			227							
226.8														
0.9	Sandy SILT, trace clay Compact Brown Moist		1	SS	19									
226.2														
1.5	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Brown Moist		2	SS	11		226							
			3	SS	12		225							0 0 59 41
			4	SS	14		224							
	Grey		5	SS	17		223							0 0 55 45
							222							
			6	SS	11		221							
							220							
219.5			7	SS	13									
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 14-38

1 OF 1

METRIC

W.P. P-13-03 LOCATION Ramp W-S N 4 881 471.0 E 294 781.6 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.17 - 2014.11.17 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20    40    60    80    100	W P                      W                      W L	GR   SA   SI   CL				
225.3	GROUND SURFACE													
0.0	ASPHALT: (25mm)		1	GS		▽	225							
	SAND, some gravel to gravelly Compact Brown to Dark Brown Moist (FILL)													
224.2			1	SS	12									
1.1	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Dark Brown to Brown Moist							224						
			2	SS	14									0   0   63   37
			3	SS	13			223						
			4	SS	15		222							
							221							
			5	SS	16		220						0   4   57   39	
	Grey													
			6	SS	13		219							
218.6														
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL IN OPEN BOREHOLE AT 1.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.													

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# RECORD OF BOREHOLE No 14-42

1 OF 1

METRIC

W.P. P-13-03 LOCATION Coffey Road N 4 881 460.9 E 294 936.9 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.14 - 2014.11.14 CHECKED BY RPR

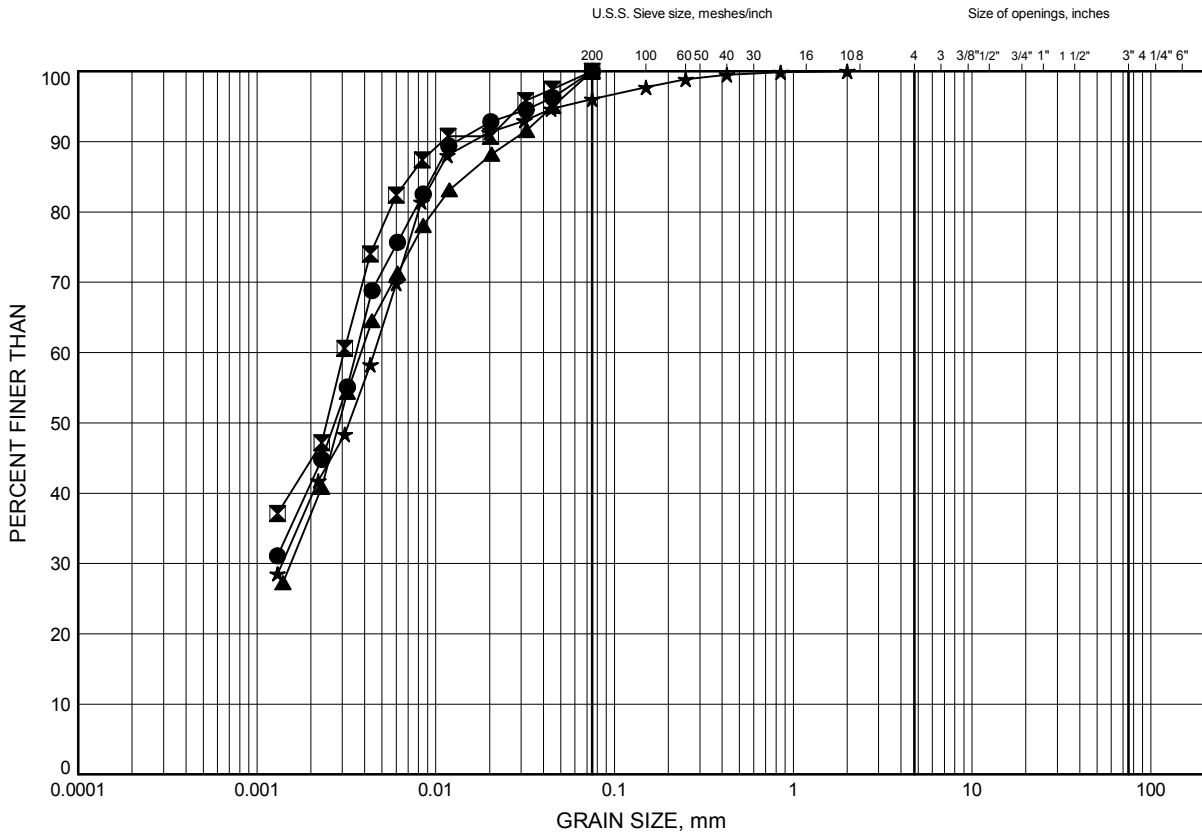
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT  W <sub>P</sub>	NATURAL MOISTURE CONTENT  W	LIQUID LIMIT  W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
224.3	GROUND SURFACE																
0.0	TOPSOIL, trace clay, occasional roots and rootlets Very Loose Dark Brown Wet		1	SS	1		224								83		
223.5																	
0.8	Silty CLAY, trace sand Stiff to Very Stiff Brown Moist		2	SS	11		223						○				
			3	SS	17		222						○				
	Grey		4	SS	27								○				
221.4																	
3.0	Hard Grey Wet		5	SS	49	▽	221						○				
	Inferred cobbles																
220.2																	
4.1			6	SS	20		220						○				
							219										
			7	SS	18		218						○				
217.6																	
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL IN OPEN BOREHOLE AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

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**GRAIN SIZE DISTRIBUTION**

FIGURE C1

**SILTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-32	2.59	225.11
⊠	14-32	4.88	222.82
▲	14-38	1.83	223.47
★	14-38	4.88	220.42

