



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD, HIGH OCCUPANCY TOLL
HIGH OCCUPANCY MESSAGE AND TOLL STATION
SIGN SUPPORTS
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
FROM STOUFFVILLE ROAD TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-02-00**

GEOCRES NO. 30M14-473

Report

to

WSP Canada Inc.

Date: February 16, 2018
File: 15786



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for detailed design of overhead sign (OHS), high occupancy toll sign (HOT), high occupancy message sign (HMS), and toll station sign (TS) support structures along Highway 404 from 0.5 km north of Stouffville Road to Major Mackenzie Drive in the City of Markham, Ontario.

The purpose of this investigation was to explore the subsurface conditions near the sign locations along the highway alignment, and based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber has been retained by WSP Canada Inc. (WSP) to carry out this foundation investigation under the MTO Assignment Number 2016-E-0014.

For preparation of this report, reference has been made to a previous report:

- Foundation Investigation Report, Median Sewer, Highway 404 HOV Lane Expansion and Rehabilitation, Contract 1, From Stouffville Road to Major Mackenzie Drive, Markham, Ontario, G.W.P. 2930-02-00, prepared by Thurber Engineering Ltd., dated February 2018 (Reference 1)

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2. PROJECT AND SITE DESCRIPTION

The locations of overhead sign support structures covered in this report are staggered along Highway 404 from approximately 1 km north of Stouffville Road to Major Mackenzie Drive. The general locations of the proposed works are shown on the key plan on the Borehole Location Drawings in Appendices A to D.

The project limits are located within the physiographic region known as Peel Plain. The topography is flat and gently undulating. The soil cover in the region typically comprises silty clay glacial tills with sand and silt layers. Shale bedrock of the Georgian Bay Formation is anticipated at an approximate depth of 50 m.

The land use adjacent to this section of Highway 404 is largely rural and agricultural, although there is increasing residential and commercial developments in recent years. The vegetation cover beyond the paved areas of the highway comprises grasses, bushes and stands of trees.

3. SITE INVESTIGATION AND FIELD TESTING

The borehole investigation and field testing program for this project was carried out from November 7, 2017 to January 8, 2018, and consisted of drilling and sampling forty-five (45) boreholes to approximate depths ranging from 6.7 to 8.2 m below existing grade. Twenty (20) boreholes were drilled for the proposed overhead sign (OHS) supports, four (4) boreholes for the high occupancy toll sign (HOT) supports, fourteen (14) boreholes for the high occupancy message sign (HMS) supports, and seven (7) boreholes for the toll station sign (TS) supports. Three (3) boreholes drilled for the median sewer from Reference 1 have also been used to address HOT supports.

Lane closures and traffic control were carefully planned for drilling each borehole. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate locations of the boreholes are shown on the Borehole Location Drawings included in Appendix E. Northing and easting co-ordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP based on the project DTM survey. The coordinates



and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendices A to D.

The boreholes were advanced using truck-mounted CME-75 and D-90 drill rigs. Solid stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full-time basis. The supervisor logged the boreholes, visually examined the recovered soil samples, and transported them to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers were installed in selected boreholes to permit monitoring of groundwater levels. The piezometers consisted of 25 mm PVC pipes with slotted screens. At the time of writing this report, the piezometers have not been decommissioned. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). In general, groundwater level readings observed from boreholes drilled for other aspects of this Highway 404 project have been used. The details of borehole completion are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole No.	Borehole Depth / Base Elevation (m)	Piezometer Tip Elevation (m)	Completion Details
HMS 1-1	8.0/210.2	None installed	Borehole backfilled with bentonite holeplug, then dry mix concrete and cold patch asphalt to surface
HMS 1-2	8.2/209.7	None installed	Borehole backfilled with bentonite holeplug, then dry mix concrete to surface
HMS 2-1	7.9/215.6	None installed	Borehole backfilled with bentonite holeplug, then dry mix concrete and cold patch asphalt to surface



HMS 2-2	8.0/215.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 3-1	8.2/227.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 3-2	8.2/227.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 4-1	8.1/230.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 4-2	8.2/230.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 5-1	8.2/244.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 5-2	8.2/243.9	7.3/244.8	Borehole backfilled with sand filter from 7.6 m to 3.0 m, bentonite holeplug from 3.0 m to 0.3 m, then dry mix concrete to surface.
HMS 6-1	7.9/246.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 6-2	7.8/246.3	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 7-1	8.2/272.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HMS 7-2	8.2/272.3	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HOT-1	8.1/229.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HOT-2	8.1/231.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
HOT-3	8.1/238.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface

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HOT-4	8.1/243.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
MS-65	6.7/204.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
MS-42	6.7/226.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
MS-32	6.7/234.0	5.8 / 234.9	Borehole backfilled with sand filter from 5.8 m to 3.0 m, bentonite holeplug from 3.0 m to 0.6 m, then bentonite holeplug and auger cuttings from 0.6 m to surface.
OHS 1-1	8.2/207.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 1-2	8.2/207.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 2-1	8.2/212.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 2-2	8.1/212.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 3-1	7.7/213.8	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 3-2	7.7/213.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete to surface
OHS 4-1	7.7/218.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 4-2	8.1/217.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 5-1	7.8/226.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 5-2	8.2/226.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface

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OHS 6-1	8.2/228.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 6-2	8.2/228.2	7.0/229.4	Borehole backfilled with sand filter from 7.3 m to 3.4 m, bentonite holeplug and auger cuttings to surface.
OHS 7-1	7.7/247.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 7-2	7.7/247.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 8-1	6.7/253.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 8-2	8.2/252.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 9-1	8.2/259.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 9-2	7.8/259.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 10-1	8.0/264.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS 10-2	8.2/263.6	7.3/264.6	Borehole backfilled with sand filter from 7.6 m to 3.0 m, bentonite holeplug and auger cuttings to 0.3m, then dry mix cement to surface.
TS-95	8.1/207.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
TS-105	8.2/215.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
TS-110	7.9/211.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
TS-125	7.8/226.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface



TS-135	8.2/229.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
TS-150	6.7/233.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
TS-190	7.8/252.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance to MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing are summarized on the Record of Borehole sheets and on the accompanying figures in Appendices A to D.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

This section presents a generalized summary of the subsurface conditions encountered at the borehole locations drilled for the proposed sign supports. Borehole location along Highway 404 are presented on the Borehole Location Drawings in Appendix E. These boreholes are identified by sections and station numbers in Table 5.1 below. Records of Borehole sheets and laboratory testing data relevant to each section are also included in the appendices.

Table 5.1
Longitudinal and Cross Sections

Identification	Approximate Hwy. 404 Station No.	Highway Section	Reference Boreholes
Section 1	11+000 to 24+700	From 1 km north of Stouffville Road to Stouffville Road	HMS 7-1, HMS 7-2, OHS-10-1, OHS 10-2, OHS 9-1, OHS-9-2
Section 2	24+700 to 22+400	From Stouffville Road to 19 th Avenue	OHS 8-1, OHS 8-2, TS-190, OHS 7-1, OHS-7-2, HMS 6-1, HMS 6-2, HMS 5-1, HMS 5-2, HOT-4, HOT-3
Section 3	22+400 to 20+300	From 19 th Avenue to Elgin Mills Road	MS-65, HOT-2, TS-150, HMS 4-1, HMS 4-2, TS-135, HOT-1, OHS 6-1, OHS 6-2, HMS 3-1, HMS 3-2, OHS 5-1, OHS 5-2, TS-125, MS-42
Section 4	20+300 to 18+300	From Elgin Mills Road to Major Mackenzie Drive	OHS 4-1, OHS 4-2, HMS 2-1, HMS 2-2, TS-105, OHS 3-1, OHS 3-2, OHS 2-1, OHS 2-2, TS-110, HMS 1-1, HMS 1-2, OHS 1-1, OHS 1-2, TS-95, MS-32

The factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the soil stratigraphy encountered along those sections of Highway 404 consists of a pavement structure (asphalt on granular) and embankment fill overlying native, typically very stiff to hard silty clay to clayey silt till, and/or compact to very dense sandy silt to silty sand tills. Sand and silt interlayers and lenses are present between and/or within the glacial till deposits. Groundwater levels measured in installed standpipe piezometers typically range between 1.5 m and 4 m depths below existing grade. It is noted that these observations are short term and subject to seasonal fluctuations, and therefore do not necessarily represent the stabilized groundwater conditions.

More detailed descriptions of the stratigraphy within these sections are presented below.



5.1 Section 1 - From 1 km north of Stouffville Road to Stouffville Road (Stations 11+000 to 24+700)

5.1.1 Asphalt

Boreholes HMS 7-1, HMS 7-2, OHS 9-1, OHS 9-2, OHS 10-1, and OHS 10-2 were drilled through an approximately 100 mm thick layer of asphalt.

5.1.2 Sand Fill

Pavement granular fill consisting of sand with trace to some gravel, and trace silt and clay was encountered below the asphalt in Boreholes HMS 7-1, HMS 7-2, OHS 9-1, OHS 9-2, OHS 10-1, and OHS 10-2. The thickness of the sand fill at the boreholes varied between 0.6 m and 0.7 m. The base of the fill is encountered at 0.7 m (Elevations 280.0 m to 266.6 m).

The measured moisture contents of selected samples of this fill varied between 9 percent and 15 percent.

5.1.3 Clayey Silt Fill

Fill materials consisting of clayey silt was encountered below the existing granular fill in Boreholes HMS 7-1, OHS 9-1, and OHS 10-2. The thickness of the clayey silt fill varied between 0.7 m and 1.5 m. The base of this cohesive fill was encountered at 1.4 to 2.2 m depths (Elevations 278.5 m to 265.2 m)

SPT 'N' values recorded in the clayey silt fill ranged from 21 and 31 blows per 0.3 m penetration, indicating a very stiff to hard consistency. The measured moisture contents of samples of this layer varied between 10 percent and 12 percent.

5.1.4 Silty Clay to Clayey Silt Till

Layers of brown to grey native silty clay to clayey silt till with sand and trace gravel were encountered in all six boreholes. Where fully penetrated, the thickness of this till were 3.4 m and 6.5 m in Boreholes OHS 9-1 and HMS 7-2, respectively. The base of this cohesive till was at 4.1 m to 7.2 m (Elevations 273.4 m to 263.3 m). The remaining boreholes were terminated within this till at 7.8 to 8.2 m depths (Elevations 272.5 m to 259.4 m).



SPT 'N' values recorded in the silty clay to clayey silt till ranged from 8 blows for 0.3m of penetration to greater than 50 blows for less than 0.3 m of penetration, indicating a stiff to hard consistency. The measured moisture contents of selected samples of this till varied between 8 percent and 22 percent.

Grain size distribution results for the tested cohesive till samples 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 A4 in Appendix A.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 17
Sand	23 to 41
Silt	27 to 62
Clay	15 to 31
Index Property	Percentage (%)
Liquid Limit	20 to 26
Plasticity Index	9 to 13

The above results show that the tills have low plasticity with a group symbol of CL.

Glacial tills inherently contain cobbles and boulders.

5.1.5 Sands and Silts

Layers of brown native sand to sand and silt with trace gravel and clay were encountered in Boreholes OHS 9-1 and HMS 7-2, which were terminated within these soils at 8.2 m depth (Elevations 259.2 m to 272.3 m).

SPT 'N' values recorded in the sands and silts ranged from 28 blows to 69 blows per 0.3m penetration, indicating a compact to very dense condition. The measured moisture contents of samples of this till varied between 7 percent and 15 percent.

The results of grain size distribution analyses carried out on representative samples of the cohesionless soils are presented on Record of Borehole Sheets and on Figure A3 in Appendix A. The results of laboratory gradation tests are summarized as follows:



Soil Particles	Percentage (%)	
Gravel	0 to 8	
Sand	38 to 92	
Silt	7	30 to 59
Clay		3 to 8

5.1.6 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole OHS 10-2. The water level in this piezometer could not be obtained at this time as the immediate areas is currently frozen. Attempts will be made again to obtain water level readings to be reported in the final report. The water levels measured in the previously installed piezometers in the area (Reference 1) are summarized in Table 5.2.

Table 5.2
Measured Groundwater Levels

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
10+392	MS-04	2017-09-24	4.0	264.1
		2017-10-23	3.9	264.2
10+290	MS-05	2017-09-24	3.7	263.5
		2017-10-24	3.9	263.3

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



5.2 Section 2 – From Stouffville Road to 19th Avenue (Stations 24+700 to 22+400)

5.2.1 Asphalt

Boreholes HMS 5-1, HMS 5-2, HMS 6-2, HOT-3, HOT-4, OHS 7-1, OHS 7-2, OHS 8-1 and TS-190 were drilled through an approximately 100 mm to 150 mm thick layer of asphalt.

5.2.2 Sand Fill

Pavement granular fill consisting of sand with some gravel, trace silt and clay was encountered below the asphalt in Boreholes HMS 5-1, HMS 5-2, HMS 6-2, HOT-3, HOT-4, OHS 7-1, OHS 7-2, and OHS 8-1, and at ground surface in Borehole HMS 6-1. Gravelly sand fill was encountered in TS-190 below the asphalt. The thickness of the sand and gravelly sand fill at the boreholes was between 0.5 m and 2.4 m. The base of this cohesionless fill was encountered at 0.7 m to 2.5 m depths (Elevations 259.4 m to 246.2 m).

SPT 'N' values within the cohesionless fill ranged from 14 blows to 53 blows per 0.3 m penetration, indicating compact to very dense conditions. The measured moisture contents of samples of the cohesionless fill varied between 3 percent and 17 percent.

The results of grain size distribution analyses carried out on representative samples of the fill are presented on the Record of Borehole Sheets included in Appendix B and on Figure B1 of Appendix B. The results of the gradation testing from selected boreholes are summarized below:

Soil Particles	Percentage (%)
Gravel	13 to 25
Sand	70 to 73
Silt and Clay	5 to 14

5.2.1 Clayey to Sandy Silt Fill

Fill materials consisting of clayey to sandy silt was encountered below the existing granular fill in Boreholes HMS 5-1 and HOT-4, respectively. The thickness of this fill



was between 0.7 m and 2.0 m. The base of the fill varied between 1.4 m and 3.0 m depths (Elevations 249.3 to 250.1 m)

SPT 'N' values recorded in the clayey silt fill ranged from 22 and 58 blows per 0.3 m penetration, indicating a very stiff to hard consistency. An 'N' value of 27 blows per 0.3m penetration was recorded for the sandy silt fill indicating a compact condition. The measured moisture contents of samples of this fill varied between 7 percent and 13 percent.

The results of grain size distribution analyses carried out on a representative sample of the clayey silt fill are presented on the Record of Borehole Sheets included in Appendix B and on Figure B2 of Appendix B. The results of the gradation testing are summarized below:

Soil Particles	Percentage (%)
Gravel	6
Sand	41
Silt	35
Clay	18

5.2.2 Silty Clay to Clayey Silt Till

Grey native silty clay to clayey silt till with sand and trace gravel were encountered in Boreholes HMS 5-1, HMS 5-2, HMS 6-1, HMS 6-2, HOT-3, HOT-4, OHS 7-1, and OHS 7-2. Where fully penetrated in Boreholes HMS 5-2 and HOT-3, the thickness of this till varied between 2.4 m and 4.2 m. The base of the till was at 3.2 to 7.2 m depths (Elevations 244.9 m to 243.8 m). Boreholes HMS 5-1, HMS 6-1, HMS 6-2, HOT-3, HOT-4, OHS 7-1, and OHS 7-2 were terminated within this till at 7.8 to 8.2 m depths, or Elevations 238.9 to 247.5 m.

SPT 'N' values recorded in the silty clay to clayey silt till typically ranged from 16 blows to 90 blows per 0.3 m, indicating very stiff to hard consistency. Higher 'N' values of greater than 50 blows for less than 0.3 m penetration at the bottom of some boreholes indicate the presence of cobbles and boulders. Occasional 'N' values of 10 and 14 were measured in Borehole HOT-4 indicating a stiff zone. The measured moisture contents of selected samples of this till varied between 7 percent and 18 percent.



Grain size distribution results for the tested cohesive till samples are presented on the Record of Borehole sheets and on Figures B3 to B5 of Appendix B. Atterberg Limit test results are presented on Figures B9 and B10 of Appendix B.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay Till

Soil Particles	Percentage (%)
Gravel	0 to 8
Sand	12 to 48
Silt	31 to 45
Clay	13 to 48
Index Property	Percentage (%)
Liquid Limit	17 to 28
Plasticity Index	6 to 14

Clayey Silt Till

Soil Particles	Percentage (%)
Gravel	0 to 20
Sand	10 to 54
Silt	27 to 63
Clay	13 to 27
Index Property	Percentage (%)
Liquid Limit	16 to 18
Plasticity Index	6 to 7

The above results show that the tills have typically low plasticity with a group symbol of CL and CL-ML.

Glacial tills inherently contain cobbles and boulders.

5.2.3 Sand and Silt Till

Grey sand and silt till with trace to some gravel, and trace to some clay was encountered in Boreholes OHS 8-1 and OHS 8-2. The boreholes were terminated



within this till at 6.7 m and 8.2 m depths, respectively (Elevations 253.5 m and 252.1 m).

SPT 'N' values recorded in the cohesionless till ranged from 18 blows to 80 blows per 0.3 m penetration, indicating compact to very dense conditions. Higher 'N' values of greater than 50 blows for less than 0.3 m penetration were recorded in Borehole OHS 8-1 inferred the presence of cobbles and boulders. The measured moisture contents of the samples of this till varied between 8 percent and 13 percent.

Grain size distribution results for the samples of the sand and silt till are presented on the Record of Borehole sheets and on Figures B6 of Appendix B. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 23
Sand	44 to 54
Silt	23 to 39
Clay	6 to 17

5.2.4 Sands and Silts

Layers of brown to grey native gravelly sand, sand, silty sand, and silt with trace to some gravel and clay were encountered in Boreholes HMS 5-2, HOT-3, OHS 8-2, and TS-190. Where fully penetrated in Borehole HOT-3 and OHS 8-2, the thickness of the cohesionless soils were 4.5 m and 4.7 m, respectively. The base of the cohesionless soils was at 7.7 m and 7.2 m depths (Elevations 239.3 m and 253.1 m). Boreholes HMS 5-2 and TS-190 were terminated within this soil at 7.9 to 8.2 m depths, or Elevations 252.2 m to 243.9 m.

SPT 'N' values recorded in the cohesionless soils typically ranged from 18 blows to 47 blows per 0.3 m penetration, indicating compact to dense conditions. An occasional 'N' value of 6 was measured in Borehole OHS 8-2, indicating a loose zone. Occasional 'N' values of greater than 50 blows for less than 0.3 m penetration in Borehole TS-190 inferred the presence of cobbles or boulders. The measured moisture contents of samples of this till varied between 10 percent and 21 percent.



Grain size distribution results for the tested cohesionless soil samples tested are presented on the Record of Borehole sheets and on Figures B7 and B8 of Appendix B. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%)	
Gravel	0 to 34	
Sand	60 to 91	
Silt	6	7 to 25
Clay		2 to 3

5.2.5 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole HMS 5-2. The water levels measured in the previously installed piezometers in the area (Reference 1) are also summarized in Table 5.3.

Table 5.3
Measured Groundwater Levels

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
24+277	MS-10	2017-09-24	1.9	259.7
		2017-10-23	1.8	259.8
23+740	MS-15	2017-09-24	3.2	252.9
		2017-10-24	3.8	252.3
23+679	MS-16	2017-09-24	3.0	252.2
		2017-10-23	2.8	252.4
23+400	HMS 5-2	2018-02-16	3.5	248.6
23+048	MS-21	2017-09-24	3.1	245.4
		2017-10-23	3.2	245.3
22+745	MS-24	2017-09-24	1.9	243.3
		2017-10-23	1.5	243.7



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

5.3 Section 3 – From 19th Avenue to Elgin Mills Road (22+400 to 20+300)

5.3.1 Asphalt

Boreholes MS-32, HOT-2, TS-150, HMS 4-1, HMS 4-2, TS-135, HOT-1, OHS 6-1, OHS 6-2, HMS 3-1, HMS 3-2, OHS 5-1, OHS 5-2, TS-125, and MS-42 were drilled through an approximately 100 to 150 mm thick layer of asphalt.

5.3.2 Sand to Silty Sand Fill

Pavement granular fill materials consisting of sand to silty sand with some gravel, trace silt, and trace clay was encountered below the asphalt in Boreholes MS-32, HOT-2, TS-150, HMS 4-1, HMS 4-2, TS-135, HOT-1, OHS 6-1, OHS 6-2, HMS 3-1, HMS 3-2, OHS 5-1, OHS 5-2, TS-125, and MS-42. The thickness of the silty sand to sand fill at the boreholes was generally between 0.3 m and 1.2 m. The base of this cohesionless fill was encountered at 0.5 m to 1.4 m depths (Elevations 232.5 m to 239.9 m).

SPT 'N' values recorded in the sand fill typically ranged from 26 blows to 48 per 0.3m, indicating a compact to dense condition. A higher 'N' value of greater than 50 blows for less than 0.3 m penetration in Borehole HOT-2 inferred the presence of cobbles or boulders. The measured moisture contents of samples of fill ranged between 3 percent and 11 percent.

The results of grain size distribution analyses carried out on a representative sample sand fill are presented on the Record of Borehole Sheets and on Figure C1 of Appendix C. The results of the gradation testing are summarized below:

Soil Particles	Percentage (%)
Gravel	5
Sand	71
Silt	15
Clay	9



5.3.3 Clayey to Sandy Silt Fill

Fill materials consisting of clayey to sandy silt with trace to some sand and gravel was encountered below existing granular fill in Boreholes HMS 4-1, HMS 4-2, TS-135, HOT-1, OHS 6-1 and OHS 6-2, and MS-42. The thickness of this fill ranged from 0.8 to 1.6 m. The base of this fill ranged from 1.5 m to 2.2 m (Elevations 231.2 m and 236.9 m).

SPT 'N' values recorded in the clayey silt fill were 12 and 58 blows per 0.3 m penetration, indicating a stiff to hard consistency. An 'N' value of 19 blows for 0.3 m penetration was measured for the sandy silt fill, indicating a compact condition. A high 'N' value of greater than 100 blows for less than 0.3 m penetration in Borehole MS-42 inferred the presence of cobbles or boulders. The measured moisture contents of samples of this layer were 9 percent and 16 percent.

5.3.4 Silty Clay to Clayey Silt

A layer of native brown silty clay with some sand were encountered in Boreholes OHS 6-1 and MS-42. Where fully penetrated, the thickness of this cohesive soil was 1.9 m and 2.2 m in OHS 6-1 and MS-42, respectively, and the bases at 4.1 m and 4.4 m depths (Elevations 232.6 m and 229.0 m).

SPT 'N' values recorded in the silty clay were 8 blows and 14 blows for 0.3 m of penetration, indicating a stiff consistency. The measured moisture contents of selected samples of this cohesive soil were 12 percent and 20 percent.

Grain size distribution results for a silty clay sample tested are presented on the Record of Borehole sheets and on Figure C2 of Appendix C.

The results of laboratory gradation are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0
Sand	18
Silt	30
Clay	52

5.3.5 Silty Clay to Clayey Silt Till

Deposits of brown to grey native silty clay to clayey silt till with sand and trace to some gravel were encountered in Boreholes MS-32, HOT-2, TS-150, HMS 4-1, HMS 4-2, TS-135, HOT-1, OHS 6-1, OHS 6-2, HMS 3-1, HMS 3-2, TS-125, and MS-42. Where fully penetrated in Boreholes MS-32, TS-125, HOT-1, HMS 3-2, HMS 4-1, OHS 6-1, and OHS 6-2, the thickness of this till varied between 2.7 m and 5.8 m. The base of this cohesive till ranged from 4.1 m to 7.2 m depths (Elevations 228.4 m and 235.1 m). Boreholes HOT-2, TS-150, TS-135, HMS 3-1, and MS-42 were terminated within this till at 6.7 m to 8.2 m depths (Elevations 226.7 m to 233.6 m).

SPT 'N' values recorded in the silty clay to clayey silt till typically ranged from 8 blows to 69 blows per 0.3 m of penetration, indicating a stiff to hard consistency. Higher 'N' values of greater than 50 blows for less than 0.3 m penetration in Boreholes HMS 4-1, OHS 6-1, and HOT-1 inferred the presence of cobbles or boulders. Lower 'N' values of 6 blows per 0.3 m of penetration indicated firm zones. The measured moisture contents of samples of this till varied between 6 percent and 21 percent.

Grain size distribution results for the cohesive till samples tested are presented on the Record of Borehole sheets and on Figures C3 to C5 of Appendix C. Atterberg Limit test results are presented on Figures C10 and C13 of Appendix C.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay Till

Soil Particles	Percentage (%)
Gravel	0 to 7
Sand	20 to 39
Silt	31 to 43
Clay	23 to 46
Index Property	Percentage (%)
Liquid Limit	17 to 39
Plasticity Index	7 to 23



The above results show that the silty clay till has typically low plasticity with a group symbol of CL, except for occasional zones of medium plasticity with a group symbol of CI.

Clayey Silt Till

Soil Particles	Percentage (%)
Gravel	0 to 8
Sand	36 to 43
Silt	33 to 43
Clay	15 to 23
Index Property	Percentage (%)
Liquid Limit	14 to 19
Plasticity Index	5 to 11

The above results show that the tills have low to slight plasticity with a group symbol of CL/CL-ML.

Glacial tills inherently contain cobbles and boulders.

5.3.6 Sand and Silt Till

A deposit of grey native sand and silt till with trace gravel and trace to some clay was encountered in Boreholes OHS 5-1, OHS 5-2, and TS-125, which terminated within this till at 7.8 to 8.2 m depths (Elevations 226.6 m to 226.0 m).

SPT 'N' values recorded in this sand and silt till ranged from 25 blows per 0.3 m penetration to greater than 50 blows for less than 0.3 m of penetration, indicating compact to very dense condition. The measured moisture contents of selected samples of this till varied between 7 percent and 13 percent.

Grain size distribution results for a sandy silt till sample are presented on the Record of Borehole sheets and on Figure C7 of Appendix C.

The results of laboratory gradation tests are summarized as follows:

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Soil Particles	Percentage (%)
Gravel	4 to 8
Sand	37 to 53
Silt	37 to 48
Clay	5 to 11

Glacial tills inherently contain cobbles and boulders.

5.3.7 Sands and Silts

Layers of brown to grey native sand, silty sand, and sandy silt with trace to some gravel and clay were encountered in Boreholes HOT-7, HMS-3-2, HMS 4-1, HOT-1, HOT-2, OHS 5-2, OHS 6-1, OHS 6-2, TS-125 and TS-150. Where fully penetrated in Borehole HOT-2, TS-125, OHS 5-2, and TS-150, the thickness of this till were 1.5 m and 2.4 m. The base of this cohesionless soil ranged from 4.1 m and 5.6 m depths (Elevations 228.4 m and 234.7 m). Boreholes MS-32, HMS-3-2, HMS 4-1, HOT-1, OHS 6-1, and OHS 6-2 were terminated within this cohesionless soil at 6.7 m to 8.2 m depths (Elevations 227.2 m to 234.0 m).

SPT 'N' values recorded in the cohesionless soils typically ranged from 17 blows to 75 blows per 0.3 m of penetration, indicating compact to very dense conditions. Higher 'N' values of greater than 50 blows for less than 0.3 m penetration in Boreholes HOT-1, HOT-2, OHS 5-2, and TS-125 inferred the presence of cobbles or boulders. The measured moisture contents of this layer varied between 6 percent and 23 percent.

Grain size distribution results for samples of sands and silts are presented on the Record of Borehole sheets and on Figure C7 to C9 of Appendix C. The results of laboratory gradation test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 8
Sand	27 to 76
Silt	14 to 68
Clay	3 to 15



5.3.8 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole OHS 6-2. The water levels measured in the previously installed piezometers in the area (Reference 1) are also summarized in Table 5.4.

Table 5.4
Measured Groundwater Levels

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
21+975	MS-32	2017-09-24	3.0	237.7
		2017-10-23	2.9	237.8
21+586	MS-35	2017-09-24	4.1	234.9
		2017-10-23	4.1	234.9
21+330	OHS 6-2	2018-02-15	2.3	234.1
20+915	MS-40	2017-09-24	1.7	232.9
		2017-10-23	1.6	233.0

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

5.4 Section 4 – From Elgin Mills Road to Major Mackenzie Drive (20+300 to 18+300)

5.4.1 Asphalt

Boreholes OHS 4-1, OHS 4-2, HMS 2-1, HMS 2-2, TS-105, OHS 3-1, OHS 2-1, OHS 2-2, TS-110, HMS 1-1, OHS 1-1, OHS 1-2, TS-95, and MS-65, were drilled through an approximately 100 mm to 280 mm thick layer of asphalt.

5.4.2 Sand to Silty Sand Fill

Pavement granular materials consisting of sand to silty sand with trace to some gravel and clay was encountered below the asphalt in Boreholes OHS 4-1, OHS 4-2, HMS



2-1, HMS 2-2, TS-105, OHS 3-1, OHS 2-1, OHS 2-2, TS-110, HMS 1-1, OHS 1-1, OHS 1-2, TS-95, and MS-65 and at ground surface in Boreholes HMS 1-2 and OHS 3-2. The thickness of the sand to silty sand fill at the boreholes varied between 0.2 m and 1.2 m. The base of this cohesionless fill ranged from 0.2 m to 1.5 m depths (Elevations 210.5 m to 225.7 m).

SPT 'N' values measured within the cohesionless fill ranged from 18 blows to 69 blows per 0.3 m of penetration indicating compact to very dense conditions. The measured moisture contents of selected samples of fill typically varied between 3 percent and 17 percent.

5.4.3 Clayey Silt Fill

Fill materials consisting of clayey silt with trace to some sand and gravel was encountered below existing granular fill in Boreholes OHS-1-2 and TS-110. The thickness of the clayey silt fill was 0.5 and 1.4 m. The base of this cohesive fill was at 1.4 m to 1.7 m depths (Elevations 213.6 m to 217.5 m).

SPT 'N' values recorded in the clayey silt fill ranged from 7 and 42 blows per 0.3 m penetration, indicating a firm to hard consistency. The measured moisture contents of samples of this layer were between 12 percent and 15 percent.

5.4.4 Silty Clay to Clayey Silt Till

Deposits of brown to grey native silty clay to clayey silt till with sand and trace to some gravel were encountered in Boreholes OHS 4-1, OHS 4-2, HMS 2-1, HMS 2-2, TS-105, OHS 3-1, OHS 3-2, OHS 2-1, TS-110, HMS 1-1, HMS 1-2, OHS 1-1, OHS 1-2, TS-95, and MS-65. Where fully penetrated in Boreholes OHS 4-1, OHS 4-2, HMS 2-1, HMS 2-2, TS-105, OHS 3-1, OHS 3-2, OHS 2-1, HMS 1-1, HMS 1-2, OHS 1-1, and OHS 1-2, the thickness of this till varied between 1.3 m and 4.8 m. The base of this cohesive till ranged from 2.2 m to 5.6 m depths (Elevations 221.0 m to 209.6 m). Boreholes HMS 1-2, HMS 2-2, TS-95, TS-105, TS-110, and HOT-5 were terminated within this till at 6.7 m to 8.2 m depths (Elevations 204.6 m to 215.2 m).

