

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

Geocres Number: 40P9-48

Report to

**Ministry of Transportation Ontario
Southwestern Region**

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Appendices include:

- Record of Borehole Sheets
- Laboratory Test Results
- Slope Stability Output
- Site Photograph
- 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 high 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 embankments of 4.5 m or greater in height and permanent cuts of 4.5m depth or deeper between the east side of Townline Road and Hanlon Expressway.

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 embankments and 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 a section of the proposed Highway 7 mainline extending from the east side of Townline Road to Hanlon Expressway. Approximate length of section of the highway is 7.0 km. A total of ten (10) embankments and deep cuts were identified within this section.

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

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. Lands adjacent to the Hanlon Expressway generally consist of commercial developments.

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

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

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.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at this site was carried out from May 21 to December, 2008. A total of eighteen (18) sampled boreholes were drilled for the proposed embankments and cuts identified along this section. At three locations within this section, it was not possible to drill boreholes since permissions to access the properties were not granted. 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 and photographs are also tabulated 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	Length (m)	Cut or Fill	Borehole	Appendix
Hwy 7 New	32+480 – 32+540	60	C	08-180	A
Hwy 7 New	32+880 – 33+120	240	C	08-181,08-182, 08-184, 08-185, 08-186	B
Hwy 7 New	33+500 – 33+720	220	F	Boreholes were not drilled at this location due to access restrictions	
Hwy 7 New	33+900 – 34+160	260	C	08-202	C
Hwy 7 New	35+000 – 35+080	80	C	08-210, 08-212	D
Hwy 7 New	35+440 – 35+520	80	C	Boreholes were not drilled at this location due to access restrictions	
Hwy 7 New	35+740 – 35+800	60	C	Boreholes were not drilled at this location due to access restrictions	
Hwy 7 New	36+000 – 36+320	320	F	08-220	E
Hwy 7 New	37+500 – 37+700	200	F	08-230,08-231, 08-232,08-236, 08-238	F
Hwy 7 New	37+770 – 38+000	230	F	08-233,08-234, 08-235, 08-237, 08-239, 08-240	G

The approximate locations of all the boreholes are shown on the Borehole Location Drawing immediately after the text of this report.

Prior to commencing the site investigation, clearance was obtained from utility companies having plant in the area. Road occupancy permit was also obtained to complete site investigation.

The boreholes were drilled using hollow and solid stem auger equipment mounted on a CME-75 truck-mounted drill rig. 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 selected boreholes, standpipe piezometer consisting of 19 mm or 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 Installation Details

Alignment/ Roadway	Approx. Station	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
Hwy 7 New	32+880 – 33+120	08-181	13.7/325.3	Piezometer with 1.5 m slotted screen installed with sand filter to 11.8 m, holeplug from 11.8 m to ground surface.
		08-185	7.8/331.1	Piezometer with 1.5 m slotted screen installed with sand filter to 5.8 m, holeplug from 5.8 m to 3.0 m, auger cuttings from 3.0 m to 0.6 m, holeplug from 0.6 to 0.5 m, sand from 0.5 m to 0.3 m, then cement to surface.
Hwy 7 New	35+000 – 35+080	08-212	7.5/337.1	Piezometer with 1.5 m slotted screen installed with sand filter to 5.5 m, bentonite seal to 0.5 m, cement grout to ground surface.
Hwy 7 New	36+000 – 36+320	08-220	6.1/335.6	Piezometer with 1.5 m slotted screen installed with sand filter to 4.0 m, bentonite from 4.0 m to 2.1 m, cuttings from 2.1 m to ground surface.
Hwy 7 New	37+500 – 37+700	08-230	6.7/334.2	Piezometer with 1.5 m slotted screen installed with sand filter to 5.2 m, bentonite from 5.2 m to 0.6 m, cuttings from 0.6 m to ground surface.
		08-238	5.1/335.9	Piezometer with 1.5 m slotted screen installed with sand filter to 3.3 m, holeplug from 3.3 m to 2.4 m, bentonite seal from 2.4 m to 0.4 m, sand from 0.4 m to 0.3 m, then holeplug to ground surface.
Hwy 7 New	37+770 – 38+000	08-234	3.4/335.3	Piezometer with 1.5 m slotted screen installed with sand filter to 1.8 m, bentonite from 1.8 m to 0.6 m, cuttings from 0.6 m to ground surface.
		08-235	2.9/335.2	Piezometer with 1.5 m slotted screen installed with sand filter to 1.4 m, bentonite from 1.4 m to 0.6 m, cuttings from 0.6 m to ground surface.
		08-237	3.7/335.8	Piezometer with 1.5 m slotted screen installed with sand filter to 1.8 m, holeplug from 1.8 m to 0.9 m, bentonite seal from 0.9 m to 0.6 m, sand from 0.6 m to 0.5 m, then concrete 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 G 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 site is underlain by topsoil or granular fill overlying two distinct, glacial till deposits within the depth of exploration: sandy silt till and silty clay till. Layers of sand and gravel, silt and sandy silt were also encountered in the boreholes. Dolostone bedrock was contacted below the till deposits in some of the borehole locations.

5.1 Hwy 7 New, Station 32+480 – 32+540 (Borehole 08-180)

5.1.1 Fill

Fill was contacted surficially in Borehole 08-180. The fill consists of brown clayey silt containing trace sand, trace gravel and occasional organics. Thickness of the clayey silt fill was 0.8 m.

The depth to the base of the clayey silt fill is 0.8 m (Elevation 344.0).

SPT 'N' value in the clayey silt fill was 7 blows per 0.3 m of penetration, indicating a firm consistency. The natural moisture content was 26%.

5.1.2 Sandy Silt Till

Native sandy silt till was contacted below the fill in Borehole 08-180. The sandy silt till generally contains trace gravel and some clay and varies in colour from brown to grey with depth.

Borehole 08-180 was terminated within the sandy silt till at 9.3 m depth (Elevation 335.4).

SPT 'N' values of the sandy silt till ranged from 22 blows per 0.3 m of penetration to higher than 100 blows per 0.125 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally lay in the range of 19% to 43%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure A1 of Appendix A. Atterberg Limits test results are presented on Figure A2 Appendix A. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	0 to 1
Sand	40 to 42
Silt	45 to 46
Clay	12 to 14

Liquid Limit	18
Plastic Limit	12

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.

5.1.3 Groundwater Conditions

Water level was not observed in the borehole during and upon completion of drilling.

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 32+880 – 33+120 (Boreholes 08-181, 08-182, 08-184, 08-185, 08-186)

5.2.1 Fill

Fill was contacted surficially in the boreholes drilled within this section. In Boreholes 08-181 and 08-182, the fill consists of brown clayey silt containing some sand, trace gravel, some topsoil and occasional rootlets. In Boreholes 08-184 to 08-186, the fill consists of sand, sandy silt and sand and gravel. The thickness of the clayey silt fill was 0.6 m and 0.3 m in Boreholes 08-181 and 08-182, respectively. The thickness of the cohesionless fill in Boreholes 08-184 to 08-186 ranged from 1.1 m to 1.5 m.

The depths to the base of the clayey silt fill are 0.6 m and 0.3 m (Elevations 338.4 and 344.0) in Boreholes 08-181 and 08-182, respectively. In Boreholes 08-184 to 08-186, the depths to the base of the sand and gravel fill and sandy silt fill are at 1.1 m to 1.5 m (Elevations 334.7 to 337.8).

SPT 'N' values in the clayey silt fill were 7 and 31 blows per 0.3 m of penetration, indicating a firm to hard consistency. SPT 'N' values in the cohesionless fill were 8, 12 and 17 blows per 0.3 m of penetration, indicating a loose to compact relative density. The natural moisture contents ranged from 5% to 24%.

Grain size distribution curve for a sand and gravel fill sample tested is presented on the Record of Borehole sheets and on Figure B1 Appendix B.

The results of laboratory tests carried out on cohesive soil samples were as follows:

Soil Particles	(%)
Gravel	49
Sand	41
Silt & Clay	10

5.2.2 Clayey Silt Till

Native brown to grey clayey silt till, sandy, trace gravel and occasional cobbles was contacted below the fill in Boreholes 08-184 to 08-186. Thickness of this layer was 2.9 m and 3.1 m in Boreholes 08-184 and 08-185, respectively. In Borehole 08-186 the clayey silt till was contacted at 1.5 m depth (Elevation 337.1) and the thickness of this layer was 5.6 m.

In Boreholes 08-184 and 08-185, the depth to the base of the clayey silt till was 4.3 m and 4.2 m (Elevations 331.8 and 334.7). In Borehole 08-186, the base of the clayey silt till was 7.1 m (Elevation 331.5).

The cohesive layer is firm to hard in consistency, based on SPT 'N' values ranging from 4 to 86 blows per 0.3 m of penetration. SPT 'N' values higher than 100 blows per 0.25 m of penetration were measured in Borehole 08-186 below Elevation 332.5. The moisture content varied from 10% to 17%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheets and on Figure B2 Appendix B. Atterberg Limits test results are presented on Figure B6 of Appendix B.

The results of laboratory tests carried out on cohesive soil samples were as follows:

Soil Particles	(%)
Gravel	1 to 4
Sand	30 to 35
Silt	48 to 49
Clay	15 to 18

Liquid Limit	17 to 18
Plastic Limit	11 to 12

The above results show that the clayey silt till is of low plasticity with a group symbol of CL-ML. It should be noted that glacial tills are known to contain cobbles and boulders.

5.2.3 Sandy Silt Till

Native sandy silt till was contacted below the fill in Boreholes 08-181 and 08-182 and below the clayey silt till layer in Boreholes 08-184 to 08-186. The sandy silt till generally contains trace gravel, trace to some clay and occasional cobbles. The sandy silt till varies in colour from brown to grey with depth.

Clayey zones were encountered within the sandy silt till in Boreholes 08-181 and 08-182 at approximately 6.0 m depth (Elevations 333.0 and 338.0).

Boreholes 08-181 and 08-182 were terminated within the sandy silt till at 13.8 m depth (Elevations 325.3 and 330.5). Boreholes 08-184 to 08-186 were also terminated within the sandy silt till at depths ranging from 7.8 m to 9.5 m (Elevations 328.3 to 331.1).

SPT 'N' values of the sandy silt till ranged from 8 blows per 0.3 m of penetration to higher than 100 blows per 0.125 m of penetration, indicating a loose to very dense relative density. The natural moisture contents generally lay in the range of 6% to 19%.

Grain size distribution curves 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 Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	0 to 9
Sand	35 to 50
Silt	35 to 50
Clay	9 to 16

Liquid Limit	17 to 23
Plastic Limit	10 to 13

The above results show that the clayey zones of the sandy silt till are 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.

5.2.4 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1.

Table 5.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-181	January 9, 2009	2.5	336.5	In piezometer
	February 9, 2009	11.4	327.6	
08-184	June 9, 2008	6.2	329.9	Open borehole
08-185	July 15, 2008	2.1	336.8	In piezometer
08-186	June 9, 2008	Dry	-	Open borehole

The piezometric reading indicates that the groundwater level is near Elevation 327.6 m in Borehole 08-181 and Elevation 336.8 in Borehole 08-185.

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 33+900 – 34+160 (Boreholes 08-202)

5.3.1 Topsoil

Topsoil was identified at the ground surface in Borehole 08-202. The topsoil thickness generally was 500 mm. The topsoil thickness may vary between and beyond the borehole location and the data is not intended for the purpose of estimating quantities.

5.3.2 Sandy Silt Till

Native sandy silt till was contacted below the topsoil in Borehole 08-202. The sandy silt till generally contains trace gravel, trace to some clay, occasional organics and rootlets and occasional cobbles. The sandy silt till varies in colour from brown to grey with depth.

Clayey zones were encountered within the sandy silt till at approximately 3.0 m depth (Elevation 342.5).

Borehole 08-202 was terminated within the sandy silt till at 7.7 m depth (Elevation 337.7).

SPT ‘N’ values of the sandy silt till ranged from 23 blows per 0.3 m of penetration to higher than 100 blows per 0.075 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally lay in the range of 8% to 13%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure C1 of Appendix C. Atterberg Limits test results are presented on Figure C2 Appendix C. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	5 to 7
Sand	42 to 43
Silt	38 to 39
Clay	13 to 14

Liquid Limit	18
Plastic Limit	11

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.

5.3.3 Groundwater Conditions

Water level was not observed in the borehole during and upon completion of drilling.

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 35+000 – 35+080 (Boreholes 08-210, 08-212)

5.4.1 Topsoil

Topsoil was identified at ground surface in Borehole 08-210. The topsoil thickness generally was 500 mm. The topsoil thickness may vary between and beyond the borehole location and the data is not intended for the purpose of estimating quantities.

5.4.2 Fill

Fill was contacted surficially in Borehole 08-212. The fill consists of brown sand and gravel with trace of topsoil. Thickness of the sand and gravel fill was 2.1 m. A layer of sand and silt fill was also contacted near the base of the fill

The depth to the base of the sand and gravel fill is 2.1 m (Elevation 342.5).

SPT 'N' values in the fill were 38 and 23 blows per 0.3 m of penetration, indicating dense to compact relative density. The natural moisture contents were 3% and 11%.

Grain size distribution curves of fill samples tested are presented on the Record of Borehole sheets and on Figures D1 and D2 of Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Gravel Fill (%)	Sand and Silt Fill (%)
Gravel	42	12
Sand	45	45
Silt	-	38
Clay	-	5
Silt & Clay	13	

5.4.3 Sandy Silt Till

Native sandy silt till was contacted below the topsoil and the fill. The sandy silt till generally contains trace gravel, trace to some clay, occasional organics and occasional cobbles and boulders. The sandy silt till varies in colour from brown to grey with depth.

Clayey zones were encountered within the sandy silt till at approximately 2.6 m depth (Elevation 345.0).

Boreholes 08-210 and 08-212 were terminated within the sandy silt till at 9.3 m and 7.5 m depth (Elevations 338.4 and 337.2), respectively.

SPT ‘N’ values in the sandy silt till ranged from 18 blows per 0.3 m of penetration to higher than 100 blows per 0.075 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally lay in the range of 5% to 12%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure D3 of Appendix D. Atterberg Limits test results are presented on Figure D4 Appendix D. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	1 to 9
Sand	29 to 32
Silt	47 to 56
Clay	10 to 18

Liquid Limit	19
Plastic Limit	13

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

This layer contains cobbles and boulders which may account for some high SPT ‘N’ values.

5.4.4 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Borehole	Date (2008)	Water Level (m)		Comment
		Depth	Elevation	
08-212	May 21	Dry	-	In piezometer
	May 27	1.8	342.8	
	June 18	2.1	342.5	

The piezometric reading indicates that the groundwater level is near Elevation 342.5 m.

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

5.5 Hwy 7 New, Station 36+000 – 36+320 (Boreholes 08-220)

5.5.1 Topsoil

Topsoil was identified at ground surface in Borehole 08-220. The topsoil thickness generally was 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.

5.5.2 Sandy Silt Till

Native sandy silt till was contacted below the topsoil. The sandy silt till generally contains trace gravel and trace to some clay. The sandy silt till varies in colour from brown to grey with depth.

Clayey zones were encountered within the sandy silt till at approximately 4.5 m depth (Elevation 337.2).

Borehole 08-220 was terminated within the sandy silt till at 6.4 m depth (Elevation 335.3).

SPT ‘N’ values of the sandy silt till ranged from 32 blows per 0.3 m of penetration to higher than 100 blows per 0.10 m of penetration, indicating a dense to very dense relative density. The natural moisture contents generally lay in the range of 7% to 12%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure E3 of Appendix E. The results of the laboratory test are summarized as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	4 to 9
Sand	32 to 44
Silt	40 to 47
Clay	6 to 17

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

5.5.3 Groundwater Conditions

Water levels were observed in the borehole during and upon completion of drilling. A standpipe piezometer was installed to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.3.

Table 5.3 – Water Level Measurements

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
08-220	April 23	0.5	341.2	In piezometer

The piezometric reading indicates that the groundwater level is near Elevation 341.2 m.

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

5.6 Hwy 7 New, Station 37+500 – 37+700 (Boreholes 08-230, 08-231, 08-232, 08-236, 08-238)

5.6.1 Topsoil

Topsoil was identified at ground surface in Boreholes 08-230 to 08-232. The topsoil thickness was 300 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 contacted below the topsoil in Boreholes 08-230 to 08-232 and surficially in Boreholes 08-236 and 08-238.

In Boreholes 08-236 and 08-238, the upper layer of fill consists of dark brown silt mixed with topsoil, some gravel, trace sand and occasional roots.

Layers of sand and gravel fill containing some silt, some clay, occasional cobbles, occasional limestone fragments and possible boulders were contacted below the silt fill and below the topsoil in all the boreholes.

Thickness of the fill ranged from 1.8 m to 3.0 m. The depths to the bases of the sand and gravel fill ranged from 2.1 m to 3.2 m (Elevations 337.7 to 340.2).

SPT 'N' values in the fill ranged from 2 to 92 blows per 0.3 m of penetration, indicating loose to very dense relative density. The natural moisture contents ranged from 7% to 21%.

Grain size distribution curves of fill samples tested are presented on the Record of Borehole sheets and on Figure F1 of Appendix F. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Gravel Fill (%)
Gravel	22 to 41
Sand	34 to 49
Silt & Clay	13 to 33

5.6.3 Sandy Silt Till

Native sandy silt till was contacted below the fill in all the boreholes. The sandy silt till generally contains trace gravel, trace to some clay, occasional to numerous cobbles and occasional limestone fragments. The sandy silt till varies in colour from brown to grey with depth. Depths and elevations where native sandy silt till was encountered are indicated in Table 5.4.

Table 5.4 – Depths and Elevations of Native Sandy Silt Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-230	3.2 to 6.7 (Borehole termination depth)	337.7 to 334.2	>3.5
08-231	2.1 to 5.3 (Borehole termination depth)*	338.6 to 335.4	3.2
08-232	2.7 to 4.3 (Borehole termination depth)*	340.2 to 338.6	1.6
08-236	3.0 to 4.6**	338.4 to 336.8	1.6
08-238	2.6 to 5.3 (Borehole termination depth)*	338.4 to 335.7	2.7

* Borehole terminated upon refusal on possible bedrock

** Borehole terminated in bedrock

SPT ‘N’ values of the sandy silt till ranged from 36 blows per 0.3 m of penetration to higher than 100 blows per 0.125 m of penetration, indicating a dense to very dense relative density. The natural moisture contents generally lay in the range of 8% to 13%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure F2 Appendix F. The results of laboratory tests carried out on sandy silt till samples were as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	0 to 10
Sand	31 to 45
Silt	41 to 55
Clay	6 to 13

This layer contains cobbles and boulders which may account for some high SPT ‘N’ values and resistance to augering.

5.6.4 Bedrock

The soils described above were found to be underlain by dolostone bedrock of the Guelph Formation. The dolostone encountered in the boreholes is described as white in colour and slightly to moderately weathered. Depth and elevations of the top of weathered bedrock are shown in Table 5.5.

Table 5.5 – Depth and elevation of Top of Weathered Bedrock

Borehole	Depth to Weathered Bedrock (m)	Top of Weathered Bedrock Elevation (m)
08-231	5.3*	335.4
08-232	4.3*	338.6
08-236	4.6**	336.8
08-238	5.3*	335.7

* Borehole terminated upon refusal on possible bedrock

** Bedrock proved by coring below augered depth.

Bedrock cores were collected from Borehole 08-236 using NQ sized coring equipment. Total core recovery (TCR) in the bedrock ranged from 86% to 100% in all core runs.

RQD values recorded for rock cores ranged from 33% to 90%. In Borehole 08-236 Run 3 RQD value was 26%. Based on RQD values, rock quality is described as poor to excellent.

Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 1 to 10.

Results of the point load tests conducted on the rock core samples are presented in Table 1 immediately following the text. Average UCS value (130 MPa) is shown on the Record of

Borehole sheets. The typical ranges of inferred UCS for various types of rock cores were from 95 MPa to 176 MPa, indicating a strong to very strong rock.

5.6.5 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.6, along with the measurements in the boreholes upon completion of drilling.

Table 5.6 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-230	February 19, 2009	1.4	339.5	In piezometer
08-231	August 6, 2008	2.6	338.1	During drilling
08-232	August 6, 2008	2.4	340.5	During drilling
08-236	June 18	4.0	337.4	During drilling
08-238	June 20, 2008	2.7	338.3	During drilling
	July 15, 2008	2.9	338.1	In piezometer

The piezometric readings indicate that the groundwater levels ranged from Elevation 338.1 to 339.5.

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.

5.7 Hwy 7 New, Station 37+770 – 38+000 (Boreholes 08-233, 08-234, 08-235, 08-237, 08-239, 08-240)

5.7.1 Topsoil

Topsoil was identified at ground surface in Boreholes 08-233 to 08-235 and 08-240. The topsoil thickness generally ranged from 150 mm to 300 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.7.2 Fill

Fill was contacted below the topsoil in Boreholes 08-233 to 08-235 and 08-240 and surficially in Boreholes 08-237 and 08-239.

In Borehole 08-234, the fill consisted of dark brown to grey sandy silt containing some gravel and trace clay.

In Boreholes 08-239, a 100-mm thick layer of silt fill mixed with topsoil was contacted surficially.

Fill encountered below the silt fill, below the topsoil, and surficially in Borehole 08-237 consists of brown to grey sand and gravel containing trace silt to silty, trace clay and occasional cobbles. Thickness of the fill ranged from 0.9 m to 1.9 m in Boreholes 08-233, 08-234, 08-239 and 08-240.

The depths to the base of the fill ranged from 1.2 m to 2.1 m (Elevations 336.9 to 338.4).

Boreholes 08-235 and 08-237 were terminated within sand and gravel the fill at 2.9 m and 3.7 m depths (Elevations 335.2 and 335.8), respectively.

SPT 'N' values in the fill ranged from 13 to 63 blows per 0.3 m of penetration, indicating compact to very dense relative density. SPT 'N' values higher than 50 blows per 0.1 m of penetration were also measured within the sand and gravel fill in Boreholes 08-235 and 08-237. The natural moisture contents ranged from 4% to 20%.

Grain size distribution curves of fill samples tested are presented on the Record of Borehole sheets and on Figures G1 and G2 of Appendix G. The results of the laboratory test are summarized as follows:

Soil Particles	Sand and Gravel Fill (%)	Sandy Silt Fill (%)
Gravel	32 to 43	0
Sand	42 to 51	58
Silt	-	33
Clay	-	9
Silt & Clay	15 to 25	-

5.7.3 Clayey Silt Till

Native brown to grey clayey silt till containing trace to some gravel and trace sand was contacted below the fill at 1.8 m and 1.2 m depth (Elevations 336.9 and 337.0) in Boreholes 08-234 and 08-240, respectively. Thickness of the clayey silt till was 300 mm.

The depths to the base of the clayey silt till were 2.1 m and 1.5 m (Elevations 336.6 and 336.7) in Boreholes 08-234 and 08-240, respectively.

SPT 'N' values in the clayey silt were 18 and 22 blows per 0.3 m of penetration, indicating a very stiff consistency. The natural moisture contents were 16% and 18%.

