



Stantec

**Foundation Investigation and
Design Report - Ramps and
Embankments**

Highway 6 (Hanlon Expressway) and
Laird Road Interchange
City of Guelph

G.W.P. 3002-05-00

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FOUNDATION INVESTIGATION REPORT

For

G.W.P 3002-05-00

Highway 6 (Hanlon Expressway) and Laird Road Interchange Ramps and Embankments
City of Guelph

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was retained by the Ministry of Transportation, Ontario (MTO) to undertake the detailed design for the replacement of an existing at-grade crossing with a grade separated interchange between Highway 6 (Hanlon Expressway) and Laird Road in the City of Guelph, Ontario.

This Foundation Investigation Report has been prepared specifically and solely for the ramp embankments for the proposed interchange. The geotechnical investigation pertaining to the bridge foundations (including the bridge approaches) for the proposed interchange is presented in a separate report.

Project Number: G.W.P.: 3002-05-00

Project Location: Highway 6 (Hanlon Expressway) and Laird Road Interchange, Guelph

The work was carried out under Agreement Number 3009-E-0003 with Stantec Consulting Ltd., the Detailed Design Consultant for this project.

2.0 Site Description and Geology

Site Location

The site location is shown on the Key Plan inset to Drawing No. 1, provided in Appendix A. It should be noted that for project orientation purposes, Highway 6 will be assumed to run north-south at the project location, with chainage increasing from south to north along Highway 6. Offsets are given with respect to Highway 6 centerline alignment. The chainage on Laird Road increases from west to east with offset given with respect to the centerline alignment of Laird Road. On the proposed ramps, chainage increases in the respective direction of each transition, for example, the chainage on E-N ramp increases from Laird Road (from east) to Highway 6 (going north).

General Site Description

At the project site, Laird Road and Highway 6 currently intersect at-grade with traffic flow being regulated with a traffic signal. Laird Road crosses Highway 6 approximately perpendicularly. Laird Road is currently two lanes in width. Highway 6 has two lanes in each direction separated by a grassed median (see site photos in Appendix A). Turning lanes and ramps are present at the intersection. McWilliams Road intersects with Laird Road approximately 150 m west of Highway 6.

The existing drainage for the highway at this site consists of a mix of catch basins leading to storm sewers with ditches and culverts.

It is noted that within the project limits, "Highway 6" and "Hanlon Expressway" refer to the same entity. Only the term "Highway 6" will be used in this report.

Physiographic Description

The site is located within a physiographic region known as the Guelph Drumlin Field (Chapman and Putnam, 1984). These drumlins were caused by the ice thrust which radiated from the western end of the Lake Ontario basin. The dominant soil materials of the drumlins are the stony tills and deep gravel terraces of the old meltwater spillways. The intervening low grounds largely contain fluvial materials. The till is considered to be loamy and calcareous, derived mostly from dolostone of the Amabel Formation. The till also contains fragments of the underlying bedrock and consequently is pale brown in colour.

In the vicinity of the project site the terrain is fairly flat.

3.0 Method of Investigation

3.1 DRILLING INVESTIGATION

A total of 27 boreholes were advanced for this project. The geotechnical investigation for the high fill embankments for the ramps of the proposed interchange included twenty one (21) boreholes. These boreholes are designated BH10-7 through BH10-27 and are shown on the Borehole Location Plan, Drawing No. 1 in Appendix A. Six boreholes (BH10-1 through BH10-6) were advanced within the general footprint of the bridge structure. The locations of these boreholes are also shown in Drawing No.1 in Appendix A.

Prior to carrying out the investigation, Stantec contacted the public utility authorities to clear the borehole locations of both private and public utilities.

The field drilling program was carried out from July 19 through August 13, 2010. The boreholes were advanced with continuous flight hollow stem augers using a CME 55 drill rig (truck- and track-mounted depending on accessibility) equipped for soil and bedrock sampling. The drilling equipment was owned and operated by DBW Drilling Ltd. of Ajax, Ontario.

The subsurface stratigraphy encountered in each borehole was recorded in the field by an experienced Stantec Field Engineer. Split spoon samples were collected at regularly spaced intervals (every 760 mm to 6 m below existing ground surface and every 1.5 m for deeper strata). All samples recovered were returned to our Ottawa laboratory for detailed classification and testing.

It is noted that during drilling, cobbles (and at times boulders) were encountered frequently in most of the boreholes. This resulted in slow augering and a few of the boreholes were slightly offset from the originally proposed drill locations due to the difficult augering.

Piezometers (standpipes) were installed in five boreholes: BH10-1, BH10-6, BH10-7, BH10-15 and BH-24 on July 26, July 21, July 22, August 10 and August 11, 2010, respectively. The water levels in these piezometers were regularly monitored and were last measured on August 18, 2010. The piezometers were decommissioned on August 18, 2010, in accordance with MOE regulations for well abandonment (O. Reg. 903). The other boreholes were backfilled immediately after drilling with a bentonite-cement mix.

3.2 SURVEY

Surveying of the borehole locations for the embankments of the proposed ramps was performed by Callon Dietz, Inc. of London, Ontario, as a component of the entire survey for the project. Locations were established with northings and eastings as well as relative to the centerline of the existing Highway 6 alignment, Laird Road and the proposed ramps. The ground surface elevation at each borehole location was surveyed on July 5, 2010, with reference to a Geodetic Benchmark provided by MTO. Summary information pertaining to the boreholes included in this report is given in Table 3.1. The boreholes presented in Table 3.1 were grouped together according to the respective ramps and bridge footprint. The locations of these elements are shown on Drawing No. 1 in Appendix A.

Table 3.1: Borehole Information Summary

Borehole	MTM Zone 10 Coordinates		Ground Elevation (m)	Total Depth (m)	End of Borehole Elevation (m)	No. of Soil Samples Collected
	Northing (m)	Easting (m)				
Bridge Structure						
10-1	4816938	247125	330.3	18.7	311.6	18
10-2	4816965	247098	330.2	22.3	307.9	22
10-3	4816960	247154	331.6	15.5	316.1	15
10-4	4816991	247123	331.2	19.1	312.1	18
10-5	4816984	247175	331.4	26.7	304.8	19
10-6	4817009	247152	330.9	19.9	311.0	18
E-N Ramp						
10-27	4817101	247242	330.7	6.7	324.0	9
10-23	4817083	247199	330.7	6.7	324.0	9
10-22	4817082	247143	330.0	6.7	323.3	9
E-S Ramp						
10-19	4816944	247068	329.9	9.8	320.1	11
10-16	4816906	247043	329.9	9.8	320.1	11

Borehole	MTM Zone 10 Coordinates		Ground Elevation (m)	Total Depth (m)	End of Borehole Elevation (m)	No. of Soil Samples Collected
	Northing (m)	Easting (m)				
10-12	4816923	246982	328.5	9.8	318.7	11
10-13	4816982	246958	328.7	9.8	319.0	11
10-15	4817011	246985	328.4	9.8	318.6	11
N-E/W Ramp						
10-10	4816877	247018	329.1	9.8	319.4	11
10-11	4816892	246996	328.5	9.8	318.8	11
10-12	4816923	246982	328.5	9.8	318.7	11
10-13	4816982	246958	328.7	9.8	319.0	11
10-14	4817029	246943	328.4	9.8	318.6	11
W-S Ramp						
10-7	4816816	247010	329.3	6.7	322.6	9
10-9	4816862	247072	330.8	6.7	324.1	9
10-18	4816873	247121	330.4	6.7	323.7	9
10-17	4816865	247170	331.4	6.7	324.7	9
W-N Ramp						
10-20	4817014	247208	329.5	8.2	321.3	10
10-21	4817034	247228	331.2	11.3	319.9	12
10-25	4817031	247290	332.2	6.7	325.5	9
10-24	4816985	247308	332.3	8.2	324.1	10
S-E/W Ramp						
10-26	4817064	247258	331.9	6.7	325.2	9
10-25	4817031	247290	332.2	6.7	325.5	9
10-24	4816985	247308	332.3	8.2	324.1	10
Approach Ramp (West)						
10-8	4816818	246974	329.3	11.3	318.0	12
10-7	4816816	247010	329.3	6.7	322.6	9
10-10	4816877	247018	329.1	9.8	319.4	11
10-16	4816906	247043	329.9	9.8	320.1	11
10-19	4816944	247068	329.9	9.8	320.1	11
Approach Ramp (East)						
10-27	4817101	247242	330.7	6.7	324.0	9
10-26	4817064	247258	331.9	6.7	325.2	9
10-21	4817034	247228	331.2	11.3	319.9	12
10-20	4817014	247208	329.5	8.2	321.3	10

Notes:

- (1) Ramps are listed in a counterclockwise direction around the Highway 6-Laird Road intersection starting from the first quadrant (E-N quadrant).
- (2) Some boreholes were strategically located to provide subsurface information on two adjacent ramps and such boreholes were duplicated as necessary in this table.

3.3 LABORATORY TESTING

All samples were taken to our Ottawa laboratory where they were subjected to a detailed visual examination by a Geotechnical Engineer. Routine soil testing was carried out on selected soil samples. The tests carried out included plasticity testing (20 samples), grain size analysis (91 samples) and moisture content testing (91 samples).

Samples remaining after testing will be placed in storage for a period of one year after issuance of the final report. After the storage period, the samples will be discarded unless we are directed otherwise by MTO.

4.0 Subsurface Conditions

4.1 SUBSURFACE PROFILE

The subsurface conditions observed in the boreholes included in this report are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided in Appendix B. The observed soil profiles are described below.

In general, the subsurface stratigraphy consists from top to bottom of: dark brown sandy silt topsoil/rootmat, sand and silt with gravel fill, gravel and sand with silt, sand and silty sand, sandy silt and silt, sandy silt with gravel till, and inferred or confirmed bedrock. Bedrock was confirmed by coring 3.81 m and 4.65 m using NQ-size rock cores in Boreholes BH10-2 and BH10-5 respectively.

Borehole location plans and stratigraphic sections of the soils encountered within the boreholes are provided on Drawings No. 1 through 5 in Appendix A.

4.1.1 Sandy Silt with Some Organics (Topsoil/Rootmat)

In all the boreholes advanced at this site a layer of dark brown sandy soil was observed. This soil had a dark brown colour and contained some organics (plant roots). The thickness of this layer ranged approximately from 250 to 600 mm.

4.1.2 Sand and Silt with Gravel (Fill)

A granular fill was encountered beneath the topsoil/rootmat in five locations: Boreholes BH10-12, 10-23, 10-24, 10-25 and 10-26. The layer was observed to be 0.4 to 1.5 m in thickness, extending to elevations 327.7 to 331.7 m. In general, the deposit was a sand with gravel although it was variable in composition. A sieve analysis on one sample indicated 6% gravel, 32% sand and 62% fines. The moisture content on the same sample was found to be 10%. The uncorrected Standard Penetration Test (SPT) blow count per 0.3 m penetration (N-value) of suggests a loose to dense state.

4.1.3 Gravel and Sand with Silt

A layer of granular soil containing gravel and sand with silt was encountered immediately beneath the topsoil/rootmat or fill in all the boreholes advanced for this project. This layer contained predominantly gravel and sand with slightly varying proportions from borehole to borehole. Cobbles and boulders were also encountered in some boreholes penetrating this layer. The bottom elevation of this layer ranged from approximately 322.6 m (BH10-7) to 327.6 m (BH10-25) m geodetic. The observed thickness of this layer ranged between approximately 2.0 m (BH10-15) and 6.3 m (BH10-7) with an average thickness of approximately 4 m. It is noted that drilling was terminated in this deposit for Borehole BH10-7 and hence, the actual estimate of this layer's thickness cannot be made for this borehole. The uncorrected standard penetration test (SPT) blow count per 0.3 m penetration (N-value) for this layer ranged from 10 to greater than 100 (i.e., split spoon refusal) suggesting that this layer is in a compact to very dense state. Laboratory index tests performed on 40 representative soil samples obtained from this layer yielded the following results:

Gravel	32 to 67%
Sand	25 to 61%
Fines	5 to 25%; and
Moisture content	1 to 10%.

The soil materials in this layer generally belong to the Unified Soil Classification System (USCS) soil categories of GP-GM, GW-GM, GM, or SP-SM (generally varying from gravel with silt and sand to sand with silt and gravel). The grain size distribution plots of samples obtained from this deposit are shown in Figure 1 in Appendix C.

4.1.4 Sand and Silty Sand

A layer of predominantly sandy soil was encountered in all boreholes beneath the layer of gravel and sand with silt described above except BH10-6, 10-7, 10-8, 10-9, 10-11 and 10-17. The bottom elevation of this layer varied between 319.3 m (BH10-12) and 325.5 m (BH10-25). The thickness of this layer varied from 1.1 to 7.1 m with an average thickness of approximately 3 m. Drilling was terminated in this layer in Boreholes BH10-18, 10-21, 10-22, 10-23, 10-24, 10-25, 10-26 and 10-27 and hence, the actual layer thickness in these boreholes is not known. The N-value for this layer ranged from 7 blows per 0.3 m to greater than 100 suggesting that this layer is in a loose to very dense state. It is noted that in most of the boreholes advanced for this project, groundwater was generally located in this layer. Laboratory index tests performed on 21 representative soil samples retrieved from this layer yielded the following results:

Gravel	0 to 23%
Sand	43 to 94%
Fines	3 to 48%; and
Water content	9 to 20%

The soil materials encountered in this layer generally belong to the USCS categories of SP, SP-SM, SW-SM or SM (generally varying from sand to silty sand). The grain size distribution plots of samples obtained from this deposit are shown in Figure 2 in Appendix C.

4.1.5 Sandy Silt and Silt

A deposit of sandy silt or silt was encountered beneath the gravel and sand layers (described in Subsections 4.1.3 and 4.1.4) in Boreholes BH10-1, 10-2, 10-3, 10-6, 10-8, 10-9, 10-11, 10-12, 10-13, 10-15, 10-16, 10-19 and 10-20. The observed bottom elevation of this layer ranged approximately between 310.1 m (BH10-5) and 324.1 m (BH10-9). The approximate thickness of this deposit ranged between 0.2 m and 4.6 m with an average thickness of approximately 2.3 m. It should be noted that drilling was terminated in this layer in Boreholes BH10-9, 10-11, 10-12, 10-13, 10-16, 10-19 and 10-20 upon attaining the proposed maximum investigation depth for these boreholes and therefore, the actual extent of the layer could not be estimated. The N-value for this layer ranged from 7 blows per 0.3 m to 82 suggesting that this layer is in a loose to very dense state. Laboratory index tests performed on 15 representative soil samples retrieved from this layer yielded the following results:

Gravel	0 %
Sand	2 to 53%
Fines	47 to 98%
Water content	9 to 23%

The soil materials encountered in this layer generally belong to the USCS soil category of ML (generally varying from sandy silt to silt). The grain size distribution plots of samples obtained from this deposit are shown in Figure 3 in Appendix C.

Atterberg Limits tests were conducted on 12 samples retrieved from this layer. The results indicated that all the tested soil samples are non-plastic.

4.1.6 Sandy Silt with Gravel / Sand with Silt and Gravel (Till)

A layer consisting of varying proportions of silt, sand and gravel (till) was encountered beneath the sandy or silty layers described above in Boreholes BH10-1, 10-2, 10-3, 10-4, 10-5, 10-6, 10-8, 10-10, 10-14, 10-15 and 10-17. In all except Boreholes BH10-2 and 10-5 drilling was terminated in this layer thus the total thickness and bottom elevations were not established for this unit. In BH10-2 and 10-5 the bottom elevations ranged between 310.1 and 311.8 m. The observed thicknesses for these boreholes were 9.3 m and 13.7 m, respectively. The N-values ranged from 7 blows per 0.3 m to well over 100 indicating a loose to very dense state. It is noted that in this layer the SPT blow count generally increased with depth. Laboratory index tests performed on 14 representative soil samples retrieved from this layer yielded the following results:

Gravel	0 to 50%
Sand	10 to 90%

Fines	5 to 97%
Water content	7 to 16%

Atterberg limits tests were carried out on 8 samples. Three were found to be non-plastic and five produced low plastic results (plasticity index of 2 to 3%). The material encountered in this unit ranged from well-graded gravel with silt and sand (GW-GM) through poorly graded sand with silt (SP-SM) to sandy silt or sandy silt with gravel (ML). The grain size distribution plots and the plasticity chart for representative samples obtained from this unit are shown in Figures 4 and 5 in Appendix C.

It is noted that although not specifically encountered in the boreholes that penetrated this till layer, cobbles and boulders should be anticipated in the glacial till due to its depositional history.

4.2 BEDROCK

Grey limestone bedrock was encountered in Boreholes BH10-2 and BH10-5. The bedrock was confirmed by coring approximately 3.8 and 4.6 m, respectively, using NQ-size coring equipment. Bedrock was encountered at elevations of 311.8 and 310.1 m (approximately 18.4 and 21.3 m below existing ground surface).

The rock core recovery ranged between 62 and 100% (with average of 91%). The rock quality designation (RQD) ranged between 0 and 92% (with average of 66%), indicating very poor to excellent rock mass quality. The bedrock was slightly weathered with joint spacing ranging from close to moderate and predominantly flat orientation. A detailed description of the rock core is provided in Field Core Logs with rock core photographs in Appendix B.

Unconfined compressive strength tests were carried out on two bedrock samples each from Boreholes BH10-2 and BH10-5. The results of these tests are summarized in Table 4.1.

Table 4.1: Unconfined Compressive Strength of Rock Cores

Borehole No	Ground Surface Elevation (m)	Test Elevation (m)	Unconfined Compressive Strength (MPa)
BH10-2	330.2	310.8	70
		309.0	167
BH10-5	331.4	308.6	52
		305.4	82

4.3 GROUNDWATER

Groundwater monitoring wells were installed in Boreholes BH10-1, 10-6, 10-7, 10-15 and 10-24 between July 22 and August 11, 2010. The water levels in these wells were monitored regularly until August 18, 2010, when the monitoring wells were decommissioned in accordance with Ontario Regulations for well abandonment. Groundwater level, as measured in these monitoring wells on August 16 and 18, 2010, was at elevations between 325.9 and 327.0 m

(depths of between 2.5 and 5.3 m below existing ground surface). Groundwater level readings in these boreholes are summarized in Table 4.2. Groundwater observations made during drilling in the remaining boreholes are included in Table 4.3 as inferred groundwater level readings.

Table 4.2: Summary of Groundwater Level Readings

Borehole No	Ground Surface Elevation (m)	Groundwater	
		Depth (m)	Elevation (m)
BH10-1	330.3	4.2	326.1
BH10-6	330.9	4.8	326.1
BH10-7	329.3	2.9	326.4
BH10-15	328.4	2.5	325.9
BH10-24	332.3	5.3	327.0

Table 4.3: Inferred Groundwater Level Readings (Time of Drilling)

Borehole No	Ground Surface Elevation (m)	Groundwater	
		Depth (m)	Elevation (m)
BH10-2	330.2	4.3	325.9
BH10-3	331.6	5.2	326.4
BH10-4	331.2	4.9	326.3
BH10-5	331.4	5.3	326.1
BH10-8	329.3	4.1	325.2
BH10-9	330.8	4.6	326.2
BH10-10	329.1	3.8	325.3
BH10-11	328.5	3.8	324.7
BH10-12	328.5	3.4	325.1
BH10-13	328.7	3.4	325.3
BH10-14	328.4	3.4	325.0
BH10-16	329.9	4.6	325.3
BH10-17	331.4	4.7	326.7
BH10-18	330.4	4.6	325.8
BH10-19	329.9	4.0	325.9
BH10-20	329.5	3.2	326.3
BH10-21	331.2	5.3	325.9
BH10-22	330.0	4.0	326.0
BH10-23	330.7	4.7	326.0
BH10-25	332.2	5.0	327.2
BH10-26	331.9	5.5	326.4
BH10-27	330.7	4.3	326.4

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.0 Closure

A subsurface investigation is a limited sampling of a site. The subsurface conditions given herein are based on information gathered at the specific borehole locations and timeframe described herein. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

This report has been prepared by Simon Gudina and Fred Griffiths. A technical review was carried out by Raymond Haché.

Respectively Submitted;

STANTEC CONSULTING LTD.



Simon Gudina, Ph.D.



Fred J. Griffiths, Ph.D., P.Eng.
Principal



Raymond Haché, M.Sc., P.Eng.
Designated Principal MTO Foundation Contact



FOUNDATION DESIGN REPORT

For

G.W.P. 3002-05-00

Highway 6 (Hanlon Expressway) – Laird Road Interchange Ramps and Embankments
City of Guelph

6.0 Discussion

6.1 PROJECT DESCRIPTION & BACKGROUND

Project Purpose/Justification

Highway 6 (Hanlon Expressway) passes through the City of Guelph, Ontario. The existing highway has two lanes in each direction separated by a grassed median. Laird Road has a single lane in each direction. Turn lanes and ramps are present at the intersection which is controlled by a traffic light (see Site Photographs in Appendix A). McWilliams Road intersects with Laird Road approximately 150 m west of Highway 6. It is proposed to construct an interchange at this location with Laird Road crossing over Highway 6 which will remain at its current elevation.

Embankments for Proposed Interchange

The existing at-grade intersection will be replaced with a grade separated interchange (Parclo A-4 configuration). In addition to the bridge structure, the proposed interchange will have several ramps between Highway 6 and Laird Road. Table 6.1 summarizes the information relevant to these ramps.

Table 6.1: Summary of Proposed Ramps

Ramp Description	Approximate Length of High-Fill Embankment (>4.5 m)	Approximate Chainage along Ramp		Maximum Embankment Height
	(m)	From	To	(m)
Approach Fill West	190	9+775	9+965	8.2
Approach Fill East	165	10+035	10+200	8.2
Ramp S-E/W	50	10+350	10+400	5.8
Ramp W-N	65	9+715	9+780	8.0
Ramp E-N	160	9+490	9+650	6.5
Ramp N-W	80	9+937	10+017	7.2
Ramp N-E/W	125	10+275	10+400	8.0
Ramp E-S	165	9+685	9+850	8.2
Ramp W-S	90	9+460	9+550	4.5

6.2 SOIL SUMMARY

The soil conditions at this site generally consist of a compact to very dense granular layer (gravel and sand with silt) over loose to very dense sand over loose to very dense silt layer over a loose to very dense sand with silt and gravel over bedrock. The depth to bedrock ranged from approximately 18 to 21 m below existing ground surface.

