FOUNDATION INVESTIGATION AND DESIGN REPORT
DEEP CUTS AND HIGH FILL EMBANKMENTS
RECONSTRUCTION AND WIDENING OF HIGHWAY 8
FROM 1.0 KM NORTH OF GRAND RIVER, SOUTHERLY
TO SPORTSWORLD DRIVE, KITCHENER, ONTARIO
G.W.P. 277-97-00

Geocres Number: 40P8-148

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for a proposed deep cut and a proposed high fill embankment required for the planned widening of Highway 8 in Kitchener, Ontario.

Highway 8 will be widened from four to eight lanes from 1 km north of the Grand River southerly to Sportsworld Drive. The project will include a deep cut between Stations 13+400 and 13+650, and a high fill embankment between Stations 13+650 and 14+500 located in the Grand River floodplain.

The purpose of this investigation was to explore the subsurface conditions along the deep cut and high fill embankment alignments and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Morrison Hershfield Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 3005-E-0035.

2 SITE DESCRIPTION

The site is located along existing Highway 8 in Kitchener, Ontario. Within this section, existing Highway 8 descends through a cut section in an elevated land area on the north side of the Grand River, crosses the Grand River bridge, and extends over the river floodplain to the south of the river on a fill embankment. Existing highway grades fall from near elevation 303 m at Station 13+400 at the north limit of the deep cut section, to elevation 288.3 m through the floodplain (approximate Stations 13+950 to 14+200), and rise again to elevation 297 m at the south limit of the high fill embankment (Station 14+500).

The existing Highway 8 cut extends from the north end of the Grand River bridge to approximately 250 m north, with a depth of up to 13 m below the adjacent tableland. The ground surface on the tableland above the cut typically rises from about elevation 307 m at the north limit of the cut section to elevation 310 m near the centre, and then falls gradually to elevation 308 m near the crest of the slope to the Grand River. The valley slope to the river is some 25 m high and inclined at approximately 2H:1V. Trees, brush and several residential dwellings are present on the tablelands.

The existing highway embankment in the river floodplain ranges in height from approximately 3.5 to 12 m and extends from the south end of the Grand River bridge to approximately 650 m south. The floodplain is generally level at approximate elevation 285 m, with a gentle slope towards the river channel. The floodplain is mainly vegetated with grass, shrubs and some sparse trees.

The preliminary profile drawing provided by Morrison Hershfield indicates a water level of elevation 282.5 m in the Grand River. The water depth measured in the river during the concurrent foundation investigation for the new bridge was approximately 1.5 m to 2.3 m at the borehole locations. The river flow is controlled by the local conservation authority.

Geologically, the site area is located within the physiographic region known as the Waterloo Hills, which is characterized by sandy hills consisting of ridges of sandy till as well as kames and kame moraines, with outwash sands occupying the intervening hollows. Locally, the Grand River spillway system contains alluvial terraces of uniform sandy and gravelly materials. The soils overlie Silurian limestone bedrock of the Guelph Formation.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for the cut section were carried out during the period September 19 to 25, 2006 and consisted of drilling and sampling six boreholes (Nos. 06-28 to 06-33) to depths of 12.5 to 20.1 m. The site investigation and field testing for the fill section were carried out between August 8 and 16, 2006 and consisted of drilling and sampling 13 boreholes (Nos. 06-34 to 06-46) to depths of 2.8 to 9.7 m, including two boreholes encountering auger refusal.

Several other boreholes (Nos. 06-11, 06-12, 06-13, 06-64 and 06-73), drilled in the fill area for concurrent investigation at other project-related structures, were referenced and are included in this report.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendix D. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations. Permission to Enter was obtained before entering private properties.

Hollow stem augers were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A

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

Standpipe piezometers, consisting of 19 or 25 mm PVC pipes with slotted tip, were installed in selected boreholes to monitor groundwater levels. The remaining boreholes were grouted on completion of drilling. The completion details of the boreholes and piezometers are shown in Table C1 of Appendix C. The piezometers will be decommissioned in accordance with MOE Reg. 903.

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 Appendix A. Approximately 25% of the recovered samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A and on the Borehole Locations and Soil Strata Drawing in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

5.1 Deep Cut - Station 13+400 to 13+650 Boreholes 06-28 to 06-33

In general terms, the site was found to be underlain by a unit of sand to silt and sand, overlying silty clay till with interbeds of sandy silt till and sand and gravel. A deposit of sandy silt to silty sand till underlies the cohesive till. More detailed descriptions of the individual strata are presented below.

5.1.1 Topsoil

A 100 to 275 mm thick layer of topsoil was encountered at the ground surface in all boreholes drilled in the cut area. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.1.2 Sand Fill

A layer of sand fill extending to 1.4 m depth (elevation 306.6 m) was encountered below the topsoil in borehole 06-33. The fill was loose with a recorded SPT N-value of 8 blows/0.3 m. The moisture content was about 10%.

5.1.3 Sand to Silt and Sand

Native deposits of brown, non-cohesive sand to silt and sand were encountered below the topsoil and fill in all boreholes. These deposits typically contained a trace to some gravel and locally contained cobbles. Grain size distribution results for the sand to silt and sand are presented on the Record of Borehole sheets and Figures B1 and B2 of Appendix B. The silt content in the tested samples varied widely from 5 to 81%, and clay contents of 6 to 14% were determined.

The lower boundary of the sand/silt material was encountered at depths of 3.1 to 6.3 m, increasing towards the south (elevation 301.7 to 305.0 m, highest near Station 13+500).

SPT N-values in the sand to silt and sand deposits varied widely from 7 to 63 blows/0.3 m penetration, with several counts exceeding 50 blows/0.15 m. The relative density indicated by the N-values ranges from loose to very dense. It must be noted however that only two N-values of less than 10 blows (loose) were obtained, and that N-values greater than 50 may reflect the presence of cobbles or boulders.

Moisture contents in this material ranged from 1% to 13%, with one sample of wet silt and sand indicating 22%.

5.1.4 Silty Clay Till

The upper sand to silt and sand layer is underlain by a deposit of brown to grey silty clay till. The upper boundary at which clay till was first encountered in the boreholes ranged from depths of 3.1 to 9.2 m (elevation 298.8 to 305.0 m). In boreholes 06-28 and 06-30, 0.5 to 2.8 m thick layers of sand and gravel to gravelly sand were encountered below the initial 0.7 to 1.1 m of clay till, with the till resuming at depths of 7.0 and 9.2 m (elevation 300.1 and 301.3 m). Zones of sandy silt till, 1.3 to 3.5 m thick, were encountered in or above the clay till in boreholes 06-31 and 06-32. In borehole 06-33, a 2.9 m thick layer of sand and gravel was encountered between the upper sand deposit and the clay till.

The lower boundary of the silty clay till was encountered at depths of 11.6 to 16.0 m (elevation 294.0 to 296.3 m).

Standard Penetration Tests conducted in the clay till yielded N-values ranging from 40 blows/0.3 m penetration to 50 blows/0.075 m, indicating a hard consistency. The higher N-values may reflect the presence of cobbles in the till. Glacial till is known to contain cobbles and boulders.

Moisture contents generally ranged from 12 to 20%, with localized values as low as 3% likely resulting from the presence of gravel particles in the sample tested.

Samples from this deposit were subjected to grain size distribution and Atterberg Limits tests. The results of the grain size analyses are reported on the Record of Borehole Sheets

and plotted in Figures B4 and B5 of Appendix B. The Atterberg Limits, plotted on Figures B7 and B8, indicate that the silt clay till has a medium to high plasticity.

5.1.5 Sand and Gravel, Gravelly Sand, and Sandy Silt Till

Localized deposits of sand and gravel to gravelly sand were encountered within or above the silty clay till stratum in boreholes 06-28, 06-30 and 06-33. The sand and gravel deposits were 0.5 to 2.8 m thick, with an upper boundary contacted at depths of 4.2 to 7.3 m (elevation 301.7 to 304.3 m). SPT N-values in these layers ranged from 27 to 88 blows/0.3 m, indicating a compact to very dense condition. Moisture contents ranged from 7 to 19%. The results of grain size analyses conducted on this material are reported on the Record of Borehole Sheets and plotted in Figure B3 of Appendix B.

Zones of sandy silt till were encountered within or above the clay till locally in boreholes 06-31 and 06-32. These zones ranged in thickness from 1.3 to 3.5 m, with upper boundaries at depths of 5.1 to 10.4 m (elevation 299.6 to 304.8 m). N-values of 25 blows/0.3 m to 50 blows/0.1 m were obtained, indicating a compact to very dense condition. Moisture contents ranged from 7 to 12%. Glacial till is known to contain cobbles and large boulders.

5.1.6 Sandy Silt to Silty Sand Till

Very dense, grey sandy silt to silty sand till was encountered below the clay till in all boreholes. The upper boundary of this till was encountered at depths of 11.6 to 16.0 m (elevation 294.0 to 296.3 m). Drilling was terminated in the till at depths of 12.5 to 20.1 m (elevation 288.0 to 294.6 m).

Samples from this deposit were subjected to grain size distribution tests. The results of the sieve and hydrometer analyses are presented on the Record of Borehole Sheets and Figure B6 of Appendix B. Moisture contents from this deposit ranged from 4 to 11%, with one value of 19% obtained locally.

All SPT test conducted in the silt/sand till deposit achieved 50 blows for less than 150 mm of penetration, indicating a very dense condition. Glacial till is known to contain cobbles and large boulders.

5.1.7 Groundwater Conditions

The sand and gravel and/or upper sand/silt deposits immediately above or within the upper part of the clay till unit were described as wet in four of the boreholes (Nos. 06-28, 06-30, 06-31 and 06-33). The wet conditions indicate that groundwater may be perched in the non-cohesive soils above or within the less permeable clay till.

Standpipe piezometers were installed in the boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1.

Table 5.1 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
06-28	18-Sept-2006	11.3	295.8
	20-Sept-2006	11.4	295.7
	21-Sept-2006	11.4	295.7
	22-Sept-2006	11.5	295.6
	29-Sept-2006	11.5	295.6
06-29	20-Sept-2006	17.0	291.2
	21-Sept-2006	13.4	294.8
	22-Sept-2006	13.3	294.9
	29-Sept-2006	13.3	294.9
06-30	21-Sept-2006	11.8	298.7
	22-Sept-2006	12.2	298.3
	29-Sept-2006	15.9	294.6
06-31	21-Sept-2006	19.7	290.3
	22-Sept-2006	14.5	295.5
	29-Sept-2006	16.3	293.7
06-32	29-Sept-2006	17.5	291.7
06-33	22-Sept-2006	16.0	292.0
	25-Sept-2006	17.5	290.5
	29-Sept-2006	17.6	290.4

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in zones of more permeable sand and gravel, or sand/silt above or within the clay till.

5.2 High Fill Embankment - Station 13+650 to 14+500 Boreholes 06-11 to 06-13, 06-34 to 06-46, 06-64 and 06-73

A separate Foundation Investigation Report has been prepared for the Grand River bridge and approach fills within 20 m of the abutments. The bridge report documents the subsurface conditions between approximate Stations 13+627 and 13+859. This report addresses the section beyond (south of) Station 13+859, and references three boreholes drilled at the south abutment of the proposed bridge.

In general terms, boreholes drilled on the Grand River floodplain encountered alluvial deposits of sand, silt and clay overlying a layer of sand and gravel. Boreholes drilled on the south part of the site ascended the existing embankment slope and encountered sand fill overlying a sand layer. At the extreme south limit of the investigation area, units of native silty clay, sandy silty clay till and silty sand till were encountered above the sand layer instead of fill. The sand and gravel and sand layers throughout the site are underlain by a heterogeneous till grading from silty sand to sandy silty clay, and interrupted by discontinuous layers of sand. More detailed descriptions of the individual strata are presented below.

5.2.1 Topsoil

A topsoil layer was encountered at the ground surface in all boreholes. The thickness of the surficial topsoil layer ranged from 25 to 150 mm in all boreholes except borehole 06-39 where the topsoil/organics extended to 800 mm depth. In borehole 06-38, a second layer of topsoil/organics, 600 mm thick, was encountered below fill at 0.8 m depth. In addition, a 75 mm thick topsoil layer was encountered below fill at depths of 500 and 100 mm in boreholes 06-11 and 06-13 at the bridge abutment.

The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.2.2 Sand Fill

Boreholes 06-40 to 06-46 were drilled at locations ascending the existing highway embankment, rising towards the south. In these boreholes, the fill thickness generally increases towards the south, from 2.2 m in borehole 06-41 to 7.0 m in borehole 06-45, and then decreases to 0.2 m in borehole 06-46. The lower boundary of the embankment fill typically ranges from elevation 284.2 to 286.1 m, rising to elevation 295.1 m in borehole 06-46 at the south limit.

The fill comprises sand containing a trace of gravel to gravelly, a trace of silt to silty, and cobbles. The results of the grain size distribution analyses conducted on the fill are reported on the Record of Borehole Sheets and plotted in Figure B9 of Appendix B. The results indicate fines contents (silt and clay) of 13 to 22%.

Standard Penetration Tests conducted in the fill typically yielded N-values of 16 to 67 blows/0.3 m penetration, indicating a compact to very dense condition. Lower N-values of 7 to 9 blows/0.3 m (loose) were obtained locally in boreholes 06-40 and 06-45. Several N-values of 50 blows for less than 150 mm are believed to reflect the presence of cobbles in the fill. Moisture contents generally ranged from 3 to 12%, with one value of 21% measured in a basal sample containing organics.

Thin layers of sand or gravel fill extending to depths of 0.2 to 0.8 m (elevation 283.5 to 284.4 m) were encountered in boreholes 06-11 to 06-13 and 06-38 drilled in the floodplain. This fill was loose to compact with N-values of 9 to 13 blows/0.3 m.

5.2.3 Alluvial Deposits (Sand to Sandy Silt, Clayey Silt to Silty Clay)

Alluvial deposits consisting of cohesionless sand to sandy silt and cohesive clayey silt to silty clay were encountered in boreholes 06-34 to 06-39, 06-64 and 06-73 drilled in the floodplain. These deposits are typically dark brown and contain organics. The lower boundary of the alluvium was encountered at depths of 0.8 to 3.0 m (elevation 282.1 to 283.7 m).

SPT N-values typically ranged from 3 to 22 blows/0.3m, indicating a very loose to compact condition or a soft to very stiff consistency. Moisture contents ranged from 14 to 41%, typically 17 to 25%.

5.2.4 Upper Silty Clay, Sandy Silty Clay Till, and Silty Sand Till

Borehole 06-46 was drilled at the south limit of the fill section and encountered several native deposits not encountered in the other boreholes. These deposits consisted of silty clay, sandy silty clay till, and silty sand till.

The silty clay layer was 2.8 m thick and was encountered between depths of 0.2 and 3.0 m (elevation 295.1 and 292.4 m). N-values of 14 to 20 blows/0.3 m indicate that this layer is very stiff. Moisture contents range from 21 to 23%. The results of a grain size analysis and Atterberg Limits testing conducted on the clay are presented on Figures B15 and B17, respectively. The results indicate the clay is highly plastic.

The underlying till consists of sandy silty clay, grading to silty sand at 4.7 m depth (elevation 290.6 m). N-values of 50 blows/0.3 m (hard) and 80/0.225 m (very dense) were obtained in the clay till and sand till, respectively. Moisture contents of about 18% were obtained. The results of a grain size analysis conducted on the silty sand till are presented on Figure B15, Appendix B. Borehole 06-46 was terminated in the till at 5.0 m depth (elevation 290.4 m).

5.2.5 Sand to Silty Sand

A layer of sand to silty sand was encountered below the embankment fill on the south half of the site (boreholes 06-41 to 06-45) at depths of 2.2 to 7.0 m (elevation 285.3 to 286.1

m). Where fully penetrated, the sand layer was 1.4 to 3.3 m thick with a lower boundary at depths of 4.6 to 8.4 m (elevation 282.1 to 284.7 m). Boreholes 06-43 and 06-44 were terminated in the sand at 5.9 and 7.8 m (elevation 284.0 and 283.9 m).

SPT N-values obtained in the sand varied significantly from 12 to 69 blows/0.3 m, indicating a compact to very dense condition. One value of 50 blows/0.025 m likely resulted from driving on a cobble. Moisture contents typically ranged from 9 to 15%, with local values of 5 and 22% obtained. The results of the grain size distribution analyses conducted on samples from this deposit are presented on the Record of Borehole Sheets and Figure B12 of Appendix B.

5.2.6 Sand and Gravel

On the north half of the site (boreholes 06-11 to 06-13, 06-34 to 06-41. 06-64 and 06-73), a layer of sand and gravel was encountered below the alluvial deposits, localized fill and sand layer. The upper boundary of the sand and gravel layer was encountered at depths of 0.2 to 4.6 m (elevation 282.1 to 284.2 m), and the lower boundary was encountered at depths of 2.9 to 6.0 m (elevation 278.5 to 282.1 m). The thickness of this layer ranged from 0.8 to 4.6 m where fully penetrated. Boreholes 06-34 and 06-36 were terminated in this deposit at depths of 2.8 and 3.9 m upon suspected boulders.

SPT N-values obtained in the sand and gravel varied significantly from 8 blows/0.3 m to 50 blows/0.125 m, indicating a loose to very dense condition. Moisture contents ranged from 4 to 19%. The results of the grain size distribution analyses conducted on samples from this deposit, presented on the Record of Borehole Sheets and Figures B10 and B11 of Appendix B, indicate silt contents of 8 to 17%.

5.2.7 Silty Sand to Silty Clay Till

Glacial till was encountered below the sand layer and sand and gravel layer in 13 of the boreholes. The till varies in gradation, as evidenced by the results of particle size distribution analyses presented on Figures B13 and B14 of Appendix B. These gradation variations result in soil classifications ranging from non-cohesive sandy silt to silty sand, and cohesive clayey silt to silty clay. Atterberg Limits tests conducted on samples of the sandy silty clay till, Figure B16 of Appendix B, indicate that the cohesive zones are of low plasticity.

The upper boundary of the till was encountered at depths of 2.9 to 6.3 m (elevation 278.5 to 282.1 m), and locally 8.4 m (elevation 284.7 m) near the south limit of the investigation. In general, the boreholes were terminated in the till at depths of 6.2 to 9.7 m (elevation 276.9 to 283.4 m). The till was underlain by gravelly sand at 9.4 and 11.6 m depth (elevation 275.1 and 272.6 m) in boreholes 06-11 and 06-12 drilled at the bridge abutment, and by sand at 7.0 m depth (elevation 277.6 m) in borehole 06-64. In addition, a sand layer was encountered within the till between 5.6 and 8.6 m depth in borehole 06-11.

The till is compact to very dense or hard, as indicated by N-values ranging from 22 blows/0.3 m to 50 blows/0.05 m. Moisture contents from this deposit ranged from 7 to 14%. As noted on the borehole logs, the till contains cobbles. Glacial till is also known to contain large boulders.

5.2.8 Silty Sand to Gravelly Sand

Discontinuous deposits of sand were encountered in three boreholes: a 1.3 m thick layer of loose silty sand was encountered between the sand and gravel layer and underlying till in borehole 06-35; a 3.0 m thick layer of very dense sand was encountered within the till in borehole 06-11; and very dense sand was encountered below the till in borehole 06-64.

Very dense gravelly sand was encountered below the till at depths of 9.4 and 11.6 m (elevation 275.1 and 272.6 m) in boreholes 06-11 and 06-12 drilled at the bridge abutment. All SPT N-values obtained in this stratum exceeded 50 blows/0.3 m. Moisture contents of 8 to 23% were measured. The gravelly sand mantled bedrock or probable bedrock at 14.0 and 14.6 m depth (elevation 270.5 and 269.6 m).

5.2.9 Bedrock

The overburden soils described above are underlain by limestone bedrock, contacted at14.0 and 14.6 m depth (elevation 270.5 and 269.6 m) in boreholes 06-11 and 06-12, respectively. The bedrock was proved by coring in borehole 06-12 at the south abutment. The bedrock is described as highly to moderately weathered, thinly bedded and grey, with occasional pitted zones and rubble zones.

Core recovery in the bedrock was between 55% and 100%. The RQD values ranged from 0 to 50%, indicating very poor to poor rock quality. The estimated unconfined compressive strength of the rock cores, based on point load tests, ranges between 73 to 155 MPa, indicating a strong to very strong rock.

5.2.10 Groundwater Conditions

Standpipe piezometers were installed in selected boreholes to monitor groundwater levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2.

Table 5.2 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
06-11	10-Aug-2006	1.3	283.2
	11-Aug-2006	1.2	283.3
	14-Aug-2006	1.2	283.3
	15-Aug-2006	1.2	283.3
	16-Aug-2006	1.2	283.3
	29-Sept-2006	1.5	283.0
06-40	15-Aug-2006	2.8	284.4
	16-Aug-2006	3.1	284.1
	29-Sept-2006	3.2	284.0
06-43	29-Sept-2006	5.2	284.7
06-46	29-Sept-2006	4.3	291.0
06-64	11-Aug-2006	1.3	283.3
	14-Aug-2006	1.5	283.1
	15-Aug-2006	1.5	283.1
	16-Aug-2006	1.5	283.1
	29-Sept-2006	1.4	283.2
06-73	10-Aug-2006	1.9	283.2
	11-Aug-2006	1.9	283.2
	14-Aug-2006	2.0	283.1
	15-Aug-2006	2.0	283.1
	16-Aug-2006	2.0	283.1
	29-Sept-2006	1.5	283.6

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

In particular, the groundwater levels in the floodplain will be governed by the water level in the adjacent Grand River. A preliminary profile provided by Morrison Hershfield indicates a water level of elevation 282.5 m in the river. The river flow is controlled by the Grand River Conservation Authority.

6 MISCELLANEOUS

Thurber Engineering Ltd. selected the borehole locations in the field relative to existing site features with consideration of access restraints, terrain conditions, and utility locations. Callon Dietz Inc., retained by Morrison Hershfield, subsequently established the co-ordinates and ground surface elevations at the staked borehole locations.

All-Terrain Drilling of Waterloo supplied and operated the drilling and sampling equipment used for the investigation. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. Stephane Loranger.

Interpretation of the field data and preparation of the investigation report were conducted by Mr. Murray Anderson, P.Eng. Overall supervision of the field program and review of the report was provided by Mr. Alastair Gorman, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents geotechnical design recommendations for cut slopes and embankments exceeding 6 m in height.

Highway 8 will be widened from four to eight lanes from 1 km north of the Grand River southerly to Sportsworld Drive. The project will include construction of a new twin bridge over the Grand River to carry the southbound lanes. A deep cut and a high fill embankment will be required at the following locations:

- Station 13+400 and 13+650 - an existing deep cut of up to 13 m depth will be widened on the west side, immediately north of the Grand River bridge.
- Station 13+650 and 14+500 - a high fill embankment is required for the new southbound lanes located in the Grand River floodplain, immediately south of the new bridge.