Date February 2015  
W.P. P-13-03

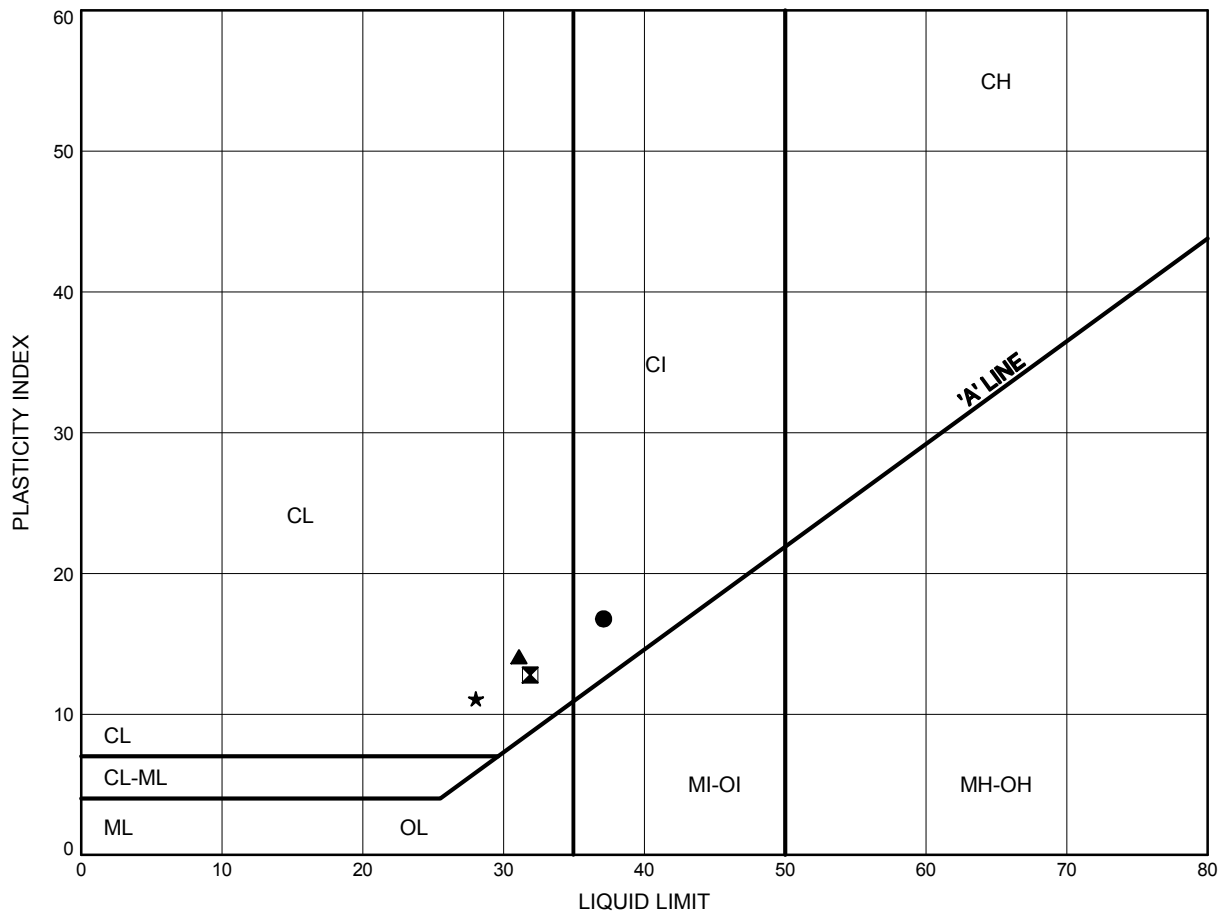


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE C2

**SILTY CLAY**



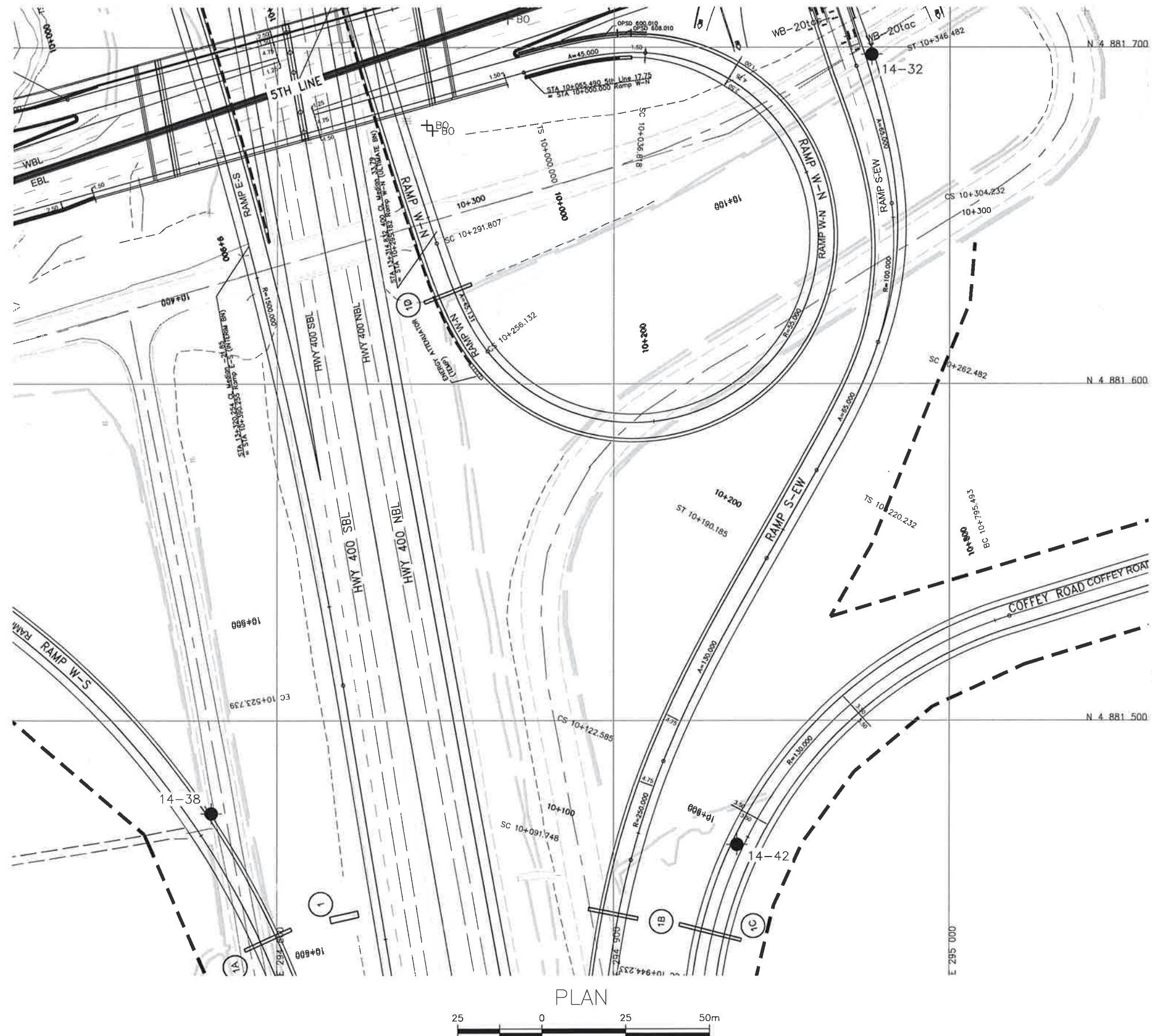
**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-32	2.59	225.11
⊠	14-32	4.88	222.82
▲	14-38	1.83	223.47
★	14-38	4.88	220.42