5.7.4 Sand and Gravel

A layer of native grey sand and gravel containing trace silt and occasional limestone fragments was contacted below the clayey silt till at 2.1 m depth (Elevation 336.6) in Borehole 08-234.

Borehole 08-234 was terminated within the sand and gravel at 3.4 m depth (Elevation 335.3).

SPT 'N' values in the sand and gravel were 47 blows per 0.3 m of penetration and higher than 50 blows per 0.15 m of penetration, indicating a dense to very dense relative density.

The natural moisture contents were 8% and 10%.

Grain size distribution curve of a sand and gravel sample tested is presented on the Record of Borehole sheets and on Figure G3 of Appendix G. The results of the laboratory test are summarized as follows:

Soil Particles	Silty Sand (%)
Gravel	51
Sand	39
Silt & Clay	10

5.7.5 Silty Sand

Native brown silty sand containing trace gravel and trace clay was contacted below the fill at 1.5 m depth (Elevation 338.4) in Borehole 08-239. Thickness of the silty sand layer was 600 mm.

The depth to the base of the silty sand was 2.1 m (Elevation 337.8) in Borehole 08-239.

SPT 'N' value in the silty sand was 13 blows per 0.3 m of penetration, indicating a compact relative density. The natural moisture content was 18%.

Grain size distribution curve of a silty sand sample tested is presented on the Record of Borehole sheet and on Figure G4 Appendix G. The results of the laboratory test are summarized as follows:

Soil Particles	Silty Sand (%)
Gravel	1
Sand	49
Silt	39
Clay	11

5.7.6 Sand

Native brown sand containing some gravel, some silt, trace clay and numerous cobbles was contacted below the silty sand at 2.1 m depth (Elevation 337.8) in Borehole 08-239. Thickness of the sand layer was 1.6 m.

The depth to the base of the sand was 3.7 m (Elevation 336.3) in Borehole 08-239.

SPT 'N' values in the sand were 42 and 43 blows per 0.3 m of penetration, indicating a dense relative density. The natural moisture contents were 16% and 19%.

Grain size distribution curves of a sand sample tested are presented on the Record of Borehole sheets and on Figure G5 Appendix G. The results of the laboratory test are summarized as follows:

Soil Particles	Silty Sand (%)
Gravel	20
Sand	58
Silt & Clay	22

5.7.7 Sandy Silt Till

Native sandy silt till was contacted below the fill in Boreholes 08-233, 08-239 and 08-240. The sandy silt till generally contains trace gravel, trace to some clay, occasional to numerous cobbles and occasional limestone fragments. The sandy silt till varies in colour from brown to grey with depth. Depths and elevations where native sandy silt till was encountered are indicated in Table 5.7.

Table 5.7 – Depths and Elevations of Native Sandy Silt Till

Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
08-233	2.1 to 3.5 (Borehole termination depth)*	337.2 to 335.7	1.5
08-239	3.7 to 5.3**	336.3 to 334.6	1.7
08-240	1.5 to 4.7 (Borehole termination depth)*	336.7 to 333.5	3.2

* Borehole terminated upon refusal on possible bedrock

** Borehole terminated in bedrock

SPT 'N' values of the sandy silt till ranged from 35 blows per 0.3 m of penetration to higher than 100 blows per 0.125 m of penetration, indicating a dense to very dense relative density. The natural moisture contents generally lay in the range of 7% to 18%.

Grain size distribution curves of sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure G6 Appendix G. The results of laboratory tests carried out on sandy silt till samples were as follows:

Soil Particles	Sandy Silt Till (%)
Gravel	3 to 11
Sand	34 to 49
Silt	35 to 54
Clay	5 to 16

This layer contains cobbles and boulders which may account for some high SPT 'N' values and resistance to augering.

5.7.8 Bedrock

The soils described above were found to be underlain by dolostone bedrock of the Guelph Formation. The dolostone encountered in the boreholes is described as white in colour and slightly to moderately weathered. Depth and elevations of the top of weathered bedrock are shown in Table 5.8.

Table 5.8 – Depth and elevation of Top of Weathered Bedrock

Borehole	Depth to Weathered Bedrock (m)	Top of Weathered Bedrock Elevation (m)
08-233	3.5*	335.7
08-234	3.4*	335.3
08-235	2.9*	335.2
08-237	3.7*	335.8
08-239	5.3**	334.6
08*240	4.7*	333.5

* Borehole terminated upon refusal on possible bedrock

** Bedrock proved by coring below augered depth.

Bedrock cores were collected from Borehole 08-239 using NQ sized coring equipment. Total core recovery (TCR) in the bedrock was 100% in all core runs.

RQD values recorded for rock cores in Borehole 08-239 ranged from 69% to 100%. In Borehole 08-239 Run 4, RQD value was 25%. Based on RQD values, rock quality is described as poor to excellent.

Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 2 to higher than 10.

Results of the point load tests conducted on the rock core samples are presented in Table 1 immediately following the text. Average values of UCS of each run are shown on the Record of Borehole sheets. The typical ranges of inferred UCS for various types of rock cores were from 88 MPa to 176 MPa, indicating a strong to very strong rock.

5.7.9 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Three standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.9, along with the measurements in the boreholes upon completion of drilling.

5.9 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
08-233	June 5, 2008	2.1	337.1	During drilling
08-234	August 20, 2008	1.6	337.1	In piezometer
	February 9, 2009	2.0	336.7	
08-235	August 20, 2008	1.5	336.6	In piezometer
	February 9, 2009	2.3	335.8	
08-237	June 20, 2008	2.4	337.1	During drilling
	July 15, 2008	2.3	337.2	In piezometer
	August 20, 2008	2.8	336.7	In piezometer
08-239	June 19, 2008	2.1	337.8	During drilling
08-240	August 20, 2008	3.0	335.2	During drilling

The piezometric reading indicates that the groundwater level is near Elevations 335.8 to 336.7.

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

6 MISCELLANEOUS

All-Terrain Drilling of Waterloo, Ontario supplied a CME 75 truck-mounted drill rig 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.

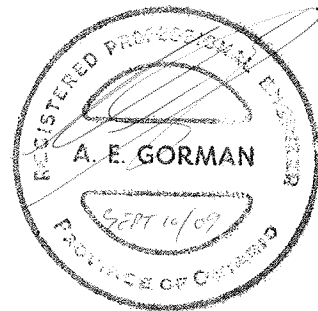
Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng. and Mr. M. Farrant, P. Eng. Interpretation of the data and preparation of the report were carried out by Ms. R. Palomeque Reyna, P.Eng.

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

Thurber Engineering Ltd



Rocío Palomeque Reyna, P.Eng.
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Senior Foundations Engineer



P.K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact

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

Geocres Number: 40P9-48

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 fill embankments and deep cuts of 4.5 m or greater in height and 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 fill embankments and deep cuts within a section of the proposed highway located from the east side Townline Road to Hanlon Expressway in the Regional Municipality of Waterloo, Ontario. High fills and deep cuts are identified as those with a height/depth greater than 4.5 m. Fill embankments height within this section ranged from 5.0 m to 8.0 m. Depths of deep cuts ranged from 4.5 m to 12.0 m.

Information related to the deep cuts and high fills is presented in Table 2. 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:

- Factor of safety against slope instability
- Settlement and compression of the fill embankments.

Where a berm is required in accordance with OPSD 202.010, this is indicated in Table 2 under the heading “Berm Req.”. The berm has been included in the stability analysis, where specific analysis has been carried out.

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 within the depth of exploration in the preliminary investigation consisted primarily of topsoil or granular fill overlying native glacial till consisting of 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.

Where the depth of cut or height of fill will exceed 10 m, a preliminary stability analysis has been conducted for that site. For the purpose of preliminary embankment stability analyses, the commercially available slope stability program GSLOPE developed by Mitre Software Inc. was used. The Bishop's simplified method for stability analysis was employed. The stability of the embankments was also checked under seismic loading assuming an acceleration of 0.08g.

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

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

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

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 8.0 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 2 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 2 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 25
Embankment compression	50 to 80
Total foundation settlement and embankment compression	60 to 105

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.
- 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 12.0 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 topsoil, compact to very dense sand and gravel fill and firm to hard clayey silt fill overlying native compact to very dense sandy silt till and stiff to hard silty clay till. It is anticipated that the base of the cut will consist of very dense sandy silt 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.

This assessment is supported by the results of analysis carried out for two, 12 m deep cuts, with the computed factors of safety shown in Table 2.

10.2 Deep Cut Design

Based on the design information currently available and the results of the analysis discussed above, 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
- 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 elev.	Ground water depth (m)	Ground water elev.	Borehole	Appendix
Hwy 7 New	32+880 – 33+120	240	4.0 to 12.0	335.0 to 332.0	2.5 11.4 (Borehole 08-181) 2.1 (Borehole 08-185)	326.5 327.6 336.8	08-181, 08-182, 08-184, 08-185, 08-186	B
Hwy 7 New	35+000 – 35+080	80	5.0 to 6.0	341.5 to 343.0	2.1	342.8	08-210, 08-212	D

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.

Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer



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



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



TABLE 1 -Point Load Results

Cut and Fill Embankments from East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph

15-64-17

	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	CONCLUSIONS			
	FT.	IN.	METERS							
	BH 08-236									
RUN #3	20	0	6.10	6.205	6.048	145.15				
	20	2	6.15	4.925	4.801	115.21	RUN #3:	130.18	145.15	115.21
RUN #4	20	6	6.25	7.535	7.344	176.25				
	20	8	6.30	4.046	3.943	94.64	RUN #4:	AVERAGE	MAX	MIN
	23	0	7.01	6.648	6.480	155.52				
	24	0	7.32	6.205	6.048	145.15				
	24	6	7.47	5.101	4.972	119.33				
	25	0	7.62	5.319	5.184	124.41				
	25	3	7.70	4.046	3.943	94.64				
	BH 08-239									
RUN #2	17	4	5.28	5.277	5.143	123.44				
	18	0	5.49	5.097	4.968	119.23				
	18	6	5.64	7.535	7.344	176.25				
	19	2	5.84	5.857	5.769	138.45				
RUN #3	20	2	6.15	4.432	4.320	103.68		AVERAGE	MAX	MIN
	21	6	6.55	7.036	6.858	164.59	RUN #1:			
	23	1	7.04	5.319	5.184	124.41	RUN #2:			
RUN #4	24	5	7.44	3.767	3.672	88.13	RUN #3:	104.78	119.23	88.13
	25	2	7.67	4.573	4.458	106.98				
	26	6	8.08	5.097	4.968	119.23				

Table 2

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		Ground water depth (m)	Slope Stability Analysis				Settlement Analysis			Appendix
						Soil Type – Depth to the base of soil layer (m)	Relative Density or Consistency		Factor of Safety				Settlement Foundation ⁽¹⁾ (mm)	Embankment Compression (mm)	Total (mm)	
									Normal condition	Seismic = 0.08g	Berm Req.	Figure				
Hwy 7 New	32+480 – 32+540	60	5.0 – 6.0	-	08-180	Clayey Silt Fill – 0.8 Sandy Silt Till – >9.3	Firm Compact to very dense	-	-	-	-	-	-	-	-	A
Hwy 7 New	32+880 – 33+120	240	4.0 – 12.0	-	08-181, 08-182, 08-184, 08-185, 08-186	Clayey Silt Fill – 0.6 Sand, silt and gravel Fill – 1.5 Clayey Silt Till – 7.1 Sandy Silt Till - > 13.8	Firm to hard Loose to compact Firm to hard Loose to very dense	2.1 to 11.4	1.4	1.1	Y	B1 B2	-	-	-	B
Hwy 7 New	33+500– 33+720	220	-	5.0 – 6.0	Boreholes were not drilled due to access restrictions			-	-	-	-	-	-	60	>60	-
Hwy 7 New	33+900 – 34+160	260	2.5 to 5.5	-	08-202	Topsoil – 500 mm Sandy Silt Till - > 7.7	- Compact to very dense	-	-	-	-	-	-	-	-	C
Hwy 7 New	35+000 – 35+080	80	5.0 – 6.0	-	08-210, 08-212	Topsoil – 500 mm Sand and Gravel Fill – 2.1 Sandy Silt Till - > 9.3	- Dense Compact to very dense	2.1	-	-	-	-	-	-	-	D
Hwy 7 New	35+440 – 35+520	80	5.0 – 6.0	-	Boreholes were not drilled due to access restrictions			-	-	-	-	-	-	-	-	-
Hwy 7 New	35+740 – 35+800	60	4.5 – 5.0	-	Boreholes were not drilled due to access restrictions			-	-	-	-	-	-	-	-	-
Hwy 7 New	36+000 – 36+320	320	-	5.0	08-220	Topsoil – 450 mm Sandy Silt Till - > 6.4	- Dense to very dense	0.5	-	-	-	-	10 to 15	50	60 to 65	E
Hwy 7 New	37+500 – 37+700	200	-	5.0 – 7.0	08-230, 08-231, 08-232, 08-236, 08-238	Topsoil – 300 mm Silt Fill – 0.8 Sand and Gravel Fill – 3.2 Sandy Silt Till – 6.7 Bedrock - >7.8	- Loose Loose to very dense Dense to very dense Strong to very strong	1.4	-	-	-	-	15 to 20	70	85 to 90	F
	37+770 – 38+000	230	-	8.0	08-233, 08-234, 08-235, 08-237, 08-239, 08-240	Topsoil – 300 mm Silt Fill – 100 mm Sandy Silt Fill – 1.8 Sand and Gravel Fill – 3.7 Clayey Silt Till – 2.1 Sand and Gravel – 3.4 Silty Sand – 2.1 Sand – 3.7 Sandy Silt Till – 5.3 Bedrock – >8.5	- - Compact Compact to very dense Very stiff Dense to very dense Compact Dense Dense to very dense Strong to very strong	2.0	-	-	-	-	20 to 25	80	100 to 105	G

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

Appendix A

**Hwy 7 New
Station 32+480 – 32+540
(Borehole 08-180)**

**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

C_{pen}


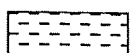



Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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

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


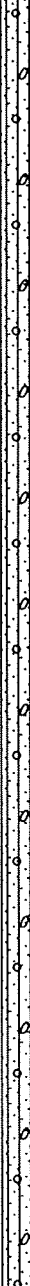

TERMS		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.				Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	
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 08-180

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 035.02 E 236 635.25 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.01 CHECKED BY MEF

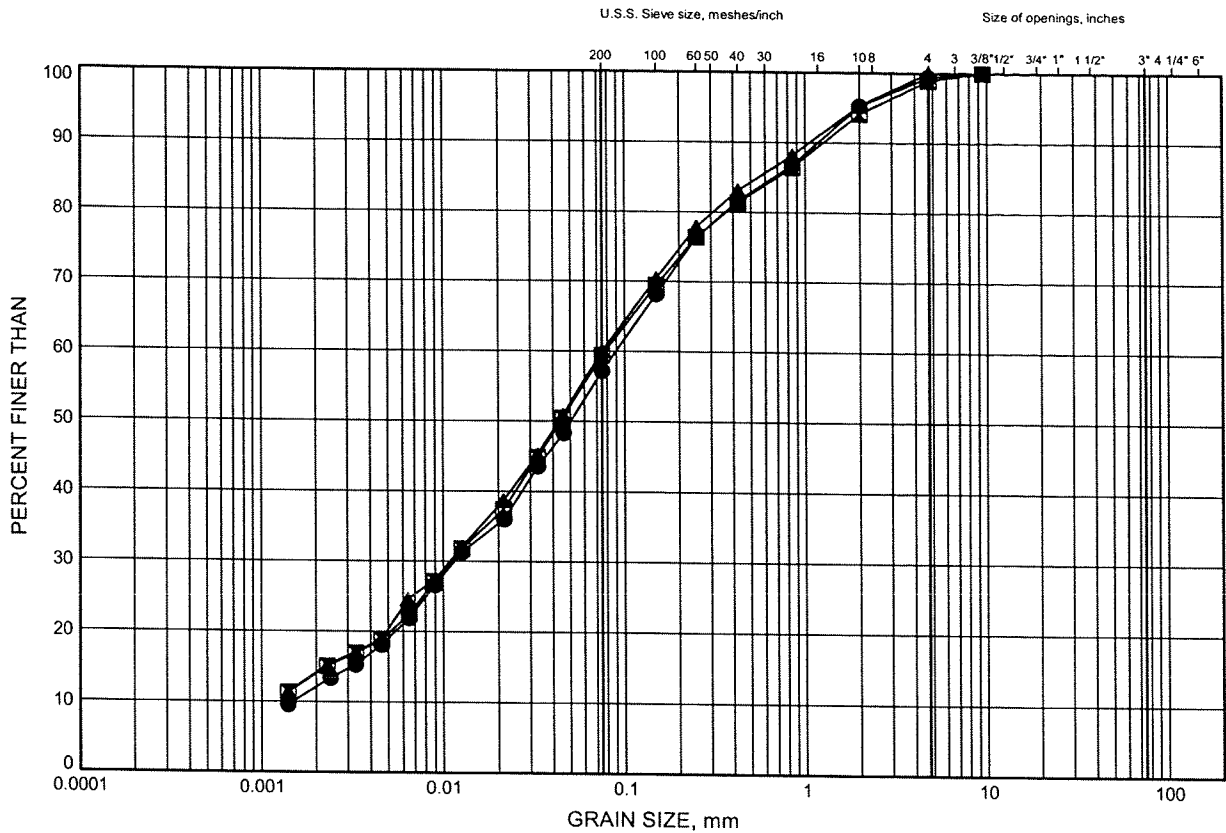
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE											
344.8	Clayey SILT, trace sand, trace gravel, occasional organics Brown Firm (FILL)		1	SS	7														
344.0																			
0.8	Sandy SILT, some clay, trace gravel Compact to Very Dense Brown (TILL)		2	SS	24		344												
			3	SS	22		343									1 42 45 12			
			4	SS	100/ 0.275		342												
			5	SS	100/ 0.200		341												
			6	SS	100/ 0.125	340													
	Grey																		
			7	SS	75/ 0.150	339													

ONTMT4S 6417R.GPJ 4/24/09

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE A1

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-180	1.83	342.94
⊠	08-180	3.35	341.41
▲	08-180	7.70	337.07

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

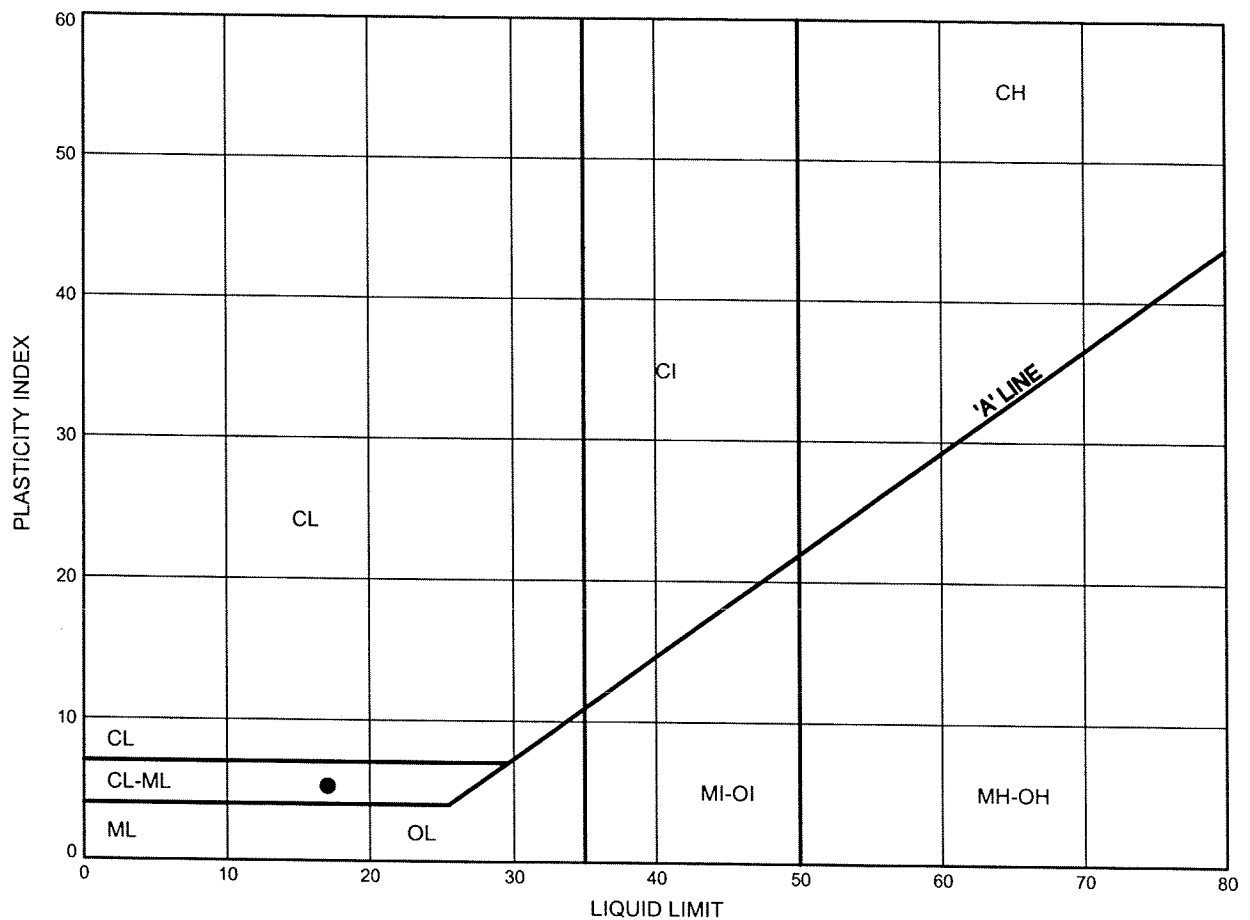
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE A2

SANDY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-180	7.70	337.07

Date April 2009

Project 408-88-00



Prep'd AN

Chkd. RPR

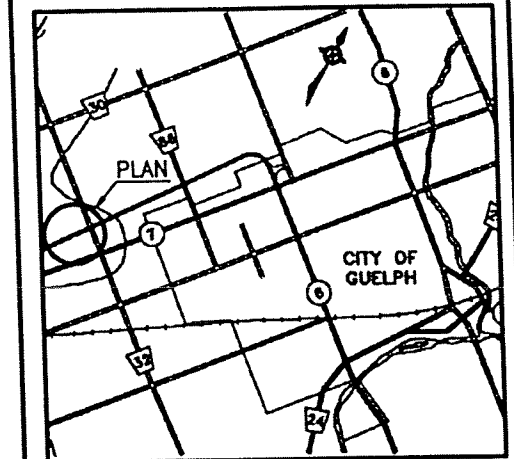
High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph



Photo - Looking west from Borehole 08-180

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

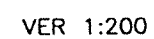
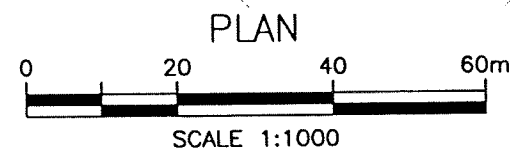
SHEET



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 17 of the E.A. Study.

