



Terraprobe

*Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing*

**FOUNDATION INVESTIGATION & DESIGN REPORT
DEEP CUTS & HIGH FILLS
HIGHWAY 406 TWINNING
PORT ROBINSION ROAD TO EAST MAIN STREET
AGREEMENT No. 2008-E-0016, W.P. 280-99-00
GEOCRES No. 30M3-263
VOLUME I**

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TABLE OF CONTENTS Volume I

Part 1

1	INTRODUCTION.....	1
2	SITE DESCRIPTION & PHYSIOGRAPHY.....	2
3	SITE INVESTIGATION AND FIELD TESTING	2
4	LABORATORY TESTING	7
5	DESCRIPTION OF SUBSURFACE CONDITIONS	7
5.1	Site 1 – Ramp East Main Street E – N.....	7
5.1.1	Topsoil.....	7
5.1.2	Silty Clay	7
5.1.3	Clayey Silt	8
5.1.4	Silty Clay Till	9
5.1.5	Silt Till.....	9
5.1.6	Water Levels.....	10
5.2	Site 2 – Woodlawn I/C Southeast Quadrant	10
5.2.1	Topsoil.....	11
5.2.2	Fill – Sand and Gravel.....	11
5.2.3	Fill – Silty Clay	11
5.2.4	Silty Clay	12
5.2.5	Silt	13
5.2.6	Silty Clay to Clayey Silt Till	13
5.2.7	Silty Sand Till.....	14
5.2.8	Sand and Gravel Till.....	14
5.2.9	Bedrock (Salina Formation)	14
5.2.10	Water Levels.....	15
5.3	Site 3 – Woodlawn I/C Southwest Quadrant	16
5.3.1	Topsoil.....	16
5.3.2	Fill – Silty Clay	16
5.3.3	Silty Clay	17
5.3.4	Clayey Silt to Silty Clay Till	18
5.3.5	Sand.....	18
5.3.6	Silty Sand to Sand and Silt Till	19
5.3.7	Bedrock (Salina Formation)	19
5.3.8	Water Levels.....	20
5.4	Site 4 – Highway 406 NBL & SBL	20
5.4.1	Topsoil.....	21
5.4.2	Fill – Sandy Gravel to Gravelly Sand.....	21
5.4.3	Fill – Silty Sand to Sand and Silt	21
5.4.4	Fill – Silty Clay	21
5.4.5	Silty Clay	22
5.4.6	Silt	23



5.4.7	Clayey Silt	24
5.4.8	Silty Clay to Clayey Silt Till	24
5.4.9	Sand	25
5.4.10	Sandy Silt to Silty Sand Till	25
5.4.11	Sandy Gravel to Sand and Gravel Till	26
5.4.12	Bedrock (Salina Formation)	26
5.4.13	Water Levels	27
5.5	Miscellaneous	29

Part 2

6	DISCUSSION AND RECOMMENDATIONS	31
6.1	General	31
6.2	SITE 1 – Ramp East Main Street E – N	34
6.2.1	General	34
6.2.2	Design Considerations	34
6.3	SITE 2 – Woodlawn I/C Southeast Quadrant	35
6.3.1	General	35
6.3.2	Embankment Stability	35
6.3.3	Embankment Settlement	36
6.4	SITE 3 – Woodlawn I/C Southwest Quadrant	37
6.4.1	General	37
6.4.2	Embankment Stability	37
6.4.3	Embankment Settlement	38
6.5	SITE 4 – Highway 406 NBL & SBL	40
6.5.1	General	40
6.5.2	Embankment Stability	40
6.5.3	Embankment Settlement	41
7	CONSTRUCTION STAGING	42
8	CONSTRUCTION CONSIDERATIONS	43
8.1	SITE 1 – Ramp East Main Street E – N	43
8.2	SITE 2 – Woodlawn I/C Southeast Quadrant, SITE 3 – Woodlawn I/C Southwest Quadrant, SITE 4 – Highway 406 NBL & SBL	44
9	SEISMIC CONSIDERATIONS	45
9.1.1	Liquefaction Potential	45



Tables

Table 1 – List of Standard Specifications Referenced in Report

Appendices

Site 1

Appendix A1 – Record of Borehole Sheets

Appendix B1 – Laboratory Test Results

Appendix C1 – Drawings titled “Borehole Locations and Soil Strata”

Site 2

Appendix A2 – Record of Borehole Sheets

Appendix B2 – Laboratory Test Results

Appendix C2 – Drawings titled “Borehole Locations and Soil Strata”

Site 3

Appendix A3 – Record of Borehole Sheets

Appendix B3 – Laboratory Test Results

Appendix C3 – Drawings titled “Borehole Locations and Soil Strata”

Site 4

Appendix A4 – Record of Borehole Sheets

Appendix B4 – Laboratory Test Results

Appendix C4 – Drawings titled “Borehole Locations and Soil Strata”

Volume II

Appendix D1 – D4	Slope Stability Data and Results
Appendix E	Comparison of Embankment Alternatives
Appendix F	Settlement Parameters and Results
Appendix G	Figures
Appendix H	Special Provision Supply & Installation of Embankment Monitoring Equipment



DESIGN SUMMARY

This project (W.P. 280-99-00) is the Ministry of Transportation of Ontario undertaking to twin Highway 406 from 0.2 km north of Port Robinson Road to its current terminus at East Main Street.

Terraprobe carried out the investigation as a sub-consultant to Giffels Associates Limited/IBI Group (Giffels), under the Ministry of Transportation Ontario (MTO) Agreement Number 2008-E-0016.

The project is located in the Regional Municipality of Niagara, City of Thorold and City of Welland, Ontario. Approximately 6.5 km of two lane staged freeway will be twinned from Sta. 10+000 to Sta. 6+400. Within the project limits Highway 406 has signalized intersections at Merritt Road, Woodlawn Road and East Main Street and one un-signalized intersection at Port Robinson Road.

A deep cut is required on Ramp East Main Street E-N, Sta. 10+000 to 10+340 approximately. High fills (embankments) are also required at the Woodlawn Road Interchange and on Highway 406 NBL and SBL where the proposed highway will cross above the Trillium Railway and the realigned Woodlawn Road.

The main design recommendations are:

- Cuts should be designed at 3H:1V side slopes.
- Local earth fill embankments should be constructed at 3H:1V side slopes. Embankment alternatives are provided if steeper side slopes are desired.
- Construction staging on this project is critical and it is required that paving operations commence as soon as possible with a target of 6 months after embankment construction. Our analyses indicates that after the first six months of embankment construction the remaining post construction settlement will be equal to or less than the acceptable maximum of 25 mm. Therefore other means/methods (light weight fill, wick drains) of accelerating the settlement are not warranted.
- Given the uncertainty in accurately predicting the time rate of settlement we recommended that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction.
- Construction operations could have adverse effects on the railway track. A NSSP is required for track monitoring and repairs and requires specific inputs from Trillium Railway.

Notwithstanding the foregoing the designer is advised to review this report in its entirety to ensure that the geotechnical recommendations provided herein are adequately addressed in the designs and contract documents.



FOUNDATION INVESTIGATION REPORT
DEEP CUTS & HIGH FILLS
HIGHWAY 406 TWINNING
ONTARIO
AGREEMENT No. 2008-E-0016, W.P. 280-99-00

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from foundation investigations conducted at the deep cut and high fill areas on the alignment of the proposed four lanes of Highway 406 and associated ramps. The project area extends from East Main Street, City of Welland to about 1.0 km north of Port Robinson Road, City of Thorold, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the identified sections and based on the data obtained, to provide borehole location plans, records of boreholes, stratigraphic profiles and cross-sections, laboratory test results and a description of the subsurface conditions. Models of the subsurface conditions were developed from the data obtained.

Terraprobe conducted the investigation as a sub-consultant to Giffels Associates Ltd./IBI Group, under the Ministry of Transportation Ontario (MTO) Agreement Number 2008-E-0016.

For reporting purposes the investigated sections are identified as follows:

- **Site 1:** Cut section, Ramp East Main Street E-N, Sta. 10+000 to 10+340 approximately.
- **Site 2:** Fill section, Woodlawn Interchange southeast quadrant consisting of Ramp 406S – Woodlawn E/W (Sta. 10+000 to Sta. 10+434 approximately) and Ramp Woodlawn W – 406N (Sta. 10+000 to Sta. 10+296 approximately).
- **Site 3:** Fill section, Woodlawn Interchange southwest quadrant consisting of Ramp Woodlawn E/W – 406S (Sta. 10+000 to Sta. 10+473 approximately).
- **Site 4:** Fill section, Highway 406 north bound and south bound main lanes, Sta. 11+950 to Sta. 13+220 approximately.

High fills are also required where Port Robinson Road will cross above the proposed four lanes of Highway 406. The subsurface data for this section will be provided in a separate report.



2 SITE DESCRIPTION & PHYSIOGRAPHY

The south limit of the project is Sta. 10+000 located at the existing Highway 406 terminus at East Main Street in the City of Welland. The north limit is about Sta. 6+400 approximately 1.0 km north of Port Robinson Road in the City of Thorold. This approximately 6.5 km long route traverses across generally flat terrain and crosses Woodlawn Road, Merritt Road and Port Robinson Road. There is an at grade railway intersection (Trillium Railway) about 265 m south of Woodlawn Road. The alignment also crosses the Welland River and Old Welland Canal.

The site is located between the Niagara Escarpment and Lake Erie in the physiographic region of Southern Ontario referred to as the Haldimand Clay Plain. The Haldimand Clay Plain is best described as falling into a series of parallel belts with the highest ground adjacent to the Escarpment. Generally this region is flat and poorly drained although it includes several distinctive landforms such as dunes, cobble, clay and sand beaches, limestone pavements and back-shore wetland basins¹.

The Niagara Region is underlain by a sequence of very gently south-dipping dolostones, limestones, shales and sandstones overlying Precambrian basement rock. The key elements in the bedrock geology of the region are the multiple layers of softer sedimentary limestones, shale, sandstone and dolostone.

The bedrock units within the project limits consist of the Salina Formation and Guelph Formation of Upper Silurian Age². The Salina Formation consists essentially of easily weathered, grey, very finely crystalline, laminated argillaceous dolostone with grey, calcareous shale partings and gypsum veins and lenses of varying thicknesses. The Guelph Formation consists essentially of unweathered, grey, laminated argillaceous dolostone.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at the four sites are outlined below:

Site 1: *Ramp East Main Street E-N* – Five boreholes drilled and sampled to depths ranging from 8.1 m to 17.3 m during the period January 15, 2010 and January 21, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C1

Site 2: *Woodlawn Interchange southeast quadrant* – Fourteen boreholes drilled and sampled to depths ranging from 6.6 m to 33.0 m during the period November 02, 2009 and January 18, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C2.