SPT 'N' values recorded in the silty clay to clayey silt till typically ranged from 18 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration,



indicating very stiff to hard consistency. The measured moisture contents of samples of this till typically varied between 7 percent and 24 percent,

Grain size distribution results for the tested cohesive till samples are presented on the Record of Borehole sheets and on Figures D1 to D4 of Appendix D. Atterberg Limit test results are presented on Figures D10 to D12 of Appendix D.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Silty Clay Till

Soil Particles	Percentage (%)
Gravel	0 to 12
Sand	19 to 39
Silt	32 to 49
Clay	21 to 39

Index Property	Percentage (%)
Liquid Limit	17 to 39
Plasticity Index	8 to 17

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

Clayey Silt Till

Soil Particles	Percentage (%)
Gravel	2 to 8
Sand	32 to 51
Silt	29 to 40
Clay	13 to 22
Index Property	Percentage (%)
Liquid Limit	16 to 19
Plasticity Index	6 to 8

The above results show that the clayey silt tills have low to slight plasticity with a group symbol of CL/CL-ML.



Glacial tills inherently contain cobbles and boulders.

5.4.5 Silty Sand Till

A deposit of grey native silty sand till with trace to some gravel and clay was encountered in Boreholes OHS 1-1 and OHS-1-2 which terminated within this till at 8.2 m depth (Elevations 207.1 m and 207.4 m).

SPT 'N' values recorded in the silty sand till ranged from 42 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration, indicating compact to very dense conditions. The measured moisture contents of selected samples of this till varied between 7 percent and 10 percent.

Grain size distribution results for a silty sand sample are presented on the Record of Borehole sheets and on Figure D5 of Appendix C.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	Percentage (%)
Gravel	10 to 26
Sand	43 to 45
Silt	26 to 32
Clay	5 to 13

Glacial tills inherently contain cobbles and boulders.

5.4.6 Sands and Silts

Layers of brown to grey native gravelly sand, sand, silty sand, sandy silt, and silt with trace to some gravel and clay were encountered in Boreholes OHS 4-1, OHS 4-2, HMS 2-1, HMS 2-2, TS-105, OHS 3-1, OHS 3-2 OHS 2-1, OHS 2-2, TS-110, HMS 1-1, HMS 1-2, OHS 1-1, and OHS 1-2. Where fully penetrated in Boreholes HMS 1-2, HMS 2-2, TS-105 and TS-110, the thickness of the cohesionless soils ranged from 3.5 m to 5.8 m. The base of this cohesionless soil ranged from 6.2 to 7.2 m (Elevations 210.7 m to 217.1 m). Boreholes OHS 4-1, OHS 4-2, HMS 2-1, OHS 3-1, OHS 3-2



OHS 2-1, OHS 2-2, HMS 1-1, OHS 1-1, and OHS 1-2 were terminated within this native layer at 7.7 m to 8.2 m depths (Elevations 207.1 m to 218.7 m).

SPT 'N' values recorded in the cohesionless soils typically ranged from 16 blows to 98 blows per 0.3 m of penetration, indicating compact to very dense conditions. An occasional 'N' value of 8 was measured in Borehole HMS 1-2, indicating a loose zone. Intermittent 'N' values of greater than 50 blows for less than 0.3 m of penetration was measured in Boreholes HMS 1-1, HMS 1-2, OHS 2-2, OHS 3-1, OHS 3-2, OHS 4-1, and OHS 4-2 inferred the presence of cobbles or boulders. The measured moisture contents of this layer varied between 3 percent and 21 percent.

Grain size distribution results for selected cohesionless soil samples are presented on the Record of Borehole sheets and on Figures D6 to D9 of Appendix D. The results of laboratory gradation test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 31
Sand	7 to 90
Silt	10 to 62
Clay	0 to 15

5.4.7 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. The water levels measured in the previously installed piezometers in the area (Reference 1) are summarized in Table 5.5.

Table 5.5
Measured Groundwater Levels

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
19+852	MS-50	2017-09-24	3.1	223.9
		2017-10-23	3.4	223.6
19+751	MS-51	2017-09-24	3.3	222.4
		2017-10-23	3.6	222.1
19+151	MS-57	2017-09-24	2.4	217.2



Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
		2017-10-23	2.4	217.2
18+852	MS-60	2017-09-24	2.6	214.1
		2017-10-23	2.6	214.1
18+576	MS-63	2017-09-24	3.1	210.5
		2017-10-23	2.9	210.7

6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Northing and easting coordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP.

Walker Drilling of Utopia, Ontario and DBW Drilling of Ajax, Ontario, supplied and operated a truck-mounted D-90 drill rig and a truck-mounted CME-75 drill rig, respectively, to carry out the drilling, sampling and in-situ testing operations for the boreholes.

The drilling and sampling operations in the field were supervised on a full-time basis by Mr. Jilesh Patel, Mr. Saeed Bastan, and Ms. Eckie Siu of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory. Overall supervision of the field program was carried out by Mr. Stephane Loranger, CET.

Overall project management was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Rod de Castro, P.Eng. The report was reviewed by Messrs. Sydney Pang, P.Eng. and P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD, HIGH OCCUPANCY TOLL
HIGH OCCUPANCY MESSAGE AND TOLL STATION
SIGN SUPPORTS
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 1
FROM STOUFFVILLE ROAD TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-02-00**

GEOCRES No. 30M14-473

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This section of the report presents interpretation of the geotechnical data presented in the factual information section and provides foundation recommendations for the detailed design of sign support structures along Highway 404 from 1 km north of Stouffville Road to Major Mackenzie Drive in the City of Markham, Ontario.

Twenty (20) boreholes were drilled for proposed overhead sign (OHS) supports, four (4) boreholes for the high occupancy toll (HOT) sign supports, fourteen (14) boreholes for the high occupancy message (HMS) sign supports, and seven (7) boreholes for the toll station (TS) sign supports. The Borehole Location Drawings in Appendix F illustrate the locations of the proposed sign supports and relevant boreholes.

Information on the proposed locations of the signs was provided to Thurber by WSP. Based on the proposed sign layout, boreholes drilled during the current and earlier investigations, that were in close proximity to each proposed sign location, have been selected to provide subsurface information for foundation design. The Record of Borehole sheets for these boreholes are presented in Appendices A to D. Table 1 immediately following the text of this report provides foundation design parameters for each sign support locations.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation, and shall not be used or relied upon for any other purposes or by any other parties including the construction contractor. The

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contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The discussion and recommendations presented in this report are based on information provided by WSP to Thurber, and on the factual data obtained during the course of this investigation.

7.1 Foundation Design Parameters

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 2).

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) "Guidelines for the Design of High Mast Pole Foundations", Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 3).
- Canadian Highway Bridge Design Code and Commentary (2014). CAN/CSA-S6-14 and S6.1-14 (Reference 4).

It is understood that a typical sign support consists of a single conventional augered caisson (drilled shaft). Each OHS and HMS sign is designed for two supports, while each TS and HOT sign is designed for one support. Table 1 following the text of this report presents the recommended parameters for foundation design of such caissons.

It is recommended that MTO's standard designs in Reference 2 be used as a basis for the sign support foundations. The foundation design parameters in Table 1 should be used in conjunction with References 1 and 2 to confirm that the standard designs are adequate.



In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.4 m below final grade should be neglected in the foundation design. It is recommended that any topsoil and organics, if present, be neglected in determining lateral resistance.

Where downward sloping fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. The stabilized groundwater level may be higher. For foundation design at the caissons, it should be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately four (4) times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the pile, and full passive resistance at the level where the slope face is at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength, q_u , ($q_u = 2 \times C_u$, undrained shear strength) is provided for cohesive soils (clayey silt to silty clay fill and native, silty clay till or clayey silt till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight, γ' , should be used. The required depth of the caisson will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

An equivalent caisson width equal to two (2) times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

7.2 Caisson Installation

Caisson installation should generally be carried out in accordance with OPSS.PROV 903.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix F.



Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers, where encountered.

The short-term groundwater levels were typically between 1 m and 3 m depths below existing ground surface. The stabilized groundwater levels may be higher. Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. The cohesionless soils would also be susceptible to disturbance (basal and sidewall instability) under conditions of unbalanced hydrostatic head. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. Any accumulated water may have to be pumped out from the hole prior to placing concrete. A balancing water head should be used inside the caisson hole in cases where the caisson base is within sands and silts. Should it be considered impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method. Suggested wording for an NSSP to cover the above aspects are provided in Appendix F.

7.3 Construction Concerns

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils, soil sloughing and water seepage from caisson sidewalls, and basal instability primarily due to unbalanced hydrostatic head. Recommendations on how to address these issues have been outlined in the previous section.

7.4 Construction Inspection and Testing

Caisson construction should be monitored by qualified geotechnical personnel as per OPSS.PROV 903 to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

8. CLOSURE

Engineering analysis and preparation of the foundation design report was carried out by Messrs. Rod de Castro, P.Eng. and Sydney Pang, P.Eng. Messrs. Jason Lee, P.Eng. and P.K. Chatterji, P.Eng., a Designated MTO Contact for Foundations, reviewed the report.

Client: WSP

File No.: 15786

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Signs\Final\15786 OHS HOT HMS VHS Hwy 404 FIDR feb 18.docx

Date: February 16, 2018

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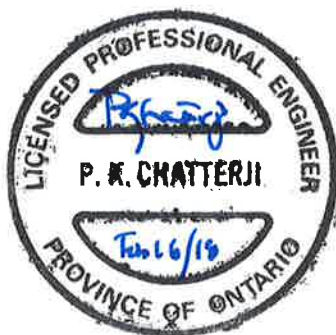
THURBER ENGINEERING LTD.



Rod de Castro, P.Eng.
Geotechnical Engineer



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Associate, Senior Geotechnical Engineer



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Review Principal, Designated MTO Contact

Client: WSP

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VHS Hwy 404 FIDR feb 18.docx

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TABLE 1
FOUNDATION DESIGN PARAMETERS
OHS, HOT, HMS AND TS SIGN SUPPORTS
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 1
MARKHAM, ONTARIO
G.W.P. 2930-02-00

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
HMS 7	11+290 SB	HMS 7-1, HMS 7-2	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	3
			Clayey Silt (Fill)	0.7 – 2.2	100	-	-	-	18	-	(below existing grade)
			Clayey Silt/Silty Clay (Till)	2.2 - 4.5	100	-	-	-	18	-	
			Silty Clay (Till)	4.5 - 8.2	200	-	-	-	19	-	
OHS 10	10+825 SB	OHS 10-1, OHS 10-2	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	3
			Clayey Silt (Fill)	0.7 – 1.4	100	-	-	-	18	-	(below existing grade)
			Clayey Silt/Silty Clay (Till)	1.4 - 4.0	180	-	-	-	19	-	
			Silty Clay (Till)	4.0 - 8.2	200	-	-	-	20	-	
OHS 9	10+350 SB	OHS 9-1, OHS 9-2	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	3
			Clayey Silt (Fill)	0.7 – 2.2	100	-	-	-	18	-	(below existing grade)
			Clayey Silt (Till)	2.2 - 4.1	150	-	-	-	20	-	
			Sand and Silty Sand	4.1 - 8.2	-	33	4,500	3.4	-	11	
OHS 8	24+145 NB	OHS 8-1, OHS 8-2	Sand (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	1
			Sand (Fill)	1.0 - 2.5	-	30	2,000	3.0	-	10	(below existing grade)
			Silty Sand	2.5 - 4.1	-	30	2,000	3.0	-	10	
			Sandy Silt	4.1 - 8.2	-	34	6,000	3.5	-	11	

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2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
TS-190	24+150 median	TS-190	Sand (Fill)	0.2 – 2.2	-	30	3,000	3.0	20	-	1
			Sand	2.2 - 5.6	-	32	4,000	3.2	-	11	(below existing grade)
			Silty Sand	5.6 - 7.8	-	36	8,000	3.8	-	11	
OHS 7	23+685 NB	OHS 7-1, OHS 7-2	Sand (Fill)	0.1 – 2.2	-	30	3,000	3.0	20	-	3
			Silty Clay/Clayey Silt (Till)	2.2 - 6.0	150	-	-	-	18	-	(below existing grade)
			Silty Clay/Clayey Silt (Till)	6.0 - 8.2	200	-	-	-	20	-	
HMS 6	23+580 SB	HMS 6-1, HMS 6-2	Sand (Fill)	0.1 – 1.2	-	30	3,000	3.0	20	-	3
			Clayey Silt (Till)	1.2 - 6.0	180	-	-	-	19	-	(below existing grade)
			Clayey Silt (Till)	6.0 - 8.2	200	-	-	-	20	-	
HMS 5	23+385 NB	HMS 5-1, HMS 5-2	Sand (Fill)	0.1 – 1.0	-	30	3,000	3.0	20	-	3
			Clayey Silt (Fill)	1.0 – 3.0	100	-	-	-	18	-	(below existing grade)
			Silty Clay (Till)	3.0 - 8.2	200	-	-	-	20	-	
HOV 4	23+280 median	HOT-4	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	3
			Sandy Silt (Fill)	0.7 – 1.4	-	30	2,500	3.0	20	-	(below existing grade)
			Clayey Silt (Till)	1.4 - 4.0	120	-	-	-	18	-	
			Silty Clay (Till)	4.0 - 8.2	200	-	-	-	20	-	
HOV 3	22+902 median	HOT-3	Sand (Fill)	0.2 - 0.8	-	30	3,000	3.0	20	-	1
			Clayey Silt (Till)	0.8 - 3.2	180	-	-	-	19	-	(below existing grade)
			Silt	3.2 - 5.8	-	33	5,000	3.4	-	11	
			Sand	5.8 - 8.0	-	32	4,000	3.2	-	11	

- Notes: 1. This table must be read in conjunction with the text of this report.
2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
HOV 7	21+975 median	MS-32	Silty Sand (Fill)	0.1 - 0.8	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Till)	0.8 - 2.2	100	-	-	-	18	-	
			Silty Clay (Till)	2.2 - 5.6	180	-	-	-	19	-	
			Silty Sand	5.6 - 6.7	-	31	3,000	3.1	-	10	
TS-150	21+770 median	TS-150	Silty Sand (Fill)	0.1 - 0.8	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Till)	0.8 - 4.1	180	-	-	-	19	-	
			Silty Sand	4.1 - 5.6	-	32	4,000	3.2	-	11	
			Clayey Silt (Till)	5.6 - 6.7	180	-	-	-	19	-	
HOV 2	21+730 median	HOT-2	Sand (Fill)	0.2 - 1.1	-	30	3,000	3.0	20	-	3 (below existing grade)
			Clayey Silt (Till)	1.1 - 3.3	200	-	-	-	20	-	
			Sandy Silt/Silty Sand	3.3 - 5.6	-	34	6,000	3.4	-	11	
			Silty Clay (Till)	5.6 - 8.1	200	-	-	-	20	-	
HMS 4	21+629 SB	HMS 4-1, HMS 4-2	Sand (Fill)	0.2 - 1.0	-	30	3,000	3.0	20	-	3 (below existing grade)
			Clayey Silt / Sandy Silt (Fill)	1.0 - 2.1	-	30	3,000	3.0	20	-	
			Clayey Silt (Till)	2.1 - 5.6	180	-	-	-	19	-	
			Silty Sand	5.6 - 8.1	-	34	6,000	3.4	-	11	
TS-135	21+570 median	TS-135	Sand (Fill)	0.2 - 1.0	-	30	3,000	3.0	20	-	3 (below existing grade)
			Clayey Silt (Fill)	1.0 - 2.4	125	-	-	-	18	-	
			Clayey Silt (Till)	2.4 - 4.0	100	-	-	-	18	-	
			Clayey Silt (Till)	4.0 - 8.2	200	-	-	-	20	-	
HOV 1	21+392 median	HOT-1	Sand (Fill)	0.1 - 0.6	-	30	3,000	3.0	20	-	3 (below existing grade)
			Clayey Silt (Fill)	0.6 - 2.2	150	-	-	-	18	-	
			Silty Clay (Till)	2.2 - 5.6	160	-	-	-	19	-	
			Sandy Silt	5.6 - 8.1	-	34	6,000	3.5	-	11	

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3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
OHS 6	21+329 SB	OHS 6-1, OHS 6-2	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	2 (below existing grade)
			Clayey Silt (Fill)	0.7 – 2.2	100	-	-	-	18	-	
			Silty Clay	2.2 – 4.1	100	-	-	-	18	-	
			Clayey Silt (Till)	4.1 – 7.2	180	-	-	-	19	-	
			Sand and Silt/Silty Sand	7.2 – 8.2	-	34	6,000	3.5	-	11	
HMS 3	21+095 NB	HMS 3-1, HMS 3-2	Sand (Fill)	0.2 – 0.9	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay / Clayey Silt (Till)	0.9 – 5.6	200	-	-	-	21	-	
			Silty Sand	5.6 – 8.2	-	32	3,500	3.2	-	11	
OHS 5	20+869 SB	OHS 5-1, OHS 5-2	Sand (Fill)	0.2 – 1.1	-	30	3,000	3.0	20	-	1 (below existing grade)
			Sandy Silt	1.1 – 4.1	-	33	5,000	3.4	-	11	
			Sand and Silt (Till)	4.1 – 8.2	-	35	7,000	3.7	-	11	
TS-125	20+770 median	TS-125	Sand (Fill)	0.2 – 1.4	-	30	3,000	3.0	20	-	2 (below existing grade)
			Clayey Silt (Till)	1.4 – 4.1	160	-	-	-	19	-	
			Sand	4.1 – 5.6	-	36	8,000	3.8	-	11	
			Sand and Silt (Till)	5.6 – 7.8	-	36	8,000	3.8	-	11	
OHS 4	19+744 NB	OHS 4-1, OHS 4-2	Sand (Fill)	0.2 – 1.4	-	30	3,000	3.0	20	-	1 (below existing grade)
			Clayey Silt (Till)	1.4 – 5.5	160	-	-	-	19	-	
			Silty Sand	5.5 – 8.1	-	35	7,000	3.7	-	11	

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2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
HOV 6	20+640 median	MS-42	Silty Sand (Fill)	0.2 – 0.9	-	30	3,000	3.0	20	-	1
			Clayey/Sandy Silt (Fill)	0.9 – 2.2	-	30	3,000	3.0	20	-	(below existing grade)
			Clayey Silt	2.2 – 4.4	160	-	-	-	19	-	
			Clayey Silt Till	4.4 – 6.7	120	-	-	-	18	-	
HMS 2	19+492 SB	HMS 2-1, HMS 2-2	Sand (Fill)	0.2 – 0.9	-	30	3,000	3.0	20	-	3
			Silty Clay / Clayey Silt (Till)	0.9 – 2.5	200	-	-	-	21	-	(below existing grade)
			Sandy Silt to Silty Sand	2.5 - 8.0	-	35	7,000	3.7	-	11	
TS-105	19+483 median	TS-105	Sand (Fill)	0.2 – 0.9	-	30	3,000	3.0	20	-	3
			Clayey Silt (Till)	0.9 - 2.7	200	-	-	-	21	-	(below existing grade)
			Sandy Silt to Silty Sand	2.7 – 6.2	-	34	6,000	3.5	-	11	
			Clayey Silt (Till)	6.2 - 8.2	200	-	-	-	20	-	
OHS 3	19+284 NB	OHS 3-1, OHS 3-2	Sand (Fill)	0.1 - 0.7	-	30	3,000	3.0	20	-	1
			Silty Clay (Till)	0.7 - 2.2	180	-	-	-	19	-	(below existing grade)
			Sand to Silty Sand	2.2 - 7.7	-	36	8,000	3.8	-	11	
OHS 2	19+192 SB	OHS 2-1, OHS 2-2	Sand (Fill)	0.2 - 1.3	-	30	3,000	3.0	20	-	1
			Sand and Silt / Silty Sand	1.3 - 4.6	-	34	6,000	3.5	-	11	(below existing grade)
			Gravelly Sand	4.6 - 8.1	-	36	8,000	3.8	-	11	
TS-110	19+075 median	TS-110	Sand (Fill)	0.2 - 0.9	-	30	3,000	3.0	20	-	1
			Clayey Silt (Fill)	0.9 - 1.4	100	-	-	-	18	-	(below existing grade)
			Gravelly Sand	1.4 - 7.2	-	36	8,000	3.8	-	11	
			Silty Clay (Till)	7.2 - 7.9	200	-	-	-	21	-	

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2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
HMS 1	18+986 NB	HMS 1-1, HMS 1-2	Sand (Fill) Silty Clay (Till) Silty Sand Silty Sand	0.1 - 0.7 0.7 - 3.5 3.5 - 5.5 5.5 - 7.5	- 200 - -	30 - 34 30	3,000 - 6,000 2,000	3.0 - 3.5 3.0	20 21 - -	- - 11 9	2 (below existing grade)
OHS 1	18+732 SB	OHS 1-1, OHS 1-2	Sand (Fill) Clayey Silt (Till) Silty Sand (Till)	0.1 - 1.7 1.7 - 4.1 4.1 - 8.2	- 180 -	30 - 36	3,000 - 8,000	3.0 - 3.8	20 19 -	- - 11	2 (below existing grade)
TS-95	18+682 median	TS-95	Sand (Fill) Silty Clay (Till)	0.2 - 1.1 1.1 - 8.1	- 200	30 -	3,000 -	3.0 -	20 21	- -	2 (below existing grade)
HOV 5	18+350 median	MS-65	Silty Sand (Fill) Silty Clay (Till) Silty Clay (Till)	0.1 - 0.8 0.8 - 2.2 2.2 - 6.7	- 160 200	30 - -	3,000 - -	3.0 - -	20 19 21	- - -	2 (below existing grade)
All Locations	-	New Fill (see Note 3)	Variable height above ground surface	-	-	30	3,000	3.0	20	-	Below base of new fill

LEGEND

q_u = Unconfined Compressive Strength (= 2 x C_u , undrained shear strength) (kPa)
 ϕ' = Angle of Internal Friction (degrees)

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n_h	=	Coefficient of Horizontal Subgrade Reaction (MN/m ³ or $\times 10^3$ kN/m ³)
K_p	=	Coefficient of Passive Earth Pressure
γ	=	Soil Unit Weight (kN/m ³)
γ'	=	Submerged Soil Unit Weight (kN/m ³) – to be used only for cohesionless soils below the groundwater table

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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 ⁽¹⁾ '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

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


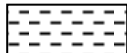



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
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)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
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	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				
<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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

Section 1 (Stations 11+000 to 24 +700 Stouffville Road)

METRIC

SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
280.7	GROUND SURFACE				
0.0	ASPHALT: (100mm)				
0.1	SAND, some gravel, trace silt Brown Moist (FILL)		1	GS	
280.0	Clayey SILT, trace gravel, trace sand, cobble pieces Hard to Very Stiff Grey Moist (FILL)		1	SS	30
0.7			2	SS	21
278.5					
2.2	Clayey SILT, with sand, trace gravel Stiff Brown Moist (TILL)		3	SS	8
277.7					
3.0	Silty CLAY, with sand Stiff to Hard Brown Moist (TILL)		4	SS	11
			5	SS	26
			6	SS	55/ 0.100
			7	SS	80
272.5					
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.8m AND DRY TO BOTTOM. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				

RECORD OF BOREHOLE No HMS 7-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 868 068.7 E 313 400.0 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.07 - 2017.11.07 CHECKED BY RD

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
280.5	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (100mm)																	
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)		1	GS			280											
279.9																		
0.7	Clayey SILT, with sand Very Stiff Brown Moist (TILL)		1	SS	16		279											
			2	SS	23													
278.3																		
2.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	25		278										0	31 40 29
			4	SS	100/ 0.270		277											
			5	SS	66		276											
							275											
			6	SS	100/ 0.270		274										4	34 41 21
273.4																		
7.2	SAND and SILT, trace clay Very Dense Grey Moist						273										0	38 59 3
272.3			7	SS	69													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY TO BOTTOM. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																	

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+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 10-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 867 607.2 E 313 475.6 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.08 - 2017.11.08 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
272.0	GROUND SURFACE							20 40 60 80 100						
0.0	ASPHALT: (100mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)			GS				20 40 60 80 100						
271.3			1	SS	39		271							
0.7	Silty CLAY, with sand, trace to some gravel Hard to Very Stiff Brown to Grey Moist (TILL)		2	SS	28		270							
			3	SS	22									
			4	SS	31		269							
							268							
			5	SS	25		267							
							266							
			6	SS	57		265							
264.0			7	SS	100/ 0.250		264							
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 5.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 10-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 867 604.5 E 313 458.5 ORIGINATED BY TM
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2017.11.07 - 2017.11.07 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
271.9	GROUND SURFACE							20 40 60 80 100		20 40 60					
0.0	ASPHALT: (100mm)														
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)			GS						○					
271.2							271			○					
0.7	Clayey SILT, some sand, trace gravel Very Stiff Grey Moist (FILL)		1	SS	22					○					
270.4							270			○					
1.4	Silty CLAY, with sand, trace gravel, some organics at 1.5m± Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	26					○					
							269			○					
							268			○					
							267			○					7 34 35 24
							266								
							265			○					
							264			○					7 28 34 31
263.6	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.1m slotted screen.														
8.2															
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.02.16 Frozen -														

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

RECORD OF BOREHOLE No OHS 9-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 867 090.4 E 313 570.2 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.09 - 2017.11.09 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
267.4	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (100mm)																		
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)		1	GS			267												
266.7																			
0.7	Clayey SILT, trace sand and gravel Very Stiff to Hard Grey Moist (FILL)		1	SS	26		266												
			2	SS	31														
265.2																			
2.2	Clayey SILT, trace gravel and sand, some organics at 2.3m Stiff to Very Stiff Brown Moist (TILL)		3	SS	17		265												
			4	SS	10		264												
263.3																			
4.1	SAND, trace gravel, trace silt and clay Dense Brown Wet		5	SS	40		263												
261.8							262												
5.6	Silty SAND, trace gravel, trace clay Compact to Dense Grey Wet		6	SS	28		261												
			7	SS	38		260												
259.2																			
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 4.3m AND WATER LEVEL AT 3.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 9-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 867 085.8 E 313 545.1 ORIGINATED BY TM
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2017.11.07 - 2017.11.07 CHECKED BY RD

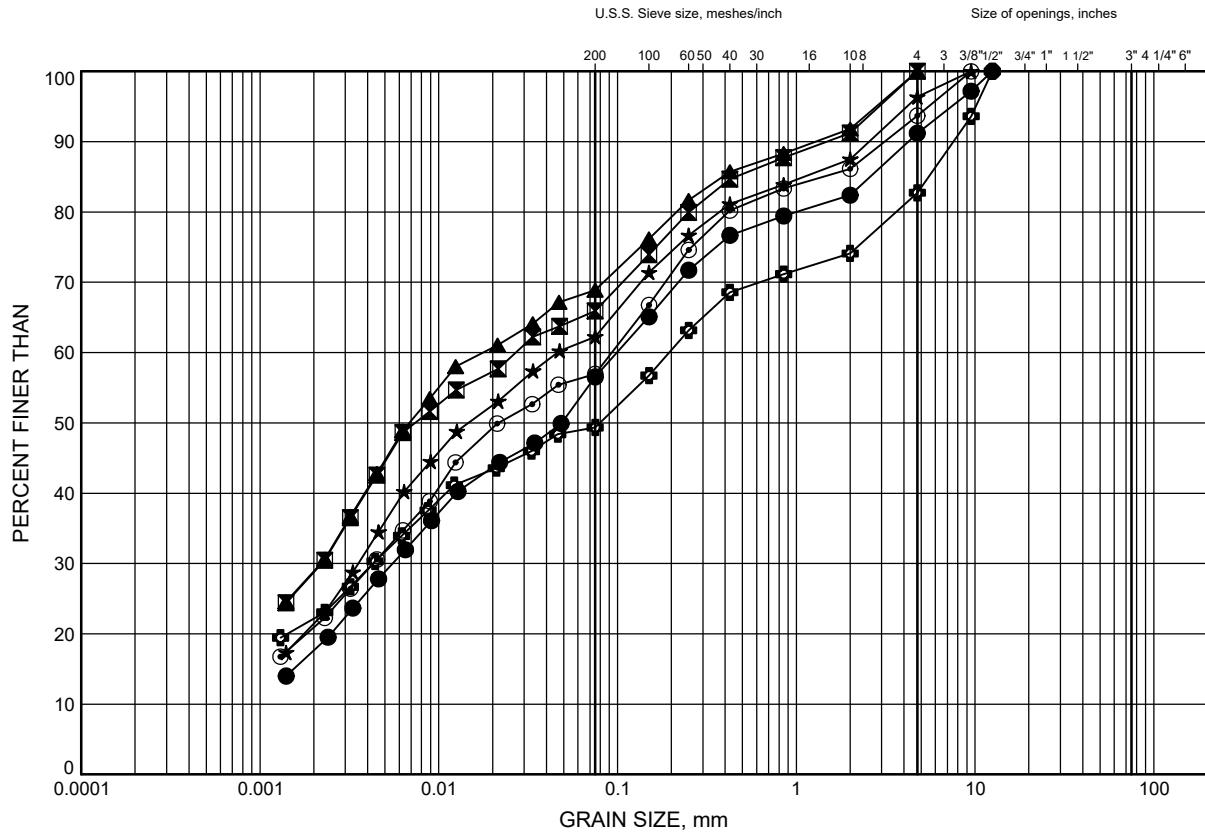
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
267.3	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (100mm)																
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)		1	GS			267							o			
266.6																	
0.7	Clayey SILT, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		1	SS	20		266							o			
			2	SS	17		265							o			
			3	SS	20		264							o			
			4	SS	30		263										
			5	SS	51		262							o			
							261										
			6	SS	49		260							o			
						</											

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HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE A1

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 7-1	2.6	278.1
⊠	HMS 7-1	4.9	275.8
▲	HMS 7-2	2.6	277.9
★	HMS 7-2	6.4	274.1
⊙	OHS 10-1	2.6	269.4
⊕	OHS 10-1	6.4	265.6

Date February 2018
W.P. 2930-02-00

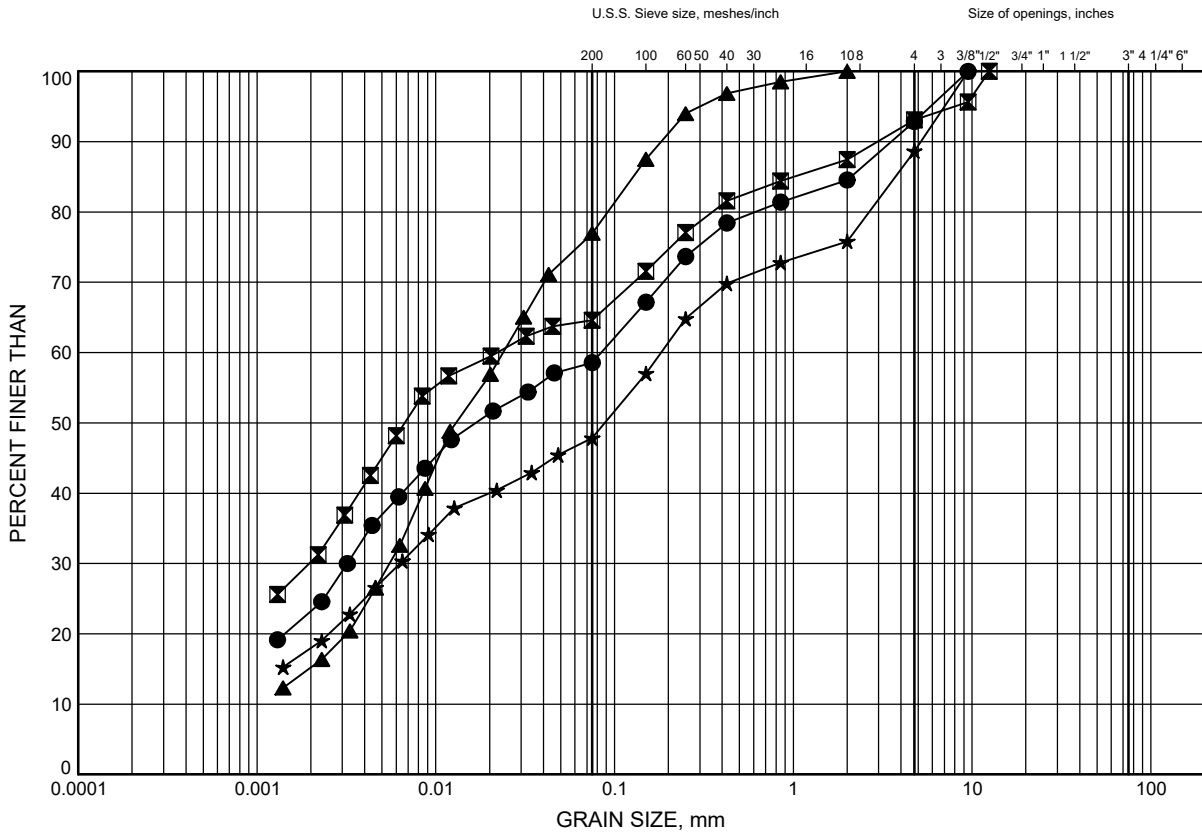


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE A2

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 10-2	4.9	267.0
⊠	OHS 10-2	7.9	263.9
▲	OHS 9-2	3.4	263.9
★	OHS 9-2	6.4	260.9