[illegible]

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix B

**Hwy 7 New
Station 32+880 – 33+120
(Boreholes 08-181, 08-182, 08-184, 08-185, 08-186)**

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

RECORD OF BOREHOLE No 08-181

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 326.63 E 236 873.69 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.11.28 - 2008.11.28 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			SHEAR STRENGTH kPa						
339.0							20 40 60 80 100							
0.0	Clayey SILT, trace gravel, some topsoil Hard		1	SS	31									
338.4	Brown to Black Moist (FILL)													
0.6	Sandy SILT, trace gravel, trace to some clay Loose to Compact Brown Moist (TILL)		2	SS	20									
			3	SS	22									
	Wet		4	SS	8									
			5	SS	11									
	Very Dense		6	SS	100/ 0.125									
	Clayey zone		7	SS	50/ 0.75									
			8	SS	50/ 0.75									
			9	SS	118/ 0.250									

Continued Next Page

+³ X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-181

2 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 326.63 E 236 873.69 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.11.28 - 2008.11.28 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	120 140 160 180 200	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
	Continued From Previous Page							SHEAR STRENGTH kPa						
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
								WATER CONTENT (%)						
								40 80 120 160 200		20 40 60				
329	Sandy SILT, trace gravel, trace clay Very Dense Grey Wet (TILL)		10	SS	100/ 0.125									2 39 50 9
328														
327			11	SS	60/ 0.25									
326														
325.3														
13.8	END OF BOREHOLE AT 13.8m. 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 2.5 336.5 2009.02.09 11.4 327.6		12	SS	50/ 0.75									

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-182

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 410.32 E 236 943.45 ORIGINATED BY LG
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2008.11.27 - 2008.11.27 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 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	
344.3							20	40	60	80	100							
0.0	Clayey SILT, some sand, trace gravel, occasional rootlets		1	SS	7													
344.0	Firm Dark Brown (FILL)																	
0.3	Sandy SILT, trace gravel, trace to some clay		2	SS	25													
	Compact Brown Moist (TILL)																	
			3	SS	20										2 50 39 9			
			4	SS	83													
	Very Dense Wet		5	SS	100/ 0.150													
			6	SS	50/ 0.25													
			7	SS	100/ 0.150										0 49 35 16			
	Clayey zone Grey		8	SS	100/ 0.125													
			9	SS	50/ 0.50													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 08-184

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 443.32 E 236 975.38 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.09 - 2008.06.09 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					
								WATER CONTENT (%)					
336.1						20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				
0.0	SAND, trace silt Brown Moist (FILL)		1	AS			○ UNCONFINED + FIELD VANE	w _P	w	w _L			
335.4							● QUICK TRIAXIAL × LAB VANE						
0.7	Sandy SILT, trace gravel, occasional topsoil staining Loose Brown Moist (FILL)		1	SS	8								
334.7													
1.4	Clayey SILT, sandy, trace gravel Stiff Brown (TILL)		2	SS	8								
			3	SS	12							1 35 49 15	
			4	SS	9								
331.8													
4.3	Sandy SILT, trace to some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		5	SS	100/ 250							2 41 44 13	
			6	SS	100/ .150							4 40 44 12	
328.3			7	SS	100/ .150								
7.8	END OF BOREHOLE AT 7.77 m. BOREHOLE OPEN TO 7.62 m AND WATER LEVEL AT 6.25 m ON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 5.5m, BENTONITE BENSEAL AND AUGER CUTTINGS TO 0.6m, HOLEPLUG TO 0.3m AND AUGER CUTTING TO SURFACE												

+³ . X³ : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-185

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 405.33 E 236 994.69 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.10 - 2008.06.10 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										
338.9								20	40	60	80	100						
0.0	SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	AS														
337.8	Occasional topsoil																	
1.1	Clayey SILT, sandy, trace gravel Stiff to Hard Brown (TILL) Occasional cobbles		2	SS	17													
			3	SS	11													
			4	SS	31													
	Brown to grey		5	SS	47													
334.7																		
4.2	Sandy SILT, trace to some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		6	SS	100/ .200													
			7	SS	100/ .125													
331.1			8	SS	100/ .225													
7.8	END OF BOREHOLE AT 7.85 m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2008.07.15 2.1 336.8																	

+³ . x³ : Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-186

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 821 386.48 E 237 031.74 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.09 - 2008.06.09 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					
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				2									

Continued Next Page

+³ x³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-186

2 OF 2

METRIC

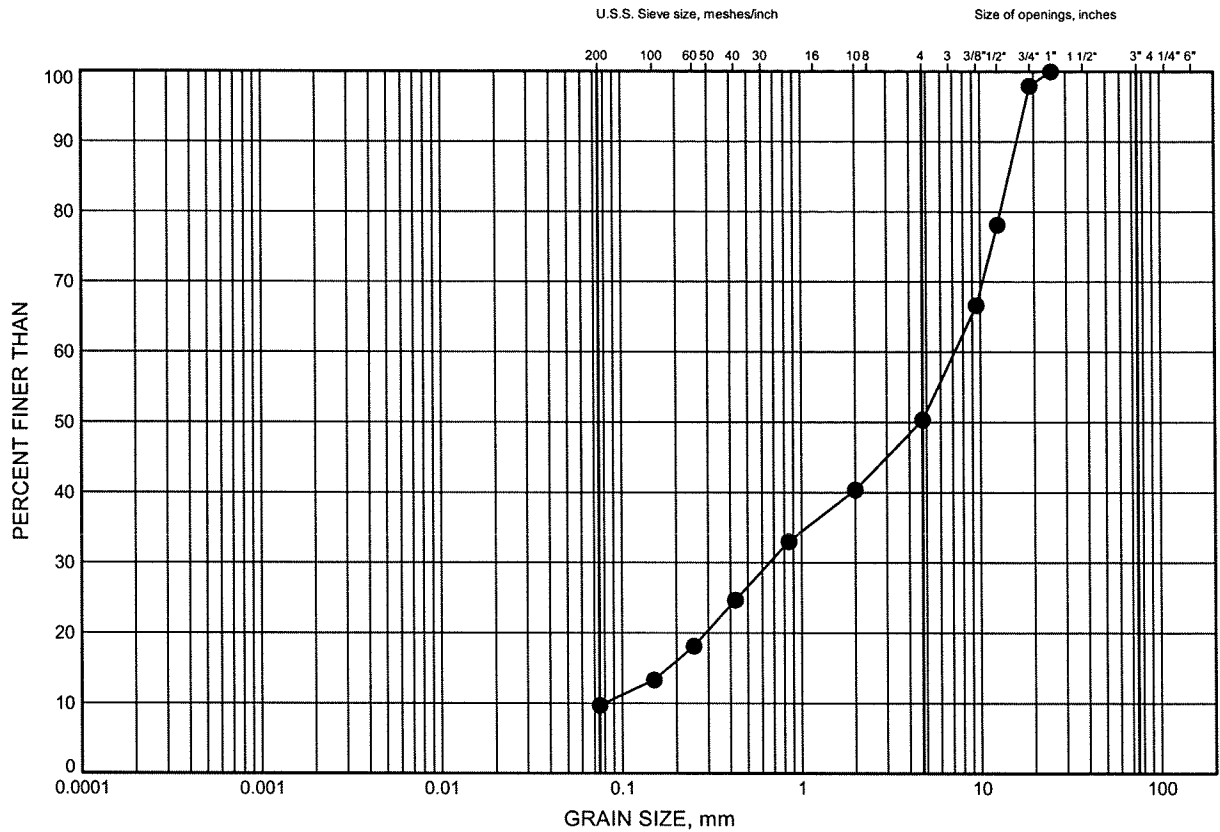
G.W.P. 408-88-00 LOCATION N 4 821 386.48 E 237 031.74 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.06.09 - 2008.06.09 CHECKED BY RPR

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					
	Continued From Previous Page																
	BOREHOLE BACKFILLED WITH HOLE PLUG TO 8.5m, THEN BENTONITE BENSEAL MIXED WITH AUGER CUTTING TO SURFACE.																

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)
●	08-186	0.15	338.45

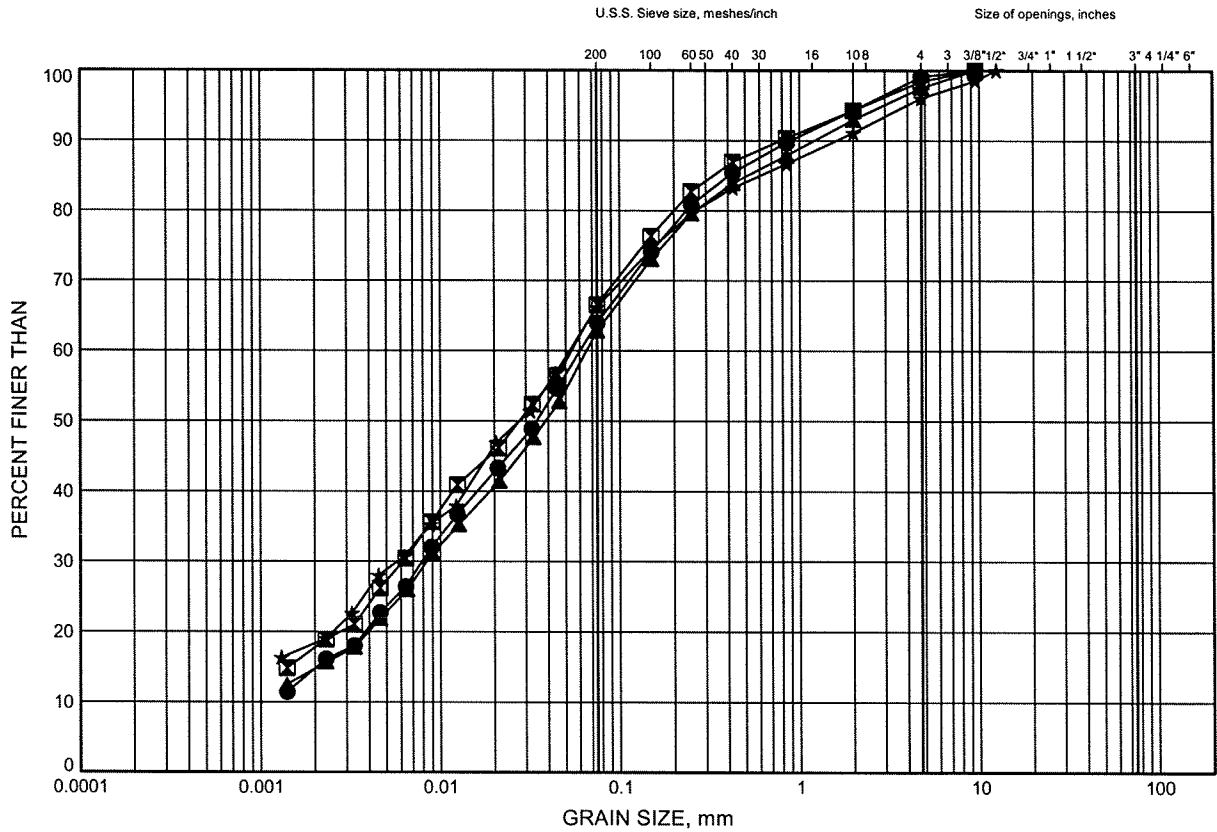


W.P.# 408-88-00.....
Prepared By .AN.....
Checked By .RPR.....

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

CLAYEY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-184	2.59	333.51
⊠	08-185	3.35	335.55
▲	08-186	2.59	336.01
★	08-186	6.32	332.28

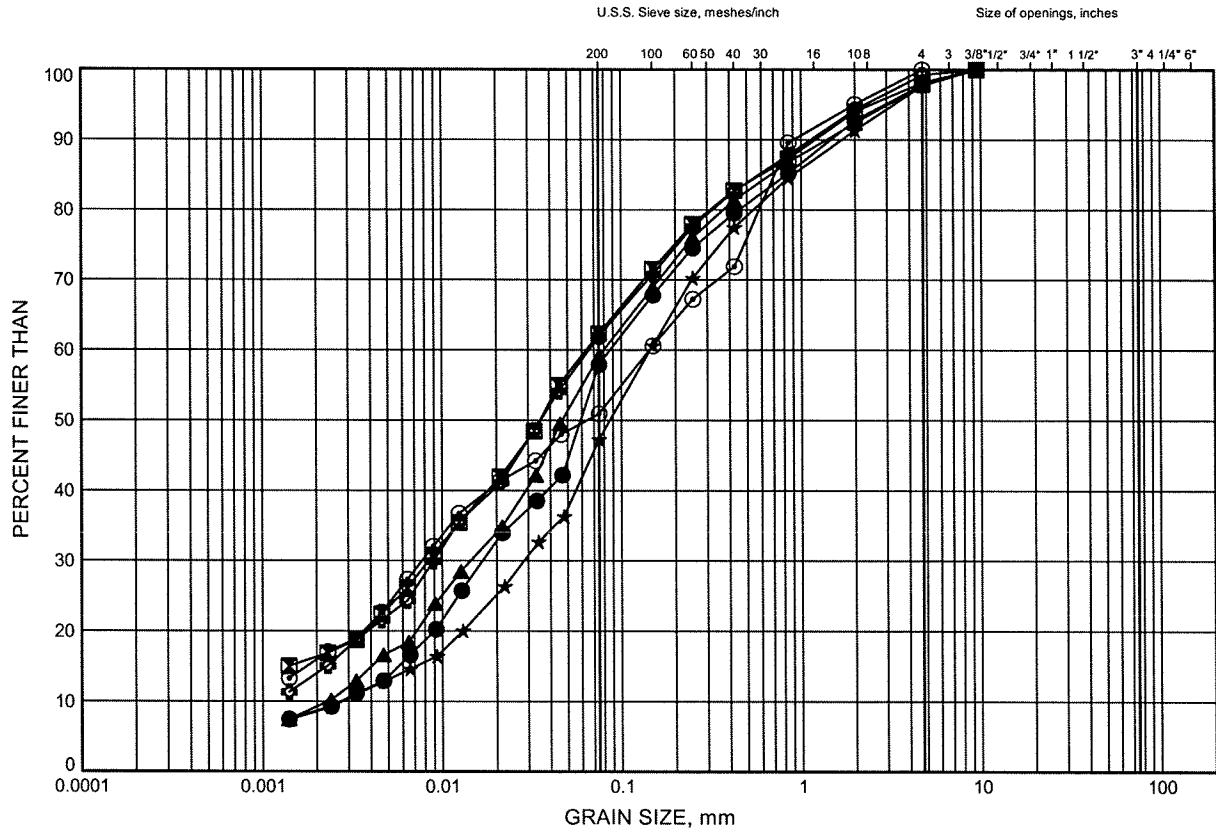


W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B3

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)
●	08-181	2.59	336.46
⊠	08-181	6.21	332.84
▲	08-181	10.97	328.08
★	08-182	1.83	342.51
⊙	08-182	6.25	338.09
⊕	08-182	10.74	333.59

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 9/8/09

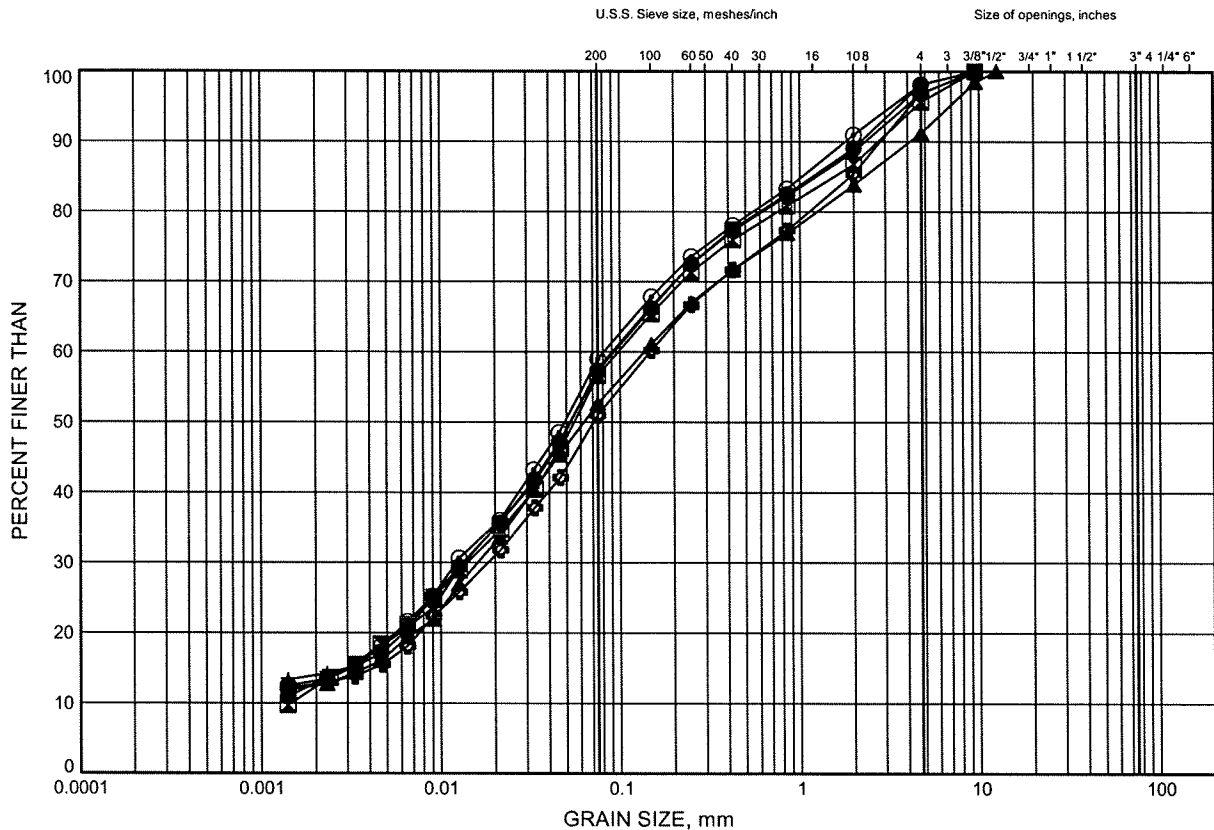
W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-184	4.79	331.31
⊠	08-184	6.25	329.85
▲	08-185	4.75	334.15
★	08-185	6.24	332.66
⊙	08-185	7.73	331.17
⊕	08-186	7.76	330.84

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 9/8/09

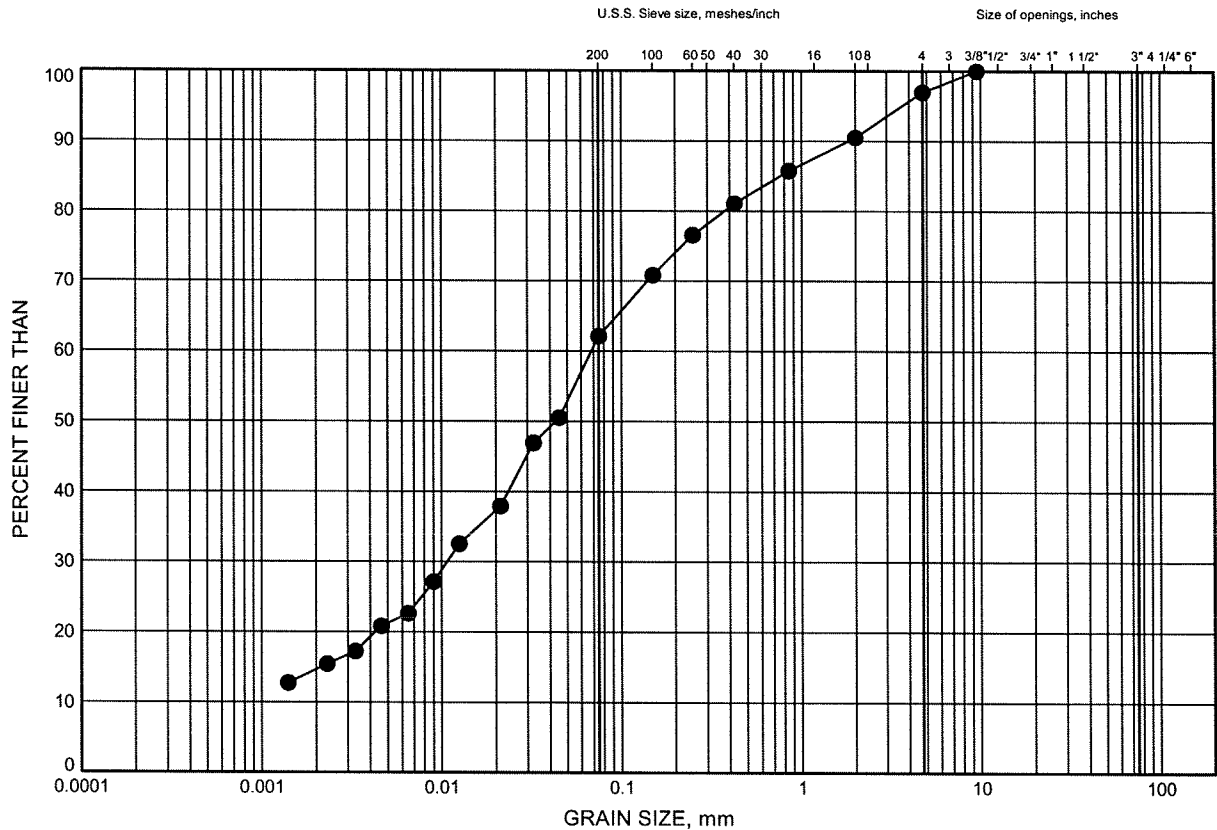
W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B5