Site 3: *Woodlawn Interchange southwest quadrant* – Eleven boreholes drilled and sampled to depths ranging from 11.2 m to 32.1 m during the period November 04, 2009 and January 08, 2010.

¹ Chapman and Putnam, "The Physiography of South Ontario", 3rd Edition, 1984.

² Ontario Division of Mines, "Quaternary Geology Of The Welland Area", Preliminary Map P.796, 1972.



The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C3.

Site 4: *Highway 406 north bound and south bound main lanes* – Fifty two boreholes drilled and sampled to depths ranging from 5.5 m to 35.0 m during the period November 02, 2009 and April 29, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C4.

The borehole locations were marked in the field by surveyors from Callon Dietz Inc. who also provided Terraprobe with their coordinates and geodetic elevations. Access to some borehole locations was difficult due to locally steep slopes, existing structures and watercourses. These boreholes were therefore relocated to be as close as feasible to the staked out location while allowing safe operation of the drill rig. Utility clearances were obtained by Terraprobe prior to drilling.

Samples of the overburden soils were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT), as specified in ASTM Method D1586. In the cohesive (clayey) deposits the undrained shear strength of the soil was measured in-situ by means of field vane tests using an MTO type field vane. Relatively undisturbed soil samples were also collected with thin-walled Shelby Tube samplers. Boreholes drilled for proposed bridges in the high fill areas were also advanced into bedrock by NQ size diamond coring techniques.

In addition to the testing outlined above, Dynamic Cone Penetration Tests (DCPT) were conducted. This test consists of continuously driving into undisturbed ground a 50 mm diameter cone (60° vertex angle) attached to a drill rod, with a driving energy of 475 J per blow (63.5 kg hammer dropping freely a vertical distance of 0.76 m). The number of blows for each 300 mm of penetration is recorded and this provides an indication of the relative changes in the soil density/consistency with depth.

Ground water conditions in the open boreholes were observed throughout the drilling operations and standpipe piezometers consisting of 19 mm diameter PVC pipe with a slotted screen enclosed in sand were installed in selected boreholes to permit longer term ground water level monitoring. The remaining boreholes were abandoned in accordance with MOE Regulation 903 by sealing/grouting with a clay slurry mixture after drilling was complete.



The locations and completion details of the piezometers are shown in Tables 3.1, 3.2, 3.3 and 3.4.

Table 3.1 – Piezometer Installation Details (Site 1 Ramp East Main Street E-N)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
EMN 10+125 Lt	17.0/165.6	Piezometer with 1.5 m slotted screen installed with filter sand to 15.2 m, bentonite seal from 15.2 m to 14.9 m, silty clay cuttings from 14.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
EMN 10+125 Rt	17.2/165.3	Piezometer with 1.5 m slotted screen installed with filter sand to 15.2 m, bentonite seal from 15.2 m to 14.6 m, silty clay cuttings from 14.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
EMN 10+175 CL	13.4/169.0	Piezometer with 1.5 m slotted screen installed with filter sand to 11.2 m, bentonite seal from 11.2 m to 10.6 m, silty clay cuttings from 10.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
EMN 10+225 Lt	8.2/174.2	Piezometer with 1.5 m slotted screen installed with filter sand to 6.4 m, bentonite seal from 6.4 m to 5.8 m, silty clay cuttings from 5.8 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
EMN 10+225 Rt	7.2/175.5	Piezometer with 1.5 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 4.9 m, silty clay cuttings from 4.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.

Table 3.2 – Piezometer Installation Details (Site 2 Woodlawn I/C Southeast Quadrant)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
S-EW 10+025Rt	18.8/164.8	Piezometer with 3.0 m slotted screen installed with filter sand to 15.1 m, bentonite seal from 15.1 m to 14.5 m, silty clay cuttings from 14.5 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
S-EW 10+050CL	12.2/171.2	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 8.2 m, silty clay cuttings from 8.2 m to 0.5 m and bentonite seal from 0.5 m to ground surface.
TSEW2	24.2/159.1	Hole sealed with bentonite from 25.0 m to 24.4 m, piezometer with 1.5 m slotted screen installed with filter sand to 21.6 m and bentonite seal from 21.6 m to ground surface.
TSEW4	22.9/160.6	Hole sealed to 23.2 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.4 m and bentonite seal from 20.4 m to ground surface.
S-EW 10+110CL	12.2/170.2	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
S-EW 10+185Rt	12.2/170.5	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 8.2 m, silty clay cuttings from 8.2 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
W-N 10+200Lt	9.1/172.4	Piezometer with 3.0 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 5.2 m, silty clay cuttings from 5.2 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
W-N 10+275Rt	13.7/168.2	Piezometer with 3.0 m slotted screen installed with filter sand to 10.0 m, bentonite seal from 10.0 m to 9.4 m, silty clay cuttings from 9.4 m to 0.3 m and bentonite seal from 0.3 m to ground surface.



Table 3.3 – Piezometer Installation Details (Site 3 Woodlawn I/C Southwest Quadrant)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
WE-S 10+200Lt	9.1/172.5	Piezometer with 1.5 m slotted screen installed with filter sand to 7.0 m, bentonite seal from 7.0 m to 6.1 m, silty clay cuttings from 6.1 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
TEW4	28.3/154.3	Hole sealed to 28.3 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 26.2 m and bentonite seal from 26.2 m to ground surface.
TEW1	15.2/167.3	Hole sealed to 15.2 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 12.8 m and bentonite seal from 12.8 m to ground surface.
WE-S 10+345CL	12.6/170.2	Piezometer with 1.5 m slotted screen installed with filter sand to 10.7 m, bentonite seal from 10.7 m to 10.1 m, silty clay cuttings from 10.1 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
WE-S 10+360Lt	19.8/163.6	Piezometer with 3.0 m slotted screen installed with filter sand to 16.2 m, bentonite seal from 16.2 m to 15.5 m, silty clay cuttings from 15.5 m to 0.6 m and bentonite seal from 0.6 m to ground surface.

Table 3.4 – Piezometer Installation Details (Site 4 Highway 406 NBL & SBL)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
NBL 12+075CL	4.9/179.7	Piezometer with 1.5 m slotted screen installed with filter sand to 2.7 m, bentonite seal from 2.7 m to 2.1 m, silty clay cuttings from 2.1 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+225CL	10.7/174.2	Piezometer with 1.5 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+375Lt	11.1/172.2	Piezometer with 3.0 m slotted screen installed with filter sand to 7.2 m, bentonite seal from 7.2 m to 6.6 m, silty clay cuttings from 6.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TN2	25.9/158.3	Hole sealed to 25.9 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 23.5 m, bentonite seal from 23.5 m to 1.5 m, sand from 1.5 m to 0.3 m and a flush mounted casing installation from 0.15 m to ground surface.
TN3	19.8/164.3	Hole sealed to 19.8 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 17.7 m, bentonite seal from 17.7 m to 0.3 m, and a flush mounted casing installation from 0.15 m to ground surface.
NBL 12+440Rt	12.2/170.8	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
NBL 12+525Lt	15.2/167.6	Piezometer with 1.5 m slotted screen installed with filter sand to 13.4 m, bentonite seal from 13.4 m to 13.1 m, silty clay cuttings from 13.1 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+525Rt	12.2/169.8	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
NBL 12+645Lt	12.2/171.1	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
NBL 12+645Rt	12.2/168.8	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.



Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
NBL 12+695Lt	12.2/170.7	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
WN2	25.9/155.3	Hole sealed to 25.9 m with bentonite, piezometer with 1.8 m slotted screen installed with filter sand to 24.1 m, bentonite seal from 24.1 m to ground surface.
WN3	22.6/159.5	Hole sealed to 22.6 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.7 m, bentonite seal from 20.7 m to ground surface with a flush mounted casing installation.
NBL 12+750Rt	12.6/170.2	Piezometer with 3.0 m slotted screen installed with filter sand to 9.0 m, bentonite seal from 9.0 m to 8.4 m, silty clay cuttings from 8.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+835Rt	10.7/172.2	Piezometer with 1.5 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+985Rt	4.6/177.7	Piezometer with 1.5 m slotted screen installed with filter sand to 2.4 m, bentonite seal from 2.4 m to 1.8 m, silty clay cuttings from 1.8 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SBL 12+185Lt	7.9/175.3	Piezometer with 1.5 m slotted screen installed with filter sand to 5.8 m, bentonite seal from 5.8 m to 5.2 m, silty clay cuttings from 5.2 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SBL 12+360CL	12.2/170.7	Piezometer with 3.0 m slotted screen installed with filter sand to 9.0 m, bentonite seal from 9.0 m to 8.4 m, silty clay cuttings from 8.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TS1	28.0/154.6	Hole sealed to 28.0 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 25.0 m and bentonite seal from 25.0 m to ground surface.
TS4	28.3/154.1	Hole sealed to 28.4 m with bentonite, piezometer with 3.0 m slotted screen installed with filter sand to 24.7 m and bentonite seal from 24.7 m to ground surface.
SBL 12+410CL	12.2/170.3	Piezometer with 1.5 m slotted screen installed with filter sand to 10.3 m, bentonite seal from 10.3 m to 10.0 m, drill cuttings from 10.0 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
SBL 12+525CL	15.2/166.6	Piezometer with 1.5 m slotted screen installed with filter sand to 13.4 m, bentonite seal from 13.4 m to 12.8 m, silty clay cuttings from 12.8 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SBL 12+600Rt	12.2/169.9	Piezometer with 1.5 m slotted screen installed with filter sand to 10.4 m, bentonite seal from 10.4 m to 10.1 m, silty clay cuttings from 10.1 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
SBL 12+685CL	10.7/172.0	Piezometer with 3.0 m slotted screen installed with filter sand to 7.0 m, bentonite seal from 7.0 m to 6.4 m, silty clay cuttings from 6.4 m to 0.3 m, bentonite seal from 0.3 m to 0.2 m and a flush mounted casing installation from 0.2 m to ground surface.
WS1	22.9/159.8	Hole sealed to 22.9 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.4 m, bentonite seal from 20.4 m to ground surface.
WS4	24.4/158.3	Hole sealed to 24.4 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 21.9 m, bentonite seal from 21.9 m to ground surface.
SBL 12+750CL	10.5/172.4	Piezometer with 3.0 m slotted screen installed with filter sand to 6.9 m, bentonite seal from 6.9 m to 6.6 m, silty clay cuttings from 6.6 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
SBL 12+900CL	5.3/177.4	Piezometer with 1.5 m slotted screen installed with filter sand to 3.2 m, bentonite seal from 3.2 m to 2.9 m, silty clay cuttings from 2.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.



