

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH EMBANKMENTS
TESTON ROAD TO KING ROAD
HIGHWAY 400 WIDENING
VAUGHAN, ONTARIO
G.W.P. 2539-04-00
ASSIGNMENT 2005-E-0036**

GEOCRES Number: 30M13-178

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the high embankment locations along the Highway 400 right-of-way between Teston Road and King Road. The proposed project involves widening of the highway to accommodate additional lanes of traffic. It is understood that the Ministry of Transportation Ontario (MTO) requires the design to accommodate an ultimate 10-lane configuration including two HOV lanes in each direction, while the current MTO right-of-way is to be maintained.

The purpose of this investigation was to explore the subsurface conditions at the sites and, based on the data obtained, to provide borehole locations plan and soil strata drawings and selected cross-sections, records of boreholes, laboratory test results and a generalized description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained during the course of the investigation.

Thurber Engineering Ltd. (Thurber) carried out this investigation as a sub-consultant to SNC-Lavalin Engineers and Constructors Inc. (SNC-Lavalin) under the MTO Agreement Number 2005-E-0036.

2 SITE DESCRIPTION

The proposed widening of Highway 400 extends from the Teston Road Underpass northerly to the King Road Underpass.

The project area is located within the physiographic region known as the South Slope of the Oak Ridges Moraine, which comprised predominantly of the Halton drift. The Halton till is an interbedded complex of clayey silt to silt till and sand. This till comprises a slightly hummocky till plain, into which the surface watercourses have eroded 10 to 15 m deep gullies. Relatively recent fluvial sediments have been deposited in the gullies. The Halton drift overlies bedrock at depths in the order of 100 m in the vicinity of the project area.

Drainage in the vicinity of the project area is largely controlled by the Humber River and its



tributaries. Localized drainage is facilitated by the creeks flowing within the gullies.

The land use adjacent to this section of Highway 400 is largely rural and agricultural, although there is increasing residential and commercial development in recent years.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this high embankment project was carried out between December 2006 and February 2007, and consisted of drilling and sampling 30 boreholes.

Information obtained from previous investigation reports has also been utilized where appropriate. These reports are listed as follows:

- Thurber report titled “Foundation Investigation and Design Report, Highway 400 – Retaining Structure, Teston Road Interchange, Region of York, Ontario”, File: 19-1351-66, dated January 26, 2005 (Reference 1).
- AMEC report titled “Final Foundation Investigation Report, Proposed Humber River Arch Culvert Extension, Highway 400 Interim Widening Vaughan, Ontario, W.P. 192-00-00, Central Region”, TT22852B, dated September 2003 (Reference 2).

The boreholes were initially marked and/or staked in the field by Thurber. Prior to commencement of drilling, utility clearances were obtained for all borehole locations. Right-of-way usage and lane closure permits were also obtained as required. All as-drilled borehole locations were tied in by surveyors co-ordinated by SNC-Lavalin, and the survey data was provided to Thurber. Approximate borehole locations are shown on the Borehole Locations and Soil Strata drawings in Appendices A to H.

Track and truck mounted drill rigs were used to undertake the drilling, sampling and in-situ testing operations.

The depths of the boreholes ranged from approximately 6 m to 22 m depth below existing ground surface. Hollow and solid stem augers were used to advance the boreholes. Soil samples were obtained at selected intervals using a 50 mm outside diameter split spoon sampler in conjunction with Standard Penetration Tests (SPT).

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers of 19 mm in diameter were installed in selected boreholes for monitoring of groundwater levels. The installation details are presented on the Record of Boreholes in Appendices A to H. Details of borehole grouting and sealing are presented in Table 3.1 immediately following the text.

A member of Thurber’s technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the soil samples in labelled and sealed containers, which were then transported to Thurber’s laboratory for further examination and testing.



4 LABORATORY TESTING

Visual identification and natural moisture content determination was undertaken on all recovered soil samples returned to the laboratory. Selected soil samples were subjected to grain size distribution analysis. Selected cohesive soil samples underwent grain size distribution and Atterberg Limits tests. The results of this testing program are shown on the Record of Borehole sheets and on the accompanying figures in Appendices A to H.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Details of the encountered soil stratigraphy are presented on Records of Borehole sheets, and on the “Borehole Locations and Soil Strata” drawings in Appendices A to H of this report. An overall description of the stratigraphy established at locations of high embankments is given in the following paragraphs. It is noted that the subsurface conditions vary between and beyond the borehole locations. The factual information presented in the Record of Borehole sheets governs any interpretation of site conditions.

For the purpose of reporting, eight sections have been identified along the Highway 400 alignment within which the high embankments are located. These sections are identified in Table 5.1 below. Each of the Appendices A to H contains borehole and laboratory testing data relevant to each high fill area.

Table 5.1
High Embankment Locations

High Fill Area	Location	Station Number
1	Hwy 400 NB & SB	Sta. 20+500 to 20+725
2	Hwy 400 SB	Sta. 21+150 to 21+250
3	Hwy 400 NB	Sta. 21+725 to 21+825
4	Hwy 400 SB	Sta. 22+025 to 22+200
5	Hwy 400 NB	Sta. 10+775 to 10+850
6	Hwy 400 SB	Sta. 10+750 to 10+825
7	Hwy 400 NB	Sta. 10+975 to 11+150
8	Hwy 400 SB	Sta. 10+975 to 11+150



5.2 High Fill Area 1 – Highway 400 NB and SB – Stations 20+500 to 20+725

5.2.1 Northbound Widening (Boreholes 06-01E, 02E, 03E, 30E, 31E, Appendix A)

Along this section of the proposed Highway 400 widening, the topography is undulating but generally sloping toward the northeast. To the east of the existing northbound lanes, five boreholes were advanced to depths of 11.0 m to 11.3 m below existing ground surface. A tributary of Purpleville (Cold) Creek flows in a culvert underneath the highway embankment and is located close to Borehole 06-30E.

The five boreholes indicate that the subsurface conditions typically consist of cohesive deposits of silty clay to clayey silt overlying cohesionless sand to sandy silt till.

Topsoil

Topsoil thicknesses ranging from 25 mm to 125 mm was encountered in four boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Fill

Fill was encountered beneath the topsoil in four boreholes. In Boreholes 06-2E, 06-3E and 06-30E, the fill is comprised of silty clay with sand. SPT N-values of the silty clay fill typically ranged from 5 to 13 blows per 0.3 m penetration indicating firm to stiff conditions. Occasional 'N' values of 0 and 16 blows indicated very soft and very stiff conditions. Moisture contents ranged between approximately 10% and 15%. A sand fill was encountered in Borehole 06-1E. The thickness and basal elevation of the fill are presented in Table 5.2.1.

Table 5.2.1: Fill Thickness and Base Elevation

Borehole Number	Fill Thickness (m)	Base Elevation (m)
06-01E	0.7	237.3
06-02E	4.2	232.7
06-03E	4.4	232.3
06-30E	4.0	229.0

Silty Clay to Clayey Silt

Cohesive deposits of brown to grey silty clay to clayey silt containing some sand and trace gravel was encountered below the fill. These soils have a stiff to occasionally very stiff consistency as indicated by SPT 'N' values of 9 to 22 blows. The soil is low plastic with clay content of 16% to 26%. Moisture contents ranged between 15% and 22%. The thickness and base elevation of these deposits are summarized in Table 5.2.2:



Table 5.2.2 Silty Clay/Clayey Silt Thickness and Base Elevation

Borehole Number	Silty Clay / Clayey Silt Thickness (m)	Base Elevation (m)
06-02E	1.6	231.1
06-03E	2.8	229.5
06-30E	1.7	227.3

Silty Clay Till

Silty clay till containing some sand and trace gravel was encountered in Boreholes 06-01E and 06-31E. This till is typically brown in colour, becoming grey with depth. This soil has low plasticity with clay content of 23% to 32%. It is generally stiff to hard as indicated by SPT 'N' values ranging from 12 to 54 blows. Glacial tills inherently contain cobbles and boulders although these were not directly encountered in the boreholes. Moisture contents were typically between 10% and 20%. The thickness and base elevation of these deposits are summarized in Table 5.2.3:

Table 5.2.3 Silty Clay Till Thickness and Base Elevation

Borehole Number	Silty Clay Till Thickness (m)	Base Elevation (m)
06-01E	9.6	227.8
06-31E	9.4	227.4

Sand

A deposit of sand containing some silt and some gravel was encountered below the silty clay/clayey silt in Boreholes 06-2E and 06-3E. This soil was in a compact state as indicated by SPT 'N' values of 18 to 30 blows per 0.3 m penetration. Moisture contents in the samples varied from 10% to 20%. The thickness and base elevation of these deposits are summarized in Table 5.2.4:

Table 5.2.4 Sand Thickness and Base Elevation

Borehole Number	Sand Thickness (m)	Base Elevation (m)
06-02E	2.9	228.3
06-03E	1.5	228.0

Sandy Silt Till to Silty Sand

Deposits of sands, silts and sandy silt till with trace clay and gravel were encountered in all five boreholes underlying the soils described above. These soils are typically grey in colour, non-plastic, and in a compact to very dense state as indicated by SPT 'N' values ranging between 11 blows per 0.3 m penetration to greater than 50 blows for less than 0.3m penetration. Glacial tills inherently contain cobbles and boulders as inferred by 'N' >



50 at some sample locations in the boreholes. Moisture contents were typically between 15% and 20%. None of the five boreholes fully penetrated these deposits.

Groundwater

Free water was noted to be present in Boreholes 06-03E and 06-31E at 3.1 m and 6.7 m depths, respectively, upon completion of drilling. Standpipe piezometers were installed in selected boreholes and measured water levels are presented in Table 5.2.5:

Table 5.2.5 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-02E (sandy silt)	February 20, 2007	8.9	228.0
	March 27, 2007	8.8	228.1
06-30E (sandy silt till)	February 20, 2007	3.5	229.5
	March 27, 2007	3.4	229.6

Based on the above readings, the stabilized groundwater level at this site ranges from Elevations 228 m to 229.5 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.2.2 Southbound Widening (Boreholes 04-01W, 02W, 03W, 22W, Appendix A)

Along this section of the proposed Highway 400 widening, the topography slopes steeply toward Purpleville (Cold) creek. To the west of the existing southbound lanes, four boreholes from a previous investigation (Reference 1) were advanced to depths of 12.8 m to 21.6 m below existing ground surface. A tributary of this creek flows in a culvert underneath the highway embankment and between Boreholes 04-03W and 04-22W.

The four boreholes indicate that the subsurface conditions typically consist of fill overlying cohesionless sandy silt grading to sand with depth.

Topsoil

Topsoil thicknesses ranging from 75 mm to 150 mm was encountered in the three boreholes located close to the floodplain. Part way up the slope on the north side, the topsoil is up to 1.1 m thick. Topsoil thickness may vary between boreholes and in other areas of the site.

Fill

Fill was encountered beneath the topsoil in three boreholes located close to the floodplain. In Boreholes 06-01W, 06-02W and 06-03W, the fill is comprised of clayey to sandy silt with trace to some gravel, rootlets and wood fibres. SPT N-values of the fill ranged from 5 to 13 blows per 0.3 m penetration indicating firm to stiff consistency for the clayey silt, and loose state for the sandy silt. Moisture contents ranged typically between 15% and



20%. The thickness and basal elevation of the fill are presented in Table 5.2.6.

Table 5.2.6: Fill Thickness and Base Elevation

Borehole Number	Fill Thickness (m)	Base Elevation (m)
06-01W	2.5	226.7
06-02W	2.4	226.7
06-03W	2.5	226.5

Sandy Silt

A deposit of sandy silt with silty sand, silt and clayey silt interlayers were encountered in below the fill or topsoil in all four boreholes. These soils are typically brown in colour changing to grey with depth, non-plastic, and in a loose to dense state as indicated by SPT 'N' values ranging typically between 8 and 47 blows per 0.3 m penetration. Moisture contents were typically between 20% and 25%. Borehole 06-22W did not fully penetrate the sandy silt deposit. For the remaining three boreholes, the thickness and basal elevation of the sandy silt are presented in Table 5.2.7.

Table 5.2.7: Sandy Silt Thickness and Base Elevation

Borehole Number	Fill Thickness (m)	Base Elevation (m)
06-01W	6.1	220.6
06-02W	6.9	219.8
06-03W	9.1	217.4

Sand

A deposit of sand containing trace silt and trace gravel was encountered below the sandy silt in Boreholes 06-01W, 06-02W and 06-03W. This soil was in a loose to compact state as indicated by SPT 'N' values ranging typically between 9 and 30 blows per 0.3 m penetration. Moisture contents in the samples varied from approximately 15% to 20%. None of the boreholes fully penetrated this sand.

Groundwater

Free water was noted to be present in Boreholes 06-01W and 06-02W at 1.5 m and 1.8 m depths, respectively, upon completion of drilling. A standpipe piezometer was installed in a selected borehole and the measured water levels are presented in Table 5.2.8:

Table 5.2.8 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-03W (sand)	July 13, 2004	1.3	227.8
	August 5, 2004	1.3	227.8



Based on the above readings, the stabilized groundwater level at this site is in the order of Elevation 228 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.3 High Fill Area 2 – Highway 400 SB – Stations 21+150 to 21+250 (Boreholes 06-04W, 05W, 06W, Appendix B)

Along this section of the proposed Highway 400 widening, the topography is undulating but generally sloping toward the southeast. To the west of the existing southbound lanes, three boreholes were advanced to depths of 8.2 m below existing ground surface. A creek flows in a culvert underneath the highway embankment and is located close to Borehole 06-05W.

The three boreholes indicate that the subsurface conditions typically consist of cohesive silty clay till overlying sandy silt to silt till.

Topsoil

Topsoil thicknesses ranging from 100 mm to 150 mm was encountered in the three boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Silty Clay Till

Below the topsoil, brown silty clay till containing trace to some sand and trace gravel was encountered in all three boreholes. Within the upper 2 m, this till is generally firm to stiff as indicated by SPT ‘N’ values ranging between 6 and 9 blows per 0.3 m penetration. Below this upper zone, the till becomes very stiff to hard as indicated by ‘N’ values ranging from 25 blows to greater than 30 blows. Glacial tills inherently contain cobbles and boulders although these were not directly encountered in the boreholes. This till is low plastic with clay content ranging from 22% to 29%. Moisture contents ranged between approximately 15% and 28%. The thickness and base elevation of these deposits are summarized in Table 5.3.1:

Table 5.3.1 Silty Clay Till Thickness and Base Elevation

Borehole Number	Silty Clay Till Thickness (m)	Base Elevation (m)
06-04W	2.1 (upper) > 2.1 m (lower)	243.8 < 237.8
06-05W	2.9	237.9
06-06W	> 8 m	< 241.3

Sandy Silt to Silt Till

Sandy silt to silt till containing some clay and trace gravel was encountered below the upper cohesive till in Boreholes 06-4W and 06-5W. These soils are typically brown to



grey in colour, non-plastic, and in a compact to very dense state as indicated by SPT 'N' values ranging between 29 blows per 0.3 m penetration to greater than 50 blows for less than 0.3m penetration. Glacial tills inherently contain cobbles and boulders as inferred by 'N' > 50 at some sample locations in the boreholes. Moisture contents ranged between 12% and 22%. The thickness and base elevation of these deposits are summarized in Table 5.3.2:

Table 5.3.2 Sandy Silt to Silt Till Thickness and Base Elevation

Borehole Number	Sandy Silt to Silt Till Thickness (m)	Base Elevation (m)
06-04W	3.8	240.0
06-05W	> 5.2	< 232.6

Groundwater

Free water was noted to be present in Borehole 06-05W at 5.0 m depth upon completion of drilling. A standpipe piezometer was installed in one selected borehole and measured water levels are presented in Table 5.3.3:

Table 5.3.3 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-06W (silty clay till)	February 20, 2007	6.5	243.0
	March 27, 2007	5.8	243.7

Based on the above readings, the stabilized groundwater level beyond the creek channel is at approximate Elevation 243.5 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.4 High Fill Area 3 – Highway 400 NB – Stations 21+725 to 21+825 (Boreholes 06-04E, 05E, 06E, Appendix C)

Along this section of the proposed Highway 400 widening, the topography is undulating but generally sloping toward the southeast. To the east of the existing northbound lanes, three boreholes were advanced to depths of 8.2 m to 9.8 m below existing ground surface.

Boreholes 06-4E, 06-5E and 06-6E indicate that the subsurface conditions typically consist of surficial silty clay overlying cohesive silty clay till with sandy silt to silty sand interlayers.

Topsoil

Topsoil thicknesses ranging from 75 mm to 150 mm was encountered in the three boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.



Silty Clay

Below the topsoil, a cohesive deposit of dark brown silty clay containing some sand and trace gravel was encountered in all three boreholes. In Boreholes 06-5E and 06-6E, it has a typical firm to very soft consistency as indicated by SPT 'N' values ranging between 8 and 0 blows for 0.3 m penetration. In Borehole 06-4E, this soil is stiff to very stiff as indicated by 'N' values of 14 to 20 blows. This soil is low plastic with clay content ranging between 19% and 29%. Moisture contents varied between approximately 15% and 30%. The thickness and base elevation of these deposits are summarized in Table 5.4.1:

Table 5.4.1 Silty Clay Thickness and Base Elevation

Borehole Number	Silty Clay Thickness (m)	Base Elevation (m)
06-04E	2.0	245.7
06-05E	1.4	241.7
06-06E	1.4	247.1

Silty Clay Till

Below the silty clay layer, brown silty clay till containing trace to some sand and trace gravel was encountered in all three boreholes. This till has a very stiff to hard consistency as indicated by 'N' values ranging from 24 blows to greater than 50 blows for 0.3 m penetration. Glacial tills inherently contain cobbles and boulders as inferred by 'N' > 50 at some sample locations in the boreholes. This soil is low plastic with clay content ranging between 20% and 32%. Moisture contents ranged between approximately 10% and 15%. Boreholes 06-4E and 06-6E did not fully penetrate this till. The thickness and base elevation of the till in the boreholes are shown in Table 5.4.2:

Table 5.4.2 Silty Clay Till Thickness and Base Elevation

Borehole Number	Silty Clay Till Thickness (m)	Base Elevation (m)
06-04E	> 7.6	< 238.2
06-05E	3.6	237.4
06-06E	> 6.8	< 240.3

Sandy Silt to Silty Sand

Sandy silt to silty sand containing trace clay was either interlayered with, or underlay, the till in all three boreholes. These soils are typically grey in colour, non-plastic, and in a dense state as indicated by SPT 'N' values ranging between 38 to greater than 50 blows for 0.3 m penetration. Moisture contents ranged between approximately 18% and 25%. The thickness and base elevation of these deposits are summarized in Table 5.4.3:



Table 5.4.3 Sandy Silt to Silty Sand Thickness and Base Elevation

Borehole Number	Sandy Silt to Silty Sand Thickness (m)	Base Elevation (m)
06-04E	1.2	241.7
06-05E	> 3.6	< 233.7
06-06E	0.6	245.1

Groundwater

Free water was noted to be present in Boreholes 06-04E and 06-5E at 8.7 m and 1.5 m depths, respectively, upon completion of drilling. A standpipe piezometer was installed in one selected borehole and measured water levels are presented in Table 5.4.4:

Table 5.4.4 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-6E (silty clay till)	February 20, 2007	4.7	243.8
	March 27, 2007	4.6	243.9

Based on the above readings, the stabilized groundwater level at this site is at approximate Elevation 243.9 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.5 High Fill Area 4 – Highway 400 SB – Stations 22+025 to 22+200 (Boreholes 06-07W, 08W, 09W, 10W, 11W, Appendix D)

Along this section of the proposed Highway 400 widening, the topography comprises a steep southwesterly slope. A residential property is adjacent to the toe of this slope. To the west of the existing southbound lanes, five boreholes were advanced to depths of 9.8 to 15.8 m below existing ground surface.

These boreholes indicate that the subsurface conditions typically consist of surficial silty clay overlying cohesive clayey silt to silty clay till which is underlain by silt and sand layers.

Topsoil

Topsoil thicknesses ranging from 100 mm to 175 mm was encountered in the five boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Silty Clay and Clayey Silt

Cohesive deposits of brown silty clay containing trace to some sand and trace gravel were encountered below the topsoil in all five boreholes, except in Borehole 06-08W where a 0.5 m layer of sand was noted between the topsoil and the clay. These soils have a firm to



stiff consistency as indicated by SPT 'N' values ranging between 4 and 14 blows for 0.3 m penetration. Gradation analysis identifies a clay content of about 29%. Moisture contents varied between approximately 15% and 24%.

In Borehole 06-07W, a layer of cohesive clayey silt with sand was encountered at 9.2 m depth below the silty clay till. This soil is grey in colour, and has a stiff to very stiff consistency as indicated by 'N' values of 9 and 27 blows. Gradation analysis identifies a clay content of about 14%. Moisture contents varied between approximately 10 and 20%.

The thickness and base elevation of these deposits are summarized in Table 5.5.1:

Table 5.5.1 Silty Clay/Clayey Silt Thickness and Base Elevation

Borehole Number	Silty Clay/Clayey Silt Thickness (m)	Base Elevation (m)
06-7W	1.2 (upper)	251.3
	3.5 (lower)	240.1
06-8W	0.7	251.3
06-9W	1.3	251.1
06-10W	1.3	250.9
06-11W	0.6	251.4

Clayey Silt to Silty Clay Till

Below the silty clay to clayey silt layer, clayey silt to silty clay till with interlayered sand, silt and clayey silt was encountered in all five boreholes. This cohesive till is typically brown in colour becoming grey with depth. This till has a very stiff to hard consistency as indicated by 'N' values ranging typically from 18 blows to greater than 50 blows for 0.3 m penetration. Glacial tills inherently contain cobbles and boulders as inferred by 'N' > 50 at some sample locations in the boreholes. This till is low plastic with clay content ranging between 22% and 27%. Moisture contents ranged between approximately 10% and 20%. Boreholes 06-10W did not fully penetrate this till. The thickness and base elevation of the till in the remaining boreholes are shown in Table 5.5.2:

Table 5.5.2 Clayey Silt to Silty Clay Till Thickness and Base Elevation

Borehole Number	Clayey Silt to Silty Clay Till Thickness (m)	Base Elevation (m)
06-7W	7.8 (upper)	243.5
	0.6 (lower)	239.5
06-8W	2.6 (upper)	248.7
	2.9 (middle)	244.0
	0.9 (lower)	239.2
06-9W	8.8 (upper)	242.3
	1.8 (lower)	238.6
06-11W	8.4	242.5



Silts and Sands

Layers, of silt, sandy silt, sand and silt, sand containing trace clay and trace gravel were encountered interlayering with the till as well as below the till in most of the boreholes. These soils are brown to grey in colour, non-plastic, and in a variably loose to very dense state as indicated by SPT 'N' values ranging typically from 4 blows to greater than 50 blows. Moisture contents ranged between approximately 10% and 20%. None of the boreholes fully penetrated these cohesionless deposits.

Groundwater

A standpipe piezometer was installed in three selected boreholes and the measured water levels are presented in Table 5.5.3:

Table 5.5.3 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-7W (sand)	February 20, 2007	7.3	245.5
	March 27, 2007	7.1	245.7
06-9W (sand)	February 20, 2007	7.1	245.5
	March 27, 2007	7.0	245.6
06-11W (silt)	February 20, 2007	6.7	245.4
	March 27, 2007	6.4	245.7

Free water was encountered in Borehole 06-08W at 9.3 m depth upon completion of drilling. Based on the above readings, the stabilized groundwater level at this site ranges between Elevations 245.4 m and 245.7 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.6 High Fill Area 5 – Highway 400 NB – Stations 10+775 to 10+850 (Boreholes 06-20E, 21E, 22E, Appendix E)

Along this section of the proposed Highway 400 widening, the topography comprises a steep easterly dipping slope. To the east of the existing northbound lanes, three boreholes were advanced to depths of 6.2 to 6.7 m below existing ground surface. A creek flows in a culvert underneath the highway embankment between Boreholes 06-21E and 06-22E. Two other culverts for highway drainage purposes are located adjacent to Boreholes 06-20E and 06-22E.

These boreholes indicate that the subsurface conditions typically consist of existing fill overlying surficial clayey silt which is underlain by cohesive silty clay till with sandy silt to silt interlayers.

Topsoil

Topsoil thicknesses ranging from 125 mm to 150 mm was encountered in two boreholes



drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Fill

Existing embankment fill of predominantly silty clay and occasional clayey silt containing trace to some sand and gravel, trace rootlets was encountered below the topsoil or at ground surface. These soils are dark brown to brown in colour, cohesive and in a variably soft to very stiff consistency as indicated by SPT 'N' values ranging between 0 and 17 blows for 0.3 m penetration. Moisture contents ranged between approximately 12% and 26%. The thickness of the fill varies between locations, ranging from 0.5 m to 2.0 m.

Clayey Silt

A cohesive deposit of clayey silt containing some sand and trace gravel was encountered immediately below the fill in Boreholes 06-20E and 06-22E. The clayey silt was less than 1 m thick at both locations. This soil is brown in colour with a variable firm to very stiff consistency as indicated by SPT 'N' values of 8 and 23 blows for 0.3 m penetration. This soil is low plastic with clay content of 13%. Moisture contents varied between approximately 12% and 18%.

Silty Clay Till

Silty clay till with sand and trace gravel was encountered in all three boreholes. This cohesive till is brown in colour becoming grey with depth. This till has a very stiff to hard consistency as indicated by 'N' values ranging typically from 17 blows to 70 blows for 0.3m penetration. Glacial tills inherently contain cobbles and boulders although these were not directly encountered in the boreholes. This soil is low plastic with clay content ranging between 23% and 25%. Moisture contents ranged between approximately 12% and 18%. Boreholes 06-20E and 06-22E did not fully penetrate this till. The thickness and base elevation of the till in Borehole 06-21E is 4.5 m and Elevation 261.9 m, respectively.

Sandy Silt to Silt

Layers of sandy silt to silt containing some sand and trace to some clay was encountered in Boreholes 06-20E and 06-21E. These soils are brown changing to grey in colour, non-plastic, and in a compact state as indicated by SPT 'N' values ranging typically from 10 to 22 blows per 0.3 m penetration. An occasional 'N' value of 66 blows indicates a very dense zone. Moisture contents ranged between 12% and 22%. In Borehole 06-20E, the sandy silt is 3.6 m thick with a base elevation at 265.7 m. The upper silt is 1 m thick in Borehole 06-21E.

Groundwater

Free water was noted to be present in Borehole 06-20E at 2.1 m depths upon completion of drilling. A standpipe piezometer was installed in Borehole 06-20E and the measured water



levels are presented in Table 5.6.1:

Table 5.6.1 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-21E (sandy silt/silty clay till)	February 20, 2007	2.2	265.9
	March 27, 2007	2.0	266.1

Based on the above readings, the stabilized groundwater level at this site is at approximate Elevation 266 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

**5.7 High Fill Area 6 – Highway 400 SB – Stations 10+750 to 10+825
(Boreholes 06-13W, 14W, 15W, Appendix F)**

Along this section of the proposed Highway 400 widening, the topography comprises a steep southwesterly slope. To the west of the existing southbound lanes, three boreholes were advanced to depths of 9.8 to 11.3 m below existing ground surface. A creek flows in a culvert underneath the highway embankment between Boreholes 06-13W and 06-14W.

These boreholes indicate that the subsurface conditions typically consist of surficial clayey silt to silty clay overlying cohesive clayey silt to silty clay till which is underlain by silt and sand layers.

Topsoil

Topsoil thicknesses ranging from 50 mm to 175 mm was encountered in the three boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Silty Clay to Clayey Silt

Surficial cohesive deposits of silty clay to clayey silt with sand and trace gravel, and mixed with topsoil, were encountered immediately below the topsoil in all three boreholes. This soil is brown to dark brown in colour. These soils have a typical firm to stiff consistency as indicated by SPT 'N' values ranging from 6 to 10 blows for 0.3 m penetration. The silty clay is low plastic with a clay content of 20%. Moisture contents varied between approximately 15% and 25%. The thickness and base elevation of these deposits are summarized in Table 5.7.1:

Table 5.7.1 Silty Clay/Clayey Silt Thickness and Base Elevation

Borehole Number	Silty Clay/Clayey Silt Thickness (m)	Base Elevation (m)
06-13W	1.3	267.2
06-14W	1.3	262.7
06-15W	0.7	267.9



Silty Clay to Clayey Silt Till

Silty clay to clayey silt till with sand and trace gravel was encountered in all three boreholes. This cohesive till is typically brown in colour becoming grey with depth. This till has a stiff to hard consistency as indicated by 'N' values ranging from 13 blows to greater than 30 blows for 0.3 m penetration. Glacial tills inherently contain cobbles and boulders although these were not directly encountered in the boreholes. This till is low plastic with clay content ranging between 21% and 37%. Moisture contents ranged between approximately 12% and 20%. The thickness and base elevation of the till in the remaining borehole is shown in Table 5.7.2:

Table 5.7.2 Silty Clay to Clayey Silt Till Thickness and Base Elevation

Borehole Number	Silty Clay to Clayey Silt Till Thickness (m)	Base Elevation (m)
06-13W	7.3	259.9
06-14W	2.1	260.6
06-15W	6.5	261.5

Silts and Sands

Layers of silt, sandy silt, silty sand and sand containing trace clay was encountered below the cohesive till, or as interlayers within the till, in all three boreholes. These soils are grey in colour, non-plastic, and in a typically compact to dense state as indicated by SPT 'N' values ranging between 11 blows and 46 blows for 0.3 m penetration. Moisture contents ranged between approximately 18% and 26%. None of the boreholes fully penetrated these cohesionless deposits.

Groundwater

Free water was noted to be present in Borehole 06-14W at 5.6 m depths upon completion of drilling. A standpipe piezometer was installed in two selected boreholes and the measured water levels are presented in Table 5.7.3:

Table 5.7.3 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-13W (silt)	February 20, 2007	8.7	259.9
	March 27, 2007	8.3	260.3
06-15W (silty sand)	February 20, 2007	Dry	-
	March 27, 2007	Dry	-

Based on the above readings, the stabilized groundwater level at this site is in the order of Elevation 260 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.



5.8 High Fill Area 7 – Highway 400 NB – Stations 10+975 to 11+150 (Boreholes 06-23E, 24E, 28E, 29E, HR1, 90, Appendix G)

Along this section of the proposed Highway 400 widening, the topography comprises a steep southeasterly dipping slope. To the east of the existing northbound lanes, four boreholes were advanced to depths of 12.8 to 15.8 m below existing ground surface. Two boreholes (90, HR1) from previous investigations by others were also located within this section. The East Humber River flows through the Humber Arch Culvert adjacent to Boreholes 06-24E, HR1 and 90.

These boreholes indicate that the subsurface conditions typically consist of existing fill overlying sand interlayered with sandy silt, cohesive silty clay, silty clay to clayey silt till.

Topsoil

Topsoil thicknesses ranging from 75 mm to 200 mm was encountered in the boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Fill

Existing embankment fill of predominantly silty clay with some silt layers was encountered below the topsoil in Boreholes 06-23E and 06-29E. This fill is dark brown in colour, cohesive and in a typically firm to occasionally stiff consistency as indicated by SPT 'N' values ranging between 5 blows to 10 blows for 0.3 m penetration. The silt fill below the silty clay fill in Borehole 06-23E was in a loose to very loose state with 'N' values smaller than 5 blows. Moisture contents typically ranged between approximately 18% and 25%. The thickness and base elevation of the fill are summarized in Table 5.8.1:

Table 5.8.1 Silty Clay/Clayey Silt Thickness and Base Elevation

Borehole Number	Silty Clay/Clayey Silt Thickness (m)	Base Elevation (m)
06-23E	2.9	255.6
06-29E	1.3	260.0

Sand

A deposit of sand containing trace to some silt and trace clay, with sandy silt to silty sand interlayers, was encountered below the topsoil or fill and occasionally below silty clay till in all the boreholes located within this section. This soil is in a typically loose to compact state as indicated by SPT 'N' ranging from 4 to greater than 30 blows per 0.3 m penetration. Moisture contents in the sand samples varied from approximately 15% to 20%. None of the boreholes fully penetrated this sand deposit.



Silty Clay to Clayey Silt Till

Silty clay to clayey silt till with sand and trace gravel was encountered in Boreholes 06-23E, 06-28E and 06-29E. The cohesive tills are brown in colour at shallow depth becoming grey with depth. The tills are generally stiff to very stiff at shallower depth becoming very stiff to hard at depth, as indicated by 'N' values ranging from 9 blows to greater than 50 blows for 0.3 m penetration. Glacial tills inherently contain cobbles and boulders as inferred by 'N' > 50 at some sample locations in the boreholes. The silty clay till is low plastic with clay content of 19% to 20%. Moisture contents typically ranged between approximately 15% and 20%. Boreholes 06-23E and 06-28E did not fully penetrate this till. The thickness and base elevation of the till in Borehole 06-29E is 2.8 m and Elevation 257.3 m, respectively.

Groundwater

Free water was noted to be present in Borehole 06-24E at ground surface upon completion of drilling. A standpipe piezometer was installed in each of Boreholes 06-28E and 06-29E, and in a previous Borehole 90. The measured water levels in the piezometers are presented in Table 5.8.2:

Table 5.8.2 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-28E (sand/silty clay till)	February 20, 2007	3.1	256.5
	March 27, 2007	3.0	256.6
06-29E (sand)	February 20, 2007	5.1	256.4
	March 27, 2007	4.8	256.7
90 (sand)	January 18, 2001	0.2	254.8

Based on the above readings, the stabilized groundwater level at this site is at approximate Elevations 256 to 257 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

5.9 High Fill Area 8 – Highway 400 SB – Stations 10+975 to 11+150 (Boreholes 06-16W, 19W, 20W, 21W, HR2, HR3, Appendix H)

Along this section of the proposed Highway 400 widening, the topography comprises a steep northeasterly dipping slope. To the west of the existing southbound lanes, four boreholes were advanced to depths of 9.6 to 15.8 m below existing ground surface. Two boreholes (HR2, HR3) from a previous investigation by others were also located within this section. The East Humber River flows through the Humber Arch Culvert between Boreholes HR2 and HR3.

These boreholes indicate that the subsurface conditions typically consist of existing fill (at



some locations) overlying surficial silty clay to clayey silt, which is in turn underlain by sand interlayered with sandy silt to silt. Clayey silt till underlies the sand at some locations.

Topsoil

Topsoil thicknesses ranging from 75 mm to 200 mm was encountered in four boreholes drilled along this section. Topsoil thickness may vary between boreholes and in other areas of the site.

Fill

A silty sand to sand and silt fill was encountered below the topsoil in Boreholes 06-16W and 06-20W. This fill is brown in colour, cohesionless and is in a loose to compact state as indicated by SPT 'N' values of 3 to 21 blows. The moisture content of a fill sample measured about 20%. This fill is approximately 0.9 m to 1.3 m in thickness.

Silty Clay to Clayey Silt

Surficial cohesive deposits of silty clay to clayey silt with sand were encountered immediately below the topsoil in Boreholes 06-16W and 06-21W. These soils are typically brown in colour becoming grey with depth. Near the floodplain grade, these deposits have a typically soft to firm consistency as indicated by SPT 'N' values ranging from 2 to 4 blows for 0.3 m penetration, with occasional stiff zones. On higher ground in Borehole 06-16W, these deposits are stiff to very stiff as indicated by SPT 'N' values ranging from 13 to 25 blows for 0.3 m penetration. These soils are low plastic with clay content ranging from 12% to 45%. Moisture contents typically ranged between 18% and 25%. The thickness and base elevation of these deposits are summarized in Table 5.9.1:

Table 5.9.1 Silty Clay/Clayey Silt Thickness and Base Elevation

Borehole Number	Silty Clay/Clayey Silt Thickness (m)	Base Elevation (m)
06-16W	3.2	258.7
06-21W	4.5	254.5

Sand and Silt

A deposit of sand containing trace to some silt, trace clay and trace gravel, with sandy silt to silty sand interlayers, was encountered at ground surface, or below the cohesive deposits in all the boreholes located within this section. This deposit is in a typically loose to very dense state as indicated by SPT 'N' values increasing with depth, from 3 blows to greater than 50 blows per 0.3 m penetration. Moisture contents in the sand samples varied from 15% to 22%. None of the boreholes appeared to have fully penetrated this sand, except at Borehole 06-16W where the thickness of the layer is 8.1 m and a base elevation of 250.7m.



Clayey Silt Till

Clayey silt till with sand and trace gravel was encountered below the sand and silt layer in Borehole 06-16W. This cohesive till is grey in colour. The till is low plastic with a clay content of 19%, and has a hard consistency as indicated by typical 'N' values of greater than 30 blows for 0.3 m penetration. Glacial tills inherently contain cobbles and boulders although these were not directly encountered in the boreholes. Gradation analysis indicates. Moisture contents ranged between approximately 15% and 18%. Borehole 06-16W did not fully penetrate this till.

Groundwater

Free water was noted to be present in Boreholes 06-20W and 06-21W at 4.3 m and 2.5 m depths, respectively, upon completion of drilling. A standpipe piezometer was installed in Boreholes 06-16W and in a previous Borehole HR2. The measured water levels in the piezometers are presented in Table 5.9.2:

Table 5.9.2 Water Level Measurements

Borehole (Screen location)	Date	Depth (m)	Elevation (m)
06-16W (sand/clayey silt)	February 20, 2007	7.3	255.8
	March 27, 2007	7.2	255.9
HR2 (silty sand)	September 18, 2002	-0.3*	254.9
	November 5, 2002	-0.2*	254.8

Note: * Water level above ground (artesian)

Based on the above readings, the stabilized groundwater level at this site is at approximate Elevation 256 m. The groundwater levels are expected to vary seasonally and are subject to severe climatic events.

6 MISCELLANEOUS

Thurber Engineering Ltd. selected the borehole locations in the field relative to existing site features with consideration of access restraints, terrain conditions, utility locations and previous site investigation data.

DBW Drilling Ltd of Ajax, Ontario and Kodiak Environmental Ltd., of Oakville, Ontario conducted drilling, sampling and in-situ testing operations. Traffic control was provided by Barricade Traffic Services Inc. (BTS). Mr. Stephane Loranger of Thurber Engineering supervised the drilling and sampling operations in the field on a full time basis.

Mr. Tony Harte, M.Sc. directed field operations. Mr. Tony Harte, M.Sc. and Mr. Sydney Pang, P.Eng. prepared the report.

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





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FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH EMBANKMENTS
TESTON ROAD TO KING ROAD
HIGHWAY 400 WIDENING
VAUGHAN, ONTARIO
G.W.P. 2539-04-00
ASSIGNMENT 2005-E-0036

GEOCRES Number: 30M13-178

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and provides foundation recommendations for the design of high embankments of 6 m or greater in height. The high fill areas covered by this report involve widening of the existing road platforms. It is understood that no grade raise is currently proposed. The locations of these high fill areas have been identified in the foundations terms of reference and are listed in the following table. This table also indicates details of culverts over which high fills are to be placed ("McCormick Rankin Corporation, Preliminary Design and Environmental Assessment Study", dated July 2003 from the proposal package). These culverts allow creeks to flow under the Highway 400 embankment.

Table 7.1

High Fill Area	Highway Direction	Approximate Stations	Embankment Height	Existing Culvert	Extension Required
1	Hwy 400 NB & SB	20+500 to 20+725 (Cold Creek Area)	Up to 10 m (retaining wall possible on west side)	Culvert #13 1.5 m x 1.1 m Concrete Box	Yes (both sides)
2	Hwy 400 SB	21+150 to 21+250	Up to 8 m	Culvert #14 1.22m x 1.22m Concrete Box	Yes (both sides)
3	Hwy 400 NB	21+725 to 21+825	Up to 8 m	Culvert #15 1.82m x 1.2m Concrete Box	No
4	Hwy 400 SB	22+025 to 22+200	Up to 8 m	None	No
5	Hwy 400 NB	10+775 to 10+850	Up to 6 m	Culvert #21 3.1m x 1.9m Concrete Box	No
6	Hwy 400 SB	10+750 to 10+825	Up to 10 m		No
7	Hwy 400 NB	10+975 to 11+150	Up to 12 m	Humber Arch Structure	No
8	Hwy 400 SB	10+975 to 11+150	Up to 12 m		No



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

The project information, including plans and profiles, utilized for the preparation of this report was provided by SNC-Lavalin.

7.1 Cold Creek Area (High Fill Area 1)

7.1.1 Background

During the preliminary design in 2004 to 2005 for the Regional Municipality of York (RMOY), a number of foundation options (see Table 7.1) were considered for the widening of Highway 400 in the Cold creek area. A retaining wall located at the toe of the existing Highway 400 embankment was considered to be a viable option. This wall was to be up to 9.5 m in height and approximately 185 m in length (Sta. 20+508 to 20+693) crossing an existing concrete box culvert located at Sta. 20+655. At that preliminary stage, a RSS wall in conjunction with partial preloading was the option considered for this location. It was also anticipated that the preloading and wall construction would require temporary creek relocation to some extent.

When MTO initiated the Highway 400 Widening Detail Design assignment in 2006, the design of the retaining wall proposed in the RMOY interchange scheme became part of the detailed design assignment. During the initial foundation design review, the Project Team identified several alternatives for the proposed retaining wall including the possibility of constructing a concrete wall supported by piles, a tangent or soldier pile wall, an RSS wall or a sheet pile wall, as well as other options including the partial use of EPS, ground improvement techniques and conventional earth embankment.

Current project requirements include widening of Highway 400 in the Cold Creek area to accommodate additional through and ramp lanes. The initial study predicted that the settlement of a proposed retaining wall and the retained fill could be up to 100 mm, due to the presence of up to 15 m of loose foundation sands and silts. This predicted settlement is supported by evidence of cracking observed at the existing concrete box culvert conveying Cold Creek Tributary D under Highway 400 in the vicinity. It was concluded that preloading of the foundation soils has to be carried out, regardless of the wall option adopted, in order to minimize settlements of the wall and the adjacent fills to be placed for widening the highway. Foundation preloading, whether it is full or partial, requires limited temporary relocation of Cold Creek to create working space for construction at the toe of the embankment. Since temporary creek relocation is inevitable for satisfying the project requirements, it was therefore concluded that a better solution appears to be to



permanently relocate the creek further west, eliminate the retaining wall and replace it with a conventional earth embankment. The embankment would be sufficiently wide to accommodate the ultimate Highway 400 widening (10-lane cross-section, including two High Occupancy Vehicle/Managed Lanes with barrier separator; 33.63 m required for southbound lanes.

7.1.2 Foundation Options

Options 1(a), 1(b), 2 and 3 involve the use of retaining structures which require preloading of the foundation soils as outlined in Option 6. Full preload will require permanent relocation of the creek. Partial preload will require creek relocation to a lesser extent. A combination of Options 2 and 6, say Terramesh Wall in conjunction with partial foundation preloading, is considered feasible. Full preload will provide the most satisfactory results in terms of road and structure performance. Partial preload will reduce post-construction total foundation settlement but could result in unpredictable differential settlement, and the risk of some degree of pavement and roadway distress will remain. Without preloading, post-construction foundation settlements will lead to unacceptable pavement and roadway distress which would be a safety concern for the travelling public.

Option 4 involves the use of EPS (expanded polystyrene) to construct a portion of the retained fill embankment. Although the total foundation settlements can be reduced, this reduction may not be sufficient to eliminate the risks of pavement and roadway distress, and could also result in differential settlement, as conventional earth fill would still need to be placed behind the wall as earth cover to the EPS.

Option 5 is a ground improvement technique that does not require preloading but requires specialist contractors. In fact, the resulting permanent, negative impact on the creek due to the construction work is anticipated to be more severe than any of the other options because all work would have to be conducted from the level of the creek bank.

Option 6 is a ground improvement technique involving placement of fill to preload the foundation soils in order to induce settlements prior to foundation and pavement construction.

7.1.3 Conclusion

As indicated above, all retaining wall options require foundation preloading which is difficult to achieve at this site without temporary creek relocation. From a foundation engineering perspective, a better solution is to permanently relocate the creek for a sufficient distance to the west of the current toe of the existing embankment so that Option 7, which involves conventional SSM fill embankment at 2H : 1V inclination, can be constructed.

It should also be noted that the existing creek bank is immediately adjacent to the current toe of the Highway 400 embankment. It is expected that the creek bank would have to be



modified in the short to intermediate term to prevent undermining of the highway embankment, if this reach of the creek migrates in an easterly direction. Modifications would likely involve hardening of the outside bend to prevent further migration.

8 ENGINEERING ANALYSIS METHODOLOGY

8.1 General

Major factors governing high embankment design at this site include the following:

- material type and geometry of the proposed embankment widening fills,
- characteristics of existing embankment fills and foundation soils including surficial loose/disturbed soils and organic deposits within, and adjacent to, the proposed embankment footprints,
- maintaining embankment stability during all stages of construction and in the long term,
- settlements during embankment construction and after construction.

8.2 Methods of Settlement and Stability Analyses

Under the new embankment loads, immediate foundation settlements due to elastic compression of the sands and silts have been estimated based on the methods described in the CHBDC, 2006 Commentary Section C6.6.3.6. Settlements due to recompression and primary consolidation of clayey silts and silty clays have been estimated based on conventional one-dimensional consolidation theory also outlined in the CHBDC.

For the purpose of embankment stability analyses, the commercially available slope stability program GSLOPE developed by Mitre Software Inc. was used.

For global stability and based on consideration of the risks involved, past experience of highway embankment performance and site specific conditions, a minimum Factor of Safety (F.S.) of 1.3 is considered appropriate.

The global stability of embankment fills due to seismic loading has been assessed based on a pseudo-static approach. In this approach, the horizontal acceleration associated with a F.S. of 1.0, referred to as the “yield acceleration”, is compared with 67% of the peak horizontal acceleration ($0.67 \times \text{PHA}$) based on seismic parameters applicable to the site location. The potential for embankment instability and lateral spreading is considered low if the yield acceleration is higher than $0.67 \times \text{PHA}$.

9 SEISMIC CONSIDERATIONS

The following seismic parameters have been used for design:

- Velocity Related Seismic Zone: 1



- Zonal Velocity Ratio: 0.05
- Acceleration Related Seismic Zone: 1
- Zonal Acceleration Ratio: 0.05
- Peak Horizontal Ground Acceleration (PHA) 0.08g
(g = acceleration due to gravity)

The Soil Profile Type at these locations is classified as Type I, which, according to Clause 4.4.6.1 and Table 4.4 of the CHBDC 2006, is associated with a Site Coefficient of 1.0. A value of 67% of the Peak Horizontal Ground Acceleration ($0.67 \times \text{PHA}$) at ground surface of 0.054g ($0.67 \times 0.08\text{g}$) has been used in the analysis. This PHA value corresponds to a probability of exceedance of 10% in 50 years.

For assessment of soil liquefaction potential, the Seed and Idriss procedure is used. This method relates cyclic stress ratio to the peak ground surface acceleration, the ratio of total to effective overburden stress, and a stress reduction factor (CHBDC 2006, Clause C4.6.2).

10 EMBANKMENT STABILITY AND SETTLEMENT ANALYSIS

10.1 General

Table 10.1 presents a summary of the embankment heights and simplified subsurface conditions encountered in the boreholes located along the alignments of the proposed high fill areas.

The subsurface information indicates that the foundation soils in Areas 1, 3 and 6, typically consist of surficial soft to stiff, cohesive clayey silt to silty clay soils, or fill, overlying compact, cohesionless soils. In Areas 2 and 4, the foundation soils are typically very stiff to hard cohesive till overlying compact to dense cohesionless soils. In Areas 5, 7 and 8, soft to very stiff surficial cohesive soil/fill overlie loose to dense cohesionless soils, which are in turn underlain by stiff to hard cohesive till.

The stability and settlement analyses presented herein have been carried out assuming the removal of topsoil, organics and other deleterious materials from the footprint of all new fill, and placement of new fills on existing embankment fills and on stiff/dense, competent subgrade. New fills may include granular materials or Select Subgrade Material (SSM).

10.2 Stability Analysis Results

10.2.1 General

Figures I1 through I18 in Appendix I present selected static stability analysis results, and Figures J1 through J8 in Appendix J present selected pseudo-static (seismic) stability analysis results. The subsurface conditions, soil properties, groundwater table and embankment geometry assumed in the stability analysis are shown on the figures. The new



fill may either be granular material, or Select Subgrade Material (SSM). All side slopes have been assumed equal to 2H : 1V.

10.2.2 Static Analysis

Results of static stability analyses carried out for selected locations are summarized in Table 10.2. These results indicate that Factors of Safety (F.S.) of at least 1.3 can be maintained for global stability considerations in each high fill area. Mid-height berms of 2m in width that are required to address surficial stability requirements (see section 11.1 for MTO policy on berm requirements) have been incorporated where applicable in Areas 1 (NB and SB), 6, 7 and 8.

10.2.3 Seismic Analysis

Liquefaction Potential

Based on the CHBDC (2006) Section C4.6, the native silty clays/clayey silts and silty clay till below the footprints of the proposed widening embankments are unlikely to undergo liquefaction.

Based on the Seed and Idriss method, it is considered that the liquefaction potential of the typically compact, cohesionless foundation sands and silts is low.

It is recommended that the new fill consist of granular material or SSM. The groundwater levels are below the base level of the embankments. As such, it is considered that there is negligible potential for liquefaction of the embankments.

Some toe failure may occur due to seismic loading, but this is expected to be minor in nature and readily repairable.

Limit Equilibrium

Table 10.3 presents selected results of pseudo-static analyses carried out to estimate the dynamic stability of the widened embankments subject to seismic loading. A review of the results presented in this table indicates that the yield acceleration is higher than 67% of the peak horizontal ground acceleration ($0.67 \times \text{PHA}$) in all analysed cases.

Based on these results, it is considered that there is low potential for embankment foundation failure to occur due to seismic loading at these high fill areas.

10.3 Settlement Analysis Results

10.3.1 General

Total settlement at the top of the embankment is a result of settlement of the foundation soils and settlement due to compression of the embankment fill.



10.3.2 Foundation Settlement

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

Settlement of the cohesive (clayey silt/silty clay) foundation soils is comprised of recompression and primary consolidation. Recompression is anticipated to occur during construction, whereas settlement due to primary consolidation is time dependent and will continue after the end of construction.

10.3.3 Embankment Compression

Based on the borehole information, the existing embankments largely consist of cohesive (clayey silt/silty clay) fill. Cohesive soils typically undergo larger post construction settlement than granulars and SSM. Since the existing embankments have been in place for an extended period of time, settlement due to embankment compression is considered to have been completed to date.

For compacted granular or SSM fill used for embankment widening purposes, the magnitude of compression can be up to 0.5% of the new fill height. Given that a majority of the compression will be completed by the end of construction, these types of fill materials are recommended in order to minimize post construction total and differential, settlements.

10.3.4 Estimated Embankment Settlements

Table 10.4 presents a summary of the estimated embankment settlements at each proposed high fill area, assuming that granular materials or SSM are used as fill. The ranges for different types of settlements are highlighted as follows:

Total foundation settlement	-	from 30 to 100 mm.
Settlement during construction (all areas)	-	from 25 to 100 mm.
Settlement after construction (Areas 2, 3, 4, 5 and 6)	-	from 5 to 25 mm.

The estimated total foundation settlements are largest in Areas 1, 7 and 8 due to the presence of deeper deposits of loose cohesionless soils. Post construction settlements will occur in Areas 2, 3, 4, 5 and 6 due to the presence of cohesive soils.

11 EMBANKMENT DESIGN AND CONSTRUCTION

11.1 Embankment Design

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



- Topsoil and organics should be removed from the footprints of the new widening embankments prior to placement of new fill. A stripping depth of up to 200 mm is recommended for all high fill areas.
- Granular materials or SSM are recommended for construction of the embankment widening in this project.
- All widening embankments must be designed for a side slope not steeper than 2H : 1V.
- Depending on the embankment heights, berms are required to address surficial stability and to provide access for post construction maintenance (see Tables 10.2 and 10.3). Where earth fill embankments are higher than 8 m, mid-height berms should be incorporated into the embankment design. The berms should be 2 m wide and extend for the length through which the embankment height exceeds 8 m. These berms should maintain a 2% positive drainage grade to shed surface run-off. The berm locations are highlighted in the following:
 - High Fill Area 1 (Highway 400 NB and SB) between Stations 20+500 to 20+725, where embankment height exceeds 8 m (2 m wide mid-height berm for surficial stability).
 - High Fill Area 6 (Highway 400 SB) between Stations 10+750 to 10+825, where embankment height exceeds 8 m (2 m wide mid-height berm for surficial stability).
 - High Fill Area 7 (Highway 400 NB) between Stations 10+975 to 11+150, where embankment height exceeds 8 m (2 m wide mid-height berm for surficial stability).
 - High Fill Area 8 (Highway 400 SB) between Stations 10+975 to 11+150, where embankment height exceeds 8 m (2 m wide mid-height berm for surficial stability).
- Paving should be delayed for a minimum period of 3 months between completion of fill placement and commencement of paving. This is essential to allow completion of all elastic foundation settlements, embankment compression, and some of the post construction foundation settlements.
- The design width of the embankment platform must include an allowance for the estimated settlements.

11.2 Culverts and Creeks

Creeks and river (East Humber) flow under the Highway 400 embankment through existing culverts. It is understood that Culverts #13 and #14 at High Fill Areas 1 and 2, respectively, are proposed to be extended (see table 7.1) to accommodate the embankment widening. Foundation investigation and design of these and other culvert extensions are



addressed in a separate report.

There is currently no plan to extend Culverts #15, #21 and the Humber Arch Structure located at High Fill Areas 3, 5, 6, 7 and 8. It is considered prudent that the structural integrity of these existing culverts be checked by the designer of this project to confirm that they are competent to support the additional weight of fill to be placed within the widening areas.

Settlements due to placement of new fill over these culverts and measures to mitigate the effects of such settlements are addressed in a separate culvert report.

11.3 Embankment Construction

11.3.1 General

Embankment construction should be carried out in accordance with Special Provision No. 206S03 “Amendment to OPSS 206, December 1993” dated November 2006. The embankment material should consist of granular materials or SSM in compliance with Special Provision No. 110F13, “Amendment to OPSS 1010, November 2003” March 2004.

Prior to placing new fill, the existing slope surfaces should be appropriately benched, as per OPSD 208.010, after stripping of vegetation, topsoil, organics, soft soils or otherwise unsuitable overburden materials.

All new embankment earth fill should be placed in regular lifts and be compacted in accordance with Special Provision No. 105S10 “Amendment to OPSS 501, February 1996” dated November 2004.

Vegetation cover should be established on all exposed earth slopes to protect against surficial erosion in accordance with Special Provision 572S01.

11.3.2 Construction Concerns

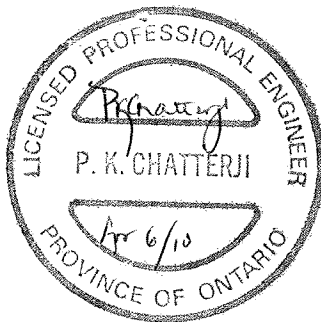
The Contract Administrator (CA) should employ experienced geotechnical staff to observe activities related to embankment construction.

A potential construction concern involves removal of organics/soft soils near creeks/river. It is recommended that a provision be included in the contract requiring the QVE to alert the CA in case there are doubts about the required stripping depth once the topsoil/organics are removed as specified in the contract.





Sydney Pang, P.Eng.
Associate, Senior Project Engineer



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



Table 3.1
Borehole Completion Details

Borehole Location	Piezometer Tip Depth / Elevation	Completion Details
06-01E	None installed	Bentonite grout to surface
06-02E	10.6 m / 226.3 m	Sand screen from 8.1 to 10.6 m depths, bentonite grout to 0.2 m, drill cuttings to surface
06-03E	None installed	Bentonite grout to surface
06-30E	6.3 / 226.7	Sand screen from 6.3 to 8.7 m depths, bentonite grout to 0.6 m, drill cuttings to surface
06-31E	None installed	Bentonite grout, then drill cuttings to surface
06-04W	None installed	Bentonite grout to surface
06-05W	None installed	Bentonite grout to surface
06-06W	8.2 m / 241.3 m	Sand screen from 4.5 to 8.2 m depths, bentonite grout to 0.2 m, drill cuttings to surface
06-04E	None Installed	Bentonite grout to surface
06-05E	None Installed	Bentonite grout to surface
06-06E	8.2 m / 240.3 m	Sand screen from 5.3 to 8.2 m depths, bentonite grout to 0.5 m, drill cuttings to surface
06-07W	14.3 m / 238.5 m	Sand screen from 11.9 to 14.3 m depths, bentonite grout to surface
06-08W	None Installed	Bentonite grout to surface
06-09W	15.8 m / 236.7 m	Sand screen from 11.3 to 15.8 m depths, bentonite grout to surface
06-10W	None Installed	Bentonite grout, then drill cuttings to surface
06-11W	11.3 m / 240.8 m	Sand screen from 6.4 to 11.3 m depths, bentonite grout to 0.4 m, drill cuttings to surface
06-20E	None Installed	Bentonite grout to surface
06-21E	6.7 m / 261.4 m	Sand screen from 3.6 to 6.7 m depths, bentonite grout to 0.5 m, drill cuttings to surface
06-22E	None Installed	Bentonite grout to surface
06-13W	11.3 m / 257.4 m	Sand screen from 7.5 to 11.3 m depths, bentonite grout to surface
06-14W	None Installed	Bentonite grout to surface
06-15W	11.3 m / 257.4 m	Sand screen from 8.7 to 11.3 m depths, bentonite 7.5 m, drill cuttings to 0.9 m, then bentonite to surface
06-23E	None Installed	Bentonite grout to surface
06-24E	None Installed	Bentonite grout to surface
06-28E	14.6 m / 245.0 m	Sand screen from 9.7 to 14.6 m depths, bentonite grout to surface
06-29E	15.7 m / 245.8 m	Sand screen from 11.5 to 15.7 m depths, bentonite grout to surface
06-16W	15.2 m / 247.9 m	Sand screen from 9.1 to 15.2 m depths, bentonite grout to 0.9 m, drill cuttings to surface
06-19W	None Installed	Bentonite grout to surface
06-20W	None Installed	Bentonite grout to surface
06-21W	None Installed	Bentonite grout to surface



TABLE 10.1

SUMMARY OF EMBANKMENT HEIGHTS AND SIMPLIFIED SUBSURFACE CONDITIONS

LOCATION	APPROXIMATE STATIONS	EMBANKMENT HEIGHT	GROUNDWATER TABLE	SUBSURFACE SOIL TYPES	RELATIVE DENSITY OR CONSISTENCY
High Fill Area 1 Hwy 400 NB	20+500 to 20+725	Up to 10 m	3.4 m to 8.8 m depths	Topsoil (25 to 125 mm) Cohesive FILL (Up to 4.4 m depth) Cohesive TILL (1 to 10 m depth) Cohesionless TILL (4.4 to > 11 m depth)	Firm to Stiff (typically 5 < N < 13) Stiff to Hard (typically 9 < N > 30) Compact to Dense (typically 5 < N < 41) (occasionally N > 50)
High Fill Area 1 Hwy 400 SB	20+500 to 20+725	Up to 10 m	1.3 m to 1.8 m depths	Topsoil (75 to 150 mm) Cohesive FILL (Up to 2.6 m depth) Cohesionless Soils (2.6 to 20 m depths)	Firm to Stiff (typically 5 < N < 13) Compact to Dense (typically 8 < N < 41)
High Fill Area 2 Hwy 400 SB	21+150 to 21+250	Up to 8 m	5 m to 5.8 m depths	Topsoil (100 to 150 mm) Cohesive TILL (2.3 to > 8.2 m depth) Cohesionless TILL (3.8 to > 8.2 m depth)	Firm to Hard (6 < N > 30) Compact to Dense (typically 29 < N > 50)
High Fill Area 3 Hwy 400 NB	21+725 to 21+825	Up to 8 m	1.5 m to 4.6 m depths	Topsoil (75 to 150 mm) Cohesive Soils (1.4 to 2.2 m depth) Cohesive TILL (2 to > 8 m depth) Cohesionless TILL (5.8 to > 8.4 m depth)	Very Soft to Firm (0 < N < 8) Very Stiff to Hard (typically 24 < N > 50) Dense (N > 30)
High Fill Area 4 Hwy 400 SB	22+025 to 22+200	Up to 8 m	6.4 m to 7.1 m depths	Topsoil (100 to 175 mm) Cohesive TILL (8.7 to 13.3 m depth) Cohesionless TILL (8.7 to > 15 m depth)	Firm to Hard (4 < N > 50) Loose to Dense (4 < N > 30)
High Fill Area 5 Hwy 400 NB	10+775 to 10+850	Up to 6 m	2 m depth	Topsoil (125 to 150 mm) Cohesive FILL (0.7 to 2.2 m depth) Cohesionless Soil (2.2 to 5.8 m) Cohesive TILL (1.7 to > 6.2 m depth)	Soft to Very Stiff (0 < N < 17) Compact (typically 10 < N < 22) Very Stiff to hard (typically 17 < N < 70)
High Fill Area 6 Hwy 400 SB	10+750 to 10+825	Up to 10 m	5.6 m to 8.3 m depths	Topsoil (50 to 175 mm) Cohesive Soils (up to 1.4 m depth) Cohesive TILL (1.4 to 8.7 m depth) Cohesionless Soil (8.5 to > 11.3 m)	Firm to Stiff (6 < N < 10) Stiff to Hard (13 < N > 30) Compact to Dense (11 < N < 46)
High Fill Area 7 Hwy 400 NB (adjacent to Humber Arch culvert)	10+975 to 11+150	Up to 12 m	0.2 m to 3 m depths	Topsoil (75 to 200 mm) Cohesive FILL (0.1 to 1.8 m depth) Cohesionless Soil (0.1 to > 12.8 m) Cohesive TILL (11.9 to > 15.8 m depth)	Very Soft to Firm (0 < N < 8) Loose to Dense (4 < N < 45) Stiff to hard (typically 9 < N > 50)
High Fill Area 8 Hwy 400 SB (adjacent to Humber Arch culvert)	10+975 to 11+150	Up to 12 m	-0.2 m to 7.2 m depths (¹ ' = artesian)	Topsoil (75 to 200 mm) Cohesive Soil (0.1 to 4.6 m depth) Cohesionless Soil (0.6 to > 11.1 m) Cohesive TILL (12.4 to > 15.8 m depth)	Soft to Very Stiff (typically 2 < N < 25) Very Loose to Very Dense (3 < N > 50) Hard (typically N > 30)



TABLE 10.2

SUMMARY OF STATIC EMBANKMENT STABILITY ANALYSIS
Granular and SSM Fill Slopes

Location	Approximate Stations	Embankment Height (m)	Factor of Safety	Berm Requirements
				Surficial Stability (berm width in m)
High Fill Area 1 Hwy 400 NB	20+675	10	1.44 (undrained)	Yes (2)
			1.37 (drained)	Yes (2)
High Fill Area 1 Hwy 400 SB	20+590	10	1.37 (undrained)	Yes (2)
			1.37 (drained)	Yes (2)
High Fill Area 2 Hwy 400 SB	21+180	8	1.6 (undrained)	-
			1.34 (drained)	-
High Fill Area 3 Hwy 400 NB	21+750	8	1.37 (undrained)	-
			1.33 (drained)	-
High Fill Area 4 Hwy 400 SB	22+075	8	1.61 (undrained)	-
			1.35 (drained)	-
High Fill Area 5 Hwy 400 NB	10+825	6	1.5 (undrained)	-
			1.33 (drained)	-
High Fill Area 6 Hwy 400 SB	10+775	10	1.45 (undrained)	Yes (2)
			1.39 (drained)	Yes (2)
High Fill Area 7 Hwy 400 NB	11+060	12	1.38 (undrained)	Yes (2)
			1.38 (drained)	Yes (2)
High Fill Area 8 Hwy 400 SB	11+075	12	1.34 (undrained)	Yes (2)
			1.33 (drained)	Yes (2)



TABLE 10.3

**SUMMARY OF PSEUDO-STATIC EMBANKMENT STABILITY ANALYSIS:
Granular and SSM Fill Slopes**

Location	Approximate Stations	Embankment Height (m)	Yield Acceleration (g)	Peak Horizontal Ground Acceleration (PHA) (0.67g)	Comments
High Fill Area 1 Hwy 400 NB	20+675	10	0.14 (2 m berm)	0.054	Embankment is stable against the assumed seismic loading
High Fill Area 1 Hwy 400 SB	20+590	10	0.12	0.054	
High Fill Area 2 Hwy 400 SB	21+180	8	0.12	0.054	
High Fill Area 3 Hwy 400 NB	21+750	8	0.115	0.054	
High Fill Area 4 Hwy 400 SB	22+075	8	0.125	0.054	
High Fill Area 5 Hwy 400 NB	10+825	6	0.115	0.054	
High Fill Area 6 Hwy 400 SB	10+775	10	0.135 (2 m berm)	0.054	
High Fill Area 7 Hwy 400 NB	11+060	12	0.125 (2 m berm)	0.054	
High Fill Area 8 Hwy 400 SB	11+075	12	0.11 (2 m berm)	0.054	



TABLE 10.4

FOUNDATION SETTLEMENTS AND EMBANKMENT COMPRESSION
Granular or SSM Fill Slopes

Location	Approximate Stations	New Widening Fill Height	Settlement				Total
			During Construction		Post Construction	Total	
			Foundation	Embankment	Foundation	Foundation	
High Fill Area 1 Hwy 400 NB	20+675	Up to 9 m	90	45	0	90	135
High Fill Area 1 Hwy 400 SB	20+590	Up to 5 m	100	20	0	100	120
High Fill Area 2 Hwy 400 SB	21+180	Up to 6 m	40	30	15	55	85
High Fill Area 3 Hwy 400 NB	21+750	Up to 4 m	45	20	25	70	90
High Fill Area 4 Hwy 400 SB	22+075	Up to 4 m	45	20	15	60	80
High Fill Area 5 Hwy 400 NB	10+825	Up to 4 m	25	20	5	30	50
High Fill Area 6 Hwy 400 SB	10+775	Up to 5 m	25	25	5	30	55
High Fill Area 7 Hwy 400 NB	11+060	Up to 5.5 m	75	30	0	75	105
High Fill Area 8 Hwy 400 SB	11+075	Up to 5.5 m	75	30	0	75	105



Appendix A

High Fill Area 1

**Highway 400 NB & SB – Approximate Stations 20+500 to 20+725
Records of Boreholes, Laboratory Test Results, Drawings**



SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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


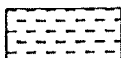


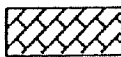
 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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

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

TERMS		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				



RECORD OF BOREHOLE No 06-01E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 436.64 E 300 547.79 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-13 - 2006-12-13 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
238.0															
0.0	TOPSOIL: (25 mm)						238								
	SAND, trace silt, trace gravel		1	SS	17										
237.3	Compact														
	Brown														
	Moist														
0.7	(FILL)														
	Silty CLAY, some sand, trace gravel		2	SS	12		237								
	Stiff														
	Brown to Grey														
	Moist														
	(TILL)(CL)														
	becoming Hard		3	SS	54		236								1 18 50 31
			4	SS	36		235								
			5	SS	38		234								
							233								
	some sand seams		6	SS	51		232								
							231								
			7	SS	46		230								
	Grey														
			8	SS	46		229								1 27 49 23
			9	SS	37										

Continued Next Page

+ 3, x 3; Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-01E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 436.64 E 300 547.79 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2006-12-13 - 2006-12-13 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						W P
	Continued From Previous Page								SHEAR STRENGTH kPa									
									○ UNCONFINED + FIELD VANE									
									● QUICK TRIAXIAL × LAB VANE									
									20	40	60	80	100	20	40	60		
227.8	Silty CLAY , some sand, trace gravel Hard						228											
10.3	SAND , with silt Very Dense Grey Wet																	
227.1			10	SS	50/													
11.0	END OF BOREHOLE AT 11.0 m. BOREHOLE OPEN TO 10.31 m AND DRY UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				150													

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-02E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 509.65 E 300 536.45 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-12 - 2006-12-13 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
236.9							20	40	60	80	100	W P	W	W L	kN/m ³	GR SA SI CL			
0.0	Silty SAND , trace gravel Loose Brown Moist (FILL)		1	SS	8														
236.3																			
0.7	Silty CLAY , with sand Stiff Brown Moist (FILL)		2	SS	11												0 23 52 25		
			3	SS	13														
234.7																			
2.2	Silty CLAY , some sand, trace gravel Stiff Brown Moist (FILL)		4	SS	12														
			5	SS	13														
232.7																			
4.2	Clayey SILT , with sand, trace rootlets and wood fragments, stained topsoil Stiff Grey Moist		6	SS	9												0 23 61 16		
231.1																			
5.8	SAND , some silt, some gravel Compact Brown Wet (saturated)		7	SS	18														
			8	SS	30														
228.3																			
8.7	SILT , with sand, trace gravel Very Dense Grey Moist (TILL)		9	SS	70														

Continued Next Page

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

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-02E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 509.65 E 300 536.45 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2006-12-12 - 2006-12-13 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
Continued From Previous Page														
226.6	SILT, with sand, trace gravel Very Dense (TILL)													
10.4	Sandy SILT, trace clay Very Dense Grey Moist		10	SS	75		226							0 22 69 9
225.7														
11.3	END OF BOREHOLE AT 11.28 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 8.9 228.0 27.03.07 8.8 228.1													

ONTMT4S 9268.GPJ 120407

RECORD OF BOREHOLE No 06-03E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 555.19 E 300 528.76 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2006-12-13 - 2006-12-13 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page														
225.4	Silty SAND, trace clay Dense Grey Wet		10	SS	37		226								
11.3	END OF BOREHOLE AT 11.28 m. BOREHOLE OPEN TO 6.18 m UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO SURFACE. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 13.12.06 3.1 233.6														

ONTMT4S 9268.GPJ 1204/07

RECORD OF BOREHOLE No 06-30E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 670.49 E 300 523.55 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY TJH

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	20 40 60 80 100	20 40 60 80 100		
233.0												
0.0	TOPSOIL: (125 mm)						233					
0.1	Silty CLAY, some sand, trace gravel, trace rootlets, topsoil stained Firm Brown (FILL)		1	SS	5							
			2	SS	8		232					
			3	SS	7		231					
	trace wood and leaf fragments		4	SS	5		230					
	Very Soft		5	SS	0							
229.0							229					
4.0	Silty CLAY, trace sand Very Stiff Brown to Grey		6	SS	22		228					
227.3							227					
5.7	Sandy SILT, trace clay, trace gravel, occasional inferred cobbles Compact Grey Moist to Wet (TILL)		7	SS	64/ 275		226					
			8	SS	29		225					
			9	SS	11		224					

Continued Next Page

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

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-30E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 670.49 E 300 523.55 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100									W _P	W	W _L	WATER CONTENT (%)	GR SA SI CL
SHEAR STRENGTH kPa																					
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE																					
	Continued From Previous Page						223														
222.0	Sandy SILT, trace clay, trace gravel, occasional inferred cobbles Compact Grey Moist to Wet (TILL)		10	SS	50/ .150																
11.0	END OF BOREHOLE AT 10.97 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 3.5 229.5 27.03.07 3.4 229.6																				

ONTMT4S 9266 GPJ 12/04/07

RECORD OF BOREHOLE No 06-31E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 705.10 E 300 508.88 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
238.2												
0.0	TOPSOIL: (100 mm)											
0.1	Silty CLAY, trace gravel and sand seams, trace rootlets, topsoil stained Firm Brown Moist		1	SS	6		238					
			2	SS	6		237					
236.8												
1.4	Silty CLAY, some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)(CL)		3	SS	20		236					1 19 56 24
			4	SS	21		235					
			5	SS	27		234					
			6	SS	33		233					2 14 52 32
			7	SS	30		232					
			8	SS	24		231					
	becoming Grey		9	SS	27		230					
							229					1 20 54 25

Continued Next Page

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

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-31E

2 OF 2

METRIC

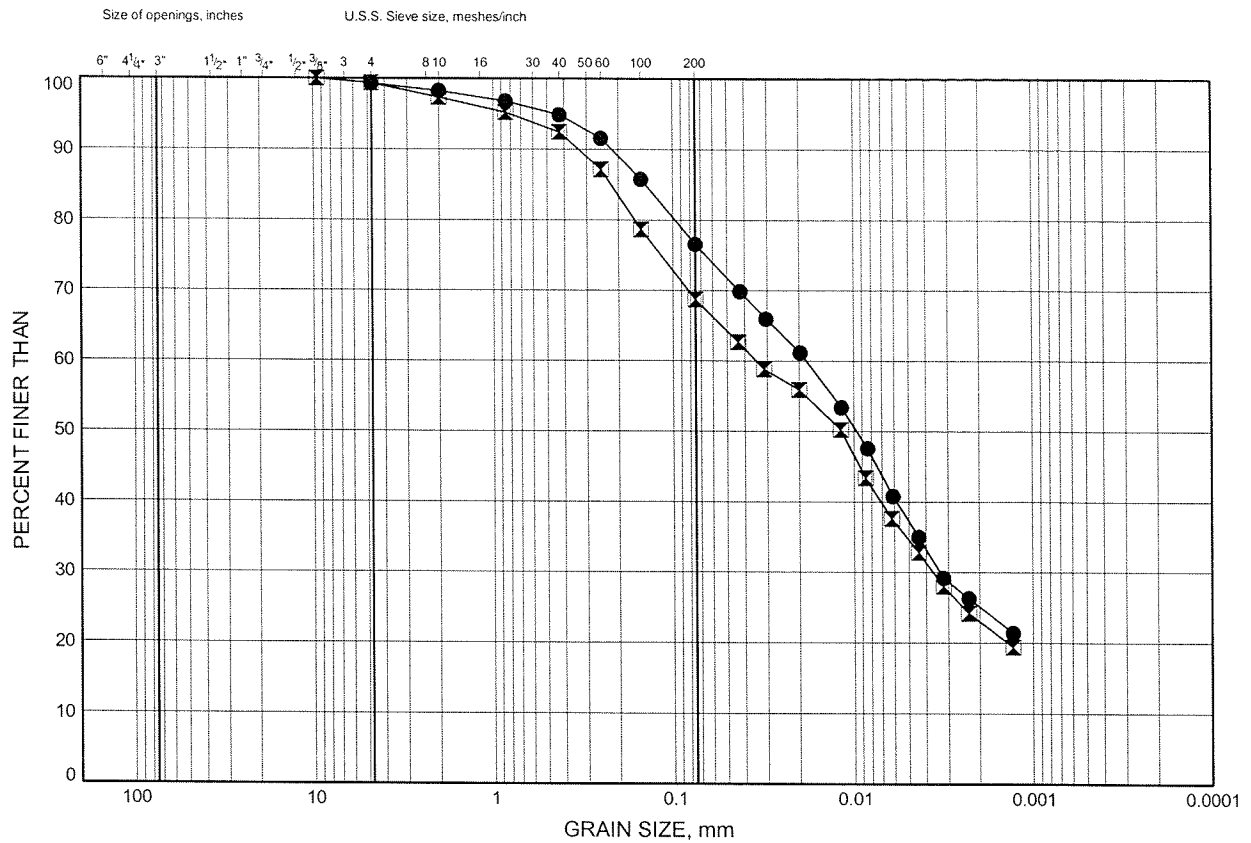
G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 705.10 E 300 508.88 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page														
227.4	Silty CLAY , some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)(CL)						228								
10.8	SAND , with silt Compact Grey		10	SS	29										
226.9	Wet														
11.3	END OF BOREHOLE AT 11.28 m. BOREHOLE OPEN UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE AND BACKFILLED WITH AUGER CUTTINGS TO SURFACE.						227								
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 12.12.06 6.7 231.5														

ONTMT4S 9268.GPJ 12/04/07

GRAIN SIZE DISTRIBUTION

SILTY CLAY FILL



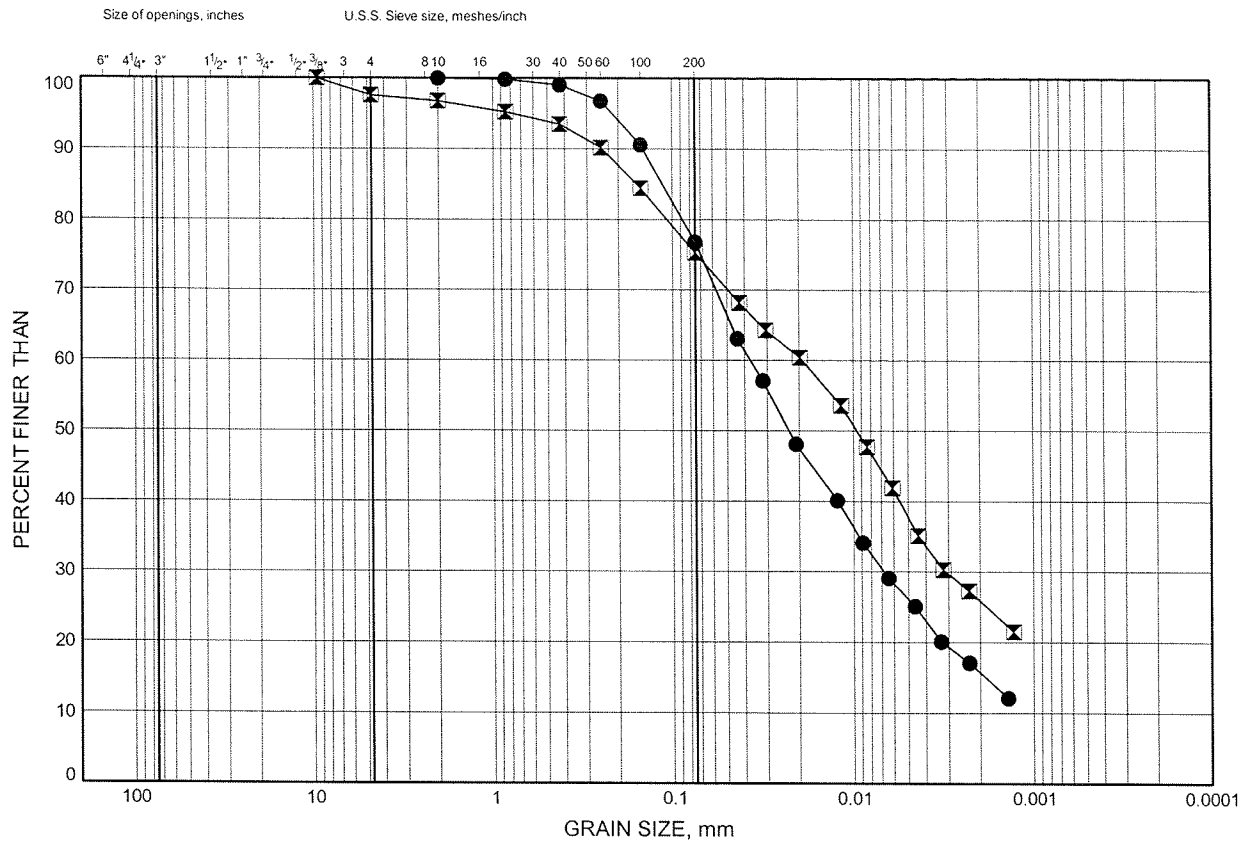
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-02E	1.07	235.87
⊠	06-03E	1.83	234.87

Date April 2007Project 2539-04-00Prep'd MFAChkd. SKP

GRAIN SIZE DISTRIBUTION

CLAYEY SILT / SILTY CLAY



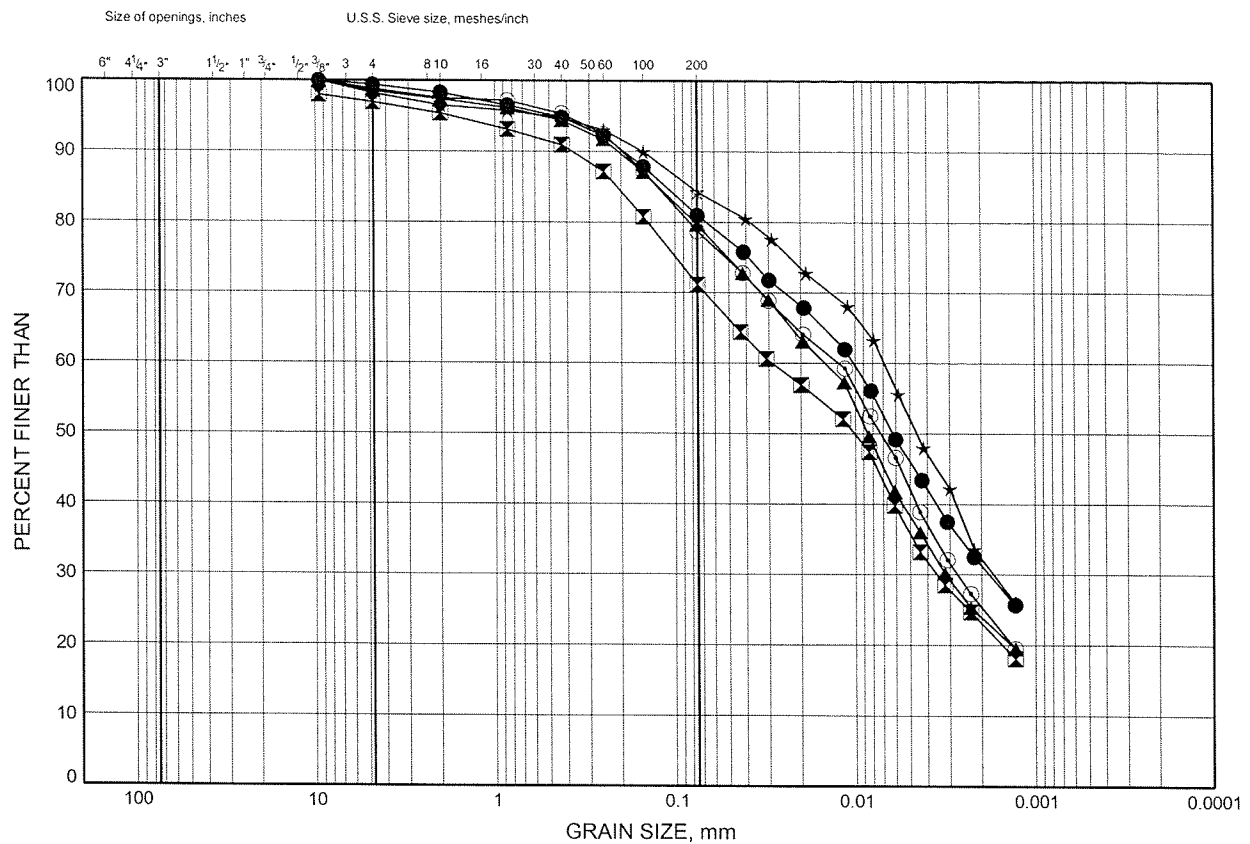
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-02E	4.88	232.06
⊠	06-03E	5.03	231.67

Date April 2007Project 2539-04-00Prep'd MFAChkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-01E	1.83	236.22
⊠	06-01E	7.92	230.13
▲	06-31E	1.83	236.38
★	06-31E	4.88	233.33
⊙	06-31E	9.45	228.76

Date April 2007

Project 2539-04-00

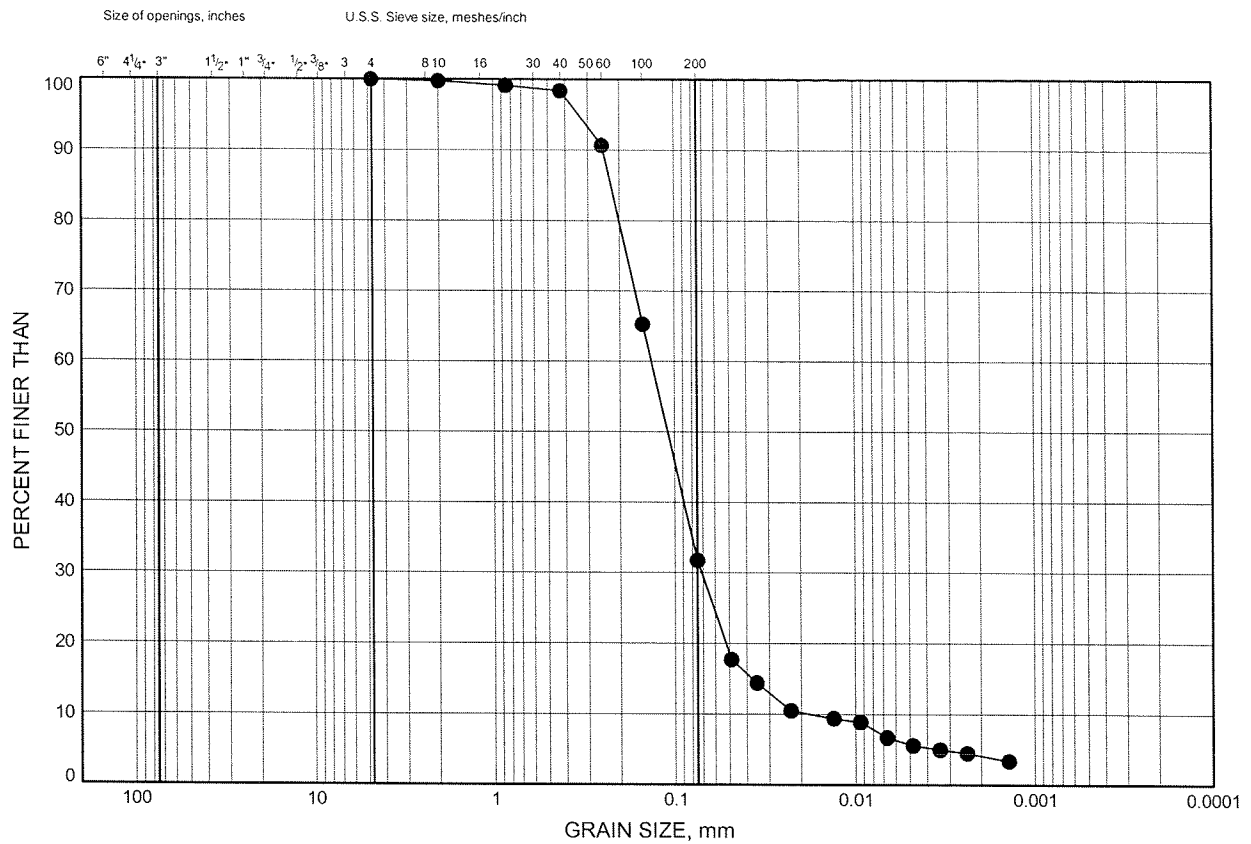


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-03E	9.45	227.25

Date April 2007

Project 2539-04-00

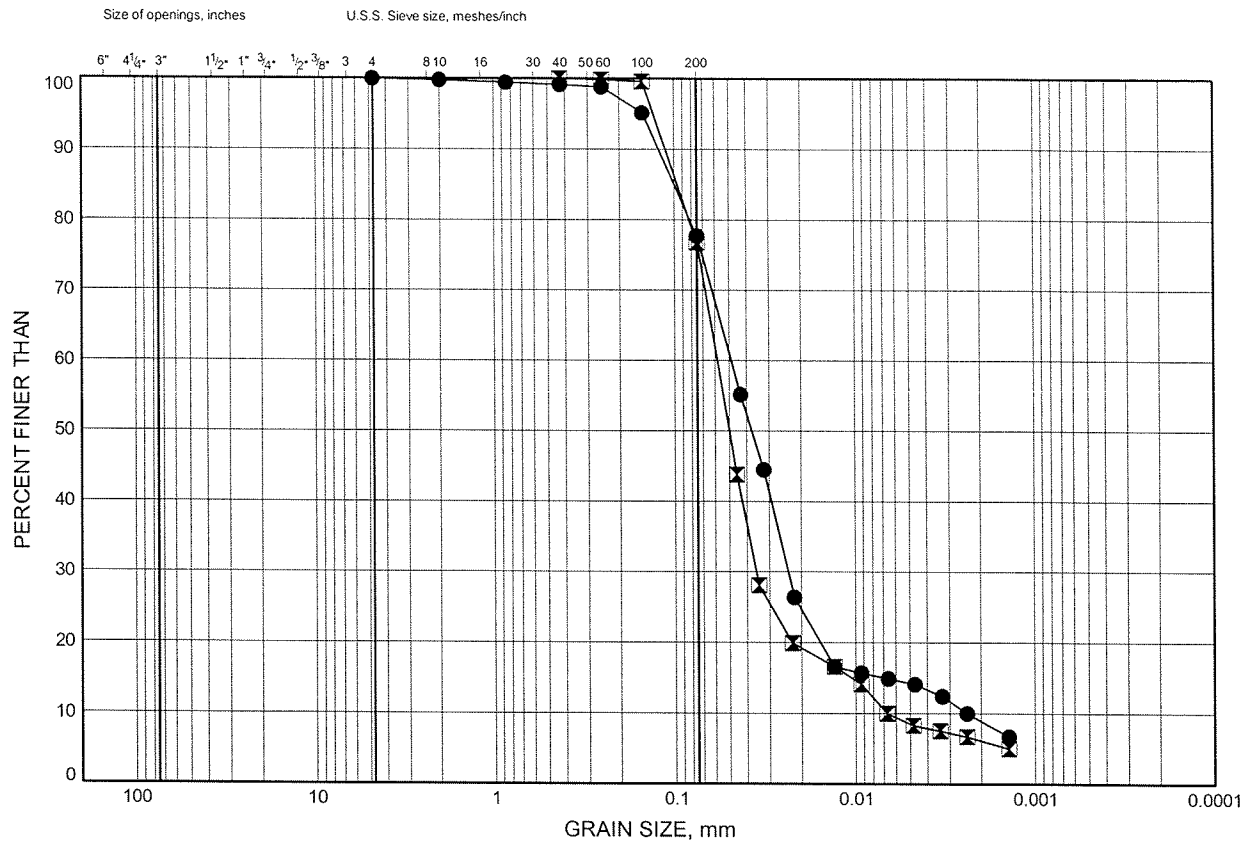


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SANDY SILT TO SANDY SILT TILL



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

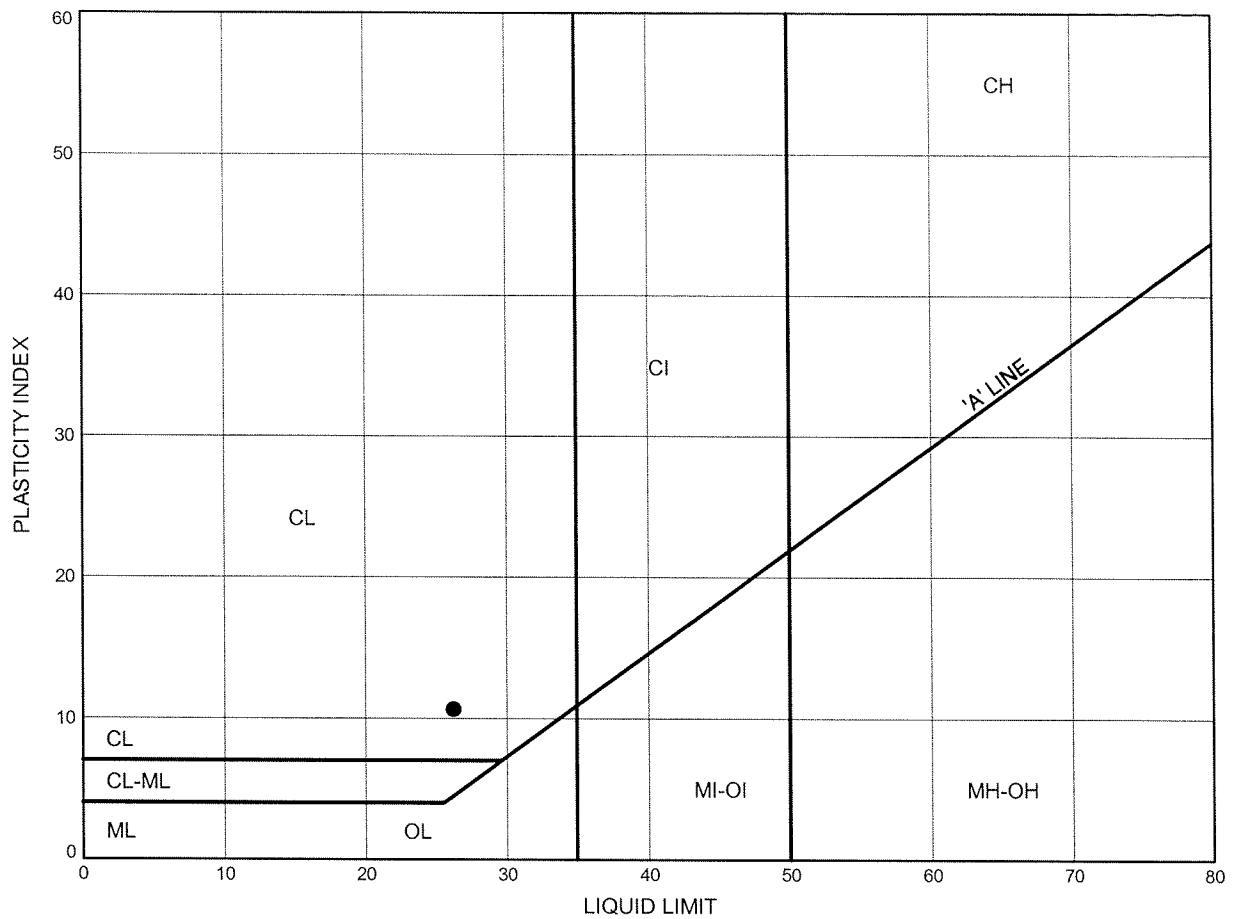
SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-02E	10.97	225.97
⊠	06-30E	7.92	225.06

Date April 2007Project 2539-04-00Prep'd MFAChkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE A6

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-30E	4.88	228.10

Date April 2007
 Project 2539-04-00

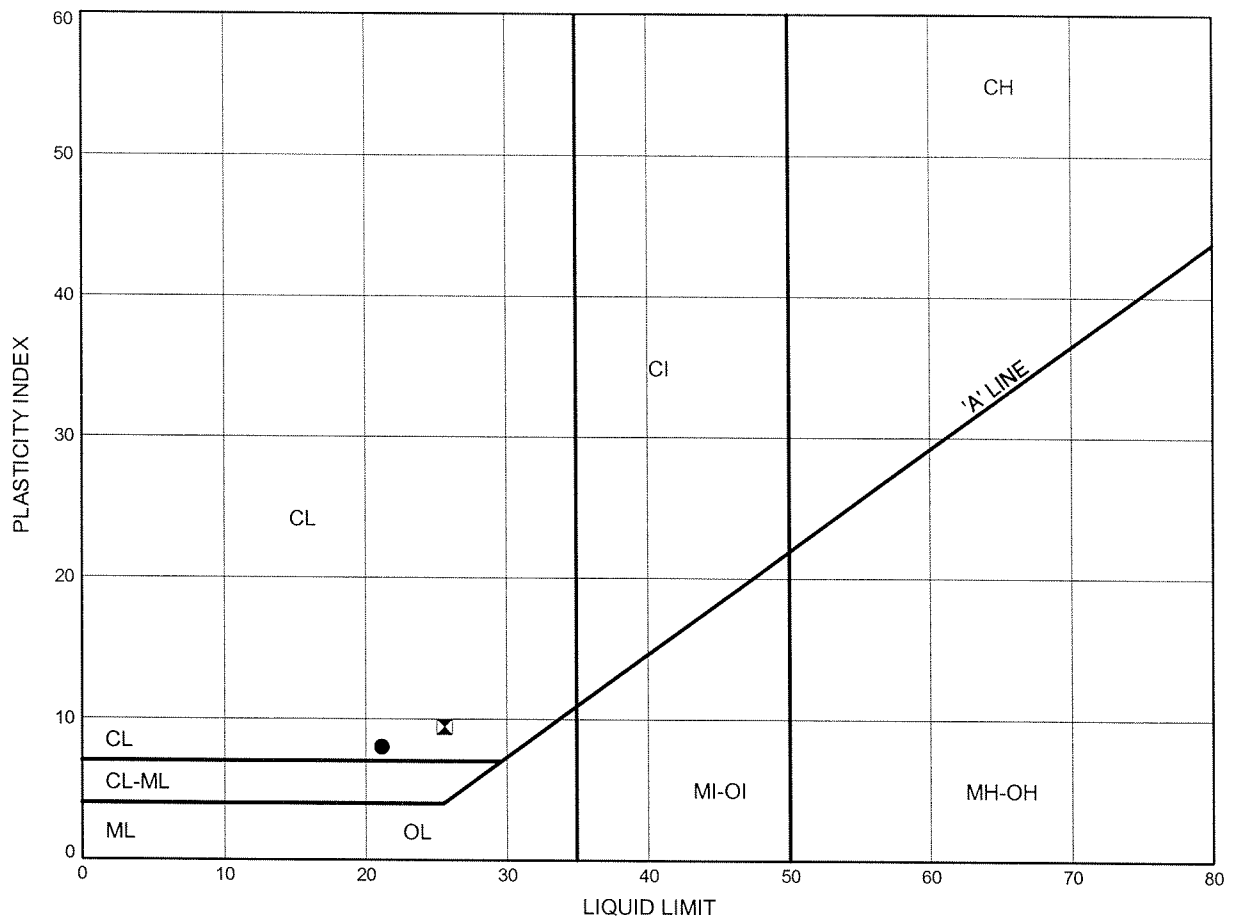


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 Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE A7

SILTY CLAY TILL



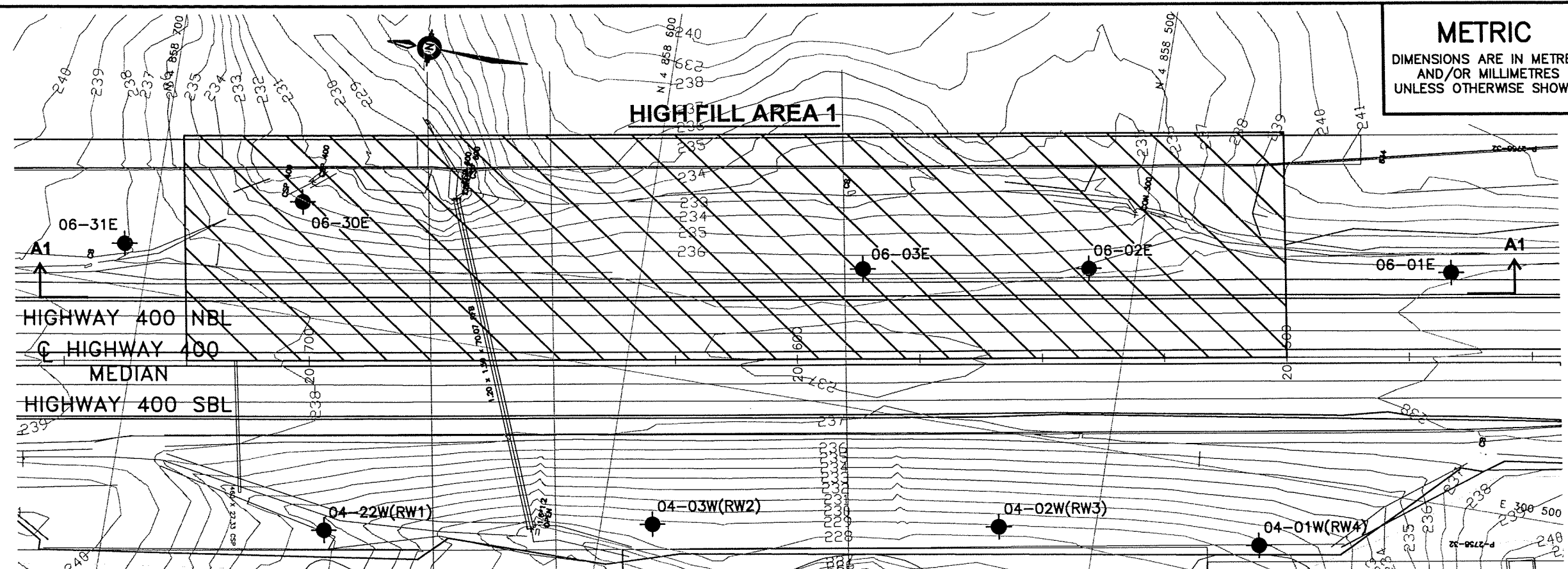
SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-01E	1.83	236.22
⊠	06-31E	1.83	236.38

Date April 2007
 Project 2539-04-00

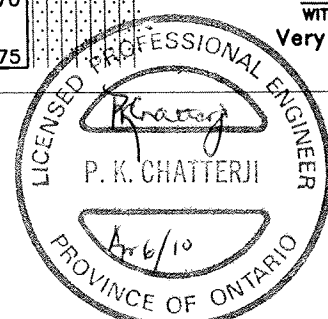
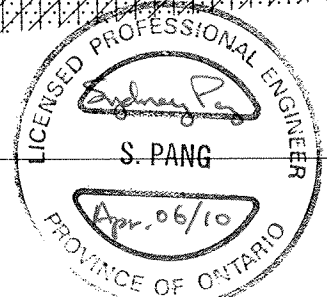
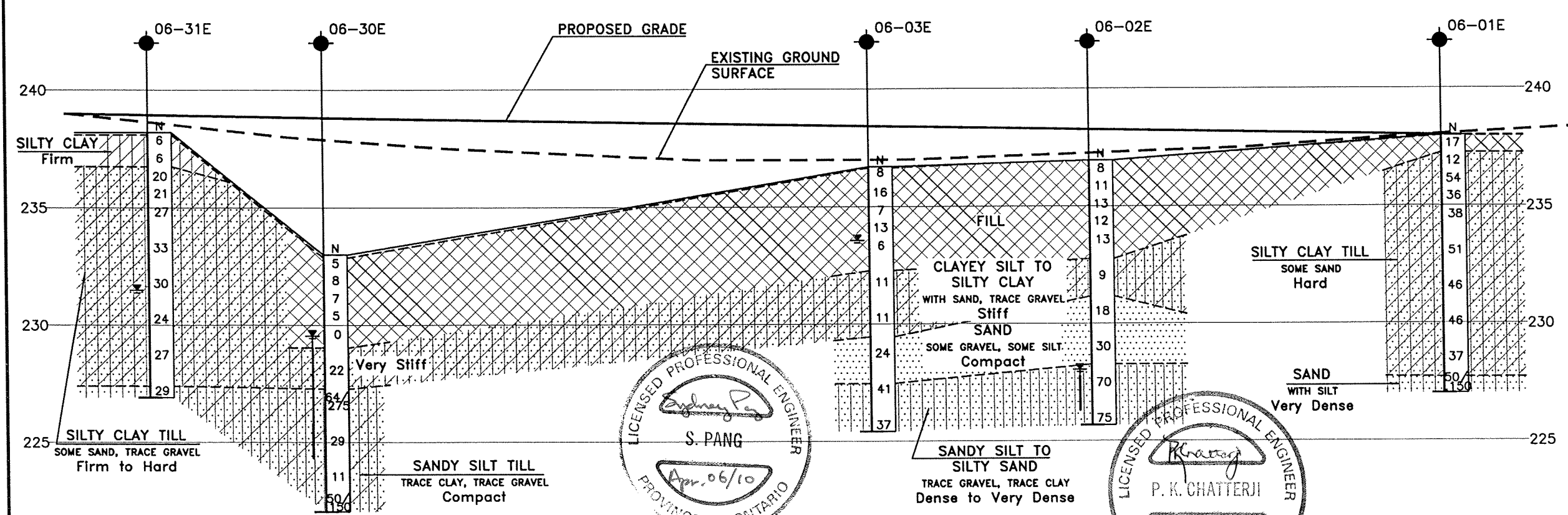


Prep'd MFA
 Chkd. SKP

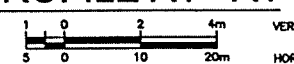
PLAN SCALE 1:1
SECTION SCALE 1:1
DATE OF TRANSMISSION: 2010-04-12



PLAN

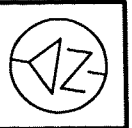


PROFILE A1 - A1



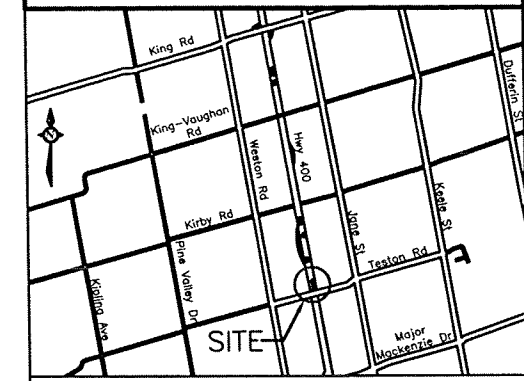
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HIGHWAY 400
CONT No
WP No 2539-04-00



HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 20+500 TO 20+780
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
06-01E	238.0	4 858 436.64	300 547.79
06-02E	236.9	4 858 509.65	300 536.45
06-03E	236.7	4 858 555.19	300 528.76
06-30E	233.0	4 858 670.49	300 523.55
06-31E	238.2	4 858 705.10	300 508.88

NOTES

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

GEOCRES No. 30M13-178

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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100 mm ON ORIGINAL DRAWING

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PLANTING: Apr 12, 2010 1:10 PM

RECORD OF BOREHOLE No 04-01W(RW4)

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 466.60 E 300 485.50 ORIGINATED BY MF
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM/SS
 DATUM Geodetic DATE 2004-07-12 - 2004-07-12 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
229.3												
0.0	TOPSOIL, (75 mm)											
0.1	Clayey SILT , some sand, trace gravel, occasional organic material, occasional black staining Firm to Stiff Brown to Grey (FILL)		1	SS	5		229					
							228					
			2	SS	13							
226.7							227					
2.6	Sandy SILT , trace clay, trace gravel Compact Brown/Grey											
			3	SS	20		226					1 57 34 8
							225					
			4	SS	30							
							224					
			5	SS	21		223					
							222					
			6	SS	15							
							221					
220.6												
8.7	SAND , trace silt to silty, fine grained, occasional cobbles, some iron oxide staining Loose to Compact Grey Moist						220					6 32 60 2
			7	SS	9							

Continued Next Page

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

ONTMT4S 9268.GPJ 140507

RECORD OF BOREHOLE No 04-01W(RW4)

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 466.60 E 300 485.50 ORIGINATED BY MF
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM/SS
DATUM Geodetic DATE 2004-07-12 - 2004-07-12 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page														
	SAND, trace silt to silty, fine grained, occasional cobbles, some iron oxide staining Loose to Compact Grey Moist		8	SS	19		219								
							218								
			9	SS	28		217								
							216								
			10	SS	29		215								
							214								
			11	SS	15		213								
							212								
	Becoming Very Dense		12	SS	73		211								
	Becoming Dense		13	SS	30										
210.4															
18.9	END OF BOREHOLE AT 18.9 m. BOREHOLE OPEN TO 18.9 m. BOREHOLE WET AT 1.5 m. BOREHOLE BACKFILLED WITH BENSEAL.														

ONTMT4S 9268.GPJ 14/05/07

RECORD OF BOREHOLE No 04-02W(RW3)

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 519.60 E 300 480.60 ORIGINATED BY MF
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM/SS
DATUM Geodetic DATE 2004-07-09 - 2004-07-12 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
229.3								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
0.0	TOPSOIL, (150 mm)							20 40 60 80 100				
0.2	Sandy SILT, some gravel, some clay, some roots and wood fragments Loose Brown (FILL)		1	SS	5		229		○			
							228					
			2	SS	7				○			0 28 54 18
226.7							227					
2.6	Clayey SILT, some sand, occasional silt pockets Stiff Grey		3	SS	11		226		○			
225.2							225					
4.1	Sandy SILT, trace clay, fine grained Compact Grey Moist		4	SS	14		224		○			
							223					0 37 60 3
			5	SS	22				○			
222.1							222					
7.2	Silty SAND Compact Grey Moist		6	SS	29		221					
							220		○			
219.8			7	SS	15							
9.5	SAND, trace silt, fine grained Compact to Dense Brown to Grey											

Continued Next Page

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

RECORD OF BOREHOLE No 04-02W(RW3)

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 519.60 E 300 480.60 ORIGINATED BY MF
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM/SS
DATUM Geodetic DATE 2004-07-09 - 2004-07-12 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
								20 40 60 80 100				
216.5	SAND, trace silt, fine grained Compact to Dense Brown to Grey		8	SS	17		219					
							218					
			9	SS	44		217					
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE OPEN TO 12.8 m. BOREHOLE WET AT 1.8 m. BOREHOLE BACKFILLED WITH BENSEAL.											

ONTMT4S 9268.GPJ 14/05/07

RECORD OF BOREHOLE No 04-03W(RW2)

1 OF 3

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 589.50 E 300 469.50 ORIGINATED BY MF
 HWY 400 BOREHOLE TYPE Solid Stem Augers / NW Casings COMPILED BY WM/SS
 DATUM Geodetic DATE 2004-07-08 - 2004-07-09 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
229.1															
0.0	TOPSOIL, (100mm)														
0.1	Clayey SILT, with sand, trace gravel, occasional rootlets, some black staining, occasional wood fibers Firm Brown to Grey (FILL)		1	SS	7		229								
							228								
			2	SS	6		227								0 37 46 17
226.5															
2.6	Sandy SILT, trace clay, with iron oxide staining, occasional silt layers Loose to Compact Grey (ML-NONPLASTIC)		3	SS	8		226								
							225								
			4	SS	12		224								
							223								0 28 68 4
			5	SS	11		222								
							221								
			6	SS	10		220								
			7	SS	12										

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 04-03W(RW2)

2 OF 3

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 589.50 E 300 469.50 ORIGINATED BY MF
HWY 400 BOREHOLE TYPE Solid Stem Augers / NW Casings COMPILED BY WM/SS
DATUM Geodetic DATE 2004-07-08 - 2004-07-09 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y 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 (%)		
	Continued From Previous Page							20 40 60 80 100									
	Sandy SILT , with iron oxide staining, occasional silt layers Loose to Compact Grey (ML-NONPLASTIC)		8	SS	9												
217.4																	
11.7	SAND , trace silt, trace gravel Loose to Compact Brown		9	SS	13												
			10	SS	18												
			11	SS	11												
			13	SS	9												
										</							

2 88 10
(SI+CL)

Continued Next Page

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

RECORD OF BOREHOLE No 04-03W(RW2)

3 OF 3

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 589.50 E 300 469.50 ORIGINATED BY MF
 HWY 400 BOREHOLE TYPE Solid Stem Augers / NW Casings COMPILED BY WM/SS
 DATUM Geodetic DATE 2004-07-08 - 2004-07-09 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page														
207.5	SAND, trace silt, trace gravel Loose to Compact Brown		14	SS	27		209								
21.6	END OF BOREHOLE AT 21.6 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 13/07/04 1.3 227.8 05/08/04 1.3 227.8						208								

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RECORD OF BOREHOLE No 04-22W(RW1)

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 655.60 E 300 457.10 ORIGINATED BY MF
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY SL/SS
 DATUM Geodetic DATE 2004-07-13 - 2004-07-13 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
233.0								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
0.0	TOPSOIL clayey, some sand, some rootlets Stiff Brown		1	SS	12		233	20 40 60 80 100				
231.9							232					
1.1	SAND and SILT, occasional silt lumps Compact Brown Moist		2	SS	28		231					
							230					
			3	SS	25		229					
228.9							228					
4.1	Sandy SILT, fine grained Dense Brown Moist		4	SS	47		227					
227.4							226					
5.6	SILT, trace to some clay, trace to some sand, occasional clay lenses Dense to Compact Grey (ML-NONPLASTIC)		5	SS	42		225					
							224					
			6	SS	11							
224.3												
8.7	Sandy SILT, trace clay, fine grained Compact Grey		7	SS	13							

ONTMT4S 9268.GPJ 14/05/07

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

RECORD OF BOREHOLE No 04-22W(RW1)

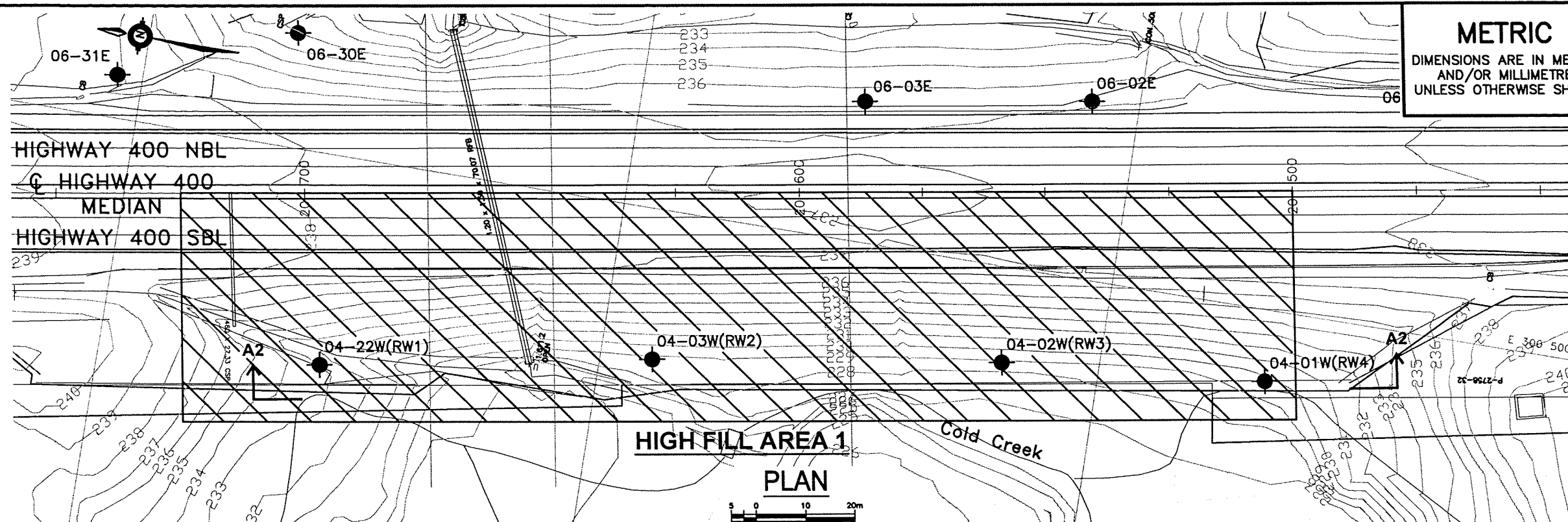
2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 858 655.60 E 300 457.10 ORIGINATED BY MF
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY SL/SS
DATUM Geodetic DATE 2004-07-13 - 2004-07-13 CHECKED BY SMS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
								20 40 60 80 100				
220.2	Sandy SILT, trace clay, fine grained Compact Grey		8	SS	16		223					
							222					
							221					
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE OPEN AND DRY TO 4.6 m. BOREHOLE BACKFILLED WITH BENSEAL.		9	SS	25							

ONTMT4S 9268.GPJ 14/05/07



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

HIGHWAY 400
CONT No
WP No 2539-04-00

HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 20+500 TO 20+780
BOREHOLE LOCATIONS AND SOIL STRATA

SNC-LAVALIN
Engineers & Constructors

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
RW-1(06-22W)	233.0	4 858 655.6	300 457.1
RW-2(06-03W)	229.1	4 858 589.5	300 469.5
RW-3(06-02W)	229.3	4 858 519.6	300 480.6
RW-4(06-01W)	229.3	4 858 466.6	300 485.5

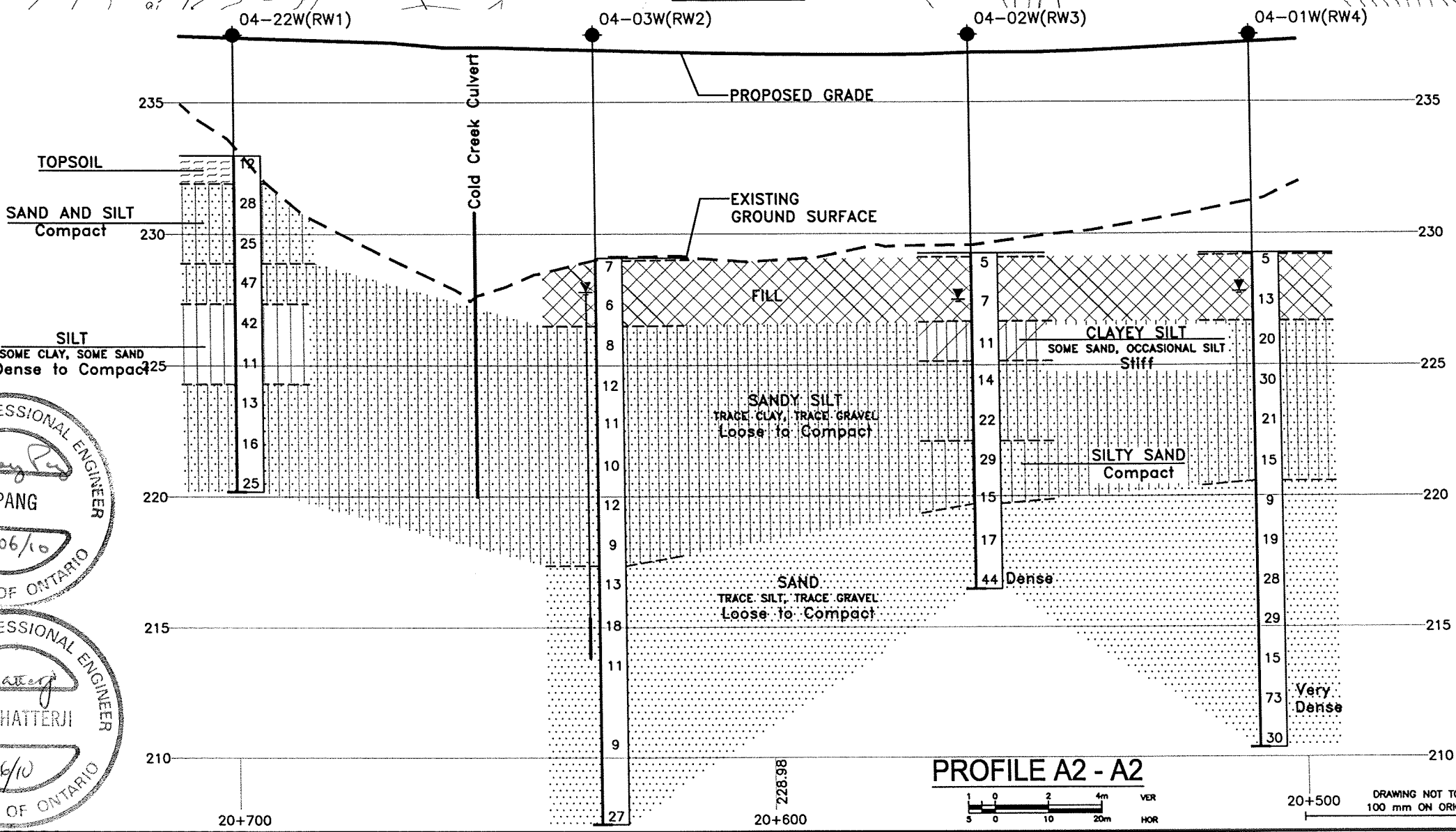
NOTES

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

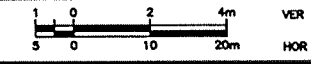
GEOCRES No. 30M13-178

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Apr 06/10
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P. K. CHATTERJI
Apr 6/10
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PROFILE A2 - A2



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
DESIGN	TH	CHK PKC CODE
DRAWN	MFA	CHK SKP SITE
STRUCT		DATE APR. 2010
DWG.	A2	

Appendix B

High Fill Area 2

**Highway 400 SB – Approximate Stations 21+150 to 21+250
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 06-04W

1 OF 1

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 096.28 E 300 383.52 ORIGINATED BY BJ
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-15 - 2006-12-15 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
246.1												
0.0	Clayey TOPSOIL: (150 mm)						246					
0.2	Silty CLAY, some sand, trace gravel Firm to Stiff Brown (TILL)(CL)		1	SS	6							
			2	SS	9		245					0 18 53 29
	Hard		3	SS	46							
243.8							244					
2.3	Sandy SILT, some clay, trace gravel, some iron oxide staining Very Dense (TILL)		4	SS	40/ .125							
			5	SS	63		243					
							242					
241.7												
4.3	SILT, some sand, some clay (TILL)		6	SS	62		241					0 14 75 11
240.0							240					
6.1	Silty CLAY, trace sand, trace gravel Hard (TILL)		7	SS	38							
							239					
			8	SS	30							
237.8							238					
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.											

ONTMT4S 9268.GPJ 14/05/07

RECORD OF BOREHOLE No 06-05W

1 OF 1

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 131.21 E 300 359.10 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-02-05 - 2007-02-05 CHECKED BY TJH

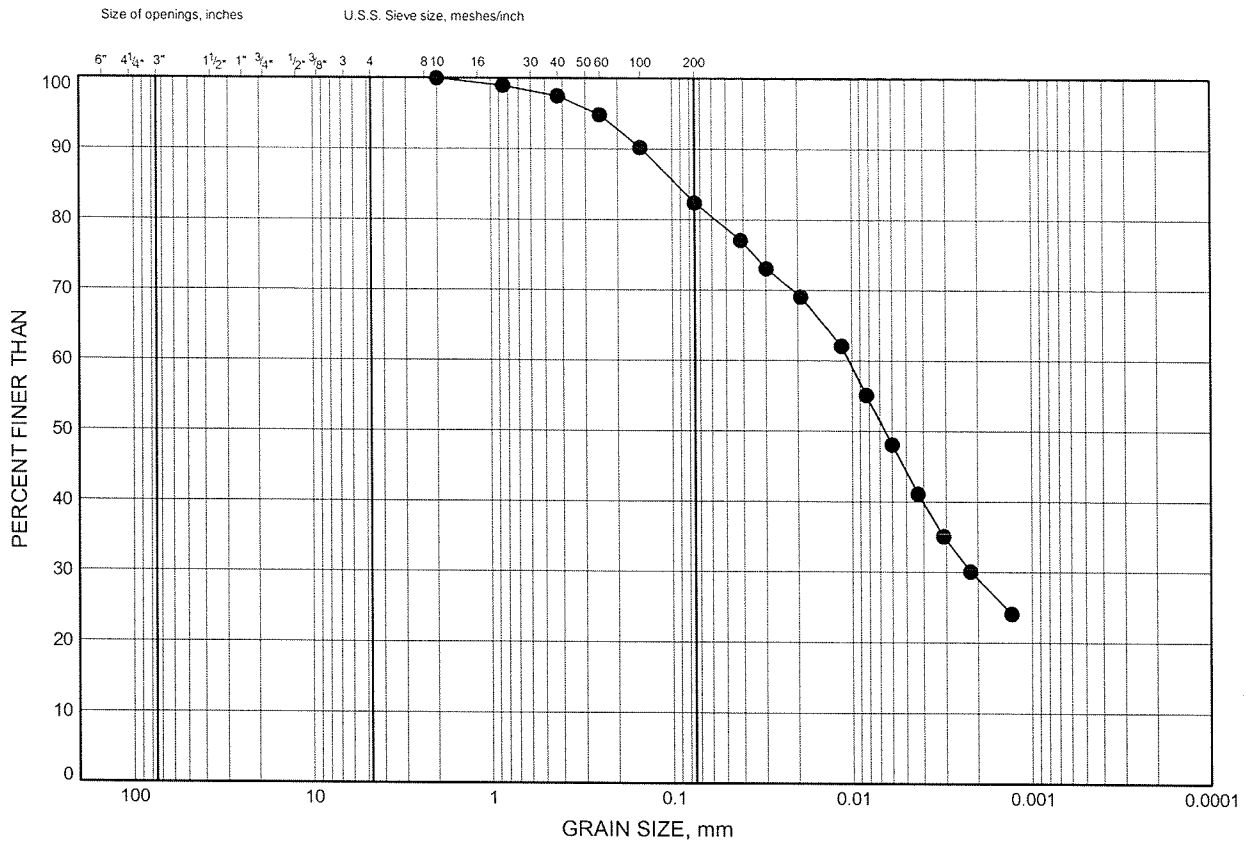
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
240.9												
0.0	TOPSOIL: (100mm)											
0.1	Silty CLAY, with sand, some sand seams Stiff to Very Stiff Dark Brown Moist (TILL)(CL)		1	SS	8		240					
			2	SS	17		239					0 22 52 26
			3	SS	27							
237.9							238					
3.0	Sandy SILT, trace clay Compact to Dense Brown Moist (TILL)		4	SS	34							
							237					
			5	SS	26		236					0 36 61 3
			6	SS	25		235					
							234					
			7	SS	34		233					
232.6												
8.2	END OF BOREHOLE AT 8.23m BOREHOLE CAVED TO 5.39m. BOREHOLE BACKFILLED WITH HOLEPLUG UPON COMPLETION.											
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 05.02.07 5.0 235.9											

ONTMT4S 9268.GPJ 12/04/07

GRAIN SIZE DISTRIBUTION

FIGURE B1

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04W	1.07	245.00

Date April 2007

Project 2539-04-00

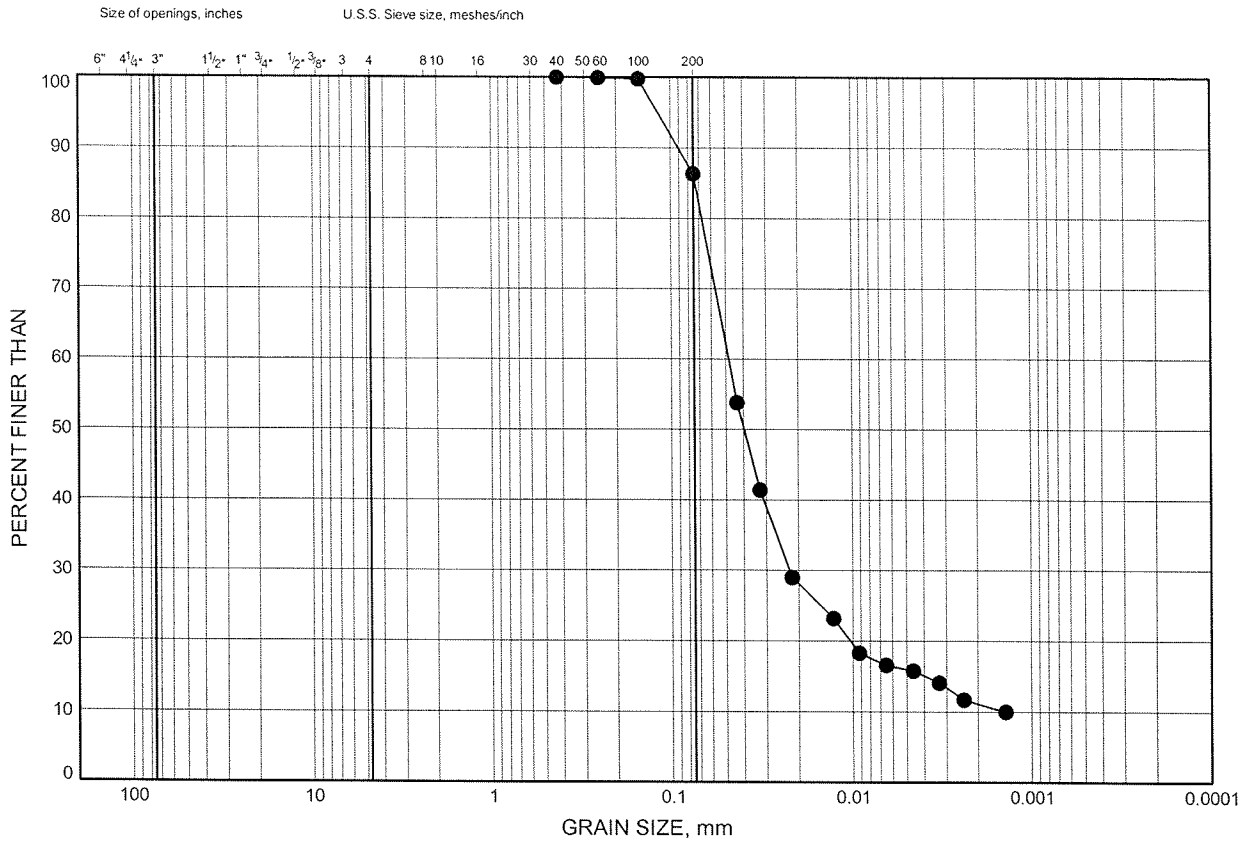


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04W	4.88	241.19

Date April 2007

Project 2539-04-00



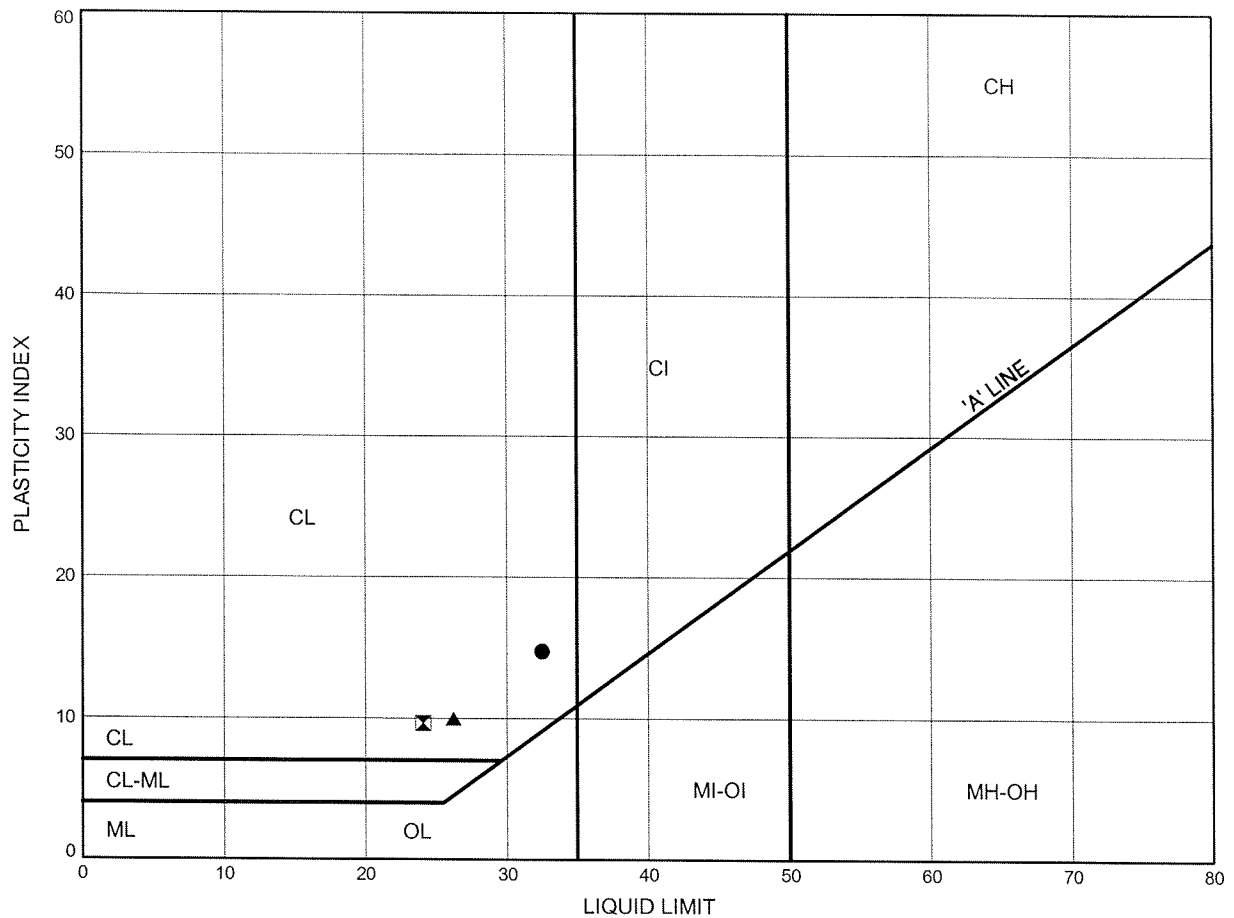
Prep'd MFA

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Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE B3

SILTY CLAY TILL

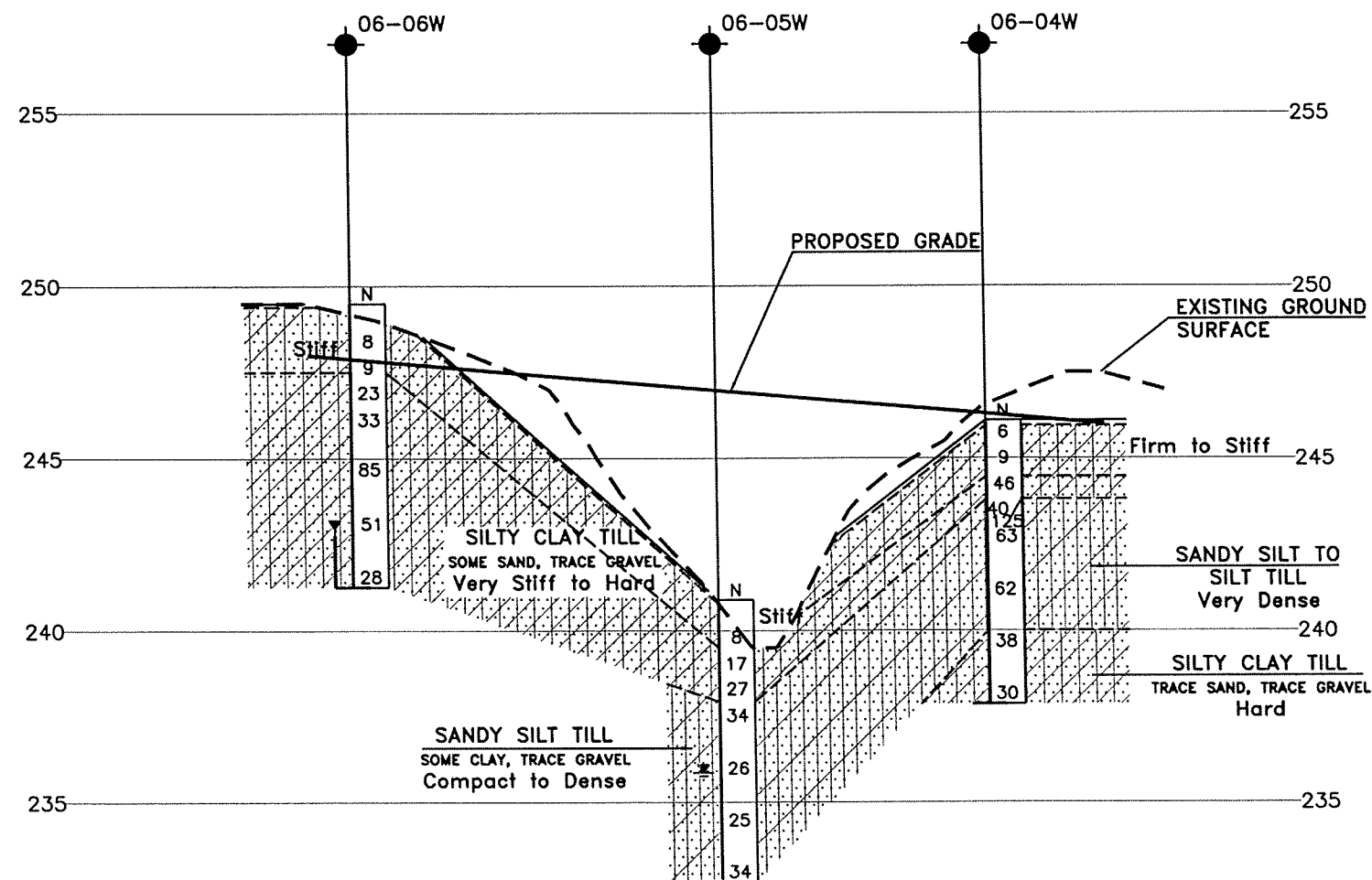
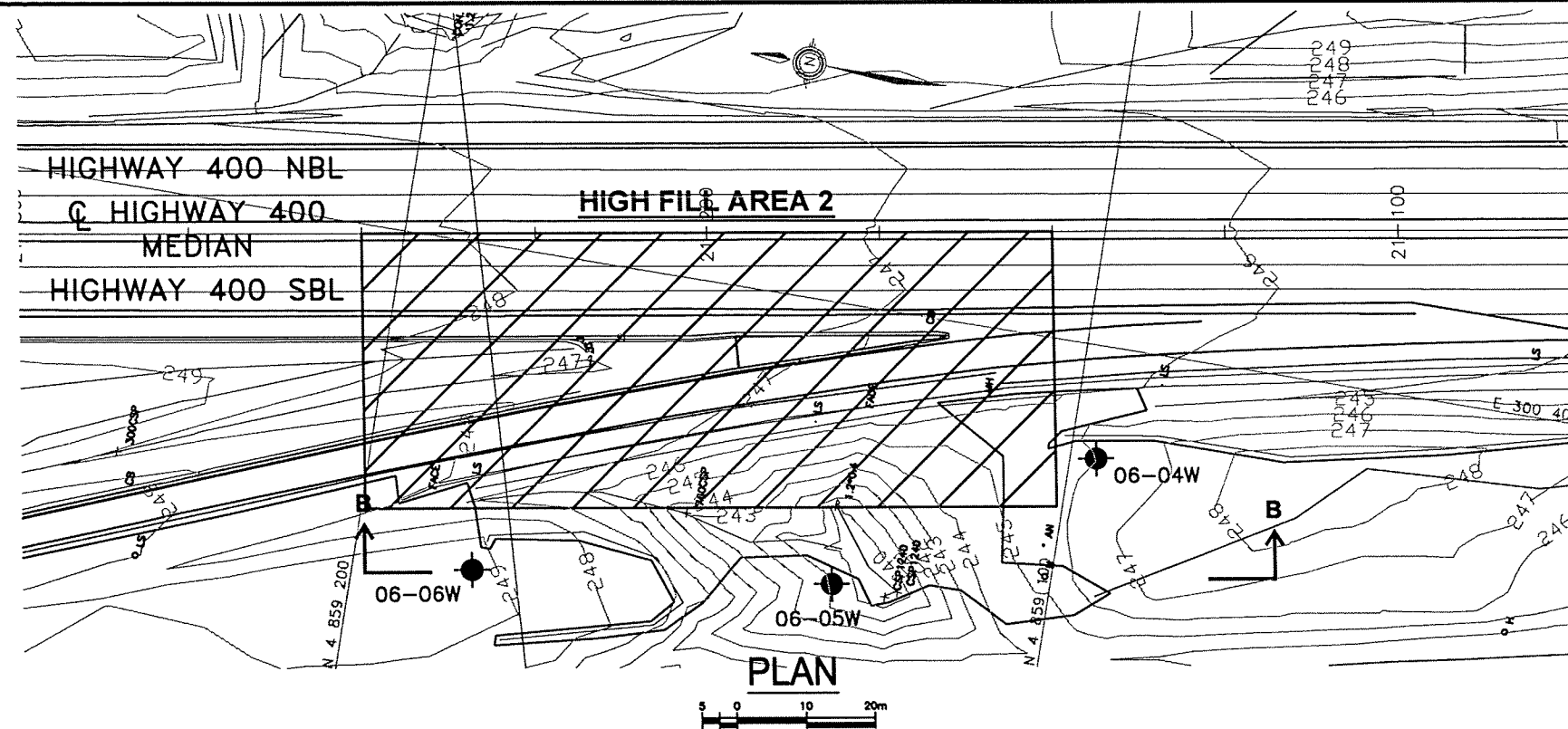


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04W	1.07	245.00
⊠	06-05W	1.83	239.04
▲	06-06W	2.59	246.93

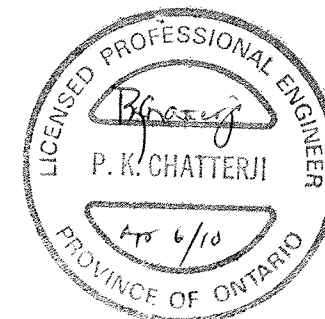
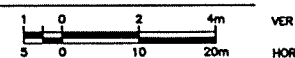
Date April 2007
 Project 2539-04-00



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PROFILE B - B



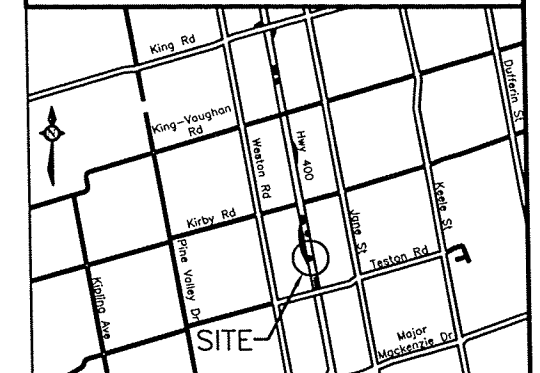
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HIGHWAY 400	
CONT No	
WP No 2539-04-00	








SHEET 1

HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 21+100 TO 21+275
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

L E G E N D

	Borehole		
	Borehole and Cone		
N	Blows /0.3m (Std Pen Test, 475J/blow)		
CONE	Blows /0.3m (60° Cone, 475J/blow)		
PH	Pressure, Hydraulic		
	Water Level		
	Head Artesian Water		
	Piezometer		
90%	Rock Quality Designation (RQD)		
A/R	Auger Refusal		
NO	ELEVATION	NORTHING	EASTING
06-04W	246.1	4 859 096.28	300 383.52
06-05W	240.9	4 859 131.21	300 359.10
06-06W	249.5	4 859 182.79	300 352.51

-NOTES-

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

GEOCRES No. 30M13-178

[illegible]

Appendix C

High Fill Area 3

**Highway 400 NB – Approximate Stations 21+725 to 21+825
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 06-04E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 683.08 E 300 354.68 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-02-01 - 2007-02-01 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
247.9												
0.0	TOPSOIL: (150mm)											
0.2	Silty CLAY, some sand, trace gravel, trace roots and rootlets, topsoil-stained Stiff to Very Stiff Dark Brown Moist		1	SS	14		247					
			2	SS	20		246					1 22 48 29
245.7												
2.2	Silty CLAY, trace sand Very Stiff to Hard Brown Moist (TILL)		3	SS	29		245					
			4	SS	31		244					
	Grey											
			5	SS	59		243					0 22 56 22
242.9												
5.0	Sandy SILT Dense Grey Moist											
242.0												
5.9	SAND, some silt						242					
241.7	Dense Grey		6	SS	52		241					
6.2	Wet Silty CLAY, some sand, trace gravel Hard Grey Moist (TILL)											
			7	SS	67		240					1 29 49 21
			8	SS	65		239					
238.2												
9.8	END OF BOREHOLE AT 9.75m.											

ONTMT4S 9268.GPJ 12/04/07

Continued Next Page

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

METRIC

[illegible]

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

RECORD OF BOREHOLE No 06-05E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 708.59 E 300 349.57 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007-02-01 - 2007-02-01 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
243.2												
0.0 0.1	TOPSOIL: (75mm) Silty CLAY, with sand, trace gravel, with roots Firm Dark Brown Moist		1	SS	8		243					3 29 49 19
241.7	topsoil-stained, trace rootlets						242					
1.5	SAND, some silt, trace clay, trace rootlets Loose Dark Brown		2	SS	4		241					
241.0							240					
2.2	Silty CLAY, some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	25		239					
			4	SS	51		238					
	Grey						237					
	occasional inferred cobbles		5	SS	90/ 275		236					1 28 51 20
237.4							235					
5.8	Silty SAND, trace clay Dense Grey Wet		6	SS	48		234					0 65 32 3
			7	SS	48							
			8	SS	50/ 150							
233.7	END OF BOREHOLE AT 9.45m. BOREHOLE CAVED TO 4.88m, BACKFILLED WITH BENTONITE											
9.4												

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-05E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 708.59 E 300 349.57 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007-02-01 - 2007-02-01 CHECKED BY TJH

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 Y 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 (%)					
	Continued From Previous Page													
	HOLEPUG TO SURFACE.													
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 01.02.07 1.5 241.7													

ONTM14S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-06E

1 OF 1

METRIC

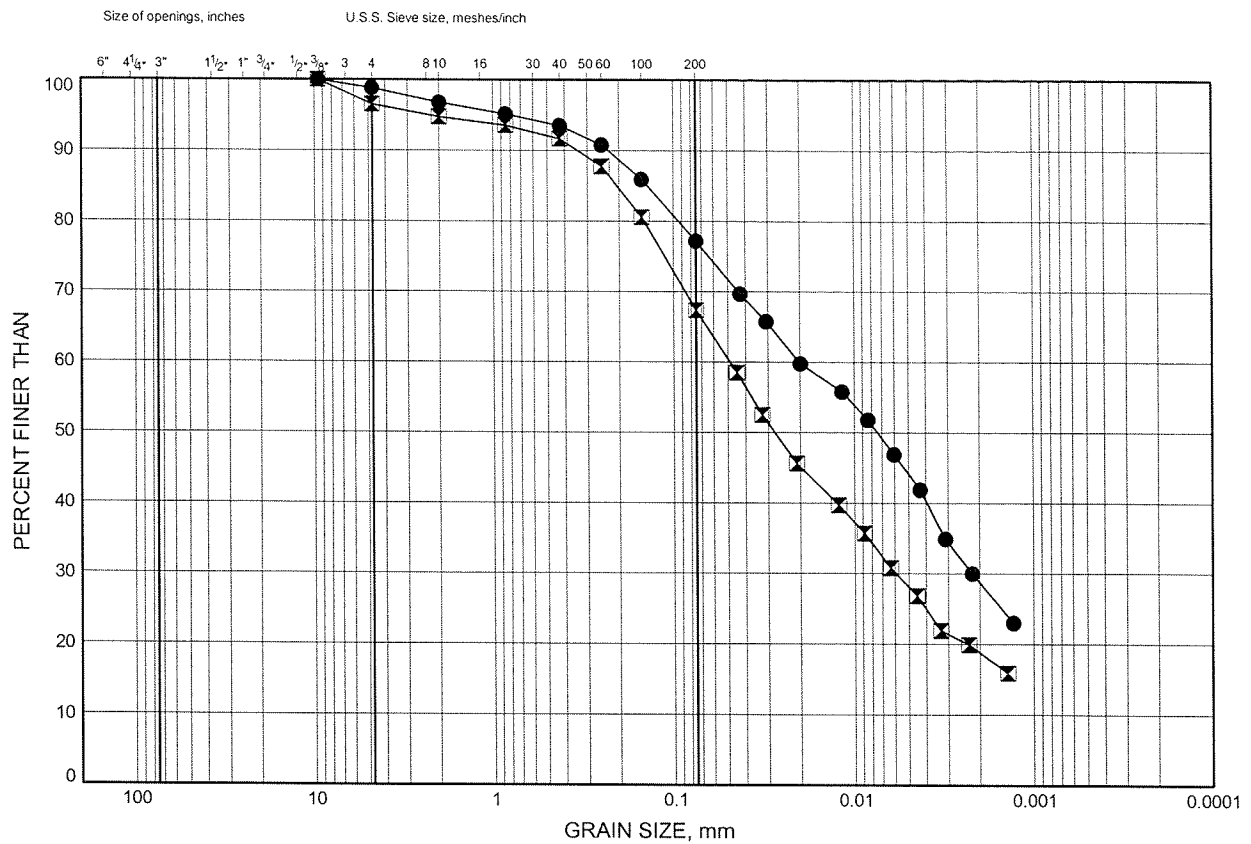
G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 783.12 E 300 332.42 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-14 - 2006-12-14 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
248.5												
0.0	TOPSOIL: (100 mm)											
0.1	Silty CLAY, some sand, topsoil stained Firm to Very Soft Dark Brown Moist		1	SS	6		248					
			2	SS	0							
247.1							247					
1.4	Silty CLAY, some sand Very Stiff to Hard Brown Moist (TILL)		3	SS	29							0 19 49 32
			4	SS	42		246					
245.7												
2.8	Silty SAND, trace clay Dense Brown Moist		5	SS	38		245					
245.1												
3.4	Silty CLAY, some sand, trace gravel Very Stiff Brown to Grey Moist (TILL)(CL)						244					
	occasional inferred cobbles		6	SS	25							
							243					
	Grey Moist to Wet		7	SS	24		242					
	With sand Hard		8	SS	40		241					1 33 46 20
240.3												
8.2	END OF BOREHOLE AT 8.23 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.											
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 4.7 243.8 27.03.07 4.6 243.9											

ONTMT4S 9268.GPJ 12/04/07

GRAIN SIZE DISTRIBUTION

SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04E	1.83	246.10
⊠	06-05E	1.07	242.10

Date April 2007

Project 2539-04-00

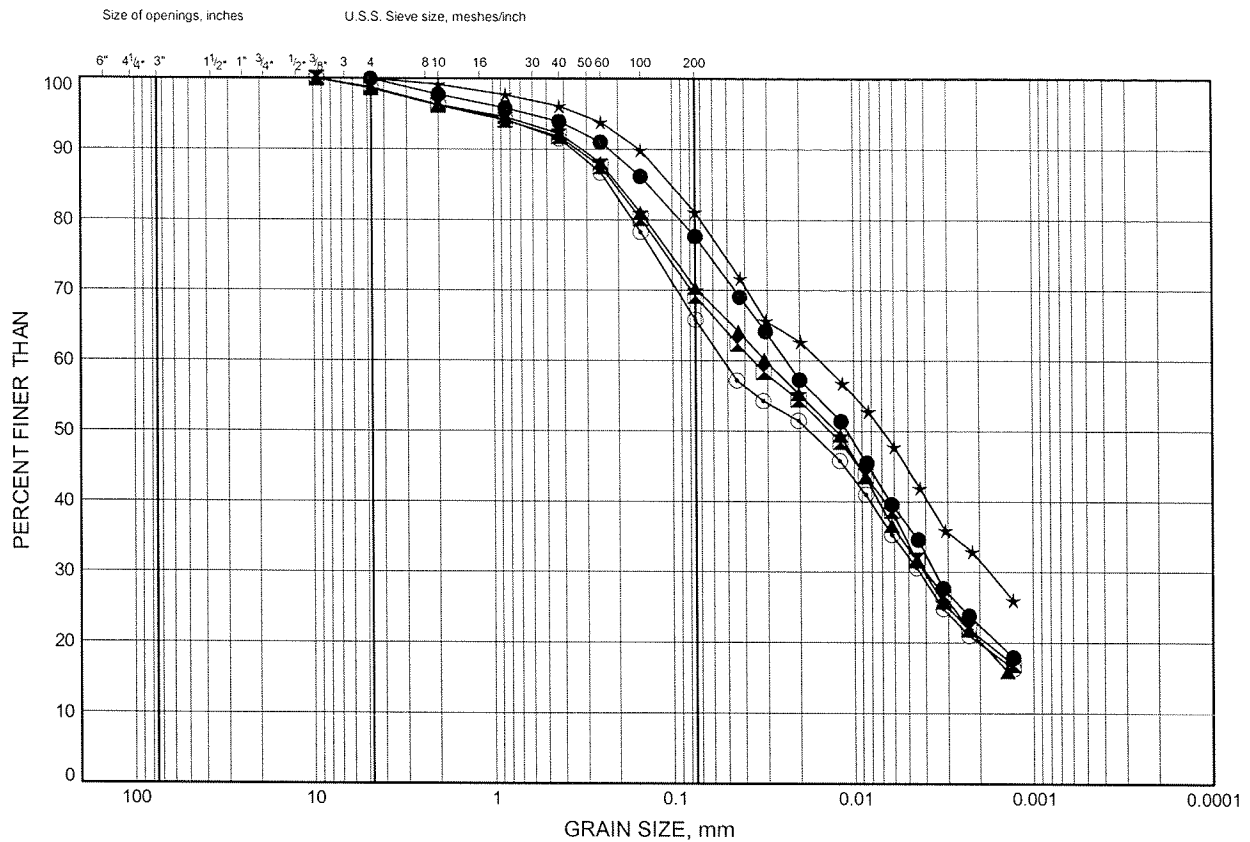


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04E	4.80	243.13
⊠	06-04E	7.92	240.01
▲	06-05E	4.80	238.37
★	06-06E	1.83	246.70
⊙	06-06E	7.92	240.61

Date April 2007

Project 2539-04-00

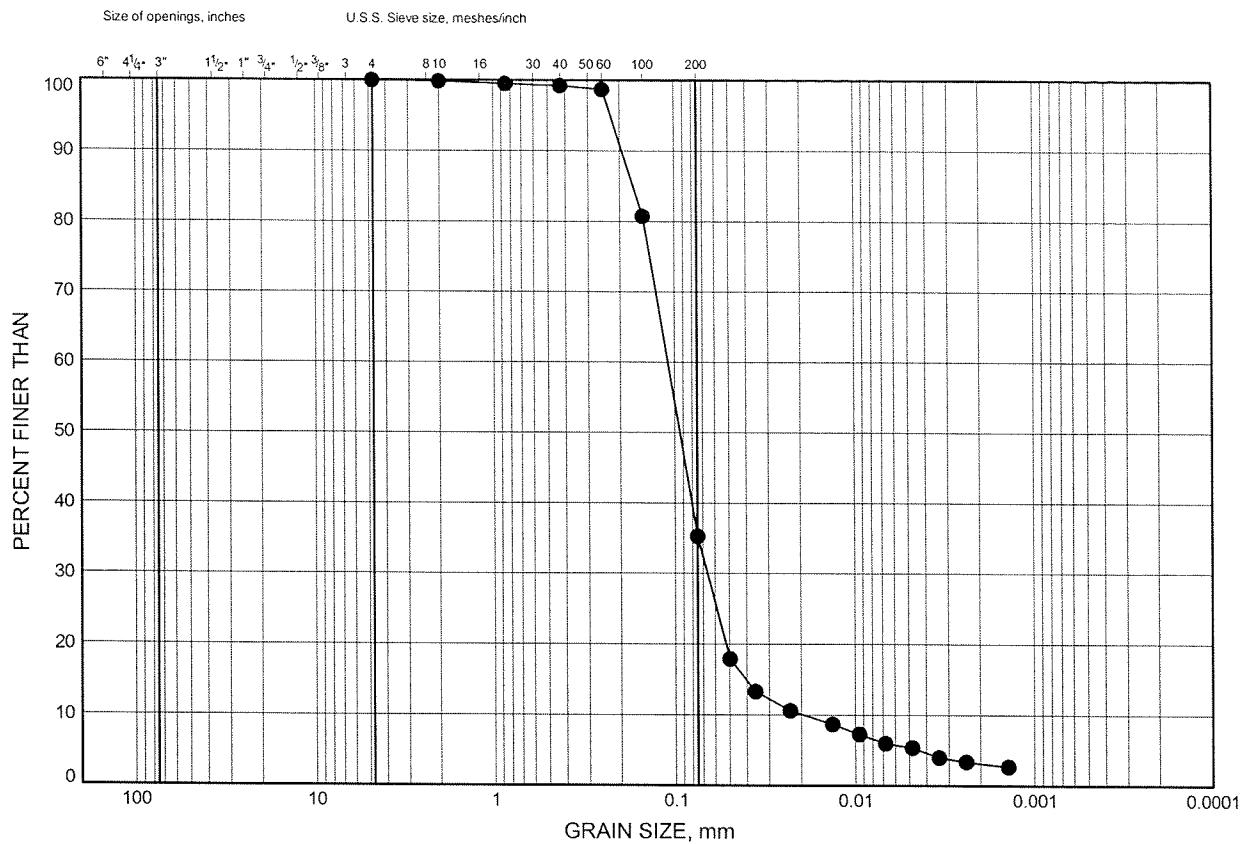


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-05E	6.40	236.77

Date April 2007

Project 2539-04-00



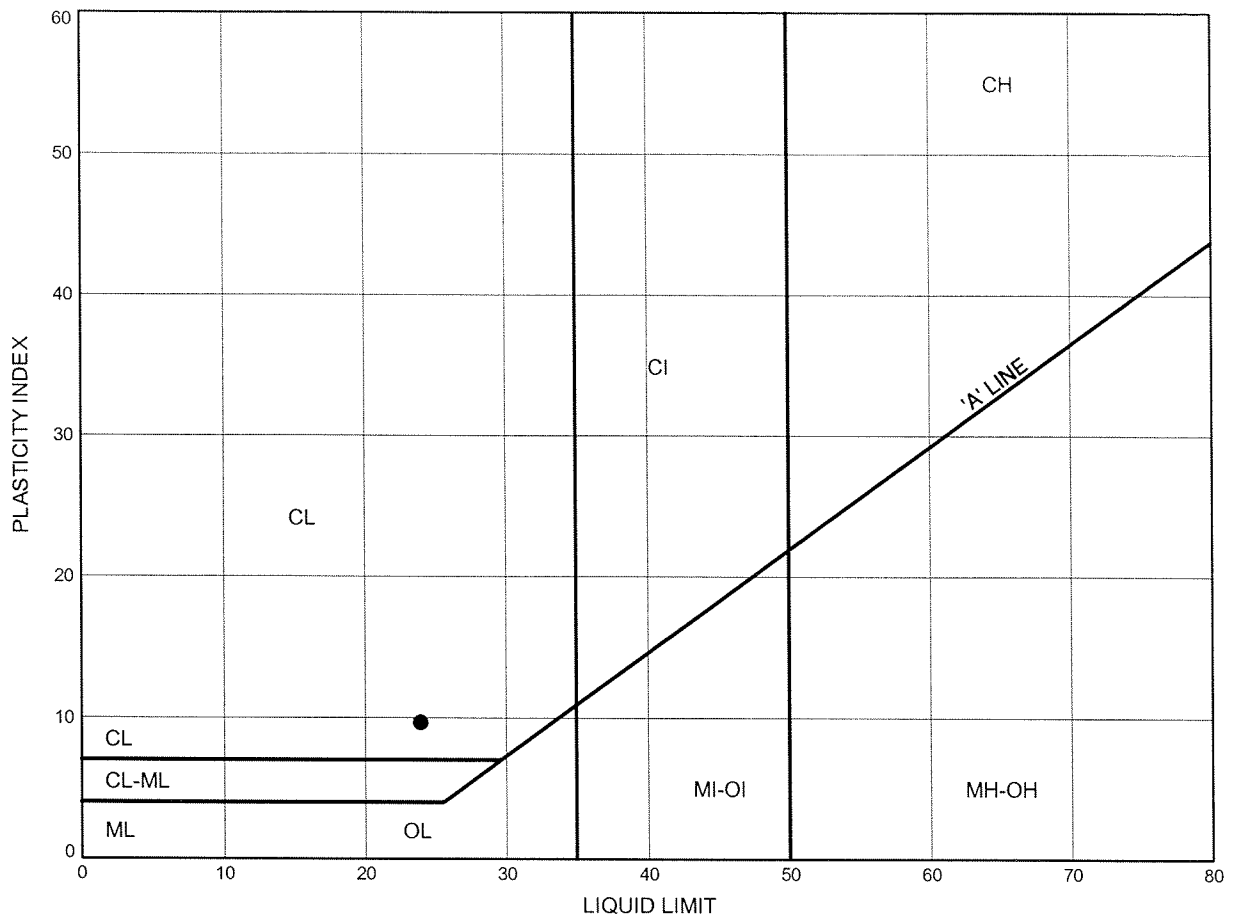
Prep'd MFA

Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE C4

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04E	1.83	246.10

Date April 2007
 Project 2539-04-00

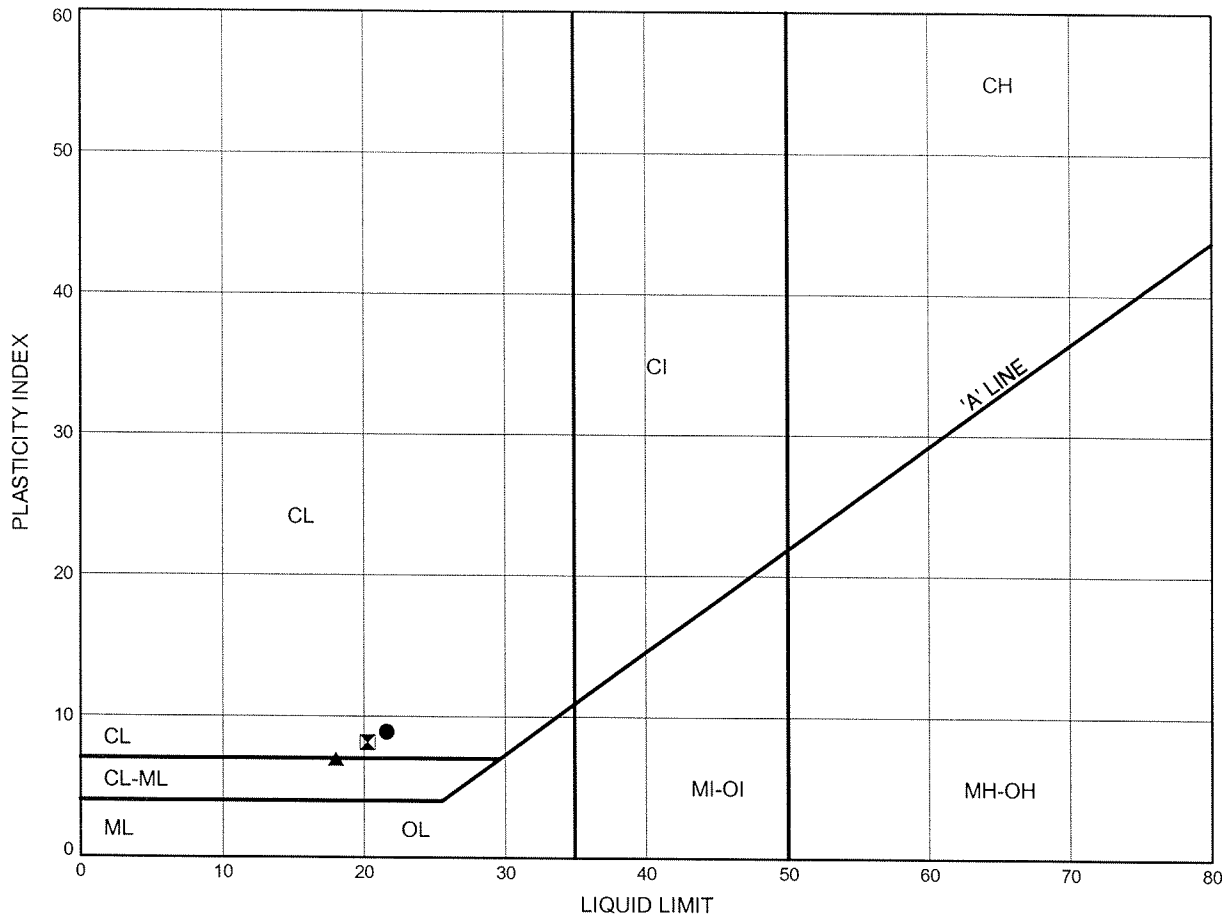


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 Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE C5

SILTY CLAY TILL

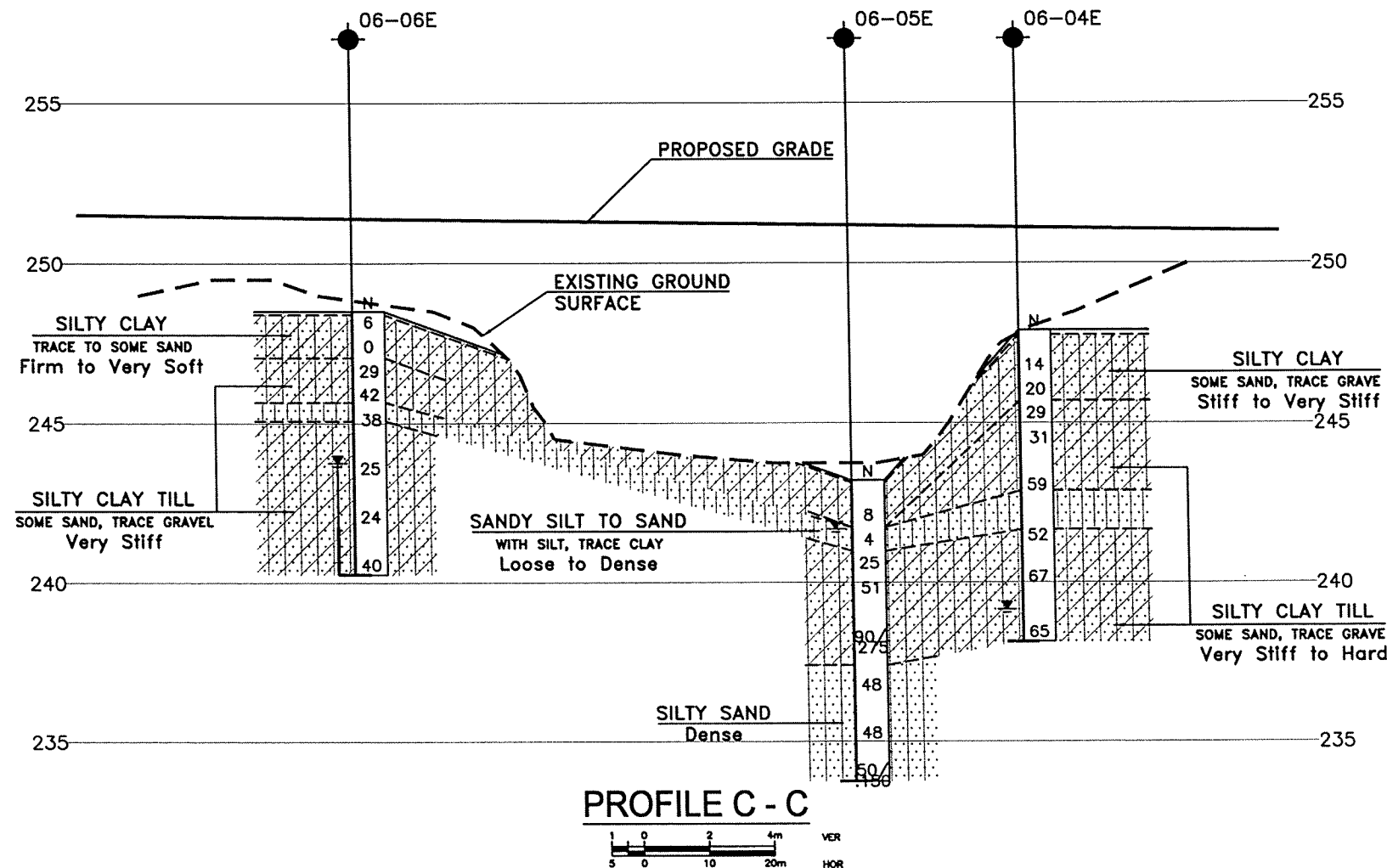
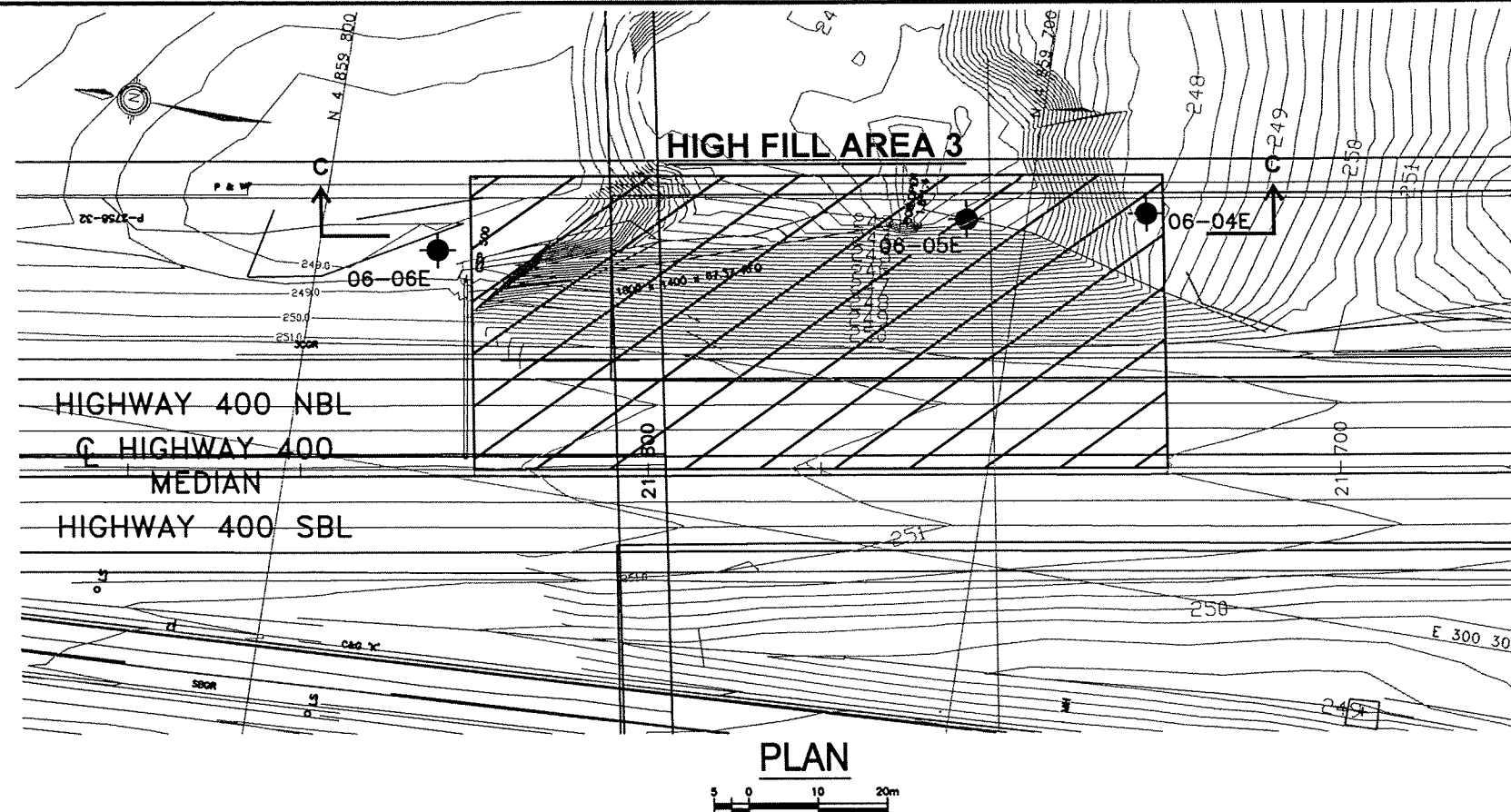


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-04E	4.80	243.13
⊠	06-05E	4.80	238.37
▲	06-06E	7.92	240.61

Date April 2007
 Project 2539-04-00



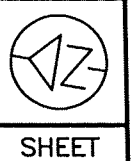
Prep'd MFA
 Chkd. SKP



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

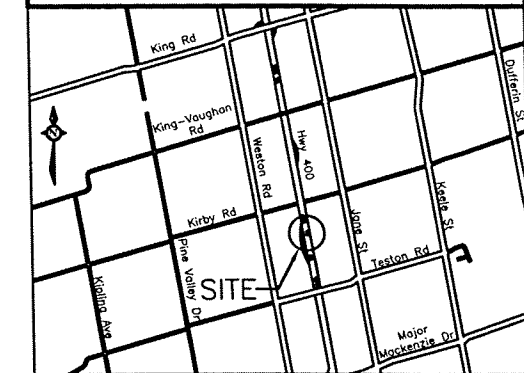
HIGHWAY 400
CONT No
WP No 2539-04-00

HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 21+700 TO 21+875
BOREHOLE LOCATIONS AND SOIL STRATA



SNC-LAVALIN
Engineers & Constructors

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
06-04E	247.9	4 859 683.08	300 354.68
06-05E	243.2	4 859 708.59	300 349.57
06-06E	248.5	4 859 783.12	300 332.42

NOTES

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

GEOCRES No. 30M13-178

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DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix D

High Fill Area 4

**Highway 400 SB – Approximate Stations 22+025 to 22+200
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 06-07W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 992 26 E 300 230.73 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-10 - 2007-01-10 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
252.8															
0.0	TOPSOIL, black with roots and rootlets: (175 mm)														
0.2	Silty CLAY, some sand, trace gravel Firm to Stiff Brown Moist		1	SS	4		252								
			2	SS	14										
251.3															
1.4	Silty CLAY, some sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	18		251								
			4	SS	26										
			5	SS	32		250								
							249								
			6	SS	50/ .125		248								
	occasional inferred cobbles						247								
			7	SS	28										
							246								
			8	SS	28		245								
							244								
243.5															
9.2	Clayey SILT, with sand Very Stiff Grey Wet		9	SS	27		243								

Continued Next Page

+ 3, × 3; Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-07W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 859 992.26 E 300 230.73 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-10 - 2007-01-10 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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 (%) w _p w w _L				
	Continued From Previous Page							20 40 60 80 100						
	Clayey SILT , with sand Very Stiff Grey Wet		10	SS	9		242							0 37 49 14
							241							
240.1			11	SS	50/ .100		240							
12.7	Silty CLAY , trace sand, trace gravel Hard Grey Moist (TILL)						239							
239.5			12	SS	10		238							
13.3	SAND , trace silt Compact Grey Wet (SP)						237							
236.9			13	SS	22									
15.8	END OF BOREHOLE AT 15.85 m. BOREHOLE OPEN TO 14.33 m AND WATER LEVEL AT 9.30 m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 7.3 245.5 27.03.07 7.1 245.7													

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-08W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 011.09 E 300 231.34 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-05 - 2007-01-05 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
252.7												
0.0	TOPSOIL: (150 mm)											
0.2	SAND, trace clay, trace gravel Loose Brown Moist		1	SS	5							
252.0												
0.7	Silty CLAY, some sand, trace gravel Stiff Brown Moist		2	SS	12		252					
251.3												
1.4	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	24		251					
			4	SS	42		250					2 22 48 27
			5	SS	44							
248.7							249					
4.0	SAND, with silt, trace gravel Very Dense Brown Moist		6	SS	75		248					
246.9												
5.8	Silty CLAY, some sand, trace gravel Hard to Very Stiff Brown to Grey Moist (TILL)		7	SS	48		247					
							246					
			8	SS	22		245					
244.0												
8.7	SAND and SILT, trace to some clay, trace gravel Compact Grey Moist to Wet		9	SS	28		244					1 42 47 10
							243					

Continued Next Page

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

ONTM14S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-08W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 011.09 E 300 231.34 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
DATUM Geodetic DATE 2007-01-05 - 2007-01-05 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
								20 40 60 80 100				
240.0	SAND and SILT, trace to some clay, trace gravel Compact Grey Moist to Wet		10	SS	7		242					
12.7	Silty CLAY, inferred cobbles Very Stiff Grey Moist (TILL)						241					
239.2			11	SS	22		240					
13.6	SAND and SILT, trace to some clay, trace gravel Compact Grey Wet		12	SS	17		239					
237.1							238					
15.6 236.9	SAND, trace silt Compact Grey Wet		13	SS	24		237					
15.8	END OF BOREHOLE AT 15.85 m. BOREHOLE OPEN TO 9.30 m UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO 0.91 m AND BACKFILLED WITH HOLEPLUG TO SURFACE.											
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 05.01.07 9.3 243.4											

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-09W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 031.57 E 300 229.37 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-10 - 2007-01-11 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
252.6															
0.0	TOPSOIL: (125 mm)														
0.1	Silty CLAY, trace sand Firm Brown Moist		1	SS	7		252								
			2	SS	14										
251.1															
1.4	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)(CL)		3	SS	19		251								
			4	SS	31		250								0 22 51 27
			5	SS	44										
							249								
			6	SS	72		248								
							247								
			7	SS	38		246								
	some sand		8	SS	40		245								0 9 69 22
							244								
			9	SS	10		243								

Continued Next Page

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

ONTMT4S 9268.GPJ 1204/07

RECORD OF BOREHOLE No 06-09W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 031.57 E 300 229.37 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-10 - 2007-01-11 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p	W	W _L	
242.3	Silty CLAY, with sand, trace gravel							20 40 60 80 100				
10.2	SILT, trace to some fine sand Loose Grey Wet		10	SS	4		242					
							241					
240.4												
12.2	Clayey SILT, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		11	SS	30		240					1 43 44 12
							239					
238.6												
14.0	SAND, with silt, trace clay Compact Grey Wet		12	SS	29		238					
			13	SS	10		237					
236.7												
15.8	END OF BOREHOLE AT 15.85 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 7.1 245.5 27.03.07 7.0 245.6											

RECORD OF BOREHOLE No 06-10W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 054.95 E 300 225.05 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-21 - 2006-12-21 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100									
								SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE						● QUICK TRIAXIAL	×
						20 40 60 80 100				20 40 60			kN/m ³	GR SA SI CL			
252.3																	
0.0	TOPSOIL, with roots: (125 mm)																
0.1	Silty CLAY, with sand Firm to Stiff Dark Brown to Brown Moist Brown		1	SS	7		252				○						
			2	SS	12						○				0 24 47 29		
250.9							251										
1.4	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Brown to Grey (TILL)		3	SS	22						○						
			4	SS	23		250				○						
			5	SS	30		249				○						
							248										
			6	SS	35		247				○						
			7	SS	55		246				○						
							245										
			8	SS	54		244				○						
			9	SS	75		243				○				0 8 66 2		
242.5																	
9.8	END OF BOREHOLE AT 9.8 m.																

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-10W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 054.95 E 300 225.05 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-21 - 2006-12-21 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page													
	BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND DRILL CUTTINGS.													

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-11W

2 OF 2

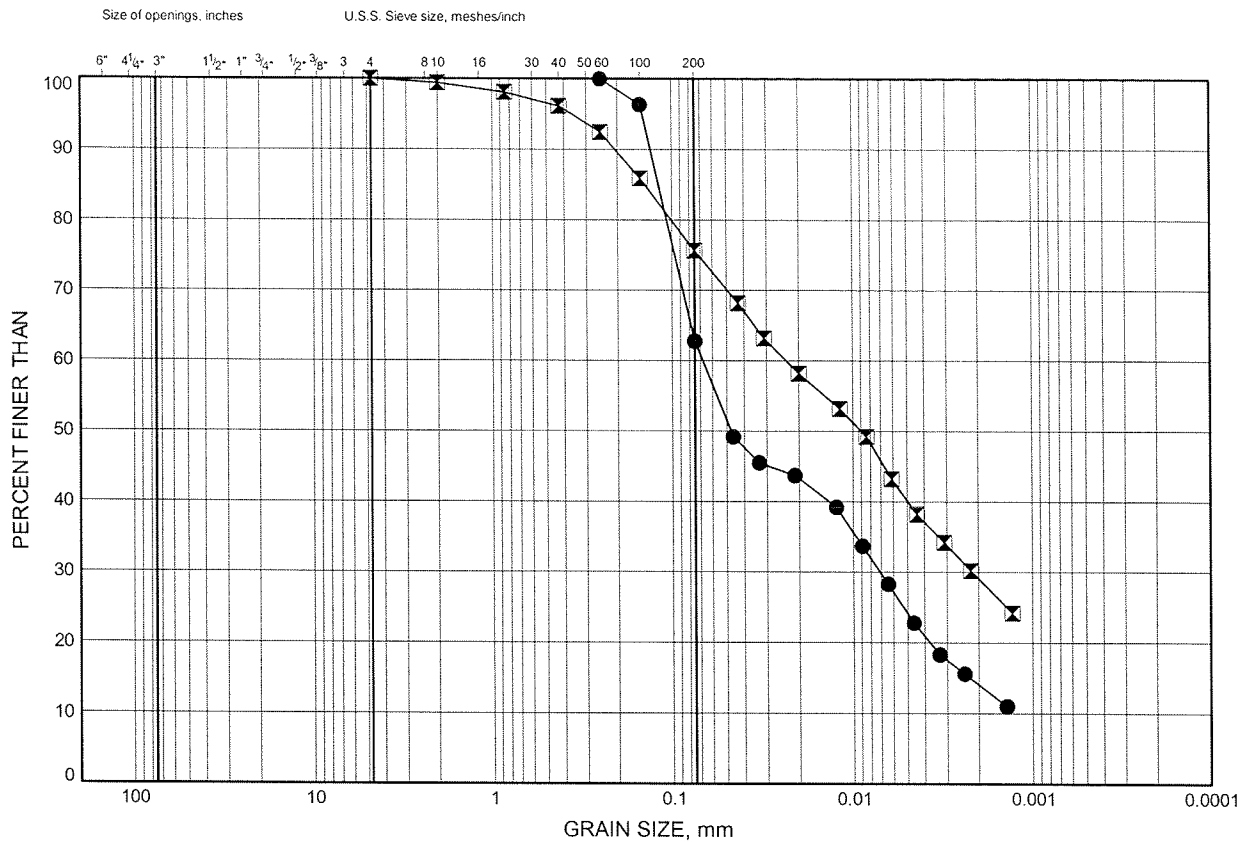
METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 860 081.26 E 300 217.93 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-21 - 2006-12-21 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100				
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
Continued From Previous Page												
241.6	SILT, some sand Very Dense						242					
10.4	Silty CLAY, trace sand, trace gravel, occasional cobbles Hard Grey Moist (TILL)		10	SS	42		241					
240.3												
11.7	SAND Dense Grey Moist to Wet		11	SS	31		240					
239.0												
13.1	Sandy SILT, trace gravel, trace clay Dense Grey Moist		12	SS	33		239					
							238					
236.7			13	SS	50/		237					
15.4	END OF BOREHOLE AT 15.4 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 6.7 245.4 27.03.07 6.4 245.7				.125							

GRAIN SIZE DISTRIBUTION

CLAYEY SILT / SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-07W	10.97	241.79
⊠	06-10W	1.07	251.21

Date April 2007

Project 2539-04-00

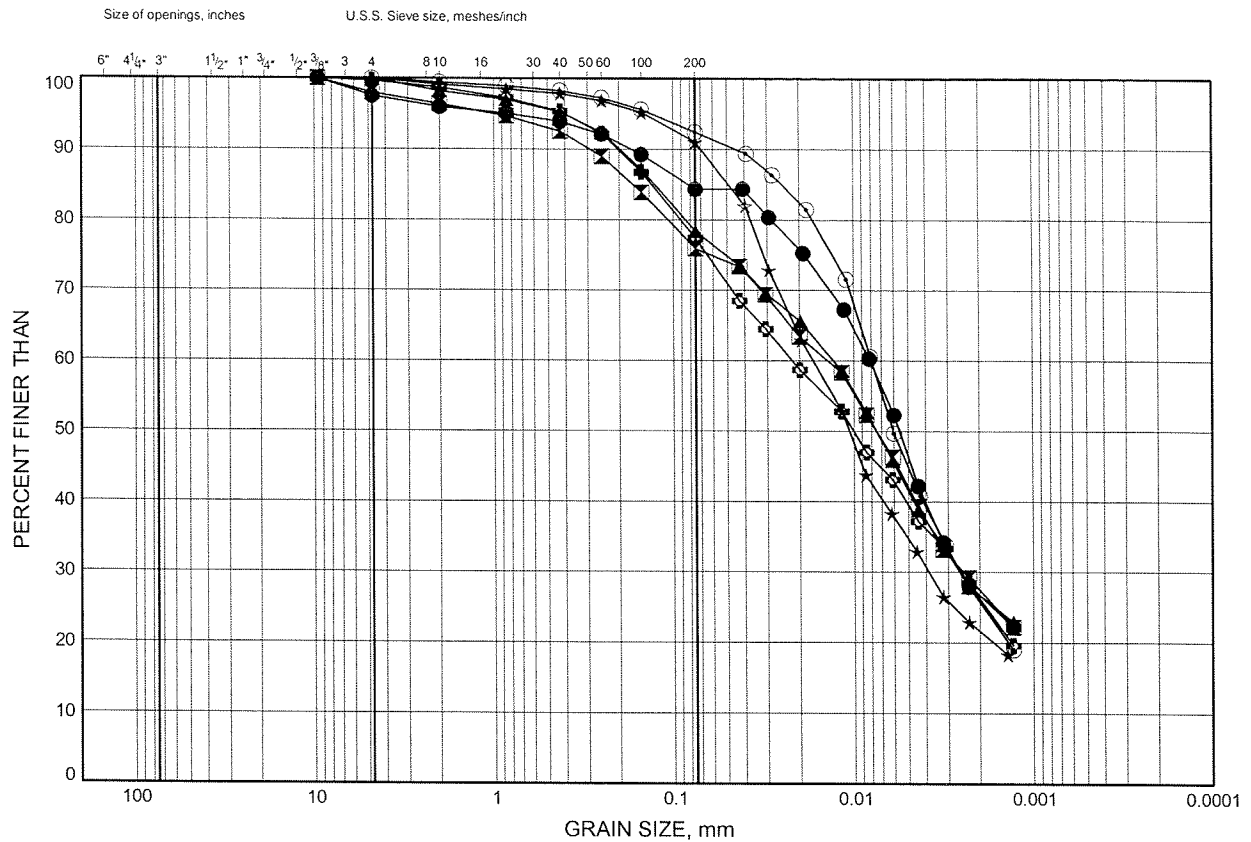


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-07W	6.40	246.36
⊠	06-08W	2.59	250.14
▲	06-09W	2.59	249.97
★	06-09W	7.92	244.64
⊙	06-10W	9.45	242.83
⊗	06-11W	7.89	244.17

Date April 2007

Project 2539-04-00

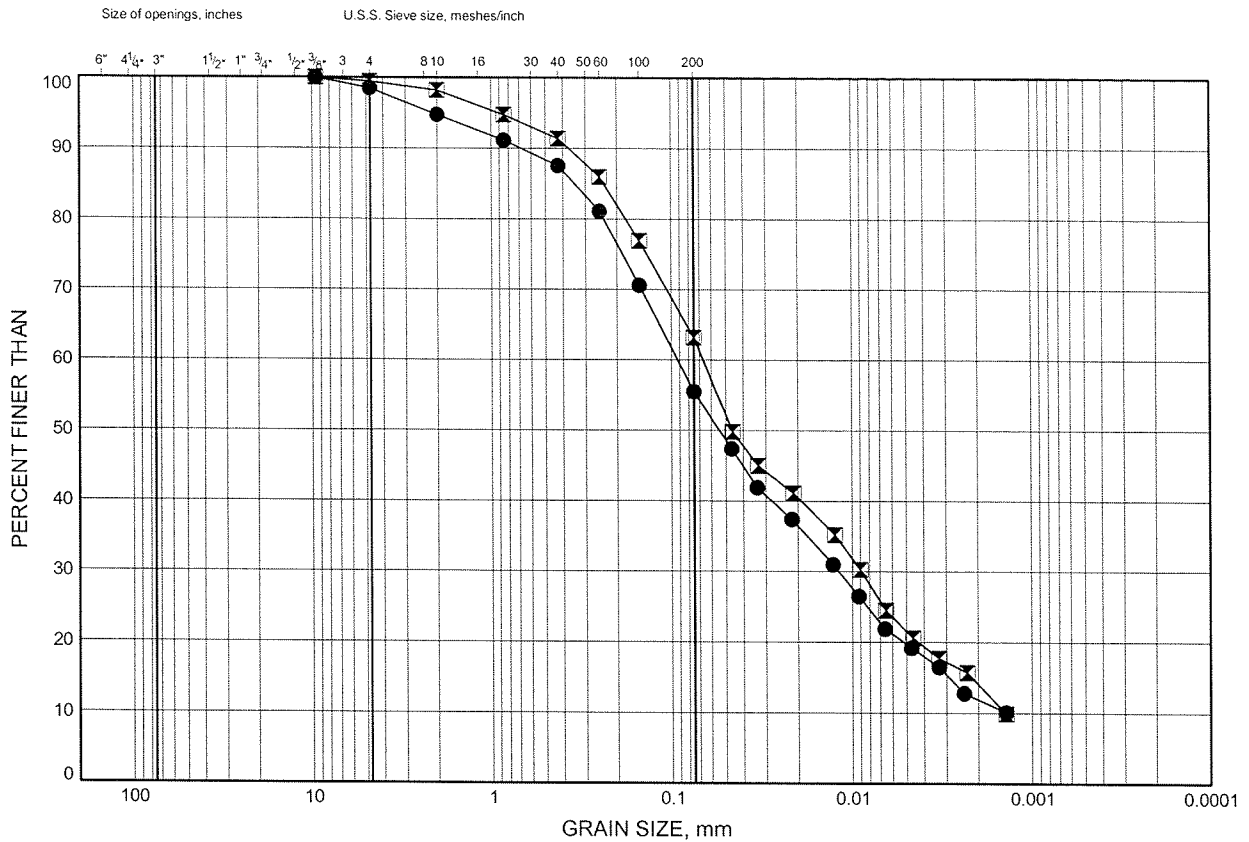


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

CLAYEY SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-09W	12.50	240.06
⊠	06-11W	1.07	250.99

Date April 2007

Project 2539-04-00



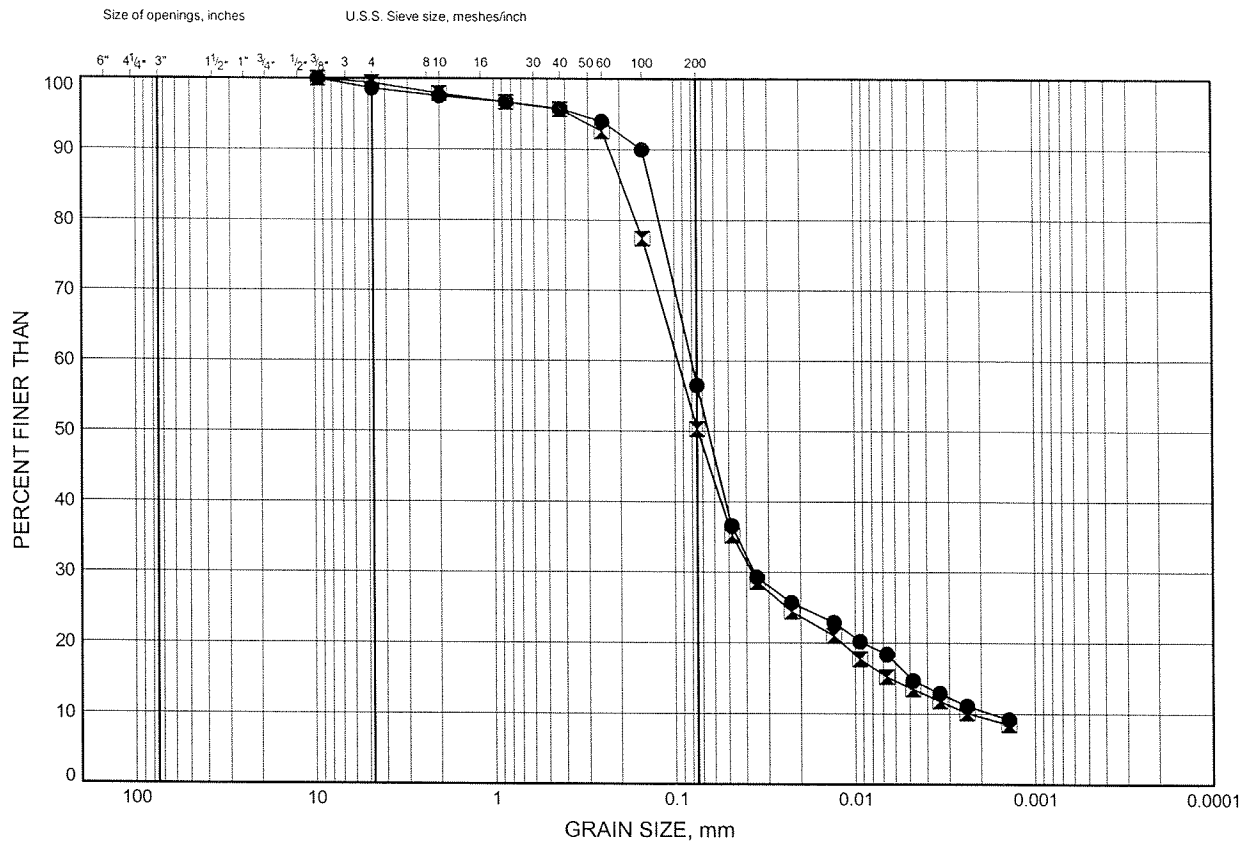
THURBER

Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SAND AND SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
--------	----	-----------	-----------

●	06-08W	9.45	243.28
⊠	06-08W	14.02	238.71

Date April 2007

Project 2539-04-00



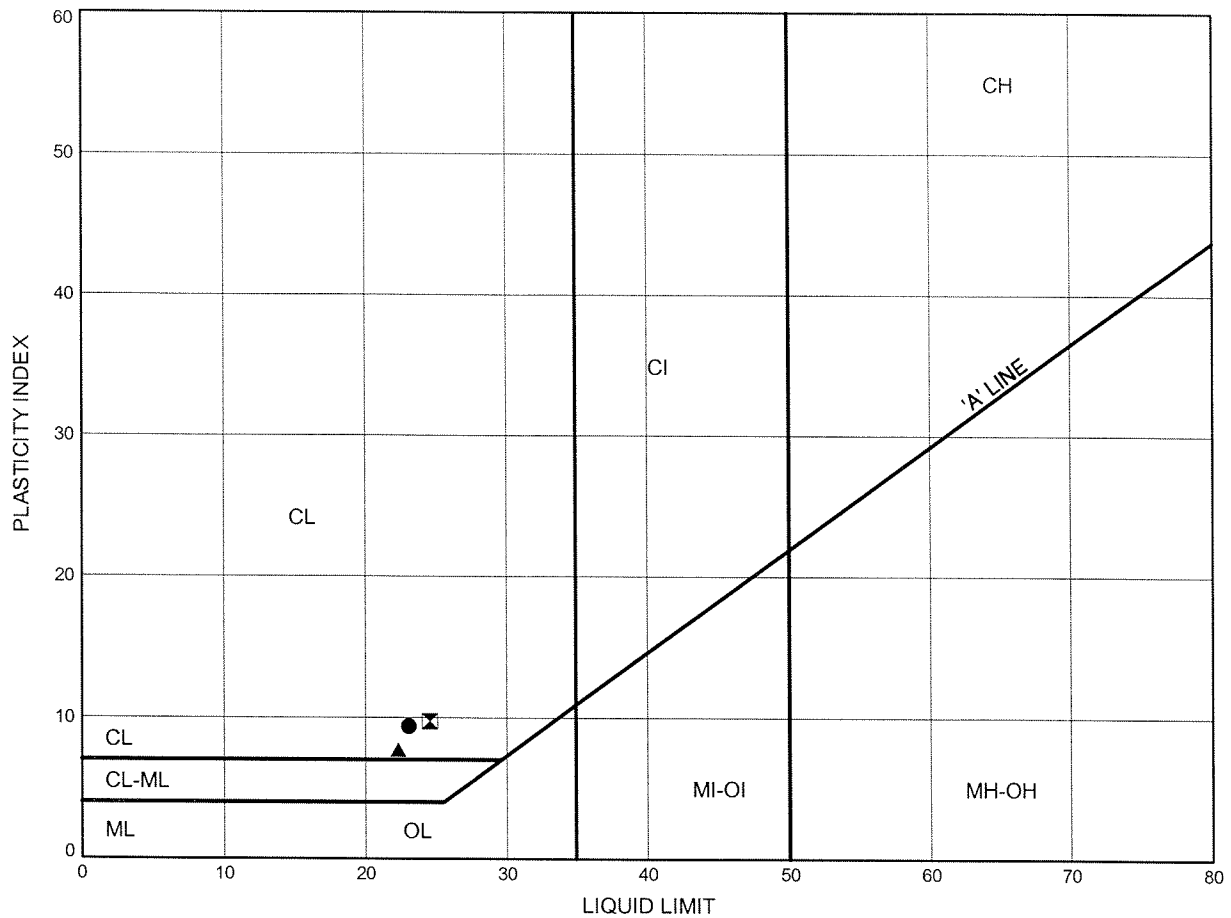
Prep'd MFA

Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE D5

SILTY CLAY TILL

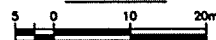


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-07W	6.40	246.36
⊠	06-08W	2.59	250.14
▲	06-09W	2.59	249.97

Date April 2007
 Project 2539-04-00



Prep'd MFA
 Chkd. SKP



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

SHEET

LTD.
MATERIALS



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

[illegible]

GEOCRES No. 30M13-178

REVISIONS

FILENAME: D:\Drafting\19\92\68 Hwy400\Hwy400 Alignments\tcds268-HighFill.dwg
PLOTDATE: Apr 12, 2010 - 1:08pm

Appendix E

High Fill Area 5

**Highway 400 NB – Approximate Stations 10+775 to 10+850
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 06-20E

1 OF 1

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 242.19 E 299 738.77 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-11 - 2007-01-11 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
271.5												
0.0	TOPSOIL: (125 mm)											
0.1	Silty CLAY, trace gravel, trace roots Firm to Stiff Dark Brown Moist (FILL)		1	SS	7		271					
			2	SS	9							
270.1							270					
1.4	Clayey SILT, some sand, trace gravel Firm to Stiff Brown Moist to Wet		3	SS	8							
269.3							269					
2.2	Sandy SILT, some clay Compact Brown Moist to Wet		4	SS	22							
			5	SS	22		268					
							267					
			6	SS	21							
265.7							266					
5.8	Silty CLAY, some sand, trace gravel Hard Grey Moist (TILL)(CL)		7	SS	47		265					
264.8												
6.7	END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 2.44 m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.											
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 11.01.07 2.1 269.4											

RECORD OF BOREHOLE No 06-22E

1 OF 1

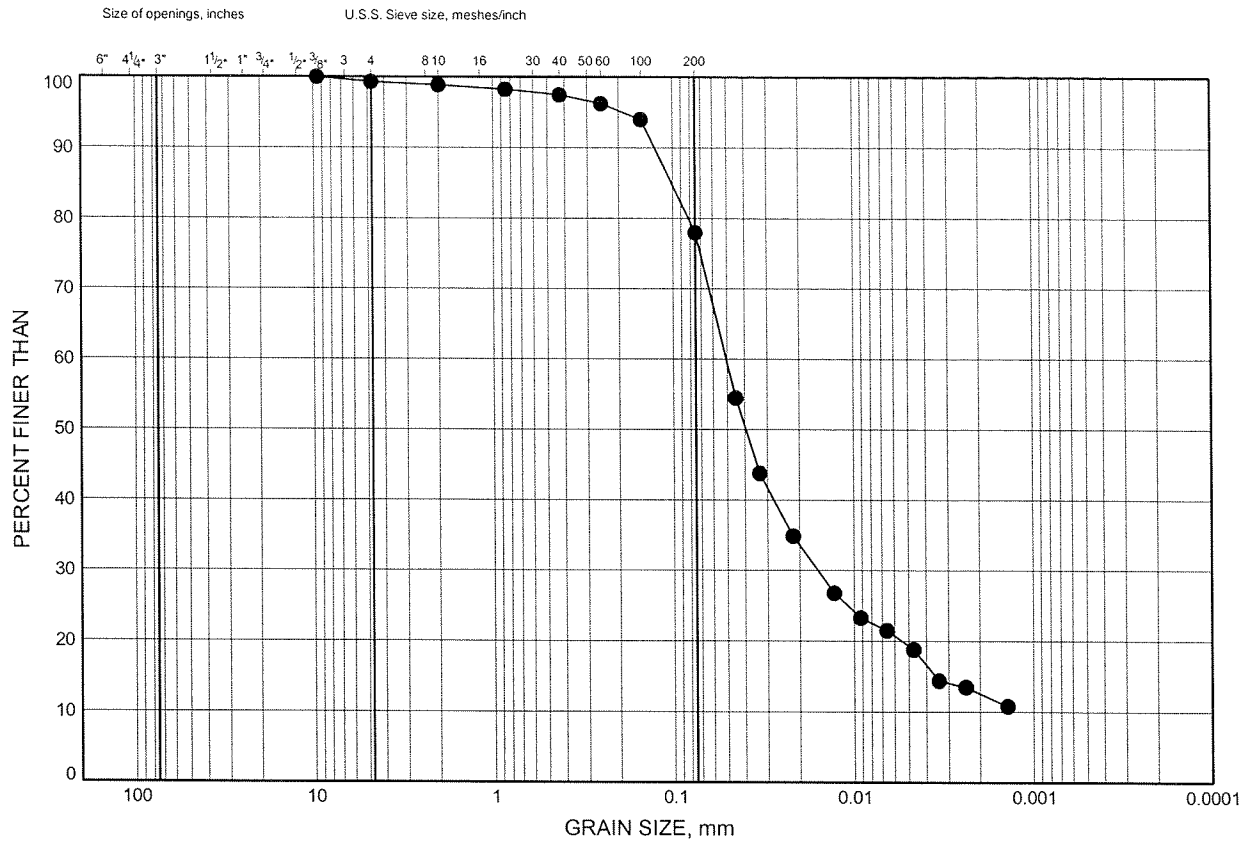
METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 347.76 E 299 710.50 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-11 - 2007-01-11 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
270.9												
0.0												
0.2	SAND Very Loose Brown (FILL) Silty CLAY, some sand, some gravel Firm Brown Moist (FILL)		1	SS	3		270					
269.5			2	SS	8		269					
1.4	Clayey SILT, some sand Very Stiff Brown Moist (FILL)		3	SS	17		269					
268.7			4	SS	23		268					1 21 65 13
2.2	Clayey SILT, with sand, trace gravel, trace organics Very Stiff Brown Moist to Wet		5	SS	17		267					0 24 53 23
267.9			6	SS	70		266					
3.0							265					
264.7			7	SS	50/							
6.2	END OF BOREHOLE AT 6.22 m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				.125							

GRAIN SIZE DISTRIBUTION

CLAYEY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-22E	2.59	268.32

Date April 2007

Project 2539-04-00

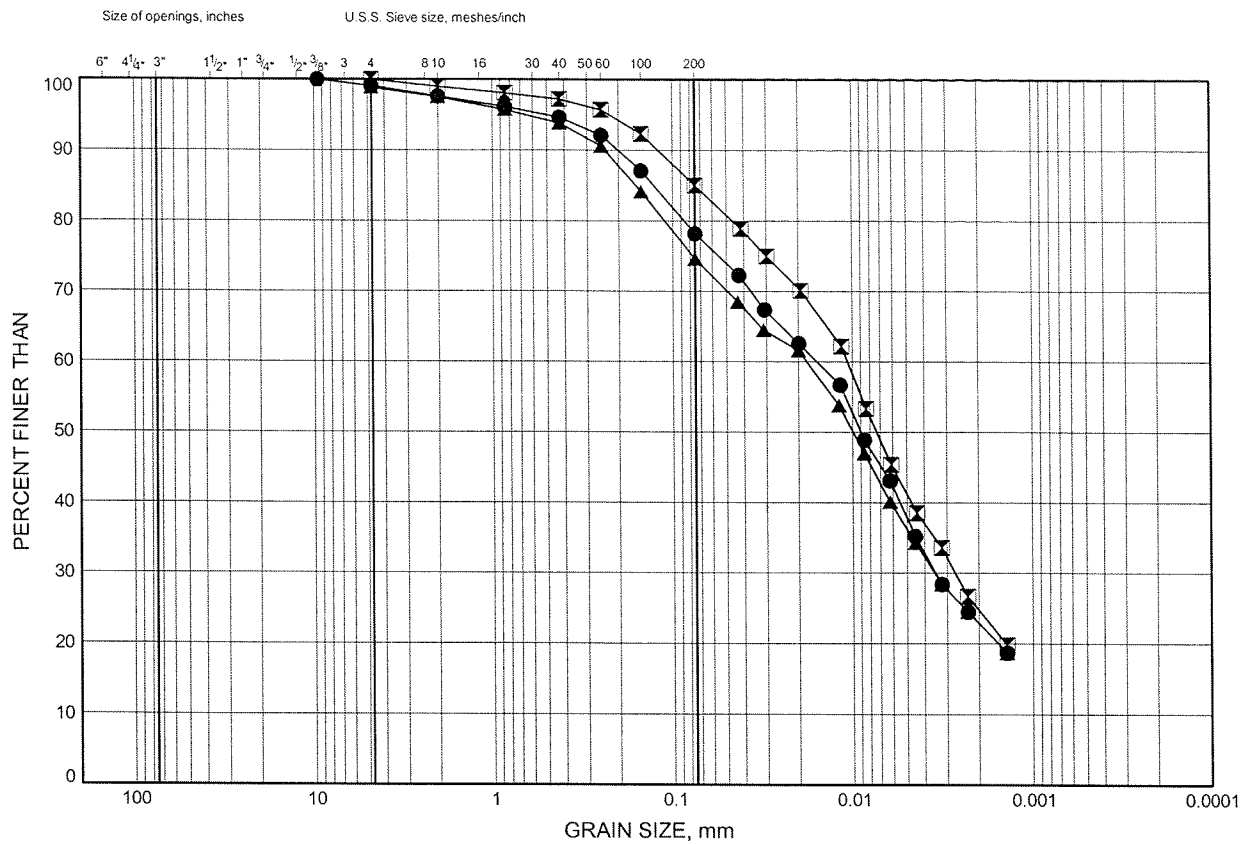


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-21E	2.59	265.51
⊠	06-21E	4.88	263.22
▲	06-22E	3.35	267.56

Date April 2007

Project 2539-04-00

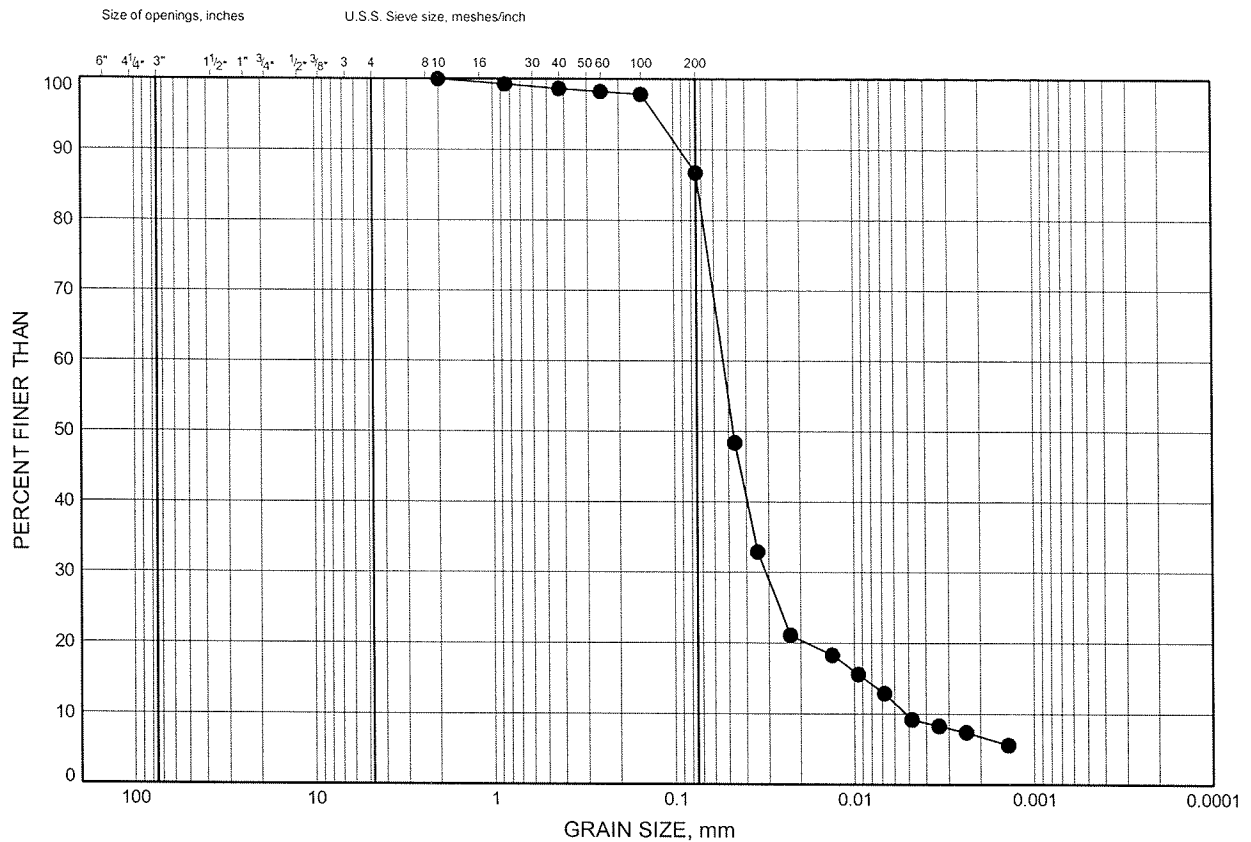


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-21E	1.07	267.03

Date April 2007
Project 2539-04-00

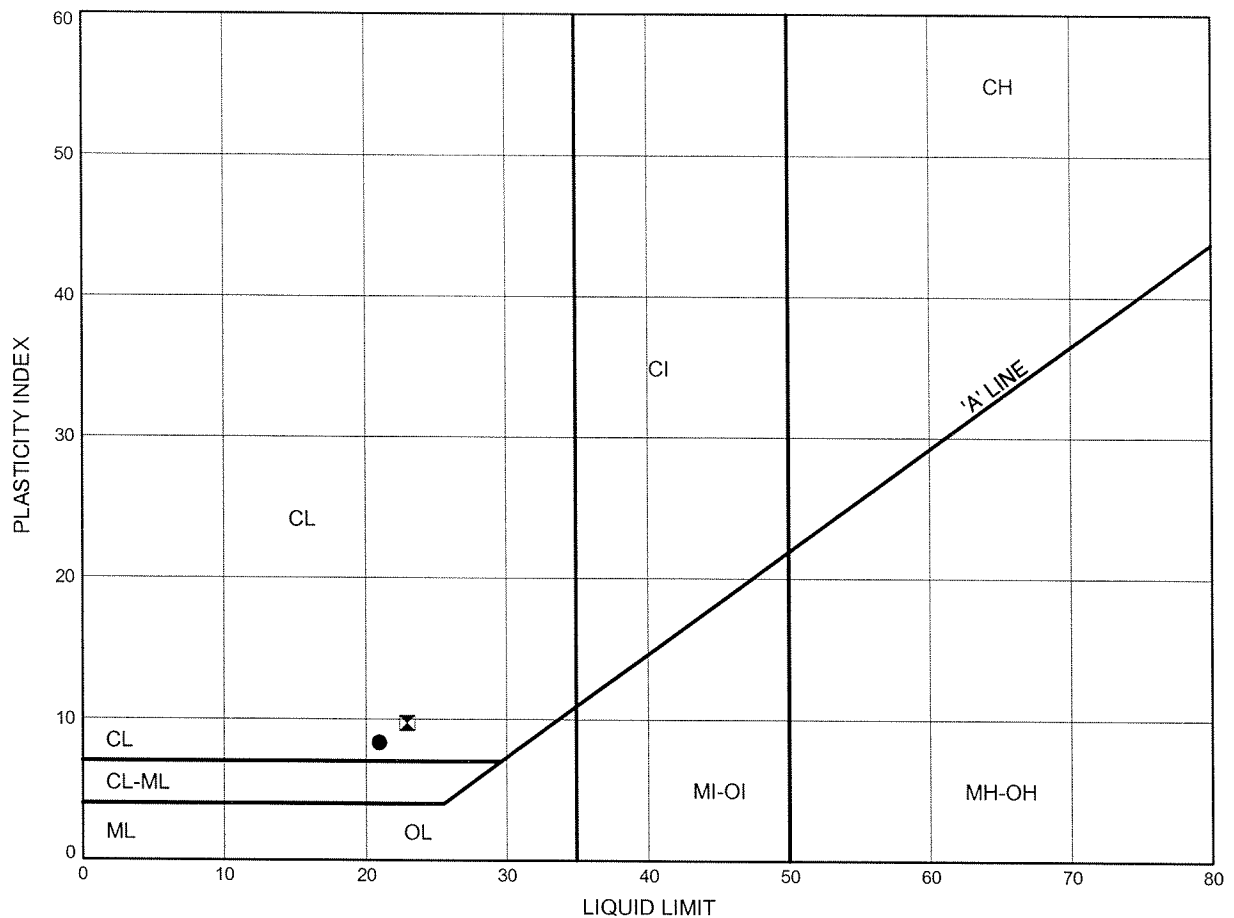


Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE E4

SILTY CLAY TILL

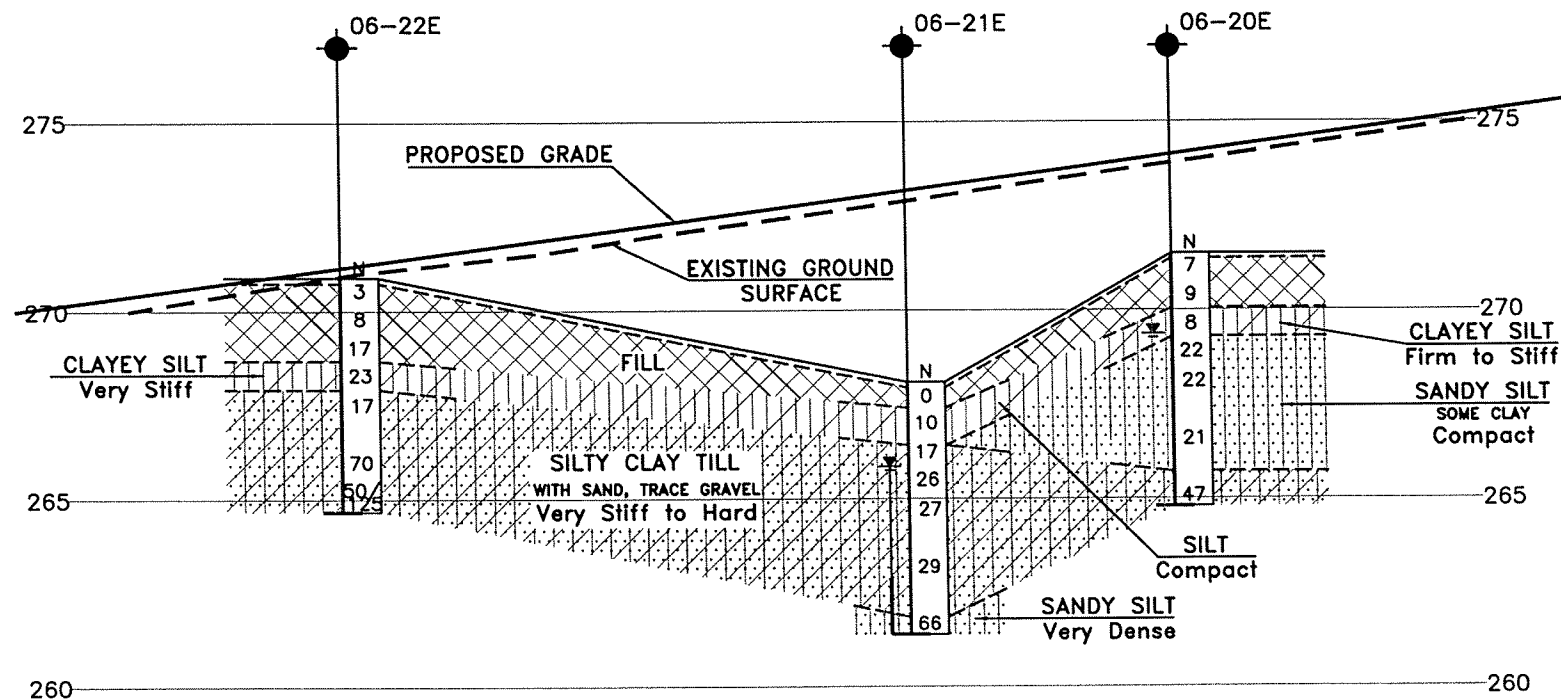
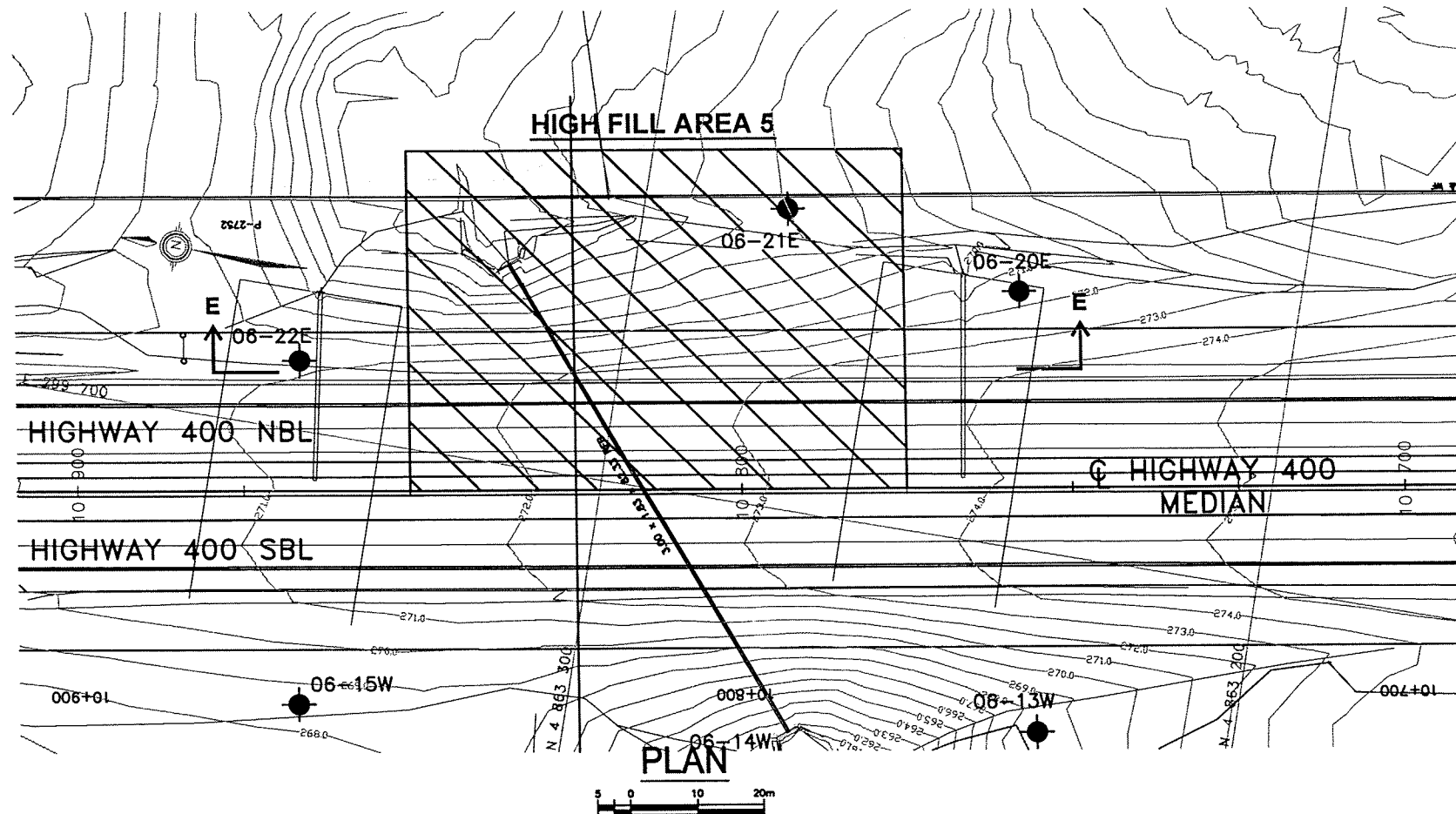


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-21E	2.59	265.51
⊠	06-21E	4.88	263.22

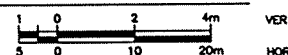
Date April 2007
 Project 2539-04-00



Prep'd MFA
 Chkd. SKP

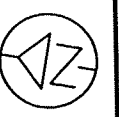


PROFILE E - E



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

HIGHWAY 400
CONT No
WP No 2539-04-00

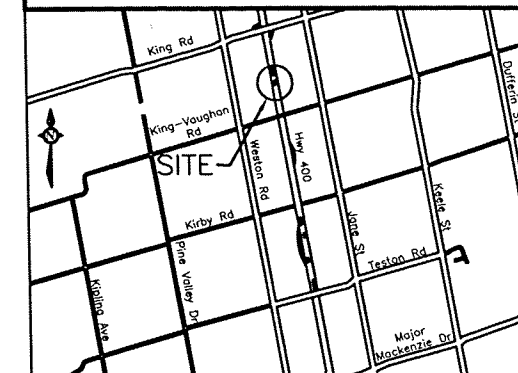


HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 10+725 TO 10+900
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

SNC-LAVALIN
Engineers & Constructors

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

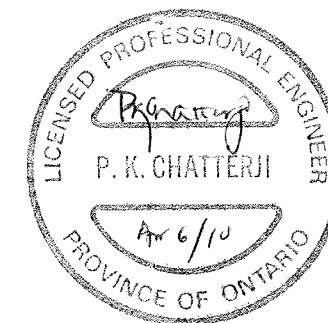
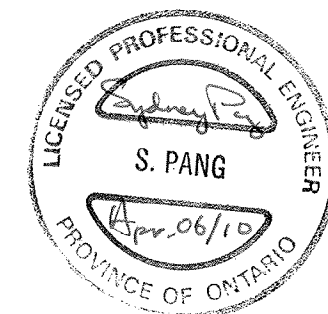
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
06-20E	271.5	4 863 242.19	299 738.77
06-21E	268.1	4 863 278.60	299 745.50
06-22E	270.9	4 863 347.76	299 710.50

-NOTES-

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

GEOCRES No. 30M13-178



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	TH	CHK	PKC
DRAWN	MFA	CHK	SKP
CODE	LOAD	DATE	APR. 2010
SITE	STRUCT	DWG.	E1

Appendix F

High Fill Area 6

**Highway 400 SB – Approximate Stations 10+750 to 10+825
Records of Boreholes, Laboratory Test Results, Drawings**



RECORD OF BOREHOLE No 06-13W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 229.28 E 299 672.96 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-12 - 2007-01-12 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
268.6												
0.0	TOPSOIL, black with roots: (125 mm)											
0.1	Silty CLAY, mixed with topsoil, trace roots and rootlets Firm Dark Brown Moist		1	SS	7		268					
			2	SS	6							
267.2												
1.4	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)(CL)		3	SS	13		267					
			4	SS	23		266					1 26 52 21
			5	SS	24							
							265					
							264					
	becoming Grey		6	SS	26							
262.8							263					
5.8	SAND, some silt Dense Grey Wet											
262.4												
6.3	Silty CLAY, some sand, trace gravel Hard Grey Moist (TILL)(CL)		7	S	44		262					
							261					0 16 58 26
	with thin silty sand seams		8	SS	38							
259.9							260					
8.7	SILT, some sand, trace clay Dense Grey Wet		9	SS	46		259					

Continued Next Page

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

ONTMT4S 9268 GPJ 12/04/07

RECORD OF BOREHOLE No 06-13W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 229.28 E 299 672.96 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-12 - 2007-01-12 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued From Previous Page													
258.4	SILT, some sand, trace clay													
10.2	Silty SAND, trace clay Compact Grey Wet													
257.4			10	SS	12		258							0 69 31 (SI+CL)
11.3	END OF BOREHOLE AT 11.28 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 8.7 259.9 27.03.07 8.3 260.3													

ONTMT4S 9258.GPJ 12/04/07

RECORD OF BOREHOLE No 06-14W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 283.70 E 299 658.48 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-02-02 - 2007-02-02 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE														
								● QUICK TRIAXIAL × LAB VANE														
							20	40	60	80	100	20	40	60	kN/m ³	GR	SA	SI	CL			
264.1																						
0.0																						
0.1	TOPSOIL: (100mm) Silty CLAY, with sand, trace gravel, topsoil-stained, trace rootlets Firm Brown Moist						264															
			1	SS	6														4	31	45	20
262.7							263															
1.4	Silty CLAY, trace gravel, with sand seams Very Stiff to Hard Brown Moist (TILL)		2	SS	18														0	18	45	37
			3	SS	32		262															
			4	SS	49		261															
260.6	with sand pockets																					
3.5	SAND, some silt Dense Brown Moist																					
259.9							260															
4.3	SILT, some sand, trace clay Compact Grey Wet		5	SS	11														0	1	88	11
							259															
							258															
257.7			6	SS	10																	
6.4	SAND, trace silt Compact Brown Moist						257															
256.1			7	SS	17																	
8.1	Silty SAND Compact Grey Wet						256															
							255															
			8	SS	42																	
254.5																						
254.4	Sandy SILT																					
9.8	Dense																					

Continued Next Page

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

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-14W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 283.70 E 299 658.48 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007-02-02 - 2007-02-02 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
	Continued From Previous Page													
	<p>END OF BOREHOLE AT 9.75m. BOREHOLE CAVED TO 7.16m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG UPON COMPLETION.</p> <p>WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 02.02.07 5.6 258.5</p>													

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-15W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 339.66 E 299 658.86 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-05 - 2007-01-05 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
268.6							20 40 60 80 100		20 40 60						
0.0	TOPSOIL: (50 mm) Clayey SILT, trace gravel, with rootlets Stiff Brown		1	SS	10					○					
267.9	Moist Clayey SILT, with sand, trace gravel, some iron oxidation Very Stiff to Hard Grey Moist (TILL)(CL-ML)		2	SS	33					○					
0.7			3	SS	27					⊢				2 21 60 17	
			4	SS	35					○					
			5	SS	37					○					
264.4															
4.3	SILT, some sand, trace clay, with some sand seams Dense Grey Moist (TILL)		6	SS	44					○					
263.0															
5.6	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)(CL)		7	SS	35					⊢				0 23 53 24	
261.5															
7.2	Silty CLAY, trace sand Firm Grey Moist to Wet		8	SS	7					○					
260.1															
8.5	Silty SAND, trace clay Dense Grey Moist (ML)		9	SS	37					○				0 66 34 (SI+CL)	

Continued Next Page

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

ONTMT4S 9268 GPJ 12/04/07

RECORD OF BOREHOLE No 06-15W

2 OF 2

METRIC

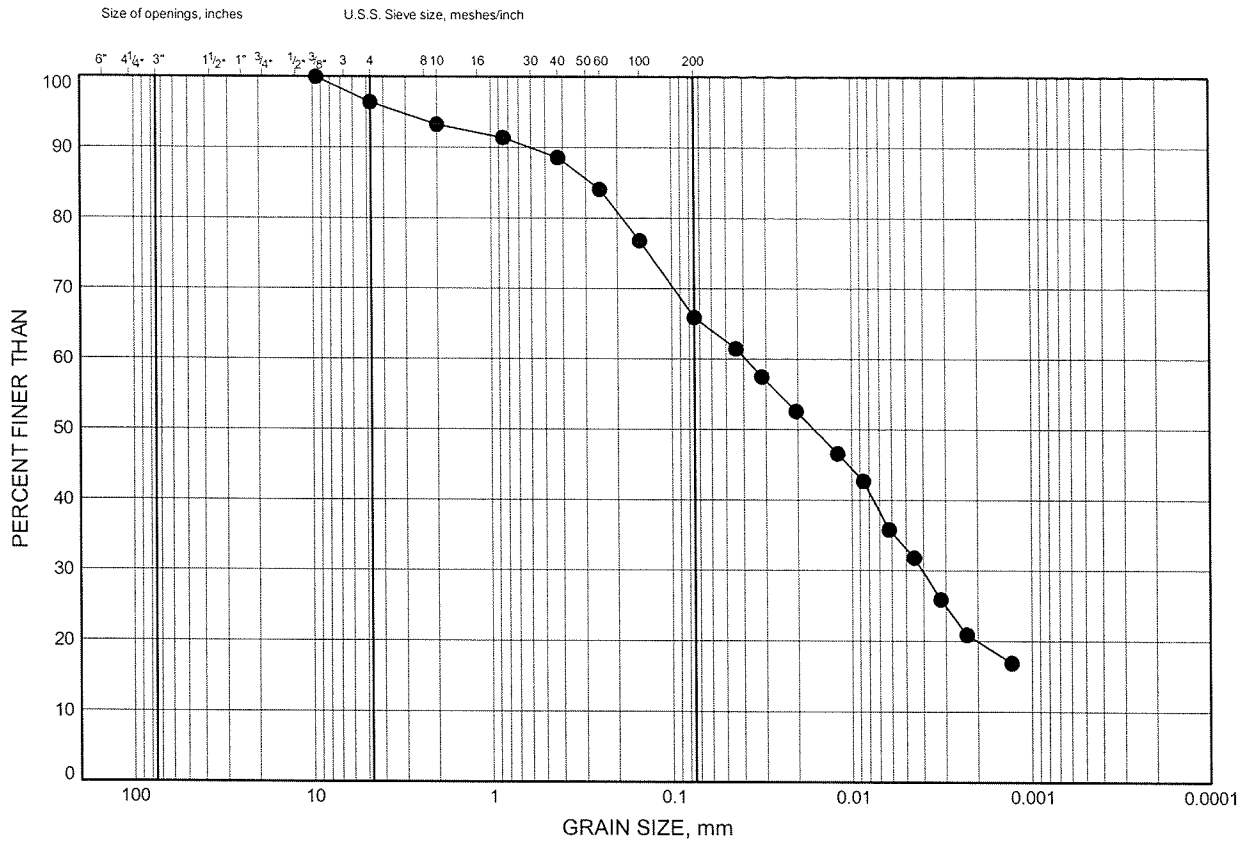
G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 339.66 E 299 658.86 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-05 - 2007-01-05 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
257.4	Silty SAND, trace clay Compact Grey Moist (ML)		10	SS	25		258								
11.3	END OF BOREHOLE AT 11.28 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 dry - 27.03.07 dry -														

ONTMT4S 9268.GPJ 12/04/07

GRAIN SIZE DISTRIBUTION

SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-14W	1.07	263.07

Date April 2007

Project 2539-04-00

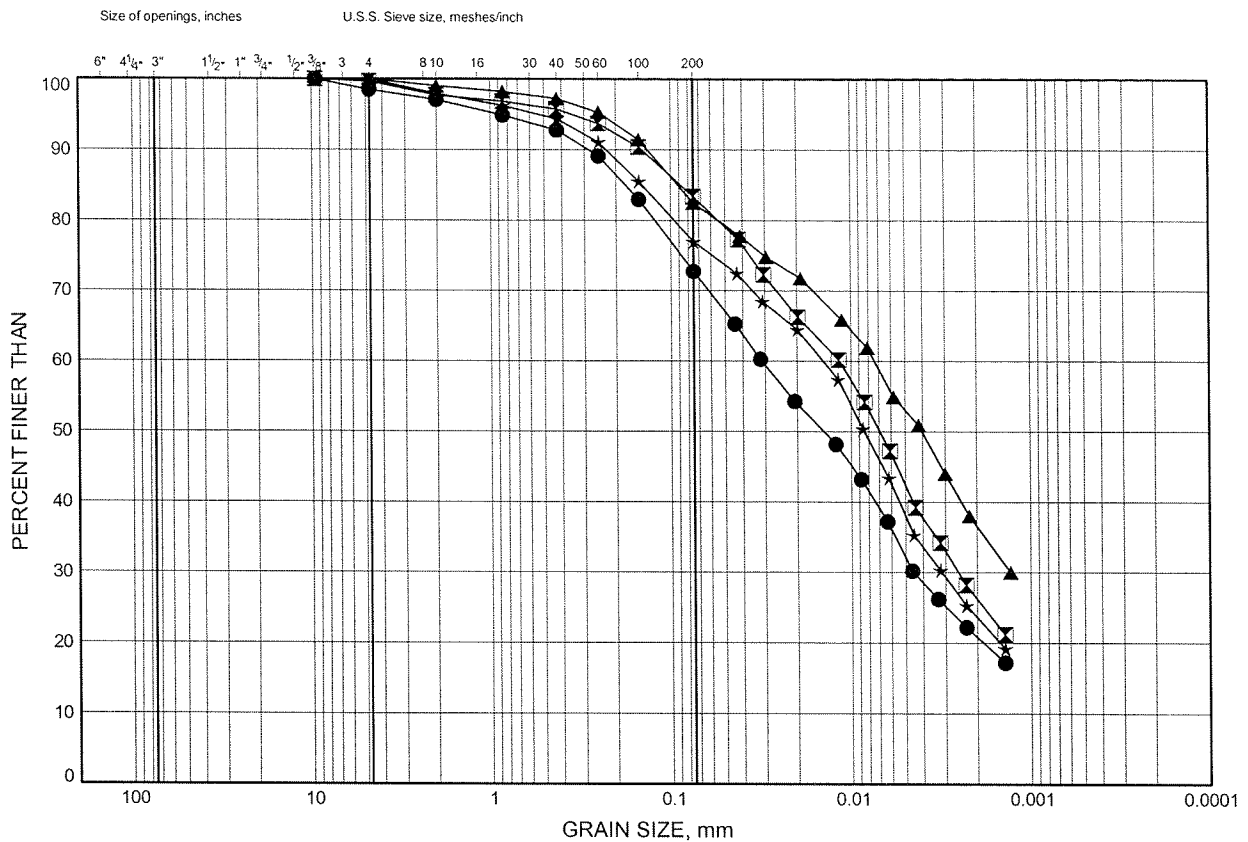


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-13W	2.59	266.04
⊠	06-13W	7.92	260.71
▲	06-14W	1.83	262.31
★	06-15W	6.40	262.23

Date April 2007

Project 2539-04-00

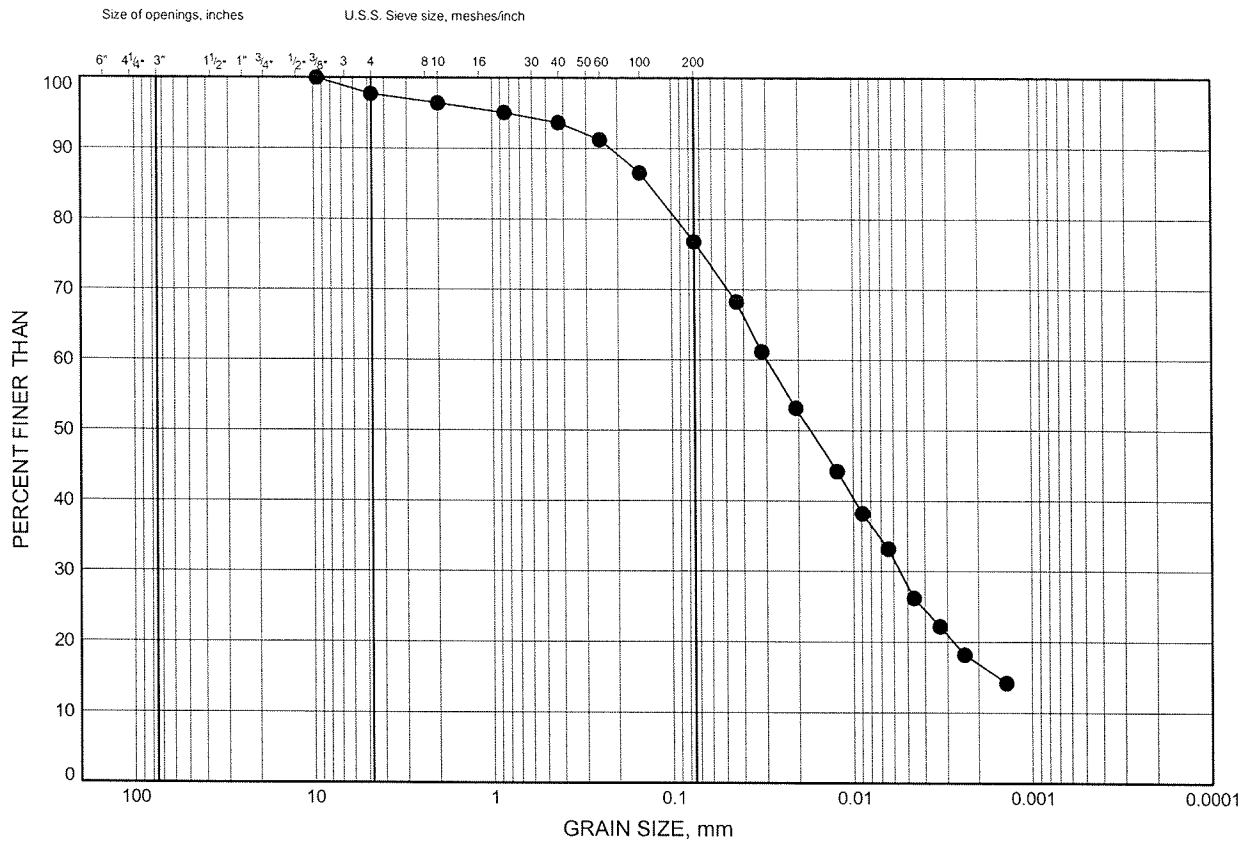


Prep'd MFA

Chkd. SKP

GRAIN SIZE DISTRIBUTION

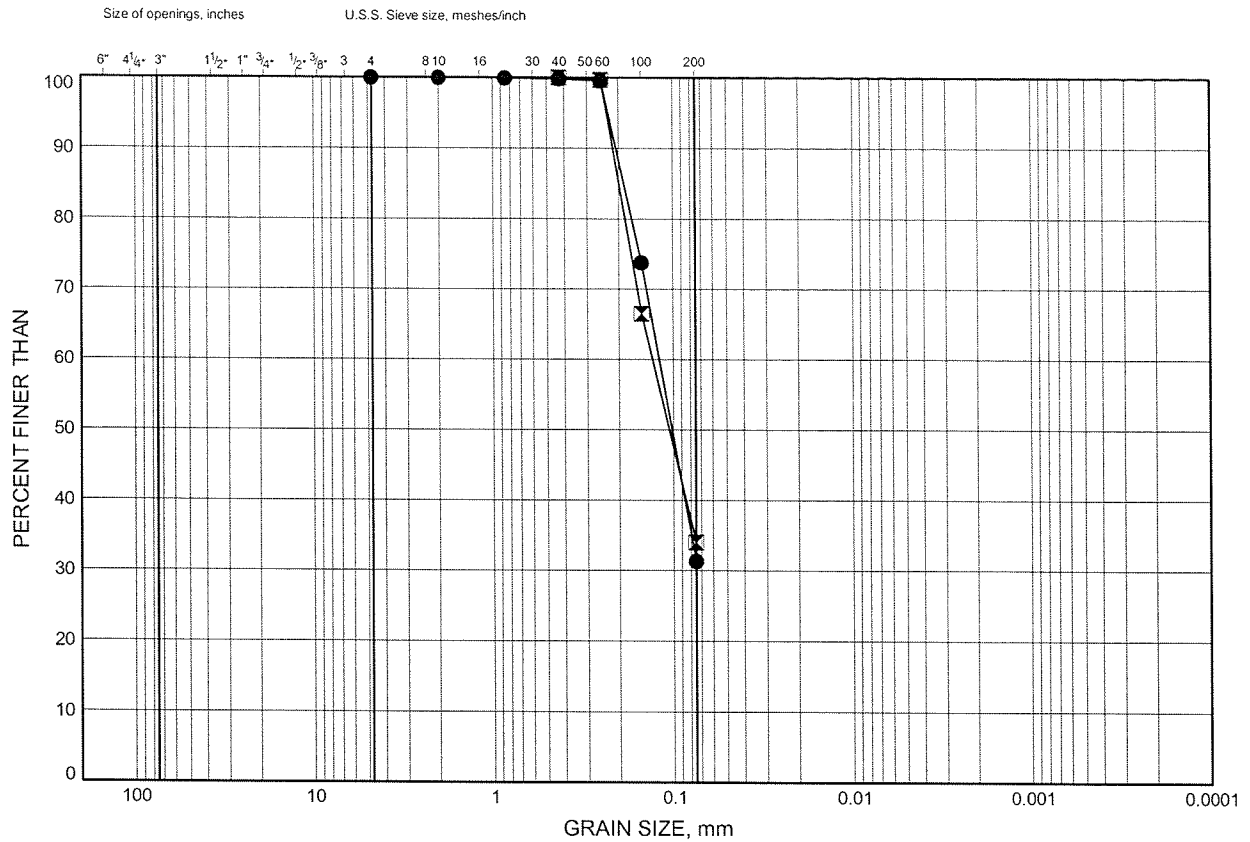
CLAYEY SILT TILL



Widening of Hwy 400, Major Mackenzie to King Road
GRAIN SIZE DISTRIBUTION

FIGURE F4

SILTY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-13W	10.97	257.66
⊠	06-15W	9.45	259.18

Date April 2007
Project 2539-04-00

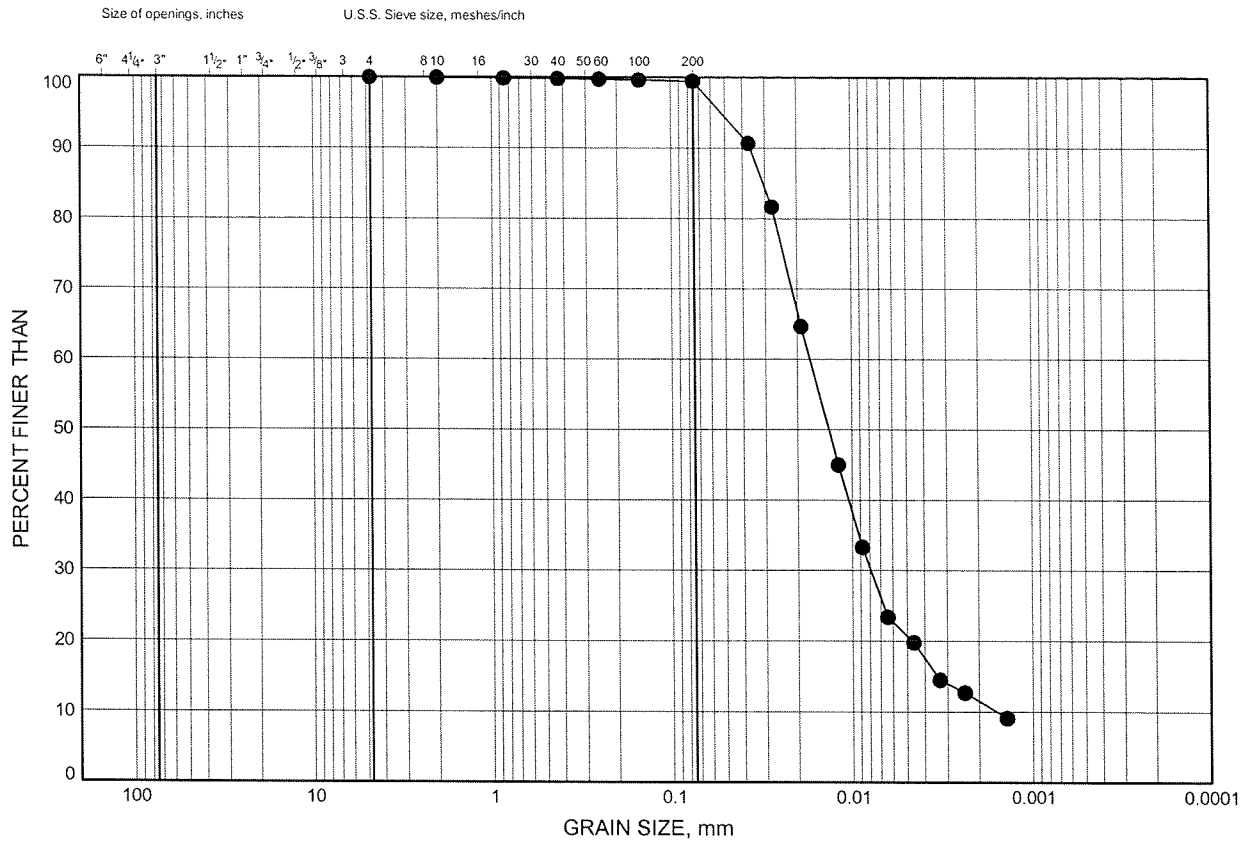


Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
GRAIN SIZE DISTRIBUTION

FIGURE F5

SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-14W	4.88	259.26

Date April 2007
Project 2539-04-00

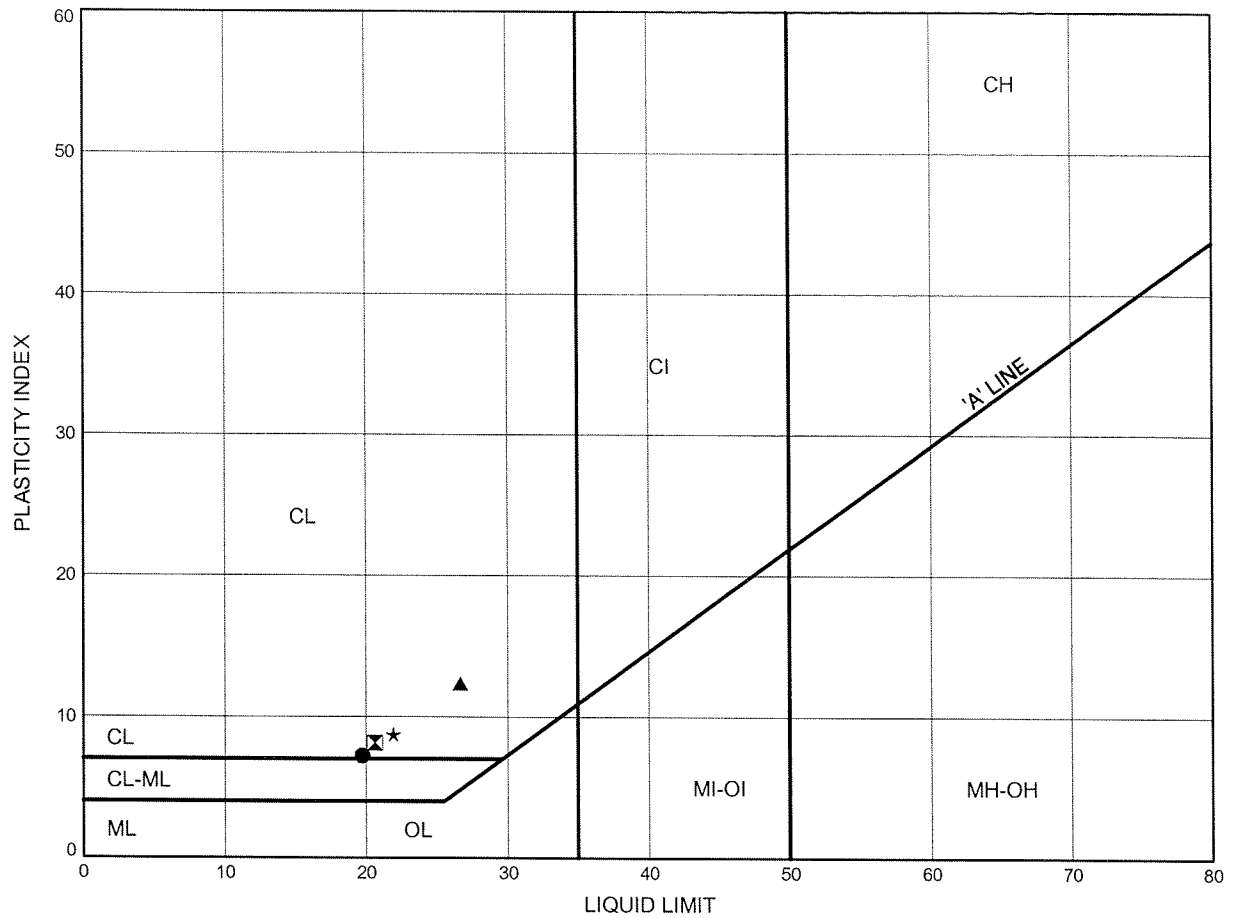


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Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE F6

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-13W	2.59	266.04
⊠	06-13W	7.92	260.71
▲	06-14W	1.83	262.31
★	06-15W	6.40	262.23

Date April 2007
 Project 2539-04-00

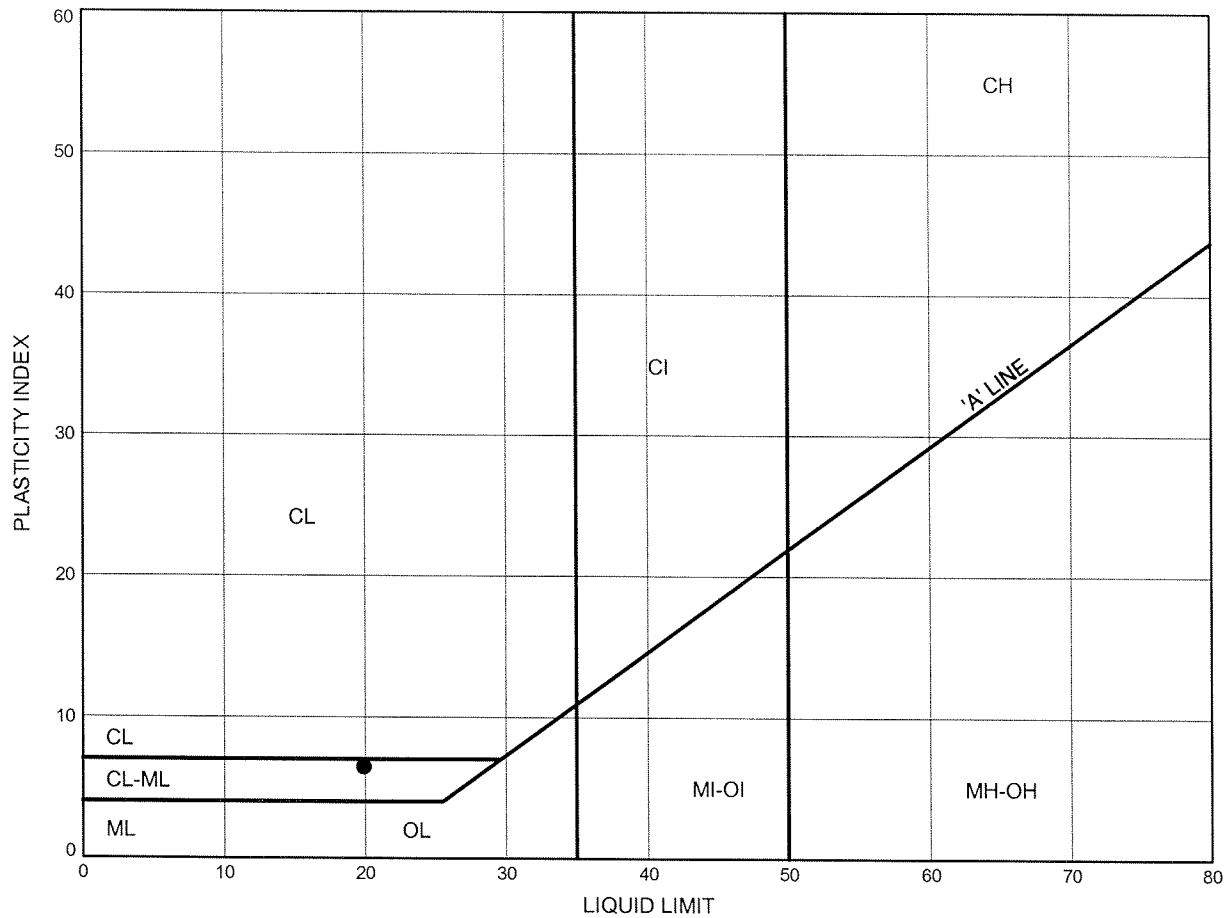


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 Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE F7

CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-15W	1.83	266.80

Date April 2007

Project 2539-04-00



Prep'd MFA

Chkd. SKP



A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. In the center, the name "P. K. CHATTERJI" is printed. Overlaid on the seal is a handwritten signature "P. K. Chatterji" and a date stamp "Apr 6/10" inside a semi-circular mark.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

High Embankments
Highway 400 Widening, Teston Road to King Road

Appendix G

High Fill Area 7

Highway 400 NB (adjacent to Humber River Culvert)

Approximate Stations 10+975 to 11+150

Records of Boreholes, Laboratory Test Results, Drawings



METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	W _p	W			W _L
258.6 0.0 0.1	TOPSOIL: (125 mm) Silty CLAY, trace roots Firm Dark Brown Moist (FILL)		1	SS	7									
			2	SS	5									
256.7 1.8	SILT, with sand, trace gravel Loose Brown to Grey Wet (FILL)		3	SS	5									
256.1 2.4	SILT, with sand, some clay, trace wood fragments, trace organics Very Loose Dark Brown Wet (FILL)		4	SS	3									
255.6 3.0	SAND, trace silt, trace clay Loose to Compact Brown Wet		6	SS	8									
			7	SS	17									
	becoming Grey	8	SS	17										
	some silt, trace clay	9	SS	21										
		10	SS	25										

+ 3, × 3: Numbers refer to Sensitivity

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-23E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 509.86 E 299 700.87 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
DATUM Geodetic DATE 2007-01-17 - 2007-01-17 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued From Previous Page											
246.7	SAND, trace silt, trace clay Compact Grey Wet		11	SS	23		248					
11.9	Clayey SILT, trace sand, trace gravel Hard Grey Moist (TILL)(CL-ML)		12	SS	46		247					
							246					
			13	SS	55		245					
							244					
242.7			14	SS	59		243					
15.8	END OF BOREHOLE AT 15.85 m. BOREHOLE OPEN TO 12.95 m UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE AND BACKFILLED WITH HOLEPLUG TO SURFACE.											

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

RECORD OF BOREHOLE No 06-24E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 531.28 E 299 703.94 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-16 - 2007-01-16 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
255.0												
0.0	TOPSOIL: (200 mm)						255					
0.2	SAND, trace silt, trace clay Loose to Compact Dark Brown Wet		1	SS	0							
			2	SS	9		254					
			3	SS	12		253					0 89 11 (SI+CL)
			4	SS	11		252					
			5	SS	11		251					
			6	SS	16		250					
249.2												
5.8	Sandy SILT, trace clay Compact Grey Wet		7	SS	16		249					
			8	SS	12		248					
							247					0 33 63 4
246.4												
8.7	SAND, trace silt, trace clay Loose to Compact Grey Wet		9	SS	8		246					

Continued Next Page

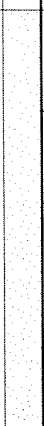
+ 3 . \times 3 : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 9268.GPJ 12/04/07

METRIC

DATUM Geodetic DATE 2007-01-16 - 2007-01-16 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100										
	Continued From Previous Page																	
242.2	SAND, trace silt, trace clay Compact Grey Wet trace silt						245								0 92 8 (SI+CL)			
			10	SS	14		244											
							243											
			11	SS	24													
12.8	END OF BOREHOLE AT 12.80 m. SAND "BLOWBACK" ENCOUNTERED INSIDE BOREHOLE. BOREHOLE OPEN TO 9.14 m AND WATER LEVEL AT SURFACE UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE AND BACKFILLED WITH HOLEPLUG TO SURFACE. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 16.01.07 0.0 255.0																	

+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 06-28E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 606.25 E 299 685.74 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-01-03 - 2007-01-04 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE					
259.6																
0.0	TOPSOIL: (75 mm)															
0.1	SAND, some silt, trace clay, trace gravel, trace rootlets		1	SS	4											
	Loose															
	Brown															
	Moist															
			2	SS	4											
			3	SS	4											1 83 16 (SI+CL)
257.1			4	SS	11											
2.5	Silty CLAY, with thin sand seams															
	Firm															
	Brown															
	Moist															
256.4																
3.2	SAND, trace silt, trace clay		5	SS	7											
	Loose															
	Brown															
	Wet															
	becoming Compact															
	trace silt and gravel		6	SS	19											
	becoming Grey															
			7	SS	19											0 90 10 (SI+CL)
			8	SS	28											
	becoming Dense		9	SS	33											

Continued Next Page

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

RECORD OF BOREHOLE No 06-28E

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 606.25 E 299 685.74 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-01-03 - 2007-01-04 CHECKED BY TJH

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 (%)			
	Continued From Previous Page							20 40 60 80 100										
	SAND, trace silt, trace clay Dense Grey Wet		10	SS	31		249							0 92 8 (SI+CL)				
247.7							248											
11.9	Silty CLAY, trace sand Very Stiff to Hard Grey Wet (TILL)		11	SS	25		247							0 9 71 20				
							246											
			12	SS	37		245											
							244											
243.9			13	SS	36													
15.7	END OF BOREHOLE AT 15.70 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 3.1 256.5 27.03.07 3.0 256.6																	

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-29E

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 630.37 E 299 680.95 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger/Hollow Stem Auger/NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2006-12-20 - 2007-01-03 CHECKED BY TJH

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						
261.5								20 40 60 80 100	20 40 60					
0.0	TOPSOIL, with roots: (125 mm)							○ UNCONFINED + FIELD VANE						
0.1	Silty CLAY, topsoil stained Firm Dark Brown Moist (FILL)		1	SS	6		261							
			2	SS	10									
260.0	trace gravel Stiff Brown						260							
1.4	Silty CLAY, with sand, trace gravel, trace rootlets Stiff Brown Moist (TILL)(CL)		3	SS	15									3 22 56 19
			4	SS	9		259							
			5	SS	18		258							
257.3														
4.2	Sandy SILT, trace clay Compact Grey Wet		6	SS	15		257							0 31 64 5
255.9							256							
5.6	SAND, some silt Compact to Dense Grey Wet		7	SS	14		255							
			8	SS	14		254							
			9	SS	45		253							
							252							

Continued Next Page

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

METRIC

ELEV. DEPTH	SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI	
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE				
								20 40 60 80 100 					
								20 40 60 80 100 20 40 60					

		SAND, some silt Compact Grey Wet				
					251	
	10	SS	28			
					250	
	11	SS	25			
					249	
					248	
	12	SS	33			
					247	
245.8	13	SS	33		246	
15.7	END OF BOREHOLE AT 15.70 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.					
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 5.1 256.4 27.03.07 4.8 256.7					

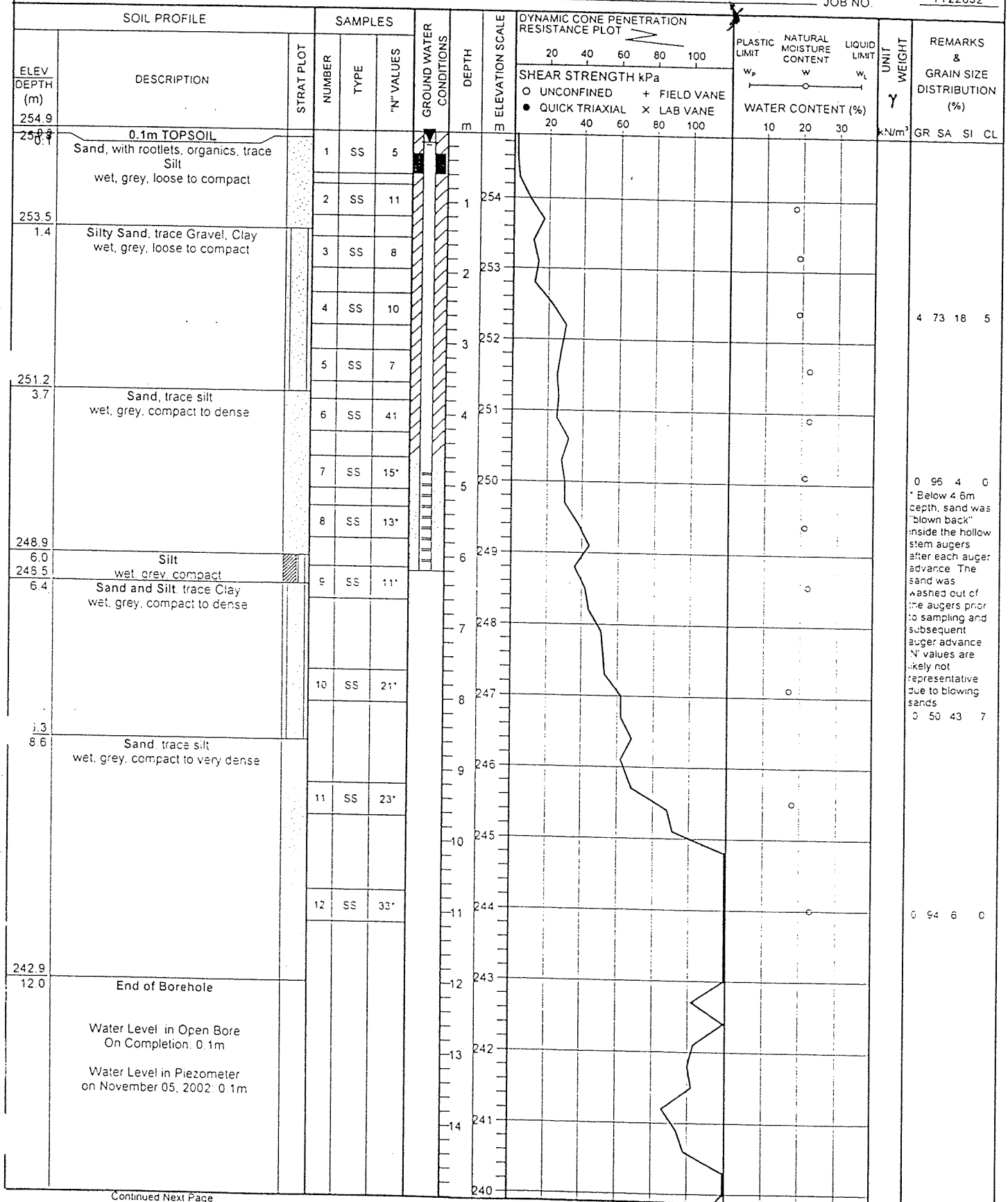
+ 3, × 3: Numbers refer to Sensitivity

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No HR1



W.P. 192-00-00 LOCATION 4863532 7N 299710 2E 1 OF 2
 DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY PPM
 DATUM Geodetic DATE 16 September 2002 - 16 September 2002 COMPILED BY IH
 PROJECT HWY 400 Widening, Vaughan, Ontario CHECKED BY AD
 JOB NO. TT22852



Continued Next Page

+ 3, X 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HR1



W.P. 192-00-00 LOCATION 4863532.7N 299710.2E 2 OF 2
 DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY PPM
 DATUM Geodetic DATE 16 September 2002 - 16 September 2002 COMPILED BY IH
 PROJECT HWY 400 Widening, Vaughan, Ontario CHECKED BY AD
 JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				20	40	60	80	100	W _p	W	W _L		
236.6							16	239										
18.3	End of DCPT						17	238										
	DCPT carried out about 2m east of borehole						18	237										

PROJECT 001-1122F				RECORD OF BOREHOLE No 90				1 OF 2		METRIC					
W.P. 222-97-00				LOCATION N 4863549 E 299699				ORIGINATED BY AZ							
DIST Central HWY 400				BOREHOLE TYPE 108mm I.D. Hollow Stem Augers				COMPILED BY LCC							
DATUM Geodetic				DATE October 16 & 17, 2000				CHECKED BY ASP							
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							
255.0	GROUND SURFACE						20 40 60 80 100	20 40 60 80 100	10 20 30						
0.0 254.7	Topsoil (silty clay with organics)														
254.4	Silty Clay, trace organics Brown														
0.6 252.8	Silty Sand, trace gravel, trace clay, trace organics Compact to dense Brown to grey Wet below 1.5m depth 20mm layer of organics at about 1.8m depth		1	SS	47										
			2	SS	12										
2.2 242.5	Sand, trace to some silt Compact to dense Brown becoming grey at 4.5m depth Wet SPT "N" values are considered to be impacted by blowing sands (See Note 1). Layer of grey sandy silt, trace clay encountered at 7.6m depth.		3	SS	13										
			4	SS	3										
			5	SS	7									0 93 7	
			6	SS	6										
			7	SS	15									0 94 7	
			8	SS	12										
			9	SS	19										
			10	SS	20										
			11	SS	18										
12.5 242.5	Probably compact to dense sand														

ON MOT 001-1122.GPJ ON MOT.GDT 19/3/01

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 90

2 OF 2

METRIC

PROJECT 001-1122F

W.P. 222-97-00

LOCATION N 4863549; E 299699

ORIGINATED BY AZ

DIST Central HWY 400



BOREHOLE TYPE 108mm I.D. Hollow Stem Augers

COMPILED BY LCC

DATUM Geodetic

DATE October 16 & 17, 2000

CHECKED BY ASP

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 (%)							
									20 40 60 80 100	20 40 60 80 100						10 20 30
— CONTINUED FROM PREVIOUS PAGE —							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED									
238.2 16.8	Probably compact to dense sand						239									
	END OF BOREHOLE															
	Notes: 1. Below about 2.5m depth, between 1.5m and 3.5m of sand was "blown back" inside the hollow stem augers after each auger advance. This material was washed out of the augers prior to sampling and subsequent auger advance. 2. Water level in open borehole at 1.5m depth (Elev.253.5m) during drilling and at 1.1m depth (Elev.253.9m) on completion of drilling. 3. Water level in piezometer at 0.2m depth (Elev.254.8m) on January 18, 2001.															

N MOT 001-1122.GPJ ON MOT.GDT 19/3/01

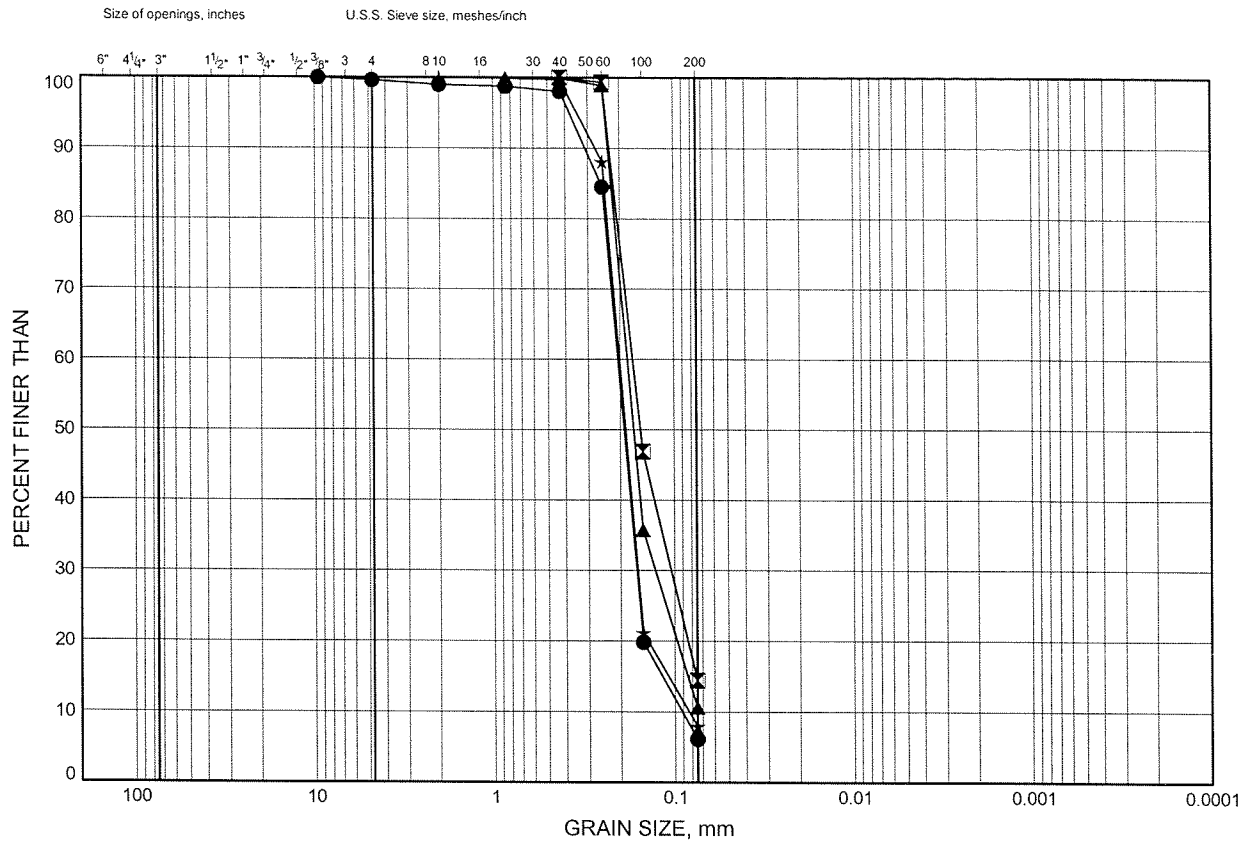
ON MOT 001-1122.GPJ ON MOT.GDT 19/3/01

+ 3 X 3. Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION

SAND



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-23E	3.35	255.20
⊠	06-23E	7.92	250.63
▲	06-24E	1.83	253.21
★	06-24E	10.97	244.07

Date April 2007

Project 2539-04-00



Prep'd MFA

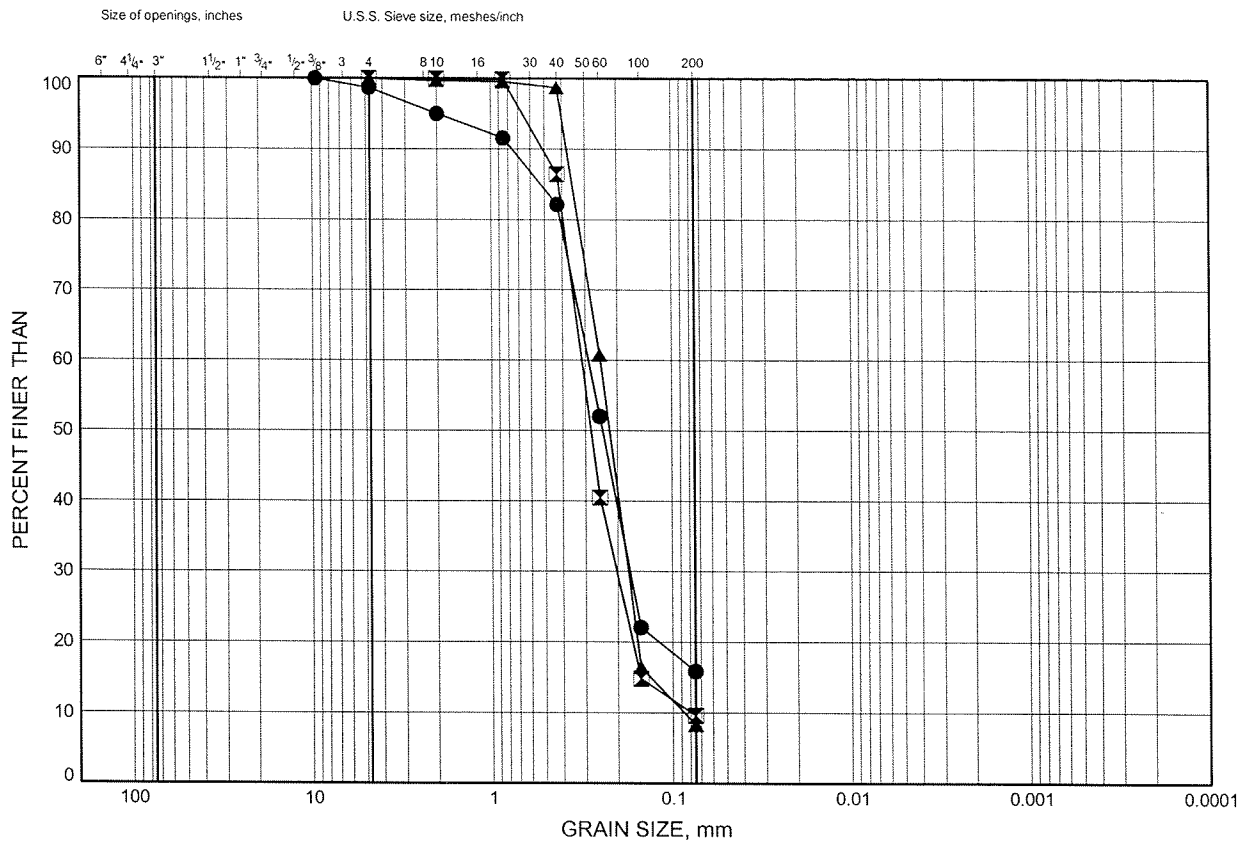
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road

GRAIN SIZE DISTRIBUTION

FIGURE G2

SAND



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28E	1.83	257.77
⊠	06-28E	6.40	253.20
▲	06-28E	10.90	248.70

Date April 2007

Project 2539-04-00



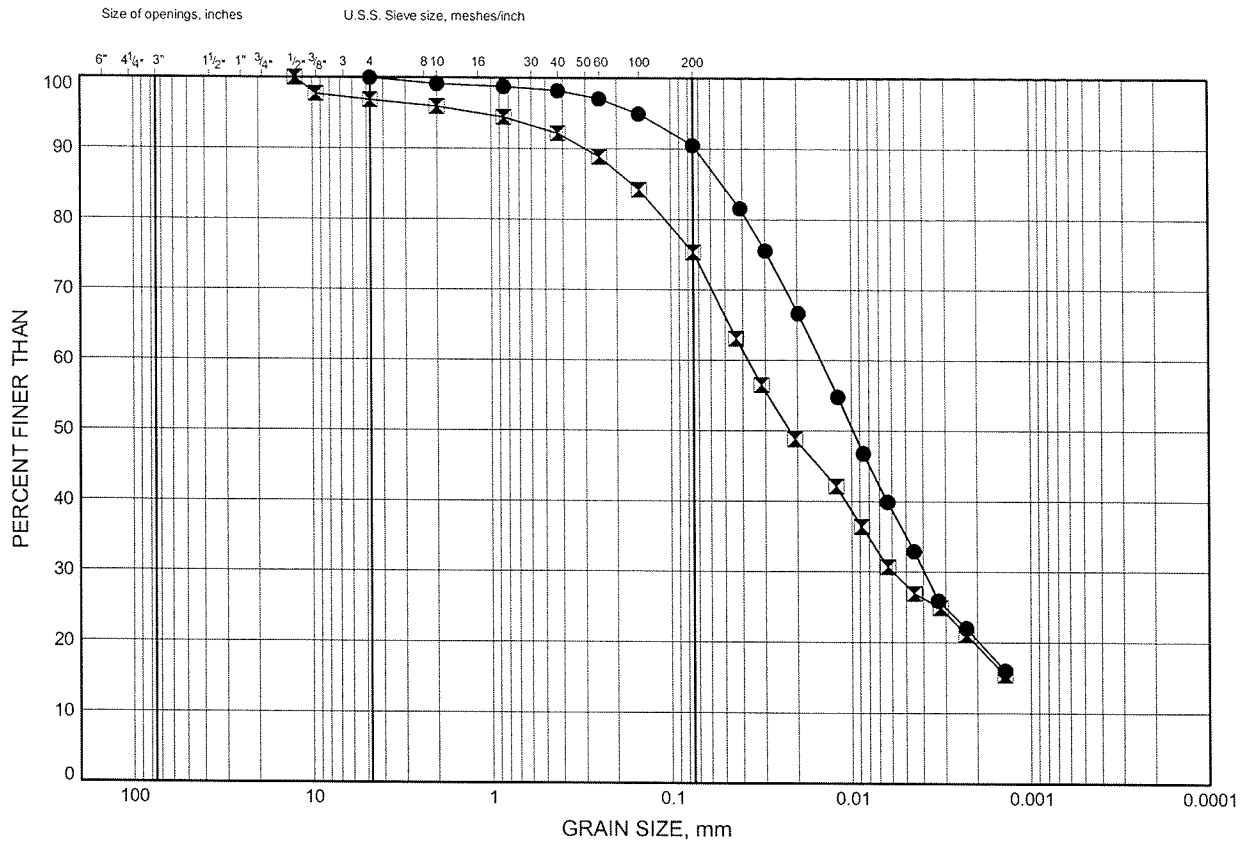
Prep'd MFA

Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
GRAIN SIZE DISTRIBUTION

FIGURE G3

SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28E	12.42	247.18
⊠	06-29E	1.83	259.66

Date April 2007
Project 2539-04-00



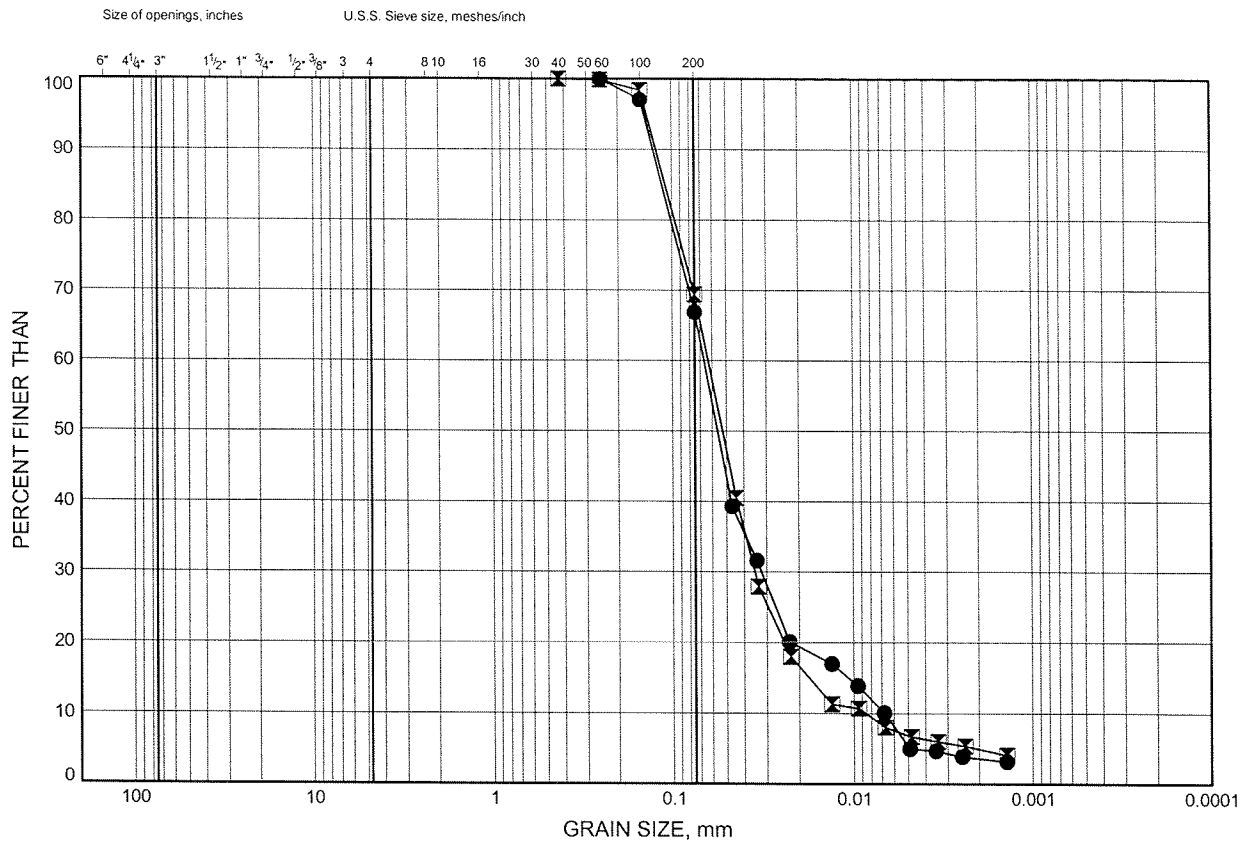
Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road

GRAIN SIZE DISTRIBUTION

FIGURE G4

SANDY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-24E	7.92	247.12
⊠	06-29E	4.88	256.61

Date April 2007
Project 2539-04-00

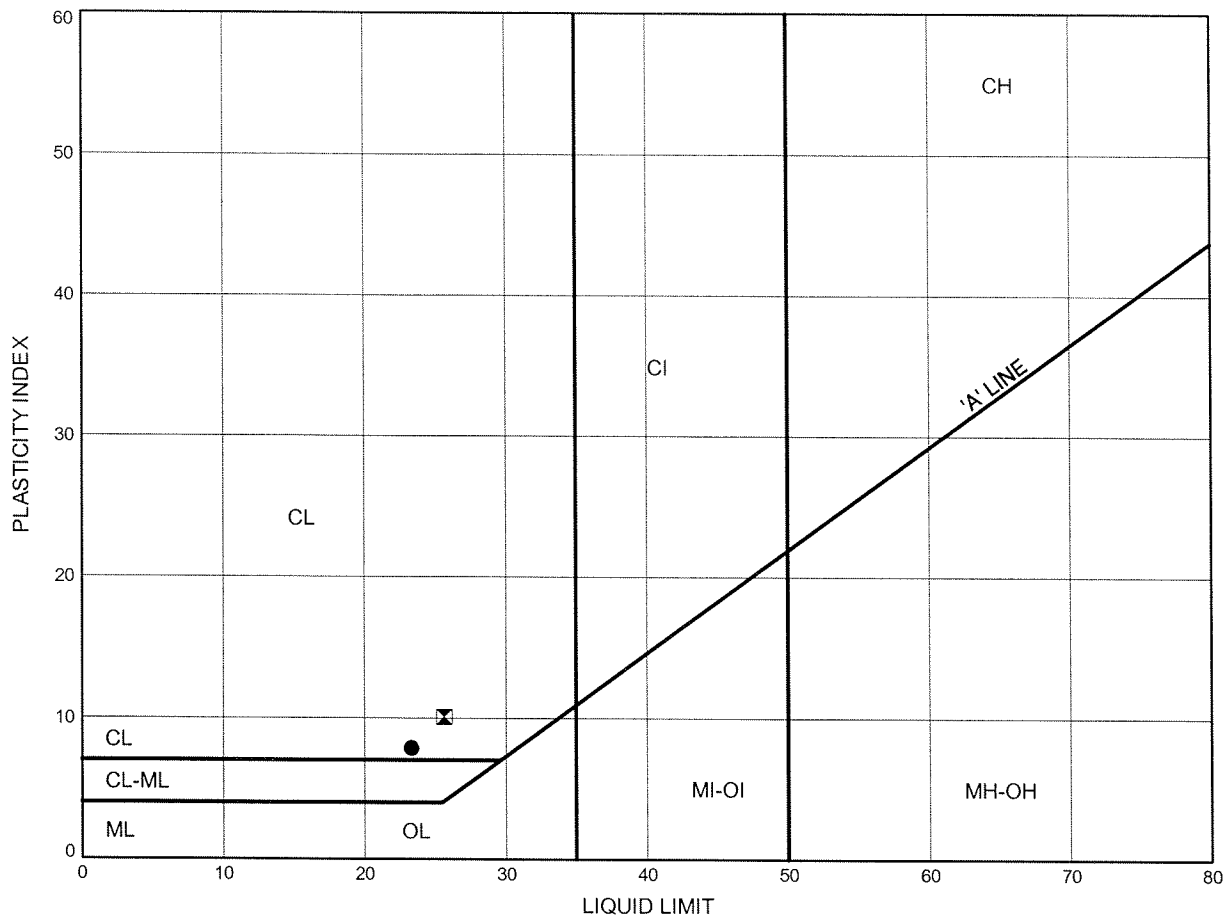


Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE G5

SILTY CLAY TILL

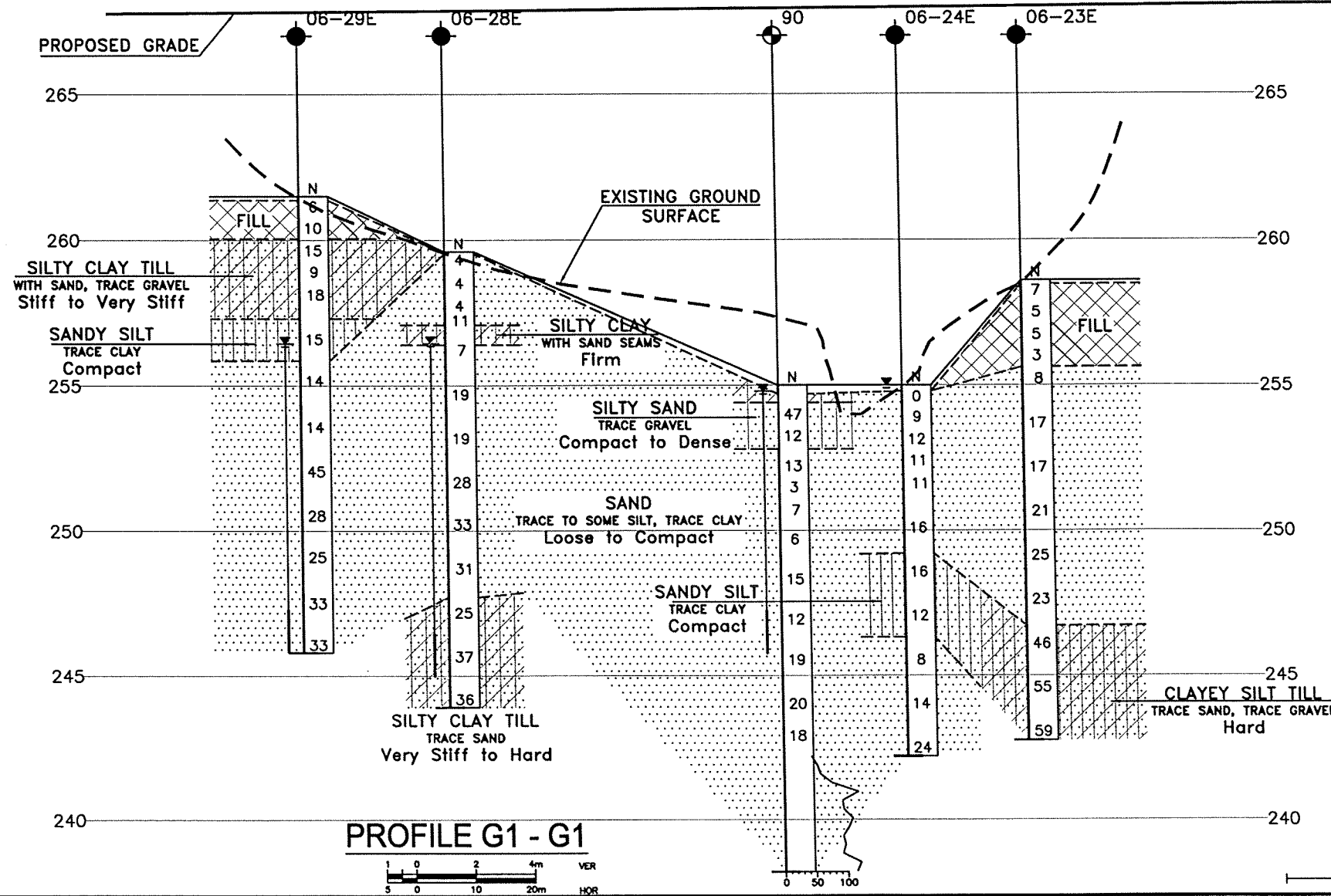
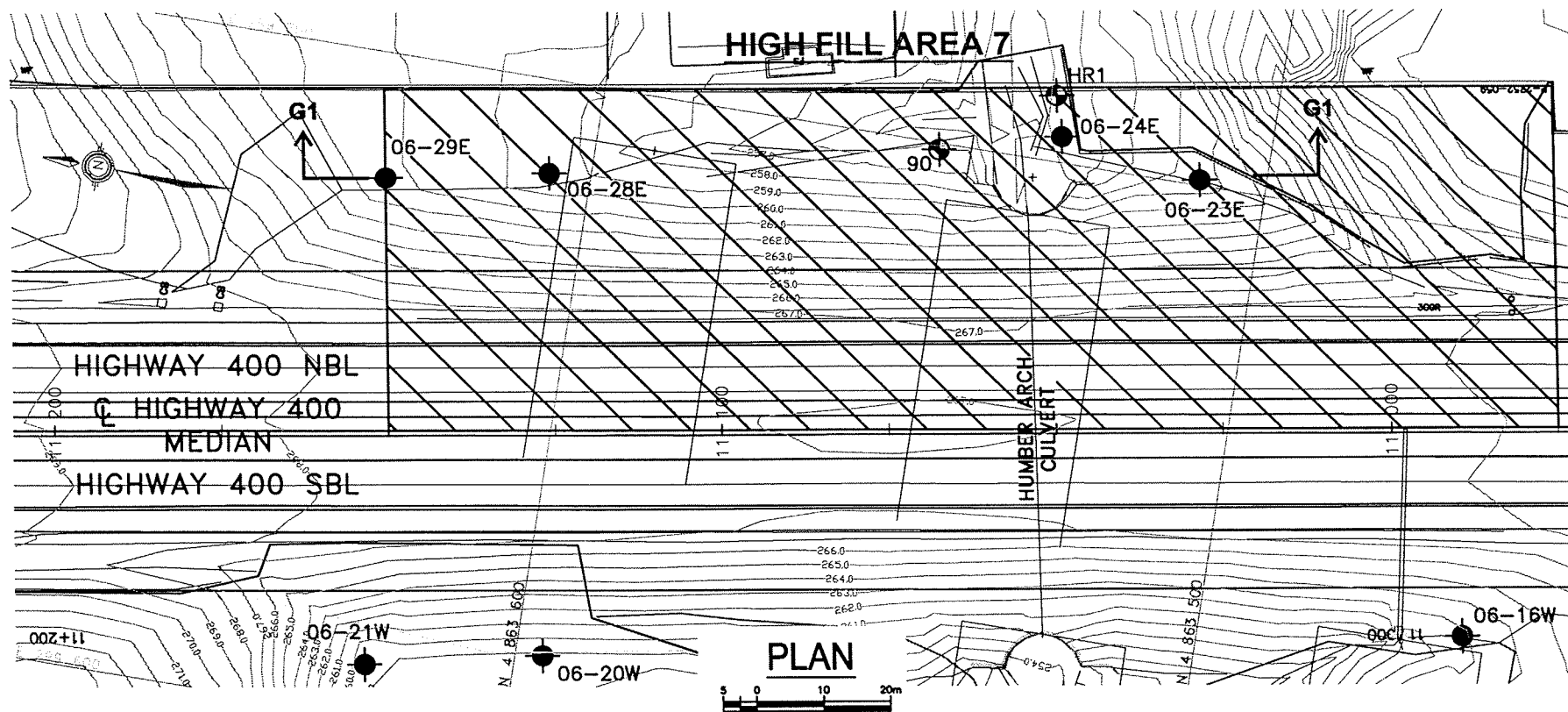


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-29E	1.83	259.66
⊠	06-29E	3.35	258.14

Date April 2007
 Project 2539-04-00



Prep'd MFA
 Chkd. SKP

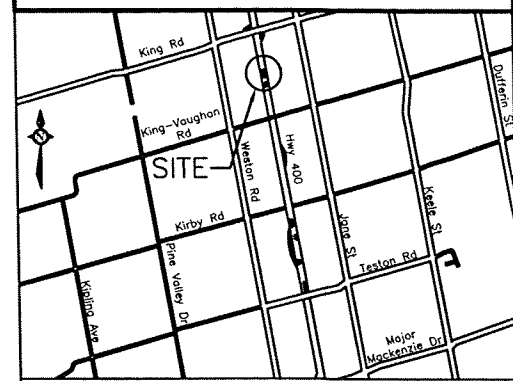


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HIGHWAY 400
CONT No
WP No 2539-04-00
HWY 400 WIDENING
TESTON ROAD TO KING ROAD
STATIONS 20+500 TO 20+780
BOREHOLE LOCATIONS AND SOIL STRATA

SNC-LAVALIN
Engineers & Constructors

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
06-23E	258.6	4 863 509.86	299 700.87
06-24E	255.0	4 863 531.28	299 703.94
06-28E	259.6	4 863 606.25	299 685.74
06-29E	261.5	4 863 630.37	299 680.95
90	255.0	4 863 549.00	299 699.00

NOTES

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

GEOCREs No. 30M13-178



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix H

High Fill Area 8

Highway 400 SB (adjacent to Humber River Culvert)

Approximate Stations 10+975 to 11+150

Records of Boreholes, Laboratory Test Results, Drawings



RECORD OF BOREHOLE No 06-16W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 460.90 E 299 639.14 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-08 - 2007-01-08 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100							20 40 60 80 100		
								SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE							w P w w L		
								● QUICK TRIAXIAL × LAB VANE									
263.1																	
0.0	TOPSOIL: (200 mm)						263										
0.2	Silty SAND Very Loose Brown Wet (FILL)		1	SS	3												
261.9			2	SS	21		262										
1.1	Silty CLAY, trace sand, with thin silty sand seams Very Stiff to Stiff Brown Moist (CL)		3	SS	25		261							0 6 49 45			
260.2			4	SS	13												
2.9	Clayey SILT, occasional sand seams Very Stiff Grey Wet		5	SS	17		260										
258.7							259										
4.3	SILT, trace sand, trace clay, trace gravel Dense Moist (ML-NP)		6	SS	39		258							1 7 86 6			
257.0	inferred boulder or cobble at 5.72 to 5.82 m																
6.1	SAND, trace to some silt, trace clay Very Dense Brown Moist gravel seams at 6.25 to 6.28 m		7	SS	63		257										
255.7							256										
7.3	compact		8	SS	22		255							0 81 19 (SI+CL)			
254.5																	
8.5			9	SS	51		254										

Continued Next Page

+ 3, × 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-16W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 460.90 E 299 639.14 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2007-01-08 - 2007-01-08 CHECKED BY TJH

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 (%)		
Continued From Previous Page								20 40 60 80 100										
252.7	SAND, trace to some silt, trace clay Very Dense						253											
10.4	Clayey SILT, some sand, trace gravel Hard Grey Wet		10	SS	56													
251.9							252											
11.1	SAND, some silt Very Dense Grey Wet																	
250.7							251											
12.4	Clayey SILT, trace sand, trace gravel Hard Grey Wet (TILL)		11	SS	63													
							250											
			12	SS	39										1 5 75 19			
							249											
							248											
247.2			13	SS	10													
15.8	END OF BOREHOLE AT 15.85 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20.02.07 7.3 255.8 27.03.07 7.2 255.9																	

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-19W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 548.36 E 299 615.42 ORIGINATED BY SLL/SM
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007-02-06 - 2007-02-06 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
257.4															
0.0 0.1	TOPSOIL: (75mm) SAND AND SILT, trace clay, trace gravel, trace rootlets Compact Brown Moist		1	SS	11		257				○				0 51 40 9
255.9							256				○				
1.4	SAND, trace to some silt, trace gravel Loose to Compact Brown Moist		2	SS	8		255				○				
	Wet		3	SS	21		254				○				0 90 10 (SI+CL)
			4	SS	17		253				○				
			5	SS	28		252				○				
			6	SS	25		251				○				
250.2							250				○				
7.2	Sandy SILT, trace clay Compact Grey Wet		7	SS	28		249				○				0 28 68 4
			8	SS	19		248				○				

Continued Next Page

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

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-19W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 548.36 E 299 615.42 ORIGINATED BY SLL/SM

HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA

DATUM Geodetic DATE 2007-02-06 - 2007-02-06 CHECKED BY TJH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										w _p w w _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
	Continued From Previous Page																			
246.3	Sandy SILT, trace clay Compact Grey Wet		9	SS	27		247													
11.1	END OF BOREHOLE AT 11.13m. BOREHOLE OPEN TO 2.44m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG UPON COMPLETION.																			

+ 3, × 3; Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-20W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 595.91 E 299 613.49 ORIGINATED BY SLL
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-02-07 - 2007-02-07 CHECKED BY TJH

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
258.9															
0.0	TOPSOIL: (75mm)														
0.1	SAND and SILT, with sand seams, trace gravel, trace roots and rootlets Compact Brown Moist (FILL)		1	SS	11		258								1 39 47 13
257.5															
1.4	Sandy SILT, trace clay, topsoil-stained Loose to Compact Brown Moist		2	SS	10		257								
256.7															
2.2	SAND, trace silt Compact Brown Wet		3	SS	18										0 92 8 (SI+CL)
							256								
			4	SS	12										
							255								
	trace gravel Dense to Very Dense		5	SS	35		254								1 94 5 (SI+CL)
							253								
	Grey		6	SS	56										
							252								
			7	SS	47		251								
							250								
			8	SS	66										
249.3															
9.6	END OF BOREHOLE AT 9.60m. BOREHOLE OPEN TO 4.57m.														

ONTMT4S 9268.GPJ 120407

Continued Next Page

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

RECORD OF BOREHOLE No 06-20W

2 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 595.91 E 299 613.49 ORIGINATED BY SLL
HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
DATUM Geodetic DATE 2007-02-07 - 2007-02-07 CHECKED BY TJH

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 Y 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 (%)					
	Continued From Previous Page													
	BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.													
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 07.02.07 4.3 254.6													

ONTMT4S 9268.GPJ 12/04/07

RECORD OF BOREHOLE No 06-21W

1 OF 2

METRIC

G.W.P. 2539-04-00 LOCATION Hwy 400, Teston Road to King Road N 4 863 617.00 E 299 608.63 ORIGINATED BY SLL/SM
 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2007-02-08 - 2007-02-08 CHECKED BY TJH

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	20 40 60 80 100	20 40 60 80 100		
259.1												
0.0	TOPSOIL: (75mm)											
0.1	Clayey SILT, with sand Soft to Firm Brown Moist		1	SS	2		259					0 31 53 16
			2	SS	9		258					
							257					
	trace gravel Grey		3	SS	3		256					1 22 65 12
			4	SS	4		255					
254.5							254					
4.6	SAND, trace to some silt Loose to Compact Grey Wet		5	SS	5		253					0 88 12 (SI+CL)
							252					
			6	SS	16		251					
			7	SS	24		250					
	Dense		8	SS	50							
249.3												
9.8	END OF BOREHOLE AT 9.75m.											

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 9268.GPJ 120407

METRIC

[illegible]

+ 3, × 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HR2



W.P. 192-00-00 LOCATION 4863525 9N 299615 6E 1 OF 1
 DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY IH
 DATUM Geodetic DATE 17 September 2002 - 17 September 2002 COMPILED BY IH
 PROJECT HWY 400 Widening, Vaughan, Ontario CHECKED BY AD
 JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
254.6									20 40 60 80 100						
0.0	Silty Sand, with Gravel, trace clay, rootlets		1	SS	3		1	254							0 93 7 0
254.0	damp, brown, very loose		2	SS	6										
0.6	Sand, trace silt		3	SS	47		2	253							
	wet, brown to grey, loose		4	SS	5*		3	252							
251.6			5	SS	9*		4	251							8 78 (14)
3.0	Silty Sand, trace Gravel, Clay		6	SS	9*		5	250							0 67 27 6
	wet, grey, loose to compact		7	SS	17*		6	249							* Below 2.3m depth, sand was "blown back" inside the hollow stem augers after each auger advance. The sand was washed out of the augers prior to sampling and subsequent auger advance "N" values are likely not representative due to blowing sands.
247.6			8	SS	5*		7	248							
7.0	Sand, trace Silt, Clay		9	SS	6*		8	247							
	wet, grey, loose to compact		10	SS	12*		9	246							
243.3			11	SS	20*		10	245							1 83 10 6
11.3	End of DCPT						11	244							
242.4	DCPT carried out about 2m west of borehole						12	243							
12.2	End of Borehole														
	Water Level in Open Bore On Completion : 1.2m September 18, 2002: 0.3m above augers November 05, 2002: 0.2 m above ground														

RECORD OF BOREHOLE No HR3

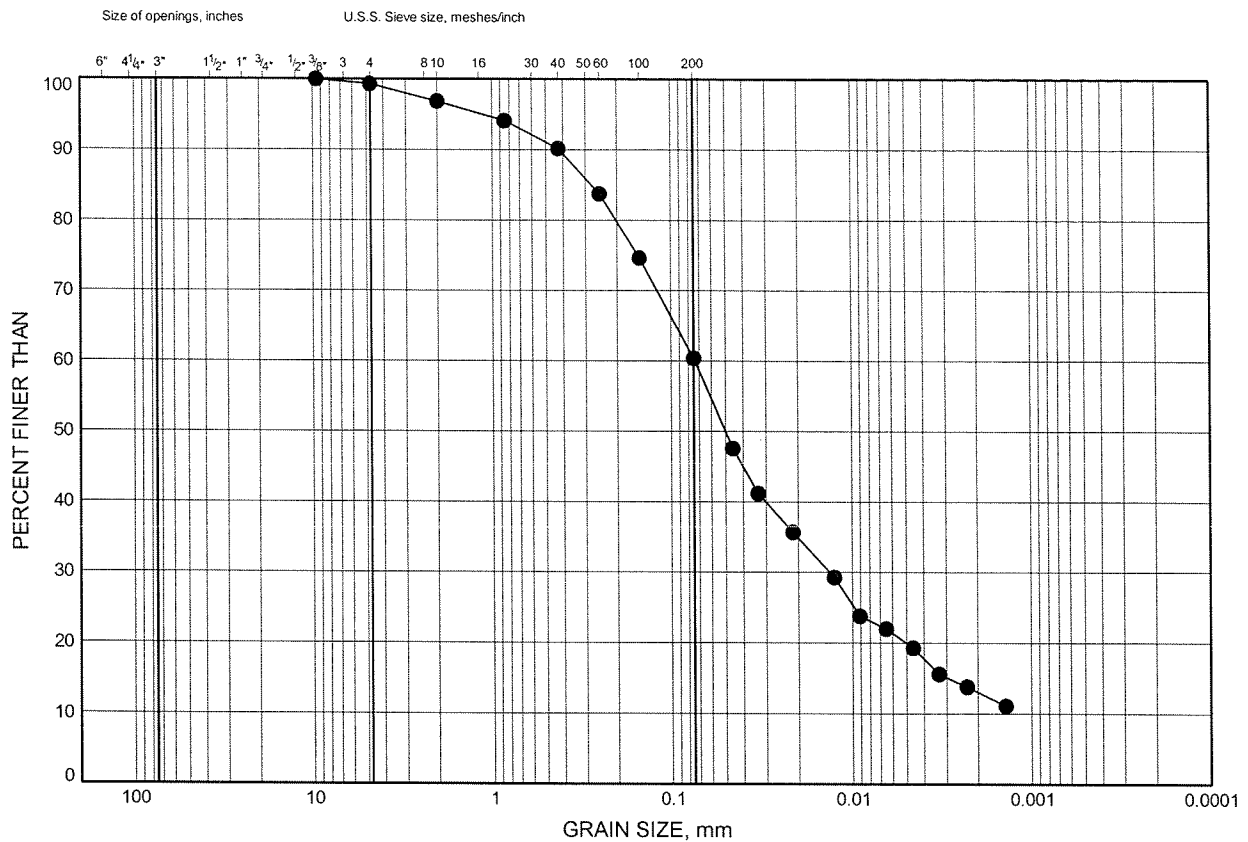


W.P. 192-00-00 LOCATION 4863514 9N 299615.6E 1 OF 1
 DIST HWY 400 BOREHOLE TYPE Hollow Stem Augering ORIGINATED BY IH
 DATUM Geodetic DATE 17 September 2002 - 18 September 2002 COMPILED BY IH
 PROJECT HWY 400 Widening, Vaughan, Ontario CHECKED BY AD
 JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa							WATER CONTENT (%)
									○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
254.7									20 40 60 80 100	20 40 60 80 100	10 20 30					
0.0	Sand, with Gravel, some Organics, Rootlets		1	SS	3											
254.0	damp, brown to grey, very loose		2	SS	8											
0.7	Sand, with Gravel moist, grey, loose															
253.3			3	SS	17											
1.4	Sand, trace Silt wet, grey, loose to dense		4	SS	50											
			5	SS	6*											
			6	SS	7*											
250.3	Silty Sand, trace Clay wet, grey, loose to compact		7	SS	5*											
4.4			8	SS	20*											
			9	SS	13*											
			10	SS	19*											
			11	SS	31*											

GRAIN SIZE DISTRIBUTION

SAND AND SILT FILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-20W	1.07	257.83

Date April 2007
Project 2539-04-00

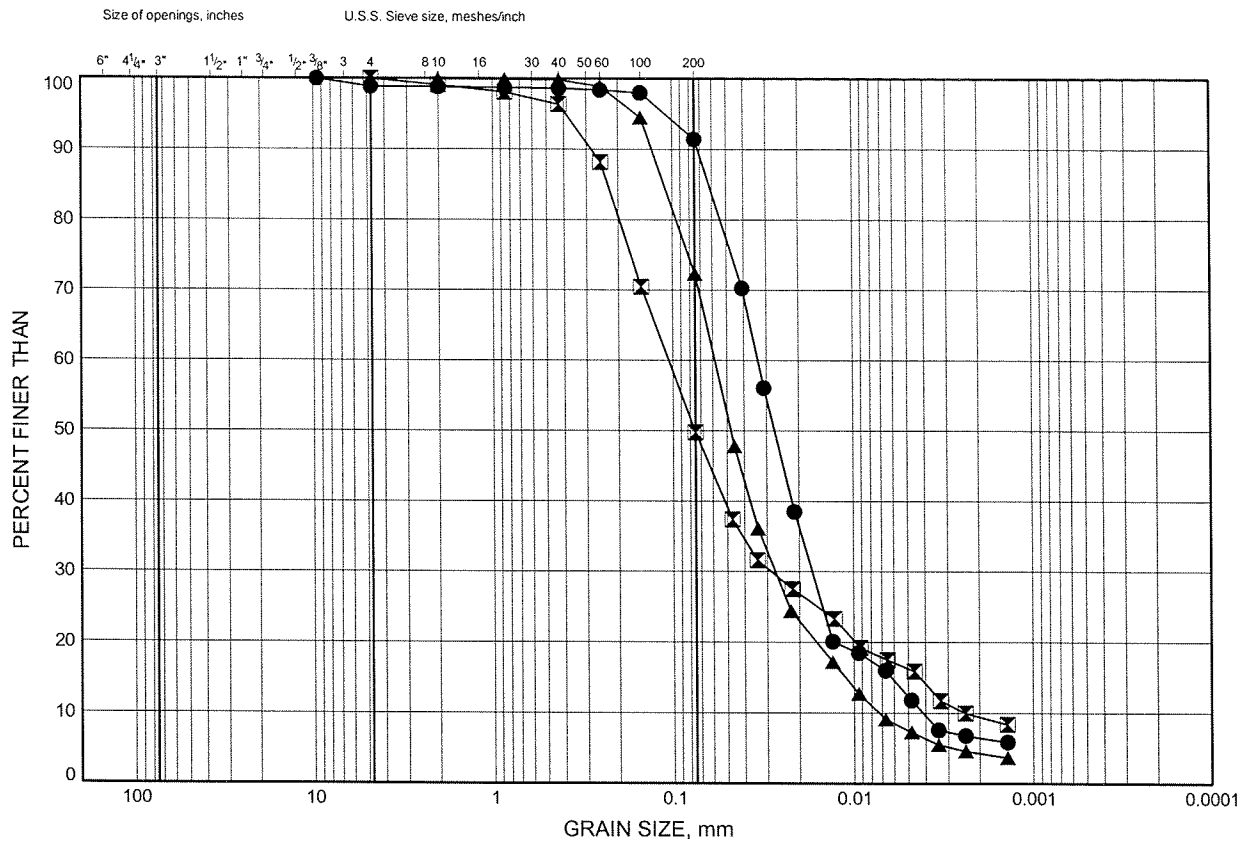


Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
GRAIN SIZE DISTRIBUTION

FIGURE H2

SANDS AND SILTS



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-16W	4.88	258.21
⊠	06-19W	1.07	256.31
▲	06-19W	7.85	249.53

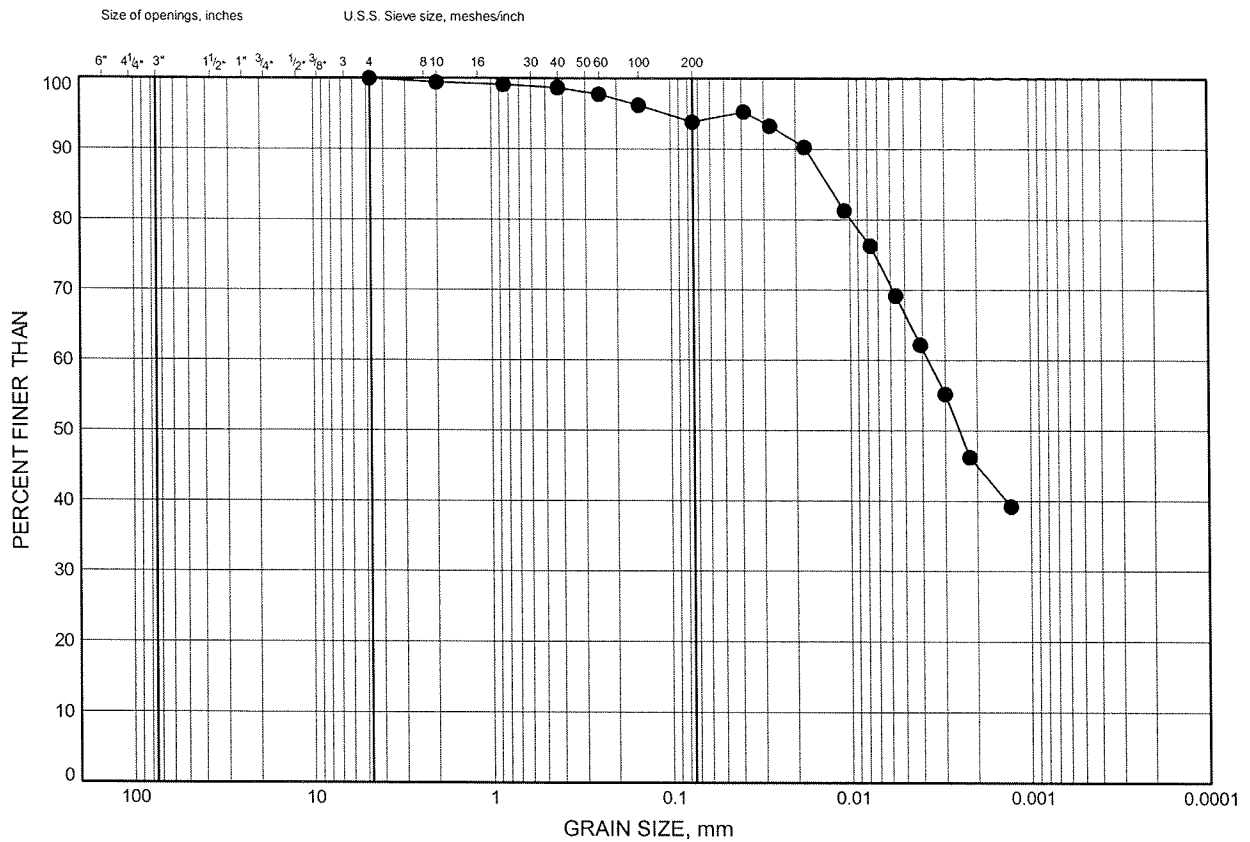
Date April 2007
Project 2539-04-00



Prep'd MFA
Chkd. SKP

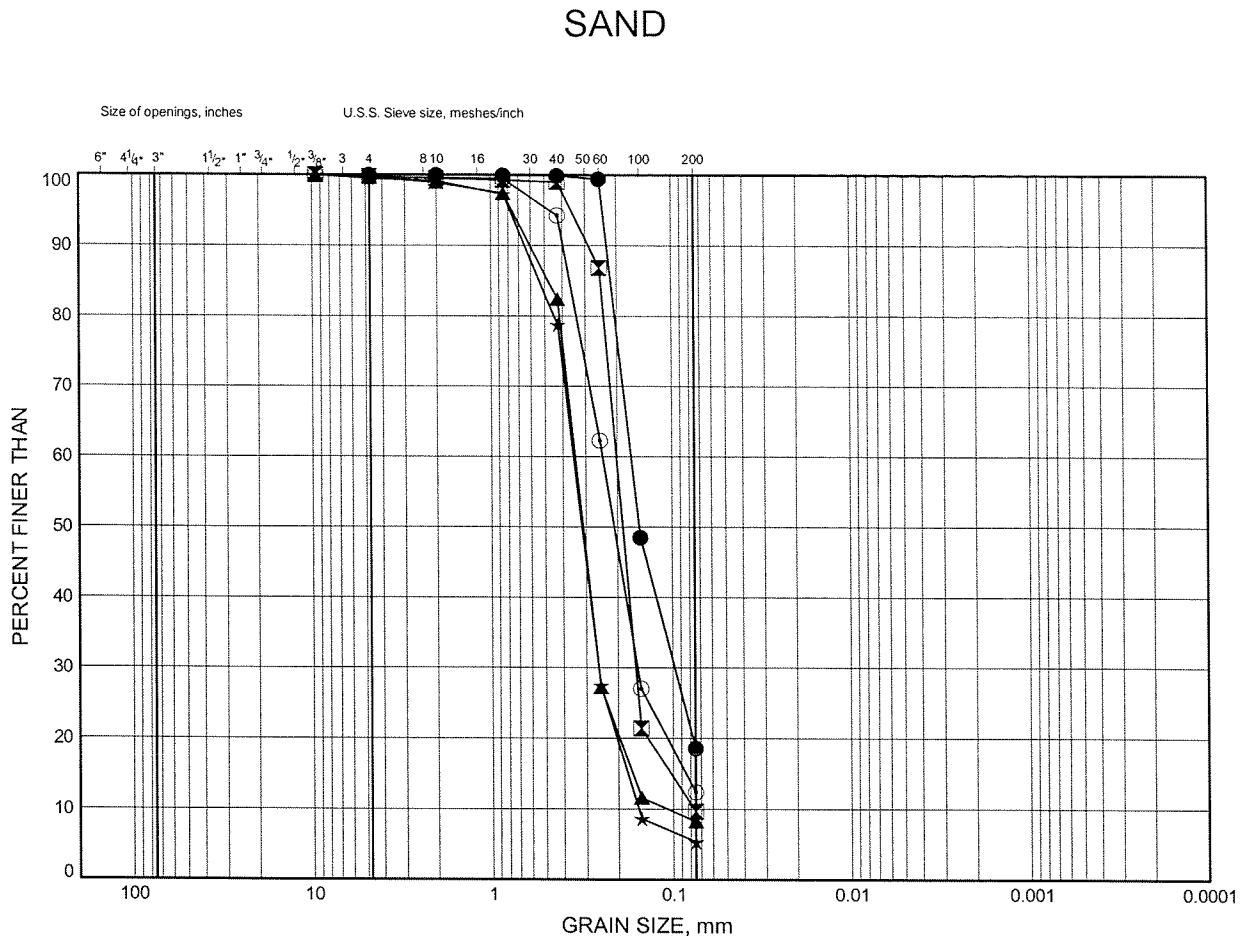
GRAIN SIZE DISTRIBUTION

SILTY CLAY



Widening of Hwy 400, Major Mackenzie to King Road
GRAIN SIZE DISTRIBUTION

FIGURE H4



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-16W	7.92	255.17
⊠	06-19W	3.35	254.03
▲	06-20W	2.59	256.31
★	06-20W	4.88	254.02
⊙	06-21W	6.40	252.68

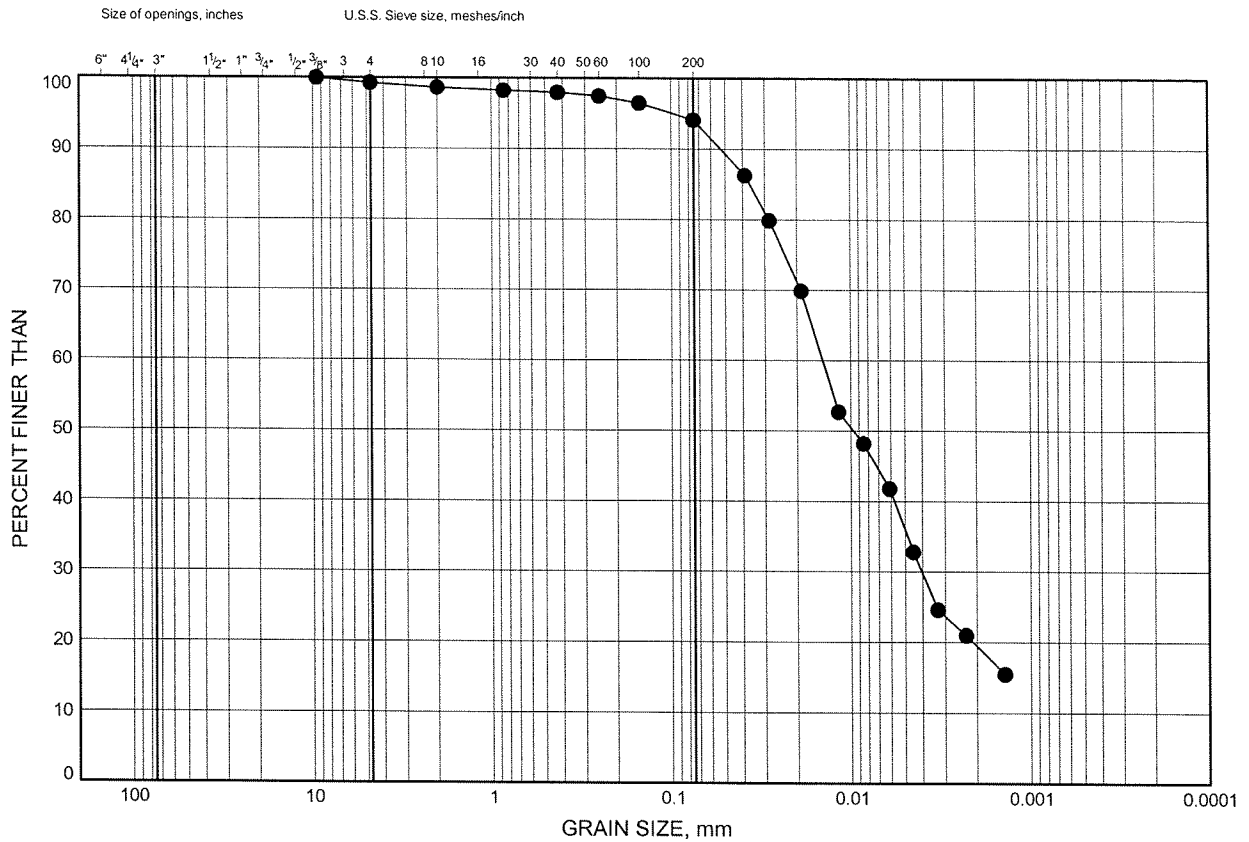
Date April 2007
Project 2539-04-00



Prep'd MFA
Chkd. SKP

GRAIN SIZE DISTRIBUTION

CLAYEY SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-16W	14.02	249.07

Date April 2007
Project 2539-04-00

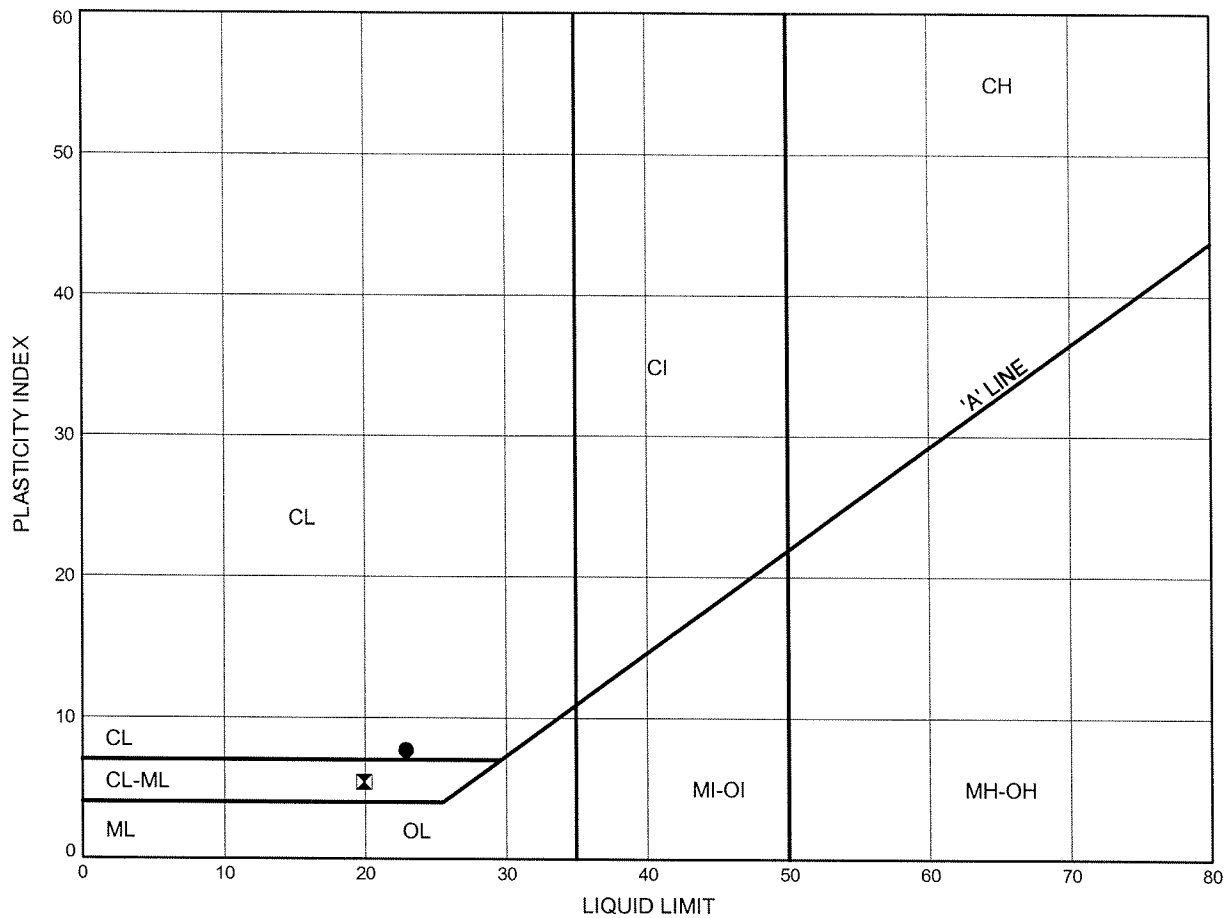


Prep'd MFA
Chkd. SKP

Widening of Hwy 400, Major Mackenzie to King Road
ATTERBERG LIMITS TEST RESULTS

FIGURE H6

CLAYEY SILT

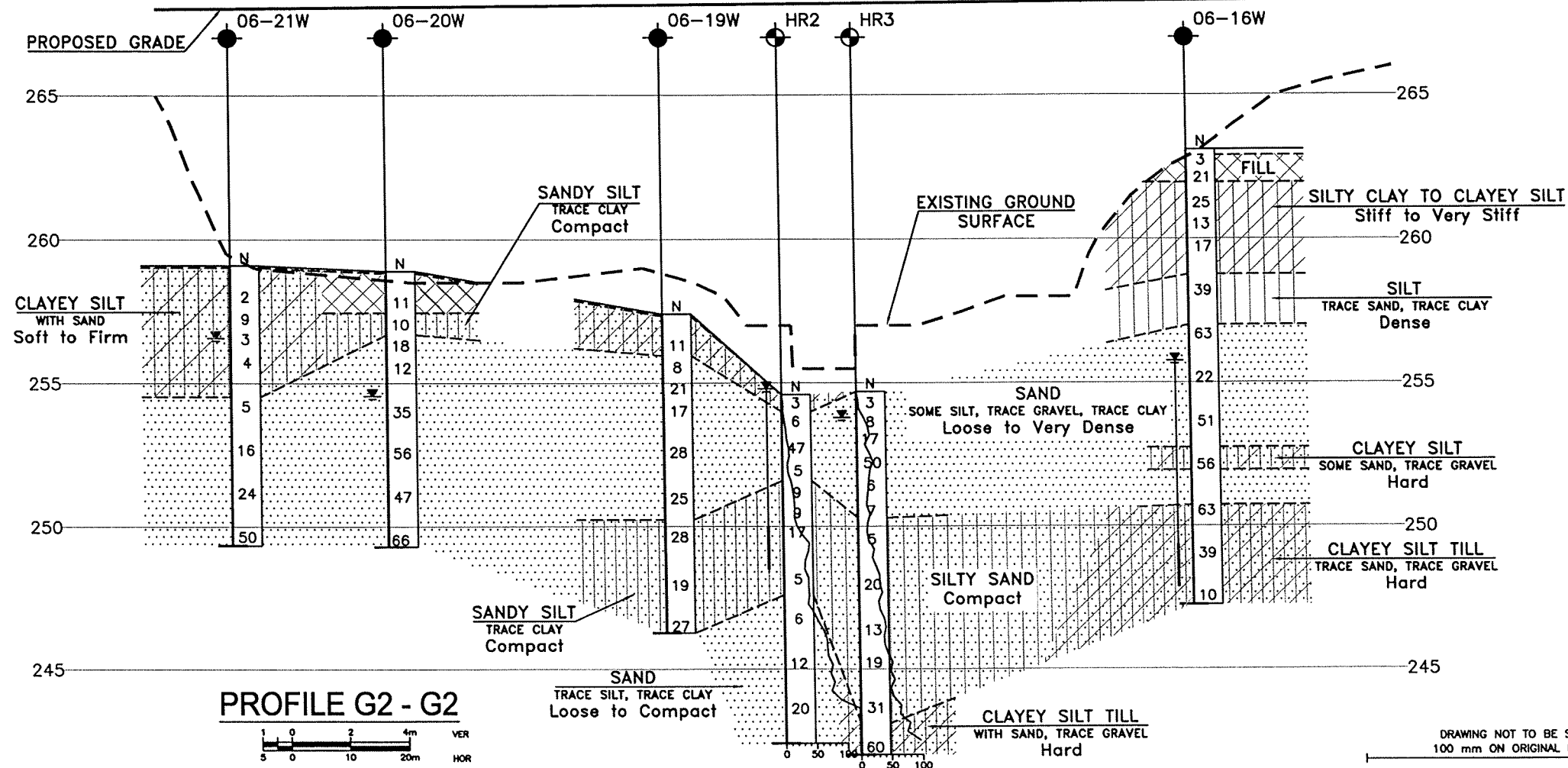
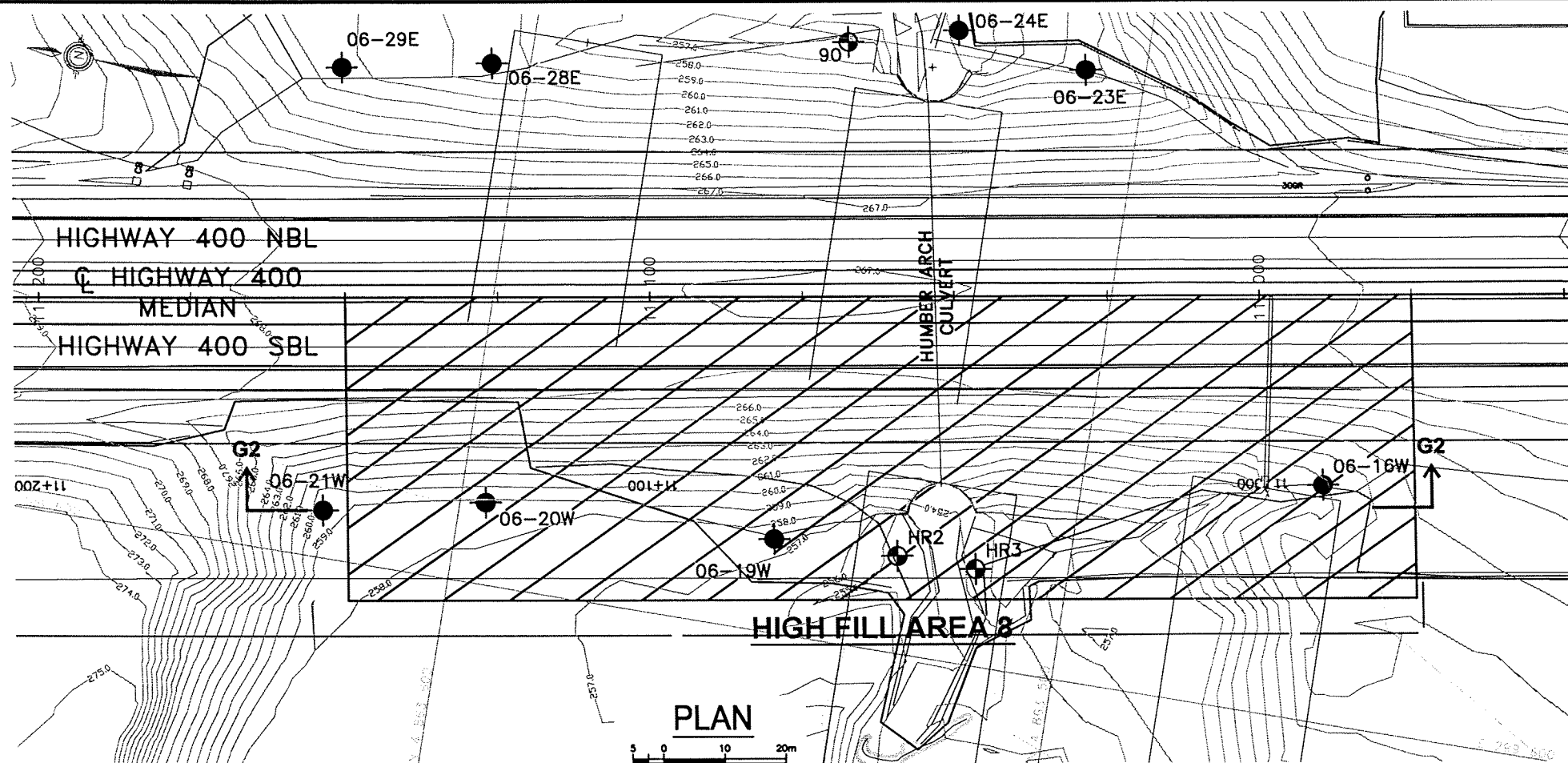


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-21W	1.07	258.01
⊠	06-21W	3.35	255.73

Date April 2007
 Project 2539-04-00



Prep'd MFA
 Chkd. SKP



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

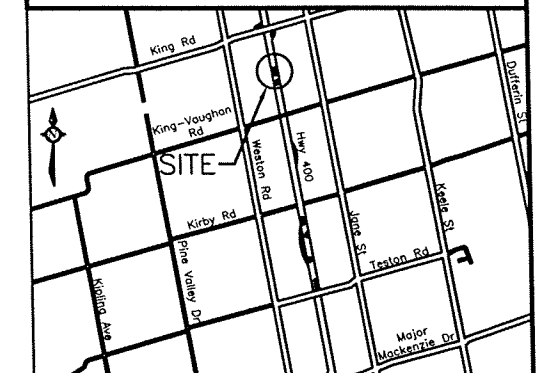
5	HIGHWAY 400 CONT No WP No 2539-04-00	
	HWY 400 WIDENING TESTON ROAD TO KING ROAD STATIONS 20+500 TO 20+780 BOREHOLE LOCATIONS AND SOIL STRATA	



SNC-LAVALIN
Engineers & Constructors








THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
06-16W	263.1	4 863 460.90	299 639.14
06-19W	257.4	4 863 548.36	299 615.42
06-20W	258.9	4 863 595.91	299 613.49
06-21W	259.1	4 863 617.00	299 608.63
HR2	254.6	4 863 525.90	299 615.60
HR3	254.7	4 863 514.90	299 615.60

-NOTES-

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

GEOCRES No. 30M13-178

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	TH	CHK	PKC	CODE	LOAD		DATE APR. 2010		
DRAWN	MFA	CHK	SKP	SITE	STRUCT		DWG. G2		

FILENAME: D:\Drafting\19\92\88 Hwy400\Hwy400 Alignments\Led9288-HighFill.dwg
PLOTDATE: Apr 12, 2010 -- 1:09pm

Appendix I

Selected Static Stability Analyses Results



Teston Road High Fill Area 1 - Highway 400 Widening
May 3, 2007
Embankment Slope at 2:1 Station 20+675 NBL with berm
Drained

$$F = 1.370$$

	Gamma C kN/m3	Phi deg	Min c/p	Piezo Surf.	
Emb. FILL (berm)	21	0	31	0	1
Emb. FILL (new)	21	0	31	0	1
Emb. FILL (old)	20	0	30	0	1
Soil with org.	17	0	28	0	1
Clayey Silt	19	0	29	0	1
Sands and Silts	20	0	30	0	1

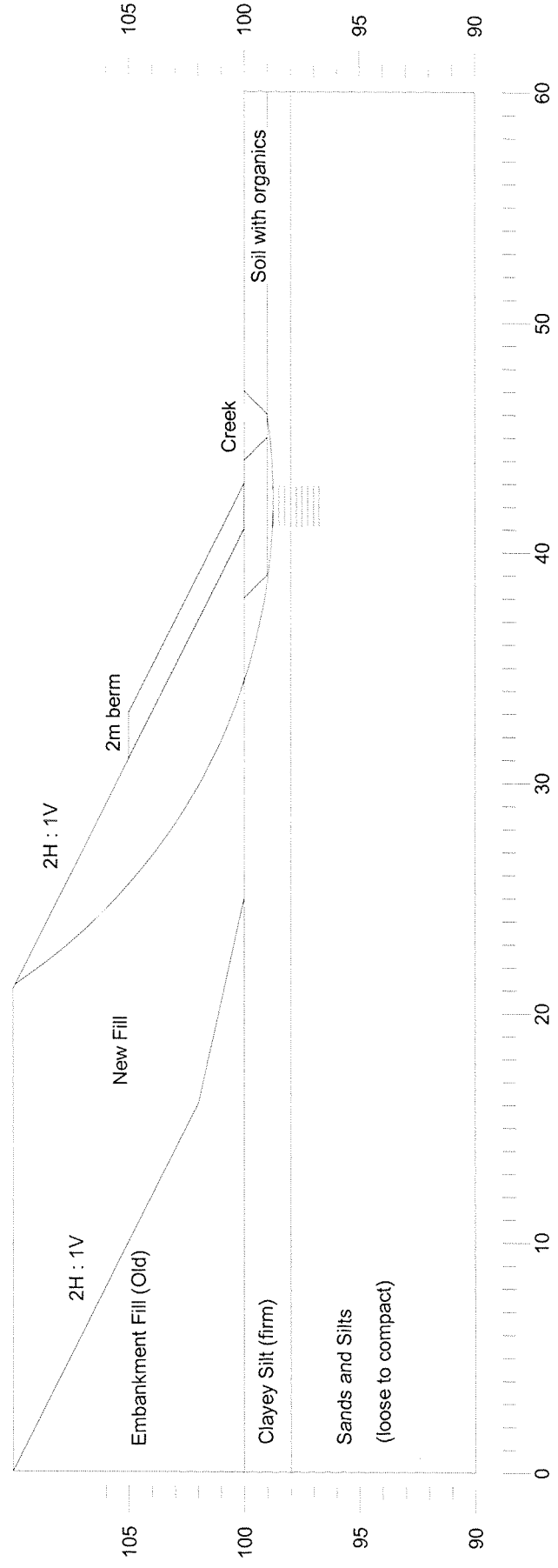


FIGURE I1

Thurber Engineering Ltd. - Toronto
 19-92-68
 Teston Road High Fill Area 1 - Highway 400 Widening
 May 3, 2007
 Embankment Slope at 2:1 Station 20+675 NBL with berm
 Undrained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	31	0	1
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Soil with org.	17	28	0	1
Clayey Silt	19	40	0	1
Sands and Silts	20	0	0	1

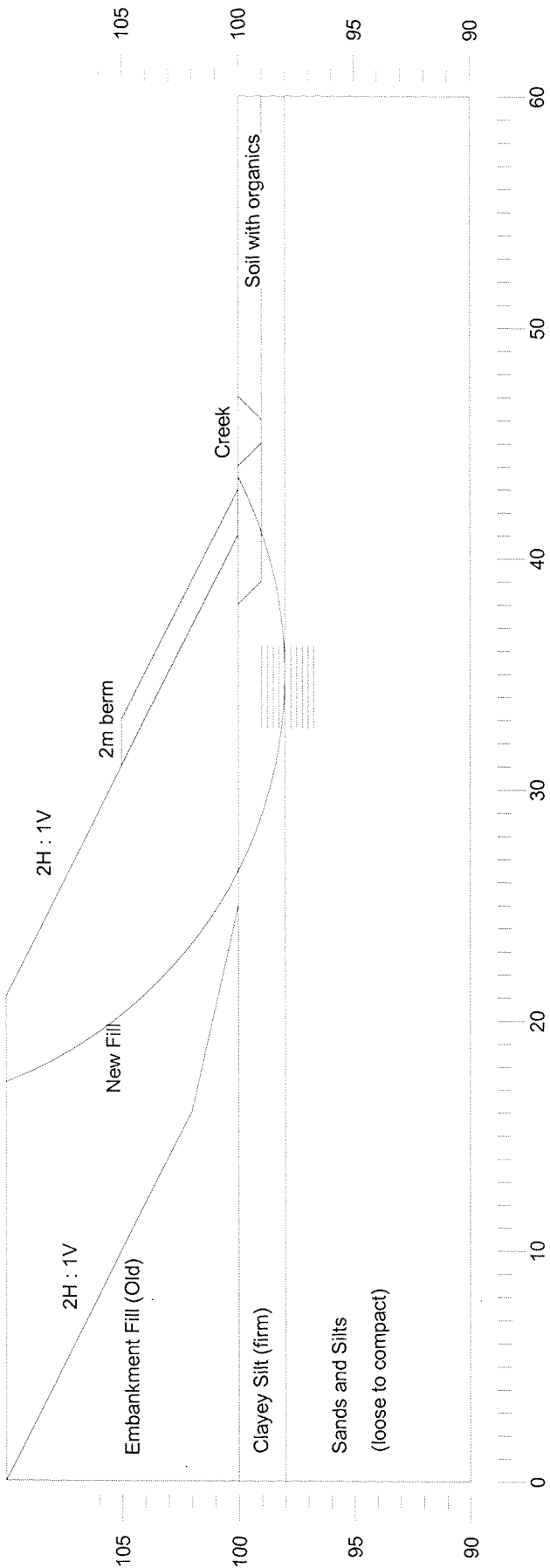
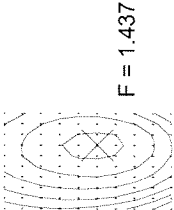


FIGURE I2

Thurber Engineering Ltd. - Toronto					
19-92-68					
Cold Creek High Fill Area 1 - Highway 400 Widening					
May 7, 2007					
F = 1.373					
Embankment Slope at 2:1 Station 20+590 SBL with berm					
Drained - assume creek is relocated and channel backfilled					
	Gamma C	Phi	Min	Piezo	
	kN/m ³	deg	c/p	Surf.	
Emb. FILL (berm)	21	0	31	0	1
Emb. FILL (new)	21	0	31	0	1
Emb. FILL (old)	20	0	30	0	1
FILL	20	0	30	0	1
Soil with org.	17	0	28	0	1
Sands and Silts	20	0	30	0	1

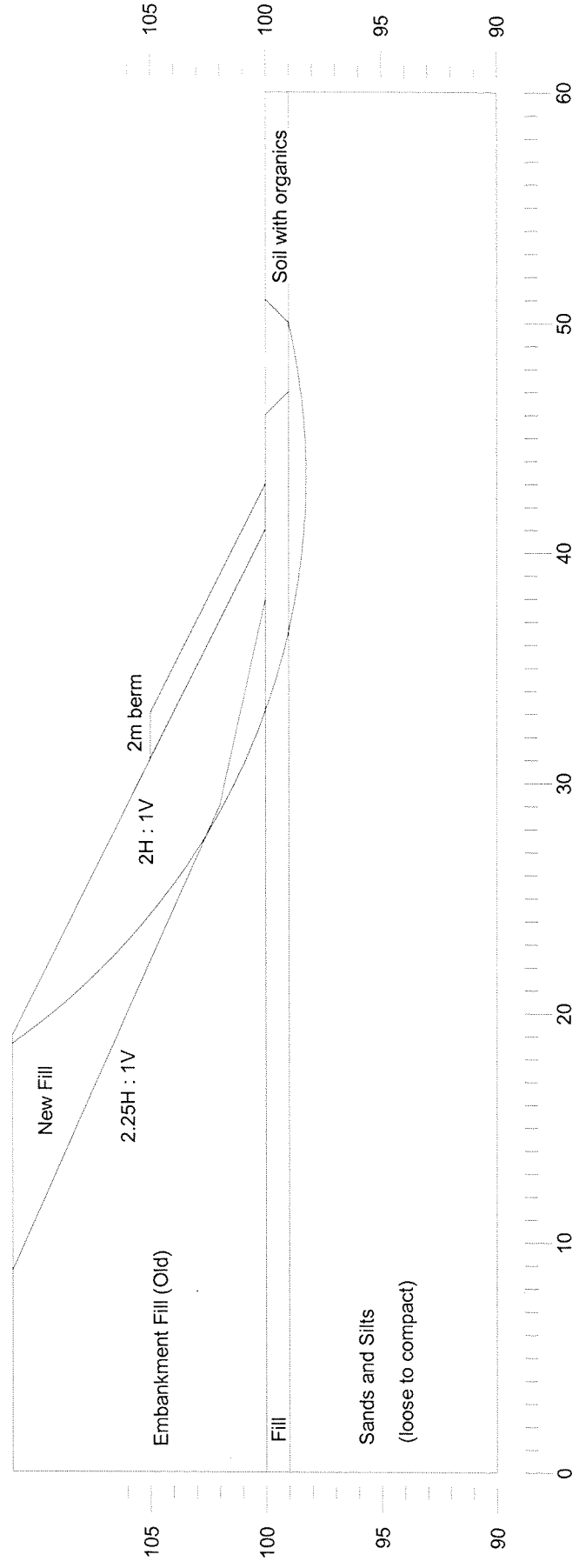


FIGURE I3

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	31	0	1
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
FILL	20	30	0	1
Soil with org.	17	20	0	1
Sands and Silts	20	30	0	1

Thurber Engineering Ltd. - Toronto
19-92-68
Cold Creek High Fill Area 1 - Highway 400 Widening
May 7, 2007
F = 1.373
Embankment Slope at 2:1 Station 20+590 SBL with berm
Undrained - assume creek is relocated and channel backfilled

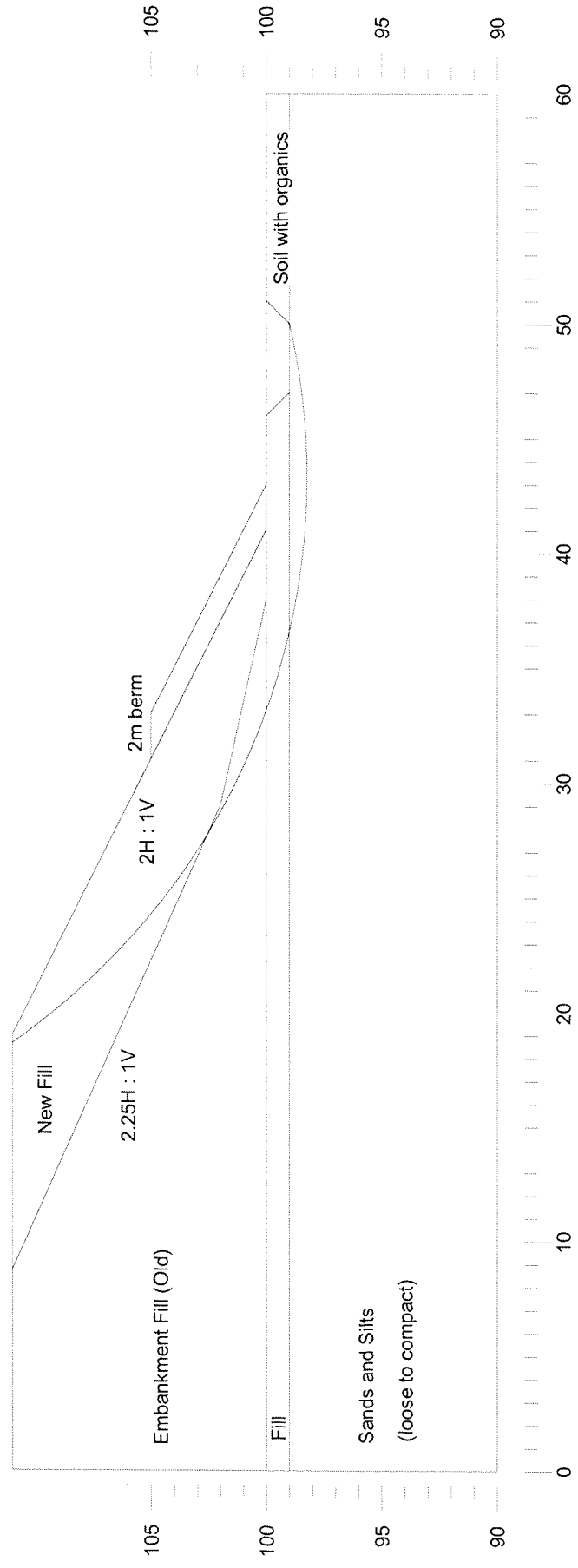


FIGURE I4

Thurber Engineering Ltd. - Toronto
 19-92-68
 North of Teston Road High Fill Area 2 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+180 SBL
 Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.	20	28	0	1
Silty Clay v.st.	20	29	0	1
Sandy Silt TILL	21	32	0	1

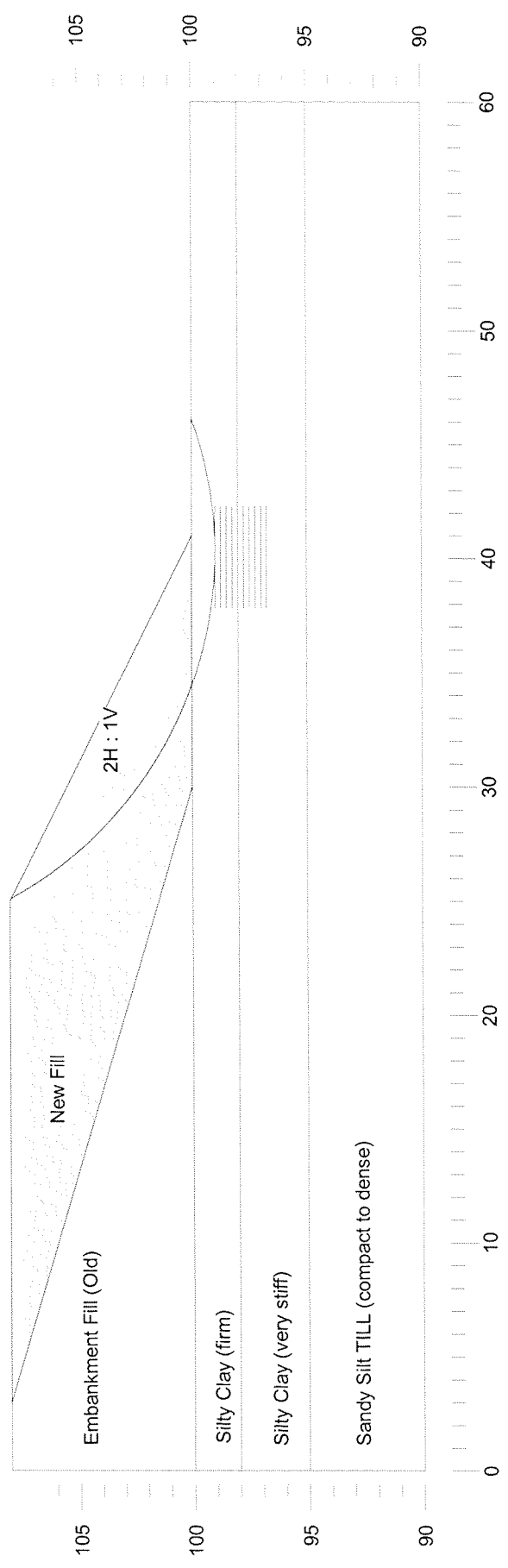
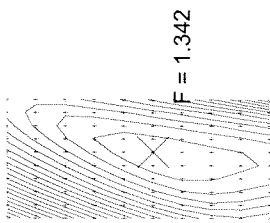


FIGURE I5

Thurber Engineering Ltd. - Toronto
 19-92-68
 North of Teston Road High Fill Area 2 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+180 SBL
 Undrained with pore pressure generation (Bbar = 0.9)

	Gamma C	Phi	Min	Piezo
kN/m3	deg	c/p	Surf.	
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.	20	40	0	2
Silty Clay v.st.	20	100	0	3
Sandy Silt TILL	21	0	32	0

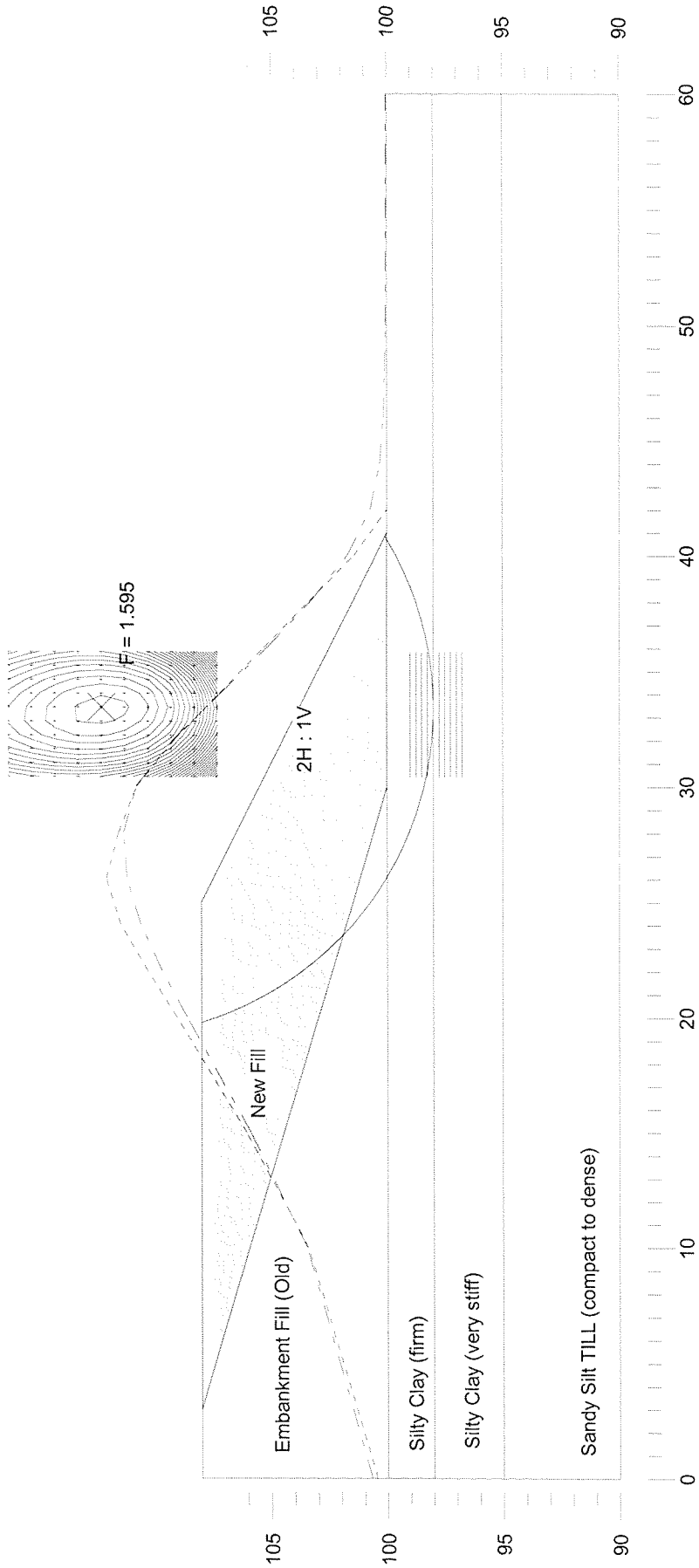


FIGURE I6

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 3 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+750 NBL
 Drained

	Gamma C	Phi	Min	Piezo
	kN/m ³	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Fill L.	19	29	0	1
Silty Clay f.	19	28	0	1
Sand	19	29	0	1
Silty Clay TILL	20	30	0	1
Sandy Silt TILL	21	32	0	1

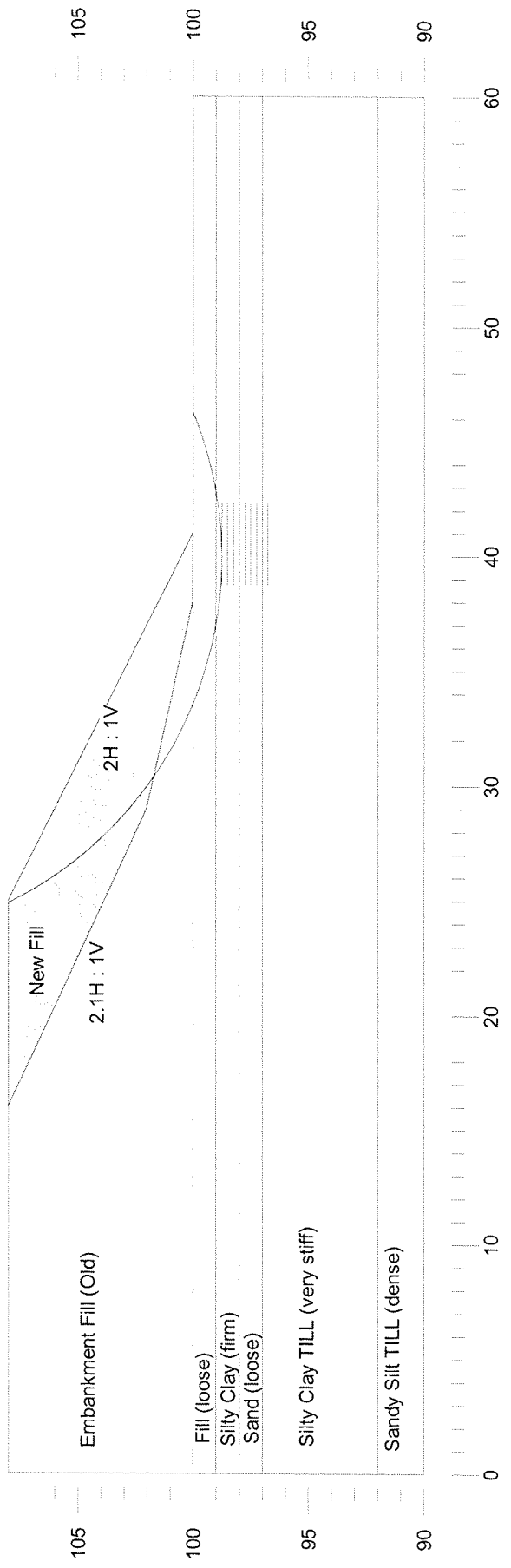
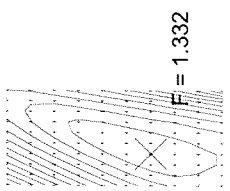


FIGURE I7

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 3 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+750 NBL
 Undrained with pore pressure generation (Bbar = 0.9)

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Fill I.	19	29	0	1
Silty Clay f.	19	40	0	2
Sand	19	0	29	1
Silty Clay TILL	20	100	0	1
Sandy Silt TILL	21	0	32	1

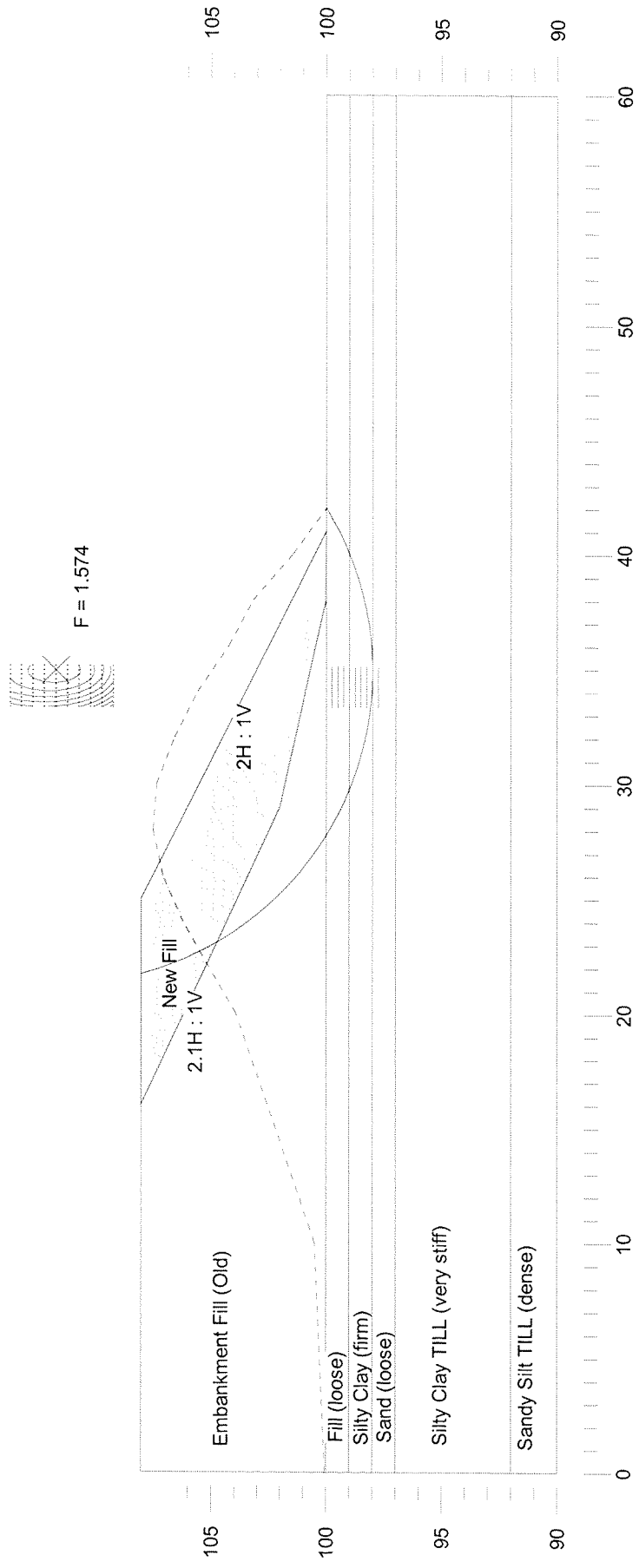


FIGURE I8

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 4 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 22+075 SBL
 Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.st	20	29	0	1
Silty Clay v.st.	20	30	0	1
Sandy Silt TILL	21	32	0	1

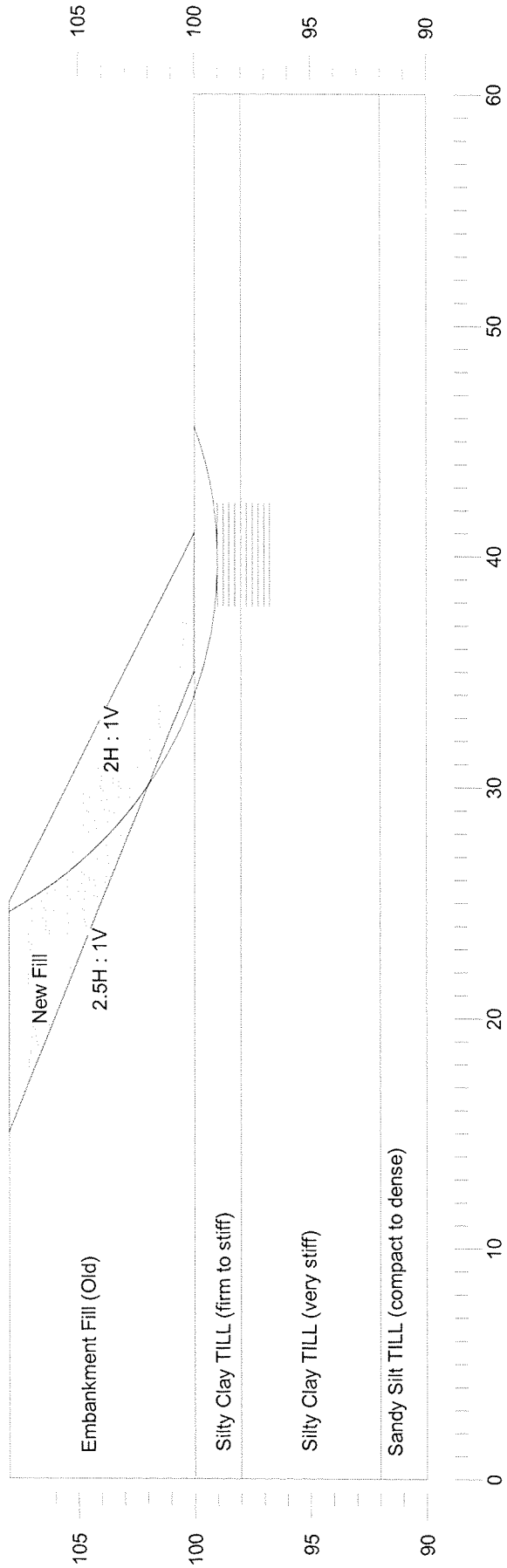
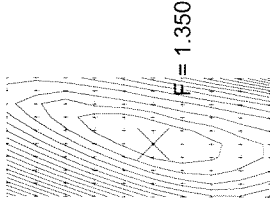


FIGURE I9

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 4 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 22+075 SBL
 Undrained with pore pressure generation (Bbar = 0.9)

	Gamma C	Phi	Min	Piezo
	kN/m ³	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.st	20	40	0	1
Silty Clay v.st.	20	100	0	1
Sandy Silt TILL	21	0	32	0

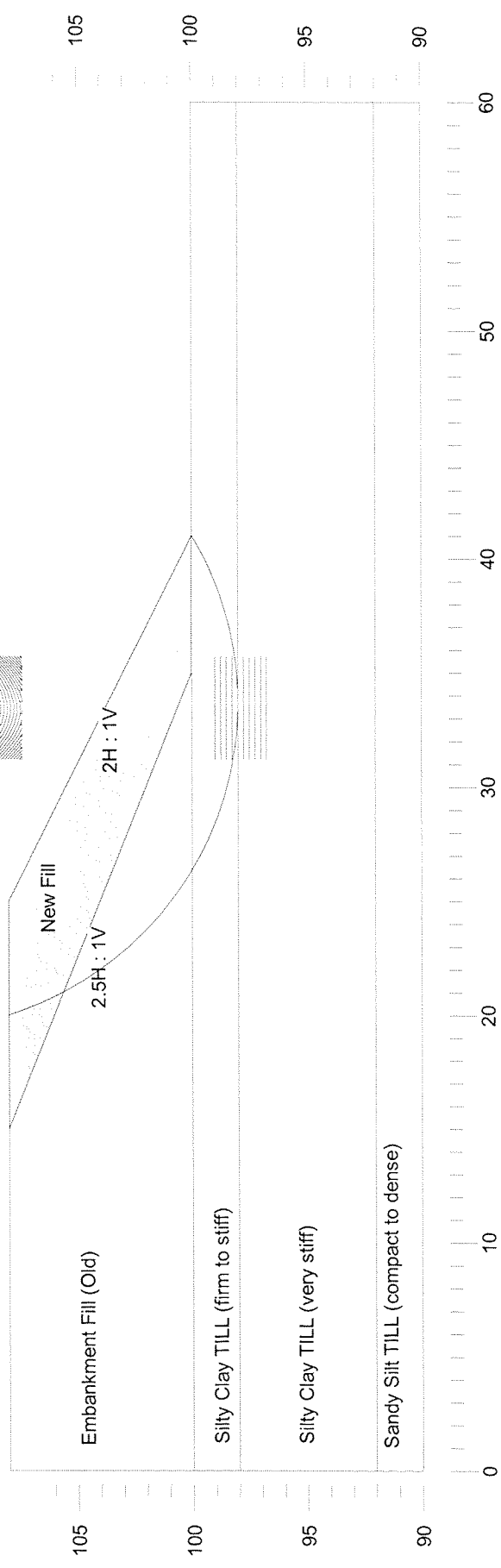
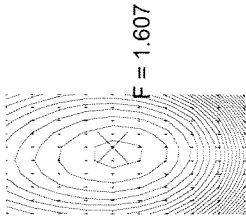


FIGURE I10

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Humber Arch High Fill Area 5 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 10+825 NBL
 Drained

	Gamma C	Phi	Min	Piezo
	kN/m ³	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Fill (L.)	19	28	0	1
Silt	20	30	0	1
Silty Clay TILL	20	30	0	1
Sandy Silt v.d.	21	32	0	1

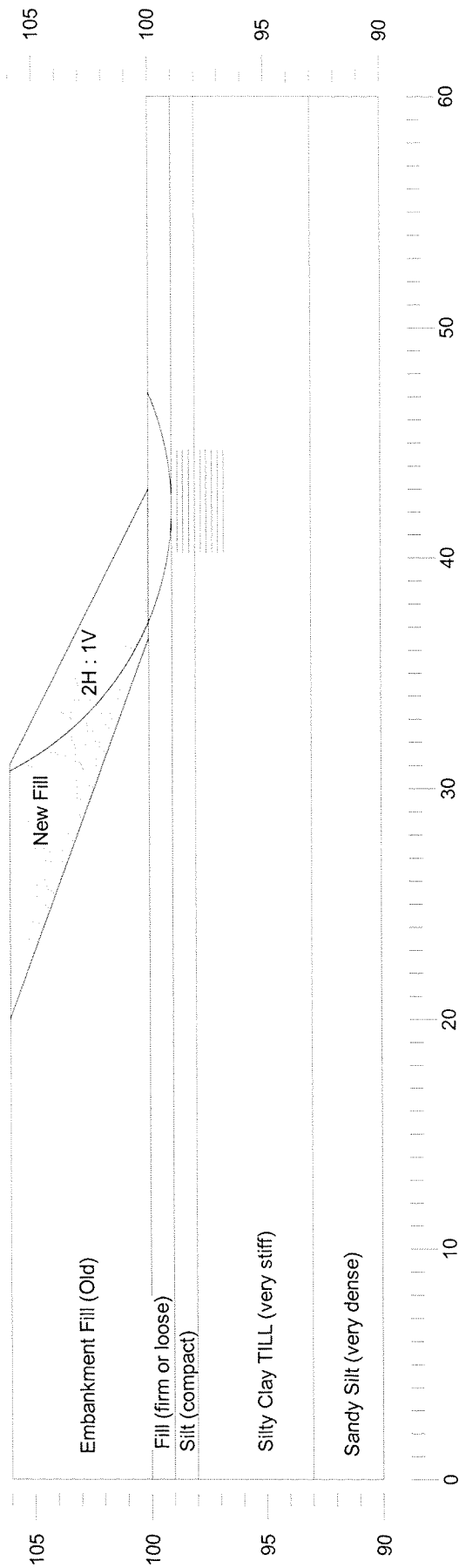
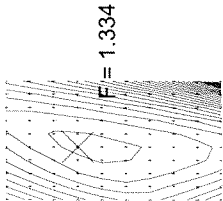


FIGURE I11

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Humber Arch High Fills (Area 5) - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 10+825 NBL
 Undrained with pore water pressure generation (Bbar = 0.9)

	Gamma C	Phi	Min	Piezo
	kN/m ³	deg	c/p	Surf.
Emb. FILL (new)	21	0	31	0
Emb. FILL (old)	20	0	30	0
Fill (f.)	19	25	0	2
Silt	20	0	30	0
Silty Clay TILL	20	150	0	0
Sandy Silt v.d.	21	0	32	0

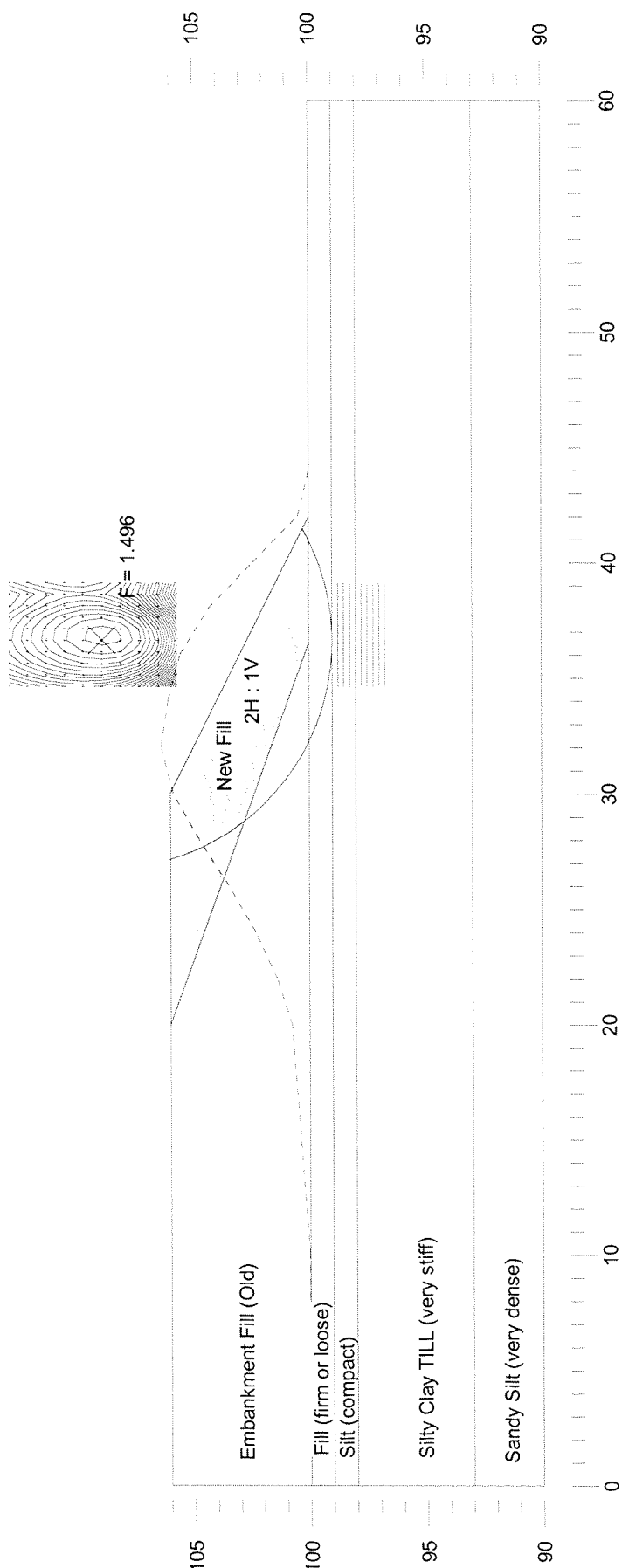
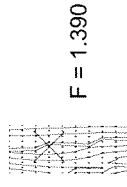


FIGURE I12

Thurber Engineering Ltd. - Toronto
 19-92-68
 North of King-Vaughan High Fill Area 6 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 10+775 SBL with berm
 Drained



	Gamma C kN/m ³	Phi deg	Min c/p	Piezo Surf.
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
Soil with org.	17	0	28	1
Clay/Silt	19	0	29	1
Clay/Silt TILL	20	0	30	1
Sands and Silts	20	0	30	1
Sand/Silt TILL	21	0	32	1

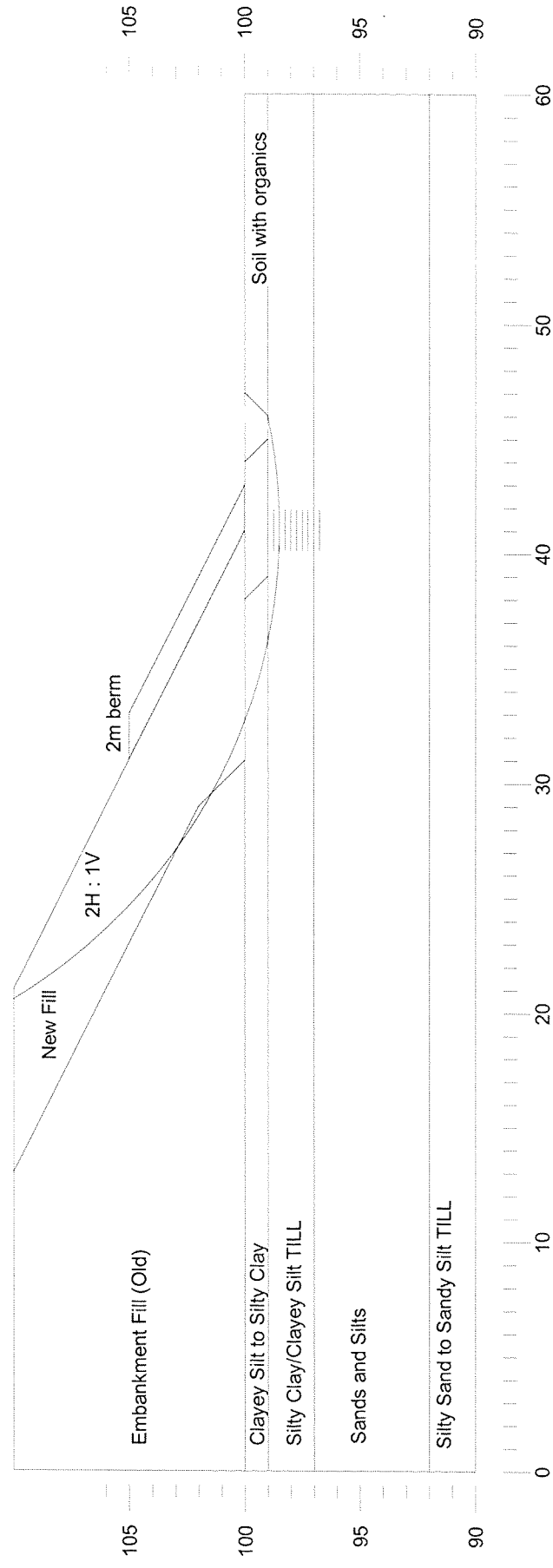


FIGURE I13

$$F = 1.449$$

	Gamma C kN/m ³	Phi deg	Min c/p	Piezo Surf.
Emb. FILL (berm)	21	31	0	1
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Soil with org.	17	28	0	1
Clay/Silt	19	40	0	2
Clay/Silt TILL	20	80	0	1
Sands and Silts	20	30	0	1
Sand/Silt TILL	21	32	0	1

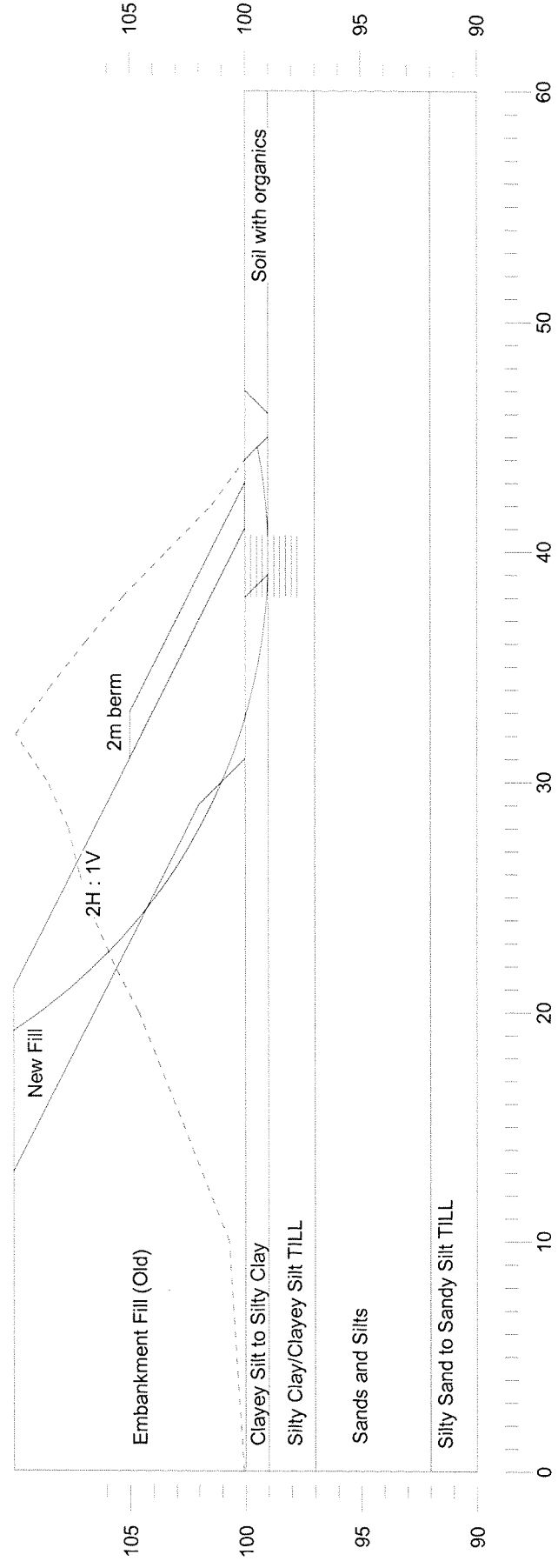


FIGURE I14

Thurber Engineering Ltd. - Toronto
 19-92-68
 Humber Arch High Fill Area 7 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 11+060 NBL with berm
 Drained

	Gamma C	Phi	Min	Piezo
kN/m3	kPa	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	0
Emb. FILL (new)	21	0	31	0
Emb. FILL (old)	20	0	30	0
Soil with org.	17	0	28	0
Sand (loose)	20	0	30	0
Sand (comp)	20	0	31	0

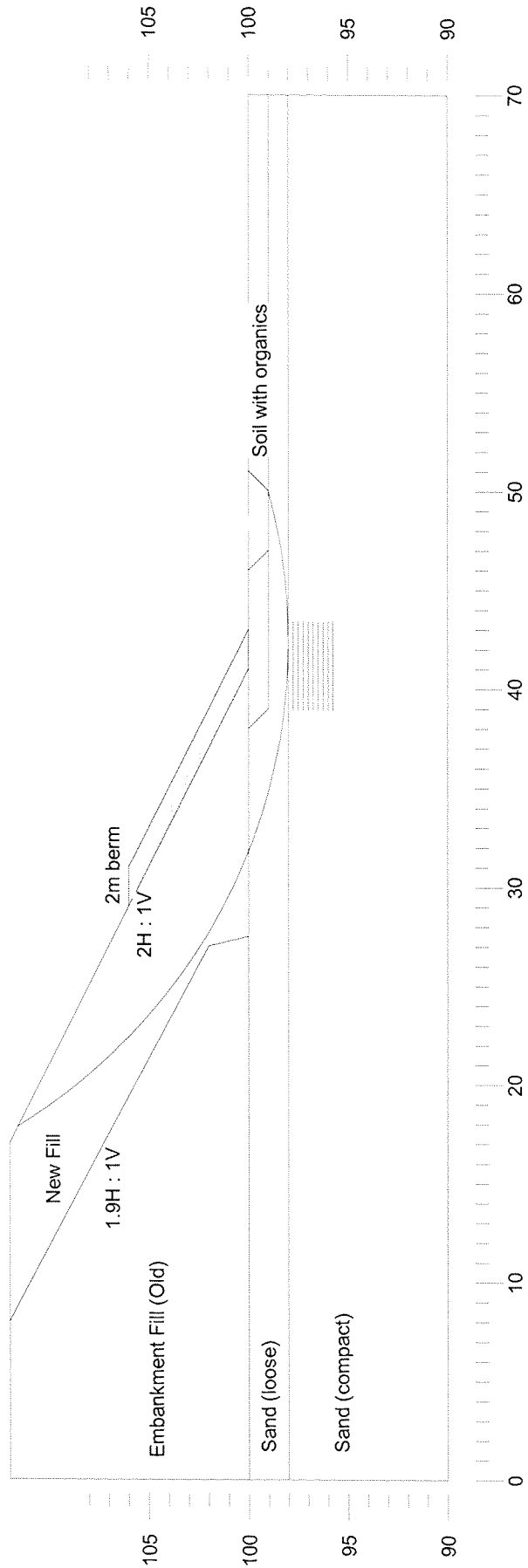
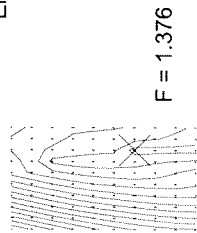


FIGURE I15

	Gamma C	Phi	Min	Piezo
kN/m ³	deg	c/p	Surf.	
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
Soil with org.	17	20	0	1
Sand (loose)	20	0	30	1
Sand (comp)	20	0	31	1

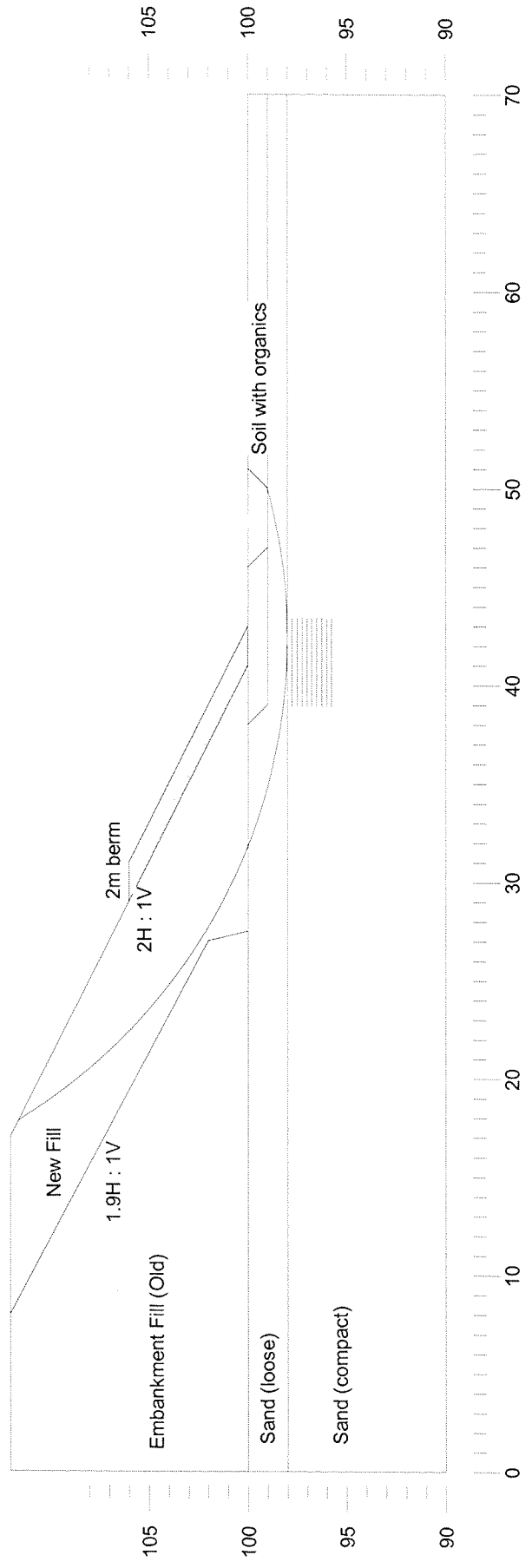
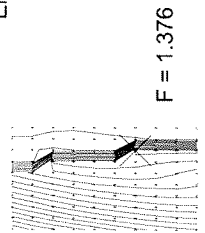
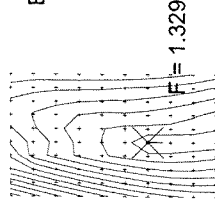


FIGURE I16

Thurber Engineering Ltd. - Toronto
 19-92-68
 Humber Arch High Fill Area 8 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 11+075 SBL with berm
 Drained



	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	0
Emb. FILL (new)	21	0	31	0
Emb. FILL (old)	20	0	30	0
Soil with org.	17	0	28	0
Silty Clay firm	19	0	29	0
Sand (comp)	20	0	31	0

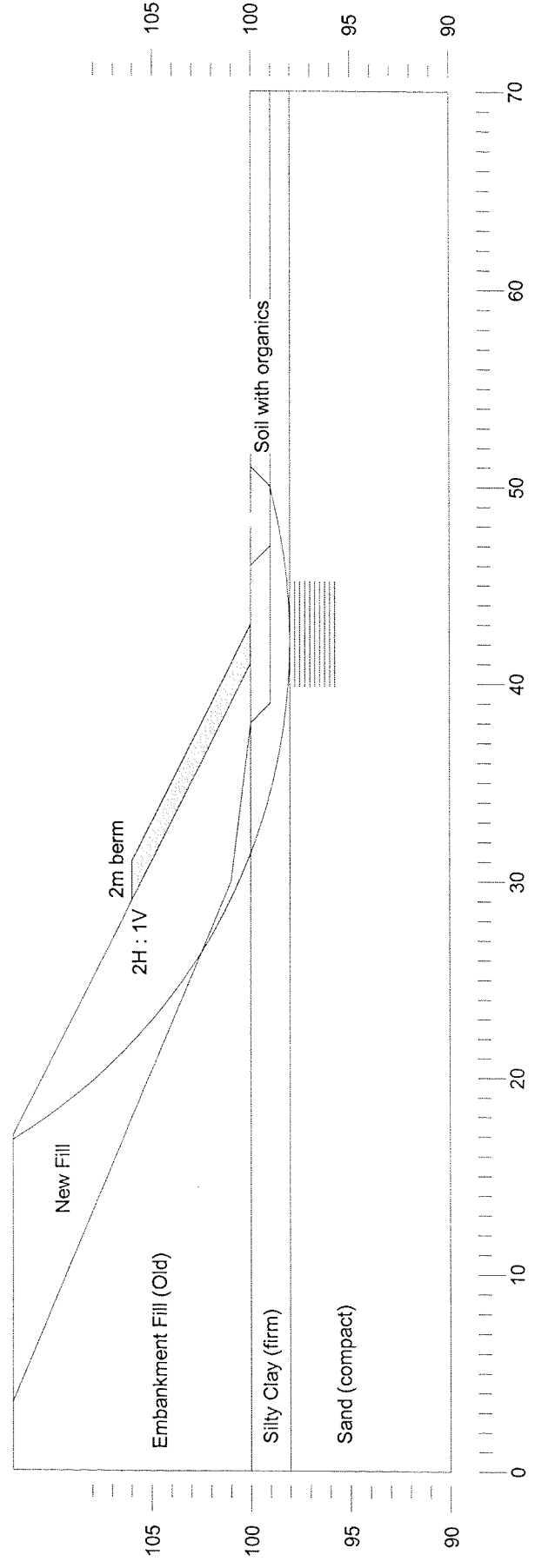


FIGURE I17

Thurber Engineering Ltd. - Toronto
 19-92-68
 Humber Arch High Fill Area 8 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 11+075 SBL with berm
 Undrained with pore water pressure generation (Bbar = 0.9)

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	0
Emb. FILL (new)	21	0	31	0
Emb. FILL (old)	20	0	30	0
Soil with org.	17	20	0	0
Silty Clay firm	19	40	0	0
Sand (comp)	20	0	31	0

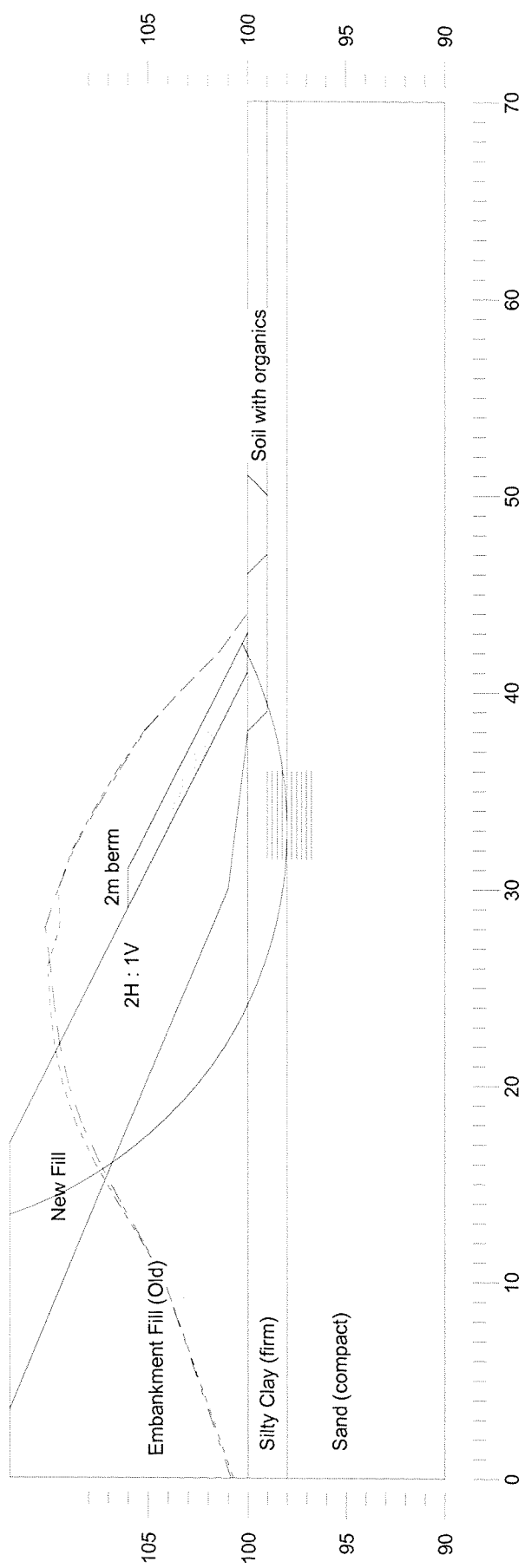
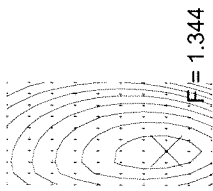


FIGURE I18

Appendix J

Selected Pseudo-Static Stability Analyses Results



Thurber Engineering Ltd. - Toronto
 19-92-68
 Teston Road High Fill Area 1 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 20+675 NBL with berm
 Pseudo-Static (Seismic) Stability - Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	0
Emb. FILL (new)	21	0	31	0
Emb. FILL (old)	20	0	30	0
Soil with org.	17	0	28	0
Clayey Silt	19	0	29	0
Sands and Silts	20	0	30	0

Seismic coefficient = 0.14

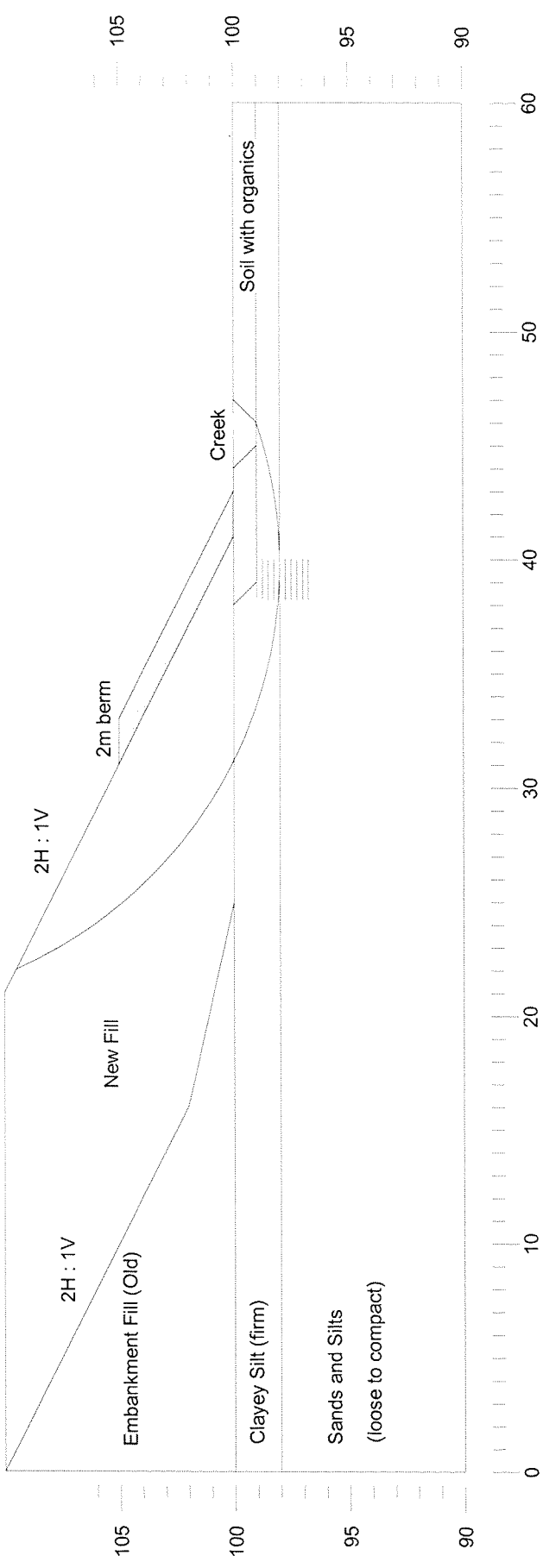
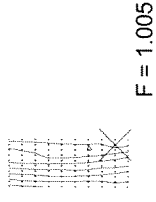
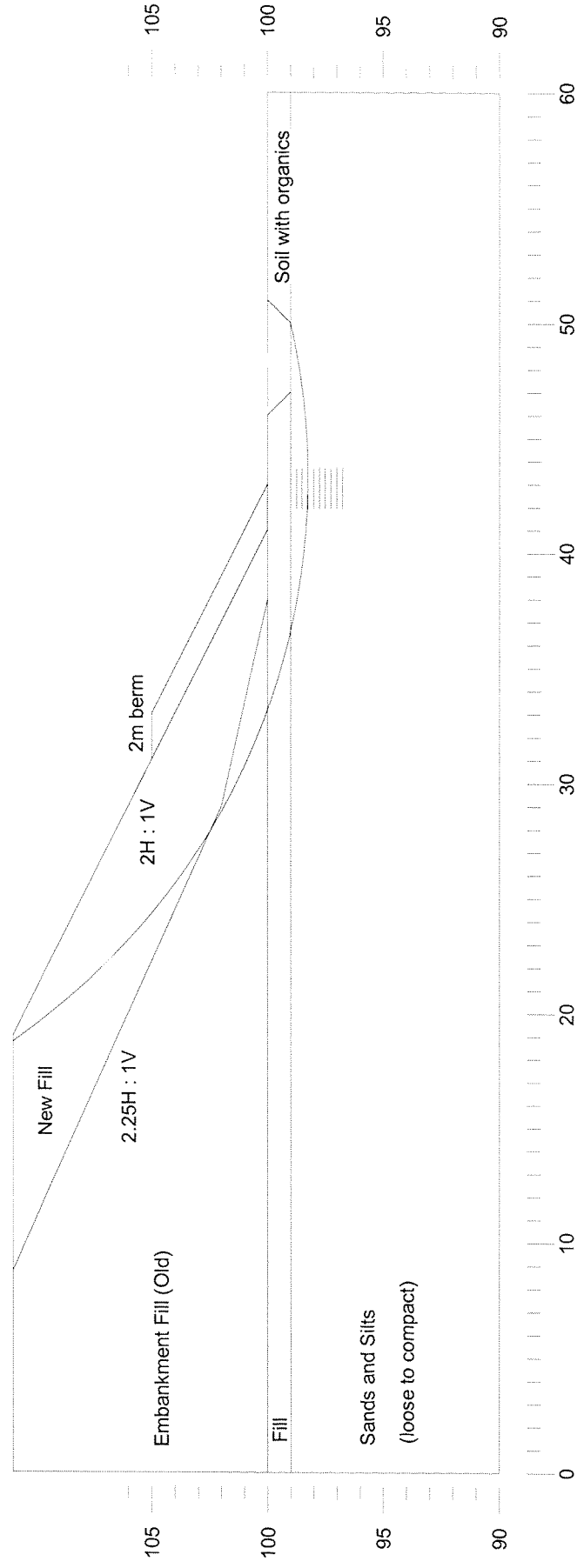


FIGURE J1

	Gamma C kN/m ³ kPa	Phi deg	Min c/p	Piezo Surf.
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
FILL	20	0	30	1
Soil with org.	17	0	28	1
Sands and Silts	20	0	30	1

Seismic coefficient = 0.12



Thurber Engineering Ltd. - Toronto
 19-92-68
 North of Teston Road High Fill Area 2 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+180 SBL
 Pseudo-Static (Seismic) Stability - Drained

	Gamma C	Phi	Min	Piezo
	kN/m ³	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.	20	28	0	1
Silty Clay v.st.	20	29	0	1
Sandy Silt TILL	21	32	0	1

Seismic coefficient = 0.12

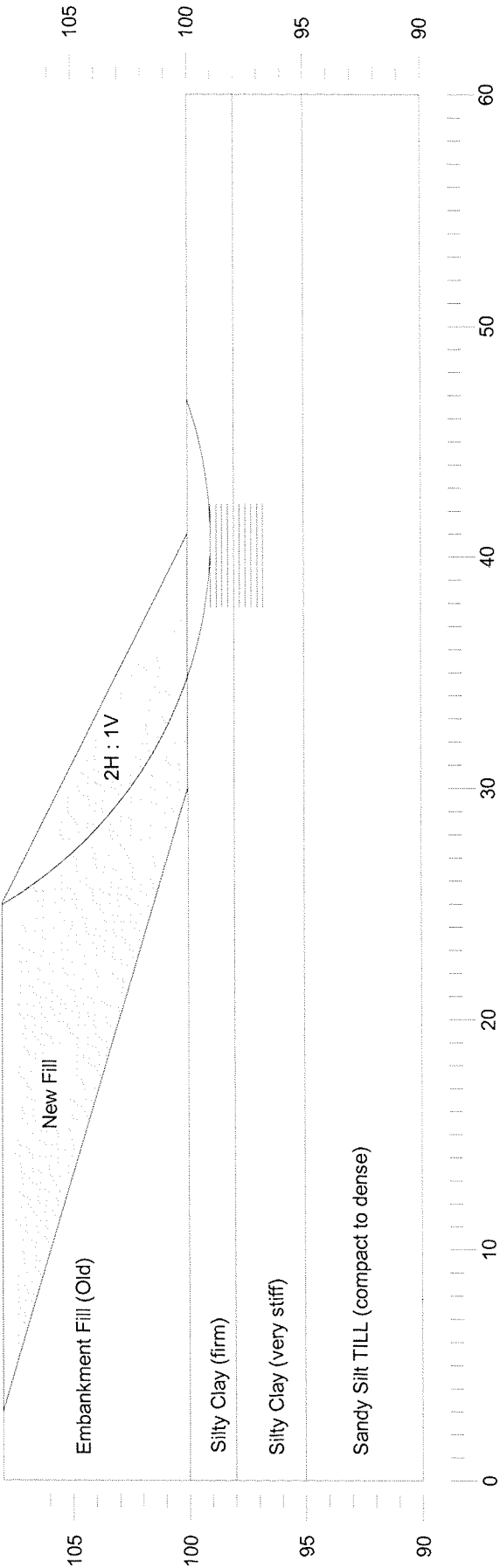
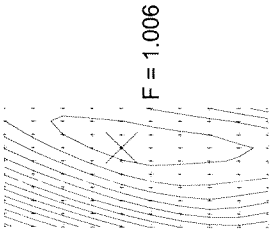


FIGURE J3

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 3 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 21+750 NBL
 Pseudo-Static (Seismic) - Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Fill I.	19	29	0	1
Silty Clay f.	19	28	0	1
Sand	19	29	0	1
Silty Clay TILL	20	30	0	1
Sandy Silt TILL	21	32	0	1

Seismic coefficient = 0.115

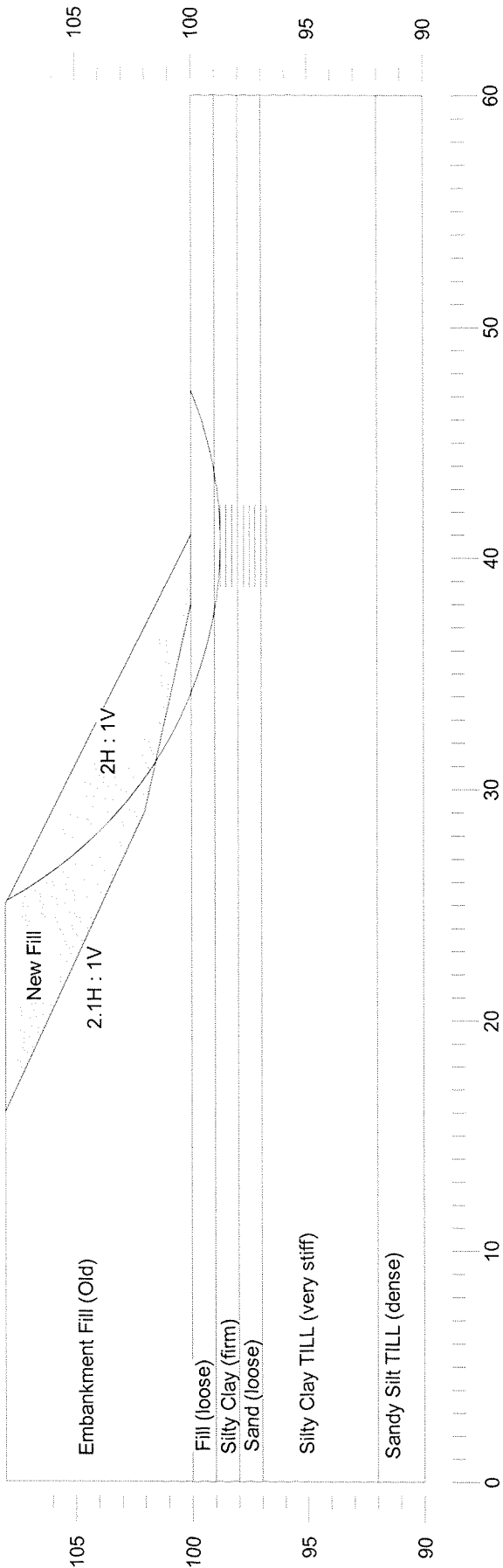
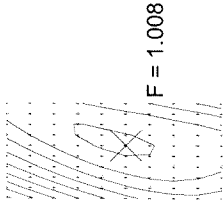


FIGURE J4

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Kirby Road High Fill Area 4 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 22+075 SBL
 Pseudo-Static (Seismic) Stability - Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Silty Clay f.st	20	29	0	1
Silty Clay v.st.	20	30	0	1
Sandy Silt TILL	21	32	0	1

Seismic coefficient = 0.125

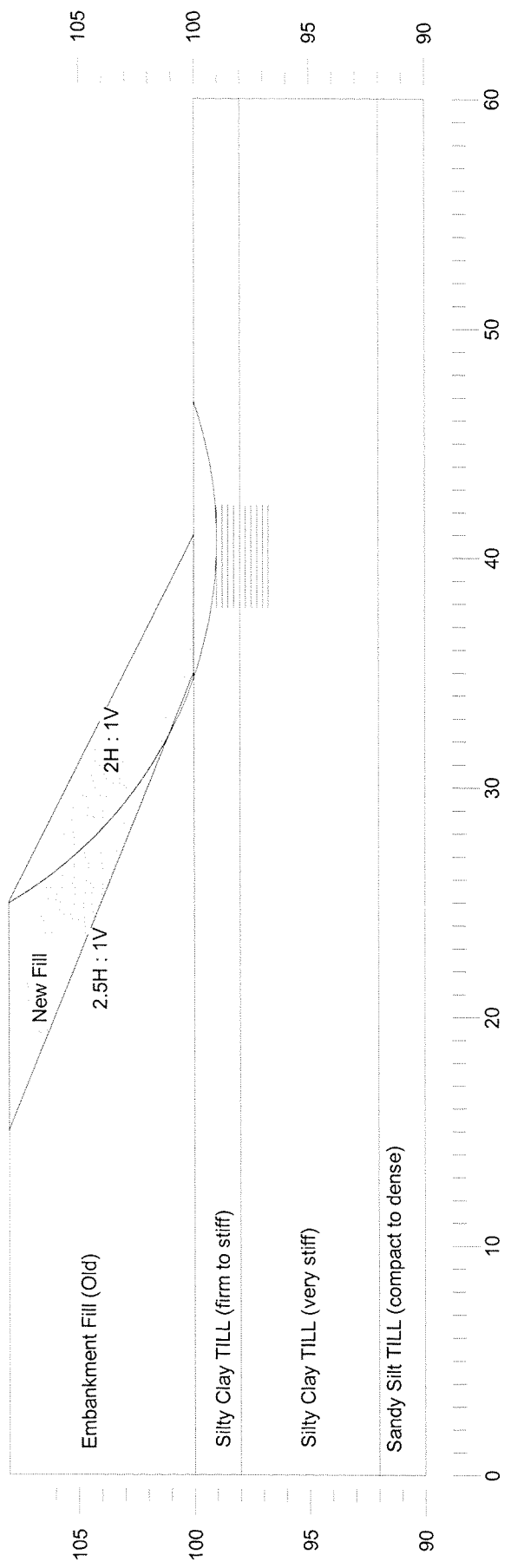
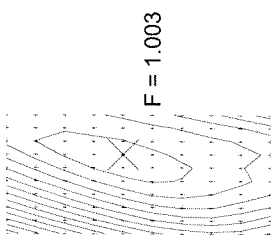


FIGURE J5

Thurber Engineering Ltd. - Toronto
 19-92-68
 South of Humber Arch High Fill Area 5 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 10+825 NBL
 Pseudo-Static (Seismic) Stability - Drained

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (new)	21	31	0	1
Emb. FILL (old)	20	30	0	1
Fill (l.)	19	28	0	1
Silt	20	30	0	1
Silty Clay TILL	20	30	0	1
Sandy Silt v.d.	21	32	0	1

Seismic coefficient = 0.115

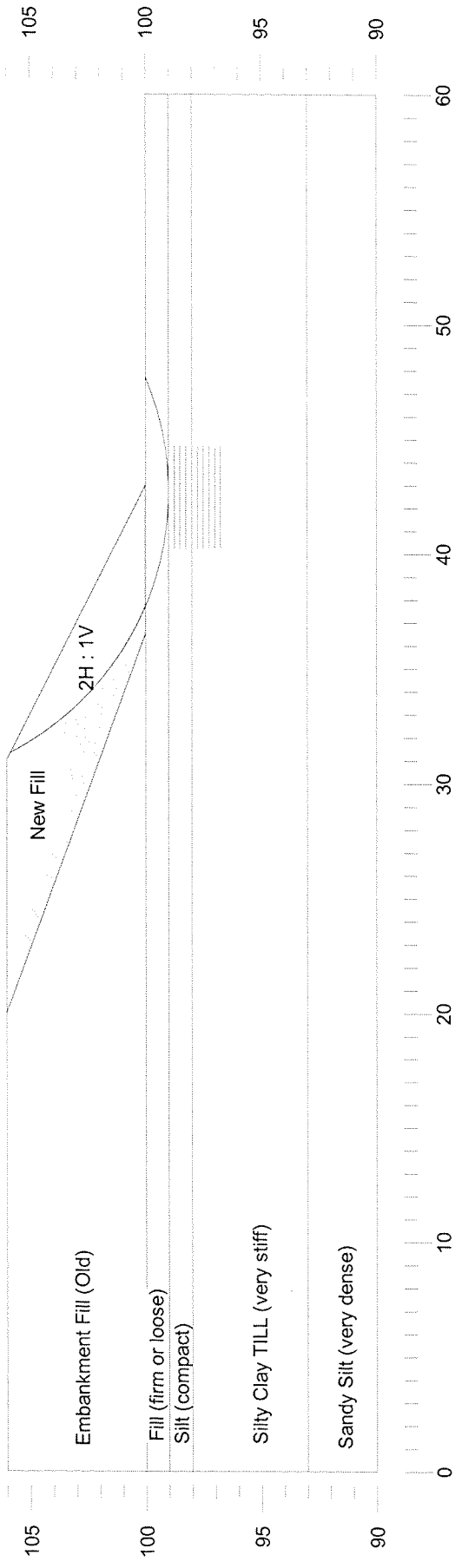
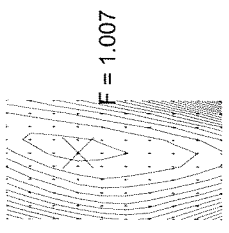
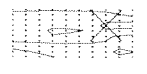


FIGURE J6

Thurber Engineering Ltd. - Toronto
 19-92-68
 North of King-Vaughan High Fill Area 6 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 10+775 SBL with berm
 Pseudo-Static (Seismic) Stability - Drained



F = 1.005

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
Soil with org.	17	0	28	1
Clay/Silt	19	0	29	1
Clay/Silt TILL	20	0	30	1
Sands and Silts	20	0	30	1
Sand/Silt TILL	21	0	32	1

Seismic coefficient = 0.135

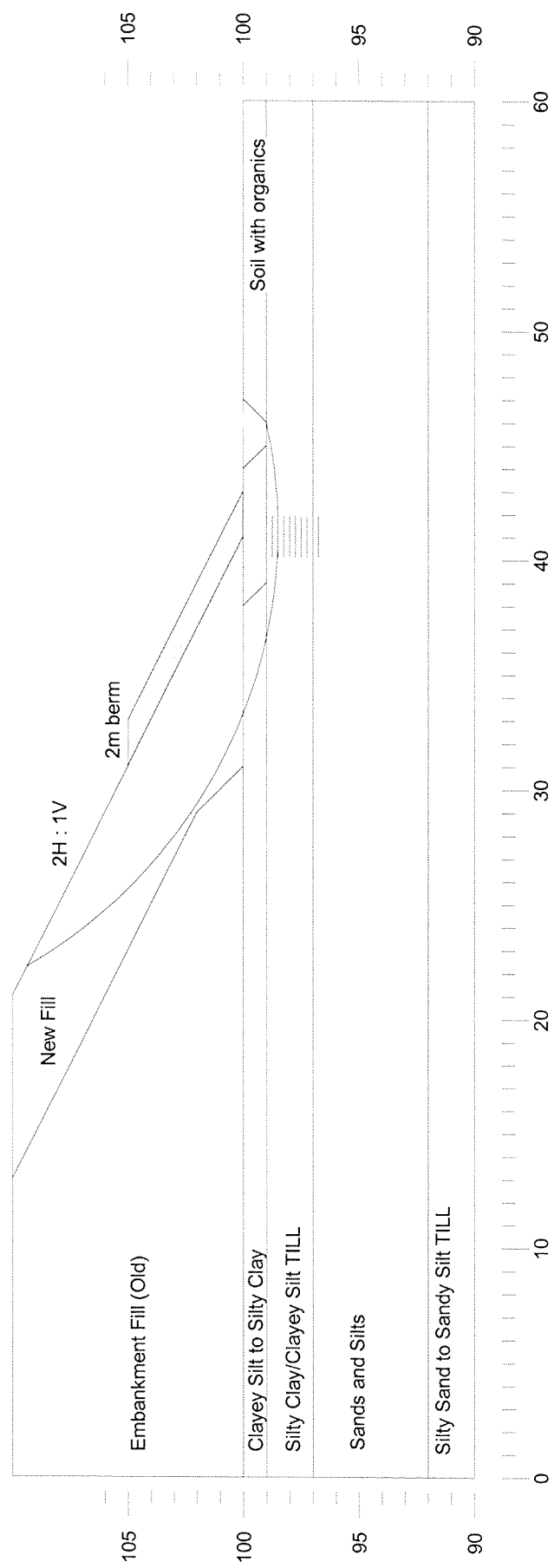
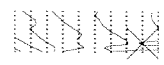


FIGURE J7

Thurber Engineering Ltd. - Toronto
 19-92-68
 Humber Arch High Fill Area 7 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 11+060 NBL with berm
 Pseudo-Static (Seismic) Stability - Drained



F = 1.008

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
Soil with org.	17	0	28	1
Sand (loose)	20	0	30	1
Sand (comp)	20	0	31	1

Seismic coefficient = 0.125

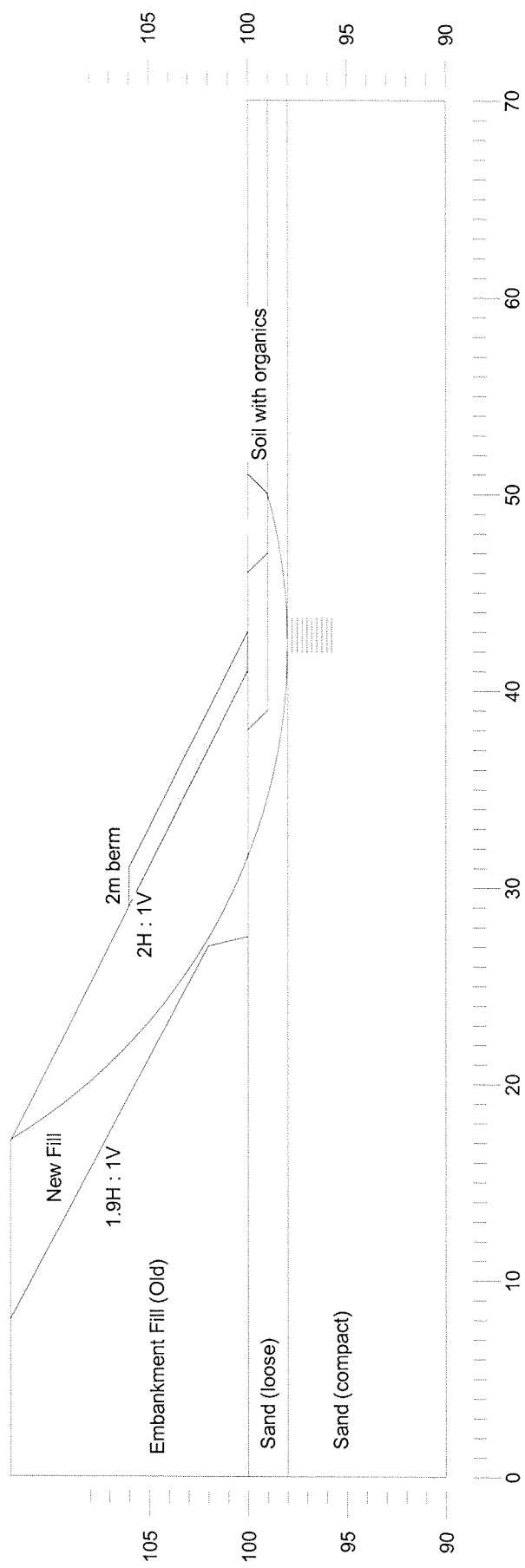
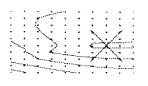


FIGURE J8

Thurber Engineering Ltd. - Toronto
 19-92-68
 Humber Arch High Fill Area 8 - Highway 400 Widening
 May 7, 2007
 Embankment Slope at 2:1 Station 11+075 SBL with berm
 Pseudo-Static (Seismic) Stability - Drained



F = 1.008

	Gamma C	Phi	Min	Piezo
	kN/m3	deg	c/p	Surf.
Emb. FILL (berm)	21	0	31	1
Emb. FILL (new)	21	0	31	1
Emb. FILL (old)	20	0	30	1
Soil with org.	17	0	28	1
Silty Clay firm	19	0	29	1
Sand (comp)	20	0	31	1

Seismic coefficient = 0.11

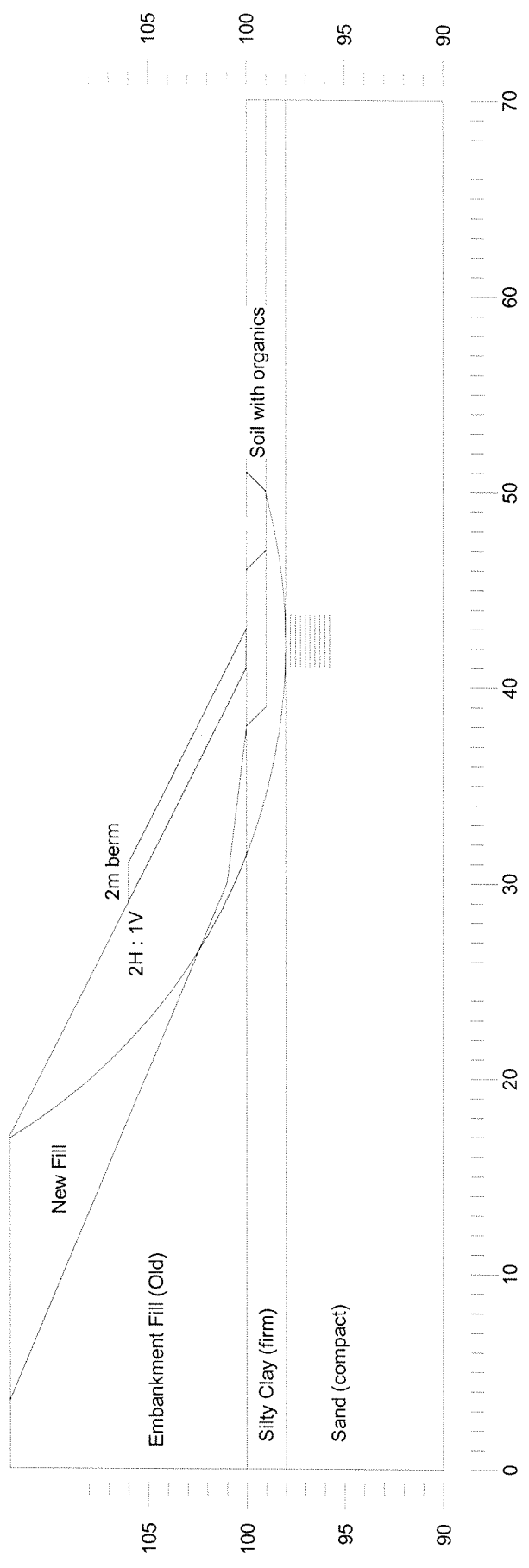


FIGURE J9