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-186	9.36	329.24

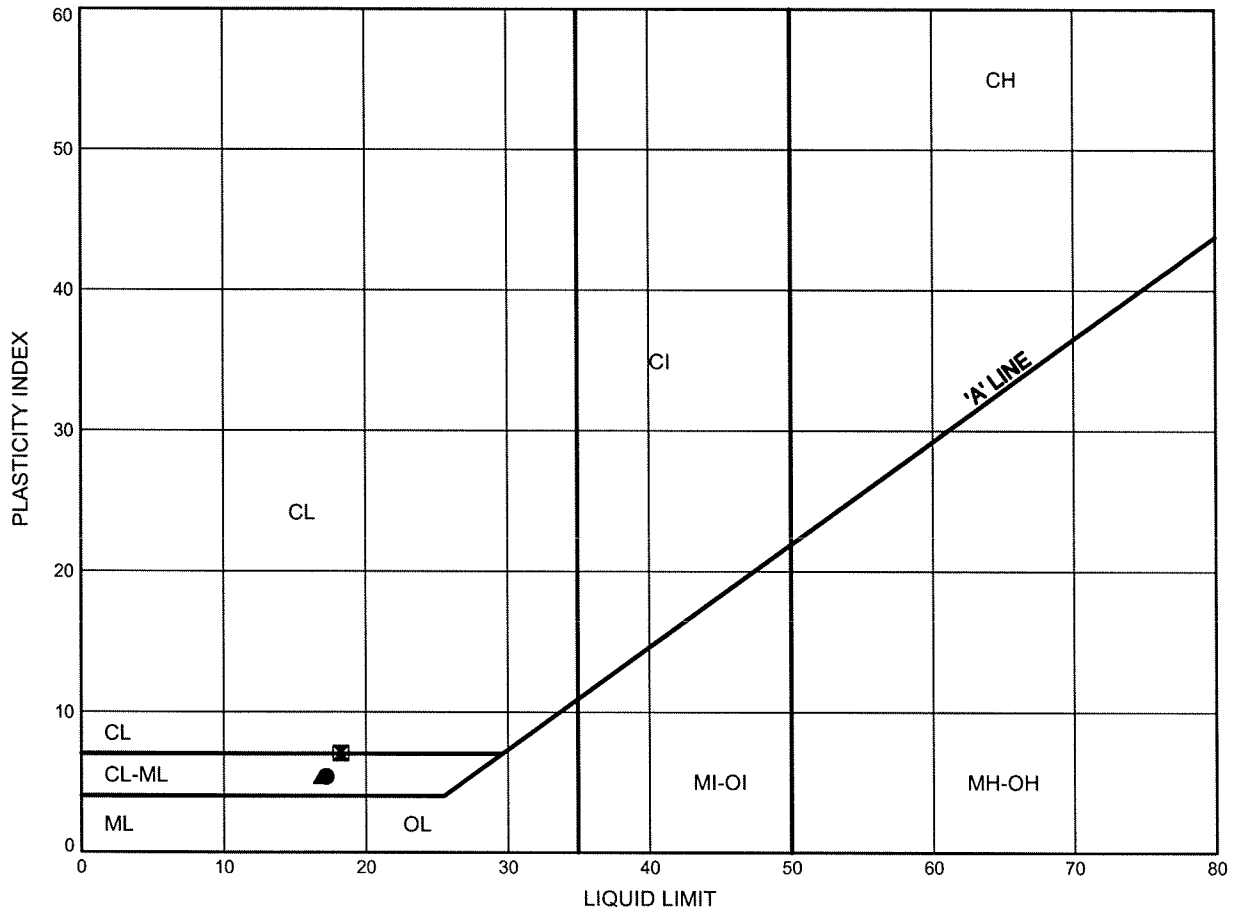


W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B6

CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-184	2.59	333.51
⊠	08-185	3.35	335.55
▲	08-186	2.59	336.01

Date September 2009
 Project 408-88-00

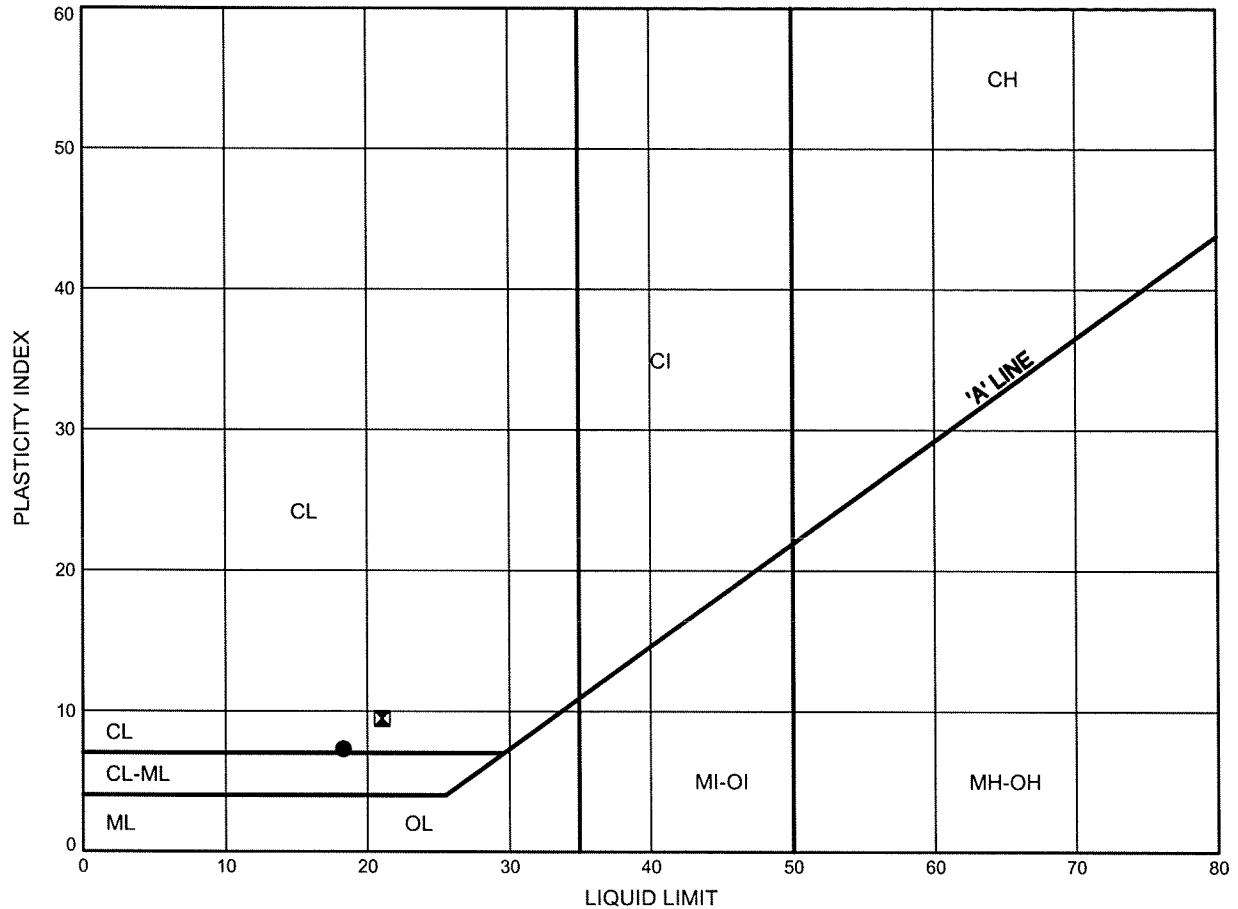


Prep'd AN
 Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B7

SANDY SILT TILL (Clayey Zone)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-181	6.21	332.84
☒	08-182	6.40	337.94

Date September 2009
 Project 408-88-00



Prep'd AN
 Chkd. RPR

Thurber Engineering Ltd. - Toronto
 15-64-17 - Highway 7 New
 Deep Cut, 12.0 m
 June 18, 2009
 Station 32+880 to 33+120

	Gamma	C	Phi	Piezo
	kN/m ³	kPa	deg	Surf.
Clayey silt fill	20	45	0	1
Sandy Silt Till	21	0	32	1

Clayey silt fill
 Sandy Silt Till

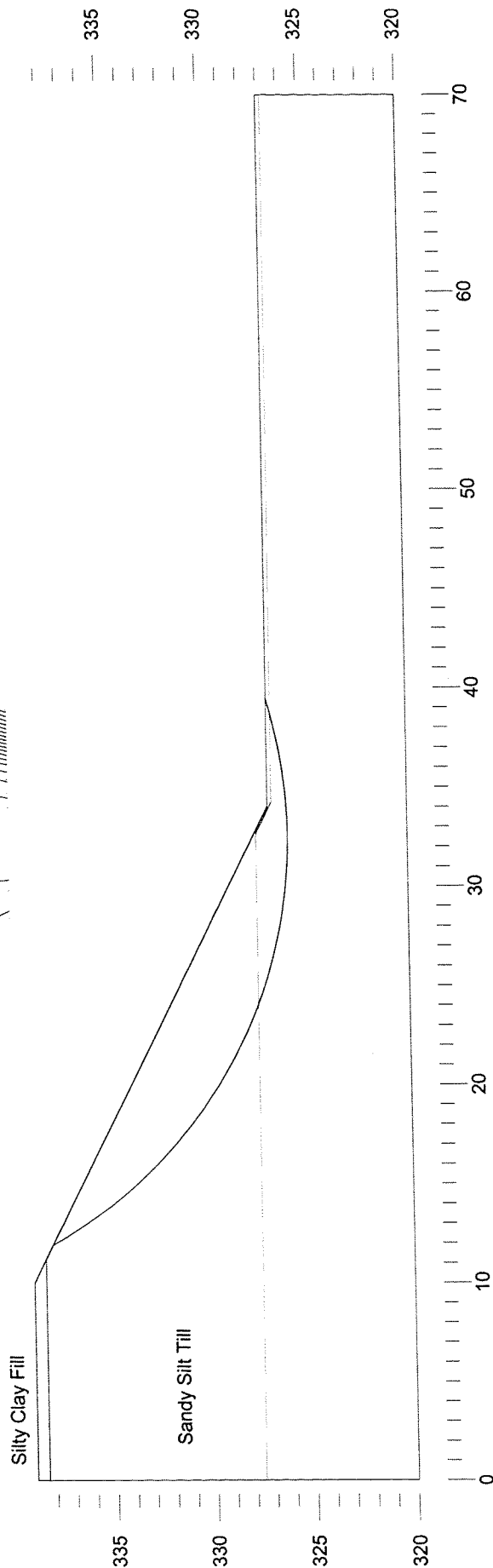
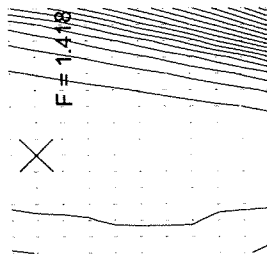


FIGURE B1

Thurber Engineering Ltd. - Toronto
 15-64-17 - Highway 7 New
 Deep Cut, 12.0 m
 June 18, 2009
 Station 32+880 to 33+120

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Clayey silt fill	20	0	1
Sandy Silt Till	21	32	1

Seismic coefficient = 0.08

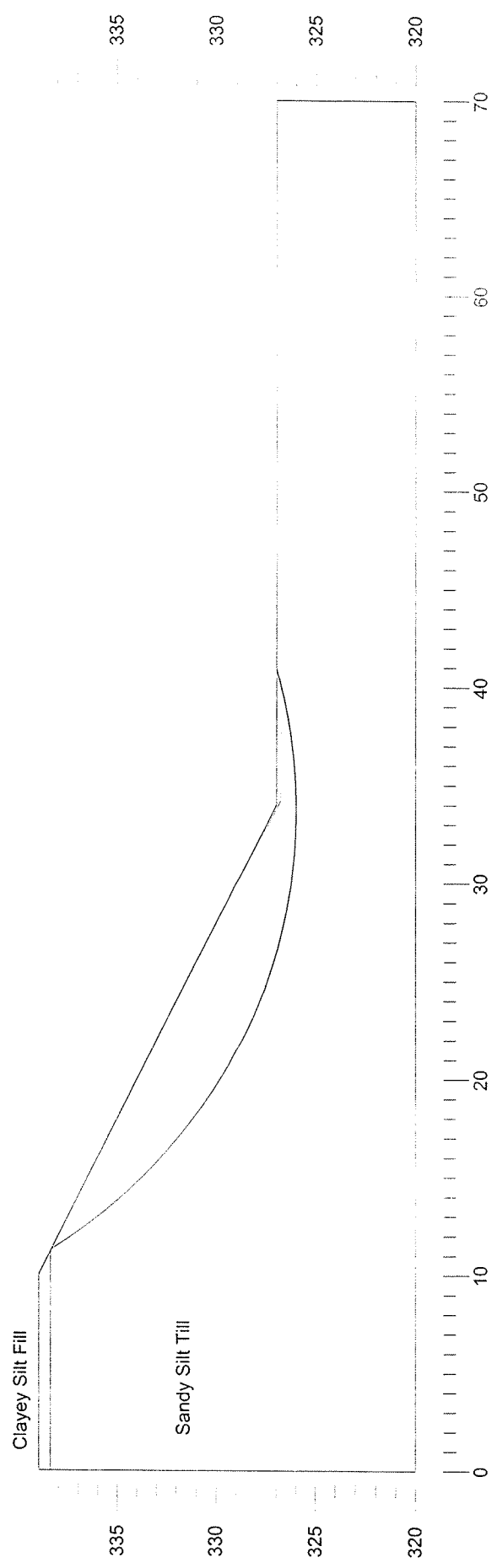
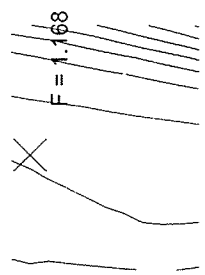


FIGURE B2

High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph

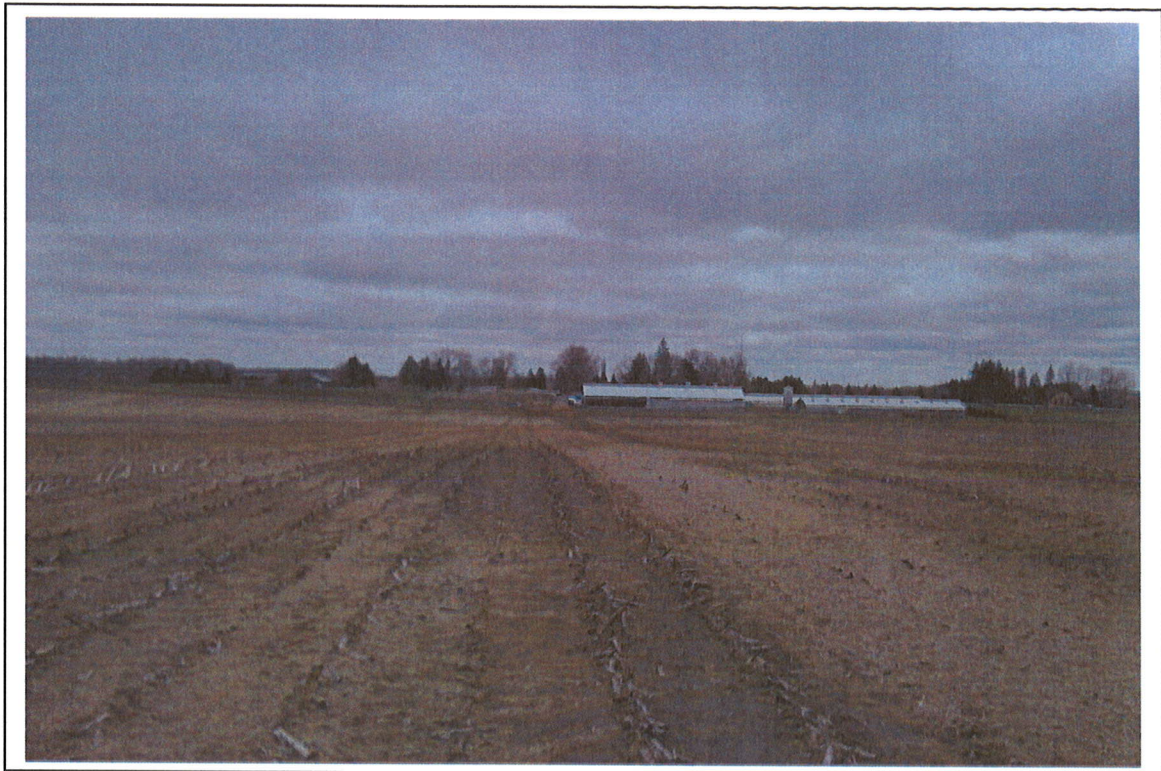


Photo - Looking to the west side of Borehole 08-181



Photo - Looking southwest of Borehole 08-182

High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph



Photo - Looking south of Borehole 08-182



Photo - Looking east of Borehole 08-182

High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph

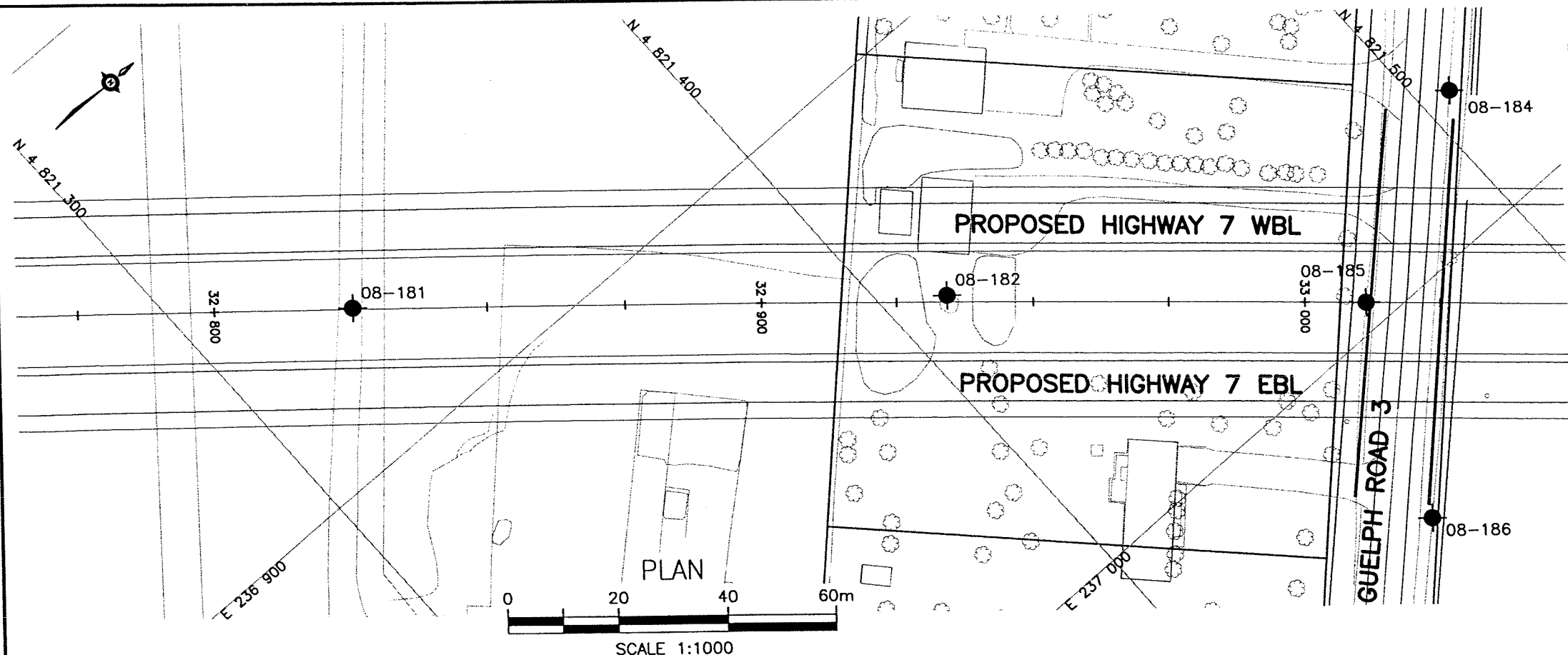


Photo - Looking north along Guelph Road 3



Photo - Looking north along Guelph Road 3

PLATE 17 OF 17
PH-0-007
MAY 1998



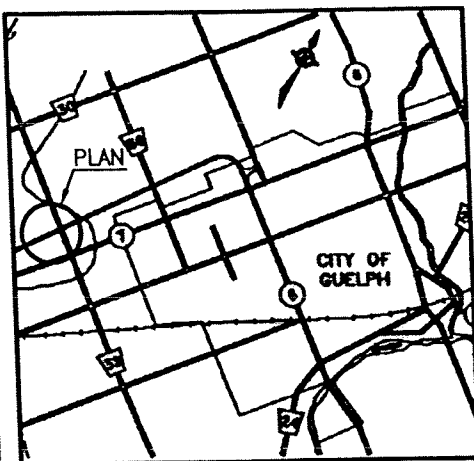
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 408-88-00
HIGHWAY 7
RECOMMENDED ROUTE
32+880 TO 33+120
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

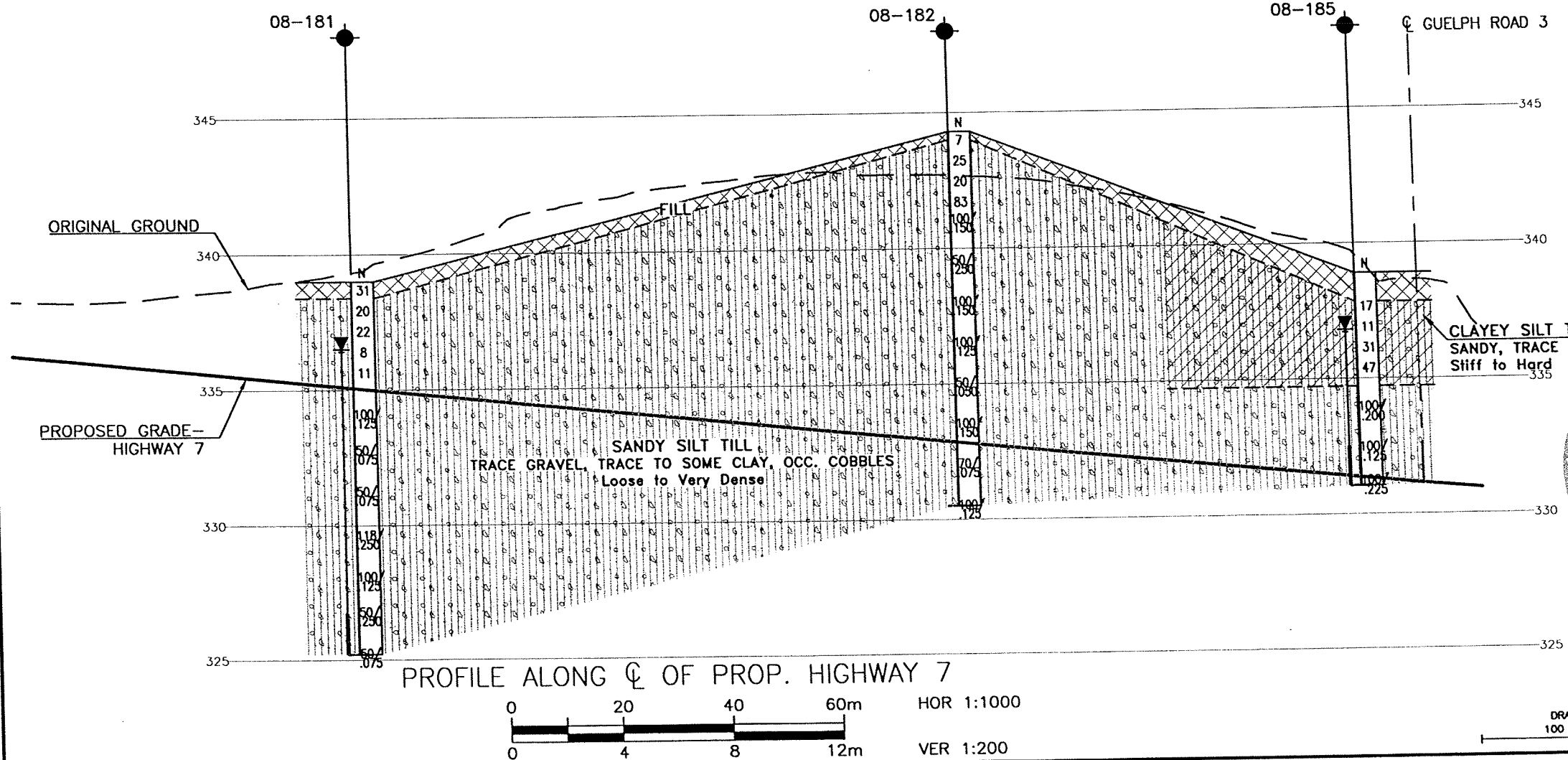
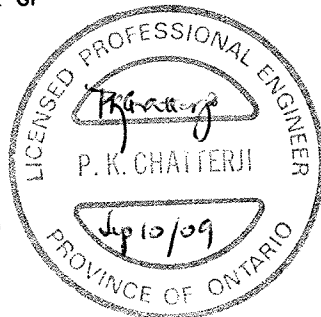
- Borehole
- Borehole and Cone
- N
- CONC
- PH
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
08-181	339.0	4 821 326.6	236 873.7
08-182	344.3	4 821 410.3	236 943.4

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 17 of the E.A. Study.