Date February 2018
W.P. 2930-02-00

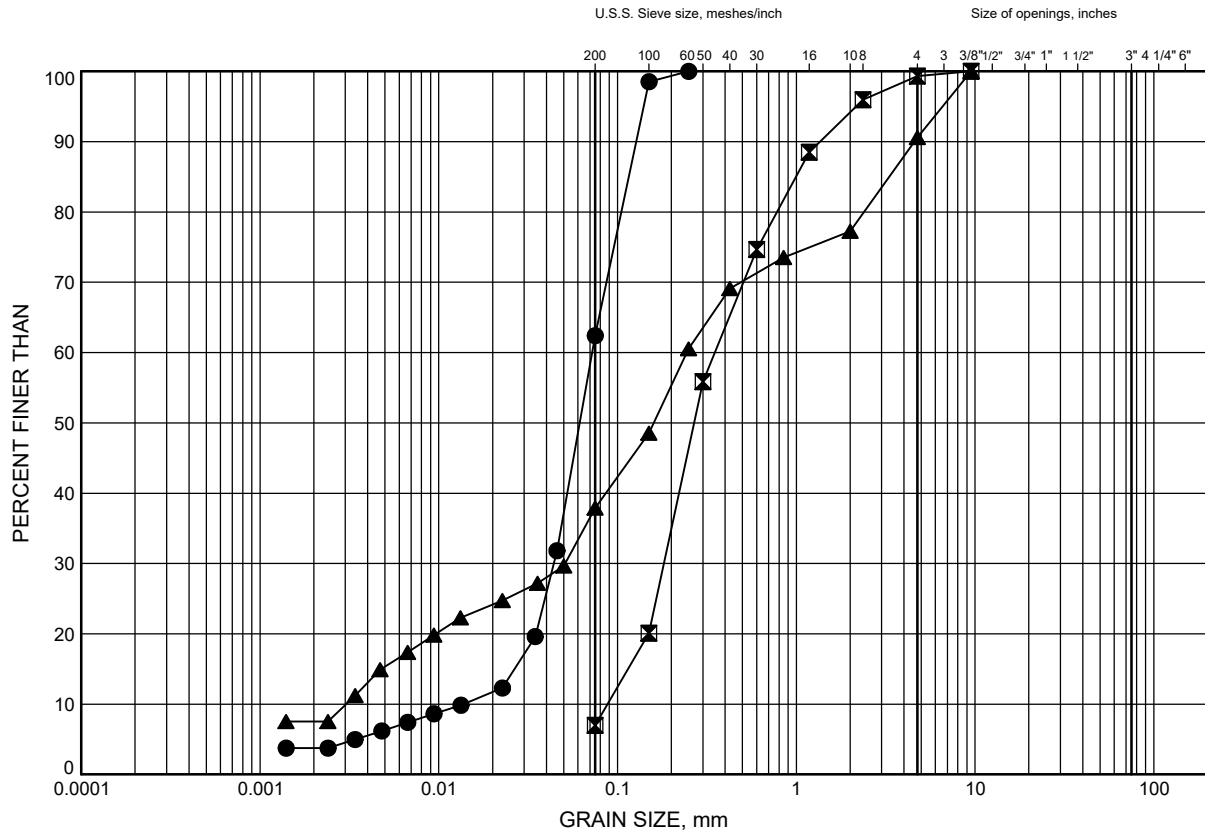


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE A3

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 7-2	7.9	272.6
⊠	OHS 9-1	4.9	262.5
▲	OHS 9-1	6.4	261.0

Date February 2018
W.P. 2930-02-00

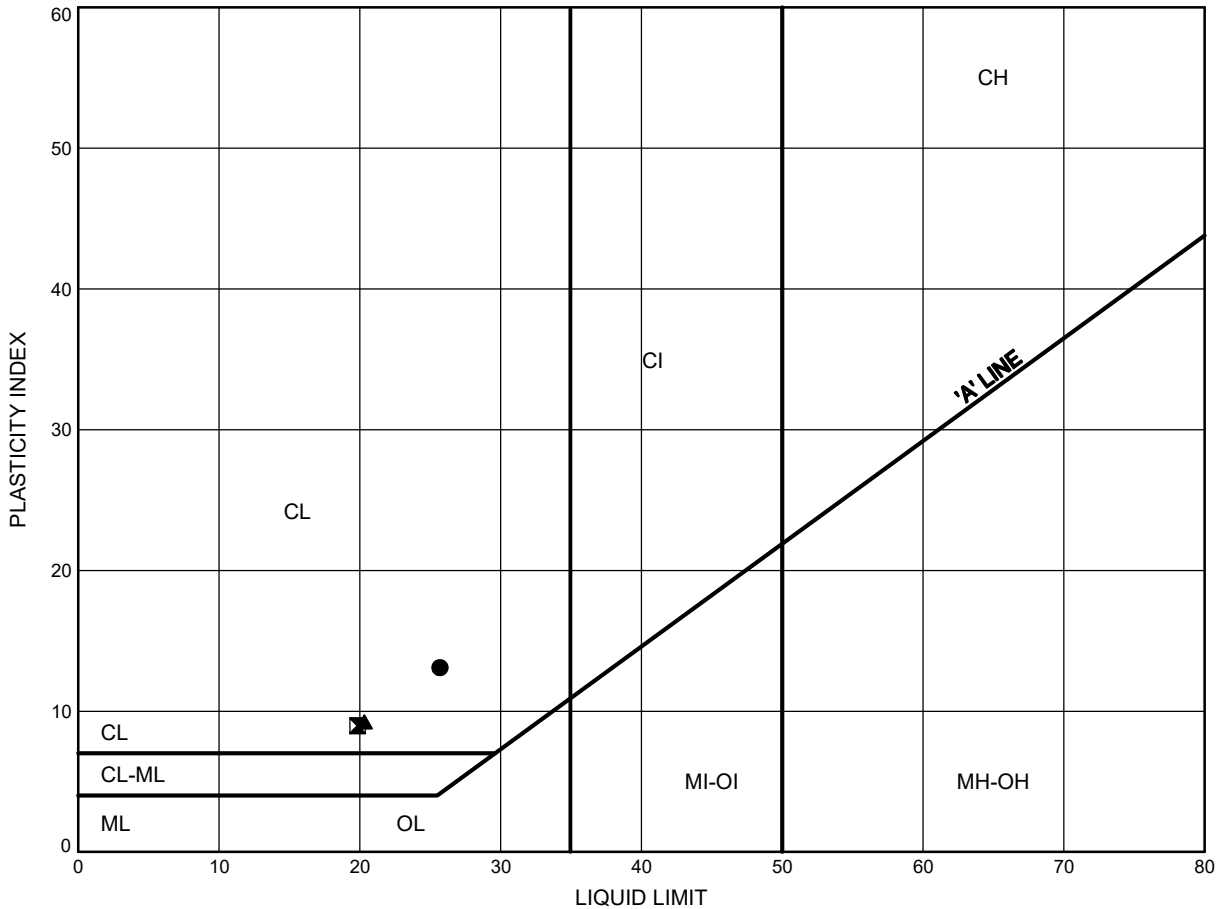


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE A4

Silty CLAY to Clayey SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 7-1	4.9	275.8
⊠	OHS 10-1	2.6	269.4
▲	OHS 10-2	4.9	267.0

Date February 2018
W.P. 2930-02-00



Prep'd MP
Chkd. RD



Appendix B

Section 2 (Stations 24+700 Stouffville Road to 22+400 19th Avenue)

RECORD OF BOREHOLE No OHS 8-1 / MS-11

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION NB N 4 866 208.1 E 313 679.2 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.22 - 2017.06.22 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
260.2	GROUND SURFACE						20 40 60 80 100						
0.0	ASPHALT: (100mm)												
0.1	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	48								
259.4													
0.8	SAND and SILT, trace to some gravel, trace to some clay Very Dense Grey Moist (TILL)		2	SS	50								0 44 39 17
			3	SS	73/ 0.100								
			4	SS	70								
			5	SS	50/ 0.100								10 54 30 6
			6	SS	80								
254.6	Compact												
5.6													
			7	SS	18								
253.5	END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 5.5m AND WATER LEVEL AT 3.7m DEPTH UPON COMPLETION.. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.												
6.7													

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RECORD OF BOREHOLE No OHS 8-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 866 168.8 E 313 698.5 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.01.08 - 2018.01.08 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
260.3	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	SAND , trace to some gravel Dense to Compact Brown Moist to Wet (FILL)		1	SS	46								
			2	SS	32								
			3	SS	28								
257.8													
			4	SS	24								
2.5	Gravelly SAND , trace gravel Loose Brown Wet		5	SS	6								
256.2													
4.1	SAND , some silt, trace gravel, trace clay, Dense Grey Moist		6	SS	34								
			7	SS	46								
253.1													
7.2	SAND and SILT , with gravel, trace clay Dense Grey Moist (TILL)		8	SS	46								
252.1													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 0.9m AND WATER LEVEL AT 0.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No TS-190

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 866 179.1 E 313 678.7 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.14 - 2017.12.14 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
260.0	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	Gravelly SAND , trace silt Dense to Compact Brown Moist (FILL)		1	SS	34		259							25 70 5 (SI+CL)
			2	SS	43									
			3	SS	14		258							
257.8														
2.2	SAND , trace gravel, trace to some silt and clay Dense to Compact Grey Wet		4	SS	35		257							1 85 14 (SI+CL)
			5	SS	20									
							256							
			6	SS	18		255							0 91 7 2
254.4														
5.6	Silty SAND , trace gravel, trace clay Dense to Very Dense Grey Moist		7	SS	47		254							2 71 25 2
							253							
252.2			8	SS	50/ 0.075									
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE CAVED TO 3.1m AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 7-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 717.8 E 313 638.3 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.10 - 2017.12.10 CHECKED BY RD

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 ³	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 _P W W _L									
255.2	GROUND SURFACE							20	40	60	80	100					GR	SA	SI	CL	
0.0	ASPHALT: (150mm)							20	40	60	80	100									
0.2	SAND, some sand, trace gravel Compact to Dense Brown Wet (FILL)		1	SS	23		255							○							
			2	SS	37		254							○							
			3	SS	20									○							
253.0							253														
2.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		4	SS	19									⊕				2	44	34	20
			5	SS	37		252							○							
							251														
			6	SS	16									○							
							250														
							249							⊕				0	35	38	27
			7	SS	48																
							248														
247.5			8	SS	50/									○				8	48	31	13
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE CAVED TO 7.3m and WATER LEVEL AT 7.01m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				0.025																

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

RECORD OF BOREHOLE No OHS 7-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 748.5 E 313 654.9 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.15 - 2017.11.15 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
255.4	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (100mm)												
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)		1	GS			255						
254.7													
0.7	Clayey SILT, with sand, trace to some gravel Hard Brown to Grey Moist (TILL)		1	SS	61		254						
			2	SS	41								
253.2							253						
2.2	Very Stiff		3	SS	19								20 37 27 16
			4	SS	24		252						
							251						
			5	SS	20								6 54 27 13
249.7							250						
5.6			6	SS	90		249						
							248						
247.6			7	SS	100/								3 43 32 22
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 6.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				0.125								

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 6-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 615.3 E 313 609.4 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.09 - 2017.11.09 CHECKED BY RD

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 ³	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 _P	W		W _L				
254.1	GROUND SURFACE																			
0.0	SAND , trace silt, trace gravel Brown Moist (FILL)			GS								○								
253.4												○								
0.7	Clayey SILT , with sand, some gravel Hard to Very Stiff Grey Moist (TILL)		1	SS	64							○								
			2	SS	58							○								
			3	SS	17							○								
			4	SS	28							○					11	43	28	18
			5	SS	27							○								
			6	SS	40							○					12	37	33	18
			7	SS	100/							○								
246.2																				
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 7.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, THEN DRY MIX CONCRETE TO SURFACE.				0.270															

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RECORD OF BOREHOLE No HMS 6-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 617.5 E 313 594.5 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.17 - 2017.11.17 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
254.1	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)			GS										
252.9			1	SS	53		253							
1.2	Clayey SILT, with sand, trace gravel, trace cobbles Hard Brown Moist (TILL)		2	SS	57		252							
			3	SS	33		251							
			4	SS	31		250							
250.0							249							
4.1	Very Stiff		5	SS	26		248							
248.5							247							
5.6			6	SS	51									
246.3			7	SS	100/									
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				0.200									

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

RECORD OF BOREHOLE No HMS 5-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 415.1 E 313 615.8 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.10 - 2017.12.10 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
252.2	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (150mm)																			
0.2	SAND, some gravel, trace to some silt Dense Brown Wet (FILL)		1	SS	43		252												13 73 14 (SI+CL)	
251.2			2	SS	31															
1.0	Clayey SILT, with sand, trace gravel Hard to Very Stiff Brown Moist (FILL)						251													
			3	SS	58															
							250												6 41 35 18	
			4	SS	22															
249.3							249													
3.0	Silty CLAY, some sand, some organics at 3.0m± Very Stiff to Hard Brown to Grey Moist (TILL)		5	SS	34															
							248													
			6	SS	23															
							247													
			7	SS	35		246												0 15 37 48	
							245													
			8	SS	27															
244.0																				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY TO BOTTOM. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 5-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 431.8 E 313 629.1 ORIGINATED BY TM
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2017.11.15 - 2017.11.15 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
252.1	GROUND SURFACE							20 40 60 80 100						
0.0	ASPHALT: (100mm)						252							
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)			GS										
251.4														
0.7	Clayey SILT, with sand, trace gravel Hard to Very Stiff Brown Moist (FILL)		1	SS	50		251							
			2	SS	53		250							6 46 29 19
			3	SS	26									
249.1							249							
3.0	Silty CLAY, some sand, trace gravel, some organics at 3.0m± Hard Brown Moist (TILL)		4	SS	30									
			5	SS	33		248							
			6	SS	50		247							1 12 45 42
244.9							246							
7.2	SILT, some clay, trace sand Dense Grey Wet		7	SS	45		245							0 3 85 12
243.9							244							
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) 2018.02.16 3.5 248.6													

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/16/18

+³ ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HOT-4

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 865 362.5 E 313 594.9 ORIGINATED BY ES
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.20 - 2017.11.20 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
251.4	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (150mm)							20	40	60	80	100							
0.2	SAND, trace gravel Brown Moist (FILL)		1	GS			251												
250.8																			
0.7	Sandy SILT, trace gravel, trace clay Compact Brown Moist (FILL)		1	SS	27		250												
250.1																			
1.4	Clayey SILT, with sand, trace gravel, some organics at 1.5m± Very Stiff to Stiff Brown Moist (TILL)		2	SS	26		249												
			3	SS	10														
			4	SS	14		248												
	Hard		5	SS	44		247												
245.9							246												
5.6	Silty CLAY, some sand Hard Grey Moist (TILL)		6	SS	39		245												
			7	SS	43		244												
243.4																			
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE OPEN AND WATER LEVEL AT 5.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

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

RECORD OF BOREHOLE No HOT-3

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 864 936.6 E 313 633.1 ORIGINATED BY ES
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.20 - 2017.11.20 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
247.0	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)							20 40 60 80 100					
0.2	SAND, trace gravel Brown Moist (FILL)			GS				20 40 60 80 100					
246.2								20 40 60 80 100					
0.8	Clayey SILT, some sand Very Stiff to Hard Brown Moist (TILL)		1	SS	26		246	20 40 60 80 100					
			2	SS	38		245	20 40 60 80 100					
			3	SS	31		244	20 40 60 80 100				0 10 63 27	
243.8			4	SS	40		243	20 40 60 80 100					
3.2	SILT, some sand, some clay Dense Brown Wet		5	SS	36		242	20 40 60 80 100				0 20 68 12	
241.2			6	SS	22		241	20 40 60 80 100				0 77 20 3	
5.8	SAND, some silt, trace clay Compact Brown Wet						240	20 40 60 80 100					
239.3			7	SS	75		239	20 40 60 80 100					
7.7	Clayey SILT, with sand Hard Grey Wet (TILL)							20 40 60 80 100					
238.9								20 40 60 80 100					
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED TO 5.2m AND WATER LEVEL AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.							20 40 60 80 100					

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+³, ×³: Numbers refer to
Sensitivity

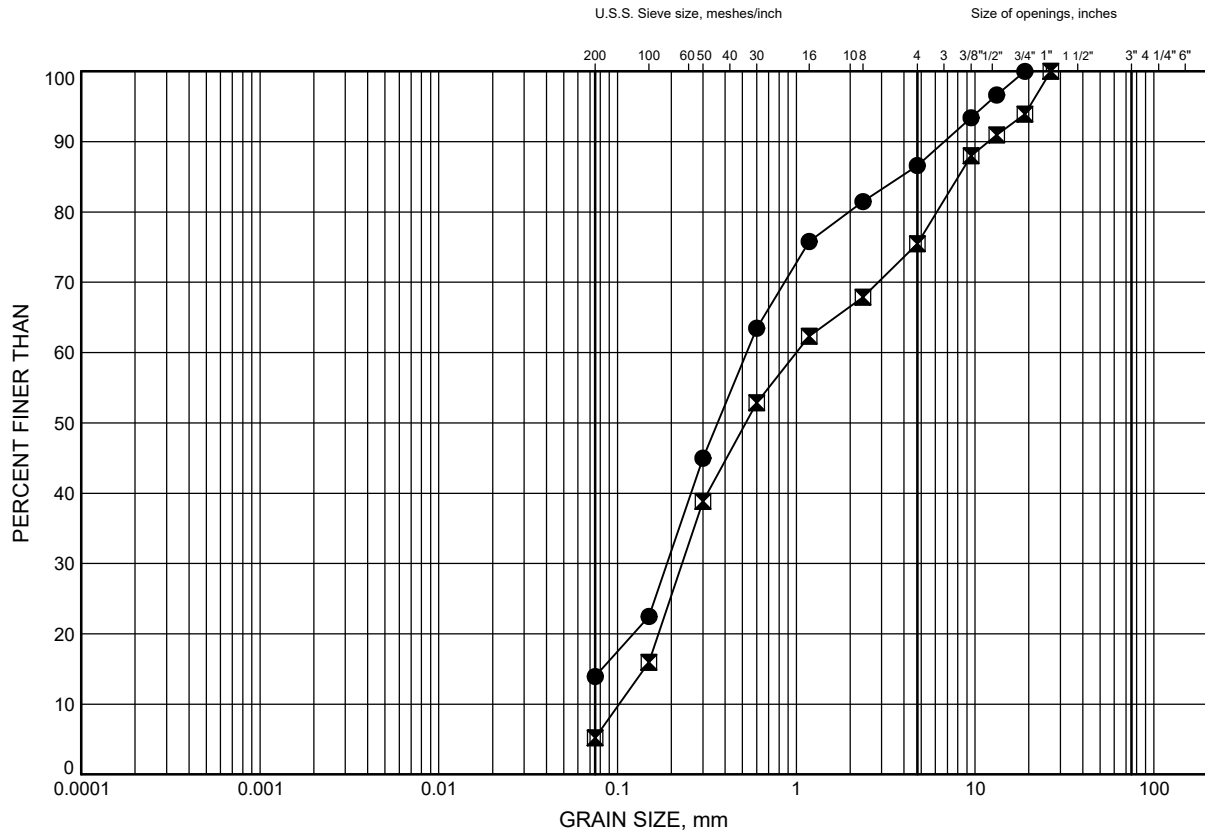
20
15
10

(%) STRAIN AT FAILURE

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 5-1	0.5	251.8
⊠	TS-190	1.1	258.9

Date February 2018
W.P. 2930-02-00

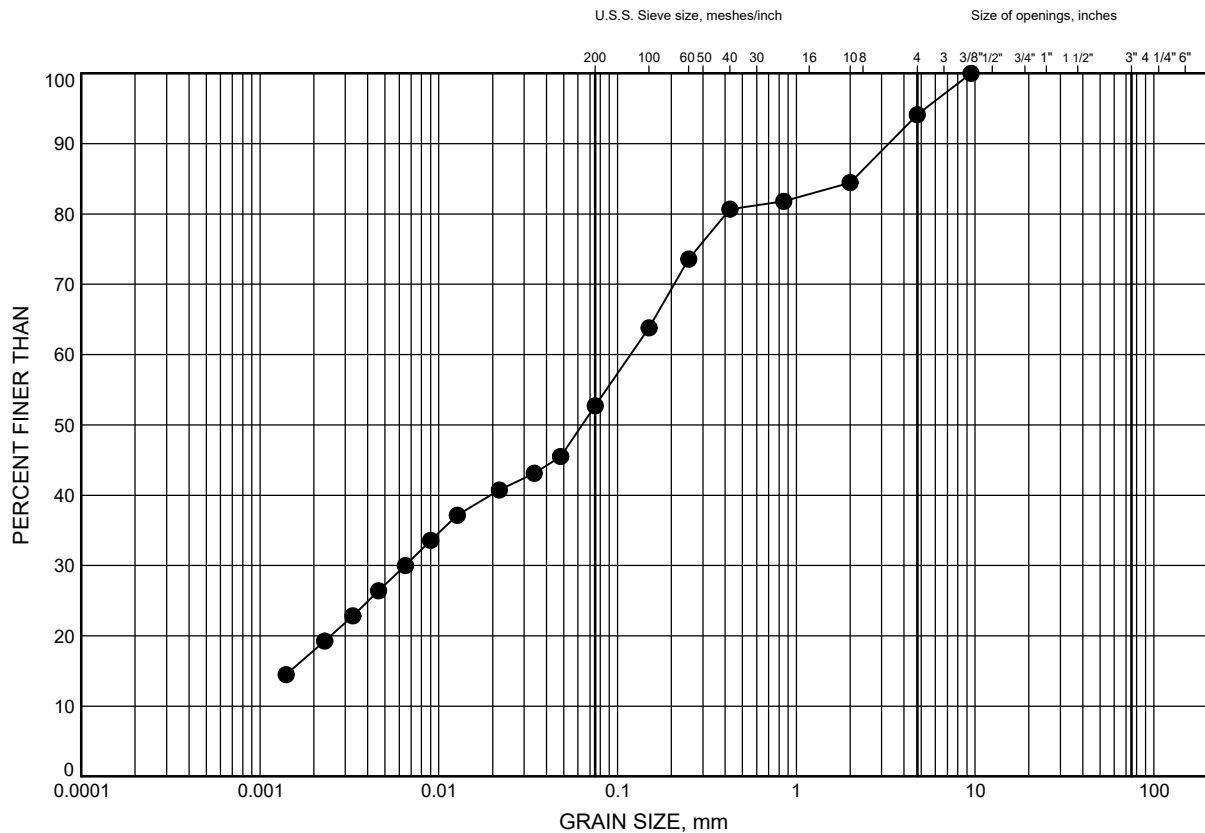


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B2

Clayey SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 5-1	2.6	249.6

Date February 2018
W.P. 2930-02-00

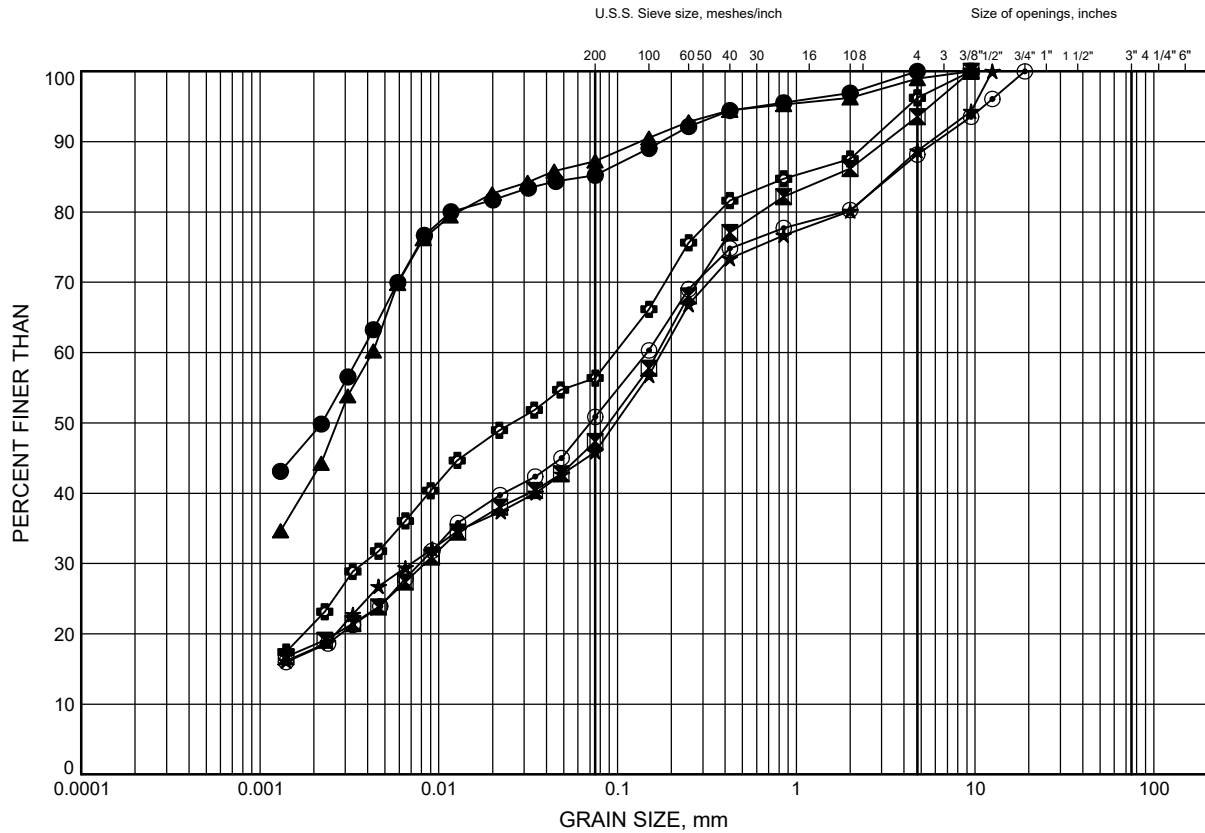


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B3

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 5-1	6.4	245.8
⊠	HMS 5-2	1.8	250.3
▲	HMS 5-2	4.9	247.2
★	HMS 6-1	3.4	250.8
⊙	HMS 6-1	6.4	247.7
⊕	HMS 6-2	2.6	251.5

Date February 2018
W.P. 2930-02-00

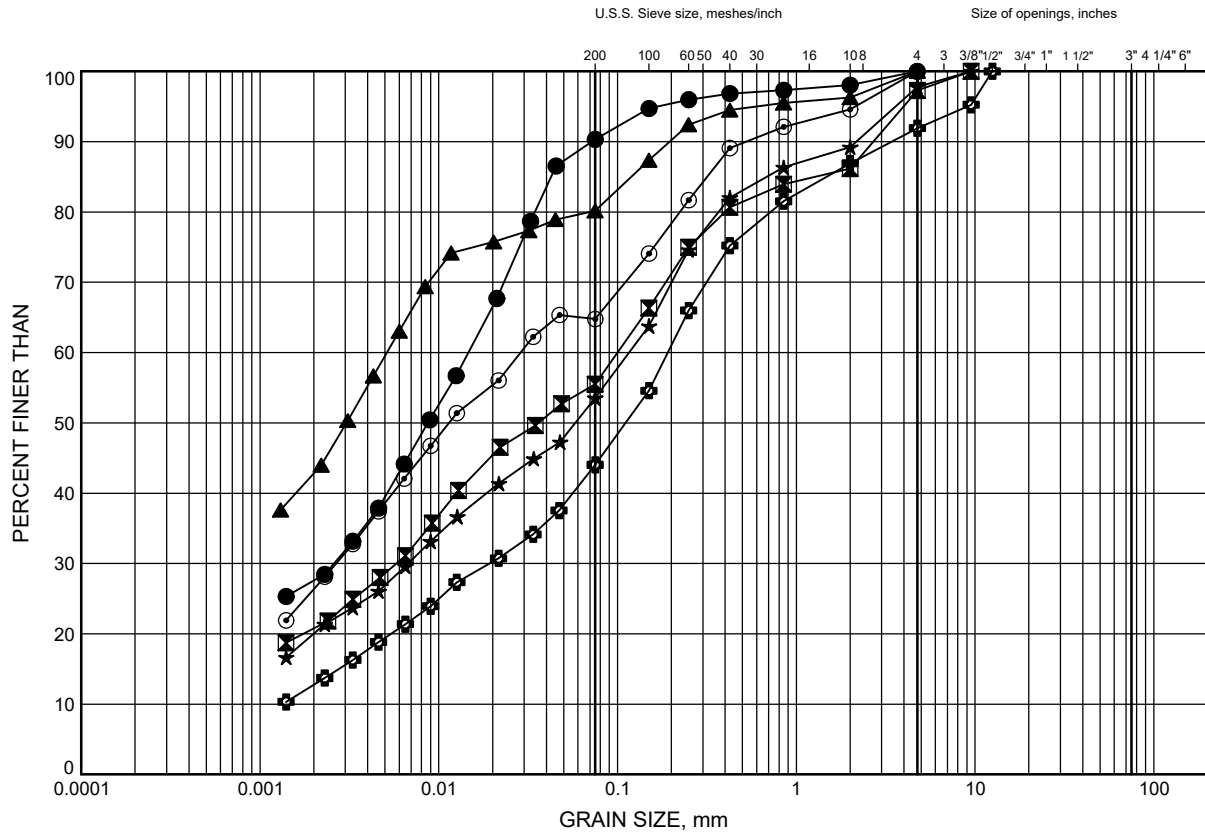


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HOT-3	2.5	244.5
⊠	HOT-4	2.5	248.9
▲	HOT-4	6.3	245.1
★	OHS 7-1	2.6	252.6
⊙	OHS 7-1	6.4	248.8
⊕	OHS 7-1	7.7	247.5