The proposed deep cut section comprises a widening of the existing highway cut and extends from the north end of the Grand River bridge to approximately 250 m north. The ground surface on the tableland above the cut typically rises from about elevation 307 m at the north limit of the cut section to elevation 310 m near the centre, and then falls gradually to elevation 308 m near the crest of the slope to the Grand River. Road grades will descend from near elevation 303 m at the north limit of the deep cut (Station 13+400) to elevation 295 m at the bridge (Station 13+650).

The proposed high fill embankment is located adjacent to the existing highway embankment and extends from the south end of the Grand River bridge to approximately 650 m south. The existing embankment height ranges from approximately 3.5 to 12 m above the river floodplain. In the south half of the floodplain, the existing fill embankment was previously constructed to within about 2 m of existing road grade for a width of approximately 10 to 15 m west of the edge of the existing

highway. The floodplain is generally level at approximate elevation 285 m, with a gentle slope towards the river channel.

This report addresses the cut and fill sections beyond the limits of the Grand River bridge approaches. A separate Foundation Investigation and Design Report was prepared for the Grand River SBL bridge structure and approaches between approximate Stations 13+627 and 13+859.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of the investigation.

8 ENGINEERING ANALYSIS METHODOLOGY

The geotechnical analyses summarized in this report include assessment of the global stability of the embankment and cut slope geometries and material types for both short and long term conditions. Assessment of immediate and long-term settlements, including magnitude and time rate, was also carried out for the embankments. The analyses were based on the soil profiles and properties encountered at various locations, selected for critical conditions.

The stability analyses were carried out using the commercially available slope stability program GSLOPE developed by Mitre Software Inc. Bishop's modified method of slices was used for the limit equilibrium analyses. Based on consideration of the risk involved and past experience with highway embankment design/monitoring, the minimum factors of safety considered appropriate to achieve stability are 1.3 for short-term stability of cut slopes and embankments, 1.3 for long-term stability of embankments founded on cohesionless foundation soils, and 1.5 for long-term stability of cut slopes and embankments founded on cohesive foundation soils.

The stability of the embankments under seismic loading was assessed based on a pseudo-static approach using the parameters presented in Section 11. The pseudo-static analysis considers the application of the peak horizontal acceleration (PHA) to the soil mass on a non-softening foundation to assess the embankment stability. A minimum factor of safety of 1.0 is considered appropriate for seismic loading.

Settlement analysis involved computation of the immediate settlement of the foundation soils under the imposed embankment loading using elastic theory and, where cohesive deposits are present, calculation of long-term consolidation settlement using Terzaghi one-dimensional consolidation theory.

The engineering properties of the soils used in the analyses were selected based on correlations developed between index/strength tests and compression parameters from previous investigations involving similar materials.

9 CUT SLOPE DESIGN AND CONSTRUCTION

Preliminary cross-sections of the cut area show that road grades will descend from near elevation 303 m at the north limit of the deep cut (Station 13+400) to elevation 295 m at the Grand River bridge (Station 13+650). The maximum cut depth is approximately 13 m. Side ditches will extend about 1 m below the road grade.

The borehole information indicates that the cut will primarily extend through compact to very dense silt and sand to depths of 3.1 to 6.3 m (elevation 301.7 to 305.0 m), and into hard silty clay till. Zones of sand and gravel, gravelly sand, and sandy silt till, 0.5 to 3.5 m thick, are present locally within or above the clay till deposit. The groundwater level falls towards the south from elevation 295.6 to 290.4 m, and is approximately 3 to 6 m below the base of the cut.

9.1 Cut Slope Stability

A cut slope with an inclination of 2H:1V and a maximum height of 13 m was assessed. Station 13+600 (borehole 06-32) was selected as the critical section for the stability analysis in view of the maximum cut depth and the soil profile encountered at this location.

The results of the stability analysis are presented in Figures C1 to C4, Appendix C. The computed factors of safety against failure were greater than 2.0 for short-term conditions and 1.4 for critical long-term conditions (Figures C1 and C2). Incorporation of a mid-height bench increases the long-term safety factor to 1.5 (Figure C3). The computed factor of safety under seismic loading of a benched slope is near 1.2 (Figure C4).

Based on these results, a cut slope inclination of 2H:1V is considered stable for the proposed deep cut and is recommended. A mid-height bench may be considered to increase the safety factor and for reasons other than stability. If employed, the bench should be a minimum 2 m in width and sloped at 2% to shed surface water run-off.

9.2 Cut Slope Construction

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

Selection of the method of excavation is the responsibility of the contractor and must be based on his equipment, experience and interpretation of the site conditions. From the viewpoint of constructability, use of heavy duty excavators or dozers is considered feasible to excavate the very dense/hard till and sand and gravel materials, and to handle cobbles and possible boulders in these deposits.

The groundwater levels measured in the piezometers installed in the boreholes are below the proposed depth of cut and therefore dewatering to lower the groundwater table should not be required. However, wet zones were encountered locally in the sand and gravel and sand/silt layers situated above and within the clay till deposit. Localized seepage of perched water from the more permeable layers should be anticipated during construction.

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the native soils at this site may be classified as Type 2 soils except for the upper 3 to 6 m thick layer of sand to silt and sand that should be treated as Type 3 soil.

Permanent drainage of the cut slope using roadside ditches is considered adequate. An interceptor ditch should be provided at the top of cut as per OPSD 200.020. Earth cut slopes must be provided with erosion protection in accordance with OPSS 572.

10 EMBANKMENT DESIGN AND CONSTRUCTION

10.1 General

Previous contract drawings show that existing road grades in the high fill embankment section descend from near elevation 291 m at the south end of the Grand River bridge (Station 13+840) to elevation 288.3 m through the floodplain (approximate Stations 13+950 to 14+200), and then rise to elevation 297 m at the south limit (Station 14+500). The existing embankment height ranges from approximately 3.5 to 12 m above the river floodplain. The floodplain is generally at elevation 285 m.

The borehole information indicates that alluvial deposits of sand, silt, clay and/or organics extend to depths of 0.8 to 3.0 m (elevation 282.1 to 283.7 m) in the floodplain on the north part of the site. The alluvial deposits are very loose to compact or soft to very stiff and overlie sand and gravel. Boreholes drilled on the south part of the alignment ascended the existing widened embankment and typically encountered compact to very dense sand fill overlying a sand layer. The sand and sand and gravel layers are underlain by glacial till.

The results of stability analyses and settlement computations for the fill embankment are presented in the subsequent sections. It is recommended that all embankment fill consist of inorganic material from the cut section or imported non-plastic sand or sand and gravel available in the area. Prior to embankment construction, all topsoil and loose material within the embankment footprint should be removed.

Mid-height berms comprising 2 m wide benches should be incorporated along the length of embankments exceeding 8 m in height. The bench should maintain a 2% slope to shed surface run-off.

Earth fill embankment slopes must be provided with erosion protection in accordance with OPSS 572.

10.2 Stability Analysis

Stability analyses were carried out for an earth fill embankment under static and seismic loading conditions. For cohesive soils, short term (undrained) and long term (effective stress) conditions were assessed. Embankment slope inclinations of 2H:1V were assumed

for earth fill. Mid-height berms of 2 m width were applied to slopes exceeding 8 m in height. Analyses were carried out at two critical locations, selected based on the greatest thickness of soft clay alluvium (Station 14+060) and fill (Station 14+450), respectively.

Results of the stability analyses carried out at the selected critical locations (Stations 14+060 and 14+450) are presented in Figures C5 to C10 in Appendix C. The results indicate that the Factor of Safety (FS) for the embankment geometries analysed will be greater than 1.3 for short-term conditions, near 1.5 for long-term conditions, and near 1.2 for the seismic analyses. It is therefore recommended that side slopes for the high embankment to 12 m height be constructed no steeper than 2H:1V.

Based on the subsurface conditions encountered at the embankment locations, the potential for liquefaction of the foundation soils during a seismic event is considered to be low in accordance with CHBDC Section C4.6. Some local liquefaction and resulting toe failure may occur during a seismic event, but this is expected to be readily repaired.

10.3 Settlement Analysis

The results of the settlement analyses indicate that the immediate (elastic) foundation settlement under the loading imposed by a 3.5 to 12 m high embankment will be less than 25 mm for the subsurface conditions at this site. This settlement is expected to occur essentially as the fill is placed.

In the lower part of the floodplain near the Grand River, the embankment height will range from about 3.5 to 5.0 m. The embankment in this area will be constructed over alluvial deposits with a maximum thickness of about 3.0 m. Portions of the alluvium consist of soft to stiff cohesive clayey silt to silty clay, which may experience consolidation under the added embankment load. Based on approximate consolidation parameters inferred from the soil description, consistency and moisture content profile of the alluvium ($\gamma = 18$ kN/m^3, $e_o = 0.6$ to 0.9, $C_c = 0.2$ to 0.4, $C_r = 0.02$ to 0.04, and $c_v = 10^{-3}$ cm^2/s), consolidation of the cohesive zones is expected to result in variable settlements of up to about 100 mm. This settlement should be essentially completed within six months of embankment construction.

To minimize the effects of the consolidation settlement, it is recommended that the embankment be constructed at least six months in advance of pavement construction. Full subexcavation of the alluvial material is not recommended in view of the relatively low anticipated settlement and the high groundwater table at the site.

The estimated settlement of earth fill embankments due to compression of the compacted earth fill is 0.5% of the embankment height and is expected to be completed within six months after construction. Based on this value, the estimated settlement due to embankment compression ranges from 20 to 60 mm for embankment heights of 3.5 and 12.0 m, respectively.

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

All topsoil and highly organic material should be stripped from the footprint of the embankment prior to placing fill, as specified in the next section.

10.4 Embankment Construction

Embankment construction should be carried out in accordance with OPSS 206 as amended by the most recent Special Provision. Earth fill may consist of granular materials and Select Subgrade Material (SSM) in compliance with Special Provision 110F113, "Amendment to OPSS 1010, March 1993.

Prior to placement of new fill against the existing embankment slope, the existing earth slope should be benched in accordance with OPSD 208.010.

All topsoil and highly organic material should be stripped from the footprint of the embankment prior to placing fill. Table 10.1 summarizes the minimum depth of stripping required, based on the conditions encountered at the borehole locations. Stripping depths may vary at locations between and away from the boreholes.

Table 10.1 – Depth of Stripping at Borehole Locations

Borehole	Station	Minimum Stripping Depth	
		Depth (m)	Elevation (m)
06-11	13+835	0.6	283.9
06-12	13+840	0.2	284.0
06-13	13+860	0.2	284.1
06-34	13+900	0.2	284.3
06-64	13+950	0.2	284.4
06-35	13+950	0.2	284.2
06-36	14+000	0.2	284.6
06-37	14+050	0.2	284.7
06-73	14+060	0.2	284.9
06-38	14+100	1.4	283.7
06-39	14+150	0.8	284.1

Trafficability of construction equipment may be problematic in the floodplain where soft/loose and organic alluvial material may be encountered. Further, drainage in the floodplain is likely to be poor, with groundwater levels varying subject to fluctuations in the water level in the Grand River. The contractor must be prepared to supply equipment capable of working on this terrain and/or provide alternative measures to improve trafficability such as placement of a granular pad in working areas.

11 SEISMIC CONSIDERATIONS

The site is treated as lying in Seismic Zone 1. The following seismic parameters should be used for design:

- Velocity Related Seismic Zone 0
- Zonal Velocity Ratio 0.05
- Acceleration Related Seismic Zone 1
- Zonal Acceleration Ratio 0.05
- Peak Horizontal Acceleration 0.08

The soil profile type at this site has been classified as Type I. Therefore, according to Table 4.4.6.1 of the CHBDC, a Site Coefficient "S" (ground motion amplification factor) of 1.0 should be used in seismic design.

12 CONSTRUCTION CONCERNS

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

- Cobbles and boulders may be encountered during excavation of the till and sand and gravel in the cut section. Localized seepage of perched water may also be experienced, requiring drainage.
- The thickness and presence of fill, topsoil and alluvial deposits were investigated at the borehole locations only. These deposits may extend to greater depths or be encountered at other locations between boreholes.
- Geotechnical confirmation is required that all topsoil and highly organic materials within the proposed embankment footprint are sub-excavated and replaced with approved backfill.
- Trafficability of construction equipment may be problematic in the floodplain where soft/loose and organic alluvial material may be encountered.

13 CLOSURE

Engineering analysis and preparation of the foundation design report was conducted by Mr. Murray Anderson, P.Eng. The report was reviewed by Mr. Alastair Gorman, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Review Principal

Appendix A

Record of Borehole Sheets

Deep Cut – **Boreholes 06-28 to 06-33**

High Fill – **Boreholes 06-11 to 06-13, 06-34 to 06-46, 06-64 and 06-73**

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

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

$\overline{\blacktriangledown}$ 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

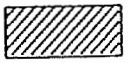
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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			

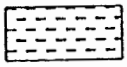
EXPLANATION OF ROCK LOGGING TERMS

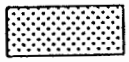
ROCK WEATHERING CLASSIFICATION

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

SYMBOLS


CLAYSTONE


SILTSTONE


SANDSTONE


COAL


Bedrock (general)

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

TERMS

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

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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Ontario

THURBER

RECORD OF BOREHOLE No 06-11 1 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 300.78 E 230 631.30 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 08.08.06 - 09.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.5 / 0.0	**TOPSOIL**: (125 mm)										
0.1 / 284.0	**SAND**, some gravel, trace silt Loose Dark brown Moist (FILL)		1	SS	9		284	○	○		
0.5 / 284.0	**TOPSOIL**: (75 mm)										
0.6 / 283.9	**SAND and GRAVEL**, trace silt, occasional cobbles Compact to Dense Brown Moist		2	SS	14						
			3	SS	30		283		○		
			4	SS	45		282		○		
280.9			5	SS	39				○		49 42 9 (SI+CL)
3.6 / 278.9	**SILT and SAND**, some clay, trace gravel Very Dense Brown Moist (TILL)		6	SS	71		281		○		1 37 49 13
							280				
5.6 / 275.9	**SAND**, trace to some silt, some gravel Very dense Grey Moist to wet		7	SS	90/.275		279		○		
			8	SS	88/.275		278				
8.6 / 275.1	Silty **CLAY**, trace sand Hard Grey (TILL)		9	SS	50/.050		277		○		
9.4	Gravelly **SAND**, trace silt Very Dense Grey						276				
							275				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

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THURBER

RECORD OF BOREHOLE No 06-11 2 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 300.78 E 230 631.30 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 08.08.06 - 09.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Wet						274				
			10	SS	50/.075				○		
							273				
			11	SS	70/.275				○		
							272				
							271				
270.5			12	SS	50/.050				○		0 93 2 (SI+CL)
14.0	END OF BOREHOLE AT 14.02 m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
10.08.06	1.27	283.2
11.08.06	1.21	283.3
14.08.06	1.23	283.3
15.08.06	1.20	283.3
16.08.06	1.24	283.3
29.09.06	1.50	283.0

$+^3, \times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 06-12 1 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 286.20 E 230 626.37 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers / NQ Core Barrel COMPILED BY JHL

DATUM Geodetic DATE 08.08.06 - 08.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.2											
0.0	**TOPSOIL:** (100 mm)										
0.1	**SAND**,some silt, trace clay, trace gravel, topsoil stained, trace roots Compact Dark brown Moist (FILL)		1	SS	13		284		○		
283.5											
0.7	**SAND AND GRAVEL**, some silt Compact to Very Dense Brown Moist		2	SS	21		283		○		
	Occasional cobbles, wet		3	SS	61				○		
			4	SS	50/.125		282		○		
280.6			5	SS	40		281		○ ○		47 41 12 (SI+CL)
3.6	Sandy **SILT**, some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		6	SS	74		280		○		
			7	SS	50/.100		279				
			8	SS	50/.125		278		○		3 32 55 11
			9	SS	50/.100		277		○		
							276				
							275		○		

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-12 2 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 286.20 E 230 626.37 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers / NQ Core Barrel COMPILED BY JHL

DATUM Geodetic DATE 08.08.06 - 08.08.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
274.1											
10.1	Silty **CLAY**, trace sand, trace gravel Very stiff Grey (TILL)(CL)						274				
			10	SS	24				○		1 4 62 34
272.6							273				
11.6	Gravelly **SAND**, silty, trace clay, occasional cobbles Very dense Grey Wet		11	SS	50/.125		272		○		
			12	SS	50/.125		271		○		
269.6							270				
14.6	Highly to moderately weathered, thinly bedded, grey, strong to very strong, **LIMESTONE BEDROCK**, with occasional rubble zones, occasional pitted zones		1	RUN						FI 10	RUN 1# TCR=100%,
			2	RUN						5	SCR=43%, RQD=0%,
			3	RUN			269			>10 7 7	UCS=MPa RUN 2# TCR=92%, SCR=75%, RQD=50%, UCS=73MPa
			4	RUN			268 267			>10 3 6	RUN 3# TCR=60%, SCR=44%, RQD=12%, UCS=86MPa RUN 4# TCR=55%, SCR=42%, RQD=23%, UCS=155MPa
266.1											
18.1	END OF BOREHOLE AT 18.12 m. BOREHOLE GROUTED WITH BENTONITE UPON COMPLETION.										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-13 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 280.86 E 230 645.36 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 11.08.06 - 11.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.3											
0.0	**TOPSOIL**: (50 mm)										
0.0	**GRAVEL**: (FILL)										
0.1	**TOPSOIL**: (75 mm)		1	SS	25		284		○		
0.2	**SAND and GRAVEL**, trace silt Compact to Very Dense Brown Moist		2	SS	34		283		○		
			3	SS	100/.275				○		
			4	SS	61		282		○		38 55 8 (SI+CL)
281.0			5	SS	30		281		○		
3.4	**SILT and SAND**, some clay, trace gravel, occasional cobbles Dense to Very Dense Grey Moist (TILL)		6	SS	36		280		○		5 40 44 11
							279				
278.0			7	SS	50/.075				○		
6.3	END OF BOREHOLE AT 6.33 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-28 1 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 498.24 E 230 248.75 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 19.09.06 - 19.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
307.1							
0.0 / 306.8	**TOPSOIL:** (250mm), black						307
0.3	**SILT and SAND**, some clay, trace gravel Compact Brown Moist: (TILL)		1	SS	11		
			2	SS	22		306
304.8							
2.3	**SAND**, trace silt, trace gravel Very dense Brown Moist to wet		3	SS	63		305
303.9							
3.1	Silty **CLAY**, trace sand Hard Brown (TILL)		4	SS	71		304
302.9							
4.2	Gravelly **SAND**, some silt Compact to Dense Brown Wet		5	SS	27		303
	Occasional cobbles		6	SS	38		302
300.1							301
7.0	Silty **CLAY**, trace sand, trace gravel Hard Grey (TILL)(CH)		7	SS	56		300
			8	SS	72		299
							298

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
	0	38	48	14
	33	53	13	(SI+CL)
	0	2	35	63

Continued Next Page

$+^3$, $\times^3$ Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-28 2 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 498.24 E 230 248.75 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 19.09.06 - 19.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ÷ FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
							297				
			9	SS	76/ .275				○		
295.5							296				
11.6	Sandy **SILT**, some clay, trace gravel Very Dense Grey (TILL)										
294.6			10	SS	50/ .150		295				
12.5	END OF BOREHOLE AT 12.50m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
18/09/06	11.32	295.76
20/09/06	11.35	295.73
21/09/06	11.41	295.67
22/09/06	11.45	295.63
29/09/06	11.49	295.59

÷ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-29 1 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
308.2											
0.0	**TOPSOIL:** (200mm), black										
0.2	**SAND**, some gravel, trace silt, with cobbles Compact to Very Dense Brown Moist		1	SS	14		308		○		
			2	SS	21		307		○		
	becoming sand and gravel		3	SS	48		306		○		41 49 10 (SI+CL)
			4	SS	50/.125		305		○		
304.4											
3.8	Silty **CLAY**, trace sand Hard Grey (TILL)(Cl)		5	SS	41		304		○		
			6	SS	53		303		○		0 1 51 49
			7	SS	48		302		○		
			8	SS	83		301		○		
							300				
							299				

ONTMT4S 7938.GPJ 20/03/07

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+ 3, × 3: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-29 2 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
			9	SS	44		298				0 2 37 62
296.3							297				
11.9	**SILT and SAND**, trace clay, trace gravel Very dense Grey Moist: (TILL)		10	SS	50/ .125		296				
			11	SS	50/ .125		295 ▼				2 41 41 16
			12	SS	50/ .125		294				
			13	SS	50/ .025		293				
							292				
							291				
			14	SS	50/ .125		290				
							289				
288.3			15	SS	50/						

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÷ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

UNIM145 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-29 3 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
19.9	END OF BOREHOLE AT 19.94M. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20/09/06 17.00 291.19 21/09/06 13.38 294.81 22/09/06 13.28 294.91 29/09/06 13.33 294.86				.125						

+ 3 . × 3 : Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-30 1 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.5											
0.0 / 310.3	**TOPSOIL:** (250mm), black										
0.3	**SILT and SAND**, trace gravel, trace clay Loose to Compact Brown Moist		1	SS	8		310				
308.5			2	SS	11		309				1 39 52 8
2.0	**SAND**, trace silt Compact Brown Moist		3	SS	28		308				
306.5			4	SS	24		307				0 95 5 (SI+CL)
4.0	**SILT and SAND**, trace gravel, trace clay Dense Brown Wet		5	SS	35		306				
305.0							305				
5.5 / 304.3	Silty **CLAY**, trace sand, trace gravel Grey (TILL)										
6.2 / 303.8	**SAND and GRAVEL**, trace silt Very dense Grey Wet		6	SS	72		304				
6.7 / 303.2	Silty **CLAY**, trace sand, trace gravel Grey (TILL)										
7.3	**SAND and GRAVEL**, trace silt Very dense Grey Wet		7	SS	88		303				
301.3							302				38 56 6 (SI+CL)
9.2	Silty **CLAY**, trace sand, trace gravel Hard Grey (TILL)(CH)		8	SS	50/.150		301				

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+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-30 2 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
			9	SS	66		300				
							299				
			10	SS	40		298				0 2 33 65
							297				
			11	SS	50/.125		296				
295.7											
14.8	**SILT and SAND**, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		12	SS	50/.150		295				
			13	SS	50/.125		294				5 40 39 16
							293				
			14	SS	50/.125		292				
							291				
290.6			15	SS	50/						

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+ ³, × ³ : Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-30 3 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
19.9	END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 21/09/06 11.84 298.67 22/09/06 12.19 298.32 29/09/06 15.95 294.56				.125						