GEOCRE No. 40P9-48



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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

Appendix C

**Hwy 7 New
Station 33+900 – 34+160
(Boreholes 08-202)**

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

METRIC

CHECKED BY MEF

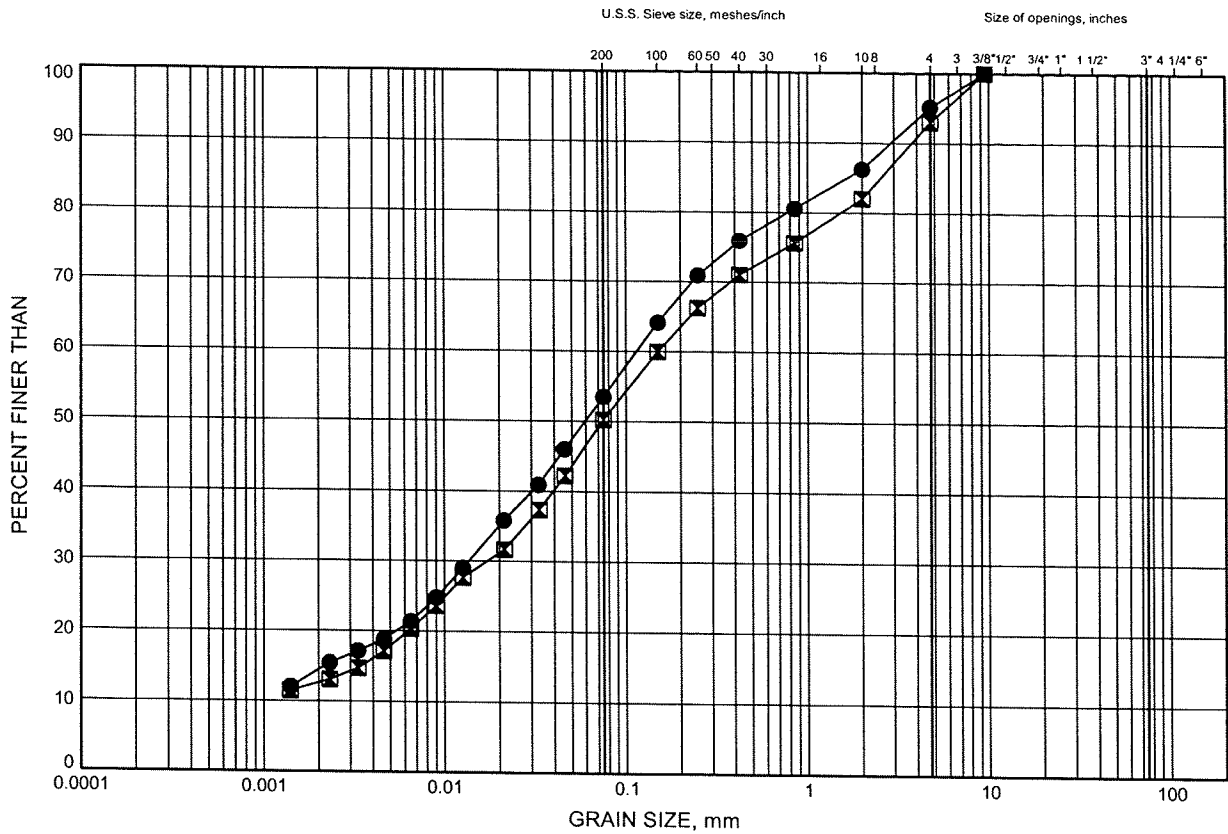
+³, X³: Numbers refer to Sensitivity

ONTMT4S 6417R.GPJ 4/24/09

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE C1

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-202	3.35	342.11
⊠	08-202	6.13	339.33

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

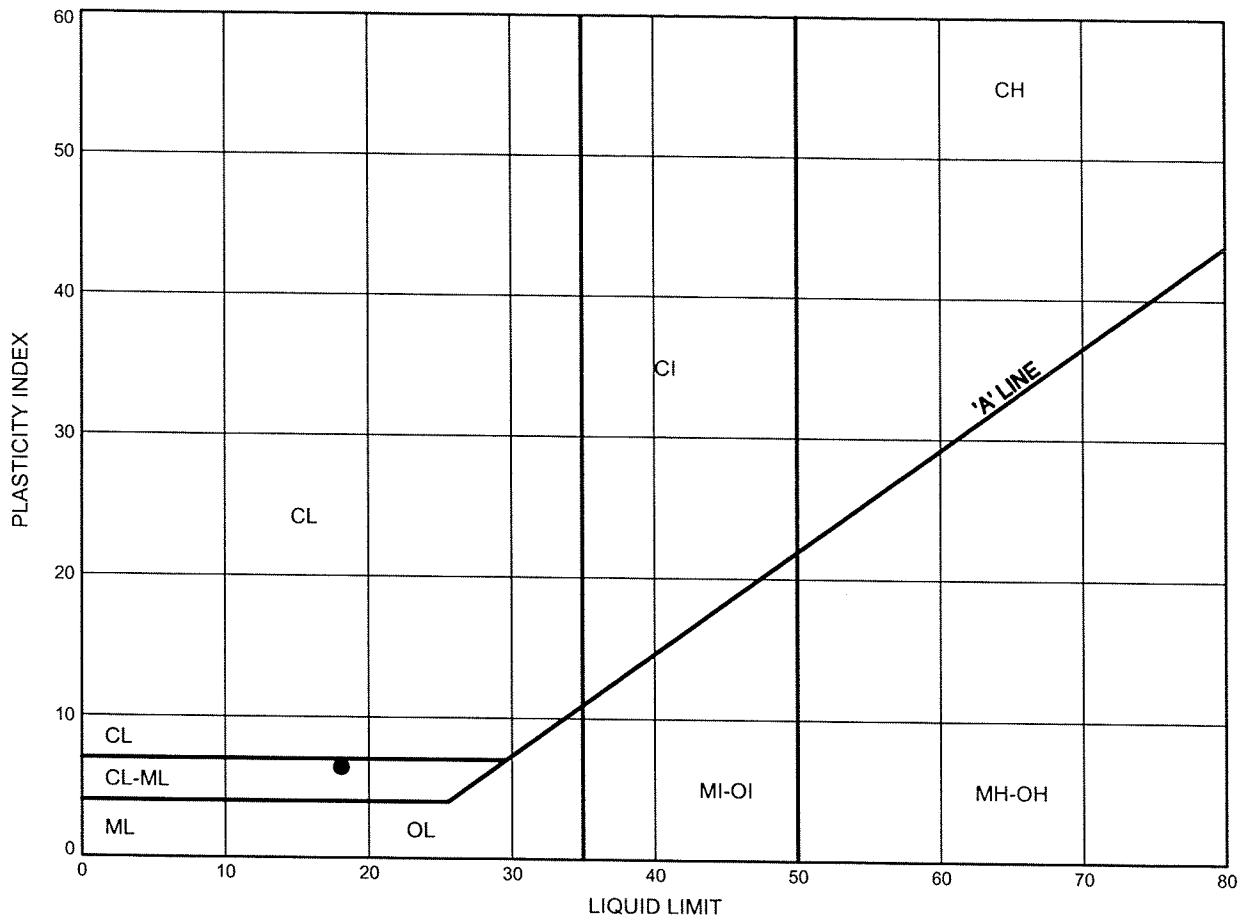
W.P.# 408-88-00.....
Prepared By AN.....
Checked By RPR.....



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

FIGURE C2

SANDY SILT TILL (Clayey Zone)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-202	3.35	342.11

Date April 2009

Project 408-88-00



Prep'd AN

Chkd. RPR

High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph



Photo - Looking north of Borehole 08-202

UNIVERSITY OF TRANSPORTATION, BIRMINGHAM

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

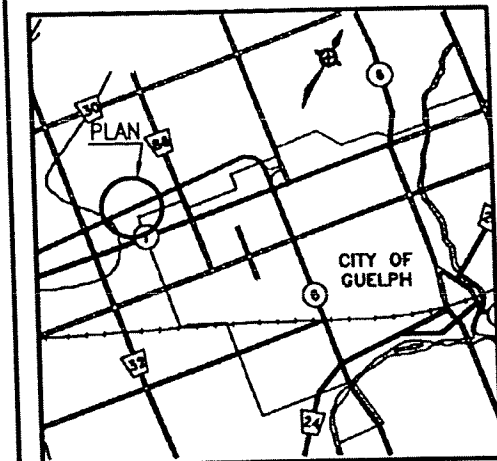
CONT No
GWP No 408-88-00

HIGHWAY 7
RECOMMENDED ROUTE
33+900 TO 34+160
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

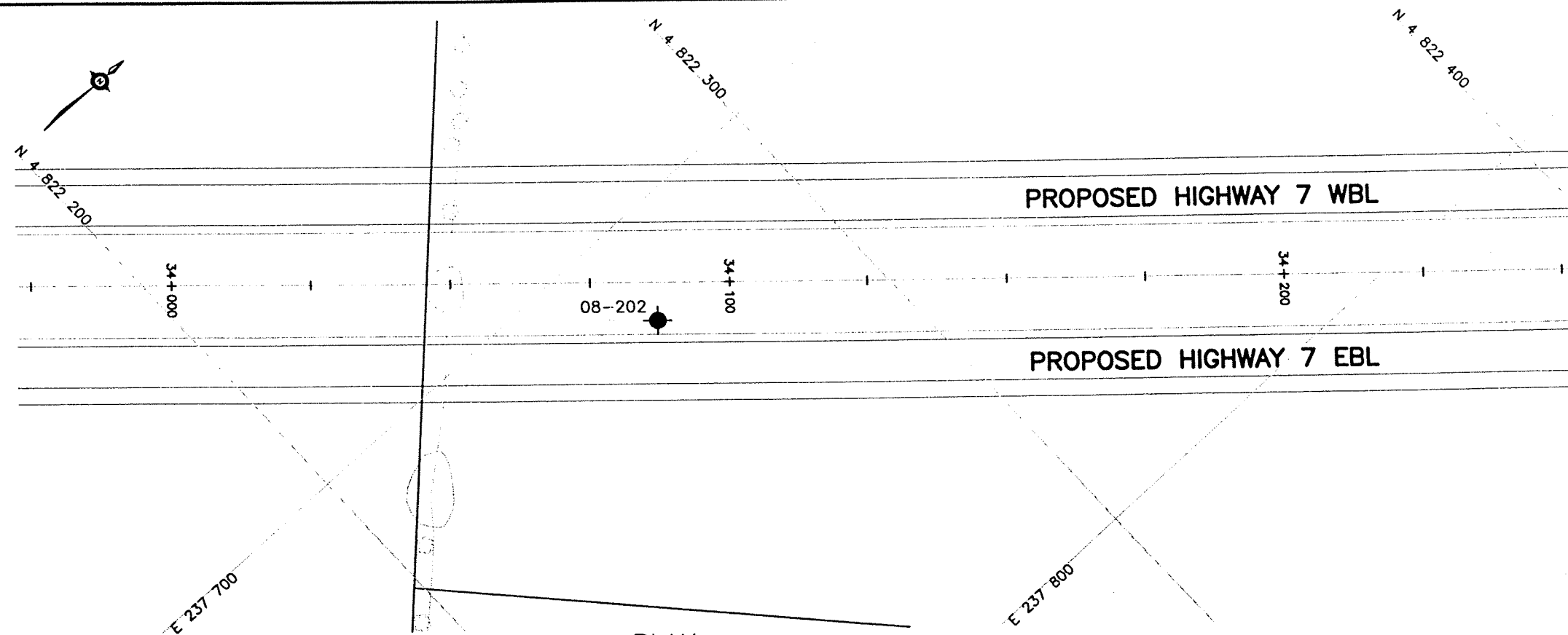
- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation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

[illegible]

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Proposed grades are from Plate 19 of the E.A. Study.

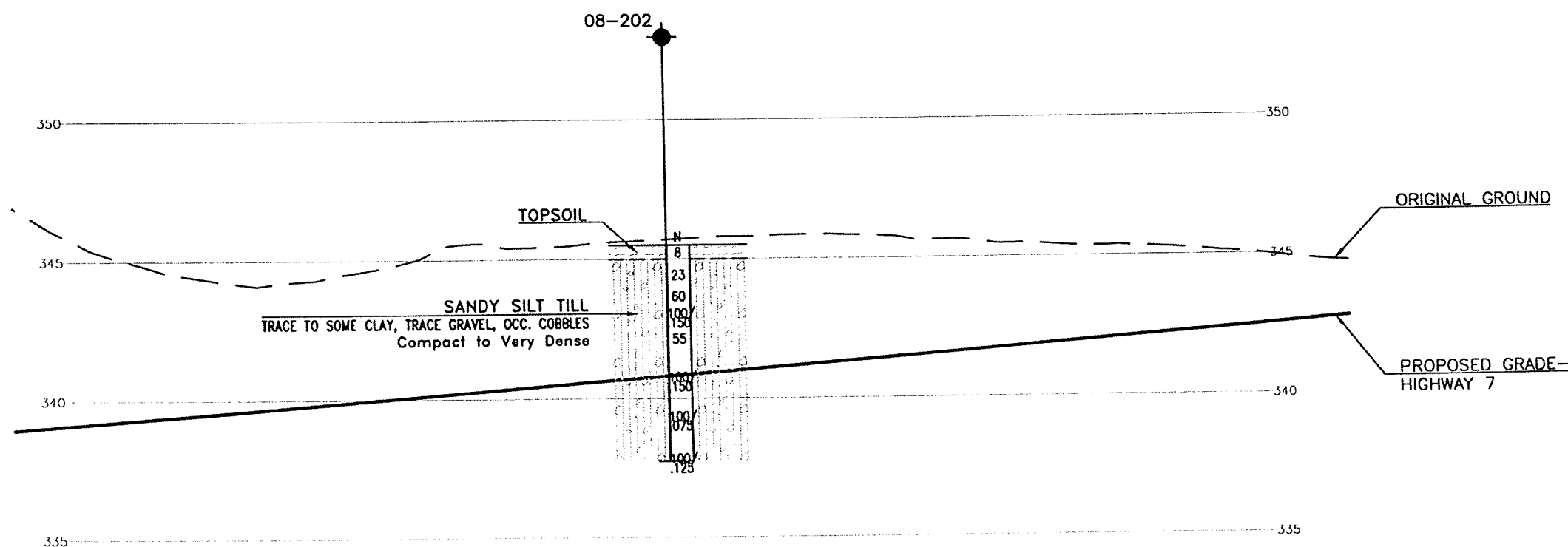
GEOCRES No. 40P9-48



PLAN



SCALE 1:1000



PROFILE ALONG C_L OF PROP. HIGHWAY 7



HOR 1:1000

VER 1:200

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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

Appendix D

**Hwy 7 New
Station 35+000 – 35+080
(Boreholes 08-210, 08-212)**

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

RECORD OF BOREHOLE No 08-210

1 OF 2

METRIC

G.W.P. 408-88-00

LOCATION N 4 822 888.27 E 238 314.22

ORIGINATED BY LH

HWY 7

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.11.27 - 2008.11.27

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 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										
347.6							20 40 60 80 100											
0.0	TOPSOIL (500mm)		1	SS	8		40 80 120 160 200											
347.2																		
0.5	Sandy SILT, trace to some clay, trace gravel, occasional organics, occasional cobbles Compact to Very Dense Brown Moist to Wet (TILL)		2	SS	50/ 0.025		347											
			3	SS	23		346											
	Clayey zone Moist		4	SS	100/ 0.050		345								6 31 50 13			
			5	SS	100/ 0.050		344											
	Occasional cobbles and boulders		6	SS	100/ 0.075		343											
			7	SS	100/ 0.125		342								2 31 55 12			
	Brown to Grey		8	SS	100/ 0.125		340											
338.4							339											
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS		9	SS	100/ 0.125										1 32 49 18			

Continued Next Page

ONTMT4S 6417R.GPJ 4/24/09

+³ ×³: Numbers refer to
Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

METRIC

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 08-212

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 000.40 E 238 375.55 ORIGINATED BY SLL
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008.05.21 - 2008.05.21 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							WATER CONTENT (%)					
								20 40 60 80 100								PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
344.6																				
0.0																				
	SAND and GRAVEL Compact to Dense Brown Moist (FILL)		1	AS																
			1	SS	38															42 45 13 (SI+CL)
			2	SS	23															12 45 38 5
342.5	Layer of sand and silt fill trace topsoil																			
2.1	Sandy SILT, trace to some clay, trace gravel Compact to Hard Brown to Grey Moist (TILL)		3	SS	18															
			4	SS	21															
			5	SS	100/ .125															5 29 56 10
			6	SS	100/ .125															
															</					

+³, X³: Numbers refer to
Sensitivity

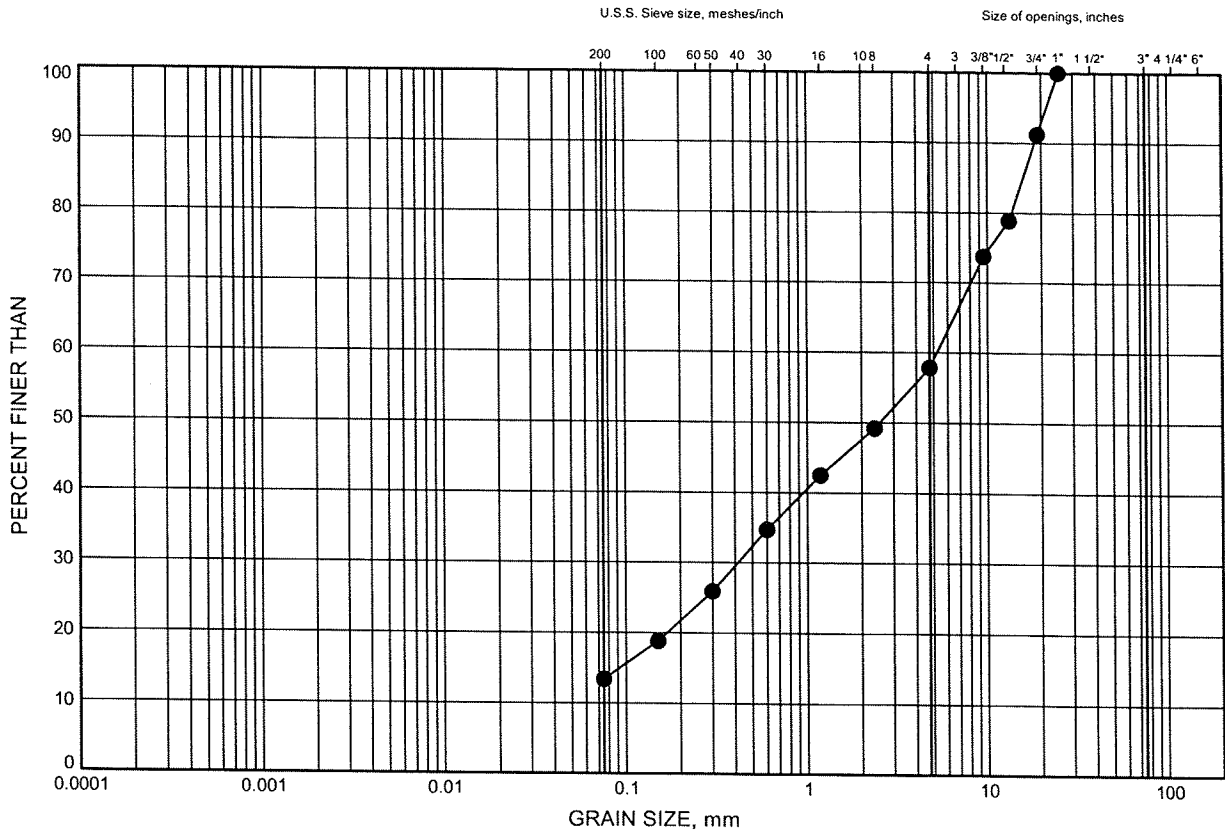
20
15
10

(%) STRAIN AT FAILURE

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE D1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-212	0.84	343.81