The drilling, sampling and in-situ testing operations were observed on a full time basis by members of Terraprobe's technical staff who logged the boreholes and processed the recovered soil and rock samples for transport to Terraprobe's Brampton laboratory for further examination and testing.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and natural moisture content determination. Select samples were also subjected to a laboratory testing programme consisting of gradation analysis and Atterberg Limits tests, consolidation tests, unit weight, unconfined compression tests and undrained shear strength testing with a laboratory vane. The results of this testing program are shown on the Record of Borehole sheets in Appendix A1 – A4 and the figures in Appendix B1 – B4.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 Site 1 – Ramp East Main Street E – N

Reference is made to the Record of Borehole sheets in Appendix A1. Details of the encountered soil stratigraphy are presented in these appendices and on the “Borehole Locations and Soil Strata” drawings in Appendix C1. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by overburden soils consisting of topsoil, native deposits of firm to hard silty clay, very stiff clayey silt, stiff to very stiff silty clay till and compact silt till.

5.1.1 Topsoil

Topsoil ranging from 60 mm to 130 mm in thickness was encountered at this site. Topsoil thickness may vary between and beyond the boreholes.

5.1.2 Silty Clay

A silty clay deposit was encountered across the site and Boreholes EMN 10+225Lt and EMN 10+225Rt were terminated in this deposit at depths of 8.5 (Elev. 173.9 m) and 8.1 m (Elev. 174.6 m) respectively. This deposit was fully penetrated in the remaining boreholes where it was found to extend to depths ranging from 7.1 m (Elev. 175.4 m) to 8.6 m (Elev. 173.8 m) below ground surface.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B1-1 to B1-3 inclusive. These results show a grain size distribution consisting of 0-3% gravel, 1-4% sand, 40-70% silt and 28-59% clay size particles.



Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B1-4 to B1-6. The index values from these tests are summarized below:

Liquid Limit:	26-50%
Plastic Limit:	14-25%
Plasticity Index:	11-24%
Natural Moisture Content:	8-34%

These values indicate that the silty clay has a generally low to intermediate plasticity.

Standard Penetration tests in this stratum gave 'N' values that ranged from 4 to 52 blows for 0.3 m penetration. Field vane tests gave in-situ undrained shear strengths ranging from 56 kPa to in excess of 120 kPa. Laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 89 kPa to 173 kPa. These values indicate that the consistency of the silty clay is generally firm to hard. The variation of undrained shear strength with elevation is depicted in Figure B1-12. There are no discernable trends of undrained shear strength with depth. The moisture content of samples of the silty clay range from 8% to 34% by weight and the unit weight of selected samples ranged from 20.0 to 22.3 kN/m³.

5.1.3 Clayey Silt

A native clayey silt deposit was encountered at this site in Borehole EMN 10+125 Rt. The deposit is approximately 1.5 m thick and extends to a depth of 8.6 m (Elev. 173.9 m) below ground surface.

The grain size distribution plot of a tested sample of the clayey silt is presented in Figure B1-7. The result shows a grain size distribution consisting of 0% gravel, 0% sand, 82% silt and 18% clay size particles.

One sample was also subjected to an Atterberg Limits test and the result is illustrated on the plasticity chart, Figure B1-8. The index values from this test are summarized below:

Liquid Limit:	26%
Plastic Limit:	19%
Plasticity Index:	8%
Natural Moisture Content:	23%

These results are typical for low plasticity clayey silt soils.

An SPT 'N' value of 27 blows for 0.3 m penetration was obtained from a Standard Penetration test conducted in this deposit and a field vane test gave an in-situ undrained shear strength in excess of 120 kPa. Based on these results the deposit is considered to have a very stiff consistency. The moisture content of a sample from this deposit is 23% by weight.



5.1.4 Silty Clay Till

A native silty clay till deposit was encountered at this site in some of the boreholes. This deposit was not encountered in Boreholes EMN 10+225 Lt and EMN 10+225Rt. In Borehole EMN 10+125 Lt this silty clay till extends to a depth of 16.2 m (Elev. 166.4 m) below ground surface. The remaining boreholes were terminated in this deposit at depths of 13.7 m (Elev. 168.7 m) and 17.3 m (Elev. 165.2 m) below ground surface.

The grain size distribution plots of tested samples from this unit are depicted in Figure B1-9. These results show a grain size distribution consisting of 1-7% gravel, 11-21% sand, 53-64% silt and 20-24% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Samples were also subjected to Atterberg Limits tests and the results are plotted on the plasticity chart, Figure B1-10. The index values from these tests are summarized below:

Liquid Limit:	23-29%
Plastic Limit:	13-16%
Plasticity Index:	9-12%
Natural Moisture Content:	12-31%

These values are typical of clayey soils of low plasticity.

Standard Penetration tests in this stratum yielded 'N' values ranging from 11 to 29 blows per 0.3 m penetration. Field vane tests were also conducted in this deposit and the results indicate an undrained shear strength ranging from 88 kPa to in excess of 120 kPa. Laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 76 kPa to in excess of 120 kPa. Based on these results, the silty clay till is considered to have a stiff to very stiff consistency. The moisture content of samples from this deposit varies from 12% to 31% by weight and the unit weight of selected samples ranged from 20.2 to 21.1 kN/m³.

5.1.5 Silt Till

A deposit of silt till was encountered in Borehole EMN 10+125 Lt. This unit extends to a borehole termination depth of 17.3 m (Elev. 165.3 m) and possibly beyond.

The grain size distribution plot of a tested sample from this stratum is depicted in Figures B1-11. These results show a grain size distribution consisting of 0% gravel, 16% sand, 78% silt and 6% clay size particles.

A Standard Penetration test in this deposit yielded an 'N' value of 13 blows per 0.3 m penetration. Based on this result, the unit is considered to have a compact relative density. The moisture content of a sample from this stratum is 21% by weight.



5.1.6 Water Levels

Standpipe piezometers were installed in selected boreholes. The water level readings measured on separate visits made after the completion of drilling are presented in Table 5.1.1.

Table 5.1.1 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
EMN 10+125 Lt	Jan. 27, 2010	12.0	170.6
	Feb. 08, 2010	11.8	170.8
	Feb. 19, 2010	11.9	170.7
EMN 10+125 Rt	Jan. 19, 2010	16.8	165.7
	Jan. 27, 2010	16.1	166.4
	Feb. 08, 2010	12.2	170.3
	Feb. 19, 2010	10.1	172.4
	Apr. 16, 2010	9.3	173.2
	May. 04, 2010	9.4	173.1
	May. 06, 2010	9.4	173.1
EMN 10+175 CL	Jan. 27, 2010	13.5	168.9
	Feb. 08, 2010	13.2	169.2
	Feb. 19, 2010	12.8	169.6
	Apr. 16, 2010	8.0	174.4
	May. 04, 2010	7.6	174.8
	May. 06, 2010	7.5	174.9
	May. 18, 2010	7.7	174.7
EMN 10+225 Lt	Jan. 27, 2010	dry	-
	Feb. 08, 2010	dry	-
	Feb. 19, 2010	dry	-
EMN 10+225 Rt	Jan. 27, 2010	7.2	175.5
	Feb. 08, 2010	6.4	176.3
	Feb. 19, 2010	5.9	176.8
	Apr. 16, 2010	4.3	178.4
	May. 04, 2010	4.1	178.6
	May. 06, 2010	4.4	178.3
	May. 18, 2010	4.0	178.7

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a phreatic surface that generally follows the ground surface topography. The water level exists at Elev. ± 173.1 m at Sta. 10+125 and it rises to Elev. ± 178.7 m at Sta. 10+225.

All ground water observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

5.2 Site 2 – Woodlawn I/C Southeast Quadrant

Reference is made to the Record of Borehole sheets in Appendix A2. Details of the encountered soil and rock stratigraphy are presented in these appendices and on the “Borehole Locations and Soil Strata” drawings in Appendix C2. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil, fill material (loose to dense sand and gravel and sand, firm to hard silty clay) and native overburden deposits of stiff to hard silty clay, compact to dense



silt, very stiff to hard silty clay to clayey silt till, dense to very dense silty sand till and compact to very dense sand and gravel till. These soils are underlain by bedrock consisting primarily of dolostone and shale of the Salina formation.

5.2.1 Topsoil

Topsoil ranging from 30 mm to 250 mm thick was encountered at this site. Topsoil thickness may vary between and beyond the boreholes.

5.2.2 Fill – Sand and Gravel

Fill material ranging from sand and gravel to sand some gravel was encountered in Boreholes TSEW1, TSEW2, TSEW3 and W-N 10+275Rt. This fill material extends to depths ranging from 0.7 m (Elev. ± 182.8 m) to 1.1 m (Elev. ± 180.8 m) below ground surface.

Samples of this fill material were subjected to grain size distribution tests and the results are illustrated in Figure B2-1. These results show a grain size distribution consisting of 10-43% gravel, 30-76% sand, 13-25% silt and 3-15% clay size particles.

Standard Penetration tests in this granular fill gave 'N' values that ranged from 6 to 32 blows per 0.3 m penetration. Based on these results the fill is considered to have a loose to dense relative density. The moisture content of samples of this fill ranged from 1% to 29% by weight.

5.2.3 Fill – Silty Clay

Silty clay fill material was encountered at this site extending to depths ranging from 0.7 m (Elev. 182.7 m) to 4.4 m (Elev. 179.2 m) below ground surface.

Samples of the silty clay fill were subjected to grain size distribution tests and the results are presented in Figure B2-2. These results show grain size distributions consisting of 0-9% gravel, 0-14% sand, 38-59% silt and 30-56% clay size particles.

Samples of the fill were also subjected to Atterberg Limits tests and the results are presented in Figure B2-3. The index values from these tests are summarized below:

Liquid Limit:	26-54%
Plastic Limit:	14-25%
Plasticity Index:	12-29%
Natural Moisture Content:	9-20%

These values are characteristic of clayey soils of low to high plasticity.

Standard Penetration tests in the silty clay fill gave 'N' values that ranged from 4 to 93 blows for 0.3 m penetration. Based on these results the fill is considered to have a firm to hard consistency. The moisture content of samples of this fill ranged from 8% to 28% by weight.