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-31 1 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.0							310				
0.0	**TOPSOIL:** (100mm), black										
0.1	**SAND**, trace silt, trace gravel Dense to Compact Brown Moist										
			1	SS	44		309		○		
			2	SS	32				○		
							308				
			3	SS	27				○		
307.0							307				
2.9	**SILT**, some sand to sandy, trace clay Compact Brown Moist to wet		4	SS	23				○		0 13 81 6
							306				
			5	SS	13				○		
304.8							305				
5.1	Sandy **SILT**, some clay, trace gravel Compact Grey Moist: (TILL)										
			6	SS	25		304		○		8 28 48 16
302.3							303				
7.6	Silty **CLAY**, trace sand, occasional cobbles Hard Grey (TILL)		7	SS	71		302		○		
			8	SS	64		301		○		

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+ ³, × ³: Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-31 2 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
299.6							300				
10.4	Sandy **SIL**T, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		9	SS	50/.125		299		○		
298.2							298				
11.7	Silty **CLAY**, trace sand, occasional cobbles Hard Grey (TILL)(CH)		10	SS	90		297		○		0 1 36 64
			11	SS	50/.125		296		○		
			12	SS	50/.125		295		○		
294.0							294				
16.0	Silty **SAND**, some gravel, occasional cobbles Very Dense Grey Moist: (TILL)		13	SS	50/.125		293		○		
			14	SS	50/.125		292		○		24 48 28 (SI+CL)
290.0			15	SS	50/		291		○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-31 3 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
19.9	END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.				.125						

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
21/09/06	19.68	290.28
22/09/06	14.48	295.48
29/09/06	16.28	293.68

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\Phi\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-32 1 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.2											
0.0 / 308.9	**TOPSOIL:** (275mm), black						309				
0.3	**SAND**, trace silt, trace gravel Compact Brown Moist		1	SS	10				○		
307.0			2	SS	12		308				
2.2	**SAND**, some silt to silty, trace gravel Dense to Compact Brown Moist		3	SS	33		307		○		0 76 24 (SI+CL)
			4	SS	17		306		○		
			5	SS	37		305		○		1 86 13 (SI+CL)
303.6							304				
5.6	Silty **CLAY**, trace sand, trace gravel Hard Grey (TILL)		6	SS	47		303		○		
302.0							302				
7.2	Sandy **SILT**, some clay, trace gravel Very dense Grey Moist: (TILL)		7	SS	50/.100		301		○		
			8	SS	50/.100		300		○		

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+ ³, × ³ Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-32 2 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P w w_L) WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
298.5							299				
10.7	Silty **CLAY**, trace sand Hard Grey (TILL)(CI)		9	SS	60/.100		298		○		
			10	SS	92/.250		297				0 1 35 63
			11	SS	50/.075		296		○		
294.3							295				
14.9	Sandy **SILT**, some clay, trace gravel Very dense Grey Moist: (TILL)		12	SS	50/.100		294		○		
			13	SS	50/.075		293		○		
						▼	292				
			14	SS	50/.125		291		○		6 27 53 14
289.3			15	SS	50/		290		○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-32 3 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
19.9	END OF BOREHOLE AT 19.91m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/09/06 17.49 291.72				.100						

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

$15 \overset{20}{\oplus} 5$ 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-33 1 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 377.69 E 230 442.29 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 22.09.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
308.0							308				
0.0	**TOPSOIL:** (100mm), black										
0.1	**SAND**, trace gravel, trace wood fragments Loose Brown Moist: (FILL)		1	SS	8		307		○		
306.6											
1.4	**SAND**, some gravel, trace silt Loose to Very Dense Brown Moist		2	SS	7		306		○		
			3	SS	38				○		
			4	SS	52		305		○		16 76 8 (SI+CL)
			5	SS	50/ .150		304		○		
	Occasional cobbles						303				
301.7			6	SS	50/ .125		302		○		
6.3	**SAND and GRAVEL**, trace silt Very dense Grey Wet						301				
			7	SS	67		300		○		56 37 7 (SI+CL)
298.8											
9.2	Silty **CLAY**, trace sand Hard Grey (TILL)		8	SS	67		299		○ ○		

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-33 2 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 377.69 E 230 442.29 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 22.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
							298				
			9	SS	80						0 2 40 58
							297				
	Occasional cobbles										
							296		○		
			10	SS	50/ .125						
294.5							295				
13.5	**SILT and SAND**, some clay, trace gravel, occasional cobbles, occasional sand layers Very dense Grey Moist: (TILL)		11	SS	50/ .100				○		
							294				
							293				
			12	SS	50/ .125				○		4 38 43 15
							292				
			13	SS	50/ .125				○		
							291				
						▼					
			14	SS	50/ .125		290		○		
							289				
			15	SS	50/				○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\underset{10}{\oplus}} 5$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-33 3 OF 3 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 377.69 E 230 442.29 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 21.09.06 - 22.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT w_P w w_L	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 20 40 60	γ kN/m^3	GR SA SI CL
288.0					100		288				
20.1	END OF BOREHOLE AT 20.07m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
22/09/06	16.03	292.00
25/09/06	17.50	290.53
29/09/06	17.62	290.41

+^{3}, ×^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-34 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 259.39 E 230 677.71 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 11.08.06 - 11.08.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
284.5											
0.0	**TOPSOIL**: (100 mm)										
0.1	**SAND**, some gravel Compact Brown		1	SS	17		284		○		
283.7	Moist										
0.8	**SAND and GRAVEL**, some silt Very Dense Brown Moist		2	SS	56				○		
			3	SS	72		283		○		42 45 12 (SI+CL)
			4	SS	100		282		○		
281.6											
2.8	END OF BOREHOLE AT 2.82 m. AUGER REFUSAL AT 2.82 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND DRILL CUTTINGS TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-35 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 223.85 E 230 711.74 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.4											
0.0	**TOPSOIL**: (125 mm)										
0.1	**SAND**, some silt Loose Dark Brown Wet		1	SS	4		284		○		
283.5											
0.9	**SAND and GRAVEL**, trace silt, occasional cobbles Loose to Compact Brown Moist		2	SS	8		283		○		
			3	SS	12						
	Becoming Very Dense occasional boulders		4	SS	63		282		○		
	Becoming Grey		5	SS	74		281		○		49 43 8 (SI+CL)
280.1											
4.3	Silty **SAND**, some gravel Loose Grey Wet		6	SS	8		280		○		
278.8							279				
5.6	Silty **SAND**, some gravel Very Dense Grey										
278.2	Wet		7	SS	50/				○		
6.2	(TILL)				.100						
	END OF BOREHOLE AT 6.20 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

15 (20 / 10) 5 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-36 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 204.75 E 230 760.97 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
284.8											
0.0	**TOPSOIL**: (125 mm)										
0.1	Clayey **SILT**, trace organics Firm Brown to Dark Brown		1	SS	8				○		
			2	SS	6		284		○		
283.0											
1.8	**SAND and GRAVEL**, some silt, occasional cobbles Compact to Very Dense Brown Wet		3	SS	20		283				
			4	SS	34				○		
							282				
			5	SS	56				○		47 38 15 (SI+CL)
280.9							281				
3.9	END OF BOREHOLE AT 3.89 m. AUGER REFUSAL AT 3.89 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-37 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 177.28 E 230 798.64 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.9											
0.0	**TOPSOIL**: (125 mm)						285				
0.1	**SAND**, some gravel, trace silt, trace organics Loose to Compact Brown to Dark Brown Moist		1	SS	4				○		
			2	SS	8		284		○		
			3	SS	14						
282.7							283				
2.2	**SAND and GRAVEL**, some silt, occasional cobbles Dense Brown Wet		4	SS	46				○		59 30 11 (SI+CL)
281.4			5	SS	44		282		○ ○		
3.5	Sandy **SILT**, trace clay, trace gravel Compact Brown Moist (TILL)						281				
			6	SS	22		280		○		
279.3											
5.6	Sandy, Silty **CLAY** Hard Grey (TILL)(CL)		7	SS	44		279		○		0 31 47 20
277.8							278				
7.2	Sandy **SILT**, trace clay, trace gravel, occasional cobbles Very dense Grey Moist (TILL)		8	SS	76/ 275				○		
276.9							277				
8.1	END OF BOREHOLE AT 8.05 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-38 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 141.34 E 230 838.70 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
285.2											
0.0	**TOPSOIL**: (125mm)										
0.1	**SAND**, trace silt and gravel Compact Brown Moist		1	SS	12		285		○		
284.4	(FILL)										
0.8	**TOPSOIL**, mixed with clayey silt Stiff Dark Brown		2	SS	9				○		
283.7							284				
1.4	Sandy **SILT**, some topsoil Loose to Compact Brown Moist		3	SS	5				○		
			4	SS	22		283				
282.1											
3.0	**SAND and GRAVEL**, trace silt Dense Brown Moist		5	SS	34		282		○		38 53 9 (SI+CL)
281.4											
3.8	**SILT AND SAND**, trace clay, trace gravel, occasional cobbles Dense to Very Dense Grey Moist (TILL)		6	SS	47		281		○		
			7	SS	34		280				
							279		○		6 42 46 6
							278				
277.3			8	SS	50/.125				○		
7.9	END OF BOREHOLE AT 7.90 m BOREHOLE GROUTED WITH BENTONITE TO SURFACE										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-39 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 107.47 E 230 868.98 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL**, some roots Loose Black Moist		1	SS	7				○		
284.1											
0.8	Sandy **SILT** Loose Dark Brown Moist		2	SS	4		284		○		
283.5											
1.4	**SAND and GRAVEL**, some silt, occasional cobbles Very Dense to Compact Brown Wet		3	SS	82		283		○		52 36 13 (SI+CL)
282.0			4	SS	24						
2.9	Sandy **SILT**, trace clay, trace gravel, occasional cobbles Compact to Very Dense Grey Moist (TILL)		5	SS	25		282		○		
							281				
			6	SS	68		280		○		3 32 53 7
							279				
278.4			7	SS	85/.225				○		
6.5	END OF BOREHOLE AT 6.48 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\underset{10}{\oplus}} 5$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-40 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 080.05 E 230 915.85 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
287.2											
0.0	**TOPSOIL**: (75 mm)										
0.1	**SAND**, some silt, trace gravel Compact to Loose Brown Moist (FILL)		1	SS	18		287	○	○		
	Occasional cobbles		2	SS	18		286	○	○		
			3	SS	23				○		
284.2			4	SS	9		285		○		
3.0	**SAND and GRAVEL**, trace silt, occasional cobbles Very dense Brown Moist to wet		5	SS	82	▼	284		○		
			6	SS	92/275		283		○		42 49 9 (SI+CL)
281.4							282				
5.8	Sandy **SILT**, trace gravel Compact Grey Moist (TILL)		7	SS	28		281		○		
279.9							280				
7.3	Clayey **SILT**, some sand, trace gravel Hard Grey Moist (TILL)		8	SS	91/250				○		0 18 64 16
279.2											
8.0	END OF BOREHOLE AT 8.03 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 15.08.06 2.81 284.37 16.08.06 3.12 284.06 29.09.06 3.25 283.95										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\underset{10}{\oplus}} 5$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-41 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 045.34 E 230 953.06 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
287.5								20 40 60 80 100	20 40 60		
0.0 / 0.1	**TOPSOIL**: (50 mm)										
	SAND, trace silt Compact Brown Moist (FILL)		1	SS	16		287		○		
	trace gravel		2	SS	28				○		
	occasional cobbles		3	SS	23		286		○		
285.3											
2.2	**SAND**, some gravel, some silt, occasional cobbles Compact Brown Moist		4	SS	14		285		○		
			5	SS	17				○		
282.9							284				
4.6	**SAND and GRAVEL**, some silt, occasional cobbles Very Dense Grey Moist		6	SS	83		283		○		42 41 17 (SI+CL)
282.1											
5.4	Sandy, Silty **CLAY** Hard Grey (TILL)(CL)		7	SS	35		282		⊢		1 31 48 20
							281				
279.4	occasional cobbles		8	SS	95/250		280		○		
8.0	END OF BOREHOLE AT 8.03 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-42 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 012.79 E 230 991.33 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 2006-08-15 - 2006-08-15 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
288.4											
0.0 / 0.1	**TOPSOIL**: (75 mm)										
	Gravelly **SAND**, some silt Dense to Compact Brown Moist (FILL)		1	SS	31		288		○		
			2	SS	20				○		
			3	SS	44		287		○		32 51 17 (SI+CL)
285.4			4	SS	35		286		○		
3.0	Silty **SAND**, some gravel Compact to Dense Brown Moist to wet		5	SS	12		285		○		
			6	SS	30		284		○		21 55 24 (SI+CL)
282.1							283				
6.3	Sandy **SILT**, trace gravel Compact to Very Dense Grey Moist (TILL)		7	SS	24		282		○		
280.5			8	SS	50/.125		281		○		
7.9	END OF BOREHOLE AT 7.90 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 6/26/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-43 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 981.61 E 231 029.48 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 15.08.06 - 15.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ÷ FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
289.9											
0.0 / 0.1	**TOPSOIL**: (50 mm) Gravelly **SAND**, some silt to silty, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	50/.125				○		
			2	SS	54		289		○		
			3	SS	39		288		○		
			4	SS	91/.225				○		27 51 22 (SI+CL)
286.1			5	SS	22		287		○		
3.8	Silty **SAND**, some gravel, occasional cobbles Very dense Brown to grey Moist		6	SS	69		286		○		21 48 30 (SI+CL)
284.0							285				
5.9	END OF BOREHOLE AT 5.87 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
29.09.06	5.19	284.71

÷ ³, × ³: Numbers refer to Sensitivity

15 (20 / 10) 5 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-44 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 948.45 E 231 068.08 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 15.08.06 - 15.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
291.7											
0.0 / 0.1	**TOPSOIL**: (50 mm)										
	Gravelly **SAND**, some silt, occasional cobbles Dense to Very Dense Brown Moist (FILL)		1	SS	38		291	○			
			2	SS	65			○			
			3	SS	50/.125		290	○			
			4	SS	67			○			26 57 17 (SI+CL)
			5	SS	61		289	○			
287.1							288				
4.6	Sandy **SILT**, trace gravel, trace clay, occasional cobbles Dense Grey Moist (FILL)		6	SS	31		287	○			
285.7							286				
5.9	Silty **SAND**, some gravel Dense to Very Dense Brown with topsoil staining Moist		7	SS	47			○			17 54 29 (SI+CL)
							285				
283.9			8	SS	50/.025		284	○			
7.8	END OF BOREHOLE AT 7.80 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

÷ ^{3}, × ^{3}: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-45 1 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 921.39 E 231 098.77 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
293.1											
0.0	**TOPSOIL**: (25 mm)						293				
	SAND, trace to some gravel, trace to some silt, occasional cobbles Very Dense to Loose Brown Moist (FILL)		1	SS	52						
			2	SS	9		292				
			3	SS	34						
			4	SS	36		291				
			5	SS	39		290				25 62 13 (SI+CL)
			6	SS	8		289				
	Dark Brown, trace organics		7	SS	7		288				
286.0							287				
7.0	**SAND**, some gravel, some silt Very dense Grey Wet		8	SS	64		286				
284.7							285				
8.4	Sandy, Silty **CLAY** Hard Brown Moist (TILL)(CL)		9	SS	35		284				0 26 49 23
283.4											
9.7	END OF BOREHOLE AT 9.68 m. BOREHOLE GROUTED WITH										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-45 2 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 921.39 E 231 098.77 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

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

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-46 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 886.60 E 231 145.17 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
295.3											
0.0	**TOPSOIL:** (25 mm)										
0.2	**SAND**, trace silt Compact Brown Moist (FILL)		1	SS	14		295	○			
	Silty **CLAY**, trace sand Very stiff Brown (CH)		2	SS	15			○			
			3	SS	20		294	○			0 2 35 64
	Becoming Grey		4	SS	19		293	○			
292.4											
3.0	Sandy, Silty **CLAY**, trace gravel, occasional cobbles Hard Grey (TILL)		5	SS	50		292	○			
290.6							291				
4.7 290.4	Silty **SAND**, some gravel, occasional cobbles Very dense Grey Moist (TILL)		6	SS	80/ .225			○			17 54 28 (SI+CL)
5.0	END OF BOREHOLE AT 4.95 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29.09.06 4.28 291.04										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\Leftrightarrow} 5$ $\overset{10}{}$ (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-64 1 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 235.31 E 230 718.37 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
284.6											
0.0 / 0.1	**TOPSOIL:** (150 mm)										
	Silty **CLAY**, trace sand, topsoil stained Firm to Stiff Dark Brown		1	SS	5		284				
			2	SS	13						
283.1						▼	283				
1.4	**SAND and GRAVEL**, trace silt, occasional cobbles Loose Brown Moist		3	SS	8						
	Becoming Very Dense occasional cobbles and boulders		4	SS	70		282				
			5	SS	92/ .275						50 42 8 (SI+CL)
							281				
			6	SS	88		280				
278.5											
6.0	Sandy **SILT**, trace gravel, occasional cobbles Very Dense Grey Moist to Wet (TILL)		7	SS	50/ .125		279				
277.6							278				
7.0	**SAND**, some silt, trace gravel, occasional cobbles Very Dense Grey Wet		8	SS	50/ .100		277				
							276				
275.4											
9.2	END OF BOREHOLE AT 9.19 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		9	SS	50/ .050						

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-64 2 OF 2 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 235.31 E 230 718.37 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

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

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
11.08.06	1.34	283.24
14.08.06	1.47	283.11
15.08.06	1.48	283.10
16.08.06	1.49	283.09
29.09.06	1.39	283.19

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 06-73 1 OF 1 METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 157.57 E 230 802.08 ORIGINATED BY SLL

HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 09.08.06 - 09.08.06 CHECKED BY MEF

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
285.1											
0.0	**TOPSOIL**: (150 mm)										
0.1	**SAND**, trace organics Very Loose Dark Brown Moist		1	SS	3		285				
284.4											
0.7	Clayey **SILT**, some sand, trace organics Soft Dark Brown		2	SS	4		284				
			3	SS	3	▼					
	Becoming Very Stiff		4	SS	17		283				
282.2											
3.0	**SAND and GRAVEL**, some silt, occasional cobbles Compact Brown Wet		5	SS	18		282				
281.2											
4.0	**SILT and SAND**, trace clay, trace gravel Dense to Very Dense Brown to Grey Moist (**T**ILL)		6	SS	31		281				2 43 47 7
							280				
278.7			7	SS	50/.125		279				
6.4	END OF BOREHOLE AT 6.37 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
10.08.06	1.95	283.18
11.08.06	1.92	283.21
14.08.06	2.02	283.11
15.08.06	2.00	283.13
16.08.06	2.00	283.13
29.09.06	1.52	283.61

$+^3$, $\times^3$: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 7938.GPJ 20/03/07

Appendix B

Laboratory Test Results

Deep Cut – Figures B1 to B8

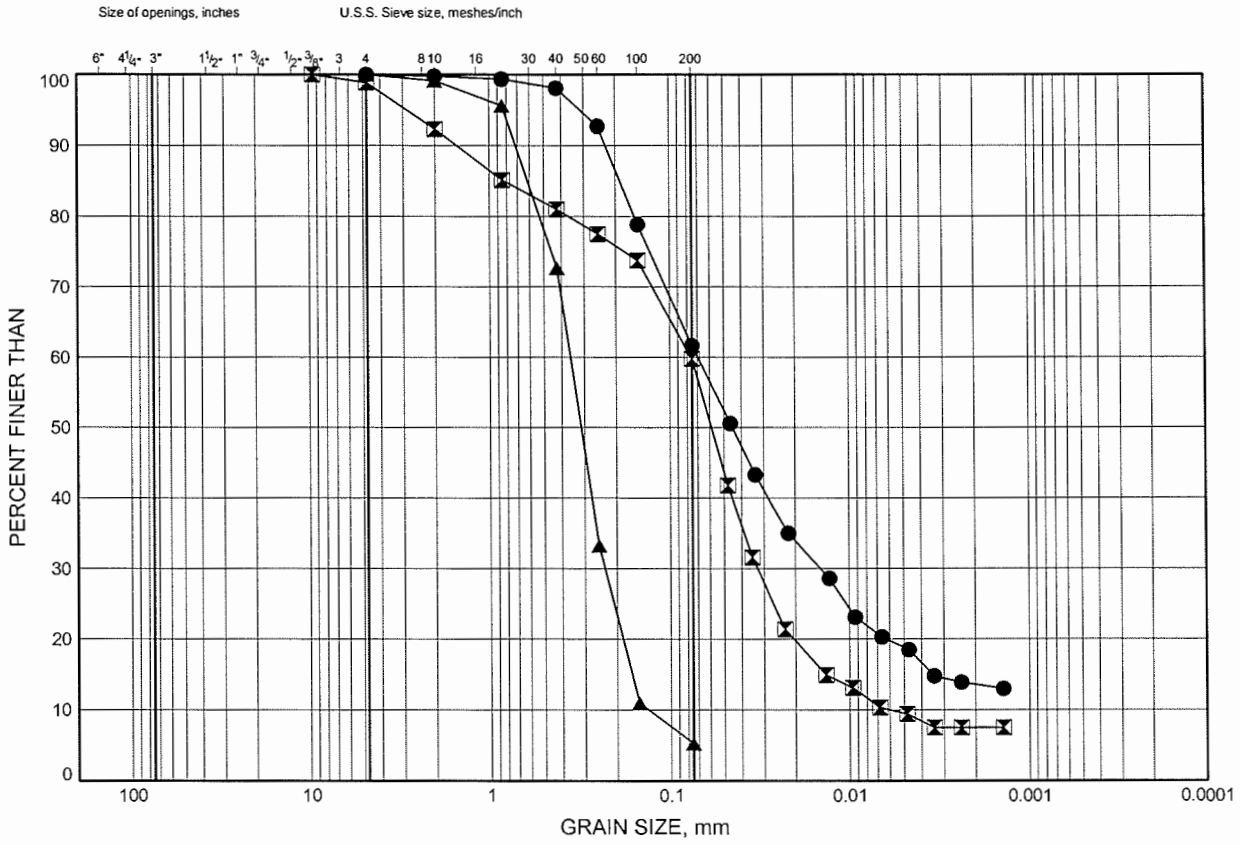
High Fill – Figures B9 to B17

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND TO SILT AND SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	1.83	305.25
⧓	06-30	1.83	308.68
▲	06-30	3.35	307.16