Date February 2015  
 W.P. P-13-03



Prep'd AN  
 Chkd. RPR



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

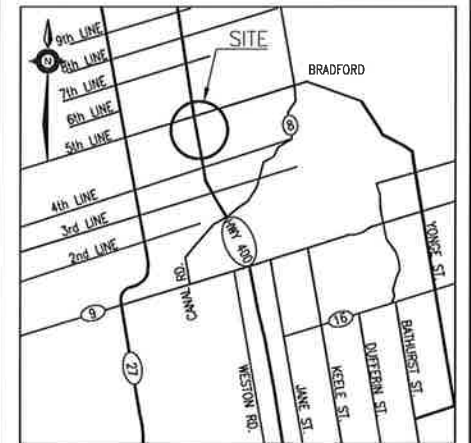
CONT No  
WP No P13-03

HIGHWAY 400 & LINE 5  
EMBANKMENTS LESS THAN 4.5m HIGH  
BOREHOLE LOCATIONS PLAN

**AECOM**



THURBER ENGINEERING LTD.



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
14-32	227.7	4 881 698.8	294 979.0
14-38	225.3	4 881 471.0	294 781.6
14-42	224.3	4 881 460.9	294 936.9

**-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.
- 3) This plan only shows the boreholes drilled specifically for Ramps S-EW, W-S and Coffey Road.

GEOCREs No. 31D-605



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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## **Appendix D**

### **Culvert extensions at Sucker Creek Culvert, Highway 400**

#### **Boreholes 14-01 to 14-04**

- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”

# RECORD OF BOREHOLE No 14-01

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 058.1 E 294 691.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.28 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 (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				WATER CONTENT (%) W <sub>P</sub> W      W <sub>L</sub>				GR	SA	SI	CL	
222.5	GROUND SURFACE							20	40	60	80	100								
0.0	<b>TOPSOIL</b> , occasional roots and rootlets Loose Dark Brown Moist		1	SS	6		222													
221.7																				
0.8	Silty <b>CLAY</b> , trace sand, trace gravel, occasional rootlets Firm to Stiff Brown to Grey Moist		2	SS	6		221										0	9	61	30
	Occasional sand seams		3	SS	7					2.6										
220.3																				
2.2	Stiff Grey		4	SS	13		220													
			5	SS	10		219			2.8										
			6	SS	9		218			2.3							0	7	47	46
							217													
			7	SS	9		216			2.2										
215.3																				
7.2	Firm		8	SS	9		215			2.4							0	6	55	39
							214													
			9	SS	8		213			2.2										
212.7																				
9.8	END OF BOREHOLE AT 9.8m.																			

Continued Next Page

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

# RECORD OF BOREHOLE No 14-01

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 058.1 E 294 691.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.10.28 - 2014.10.28 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									
	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)  Nov 07/ 14      1.4      221.1 Dec 08/ 14      1.2      221.3 Jan 06/ 15      1.4      221.1  NOTE: Field vane shear values were measured in a separate hole located adjacent to the original sampled borehole.																



# RECORD OF BOREHOLE No 14-02

1 OF 3

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 047.5 E 294 728.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration test COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.24 - 2014.11.24 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
227.5	GROUND SURFACE													
0.0	ASPHALT:(125mm)													
0.1	SAND and GRAVEL Compact Brown Moist (FILL)		1	GS										
			1	SS	17									
			2	SS	19									
			3	SS	15									
			4	SS	18									
			5	SS	11									
222.0														
5.5	Silty CLAY, with sand, trace gravel Firm Brown Moist		6	SS	4									
220.3														
7.2			7	SS	19									
	Trace sand Firm Grey Wet		8	SS	5									

Continued Next Page

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

20  
15  
10  
5  
0  
(%) STRAIN AT FAILURE

ONTMT4S 0615.GPJ 2015TEMPLATE(MTO).GDT 4/21/15



# RECORD OF BOREHOLE No 14-02

2 OF 3

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 047.5 E 294 728.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration test COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.24 - 2014.11.24 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page													
	Silty <b>CLAY</b> , some sand Firm to Stiff Grey Wet		9	SS	7		217	2.4						
							216	2.9						
			10	SS	9		215							0 15 50 35
214.4 13.1	End of sampling and start of DCPT						214	2.5						
							213							
							212							
							211							
							210							
							209							
							208							

Continued Next Page

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

# RECORD OF BOREHOLE No 14-02

3 OF 3

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 047.5 E 294 728.5 ORIGINATED BY ES  
 HWY 400 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration test COMPILED BY AN  
 DATUM Geodetic DATE 2014.11.24 - 2014.11.24 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W <sub>p</sub>	W	W <sub>L</sub>	WATER CONTENT (%)		
	Continued From Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60						
202.8							207							
							206							
							205							
							204							
							203							
24.7	END OF BOREHOLE AT 24.7m. WATER LEVEL IN OPEN BOREHOLE AT 5.9m UPON COMPLETION.  BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.													

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	<div><div></div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div>	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			
227.5	GROUND SURFACE										
0.0 0.1	ASPHALT:(75 mm)										
226.7	SAND and GRAVEL, some silt and clay Compact Brown Moist (FILL)		1	SS	29						39 50 11 (SI+CL)
0.8			2	SS	26						
	Silty CLAY, trace to some sand, trace gravel Very Stiff Brown Moist (FILL)		3	SS	24						
			4	SS	18						
			5	SS	17						
			6	SS	19						0 0 48 52
222.8	Silty CLAY, trace sand Stiff Brown to Grey Moist		7	SS	15						0 5 51 44
4.6			8	SS	14						
			9	SS	16						2 8 40 50
	Trace gravel Very Stiff Grey Moist to Wet		10	SS	17						

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

# RECORD OF BOREHOLE No 14-03

2 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 057.7 E 294 754.1 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.16 - 2014.01.16 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
216.2	Silty <b>CLAY</b> , trace sand Stiff Grey Wet		11	SS	13		217										
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 11.3m AND WATER LEVEL AT 9.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, CONCRETE TO 0.1m THEN ASPHALT PATCH TO SURFACE.																