For design purposes, the representative soil profile indicated in the following Table 6.2 can be used. The geotechnical soil profile was developed based on the synthesis of the measured N-values and the laboratory index test results (including moisture contents) of soil samples retrieved from boreholes BH10-1 through BH10-6 and BH10-19 and BH10-20 which are located where the proposed fills are highest. This soil profile is indicated in Figure 6 in Appendix D. For other ramps, the relative elevations are slightly variable depending on each particular alignment, however, the given stratigraphic profile is similar along all ramps.

Table 6.2: Representative Soil Profile

Elevation (m)		Soil Type	Design Parameters ¹		
From	To		γ	ϕ	E
330	327	Gravel and sand with silt containing cobbles and boulders (compact to very dense)	21	38	200
327	324	Sand to silty sand (loose to very dense)	20	33	40
324	316	Sandy silt to silt (loose to very dense)	20	31	25
316	310	Sand with silt and gravel - Till (loose to very dense)	22	40	200

Note: (1) γ = total unit weight (kN/m³), ϕ = soil friction angle (°), and E = soil modulus (MPa).

Though not encountered, cobbles and boulders are anticipated in the till (elevation 316 to 310 m).

A typical groundwater level elevation of 326.0 m can be used for analysis. For drained or effective stress analyses, the submerged unit weight is calculated as $\gamma' = \gamma - \gamma_w$, where γ_w is the unit weight of water and is used below the water table.

The parameters in Table 6.3 are applicable to fill materials imported to the site.

Table 6.3: Representative Soil Parameters for Imported Materials

Material	Design Parameters	
	γ (kN/m ³)	ϕ (°)
Earth Borrow	20.0	29
Select Subgrade Material (SSM)	21.0	32
Granular B Type I	21.2	32
Granular B Type II	22.8	35
Granular A	22.8	35

7.0 Recommendations

The design recommendations presented in the following sections have been developed in accordance with the requirements and methods described in the Canadian Highway Bridge Design Code (CHBDC, 2006).

7.1 SEISMIC DESIGN CONSIDERATIONS

7.1.1 Zonal Acceleration Ratio

Table A3.1.1 of the CHBDC indicates that the Zonal Acceleration Ratio (ZAR) for Guelph is 0.05. A seismic hazard calculation for the site was obtained from Natural Resources Canada (copy attached in Appendix E). It indicates that for this site, the peak ground acceleration (PGA) value corresponding to 10% exceedance on 50 years is 0.053, which is in close agreement with the ZAR for Guelph.

7.1.2 Liquefaction of Site Soils

Seismic liquefaction refers to a situation where a sudden loss of stiffness and strength of soil occurs due to cyclic loading effects of earthquake. Liquefaction can cause loss of bearing resistance and/or excessive settlement. An assessment for seismically induced liquefaction has been carried out for this site. This assessment indicates that liquefaction of the soils is not a concern at this site due to low peak horizontal acceleration at the site and the predominantly compact to very dense soil conditions.

7.2 EMBANKMENT DESIGN

Embankments are required for the ramps of the proposed interchange. These ramps, with approximate lengths and heights, are summarized in Table 6.1.

7.2.1 Slope Stability Evaluation

A slope stability evaluation was carried out using commercially available limit equilibrium based software called SLOPE/W (GEO-SLOPE, 2007). The analysis included dynamic loading due to traffic by considering an equivalent static load equivalent to 0.8 m of additional fill, as per Section 6.9.5 of the CHBDC. The analyses also considered seismic loading using one-half of the ZAR.

Slope stability analysis results for two embankment fill materials (Select Subgrade Material and Earth Borrow) under traffic loads are presented in Figures 7 and 8 in Appendix D. A 2.5H:1V slope is required for embankments constructed of Earth Borrow. A 2H:1V slope is required for embankments constructed of Select Subgrade Material (SSM). Figures 9 and 10 provide the results under simultaneous seismic and traffic loads.

The slope stability evaluation results indicate that the failure planes generally tend to be relatively shallow (veneer type of failure). The beneficial effects of any vegetation on the slope and the apparent cohesion of granular material were disregarded in carrying out the slope stability evaluation. The actual factor of safety against shallow failure planes is anticipated to be greater than that presented herein.

7.2.2 Evaluation of Potential Ground Settlement due to Embankment

Settlement of the underlying soil due to the embankment was evaluated. The following assumptions were made in evaluating the settlement of the site soil under the proposed embankments:

- Typical soil profile given Table 6.2 was considered representative;
- The load from the bridge abutments will be transferred to deeper and more competent strata by the piles (other than that by the centre pier) and hence does not contribute to the settlement of the site soil;
- Only immediate (elastic) settlement was considered due to the presence of non-cohesive soils;
- A Poisson's ratio of 0.35 was used for all soil types;
- The existing grade is at approximate elevation of 330.0 m;
- Groundwater is at elevation of 326.0 m (approximately 4.0 m below the existing ground surface);
- The maximum embankment height is approximately 8.2 m (in the immediate vicinity of the bridge abutment);
- Embankment extends approximately 250 m east and west from the abutment;
- The top width of the embankment is 30.0 m;
- The distance between the abutments is approximately 67 m; and
- The pier footing is approximately 4.0 m wide by 30.0 m long.

Evaluation of soil settlement due to the effects discussed above was performed using a computer program called Settle3D (Rocscience, 2009). It is a three-dimensional computer program for the analysis of the immediate vertical settlement and consolidation of soil under surface loads such as embankments. Settlement evaluation was carried out for embankments constructed using Select Subgrade Material (SSM) with 2H:1V slopes and using Earth Borrow with 2.5H:1V slopes.

The analysis result indicates that for the conditions presented herein, the maximum total vertical settlement of the existing materials is approximately 50 and 45 mm, respectively, under SSM and Earth Borrow embankments. The maximum settlement will take place approximately 20 m back from each bridge abutment. This settlement will take place rapidly and is expected to be completed during construction of the embankment. Plots of settlement contours from typical Settle3D analyses are given in Figures 11 and 12 in Appendix D.

The settlement beneath the abutment centerline which will be caused by the 8.2 m high SSM embankment was evaluated to be 38 mm; a profile of settlement versus depth below original grade (elevation 330.0 m) for this location is provided on Figure 13 in Appendix D.

It is noted that there will also be a minor amount of self-weight settlement of the embankment fill. This self-weight settlement was estimated using charts provided by Poulos and Davis (1974) for embankments having similar geometries to the SSM and Earth Borrow embankments presented herein. The estimated self-weight settlement was approximately 20 mm and 30 mm, respectively, for the SSM and Earth Borrow embankment fills. This settlement is also expected to be completed by the end of construction.

No settlement monitoring will be required for this project.

8.0 Construction Considerations

8.1 EXCAVATION AND BACKFILLING – AND MATERIAL REUSE

Site soil encountered during geotechnical investigation revealed that topsoil/rootmat with thickness ranging approximately from 250 to 600 mm was observed. This layer consists of root mat and other plant remains.

Any vegetation, fill, organic soils and other deleterious materials must be removed from beneath the embankments for the proposed interchange. Where deleterious materials are encountered, the materials should be excavated, wasted and replaced. The lateral extent of such excavation should include all deleterious material within the influence zone of the embankments.

Grading work should be carried out in accordance with OPSS 206 Construction Specification for Grading and SP 206S03.

Any side slopes for open cut excavations should conform to Occupational Health and Safety Act regulations for Construction Projects (OHSA) (Ministry of Labour, 2002). The surficial gravel and sand with silt is compact to very dense and should be considered as a Type 3 soil.

It is noted that the native surficial soil observed at this site is a gravel and sand with silt deposit which ranged in thickness from 2 m to greater than 6 m in depth. All of the 40 gradation tests carried out on this material met the gradation limits for OPSS Select Subgrade Material. If a similar material is used to construct the embankments, the SSM embankment configuration could be used for design.

8.2 CONSTRUCTION SEQUENCING

The geotechnical conditions at this site do not pose significant constraints to the project.

9.0 Specifications

The following specifications are referenced in this report:

Table 9.1: Specifications Referenced in Report

Document	Title
OPSS 206	Construction Specification for Grading
SP 206S03	Earth Excavation, Grading

10.0 References

Chapman, L.J., and Putnam, D.F. 1984. The physiography of Southern Ontario, Ontario Geological Survey Special Volume 2. Ontario Research Foundation, Toronto, Ontario.

CHBDC, 2006. Canadian Highway Bridge Design Code. Canadian Standards Association, Mississauga, Ontario.

GEO-SLOPE International Ltd. 2007. Stability Modeling with SLOPE/W 2007©. Calgary, AB.

Ministry of Labour. 2002. Occupational Health and Safety Act and Regulations for Construction Projects. Publications Ontario, Toronto, Ontario.

Poulos, H.G., and Davis, E.H. 1974. Elastic Solutions for Soil and Rock Mechanics. John Wiley & Sons, Inc., New York.

Rocscience, 2009. Settle3D Settlement and Consolidation Analysis: Theory Manual, Rocscience, Inc.

11.0 Closure

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete.

A soil investigation is a limited sampling of a site. The conclusions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information and its effects on the above recommendations.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

This report has been prepared by Simon Gudina and Fred Griffiths. Technical review was carried out by Raymond Haché.

Respectfully submitted,

STANTEC CONSULTING LTD.



Simon Gudina, Ph.D.



Fred J. Griffiths, Ph.D., P.Eng.
Principal



Raymond Haché, M.Sc., P.Eng.
Designated Principal MTO Foundation Contact

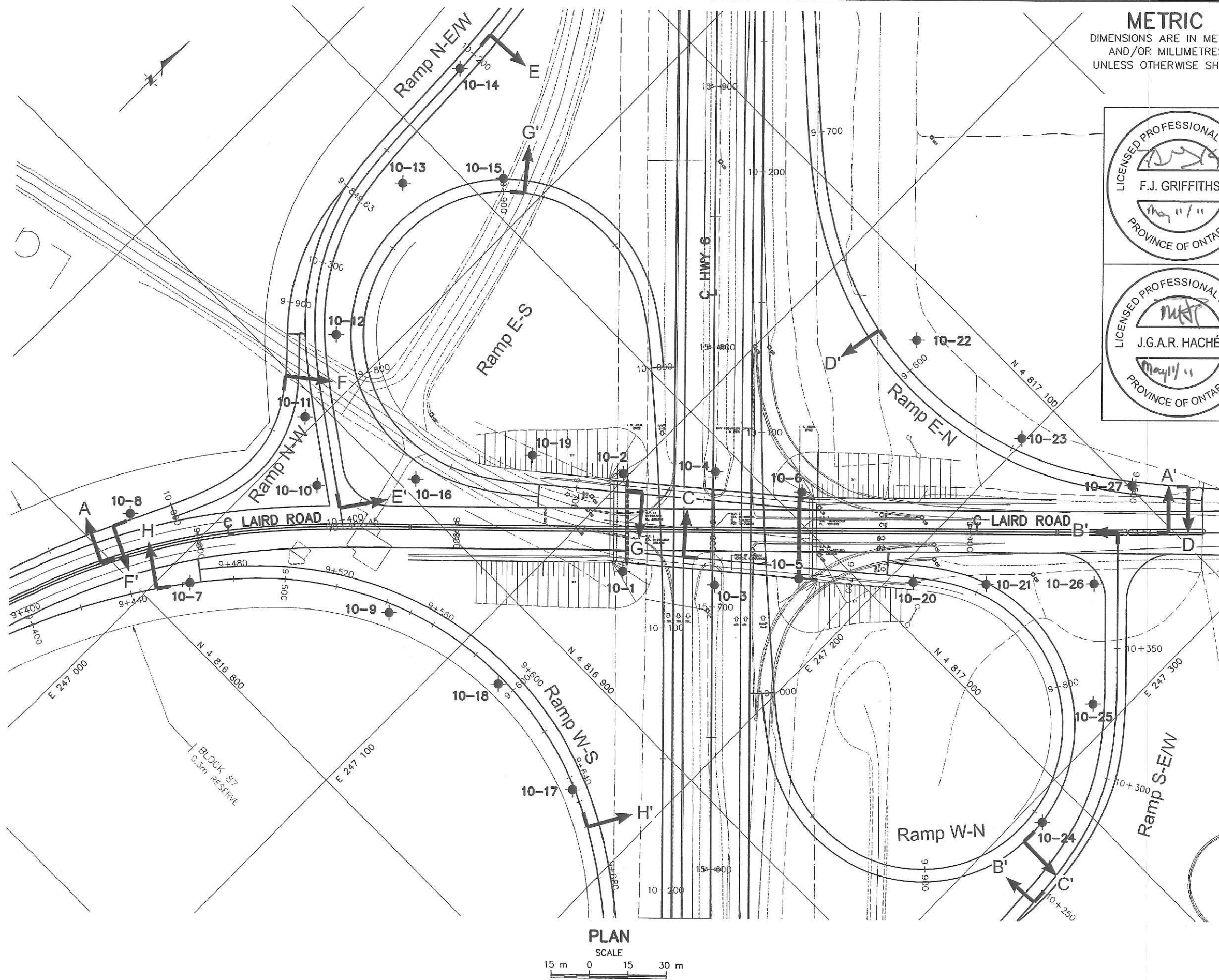


APPENDIX A

Drawings No. 1-5 – Borehole Location Plan and Soil Strata Plots
Site Photographs

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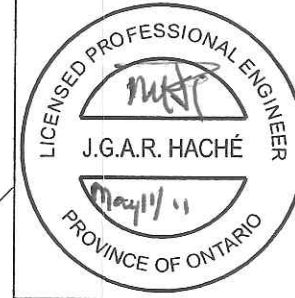
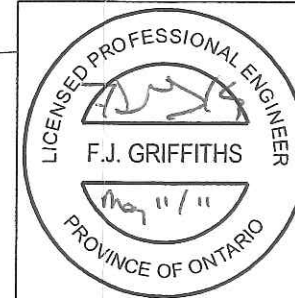


PLATE No
CONT
WP 3002-05-00

HWY 6/LAIRD RD INTERCHANGE
STA TO STA
BOREHOLE LOCATIONS



LEGEND			
● Bore Hole			
No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
10-1	330.3	4 816 937.8	247 124.5
10-2	330.2	4 816 964.5	247 098.1
10-3	331.6	4 816 959.5	247 153.6
10-4	331.2	4 816 990.6	247 123.1
10-5	331.4	4 816 984.3	247 175.0
10-6	330.9	4 817 008.7	247 152.4
10-7	329.3	4 816 815.7	247 009.5
10-8	329.3	4 816 818.1	246 974.4
10-9	330.8	4 816 862.2	247 071.6
10-10	329.1	4 816 877.2	247 017.6
10-11	328.5	4 816 892.5	246 995.7
10-12	328.5	4 816 923.2	246 981.7
10-13	328.7	4 816 982.2	246 958.4
10-14	328.4	4 817 029.0	246 943.0
10-15	328.4	4 817 011.3	246 984.8
10-16	329.9	4 816 905.7	247 042.5
10-17	331.4	4 816 864.9	247 169.7
10-18	330.4	4 816 872.9	247 120.8
10-19	329.9	4 816 944.4	247 068.1
10-20	329.5	4 817 014.7	247 207.6
10-21	331.2	4 817 034.2	247 228.3
10-22	330.0	4 817 081.6	247 142.9
10-23	330.7	4 817 083.8	247 198.7
10-24	332.3	4 816 985.2	247 308.0
10-25	332.2	4 817 030.9	247 290.1
10-26	331.9	4 817 063.8	247 258.0
10-27	330.7	4 817 101.0	247 241.9

NOTES
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

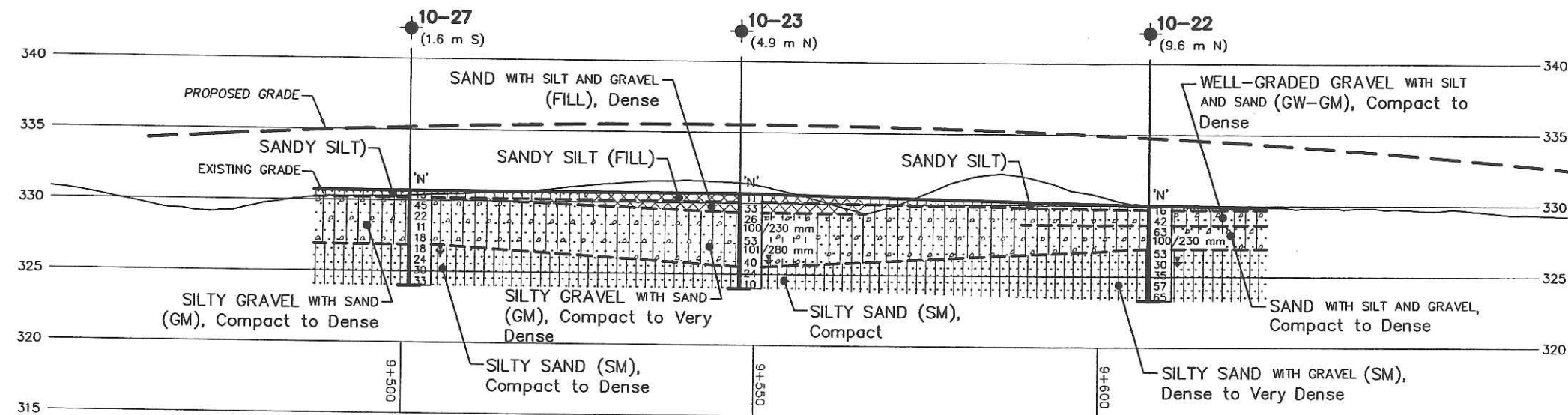
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

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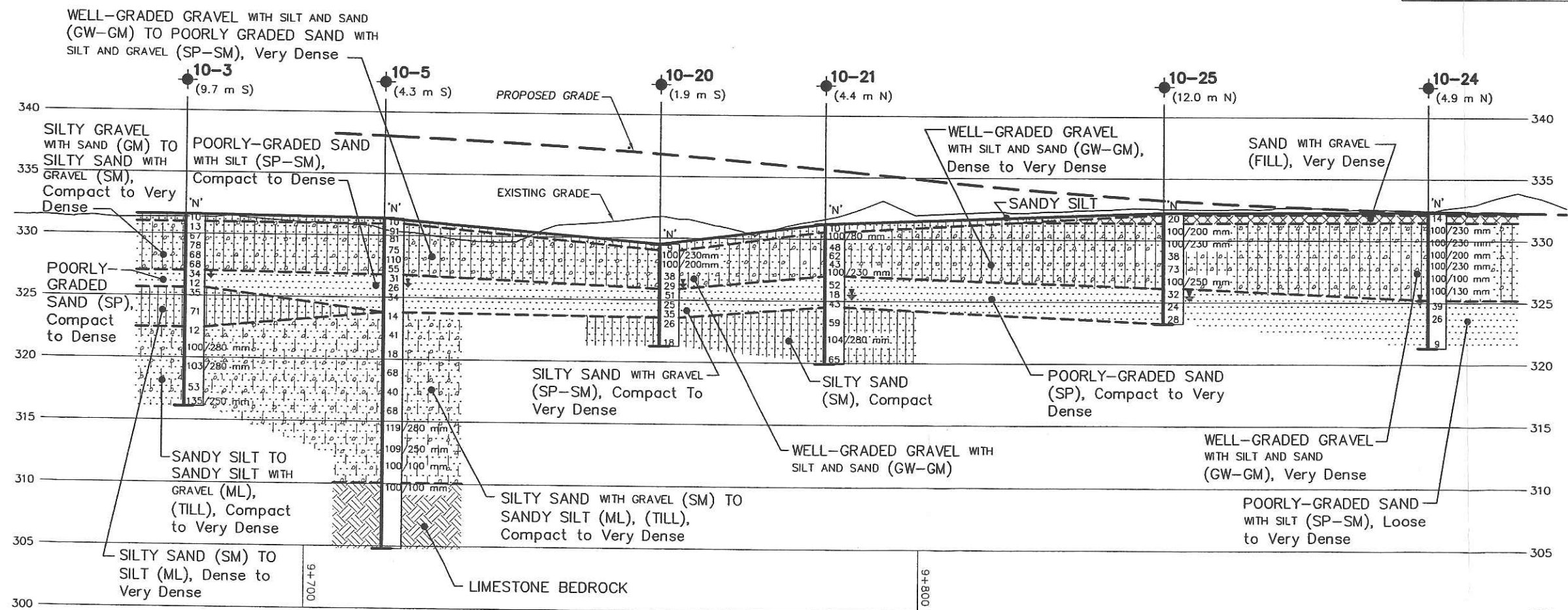
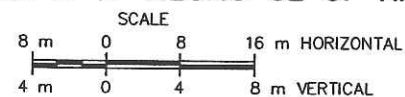
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SUBMD SG	CHECKED	APPROVED	DWG 1
DRAWN GBB	CHECKED		

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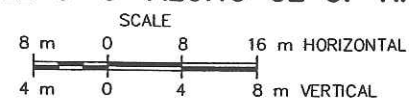
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PROFILE D-D' ALONG CL OF RAMP E-N



PROFILE C-C' ALONG CL OF RAMP W-N



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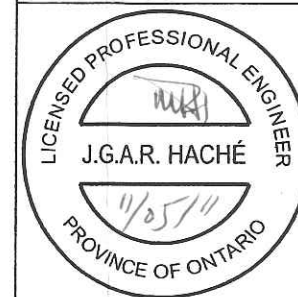
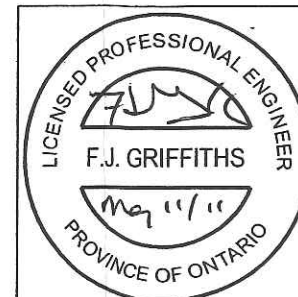


PLATE No
CONT
WP 3002-05-00
HWY 6/LAIRD RD INTERCHANGE
STA TO STA
SOIL STRATA
SHEET



KEY PLAN

LEGEND

- Bore Hole
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- W.L. at time of investigation July-August 2010

No	ELEVATION	MTM ZONE 10 COORDINATES	
		NORTH	EAST
10-3	331.6	4 816 959.5	247 153.6
10-5	331.4	4 816 984.3	247 175.0
10-20	329.5	4 817 014.7	247 207.6
10-21	331.2	4 817 034.2	247 228.3
10-22	330.0	4 817 081.6	247 142.9
10-23	330.7	4 817 083.8	247 198.7
10-24	332.3	4 816 985.2	247 308.0
10-25	332.2	4 817 030.9	247 290.1
10-27	330.7	4 817 101.0	247 241.9