Date January 2007

Project 277-97-00

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Chkd. MRA

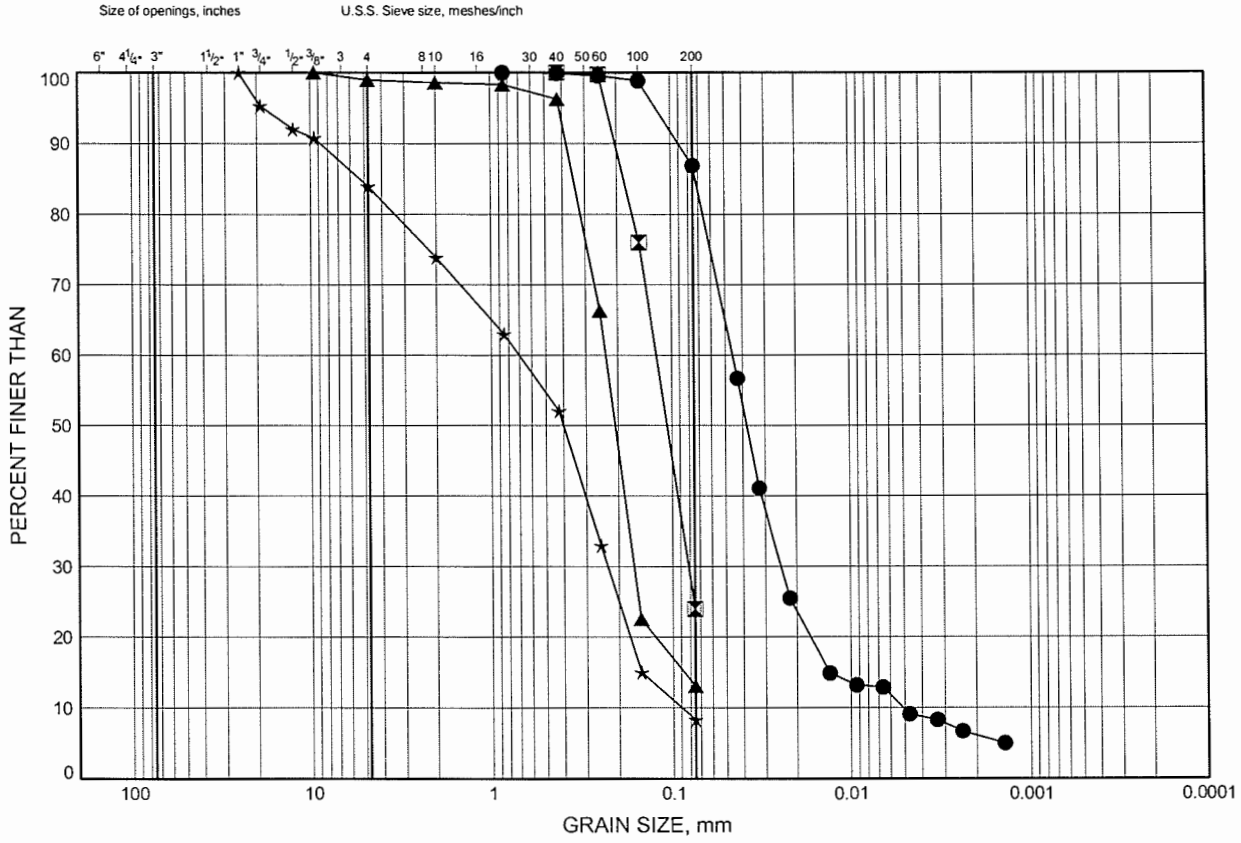
THURBGSD 7938.GPJ 17/01/07

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND TO SILT AND SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	3.35	306.60
⧓	06-32	2.59	306.62
▲	06-32	4.88	304.33
★	06-33	3.35	304.67

Date January 2007

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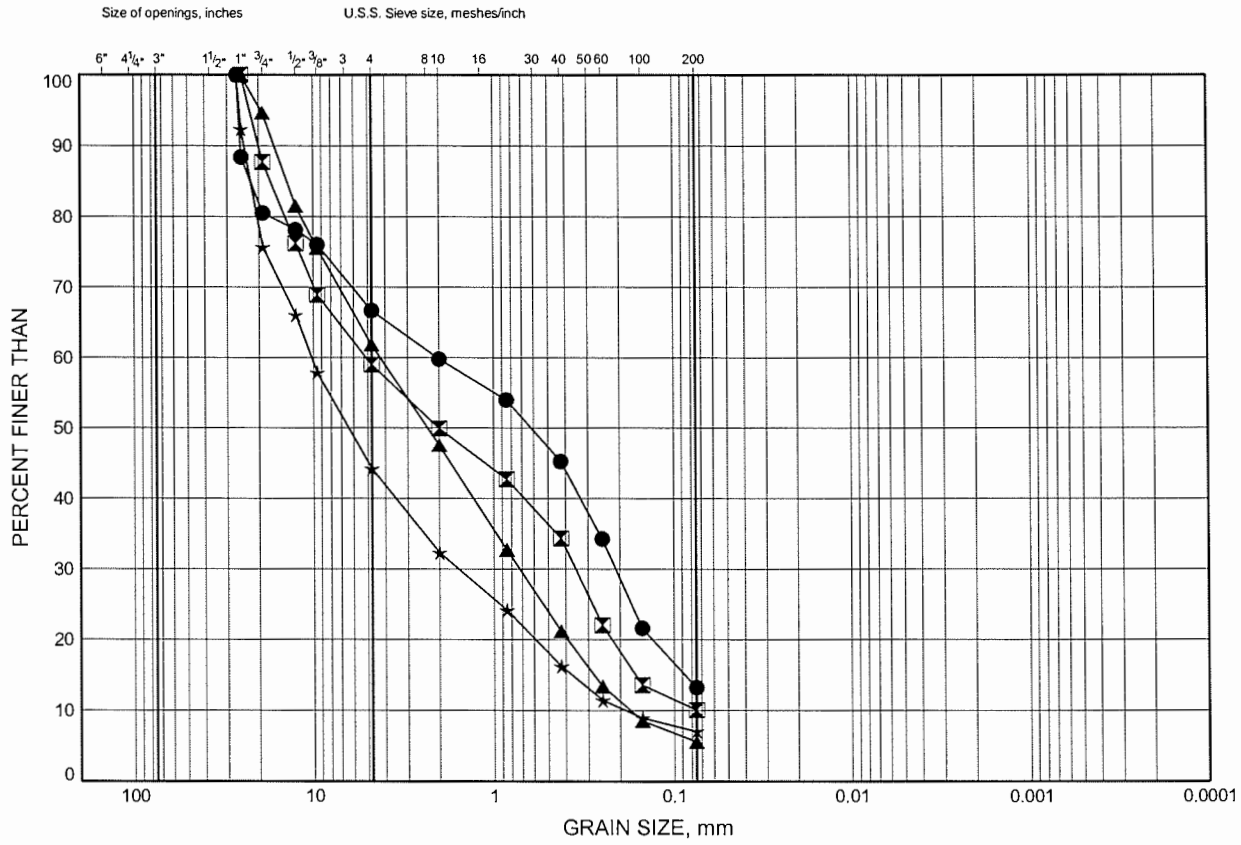
Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND AND GRAVEL TO GRAVELLY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	4.88	302.21
⊠	06-29	2.59	305.60
▲	06-30	7.85	302.66
★	06-33	7.92	300.10

Date January 2007

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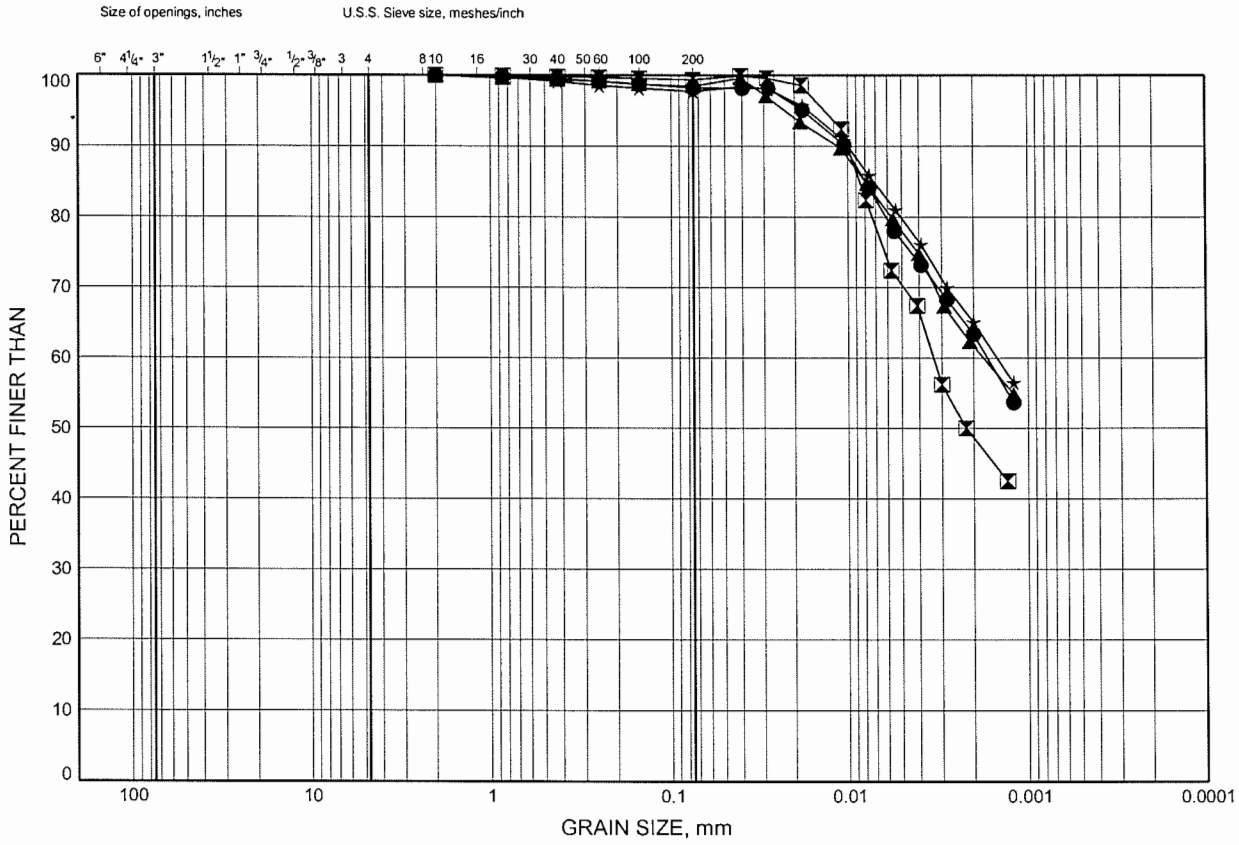
Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	9.35	297.73
⊠	06-29	6.40	301.79
▲	06-29	10.97	297.22
★	06-30	12.50	298.01

Date January 2007

Project 277-97-00

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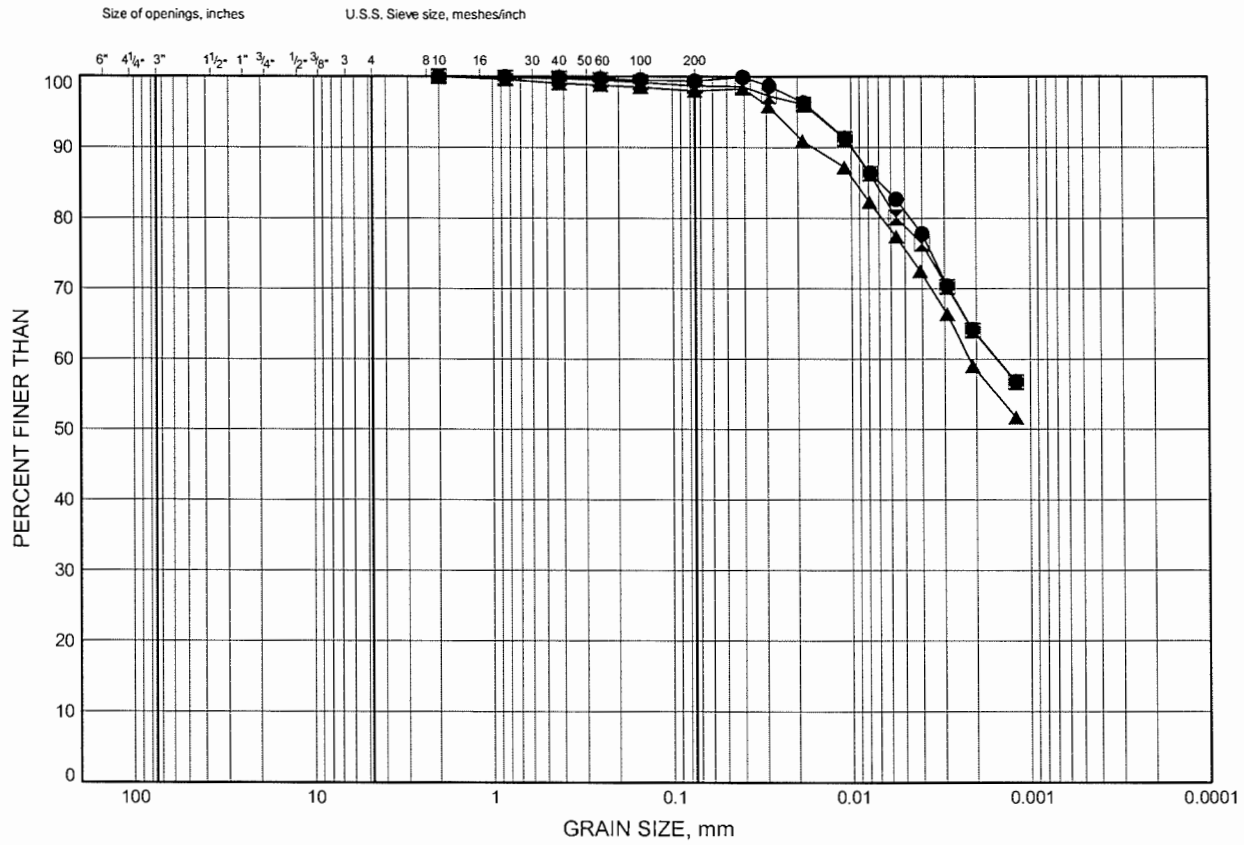
Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	12.42	297.53
⊠	06-32	12.40	296.81
▲	06-33	10.90	297.13

Date January 2007

Project 277-97-00

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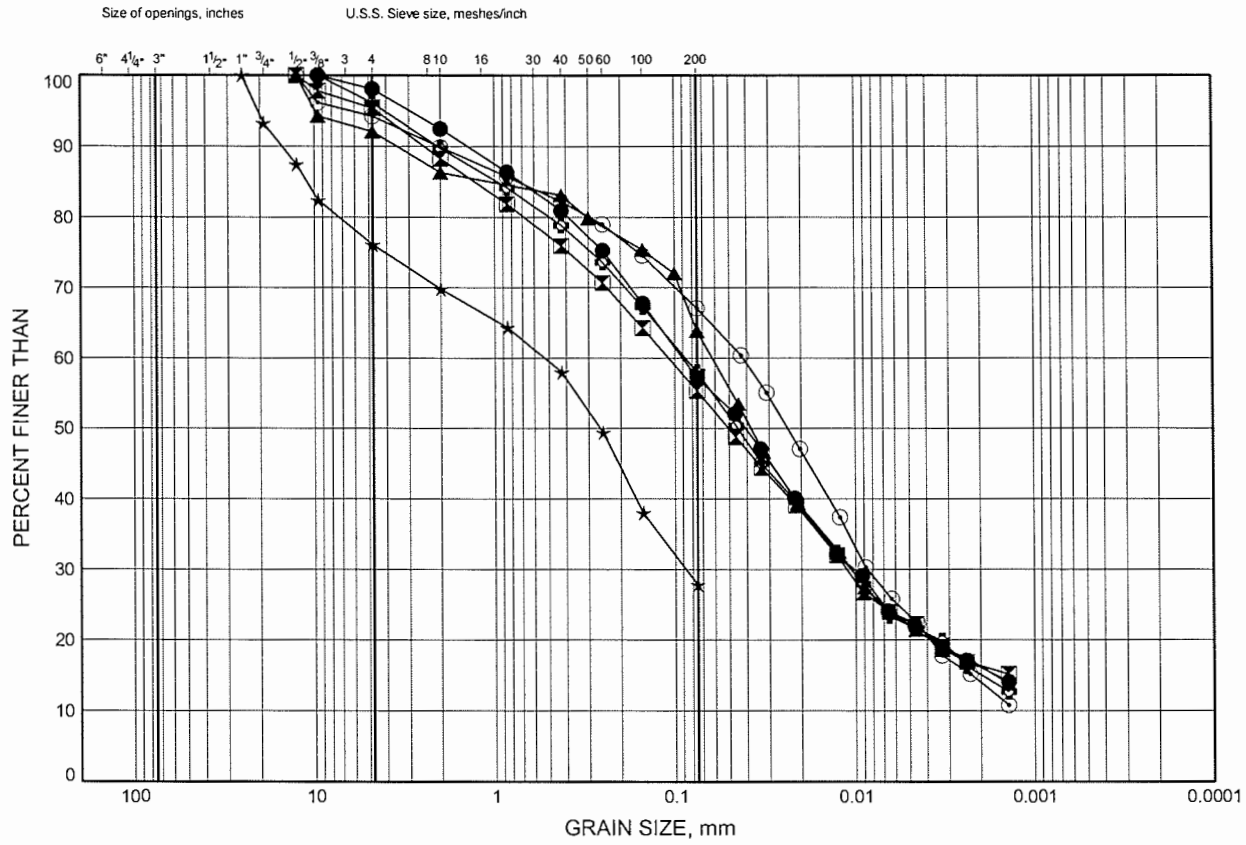
Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B6

SANDY SILT TO SILTY SAND TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-29	13.78	294.41
⧓	06-30	16.90	293.60
▲	06-31	6.40	303.55
★	06-31	18.58	291.37
⊙	06-32	18.34	290.87
✪	06-33	15.38	292.65

Date January 2007

Project 277-97-00

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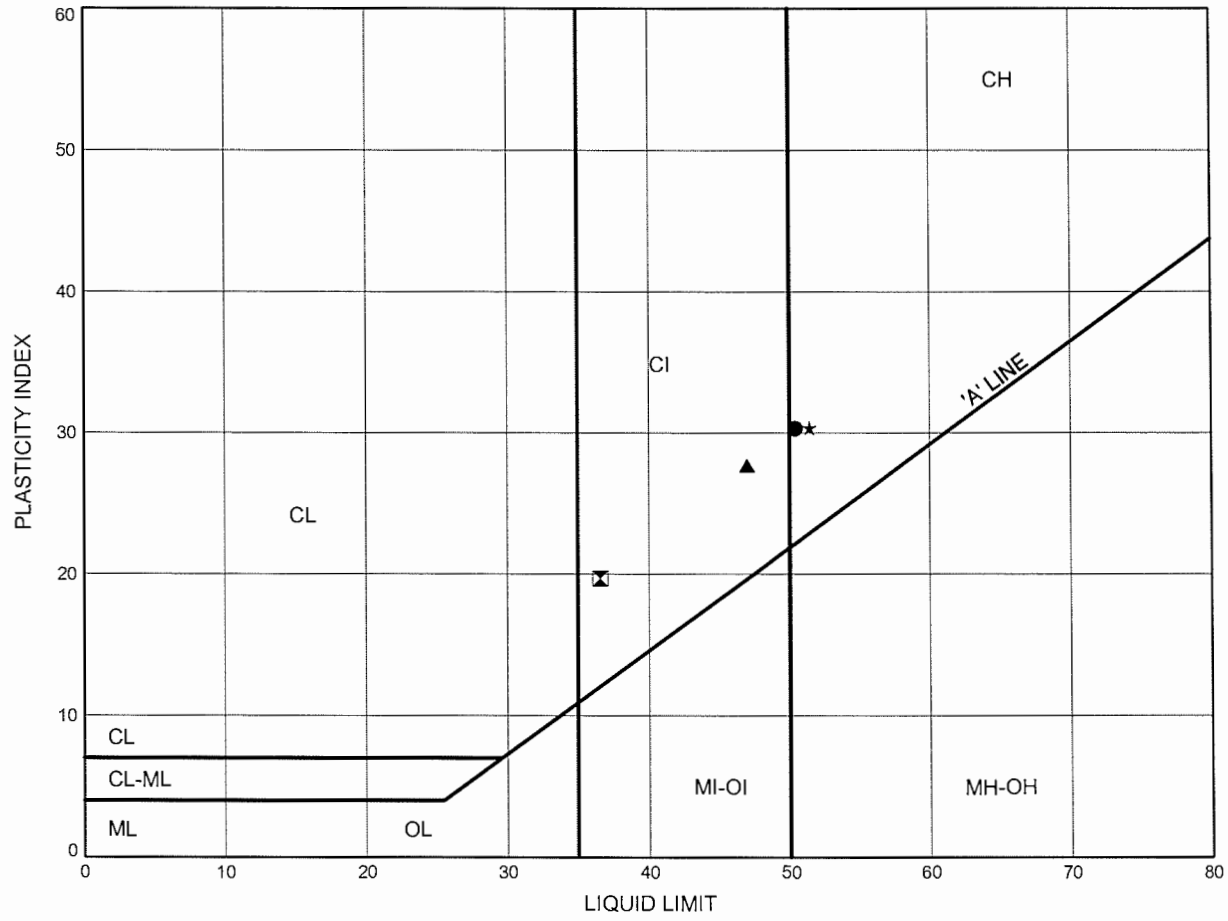
Highway 8 Widening Over Grand River

ATTERBERG LIMITS TEST RESULTS

FIGURE B7

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	9.35	297.73
⊠	06-29	6.40	301.79
▲	06-29	10.97	297.22
★	06-30	12.50	298.01