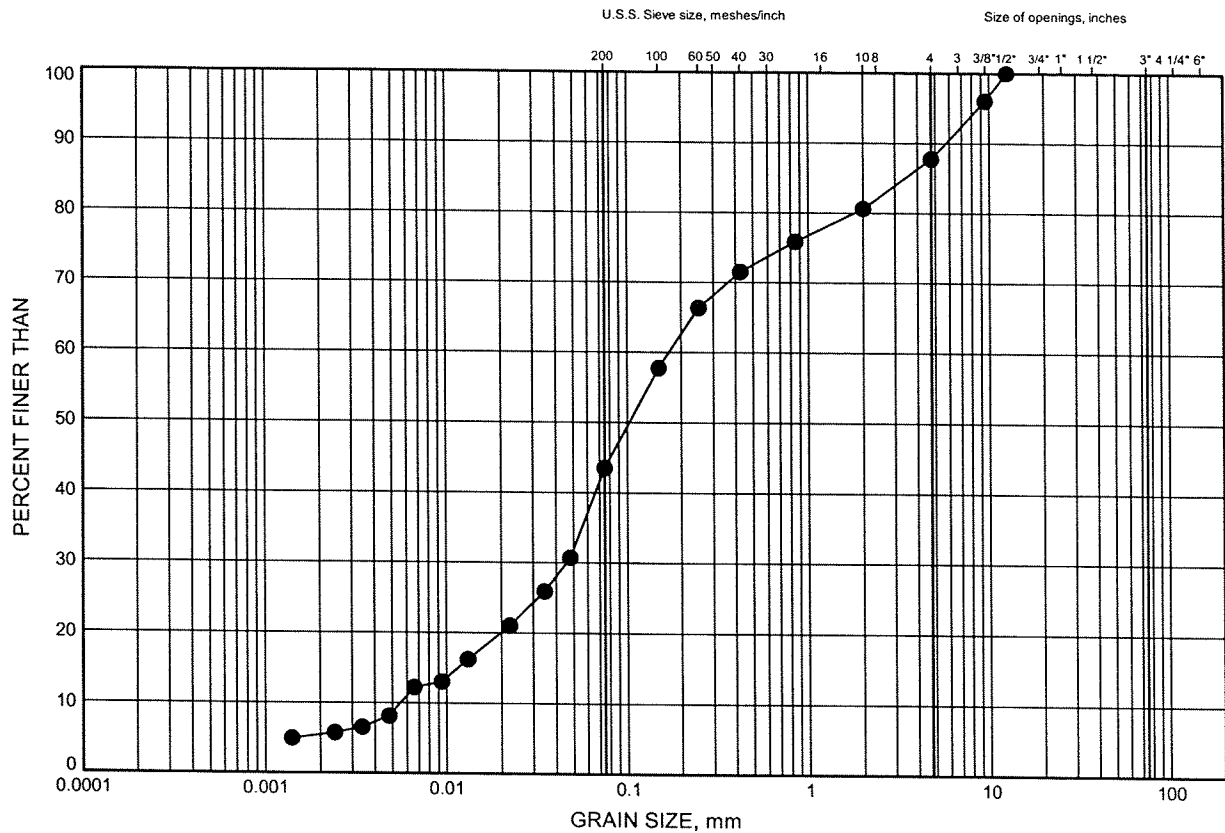


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE D2

SAND & SILT FILL



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

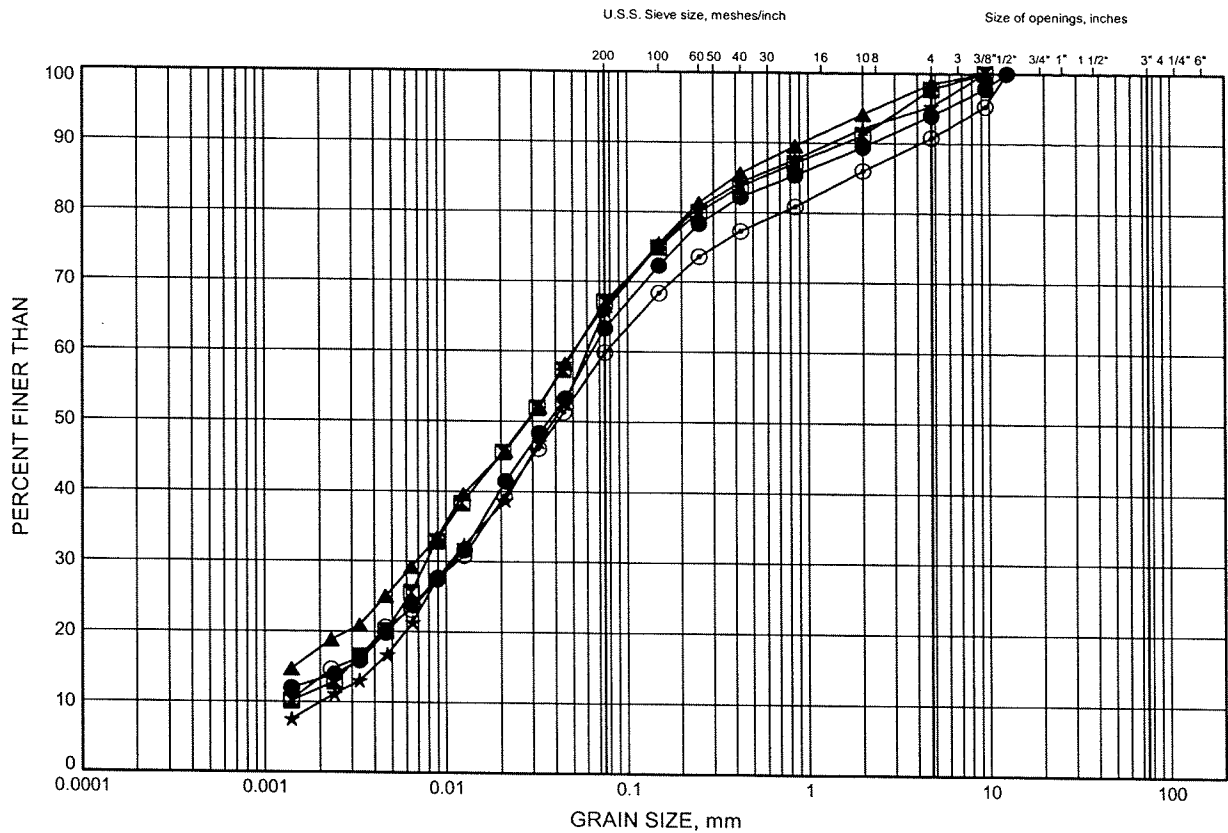
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-212	1.68	342.97

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE D3

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-210	2.59	345.05
⊠	08-210	6.16	341.48
▲	08-210	9.21	338.43
★	08-212	4.40	340.25
⊙	08-212	7.39	337.26

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

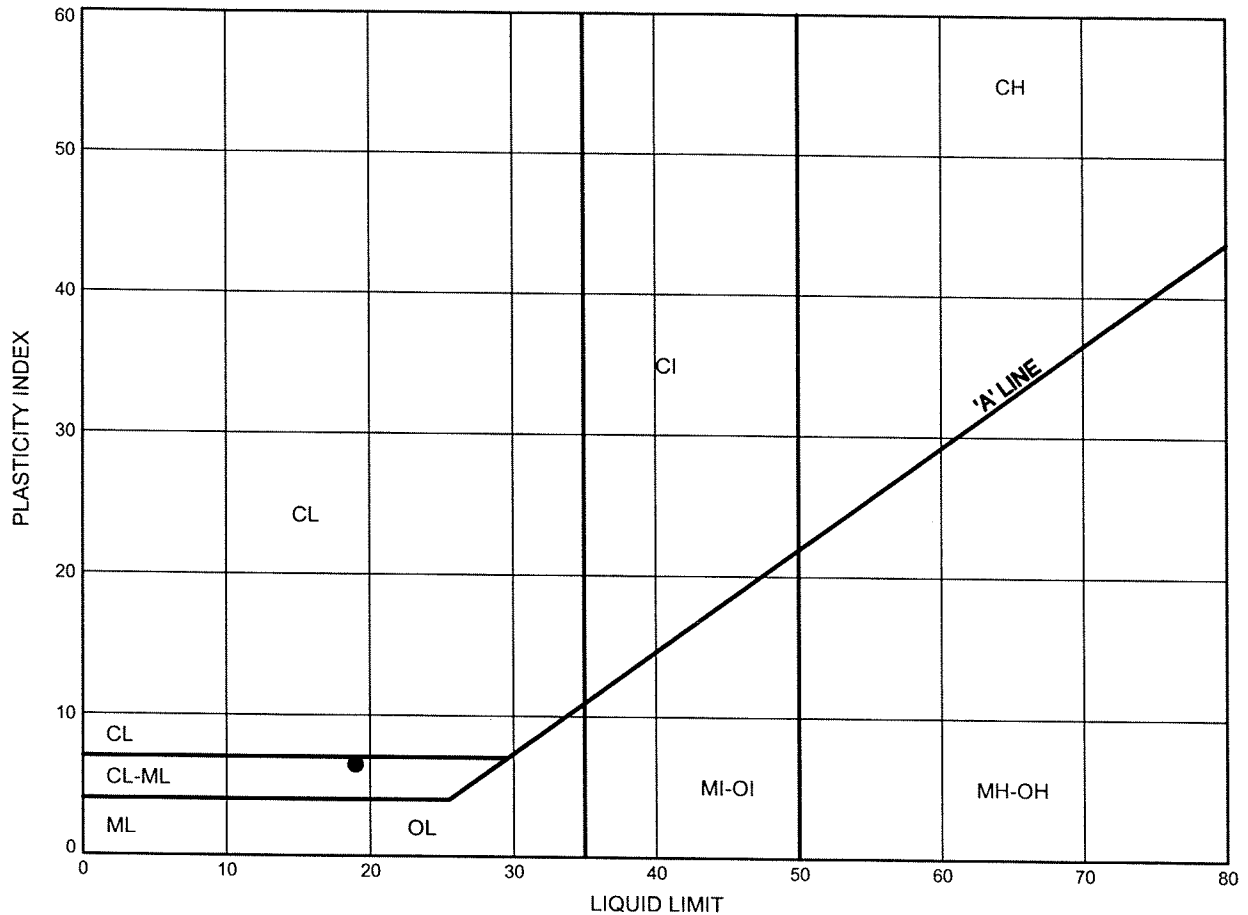
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New
ATTERBERG LIMITS TEST RESULTS

FIGURE D4

SANDY SILT TILL (Clayey Zone)



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-210	2.59	345.05

Date April 2009
 Project 408-88-00

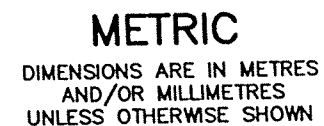


Prep'd AN
 Chkd. RPR

High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph



Photo - Looking north along County Road 86








SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
08-210	347.6	4 822 888.3	238 314.2
08-212	344.6	4 823 000.4	238 375.5

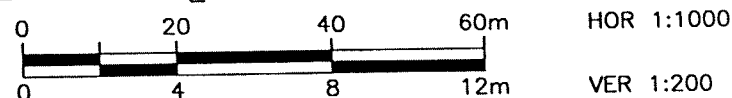
-NOTES-

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

GEOCRES No. 40P9-48



PROFILE ALONG C_L OF PROP. HIGHWAY 7



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

[illegible]

Appendix E

**Hwy 7 New
Station 36+000 – 36+320
(Boreholes 08-220)**

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

RECORD OF BOREHOLE No 08-220

1 OF 1

METRIC

G.W.P. 408-88-00

LOCATION N 4 823 878.60 E 239 156.85

ORIGINATED BY LG

HWY 7

BOREHOLE TYPE Solid Stem Augers

COMPILED BY AN

DATUM Geodetic

DATE 2008.11.28 - 2008.11.28

CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)										
								○ UNCONFINED + FIELD VANE		● QUICK TRIAXIAL x LAB VANE		W _p	W	W _L								
							20	40	60	80	100	20	40	60	GR	SA	SI	CL				
341.7	TOPSOIL (450mm)		1	SS	8																	
0.0																						
341.2																						
0.5	Sandy SILT, trace to some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		2	SS	39													9	45	40	6	
			3	SS	32																	
			4	SS	100/ 0.150																	
	Brown to Grey																					
			5	SS	100/ 0.125																	
	Clayey zone		6	SS	100/0.100														4	32	47	17

+ 3. X 3: Numbers refer to
Sensitivity

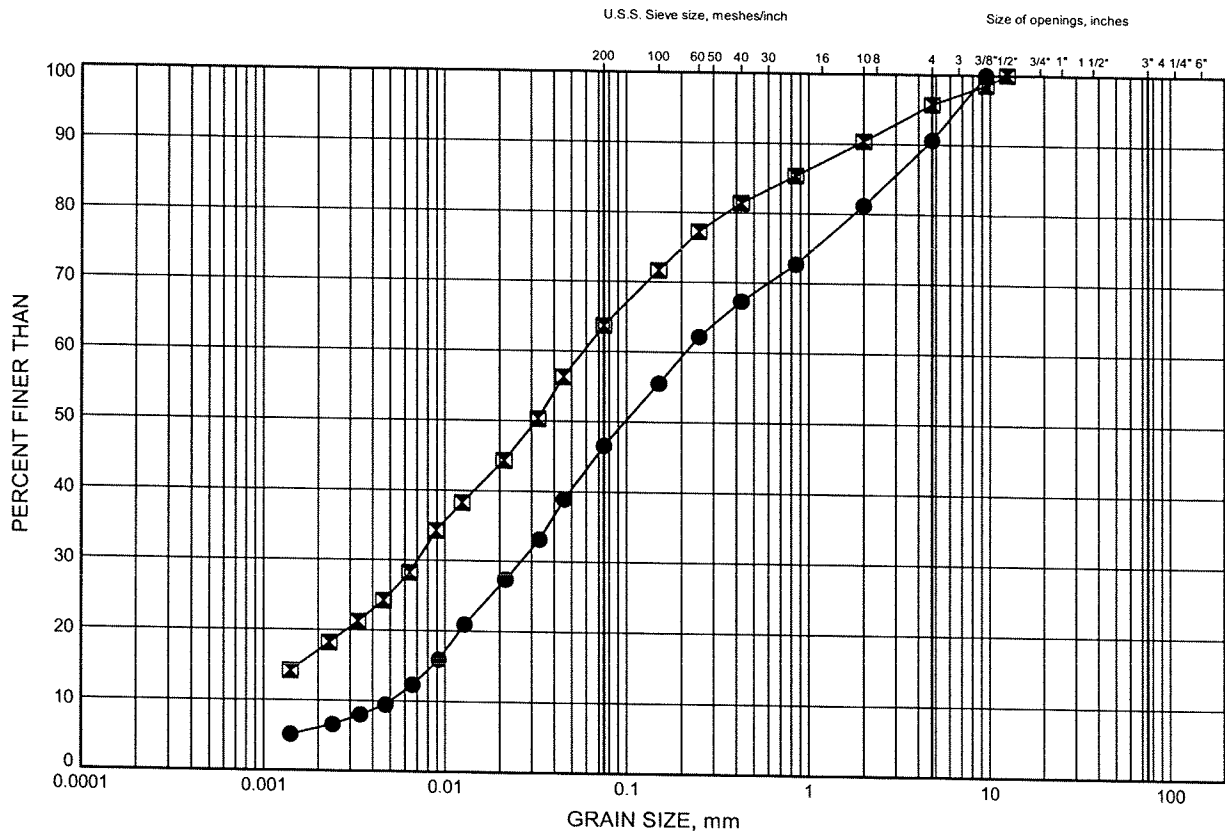
20
15
10

(%) STRAIN AT FAILURE

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE E1

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-220	1.07	340.61
◻	08-220	4.70	336.98

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

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



High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph



Photo – Looking to Borehole 220 from south side



Photo - Looking to Borehole 220 from north side

Appendix F

**Hwy 7 New
Station 37+500 – 37+700
(Boreholes 08-230, 08-231, 08-232, 08-236, 08-238)**

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

RECORD OF BOREHOLE No 08-230

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 833.32 E 240 143.44 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.06 - 2008.08.06 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						
340.9								20	40	60	80	100		
0.0	TOPSOIL, occasional roots: (300mm)							40	80	120	160	200		
340.6			1	SS	3									
0.3	SAND and GRAVEL, some silt, some clay Loose to Dense Brown Moist to Wet (FILL) Occasional cobbles		2	SS	27									
			3	SS	39									
			4	SS	32									
337.7			5	SS	44									
3.2	Sandy SILT, trace to some clay, trace gravel, occasional cobbles Dense to Very Dense Brown Moist (TILL)		6	SS	50/ 0.075									
			7	SS	50/ 0.075									
334.2														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO 0.6m AND AUGER CUTTINGS AND HOLEPLUG TO SURFACE. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.02.19 1.4 339.5													

ONTMT4S 6417R.GPJ 7/30/09

RECORD OF BOREHOLE No 08-231

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 763.02 E 240 213.07 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.06 - 2008.08.06 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 NATURAL MOISTURE CONTENT LIQUID LIMIT					
340.7															
0.0	TOPSOIL, occasional roots: (300mm)														
340.4			1	SS	4										
0.3	SAND and GRAVEL, some clay, some silt, occasional cobbles Loose to Dense Brown Moist (FILL)														
			2	SS	33										
			3	SS	36										
338.6															
2.1	Sandy SILT, some clay, some gravel, occasional cobbles Dense to Very Dense Brown Moist to Wet (TILL) Occasional limestone fragments														
			4	SS	36										
			5	SS	44										
			6	SS	82										
335.4	Auger grinding at 5.2m.														
5.3	END OF BOREHOLE AT 5.3m ON POSSIBLE BEDROCK. WATER LEVEL OBSERVED AT 2.6m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG AND AUGER CUTTINGS MIXED TO SURFACE.														

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

RECORD OF BOREHOLE No 08-232

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 690.69 E 240 286.62 ORIGINATED BY SA
HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
DATUM Geodetic DATE 2008.08.06 - 2008.08.06 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	120 140 160 180 200	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
342.9														
0.0	TOPSOIL, occasional roots													
342.6	Dark Brown		1	SS	5									
0.3	(300mm)													
	SAND and GRAVEL, some silt, some clay, occasional limestone fragments Loose to Very Dense		2	SS	42		342							33 34 33 (SI+CL)
	Brown													
	Moist		3	SS	54		341							
	(FILL)													
340.2			4	SS	52									
2.7	Sandy SILT, some gravel, some clay, occasional cobbles, limestone fragments						340							
	Dense													
	Brown		5	SS	45									7 43 44 6
	Wet													
	(TILL)													
338.6							339							
4.3	Auger grinding at 4.2m													
	END OF BOREHOLE AT 4.3m ON POSSIBLE BEDROCK. WATER LEVEL OBSERVED AT 2.4m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG AND AUGER CUTTINGS MIXED TO SURFACE.													

+³, X³: Numbers refer to
Sensitivity

20
15 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-236

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 685.76 E 240 320.65 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES
 DATUM Geodetic DATE 2008.06.18 - 2008.06.18 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				
								20 40 60 80 100				
341.4												
0.0	SILT, mixed with topsoil, occasional roots Loose Dark brown Moist (FILL)		1	SS	2							
340.6												
0.8	SAND and GRAVEL, some silt, trace clay Compact to very dense Brown Moist (FILL) Cobbles Auger grinding, split spoon bouncing		2	SS	25							
			3	SS	53							
			4	SS	75							
338.4												
3.0	Sandy SILT, numerous cobbles Very dense Grey Moist (TILL)		5	SS	88							
336.8												
4.6	Coring started at 4.62m DOLOSTONE Slightly to moderately weathered White		1	RUN								
			2	RUN								
			3	RUN								
			4	RUN								
333.7												
7.8	END OF BOREHOLE AT 7.8m. WATER OBSERVED AT 4.0m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 4.6m THEN BENTONITE SEAL TO 0.6m THEN GROUT TO SURFACE.											

ONTMT4S 6417R.GPJ 4/20/09

+³ . X³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-238

1 OF 1

METRIC

G.W.P. 408-88-00

LOCATION N 4 823 655.45 E 240 290.22

ORIGINATED BY SA

HWY 7

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY ES

DATUM Geodetic

DATE 2008.06.18 - 2008.06.20

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 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						× LAB VANE		
341.0							20	40	60	80	100							
0.0	SILT, some gravel, trace sand, mixed with topsoil Dark brown Moist (FILL)		1	AS														
340.2																		
0.8	SAND and GRAVEL, some silt, trace clay, numerous cobbles Compact to very dense Brown Moist (FILL)		1	SS	23													
			2	SS	92													
338.4	Possible boulder at 2.5m														41 46 13 (SI+CL)			
2.6	Sandy SILT, trace gravel, some clay Very dense Brown Moist to wet (TILL)		3	SS	50										3 31 55 11			

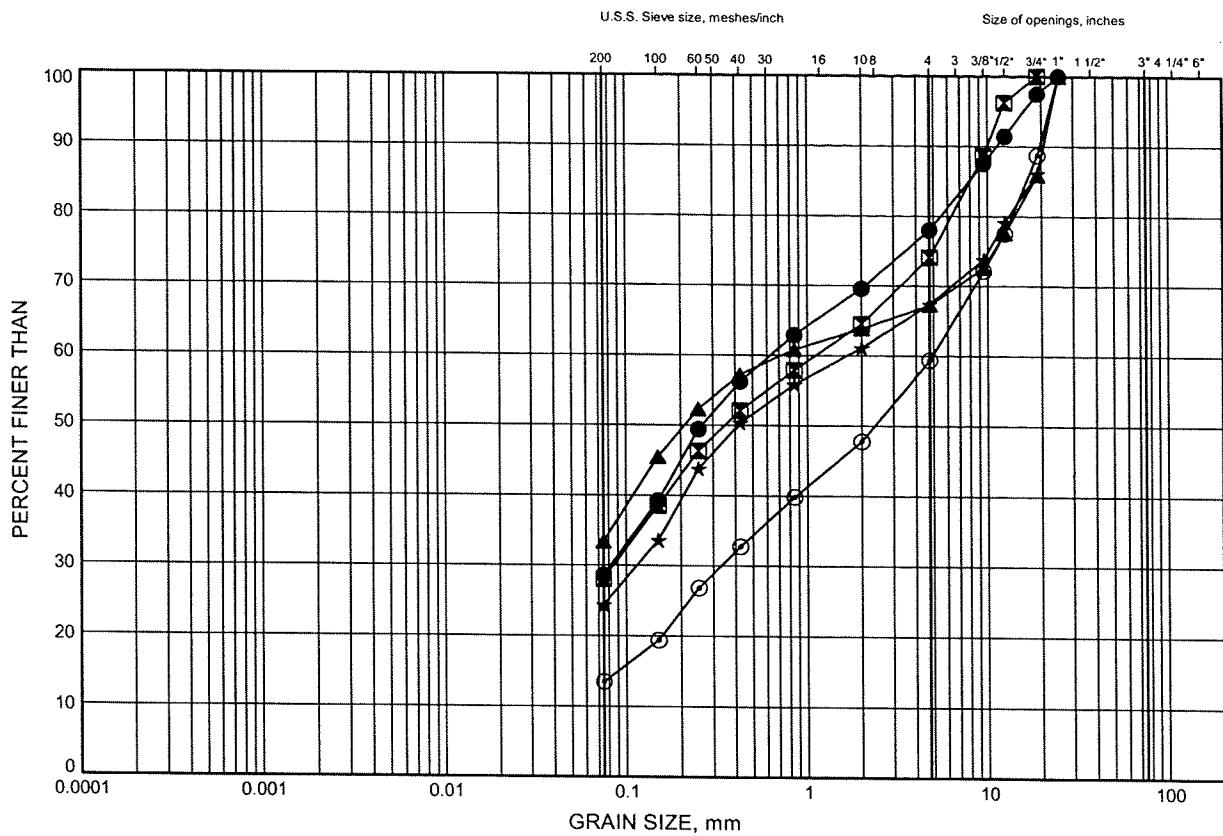
+³, X³: Numbers refer to Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE F1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-230	2.59	338.32
⊠	08-231	1.83	338.91
▲	08-232	1.07	341.83
★	08-236	1.83	339.61
⊙	08-238	1.83	339.21