5.2.4 Silty Clay

A major silty clay deposit was encountered across the site. This deposit was fully penetrated in some of the boreholes where it was found to extend to depths ranging from 12.4 m (Elev. 169.5 m) to 16.2 m (Elev. 167.4 m) below ground surface. The remaining boreholes were terminated within this deposit at depths ranging from 6.6 m (Elev. 176.0 m) to 14.0 m (Elev. 168.4 m) below ground surface.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B2-4 to B2-12 inclusive. These results show a grain size distribution consisting of 0-4% gravel, 0-13% sand, 37-81% silt and 17-61% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B2-13 to B2-21 inclusive. The index values from these tests are summarized below:

Liquid Limit:	24-58%
Plastic Limit:	14-25%
Plasticity Index:	7-33%
Natural Moisture Content:	16-23%

These values indicate that the silty clay has a generally low to intermediate plasticity with occasional zones of high plasticity.

Standard Penetration tests in this stratum gave 'N' values that ranged from 1 to 42 blows for 0.3 m penetration. Field vane tests gave in-situ undrained shear strengths ranging from 35 kPa to in excess of 100 kPa and laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 56 kPa to 113 kPa. The variation of undrained shear strength with elevation is depicted in Figure B2-29. These values indicate that the consistency of the silty clay is generally stiff to hard. There are no discernable trends of undrained shear strength with depth. Moisture content of samples of the silty clay range from 6% to 24% by weight and the unit weight of selected samples ranged from 20.4 to 20.8 kN/m³

The Atterberg Limits tests results are also plotted against elevation, Figure B2-30. These results illustrate that the natural moisture contents are generally at or below the plastic limit above Elev. 177 m. Below Elev. 177 m there is a trend of increasing moisture content and the natural moisture content is between plastic limit and liquid limit.

Consolidation tests were also performed on Shelby tube samples retrieved from Boreholes S-EW 10+050CL, TSEW3, and W-N 10+275Rt and the results are presented in Figures B2-31 to B2-39 inclusive. Preconsolidation pressures were estimated from the e-log p curves. Due to the rounded nature of the curves the preconsolidation pressures were also assessed based on the 'Work' – method proposed by Becker et al. (1987).



The details of the test results are summarized below.

Borehole/Sample No.	Sample Depth/Elevation (m)	P _c (kPa)	C _c	C _r	e _o
S-EW 10+050CL TW9	9.1/174.3	310 – 400	0.221	0.027	0.63
TSEW 3 TW13	12.2/171.1	230 – 300	0.208	0.037	0.62
W-N 10+275Rt. TW9	9.1/172.8	280 – 400	0.197	0.035	0.58

Where: P_c = Preconsolidation pressure
C_c = Compression index
C_r = Recompression index
e_o = Initial void ratio

5.2.5 Silt

Boreholes W-N 10+125CL, W-N 10+200Lt, W-N 10+200Rt and W-N 10+275Rt encountered a silt deposit. The stratum is approximately 0.8 m to 1.1 m thick and extends to depths ranging from 2.9 m (Elev. 178.6 m) to 4.0 m (Elev. 177.9 m) below ground surface. Based on visual and tactile examinations of the retrieved samples, the unit is essentially a cohesionless silt with frequent cohesive silty clay seams and partings.

The grain size distribution plot of a tested sample of the silt deposit is presented in Figure B2-22. These results show a grain size distribution consisting of 0% gravel, 1% sand, 88% silt and 11% clay size particles.

The deposit is considered to have a compact to dense relative density based on SPT 'N' values that ranged from 22 to 32 blows for 0.3 m penetration. The moisture content of samples from this deposit ranged from 16% to 19% by weight.

5.2.6 Silty Clay to Clayey Silt Till

Layers of silty clay to clayey silt till were encountered across the site extending to depths ranging from 26.9 m (Elev. 156.6 m) to 28.0 m (Elev. 155.5 m). Boreholes S-EW 10+025Rt and W-N 10+275Rt were terminated in this unit at depths of 14.2 m (Elev. ±167.7 m) and 18.8 m (Elev. ±164.8 m) respectively.

The grain size distribution plots of tested samples from these till deposits are depicted in Figures B2-23 and B2-24. These results show a grain size distribution consisting of 3-28% gravel, 2-34% sand, 32-63% silt and 13-33% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Samples were also subjected to Atterberg Limits tests and the results are presented in the plasticity charts, Figures B2-25 and B2-26. The index values from these tests are summarized below:

Liquid Limit: 18-31%
Plastic Limit: 11-16%
Plasticity Index: 5-16%
Natural Moisture Content: 7-26%

These values are characteristic of clayey soils of low plasticity.



Standard Penetration tests in these deposits yielded 'N' values ranging from 15 to more than 100 blows per 0.3 m penetration. Field vane tests were also attempted in these deposits and the results (no-turn on vane) indicate undrained shear strengths more than 100 kPa. Based on these results the silty clay to clayey silt till is considered to have a very stiff to hard consistency. The moisture content of samples from these deposits varies from 1% to 26% by weight.

5.2.7 Silty Sand Till

A silty sand till deposit was encountered at this site. This deposit extends to depths ranging from 24.0 m (Elev. 159.5 m) to 25.4 m (Elev. 157.9 m) below ground surface.

The results of grain size distribution tests conducted on samples obtained from this deposit are illustrated in Figure B2-27. These results show grain size distributions consisting of 15-35% gravel, 31-45% sand, 28-32% silt and 6-9% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in this deposit gave 'N' values that generally ranged from 30 to more than 100 blows per 0.3 m penetration indicating a dense to very dense relative density. The moisture content of samples from this deposit ranged from 4% to 17% by weight.

5.2.8 Sand and Gravel Till

A deposit of sand and gravel till was encountered at this site overlying the bedrock surface. Occasional cobbles were also encountered in this deposit. This stratum extends to depths ranging from 29.5 m to 29.7 m below ground surface or to elevations of 153.6 m to 154.0 m.

Samples from this deposit were subjected to grain size distribution tests and the results are illustrated in Figure B2-28. These results show a grain size distribution consisting of 34-42 % gravel, 37-44 % sand, 14-22 % silt and 7 % clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in this deposit gave 'N' values that ranged from 18 to more than 100 blows per 0.3 m penetration. Based on these results the deposit is considered to have a compact to very dense relative density. The moisture content of samples from this stratum ranged from 2% to 16% by weight.

5.2.9 Bedrock (Salina Formation)

The overburden soils described above are underlain by the Salina Formation. Bedrock was proved by coring at the abutment locations of the proposed bridge structure on the Ramp 406S – Woodlawn E/W alignment. Table 5.2.1 summarizes the bedrock depth and the elevations to the top of bedrock.

Table 5.2.1 – Depth to Bedrock

Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
South Abutment	TSEW1	29.7	153.8
	TSEW2	29.6	153.7
North Abutment	TSEW3	29.7	153.6
	TSEW4	29.5	154.0



The bedrock is described as unweathered dolostone and shale and its colour is generally grey. It is thinly laminated with white unweathered gypsum and calcite veins. Total core recovery in the bedrock ranged from 59% to 100%. The RQD values ranged widely from 0% to 84% but generally most of the RQD values were below 50%. Rubble and highly fractured zones were observed in the rock cores which contributed to the relatively low RQD values. The core data reveals that there is generally no trend of improving rock quality with depth. Based on these results the rock quality is considered to be very poor to poor with occasional zones of fair to good quality rock.

5.2.10 Water Levels

A standpipe piezometer was installed in selected boreholes. The water level readings measured on separate visits made after the completion of drilling are presented in Table 5.2.2.

Table 5.2.2 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
S-EW 10+025Rt	December 08, 2009	17.7	165.9
	December 15, 2009	16.1	167.5
	January 04, 2010	5.0	178.6
	January 11, 2010	3.9	179.7
	January 19, 2010	4.0	179.6
S-EW 10+050CL	December 08, 2009	2.4	181.0
	December 15, 2009	2.4	181.0
	January 04, 2010	2.4	181.0
	January 11, 2010	2.4	181.0
TSEW2	January 11, 2010	8.5	174.8
	January 19, 2010	8.6	174.7
	January 27, 2010	8.8	174.5
	February 08, 2010	8.8	174.5
TSEW4*	-	-	-
S-EW 10+110CL	November 09, 2009	2.7	179.7
	November 20, 2009	1.1	181.3
	November 30, 2009	1.6	180.8
	December 08, 2009	1.3	181.1
	January 04, 2010	1.3	181.1
S-EW 10+185Rt	November 09, 2009	9.5	173.2
	November 20, 2009	3.2	179.5
	November 30, 2009	2.8	179.9
	December 08, 2009	2.5	180.2
	January 04, 2010	2.2	180.5
	January 19, 2010	2.2	180.5
W-N 10+200Lt	November 09, 2009	7.0	174.5
	November 20, 2009	1.9	179.6
	November 30, 2009	1.4	180.1
	January 04, 2010	1.3	180.2
W-N 10+275Rt	November 09, 2009	10.8	171.1
	November 19, 2009	2.8	179.1
	November 30, 2009	2.7	179.2
	December 08, 2009	2.5	179.4
	January 04, 2010	2.5	179.4

* Piezometer destroyed after installation.

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a ground water table that is estimated to range between Elev. ±179.5 m and



Elev. ± 181.0 m. Perched water can also be expected to occur where permeable layers of sand and gravel are underlain by more impermeable silty clay soils.

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

5.3 Site 3 – Woodlawn I/C Southwest Quadrant

Reference is made to the Record of Borehole sheets in Appendix A3. Details of the encountered soil and rock stratigraphy are presented in these appendices and on the “Borehole Locations and Soil Strata” drawings in Appendix C3. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil, firm to very stiff silty clay fill and native overburden deposits of firm to hard silty clay, very stiff to hard clayey silt to silty clay till, dense to very dense sand, and compact to very dense silty sand to sand and silt till. These soils are underlain by bedrock consisting primarily of dolostone and shale of the Salina formation.

5.3.1 Topsoil

Topsoil ranging from 50 mm to 300 mm in thickness was encountered across the site. Topsoil thickness may vary between and beyond the boreholes.

5.3.2 Fill – Silty Clay

Silty clay fill material was encountered at this site extending to depths ranging from 0.7 m to 2.9 m below ground surface or to elevations ranging from 182.9 m to 180.3 m.

Samples of the silty clay fill were subjected to grain size analysis and the results are presented in Figure B3-1. These results show a grain size distribution consisting of 0-1% gravel, 2-5% sand, 33-63% silt and 34-64% clay size particles.

Samples of the fill material were also subjected to Atterberg Limits tests and the results are presented in Figure B3-2. The index values from these tests are summarized below:

Liquid Limit:	42-62%
Plastic Limit:	20-27%
Plasticity Index:	22-34%
Natural Moisture Content:	15-40%

These values indicate that the silty clay fill generally has an intermediate plasticity with infrequent zones of high plasticity.