Date February 2018
W.P. 2930-02-00

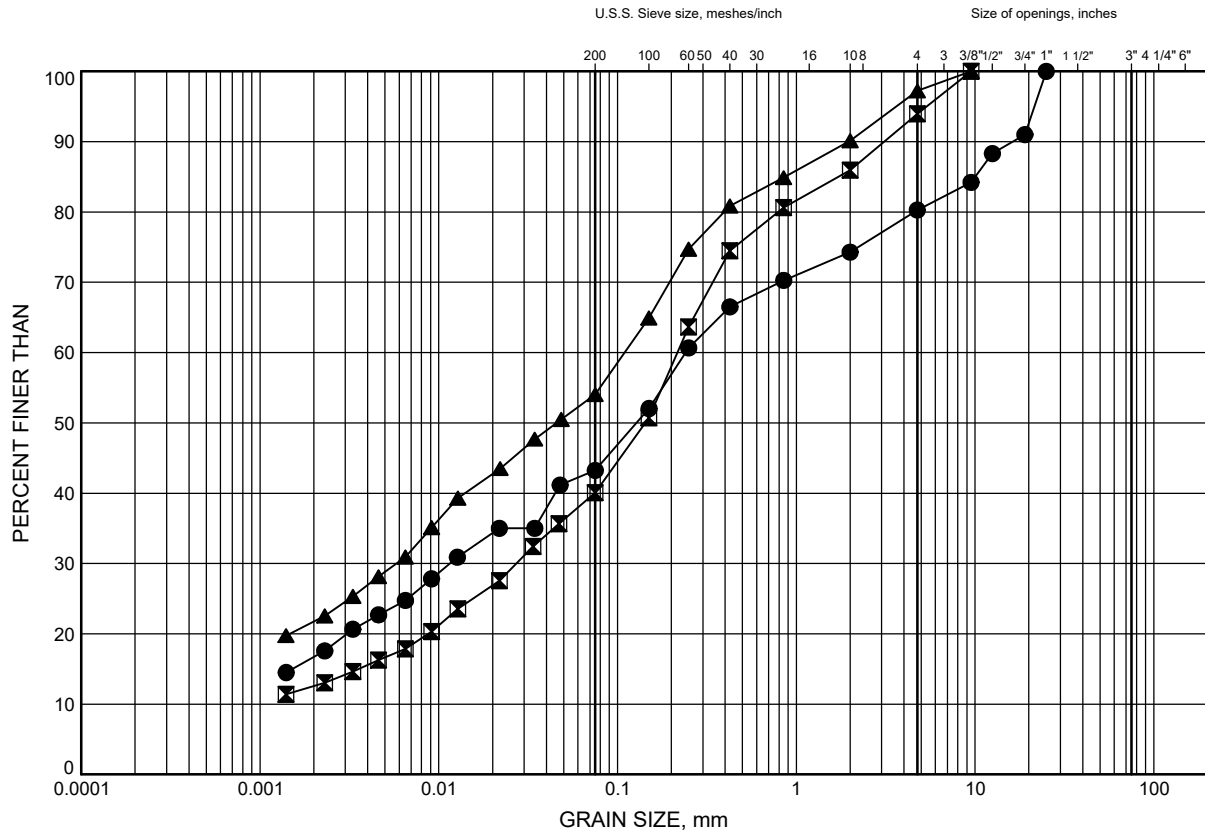


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B5

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 7-2	2.6	252.8
⊠	OHS 7-2	4.9	250.5
▲	OHS 7-2	7.7	247.6

Date February 2018
W.P. 2930-02-00

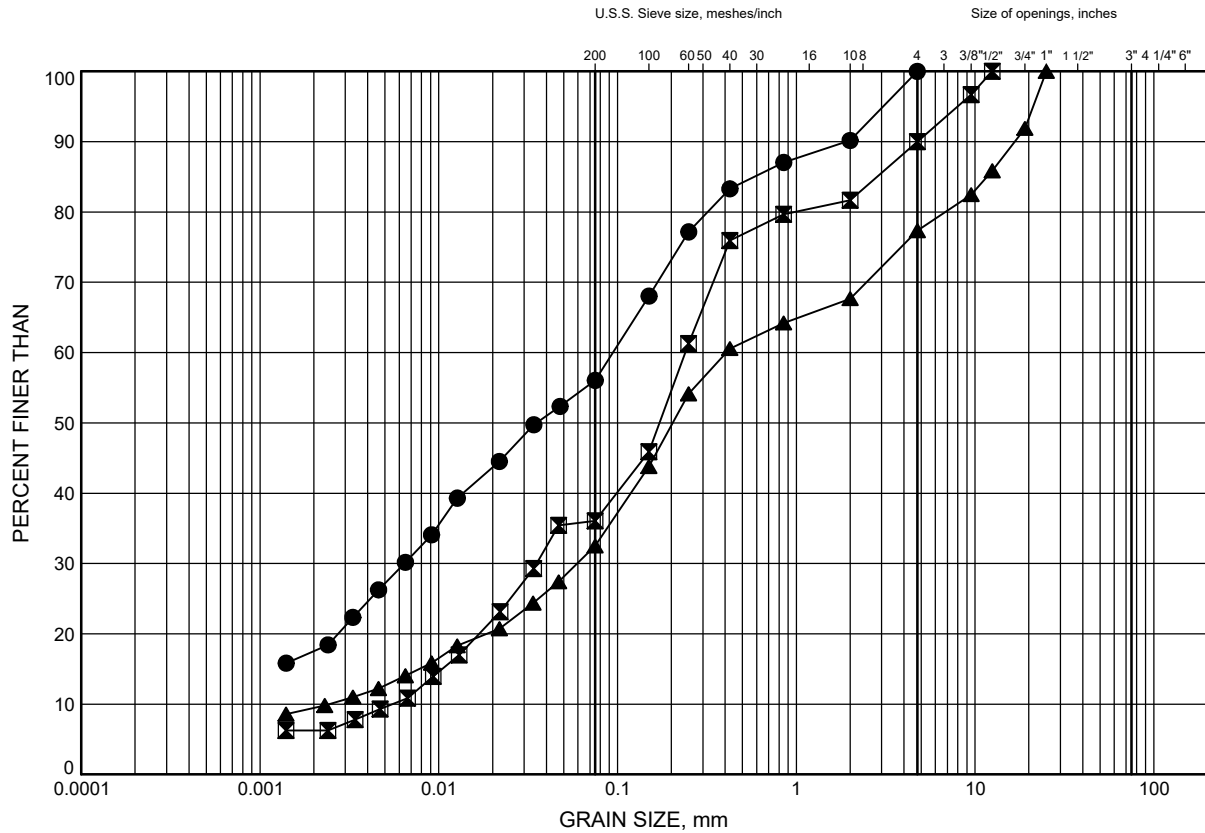


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B6

SAND and SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 8-1 / MS-11	1.1	259.1
⊠	OHS 8-1 / MS-11	3.2	257.0
▲	OHS 8-2	7.9	252.4

Date February 2018
W.P. 2930-02-00

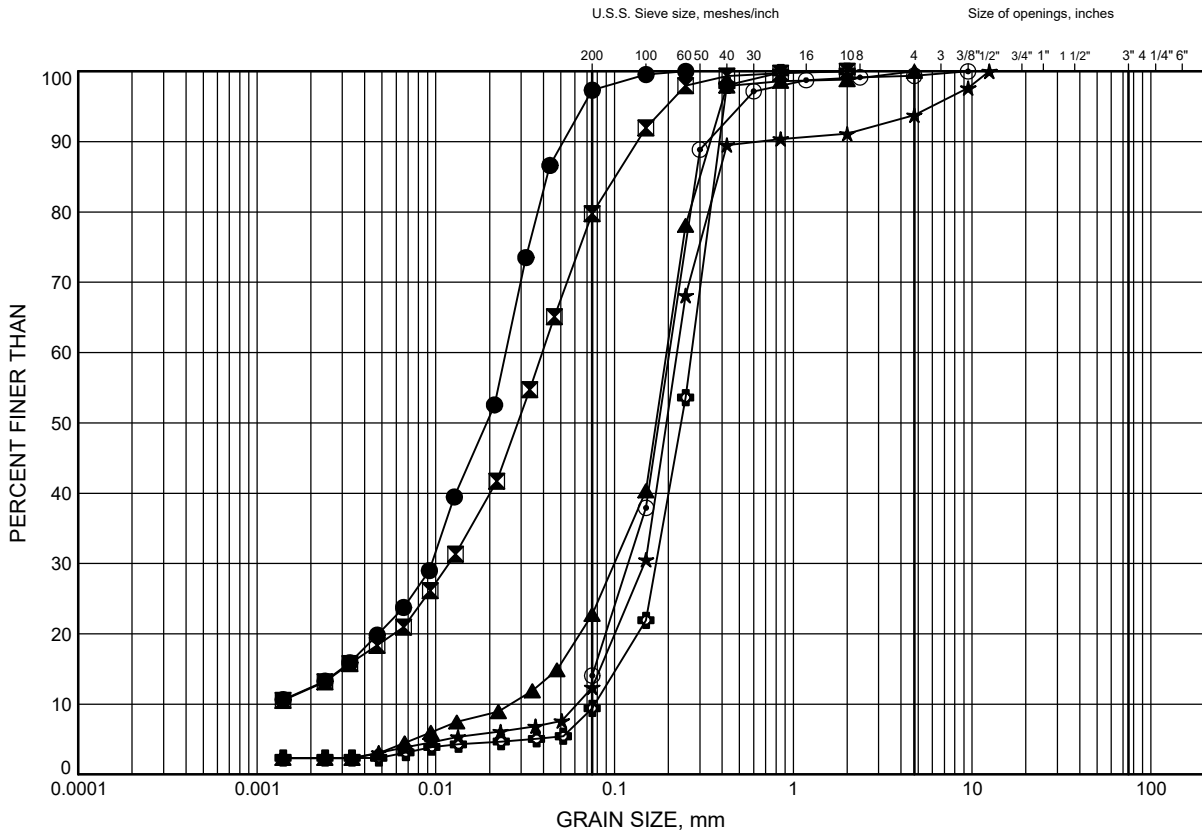


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B7

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 5-2	7.9	244.2
⊠	HOT-3	4.8	242.2
▲	HOT-3	6.3	240.7
★	OHS 8-2	4.9	255.4
⊙	TS-190	2.6	257.4
⊕	TS-190	4.9	255.1

Date February 2018
W.P. 2930-02-00

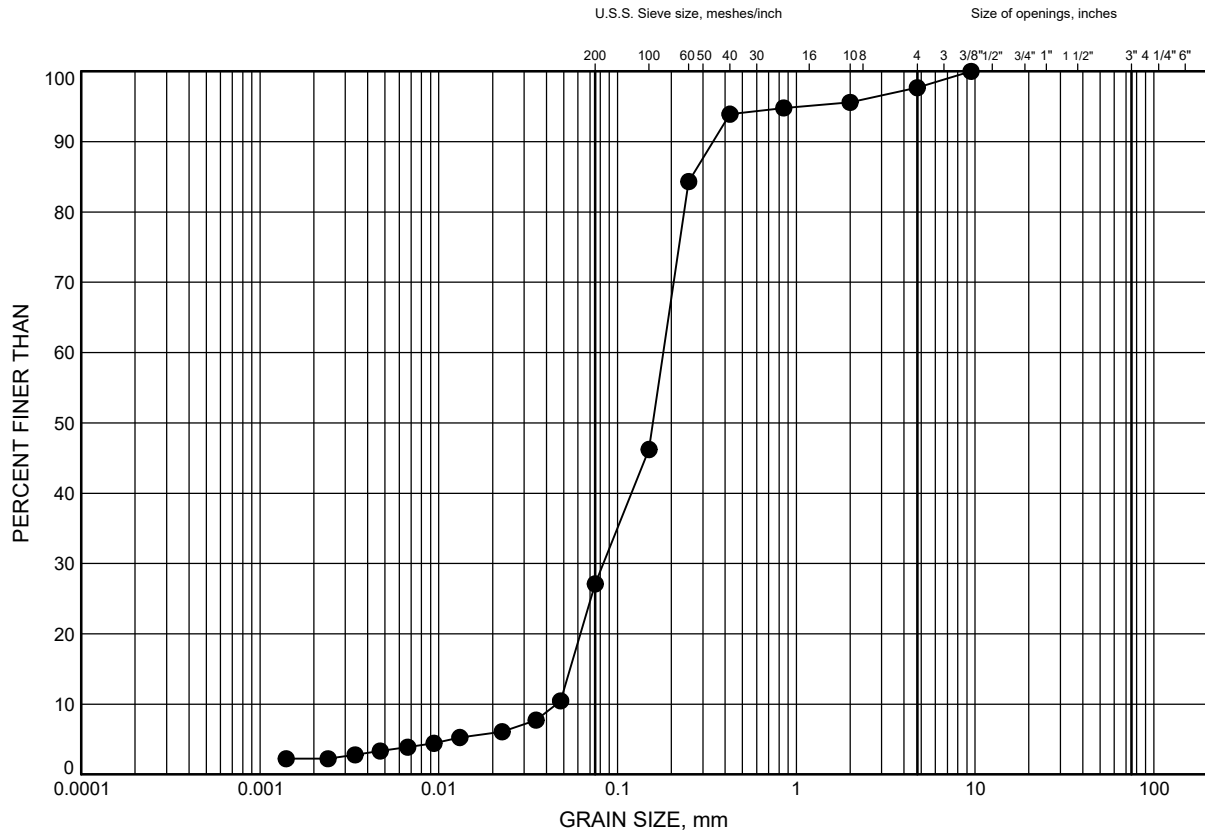


Prep'd AN
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B8

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	TS-190	6.4	253.6

Date February 2018
W.P. 2930-02-00

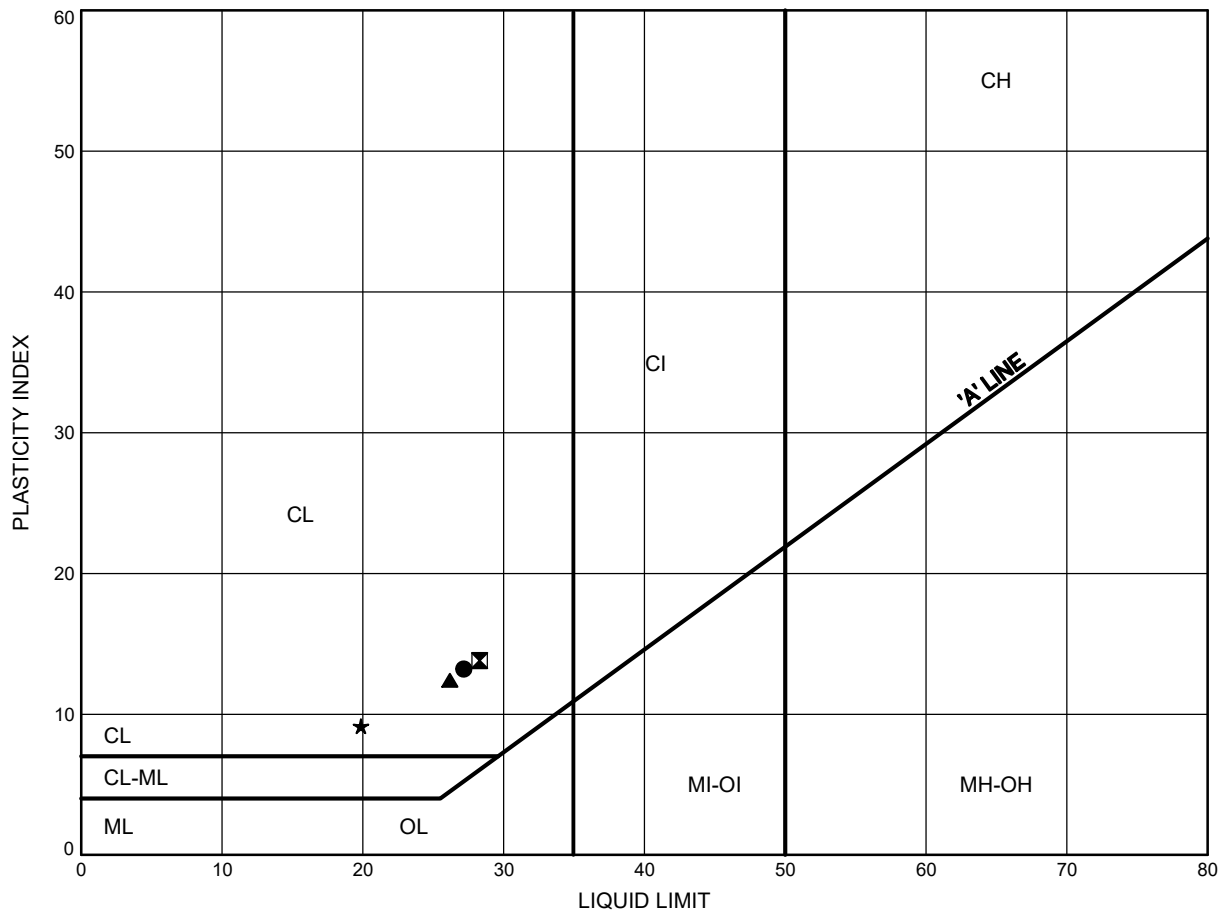


Prep'd AN
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B9

Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 5-1	6.4	245.8
⊠	HMS 5-2	4.9	247.2
▲	HOT-4	6.3	245.1
★	OHS 7-1	2.6	252.6

Date February 2018
W.P. 2930-02-00

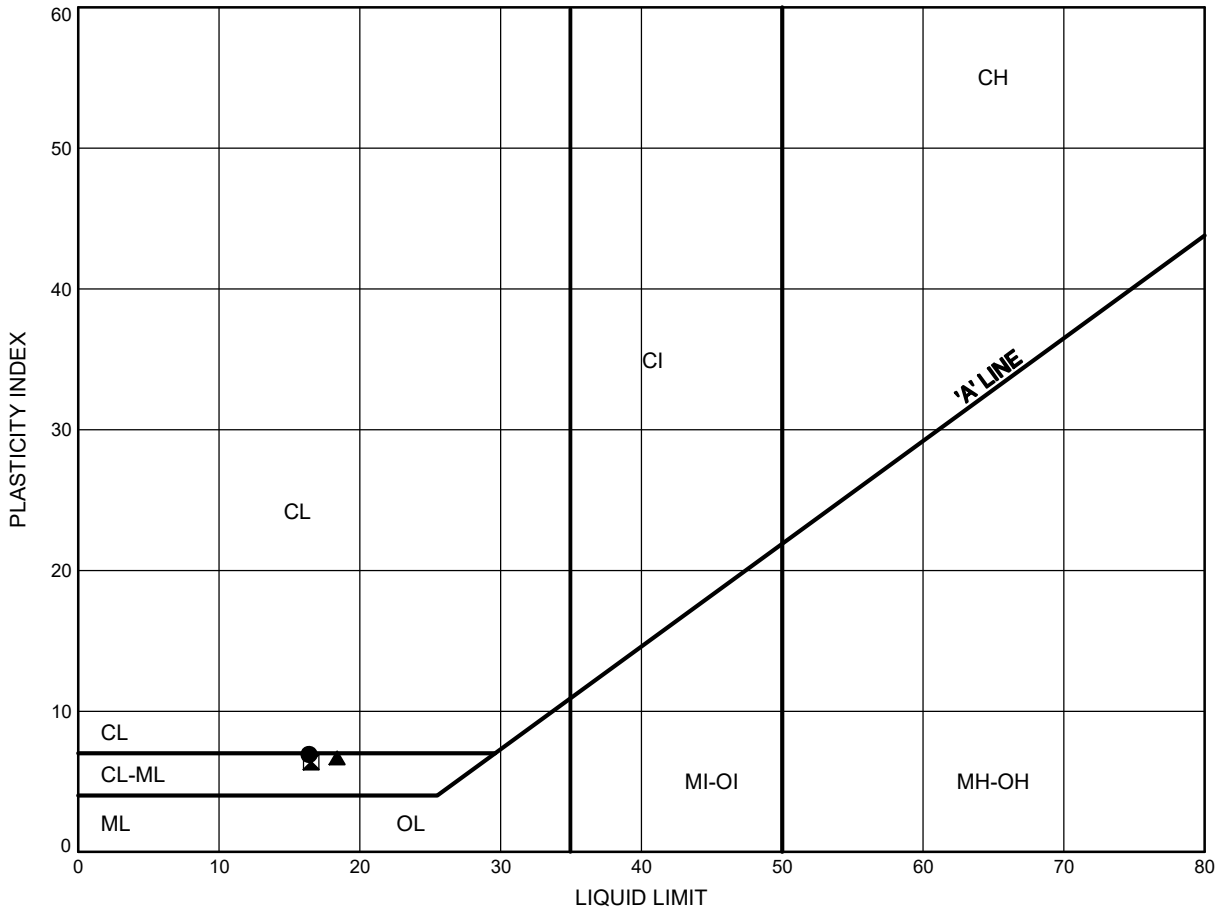


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B10

Clayey SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 6-2	6.4	247.7
⊠	OHS 7-1	6.4	248.8
▲	OHS 7-2	4.9	250.5

Date February 2018
W.P. 2930-02-00



Prep'd MP
Chkd. RD



Appendix C

Section 3 (Stations 22+400 19th Avenue to 20+300 Elgin Mills Road)

RECORD OF BOREHOLE No MS-32

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION SB N 4 864 023.5 E 313 794.6 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.08.11 - 2017.08.11 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
240.7	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (100mm)																
0.1	Silty SAND, trace gravel Brown Moist (FILL)		1	GS										○			
239.9																	
0.8	Silty CLAY, with sand, trace gravel Firm to Very Stiff Brown Moist (TILL)		1	SS	13									○ —			0 23 31 46
			2	SS	6									○			
			3	SS	22									○			
			4	SS	25									○			
			5	SS	23									○			
235.1																	
5.6	Silty SAND, some clay, trace gravel Compact Grey Wet																
			6	SS	16									○			8 52 25 15
234.0																	
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 4.6m DEPTH UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.09.24 3.0 237.7 2017.10.23 2.9 237.8																

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/13/18

RECORD OF BOREHOLE No HOT-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 842.8 E 313 828.3 ORIGINATED BY ES
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2017.11.20 - 2017.11.20 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
239.5	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (150mm)																			
0.2	SAND, some gravel, cobble pieces Very Dense Brown Moist (FILL)			GS			239													
			1	SS	50/ 0.025															
238.4																				
1.1	Clayey SILT, with sand, trace gravel Hard Brown to Grey Moist (TILL)		2	SS	50/ 0.150		238													
			3	SS	44		237													
236.2			4	SS	100/ 0.250		236													
3.3	Sandy SILT, trace gravel, trace clay Very Dense Brown Moist																			
							235													
234.8			5	SS	38															
4.7	Silty SAND, trace gravel, trace clay Dense Brown Wet						234													
233.9																				
5.6	Silty CLAY, some sand Hard Grey Moist (TILL)		6	SS	44		233													
							232													
231.4			7	SS	34															
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED TO 4.9m AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS-150 / MS-33

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION NB N 4 863 842.5 E 313 846.3 ORIGINATED BY TM
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2017.07.17 - 2017.07.17 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
240.3	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	Silty SAND, trace to some gravel Brown Moist (FILL)		1	GS			240							
239.6														
0.8	Silty CLAY, with sand, trace gravel, trace cobbles Hard to Very Stiff Brown Moist (TILL)		1	SS	42		239							
			2	SS	27									
			3	SS	25		238							
			4	SS	48		237							
236.2														
4.1	Silty SAND, trace gravel Compact Brown Wet		5	SS	26		236							
234.7							235							
5.6	Clayey SILT, some sand, trace gravel Very Stiff Grey Moist (TILL)		6	SS	28		234							
233.6														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 5.5m AND WATER LEVEL AT 3.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.5m, DRY MIX CONCRETE TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.													

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

RECORD OF BOREHOLE No HMS 4-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 674.2 E 313 859.3 ORIGINATED BY ES
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.20 - 2017.11.20 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
238.3	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND, trace gravel Brown Moist (FILL)		1	SS			238							
237.4			1	SS	58									
1.0	Clayey SILT, some sand, trace gravel Stiff Brown Moist (FILL)		2	SS	12		237							
236.2														
2.1	Clayey SILT, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	18		236							5 42 33 20
			4	SS	32		235							
							234							
			5	SS	50/ 0.125									
232.8							233							
5.6	Silty SAND, trace clay Dense to Compact Brown Wet		6	SS	44		232							0 74 23 3
							231							
230.2			7	SS	23									
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED TO 4.6m AND WATER LEVEL AT 3.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No HMS 4-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 673.5 E 313 845.2 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.29 - 2017.11.29 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
238.3	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.1	SAND, some gravel, trace silt Compact Brown Moist (FILL)		1	SS	26		238							
237.6														
0.7	Sandy SILT, some clay, trace gravel Compact Brown Moist (FILL)		2	SS	19		237							
236.9														
1.4	Clayey SILT, with sand, trace gravel Very Stiff Brown Moist (TILL)		3	SS	16		236							
	cobble pieces		4	SS	16		235							6 39 39 16
			5	SS	20		234							
							233							
			6	SS	25		232							
231.1							231							
7.2	Silty SAND, trace gravel, trace clay Very Dense Grey Moist		8	SS	75									7 63 22 8
230.1														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS-135

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 627.1 E 313 862.4 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.05 - 2017.12.05 CHECKED BY RD

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W _P	W	W _L		
238.1	GROUND SURFACE																
0.0	ASPHALT: (150mm)																
0.2	SAND, some silt, trace gravel Dense Brown Moist (FILL)		1	SS	40											5 71 15 9	
237.2																	
1.0	Clayey SILT, some sand, trace gravel Hard Brown Moist (FILL)		2	SS	47												
			3	SS	46												
235.7																	
2.4	Clayey SILT, with sand, trace gravel Stiff to Hard Brown Wet (TILL)		4	SS	8												
			5	SS	10											3 43 33 21	
			6	SS	30												
			7	SS	44												
			8	SS	49												
229.9																	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																

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

RECORD OF BOREHOLE No HOT-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 452.1 E 313 917.2 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.14 - 2017.12.14 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
237.7	GROUND SURFACE							20	40	60	80	100		
0.0	ASPHALT: (150mm)							20	40	60	80	100		
0.2	SAND, trace gravel, trace silt Dense Brown Moist (FILL)		1	SS	44		237							
237.1														
0.6	Clayey SILT, some sand, trace gravel Very Stiff to Hard Brown Moist (FILL)		2	SS	29		236							
			3	SS	47		235							
235.5														
2.2	Silty CLAY, with sand, trace gravel, some organics at 2.3m± Very Stiff Brown Moist (TILL)		4	SS	21		234							
			5	SS	27		233							
			6	SS	16		232							
232.1														
5.6	SAND, some silt, trace clay Dense to Very Dense Grey Wet		7	SS	49		231							
			8	SS	50/ 0.125		230							
229.7														
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 5.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No OHS 6-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 403.4 E 313 900.4 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.30 - 2017.11.30 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
236.8	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.1	SAND, trace silt, trace gravel Dense Brown Moist (FILL)		1	SS	44		236							
236.1														
0.7	Clayey SILT, some sand, trace gravel, cobble pieces Hard Brown Moist (FILL)		2	SS	43									
			3	SS	37		235							
234.5														
2.2	Silty CLAY, some sand, some organics at 2.3m± Stiff Dark Brown to Brown Moist		4	SS	14		234							
			5	SS	8									
							233							
232.6														
4.1	Clayey SILT, with sand Hard Brown to Grey Moist (TILL)		6	SS	43		232							
							231							
			7	SS	50/ 0.125									
							230							
229.6														
7.2	SAND and SILT , trace clay Dense Grey Wet		8	SS	31		229							
228.5														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED AT 6.7m and WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 6-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 383.5 E 313 896.0 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.07 - 2017.12.07 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																
236.4	GROUND SURFACE							20	40	60	80	100												
0.0	ASPHALT: (150mm)																							
0.2	SAND, some gravel, trace silt Brown Wet (FILL)		1	SS	31		236																	
235.9																								
0.5	Clayey SILT, trace gravel, trace sand Very Stiff Brown Wet (FILL)		2	SS	20		235																	
234.9	Clayey SILT, with sand, trace gravel Stiff to Hard Brown Moist to Wet (TILL)		3	SS	14		234																	
1.4																								
			4	SS	10		233																	
			5	SS	33		232																	
			6	SS	16		231																	
			7	SS	47		230																	
229.2							229																	
7.2	Silty SAND, trace gravel, trace clay Dense Brown Wet		8	SS	43																			
228.2																								
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 5.5m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2016.02.15 2.3 234.1																							

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No HMS 3-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 162.1 E 313 970.0 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.12 - 2017.12.12 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
236.1	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (150mm)						236													
0.2	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	40															
235.2																				
0.9	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	51		235													
			3	SS	32															
233.9							234													
2.2	Very Stiff		4	SS	24															
233.1																				
3.0			5	SS	51		233													
							232													
			6	SS	30															
							231													
							230													
			7	SS	69															
							229													
	Stiff																			
			8	SS	12		228													
227.9																				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.7 m AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																			

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

RECORD OF BOREHOLE No HMS 3-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 863 165.8 E 313 987.1 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.07 - 2017.12.07 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
235.9	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND, trace silt, some gravel Dense		1	SS	32									
235.3	Brown to Grey Moist (FILL)													
0.6	Clayey SILT, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		2	SS	20									
			3	SS	40									
			4	SS	36									
			5	SS	48									
			6	SS	52									
230.3														
5.6	SAND, some silt, trace gravel, trace clay Dense to Compact Grey Wet		7	SS	48									
			8	SS	17									
227.7														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No OHS 5-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 862 936.7 E 313 987.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.30 - 2017.11.30 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	20 40 60	20 40 60	20 40 60				
234.5	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	SAND, some gravel, trace silt		1	SS	46											
233.9	Dense															
0.6	Brown		2	SS	88											
	Moist (FILL)															
	SAND and SILT, trace gravel, trace clay															
	Very Dense to Dense															
	Brown		3	SS	54										5 53 37 5	
	Moist (TILL)															
232.3																
2.2			4	SS	25											
	Compact															
231.5			5	SS	36											
3.0																
			6	SS	50/ 0.100										4 37 48 11	
			7	SS	50/ 0.100											
	cobble pieces															
									</							

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 5-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 862 934.0 E 313 968.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.29 - 2017.11.29 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
								20 40 60 80 100					
234.2	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.1	SAND, some gravel, some silt Dense Grey Moist (FILL)		1	SS	48								
233.1			2	SS	23								
1.1	Sandy SILT, trace clay, trace gravel Compact to Dense Brown Moist												
			3	SS	38								
			4	SS	34								
			5	SS	28								
230.1													
4.1	SAND and SILT , trace gravel, trace to some clay Very Dense Grey Wet (TILL)		6	SS	60/ 0.100								
			7	SS	65								
			8	SS	58								
226.0													
8.2	END OF BOREHOLE AT 7.8m. BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No TS-125

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 862 844.4 E 314 000.2 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.30 - 2017.11.30 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)							
							20 40 60							

234.0	GROUND SURFACE						234										
0.0	ASPHALT: (150mm)																
0.2	SAND, some gravel, trace silt Dense to Compact Brown Moist (FILL)		1	SS	40		233										
			2	SS	27												
232.6																	
1.4	Clayey SILT, trace sand, trace gravel, some organics at 1.5m Very Stiff to Stiff Dark Brown Moist (TILL)		3	SS	23		232										
			4	SS	25												
			5	SS	13		231										
229.9							230										
4.1	SAND, some silt, trace gravel, trace clay Very Dense Brown Wet		6	SS	54		229									5 76 14 5	
228.4																	
5.6	SAND and SILT, trace gravel, trace clay, cobble pieces Very Dense Grey Wet (TILL)		7	SS	50/ 0.100		228										
							227										
226.2			8	SS	50/ 0.075											8 37 45 10	
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE CAVED TO 4.3m AND WATER LEVEL AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

RECORD OF BOREHOLE No MS-42

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION SB N 4 862 711.9 E 314 027.8 ORIGINATED BY SLL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.08.15 - 2017.08.15 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
233.4	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	Silty SAND, trace gravel Brown Moist (FILL)		1	GS			233						
232.5	Clayey SILT, trace gravel Very Stiff Brown Moist (FILL)		1	SS	20		232						
232.0	Sandy SILT, trace gravel, occasional cobbles Very Dense Brown Moist (FILL)		2	SS	100/ 0.250								
231.2	Clayey SILT, some sand, with organics stained and rootlets Very Stiff Dark Brown Moist		3	SS	18		231						
2.2			4	SS	18		230						
229.0							229						
4.4	Clayey SILT, with sand, trace gravel Very Stiff to Firm Brown Moist (TILL)		5	SS	16		228						
			6	SS	6		227						
226.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN TO 5.8m AND WATER LEVEL AT 5.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.8m, DRY CEMENT TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												
6.7													