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

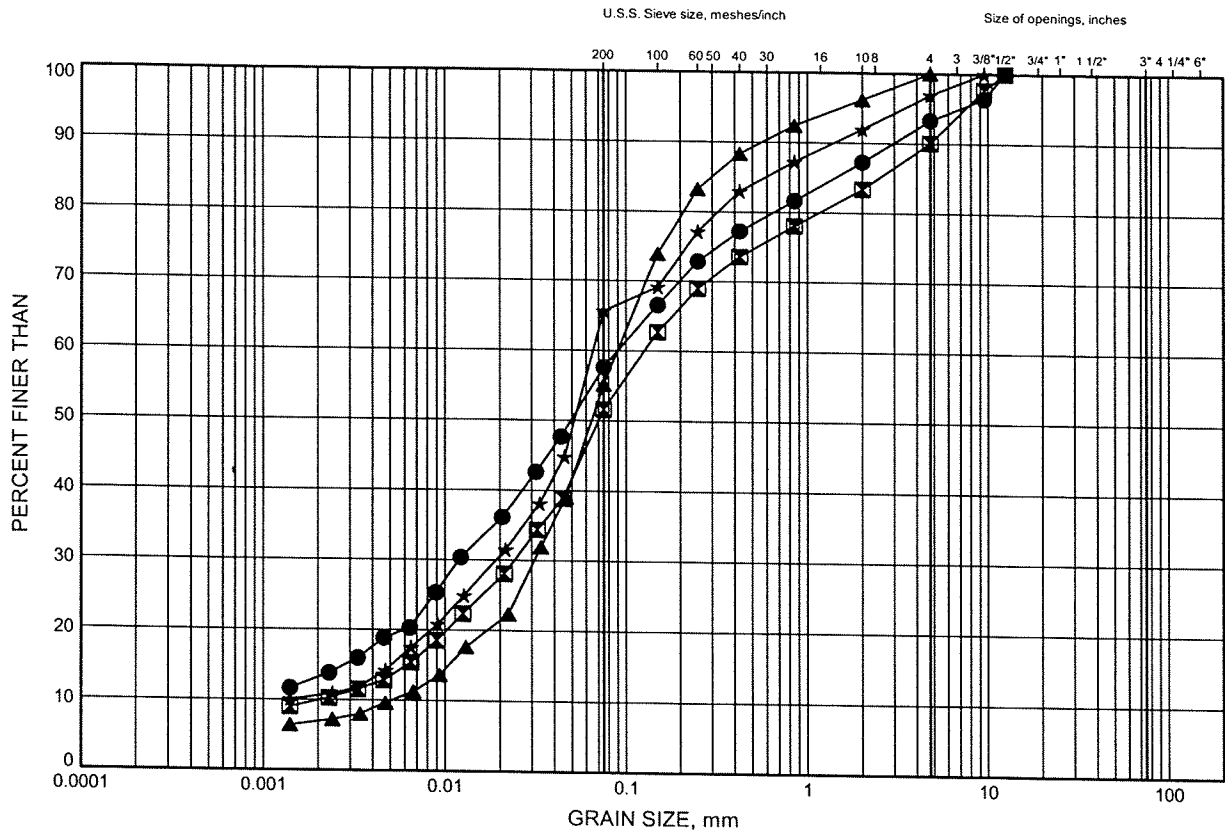
W.P.# 408-88-00
Prepared By AN
Checked By RPR



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE F2

SANDY SILT TILL



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

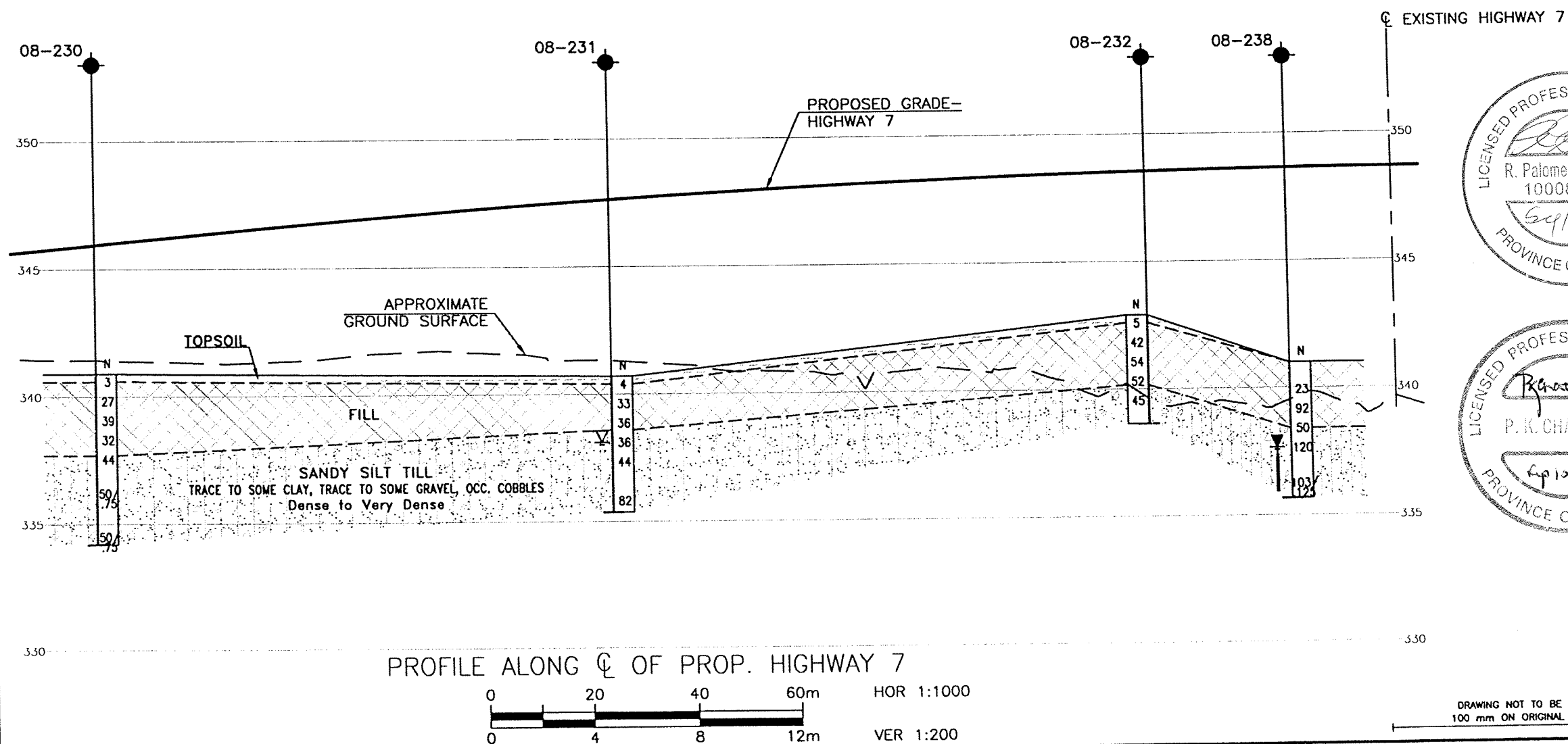
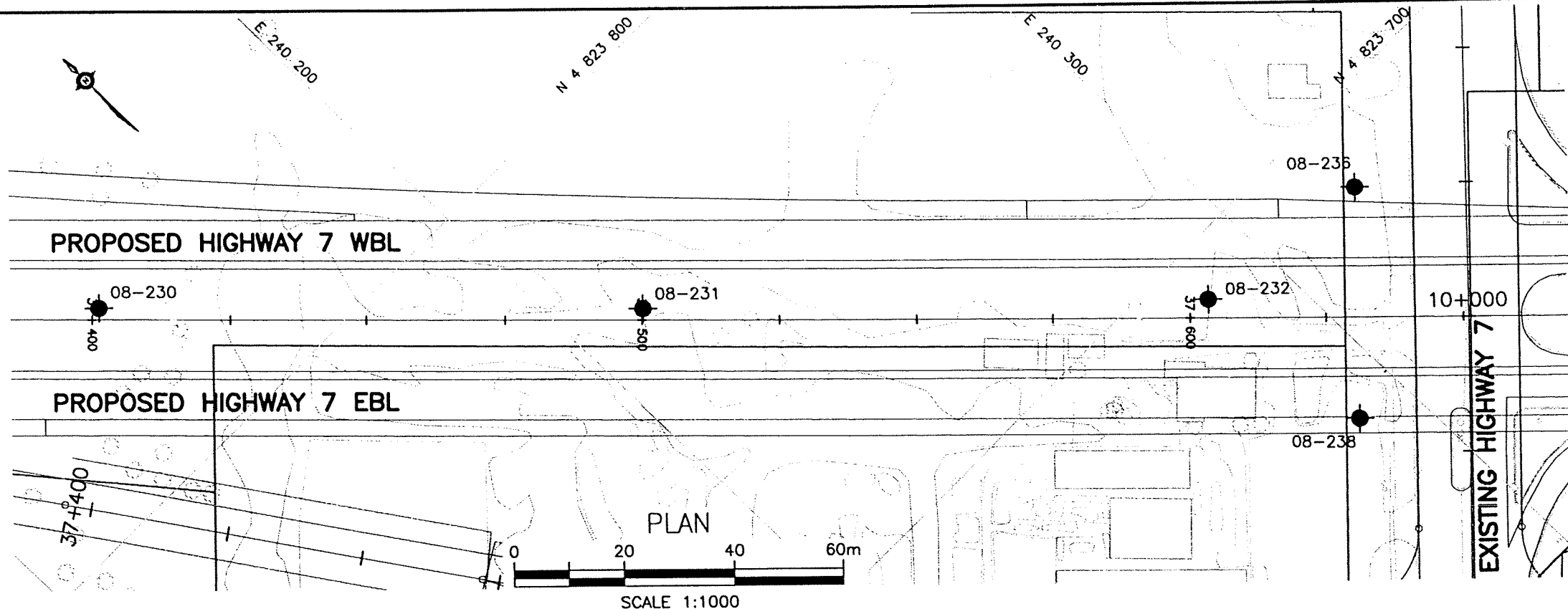
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-230	4.88	336.03
■	08-231	3.35	337.38
▲	08-236	3.16	338.27
★	08-238	2.51	338.52

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

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





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

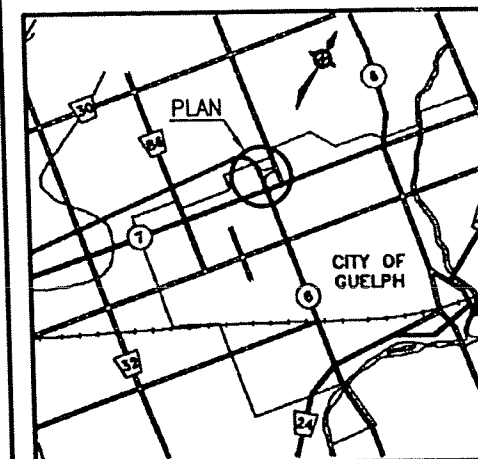
CONT No
GWP No 408-88-00

HIGHWAY 7
RECOMMENDED ROUTE
37+500 TO 37+700
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
08-230	340.9	4 823 833.3	240 143.4
08-231	340.7	4 823 763.0	240 213.1
08-232	342.9	4 823 690.7	240 286.6
08-236	341.4	4 823 685.8	240 320.0
08-238	341.0	4 823 655.5	240 290.1

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Proposed grades are from Plate 23 of the E.A. Study.

GEOCRES No. 40P9-48

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Appendix G

**Hwy 7 New
Station 37+770 – 38+000
Boreholes (08-233, 08-234, 08-235, 08-237, 08-239, 08-240)**

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

RECORD OF BOREHOLE No 08-233

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 618.73 E 240 352.94 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 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 ● QUICK TRIAXIAL × LAB VANE ○ UNCONFINED + FIELD VANE							
339.2															
0.0	TOPSOIL, occasional roots: (150mm)														
0.2	SAND and GRAVEL, some silt, trace clay, occasional cobbles Compact to Very Dense Brown to Grey Moist (FILL)		1	SS	18		339								
			2	SS	44										
			3	SS	51		338								
337.2															
2.1	Sandy SILT, some gravel, trace clay, occasional cobbles Dense to Very Dense Grey Wet (TILL) Occasional limestone shale fragments		4	SS	35		337								
			5	SS	72		336								
335.7															
3.5	END OF BOREHOLE AT 3.5m ON POSSIBLE BEDROCK. WATER LEVEL OBSERVED AT 2.1m DURING DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.3m, THEN HOLEPLUG TO SURFACE.														

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

RECORD OF BOREHOLE No 08-234

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 574.05 E 240 398.43 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
338.7	TOPSOIL, occasional roots: (300mm)																
0.0																	
338.4																	
0.3	Sandy SILT, some gravel, trace clay Compact Dark Brown to Grey Moist (FILL)		1	SS	13		338										0 58 33 9
336.9																	
1.8	Clayey SILT, trace gravel, trace sand Very Stiff Brown to Grey (TILL)		3	SS	18		337										
336.6																	
2.1	SAND and GRAVEL, trace silt, occasional limestone fragments Dense to Very Dense Grey Wet		4	SS	47		336										51 39 10 (SI+CL)
335.3																	
3.4	END OF BOREHOLE AT 3.4m ON POSSIBLE BEDROCK. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. 2008.08.20 1.6 337.1 2009.02.09 2.0 336.7		5	SS	50/												

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

RECORD OF BOREHOLE No 08-235

1 OF 1

METRIC

G.W.P. 408-88-00

LOCATION N 4 823 477.67 E 240 495.04

ORIGINATED BY SA

HWY 7

BOREHOLE TYPE Solid Stem Augers

COMPILED BY LG

DATUM Geodetic

DATE 2008.08.05 - 2008.08.05

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
338.1																	
0.0	TOPSOIL, occasional roots: (300mm)		1	SS	24												
337.8																	
0.3	SAND and GRAVEL, some silt, trace clay, occasional cobbles Compact to Very Dense Brown to Grey Wet (FILL)		2	SS	16												
			3	SS	15												
			4	SS	62/200												
335.2	Occasional limestone shale fragments Auger grinding at 2.9m																
2.9	END OF BOREHOLE AT 2.9m ON POSSIBLE BEDROCK. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.08.20 1.5 336.6 2009.02.09 2.3 335.8																

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

RECORD OF BOREHOLE No 08-237

1 OF 1

METRIC

G.W.P. 408-88-00

LOCATION N 4 823 653.07 E 240 355.32

ORIGINATED BY SA

HWY 7

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY ES

DATUM Geodetic

DATE 2008.06.20 - 2008.06.20

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								
339.5								20 40 60 80 100								
0.0	SAND and GRAVEL , silty, trace clay, numerous cobbles Dense to very dense Brown Moist (FILL) Possible boulders		1	SS	50/ .100		339									
	Wet, gas odour		2	SS	37		338									
			3	SS	63		337									
			4	SS	57		336									
335.8																
3.7	END OF BOREHOLE AT 3.66m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. WATER OBSERVED AT 2.4m DURING DRILLING. Piezometer installation consists of 25mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2008.07.15 2.3 337.2 2008.08.20 2.8 336.7															

+³ . X³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-239

1 OF 1

METRIC

G.W.P. 408-88-00

LOCATION N 4 823 617.26 E 240 315.41

ORIGINATED BY SLL

HWY 7

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY ES

DATUM Geodetic

DATE 2008.06.19 - 2008.06.19

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		
339.9														
0.0														
0.1	SILT, mixed with topsoil, roots Dark brown Moist (FILL)		1	SS	35		340							
	SAND and GRAVEL, trace silt Dense Brown Moist (FILL)		2	SS	46		339							
338.4	Silty, organic, gas odour Dark brown													
1.5	Silty SAND, trace gravel, some clay, gas odour		3	SS	13									
337.8	Compact Brown Moist						338							1 49 39 11
2.1	SAND, fine grained, some gravel, some silt, trace clay, numerous cobbles Dense Brown Wet		4	SS	42		337							
			5	SS	43									20 58 22 (SI+CL)
336.3														
3.7	Sandy SILT, trace gravel, trace clay Very dense Brown Wet (TILL)		6	SS	58		336							
334.6							335							3 34 54 9
5.3	DOLOSTONE Coring started at 5.3m Slightly to moderately weathered White		1	RUN									FI	RUN 1#
			2	RUN									2	TCR=100%,
													10	SCR=100%,
													10	RQD=100%,
													2	UCS=MPa
			3	RUN			334						10	RUN 2#
													10	TCR=100%,
													2	SCR=100%,
													10	RQD=80%,
													10	UCS=140MPa
													2	RUN 3#
													10	TCR=100%,
													2	SCR=100%,
													10	RQD=69%,
													2	UCS=130MPa
			4	RUN			333						2	RUN 4#
													10	TCR=100%,
													2	SCR=100%,
													10	RQD=25%,
													5	UCS=105MPa
331.5							332						4	
8.5	END OF BOREHOLE AT 8.46m. WATER OBSERVED AT 2.1m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 5.2m, BENTONITE BENSEAL TO 0.6m THAN HOLEPLUG TO SURFACE.													

+ 3 . x 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-240

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 527.12 E 240 444.16 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 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	120 140 160 180 200	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
338.2														
0.0	TOPSOIL, occasional roots: (300mm)		1	SS	29		338							
337.9														
0.3	SAND and GRAVEL, trace silt Compact Brown to Grey Moist (FILL)		2	SS	22		337							
337.0														
1.2	Clayey SILT, some gravel, trace sand Very Stiff Brown to Grey (TILL)		3	SS	61		336							
336.7														
1.5	Sandy SILT, some clay, trace gravel, occasional limestone fragments Very Dense Grey Moist (TILL)		4	SS	50/ 125		335							
	Moist to Wet		5	SS	89		334							
333.5	Occasional limestone shale fragments		6	SS	50/ 125									
4.7	END OF BOREHOLE AT 4.7m ON POSSIBLE BEDROCK. WATER LEVEL OBSERVED AT 3.0m DURING DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.3m, THEN HOLEPLUG TO SURFACE.				.150									

+³ . X³ : Numbers refer to
Sensitivity

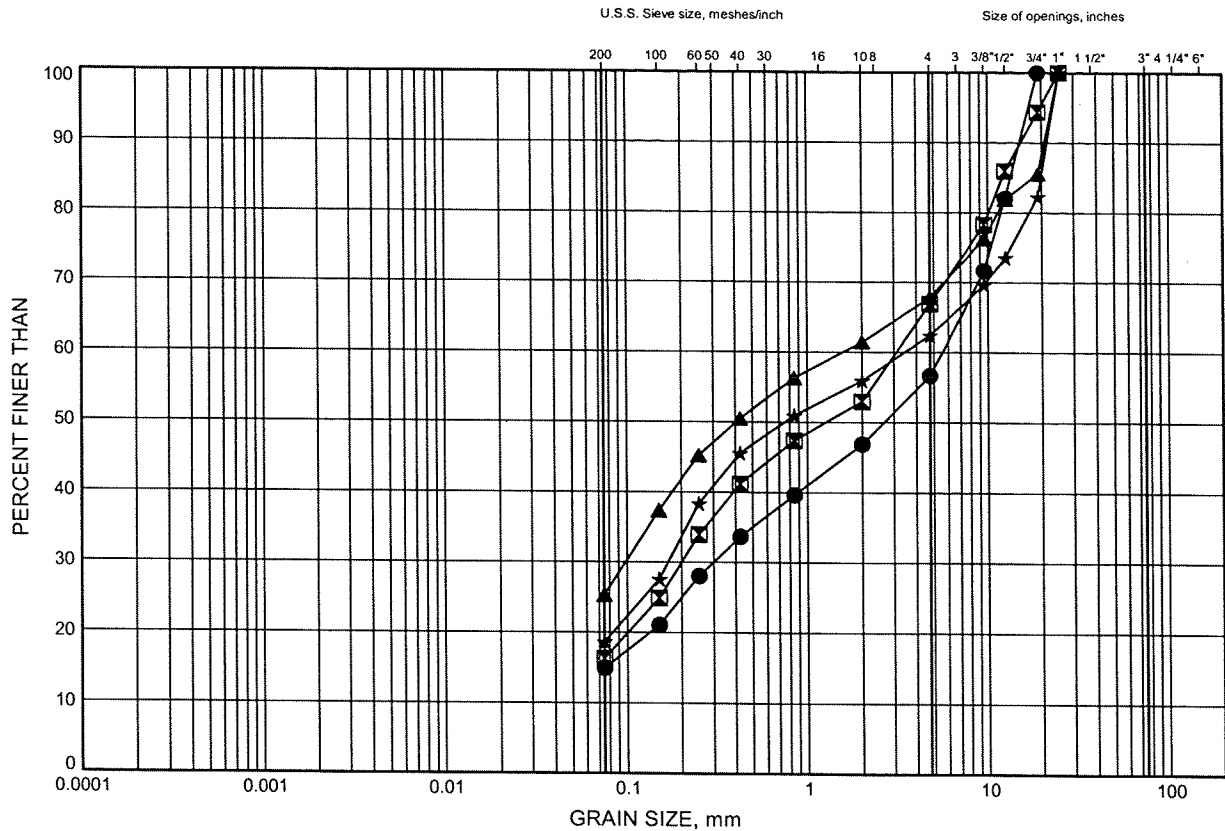
20
15
10

(%) STRAIN AT FAILURE

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G1

SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-233	1.83	337.40
⊠	08-235	1.83	336.25
▲	08-237	1.83	337.67
★	08-237	3.35	336.15

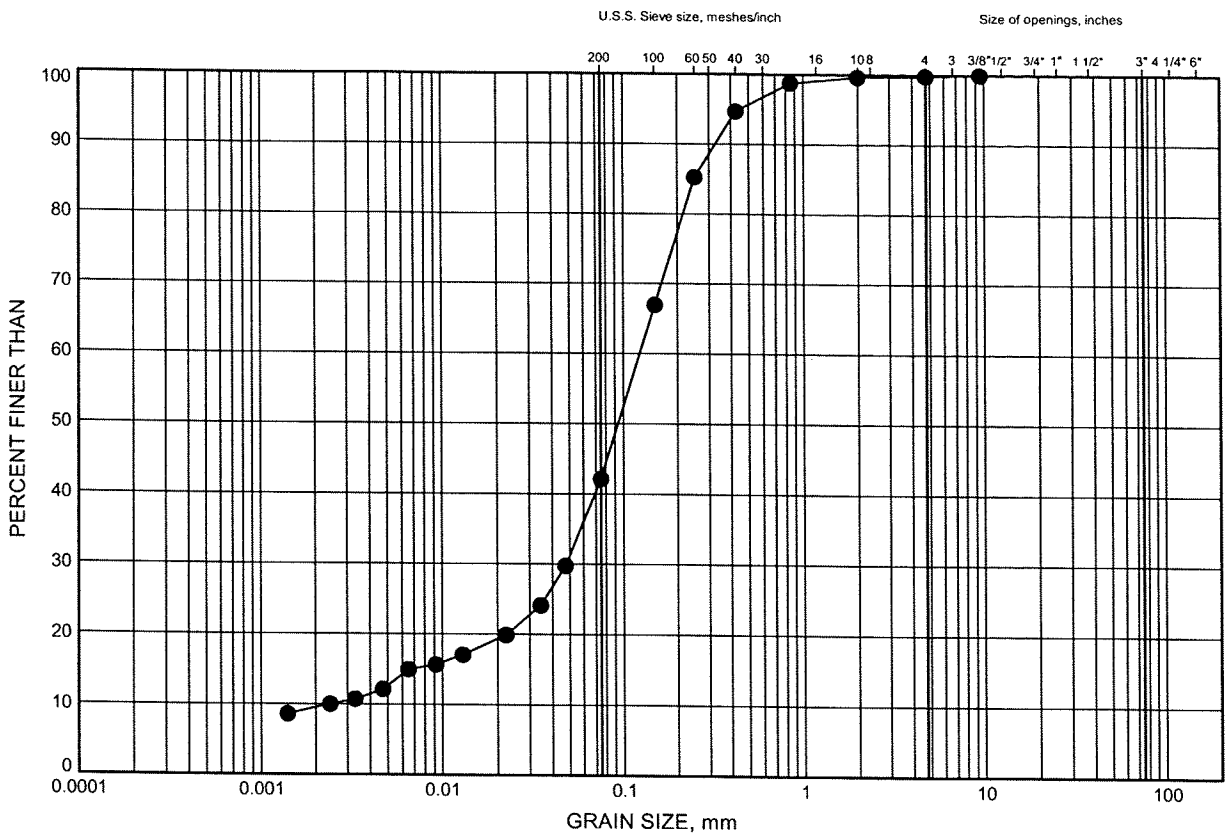


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Prepared By AN.....
Checked By RPR.....