Date January 2007

Project 277-97-00

THURBER

Prep'd MFA

Chkd. MRA

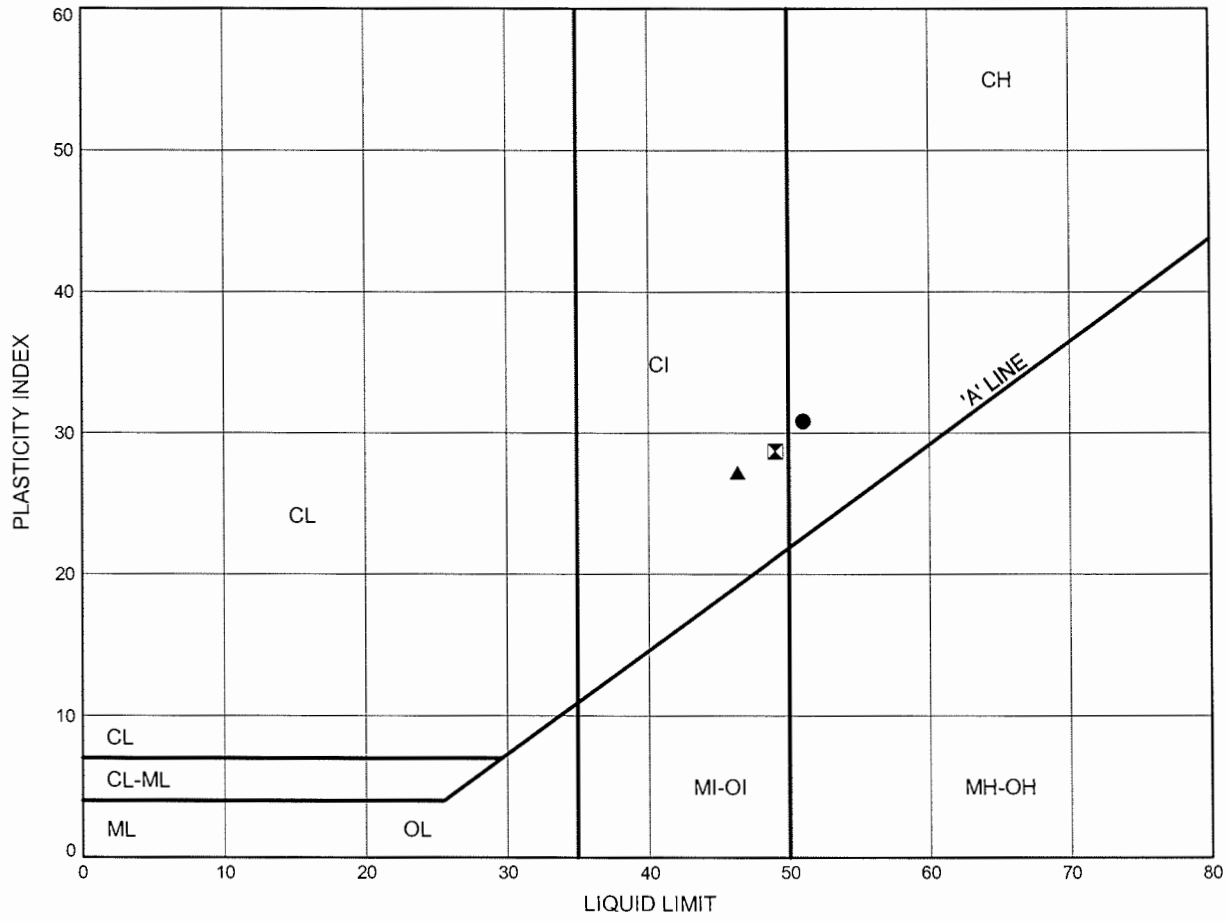
THURBALT 7938.GPJ 17/01/07

Highway 8 Widening Over Grand River

ATTERBERG LIMITS TEST RESULTS

FIGURE B8

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	12.42	297.53
⧓	06-32	12.40	296.81
▲	06-33	10.72	297.31

Date January 2007

Project 277-97-00

THURBER

Prep'd MFA

Chkd. MRA

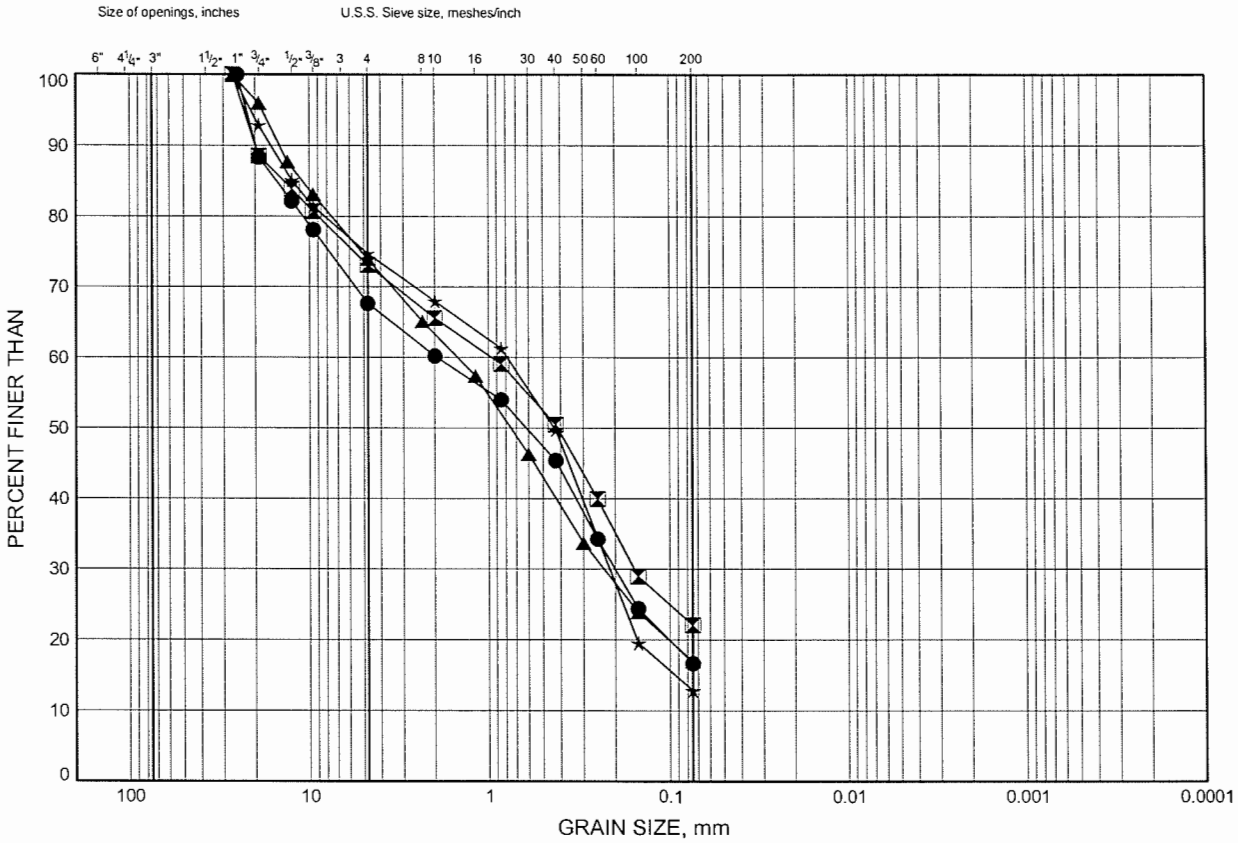
THURBALT 7938.GPJ 17/01/07

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B9

SAND FILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-42	1.83	286.57
⧓	06-43	2.59	287.30
▲	06-44	2.59	289.09
★	06-45	3.35	289.70

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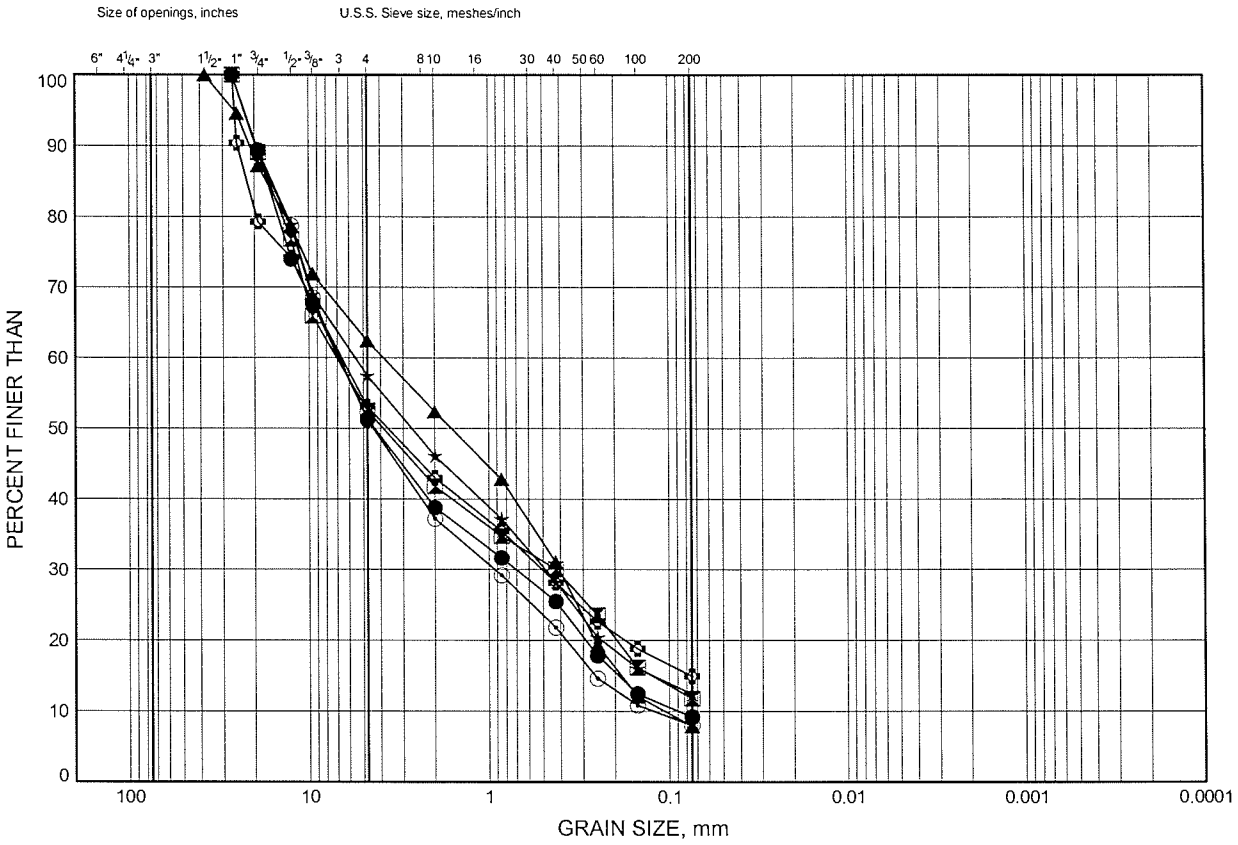
Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B10

SAND AND GRAVEL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-11	3.35	281.15
⧓	06-12	3.18	281.02
▲	06-13	2.51	281.80
★	06-34	1.83	282.63
⊙	06-35	3.28	281.13
✿	06-36	3.35	281.42

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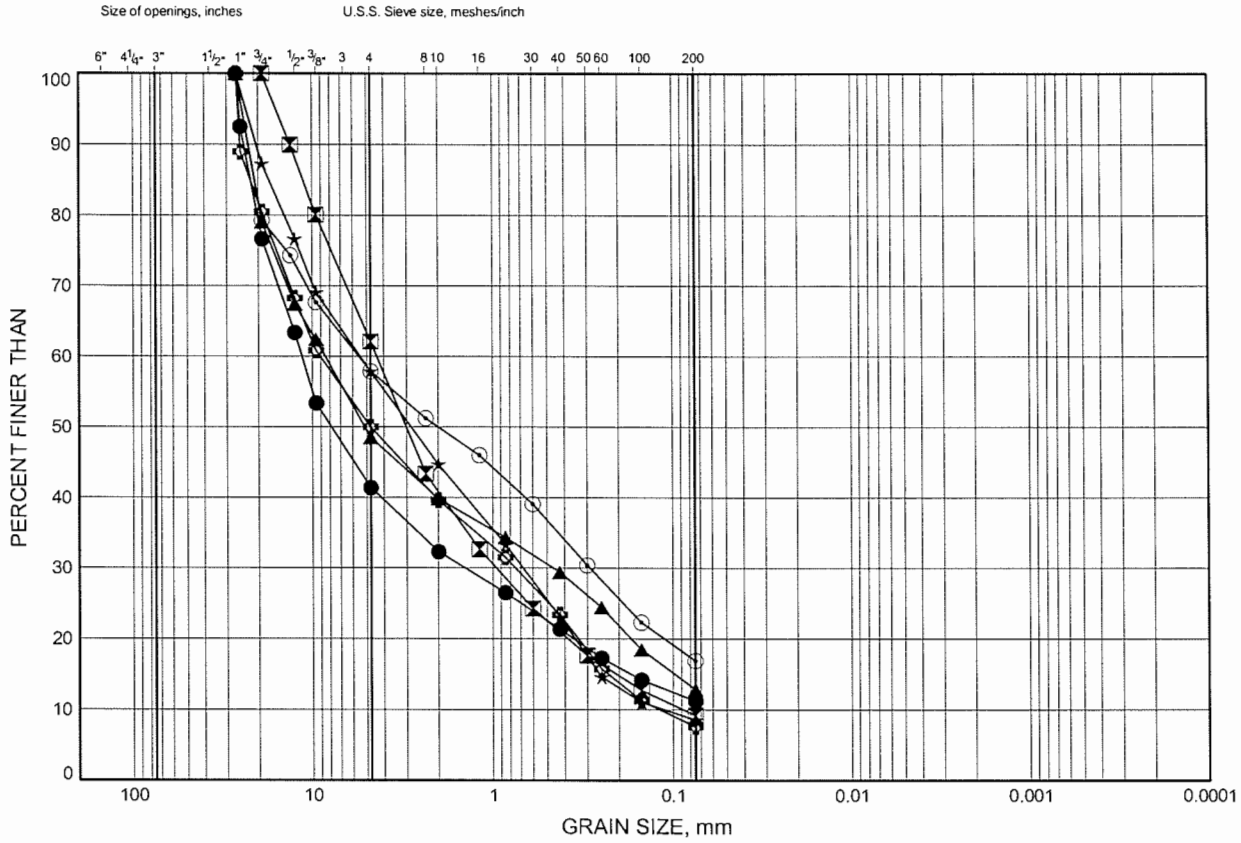
GRAIN SIZE DISTRIBUTION

FIGURE B11

SAND AND GRAVEL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	2.59	282.36
⧓	06-38	3.35	281.82
▲	06-39	1.83	283.09
★	06-40	4.80	282.38
⊙	06-41	4.88	282.59
✿	06-64	3.25	281.33

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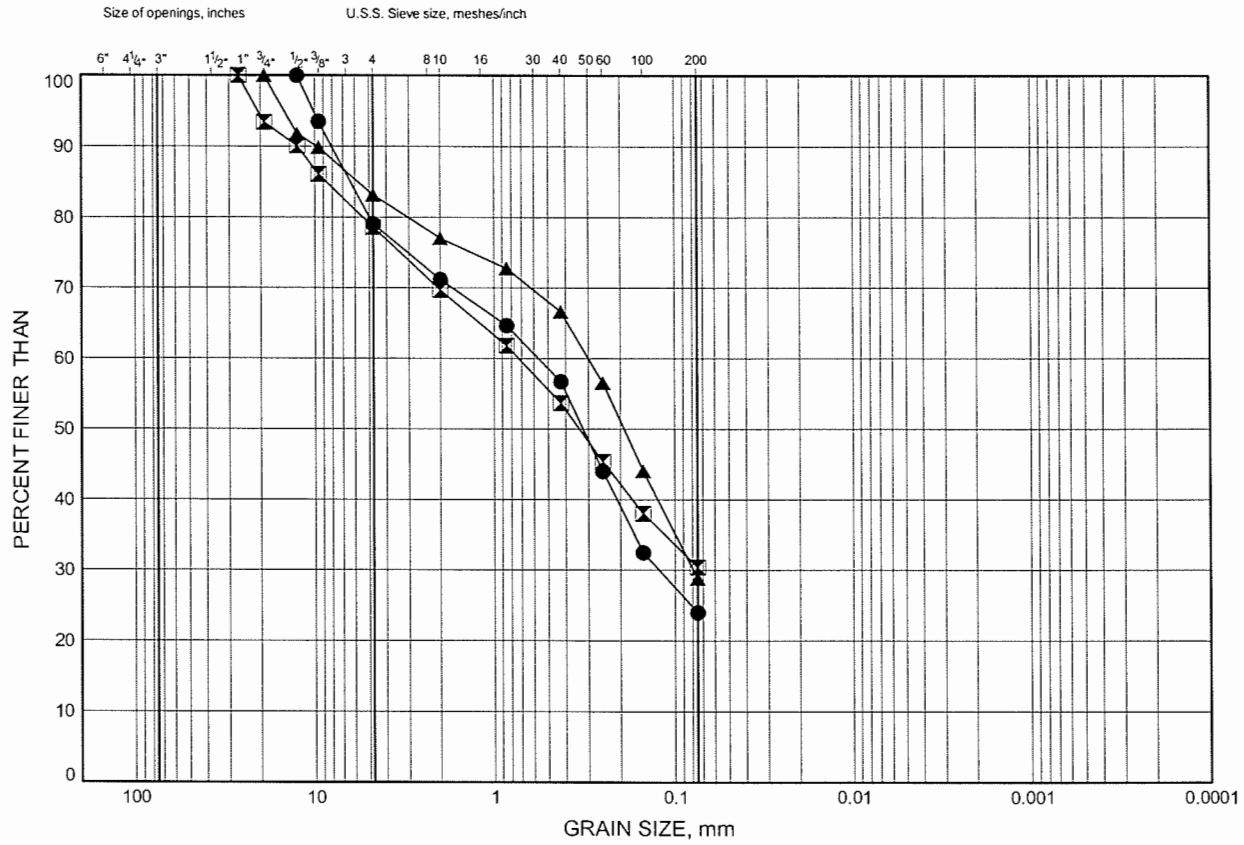
GRAIN SIZE DISTRIBUTION

FIGURE B12

SAND TO SILTY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-42	4.80	283.59
⧓	06-43	4.88	285.01
▲	06-44	6.32	285.36

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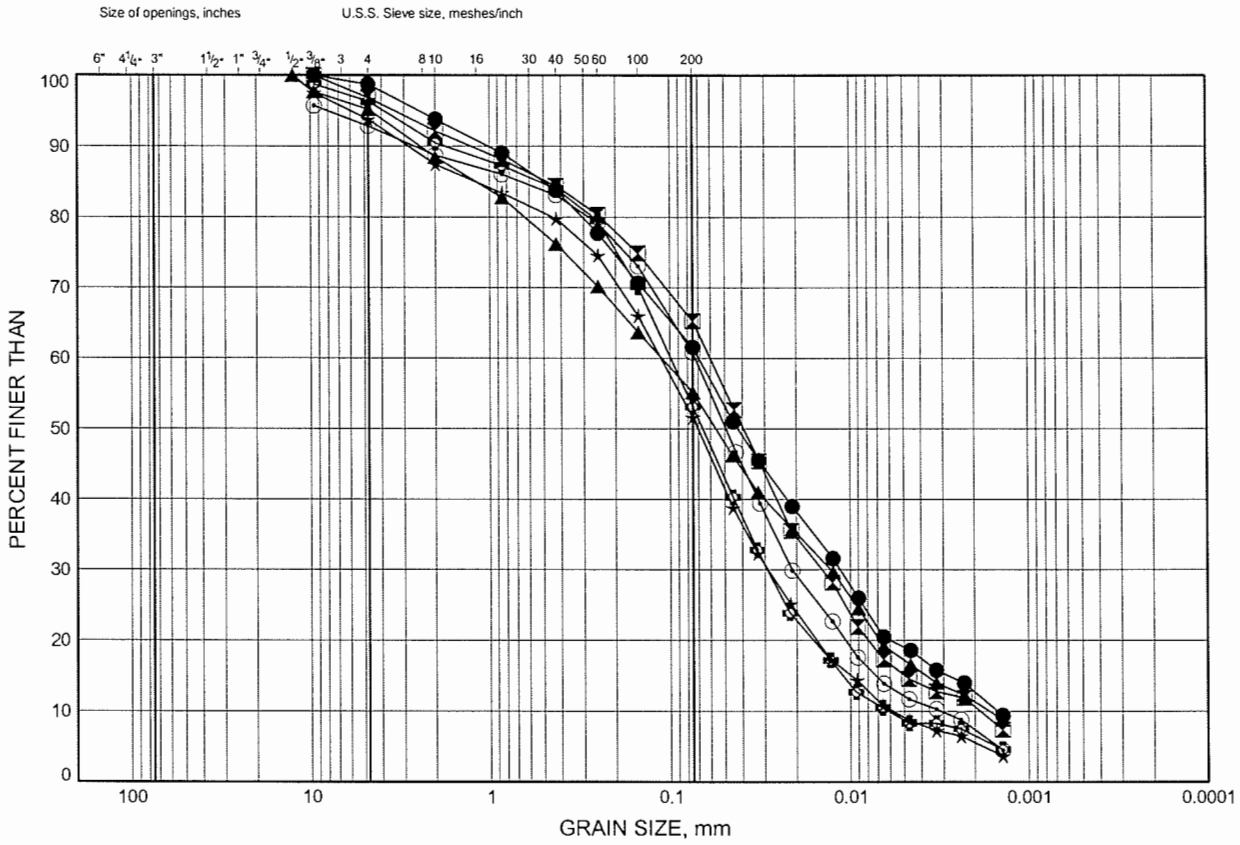
GRAIN SIZE DISTRIBUTION

FIGURE B13

SILTY SAND TO SANDY SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-11	4.88	279.63
⊠	06-12	6.22	277.97
▲	06-13	4.88	279.43
★	06-38	6.40	278.77
⊙	06-39	4.88	280.04
✿	06-73	4.88	280.25

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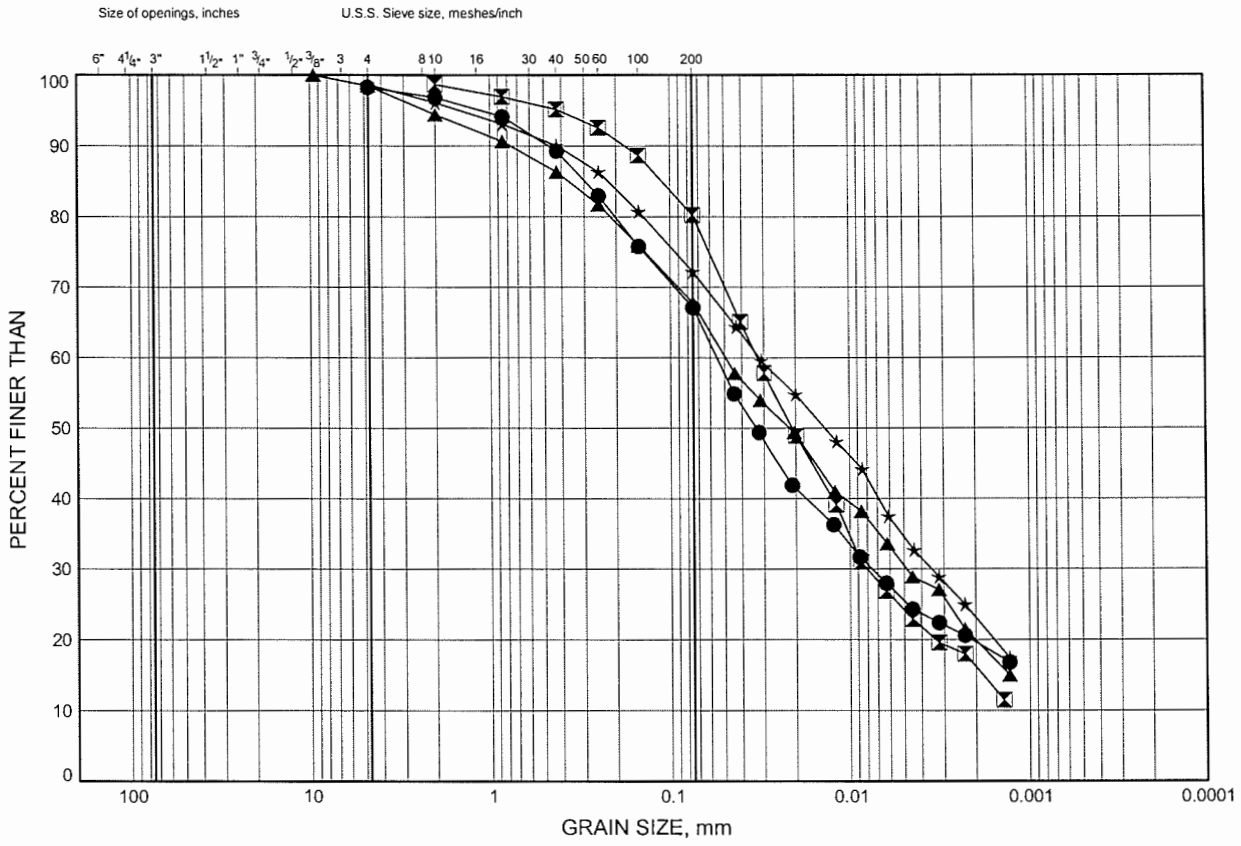
GRAIN SIZE DISTRIBUTION