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/13/18

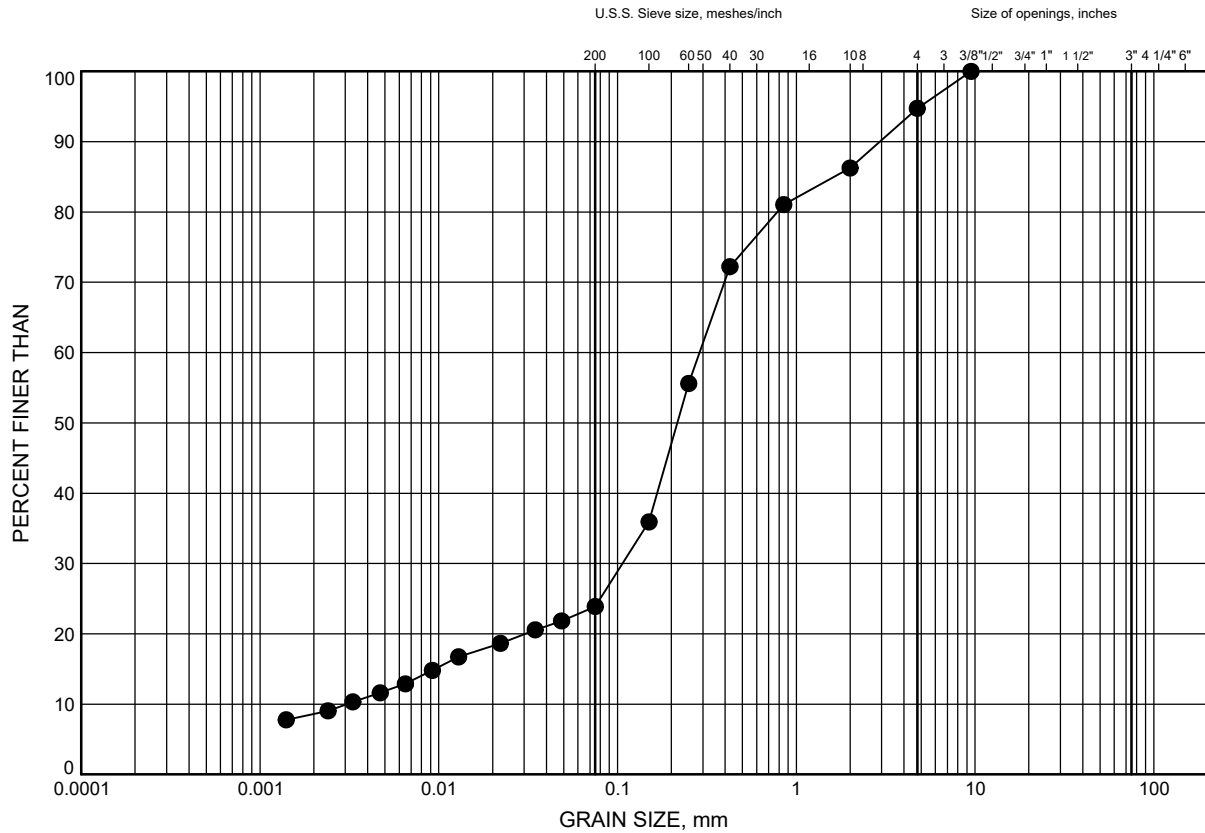
+³, ×³: Numbers refer to
Sensitivity

20
15 10 5 0
(%) STRAIN AT FAILURE

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C1

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	TS-135	0.5	237.7

Date February 2018
W.P. 2930-02-00

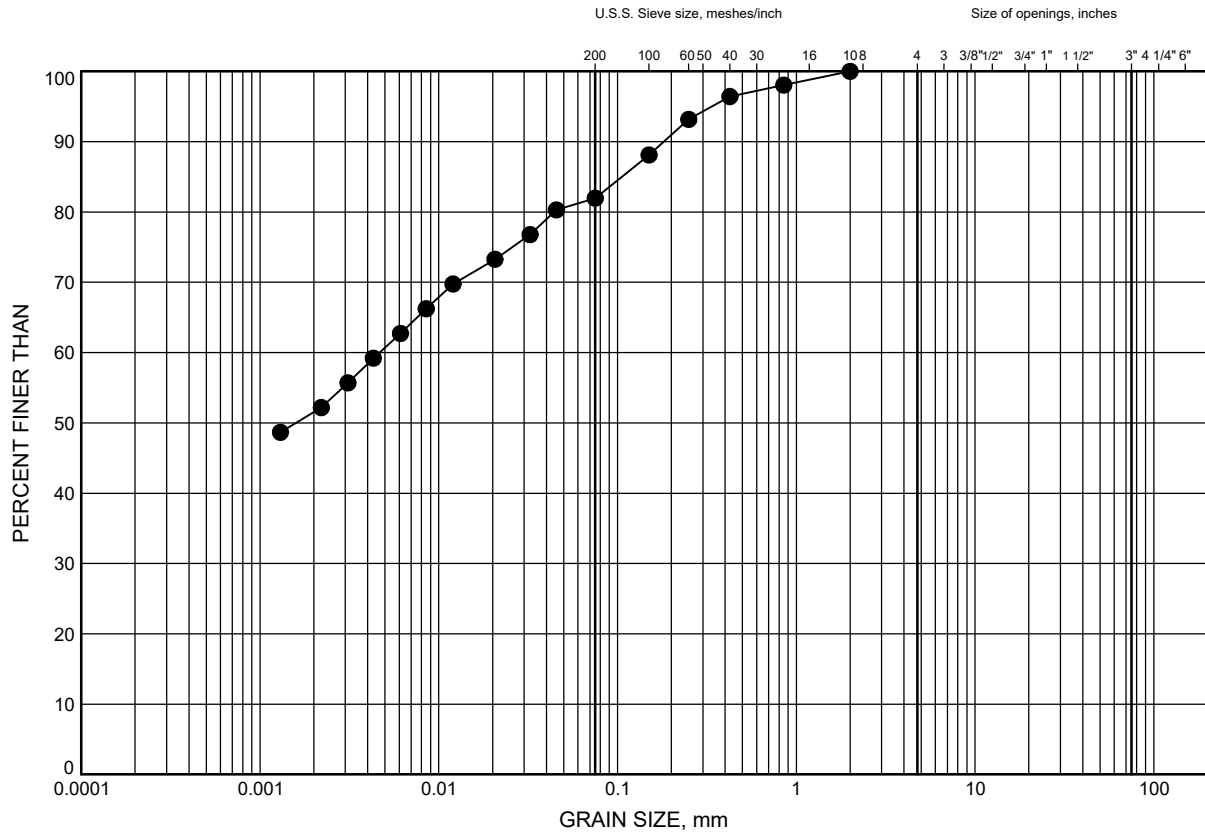


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C2

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 6-1	3.4	233.4

Date February 2018
W.P. 2930-02-00

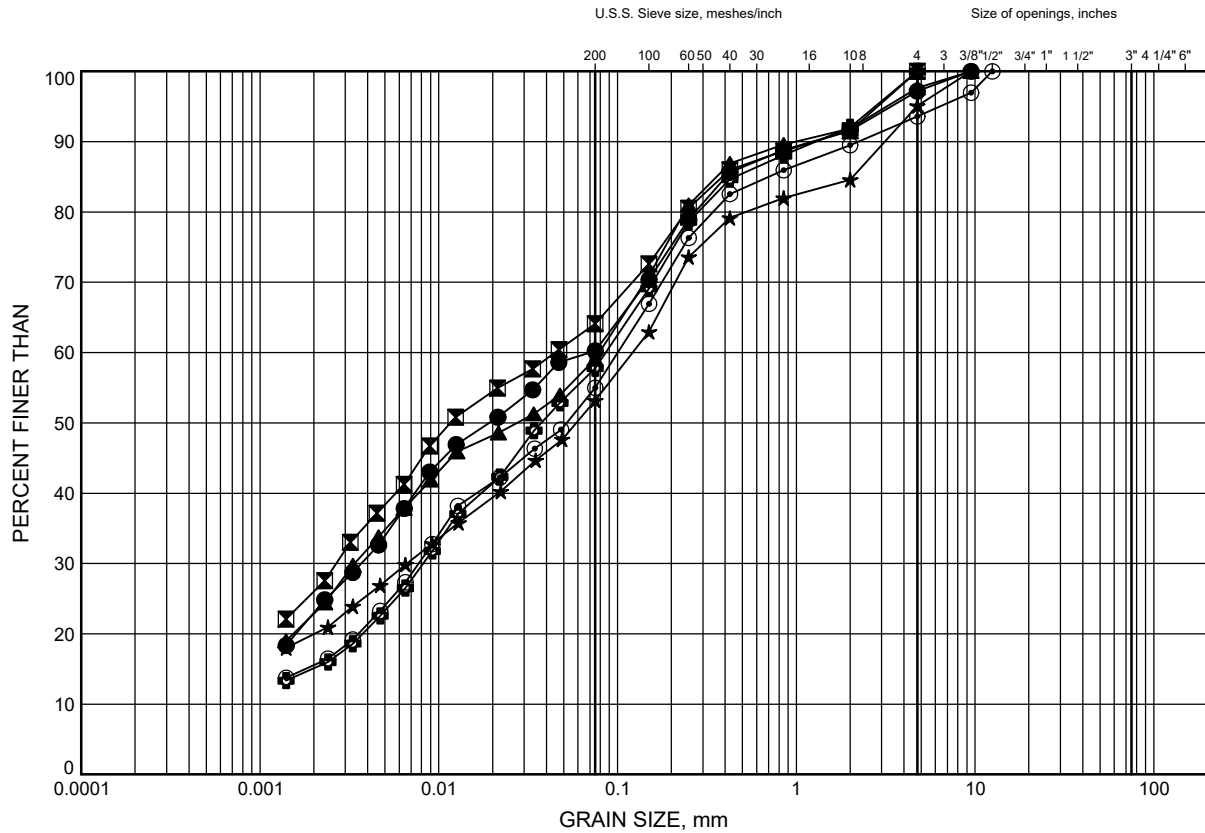


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C3

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 3-1	1.8	234.3
⊠	HMS 3-1	2.6	233.5
▲	HMS 3-1	6.4	229.7
★	HMS 4-1	2.5	235.8
⊙	HMS 4-2	2.6	235.7
⊕	OHS 6-1	4.9	231.9

Date February 2018
W.P. 2930-02-00



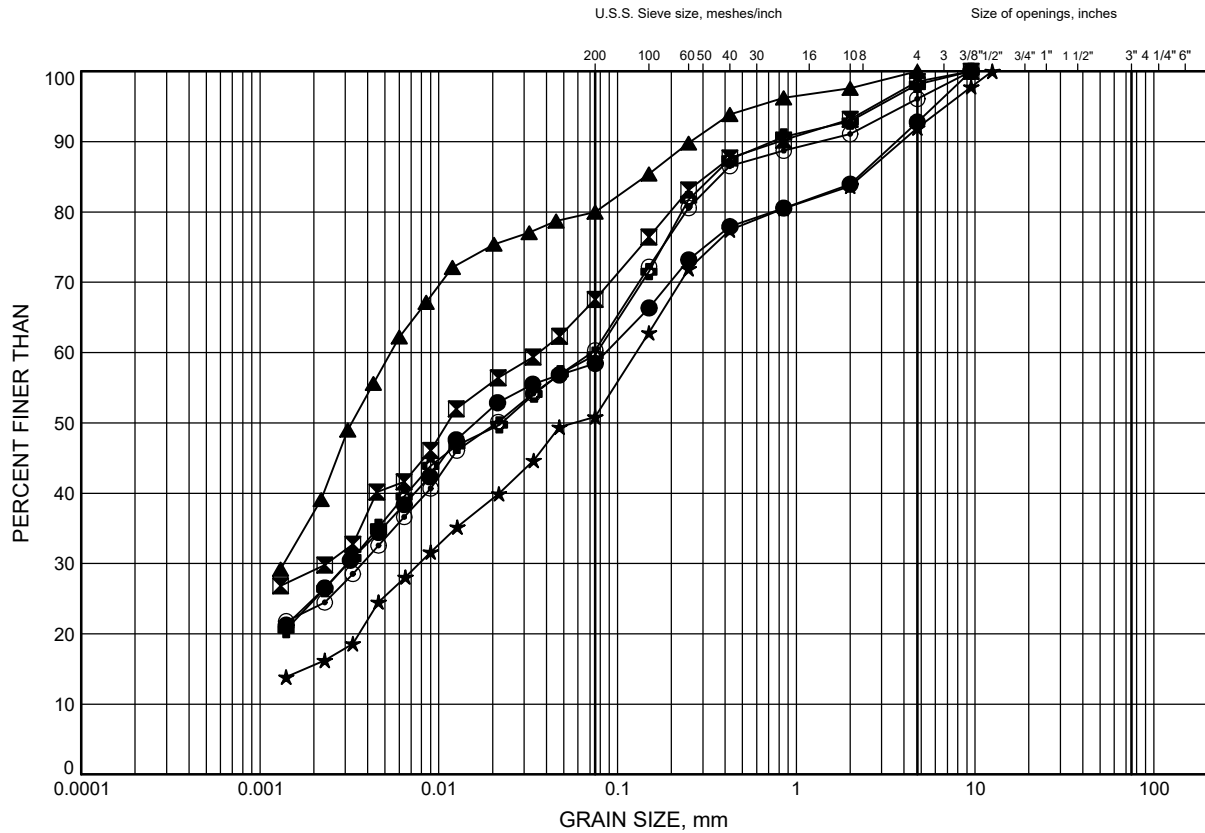
Prep'd MP
Chkd. RD

HWY 404 Widening

GRAIN SIZE DISTRIBUTION

FIGURE C4

Silty Clay to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HOT-1	2.6	235.1
⊠	HOT-1	4.9	232.9
▲	HOT-2	6.3	233.2
★	OHS 6-2	2.6	233.8
⊙	OHS 6-2	6.4	230.0
⊕	TS-150 / MS-33	2.6	237.7

Date February 2018
W.P. 2930-02-00

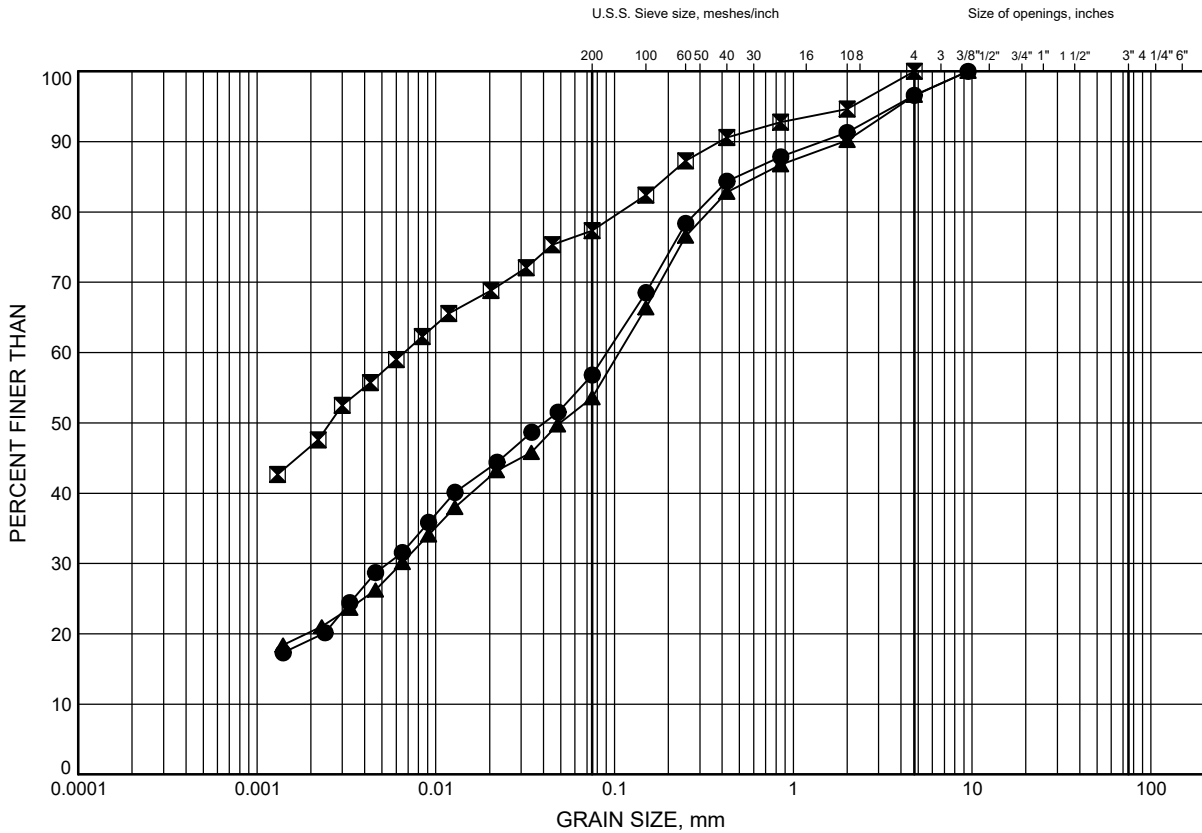


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C5

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-42	4.9	228.5
⊠	MS-32	1.1	239.6
▲	TS-135	3.4	234.8

Date February 2018
W.P. 2930-02-00

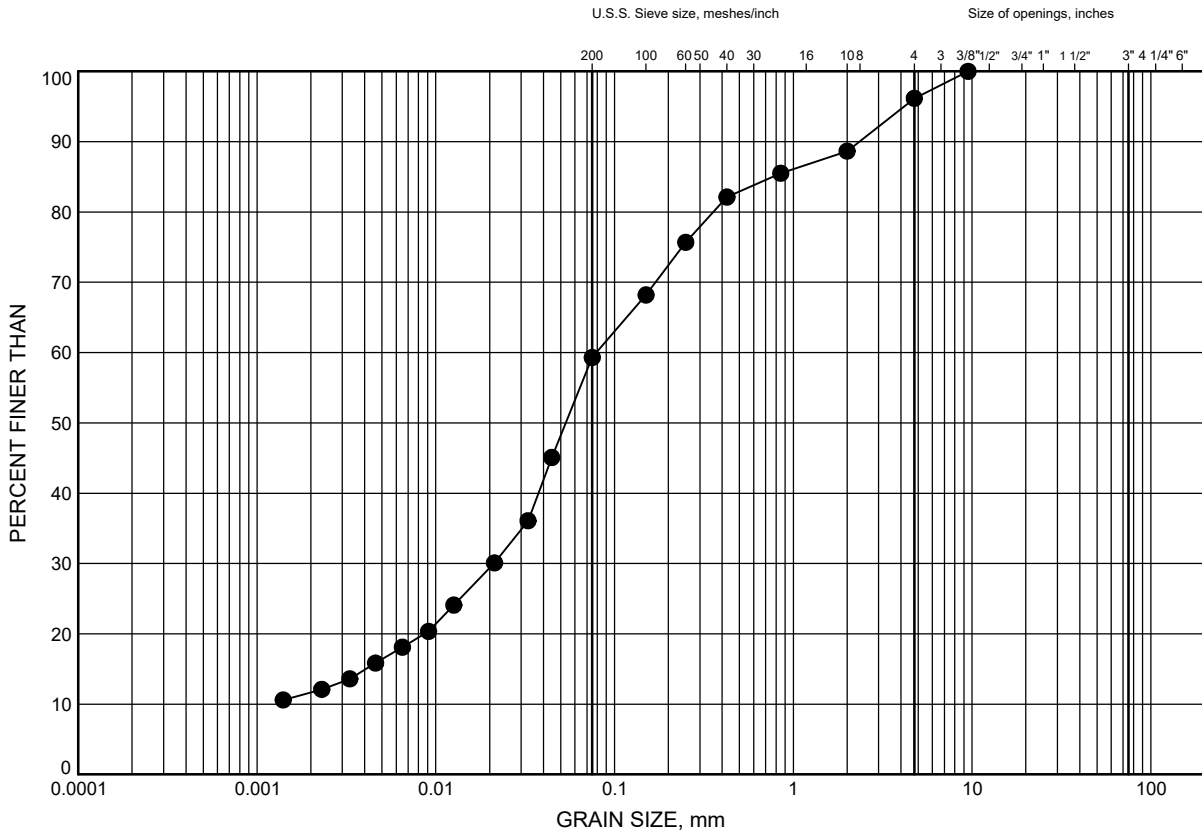


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C6

Sandy SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 5-1	4.7	229.8

Date February 2018
W.P. 2930-02-00

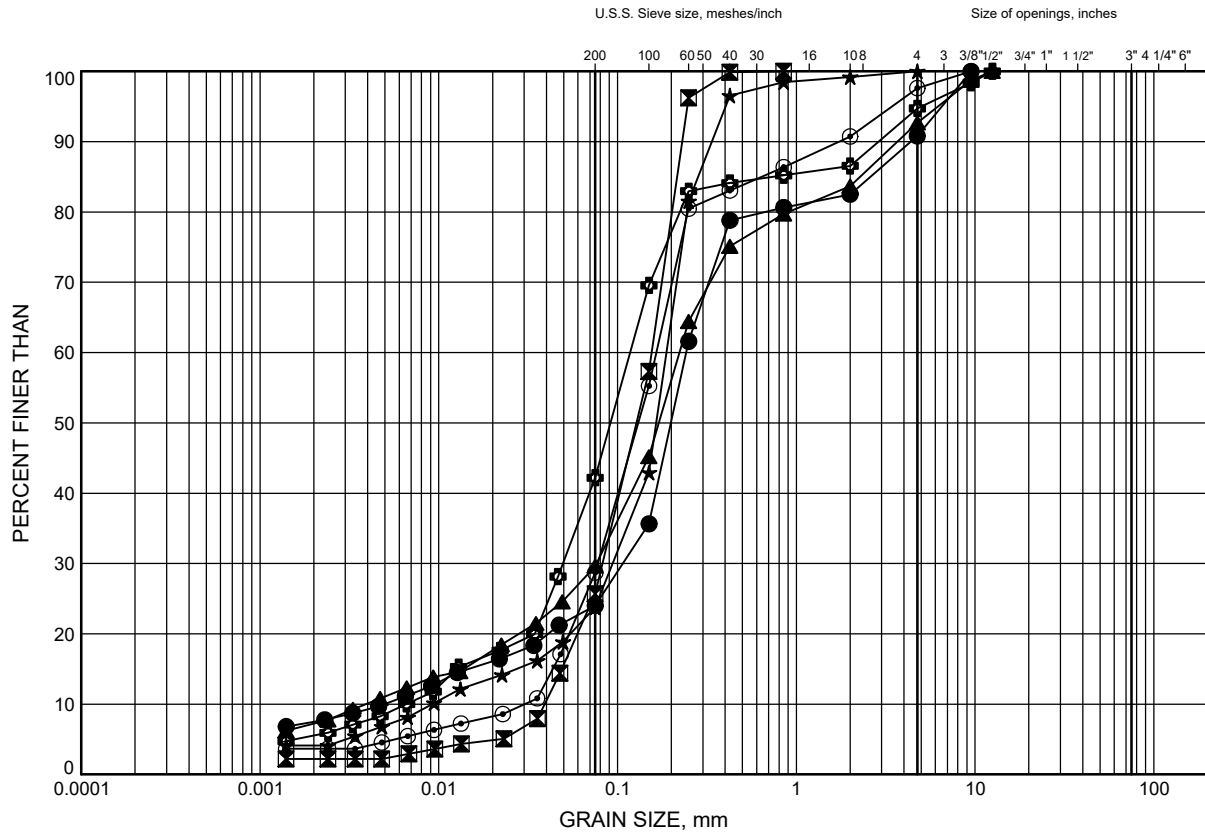


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C7

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 3-2	6.4	229.5
⊠	HMS 4-1	6.3	232.0
▲	HMS 4-2	7.9	230.4
★	HOT-1	6.4	231.3
⊙	HOT-2	4.8	234.7
⊕	OHS 5-1	1.8	232.7

Date February 2018
W.P. 2930-02-00

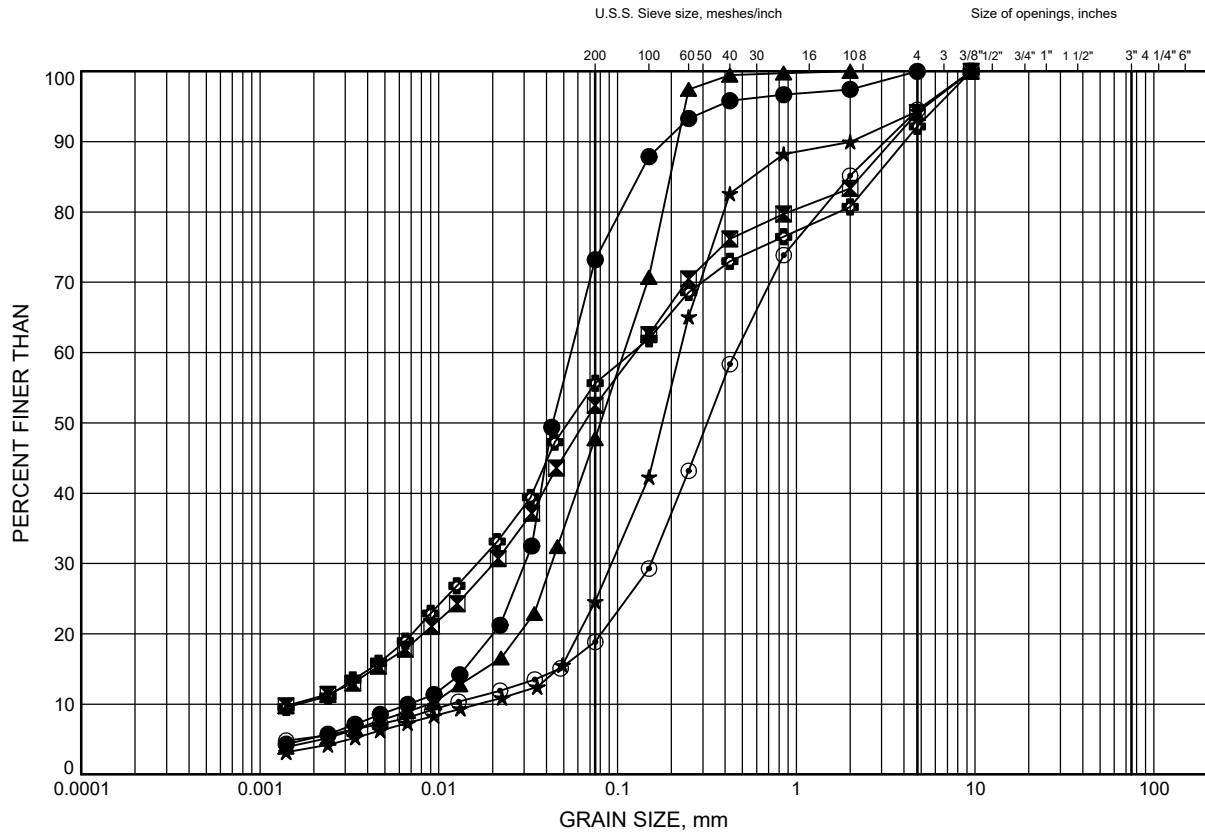


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C8

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 5-2	3.4	230.8
⊠	OHS 5-2	4.8	229.4
▲	OHS 6-1	7.9	228.8
★	OHS 6-2	7.9	228.5
⊙	TS-125	4.9	229.2
⊕	TS-125	7.7	226.3

Date February 2018
W.P. 2930-02-00

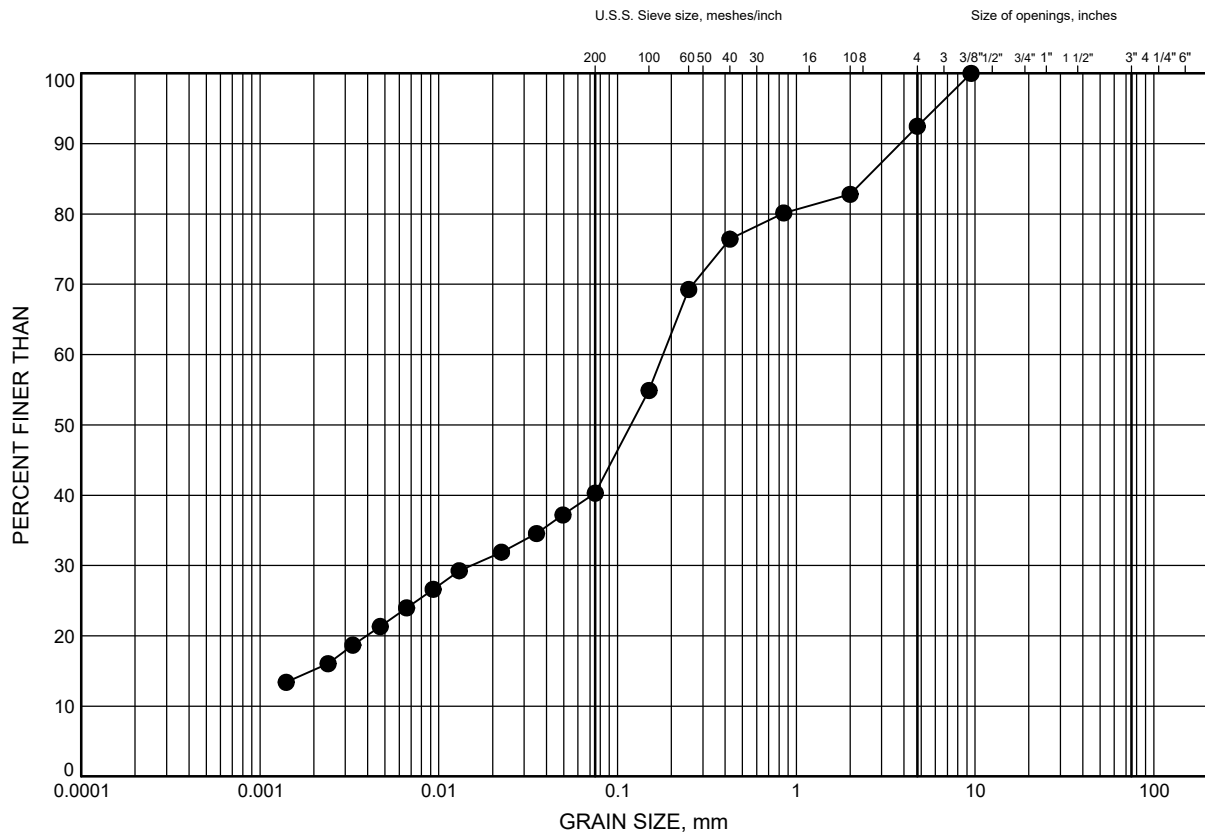


Prep'd MP
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE C9

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-32	6.4	234.3

Date February 2018
W.P. 2930-02-00

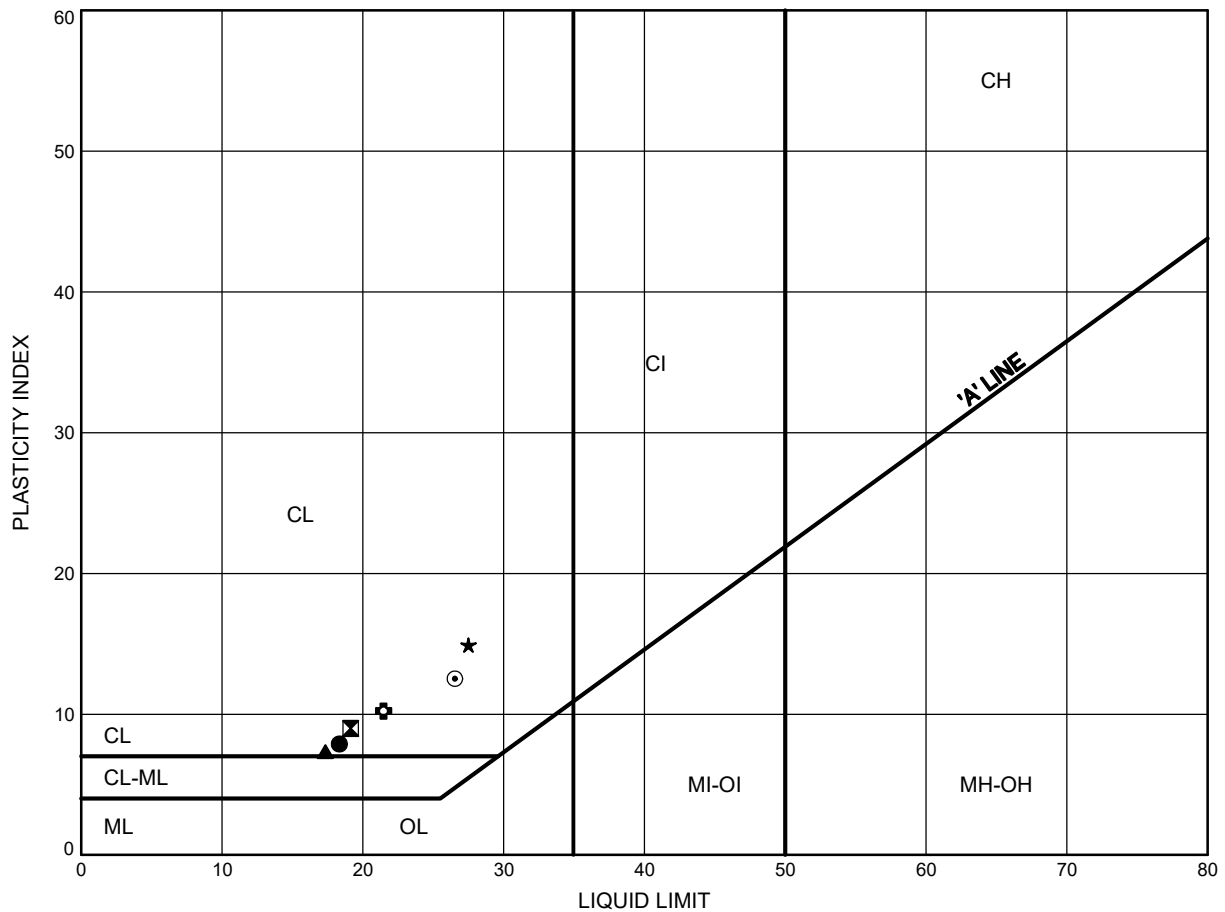


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE C10

Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 3-1	2.6	233.5
⊠	HMS 4-1	2.5	235.8
▲	HMS 4-2	2.6	235.7
★	HOT-1	4.9	232.9
⊙	HOT-2	6.3	233.2
⊕	TS-150 / MS-33	2.6	237.7

Date February 2018
W.P. 2930-02-00

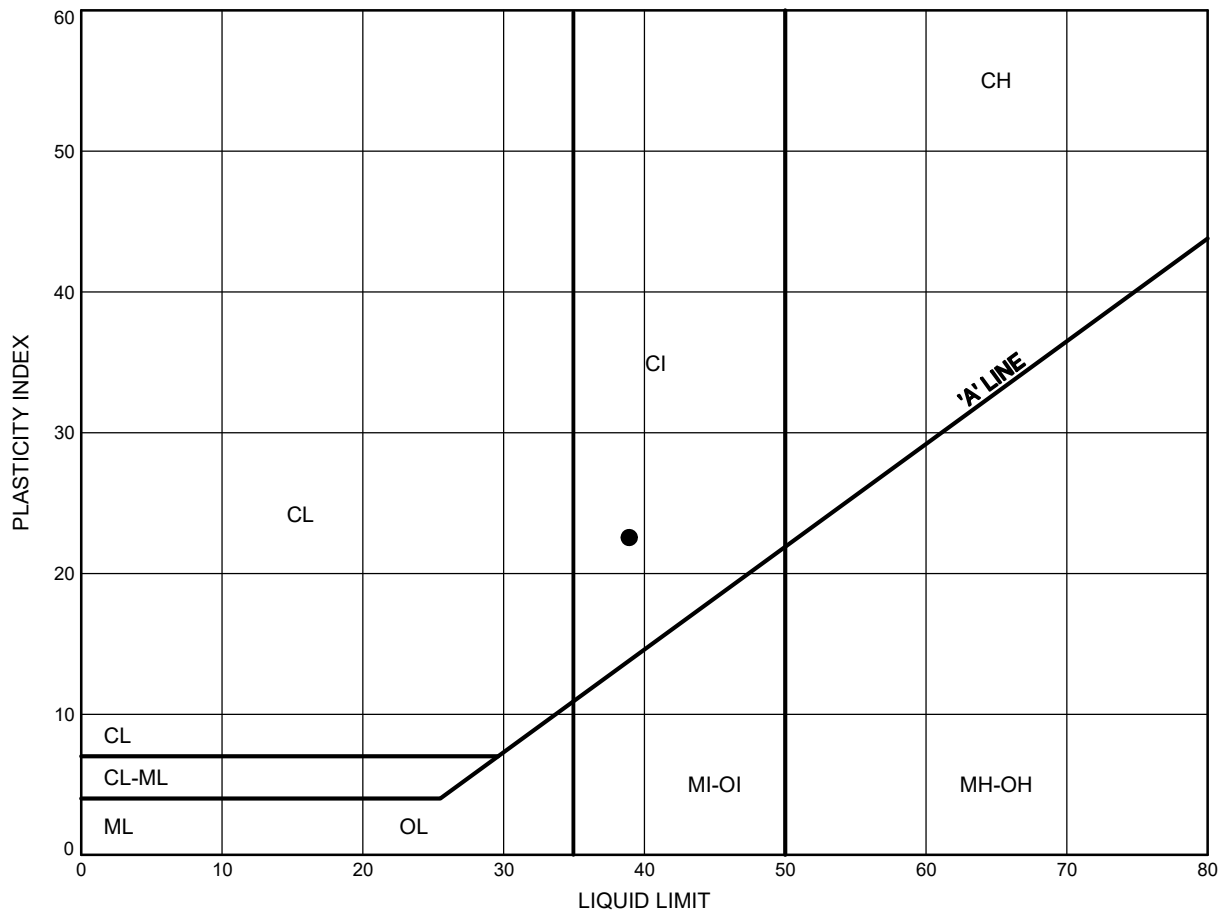


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE C11

Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-32	1.1	239.6

Date February 2018
W.P. 2930-02-00

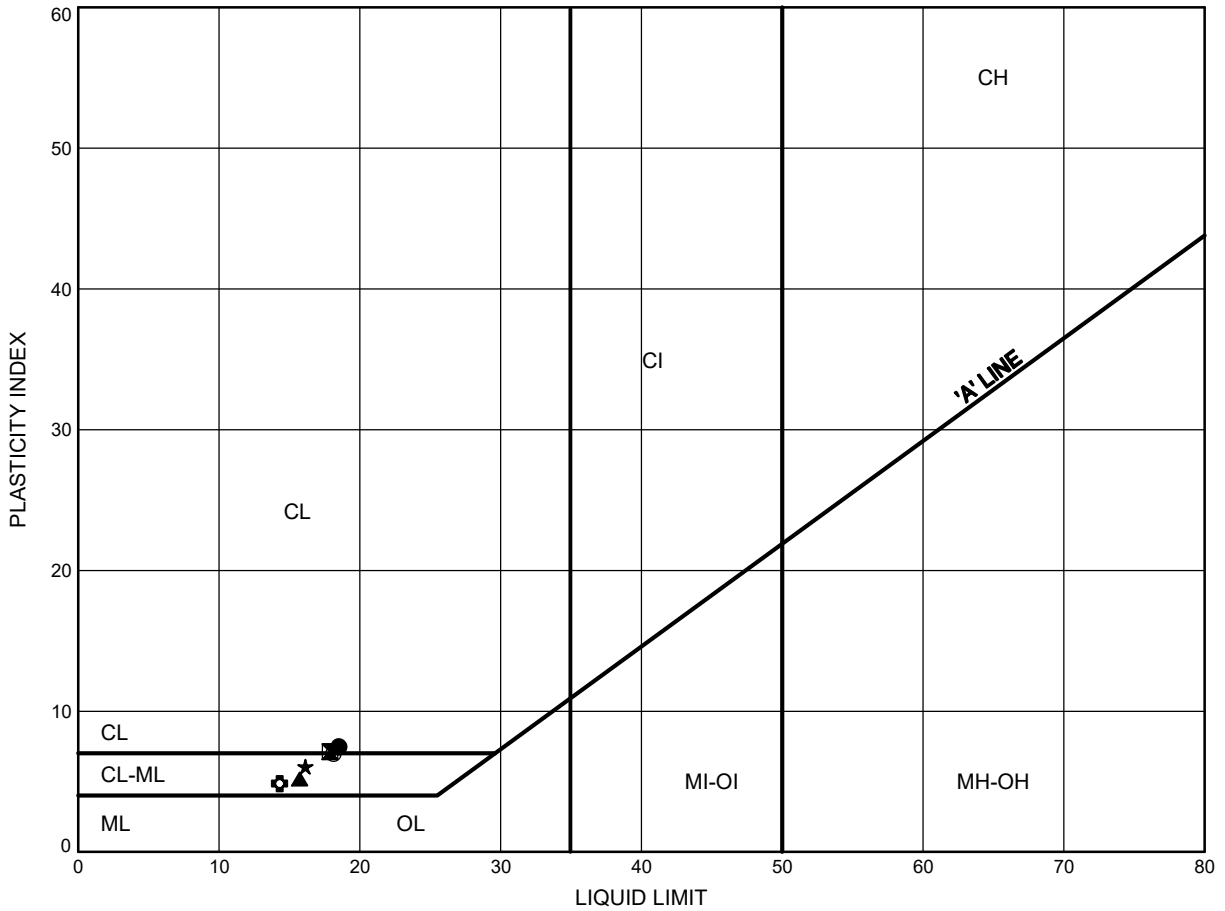


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE C12

Clayey SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 3-2	3.4	232.6
⊠	OHS 6-1	4.9	231.9
▲	OHS 6-2	2.6	233.8
★	OHS 6-2	6.4	230.0
⊙	TS-135	3.4	234.8
⊕	TS-135	6.4	231.7

Date February 2018
W.P. 2930-02-00

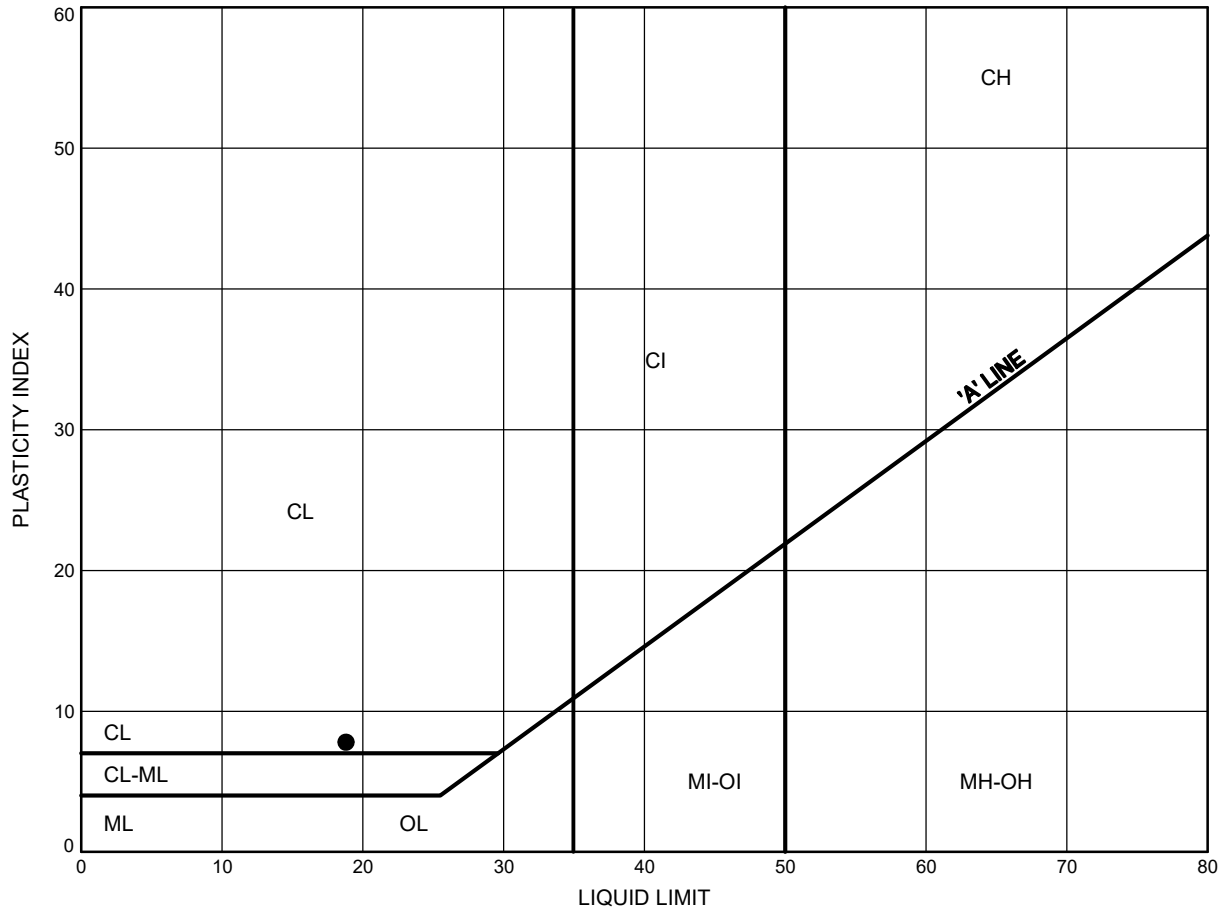


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE C13

Clayey SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-42	4.9	228.5

Date February 2018
W.P. 2930-02-00



Prep'd MP
Chkd. RD



Appendix D

Section 4 (Stations 20+300 Elgin Mills Road to 18+300 Major Mackenzie Drive)

RECORD OF BOREHOLE No OHS 4-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 880.6 E 314 196.8 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.14 - 2017.11.14 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
226.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (100mm)																	
0.1	SAND, some gravel, trace silt Brown Moist (FILL)			GS			226											
225.7																		
0.7	Clayey SILT, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		1	SS	21		225											
			2	SS	19													
							224											
			3	SS	32													
			4	SS	100/ 0.270		223											
							222											
			5	SS	100/ .250													
220.9							221											
5.5	Silty SAND, trace gravel, trace to some clay Very Dense Brown Moist		6	SS	100/ 0.050		220											
218.7			7	SS	100/ 0.075		219											
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 6.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																	

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+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 4-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 838.1 E 314 227.0 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.07 - 2017.12.07 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
225.7	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)												
0.2	SAND, some gravel, trace silt Dense to Compact Brown to Grey Wet (FILL)		1	SS	38		225						
			2	SS	18								
224.3													
1.4	Clayey SILT, with sand, trace gravel Hard Brown to Grey Moist (TILL) cobble pieces		3	SS	41		224						
			4	SS	60/ 0.125		223						8 45 31 16
			5	SS	85		222						
			6	SS	50/ 0.050		221						6 44 34 16
220.3													
5.4	Silty SAND, trace gravel, trace clay Very Dense Grey Wet		7	SS	77		220						9 61 25 5
							219						
			8	SS	50/ 0.125		218						
217.7													
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED TO 7.3m AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.												

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 2-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 580.0 E 314 229.3 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.03 - 2017.12.03 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
223.5	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	48		223						
222.7													
0.8	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	31		222						
			3	SS	74		221						5 31 33 31
			4	SS	44		221						
220.5													
3.0	Sandy SILT, some clay Very Dense Brown Wet		5	SS	55		220						
219.4													
4.1	SAND, trace gravel, trace silt, trace clay Dense Brown Wet		6	SS	35		219						2 86 10 2
							218						
217.0			7	SS	46		217						
6.4	Silty SAND, some clay, some gravel Dense to Very Dense Grey Moist												
							216						
215.6			8	SS	50/								11 51 26 12
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				0.125								

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 2-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 571.2 E 314 217.2 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.06 - 2017.12.06 CHECKED BY RD

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
223.2	GROUND SURFACE					▽	223												
0.0 223.0	ASPHALT: (250mm)																		
0.3	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	44									○					
222.3																			
0.9	Clayey SILT, with sand, trace gravel Hard Brown Wet (TILL)		2	SS	40									○					
			3	SS	46									○					
221.0																			
2.2	Sandy SILT, trace gravel, trace clay Dense to very dense Brown Wet		4	SS	44							○							
			5	SS	51							○							
219.1																			
4.1	SAND, some silt, trace gravel, trace clay Compact Brown Wet		6	SS	27							○					3 76 19 2		
216.9																			
6.3	Clayey SILT, with sand, trace gravel Hard Grey Moist (TILL)		7	SS	69							○							
215.2			8	SS	50/ 0.075							○					8 48 29 15		
8.0	END OF BOREHOLE AT 7.9m. BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 4.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

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

RECORD OF BOREHOLE No TS-105

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 568.9 E 314 233.1 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.03 - 2017.12.03 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
223.3	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (150mm)																		
0.2	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	31		223												
222.4																			
0.9	Clayey SILT, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	44		222												
			3	SS	68		221												
220.6			4	SS	63														
2.7	Sandy SILT, trace clay Very Dense Brown Moist		5	SS	59		220												
219.2																			
4.1	Silty SAND, trace gravel Dense Brown Wet		6	SS	39		219												
							218												
217.1																			
6.2	Clayey SILT, with sand, trace gravel Hard Grey Moist (TILL)		7	SS	35		217												
							216												
			8	SS	35														
215.1																			
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO BOTTEM AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 3-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 428.1 E 314 276.6 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.14 - 2017.11.14 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	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	ASPHALT: (100mm)							20	40	60	80	100			
0.1	SAND, some gravel, trace silt Brown Moist (FILL)		1	GS			221								
220.8															
0.7	Silty CLAY, with sand Hard Grey Moist (TILL)		1	SS	66		220								
			2	SS	56										
219.3															
2.2	SAND, trace silt, trace clay Very Dense to Dense Brown to grey Moist		3	SS	90		219								
			4	SS	40		218								0 26 49 25
			5	SS	37		217								
							216								
			6	SS	93		215								
213.8							214								
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE CAVED TO 4.0m AND WATER LEVEL AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.		7	SS	100										
					0.075										

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 3-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 381.5 E 314 303.8 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.27 - 2017.11.27 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
220.9	GROUND SURFACE													
0.0	Silty SAND , some clay, some gravel Compact Brown Wet (FILL)		1	SS	21									
220.2														
0.7	Silty CLAY , some sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		2	SS	20		220							
			3	SS	60		219							
			4	SS	27		218							3 19 39 39
			5	SS	29		217							
216.8														
4.1	Silty SAND , some gravel, some clay Compact to Very Dense Grey Wet		6	SS	16		216							12 45 33 10
							215							
			7	SS	50/ 0.100									
							214							
213.2			8	SS	50/ 0.125									
7.7	END OF BOREHOLE AT 7.7m. WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, THEN DRY MIX CONCRETE TO SURFACE.													

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RECORD OF BOREHOLE No OHS 2-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 283.9 E 314 283.0 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.27 - 2017.11.28 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
220.3	GROUND SURFACE							20	40	60	80	100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
0.0	ASPHALT: (150mm)							20	40	60	80	100	WATER CONTENT (%)			
0.1	SAND, some gravel, trace silt Very Dense Brown Moist (FILL)		1	SS	52	∇	220									
219.2			2	SS	50											
1.2	SAND and SILT, some gravel, some clay Compact to Dense Brown Moist to Wet		3	SS	27		219									
			4	SS	39		218									
217.4	Clayey SILT, with sand, trace gravel Hard Grey Moist to Wet (TILL)		5	SS	31		217									
			6	SS	82		216									
			7	SS	72		215									
213.2							214									
7.2	SAND, some gravel, trace silt, trace clay Compact Grey Wet		8	SS	17	213										
212.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.															
8.2																

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

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

RECORD OF BOREHOLE No OHS 2-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 277.1 E 314 272.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.06 - 2017.12.06 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								WATER CONTENT (%)							
220.1	GROUND SURFACE						20	40	60	80	100	PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	
0.0	ASPHALT: (280mm)						20	40	60	80	100				
219.8															
0.3	SAND, some gravel, trace silt Compact Brown Wet (FILL)		1	SS	28										
			2	SS	26										
218.8															
1.3	SAND and SILT, trace clay, trace gravel Very Dense Brown Wet		3	SS	51										9 46 40 5
217.5			4	SS	31										
2.6	Silty SAND, trace clay Dense Brown Wet		5	SS	33										0 64 27 9
215.4															
4.6	Gravelly SAND, some silt, some clay Very Dense Grey Moist		6	SS	50/ 0.125										31 47 12 10
			7	SS	79										
			8	SS	50/ 0.125										
212.0															
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE CAVED AT 6.1m AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.														

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS-110

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 169.1 E 314 325.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.12 - 2017.12.12 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
219.0	GROUND SURFACE							20 40 60 80 100						GR SA SI CL	
0.0	ASPHALT: (150mm)							20 40 60 80 100							
0.2	SAND, some silt, trace gravel, occasional cobbles Very Dense Brown Wet (FILL)		1	SS	69	▽	218								21 69 10 (SI+CL)
218.1															
0.9	Clayey SILT, trace sand, trace gravel Hard Brown Moist (FILL)		2	SS	42										
217.5															
1.4	Gravelly SAND, trace to some silt and clay Very Dense to Dense Brown Moist to Wet		3	SS	59										
			4	SS	77										
			5	SS	55										
			6	SS	44										
			7	SS	49										
211.8															
7.2	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		8	SS	50/										
211.1															
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 4.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.				0.125										

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 1-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 106.9 E 314 334.8 ORIGINATED BY TM
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.14 - 2017.11.14 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
218.3	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND, trace silt, trace gravel Brown Moist (FILL)			GS			218							
217.6														
0.7	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL)		1	SS	52		217							
			2	SS	50/ 0.125									
			3	SS	55		216							
			4	SS	83		215							
214.1														
4.1	SILT, some clay, trace sand Very Dense Brown Wet		5	SS	60/ 0.125		214							
212.3							213							
5.9	SAND, trace gravel, trace silt and clay Very Dense Brown Wet		6	SS	82		212							
							211							
210.2			7	SS	59/ 0.100									
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE OPEN TO 6.7m AND WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HMS 1-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 861 084.5 E 314 357.4 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.27 - 2017.11.27 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
217.9	GROUND SURFACE													
0.0	SAND , some gravel Compact Brown Moist (FILL)		1	SS	13									
0.2	Silty CLAY , some gravel, some sand Hard Brown Moist (TILL)		2	SS	38									
			3	SS	40									
	cobble pieces		4	SS	61									
			5	SS	45									
214.5														
3.5	Silty SAND , some gravel Dense Brown Wet													
			6	SS	36									
	Loose		7	SS	8									
210.7														
7.2	Silty CLAY , with sand Hard Grey Moist (TILL)		8	SS	46									
209.7														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 5.8m AND WATER LEVEL AT 3.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, THEN DRY MIX CONCRETE TO SURFACE.													

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/1/18

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 1-1

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 860 840.3 E 314 362.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.11.28 - 2017.11.28 CHECKED BY RD

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	SHEAR STRENGTH kPa			WATER CONTENT (%)			GR	SA	SI	CL
215.6	GROUND SURFACE																		
0.0	ASPHALT: (150mm)																		
0.1	SAND, some gravel, trace silt Dense Brown Moist (FILL)		1	SS	44		215												
214.6			2	SS	47														
1.0	Clayey SILT, with sand, trace gravel Hard to Very Stiff Brown Moist to Wet (TILL)		3	SS	51		214												
			4	SS	28		213												
			5	SS	20		212												
211.5																			
4.1	Silty SAND, some gravel, some clay Dense to Very Dense Brown to Grey Moist to Wet (TILL)		6	SS	42		211												
							210												
			7	SS	100/ 0.250		209												
							208												
207.4			8	SS	76														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 3.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS 1-2

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 860 834.7 E 314 344.8 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.06 - 2017.12.09 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
215.3	GROUND SURFACE															
0.0	ASPHALT: (100mm)															
214.9	GRANULAR: (200mm)															
0.3	Clayey SILT , trace gravel, trace sand Firm to Very Stiff Brown Wet (FILL)		1	SS	7											
			2	SS	26											
213.6																
1.7	Clayey SILT , with sand, trace gravel Hard Brown to Grey Moist (TILL)		3	SS	30											
			4	SS	60											
	pieces of cobbles		5	SS	77											
			6	SS	63											
209.6																
5.6	Silty SAND , with gravel, trace clay Very Dense Grey Wet (TILL)		7	SS	78											
	pieces of cobbles		8	SS	98											
207.1																
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED AT 6.4m AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.															

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

RECORD OF BOREHOLE No TS-95

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION N 4 860 783.2 E 314 370.9 ORIGINATED BY JHP
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2017.12.05 - 2017.12.05 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
215.1	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND, some silt, trace to some gravel Compact Brown Wet (FILL)		1	SS	22									
214.0			2	SS	31									
1.1	Silty CLAY, with sand, trace gravel Hard Brown Wet (TILL)		3	SS	43									
			4	SS	47									
			5	SS	37									
210.9														
4.1			6	SS	25									
209.4														
5.6			7	SS	57									
207.0			8	SS	50/ 0.125									
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE OPEN TO BOTTOM AND WATER LEVEL AT 5.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS, AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No MS-65

1 OF 1

METRIC

W.P. 2930-02-00 LOCATION NB N 4 860 457.6 E 314 452.0 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.24 - 2017.07.24 CHECKED BY PP

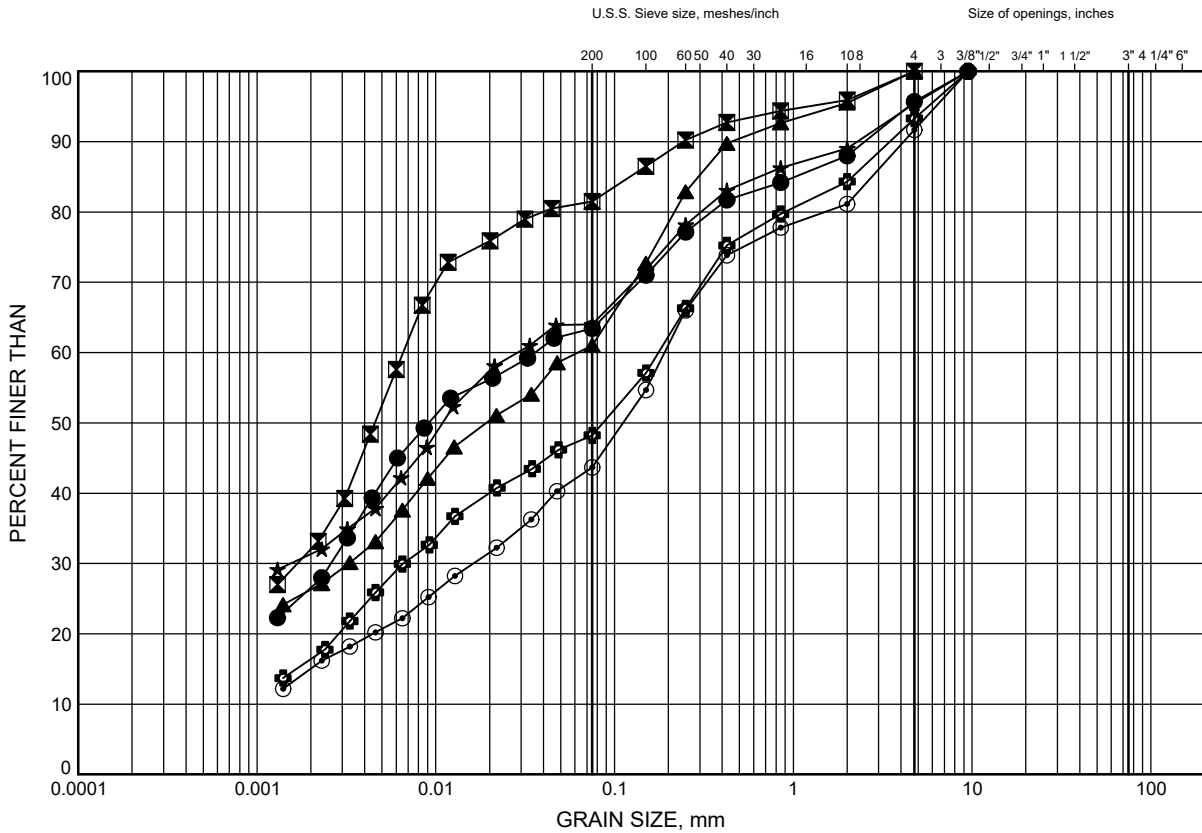
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _P W W _L							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)							
211.3	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (100mm)																		
0.1	Silty SAND , trace gravel Brown Moist (FILL)		1	GS			211							○					
210.5																			
0.8	Silty CLAY , with sand, trace gravel Stiff to Hard Brown Moist (TILL)		1	SS	18		210							●	—			8 27 32 33	
			2	SS	25									○					
			3	SS	41		209							○					
			4	SS	39		208							○					
							207												
			5	SS	47		206							○					
			6	SS	26		205							○				0 38 38 24	
204.6														○					
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND DRY MIX CONCRETE, THEN COLD PATCH ASPHALT TO SURFACE.																		

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/13/18

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D1

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 1-1	3.3	214.9
⊠	HMS 1-2	2.6	215.3
▲	HMS 1-2	7.9	210.0
★	HMS 2-1	1.8	221.7
⊙	HMS 2-2	7.8	215.4
⊕	OHS 1-1	2.6	213.0

Date February 2018
W.P. 2930-02-00

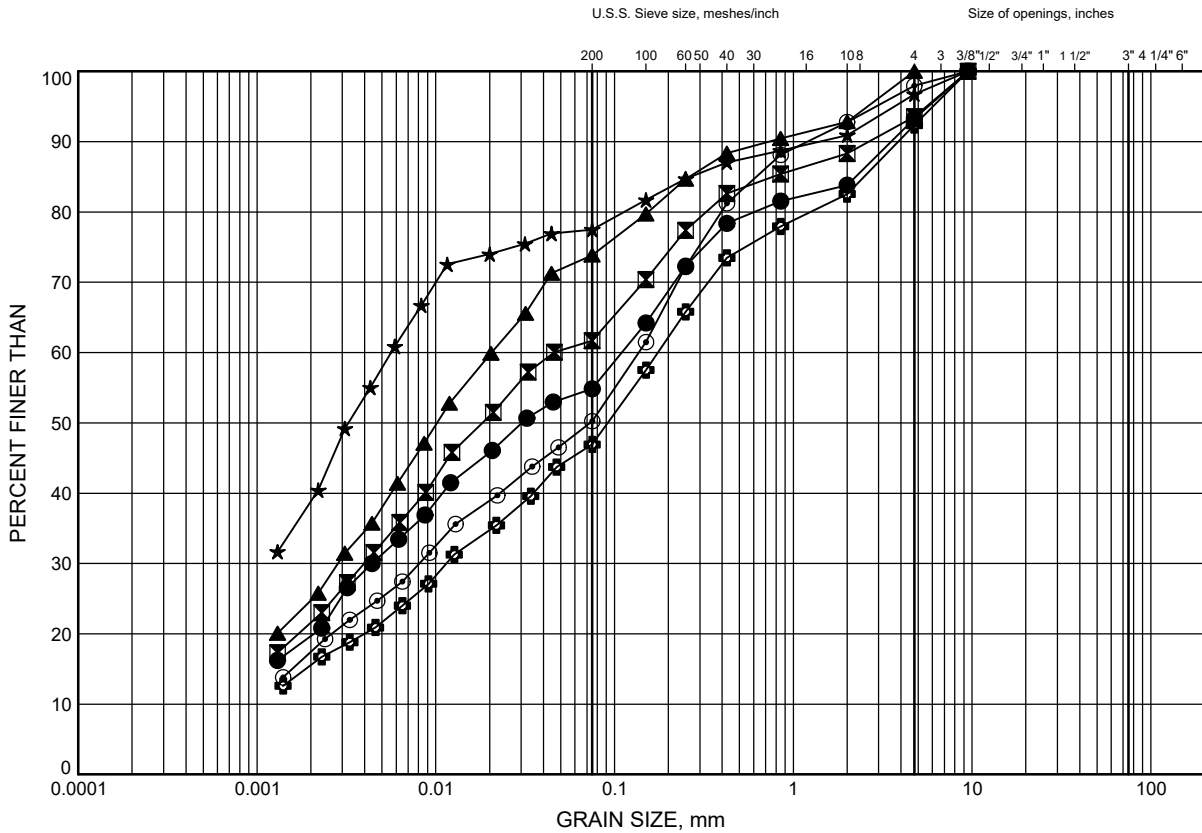


Prep'd AN
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D2

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 1-2	2.6	212.7
⊠	OHS 2-1	3.4	217.0
▲	OHS 3-1	1.8	219.6
★	OHS 3-2	2.6	218.3
⊙	OHS 4-1	2.6	223.8
⊕	OHS 4-2	2.4	223.3

Date February 2018
W.P. 2930-02-00

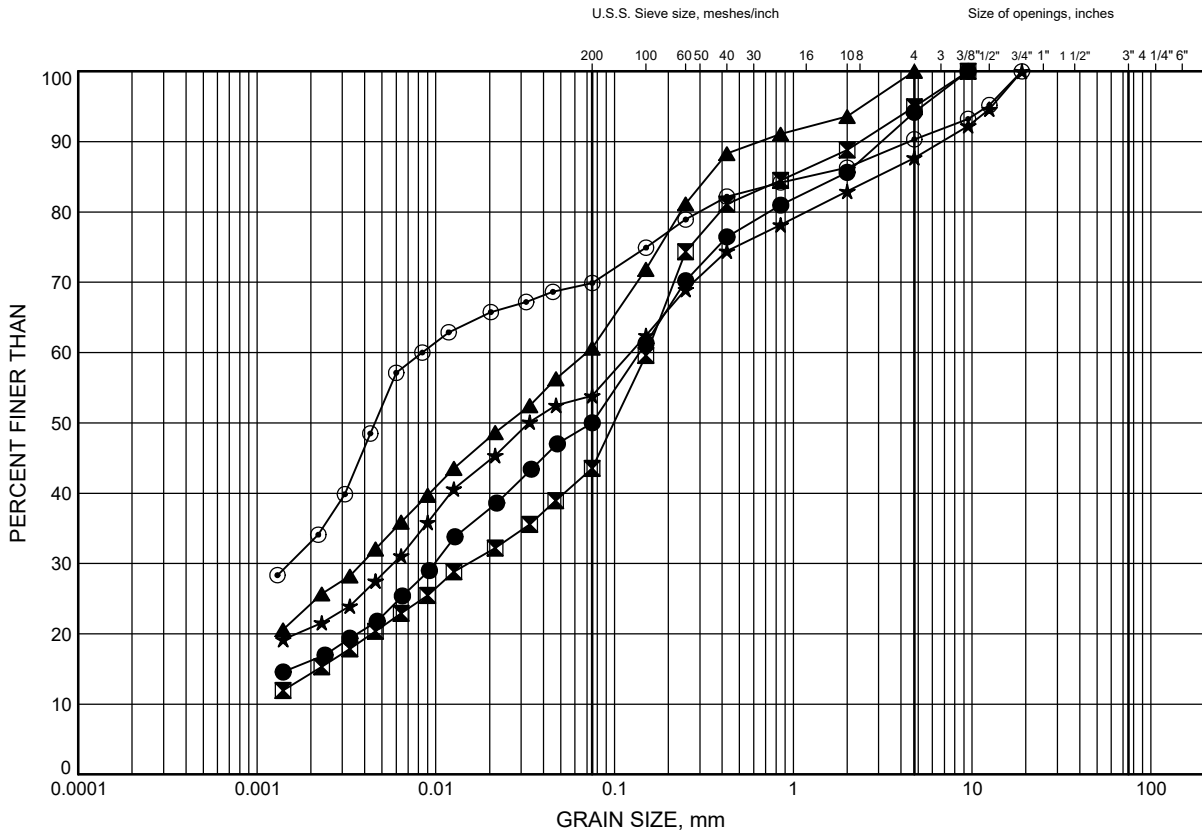


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D3

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 4-2	4.7	221.0
⊠	TS-105	6.4	216.9
▲	TS-110	7.8	211.2
★	TS-95	1.8	213.2
⊙	TS-95	4.9	210.2

Date February 2018
W.P. 2930-02-00

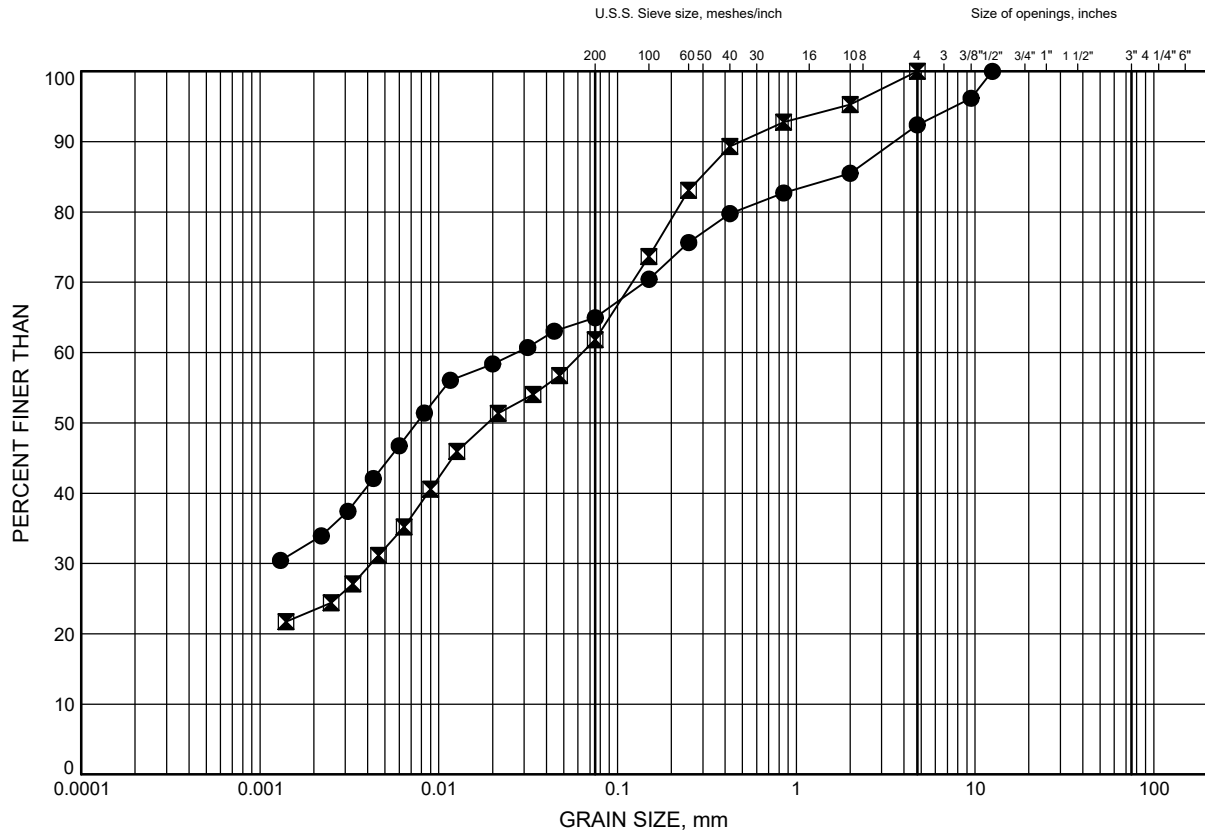


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D4

Silty CLAY to Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-65	1.1	210.2
⊠	MS-65	6.4	204.9

Date February 2018
W.P. 2930-02-00

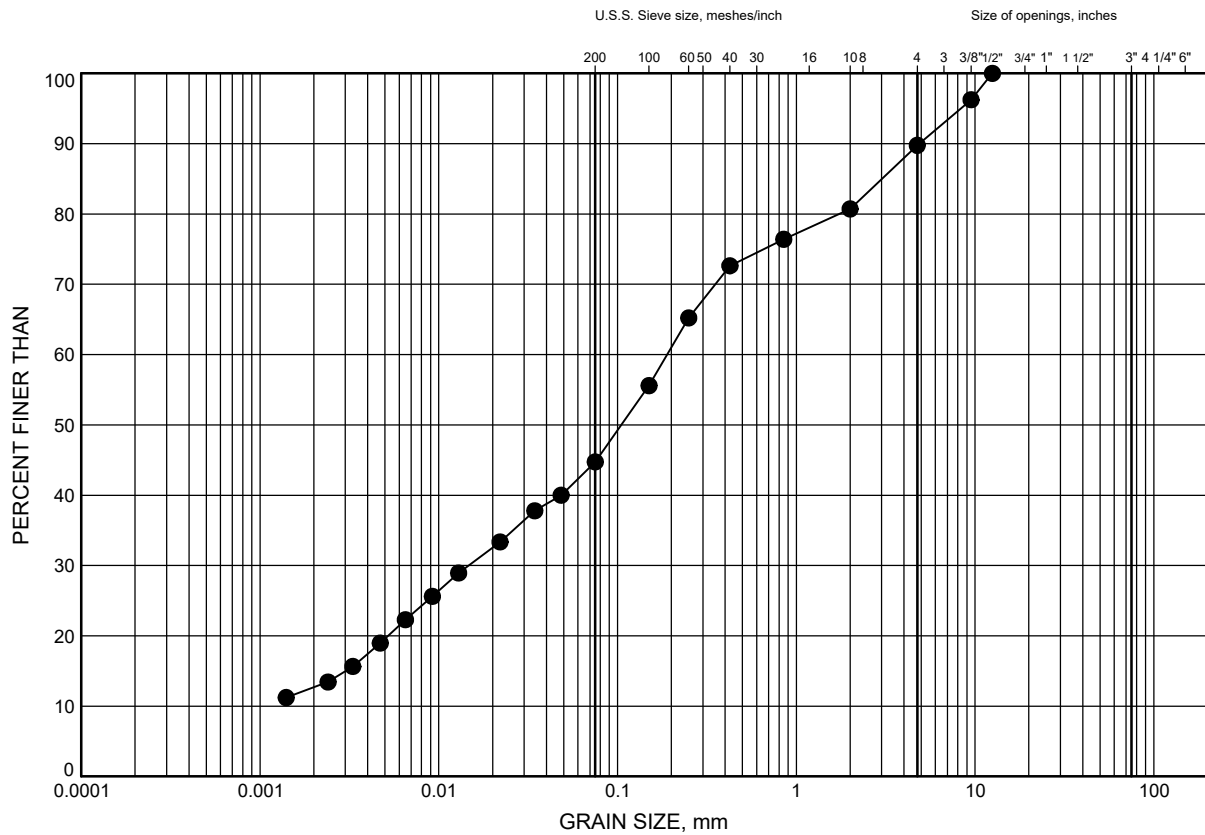


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D5

Silty SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 1-1	6.3	209.3

Date February 2018
W.P. 2930-02-00

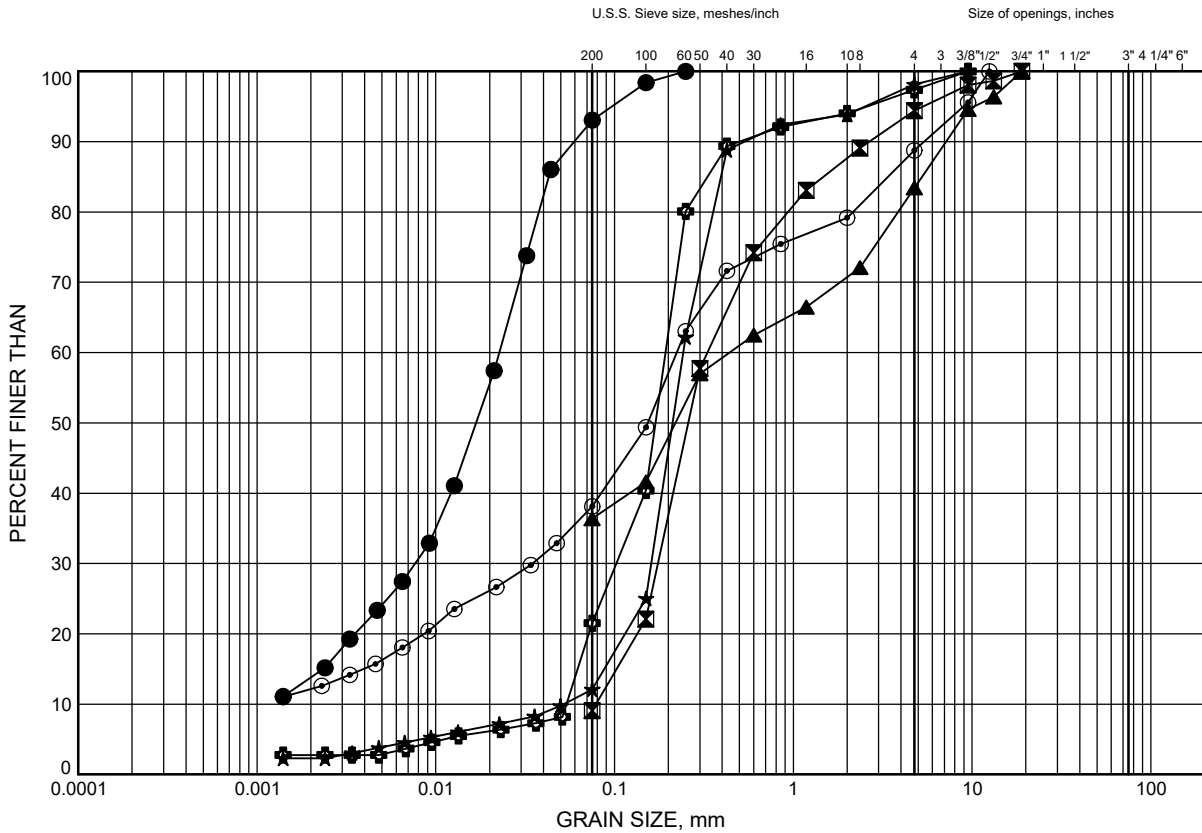


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D6

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 1-1	4.8	213.4
⊠	HMS 1-1	7.8	210.4
▲	HMS 1-2	4.9	213.0
★	HMS 2-1	4.9	218.6
⊙	HMS 2-1	7.8	215.7
⊕	HMS 2-2	4.9	218.3

Date February 2018
W.P. 2930-02-00

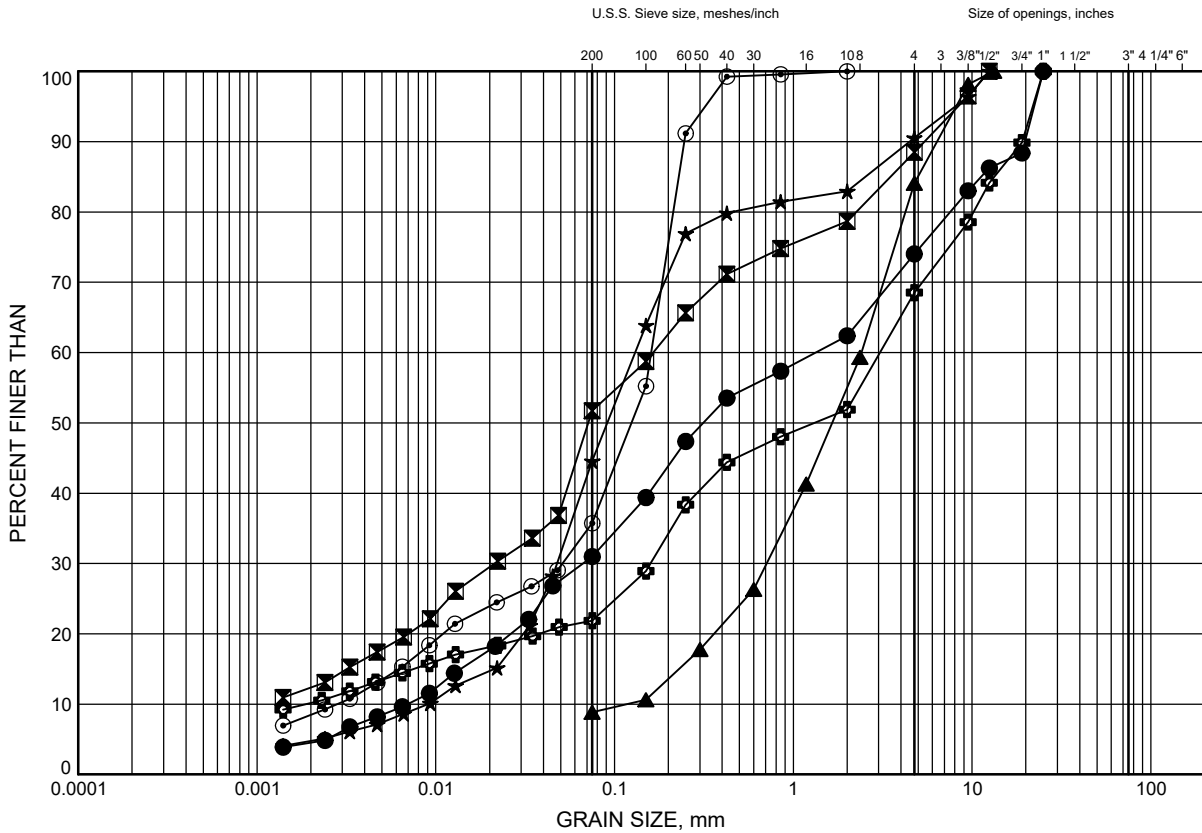


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D7

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 1-2	6.4	208.9
⊠	OHS 2-1	2.6	217.7
▲	OHS 2-1	7.9	212.4
★	OHS 2-2	1.8	218.3
⊙	OHS 2-2	3.4	216.7
⊕	OHS 2-2	4.7	215.4

Date February 2018
W.P. 2930-02-00

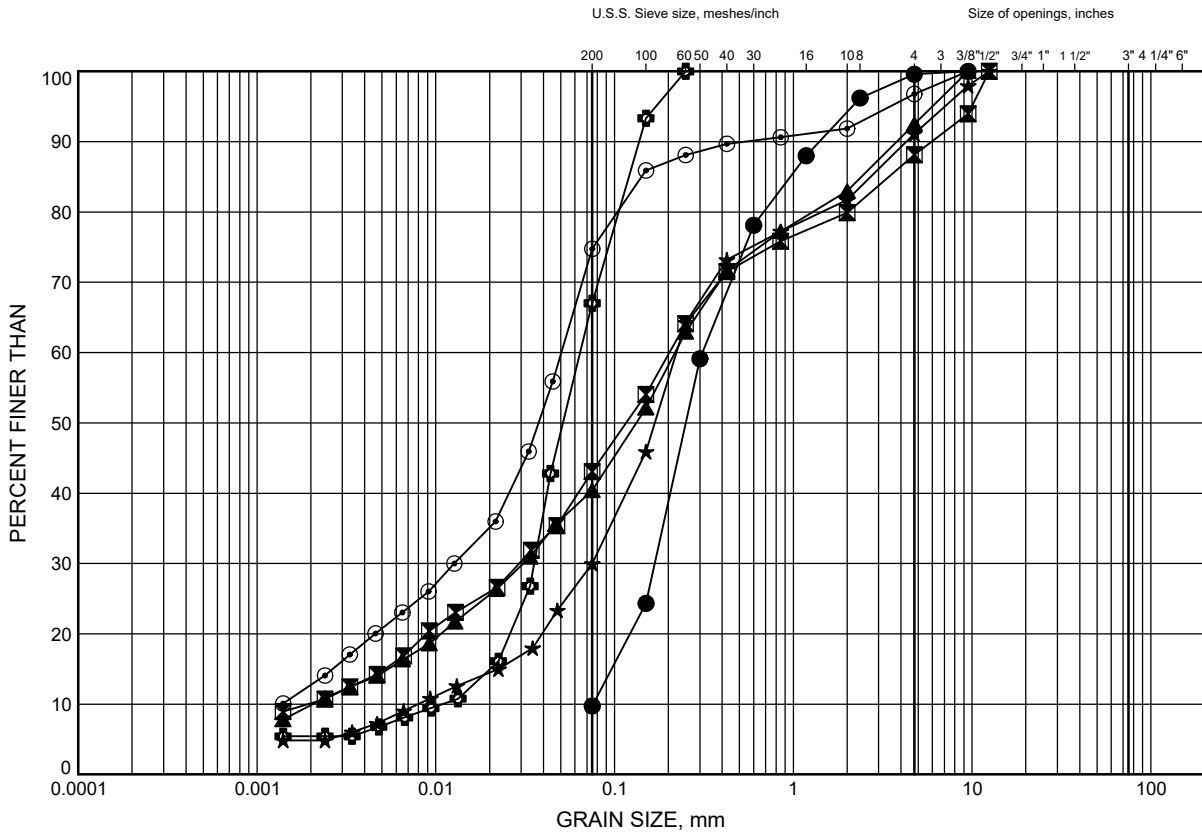


Prep'd AN
Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D8

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 3-1	3.4	218.1
⊠	OHS 3-2	4.9	216.1
▲	OHS 4-1	7.7	218.7
★	OHS 4-2	6.4	219.3
⊙	TS-105	2.6	220.7
⊕	TS-105	3.4	220.0

Date February 2018
W.P. 2930-02-00

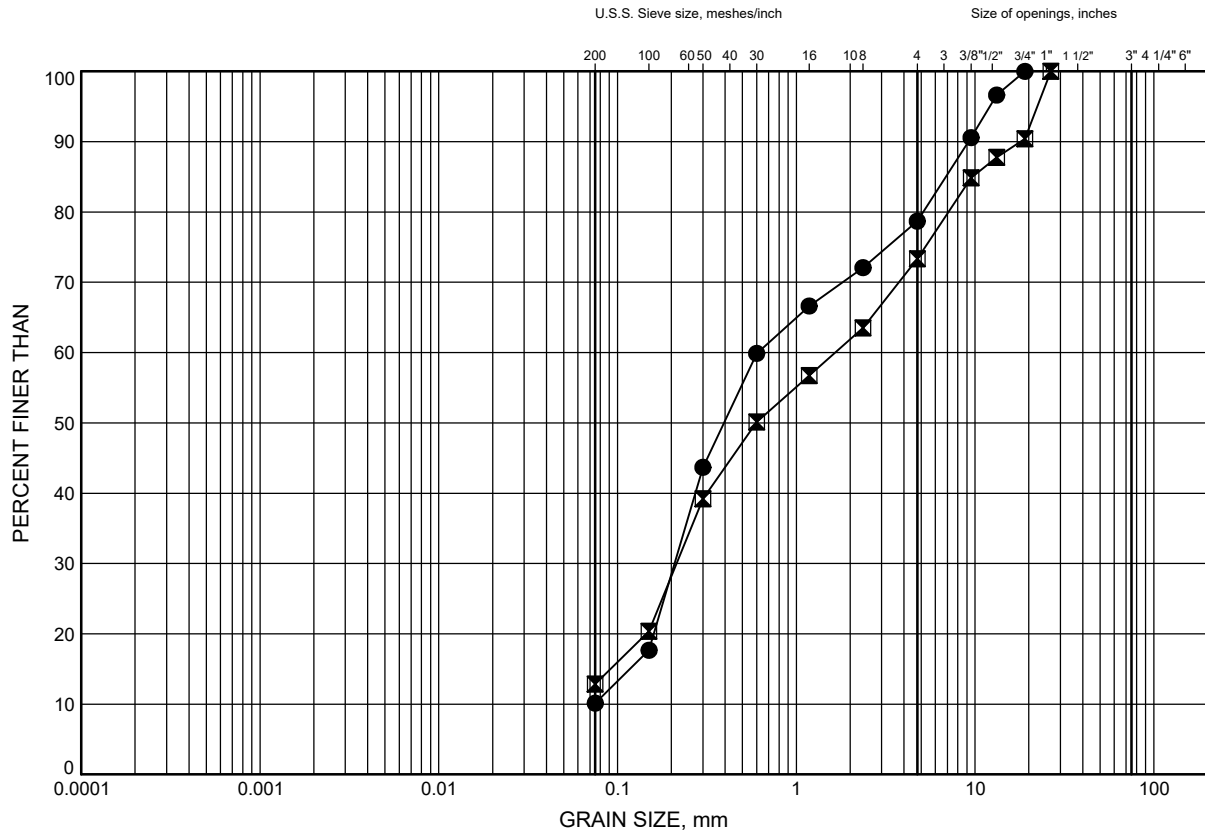


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Chkd. RD

HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE D9

SANDS and SILTS



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	TS-110	1.8	217.2
⊠	TS-110	6.4	212.6

Date February 2018
W.P. 2930-02-00

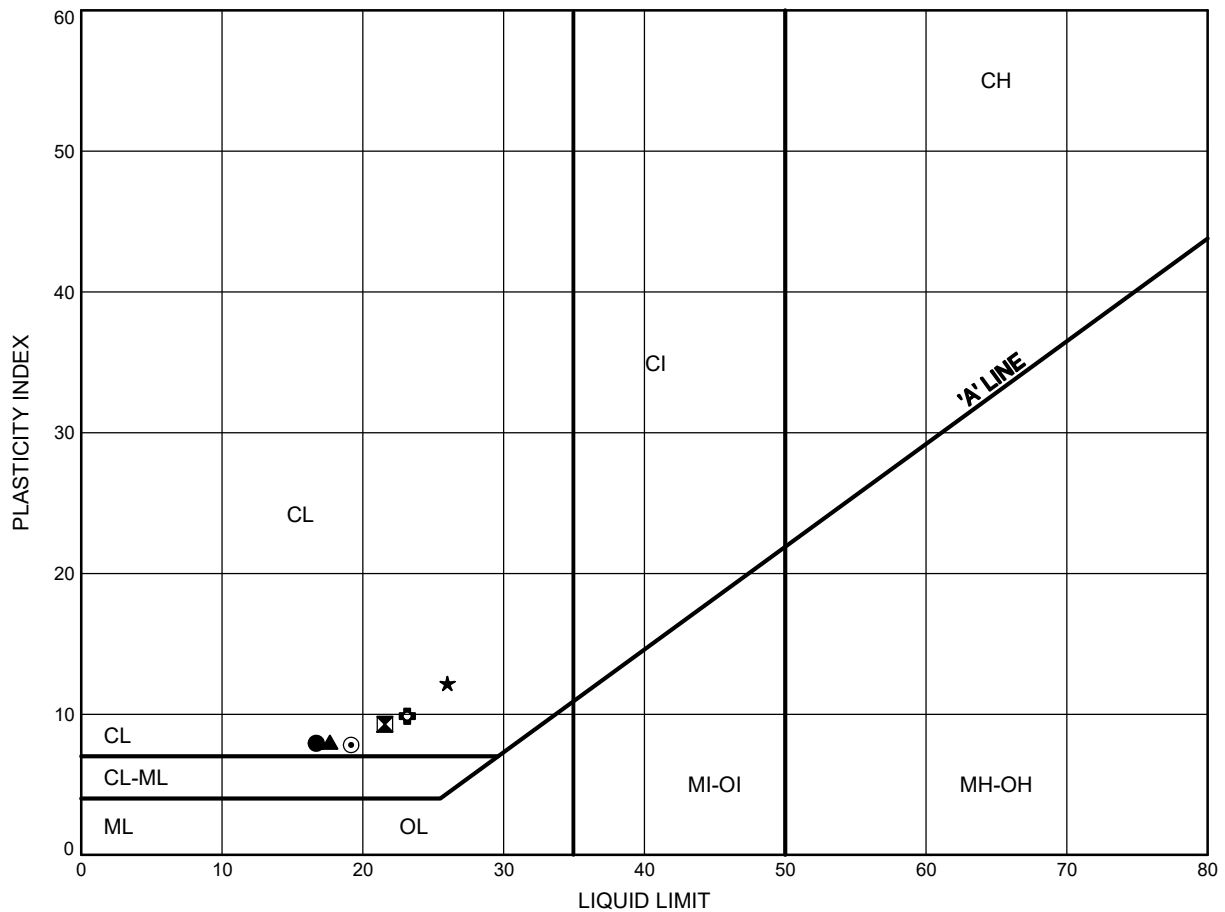


Prep'd AN
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE D10

Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HMS 1-2	7.9	210.0
⊠	HMS 2-1	1.8	221.7
▲	OHS 1-1	2.6	213.0
★	OHS 3-2	2.6	218.3
⊙	OHS 4-1	2.6	223.8
⊕	TS-95	4.9	210.2

Date February 2018
W.P. 2930-02-00

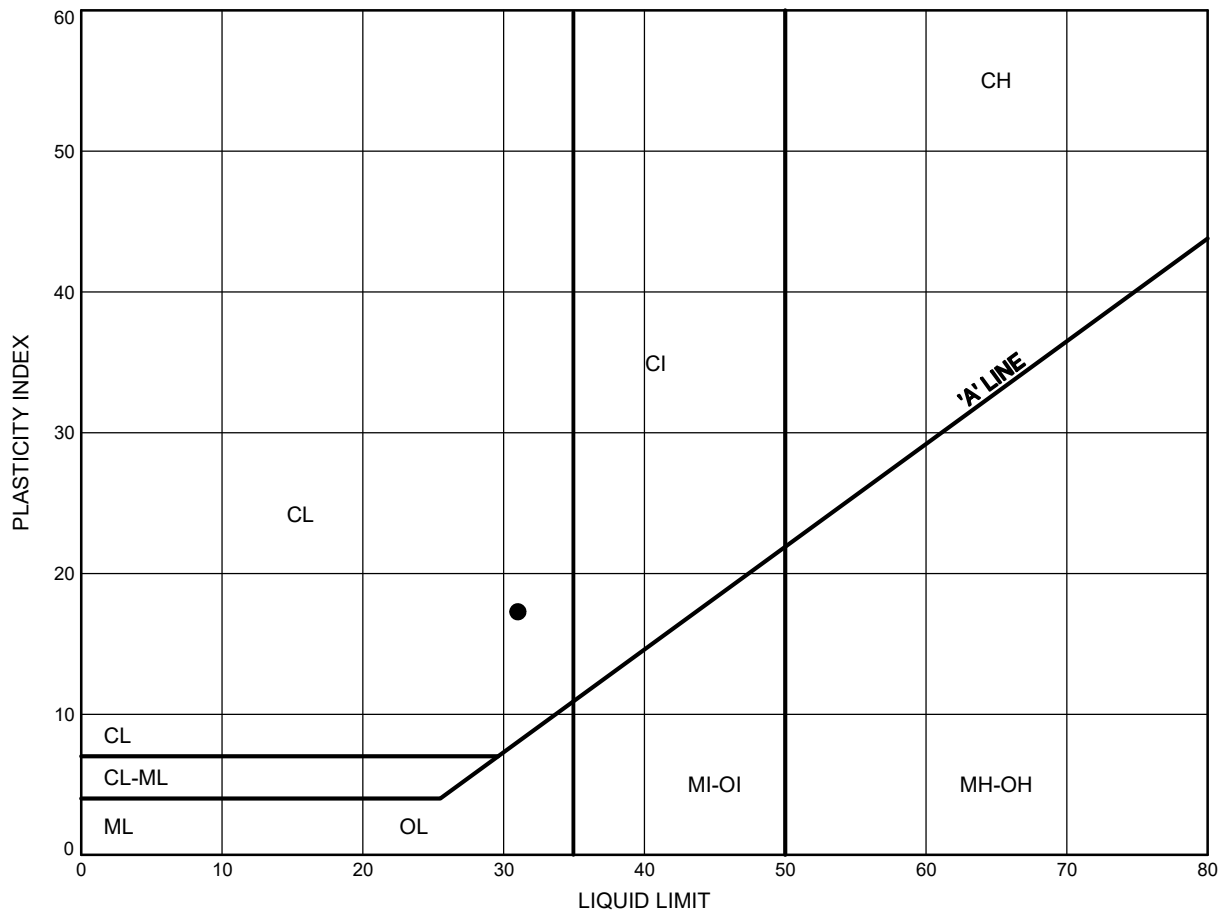


Prep'd AN
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE D11

Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MS-65	1.1	210.2

Date February 2018
W.P. 2930-02-00

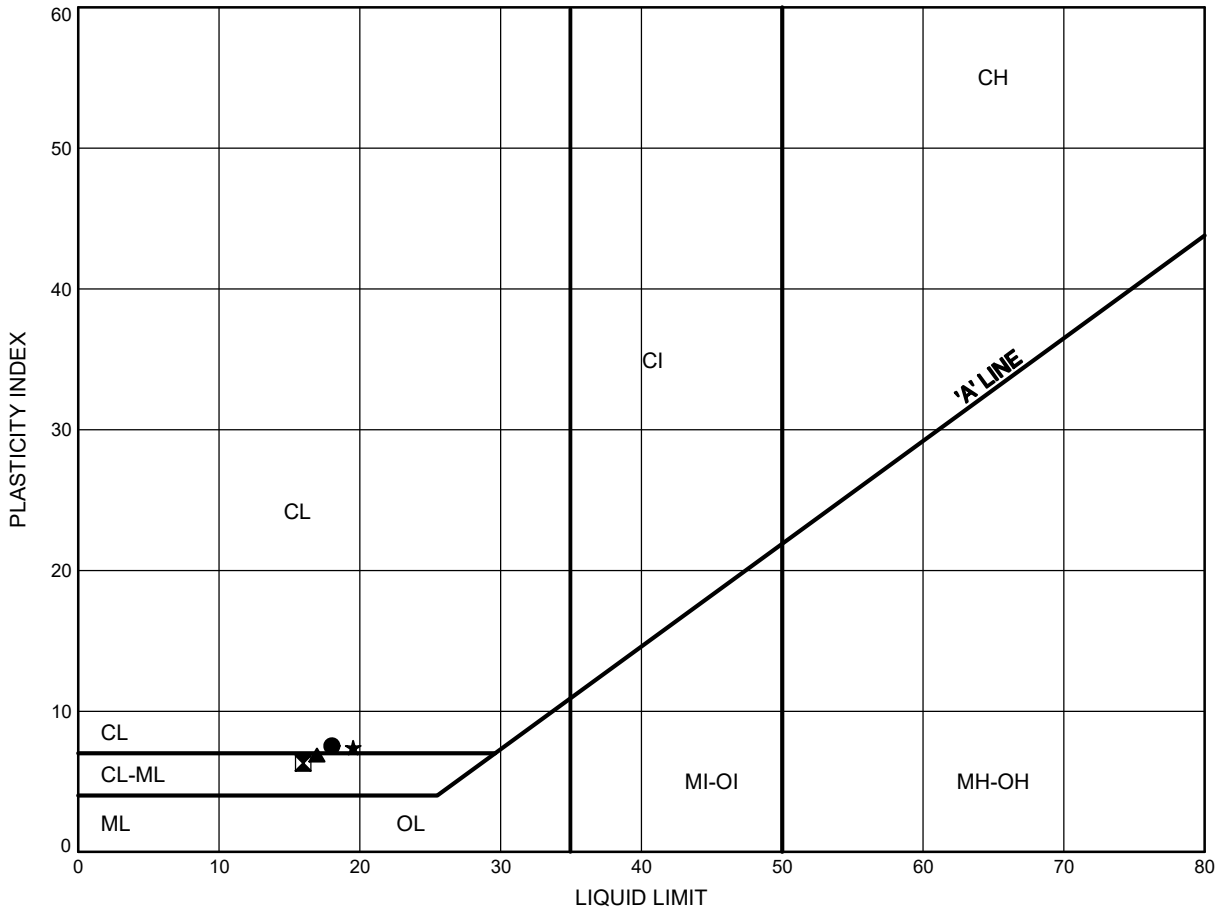


Prep'd MP
Chkd. RD

HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE D12

Clayey SILT TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS 1-2	2.6	212.7
⊠	OHS 2-1	3.4	217.0
▲	TS-110	7.8	211.2
★	TS-95	1.8	213.2

Date February 2018
W.P. 2930-02-00

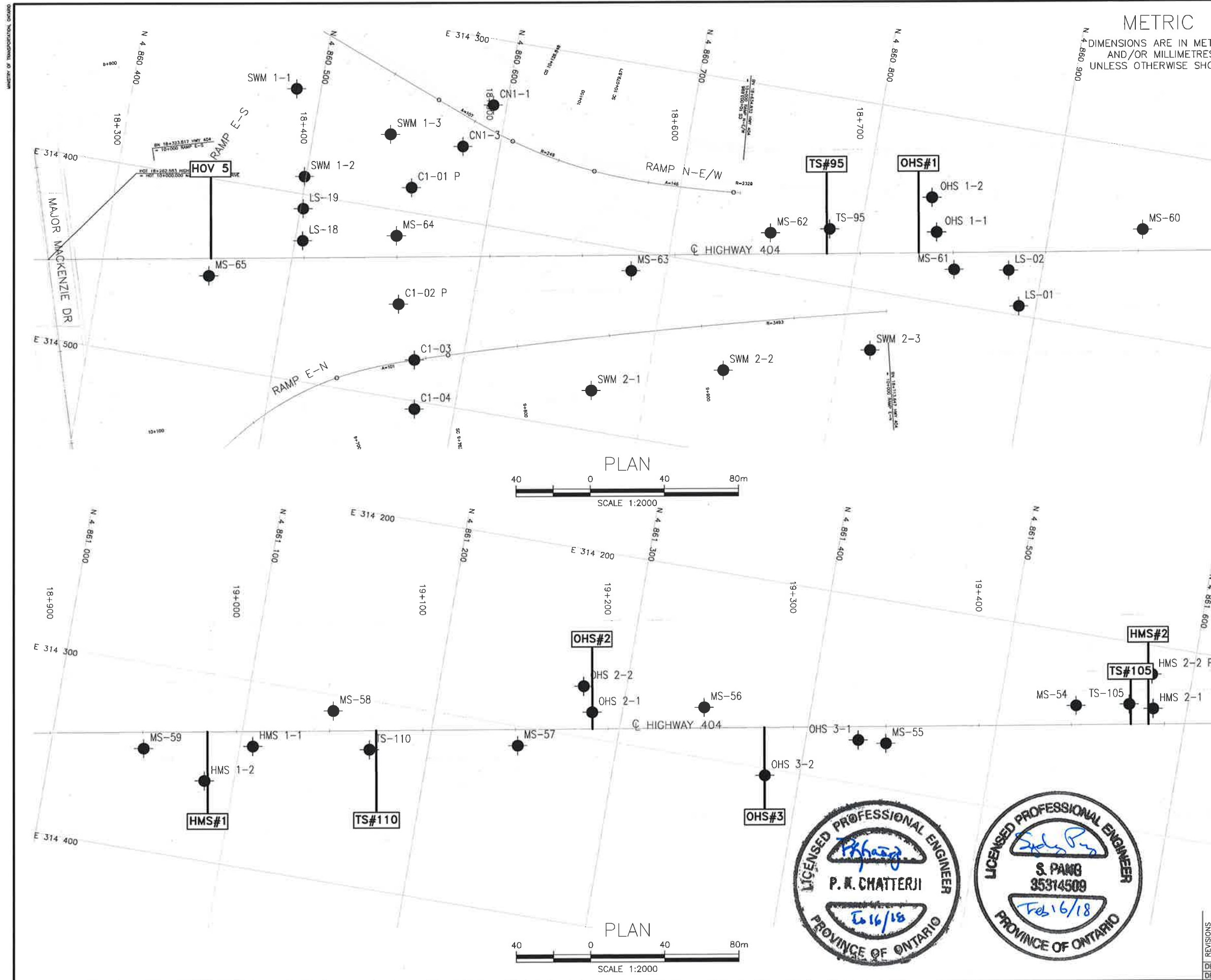


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Chkd. RD



Appendix E

Borehole Location Drawings



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

CONT No 2017-2045
WP No 2930-02-00

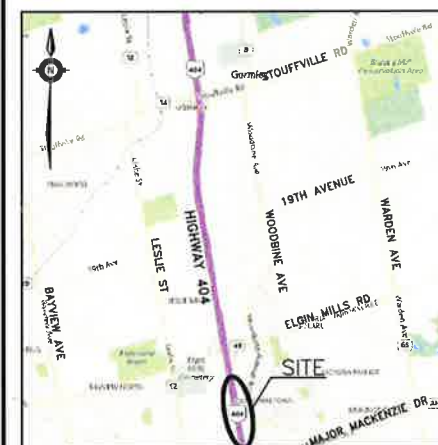
HIGHWAY 404
WIDENING
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN



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) |

NO	ELEVATION	NORTHING	EASTING
HMS 1-1	218.3	4 861 106.9	314 334.8
HMS 1-2	217.9	4 861 084.5	314 357.4
HMS 2-1	223.5	4 861 581.9	314 233.4
HMS 2-2 P	223.2	4 861 578.2	314 215.3
MS-65	211.3	4 860 457.6	314 452.0
OHS 1-1	215.6	4 860 840.3	314 362.9
OHS 1-2	215.3	4 860 834.7	314 344.9
OHS 2-1	220.3	4 861 283.9	314 285.9
OHS 2-2	220.1	4 861 277.1	314 272.9
OHS 3-1	221.5	4 861 428.1	314 276.6
OHS 3-2	220.9	4 861 381.5	314 303.8
TS-95	215.1	4 860 783.2	314 370.9
TS-105	223.3	4 861 568.9	314 233.1
TS-110	219.0	4 861 169.1	314 325.9

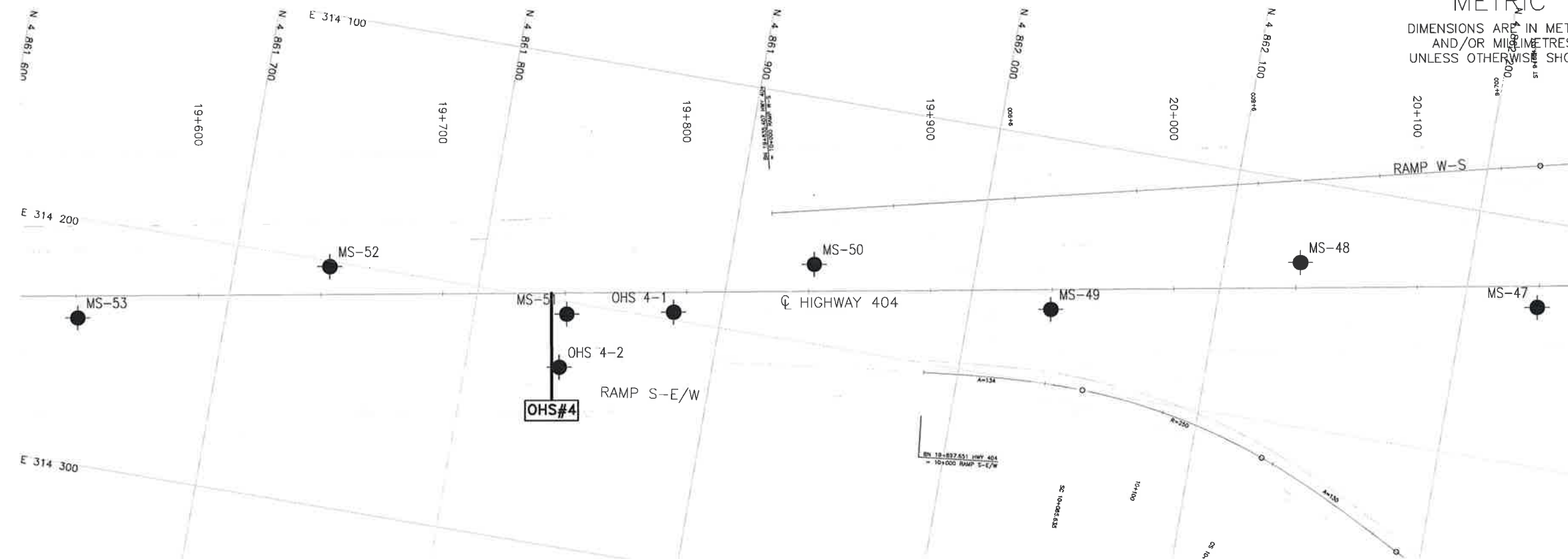
-NOTES-

- 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.

GEOCRES No. 30M14-473

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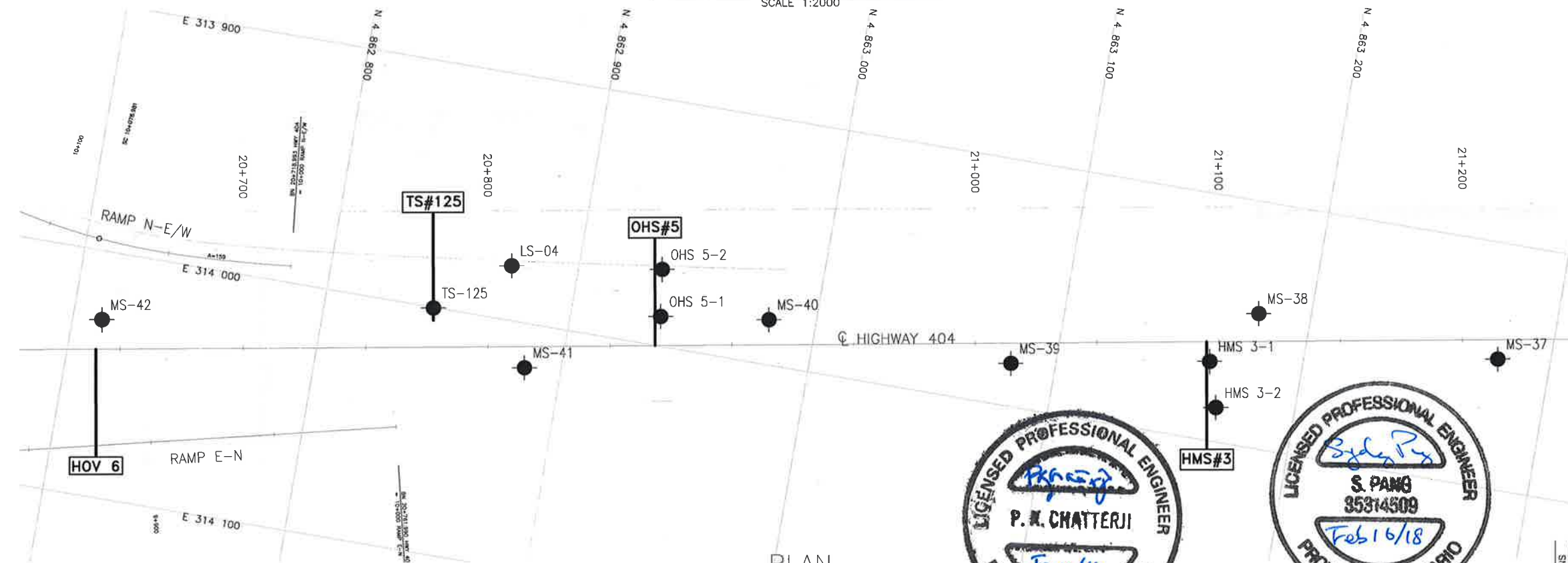
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



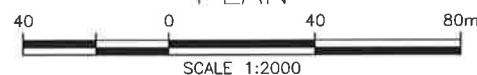
PLAN



SCALE 1:2000



PLAN



SCALE 1:2000



CONT No 2017-2045
WP No 2930-02-00



SHEET

HIGHWAY 404
WIDENING
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN

wsp



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)

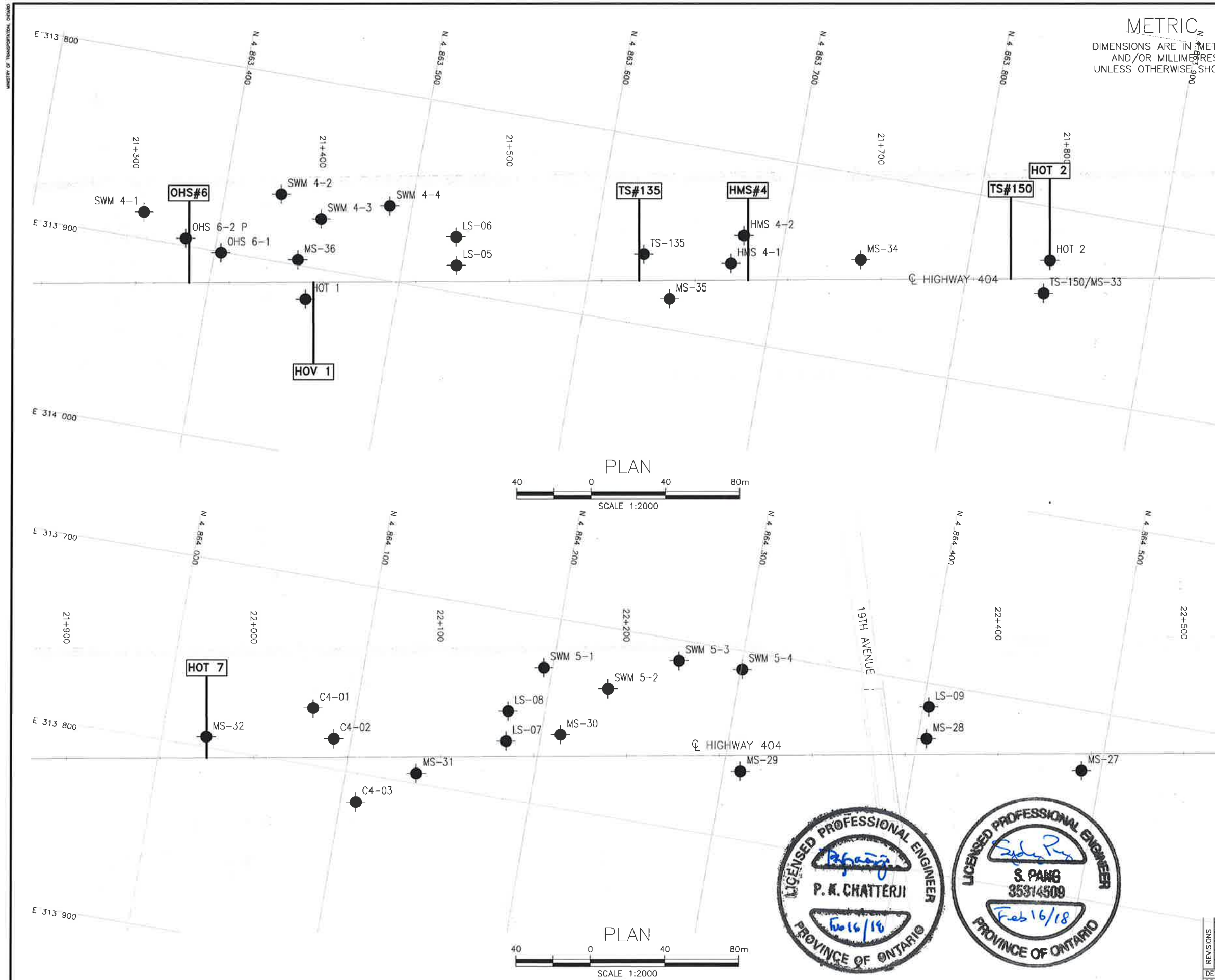
NO	ELEVATION	NORTHING	EASTING
HMS 3-1	236.1	4 863 162.1	313 968.0
HMS 3-2	235.9	4 863 167.8	313 986.1
MS-42	233.4	4 862 711.9	314 027.8
OHS 4-1	226.4	4 861 880.6	314 196.8
OHS 4-2	225.7	4 861 838.1	314 227.0
OHS 5-1	234.5	4 862 936.7	313 987.9
OHS 5-2	234.2	4 862 934.0	313 968.9
TS-125	234.0	4 862 844.4	314 000.2

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GEOCREs No. 30M14-473

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

CONT No 2017-2045
WP No 2930-02-00

HIGHWAY 404
WIDENING
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN

wsp

SHEET

THURBER ENGINEERING LTD.

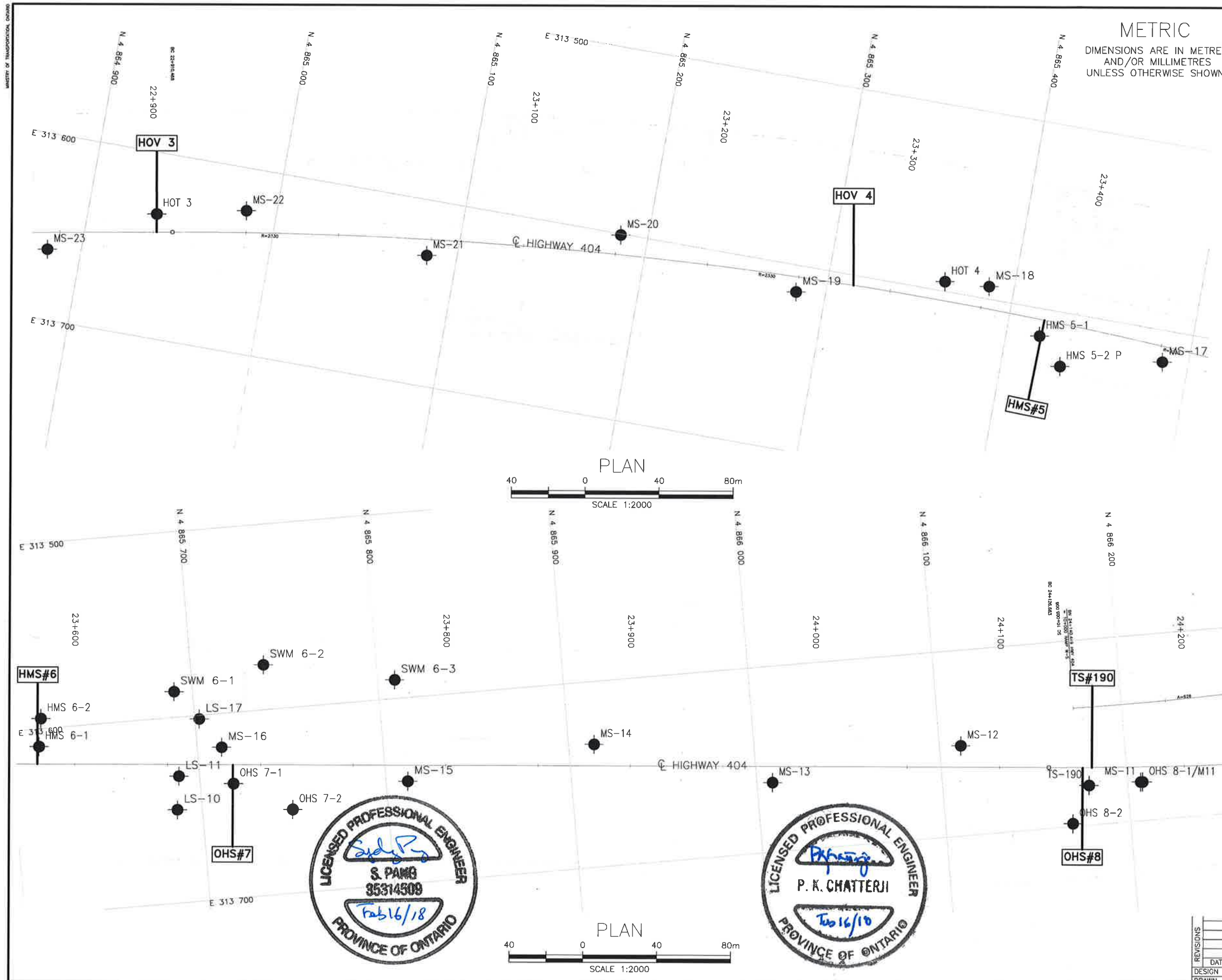
KEYPLAN

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)		
NO	ELEVATION	NORTHING	EASTING
HMS 4-1	238.3	4 863 674.2	313 859.3
HMS 4-2	238.3	4 863 678.5	313 843.3
HOT 1	237.7	4 863 452.1	313 917.2
HOT 2	239.5	4 863 842.8	313 828.3
MS-32	240.7	4 864 023.5	313 794.6
OHS 6-1	236.8	4 863 403.4	313 900.4
OHS 6-2 P	266.4	4 863 383.5	313 896.0
TS-135	238.1	4 863 627.1	313 862.4
TS-150/MS-33	240.3	4 863 842.5	313 846.3

- 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.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN RD	CHK SKP	CODE	LOAD
DRAWN AN	CHK RD	SITE	STRUCT
			DATE FEB 2018
			DWG 3

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METRIC
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UNLESS OTHERWISE SHOWN

CONT No 2017-2045
WP No 2930-02-00

SHHEET

HIGHWAY 404
WIDENING
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN

THURBER ENGINEERING LTD.

KEYPLAN

Borehole

Borehole and Cone

N

CONE

PH

90%

Blows /0.3m (Std Pen Test, 475J/blow)

Blows /0.3m (60' Cone, 475J/blow)

Pressure, Hydraulic

Water Level

Head Artesian Water

Piezometer

Rock Quality Designation (RQD)

NO	ELEVATION	NORTHING	EASTING
HMS 5-1	252.2	4 865 418.1	313 614.9
HMS 5-2 P	252.1	4 865 431.8	313 629.1
HMS 6-1	254.1	4 865 615.3	313 609.4
HMS 6-2	254.1	4 865 617.5	313 594.5
HOT 3	247.0	4 864 936.6	313 633.1
HOT 4	251.4	4 865 362.5	313 594.9
OHS 7-1	255.2	4 865 717.8	313 638.3
OHS 7-2	255.4	4 865 748.5	313 654.9
OHS 8-1/M11	260.2	4 866 208.1	313 679.2
OHS 8-2	260.3	4 866 168.8	313 698.5
TS-190	260.0	4 866 179.1	313 678.7

-NOTES-

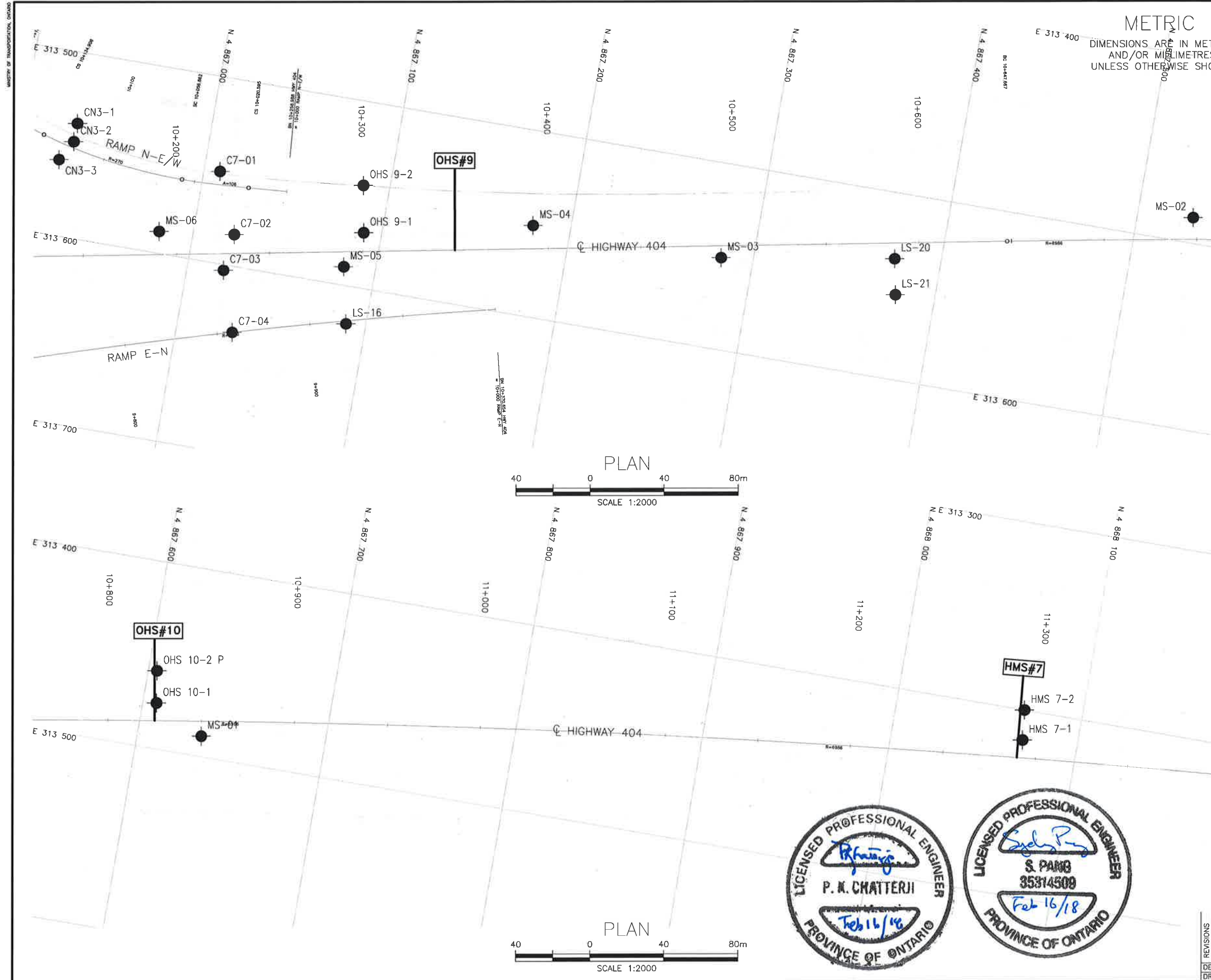
1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M14-473

REVISIONS		DATE	BY	DESCRIPTION
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		LOAD	DATE	FEB 2018
		STRUCT	DWG	4

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METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No 2017-2045
WP No 2930-02-00

HIGHWAY 404
WIDENING
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN

WS|D








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) |

[illegible]

-NOTES-

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

GEOCRES No. 30M14-473

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Appendix F

List of Special Provisions

And

Suggested Text for NSSP



List of Special Provisions Referenced in this Report

OPSS 903

Suggested Text for NSSP on:

“Augered Caisson Construction for OHS, HOT, HMS and TS Support Foundations”

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the OHS, HOT, HMS and TS foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
2. Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. Obstructions including rubble, cobbles and boulders may also be present within the embankment fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard/very dense layers.
3. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill and cohesionless soils at some locations. The cohesionless soils would be susceptible to disturbance (basal and sidewall) under conditions of unbalanced hydrostatic head and therefore water supply should be made available on site to maintain a balancing water head inside the caisson hole where required. Temporary liners shall be available on site, or be made available on very short notice, to support the caisson sidewalls and provide partial seepage cut-off where required. If a cave-in or basal instability condition is encountered, consideration should be given to advancing the temporary liner ahead of excavating/augering and/or using the slurry method to minimize disturbance at the base and the sides of the caisson foundation. All concrete should be placed in the dry. Should it be impractical to remove accumulated water in the caisson hole, consideration should be given to using the tremie technique to place the concrete.

The Contractor is responsible for constructing the OHS, HOT, HMS, and TS foundations without disturbing the material at the sides or bases of the foundations.