# RECORD OF BOREHOLE No 14-04

1 OF 2

METRIC

W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 060.0 E 294 769.6 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.31 - 2014.01.31 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20    40    60    80    100	W <sub>P</sub> W      W <sub>L</sub>	GR    SA    SI    CL				
222.3	GROUND SURFACE													
0.0	TOPSOIL: (125 mm)													
0.1	Silty <b>CLAY</b> , trace sand, occasional rootlets Firm Brown to Grey Moist to Wet		1	SS	7		222							
			2	SS	7									
	Wet						221							
			3	SS	7									
220.1														
2.2	Stiff to Very Stiff		4	SS	13		220							
	Grey Wet		5	SS	18		219							
			6	SS	17		218							
			7	SS	16		217							
	Trace gravel		8	SS	13		216							
							215							
			9	SS	9		214							
	Firm		10	SS	6		213							

Continued Next Page

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

# RECORD OF BOREHOLE No 14-04

2 OF 2

METRIC

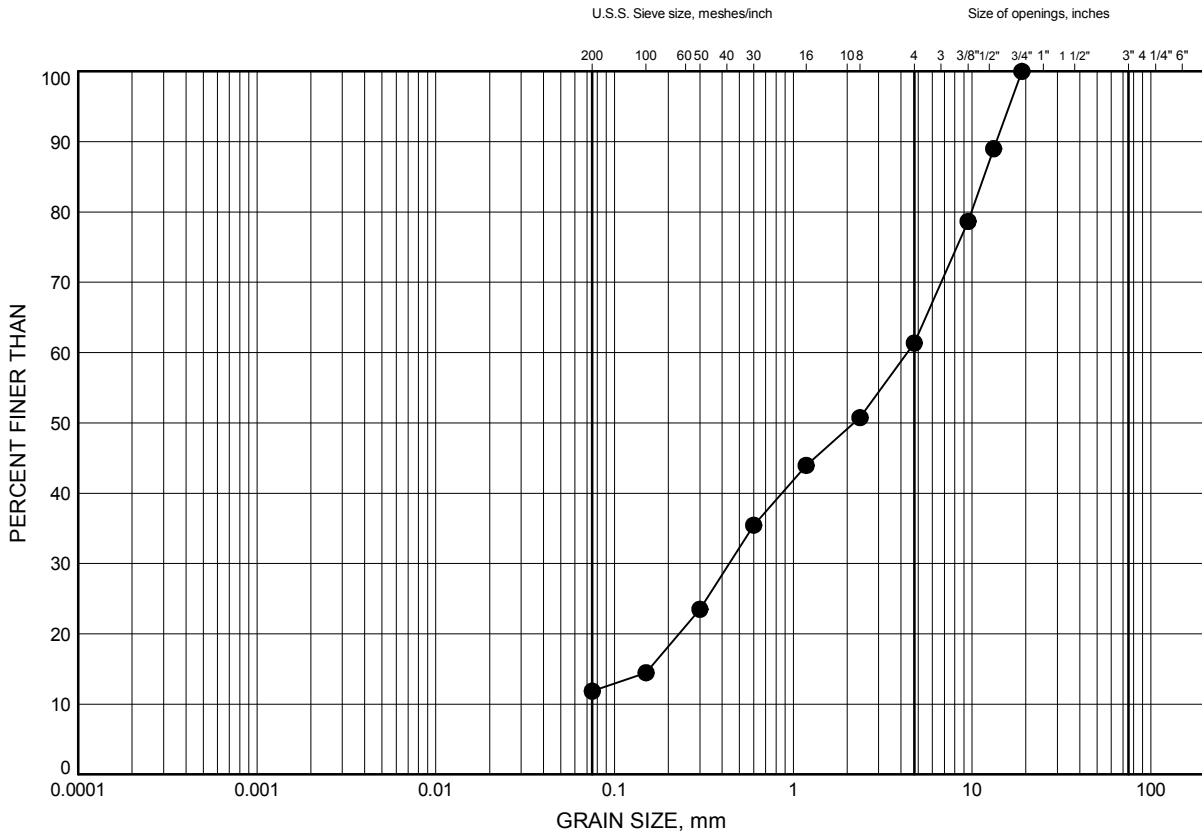
W.P. P-13-03 LOCATION Sucker Creek Culvert N 4 882 060.0 E 294 769.6 ORIGINATED BY GA  
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2014.01.31 - 2014.01.31 CHECKED BY RPR

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 $\gamma$ 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																
211.0	Silty <b>CLAY</b> Firm to Stiff Grey Wet		11	SS	6		212										
11.3	END OF BOREHOLE AT 11.3 m. BOREHOLE OPEN TO 11.3 m AND WATER LEVEL AT 1.5 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m)  Jan 21/ 15      1.3      221.0																

Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE D1

**SAND & GRAVEL FILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-03	0.38	227.07

Date February 2015  
W.P. P-13-03

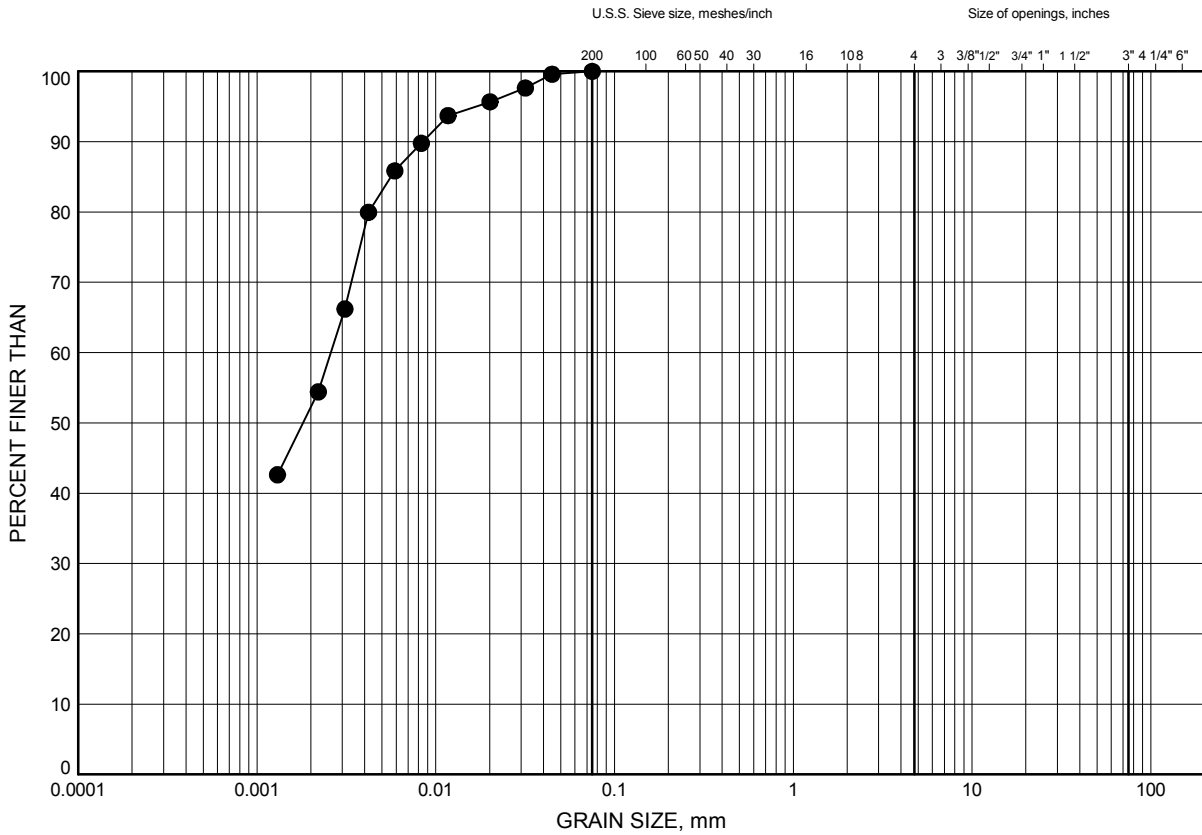


Prep'd AN  
Chkd. RPR

Foundation Engineering, Hwy. 400 and 5th Line  
**GRAIN SIZE DISTRIBUTION**

FIGURE D2

**SILTY CLAY FILL**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-03	4.11	223.34

Date February 2015  
W.P. P-13-03



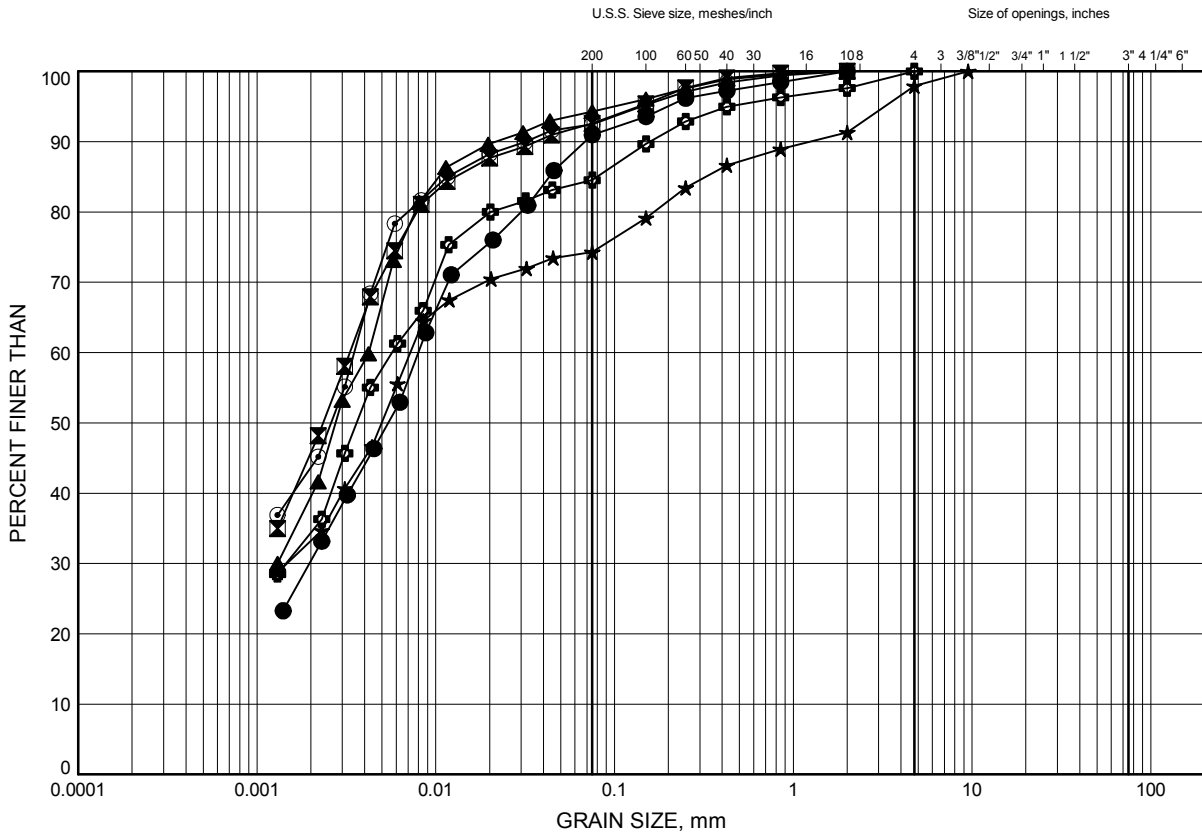
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**GRAIN SIZE DISTRIBUTION**

FIGURE D3

**SLLTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-01	1.07	221.43
⊠	14-01	4.88	217.62
▲	14-01	7.92	214.58
★	14-02	2.59	224.86
⊙	14-02	9.45	218.00
⊕	14-02	12.50	214.96

Date February 2015  
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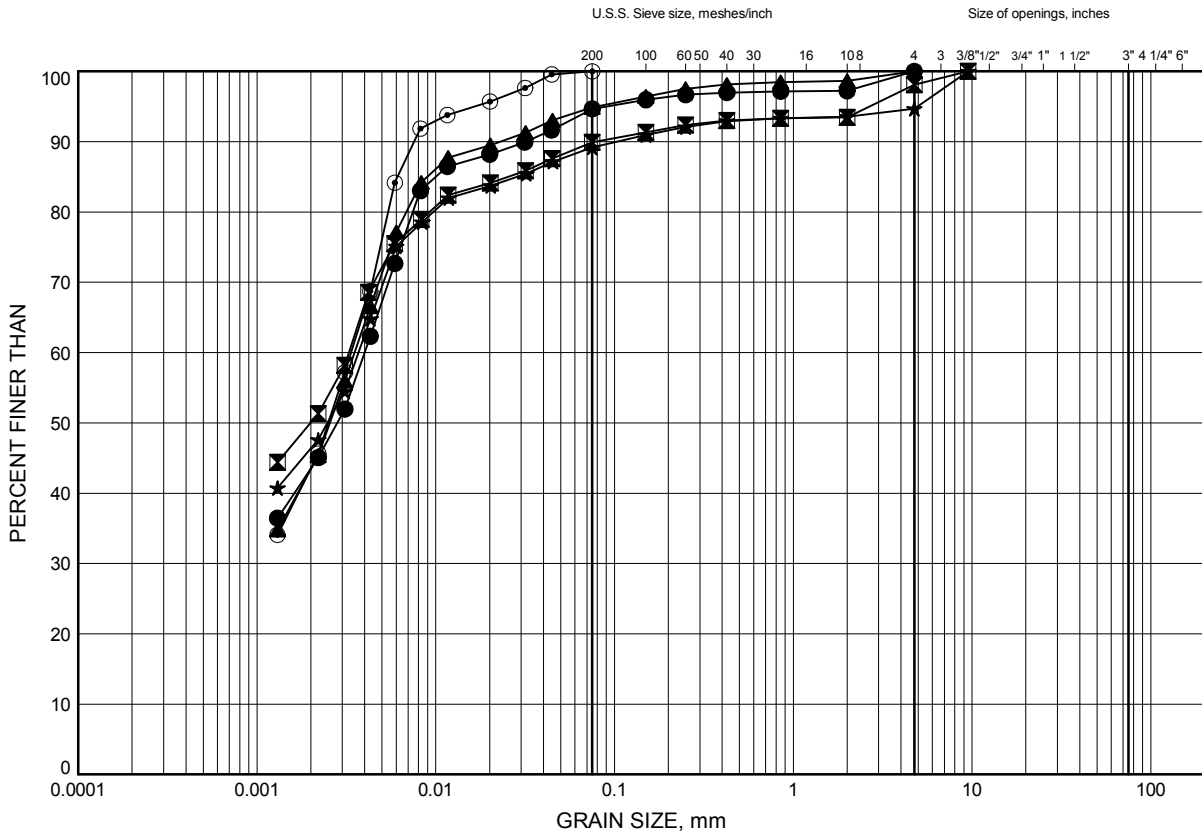