FIGURE B14

CLAYEY SILT TO SANDY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	6.40	278.55
⧓	06-40	7.82	279.35
▲	06-41	6.40	281.07
★	06-45	9.41	283.65

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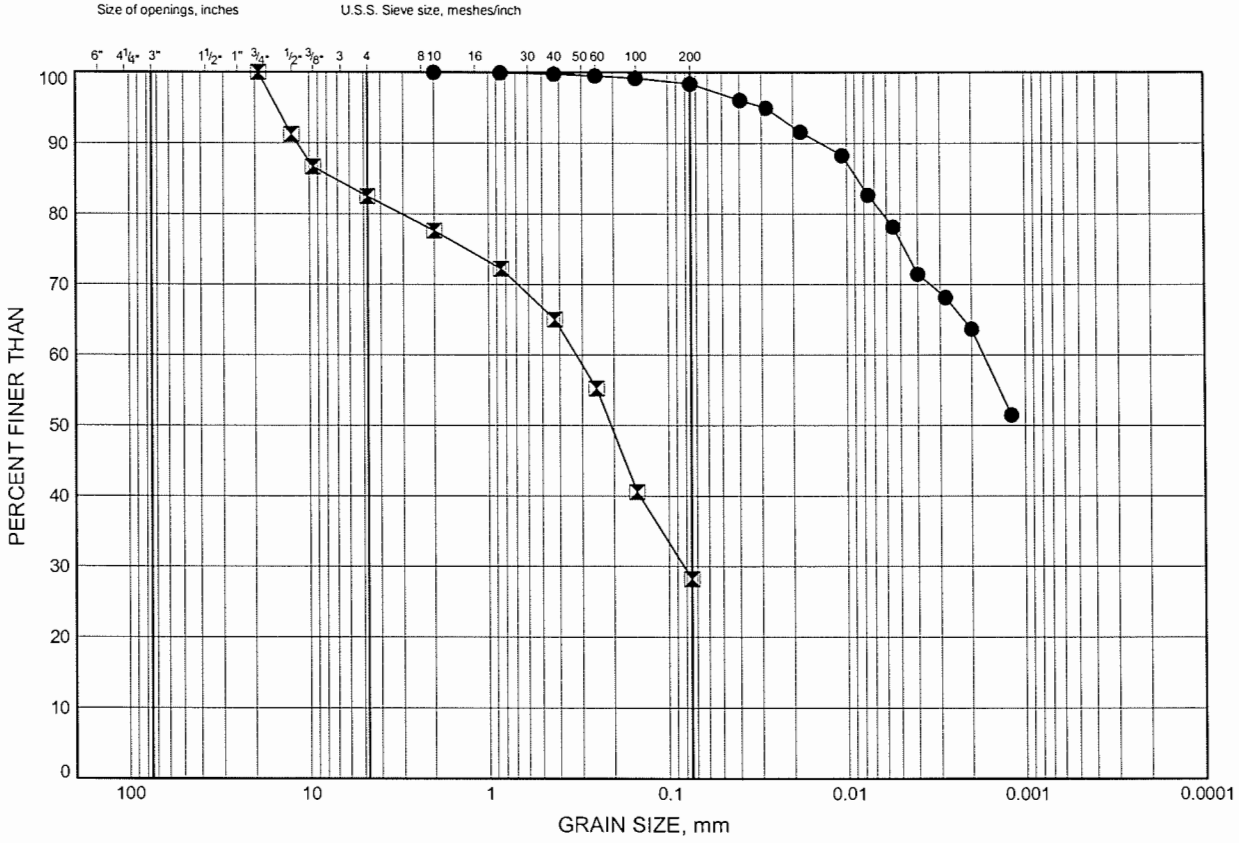
GRAIN SIZE DISTRIBUTION

FIGURE B15

SILTY CLAY, SILTY SAND TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-46	1.83	293.49
⧓	06-46	4.83	290.49

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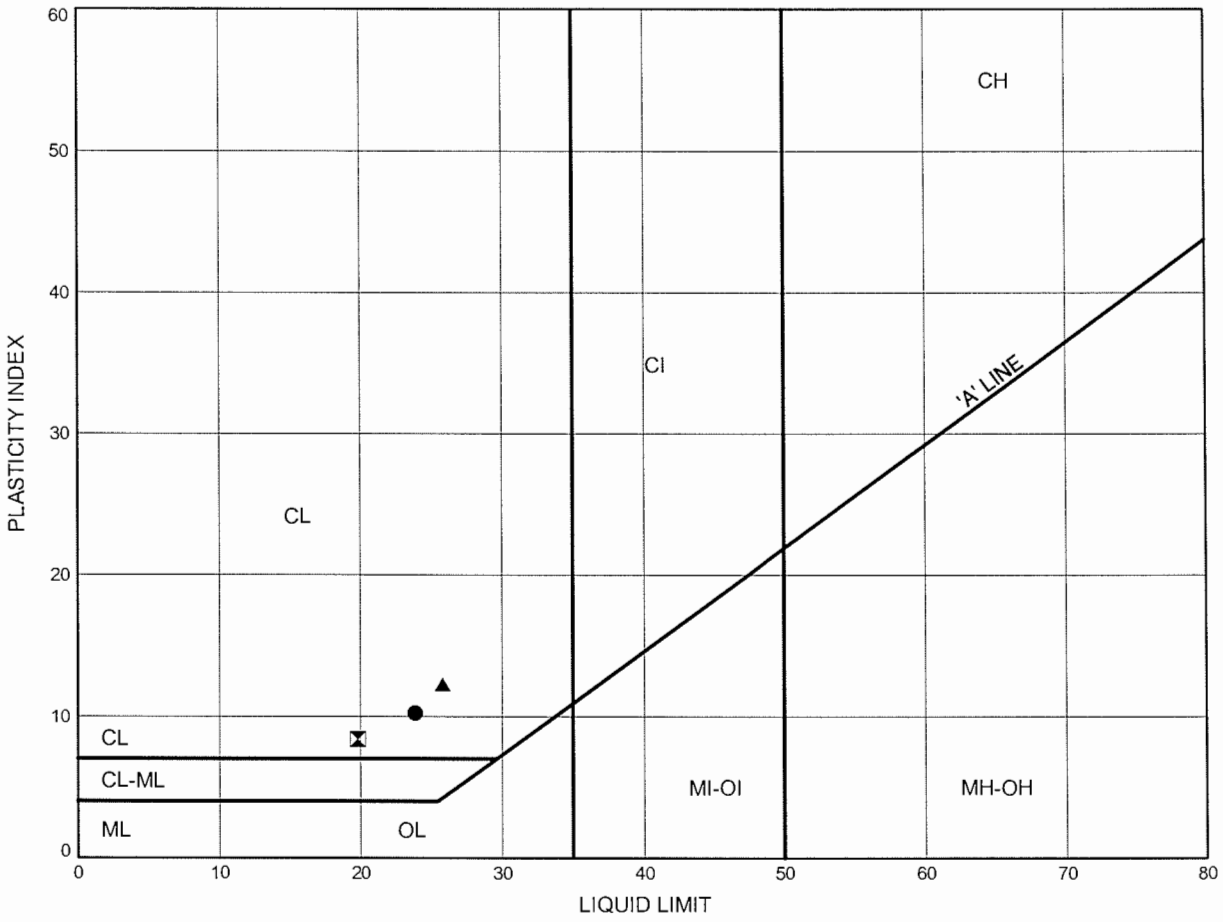
Highway 8 Widening Over Grand River

ATTERBERG LIMITS TEST RESULTS

FIGURE B16

SANDY SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	6.40	278.55
⊠	06-41	6.40	281.07
▲	06-45	9.41	283.65

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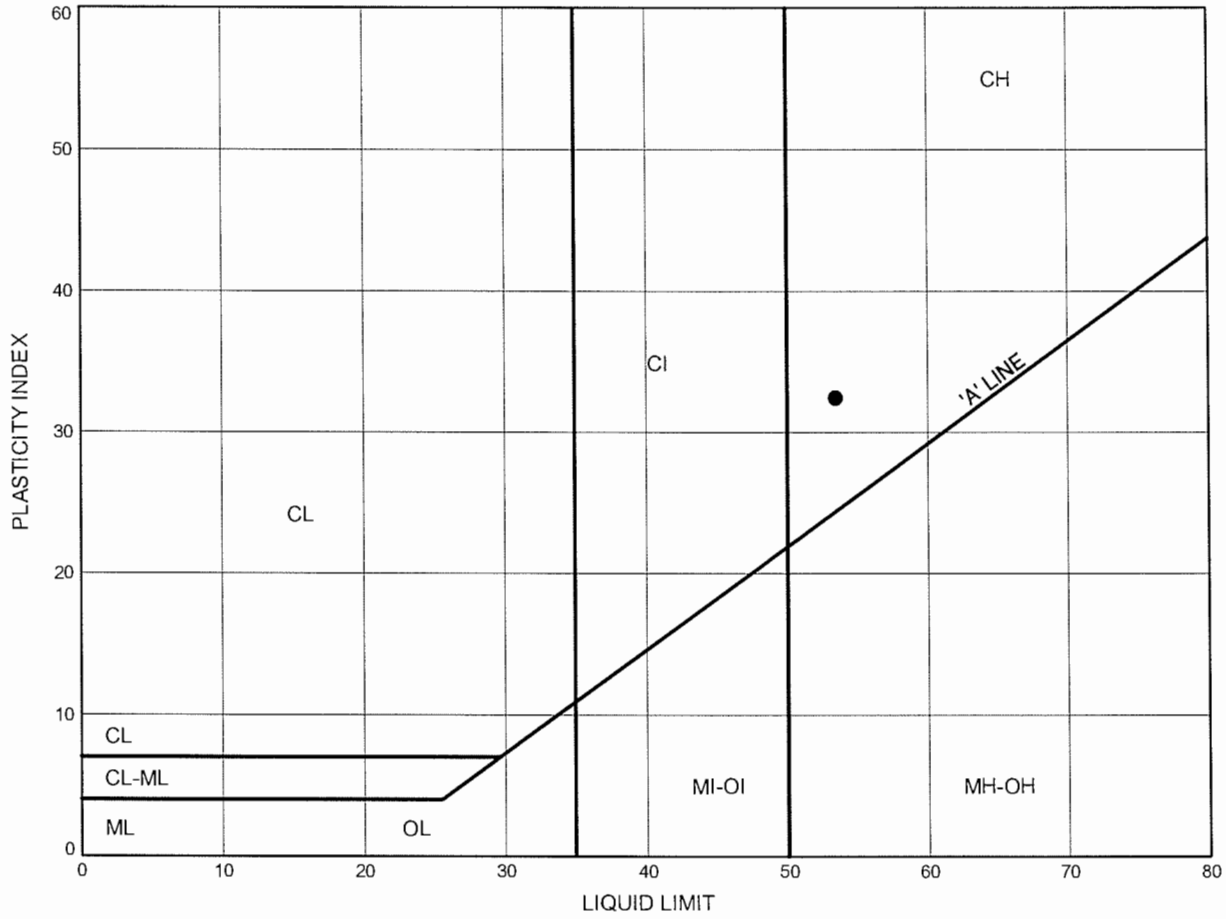
Highway 8 Widening Over Grand River

ATTERBERG LIMITS TEST RESULTS

FIGURE B17

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-46	1.83	293.49

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Appendix C

Tables and Figures

TABLE C1 – BOREHOLE COMPLETION DETAILS

Borehole	Piezometer Tip (Sand Filter) Details			Backfill
	Depth	Elevation	Stratum	
06-11	14.0 – 12.2	270.5 - 272.3	Gravelly sand	Bentonite seal to 11.6 m, grout to surface
06-12	-	-	-	Bentonite grout to ground surface
06-13	-	-	-	Bentonite grout to ground surface
06-28	12.0 – 9.6	295.1 – 297.5	Silty clay till, sandy silt till	Bentonite seal to 8.9 m, grout to 1.2 m, cuttings to surface
06-29	19.9 – 17.7	288.3 – 290.5	Silt and sand till	Bentonite seal to 17.2 m, grout to 1.2 m, cuttings to surface
06-30	19.8 – 18.0	290.7 – 292.5	Silt and sand till	Bentonite seal to 17.2 m, grout to surface
06-31	19.9 – 17.8	290.1 – 292.2	Silty sand till	Bentonite seal to 17.3 m, grout to 0.9 m, cuttings to 0.6 m, bentonite to surface
06-32	19.9 – 17.8	289.3 – 291.4	Sandy silt till	Bentonite seal to 17.1 m, grout to 0.9 m, bentonite to 0.3 m, cuttings to surface
06-33	20.1 – 18.1	287.9 – 289.9	Silt and sand till	Bentonite seal to 17.0 m, grout to 0.9 m, cuttings to surface
06-34	-	-	-	Bentonite seal to 2.1 m, cuttings to surface
06-35	-	-	-	Bentonite grout to ground surface
06-36	-	-	-	Bentonite grout to ground surface
06-37	-	-	-	Bentonite grout to ground surface
06-38	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-39	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-40	7.9 – 6.0	279.3 – 281.2	Sandy silt till, clayey silt till	Bentonite seal to 5.3 m, grout to 0.3 m, bentonite to surface
06-41	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-42	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-43	5.7 – 4.0	284.2 - 285.9	Silty sand	Bentonite seal to 3.7 m, grout to 0.3 m, bentonite to surface
06-44	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-45	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-46	5.0 – 2.7	290.3 - 292.6	Sandy silty clay till, silty sand till	Bentonite seal to 2.1 m, grout to surface
06-64	9.1 – 7.0	275.5 – 277.6	Sand	Bentonite seal to 6.6 m, grout to 0.3 m, bentonite to surface
06-73	5.9 – 3.8	279.2 – 281.3	Silt and sand till	Bentonite grout to ground surface

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand	20	0	30	0
Sand	20	0	32	0
Silty Clay Till	20	100	0	0
Sandy Silt Till	21	0	33	0
Silty Clay Till	20	100	0	0
Sandy Silt Till	21	0	34	1

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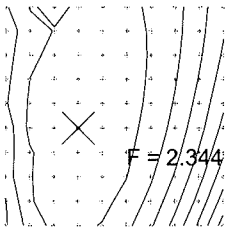

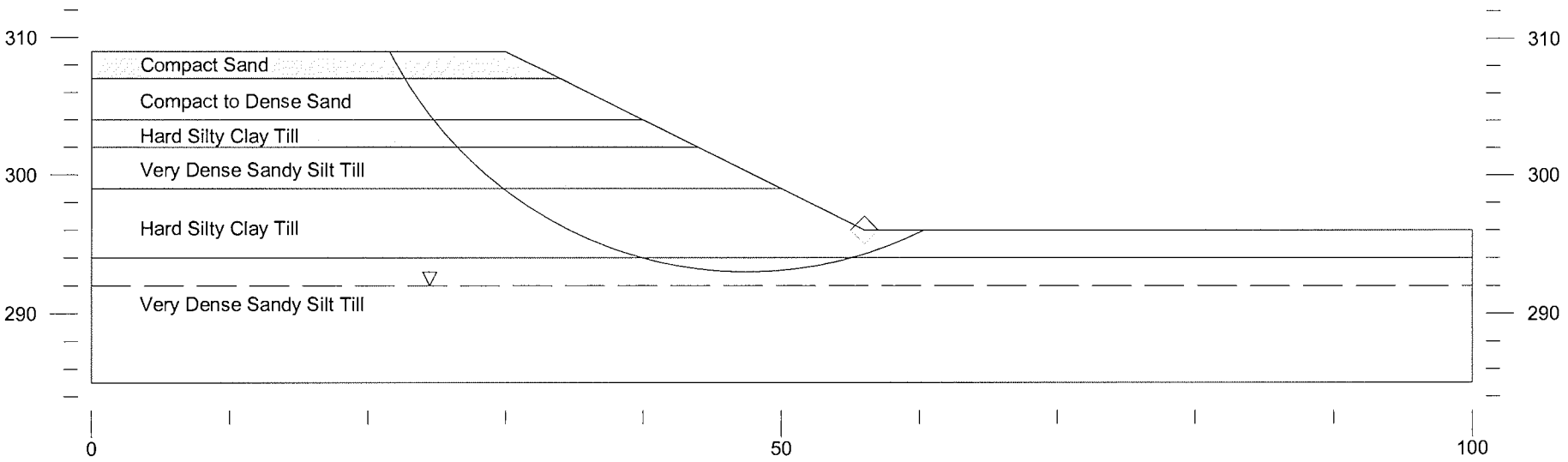

Figure C1

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand	20	0	30	0
Sand	20	0	32	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	33	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	34	1

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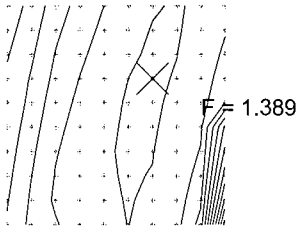

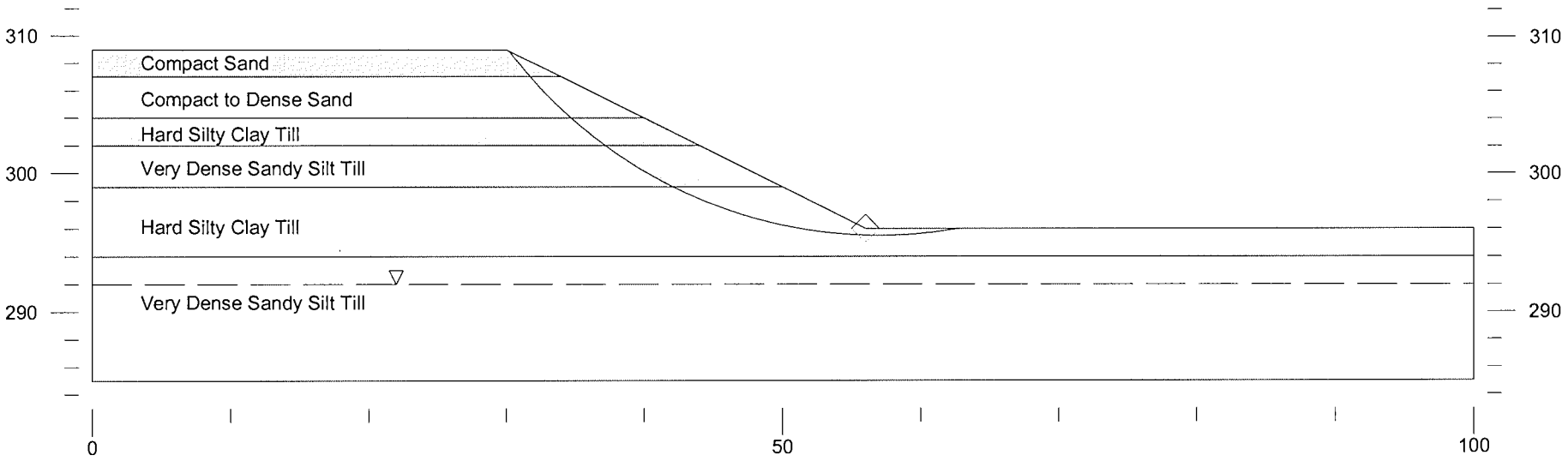

Figure C2

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand	20	0	30	0
Sand	20	0	32	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	33	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	34	1

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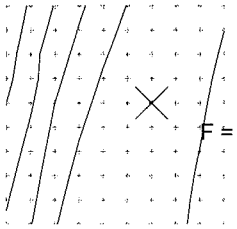
Long Term Sta 13+600



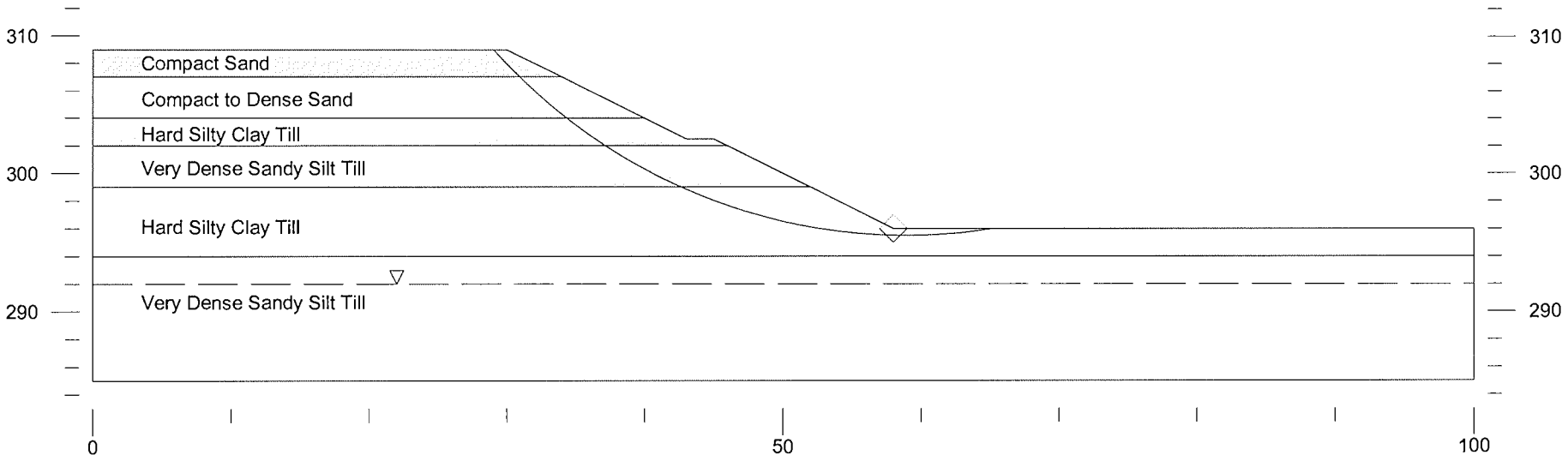


Figure C3

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand	20	0	30	0
Sand	20	0	32	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	33	0
Silty Clay Till	20	0	30	0
Sandy Silt Till	21	0	34	1

Seismic coefficient = 0.08

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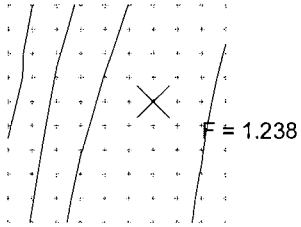

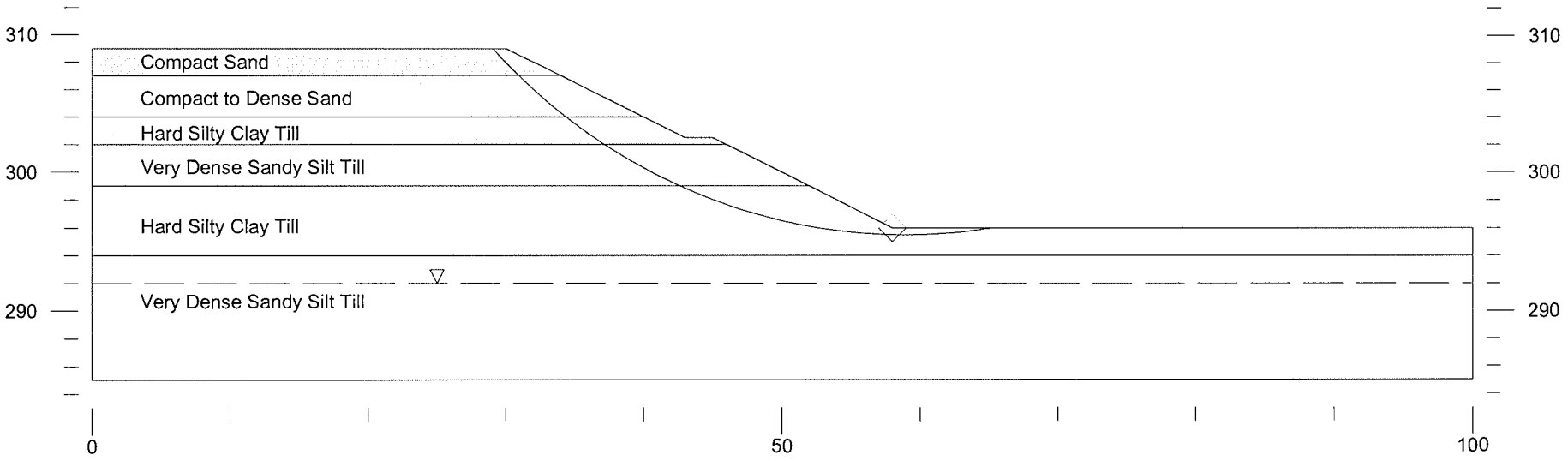

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Figure C4

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Earth Fill	21	0	30	0
Alluvium	18	20	0	1
Sand and Gravel	21	0	32	1
Silt/Sand Till	21	0	34	1

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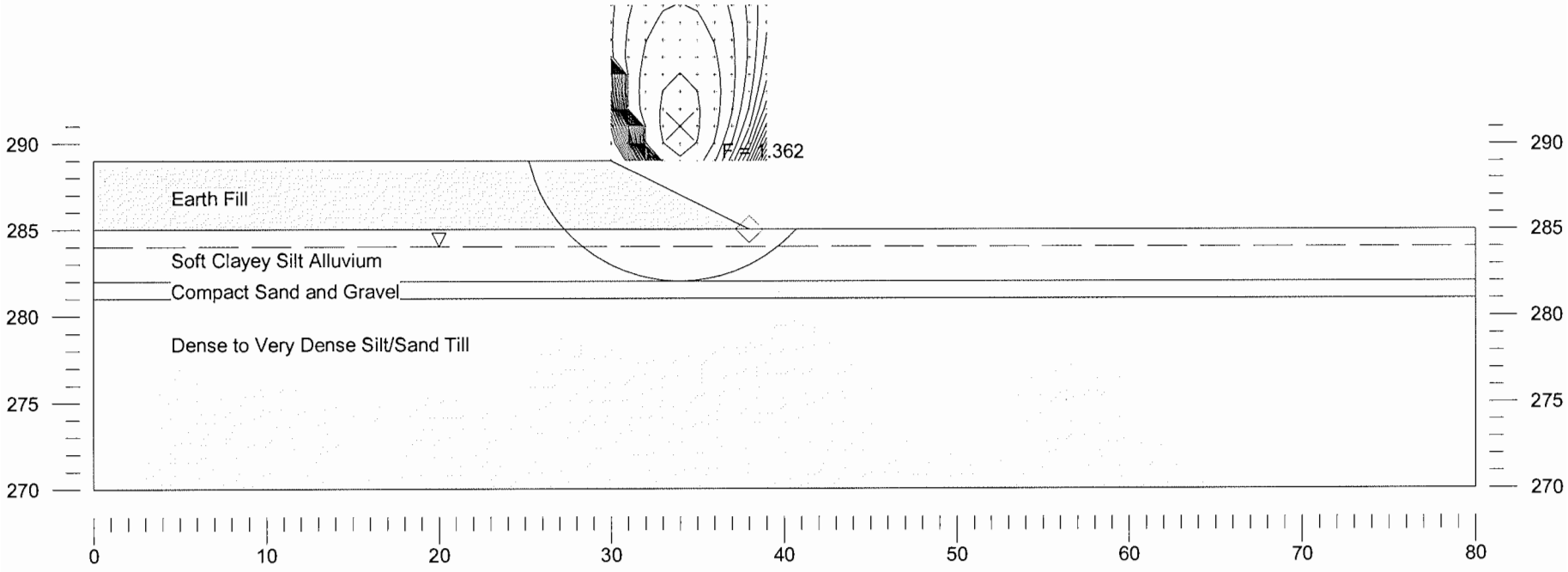

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Figure C5

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Earth Fill	21	0	30	0
Alluvium	18	0	26	1
Sand and Gravel	21	0	32	1
Silt/Sand Till	21	0	34	1

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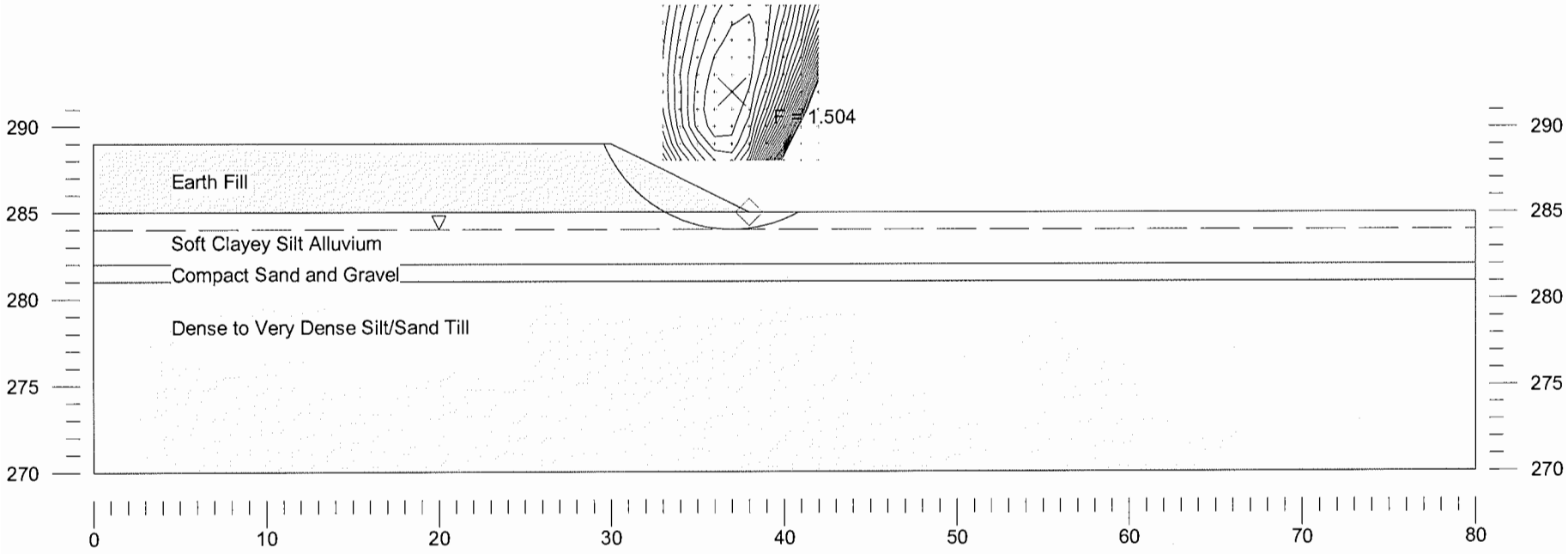

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Figure C6

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Earth Fill	21	0	30	0
Alluvium	18	0	26	1
Sand and Gravel	21	0	32	1
Silt/Sand Till	21	0	34	1

Seismic coefficient = 0.08

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Fill Embankment 2H:1V
Long Term Seismic Sta 14+060

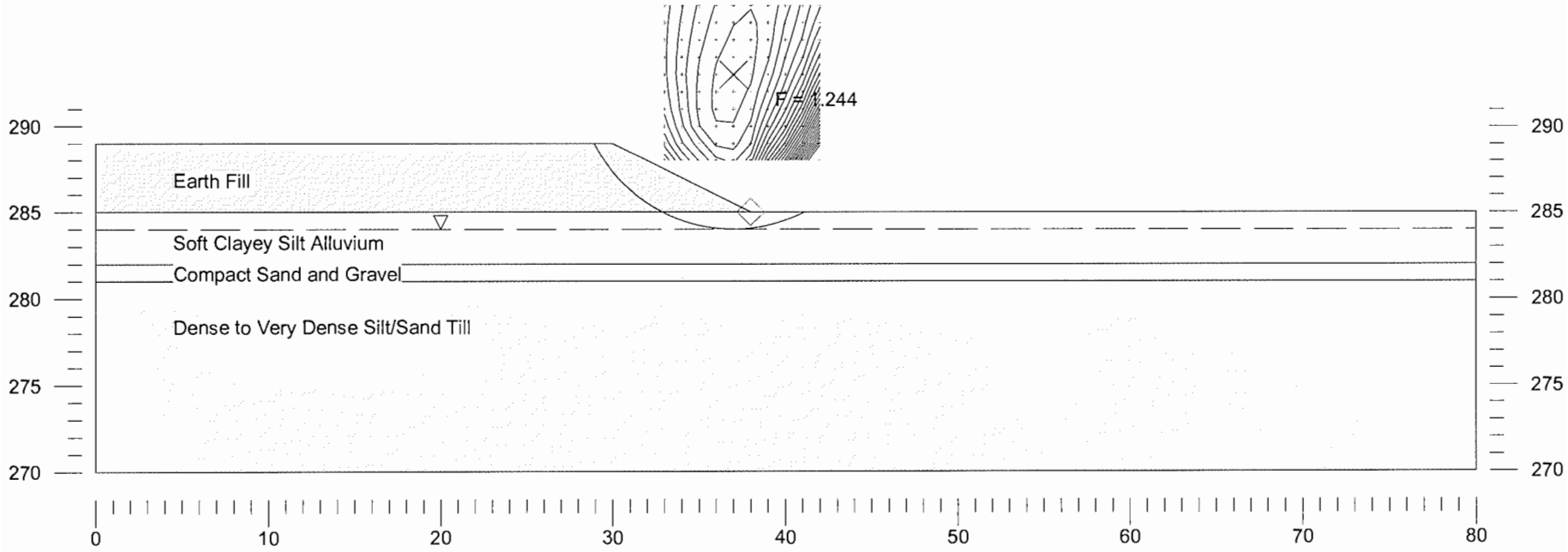

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Figure C7

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand Fill	21	0	30	0
Sand Fill	20	0	29	0
Sand	21	0	33	1
Silty Clay Till	21	100	0	1

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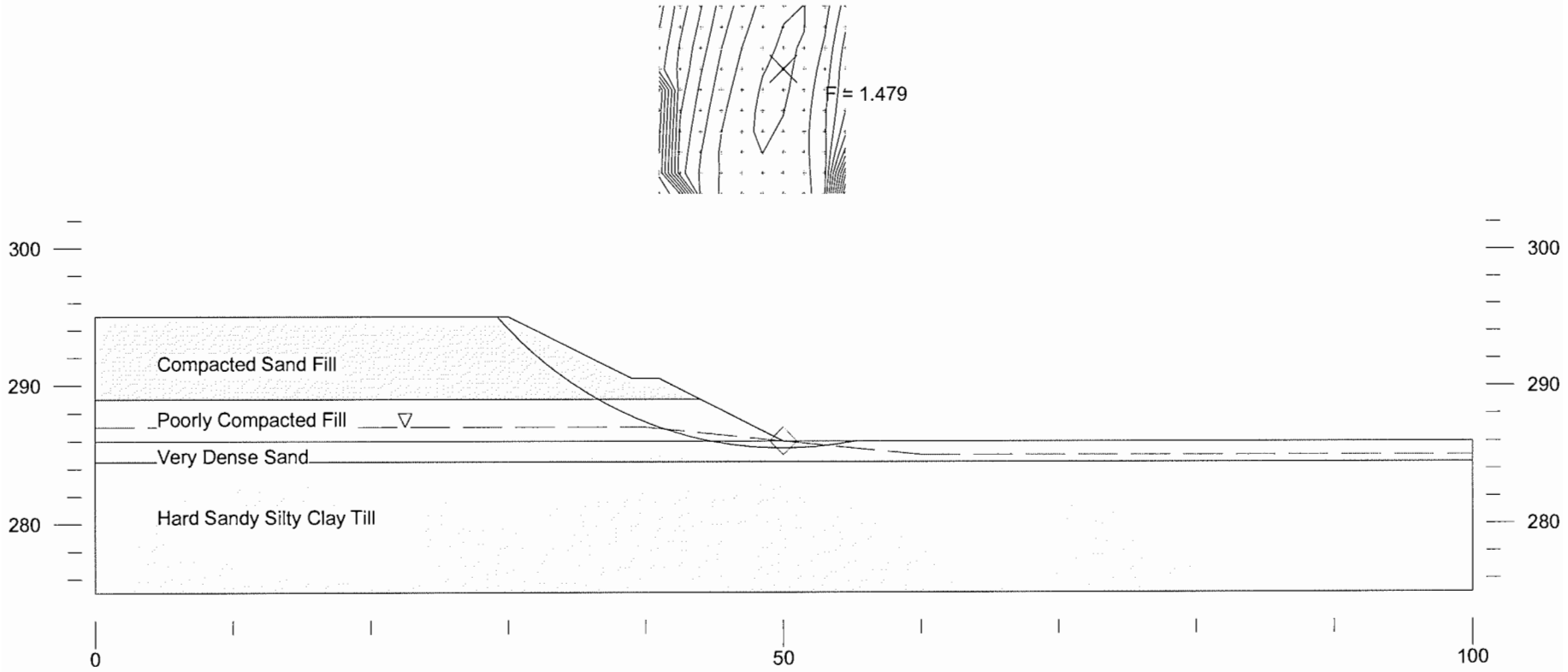

Figure C8

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand Fill	21	0	30	0
Sand Fill	20	0	29	0
Sand	21	0	33	1
Silty Clay Till	21	0	30	1

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Fill Embankment 2H:1V
Long Term Sta 14+450

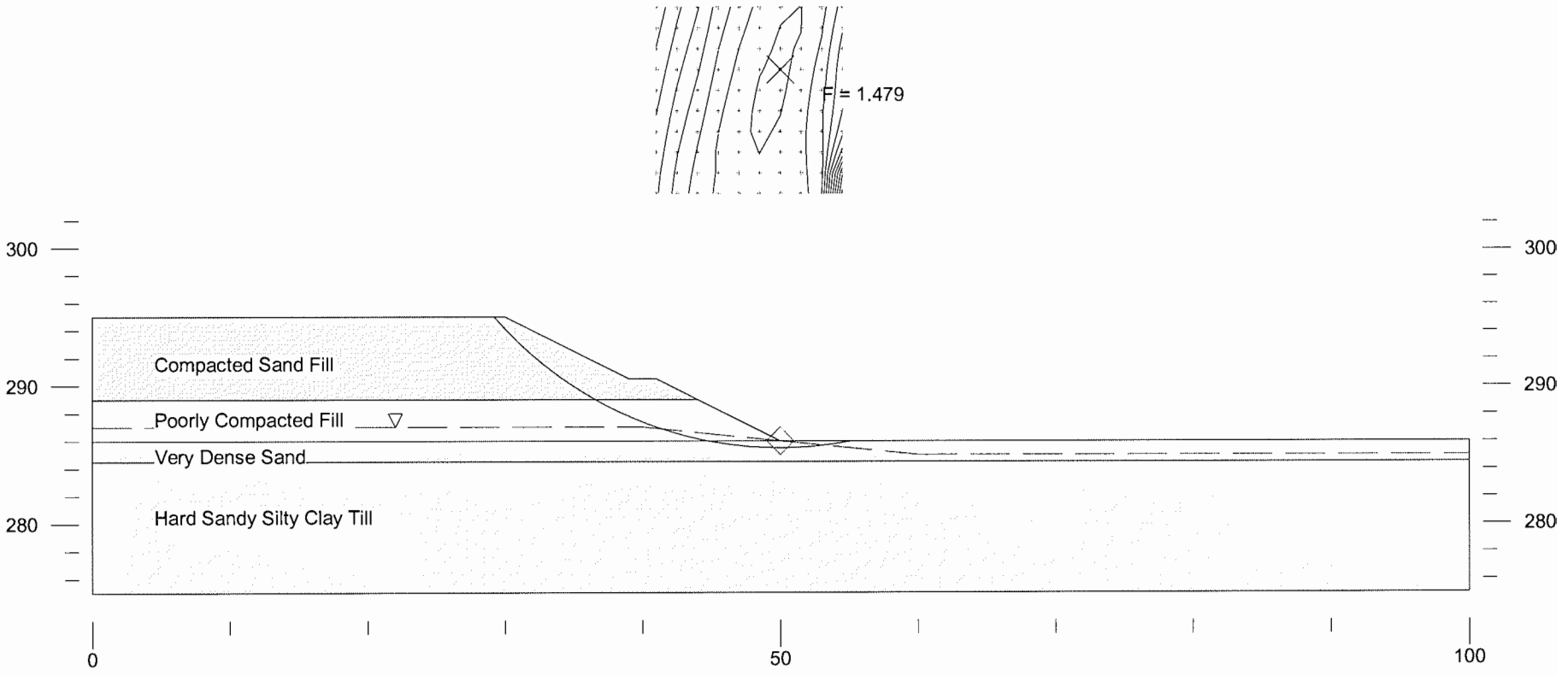

Figure C9

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Sand Fill	21	0	30	0
Sand Fill	20	0	29	0
Sand	21	0	33	1
Silty Clay Till	21	0	30	1

Seismic coefficient = 0.08

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Fill Embankment 2H:1V
Long Term Seismic Sta 14+450