Standard Penetration tests in the silty clay fill gave ‘N’ values that ranged from 6 to 65 blows for 0.3 m penetration but generally ‘N’ values ranged from 6 to 27 blows for 0.3 m penetration. Based on these results, the fill is considered to have a generally firm to very stiff consistency with



occasional hard zones. The moisture content of samples of this fill ranged from 15% to 40% by weight.

5.3.3 Silty Clay

A silty clay deposit was encountered across the site. This deposit was fully penetrated in Boreholes WE-S 10+360 Lt, TEW1, TEW2, TEW3 and TEW4 where it extended to depths ranging from 14.6 m (Elev. 168.0 m) to 16.1 m (Elev. 167.3 m) below ground surface. The remaining boreholes drilled along the alignment of this ramp were terminated in this deposit at depths ranging from 11.2 m to 14.6 m below ground surface or to elevations ranging from 172.7 m to 168.2 m.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B3-3 to B3-8 inclusive. These results show a grain size distribution consisting of 0-6% gravel, 1-7% sand, 52-81% silt and 17-47% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B3-9 to B3-14 inclusive. The index values from these tests are summarized below:

Liquid Limit:	24-40%
Plastic Limit:	11-20%
Plasticity Index:	6-29%
Natural Moisture Content:	11-28%

These values indicate that the silty clay has a generally low to intermediate plasticity with occasional clayey silt zones.

Standard Penetration tests in this stratum gave 'N' values that ranged from 6 to 77 blows for 0.3 m penetration. Field vane tests gave in-situ undrained shear strengths ranging from 56 kPa to in excess of 120 kPa. An unconfined compression test gave an undrained shear strength of 65 kPa and laboratory vane tests on a relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 34 to 140 kPa. The variation of undrained shear strength with elevation is depicted in Figure B3-21. These values indicate that the consistency of the silty clay is generally firm to hard. There are no discernable trends of undrained shear strength with depth. Moisture content of samples of the silty clay range from 11% to 28% by weight and the unit weight of tested samples ranged from 20.6 to 20.8 kN/m³

The Atterberg Limits tests results are also plotted against elevation, Figure B3-22. These results illustrate that the natural moisture contents are generally below the plastic limit down to Elev. 178.0 m. The moisture contents are at or slightly above the plastic limit below Elev. 178.0 m.

Consolidation tests were also performed on Shelby tube samples retrieved from Boreholes WE-S 10+295CL, WE-S 10+345CL and WE-S 10+360Lt and the results are presented in Figures B3-23 to B3-31. Preconsolidation pressures were estimated from the e-log p curves. Due to the rounded nature of the curves the preconsolidation pressures were also assessed based on the 'Work' – method proposed by Becker et al. (1987). The details of the test results are summarized in the following table.



Borehole/Sample No.	Sample Depth/Elevation (m)	P _c (kPa)	C _c	C _r	e _o
WE-S 10+295CL TW10	9.1/173.7	350	0.160	0.028	0.55
WE-S 10+345CL TW10	10.7/172.1	230 – 370	0.183	0.019	0.56
WE-S 10+360Lt. TW11	12.2/171.2	220 – 260	0.157	0.029	0.59

Where: P_c = Preconsolidation pressure
C_c = Compression index
C_r = Recompression index
e_o = Initial void ratio

5.3.4 Clayey Silt to Silty Clay Till

Discontinuous layers of clayey silt to silty clay till were encountered in Boreholes TEW1 and TEW2. The thickness of these deposits range from 0.7 m to 4.7 m and these strata extend to depths ranging from 23.8 m (Elev. 158.9 m) to 24.2 m (Elev. 158.3 m) below ground surface. In Boreholes TEW3 and TEW4, the till deposit is undivided and extends to depths ranging from 24.7 m (Elev. 157.9 m) to 24.8 m (Elev. 157.8 m) below ground surface. Borehole WE-S10+360Lt was terminated in this deposit at a depth of 20.3 m (Elev. 163.1 m) below ground surface.

The grain size distribution plots of tested samples from these strata are presented in Figures B3-15 and B3-16. These results show a grain size distribution consisting of 4-12% gravel, 13-31% sand, 43-62% silt and 14-21% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Seven samples were also subjected to Atterberg Limits tests and the results are presented in Figures B3-17 and B3-18. The index values from these tests are summarized below:

Liquid Limit: 17-23%
Plastic Limit: 11-14%
Plasticity Index: 5-9%
Natural Moisture Content: 7-16%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in these deposits yielded 'N' values ranging from 30 to more than 100 blows per 0.3 m penetration. Field vane tests were also attempted in these deposits and the results (no-turn on vane) indicate undrained shear strengths more than 100 kPa. Based on these results, the clayey silt to silty clay till is considered to have a very stiff to hard consistency. The moisture content of samples from these deposits varies from 7% to 16% by weight.

5.3.5 Sand

Discontinuous layers of sand and gravel to gravelly sand were encountered in Boreholes TEW1 and TEW2. These deposits are approximately 0.8 m to 1.8 m thick and extend to depths of 23.1 m below ground surface or to elevations ranging from 159.4 m to 159.6 m.



A sample from this stratum was subjected to a grain size distribution test and the results are illustrated in Figure B3-19. These results show a grain size distribution consisting of 32 % gravel, 56 % sand, 10 % silt and 2 % clay size particles.

Standard Penetration tests in these deposits gave 'N' values that ranged from 34 to more than 100 blows per 0.3 m penetration. Based on these results, the deposits are considered to have a dense to very dense relative density. The moisture content of samples from these strata ranged from 8% to 12% by weight.

5.3.6 Silty Sand to Sand and Silt Till

A deposit of silty sand to sand and silt till was encountered at this site overlying the bedrock surface. This deposit extends to depths ranging from 28.7 m (Elev. 154.0 m) to 28.9 m (Elev. 153.7 m) below ground surface.

Samples from these deposits were subjected to grain size distribution tests and the results are illustrated in Figure B3-20. These results show a grain size distribution consisting of 2-26 % gravel, 38-95 % sand, 3-38 % silt and 7-8 % clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in these deposits gave 'N' values that ranged from 21 to more than 100 blows per 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 7% to 15% by weight.

5.3.7 Bedrock (Salina Formation)

The overburden soils described above are underlain by the Salina Formation. Bedrock was proved by coring at the abutment locations of the proposed bridge structure on this alignment. Table 5.3.1 summarizes the bedrock depth and the elevations to the top of bedrock.

Table 5.3.1 – Depth to Bedrock

Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
South Abutment	TEW1	28.8	153.7
	TEW2	28.7	154.0
North Abutment	TEW3	28.9	153.7
	TEW4	28.7	153.9

The bedrock is described as unweathered dolostone and shale and its colour is generally grey. It is thinly laminated with white unweathered gypsum and calcite veins. Total core recovery in the bedrock ranged from 50% to 100%. The RQD values ranged widely from 0% to 78% but generally, most of the RQD values were below 50%. Rubble and highly fractured zones were observed in the rock cores, which contributed to the relatively low RQD values. The core data also reveals that there is no trend of improving rock quality with depth. Based on these results the rock quality is considered to be very poor to poor with occasional zones of fair to good quality rock.



5.3.8 Water Levels

Standpipe piezometers were installed in selected boreholes. The water level readings measured on separate visits made after the completion of drilling are presented in Table 5.3.2.

Table 5.3.2 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
WE-S 10+200Lt	November 09, 2009	6.8	174.8
	November 20, 2009	3.2	178.4
	November 30, 2009	2.7	178.9
	December 07, 2009	2.6	179.0
	December 15, 2009	2.6	179.0
TEW4	January 11, 2010	10.2	172.4
	January 19, 2010	10.6	172.0
	January 27, 2010	10.5	172.1
	February 08, 2010	10.6	172.0
TEW1	January 19, 2010	3.2	179.3
	January 27, 2010	2.4	180.1
	February 08, 2010	2.4	180.1
WE-S 10+345CL	November 19, 2009	4.0	178.8
	November 30, 2009	3.4	179.4
	December 07, 2009	3.1	179.7
	December 15, 2009	3.0	179.8
	January 11, 2010	2.6	180.2
	January 27, 2010	2.7	180.1
WE-S 10+360Lt	November 20, 2009	6.3	177.1
	November 30, 2009	7.7	175.7
	December 15, 2009	5.9	177.5
	January 04, 2010	5.7	177.7
	January 11, 2010	5.5	177.9

The ground water table was estimated based on the recorded water levels in the standpipe piezometers, our review of moisture contents of the retrieved samples and the change in colour of the soil matrix from brown to grey. This interpretation indicates an estimated ground water table of Elev. ± 179.5 m at Sta. 10+200, increasing southward to about Elev. ± 180.5 m from Sta. 10+250 to Sta. 10+360. The ground water table is estimated to be at Elev. ± 181.0 m at Sta. 10+425.

All ground water observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

5.4 Site 4 – Highway 406 NBL & SBL

Reference is made to the Record of Borehole sheets in Appendix A4. Details of the encountered soil and stratigraphy are presented in these appendices and on the “Borehole Locations and Soil Strata” drawings in Appendix C4. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil and about 25.9 m to 30.6 m of overburden soils consisting of fill material (compact to very dense sandy gravel to gravelly sand, loose to compact silty sand to sand and silt and soft to hard silty clay) and native deposits of firm to hard silty clay, loose to very dense silt, very stiff to hard clayey silt, stiff to hard silty clay to clayey silt till, dense



to very dense sand, compact to very dense silty sand to sandy silt till and compact to very dense sandy gravel to sand and gravel till. These soils are underlain by bedrock of the Salina Formation.

5.4.1 Topsoil

Topsoil ranging from 25 mm to 380 mm in thickness was encountered at this site. Topsoil thickness may vary between and beyond the boreholes.

5.4.2 Fill – Sandy Gravel to Gravelly Sand

Some of the boreholes were extended through the gravel shoulders of roadways where they encountered granular fill material ranging in composition from sandy gravel to gravelly sand. This fill extends to depths ranging from 0.4 m to 0.8 m below ground surface or to elevations ranging from 184.9 m to 180.6 m.

The grain size distribution plots of tested samples of this granular fill are depicted in Figure B4-1. These results show a grain size distribution consisting of 30-72% gravel, 17-51% sand and 7-16% silt and 2-4% clay size particles.

Standard Penetration tests in the granular fill gave 'N' values that ranged from 11 to 53 blows for 0.3 m penetration. Based on these results the fill is considered to have a compact to very dense relative density. The moisture content of samples of the fill ranged from 2% to 6% by weight.