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**GRAIN SIZE DISTRIBUTION**

FIGURE D4

**SLLTY CLAY**



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

**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-03	4.88	222.58
⊠	14-03	7.92	219.53
▲	14-04	2.59	219.71
★	14-04	6.40	215.90
⊙	14-04	10.97	211.33

Date February 2015  
W.P. P-13-03

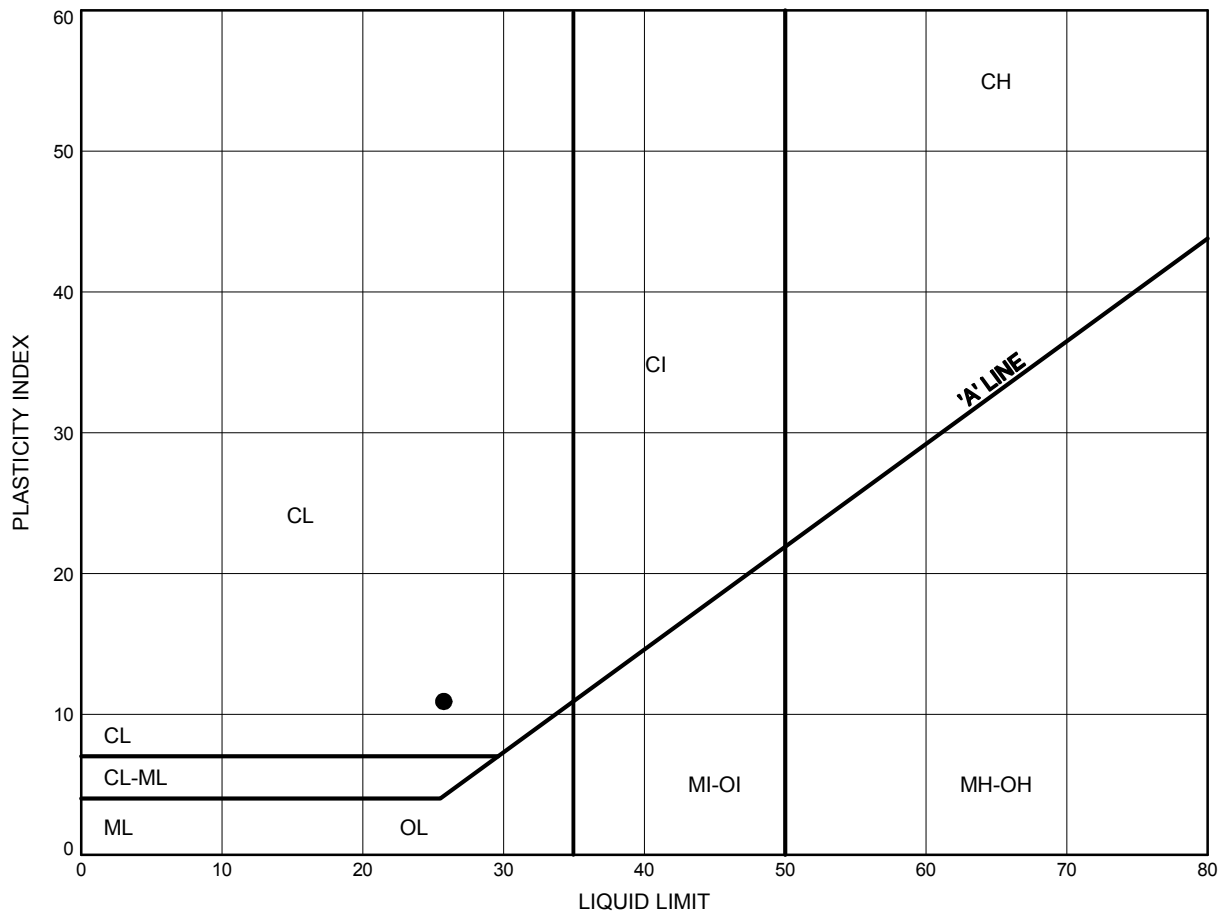


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE D5

**SILTY CLAY FILL**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-03	4.11	223.34

Date February 2015  
W.P. P-13-03

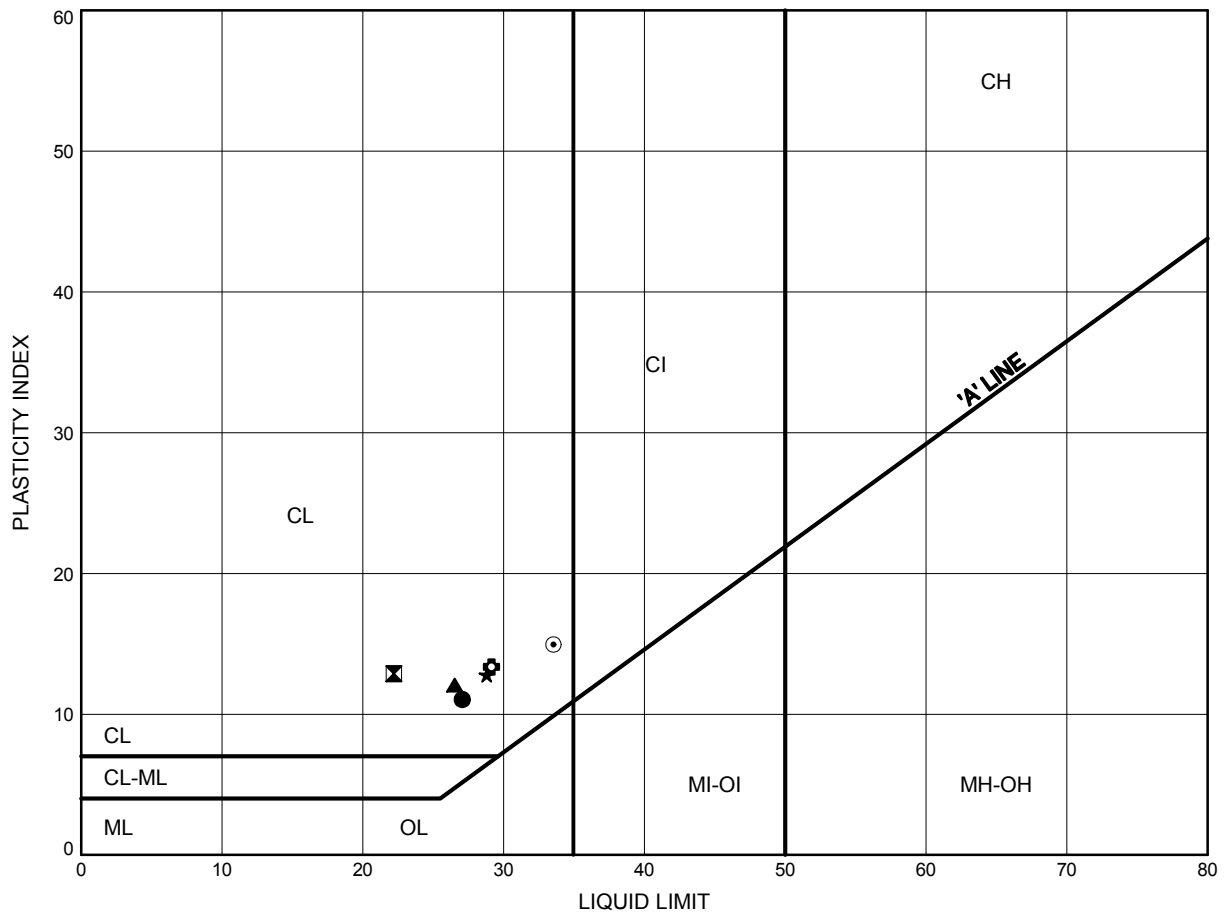


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE D6

**SILTY CLAY**



**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-01	4.88	217.62
⊠	14-01	7.92	214.58
▲	14-02	2.59	224.86
★	14-02	9.45	218.00
⊙	14-03	4.88	222.58
⊕	14-03	7.92	219.53

Date February 2015  
 W.P. P-13-03

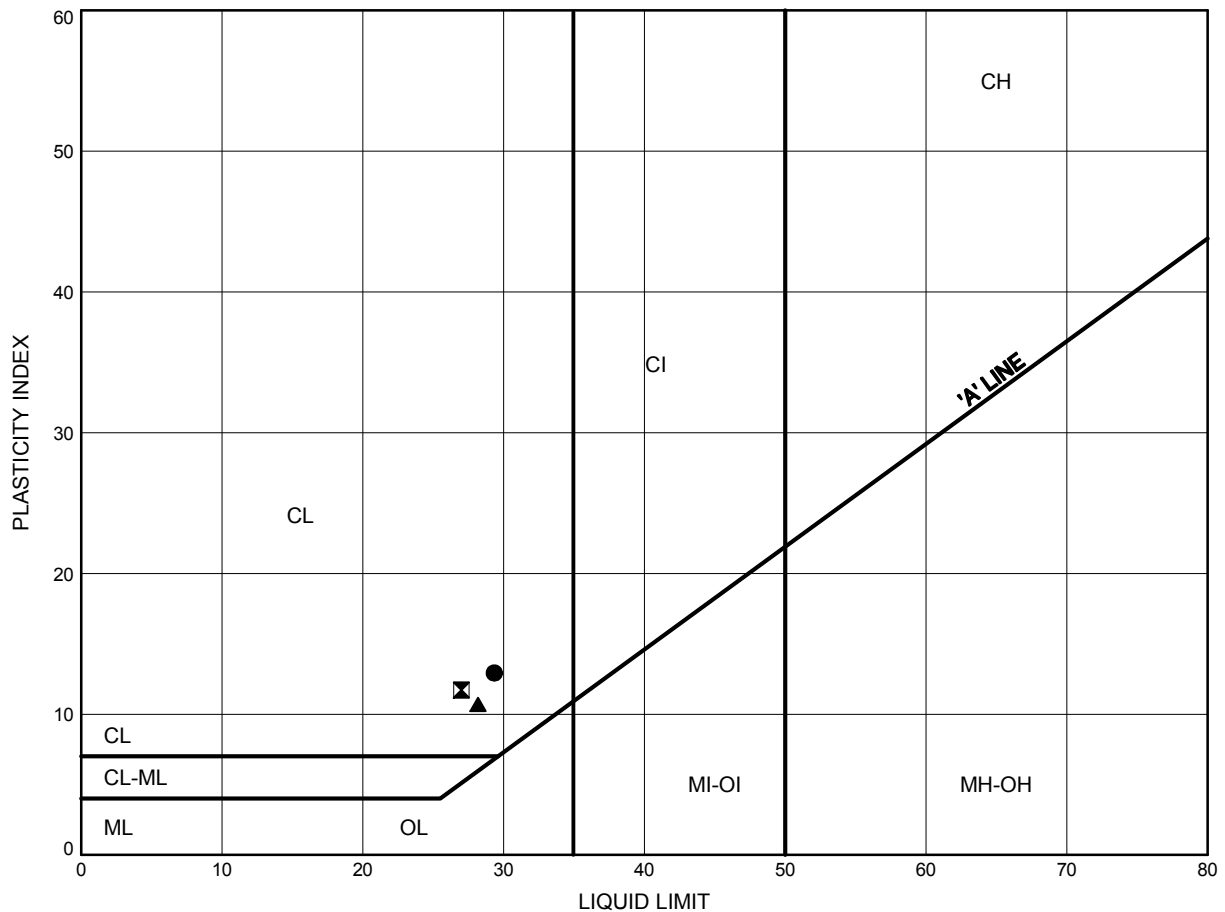


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**ATTERBERG LIMITS TEST RESULTS**

FIGURE D7

**SILTY CLAY**



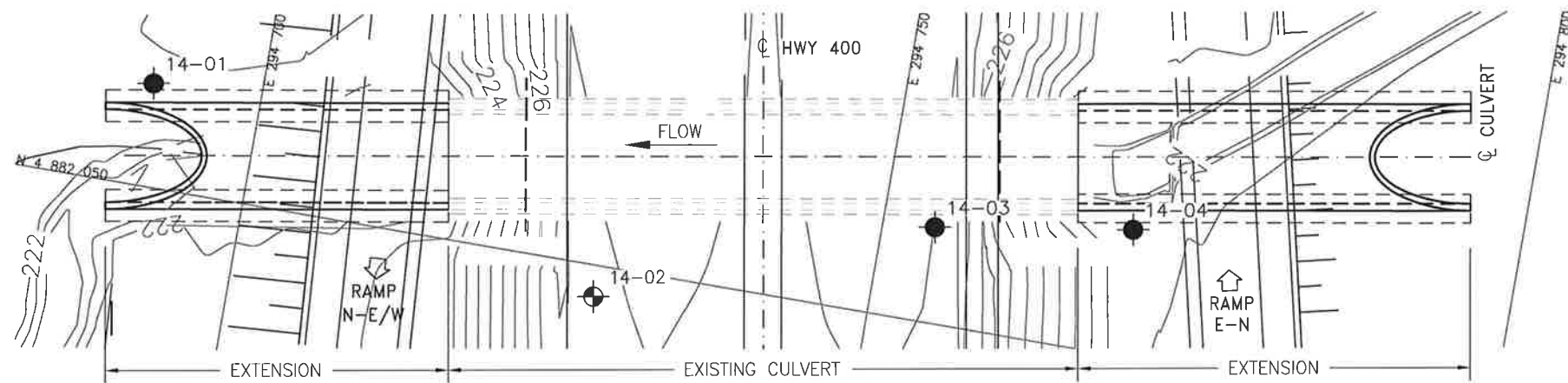
**LEGEND**

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-04	2.59	219.71
⊠	14-04	6.40	215.90
▲	14-04	10.97	211.33

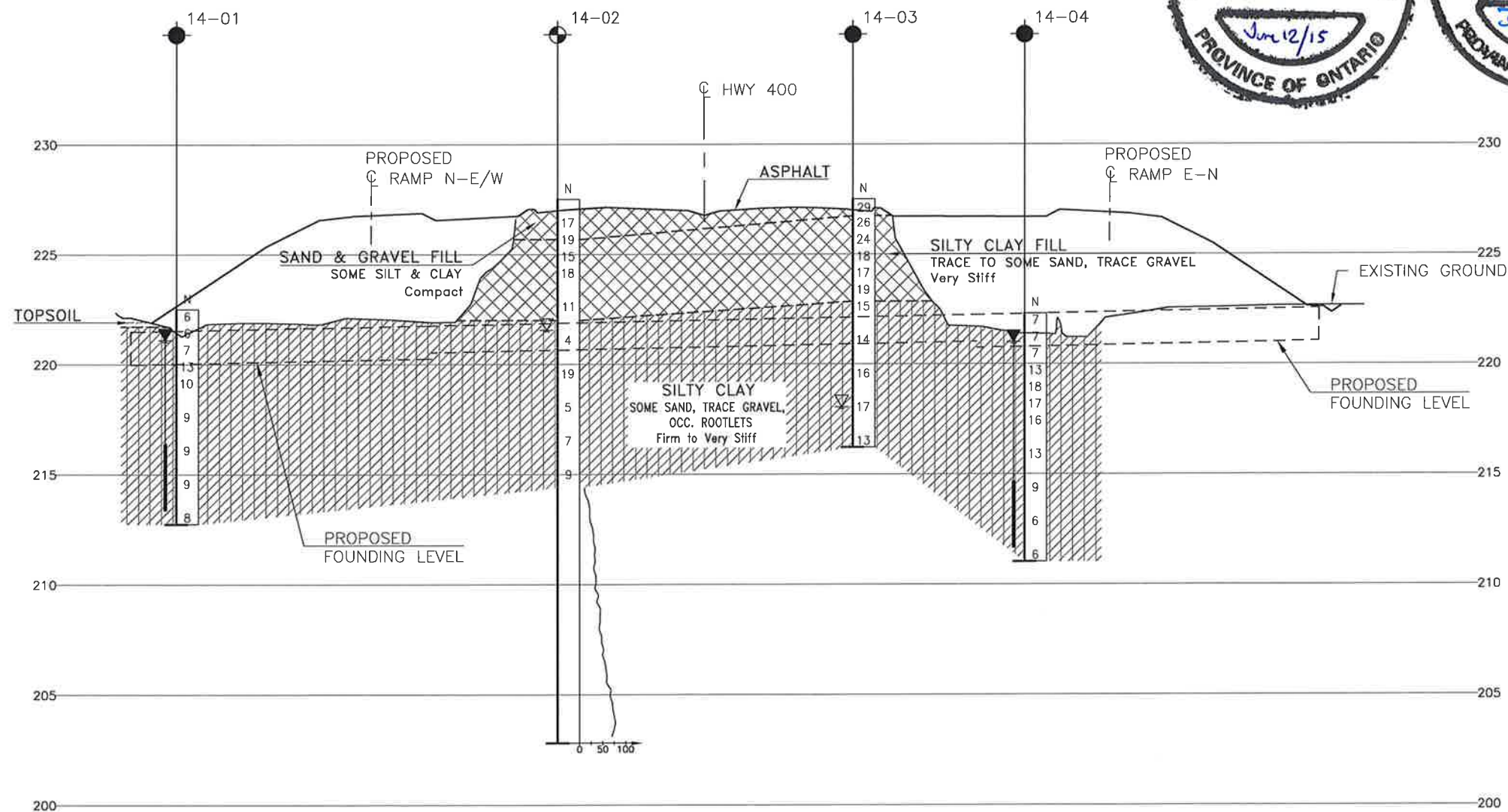
Date February 2015  
W.P. P-13-03



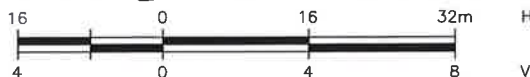
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PLAN



PROFILE ALONG C SUCKER CREEK CULVERT



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



CONT No  
WP No P13-03

HIGHWAY 400 & LINE 5  
SUCKER CREEK  
CULVERT EXTENSION  
BOREHOLE LOCATIONS & SOIL STRATA

**AECOM**

**THURBER ENGINEERING LTD.**



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
14-01	222.5	4 882 058.1	294 691.5
14-02	227.5	4 882 047.5	294 728.5
14-03	227.5	4 882 057.5	294 754.1
14-04	222.3	4 882 060.0	294 769.6

-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-605

DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC CODE
DRAWN	AN	CHK RPR SITE
		LOAD
		STRUCT
		DWG 1D