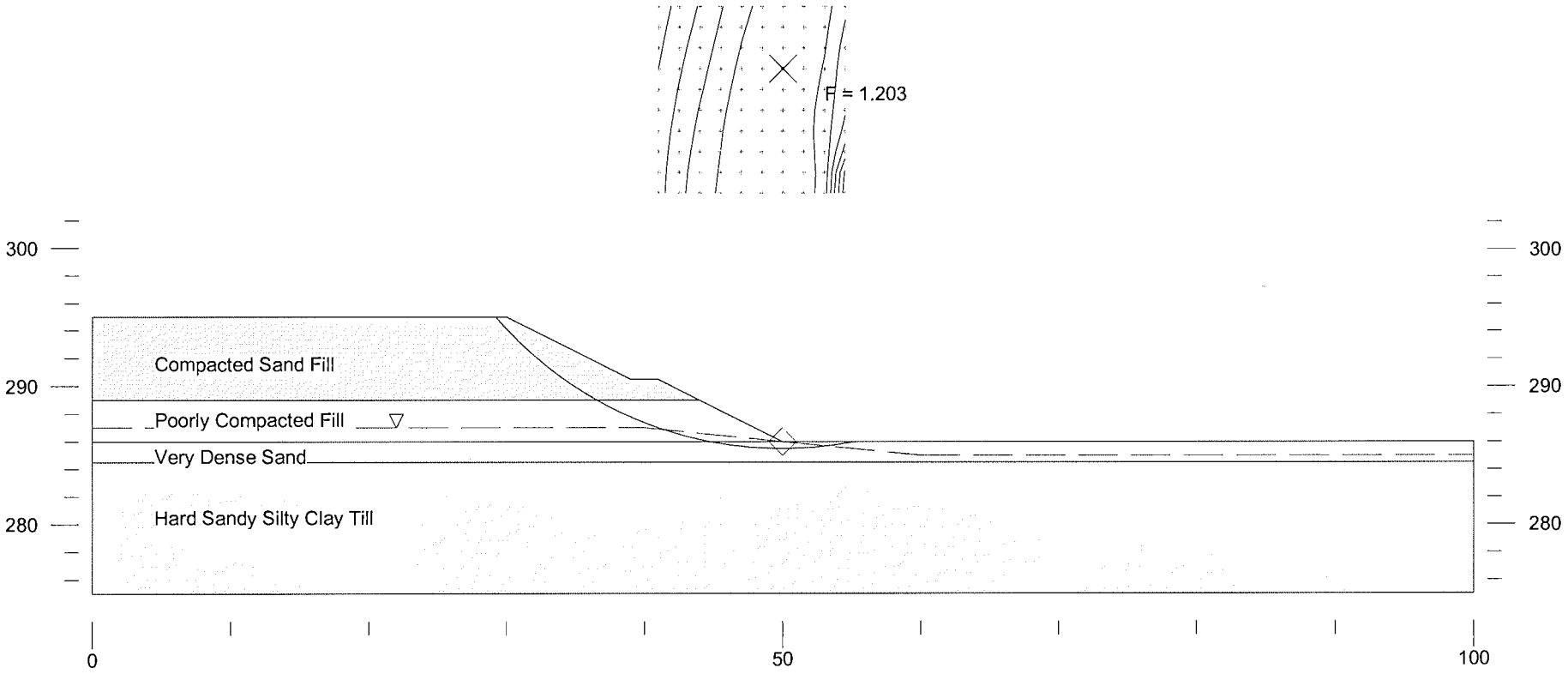
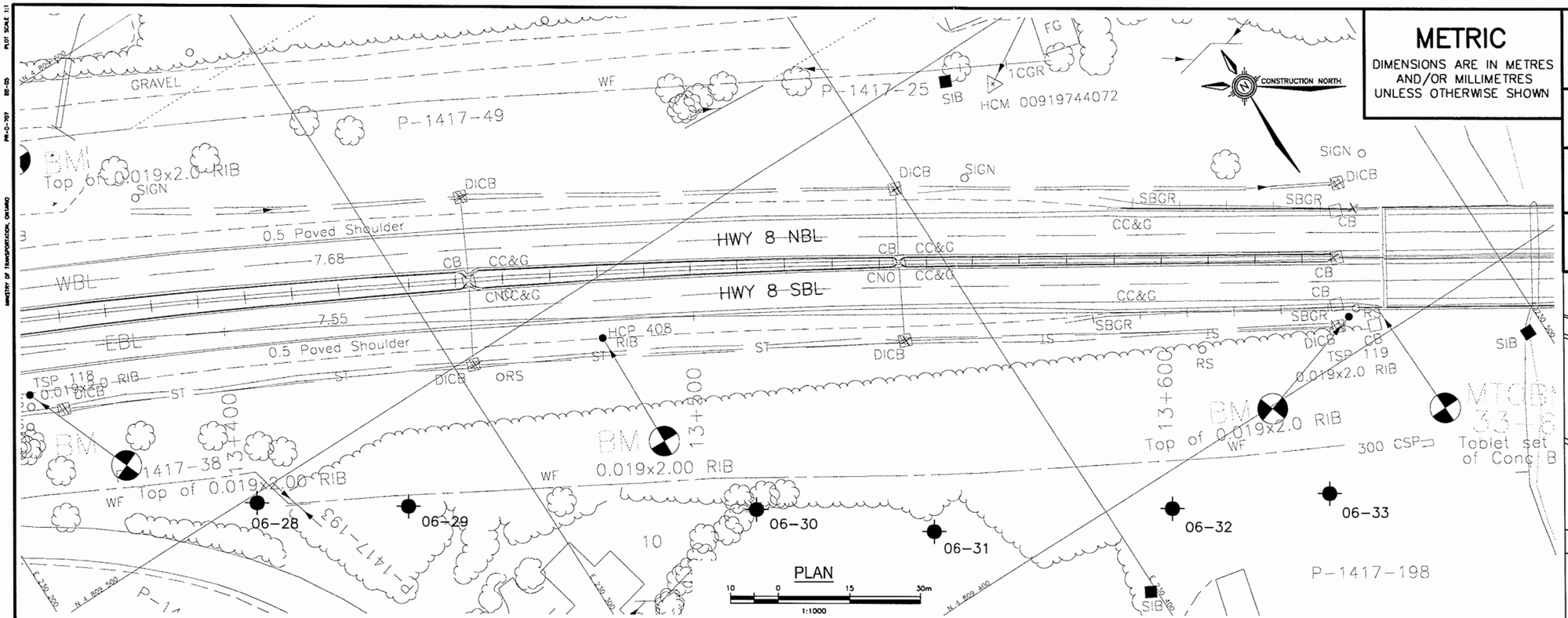


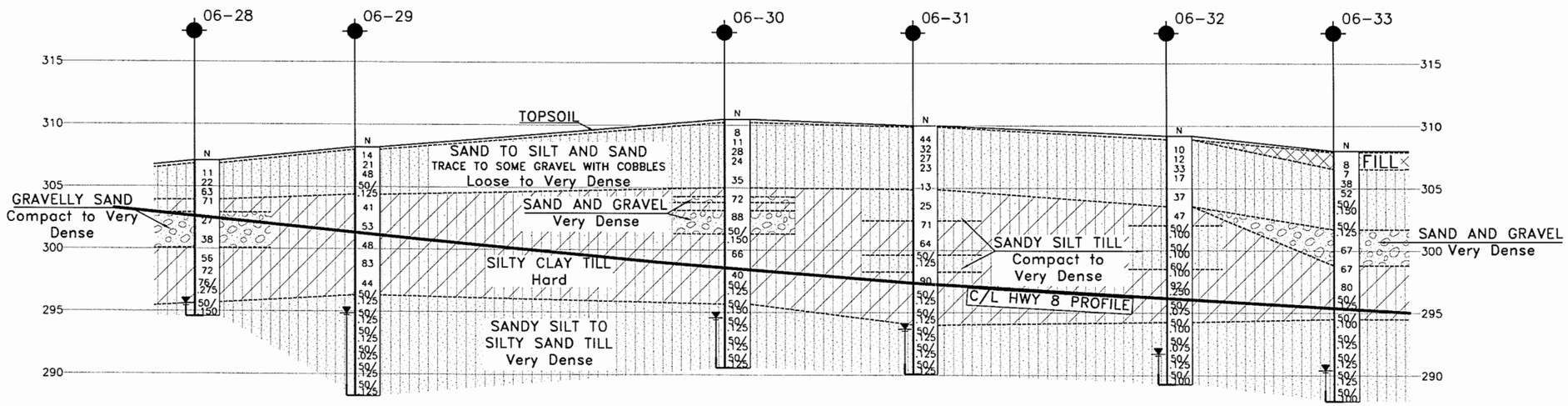
Figure C10

Appendix D

Drawings

Borehole Locations and Soil Strata





METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
GWP No.277-97-00

SHEET

DEEP CUT
HWY 8 WIDENING
KITCHENER
BOREHOLE LOCATIONS AND SOIL STRATA

MORRISON HERSHFIELD

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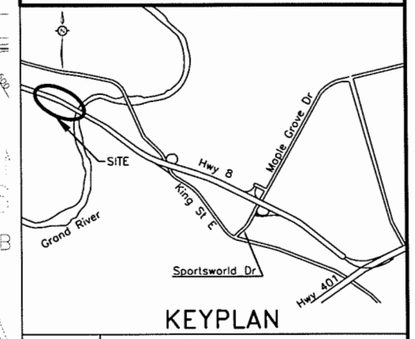

KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
06-28	307.1	4 809 498.2	230 248.8
06-29	308.2	4 809 480.4	230 275.7
06-30	310.5	4 809 440.1	230 337.9
06-31	310.0	4 809 416.0	230 366.9
06-32	309.2	4 809 393.0	230 412.3
06-33	308.0	4 809 377.7	230 442.3

-NOTES-

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

GEOCRES No. 40P8-148

LICENSED PROFESSIONAL ENGINEER
M. R. ANDERSON
June 27/07
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
June 27/07
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	MRA	CHK	PKC	CODE	LOAD
DRAWN	MFA	CHK	PKC	SITE	STRUCT

DATE JAN 2007
DWG 1

PLOT SCALE 1:1
PLOT DATE: Jun 26, 2007 - 4:50pm
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MINISTRY OF TRANSPORTATION, ONTARIO
MODIFIED:
DRAWING NAME: TED79381DeepCut.dwg
CREATED: JAN 07

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

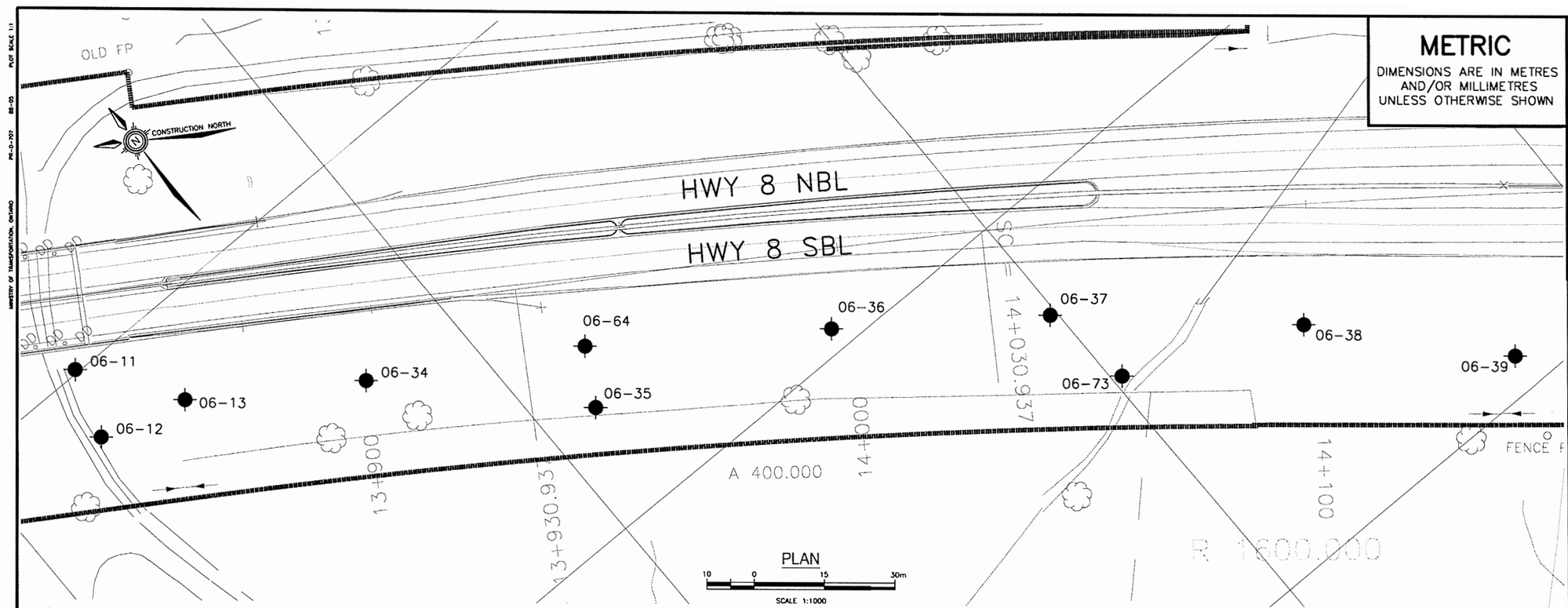
CONT No
GWP No 277-97-00

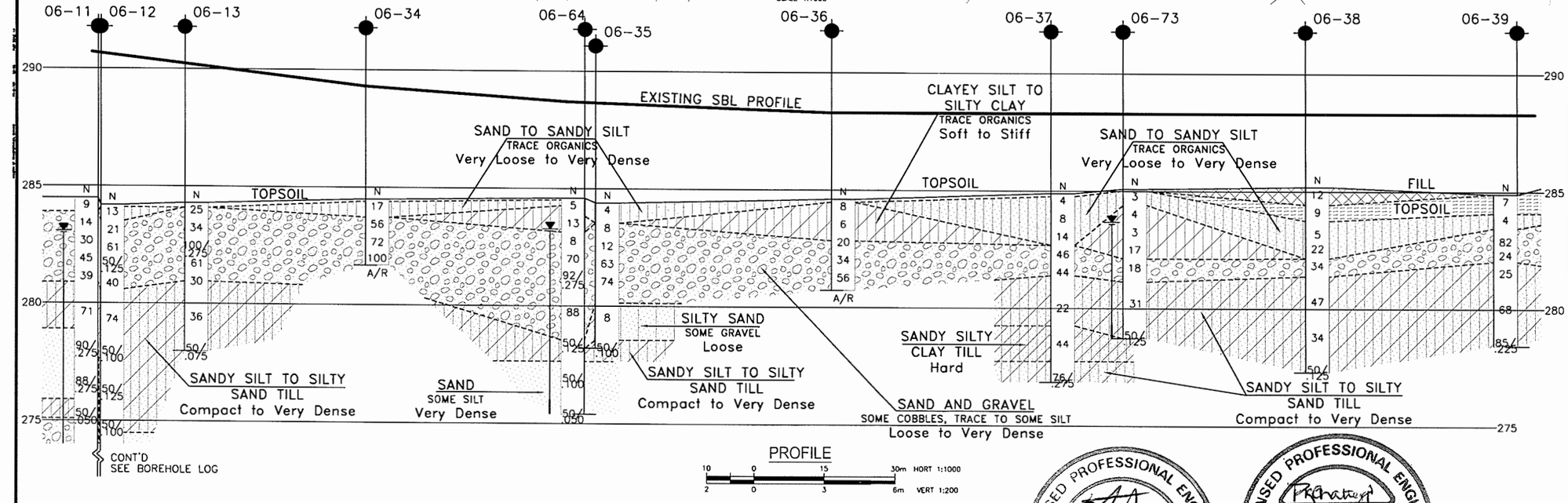
SHEET

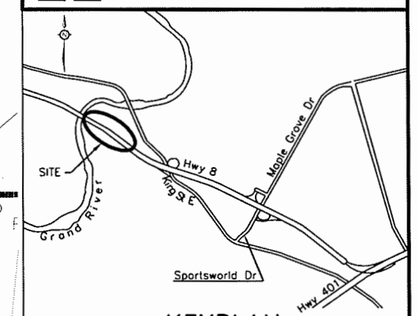
HIGH FILL
HWY 8 WIDENING
STA. 13+859 TO 14+150
BOREHOLE LOCATIONS AND SOIL STRATA

MORRISON HERSHFIELD

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS







KEYPLAN

LEGEND

	BoreHole
	BoreHole and Cone
	BoreHole from Previous Investigation (Approximate)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesion Water Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusol

NO	ELEVATION	NORTHING	EASTING
06-11	284.5	4 809 300.8	230 631.3
06-12	284.2	4 809 286.2	230 626.4
06-13	284.3	4 809 280.9	230 645.4
06-34	284.5	4 809 259.4	230 677.7
06-35	284.4	4 809 223.9	230 711.7
06-36	284.8	4 809 204.8	230 761.0
06-37	284.9	4 809 177.3	230 798.6
06-38	285.2	4 809 141.3	230 838.7
06-39	284.9	4 809 107.5	230 869.0
06-64	284.6	4 809 235.3	230 718.4
06-73	285.1	4 809 157.6	230 802.1

-NOTES-

1) The boundaries between soil stroto hove been estoblished only ot Borehole locotions. Between Boreholes the boundories ore ossumed from geologicol evidence.
2) This drawing is for subsurface information only. Surface detoils and features are for conceptual illustration.

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	MRA	CHK PKC	CODE	LOAD	DATE JAN 2007
DRAWN	JHL	CHK PKC	SITE	STRUCT	DWG 2

MINISTRY OF TRANSPORTATION, ONTARIO PR-0-707 88-05 PLOT SCALE 1:1

FILENAME: G:\Jobs Files\1\1479\38 Hwy 8\TE07938 Highfill.dwg
PLOTDATE: June 26, 2007 - 4:36pm

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

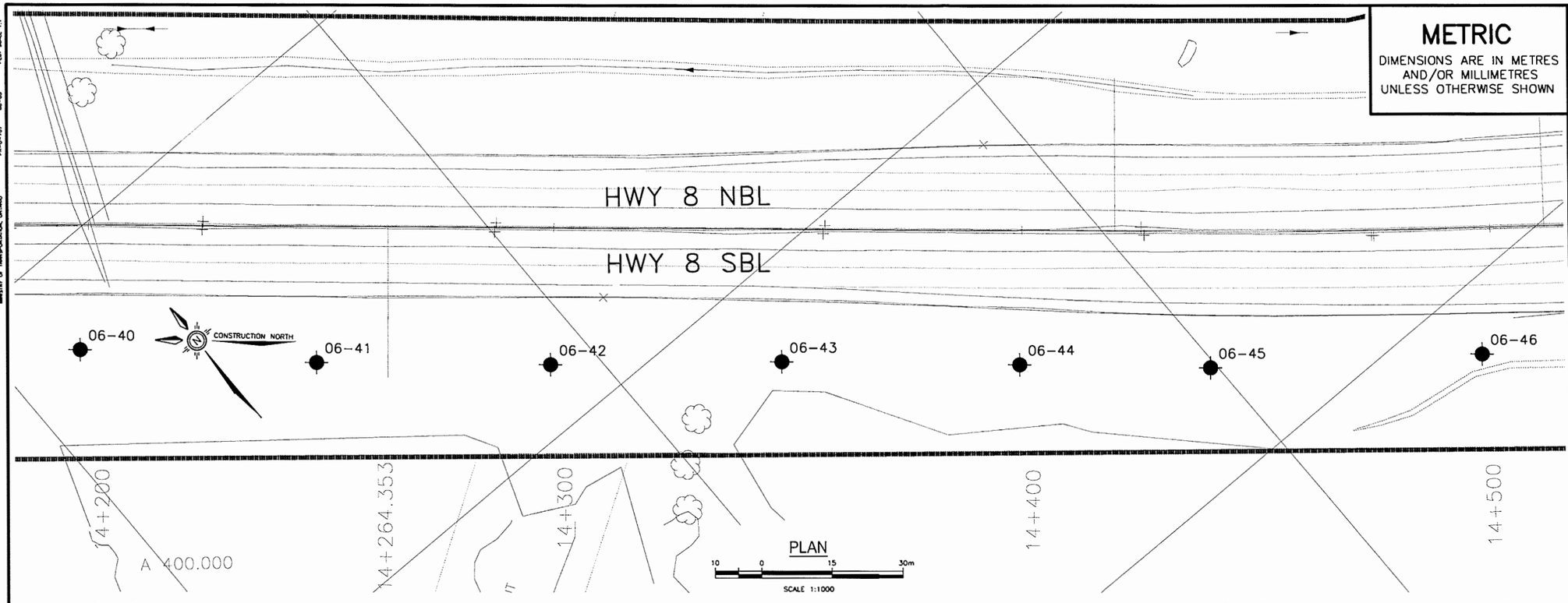
CONT No
GWP No 277-97-00

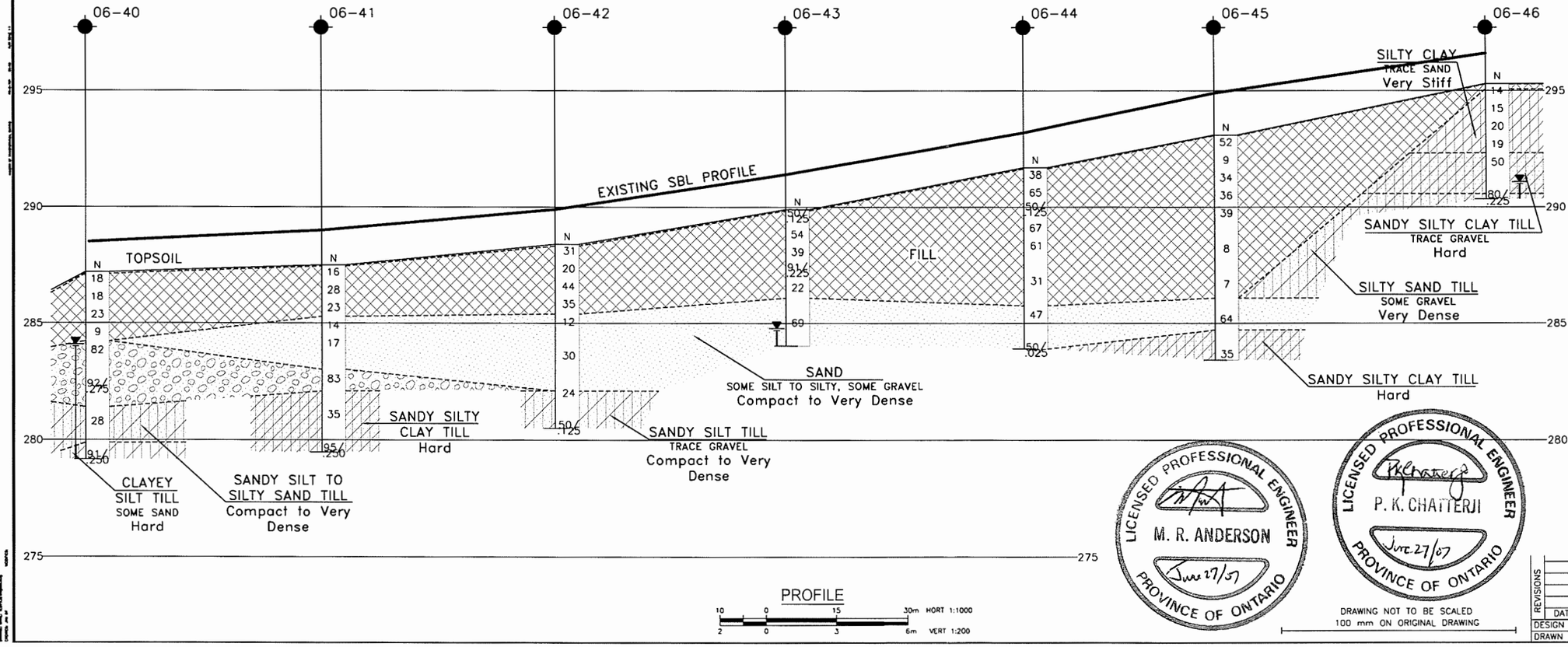
SHEET

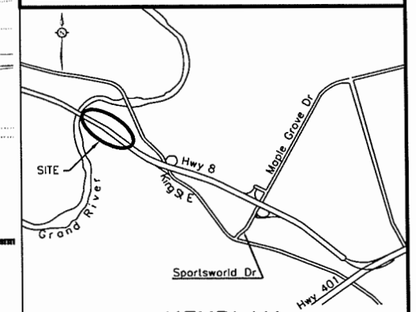
HIGH FILL
HWY 8 WIDENING
STA. 14+150 TO 14+500
BOREHOLE LOCATIONS AND SOIL STRATA

MORRISON HERSHFIELD

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS







KEYPLAN

LEGEND

	BoreHole
	BoreHole and Cone
	BoreHole from Previous Investigation (Approximate)
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
06-40	287.2	4 809 080.1	230 915.9
06-41	287.5	4 809 045.3	230 953.1
06-42	288.4	4 809 012.8	230 991.3
06-43	289.9	4 808 981.6	231 029.5
06-44	291.7	4 808 948.5	231 068.1
06-45	293.1	4 808 921.4	231 098.8
06-46	295.3	4 808 886.6	231 145.2

-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.

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	MRA	CHK	PKC	CODE		LOAD	DATE JAN 2007
DRAWN	JHL	CHK	PKC	SITE		STRUCT	DWG 3

PLOT SCALE 1:1
PLOT DATE 26-06-07
MINISTRY OF TRANSPORTATION, ONTARIO

FILENAME: D:\Jobs Files\19\479\38 Hwy 8\TED79381Highfill.dwg
PLOTDATE: Jun 26, 2007 - 5:00pm