5.4.3 Fill – Silty Sand to Sand and Silt

Fill material consisting of silty sand to sand and silt was encountered in Boreholes TN1, NBL 12+645Rt and SBL 12+650CL extending to depths ranging from 0.2 m to 1.4 m below ground surface or to elevations ranging from 183.0 m to 180.8 m.

The grain size distribution plots of tested samples of these fill are presented in Figure B4-2. These results show a grain size distribution consisting of 13-17% gravel, 57-65% sand and 18-22% silt and 8% clay size particles.

The blow counts from Standard Penetration tests conducted in this fill material ranged from 5 to 16 blows for 0.3 m penetration. Based on these results the fill is considered to have a loose to compact relative density. The moisture content of samples of this fill ranged from 5% to 19% by weight.

5.4.4 Fill – Silty Clay

Silty clay fill material was encountered at this site extending to depths ranging from 0.7 m (Elev. 183.9 m) to 3.7 m (Elev. 178.8 m) below ground surface.

The grain size distribution plots of tested samples of this fill are illustrated in Figures B4-3 to B4-5 inclusive. These results show a grain size distribution consisting of 0-15% gravel, 1-18% sand, 35-67% silt and 22-63% clay size particles.



Samples of the fill were also subjected to Atterberg Limits tests and the results are presented in Figures B4-6 and B4-7. The index values from these tests are summarized below:

Liquid Limit:	24-59%
Plastic Limit:	14-27%
Plasticity Index:	10-32%
Natural Moisture Content:	15-39%

These values are characteristic of clayey soils of low to high plasticity.

Standard Penetration tests in the silty clay fill gave 'N' values ranging from 2 to 91 blows for 0.3 m penetration. Based on these results the fill is considered to have a soft to hard consistency. The moisture content of samples of the silty clay fill generally ranged from 6% to 33% by weight and moisture contents of 37% to 44% (by weight) were recorded from samples retrieved from organic rich zones in the fill.

5.4.5 Silty Clay

All of the boreholes encountered a native silty clay deposit. This deposit was fully penetrated in some of the boreholes where it was found to extend to depths ranging from 13.2 m to 15.7 m below ground surface or to elevations ranging from 169.5 m to 166.9 m. Boreholes were also terminated in this deposit at depths ranging from 14.6 m to 5.5 m or to elevations ranging from 178.8 m to 168.5 m.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B4-8 to B4-38 inclusive. These results show a grain size distribution consisting of 0-17% gravel, 0-11% sand, 36-87% silt and 12-63% clay size particles. One tested sample from borehole TN3 at approximately 5.5 m depth (Elev. 178.6 m) contained 41% sand and was described as sandy.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B4-39 to B4-68 inclusive. The index values from these tests are summarized below:

Liquid Limit:	23-52%
Plastic Limit:	10-24%
Plasticity Index:	5-29%
Natural Moisture Content:	12-33%

These values indicate that the silty clay has a generally low to intermediate plasticity with occasional zones of high plasticity and infrequent clayey silt zones.

Standard Penetration tests in this stratum gave 'N' values that ranged from 1 to 61 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 32 kPa to in excess of 100 kPa. Unconfined compression tests gave undrained shear strengths ranging from 36 kPa to 93 kPa and laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 49 kPa to in excess of 100 kPa. The variation of undrained shear strength with elevation is depicted in Figures B4-88 and B4-89. These values indicate that



the consistency of the silty clay is generally stiff to hard with infrequent firm zones. There are no discernable trends of undrained shear strength with depth. The moisture content of samples from this stratum ranged from 10% to 33% by weight and the unit weight of tested samples ranged between 20.4 and 21.1 kN/m³.

The Atterberg Limits tests results are also plotted against elevation, Figures B4-90 and B4-91. These results illustrate that the natural moisture contents are generally at or below the plastic limit above Elev. 178.0 m. Below Elev. 178.0 the moisture content increases and is generally between the plastic and liquid limit up to Elev. 169.0 m. Below Elev. 169.0 m the natural moisture content decreases and is generally at or below the plastic limit.

Consolidation tests were also performed on Shelby tube samples retrieved from Boreholes NBL 12+375Lt, NBL 12+440Rt, NBL 12+695Lt, NBL 12+750Rt, SBL 12+360CL, SBL 12+410CL, SBL 12+685CL, and SBL 12+750CL and the results are presented in Figures B4-92 to B4-115 inclusive. Preconsolidation pressures were estimated from the e-log p curves. Due to the rounded nature of the curves the preconsolidation pressures were also assessed based on the 'Work' – method proposed by Becker et al. (1987). The details of the test results are summarized below.

Borehole/Sample No.	Sample Depth/Elevation (m)	P _c (kPa)	C _c	C _r	e _o
NBL 12+375Lt. TW9	9.1/174.2	310	0.204	0.036	0.60
NBL 12+440Rt. TW10	10.7/172.3	370 – 480	0.193	0.025	0.59
NBL 12+695Lt. TW11	12.2/170.7	320 – 450	0.224	0.028	0.60
NBL 12+750Rt. TW9	9.1/173.7	320 – 340	0.194	0.026	0.57
SBL 12+360CL TW10	10.7/172.2	340 – 500	0.201	0.030	0.57
SBL 12+410CL TW9	9.1/173.4	300 – 350	0.205	0.031	0.60
SBL 12+685CL TW10	10.7/172.0	370 – 550	0.233	0.027	0.59
SBL 12+750CL TW10	9.9/173.0	370 – 380	0.171	0.020	0.50

Where: P_c = Preconsolidation pressure
C_c = Compression index
C_r = Recompression index
e_o = Initial void ratio

5.4.6 Silt

A discontinuous silt deposit was encountered at this site. The deposit is approximately 0.5 m to 1.9 m thick and extends to depths ranging from 2.1 m (Elev. ±180.7 m) to 5.9 m (Elev. ±176.8 m) below ground surface. Based on visual and tactile examinations of the retrieved samples, the unit is essentially a cohesionless silt with frequent cohesive silty clay seams and partings.

The grain size distribution plots of tested samples of the silt are presented in Figures B4-69 and B4-70. These results show a grain size distribution consisting of 0-1% gravel, 0-2% sand, 75-87% silt and 12-22% clay size particles.

The deposit is considered to have a loose to very dense relative density based on SPT 'N' values that ranged from 9 to 64 blows for 0.3 m penetration. The moisture content of samples from this deposit ranged from 16% to 23% by weight.



5.4.7 Clayey Silt

A clayey silt deposit was encountered at this site in Boreholes NBL 12+835Lt and NBL 12+835Rt. The deposit is approximately 1.5 m to 1.6 m thick and extends to depths of 5.6 m (Elev. ± 175.6 m) and 7.1 m (Elev. ± 175.8 m) below ground surface.

The grain size distribution plot of a tested sample of the clayey silt is presented in Figure B4-71. These results show a grain size distribution consisting of 0% gravel, 0% sand, 87% silt and 13% clay size particles.

A sample of the clayey silt was also subjected to Atterberg Limits tests and the results are presented in Figures B4-72. The index values from these tests are summarized below:

Liquid Limit:	23%
Plastic Limit:	17%
Plasticity Index:	6%
Natural Moisture Content:	21%

These values indicate that a low plasticity clayey silt.

Standard Penetration tests in this stratum gave 'N' values ranging from 15 to 34 blows for 0.3 m penetration. Field vane tests were also attempted in these deposits and the results (no-turn on vane) indicate undrained shear strengths more than 100 kPa. Based on these results the clayey silt is considered to have a very stiff to hard consistency. The moisture content of samples from this stratum ranged from 19% to 21% by weight.

5.4.8 Silty Clay to Clayey Silt Till

Discontinuous layers of silty clay to clayey silt till were encountered at this site. An upper silty clay to clayey silt till unit was encountered directly underlying the native silty clay deposit. This unit was fully penetrated in the deep boreholes drilled at the proposed Trillium Overhead and Woodlawn Overhead structures where it was found to extend to depths ranging from 16.2 m to 21.6 m below ground surface or to elevations of 165.4 m to 161.7 m. Boreholes NBL 12+525Lt, NBL 12+595Rt, SBL 12+485Lt, SBL 12+485Rt and SBL 12+525CL were terminated within the upper silty clay to clayey silt till stratum at depths ranging from 14.2 m (Elev. 167.4 m) to 17.0 m (Elev. 164.8 m) below ground surface. Some of the deep boreholes drilled for the Trillium Overhead and Woodlawn Overhead structures encountered lower deposits of silty clay to clayey silt till that extends to depths ranging from 22.3 m (Elev. 160.8 m) to 28.4 m (Elev. 155.1 m) below ground surface.

The grain size distribution plots of samples of the silty clay to clayey silt till deposits are presented in Figures B4-73 to B4-77 inclusive. These results show a grain size distribution consisting of 0-20% gravel, 3-39% sand, 35-76% silt and 12-42% clay size particles. Till soils can also be expected to contain random cobble and boulder inclusions.



Samples of the silty clay to clayey silt till were also subjected to Atterberg Limits tests and the results are presented in Figures B4-78 to B4-82 inclusive. The index values from these tests are summarized below:

Liquid Limit:	15-32%
Plastic Limit:	11-16%
Plasticity Index:	4-16%
Natural Moisture Content:	7-29%

These values indicate low plasticity silty clay and clayey silt soils.

Standard Penetration tests in the silty clay to clayey silt till yielded 'N' values ranging from 10 to more than 100 blows for 0.3 m penetration. Field vane tests gave in-situ undrained shear strengths ranging from 88 kPa to in excess of 100 kPa. These values indicate that the consistency of the silty clay to clayey silt till is generally very stiff to hard with occasional stiff zones. Moisture contents of samples of the silty clay to clayey silt till range from 2% to 29% by weight.

5.4.9 Sand

Discontinuous layers of sand and gravel to gravelly sand were encountered at this site in Boreholes TS1, TS2, and TS3. These deposits are approximately 0.8 m to 2.4 m thick and extend to depths ranging from 24.8 m (Elev. 157.8 m) to 26.2 m (Elev. 157.1 m) below ground surface.

Two samples from these strata were subjected to a grain size distribution tests and the results are illustrated in Figure B4-83. These results show a grain size distribution consisting of 31-32 % gravel, 56-57 % sand and 12 % silt and clay size particles.

Standard Penetration tests in these deposits gave 'N' values that ranged from 40 to more than 100 blows per 0.3 m penetration. Based on these results the deposits are considered to have a dense to very dense relative density. The moisture content of samples from these strata ranged from 5% to 14% by weight.

5.4.10 Sandy Silt to Silty Sand Till

Till deposits ranging in composition from sandy silt to sand some silt were encountered in the deep boreholes drilled for the Trillium Overhead and Woodlawn Road Overhead structures. These deposits extend to depths ranging from 23.9 m to 30.6 m below ground surface or to elevations ranging from 160.3 m to 153.0 m.