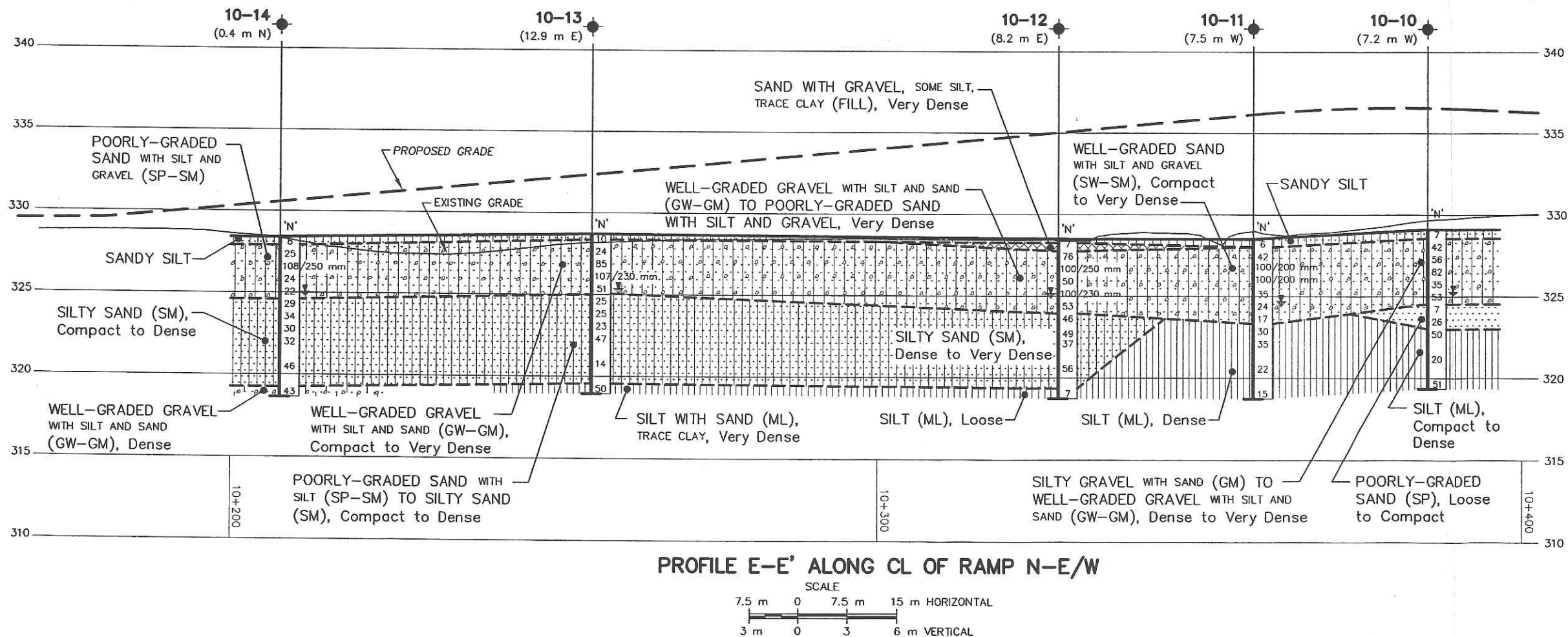
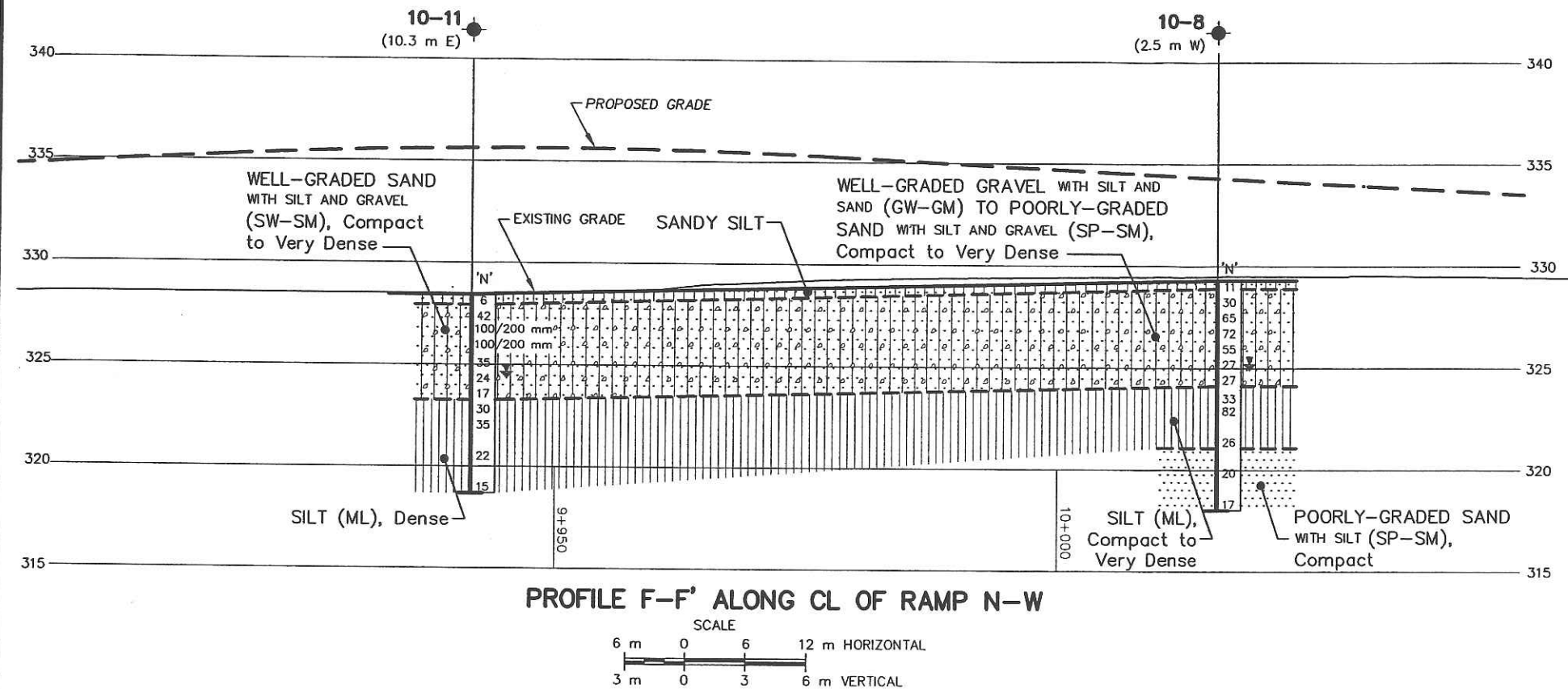
NOTES

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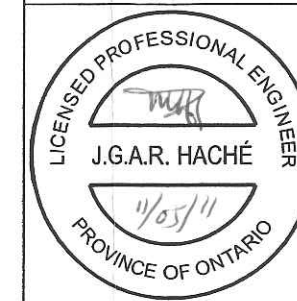
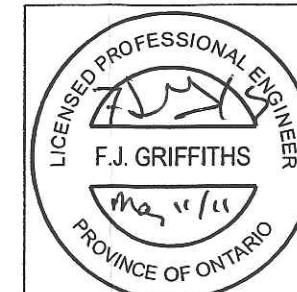
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.



REVISIONS					
DATE	BY	DESCRIPTION			
GEOCRE No 40PB-196					
HWY No 6				DIST	
SUBM'D SG	CHECKED	DATE 2010-10-29	SITE 25-319-C		
DRAWN GBB	CHECKED	APPROVED	DWG 3		



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PLATE	No
CONT	
WP	3002-05-00
HWY 6/LAIRD RD INTERCHANGE	
STA	TO STA
SOIL STRATA	



LEGEND				
 Bore Hole				
N Blows/0.3m (Std Pen Test, 475 J/blow)				
 WL at time of investigation July–August 2010				
MTM ZONE 10 COORDINATES				
No	ELEVATION	NORTH		EAST
10-8	329.3	4 816	818.1	246 974.4
10-10	329.1	4 816	877.2	247 017.6
10-11	328.5	4 816	892.5	246 995.7
10-12	328.5	4 816	923.2	246 981.7
10-13	328.7	4 816	982.2	246 958.4
10-14	328.4	4 817	029.0	246 943.0

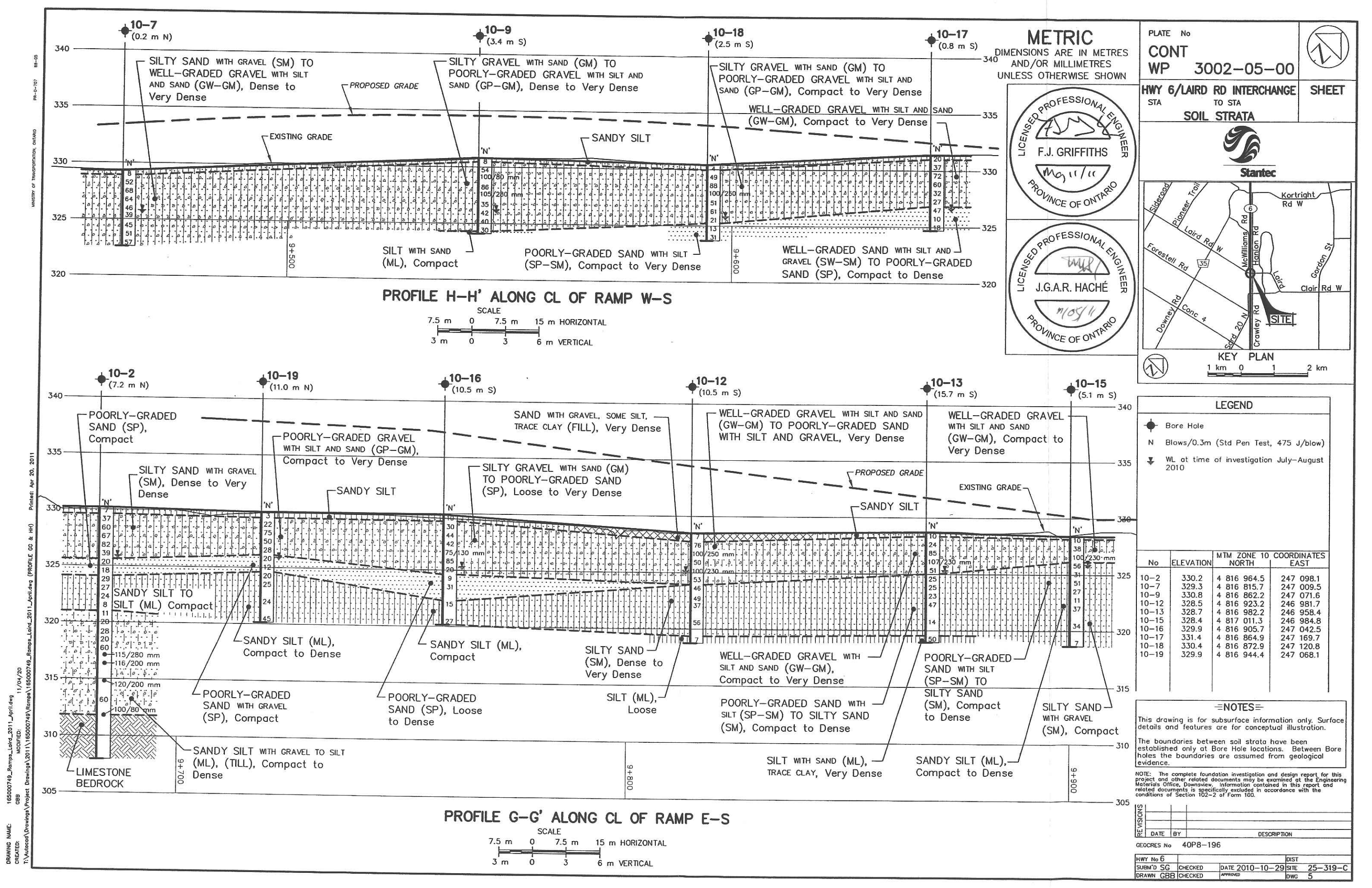
NOTES

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REVISIONS				
	DATE	BY	DESCRIPTION	
GEORES No 40P8-196				
HWY No 6				DIST
SUBM'D SC	CHECKED	DATE 2010-10-29		SITE 25-319-C
DRAWN GBR	CHECKED	APPROVED		DWG 4



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LICENSED PROFESSIONAL ENGINEER
F.J. GRIFFITHS
M9/11/11
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.G.A.R. HACHE
M10/09/11
PROVINCE OF ONTARIO

PLATE No
CONT
WP 3002-05-00

HWY 6/LAIRD RD INTERCHANGE
STA TO STA
SOIL STRATA

SHEET

Stantec

KEY PLAN
1 km 0 1 2 km

LEGEND

- Bore Hole
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- WL at time of investigation July-August 2010

No	ELEVATION	MTM ZONE 10 COORDINATES NORTH	EAST
10-2	330.2	4 816 964.5	247 098.1
10-7	329.3	4 816 815.7	247 009.5
10-9	330.8	4 816 862.2	247 071.6
10-12	328.5	4 816 923.2	246 981.7
10-13	328.7	4 816 982.2	246 958.4
10-15	328.4	4 817 011.3	246 984.8
10-16	329.9	4 816 905.7	247 042.5
10-17	331.4	4 816 864.9	247 169.7
10-18	330.4	4 816 872.9	247 120.8
10-19	329.9	4 816 944.4	247 068.1

NOTES

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REVISIONS

DATE	BY	DESCRIPTION

GEOCRES No 40P8-196

HWY No 6	SUBM'D SG	CHECKED	DATE 2010-10-29	SITE	DIST
				25-319-C	

DRAWN GBB CHECKED APPROVED DWG 5



Photograph 1. Looking north at the Highway 6-Laird Road intersection along Highway 6 (Google Earth Pro® Image).



Photograph 2. Looking west at the Highway 6-Laird Road intersection along Laird Road (Google Earth Pro® Image).



Photograph 3. Looking south at the Highway 6-Laird Road intersection along Highway 6 (Google Earth Pro® Image).



Photograph 4. Looking east at the Highway 6-Laird Road intersection along Laird Road (Google Earth Pro® Image).

APPENDIX B

Symbols and Terms Used on Borehole Records

Borehole Records

Rock Core Records

Rock Core Photographs

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200



ROCK DESCRIPTION

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

Terminology describing rock strength:

Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.



STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel



Sand



Silt



Clay



Organics



Asphalt



Concrete



Fill



Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT



measured in standpipe,
piezometer, or well



inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



Stantec

RECORD OF BOREHOLE No BH 10-01

1 OF 2

METRIC

W.P. 3002-05-00 LOCATION 9+964 16.5m Rt CL Laird Road N: 4 816 938 E: 247 125 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 26 - 2010 07 27 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE						
330.3							20 40 60 80 100								
0.0	Sandy silt, dark brown, some roots		1	SS	6										
329.8															
0.5	Poorly-graded gravel with silt and sand (GP-GM), compact to very dense, moist, brown to light brown		2	SS	10										
	- occasional cobbles		3	SS	44										
			4	SS	64										
			5	SS	45										
			6	SS	20										
325.8															
4.6	Poorly-graded sand with silt (SP-SM), loose to compact, wet, brown		7	SS	18									58 32 (10)	
			8	SS	6									62 31 (7)	
			9	SS	8										
323.6															
6.7	Silt with sand (ML), compact to dense, wet, brown		10	SS	31									4 87 (9)	
			11	SS	32										
			12	SS	20									0 17 (83)	
			13	SS	21										

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

Continued Next Page

✕, ✕³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-01

2 OF 2

METRIC

W.P. 3002-05-00 LOCATION 9+964 16.5m Rt CL Laird Road N: 4 816 938 E: 247 125 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 26 - 2010 07 27 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL						
							20	40	60	80	100					
318.2	Sandy silt with gravel (ML), compact to very dense, moist, grey, TILL		14	SS	20										16 32 (52)	
12.2																
					15	SS	35									
			16	SS	100/ 250mm											
			17	SS	110/ 230mm											

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-02

1 OF 2

METRIC

W.P. 3002-05-00 LOCATION 9+964 21.0m Lt CL Laird Road N: 4 816 965 E: 247 098 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers, NQ Coring Equipment COMPILED BY KF
 DATUM Geodetic DATE 2010 07 19 - 2010 07 20 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20	40	60							80	100
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL							✕ LAB VANE	
330.2							20	40	60	80	100							
0.0	Sandy silt, dark brown, some roots		1	SS	7	▽	330											
329.6	Silty sand with gravel (SM), dense to very dense, moist, brown to light brown		2	SS	37		329											
0.6	- frequent cobbles		3	SS	60		328									32 48 (20)		
	- occasional boulders		4	SS	67		327									42 43 (15)		
			5	SS	82		326											
			6	SS	39		325											
325.6	Poorly-graded sand (SP), compact		7	SS	20		324									3 94 (3)		
4.6			8	SS	18		323											
			9	SS	29		322									0 37 (63)		
	- becomes loose		10	SS	27		321											
			11	SS	24		320											
			12	SS	8		319									0 4 (96)		
321.0	Sandy silt to silt (ML), compact, wet, grey		13	SS	11													
9.1	Sandy silt with gravel to silt (ML), compact to very dense, moist, grey, TILL		14	SS	20													
			15	SS	28													
			16	SS	20													

Continued Next Page

✕³, ✕³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-02

2 OF 2

METRIC

W.P. 3002-05-00 LOCATION 9+964 21.0m Lt CL Laird Road N: 4 816 965 E: 247 098 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers, NQ Coring Equipment COMPILED BY KF
 DATUM Geodetic DATE 2010 07 19 - 2010 07 20 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED	✕ FIELD VANE						
								● QUICK TRIAXIAL	✕ LAB VANE						
						20 40 60 80 100			10 20 30						
	Sandy silt with gravel to silt (ML), compact to very dense, moist, grey, TILL (continued)		17	SS	60		318								
			18	SS	115/ 280mm		317								
			19	SS	116/ 200mm		316								
			20	SS	120/ 200mm		315								
			21	SS	60		313								
311.8 18.4	Grey LIMESTONE bedrock - very poor to excellent quality - slightly weathered - flat to dipping - close to moderate joint spacing - rough planar		22	SS	100/ 80mm		312								
			23	NQ	REC 62/ RQD 0		311								
			24	NQ	REC 98/ RQD 74		310								
			25	NQ	REC 100/ RQD 92		309								
307.9 22.3	End of Borehole						308								
	Groundwater level inferred during drilling														

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-03

1 OF 2

METRIC

W.P. 3002-05-00 LOCATION 10+000 22.0m Rt CL Laird Road N: 4 816 960 E: 247 154 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 29 - 2010 07 29 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT kN/m³	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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	WATER CONTENT (%)		
							20 40 60 80 100						
331.6													
0.0	Sandy silt, dark brown, some roots		1	SS	10		331						
331.0													
0.6	Silty gravel with sand (GM) to silty sand with gravel (SM), compact to very dense, moist, brown to light brown		2	SS	13		330						
	- frequent cobbles		3	SS	67		329						
			4	SS	78		328						
			5	SS	68		327						
			6	SS	68		326						
327.1													
4.6	Poorly-graded sand (SP), compact to dense, moist, brown/grey		7	SS	34		325						
			8	SS	12		324						
325.7													
5.9	Silty sand (SM) to silt (ML), dense to very dense, moist, brown/grey		9	SS	35		323						
			10	SS	71		322						
							321						
322.5													
9.1	Sandy silt to sandy silt with gravel (ML), compact to very dense, moist, brown/grey, TILL		11	SS	12		320						
			12	SS	100/ 280mm								

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✕, ✕³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-04

1 OF 2

METRIC

W.P. 3002-05-00 LOCATION 10+000 22.5m Lt CL Laird Road N: 4 816 991 E: 247 123 ORIGINATED BY MA.
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 03 - 2010 08 03 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100					
								SHEAR STRENGTH kPa					
								20 40 60 80 100					
331.2													
0.0	Sandy silt, dark brown, some roots		1	SS	5		331						
330.6													
0.6	Silty gravel with sand (GM), dense to very dense, moist, brown to light brown		2	SS	48		330						52 34 (14)
			3	SS	100/100mm								
							329						
			4	SS	85								
							328						46 41 (13)
			5	SS	36								
							327						
326.8			6	SS	47								
4.4	Silty sand (SM), compact, wet, brown						326						
			7	SS	23								
							325						
			8	SS	18								1 82 (17)
							324						
			9	SS	25								
323.6							323						
7.6	Poorly-graded sand with silt and gravel (SP-SM) to silty sand with gravel (SM), compact to dense, wet, brown, TILL		10	SS	31								41 53 (6)
							322						
			11	SS	22								
							321						
320.2							320						
11.0	Sandy silt with gravel (ML), compact to very dense, moist, grey, TILL		12	SS	10								20 64 (16)

Continued Next Page

✕.✕.✕: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-05

1 OF 3

METRIC

W.P. 3002-05-00 LOCATION 10+034 19.0m Rt CL Laird Road N: 4 816 984 E: 247 175 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers, NO Coring Equipment COMPILED BY KF
 DATUM Geodetic DATE 2010 07 27 - 2010 07 28 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE	WATER CONTENT (%)		
331.4	0.0	Sandy silt, dark brown, some roots	1	SS	10							
331.0	0.5	Well-graded gravel with sand and silt (GW-GM) to poorly-graded sand with gravel and silt (SP-SM), very dense, brown to light brown	2	SS	91							
		- frequent cobbles	3	SS	81							
		- occasional boulders	4	SS	75							
			5	SS	110							
			6	SS	55							
326.9	4.6	Poorly-graded sand with silt (SP-SM), compact to dense, brown	7	SS	31							
		- becomes wet	8	SS	26							
			9	SS	34							
323.8	7.6	Silty sand with gravel (SM) to sandy silt (ML), compact to very dense, moist, brown/grey, TILL	10	SS	14							
			11	SS	41							
			12	SS	18							

Continued Next Page

✕³, ✕³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

✕³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-06

1 OF 2

METRIC

W.P. 3002-05-00 LOCATION 10+034 15.0 Lt CL Laird Road N: 4 817 009 E: 247 152 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 21 - 2010 07 22 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100	20 40 60 80 100	10 20 30					
330.9	Sandy silt, dark brown, some roots		1	SS	8										
330.5															
0.4	Well-graded gravel with sand and silt (GW-GM) to poorly-graded sand with gravel and silt (SP-SM), dense to very dense, brown to light brown		2	SS	67		330								
			3	SS	96		329								
			4	SS	79		328								59 29 (12)
			5	SS	82		327								
			6	SS	76		326								
			7	SS	34		325								40 50 (10)
325.8			8	SS	25		324								
5.2	Silty sand (SM) to sandy silt (ML), compact to dense, wet, grey		9	SS	44		323								0 34 (66)
			10	SS	16		322								
			11	SS	11		321								21 39 (40)
321.8			12	SS	30		320								
9.1	Silty sand with gravel (SM) to sandy silt (ML), compact to very dense, moist, grey, TILL						319								

Continued Next Page

✕ 3. ✕ 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 10-06

2 OF 2

METRIC

W.P. 3002-05-00 LOCATION 10+034 15.0 Lt CL Laird Road N: 4 817 009 E: 247 152 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 21 - 2010 07 22 CHECKED BY SG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Silty sand with gravel (SM) to sandy silt (ML), compact to very dense, moist, grey, TILL (continued)		13	SS	27								
						318							
			14	SS	37	317							
						316							
			15	SS	38	315							
						314							
			16	SS	110/ 250mm	313							
						312							
			17	SS	111/ 250mm								
311.0	End of Borehole		18	SS	100/ 80mm								
19.9	25 mm diameter standpipe installed Groundwater level measured in standpipe on August 16, 2010 at elevation 326.1 m												

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO.MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-07

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+476 6.3m Lt CL Ramp W-S N: 4 816 816 E: 247 010 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 22 - 2010 07 22 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE						20	40	60
329.3																			
0.0	Sandy silt, moist, dark brown, some roots		1	SS	8														
328.9																			
0.4	Silty sand with gravel (SM) to well-graded gravel with silt and sand (GW-GM), dense to very dense, moist to wet, brown - hard augering - cobbles and boulders encountered		2	SS	52														
			3	SS	68														
			4	SS	64											42 42 (16)			
			5	SS	46														
			6	SS	39											56 35 (9)			
			7	SS	45														
			8	SS	51											39 55 (6)			
			9	SS	57														
322.6																			
6.7	End of Borehole 25 mm standpipe installed Groundwater level measured in standpipe on August 18, 2010 at elevation 326.4 m																		

RECORD OF BOREHOLE No BH 10-08

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+777 14.0m Lt CL Laird Road N: 4 816 818 E: 246 974 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 26 - 2010 07 26 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)	
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL							✕ LAB VANE
								20	40	60							80
329.3																	
0.0	Sandy silt, moist, dark brown, some roots		1	SS	11		329										
328.9																	
0.4	Well-graded gravel with silt and sand (GW-GM) to poorly graded sand with silt and gravel (SP-SM), compact to very dense, moist, brown		2	SS	30		328								54 34 (12)		
			3	SS	65		327										
			4	SS	72		326										
			5	SS	55		325										
			6	SS	27		324										
			7	SS	27		323										
324.1																	
5.2	Silt (ML), compact to very dense, wet, brown		8	SS	33		322										
			9	SS	82		321										
			10	SS	26		320								0 15 (85) Non-plastic		
321.1																	
8.2	Poorly graded sand with silt (SP-SM), compact, wet, brown						319										
			11	SS	20												
			12	SS	17										0 90 (10)		
318.0																	
11.3	End of Borehole																
	Groundwater level inferred during drilling																

RECORD OF BOREHOLE No BH 10-09

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+550 CL Ramp W-S N: 4 816 862 E: 247 072 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 30 - 2010 07 30 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
330.8 0.0	Sandy silt, moist, dark brown, some roots		1	SS	8												
330.5 0.4	Silty gravel with sand (GM) to poorly graded gravel with silt and sand (GP-GM), dense to very dense, moist, brown		2	SS	54												
	- frequent cobbles		3	SS	100/ 80mm												
			4	SS	86												
			5	SS	105/ 280mm												
			6	SS	35												
			7	SS	42												
			8	SS	40												
			9	SS	30												
324.3 6.5	Silt with sand (ML), compact, wet																
324.1 6.7	End of Borehole																
	Groundwater level inferred during drilling																

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-10

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+387 8.4m Rt CL Ramp N-EW N: 4 816 877 E: 247 018 ORIGINATED BY MA
DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
DATUM Geodetic DATE 2010 08 04 - 2010 08 04 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
329.1							20	40	60	80	100							
0.0	Sandy silt, moist, dark brown, some roots		1	SS	7	▽	329									47 40 (13)		
328.6																		
0.6	Silty gravel with sand (GM) to well-graded gravel with silt and sand (GW-GM), dense to very dense, wet, brown		2	SS	42		328											
	- frequent cobbles		3	SS	56		327											
			4	SS	82		326											
			5	SS	35		325											
			6	SS	53		324											
324.6																		
4.6	Poorly graded sand (SP), loose to compact, wet, brown		7	SS	7		323											
			8	SS	26		322											
323.0																		
6.1	Silt (ML), compact to dense, wet, brown		9	SS	50	321												
			10	SS	20	320												
			11	SS	51													
319.4																		
9.8	End of Borehole																	
	Groundwater level inferred during drilling																	

RECORD OF BOREHOLE No BH 10-11

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+358 6.0m Rt CL Ramp N-EW N: 4 816 892 E: 246 996 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 04 - 2010 08 04 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
328.5																	
0.0	Sandy silt, moist, dark brown, some roots		1	SS	6												
328.0							328										
0.5	Well-graded sand with silt and gravel (SW-SM), compact to very dense, wet, brown		2	SS	42												
	- some cobbles		3	SS	100/ 200mm		327										
			4	SS	100/ 200mm		326										
			5	SS	35		325										
			6	SS	24		324										
			7	SS	17		323										
323.3			8	SS	30		322										
5.2	Silt (ML), dense, wet, brown to grey, some sand		9	SS	35		321										
			10	SS	22		320										
			11	SS	15		319										
318.8	End of Borehole																
9.8	Groundwater level inferred during drilling																


ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-12

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+325 9.0m Lt CL Ramp N-E/W N: 4 816 923 E: 246 982 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 04 - 2010 08 04 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
							20	40	60	80	100	10	20	30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
328.5	Sandy silt, dark brown, moist, FILL		1	SS	7	▽	328																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

RECORD OF BOREHOLE No BH 10-13

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+256 11.6m Lt CL Ramp N-E/W N: 4 816 982 E: 246 958 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 10 - 2010 08 10 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE					
328.7							20	40	60	80	100					
0.0	Sandy silt, moist, dark brown, some roots		1	SS	10											
328.4																
0.4	Well graded gravel with silt and sand (GW-GM), compact to very dense, moist, brown - hard augering - some cobbles		2	SS	24											
			3	SS	85							○				52 37 (11)
			4	SS	107/ 230 mm											
			5	SS	51							○				48 46 (6)
325.1																
3.7	Poorly graded sand with silt (SP-SM) to silty sand (SM), compact to dense, wet, brown		6	SS	25											
			7	SS	25											
			8	SS	23											
			9	SS	47											
			10	SS	14								○			0 52 (48) Non-plastic
319.6																
9.1	Silt with sand (ML), trace clay, very dense, wet, grey		11	SS	50											
319.0																
9.8	End of Borehole															
	Groundwater level inferred during drilling															

RECORD OF BOREHOLE No BH 10-14

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+208 CL Ramp N-E/W N: 4 817 029 E: 246 943 ORIGINATED BY M.A.
 DIST HWY 6 BOREHOLE TYPE Spillspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 11 - 2010 08 11 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20 40 60 80 100												
								20 40 60 80 100												
328.4	Sandy silt, moist, dark brown, some roots		1	SS	8		328													
327.9																				
0.5			Poorly graded sand with silt and gravel (SP-SM), wet, brown	2	SS		25	327												
				3	SS		108/ 250 mm	326												
				4	SS		24													
			5	SS	22		325													
324.6	Silty sand (SM), compact to dense, wet, brown		6	SS	29			324												
			7	SS	34		323													
			8	SS	30		322													
			9	SS	32		321													
			10	SS	46		320													
319.3																				
9.1	Well graded gravel with silt and sand (GW-GM), dense, brown		11	SS	43		319													
318.6																				
9.8	End of Borehole																			
	Groundwater level inferred during drilling																			

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-15

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+900 CL Ramp E-S N: 4 817 011 E: 246 985 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 10 - 2010 08 10 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								20 40 60 80 100									
							20 40 60 80 100					10 20 30					
							20 40 60 80 100					10 20 30					
328.4																	
0.0																	
328.1	Sandy silt, moist, dark brown, some roots																
0.3	Well graded gravel with silt and sand (GW-GM), compact to very dense, wet, brown - some cobbles		1	SS	10		328									47 45 (8)	
			2	SS	38		327										
			3	SS	100/ 230 mm		326										
326.1	Poorly graded sand with silt and gravel (SP-SM) to silty sand (SM), compact to very dense, wet, brown - some cobbles		4	SS	56		325										
			5	SS	31		324										
			6	SS	51		323										
			7	SS	27		322										
323.2	Sandy silt (ML), compact to dense, wet, brown		8	SS	11		321									0 39 (61)	
			9	SS	37		320									0 44 (56)	
321.7	Silty sand with gravel (SM), compact, wet, brown		10	SS	34		319										
			11	SS	7												
318.6	End of Borehole																
9.8	25mm standpipe installed Groundwater level measured in standpipe on August 18, 2010 at elevation 325.9m																

RECORD OF BOREHOLE No BH 10-16

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+760 13.7m Lt CL Ramp E-S N: 4 816 906 E: 247 043 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 05 - 2010 08 05 CHECKED BY SG










SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	✱ FIELD VANE	● QUICK TRIAXIAL						✕ LAB VANE	WATER CONTENT (%)
329.9							20	40	60	80	100						
0.0	Sandy silt, moist, dark brown, some roots		1	SS	10												
329.3																	
0.6	Silty gravel with sand (GM) to poorly graded sand (SP), loose to very dense, moist to wet, brown - some cobbles - becoming less gravelly with depth		2	SS	30										52 36 (12)		
			3	SS	44												
			4	SS	42												
			5	SS	75/ 130mm												
			6	SS	85												
			7	SS	20												
324.6																	
5.3	Poorly graded sand (SP), loose to dense, wet, brown		8	SS	9										11 85 (4)		
			9	SS	31												
322.3																	
7.6	Sandy silt (ML), compact, wet, brown		10	SS	15										0 49 (51) Non-plastic		
			11	SS	27												
320.1																	
9.8	End of Borehole																
	Groundwater level inferred during drilling																

RECORD OF BOREHOLE No BH 10-17

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+650 CL Ramp W-S N: 4 816 865 E: 247 170 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 05 - 2010 08 05 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
331.4								20	40	60	80	100		
0.0	Sandy silt, moist, dark brown, some roots		1	SS	20	▽	331							
331.0	Well graded gravel with silt and sand (GW-GM), compact to very dense, moist, brown - frequent cobbles		2	SS	37		330							
0.4			3	SS	72									
			4	SS	60		329							49 40 (11)
			5	SS	32		328							
			6	SS	27		327							38 50 (12)
326.8		Well graded sand with silt and gravel (SW-SM) to poorly graded sand (SP), compact to dense, wet, brown		7	SS		47	326						
4.6			8	SS	10									
			9	SS	18		325							24 70 (6)
324.7	End of Borehole													
6.7	Groundwater level inferred during drilling													

RECORD OF BOREHOLE No BH 10-18

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+600 CL Ramp W-S N: 4 816 873 E: 247 120 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splispoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 05 - 2010 08 05 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE								
330.4							20	40	60	80	100	10	20	30	GR	SA	SI	CL	
0.0	Sandy silt, moist, dark brown, some roots		1	SS	4	▽	330								45	40	(15)		
330.0	Silty gravel with sand (GM) to poorly graded gravel with silt and sand (GP-GM), compact to very dense, moist, brown - frequent cobbles																		
0.5			2	SS	49		329												
			3	SS	88		328												
			4	SS	100/ 250mm		327												
			5	SS	51		326												
			6	SS	61		325												
			7	SS	21		324												
325.2			Poorly graded sand with silt (SP-SM), compact to very dense, wet, brown	8	SS		13												
5.2		9	SS	31															
323.7	End of Borehole																		
6.7	Groundwater level inferred during drilling																		

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-19

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+929 28.0m Lt CL Laird Road N: 4 816 944 E: 247 068 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 07 30 - 2010 07 30 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)																																																																																																	
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE	20						40	60	80	100	10	20	30																																																																																											
329.9 0.0	Sandy silt, moist, dark brown, some roots		1	SS	3	▽	329																																																																																																												
329.4 0.5	Poorly-graded gravel with silt and sand (GP-GM), compact to very dense, moist, brown to light brown		2	SS	22												328																																																																																																		
	- occasional cobbles		3	SS	75																							327																																																																																							
			4	SS	50																																		326																																																																												
			5	SS	28																																													325																																																																	
326.1 3.8	Poorly-graded sand with gravel (SP), compact, wet, brown		6	SS	20																																																								324																																																						
			7	SS	12																																																																			323																																											
324.6 5.3	Sandy silt (ML), compact to dense, wet, brown		8	SS	20																																																																														322																																
			9	SS	25																																																																																									321																					
			10	SS	24																																																																																																														
			11	SS	45																																																																																																														
320.1 9.8	End of Borehole																																																																																																																		
	Groundwater level inferred during drilling																																																																																																																		

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-20

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+078 20.0m Rt Laird Road N: 4 817 015 E: 247 208 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splispoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 13 - 2010 08 13 CHECKED BY SG





SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED ✕ FIELD VANE											
								● QUICK TRIAXIAL ✕ LAB VANE											
					WATER CONTENT (%)														
					20 40 60 80 100					10 20 30									
329.5																			
0.0	Sandy silt, moist, dark brown, some roots		1	SS	9														
329.0																			
0.5	Well-graded gravel with sand and silt (GW-GM) to poorly graded sand with silt and gravel (SP-SM), dense to very dense, moist, brown to light brown - frequent cobbles		2	SS	100/ 230mm														
			3	SS	100/ 200mm														
			4	SS	38														
			5	SS	29														
325.9																			
3.7	Silty sand with gravel (SP-SM), compact to very dense, wet, brown		6	SS	51														
			7	SS	25														
			8	SS	35														
323.6																			
5.9	Silty sand (SM), compact, wet, brown		9	SS	26														
			10	SS	18														
321.3																			
8.2	End of Borehole																		
	Groundwater level inferred during drilling																		

RECORD OF BOREHOLE No BH 10-21

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+750 1.4m Lt CL Ramp W-N N: 4 817 034 E: 247 228 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 12 - 2010 08 12 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE						
331.2 0.0	Sandy silt, moist, dark brown, some roots		1	SS	10										
330.6 0.6	Well graded gravel with silt and sand (GW-GM), dense to very dense, wet, brown - frequent cobbles		2	SS	100/ 80mm										
			3	SS	48										
			4	SS	62										
			5	SS	43										
			6	SS	100/ 230mm										
327.0 4.2	Poorly graded sand (SP), compact to very dense, wet, brown		7	SS	52										
			8	SS	18										
			9	SS	43										
324.5 6.7	Silty sand (SM), very dense, wet, brown		10	SS	59										
			11	SS	104/ 280mm										
			12	SS	65										
319.9 11.3	End of Borehole														
	Groundwater level inferred during drilling														

RECORD OF BOREHOLE No BH 10-22

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+613 6.5m Rt CL Ramp E-N N: 4 817 082 E: 247 143 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 16 - 2010 08 16 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100								
								SHEAR STRENGTH kPa								
								20 40 60 80 100								
330.0																
0.0	Sandy silt, moist, dark brown, some roots		1	SS	16		329								18 50 (32)	
329.7																
0.3	Well graded gravel with silt and sand (GW-GM), compact to very dense, wet, brown		2	SS	42											
328.6																
1.4	Sand with silt and gravel, compact to dense, moist, brown		3	SS	63				328							
			4	SS	100/ 230mm											
326.9									327							
3.1	Silty sand with gravel (SM), dense to very dense, wet, brown - becoming less gravelly with depth		5	SS	53											
									326							
			6	SS	30											
							325									
			7	SS	35											
							324									
			8	SS	57											
			9	SS	65											
323.3																
6.7	End of Borehole															
	Groundwater level inferred during drilling															

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MTO.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-23

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+555 CL Ramp E-N N: 4 817 084 E: 247 199 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 13 - 2010 08 16 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20 40 60 80 100										
330.7 0.0	Sandy silt, dark brown, moist, FILL		1	SS	11		330								46 37 (17)			
330.1 0.6	Sand with silt and gravel, dense, moist, brown, FILL		2	SS	33													
329.4 1.4	Silty gravel with sand (GM), compact to very dense, wet, brown		3	SS	26			329										
			4	SS	100/ 230mm				328									
			5	SS	53					327								
			6	SS	101/ 280mm						326							
			7	SS	40							325						
325.6 5.2	Silty sand (SM), compact, wet, brown		8	SS	24													
			9	SS	10													
324.0 6.7	End of Borehole																	
	Groundwater level inferred during drilling																	

RECORD OF BOREHOLE No BH 10-24

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+846 CL Ramp W-N N: 4 816 985 E: 247 308 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Spillspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 11 - 2010 08 11 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
332.3								20	40	60	80	100					
332.0	Sandy silt, dark brown, moist, FILL		1	SS	14												
0.2	Sand with gravel, very dense, damp, brown, FILL																
331.7																	
0.6	Well-graded gravel with silt and sand (GW-GM), very dense, moist, brown - frequent cobbles		2	SS	100/ 230 mm												55 33 (12)
			3	SS	100/ 230 mm												
			4	SS	100/ 200 mm												
			5	SS	100/ 230 mm												57 34 (9)
			6	SS	100/ 100 mm												
			7	SS	100/ 130 mm												
327.0																	
5.3	Poorly graded sand with silt (SP-SM), loose to very dense, wet, brown		8	SS	39												
			9	SS	26												
			10	SS	9												1 73 (26)
324.1																	
8.2	End of Borehole																
	25 mm standpipe installed																
	Groundwater level measured in standpipe on August 18, 2010 at elevation 327.0m																

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-25

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+330 10.5m Lt CL Ramp S-EW N: 4 817 031 E: 247 290 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splittings, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 12 - 2010 08 12 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE									
332.2																				
330.4 0.1	Sandy silt, moist, dark brown, FILL Sand with gravel, very dense, damp, brown, FILL		1	SS	20		332													
331.6 0.6	Well graded gravel with silt and sand (GW-GM), dense to very dense, moist, brown - some cobbles		2	SS	100/ 200 mm		331													
			3	SS	100/ 230 mm		330													
			4	SS	38		329									51 40 (9)				
			5	SS	73		328									39 53 (8)				
			6	SS	100/ 250 mm		327									4 93 (3)				
327.6 4.6	Poorly graded sand (SP), compact to very dense, wet, brown - some cobbles		7	SS	32		326													
			8	SS	24															
			9	SS	28															
325.5 6.7	End of Borehole Groundwater level inferred during drilling																			

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ ONTARIO MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-26

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 10+371 7.0m Lt CL Ramp S-EW N: 4 817 064 E: 247 258 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 12 - 2010 08 12 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20	40	60	80			100	
331.9	0.0	Sandy silt, moist, dark brown, FILL	1	SS	11										
331.3	0.6	Sandy silt with gravel (ML), dark brown, compact, moist, FILL	2	SS	15										
			3	SS	18										
329.8	2.1	Silty gravel with sand (GM) to poorly graded sand with silt and gravel (SP-SM), compact to very dense, moist to wet, brown	4	SS	100/ 130mm										
		- frequent cobbles	5	SS	100/ 100mm										
			6	SS	100/ 50mm										
			7	SS	50										
326.4	5.5	Poorly graded sand with silt (SP-SM), compact to very dense, wet, brown	8	SS	51										
			9	SS	21										
325.2	6.7	End of Borehole													
		Groundwater level inferred during drilling													

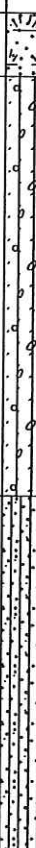

ONTARIO MTO STANTEC 165000749 - HWY 6 & LAIRD RD.GPJ_ONTARIO.MOT.GDT 5/5/11

RECORD OF BOREHOLE No BH 10-27

1 OF 1

METRIC

W.P. 3002-05-00 LOCATION 9+508 8.0m Lt CL Ramp E-N N: 4 817 101 E: 247 242 ORIGINATED BY MA
 DIST HWY 6 BOREHOLE TYPE Splitterspoons, Hollow Stem Augers COMPILED BY KF
 DATUM Geodetic DATE 2010 08 13 - 2010 08 13 CHECKED BY SG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE	WATER CONTENT (%)					
330.7																	
0.0	Sandy silt, moist, dark brown		1	SS	13		330										
330.2																	
0.5	Silty gravel with sand (GM), compact to dense, moist, brown		2	SS	45												41 34 (25)
			3	SS	22			329									
			4	SS	11			328									
			5	SS	18												46 48 (6)
326.9							327										
3.8	Silty sand (SM), compact to dense, wet, brown		6	SS	18												
			7	SS	24		326										
			8	SS	30		325									8 74 (18)	
			9	SS	33												
324.0							324										
6.7	End of Borehole																
	Groundwater level inferred during drilling																

3, 3: Numbers refer to Sensitivity

3% STRAIN AT FAILURE



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Field Core Log

Client:	MTO	Project No.:	165000749
Project:	Highway 6 and Laird Road Interchange, Guelph	Date:	July 20, 2010
Contractor:	DBW	Borehole No.:	BH10-2
		Logger:	M. Abdel-Mesih

DEPTH FROM (m)	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO (m)	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	
18.44	1	62	0	18.9	Grey limestone	S	S	1	B	F	C-M	RP		T	
18.9	2	98	74	20.42	Grey limestone		S	1	B	F	C-M	RP		T	
20.42	3	100	92	22.25	Grey limestone	VS	S	1	B	F	C-M	RP		T	

STRENGTH (MPa)
EH = Extremely Strong = > 250
VS = Very Strong = 100-250
S = Strong = 50-100
MS = Medium Strong = 25-50
W = Weak = 5 - 25

WEATHERING
U = Unweathered = No Signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-like

DISCONTINUITY TYPE
B = Bedding Joint
J = Cross Joint
F = Fault
S = Shear Plane

SPACING
VW = Very Wide = >3m
W = Wide = 1-3 m
M = Moderate = 0.3-1 m
C = Close = 5-30 cm
VC = Very Close = <5 cm

ORIENTATION
F = Flat = 0-20°
D = Dipping = 20-50°
V = n-Vertical = >50°

ROUGHNESS
RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
LU = Slickensided Undulating
LP = Slickensided Planar

FILLING
T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Silty, Minor Clay
NC = Non-softening Clay
SC = Swelling, Soft Clay



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Field Core Log

Client: MTO
Project: Highway 6 and Laird Road Interchange, Guelph
Contractor: DBW
Project No.: 165000749
Date: July 28, 2010
Borehole No.: BH10-5
Logger: M. Abdel-Mesih

DEPTH FROM (m)	RUN NO.	% CORE RECOVERY	% RQD	DEPTH TO (m)	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	
22.05	1	93	71	23.01	Grey limestone	S	S	1	B	F	C	RP		T	
23.01	2	96	75	24.84	Grey limestone		S	1	B	D		RP		T	
24.84	3	96	84	26.7	Grey limestone	S	S	1	B	F		RP		T	

STRENGTH (MPa)
 EH = Extremely Strong = > 250
 VS = Very Strong = 100-250
 S = Strong = 50-100
 MS = Medium Strong = 25-50
 W = Weak = 5 - 25

WEATHERING
 U = Unweathered = No Signs
 S = Slightly = Oxidized
 M = Moderately = Discoloured
 H = Highly = Friable
 C = Completely = Soil-like

SPACING
 VW = Very Wide = >3m
 W = Wide = 1-3 m
 M = Moderate = 0.3-1 m
 C = Close = 5-30 cm
 VC = Very Close = <5 cm

DISCONTINUITY TYPE
 B = Bedding Joint
 J = Cross Joint
 F = Fault
 S = Shear Plane

ORIENTATION
 F = Flat = 0-20°
 D = Dipping = 20-50°
 V = n-Vertical = >50°

FILLING
 T = Tight, Hard
 O = Oxidized
 SA = Slightly Altered, Clay Free
 S = Sandy, Clay Free
 Si = Sandy, Silty, Minor Clay
 NC = Non-softening Clay
 SC = Swelling, Soft Clay

ROUGHNESS
 RU = Rough Undulating
 RP = Rough Planar
 SU = Smooth Undulating
 SP = Smooth Planar
 LU = Slickensided Undulating
 LP = Slickensided Planar

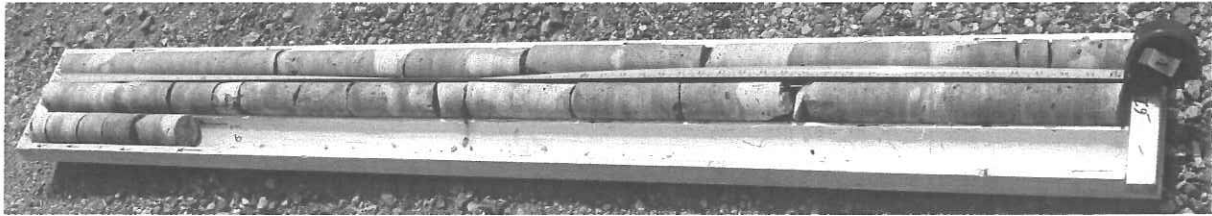


Photo No. 1: BH10-2 – Depth 18.44 m to 22.25 m



Photo No. 2: BH10-5 – Depth 22.05 m to 26.7 m



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Project No. 165000749

APPENDIX C

Laboratory Test Results

Figures 1-4: Grain Size Distribution Plots

Figure 5: Plasticity Chart

CLAY & SILT	SAND			Gravel	
	Fine	Medium	Coarse	Fine	Coarse

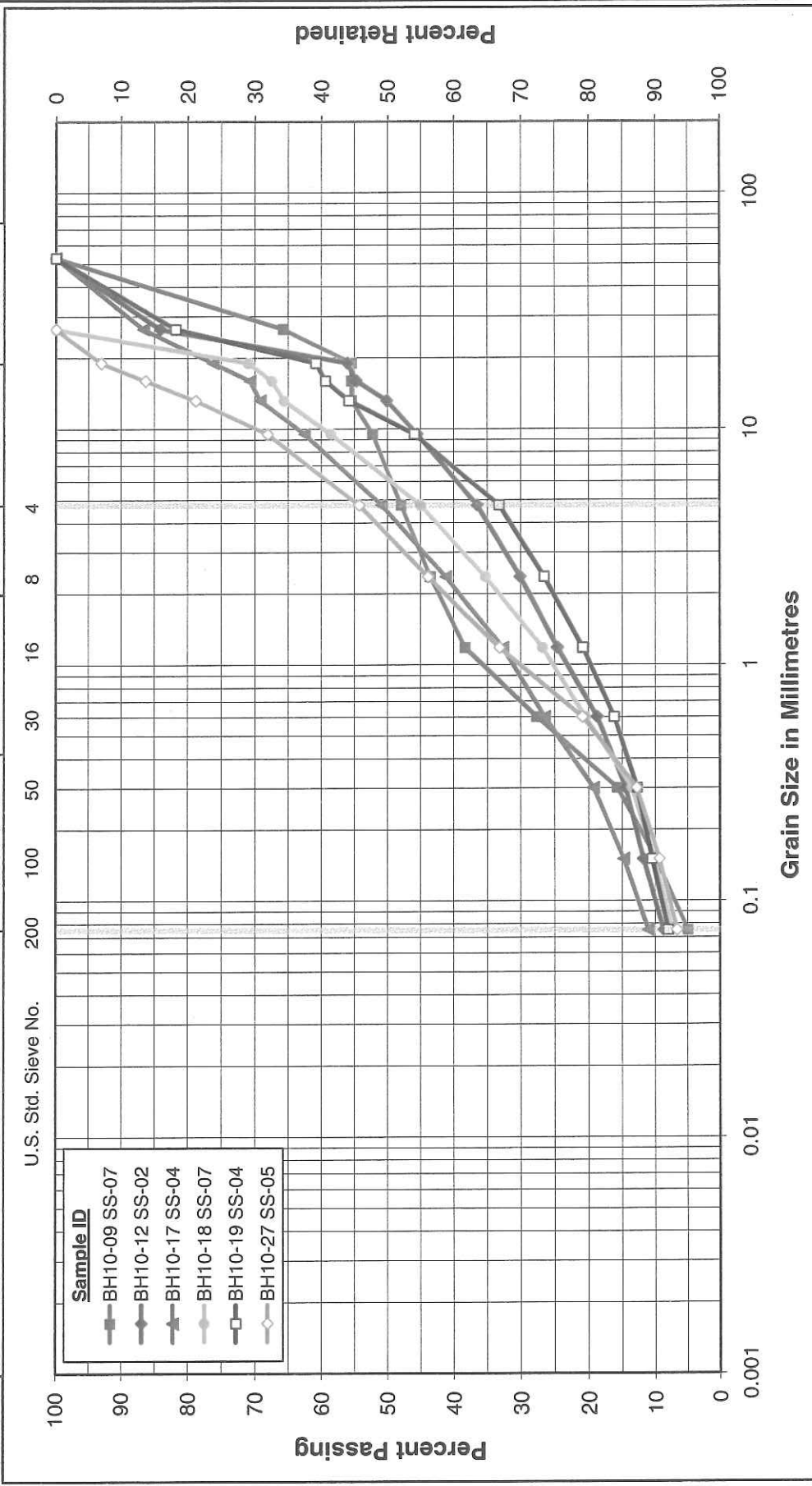


Gravel with Silt and Sand (GP-GM, GM, GW-GM)

Project No. 165000749

Unified Soil Classification System

CLAY & SILT		SAND			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



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GRAIN SIZE DISTRIBUTION

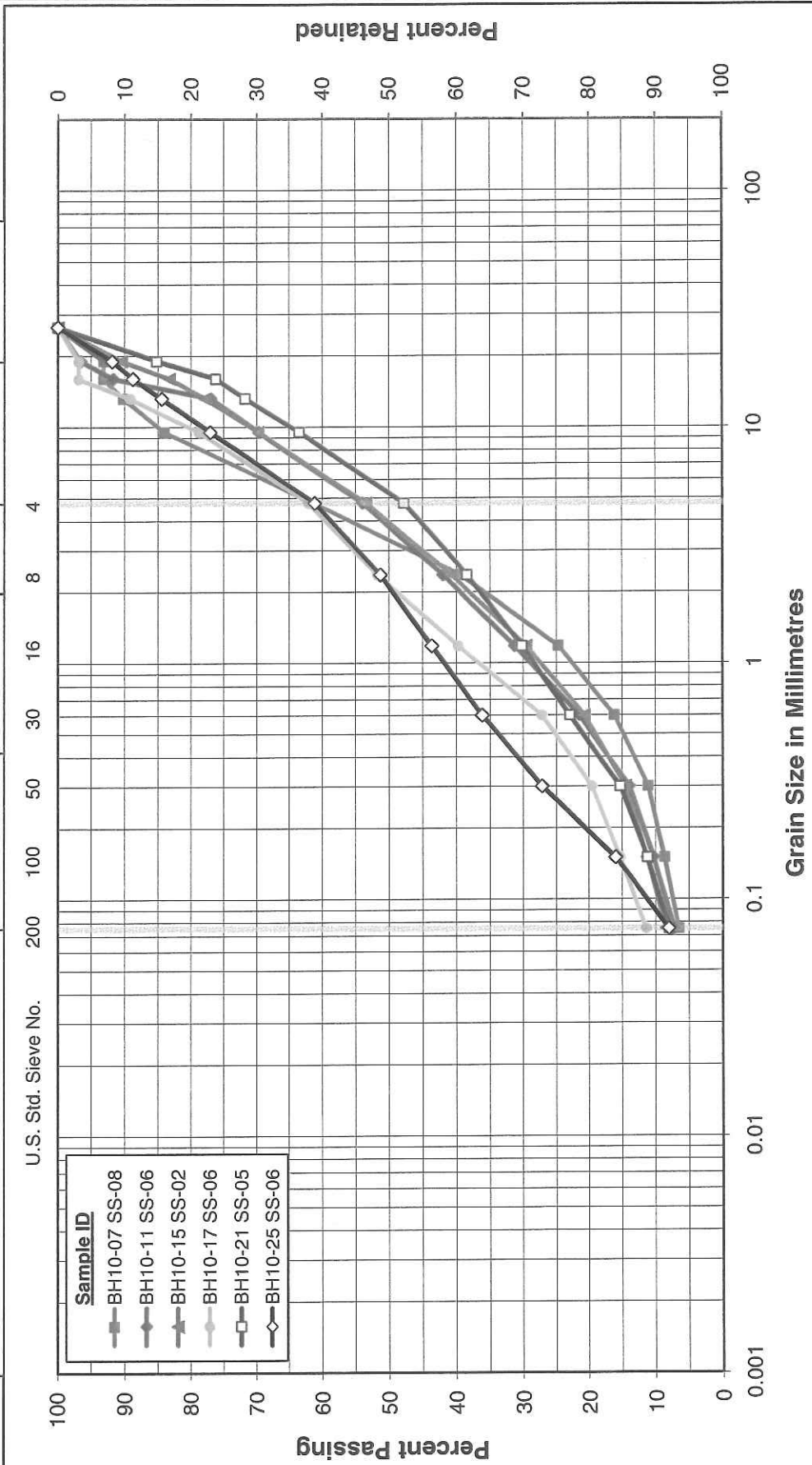
Gravel with Silt and Sand (GW-GM, GP-GM)

Figure No. 1b

Project No. 165000749

Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

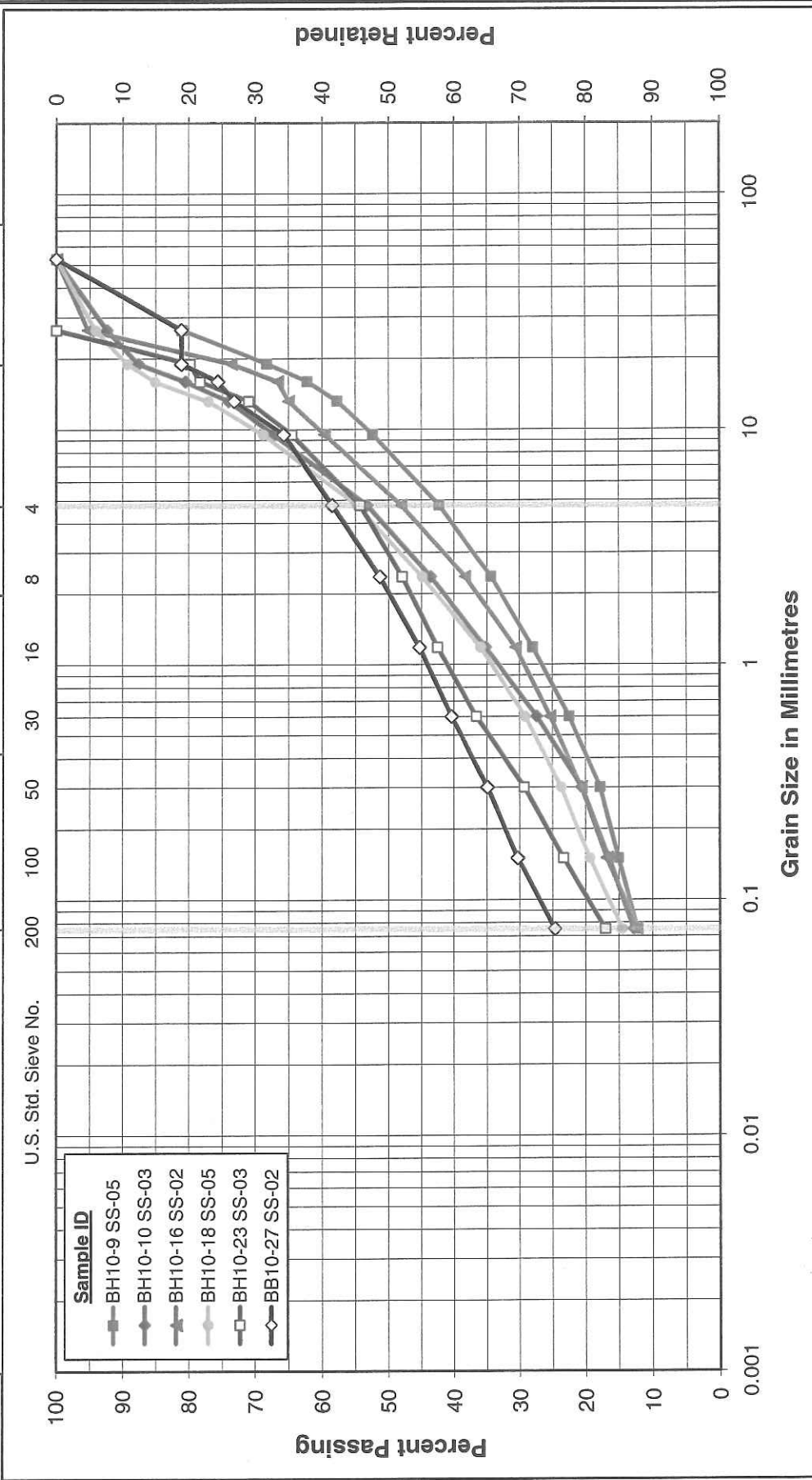
Gravel and Sand with Silt (GW-GM, SW-SM, SP)

Figure No. 1c

Project No. 165000749

Unified Soil Classification System

CLAY & SILT		SAND				Gravel	
		Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

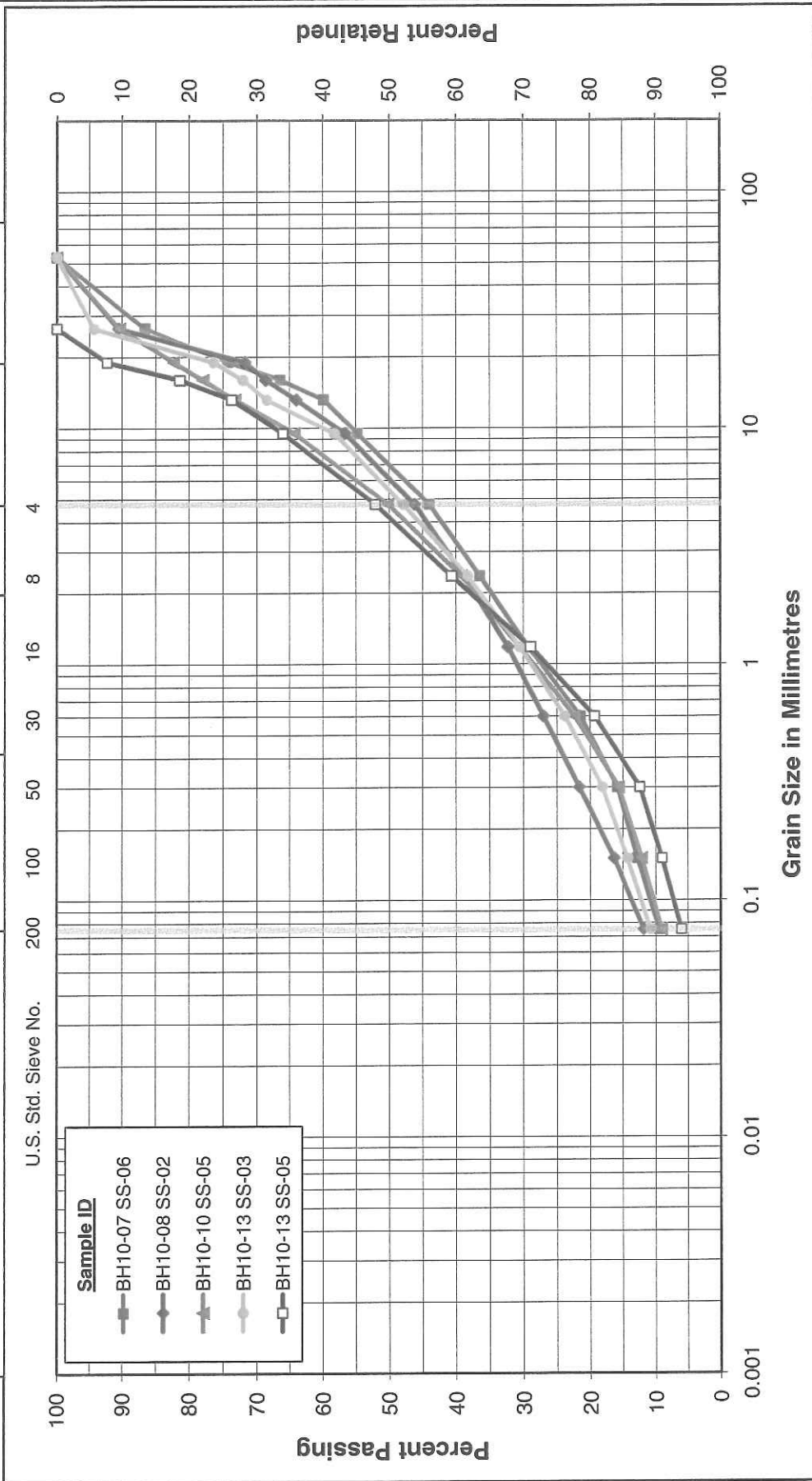
Silty Gravel with Sand (GM)

Figure No. 1d

Project No. 165000749

Unified Soil Classification System

CLAY & SILT	SAND				GRAVEL	
	Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

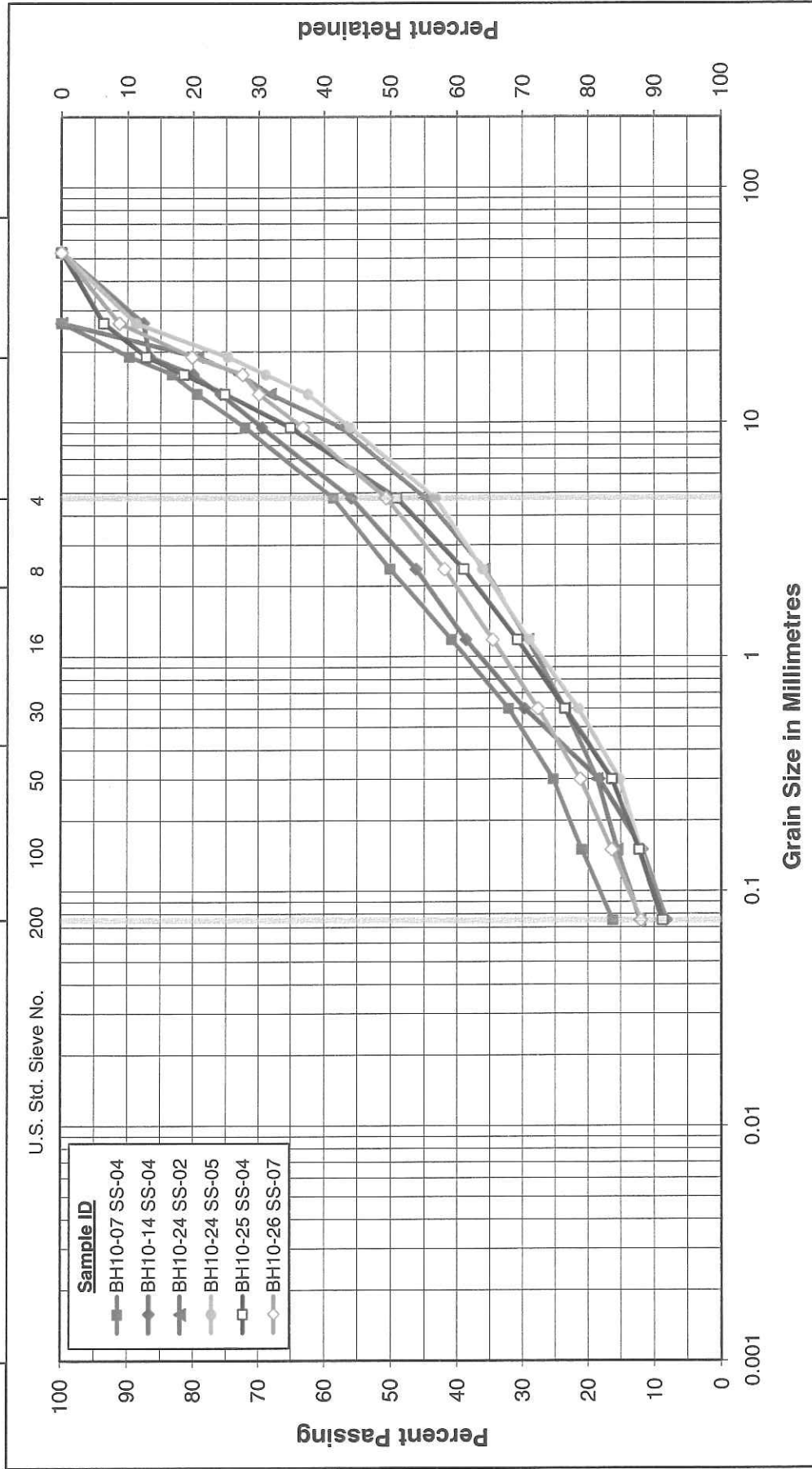
Well-graded Gravel with Silt and Sand (GW-GM)

Figure No. 1e

Project No. 165000749

Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

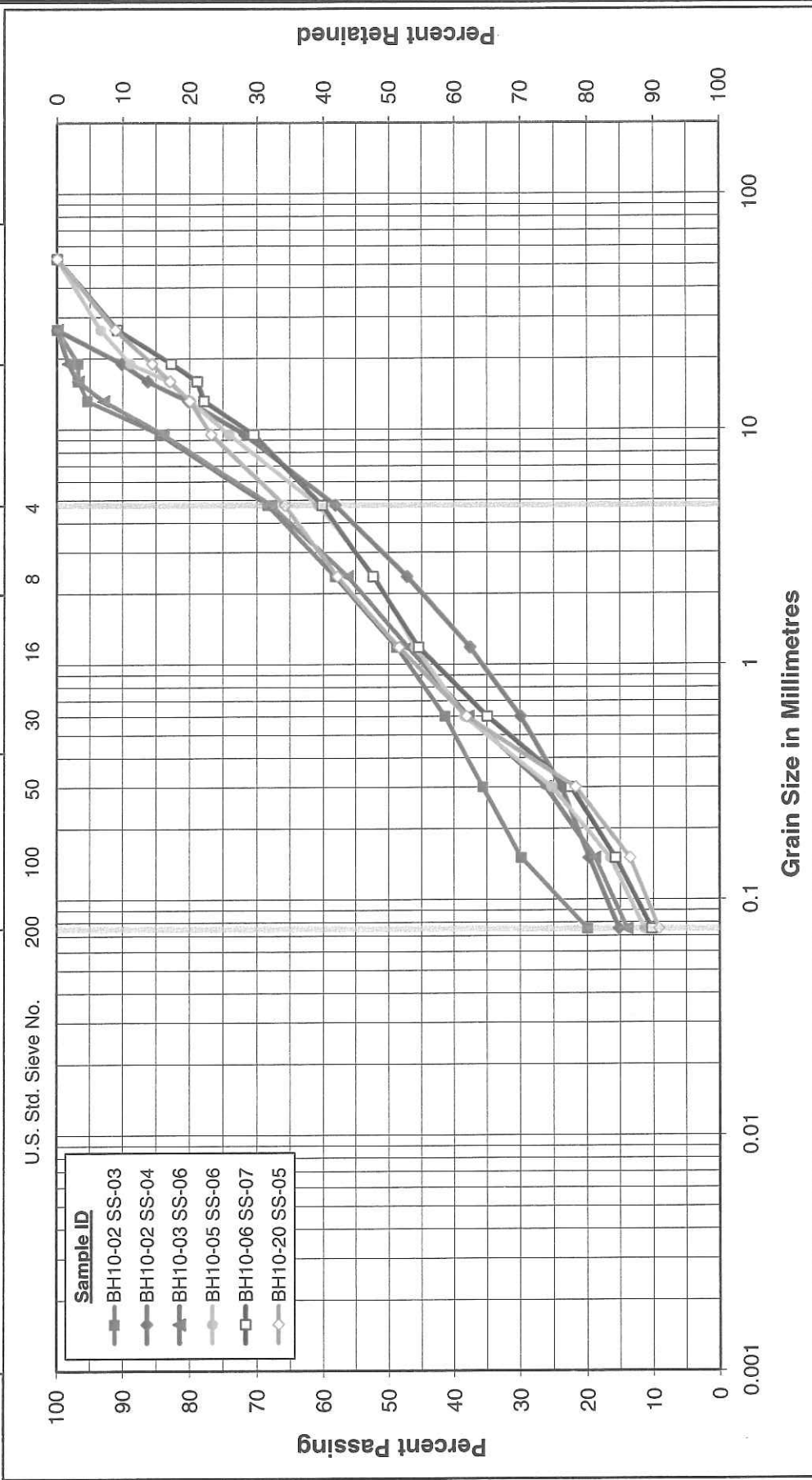
Well-graded Gravel with Silt and Sand (GW-GM)

Figure No. 1f

Project No. 1650000749

Unified Soil Classification System

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse



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GRAIN SIZE DISTRIBUTION

Sand with Silt and Gravel (SP-SM)

Figure No. 1g

Project No. 165000749

	SAND			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
CLAY & SILT					

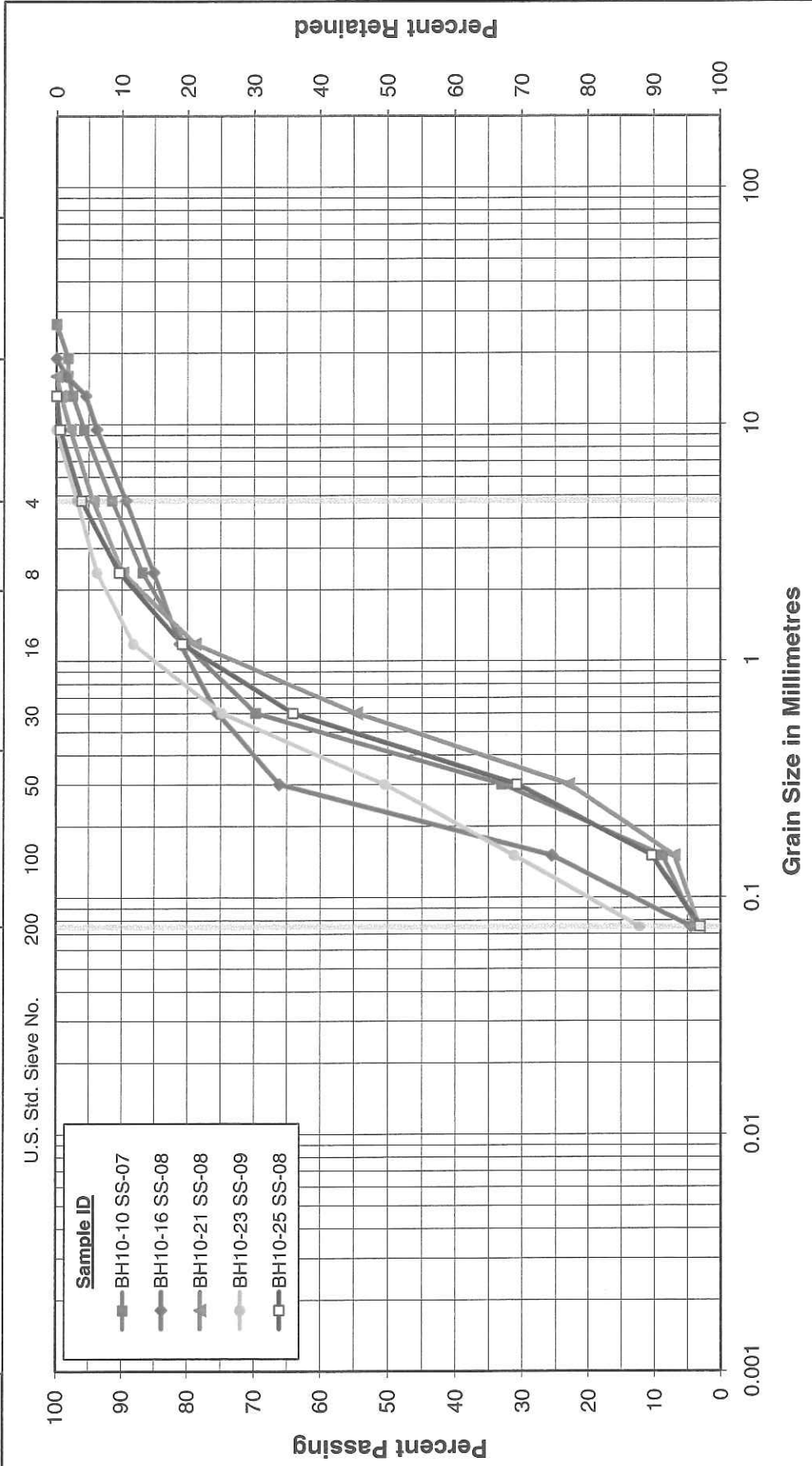


Silty Sand with Gravel (SM)

Project No. 165000749

Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

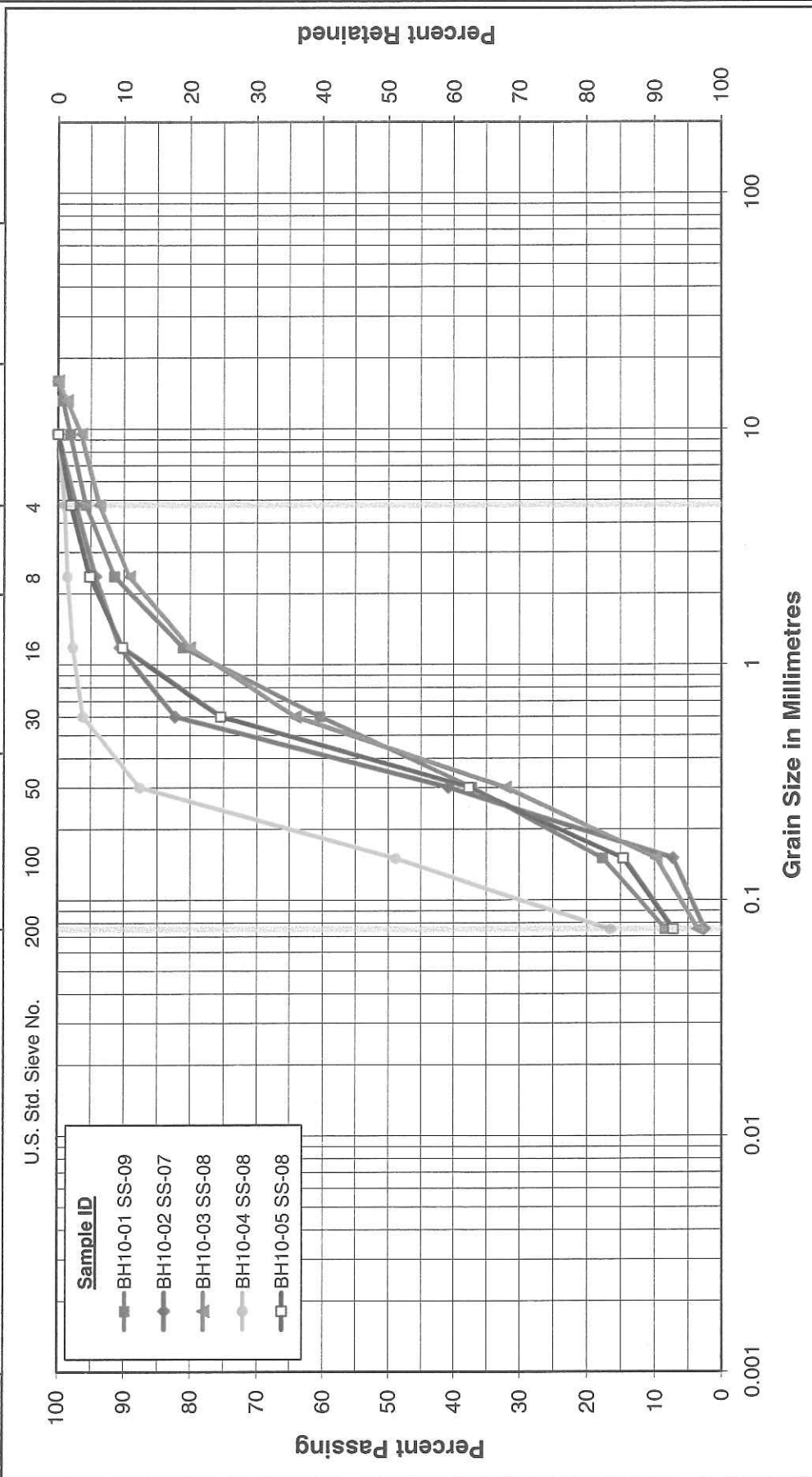
Poorly Graded Sand (SP)

Figure No. 2b

Project No. 165000749

Unified Soil Classification System

CLAY & SILT		SAND				Gravel	
		Fine	Medium	Coarse		Fine	Coarse



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GRAIN SIZE DISTRIBUTION

Sand (SP, SW-SM, SP-SM)

Figure No. 2c

Project No. 165000749

		SAND			Gravel	
		Fine	Medium	Coarse	Fine	Coarse
CLAY & SILT						

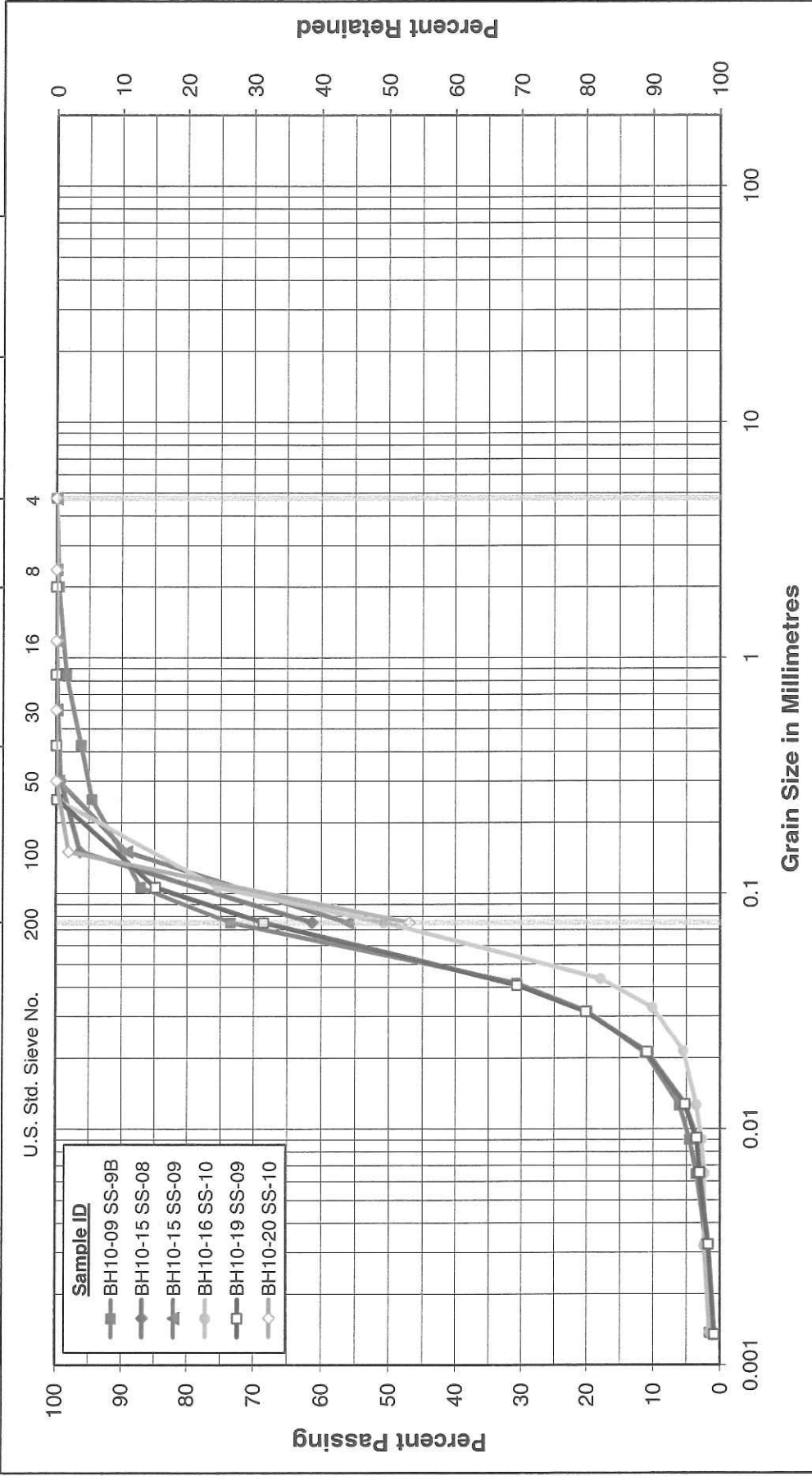


Silty Sand (SM)

Project No. 165000749

Unified Soil Classification System

CLAY & SILT		SAND			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



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GRAIN SIZE DISTRIBUTION

Silt to Sandy Silt (ML)

Figure No. 3a

Project No. 165000749

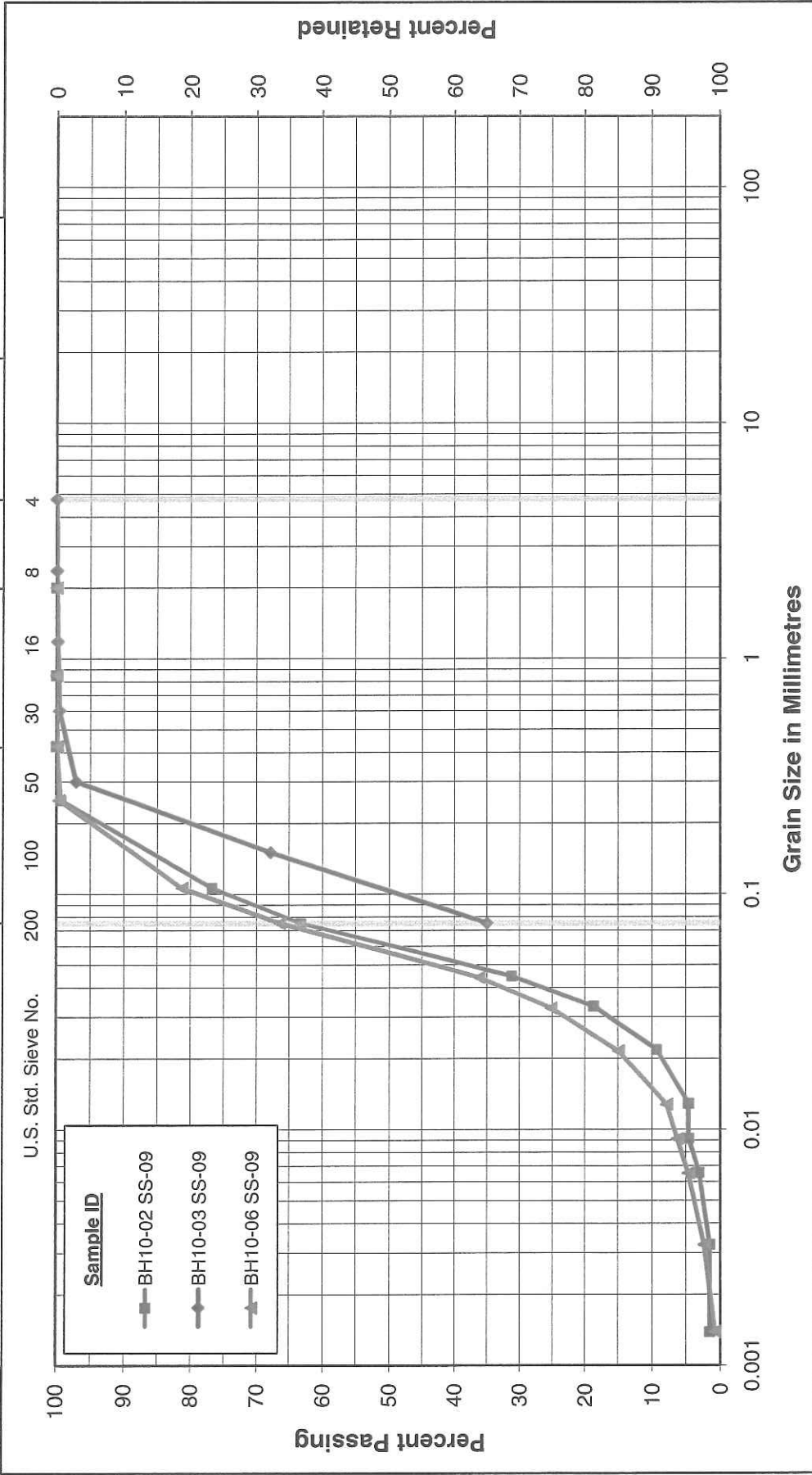
	SAND			Gravel	
CLAY & SILT	Fine	Medium	Coarse	Fine	Coarse



Project No. 165000749

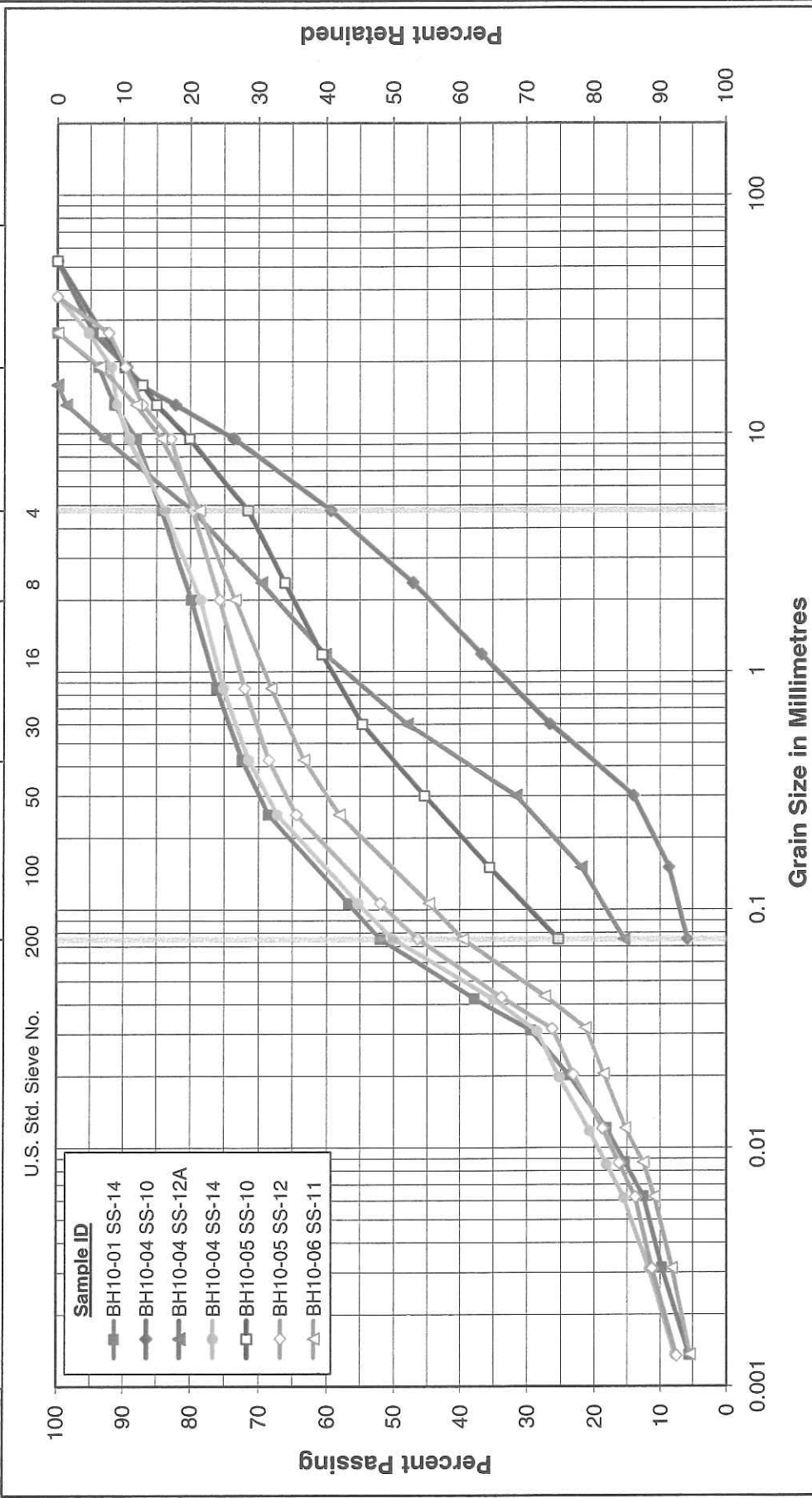
Unified Soil Classification System

CLAY & SILT	SAND			Gravel	
	Fine	Medium	Coarse	Fine	Coarse



Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse		Fine	Coarse



GRAIN SIZE DISTRIBUTION

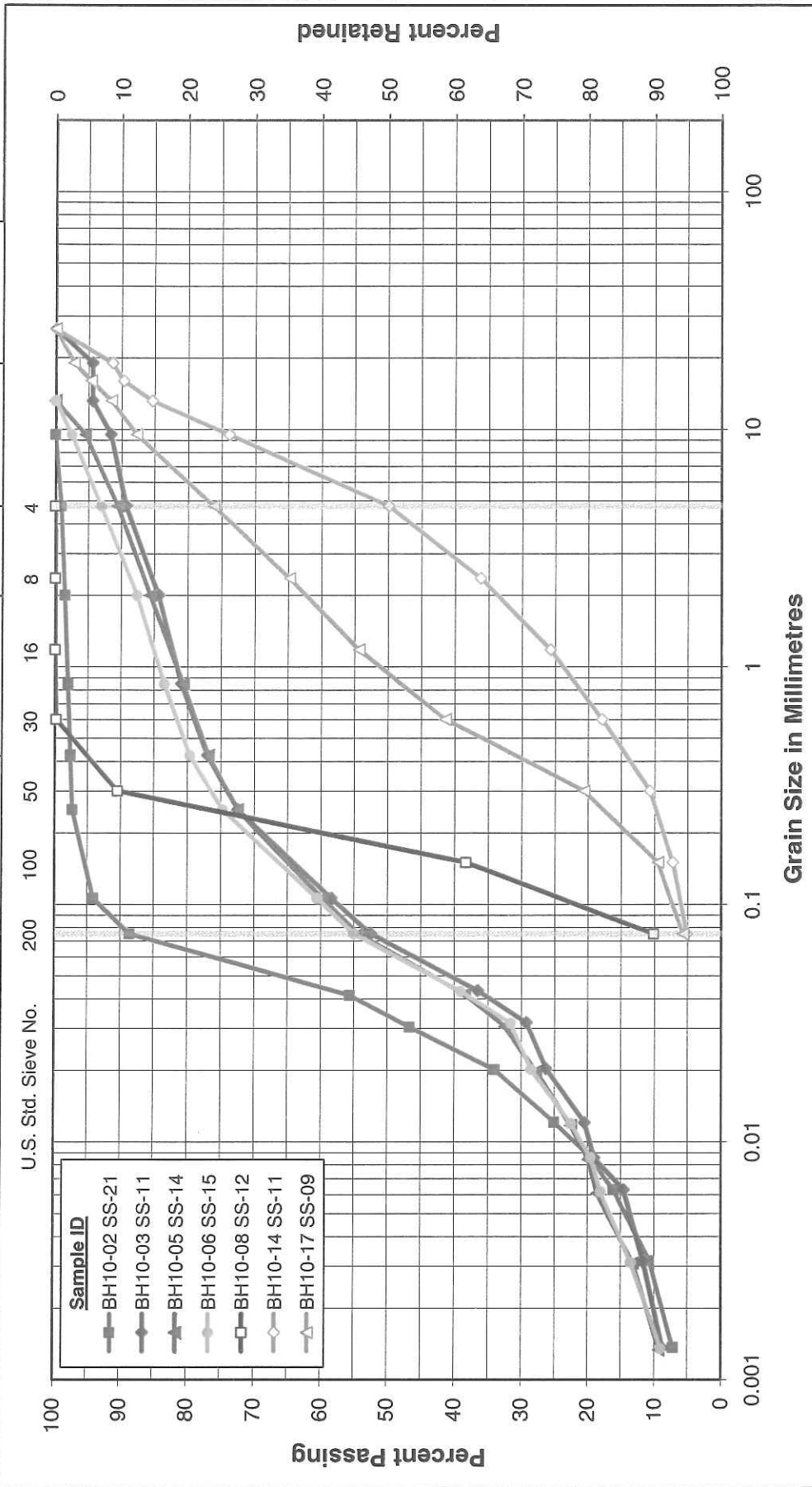
Sandy Silt with Gravel (ML) / TILL

Figure No. 4a

Project No. 165000749

Unified Soil Classification System

CLAY & SILT	SAND				Gravel	
	Fine	Medium	Coarse	Fine	Fine	Coarse



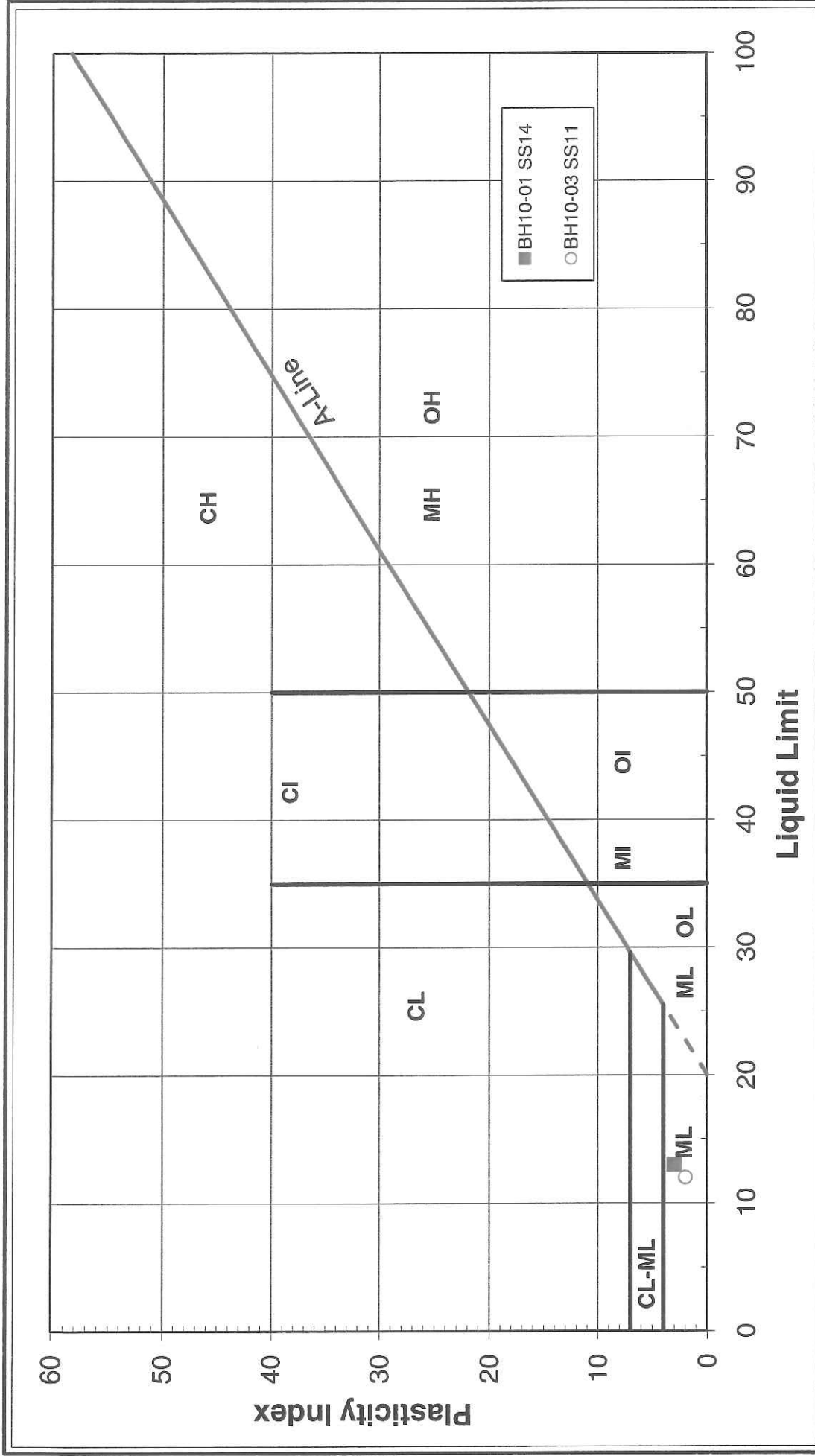
Stantec

GRAIN SIZE DISTRIBUTION

Gravel and Sand with Silt, Sand, Silt
(GW-GM, SW-SM, SP, ML) / TILL

Figure No. 4b

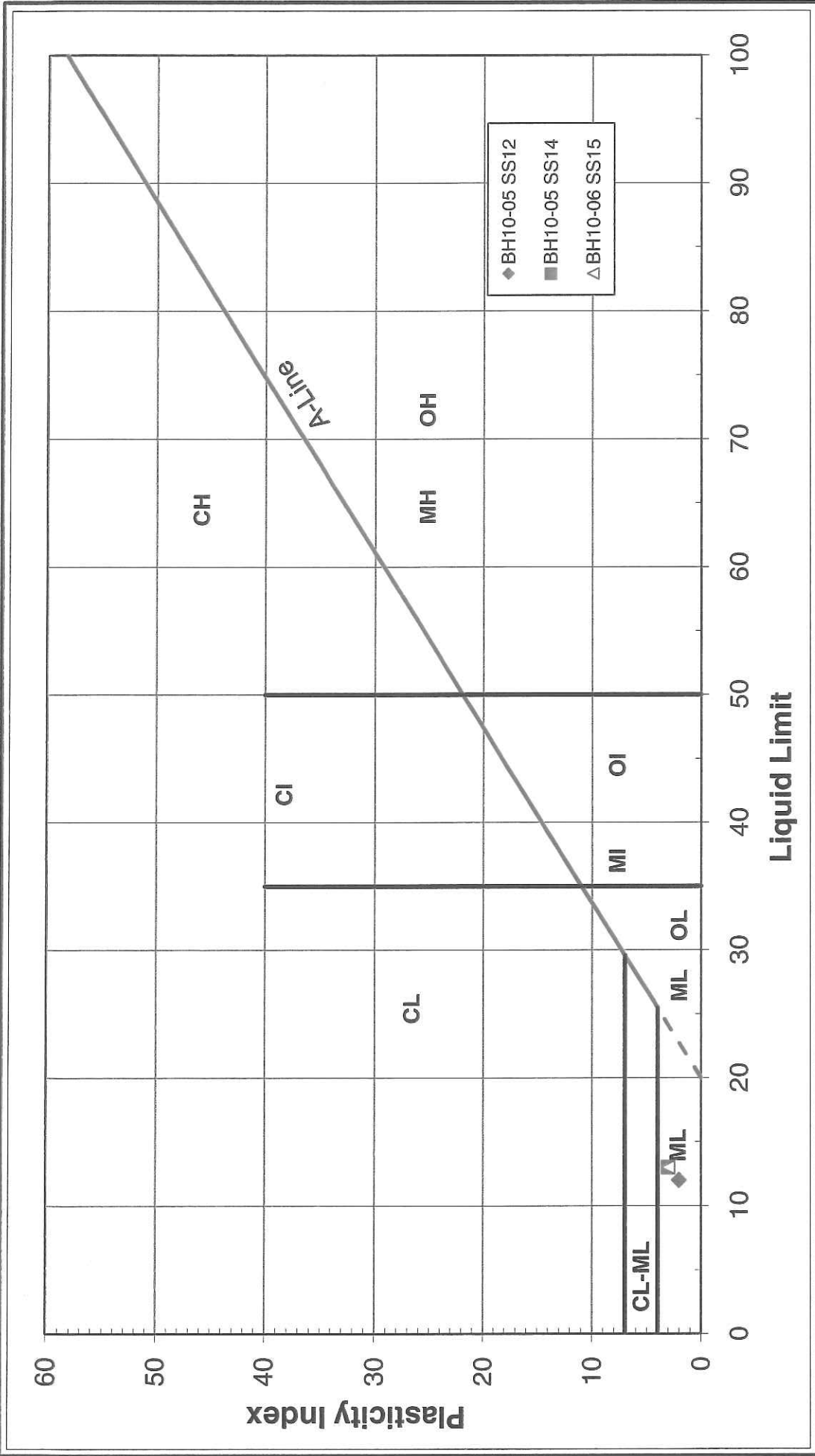
Project No. 165000749



PLASTICITY CHART

Figure No. 5a

Project No. 165000749



PLASTICITY CHART

Figure No. 5b

Project No. 165000749

APPENDIX D

Figure 6: Design Parameters

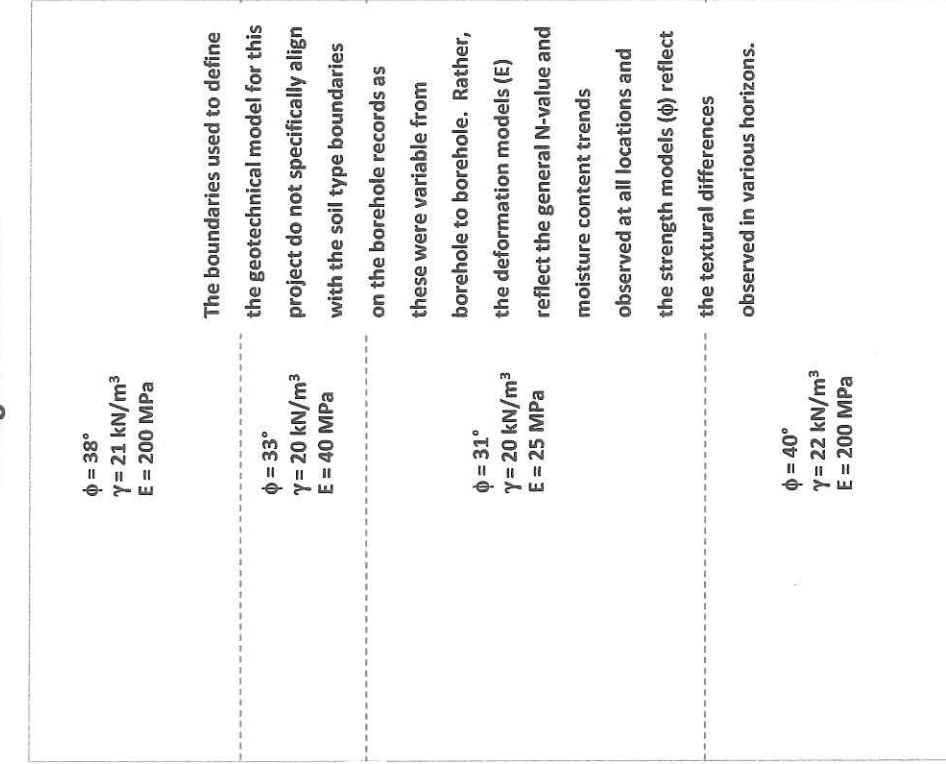
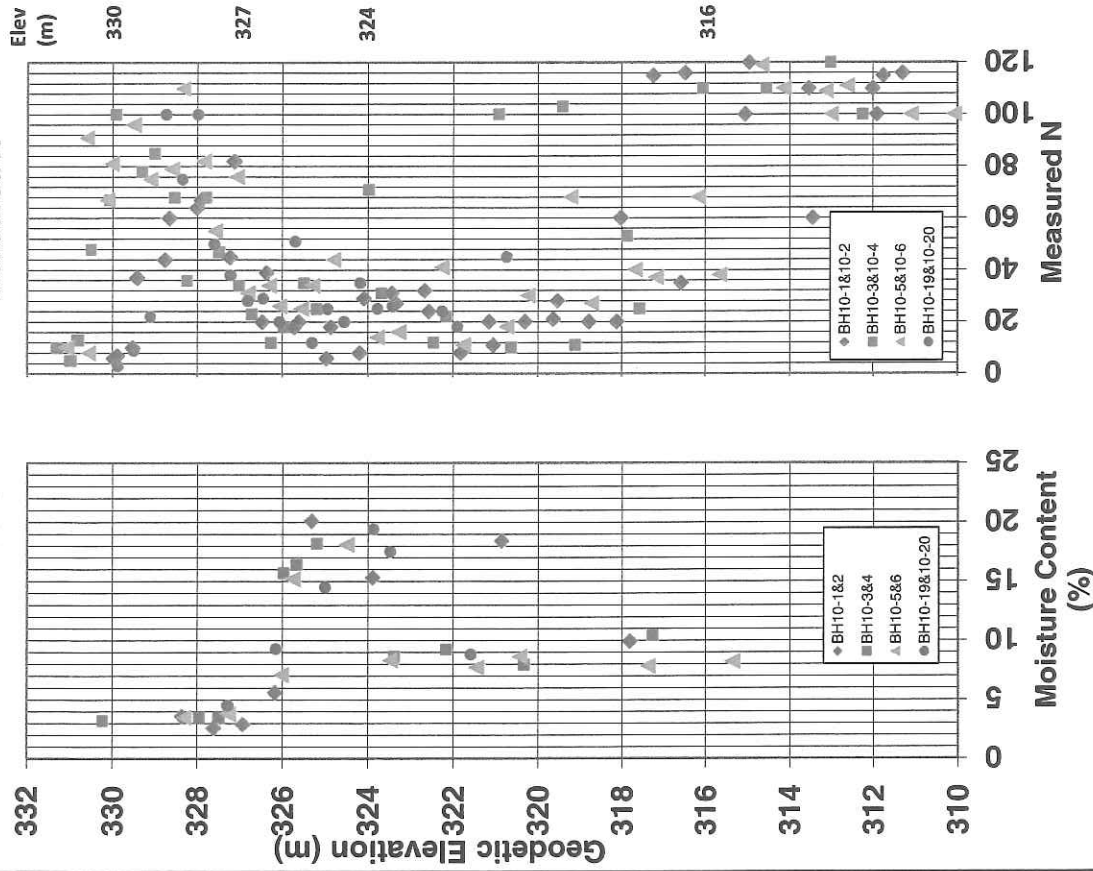
Figure 7-10: Typical Slope Stability Evaluation Results (Slope/W)

Figure 11-13: Typical Settlement Evaluation Results (Settle3D)

Moisture Content

Measured N

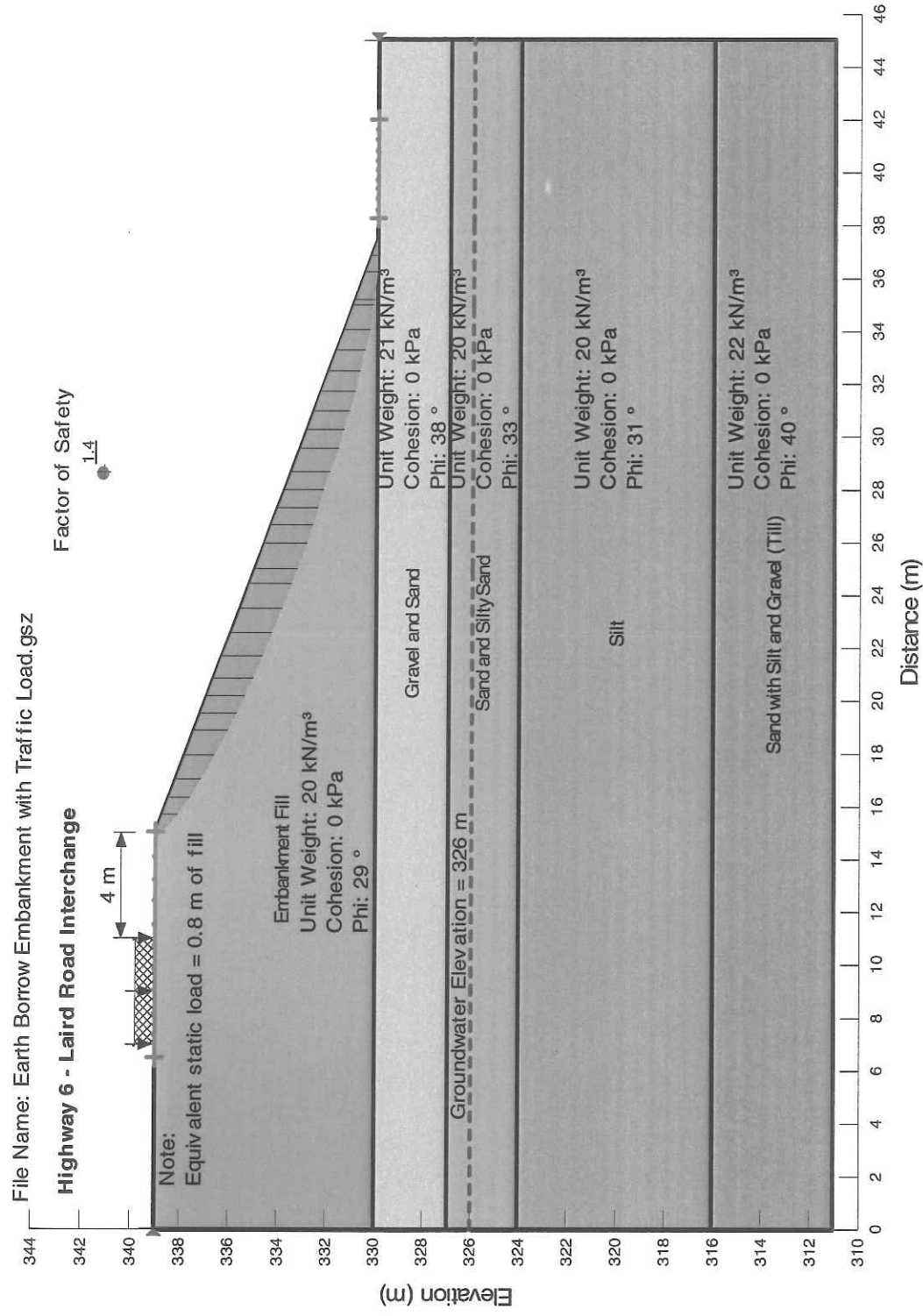
Design Parameters



Stantec Consulting Ltd.

Project No. 16500749

Figure 6



Static Slope Stability Analysis

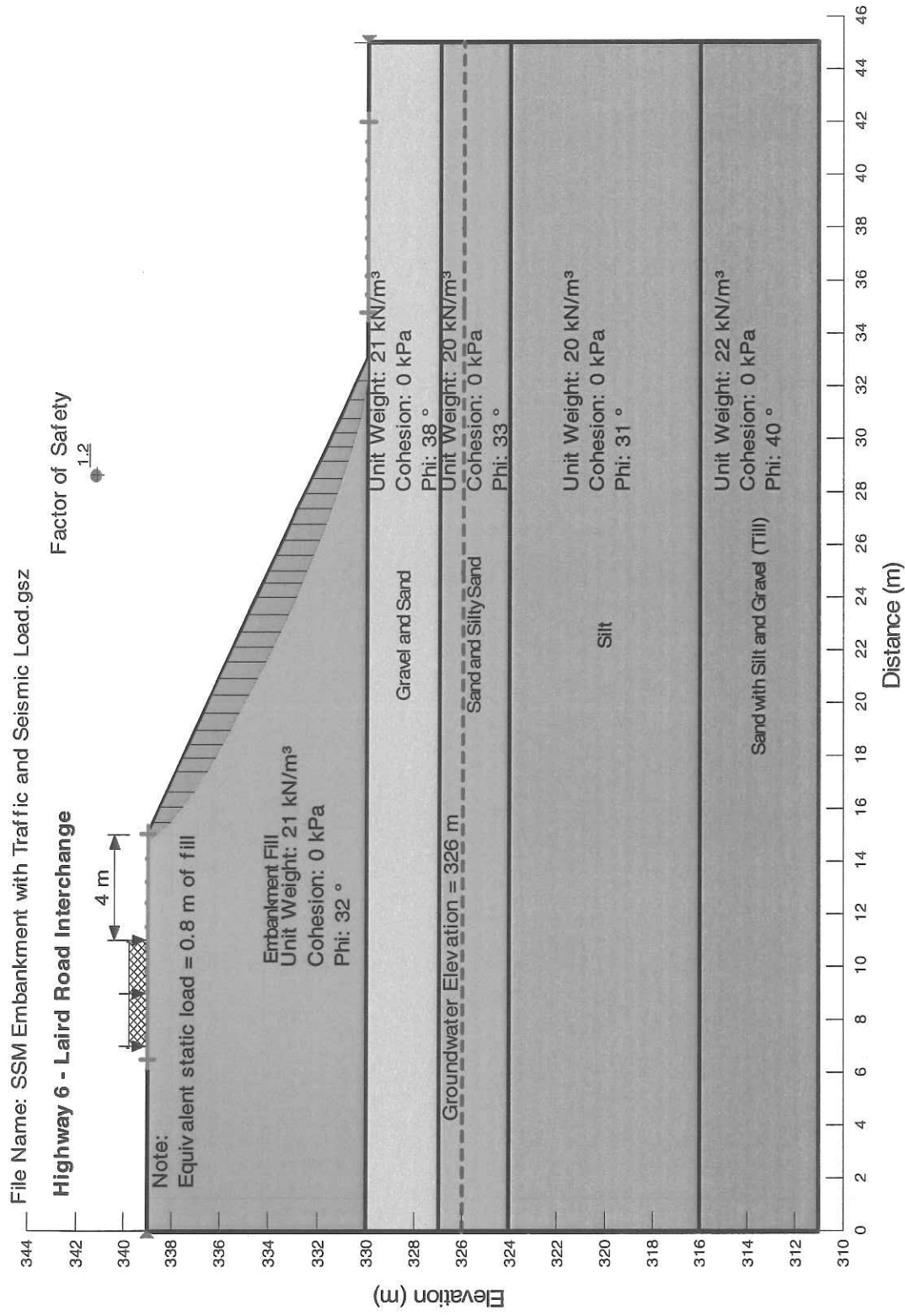
Highway 6 - Laird Road Interchange
Earth Borrow: Side slope at 2.5H:1V

Figure 8

Project No. 165000749



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Seismic Slope Stability Analysis

Highway 6 - Laird Road Interchange

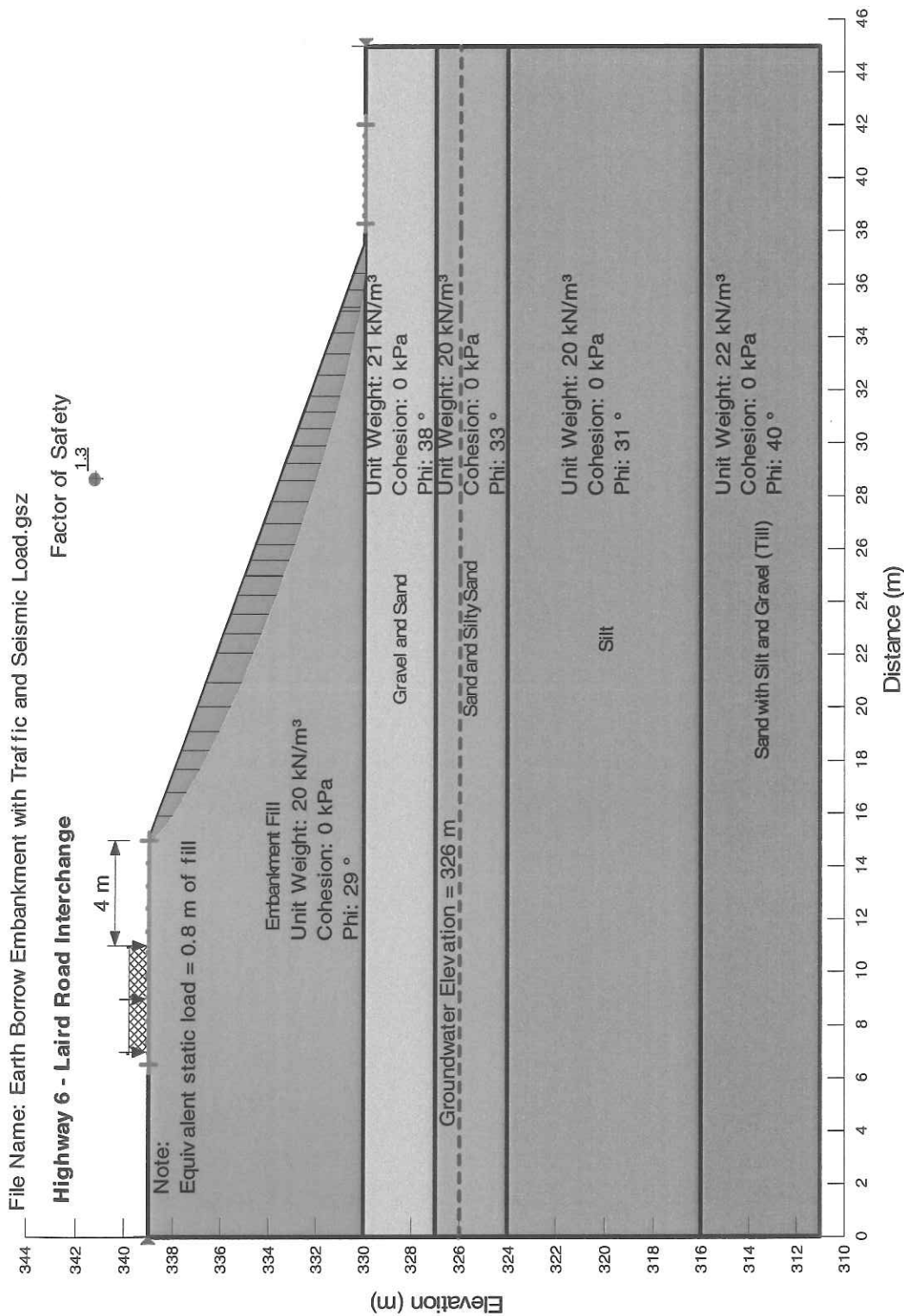
SSM: Side slope at 2H:1V

Figure 9

Project No. 165000749



Stantec



Seismic Slope Stability Analysis

Highway 6 - Laird Road Interchange

Earth Borrow: Side slope at 2.5H:1V

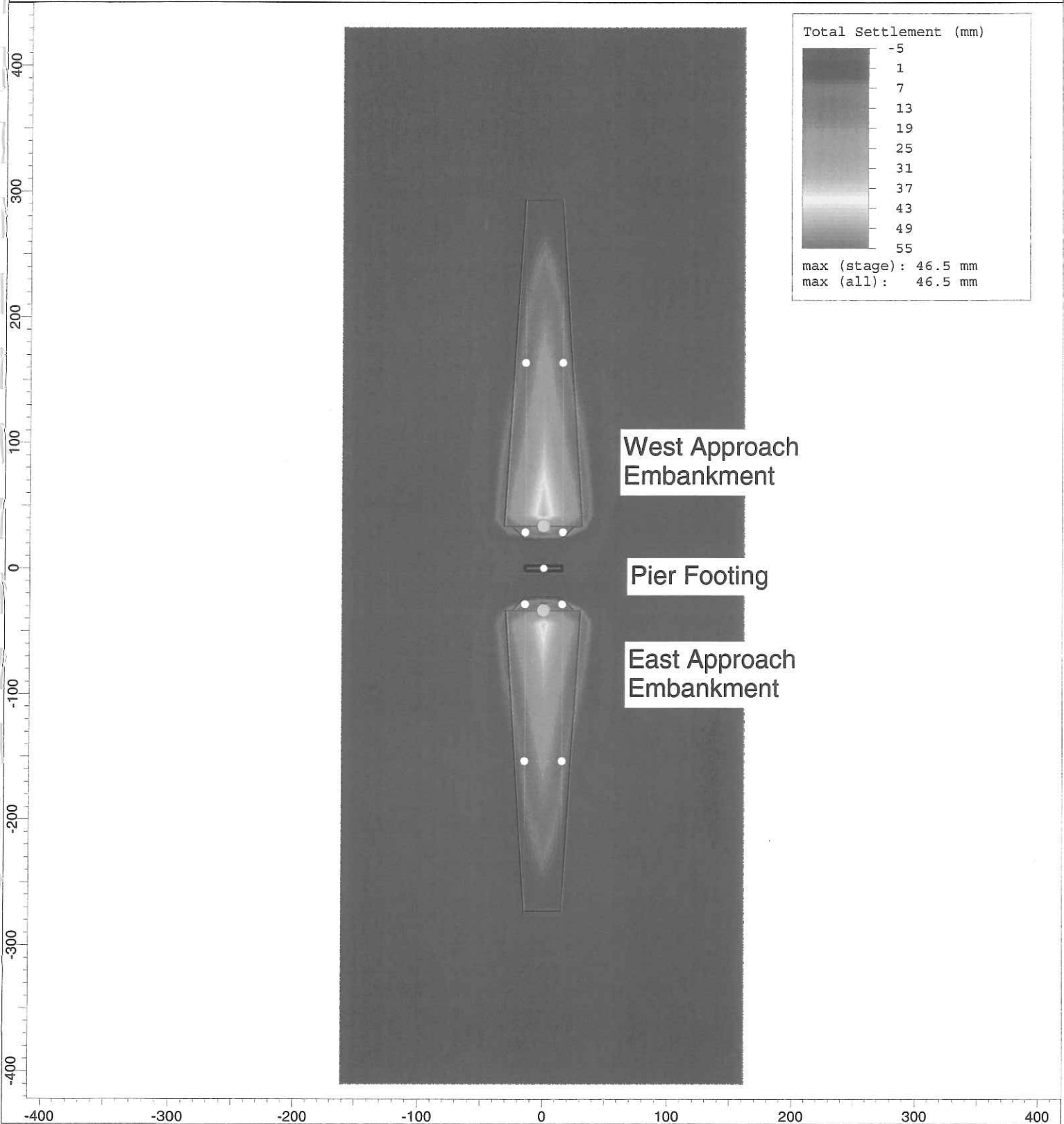
Figure 10

Project No. 165000749



Stantec

Figure 11

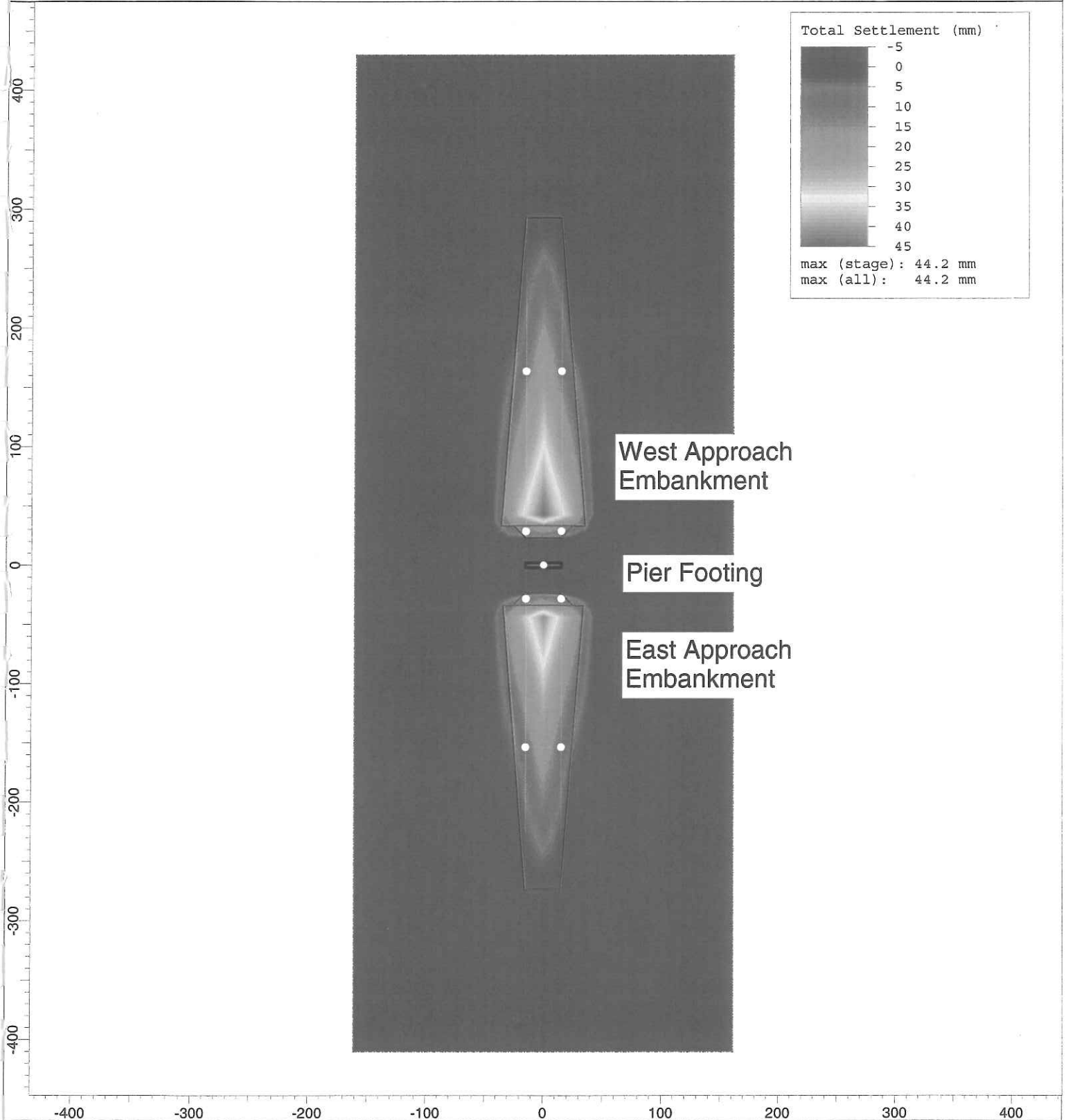


Stantec

SETTLE3D 2.010

Project			Highway 6 - Laird Road Interchange		
Analysis Description			Settlement Due to Approach Embankment and Granular Pad - SSM		
Drawn By		SG	Company		Stantec Consulting Ltd
Date		9/17/2010, 12:48:15 PM	File Name		W-E Embankment - SSM with GranPad.s3z

Figure 12

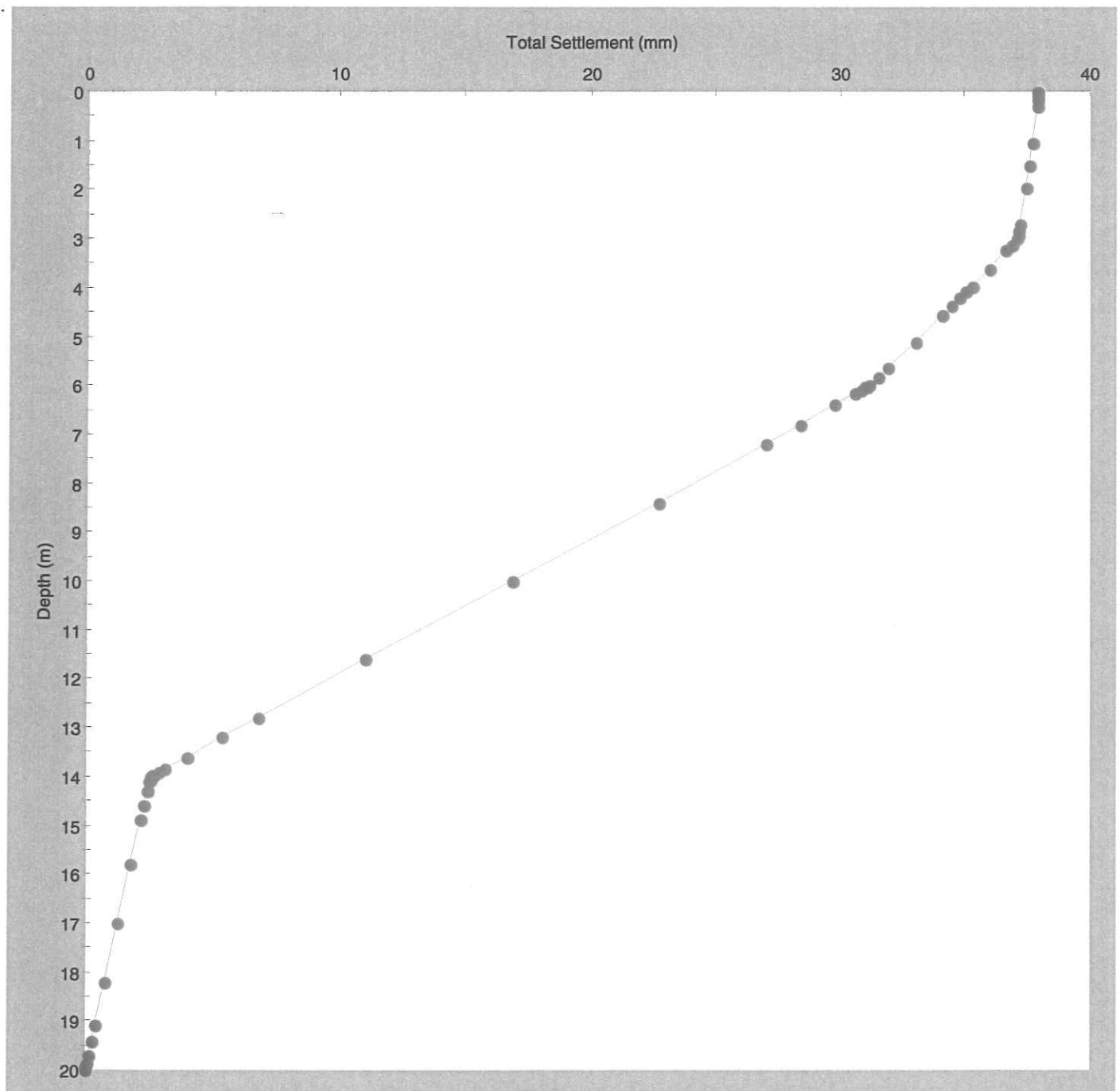


Stantec

Project			Highway 6 - Laird Road Interchange		
Analysis Description			Settlement Due to Approach Embankment and Granular Pad - Earth Borrow		
Drawn By			SG		Company
					Stantec Consulting Ltd
Date			9/17/2010, 12:48:15 PM		File Name
					W-E Embankment- Earth Borrow with GranPad.s3z

Figure 13

Total Settlement vs. Depth



Query Point 1 (Stage 1)
Reference Stage: None



SETTLE3D 2.010

Stantec

Project			Highway 6 - Laird Road Interchange		
Analysis Description			Settlement Profile at Abutment Location - SSM		
Drawn By		SG		Company	
				Stantec Consulting Ltd	
Date		9/17/2010, 12:48:15 PM		File Name	
				W-E Embankment - SSM with GranPad-a.s3z	

APPENDIX E

Geological Survey of Canada Seismic Hazard Calculation

2005 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: Simon Gudina, Stantec

August 16, 2010

Site Coordinates: 43.5833 North 80.3333 West

User File Reference: Highway 6, Guelph

National Building Code ground motions:

2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.202	0.101	0.049	0.014	0.121

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2005 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. *These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.*

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.031	0.085	0.128
Sa(0.5)	0.016	0.042	0.063
Sa(1.0)	0.006	0.019	0.031
Sa(2.0)	0.002	0.006	0.009
PGA	0.017	0.053	0.080

References

National Building Code of Canada 2005 NRCC no. 47666; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3

Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2005, Structural Commentaries NRCC no. 48192

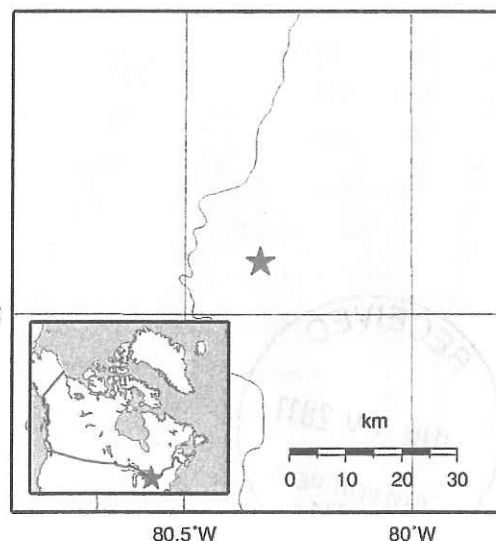
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx

Fourth generation seismic hazard maps of Canada: Grid values to be used with the 2005 National Building Code of Canada (in preparation)

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Aussi disponible en français



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