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G2

SANDY SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-234	1.07	337.63

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

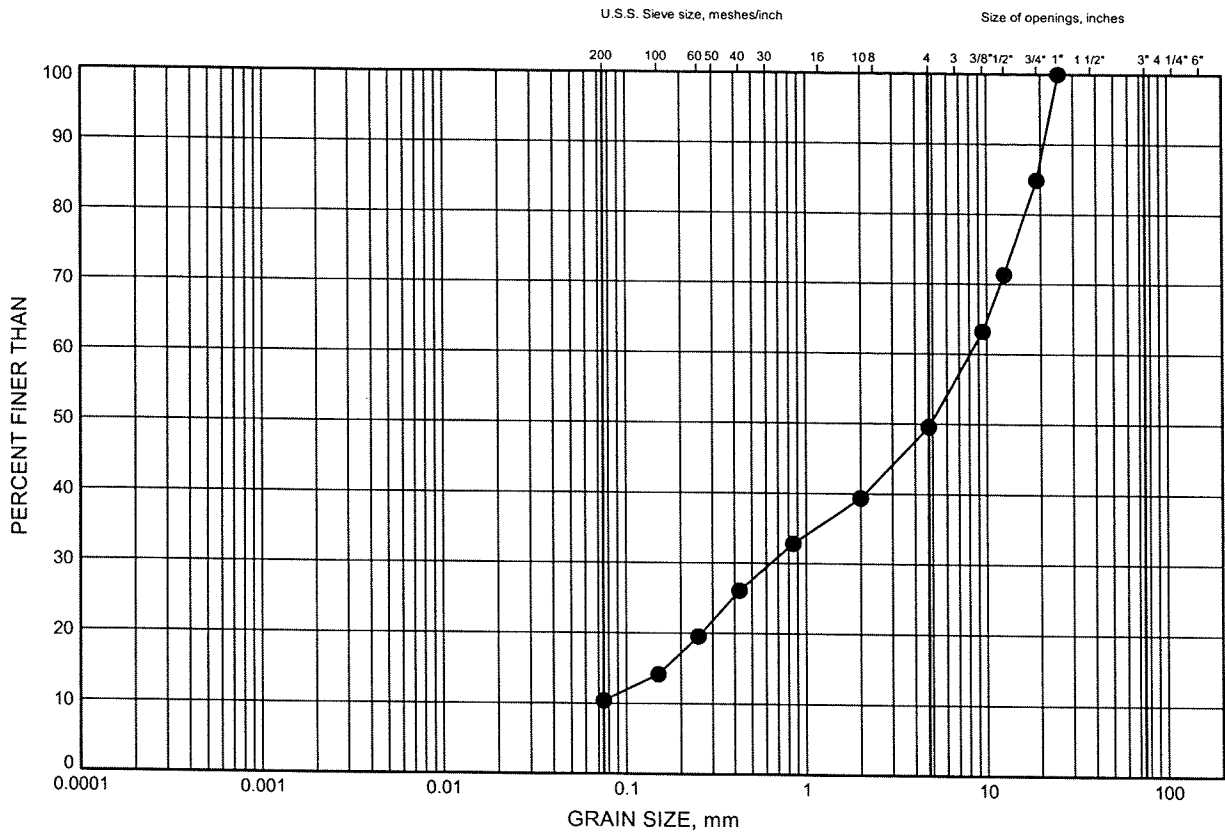
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Checked By RPR



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G3

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-234	2.59	336.11

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

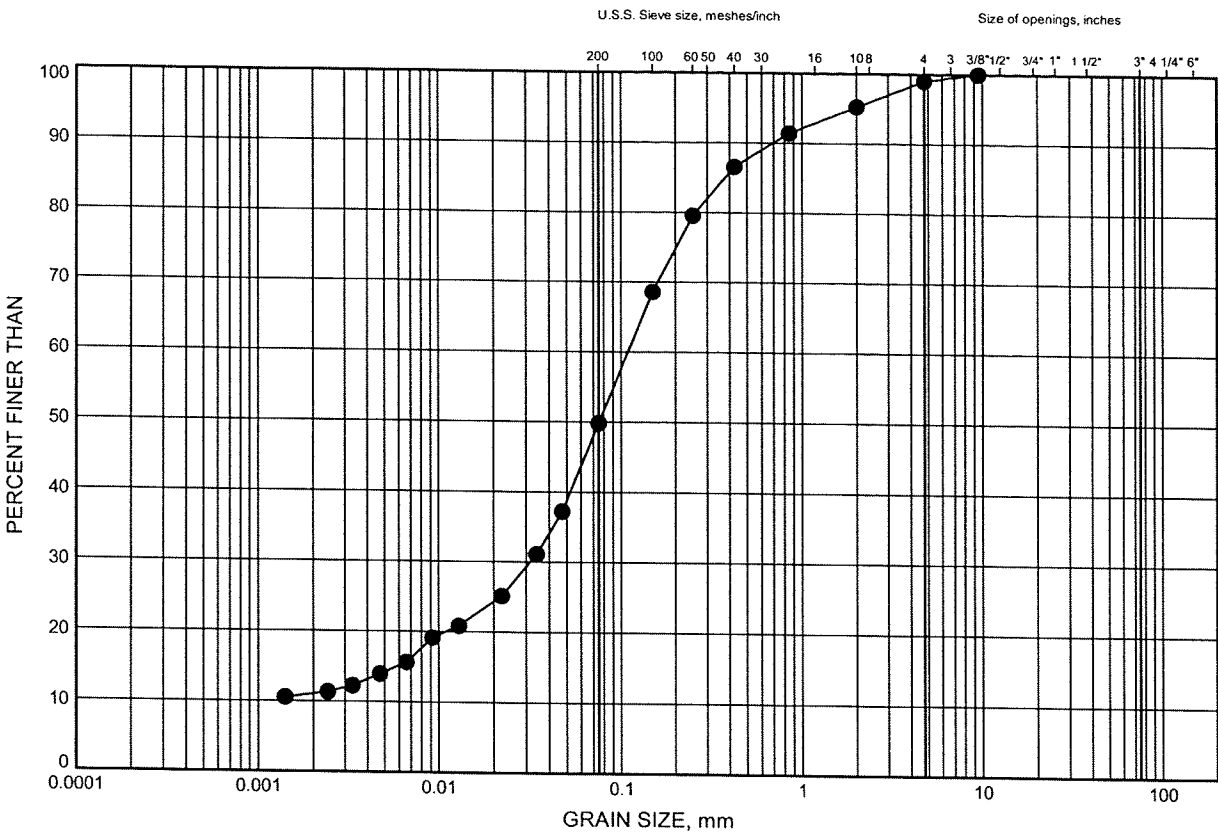
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Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE G4

SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-239	1.83	338.09

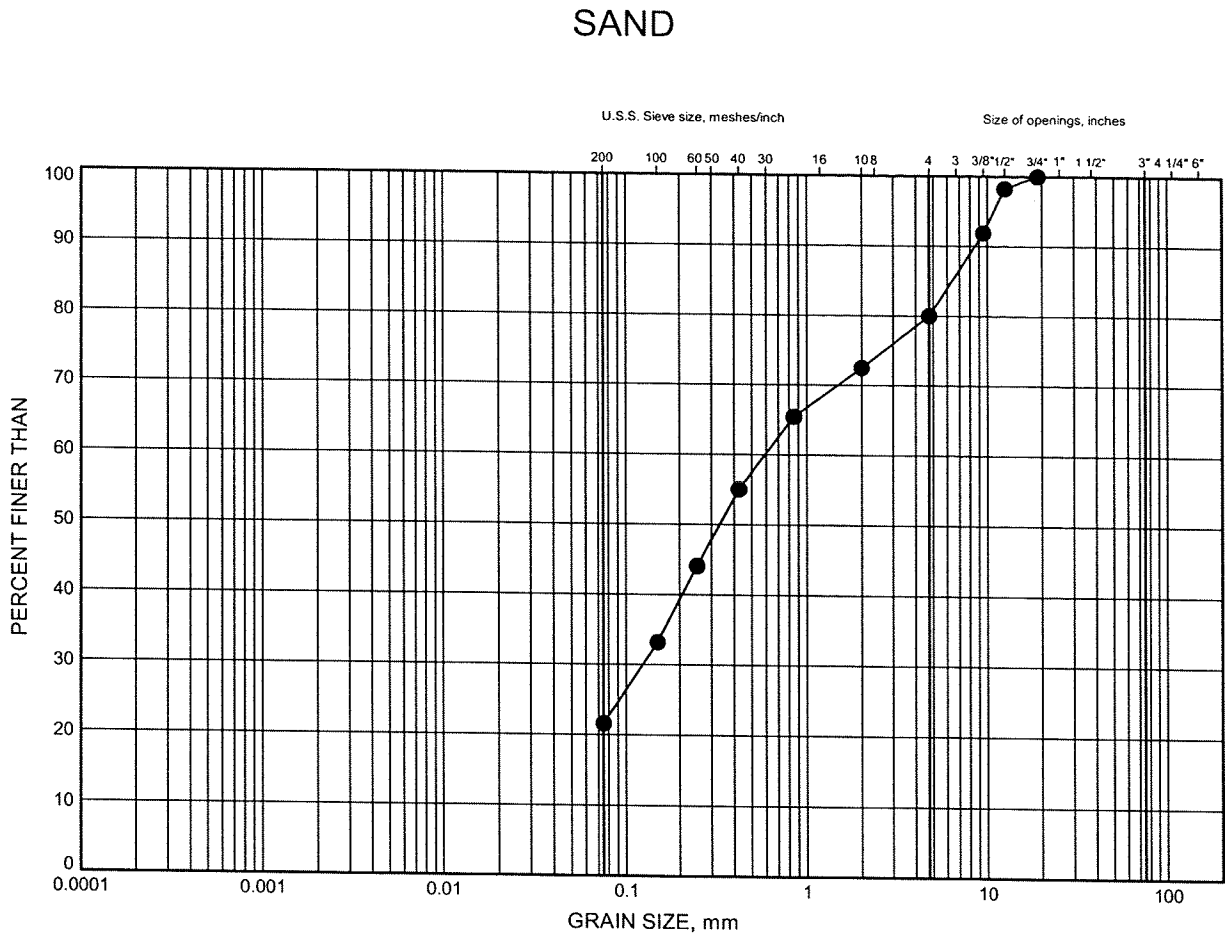
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

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Prepared By AN
Checked By RPR



Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G5



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

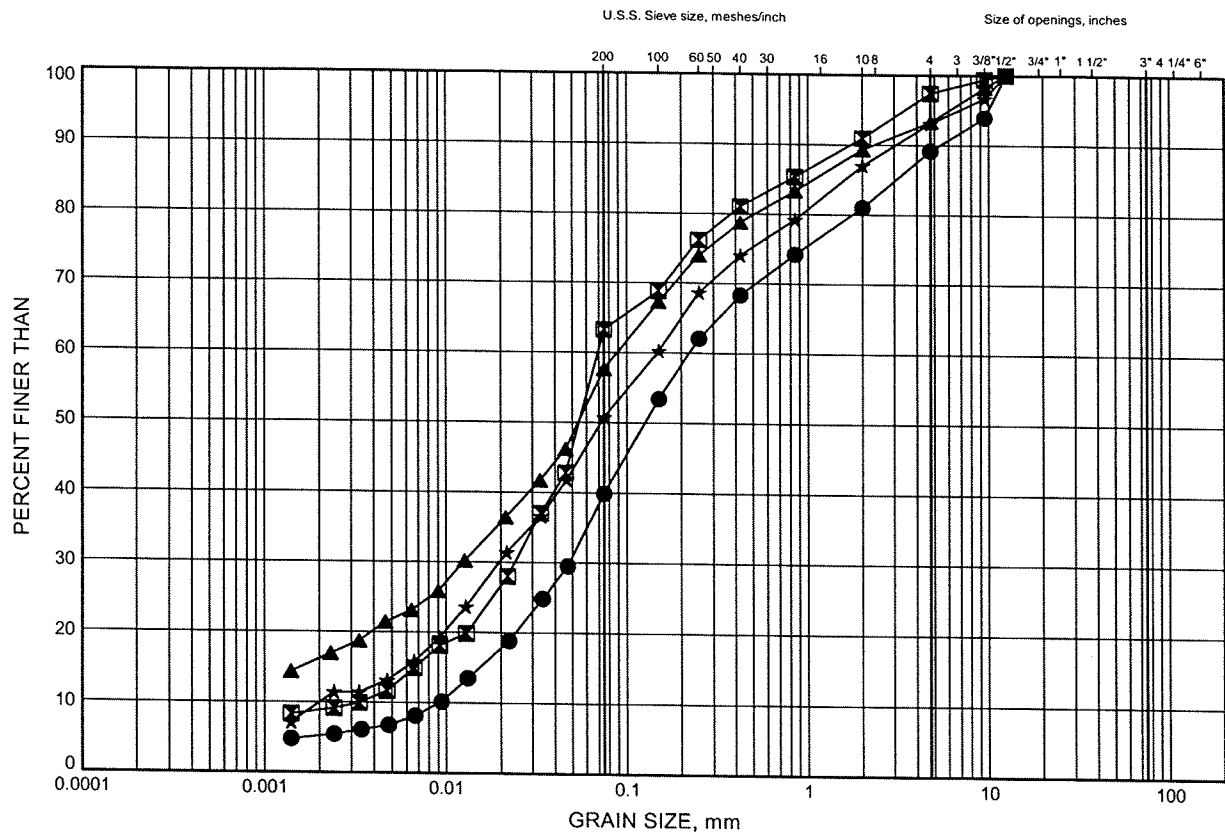
LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-239	3.35	336.57

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE G6

SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-233	3.30	335.93
◻	08-239	4.88	335.04
▲	08-240	2.59	335.59
★	08-240	4.62	333.56

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 4/20/09

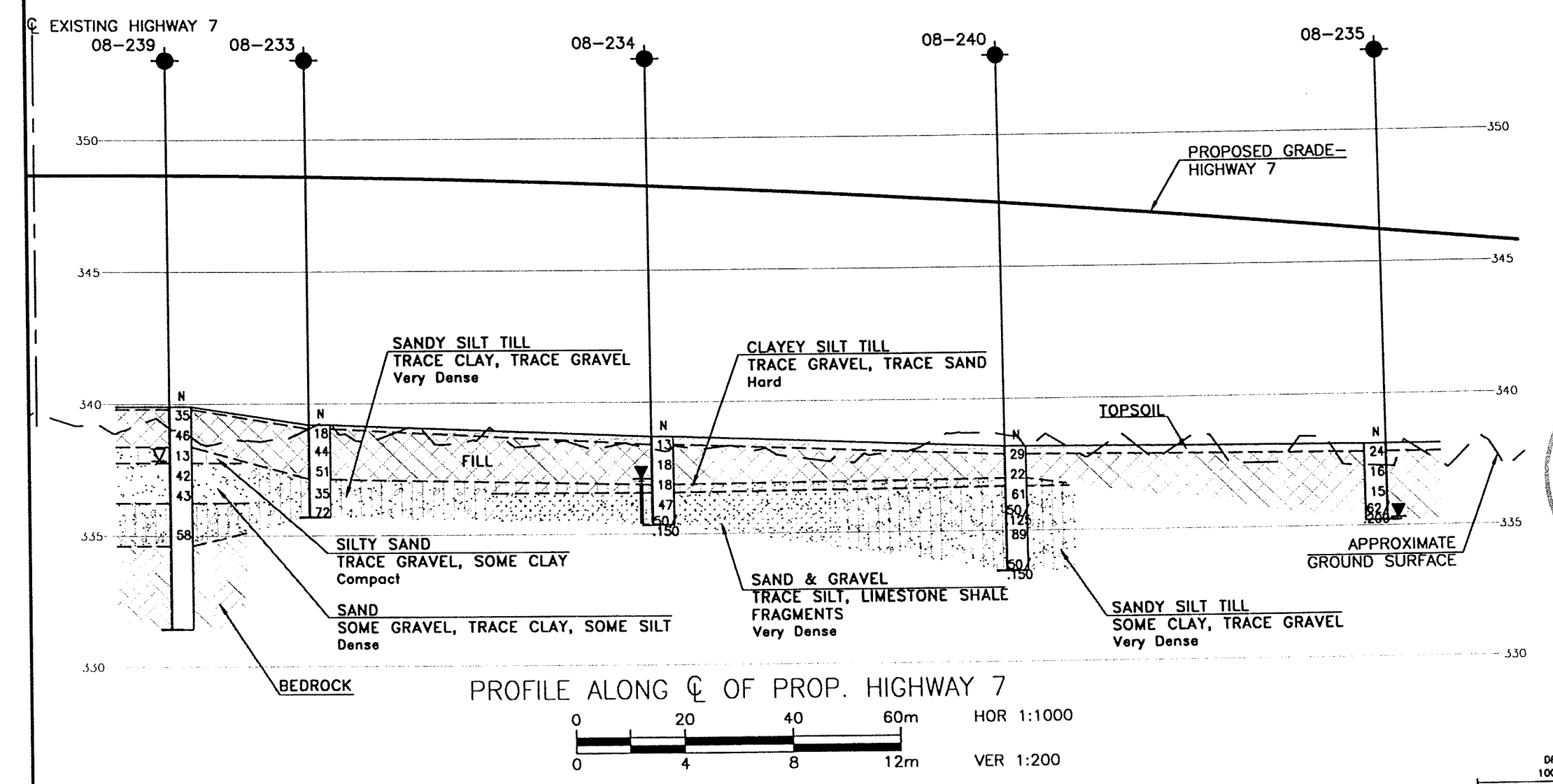
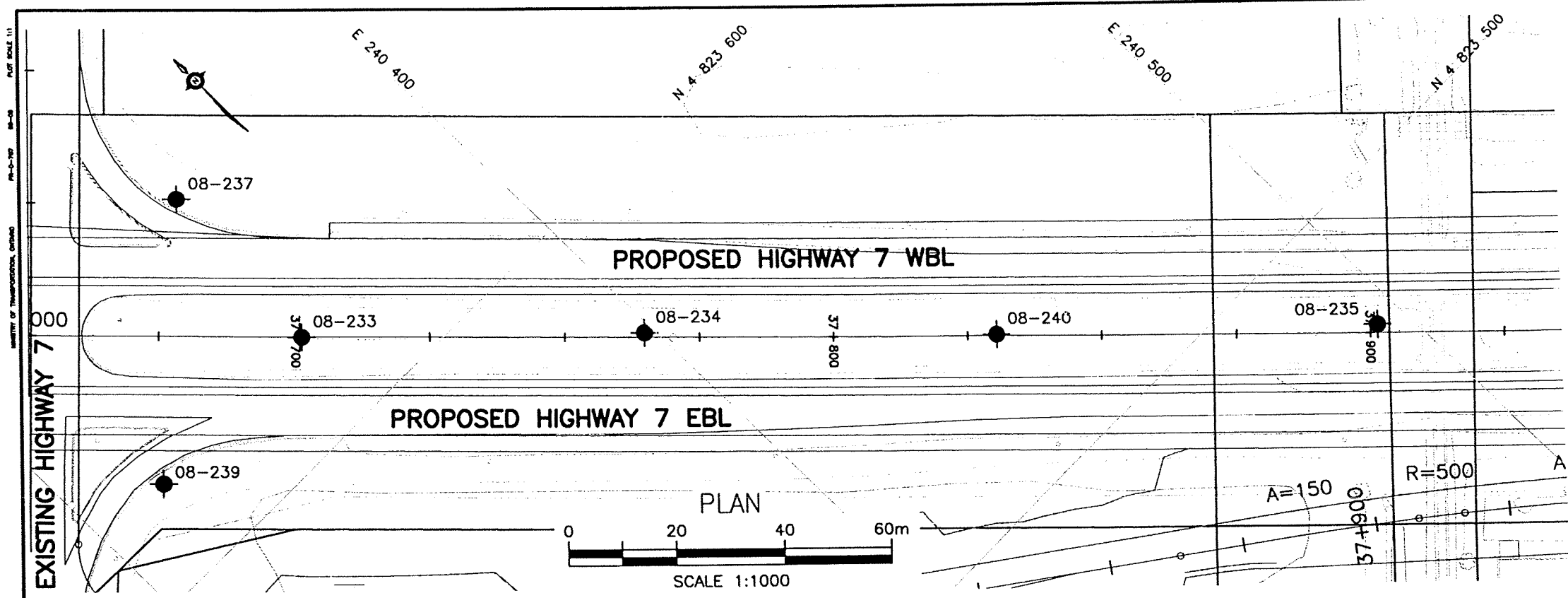
W.P.# 408-88-00
Prepared By AN
Checked By RPR



High Fills and Deep Cuts – East of Townline Road to Hanlon Expressway
Highway 7-New, Kitchener to Guelph

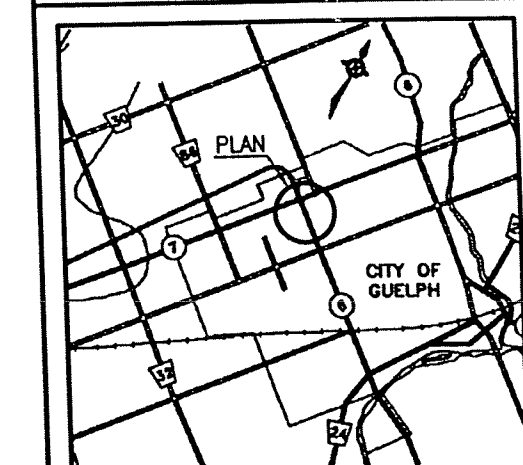


Photo - Looking east along Woodlawn Road



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

CONT No GWP No 408-88-00	SHEET
HIGHWAY 7 RECOMMENDED ROUTE 37+770 TO 38+000 BOREHOLE LOCATIONS AND SOIL STRATA	



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
08-233	339.2	4 823 618.7	240 352.9
08-234	338.7	4 823 574.1	240 398.4
08-235	338.1	4 823 477.7	240 495.0
08-237	339.5	4 823 653.1	240 355.3
08-239	339.9	4 823 617.3	240 315.4
08-240	338.2	4 823 527.1	240 444.2

- NOTES:**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
 - Proposed grades are from Plate 23 of the E.A. Study.

GEOCREs No. 40P9-48



DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC
DRAWN	AN	CHK AEG

DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING