

**PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILLS AND DEEP CUTS
FROM EAST OF REGIONAL ROAD 17 TO EAST OF TOWNLINE ROAD
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

Geocres Number: 40P8-171

Report to

**Ministry of Transportation Ontario
Southwestern Region**

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TABLE OF CONTENTS

PART 1 FACTUAL INFORMATION

1	INTRODUCTION	1
2	SITE DESCRIPTION	2
3	SITE INVESTIGATION AND FIELD TESTING.....	2
4	LABORATORY TESTING	4
5	DESCRIPTION OF SUBSURFACE CONDITIONS	4
5.1	Hwy 7 New, Station 25+100 – 25+200.....	5
	(Boreholes 08-120, 08-121)	5
5.1.1	Topsoil	5
5.1.2	Sand	5
5.1.3	Sandy Silt.....	5
5.1.4	Silty Clay Till	6
5.1.5	Sandy Silt Till.....	6
5.1.6	Groundwater Conditions.....	7
5.2	Hwy 7 New, Station 26+520 – 26+780.....	7
	(Boreholes 08-134, 08-135, 08-136, 08-138).....	7
5.2.1	Fill.....	7
5.2.2	Sand	8
5.2.3	Silty Clay Till	8
5.2.4	Sandy Silt Till.....	9
5.2.5	Groundwater Conditions.....	10
5.3	Hwy 7 New, Station 27+600 – 27+760.....	10
	(Boreholes 08-149, 08-150, 08-151).....	10
5.3.1	Peat	10
5.3.2	Clayey Silt	11
5.3.3	Sand and Gravelly Sand.....	11
5.3.4	Sandy Silt.....	11
5.3.5	Sandy Silt Till.....	12
5.3.6	Sand and Gravel.....	13
5.3.7	Groundwater Conditions.....	13
5.4	Hwy 7 New, Station 28+500 – 28+560.....	14
	(Boreholes 08-156, 08-158)	14
5.4.1	Fill.....	14
5.4.2	Clayey Silt	14
5.4.3	Sand	14
5.4.4	Silty Clay Till and Clayey Silt Till	14
5.4.5	Sandy Silt Till.....	15
5.4.6	Groundwater Conditions.....	16
5.5	Hwy 7 New, Station 30+040 – 30+140.....	17

(Borehole 08-171).....	17
5.5.1 Topsoil.....	17
5.5.2 Silty Sand.....	17
5.5.3 Sandy Silt Till.....	17
5.5.4 Groundwater Conditions.....	17
5.6 Reg. Road 30 – N/S-E Ramp, Station 10+070 – 10+115.....	17
(Borehole 08-159).....	17
5.6.1 Topsoil.....	17
5.6.2 Fill.....	17
5.6.3 Silty Clay Till	18
5.6.4 Sandy Silt Till.....	19
5.6.5 Groundwater Conditions.....	19
5.7 Reg. Road 30 – E-N/S Ramp, Station 10+374 – 10+419.....	20
(Borehole 08-153).....	20
5.7.1 Fill.....	20
5.7.2 Clayey Sandy Silt Till.....	20
5.7.3 Silty Clay Till	21
5.7.4 Groundwater Conditions.....	21
5.8 Reg. Road 30 – N/S-W Ramp, Station 10+000 – 10+035	22
(Borehole 08-152).....	22
5.8.1 Topsoil.....	22
5.8.2 Sand	22
5.8.3 Sandy Silt Till.....	22
5.8.4 Groundwater Conditions.....	23
6 MISCELLANEOUS	23
 PART 2 ENGINEERING DISCUSSION AND RECOMMENDATIONS	
7 INTRODUCTION	25
8 ENGINEERING ANALYSIS METHODOLOGY.....	26
9 HIGH FILLS.....	27
9.1 Stability Assessment	27
9.2 Settlement Analysis.....	27
9.3 Embankment Design and Construction.....	28
10 DEEP CUT	29
10.1 Stability Analysis Results	29
10.2 Deep Cut Design	29
10.3 Construction Considerations	30
11 CONSTRUCTION CONCERNS	30
12 INVESTIGATION FOR DETAIL DESIGN.....	31
13 CLOSURE	32

Appendices

Appendix A	Hwy 7 New, Station 25+100 – 25+200 (Boreholes 08-120, 08-121)
Appendix B	Hwy 7 New, Station 26+520 – 26+780 (Boreholes 08-134, 08-135, 08-136, 08-138)
Appendix C	Hwy 7 New, Station 27+600 – 27+760 (Boreholes 08-149, 08-150, 08-151)
Appendix D	Hwy 7 New, Station 28+500 – 28+560 (Boreholes 08-158, 08-156)
Appendix E	Hwy 7 New, Station 30+040 – 30+140 (Boreholes 08-171)
Appendix F	Reg. Road 30 – N/S-E Ramp, Station 10+070 – 10+115 (Borehole 08-159)
Appendix G	Reg. Road 30 – E-N/S Ramp, Station 10+374 – 10+419 (Borehole 08-153)
Appendix H	Reg. Road 30 – N/S-W Ramp, Station 10+000 – 10+035 (Borehole 08-152)

Appendices include:

- Record of Borehole Sheets
- Foundation Comparison
- Site Photographs
- Drawing titled “Borehole Locations and Soil Strata”

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a preliminary foundation investigation conducted at the proposed high fill embankment and deep cut locations along the proposed Highway 7-New mainline alignment in the Regional Municipality of Waterloo, Ontario. This report addresses all identified fill embankments of 4.5 m or greater in height and permanent cuts of 4.5 m or greater in depth from the east side of Regional Road 17 (Ebycrest Road) to the east side of Townline Road.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide borehole location plans, records of boreholes, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the potential embankment footprint or cut area was developed from the data obtained in the course of the investigation.

The information collected in the course of the investigation and presented in this report is intended for preliminary design purposes only. Additional site investigation, field testing and engineering analysis will be required at the detail design stage. The extent of the additional investigation will depend, in part, on the final location of the high fills and deep cuts.

Thurber carried out the investigation for the Ministry of Transportation Ontario, Southwestern Region (MTO) under Purchase Order Number 3006-E-0123.

In the preparation of this report, general reference has been made to information on subsurface conditions contained in Preliminary Foundation Investigation and Design Reports prepared for the proposed structures and ramps along the proposed Highway 7-New alignment. The reports were prepared by Thurber from May 2008 to March 2009.

Records of boreholes from the previous reports are attached in the appendices for reference.

2 SITE DESCRIPTION

This report addresses the section of the proposed Highway 7 mainline extending from east side of Regional Road 17 (Ebycrest Road) to the east side of Townline Road. Approximate length of this section of the highway is 5.0 Km. A total of eight (8) proposed high fills and deep cuts were identified within this section.

The proposed Highway 7-New alignment generally runs parallel to the north of the existing Highway 7.

Lands surrounding the proposed and existing Highway 7 alignments are generally undeveloped and/or agricultural. Farmsteads/residential dwellings were observed to the north of the existing Highway 7 alignment.

Currently the topography of the site slopes gently towards the east.

Based on the Ontario Geological Survey Special Volume 2, the Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till and kames or kame moraines, with outwash sands occupying the intervening hollows.

Photographs of some of the sites are included in the appendices as indicated in Table 3.1.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at this site was carried out from May 2008 to February 2009.

A total of fifteen (15) sampled boreholes were drilled for the proposed eight high fills and deep cuts identified within this section. A summary of the borehole designations employed at each embankment is provided in Table 3.1. The respective appendices including borehole logs, laboratory results, borehole locations, soil strata drawings, slope stability analysis and photographs are also provided in Table 3.1. The coordinates and elevations of the boreholes are given on the drawings and on the individual Record of Borehole Sheets.

Table 3.1 – Borehole Designations

Alignment/ Roadway	Approx. Station	Cut or Fill	Length (m)	Borehole	Appendix
Hwy 7 New	25+100 – 25+200	C	100	08-120, 08-121	A
Hwy 7 New	26+520 – 26+780	C	260	08-134, 08-135, 08-136, 08-138	B
Hwy 7 New	27+600 – 27+760	F	160	08-149, 08-150, 08-151	C
Hwy 7 New	28+500 – 28+560	C	60	08-156, 08-158	D
Hwy 7 New	30+040 – 30+140	F	100	08-171	E
Reg. Road 30 – N/S-E Ramp	10+070 – 10+115	F	45	08-159	F
Reg. Road 30 – E-N/S Ramp	10+374 – 10+419	C	45	08-153	G
Reg. Road 30 – N/S-W Ramp	10+000 – 10+035	F	35	08-152	H

The approximate locations of all the boreholes are shown on the Borehole Location Drawings included in each Appendix.

Prior to commencing the site investigation, clearance was obtained from utility companies having plant in the area.

The boreholes were drilled using hollow and solid stem auger equipment on track-mounted and truck-mounted drill rigs. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. In some boreholes, standpipe piezometer consisting of 19 mm and 25 mm diameter PVC pipe with a slotted screen was installed and enclosed in filter sand to permit longer term groundwater level monitoring. The locations and completion details of the piezometers are shown in Table 3.2. Boreholes without piezometer installations were grouted with bentonite upon completion.

The completion of the boreholes and the standpipe piezometer was carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07).

Table 3.2 – Piezometer Completion Details

Alignment/ Roadway	Approx. Station	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
Hwy 7 New	25+100 – 25+200	08-120	9.1/321.9	Piezometer with 1.5 m slotted screen installed with sand filter to 7.0 m, bentonite from 7.0 m to 5.2 m, then auger cuttings to ground surface.
Hwy 7 New	26+520 – 26+780	08-138	11.1/321.4	Piezometer with 1.5 m slotted screen installed with sand filter to 8.5 m, bentonite from 8.5 m to 8.0 m, grout form 8.0 to 1.0 m, then auger cuttings to ground surface.
Hwy 7 New	28+500 – 28+560	08-156	7.6/325.1	Piezometer with 1.5 m slotted screen installed with sand filter to 5.7 m, then bentonite to ground surface.
		08-158	21.4/308.6	Piezometer with 1.5 m slotted screen installed with sand filter to 19.0 m, then bentonite to ground surface.
Reg. Road 30 – E-N/S Ramp	10+374 – 10+419	08-153	5.5/325.6	Piezometer with 1.5 m slotted screen installed with sand filter to 3.6 m, then bentonite to ground surface.

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

4 LABORATORY TESTING

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

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendices A to H for details of the encountered soil stratigraphy. Stratigraphic profiles are presented on the Borehole Locations and Soil Strata Drawings in the appendices. Overall descriptions of the stratigraphy are given in the following paragraphs. However, 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 borehole locations.

In general, the sites are underlain by topsoil overlying native layers of sand, sandy silt and glacial till deposits within the depth of exploration. The glacial till comprises of compact to very dense silty sand/sandy silt till, silt till and stiff to hard clayey silt/silty clay till. Layers of sand and gravel were also encountered within the till deposits.

5.1 Hwy 7 New, Station 25+100 – 25+200 (Boreholes 08-120, 08-121)

5.1.1 Topsoil

Topsoil was identified at ground surface in Boreholes 08-120 and 08-121. The topsoil thickness was 300 mm and 450 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.1.2 Sand

Native brown sand containing trace silt and trace of clay was contacted below the topsoil in Borehole 08-120. Thickness of the sand layer was 2.7 m.

The depth to the base of the sand layer was 3.0 m (Elevation 328.0).

The sand is classified as loose to compact, based on SPT 'N' values ranging from 6 to 19 blows for 0.3 m of penetration. The natural moisture content measured varied from 4% to 7%.

The grain size distribution for a sand sample is presented on the Record of Borehole sheets and on Figure A1 of Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	92
Silt & Clay	8

5.1.3 Sandy Silt

Native brown sandy silt containing trace clay and occasional organics was encountered below the topsoil in Borehole 08-121. Thickness of the sandy silt was 1.0 m.

The depth to the base of the sandy silt is 1.5 m (Elevation 328.5).

SPT 'N' values in the sandy silt were 10 and 23 blows per 0.3 m of penetration, indicating loose to compact relative density. The natural moisture content was 19%.

5.1.4 Silty Clay Till

Native brown silty clay till containing trace to some sand and trace gravel was contacted below the sand at 3.0 m depth (Elevation 328.0) in Borehole 08-120. Thickness of the silty clay till was 3.3 m.

The depth to the base of the silty clay till was 6.3 m (Elevation 324.7).

A 700-mm thick layer of silty clay till was also contacted within the sandy silt till at 8.1 m depth (Elevation 322.9) in Borehole 08-120.

The cohesive till layer is very stiff to hard in consistency, based on SPT 'N' values of 18 and 38 blows per 0.3 m of penetration. The moisture content varied from 16% to 18%.

The grain size distribution for a silty clay till sample is presented on the Record of Borehole sheets and on Figure A2 in Appendix A. Atterberg Limits test results are presented on Figure A4 of Appendix A. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	18
Silt	53
Clay	29

Liquid Limit	28
Plastic Limit	15

The above results show that the silty clay till is of low plasticity with group symbols of CL.

It should be noted that glacial tills are known to contain cobbles and boulders.

5.1.5 Sandy Silt Till

Brown to grey sandy silt till containing trace clay was contacted below the silty clay in Borehole 08-120 at 6.3 m depth (Elevation 324.7) and below the silty sand in Borehole 08-121 at 1.5 m depth (Elevation 328.5).

Boreholes 08-120 and 08-121 were terminated within the sandy silt till at 9.8 m and 8.1 m depth (Elevations 321.2 and 321.9), respectively.

SPT 'N' values ranged from 23 to 69 blows per 0.3 m of penetration indicating a compact to very dense relative density. An SPT 'N' value higher than 100 blows per 0.225 m of penetration was measured at 8.1 m depth in Borehole 08-121. The natural moisture contents generally lay in the range of 4% to 20%.

The grain size distributions for sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure A3 of Appendix A. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	42 to 62
Silt	35 to 49
Clay	3 to 9

Although not specifically identified in the boreholes, glacial till layers may contain cobbles and boulders which may account for some high SPT 'N' values.

5.1.6 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-120 to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1, along with the measurements in the open boreholes upon completion of drilling.

Table 5.1 – Water Level Measurements

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
08-120	January 14	7.3	323.7	During drilling
	February 19	2.9	328.1	In piezometer
08-121	January 14	6.1	323.9	During drilling

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 Hwy 7 New, Station 26+520 – 26+780 (Boreholes 08-134, 08-135, 08-136, 08-138)

5.2.1 Fill

Fill was encountered surficially in Borehole 08-138. The fill consists of brown sand and gravel and sandy silt containing trace clay and occasional topsoil. Thickness of the fill was 1.4 m.

The depth to the base of the fill was 1.4 m (elevation 331.0).

The fill is classified as compact, based on an SPT 'N' value of 10 blows for 0.3 m of penetration. The natural moisture content ranged from 5% to 20%.

Grain size distribution curve for a sand and gravel fill sample tested is presented on the Record of Borehole sheet and on Figure B1 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	37
Sand	49
Silt & Clay	14

5.2.2 Sand

Native brown sand containing some silt, trace to some gravel, occasional rootlets and occasional cobbles was contacted surficially in Boreholes 08-134 to 08-136. Thickness of the sand layer ranged from 0.6 m to 1.4 m.

The depth to the base of the sand layer ranged from 0.6 m to 1.4 m (Elevations 326.5 to 330.2).

The sand is classified as loose to dense, based on SPT 'N' values of 7 and 42 blows for 0.3 m of penetration. The natural moisture content measured varied from 16% to 18%.

5.2.3 Silty Clay Till

Brown to grey silty clay till containing trace sand was encountered at 1.4 m and 7.0 m depth (Elevations 326.5 and 323.5) in Boreholes 08-134 and 08-136. Thickness of the silty clay till was 4.1 m in Borehole 08-134.

The depth to the base of the silty clay till was 5.5 m (Elevation 322.4) in Borehole 08-134. Borehole 08-136 was terminated within the silty clay till at 8.1 m depth (Elevation 322.5).

SPT 'N' values in the silty clay till ranged from 25 to 100 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The natural moisture contents generally lay in the range of 10% to 19%.

The grain size distributions for silty clay till samples tested are presented on the Record of Borehole sheets and on Figure B2 of Appendix B. Atterberg Limits test results are presented on Figure B6 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	Silty Clay Till (%)
Gravel	0
Sand	7 to 9
Silt	59 to 60
Clay	32 to 33

Liquid Limit	28 to 32
Plastic Limit	15 to 17

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

Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders.

5.2.4 Sandy Silt Till

Native brown to grey sandy silt till was contacted below the fill, the sand and the silty clay till layers. The sandy silt till generally contains trace gravel, trace to some clay and occasional cobbles.

Clayey zones were encountered within the sandy silt till at approximately 6.5 m and 9.0 m depth (Elevations 318.5 to 326.0).

Depths and elevations where native sandy silt till was encountered are indicated in Table 5.2.

Table 5.2 – Depths and Elevations of Native Sandy Silt Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-134	5.5 to 10.3 (borehole termination depth)	322.4 to 317.6	>4.8
08-135	1.4 to 11.0 (borehole termination depth)	330.2 to 320.6	>9.6
08-136	0.6 to 7.0	329.9 to 323.5	6.4
08-138	1.4 to 11.1 (borehole termination depth)	331.0 to 321.4	>9.6

SPT ‘N’ values of the sandy silt till ranged from 7 blows per 0.3 m of penetration to higher than 100 blows per 0.15 m of penetration, indicating a loose to very dense relative density. The natural moisture contents generally lay in the range of 3% to 19%.

The grain size distributions of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figures B3 to B5 of Appendix B. Atterberg Limits test results are presented on Figure B7 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	Sandy Silt Till (%)	Sandy Silt Till Clayey zone (%)
Gravel	1 to 7	0 to 2
Sand	8 to 58	31 to 36
Silt	29 to 79	41 to 50
Clay	8 to 16	16 to 21
Liquid Limit	-	17 to 22
Plastic Limit	-	12 to 17

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

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values and refusal to augering.

5.2.5 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-138 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.3, along with the measurements in the boreholes upon completion of drilling.

Table 5.3 – Water Level Measurements

Borehole	Date (2008)	Water Level (m)		Comment
		Depth	Elevation	
08-135	May 27	9.3	322.4	During drilling
08-138	May 28	5.9	326.6	In piezometer
	July 23	1.6	330.9	In piezometer

The piezometric reading indicates that the groundwater level lies at Elevation 330.9.

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 Hwy 7 New, Station 27+600 – 27+760 (Boreholes 08-149, 08-150, 08-151)

5.3.1 Peat

Black fibrous peat with occasional roots and wood fragments was contacted surficially in Boreholes 08-150 and 08-151. Thickness of the peat ranged from 600 mm to 800 mm.

5.3.2 Clayey Silt

Native dark brown clayey silt containing some sand was encountered below the peat at 0.8 m depth in Borehole 08-150. Thickness of the clayey silt was 1.4 m.

The depth to the base of the clayey silt was 2.2 m (Elevation 320.8).

The clayey silt is classified as firm to stiff, based on SPT 'N' values of 4 and 12 blows for 0.3 m of penetration. The natural moisture content was 10%.

5.3.3 Sand and Gravelly Sand

Native brown sand and gravelly sand layers containing some silt and some clay were contacted surficially and at 0.6 m depth (Elevations 325.4 and 321.8) in Boreholes 08-149 and 08-151, respectively. In Borehole 08-150, a layer of grey sand was contacted at 5.6 m (Elevation 317.4).

A 600-mm thick layer of sand was encountered within the sandy silt till deposit near Elevation 321.0 in Borehole 08-149.

Thickness of the sand layer and gravelly sand layer were 2.2 m and 2.4 m.

The depths to the base of the sand and gravelly sand were 2.2 m and 3.0 m (Elevations 323.2 and 319.4). Borehole 08-150 was terminated within the sand layer at 6.7 m depth (Elevation 316.3).

The sand and gravelly sand are classified as loose to compact, based on SPT 'N' values ranging from 8 to 27 blows for 0.3 m of penetration. The natural moisture content measured varied from 8% to 22%.

The grain size distributions of sand and gravelly sand samples tested is presented on the Record of Borehole sheet and on Figure C1 of Appendix C. The results of the laboratory tests are summarized as follows:

Soil Particles	Percentage (%)
Gravel	8 to 24
Sand	47 to 80
Silt & Clay	12 to 29

5.3.4 Sandy Silt

Brown sandy silt was encountered below the clayey silt at 2.2 m depth (Elevation 320.8) in Borehole 08-150. Thickness of the sandy silt was 0.8 m.

The depth to the base of the sandy silt was 3.0 m (Elevation 320.0).

The sandy silt is classified as compact, based on an SPT 'N' value of 22 blows for 0.3 m of penetration. The natural moisture content was 32%.

Grain size distribution curve of a sandy silt sample tested is presented on the Record of Borehole sheet and on Figure C2 of Appendix C. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	39
Silt	57
Clay	4

5.3.5 Sandy Silt Till

Native brown to grey sandy silt till containing trace to some clay and trace gravel was contacted below the sand and gravelly sand layers at 2.2 m and 3.0 m depths (Elevations 323.2 and 319.4) in Boreholes 08-149 and 08-151, respectively.

In Borehole 08-149, clayey zones were encountered within the sandy silt till at approximately 6.6 m depth.

Boreholes 08-149 and 08-151 were terminated within the sandy silt till layer at 6.6 m and 6.2 m depths (Elevations 318.9 and 316.1).

SPT 'N' values of the sandy silt till ranged from 14 blows per 0.3 m of penetration to higher than 100 blows per 0.15 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally lay in the range of 6% to 19%.

The grain size distributions of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figures C2 of Appendix C. Atterberg Limits test results are presented on Figure C4 of Appendix C. The results of the laboratory tests are summarized as follows:

Soil Particles	Sandy Silt Till (%)	Sandy Silt Till Clayey zone (%)
Gravel	1	3
Sand	30 to 39	31
Silt	49 to 63	50
Clay	6 to 11	16

Liquid Limit	-	17
Plastic Limit	-	10

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

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values.

5.3.6 Sand and Gravel

A grey sand and gravel layer containing trace silt and trace clay was encountered below the sandy silt at 3.0 m depth (Elevation 320.0) in Borehole 08-150. Thickness of the sand and gravel layer was 2.6 m.

The depth to the base of the sandy silt was 5.6 m (Elevation 317.4).

The sand and gravel layer is dense to compact in density, based on SPT 'N' values of 33 and 26 blows for 0.3 m of penetration. The natural moisture contents ranged from 17% to 19%.

The grain size distribution of a sand and gravel sample tested is presented on the Record of Borehole sheet and on Figure C3 of Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	34
Sand	56
Silt & Clay	10

5.3.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. The water levels measured in the boreholes upon completion of drilling are summarized in Table 5.4.

Table 5.4 – Water Level Measurements

Borehole	Date (2008)	Water Level (m)		Comment
		Depth	Elevation	
08-149	May 27	4.3	321.1	During drilling
08-150	May 29	0.5	322.5	
08-151	May 29	1.9	320.5	

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 Hwy 7 New, Station 28+500 – 28+560 (Boreholes 08-156, 08-158)

5.4.1 Fill

Fill was encountered surficially in Borehole 08-158. The fill consists of dark brown sand containing some gravel, some clay and occasional topsoil. Thickness of the fill was 500 mm.

The depth to the base of the fill was 0.5 m (Elevation 329.5). The moisture content of the fill was 5%.

5.4.2 Clayey Silt

Native black to brown clayey silt containing trace sand, occasional rootlets and occasional organics was encountered surficially in Borehole 08-156. Thickness of the clayey silt was 1.2 m.

The depth to the base of the clayey silt was 1.2 m (Elevation 331.5).

The clayey silt is classified as firm to very stiff, based on SPT 'N' values of 6 and 15 blows for 0.3 m of penetration. The natural moisture content ranged from 18% to 21%.

5.4.3 Sand

Native brown sand containing trace to some gravel, some silt and some clay was contacted below the clayey silt in Borehole 08-156. Borehole 08-156 was terminated in this sand layer at 8.2 m depth (Elevation 324.5).

The sand is classified as compact to very dense, based on SPT 'N' values ranging from 26 to 80 blows for 0.3 m of penetration. The natural moisture content measured varied from 5% to 19%.

The grain size distributions for sand samples are presented on the Record of Borehole sheets and on Figure D1 of Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0 to 21
Sand	56 to 94
Silt & Clay	6 to 25

5.4.4 Silty Clay Till and Clayey Silt Till

In Borehole 08-158, native brown to grey silty clay till and clayey silt till was contacted at depths and elevations indicated in Table 5.5.

A 500-mm layer of grey silt was contacted within the silty clay till at 8.8 m depth (Elevation 321.2).

Table 5.5 – Depths and Elevations of Native Silty Clay Till and Clayey Silt Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-158	0.5 to 9.3	329.5 to 320.7	8.8
	9.3 to 13.3*	320.7 to 316.7	4.0
	13.3 to 17.7	316.7 to 312.3	4.4

* Clayey silt till

SPT ‘N’ values of the silty clay till and clayey silt till ranged from 14 to 125 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The natural moisture contents generally lay in the range of 9% to 21%.

The grain size distributions of the silty clay till and clayey silt till samples tested are presented on the Record of Borehole sheets and on Figures D2 and D3 of Appendix D. Atterberg Limits test results are presented on Figures D6 and D7 of Appendix D. Laboratory test result for the silt layer sample is presented in Figure D4 of Appendix D. The results of the laboratory tests are summarized as follows:

Soil Particles	Silty Clay Till (%)	Clayey Silt Till (%)	Silt (%)
Gravel	1 to 2	0	1
Sand	6 to 22	5 to 7	16
Silt	35 to 48	75 to 78	76
Clay	28 to 58	15 to 20	7

Liquid Limit	25 to 42	21	-
Plastic Limit	12 to 19	18	-

The above results show that the silty clay till and clayey silt till are of low to medium plasticity with group symbols of CL-ML and CI.

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT ‘N’ values.

5.4.5 Sandy Silt Till

Native grey sandy silt till containing some clay and trace gravel was contacted below the silty clay till at 17.7 m depth (Elevation 312.3) in Borehole 08-158.

Borehole 08-158 was terminated within the sandy silt till layer at 21.4 m depth (Elevation 308.6).

SPT ‘N’ values of the sandy silt till were higher than 100 blows per 0.125 m of penetration, indicating a very dense relative density. The natural moisture contents generally lay in the range of 6% to 9%.

The grain size distributions of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figures D5 of Appendix D. Atterberg Limits test results are presented on Figure D8 of Appendix D. The results of the laboratory tests are summarized as follows:

Soil Particles	Sandy Silt Till Clayey zone (%)
Gravel	4
Sand	42
Silt	39
Clay	15

Liquid Limit	18
Plastic Limit	11

The above results show that the clayey zone of the sandy silt till is of low plasticity with a group symbol of CL-ML.

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values.

5.4.6 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in Boreholes 08-156 and 08-158 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.6.

Table 5.6 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-156	January 9, 2009	3.5	329.2	In piezometer
	February 2, 2009	7.1	325.6	
08-158	May 28, 2008	6.8	323.2	In piezometer
	June 2, 2008	8.8	321.2	
	July 15, 2008	9.0	321.0	
	August 20, 2008	6.8	323.2	

The piezometric reading indicates that the groundwater level lies at Elevation 323.2.

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

**5.5 Hwy 7 New, Station 30+040 – 30+140
(Borehole 08-171)**

5.5.1 Topsoil

Topsoil was identified at ground surface in Borehole 08-171. The topsoil thickness was 200 mm. The topsoil thickness may vary between and beyond the borehole location and the data is not intended for the purpose of estimating quantities.

5.5.2 Silty Sand

Native brown silty sand containing trace clay was encountered below the topsoil. Thickness of the silty sand layer was 1.0 m.

The depth to the base of the clayey silt was 1.2 m (Elevation 328.6).

The silty sand is classified as loose, based on SPT 'N' values of 5 blows for 0.3 m of penetration. The natural moisture content ranged from 10% to 19%.

5.5.3 Sandy Silt Till

Native brown to grey sandy silt till containing trace gravel and trace clay was encountered below the silty sand. Borehole 08-171 was terminated in the sandy silt till at 4.6 m depth (Elevation 325.2).

The silty sand is classified as compact to very dense, based on SPT 'N' values of 15 blows for 0.3 m of penetration to higher than 50 blows per 0.05 m of penetration. The natural moisture content ranged from 8% to 12%.

5.5.4 Groundwater Conditions

Water was not observed in the borehole during and upon completion of drilling. This is a short term observation 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.

**5.6 Reg. Road 30 – N/S-E Ramp, Station 10+070 – 10+115
(Borehole 08-159)**

5.6.1 Topsoil

Topsoil was identified at ground surface in Borehole 08-159. The topsoil thickness was 200 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.6.2 Fill

Fill was encountered below the topsoil in Borehole 08-159. The fill consists of brown silty clay containing trace gravel and occasional topsoil. Thickness of the fill was 1.2 m.

The depth to the base of the fill was 1.4 m (Elevation 327.8).

SPT ‘N’ value of the silty clay fill was 11 blows per 0.3 m of penetration, indicating a stiff consistency. The natural moisture content was 20%.

5.6.3 Silty Clay Till

Native brown to grey silty clay till containing some sand, trace gravel and occasional sand seams was contacted at depths and elevations indicated in Table 5.7.

Table 5.7 – Depths and Elevations of Native Silty Clay Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-159	1.4 to 4.1	327.8 to 325.1	2.7
	5.6 to 15.7	323.6 to 313.5	10.1

A 700-mm thick layer of silt till was contacted in Borehole 08-159 at 10.2 m depth (Elevation 319.0).

SPT ‘N’ values of the silty clay till ranged from 23 to 64 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. An SPT ‘N’ value of 100 blows per 0.15 m of penetration was measured near Elevation 318.5. The natural moisture contents generally lay in the range of 12% to 23%.

The grain size distributions of silty clay till samples tested are presented on the Record of Borehole sheets and on Figure F1 of Appendix F. Atterberg Limits test results are presented on Figure F4 of Appendix F. Laboratory test result for the silt till sample is presented in Figure F2 of Appendix F. The results of the laboratory tests are summarized as follows:

Soil Particles	Silty Clay Till (%)	Silt Till (%)
Gravel	0 to 5	0
Sand	1 to 34	8
Silt	35 to 68	82
Clay	23 to 64	10

Liquid Limit	19 to 45	-
Plastic Limit	12 to 20	-

The above results show that the silty clay till and clayey silt till are of low to medium plasticity with group symbols of CL-CI.

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT ‘N’ values.

5.6.4 Sandy Silt Till

Native grey sandy silt till containing some clay and trace to some gravel was contacted at depths and elevations indicated in Table 5.8.

Table 5.8 – Depths and Elevations of Native Sandy Silt Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-159	4.1 to 5.6 15.7 to 20.0 (borehole termination depth)	325.1 to 323.6 313.5 to 309.2	1.5 >4.3

SPT ‘N’ values of the sandy silt till were higher than 100 blows per 0.05 m of penetration, indicating a very dense relative density. The natural moisture contents generally lay in the range of 8% to 19%.

The grain size distributions of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure F3 of Appendix F. The results of the laboratory tests are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	5 to 16
Sand	40 to 43
Silt	33 to 40
Clay	8 to 15

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT ‘N’ values.

5.6.5 Groundwater Conditions

Groundwater was not observed in Borehole 08-159 during and upon completion of drilling.

The above is a short term observation 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.

**5.7 Reg. Road 30 – E-N/S Ramp, Station 10+374 – 10+419
(Borehole 08-153)**

5.7.1 Fill

Fill was encountered surficially in Borehole 08-153. The fill consists of black clayey silt containing occasional rootlets. Thickness of the fill was 0.8 m.

The depth to the base of the fill was 0.8 m (Elevation 330.3).

SPT ‘N’ value of the clayey silt fill was 10 blows per 0.3 m of penetration, indicating a stiff consistency. The natural moisture content was 20%.

5.7.2 Clayey Sandy Silt Till

Brown clayey sandy silt till containing trace gravel was encountered below the fill at 0.8 m depth (Elevation 330.3). Thickness of the clayey sandy silt till was 3.2 m.

The depth to the base of the clayey sandy silt till was 4.0 m (Elevation 327.1).

SPT ‘N’ values in the clayey sandy silt till ranged from 19 to 100 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. An SPT ‘N’ value of 50 blows per 0.125 m of penetration was measured near Elevation 328.0. The natural moisture contents generally lay in the range of 15% to 21%.

The grain size distribution for a clayey sandy silt till sample tested is presented on the Record of Borehole sheets and on Figure G1 of Appendix G. Atterberg Limits test results are presented on Figure G3 of Appendix G. The results of the laboratory tests are summarized as follows:

Soil Particles	Clayey Sandy Silt Till (%)
Gravel	2
Sand	34
Silt	47
Clay	17

Liquid Limit	21
Plastic Limit	12

The above results show that the clayey sandy silt till is of low plasticity with a group symbol of CL.

Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders.

5.7.3 Silty Clay Till

Grey silty clay till containing some sand was encountered at 4.0 m depth (Elevation 327.1) in Borehole 08-153.

Borehole 08-153 was terminated within the silty clay till at 6.4 m depth (Elevation 324.6).

SPT 'N' values in the silty clay till were 77 blows per 0.3 m of penetration and 100 blows per 0.2 m of penetration, indicating a hard consistency. The natural moisture contents generally lay in the range of 15% to 17%.

The grain size distribution for a silty clay till sample tested is presented on the Record of Borehole sheets and on Figure G2 of Appendix G. Atterberg Limits test results are presented on Figure G4 of Appendix G. The results of the laboratory tests are summarized as follows:

Soil Particles	Silty Clay Till (%)
Gravel	0
Sand	18
Silt	40
Clay	42
Liquid Limit	34
Plastic Limit	19

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

Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders.

5.7.4 Groundwater Conditions

Water levels were observed in the borehole during and upon completion of drilling. The water levels measured in the borehole upon completion of drilling are summarized in Table 5.9.

Table 5.9 – Water Level Measurements

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
08-153	January 9	3.2	327.9	In piezometer
	February 2	2.0	329.1	In piezometer

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.

5.8 Reg. Road 30 – N/S-W Ramp, Station 10+000 – 10+035 (Borehole 08-152)

5.8.1 Topsoil

Topsoil was identified at ground surface in Borehole 08-152. The topsoil thickness was 175 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.8.2 Sand

Native grey sand containing some silt and occasional rootlets was contacted below the topsoil. Thickness of the sandy silt till was 1.2 m.

The depth to the base of the sand was 1.4 m (Elevation 326.2).

SPT ‘N’ value of the sand was 17 blows per 0.3 m of penetration, indicating a compact relative density. The natural moisture content was 17%.

5.8.3 Sandy Silt Till

Native grey sandy silt till containing some clay and trace gravel was contacted below the topsoil. Borehole 08-152 was terminated within the sandy silt till at 6.7 m depth (Elevation 320.9).

Layers of gravelly sand and silt were contacted within the sandy silt till layer near Elevations 325.5 and 323.0, respectively.

SPT ‘N’ values of the sandy silt till ranged from 27 to 90 blows per 0.3 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally lay in the range of 5% to 22%.

The grain size distributions of sandy silt till, gravelly sand and silt samples tested are presented on the Record of Borehole sheets and on Figure H1 to H3 of Appendix H. The results of the laboratory tests are summarized as follows:

Soil Particles	Sandy Silt Till (%)	Gravelly Sand (%)	Silt (%)
Gravel	0	30	0
Sand	55	53	17
Silt	36	-	80
Clay	9	-	3
Silt & Clay	-	17	-

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values.

5.8.4 Groundwater Conditions

Groundwater was not observed in Borehole 08-152 during and upon completion of drilling.

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

6 MISCELLANEOUS

All-Terrain Drilling of Waterloo, Ontario and DBW Drilling of Ajax Ontario supplied track-mounted and truck-mounted drill rigs and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber, Mr. Luke Gilarski and Mr. Ligang Hao under the direction of Mr. Alastair E. Gorman, P.Eng and Mr. M. Farrant, P. Eng.

The coordinates for the boreholes and the ground surface elevations were obtained by Thurber Engineering Ltd. using GPS equipment.

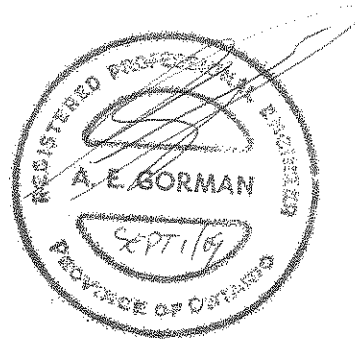
Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng. and Mr. M. Farrant, P. Eng. Interpretation of the data and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd



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Review Principal, Designated MTO Contact

**PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILLS AND DEEP CUTS
FROM EAST OF REGIONAL ROAD 17 TO EAST OF TOWNLINE ROAD
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

Geocres Number: 40P8-171

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and presents preliminary geotechnical design recommendations for the design of high embankments and deep cuts of 4.5 m or greater in height or depth along the proposed Highway 7- New alignment from Kitchener to Guelph in Ontario.

The project consists of approximately 18 km of new highway alignment running from the Wellington Street Interchange on the Kitchener-Waterloo Expressway (KWE) to north end of the Hanlan Expressway in Guelph. The alignment is generally parallel to and to the north of the existing Highway 7 alignment.

This report addresses all identified high embankments and deep cuts within a section of the proposed highway located from the east side of Regional Road 17 (Ebycrest Road) to the east side of Townline Road. High fills and deep cuts are identified as those with a height/depth greater than 4.5 m. Fill embankment within this section ranged from 4.5 m to 6.0 m in height and deep cuts ranged from 5.0 m to 8.0 m.

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

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

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

- Settlement and compression of the fill embankments.

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

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

In general the stratigraphy identified in the preliminary investigation consisted primarily of topsoil or granular fill overlying native glacial till deposits within the depth of exploration: compact to very dense silty sand/sandy silt till and stiff to hard clayey silt/silty clay till. Layers of sand, silty sand/sandy silt and sand and gravel were also encountered within the till deposits.

The project information, including preliminary plans and profiles, utilized for the preparation of this report was provided by MTO.

8 ENGINEERING ANALYSIS METHODOLOGY

The purpose of the preliminary investigation is to carry out an initial screening of the soil and groundwater conditions at each deep cut and high fill site and to assess the likelihood of there being stability or settlement issues to be dealt with at the specific site. Where issues are identified, they are flagged for further analysis during the detail design phase of the project.

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

- Proposed embankment or cut geometry (height, slope angle, footprint, etc.).
- Embankment material type (earthfill, Select Subgrade Material (SSM), granulars) or materials exposed in the cut.
- Extent and thickness of topsoil, organics and loose soils within the proposed embankment footprints.
- Thickness and engineering properties of foundation soils.
- Depth to competent layer (hard or dense soils).
- Groundwater conditions.
- The need to maintain embankment or cut stability during all stages of construction and in the long term.
- The maximum permissible settlements during embankment construction and after construction.

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

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

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

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

The assessments and analyses presented in this report are for preliminary design purposes only. They are not considered to be sufficient for the detail design phase of the project.

9 HIGH FILLS

9.1 Stability Assessment

For preliminary design purposes, the analyses indicate that embankments up to 6.0 m high that are likely to be constructed within this section of the highway will be stable at side slopes of 2H:1V if constructed using Select Subgrade Material (SSM) or granular fill.

9.2 Settlement Analysis

Table 1 shows the total settlement expected in the embankment as the sum of settlement in the foundation soils due to the load imposed by the fill plus the compression within the fill itself. For preliminary design purposes, a compression of the embankment fill equal to 1% of the height of the fill has been assumed.

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

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

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

	Settlement (mm)
Foundation settlement	10 to 20
Embankment compression	50 to 60
Total foundation settlement and embankment compression	65 to 80

Embankment and platform width design should allow for the anticipated settlements.

Further analyses should be carried out during detail design to confirm the anticipated magnitude of settlement.

9.3 Embankment Design and Construction

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

- Topsoil and organics must be removed from the footprints of the new embankments prior to placement of fill.
- Granular materials or SSM is recommended for construction of embankments in this project.
- All embankments must be designed for a side slope not steeper than 2H : 1V.
- Where earth fill embankments are higher than 8 m, 2 m wide mid-height berms must be incorporated in the design. (None is identified at present).
- Paving should be delayed for a minimum period of 3 months between completion of fill placement and commencement of paving to accommodate embankment settlement and compression
- The design width of the embankment platform and quantity estimates must include an allowance for the estimated settlements.
- Embankment construction must be carried out in accordance with Special Provision No. 206S03 “Amendment to OPSS 206, December 1993” dated November 2006. The embankment material should consist of Select Subgrade Material (SSM) in compliance with Special Provision No. 110F13, “Amendment to OPSS 1010, November 2003” March 2004.

- All new embankment fill must be placed in regular lifts and be compacted in accordance with Special Provision No. 105S10 “Amendment to OPSS 501, February 1996” dated November 2004.
- Where new embankment fill is placed against existing embankment slopes or on a sloping ground surface, the existing slope must be benched in accordance with OPSD 208.010.
- Vegetation cover must be established on all exposed earth slopes to protect against surficial erosion in accordance with Special Provision 572S01.

10 DEEP CUT

10.1 Stability Analysis Results

Deep cuts, to a maximum depth of 8.0 m, are required at some locations to construct the new Highway 7 alignment. Based on the stratigraphy encountered at this site, the soils typically consist of compact sand and gravel fill overlying native loose to dense sand, very stiff to hard silty clay till and loose to very dense sandy silt till. It is anticipated that the base of the cut will consist of compact to very dense sandy silt till and hard silty clay till. Preliminary assessment of the global stability of the cut sections has indicated that the proposed cuts will be safe in the soils encountered in the course of the investigation.

10.2 Deep Cut Design

Based on the design information currently available, the following preliminary design recommendations are provided for deep cut design:

- Deep cuts must be designed with side slopes no steeper than 2H:1V
- For cuts deeper than 8 m, a 2 m wide, mid-height bench must be incorporated in the design. (None is identified at present).
- Adequate drainage of the cut must be provided (see discussion below)
- Vegetation cover must be established on all exposed earth slopes to protect against surficial erosion in accordance with Special Provision 572S01.

Permanent drainage of the cut slope is required. Roadside ditches are expected to provide an adequate level of permanent drainage in most areas. An interceptor ditch should be provided at the top of the cut as per OPSD 200.020.

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

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

Alignment/ Roadway	Approx. Station	Length (m)	Depth of Cut (m)	Base of cut elevation	Ground water depth (m)	Ground water elev.	Borehole	Appendix
Hwy 7 New	25+100 – 25+200	100	5.0 – 6.0	324.0 to 326.0	2.9	328.1	08-120, 08-121	A
Hwy 7 New	26+520 – 26+780	260	5.0 – 8.0	325.0 to 327.5	1.6	330.9	08-134, 08-135, 08-136, 08-138	B

During the detail design phase of the project, the final grades of the highway cut sections must be reviewed with respect to the local groundwater levels and the composition of the soils exposed in the face of the cut. At that time, specific recommendations should be prepared regarding the treatment of the slopes and provision of drainage. Slope treatments could include such measures as gravel sheeting and possibly the provision of interceptor drains. There is no indication in the preliminary investigation that slope flattening will be required.

The above recommendations for cuts and fills are consistent with the recommendations for nearby or adjacent structures.

10.3 Construction Considerations

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

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

Temporary drainage of the cuts should be provided to maintain a relatively dry, stable excavation. Measures may include temporary drainage ditches or gravel sheeting to maintain surficial stability before permanent drainage measures are in effect.

11 CONSTRUCTION CONCERNS

Based on the Recommended Alignment and the preliminary geotechnical information, potential construction concerns include, but are not necessarily limited to:

- The Contract Administrator (CA) should employ experienced geotechnical staff to observe activities related to embankment construction and advise the CA on construction concerns or issues related to embankment stability or settlement.
- Inspection and confirmation that all topsoil and organic material within the proposed embankment footprints are sub-excavated and replaced with approved backfill.
- Cobbles and boulders should be expected within the till layers during excavation. Provision must be made for the removal of cobbles and boulders.

12 INVESTIGATION FOR DETAIL DESIGN

During the detail design phase of the project, the design team must review the available geotechnical information and decide on what additional information may be required. Typically, additional boreholes will be required if the horizontal or vertical alignment changes from that used to develop the preliminary investigation.

In particular, additional boreholes may be required in areas where the cut will penetrate below the groundwater level in order to fully delineate areas that may require slope treatments such as gravel sheeting. These boreholes must include piezometer installation and groundwater level/pressure monitoring.

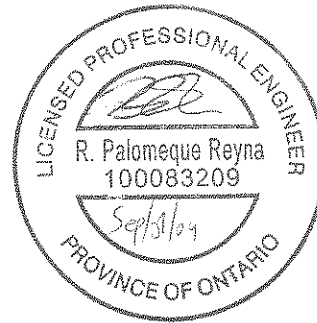
13 CLOSURE

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

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

Thurber Engineering Ltd.

Rocio Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer



Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer



P. K. Chatterji, P.Eng.,
Review Principal



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

Alignment/ Roadway	Approx. Station	Length (m)	Depth of Cut (m)	Height of Fill (m)	Borehole	Soil Stratigraphy		Berm Req.	Groundwater depth (m)	Settlement Analysis			Appendix
						Soil Type – Depth to the base of soil layer (m)	Relative Density or Consistency			Settlement Foundation ⁽¹⁾ (mm)	Embankment Compression (mm)	Total (mm)	
Hwy 7 New	25+100 – 25+200	100	5.0 – 6.0	-	08-120, 08-121	Topsoil – 450 mm Sandy Silt – 1.5 Sand – 3.0 Silty Clay – 6.3 Sandy Silt Till – 9.8	- Loose to compact Loose to compact Very stiff to hard Very dense	N	2.9	-	-	-	A
Hwy 7 New	26+520 – 26+780	260	5.0 – 8.0	-	08-134,08-135, 08-136,08-138	Sand, Gravel and Silt Fill – 1.4 Sand – 1.4 Silty Clay Till – 5.5 and 8.1 Sandy Silt Till – >11.1	Compact Loose to dense Very stiff to hard Loose to very dense	N	1.6	-	-	-	B
Hwy 7 New	27+600 – 27+760	160	-	4.5 – 6.0	08-149,08-150, 08-151	Peat – 800 mm Sand and Clayey Silt – 2.2 Sandy Silt and Gravelly Sand – 3.0 Sand and Gravel – 5.6 Sandy Silt Till – 6.7	- Loose /Firm to stiff Compact Compact to dense Compact to very dense	N	0.5 to 4.3	15 to 20	60	75 to 80	C
Hwy 7 New	28+500 – 28+560	60	5.0	-	08-158, 08-156	Sand Fill- 500 mm Clayey Silt – 1.2 Sand – 8.2 Silty Clay Till/Clayey Silt Till – 17.7 Sandy Silt Till – 21.4	- Firm to very stiff Compact to very dense Stiff to hard Very dense	N	-	-	-	-	D
Hwy 7 New	30+040 – 30+140	100	-	5.0	08-171	Topsoil – 200 mm Silty sand – 1.2 Sandy Silt Till – 4.6	- Loose Compact to very dense	N	-	15	50	65	E
Reg. Road 30 – N/S-E Ramp	10+070 – 10+115	45	-	4.50 –5.50	08-159	Topsoil – 200 mm Silty Clay Fill – 1.4 Silty Clay Till- 4.1 and 15.7 Sandy silt till – 5.6 and 20.0	- Stiff Very stiff to hard Very dense	N	-	10	55	65	F
Reg. Road 30 – E-N/S Ramp	10+374 – 10+419	45	1.0 –1.50	-	08-153	Clayey Silt Fill – 0.8 Clayey Silt Till – 4.0 Silty Clay Till – 6.4	Stiff Very stiff to hard Hard	N	2.0	10	55	-	G
Reg. Road 30 – N/S-W Ramp	10+000 – 10+035	35	-	4.50 -5.50	08-152	Topsoil – 175 mm Sand – 1.4 Sandy Silt Till – 6.7	- Compact Compact to very dense	N	-	10	55	65	H

• Settlements are expected to be completed within 3 months following embankment construction.
• ⁽¹⁾ Immediate settlement and during construction

Appendix A

**Hwy 7 New
Station 25+100 – 25+200
(Boreholes 08-120, 08-121)**

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

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽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

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

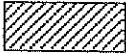
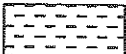



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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

RECORD OF BOREHOLE No 08-120

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 817 106.5 E 230 586.3 ORIGINATED BY LH
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.01.14 - 2009.01.14 CHECKED BY RPR

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				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL		
20 40 60 80 100			20 40 60			WATER CONTENT (%)						
331.0												
0.0	TOPSOIL (300mm)											
330.7												
0.3	SAND, trace silt, trace clay, oxidized staining Loose to Compact Brown Moist to Wet		1	SS	18							
			2	SS	6							
			3	SS	19							0 92 8 (SI+CL)
			4	SS	19							
328.0												
3.0	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Brown (TILL)		5	SS	18							
			6	SS	38							0 18 53 29
324.7			7	SS	66							
6.3	Sandy SILT, trace clay, oxidized staining Very Dense Brown Moist to Wet (TILL)											
			8	SS	23							0 52 43 5
	Layer of silty clay till (700mm)											
	Grey Wet											
			9	SS	52							0 46 49 5
321.2	Silty sand layers											
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

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

ONTMT4S 6417.GPJ 3/23/09

RECORD OF BOREHOLE No 08-120

2 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 817 106.5 E 230 586.3 ORIGINATED BY LH
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.01.14 - 2009.01.14 CHECKED BY RPR

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						
							20	40	60	80	100	20	40	60
	Continued From Previous Page													
	WATER LEVEL AT 7.3m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 09/19/02 2.9 328.1													

RECORD OF BOREHOLE No 08-121

1 OF 1

METRIC

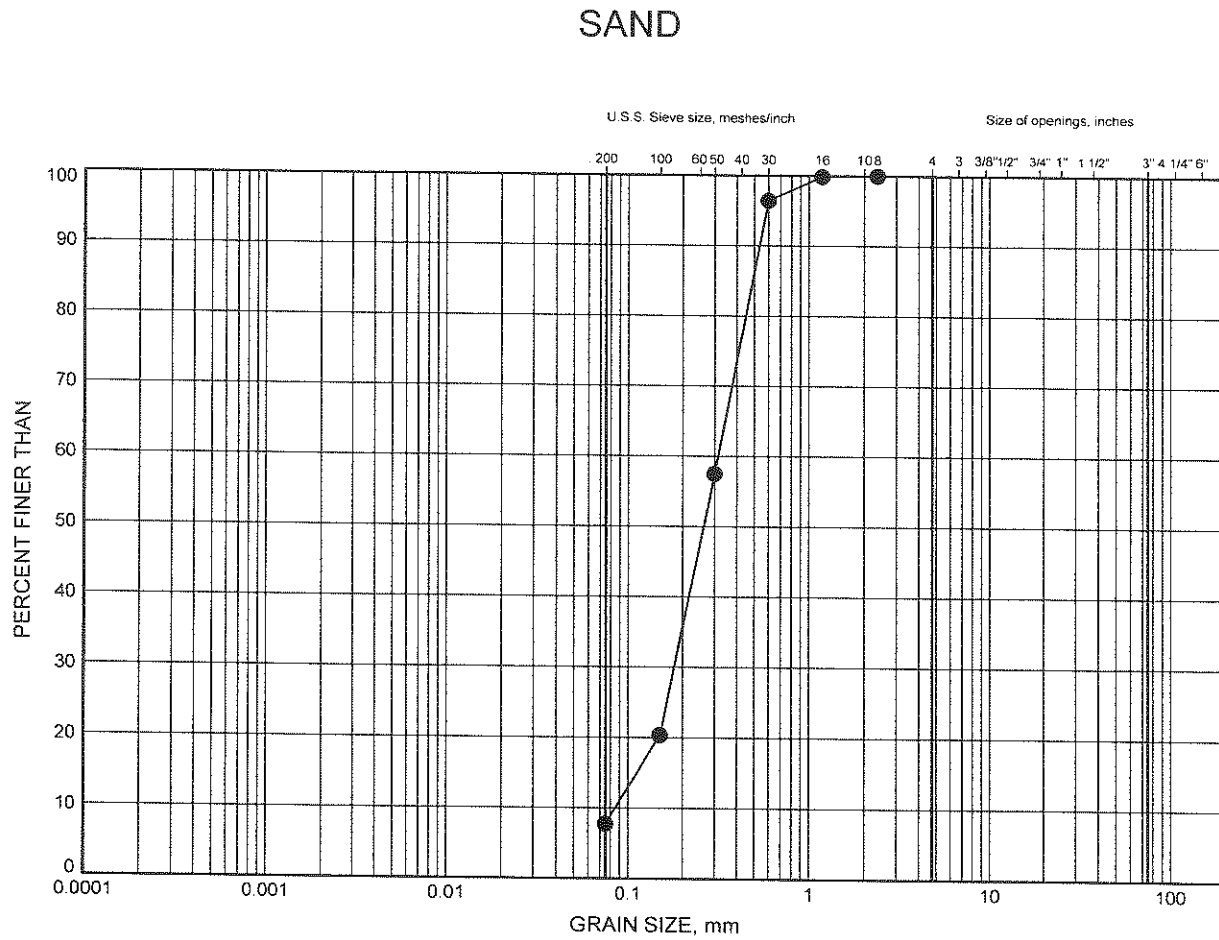
G.W.P. 408-88-00 LOCATION N 4 817 138.7 E 230 680.9 ORIGINATED BY LH
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.01.14 - 2009.01.14 CHECKED BY RPR

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		PLASTIC LIMIT w _p			NATURAL MOISTURE CONTENT w	
							○ UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL x LAB VANE							
							20 40 60 80 100		20 40 60					
330.0														
0.0	TOPSOIL (450mm)						330							
329.5														
0.5	Sandy SILT, trace clay, occasional organics, oxidized staining Loose to Compact Dark Brown Moist to Wet		1	SS	10									
			2	SS	23		329							
328.5														
1.5	Sandy SILT, trace clay, occasional oxidized staining Dense to Very Dense Brown Moist (TILL)		3	SS	35		328					0 42 49 9		
			4	SS	69									
							327							
			5	SS	63									
							326							
			6	SS	42		325							
							324					0 62 35 3		
			7	SS	26									
							323							
			8	SS	100/ 0.225									
321.9														
8.1	END OF BOREHOLE AT 8.1m. WATER LEVEL AT 6.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.													

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

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE A1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-120	1.83	329.17

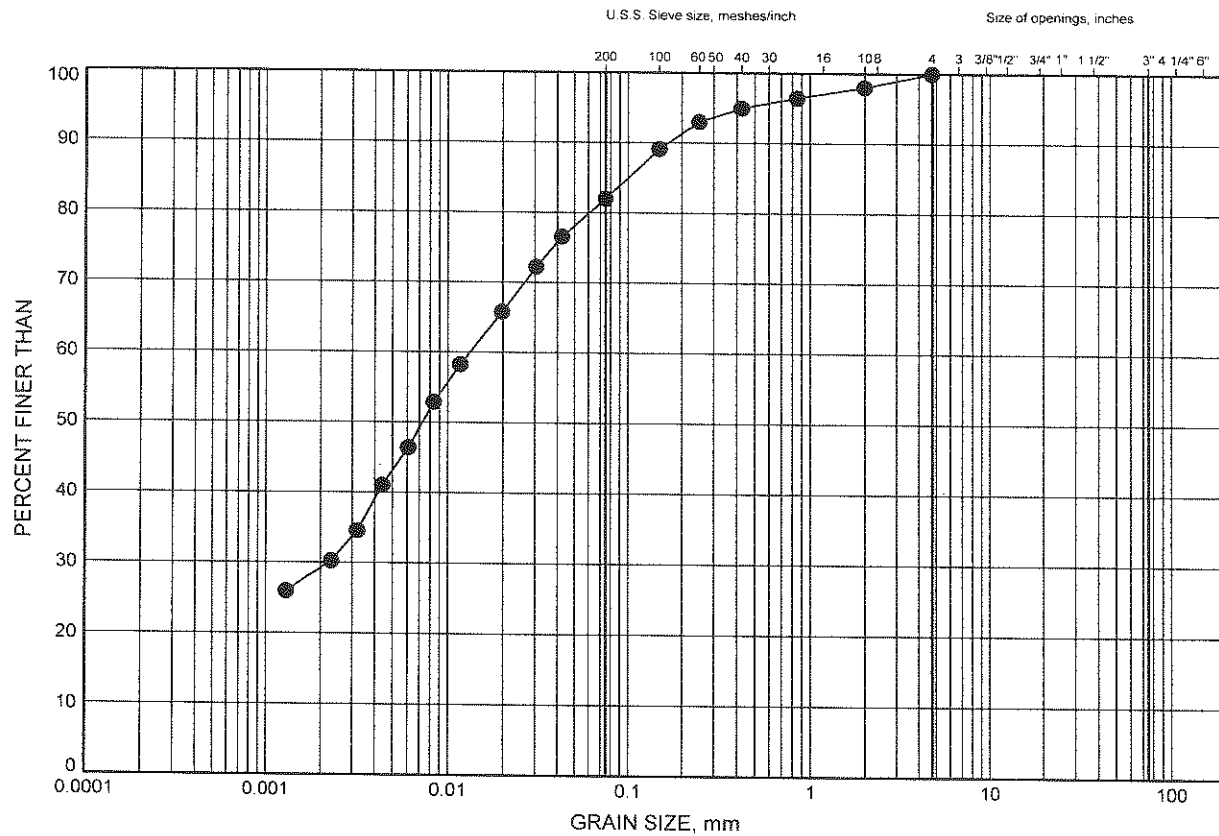


W.P.# 408-88-00
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Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE A2

SILTY CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-120	4.88	326.12

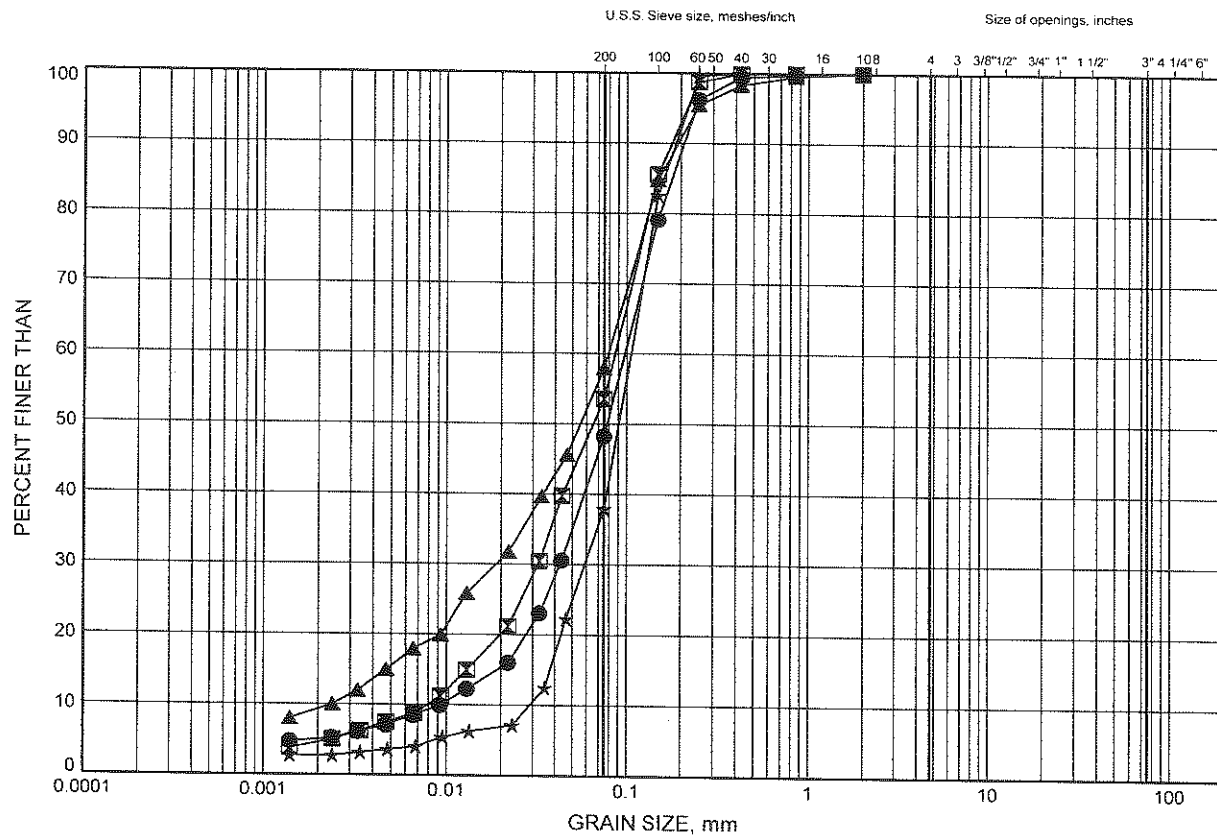


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Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE A3

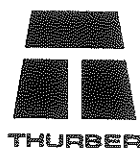
SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-120	7.77	323.23
⊠	08-120	9.45	321.55
▲	08-121	1.83	328.17
★	08-121	6.40	323.60

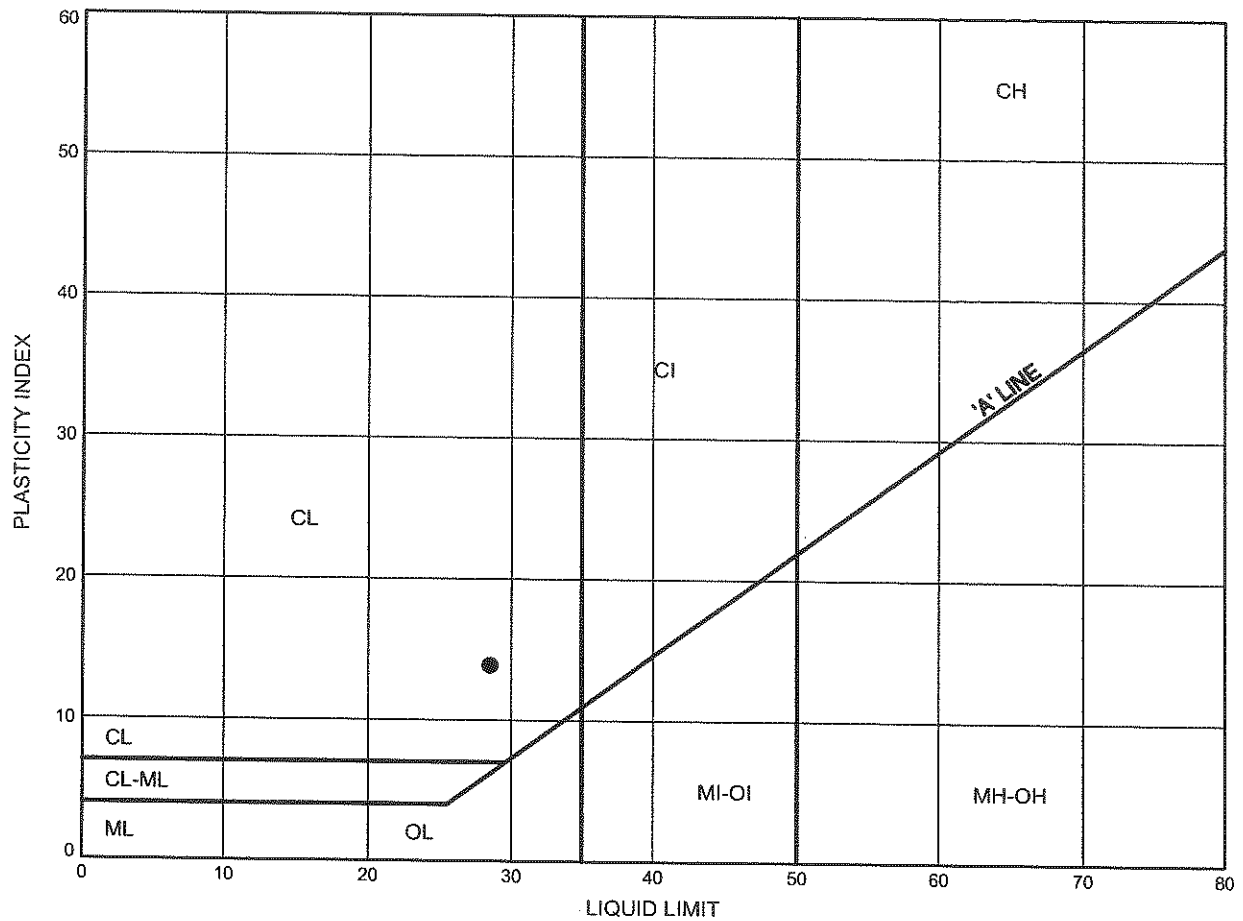


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE A4

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-120	4.88	326.12

Date March 2009

Project 408-88-00



Prep'd AN

Chkd. RPR

Appendix B

**Hwy 7 New
Station 26+520 – 26+780
(Boreholes 08-134, 08-135, 08-136, 08-138)**

**Record of Borehole Sheets
Laboratory Test Results
Site Photograph
Drawing titled “Borehole Locations and Soil Strata”**

RECORD OF BOREHOLE No 08-134

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 817 970.12 E 231 673.58 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 CHECKED BY RPR

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			20	40	60	80	100		
327.9														
0.0	SAND, some gravel, some silt, trace rootlets Dense Brown Moist to Wet		1	SS	42		327							
326.5														
1.4	Silty CLAY, trace sand Very stiff to hard Brown to Grey (TILL)		2	SS	25		326							
			3	SS	49		325							
			4	SS	45		324							
			5	SS	66		323							
322.4														
5.5	Sandy SILT, some clay, trace gravel Very Dense Grey Moist (TILL)		6	SS	100/ 175		322							
	Moist to Wet		7	SS	100/ 150		321							
	Hard to auger						320							
			8	SS	100/ 125		319							
	Clayey zone													
							318							

Continued Next Page

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

METRIC

SOIL PROFILE						DYNAMIC CONE PENETRATION RESISTANCE PLOT											UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)									
						20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L							
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								γ	kN/m³	GR SA SI CL				
Continued From Previous Page																				
317.6	Sandy SILT, some clay, trace gravel, occasional cobbles																			
10.3	Very Dense Grey Moist (TILL)																			
	END OF BOREHOLE AT 10.3m. AUGER REFUSAL AT 10.1m UPON PROBABLE BEDROCK OR BOULDER. AUGER GRINDING AT 10.2m. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL AND CUTTINGS TO SURFACE.				317															

RECORD OF BOREHOLE No 08-135

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 025.80 E 231 756.24 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 CHECKED BY RPR

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									
331.7 0.0	SAND, trace gravel, occasional rootlets, occasional cobbles Loose Brown Moist		1	SS	7		331										
330.2 1.4	Sandy SILT, trace gravel, trace clay Loose to Very Dense Brown Moist to Wet (TILL)		2	SS	8		330										1 45 46 8
			3	SS	83		329										
	occasional cobbles Grey		4	SS	100/ 275		328										
			5	SS	79		327										4 42 41 13
			6	SS	78		326										
			7	SS	100/ 200		324										1 32 59 8
			8	SS	100/ 250		323										
	Clayey zone						322										0 34 50 16

Continued Next Page

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

RECORD OF BOREHOLE No 08-135

2 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 025.80 E 231 756.24 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 CHECKED BY RPR

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			20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
	Continued From Previous Page							SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
								20 40 60 80 100	20 40 60 80 100	WATER CONTENT (%)				
320.6	Sandy SILT, some clay, trace gravel Very Dense Grey Moist to Wet (TILL)		9	SS	100/ 476		321							
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE OPEN TO 11.0m AND WATER LEVEL AT 9.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.													

RECORD OF BOREHOLE No 08-136

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 106.64 E 231 895.17 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 CHECKED BY RPR

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							WATER CONTENT (%)
								20 40 60 80 100		PLASTIC LIMIT w _p		NATURAL MOISTURE CONTENT w			
330.5															
0.0	SAND, some silt, trace gravel, occasional rootlets Brown Moist														
329.9															
0.6	Sandy SILT, some clay, trace gravel Loose to Compact Brown (TILL)		1	SS	7		330								
			2	SS	30		329								
			3	SS	20		328								
	Very Dense		4	SS	58		327								
	Layer of grey silt		5	SS	100/ 275		326								
			6	SS	100/ 260		325								
							324								
323.5															
7.0	Silty CLAY, trace sand Hard Grey (TILL)						323								
322.5			7	SS	100										
8.1	END OF BOREHOLE AT 8.1m. BOREHOLE OPEN TO 8.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL AND AUGER CUTTINGS TO SURFACE.														

ONTMT4S 6417R.GPJ 3/23/09

+ 3 X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-138

2 OF 2

METRIC

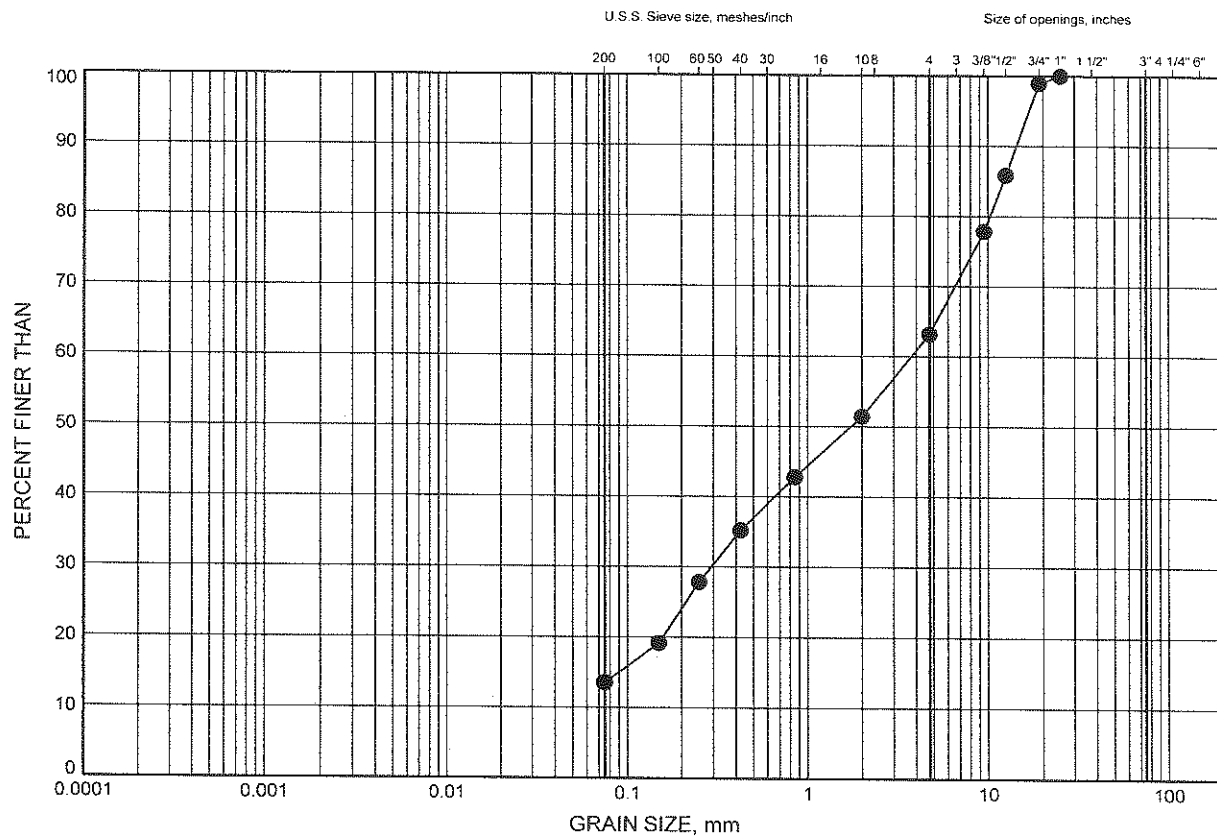
G.W.P. 408-88-00 LOCATION N 4 818 075.48 E 231 835.90 ORIGINATED BY SLL
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 2008.05.28 - 2008.05.28 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	20	40	60			
	Continued From Previous Page																
321.4	Sandy SILT, some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		9	SS	100/ 275											1 21 62 16	
11.1	END OF BOREHOLE AT 11.1m. BOREHOLE DRY ON 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) 2008.05.28 5.9 326.6 2008.07.23 1.6 330.9																

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1

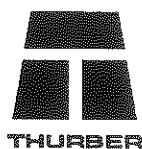
SAND & GRAVEL (FILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-138	0.13	332.33

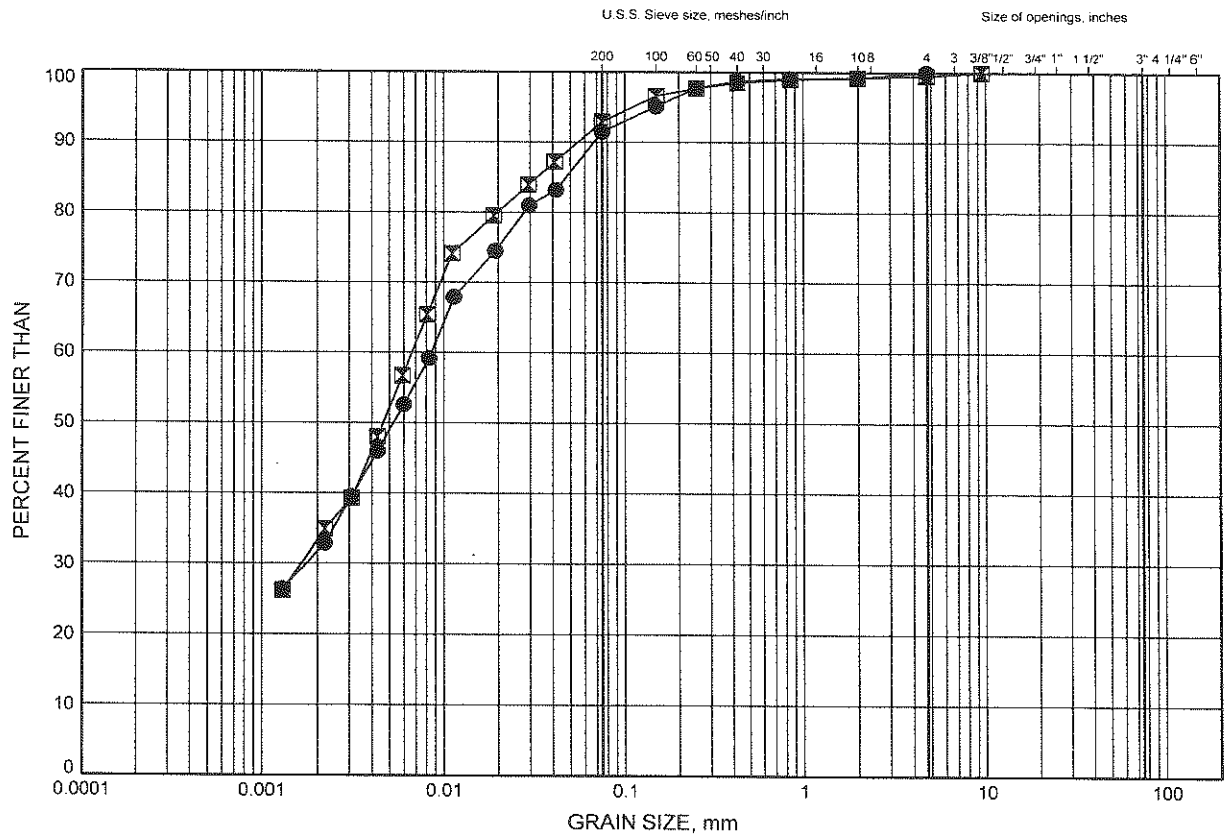


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY (TILL)



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

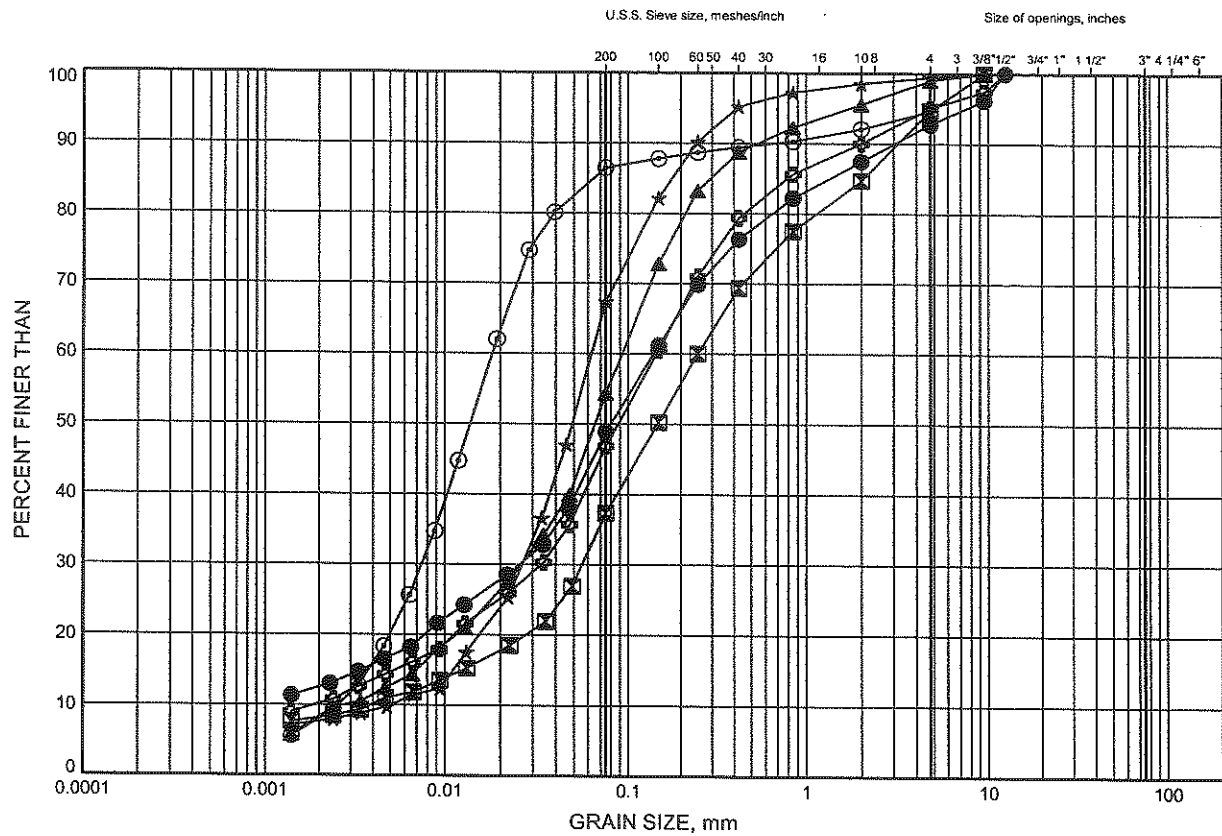
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-134	3.35	324.55
⊠	08-136	7.85	322.67

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B3

SANDY SILT TILL



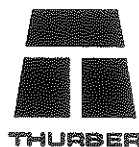
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-134	6.26	321.64
■	08-134	7.77	320.13
▲	08-135	1.83	329.83
★	08-135	7.80	323.86
⊙	08-136	4.80	325.72
⊗	08-138	1.83	330.63

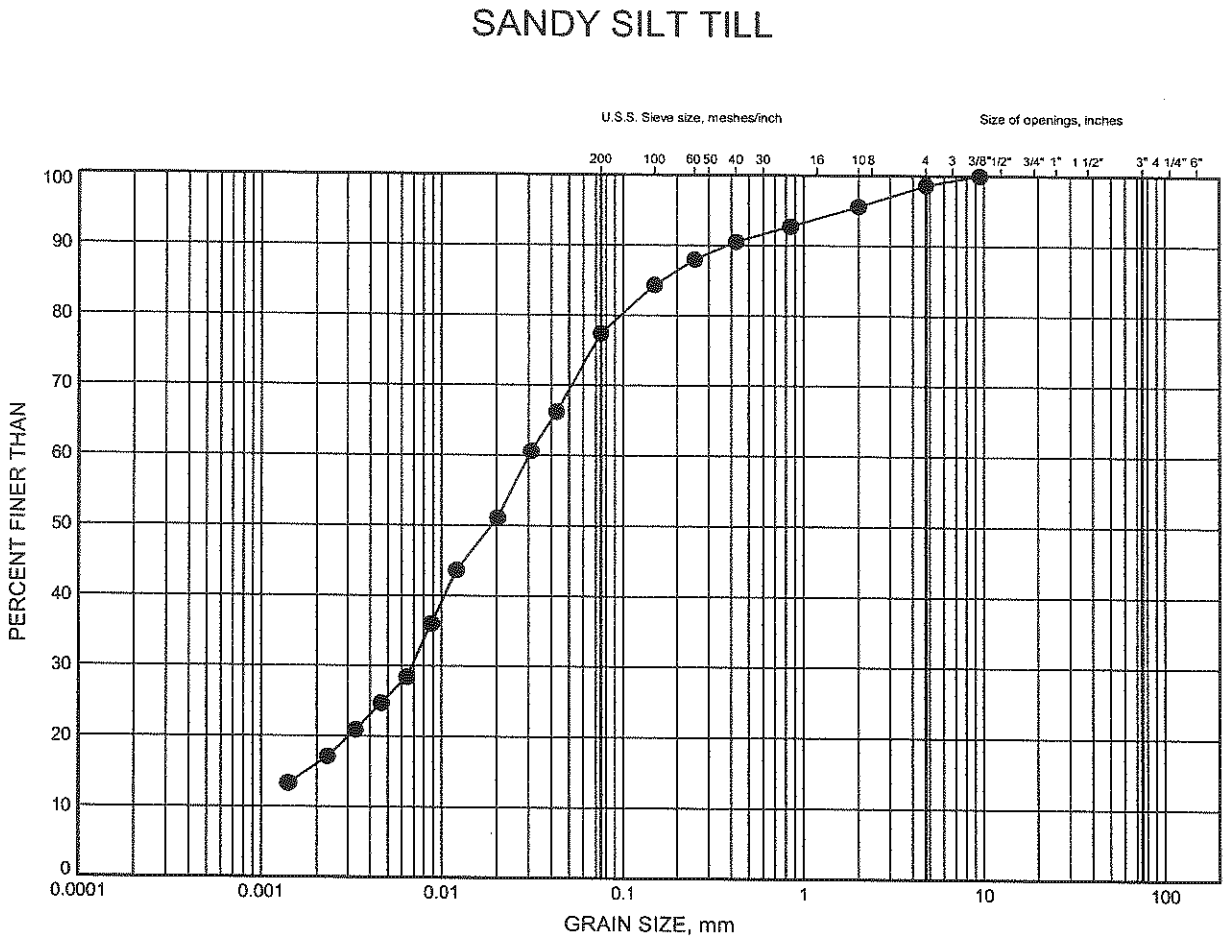
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/24/08

W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-138	10.90	321.56

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/24/09

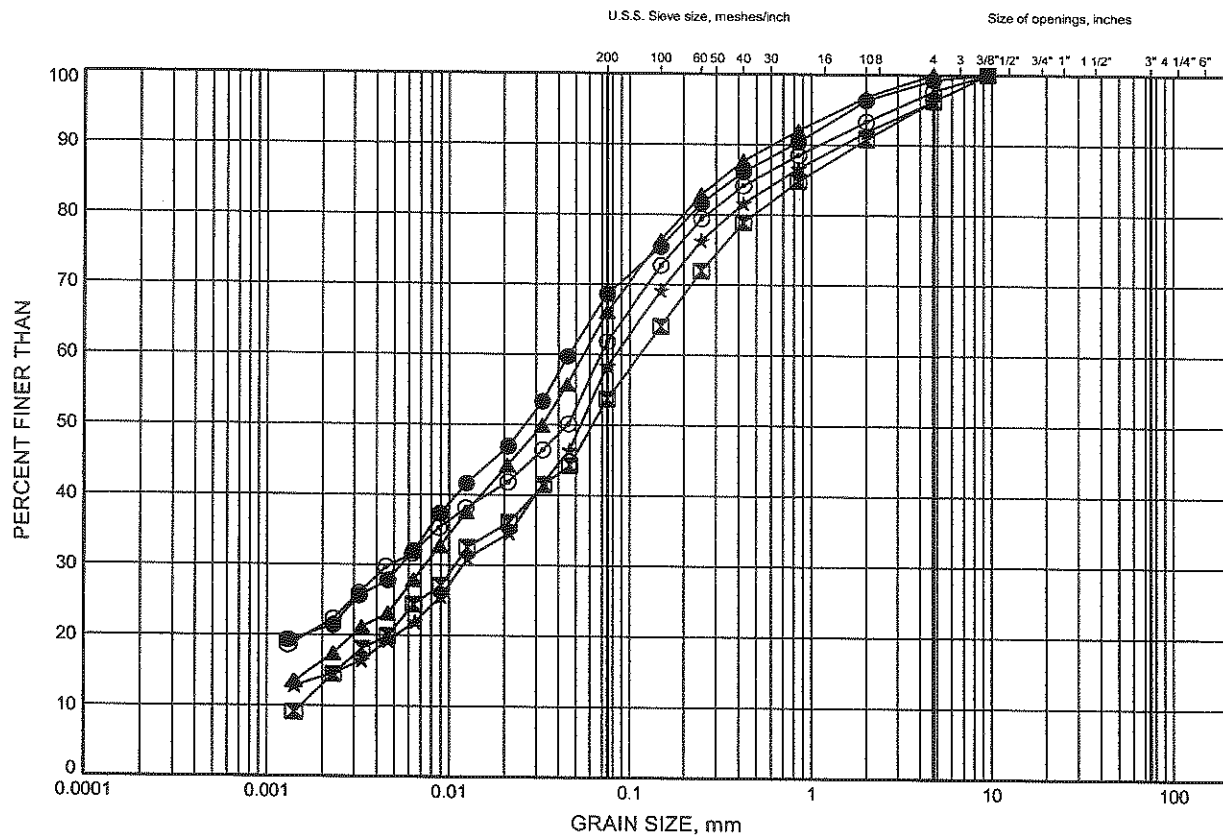
W.P.# .408-88-00.....
Prepared By .AN.....
Checked By .RPR.....



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B5

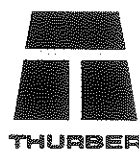
SANDY SILT TILL (Clayey Zone)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-134	9.28	318.62
⊠	08-135	4.86	326.79
▲	08-135	9.35	322.31
★	08-136	2.74	327.77
⊙	08-138	6.40	326.06

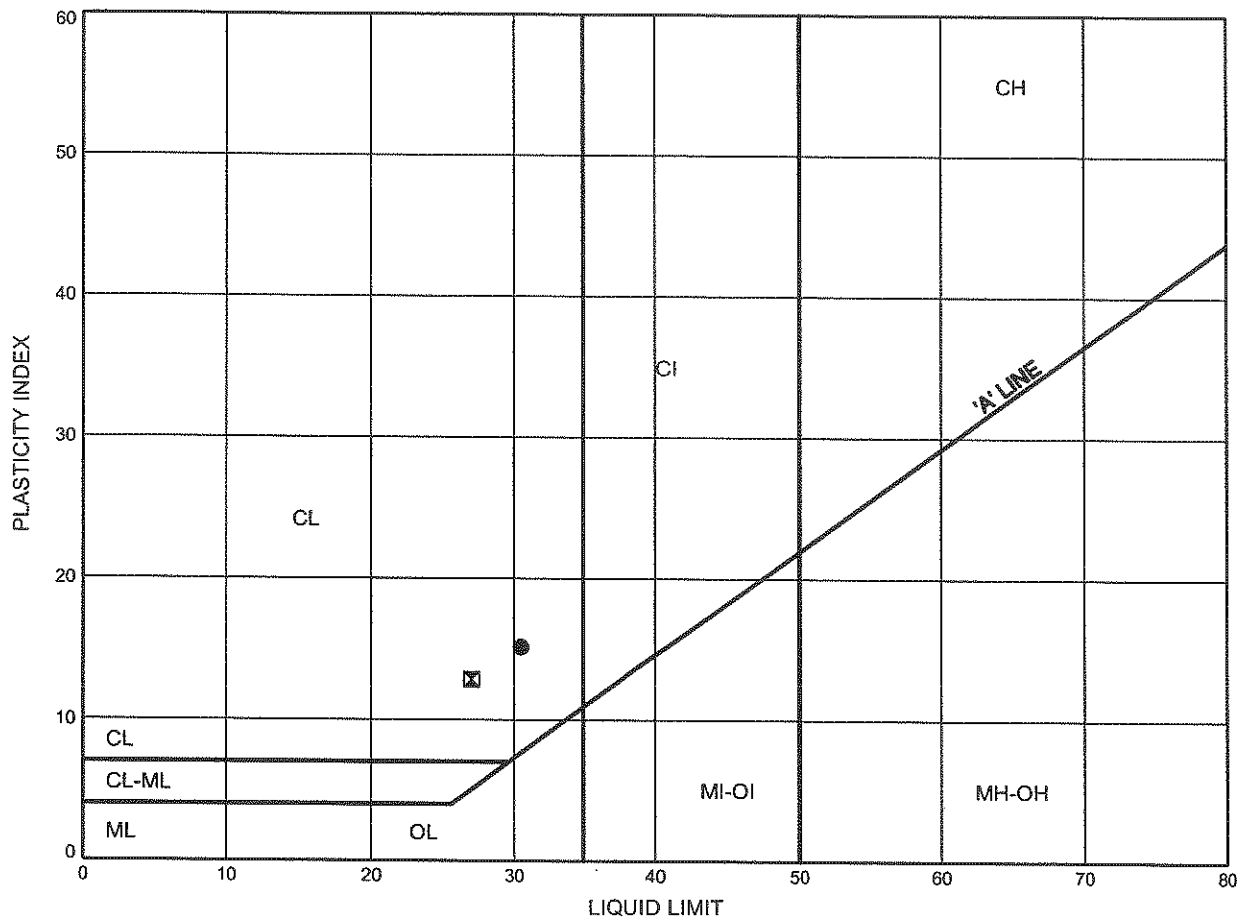


W.P.# 408-88-00
Prepared By .AN.
Checked By .RPR.

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B6

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-134	3.35	324.55
⊠	08-136	7.85	322.67

Date April 2009
Project 408-88-00

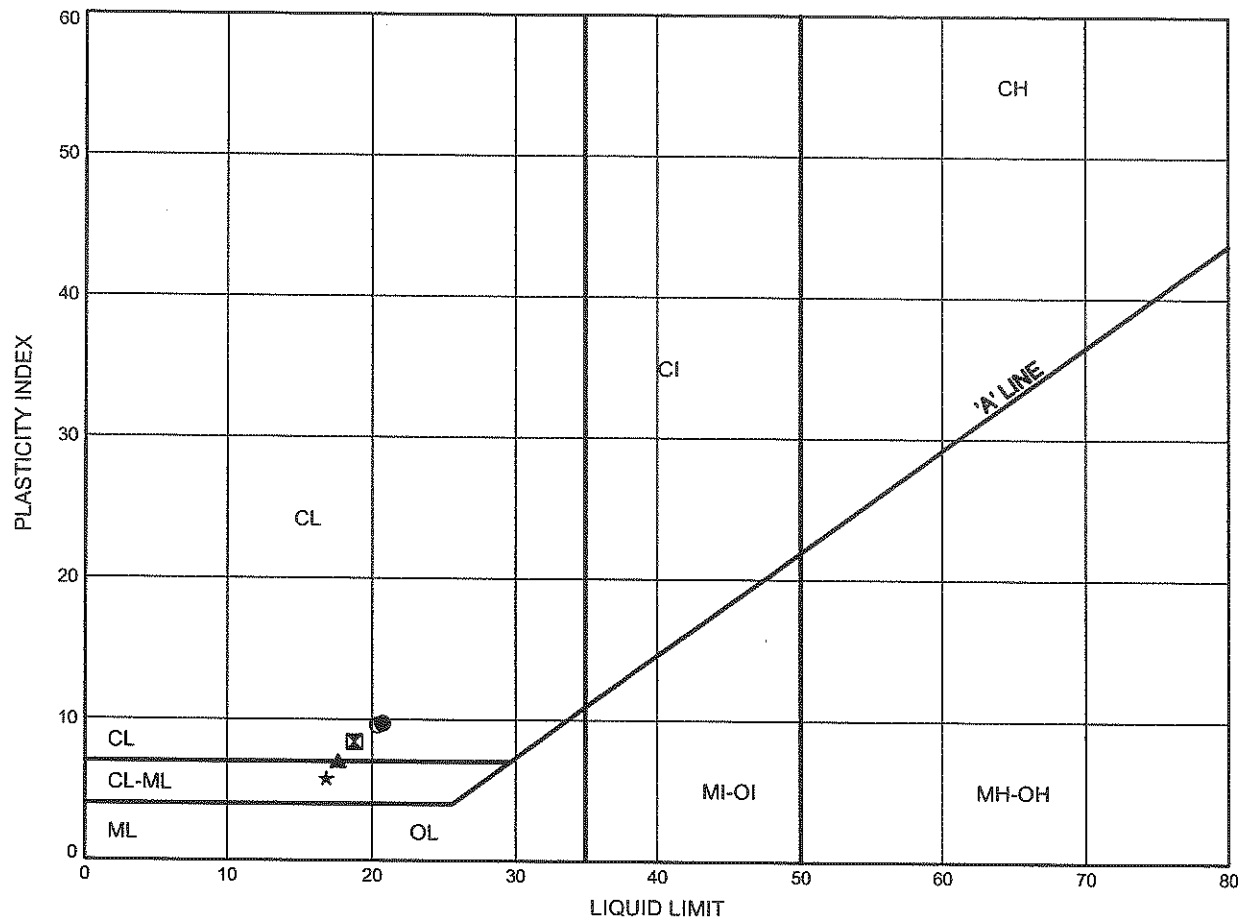


Prep'd AN
Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

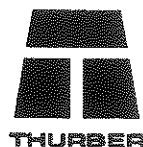
FIGURE B7

SANDY SILT TILL (Clayey Zone)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-134	9.31	318.60
⊠	08-135	4.86	326.79
▲	08-135	9.35	322.31
★	08-136	2.74	327.77
⊙	08-138	6.39	326.07

Date April 2009
Project 408-88-00

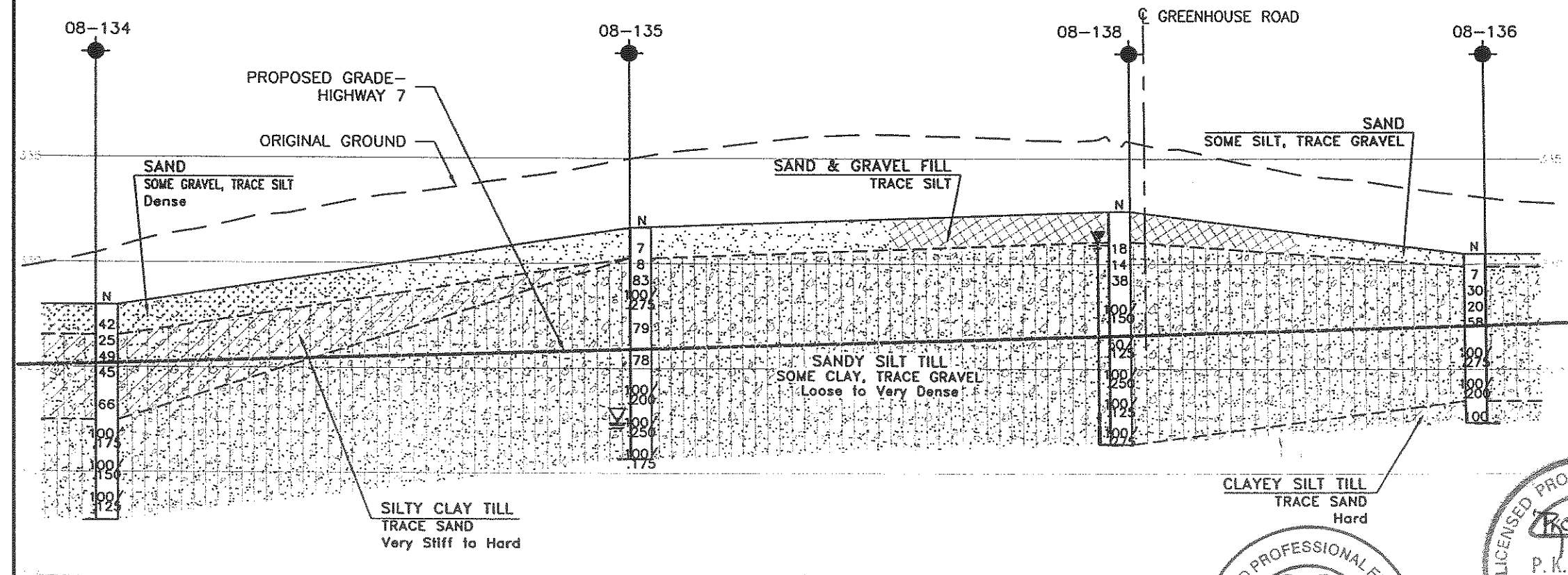
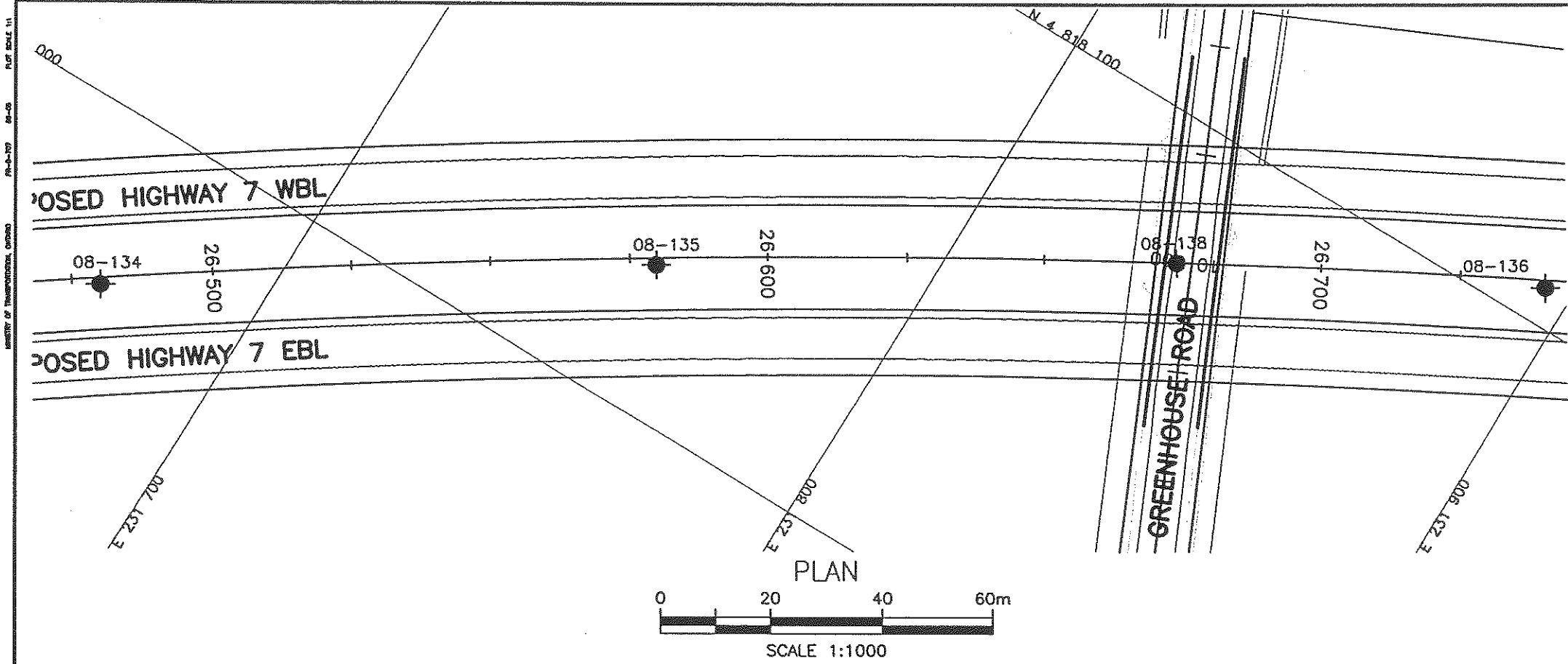


Prep'd AN
Chkd. RPR

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph



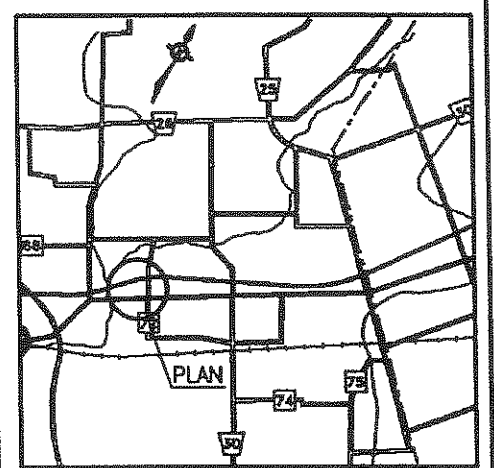
Photo - Looking north along Greenhouse Road



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

CONT No GWP No 408-88-00	SHEET
HIGHWAY 7 RECOMMENDED ROUTE 26+520 TO 26+780 BOREHOLE LOCATIONS AND SOIL STRATA	

THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

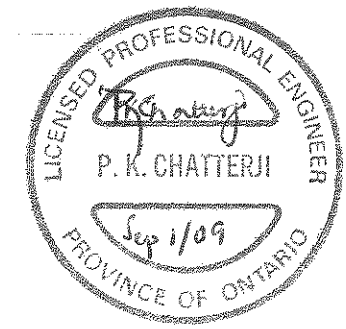
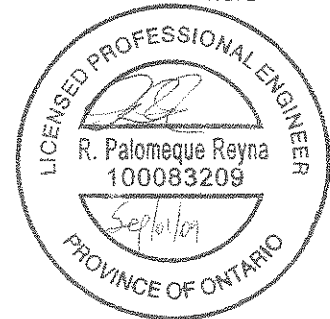
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-134	327.9	4 817 970.1	231 673.6
08-135	331.7	4 818 025.8	230 756.2
08-136	330.5	4 818 106.6	231 895.2
08-138	332.5	4 818 075.5	231 235.9

NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Proposed grades are from Plate 9 of the E.A. Study.

GEOCREs No. 40P8-171



DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

Appendix C

**Hwy 7 New
Station 27+600 – 27+760
(Boreholes 08-149, 08-150, 08-151)**

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

RECORD OF BOREHOLE No 08-149

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 407.26 E 232 646.02 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.27 - 2008.05.27 CHECKED BY RPR

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
325.4							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

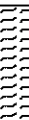
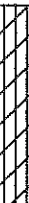



+³, X³: Numbers refer to Sensitivity
 20
 15-5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-150

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 432.64 E 232 715.80 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.29 - 2008.05.29 CHECKED BY RPR

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										
323.0							20 40 60 80 100											
0.0	PEAT, fibrous, occasional roots and wood fragments Soft Black (800mm)		1	AS		▽	323											
322.2																		
0.8	Clayey SILT, some sand Firm to Stiff Dark Brown		1	SS	4		322											
			2	SS	12													
320.8							321											
2.2	Sandy SILT, trace clay Compact Brown Wet		3	SS	22													
320.0																		
3.0	SAND and GRAVEL, trace silt, trace clay Compact to Dense Grey Wet		4	SS	33		320											
			5	SS	26		319											
							318											
317.4																		
5.6	SAND, some silt Compact Grey Wet		6	SS	20		317											
316.3																		
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 0.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL TO SURFACE.																	

+ 3, X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

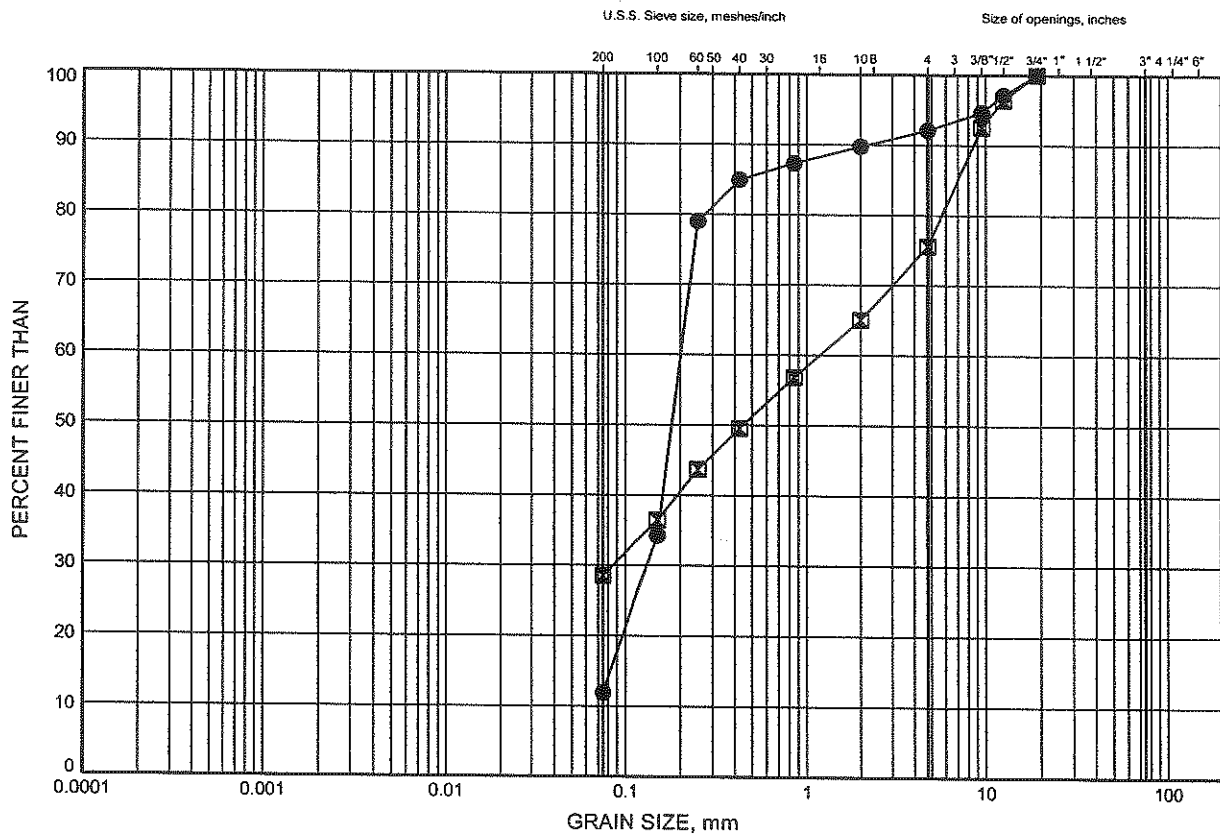
METRIC

+³, ×³: Numbers refer to Sensitivity

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE C1

SAND & GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-149	4.80	320.62
□	08-151	1.83	320.55

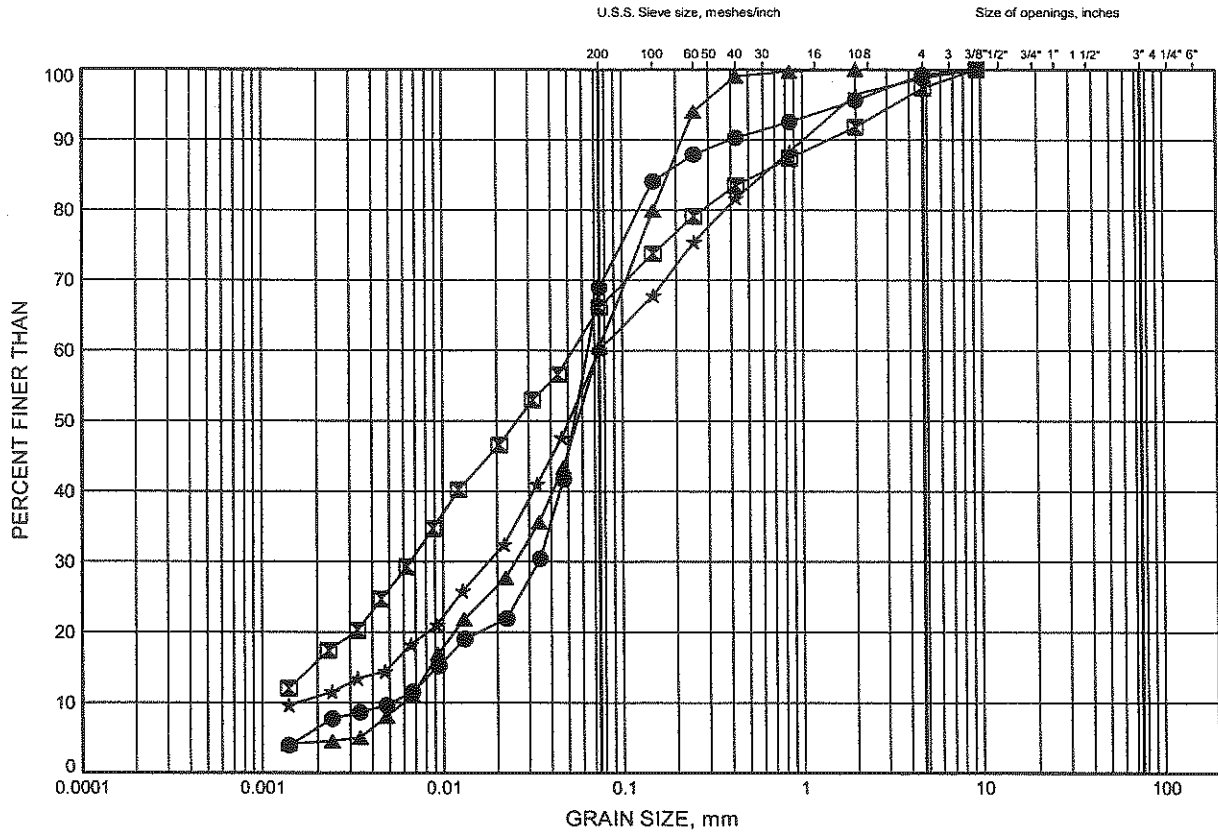


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE C2

SANDY SILT & SANDY SILT (TILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-149	3.35	322.06
⊠	08-149	6.40	319.02
▲	08-150	2.59	320.39
★	08-151	4.72	317.65

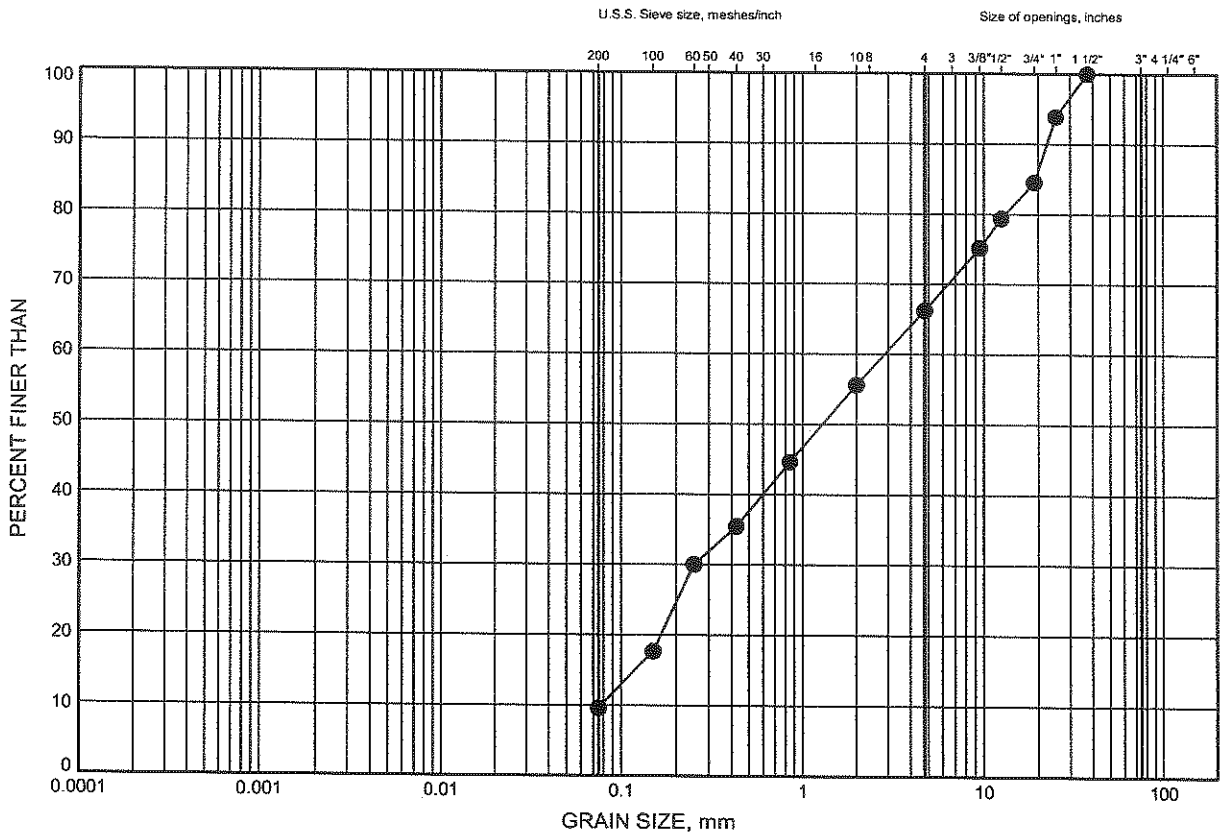


W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE C3

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-150	4.88	318.10

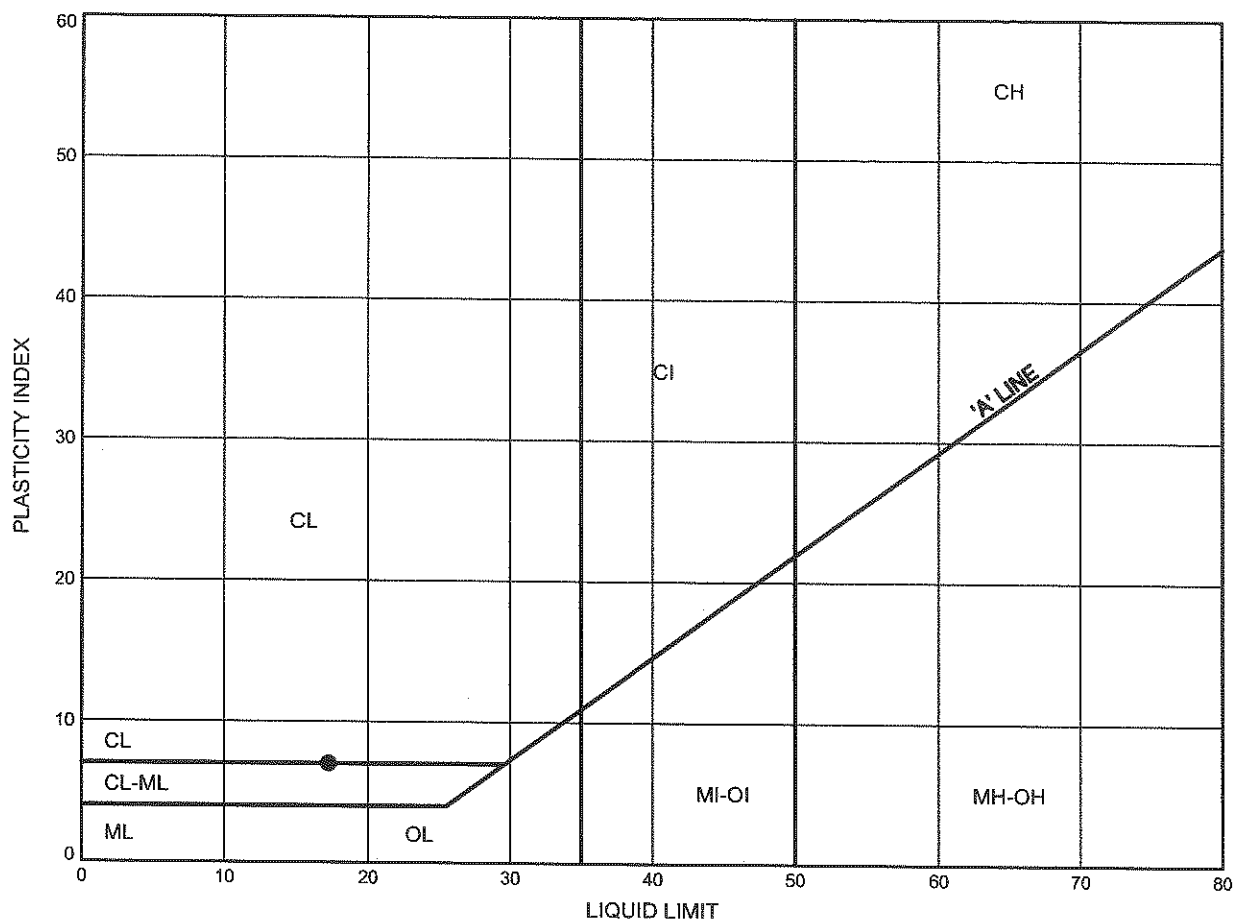


W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

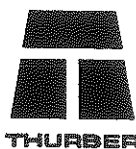
FIGURE C4

SANDY SILT (TILL) (Clayey Zone)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-149	6.40	319.02

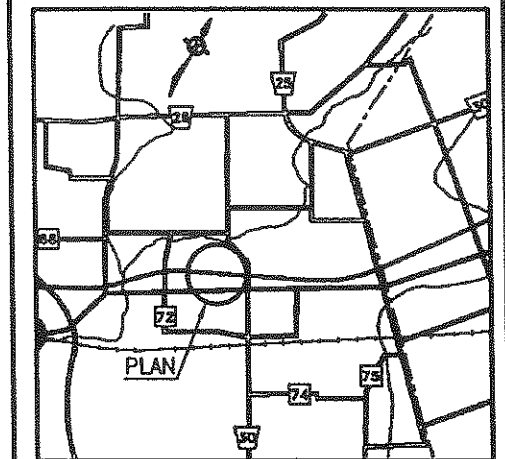
Date March 2009
Project 408-88-00



Prep'd AN
Chkd. RPR

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SHEET

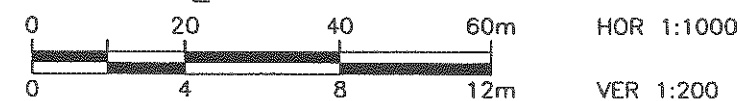
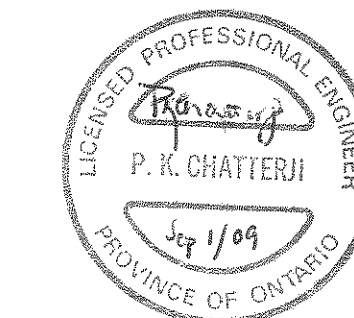


LEGEND

- [illegible]

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Proposed grades are from Plate 11 of the E.A. Study.

REVISIONS								
	DATE	BY	DESCRIPTION					
DESIGN	RPR	CHK	PKC	CODE	LOAD	DATE JUL 2009		
DRAWN	AN	CHK	AEG	SITE	STRUCT	DWG		



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix D

**Hwy 7 New
Station 28+500 – 28+560
(Boreholes 08-158, 08-156)**



**Record of Borehole Sheets
Laboratory Test Results
Site Photograph
Drawing titled “Borehole Locations and Soil Strata”**

RECORD OF BOREHOLE No 08-156

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 791.79 E 233 498.36 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.12.02 - 2008.12.02 CHECKED BY MEF

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE									
332.7																				
0.0	Clayey SILT, trace sand, occasional rootlets, occasional organics Firm to Very Stiff Black to Brown		1	SS	6															
331.5			2	SS	15															
1.2	SAND, some gravel, some silt, some clay Compact Brown Moist		3	SS	36												21 56 23 (SI+CL)			
			4	SS	27															
	trace gravel		5	SS	26												8 67 25 (SI+CL)			
	Very Dense Brown		6	SS	80															
			7	SS	55															
											</									

+³, X³: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-158

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

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						
								20 40 60 80 100						
330.0														
0.0	SAND, some gravel, some clay, occasional topsoil													
329.5	Dark Brown (FILL)													
0.5	Silty CLAY, some sand to sandy, trace gravel, occasional cobbles Stiff to Hard Brown (TILL)		1	SS	14									
			2	SS	40									
			3	SS	67									
			4	SS	74									
	Grey		5	SS	46									
			6	SS	83									
			7	SS	61									
	clay pockets													
	Layer of grey silt (500mm)													
320.7														
9.3	Clayey SILT, trace sand, trace gravel Very Stiff Grey: (TILL)		8	SS	20									

Continued Next Page

+³, X³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-158

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						x LAB VANE		
	Continued From Previous Page						20 40 60 80 100											
	Clayey SILT, trace sand Hard Grey (TILL)		9	SS	51										0 5 75 20			
			10	SS	125										0 7 78 15			
316.7																		
13.3	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)		11	SS	55													
			12	SS	31										1 6 35 58			
	Slow augering		13	SS	33													
312.3																		
17.7	Sandy SILT, some clay, trace gravel Very Dense Grey (TILL)		14	SS	100/ 175										4 42 39 15			
			15	SS	100/													

Continued Next Page

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

RECORD OF BOREHOLE No 08-158

3 OF 3

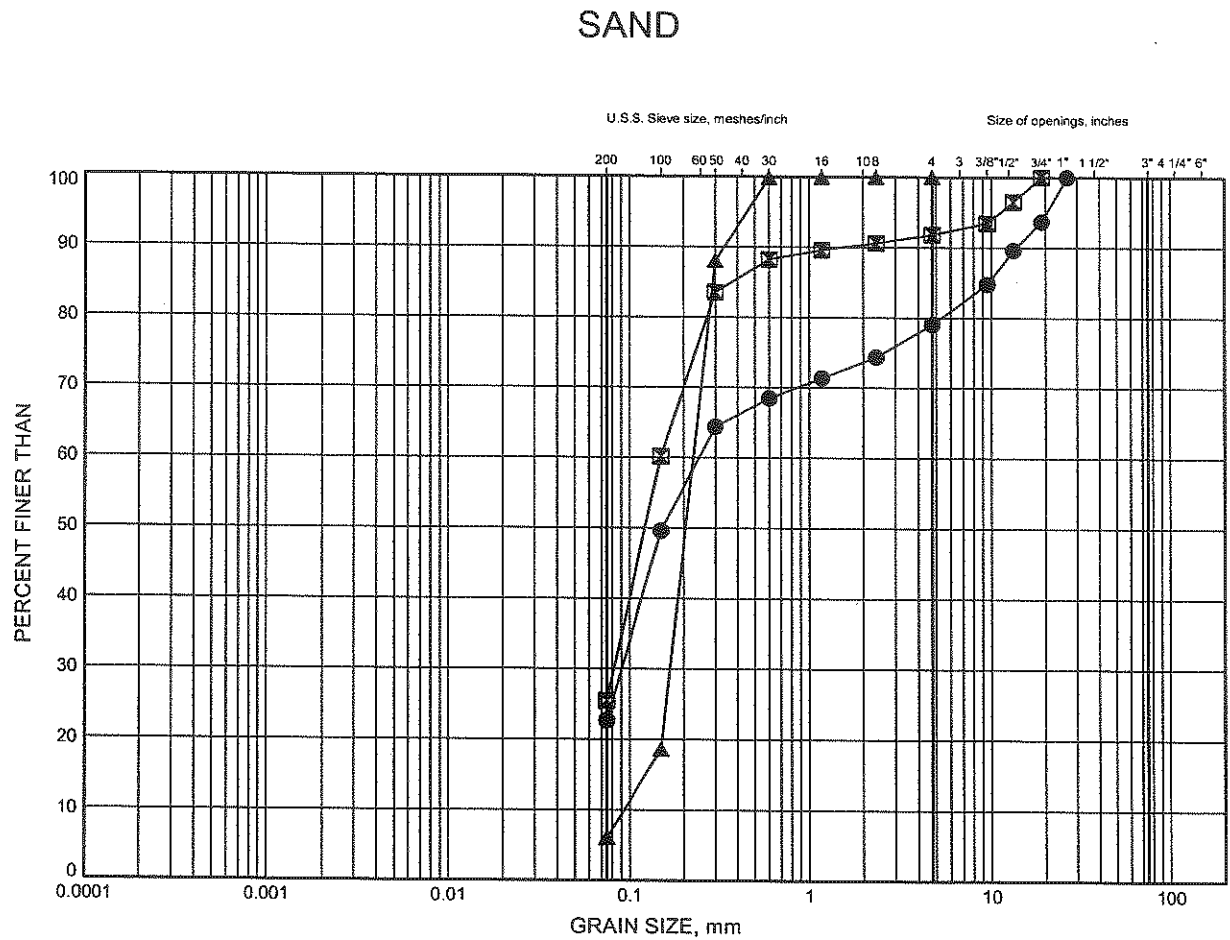
METRIC

G.W.P. 408-88-00 LOCATION N 4 818 713.04 E 233 462.61 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.22 - 2008.05.23 CHECKED BY RPR

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 x LAB VANE					WATER CONTENT (%)																				
						20	40	60	80	100	20	40	60																		
	Continued From Previous Page																														
	Sandy SILT, some clay, trace gravel Very Dense Grey (TILL)				.125																										
308.6			15	SS	100																										
21.4	END OF BOREHOLE AT 21.4m, AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH(m)</th> <th>ELEV.(m)</th> </tr> </thead> <tbody> <tr> <td>2008.05.28</td> <td>6.8</td> <td>323.2</td> </tr> <tr> <td>2008.06.02</td> <td>8.8</td> <td>321.2</td> </tr> <tr> <td>2008.07.15</td> <td>9.0</td> <td>321.0</td> </tr> <tr> <td>2008.08.20</td> <td>6.8</td> <td>323.2</td> </tr> </tbody> </table>	DATE	DEPTH(m)	ELEV.(m)	2008.05.28	6.8	323.2	2008.06.02	8.8	321.2	2008.07.15	9.0	321.0	2008.08.20	6.8	323.2				.100											
DATE	DEPTH(m)	ELEV.(m)																													
2008.05.28	6.8	323.2																													
2008.06.02	8.8	321.2																													
2008.07.15	9.0	321.0																													
2008.08.20	6.8	323.2																													

Highway 7 - New GRAIN SIZE DISTRIBUTION

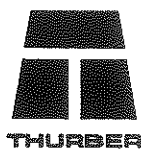
FIGURE D1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-156	1.83	330.90
⊠	08-156	3.35	329.37
▲	08-156	7.92	324.80

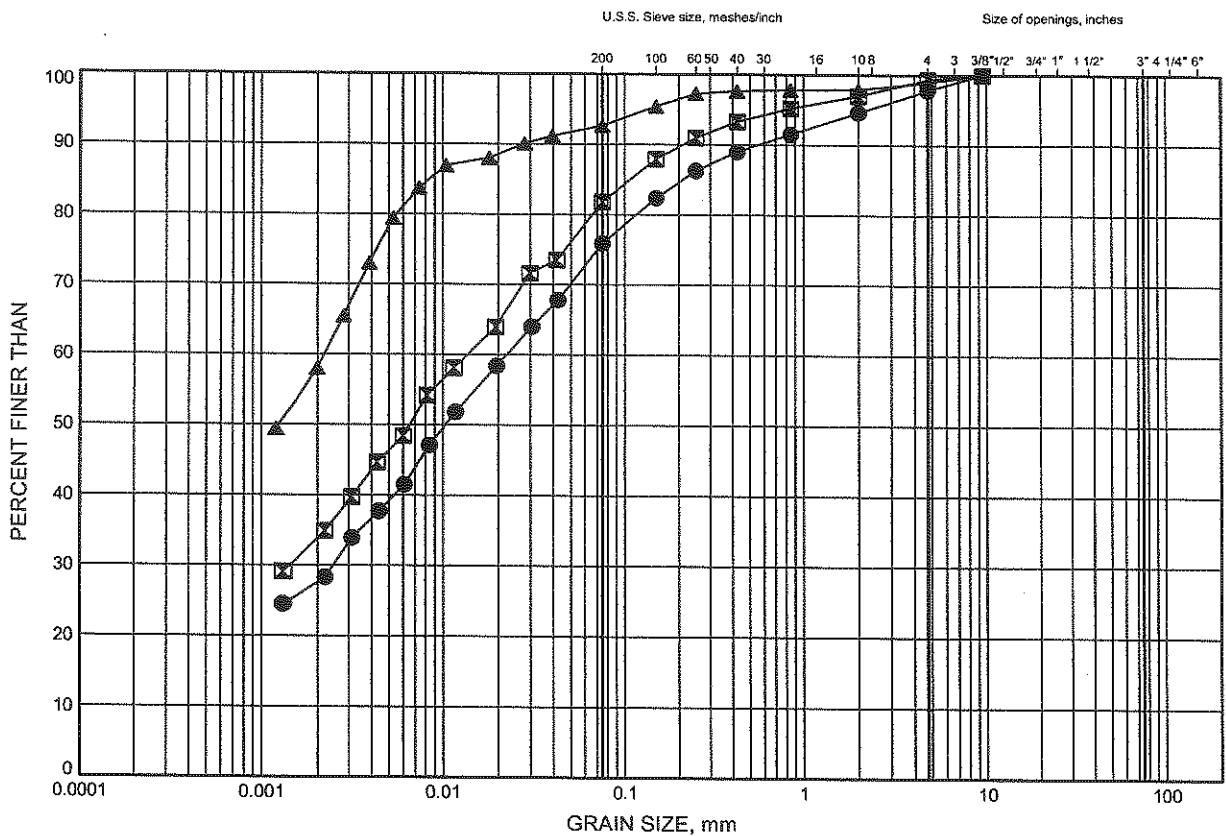


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE D2

SILTY CLAY TILL



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

LEGEND

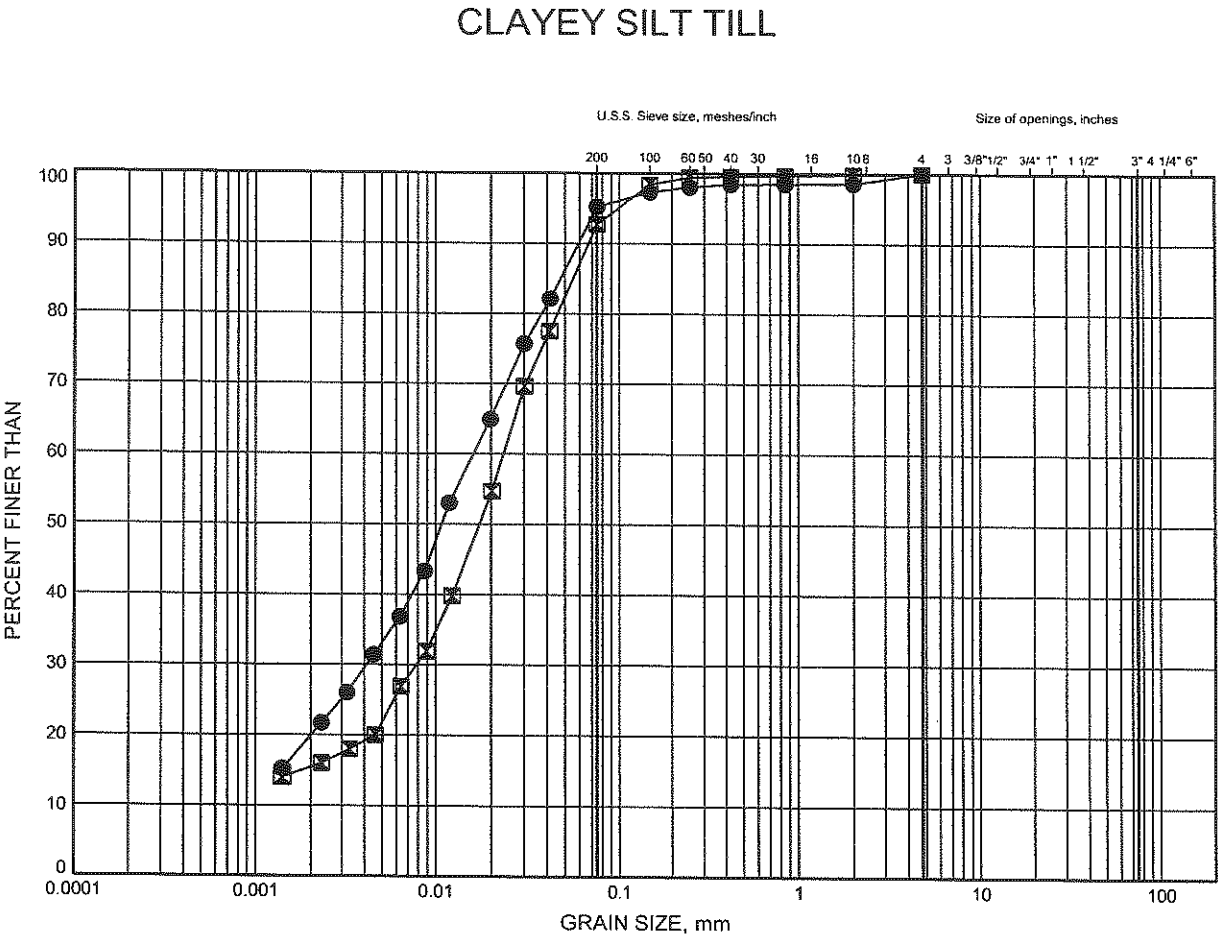
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-158	3.35	326.65
■	08-158	7.92	322.08
▲	08-158	15.54	314.46



W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE D3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-158	10.97	319.03
◻	08-158	12.50	317.50

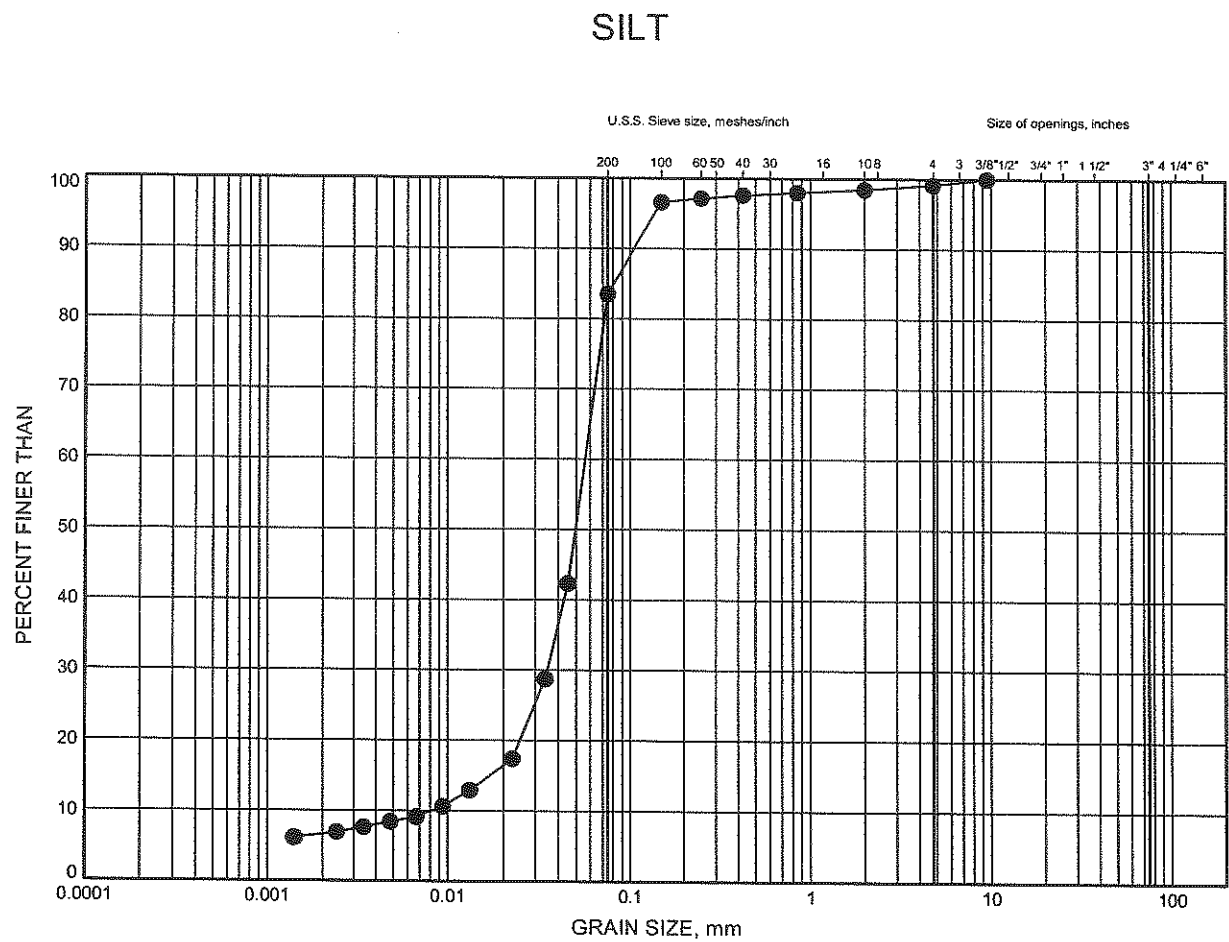
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 3/23/09

W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New
GRAIN SIZE DISTRIBUTION

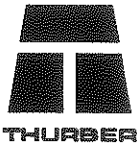
FIGURE D4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-158	9.24	320.76

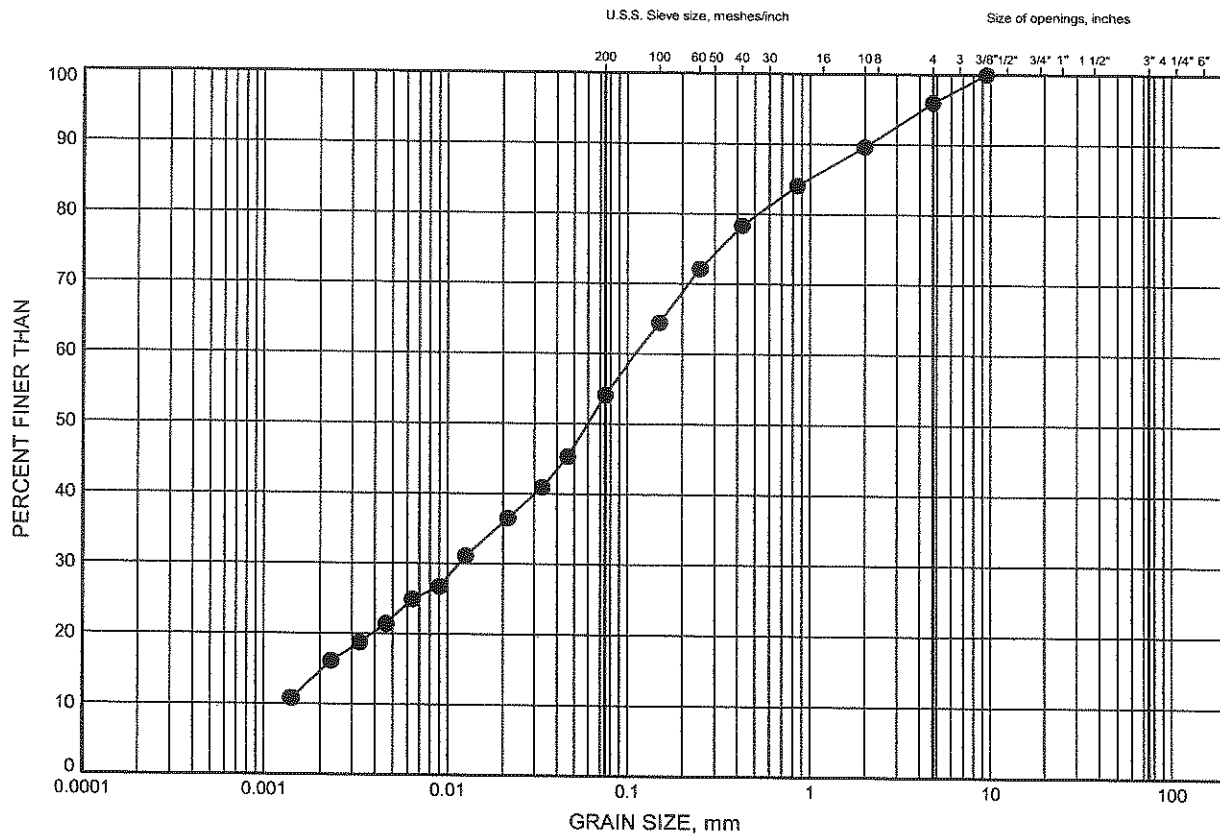


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE D5

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-158	18.30	311.70

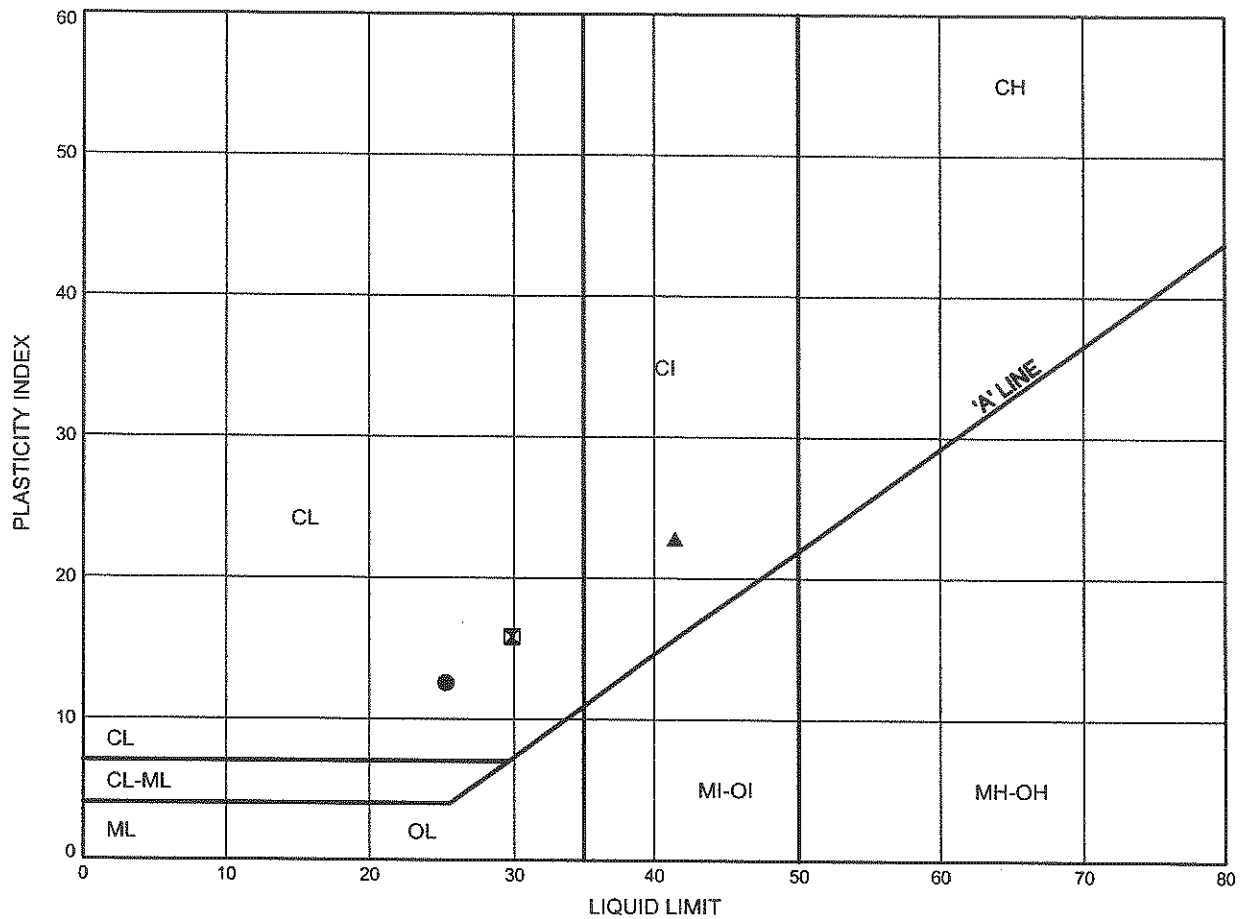


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

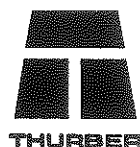
FIGURE D6

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-158	3.35	326.65
⊠	08-158	7.92	322.08
▲	08-158	15.54	314.46

Date April 2009
Project 408-88-00

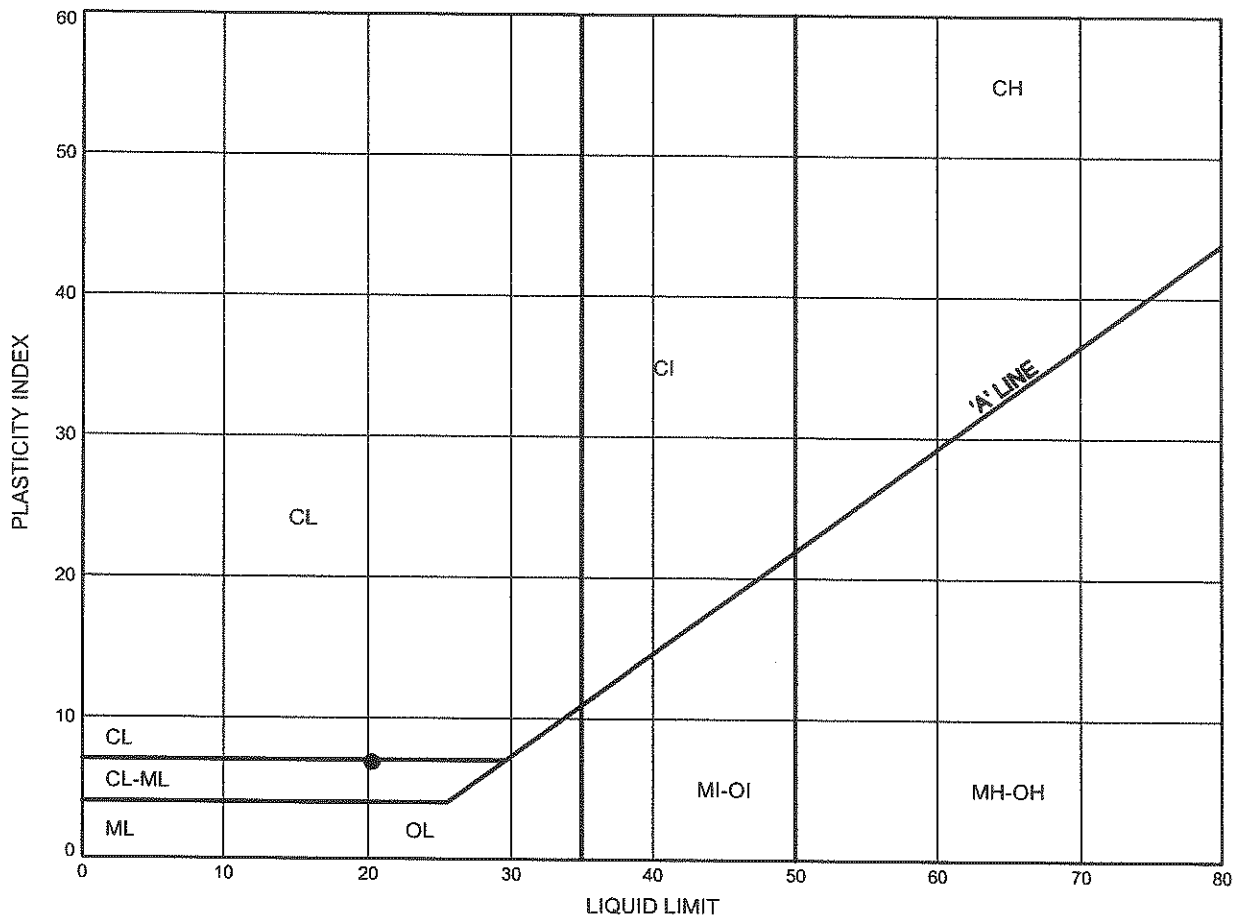


Prep'd AN
Chkd. RPR

Highway 7 - New **ATTERBERG LIMITS TEST RESULTS**

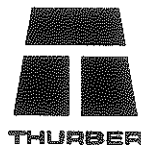
FIGURE D7

CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-158	10.97	319.03

Date June 2009
 Project 408-88-00

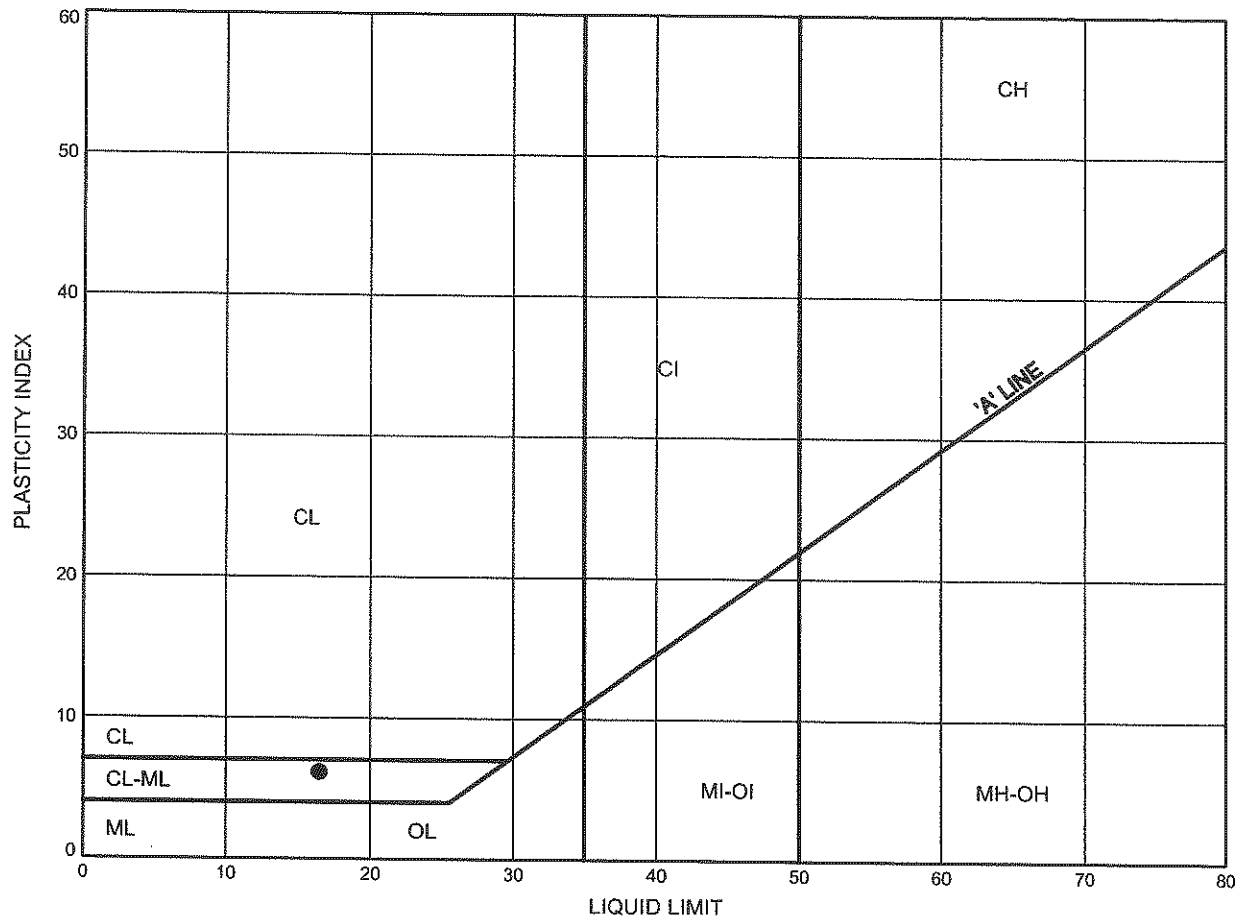


Prep'd AN
 Chkd. RPR

Highway 7 - New **ATTERBERG LIMITS TEST RESULTS**

FIGURE D8

SANDY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-158	18.44	311.56

Date March 2009
 Project 408-88-00



Prep'd AN
 Chkd. RPR

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph



Photo - Looking south along Shantz Station Road

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph



Photo - Looking east from Shantz Station Road

Appendix E

**Hwy 7 New
Station 30+040 – 30+140
(Boreholes 08-171)**

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

RECORD OF BOREHOLE No 08-171

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 819 340.3 E 235 014.0 ORIGINATED BY ARA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.05.20 - 2008.05.20 CHECKED BY RPR

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
329.8																	
0.0	TOPSOIL (200mm)																
0.2	Silty SAND, trace clay Loose Brown Moist		1	SS	5												
328.6			2	SS	5		329										
1.2	Sandy SILT, trace gravel, trace clay Compact to Very Dense Brown Moist (TILL)		3	SS	15		328										
			4	SS	34												
			5	SS	50/ 0.100		327										
							326										
325.2			6	SS	50/ 0.05												
4.6	END OF BOREHOLE AT 4.6m.																

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
(%) STRAIN AT FAILURE

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph



Photo - Looking northwest of existing Highway 7

NECESSITY OF TRANSPORTATION, CONSIDERED
 PN-0-707 00-00 PLAT NO. 1:1



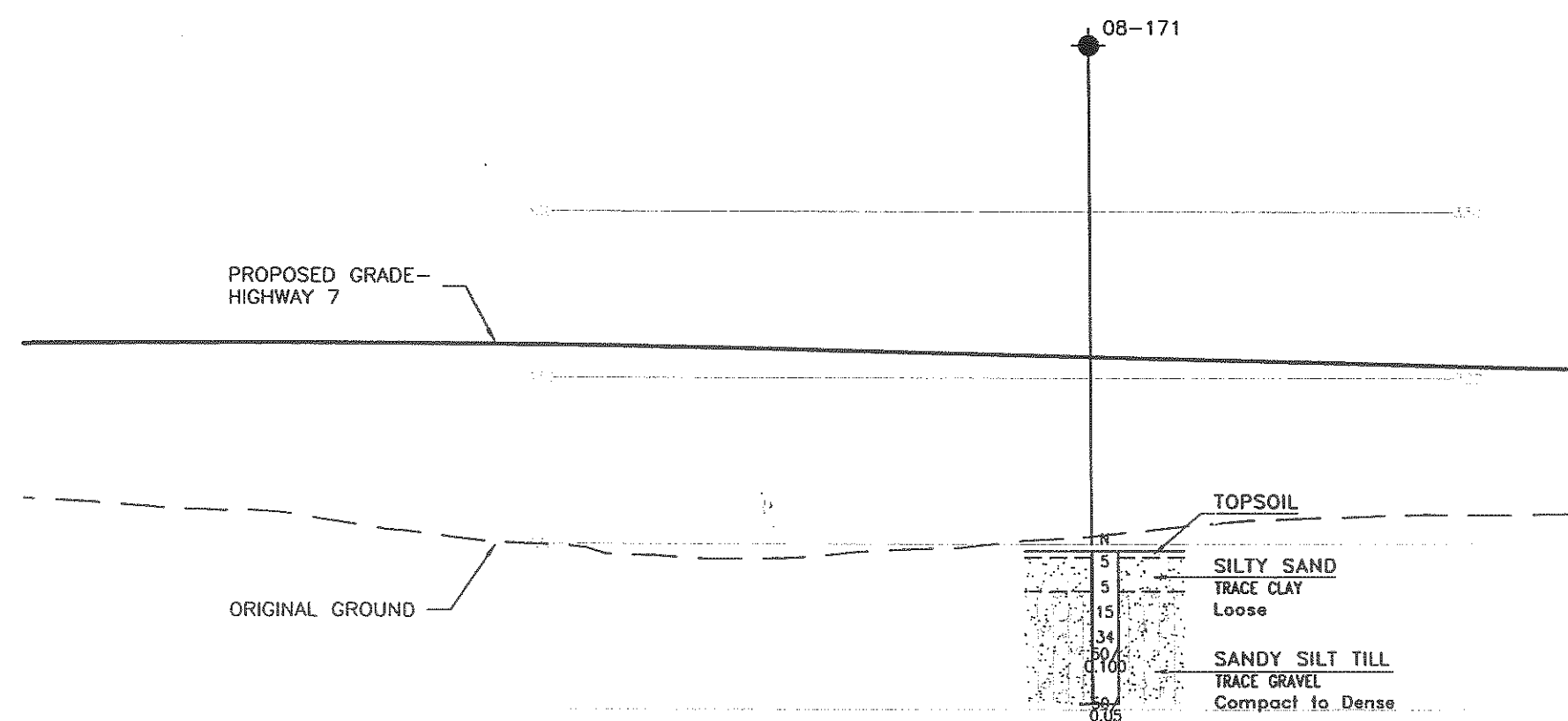
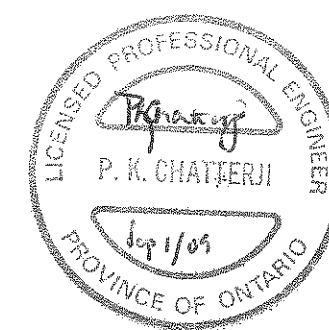
SHEET

LEGEND

[illegible]

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Proposed grades are from Plate 13 of the E.A. Study.

REASONS							DESCRIPTION		DATE JUL 2009	
	DATE	BY								
	DESIGN	RPR	CHK	PKC	CODE		LOAD			
	DRAWING	MFA	CHK	AFG	SUE		ISTRUCT	LOWG		



0 20 40 60m HOR 1:1000
0 4 8 12m VER 1:200

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix F

**Reg. Road 30 – N/S-E Ramp
Station 10+070 – 10+115
(Borehole 08-159)**

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

RECORD OF BOREHOLE No 08-159

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 685.97 E 233 461.96 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 CHECKED BY RPR

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								
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL x LAB VANE								
						20 40 60 80 100			PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L							
						20 40 60 80 100			WATER CONTENT (%) 20 40 60							
329.2																
0.0	TOPSOIL: (200mm)															
0.2	Silty CLAY, trace gravel, occasional topsoil staining Stiff Brown (FILL)		1	SS	11		329									
327.8							328									
1.4	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		2	SS	63		327									
			3	SS	42											0 15 40 45
			4	SS	64		326									
325.1							325									
4.1	Sandy SILT, some clay, trace to some gravel Very Dense Grey (TILL)		5	SS	100/ 150		324									5 40 40 15
323.6							323									
5.6	Silty CLAY, trace sand Very Stiff to Hard Grey (TILL)		6	SS	47		322									0 6 39 55
			7	SS	29		321									
	occasional sand seams		8	SS	46		320									0 3 68 29

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 08-159

3 OF 3

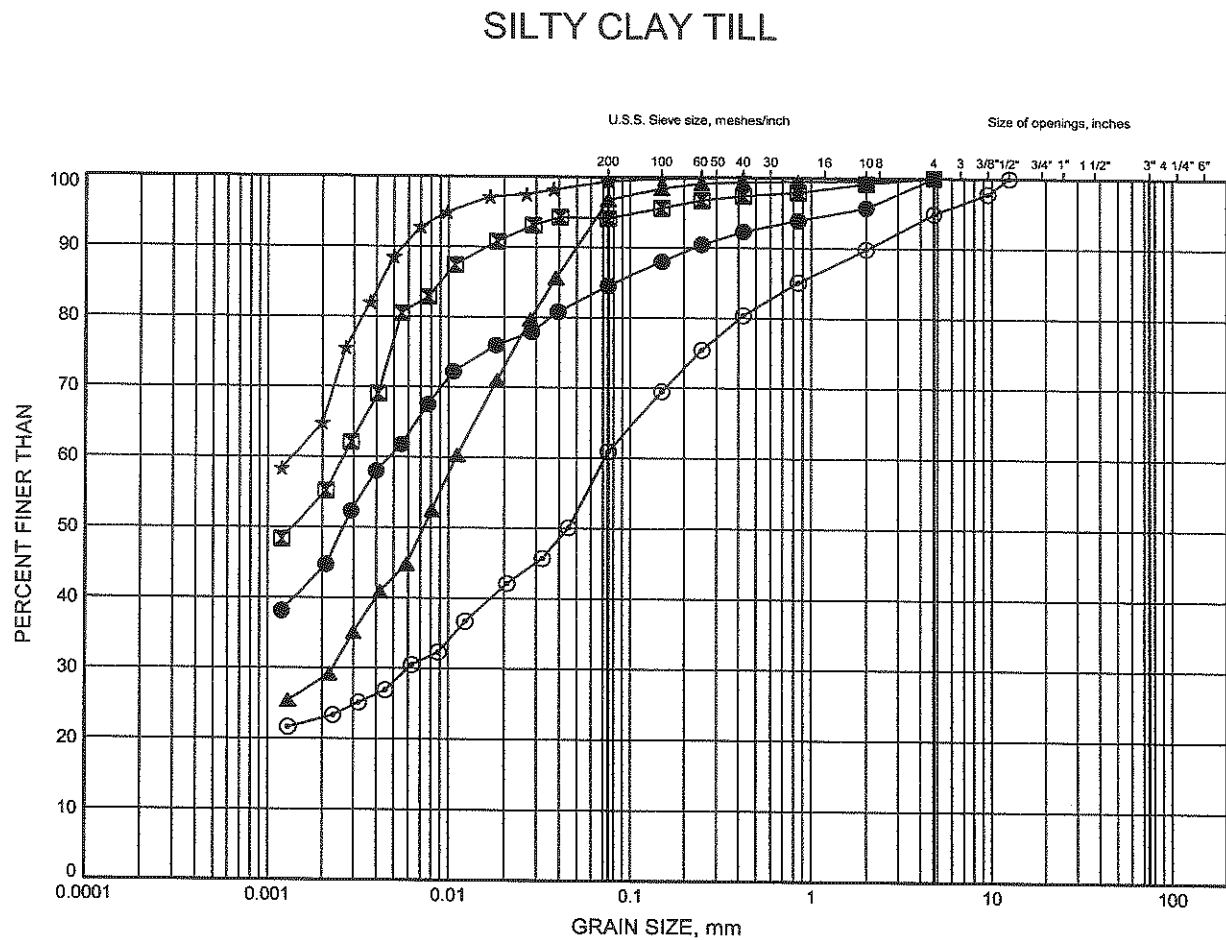
METRIC

G.W.P. 408-88-00 LOCATION N 4 818 685.97 E 233 461.96 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.03 - 2008.06.03 CHECKED BY RPR

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	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 (%)						
						20	40	60	80	100	20	40	60	kn/m ³	GR SA SI CL		
20.0	Continued From Previous Page END OF BOREHOLE AT 20.0m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH GROUT TO 15.0m, HOLEPLUG TO 3.0m, THEN AUGER CUTTINGS TO SURFACE.		15	SS	100/ .025												

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE F1



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

LEGEND

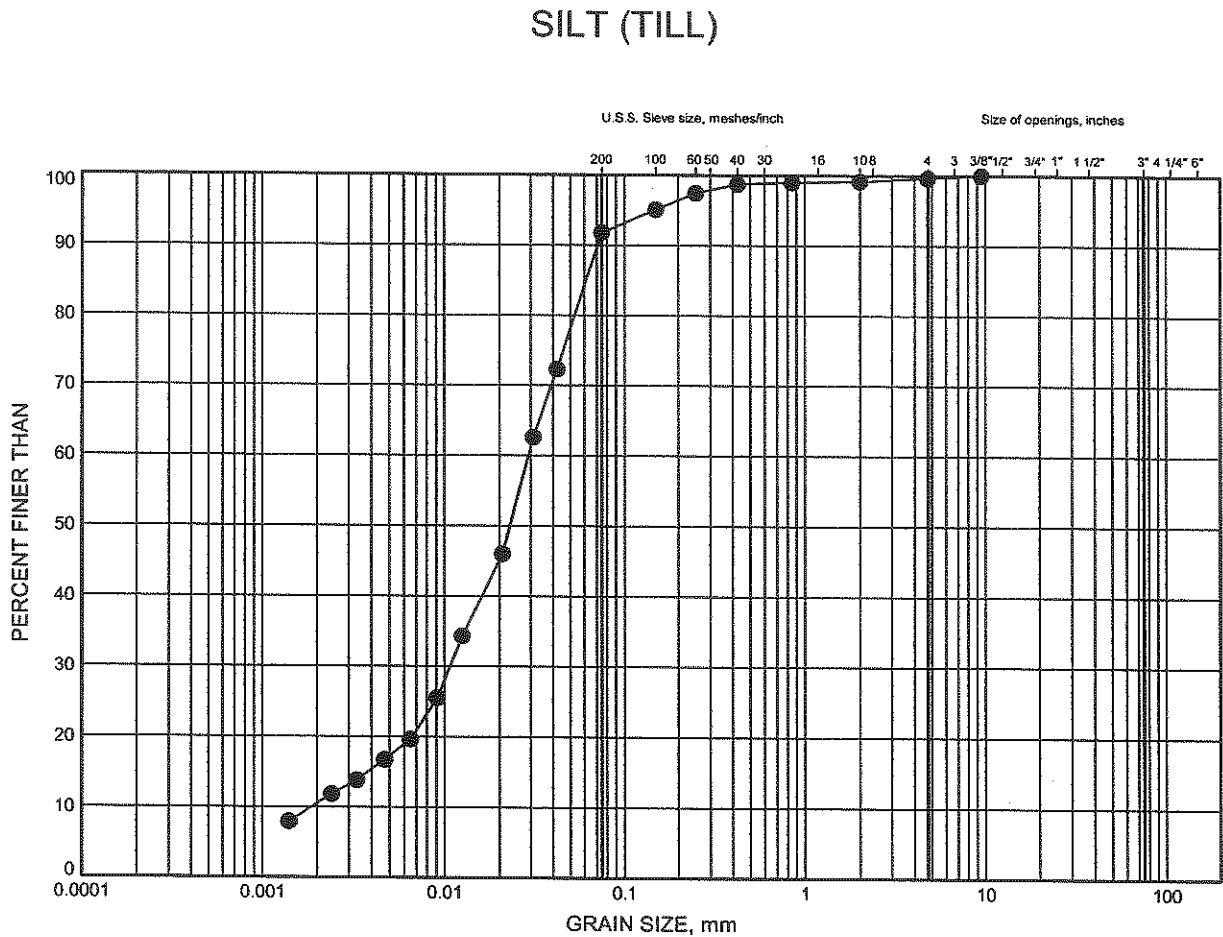
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-159	2.59	326.61
⊠	08-159	6.40	322.80
▲	08-159	9.37	319.83
★	08-159	14.02	315.18
⊙	08-159	15.49	313.71



W.P.# .408-88-00.....
Prepared By .AN.....
Checked By .RPR.....

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE F2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-159	10.79	318.41

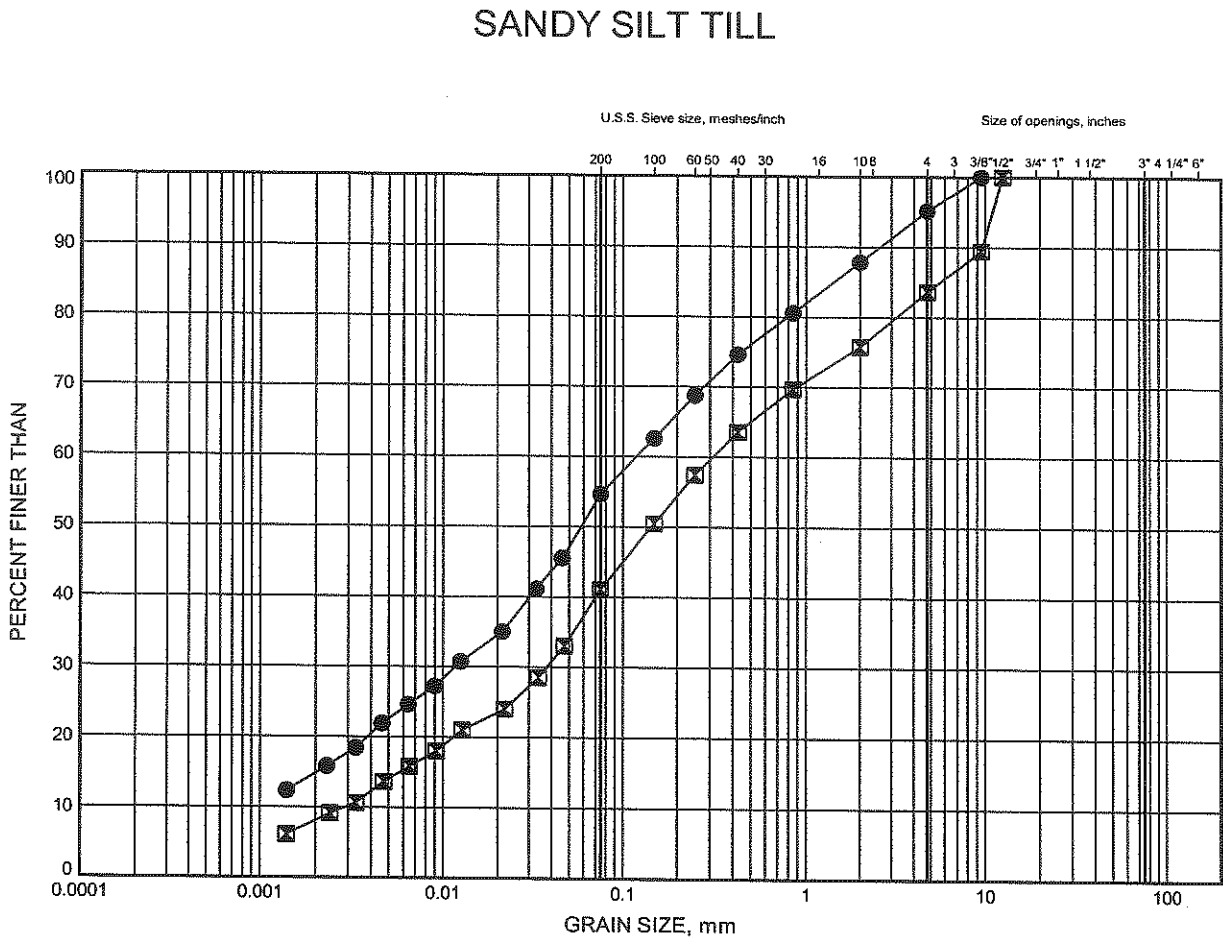


W.P.# 408-88-00
Prepared By AN
Checked By RPR

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 7/29/09

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE F3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-159	4.72	324.48
◻	08-159	16.89	312.31

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 3/23/09

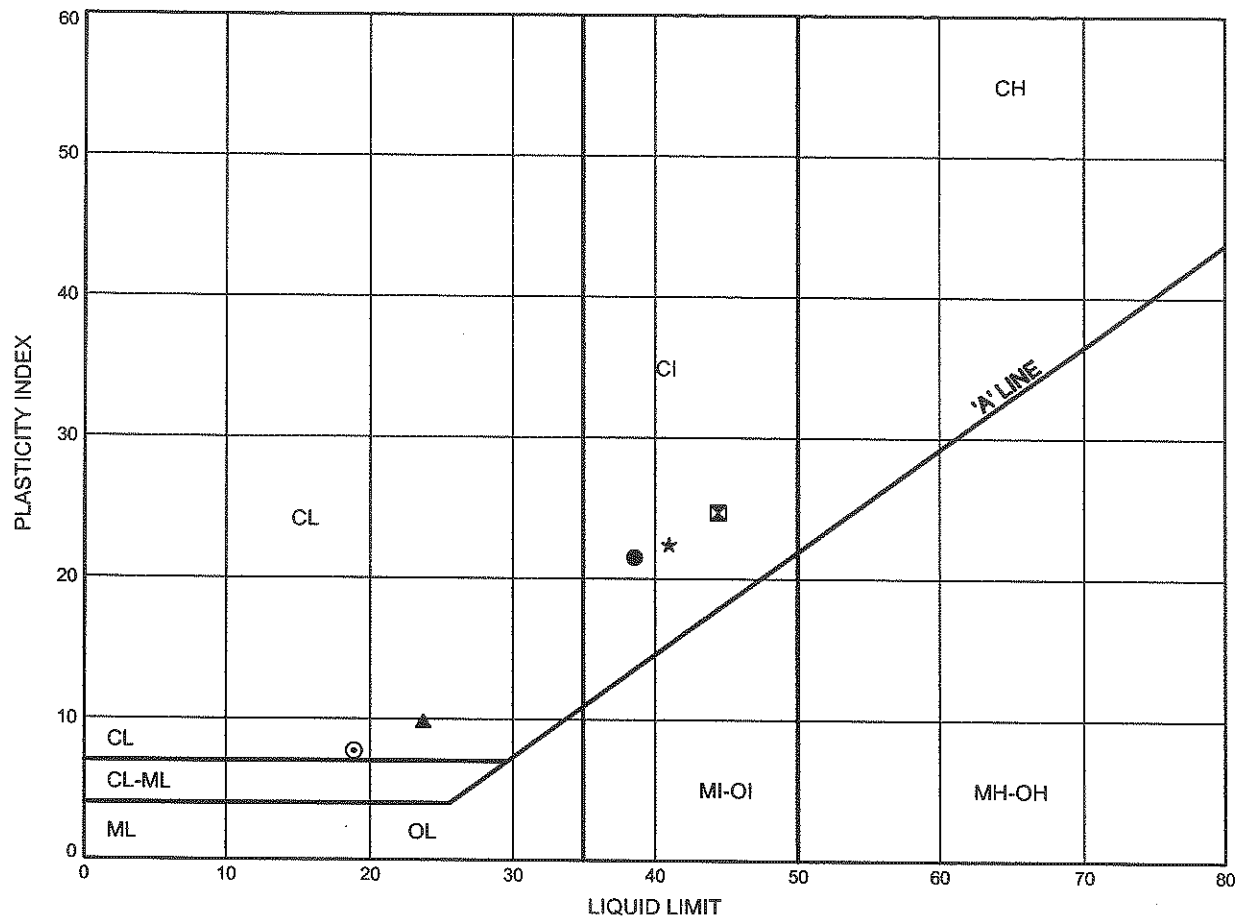
W.P.# .408-88-00.....
Prepared By .AN.....
Checked By .RPR.....



Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE F4

SILTY CLAY TILL



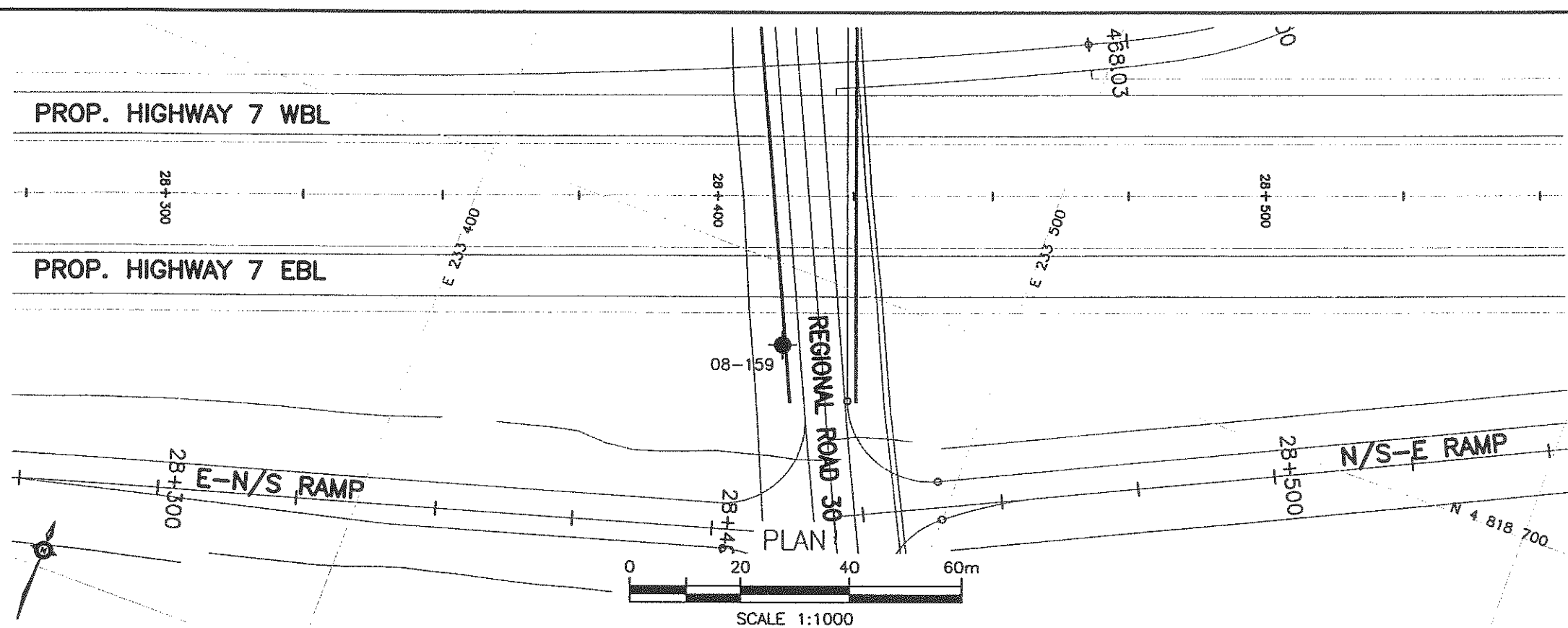
SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-159	2.59	326.61
⊠	08-159	6.40	322.80
▲	08-159	9.37	319.83
★	08-159	14.02	315.18
⊙	08-159	15.49	313.71

Date March 2009
 Project 408-88-00



Prep'd AN
 Chkd. RPR

PLAN SCALE 1:1000
PROJ. 08-159
MIN. 0-100
MINISTRY OF TRANSPORTATION, ONTARIO

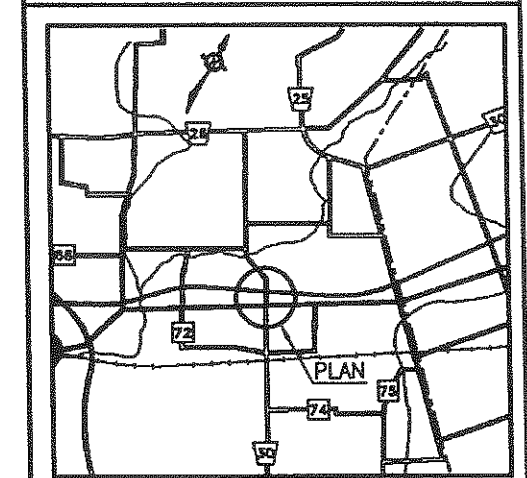


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

REG. RD.

CONT No GWP No 408-88-00	
HIGHWAY 7 RECOMMENDED ROUTE 30 N/S-E RAMP, 10+070 TO BOREHOLE LOCATIONS AND SOIL STRATA	
SHEET 10+115	

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

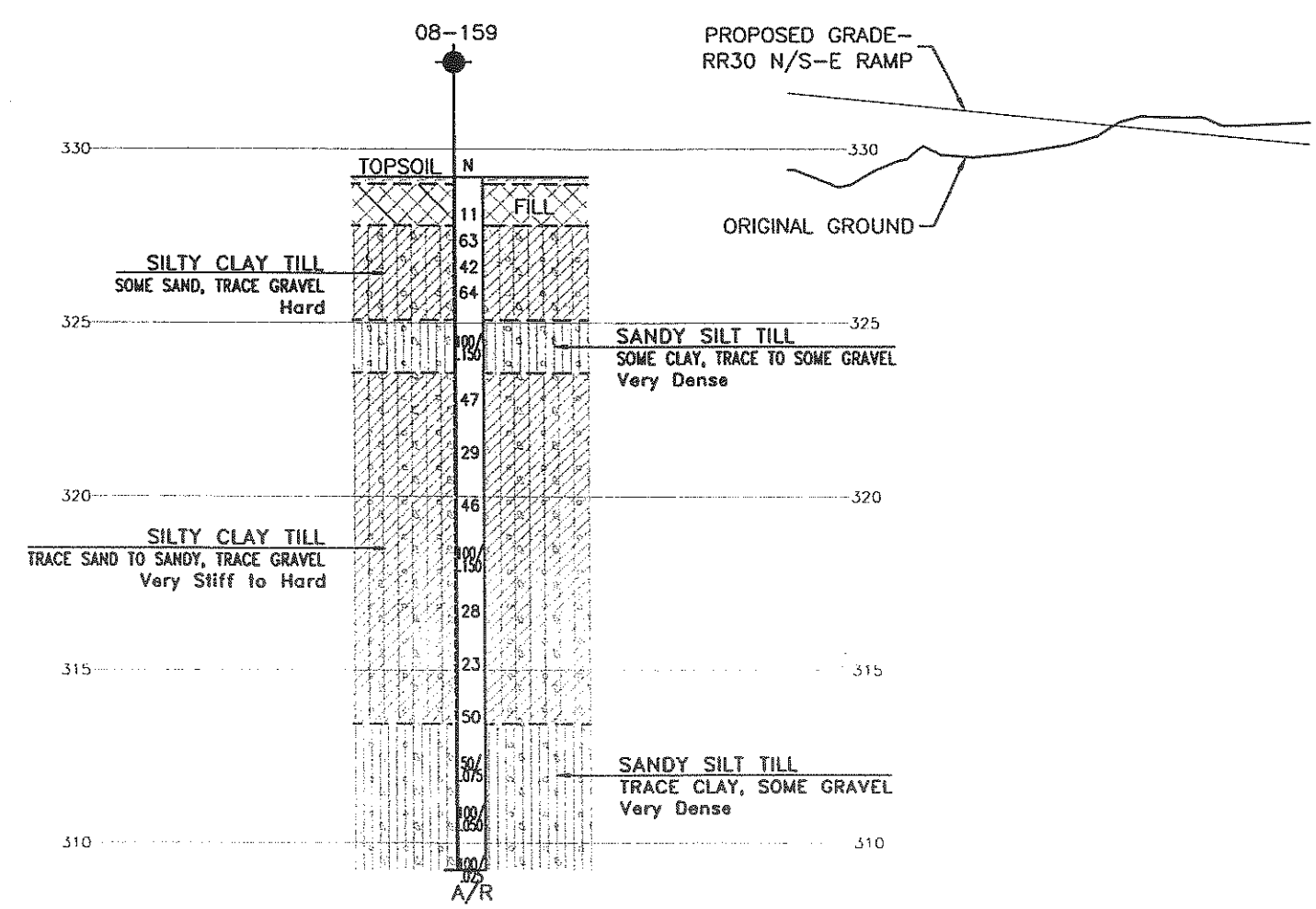
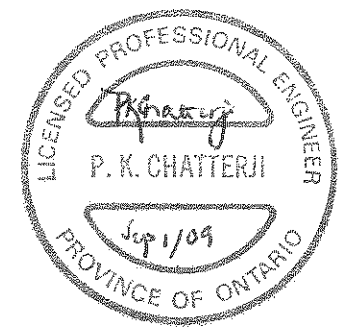
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-159	329.2	4 818 686.0	233 462.0

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.
- Proposed grades are from Plate 11 of the E.A. Study.

GEOCREs No. 40P8-171



PROFILE ALONG CL OF PROP. REGIONAL ROAD 30 N/S-E RAMP

0 20 40 60m HOR 1:1000
0 4 8 12m VER 1:200

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RPR	CHK	PKC	CODE	LOAD	DATE	JUL 2009
DRAWN	MFA	CHK	AEI	SITE	STRUCT	DWG	

Appendix G

**Reg. Road 30 – E-N/S Ramp
Station 10+374 – 10+419
(Borehole 08-153)**

**Record of Borehole Sheets
Laboratory Test Results
Site Photograph
Drawing titled “Borehole Locations and Soil Strata”**

RECORD OF BOREHOLE No 08-153

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 869.91 E 233 564.13 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.12.02 - 2008.12.02 CHECKED BY MEF

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		20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
331.1							SHEAR STRENGTH kPa	W _P	W	W _L		
							○ UNCONFINED + FIELD VANE					
							● QUICK TRIAXIAL X LAB VANE					
							40 80 120 160 200					
0.0	Clayey SILT, sandy, occasional rootlets		1	SS	10							
	Stiff											
	Black (FILL)											
330.3												
0.8	Clayey SILT, sandy, trace gravel		2	SS	19							
	Very Stiff to Hard											
	Brown (TILL)											
			3	SS	39							
			4	SS	100							
	Layer of sandy silt		5	SS	50/ 0.125							
327.1												
4.0	Silty CLAY, some sand											
	Hard											
	Grey (TILL)		6	SS	77							
324.6			7	SS	100/ 0.200							
6.4	END OF BOREHOLE AT 6.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.											
	WATER LEVEL READINGS:											
	DATE DEPTH (m) ELEV. (m)											
	2009.01.09 3.2 327.9											
	2009.02.02 2.0 329.1											

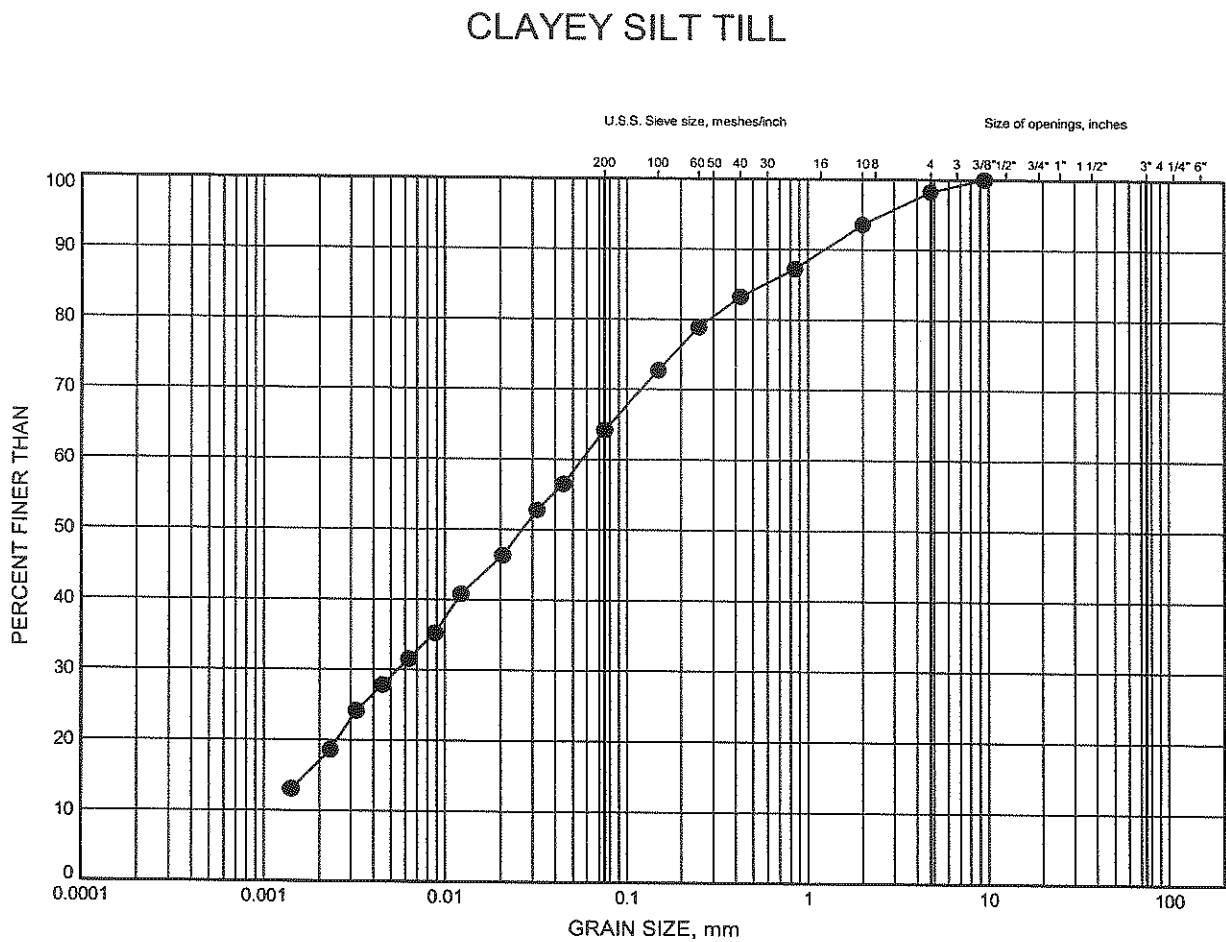
+ 3 X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE G1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-153	2.59	328.47



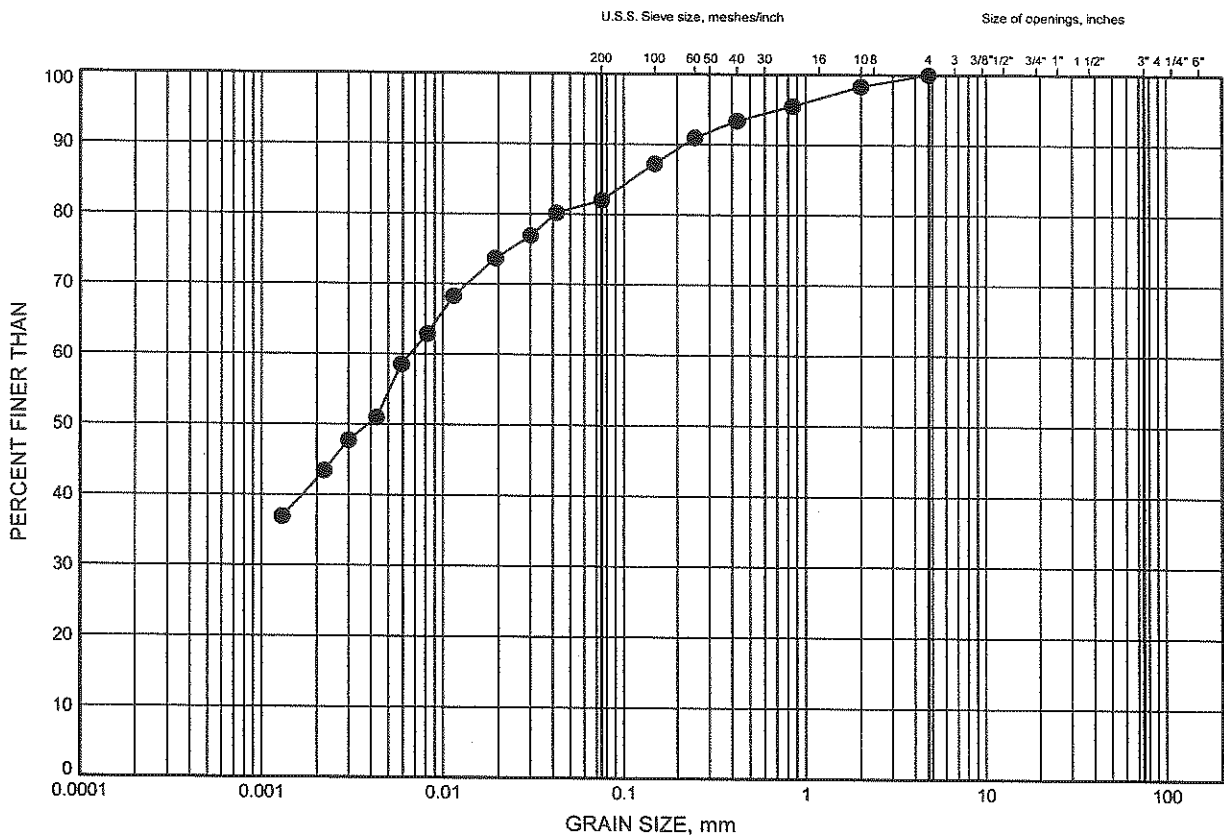
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/24/09

W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G2

SILTY CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-153	4.84	326.22

GRAIN SIZE DISTRIBUTION - THURBER 641TR.GPJ 4/24/08

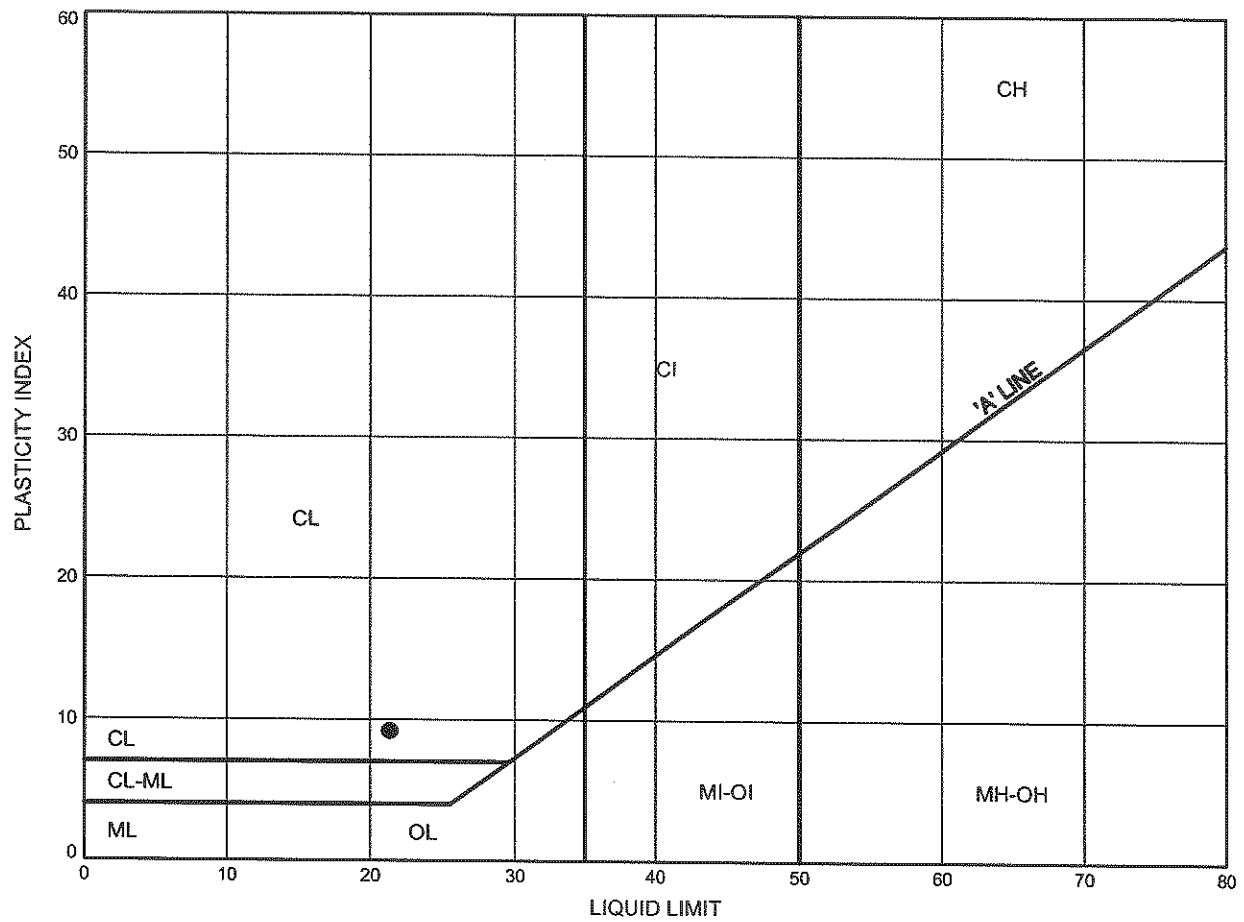
W.P.# 408-88-00
 Prepared By AN
 Checked By RPR



Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE G3

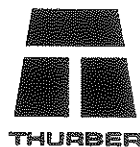
CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-153	2.59	328.47

Date April 2009

Project 408-88-00



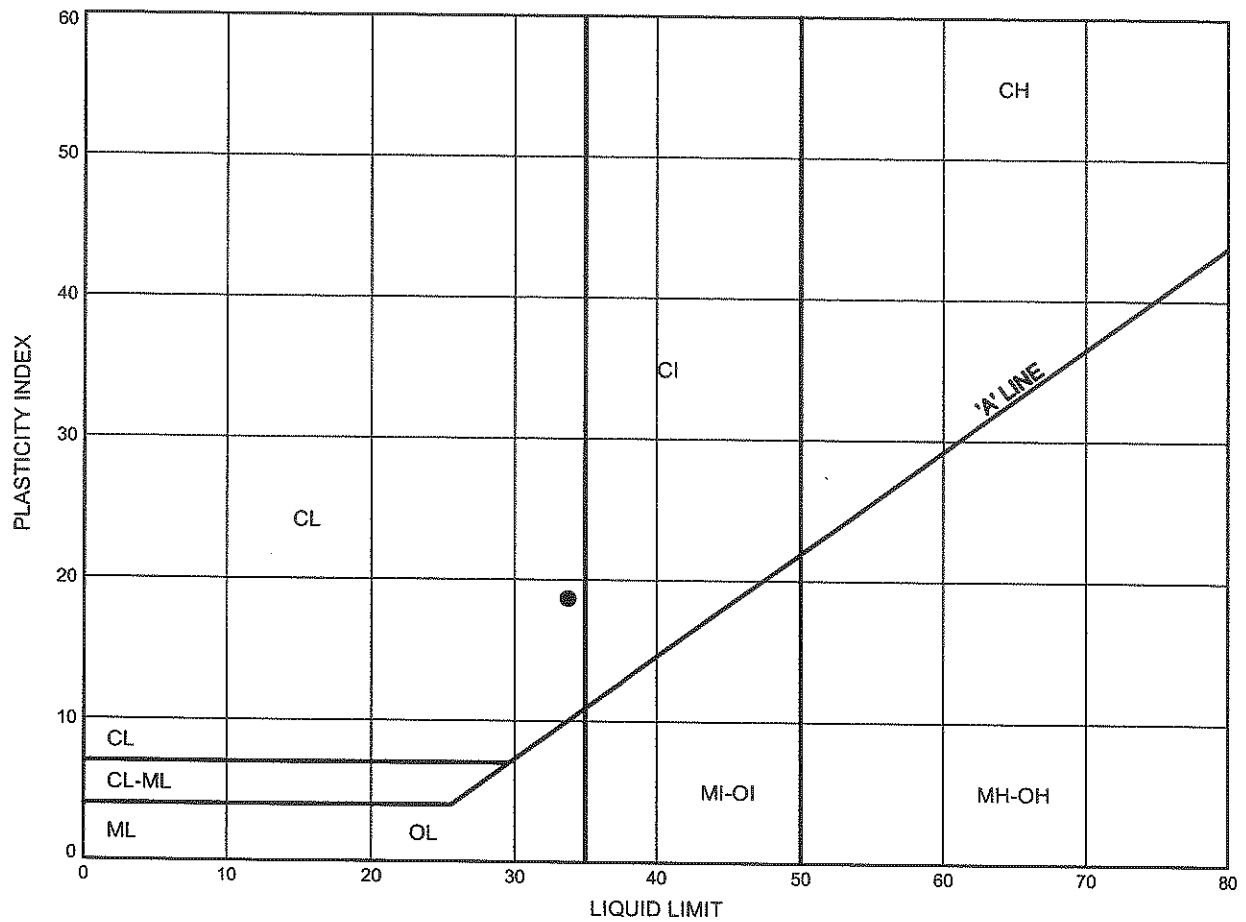
Prep'd AN

Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE G4

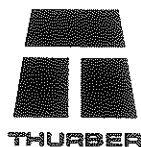
SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-153	4.84	326.22

Date April 2009

Project 408-88-00



Prep'd AN

Chkd. RPR

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph

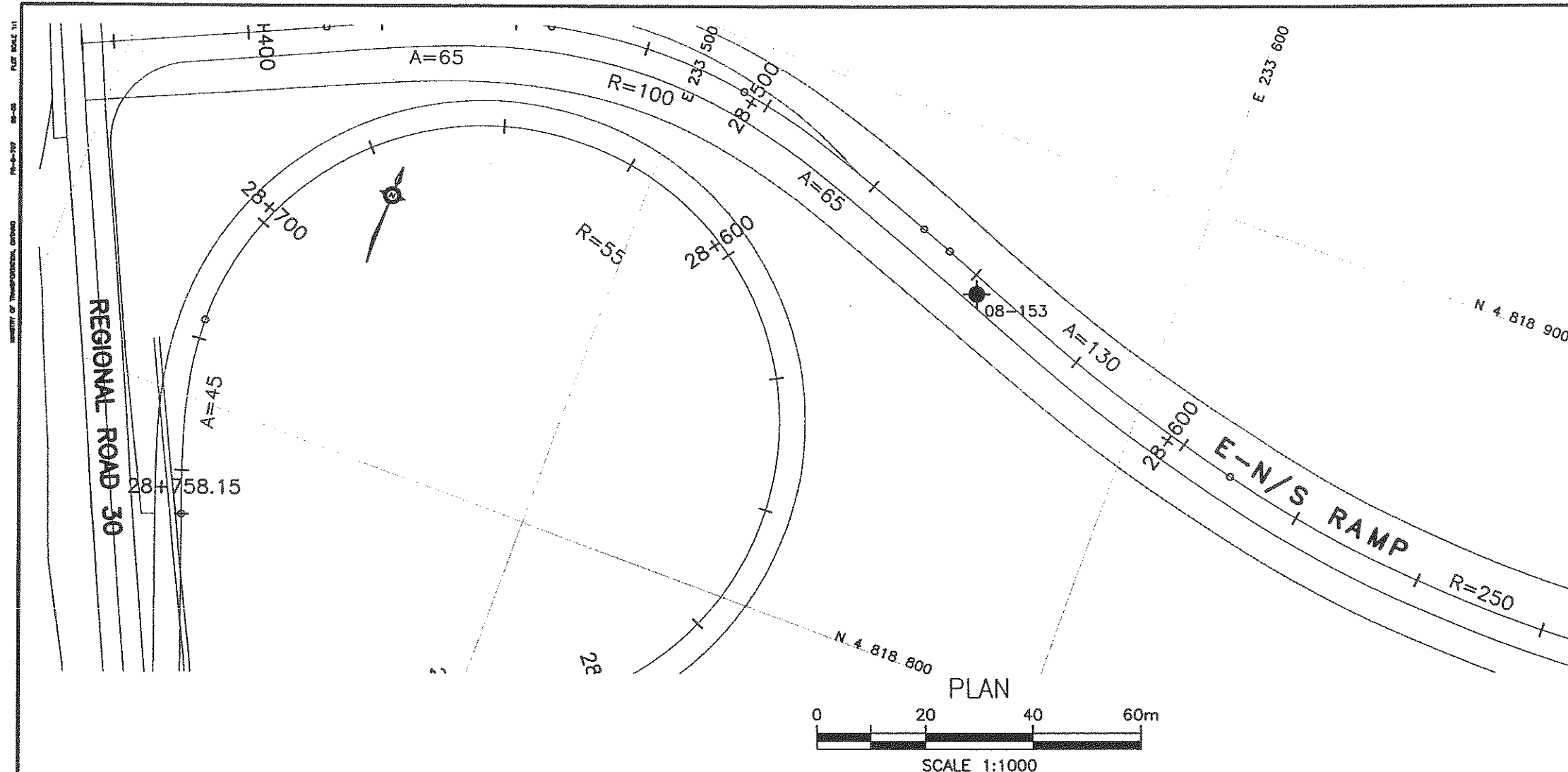


Photo - Looking west of Borehole 08-153

High Fill and Deep Cuts – East of RR17 to east of Townline Road
Highway 7-New, Kitchener to Guelph



Photo - Looking southeast of Borehole 08-153

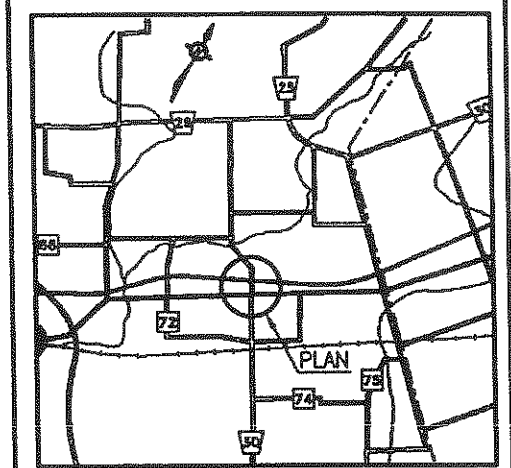


METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

REG. RD.

CONT No GWP No 408-88-00		SHEET 10+419
HIGHWAY 7 RECOMMENDED ROUTE 30 E-N/S RAMP, 10+374 TO BOREHOLE LOCATIONS AND SOIL STRATA		

THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

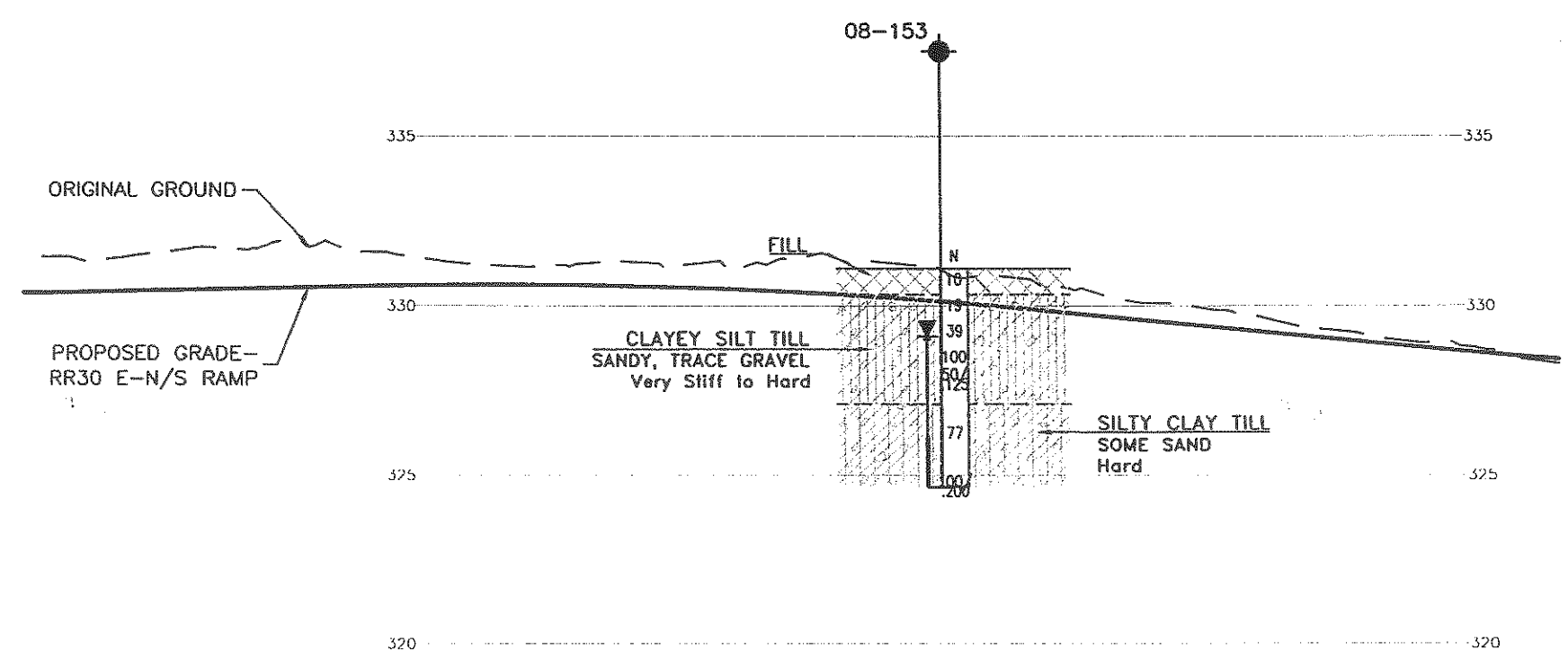
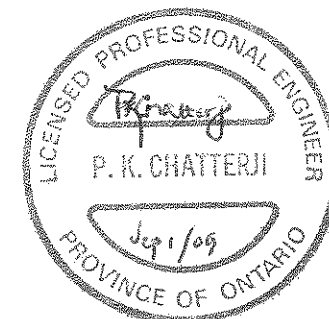
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-153	331.1	4 818 869.9	233 564.1

NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Proposed grades are from Plate 11 of the E.A. Study.

GEOCRES No. 40P8-171



PROFILE ALONG C OF PROP. REGIONAL ROAD 30 E-N/S RAMP

0 20 40 60m HOR 1:1000
 0 4 8 12m VER 1:200

DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

Appendix H

**Reg. Road 30 – N/S-W Ramp
Station 10+000 – 10+035
(Borehole 08-152)**

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

RECORD OF BOREHOLE No 08-152

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 818 766.03 E 233 381.20 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.30 - 2008.05.30 CHECKED BY RPR

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							WATER CONTENT (%)
								20 40 60 80 100							
327.6															
0.0	TOPSOIL: (175mm)														
0.2	SAND, some silt, occasional rootlets Compact Dark Brown Wet		1	SS	17										
326.2															
1.4	Sandy SILT, some clay, trace gravel Compact to Very Dense Brown Moist (TILL) Layer of gravelly sand, occasional cobbles		2	SS	27										
			3	SS	90									30 53 17 (SI+CL)	
			4	SS	24									0 55 36 9	
	Layer of silt		5	SS	75									0 17 80 3	
			6	SS	30										
320.9															
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE BACKFILLED WITH BENTONITE BENSEAL AND AUGER CUTTING TO SURFACE.														

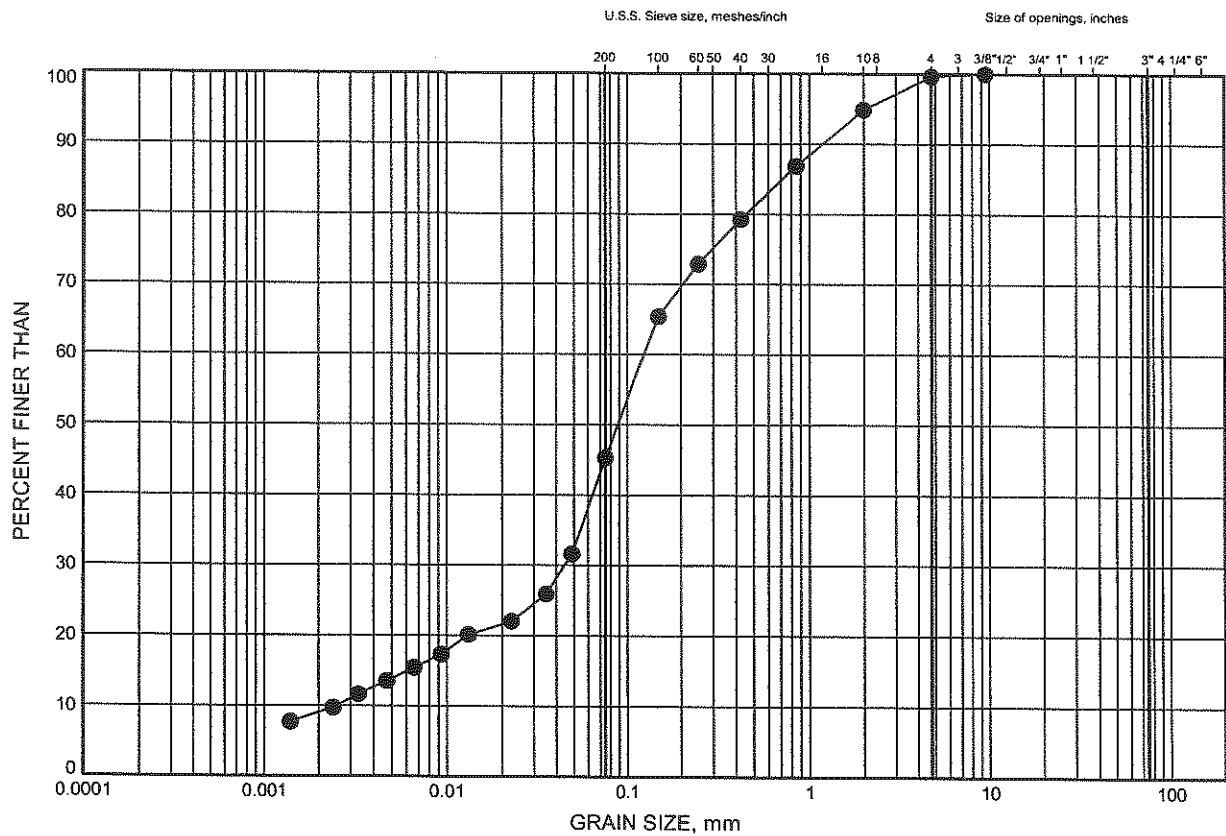
+³ . X³ : Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE H1

SANDY SILT (TILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-152	3.35	324.27

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 3/23/09

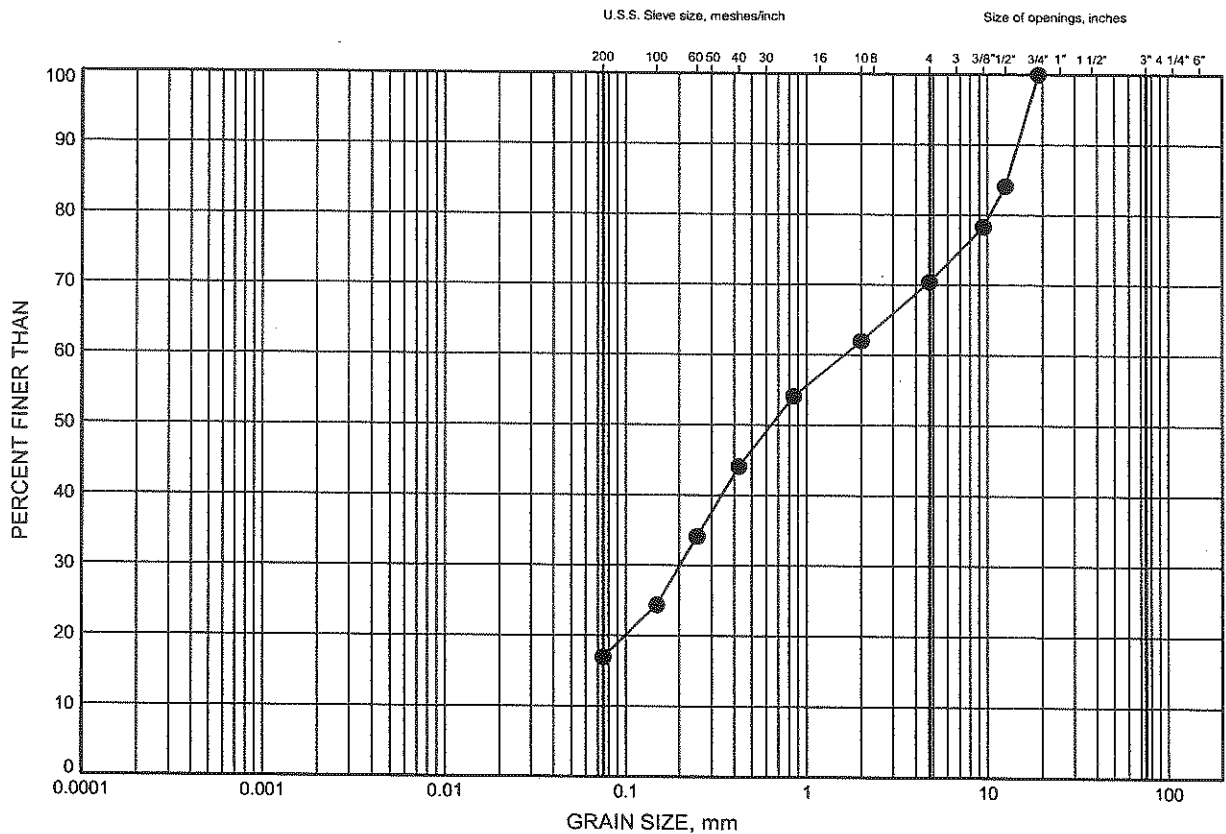
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE H2

GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-152	2.59	325.04

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 3/23/08

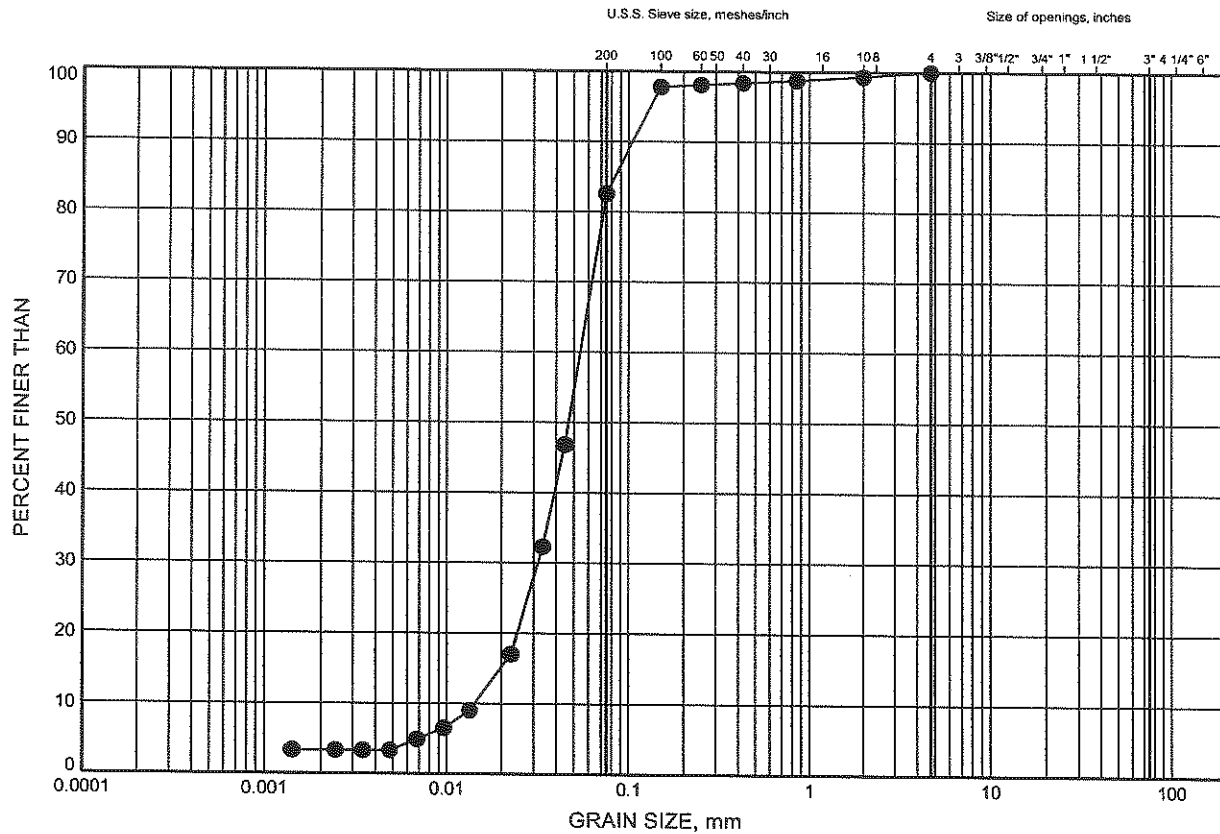
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE H3

SILT



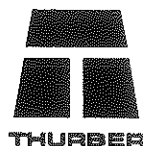
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

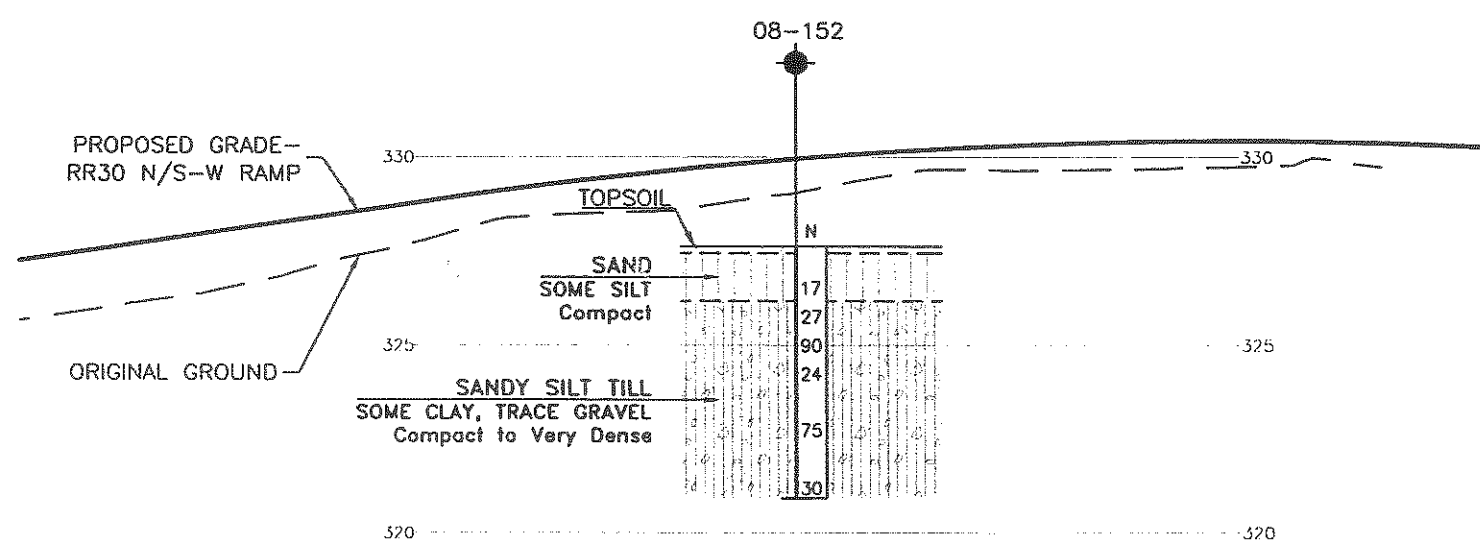
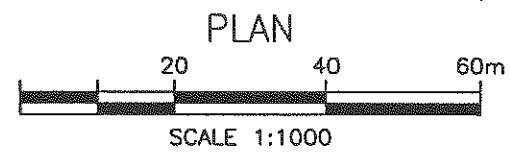
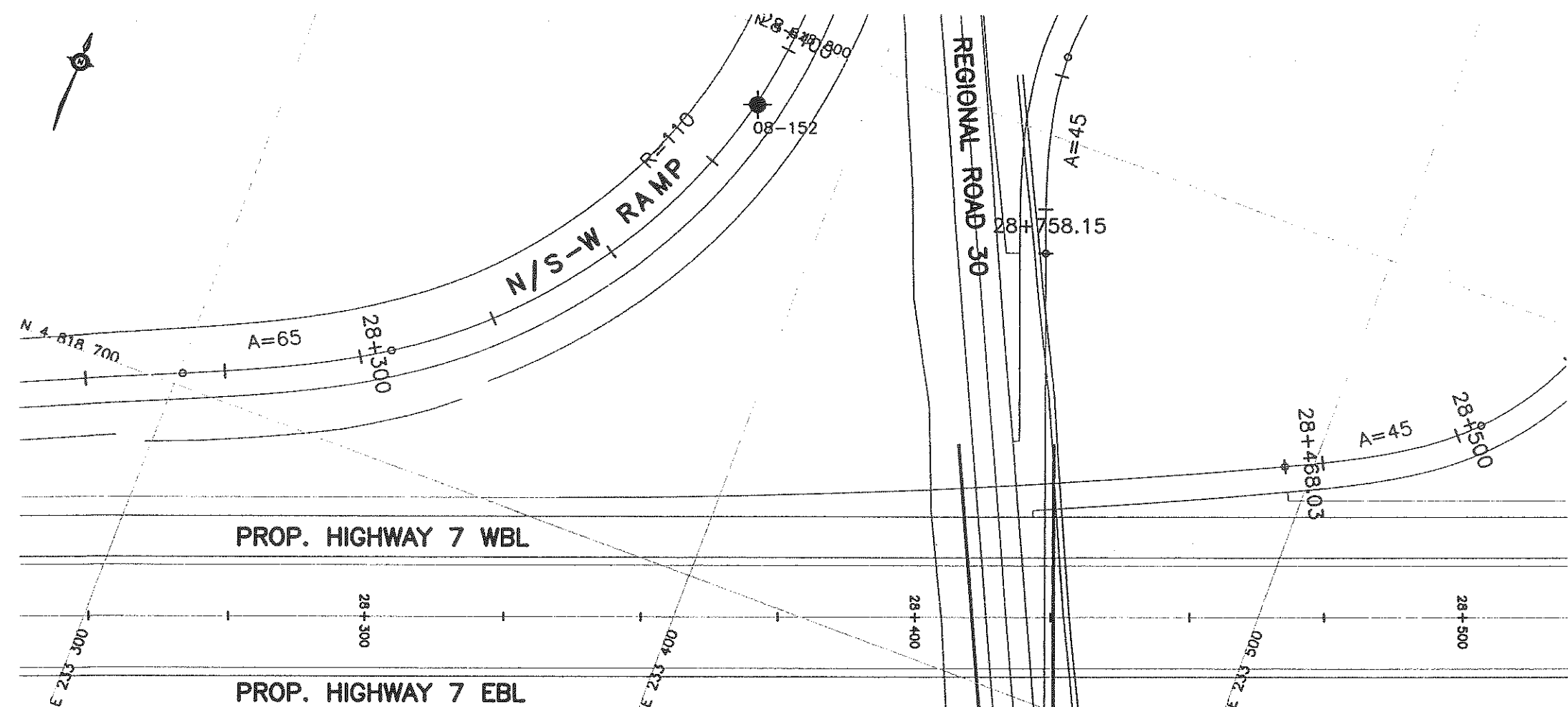
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-152	4.85	322.77

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 3/23/09

W.P.# 408-88-00
Prepared By AN
Checked By RPR



PLAT NO. 11
88-08
P.E. 0-177
MINISTRY OF TRANSPORTATION, ONTARIO



PROFILE ALONG C OF PROP. REGIONAL ROAD 30 N/S-W RAMP



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

REG. RD.

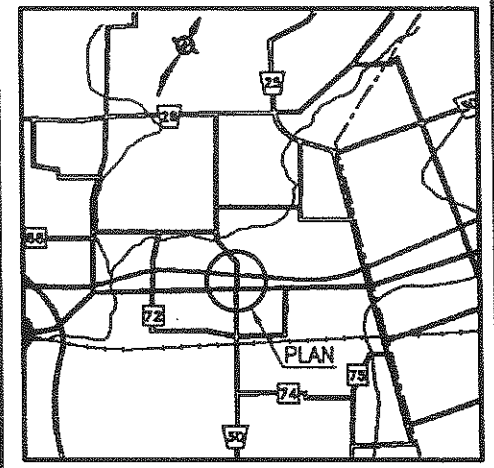
CONT No
GWP No 408-88-00

HIGHWAY 7
RECOMMENDED ROUTE
30 N/S-W RAMP, 10+000 TO 10+035
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET
10+035

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KEYPLAN

LEGEND

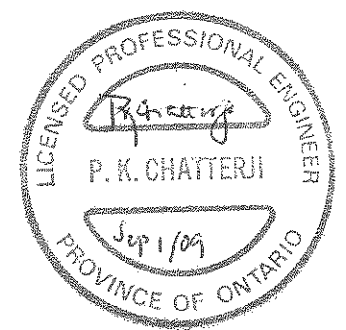
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-152	327.6	4 818 786.0	233 381.2

NOTES

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GEORES No. 40P8-171



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RPR	CHK	PKC	CODE	LOAD	DATE	JUL 2008
DRAWN	AN	CHK	AEG	SITE	STRUCT	DWG	