The results of grain size distribution tests conducted on samples obtained from these till deposits are illustrated in Figures B4-84 to B4-86 inclusive. These results show grain size distributions of 2-27% gravel, 10-72% sand, 15-72% silt and 4-17% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in these deposits gave 'N' values that ranged from 28 to more than 100 blows per 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 4% to 28% by weight.



5.4.11 Sandy Gravel to Sand and Gravel Till

Till deposits consisting of sandy gravel to sand and gravel were encountered in the deep boreholes drilled for the Trillium Overhead structures. These deposits were found to extend to depths ranging from 28.4 m and 30.5 m below the ground surface or to elevations ranging from 154.5 m to 153.7 m.

Grain size distribution tests were performed on representative samples from these deposits and the results are illustrated in Figure B4-87. These results show grain size distributions of 31-51% gravel, 26-41% sand, 14-29% silt and 5-7% clay size particles. Till soils will also contain random cobble and boulder inclusions.

The blow counts from Standard Penetration tests conducted in these deposits ranged from 23 to more than 100 blows for 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 1% to 10% by weight.

5.4.12 Bedrock (Salina Formation)

The overburden soils described above are underlain by the Salina Formation. Bedrock was proved by coring at the abutment locations of the proposed bridge structures on the NBL and SBL alignments. Table 5.4.1 summarizes the bedrock depth and the elevations to the top of bedrock.

Table 5.4.1 – Depth to Bedrock

Bridge	Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
Trillium NBL	South Abutment	TN1	30.5	153.0
		TN2	30.5	153.7
	North Abutment	TN3	29.6	154.5
		TN4	30.6	153.4
Trillium SBL	South Abutment	TS1	28.4	154.2
		TS2	29.4	153.9
	North Abutment	TS3	28.7	153.8
		TS4	28.4	154.0
Woodlawn NBL	South Abutment	WN1	27.4	155.7
		WN2	25.9	155.7
	North Abutment	WN3	26.4	155.7
		WN4	26.0	156.5
Woodlawn SBL	South Abutment	WS1	27.5	155.2
		WS2	27.3	155.8
	North Abutment	WS3	25.9	157.1
		WS4	26.3	156.4

The bedrock is described as unweathered interbedded dolostone and shale and its colour is generally grey. It is thinly laminated with white unweathered gypsum and calcite veins and coarse grained calcitic vugs. Total core recovery in the bedrock generally ranged from 20% to 100% and a recorded TCR of 0% was obtained in the first run of Borehole TN2.

The RQD values ranged widely from 0% to 78% but generally most of the RQD values were below 50%. An RQD of 0% was obtained from the first run in Boreholes TN2, TN4, TS3, WN3, and WS1. Rubble and highly fractured zones were observed in the rock cores, which contributed to the relatively low RQD values. The core data also reveals that there is no trend of improving rock



quality with depth. Based on these results the rock quality is considered to be very poor to poor with occasional zones of fair to good quality rock.

5.4.13 Water Levels

A standpipe piezometer was installed in selected boreholes. The water level readings measured on separate visits made after the completion of drilling are presented in Table 5.4.2.

Table 5.4.2 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
NBL 12+075CL	November 20, 2009	4.2	180.4
	December 08, 2009	1.2	183.4
	January 04, 2010	1.5	183.1
	January 19, 2010	1.8	182.8
NBL 12+225CL	December 08, 2009	2.0	182.9
	April 16, 2010	2.0	182.9
	April 29, 2010	2.1	182.8
NBL 12+375Lt	November 19, 2009	5.8	177.5
	November 30, 2009	3.2	180.1
	December 07, 2009	1.3	182.0
	December 15, 2009	1.8	181.5
	January 19, 2010	1.7	181.6
TN2	April 16, 2010	2.6	181.6
	April 29, 2010	1.6	182.6
	May 04, 2010	6.2	178.0
	May 06, 2010	6.2	178.0
TN3	April 16, 2010	3.9	180.2
	April 29, 2010	4.7	179.4
	May 04, 2010	8.7	175.4
	May 06, 2010	9.4	174.7
	May 18, 2010	3.8	180.3
NBL 12+440Rt	November 09, 2009	8.2	174.8
	November 19, 2009	2.1	180.9
	November 30, 2009	1.9	181.1
	December 08, 2009	1.9	181.1
NBL 12+525Lt	November 30, 2009	9.4	173.4
	December 07, 2009	6.2	176.6
	December 15, 2009	4.7	178.1
	January 04, 2010	3.4	179.4
	January 11, 2010	3.3	179.5
	January 19, 2010	3.3	179.5
NBL 12+525Rt	November 09, 2009	10.8	171.2
	November 19, 2009	4.6	177.4
	November 30, 2009	2.4	179.6
	December 08, 2009	2.0	180.0
	January 04, 2010	2.0	180.0
NBL 12+645Lt	November 09, 2009	10.3	173.0
	November 19, 2009	3.9	179.4
	November 30, 2009	5.9	177.4
	December 08, 2009	3.0	180.3
	December 15, 2009	3.0	180.3
NBL 12+645Rt	November 30, 2009	2.2	178.8
	December 08, 2009	2.0	179.0
	January 04, 2010	1.5	179.5
	January 11, 2010	1.8	179.2
	January 19, 2010	1.9	179.1



Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
NBL 12+695Lt	November 30, 2009	9.3	173.6
	December 15, 2009	3.4	179.5
	January 04, 2010	3.2	179.7
	January 11, 2010	3.3	179.6
	January 19, 2010	3.4	179.5
WN2	January 04, 2010	5.2	176.4
	January 11, 2010	4.2	177.4
	January 19, 2010	5.2	176.4
	January 27, 2010	5.2	176.4
WN3	April 16, 2010	7.7	174.4
	April 29, 2010	3.9	178.2
	May 04, 2010	5.2	176.9
	May 06, 2010	4.8	177.3
NBL 12+750Rt	December 15, 2009	5.1	177.7
	January 04, 2010	2.7	180.1
	January 11, 2010	2.7	180.1
	January 19, 2010	2.8	180.0
NBL 12+835Rt	November 09, 2009	6.7	176.2
	November 19, 2009	2.7	180.2
	November 30, 2009	2.5	180.4
	December 08, 2009	2.3	180.6
	December 15, 2009	2.3	180.6
NBL 12+985Rt	November 19, 2009	3.1	179.2
	November 30, 2009	2.9	179.4
	December 08, 2009	2.5	179.8
	December 15, 2009	1.9	180.4
	January 04, 2010	1.9	180.4
SBL 12+185Lt*	November 30, 2009	0.1	183.1
	-	-	-
SBL 12+360CL	November 19, 2009	5.0	177.9
	November 30, 2009	2.6	180.3
	December 07, 2009	2.4	180.5
	December 15, 2009	2.3	180.6
	January 04, 2010	2.1	180.8
	January 11, 2010	2.1	180.8
TS1	January 19, 2010	10.6	172.0
	January 27, 2010	10.4	172.2
	February 08, 2010	10.5	172.1
TS4	January 11, 2010	9.4	173.0
	January 19, 2010	9.9	172.5
	January 27, 2010	10.2	172.2
	February 08, 2010	10.4	172.0
SBL 12+410CL	November 30, 2009	1.7	180.8
	December 07, 2009	1.4	181.1
	December 15, 2009	1.3	181.2
SBL 12+525CL	November 19, 2009	4.5	177.3
	November 30, 2009	5.4	176.4
	December 07, 2009	4.5	177.3
	December 15, 2009	4.2	177.6
	January 04, 2010	4.1	177.7
SBL 12+600Rt	November 19, 2009	6.4	175.7
	November 30, 2009	8.3	173.8
	December 08, 2009	2.7	179.4
	January 04, 2010	1.4	180.7
	January 11, 2010	1.8	180.3
	January 19, 2010	1.6	180.5
SBL 12+685CL*	-	-	-
WS1	January 27, 2010	6.8	175.9
	February 08, 2010	6.8	175.9



Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
WS4	February 08, 2010	4.7	178.0
	April 16, 2010	2.1	180.6
	April 29, 2010	5.1	177.6
	May 04, 2010	5.7	177.0
	May 06, 2010	4.1	178.6
	May 18, 2010	5.9	176.8
SBL 12+750CL	November 19, 2009	4.6	178.3
	November 30, 2009	7.8	175.1
	December 08, 2009	4.1	178.8
	December 15, 2009	3.2	179.7
	January 04, 2010	2.7	180.2
	January 11, 2010	2.7	180.2
	January 19, 2010	2.6	180.3
SBL 12+900CL	November 19, 2009	2.5	180.2
	November 30, 2009	2.3	180.4
	December 08, 2009	2.0	180.7
	December 15, 2009	1.5	181.2
	January 04, 2010	1.7	181.0
	January 11, 2010	1.9	180.8
	January 19, 2010	1.7	181.0

* Piezometer destroyed after installation.

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a ground water table that is estimated to range between Elev. ± 179.5 m and Elev. ± 181.0 m. Perched water can also be expected to occur where permeable layers of sand and gravel and sand and silts are underlain by more impermeable silty clay soils.

All ground water observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

5.5 Miscellaneous

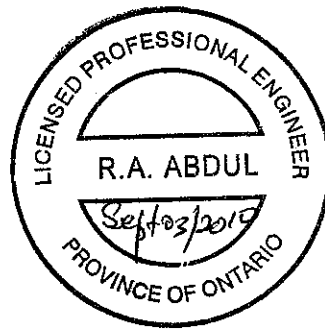
The drilling, sampling and in-situ testing operations were conducted with track and truck mounted drill rigs owned and operated by Groundworks Drilling Limited of Toronto, Ontario, DBW Drilling Limited of Ajax, Ontario and Determination Drilling & Soil Investigations of Hamilton, Ontario. The boreholes were advanced using both solid stem and hollow-stem auger drilling techniques and casing and washboring methods. NQ size rock cores of the bedrock were obtained using diamond drilling techniques.

Messrs. Phil Khuu, B.A.T., Marc Paoliello, E.I.T., Alexander Winkelmann, E.I.T. and Lucas Yu, E.I.T. observed and recorded the field work. The laboratory testing was performed at Terraprobe's Brampton laboratory and the Mississauga laboratory of Golder Associates. The report was written by Rehman Abdul, P.Eng. and reviewed by Michael Tanos, P.Eng.



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Review Principal



FOUNDATION DESIGN REPORT
DEEP CUTS & HIGH FILLS
HIGHWAY 406 TWINNING
ONTARIO
AGREEMENT No. 2008-E-0016, W.P. 280-99-00

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

6 DISCUSSION AND RECOMMENDATIONS

6.1 General

Earth Cuts (Site 1)

Earth cuts on this project will expose cohesive silty clay and clayey silt soils. Due to the inherent cohesive nature of these soils and the effects of local climate (precipitation, wetting and drying cycles, snow melt, freezing and thawing cycles), side slopes of 3H:1V are recommended in order to minimize shallow surficial failures.

The global, internal and surficial stability of the cut will depend on the slope geometry and also to a large degree on the properties of the existing soils. For the purpose of stability analyses, the commercially available slope stability program Slide 5.0 developed by Rocscience Inc. was used. The Janbu, Morgenstern-Price and Bishop's simplified method for stability analysis were employed and a minimum target factor of safety of 1.3 was established.

For the undrained (short-term) analyses, the measured field vane results were corrected by applying a vane shear correction factor intended to compensate for pore-pressure and shearing-rate effects during field testing. The correction factor was derived in accordance with Morris and Williams (1994)³.

Where cut slopes are higher than 6 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the cut section height exceeds 6 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

³ Morris, P.M., and Williams, D.T. (1994). "Effective Stress Vane Shear Strength Correction Factor Correlations," Canadian Geotechnical Journal, Vol.31, No.3, pp. 335-342.



Embankment Stability (Sites 2, 3 and 4)

Embankments constructed with local cohesive earth fill at conventional 2H:1V slopes in the Niagara area have historically performed below par. Shallow surficial failures usually occur on the face of these slopes thereby requiring frequent maintenance in order to prevent more significant deep-seated failures.

Recent studies conducted by the Ministry of Transport indicate that these shallow surficial failures occur because of the mineralogy of the local soils and its inherent effect on the effective shear strength of the local clay fill. Poor performance was also attributed to climatic effects including precipitation, wetting and drying cycles, snow melt and freezing and thawing cycles.

The historical performance of existing embankments in the area was considered when selecting embankment alternatives and design side slopes for this project. The selected alternatives are outlined below and a summary of the advantages, disadvantages, risks/consequences and approximate costs of each alternative is presented in Appendix E.

- Embankments consisting of local earth borrow.
- Composite embankment consisting of a local earth borrow core protected with a Granular A face.
- Embankments consisting of SSM imported from a designated source.
- Embankments consisting of rock fill.

The global, internal and surficial stability of the embankments will depend on their slope geometries and also to a large degree on the material used to construct the embankment. For the purpose of embankment stability analyses, the commercially available slope stability program Slide 5.0 developed by Rocscience Inc. was used. The Janbu, Morgenstern-Price and Bishop's simplified method for stability analysis were employed and a minimum target factor of safety of 1.3 was established. Critical sections were selected where the embankment height was the greatest and also where the subsurface soils were the weakest.

For the undrained (short-term) analyses, the measured field vane results were corrected by applying a vane shear correction factor intended to compensate for pore-pressure and shearing-rate effects during field testing. The correction factor was derived in accordance with Morris and Williams (1994).

In our analysis we incorporated a 2 m wide mid-height berm for earth fill, composite and SSM embankment heights equal to or greater than 8 m and for rock fill embankment heights equal to or greater than 10 m.

The composite embankment was modelled as a core of local earth fill material with a Granular A facing as depicted in Figure G2. Constructing this type of embankment requires benching the earth core/Granular A interface in accordance with OPSD 208.010.

Where earth fill, composite or SSM embankments are higher than 8 m, mid-height berms should be incorporated in the design. The berms should:



- extend for the length through which the embankment height exceeds 8 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

Where rock fill embankments are higher than 10 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the embankment height exceeds 10 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

Rock fill shall consist of rock as defined in OPSS 206 excluding shale.

Embankment Settlement (Sites 2, 3 and 4)

To predict the magnitude and time rate of settlement of the underlying silty clay soils the commercially available program Settle 3D developed by Rocscience Inc. was used. The highest embankment sections (next to the bridge approaches) and the areas where the on-ramps will tie into the Highway 406 NBL and SBL were selected as critical sections.

The deformation parameters used for the analyses were established from data obtained from consolidation tests as well as from predictions based on undrained shear strengths, laboratory index tests and soil moisture contents.

Pre-consolidation pressures were estimated from the consolidation test e-log p curves and the Strain-Energy method proposed by Becker (1987). The empirical correlation suggested in the literature by Skempton (1957) was also used to estimate preconsolidation pressures. Profiles of the preconsolidation pressure range versus elevation are illustrated as follows: Site 2, Figure F2-1, Site 3, Figure F3-1 and Site 4, Figures F4-1 to F4-4. The vertical effective overburden stress is also plotted on these figures.

Values of the compression index (C_c) and recompression index (C_r) were estimated from the consolidation tests as well as from laboratory index test data using empirical correlations proposed in literature by Terzaghi and Peck (1967), Osterberg (1972), Nagaraj and Murty (1985), Lav & Ansal (2001), Kulhawy and Mayne (1990) and Das (1993). Profiles of the design lines versus elevation are shown on Figures F2-2 and F2-3 (Site 2), Figures F3-2 and F3-3 (Site 3) and Figures F4-5 to F4-12 (Site 4).

Initial void ratio (e_0) values were estimated from the consolidation tests as well as from empirical correlations proposed in the literature by Cozzolino (1961) and Azzouz et al. (1976). Profiles of the design lines versus elevation are shown on Figure F2-4 (Site 2), Figure F3-4 (Site 3) and Figures F4-13 to F4-16 (Site 4).

Settlement monitoring is a requirement to confirm that most of the settlement is complete prior to commencing paving operations and a special provision for the supply and installation of embankment monitoring equipment will be required. This special provision and drawings of the



proposed settlement instrumentation plan will be provided when the embankment composition and detour/staging details are finalized.

6.2 SITE 1 – Ramp East Main Street E – N

6.2.1 General

An earth cut is required on Ramp East Main Street E – N between Sta. 10+000 and Sta. 10+340 approximately. The design grade of the alignment ranges from Elev. 167.5 m at Sta. 10+000 increasing to Elev. 181.8 m at Sta. 10+340. Based on this profile and the current ground surface it is envisaged that up to ± 10.5 m deep earth cuts are required.

In general, the site is underlain by overburden soils consisting of topsoil, native deposits of firm to hard silty clay, very stiff clayey silt, stiff to very stiff silty clay till and compact silt till. The local ground water table at the site generally follows the ground surface topography. The water level exists at Elev. ± 173.1 m at Sta. 10+125 and it rises to Elev. ± 178.7 m at Sta. 10+225.

The discussion and recommendations presented herein are based on our understanding of the project and on the factual data obtained in the course of the investigations.

6.2.2 Design Considerations

Tabulated below are the soil parameters used for the slope stability analyses.

Material Type	Short-Term Analysis			Long-Term Analysis		
	ϕ (degrees)	c (kPa)	γ (kN/m ³)	ϕ (degrees)	c (kPa)	γ (kN/m ³)
Silty Clay	0	50 – 120	20	27	7	20
Silt Till	30	0	19	30	0	19
Silty Clay Till	0	75 – 120	21	29	5	21

Stability analyses were conducted at selected sections for short-term and long-term conditions and slope stability models depicting the corresponding factors of safety are provided in Appendix D1. A target factor of safety of 1.3 was used for both short term and long term conditions and ditching was also accounted for in the stability analyses. Tabulated below are the minimum factors of safety obtained for potential failure surfaces.

Ramp East Main Street E-N Sta.10+000 to Sta.10+340

Location	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Sta. 10+075	3H:1V	4.1	1.4
Sta. 10+125	3H:1V	3.4 – 3.6	1.3
Sta. 10+175	3H:1V	3.1	1.5
Sta. 10+225	3H:1V	8.0	1.7

The analysis indicates that design side slopes of 3H:1V will have acceptable factors of safety of 1.3 or greater with respect to both shallow surficial failures and deep seated failures in the underlying soils.



6.3 SITE 2 – Woodlawn I/C Southeast Quadrant

6.3.1 General

Two ramps will be constructed in the southeast quadrant of the Woodlawn Road interchange. Ramp 406S – Woodlawn E/W extends from Sta. 10+000 to Sta. 10+434 approximately and the design grade ranges from Elev. 192.3 m (Sta. 10+000) decreasing to Elev. 182.7 m (Sta. 10+434). This ramp will also cross the Trillium Railway via a single span bridge. The maximum height of embankment fill is approximately 10 metres measured from existing grade.

Ramp Woodlawn W – 406N extends from Sta. 10+000 to Sta. 10+296 approximately and the design grade ranges from Elev. 182.4 m (Sta. 10+000) increasing to Elev. 190.6 m (Sta. 10+296). The maximum height of embankment fill is approximately 10 metres measured from existing grade.

6.3.2 Embankment Stability

The soil parameters used for the slope stability analyses are presented in Table 6.3.1.

Table 6.3.1 – Soil Parameters Woodlawn I/C Southeast Quadrant

Material Type	Short-Term Analysis			Long-Term Analysis		
	ϕ (degrees)	C (kPa)	γ (kN/m ³)	ϕ (degrees)	c (kPa)	γ (kN/m ³)
Local Earth Fill	31	0	19.0	31	0	19.0
Granular A	35	0	22.8	35	0	22.8
Select Subgrade Material	32	0	20.0	32	0	20.0
Rock Fill	42	0	19.0	42	0	19.0
Fill – Silty Clay	0	50	18.0	27	5	18.0
Fill – Sand and Gravel	30	0	18.0	30	0	18.0
Upper Silty Clay	0	100	20.0	29	7	20.0
Lower Silty Clay	0	60	20.5	27	5	20.5
Silty Clay to Clayey Silt Till	0	200	21.0	29	5	21.0
Silty Sand Till	45	0	21.0	45	0	21.0

Numerous stability analyses were conducted and the minimum factors of safety obtained for the various embankment options are summarized in Table 6.3.2. The slope stability models and results are also illustrated in Appendix D2.

Table 6.3.2 – Woodlawn I/C Southeast Quadrant

Embankment Composition	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Local Earth Fill Embankment	3H:1V	1.8 – 2.1	1.8 – 2.1
Composite Embankment	2.5H:1V	1.6 – 1.8	1.6 – 1.8
SSM Embankment	2H:1V	1.3 – 1.5	1.3 – 1.5
Rock Fill Embankment	2H:1V	1.3 – 1.4	1.3 – 1.4

The analysis indicates that embankments constructed at the recommended design side slopes will have acceptable factors of safety of 1.3 or greater with respect to both shallow surficial failures and deep seated failures in the underlying soils.



6.3.3 Embankment Settlement

There is a wide scatter of data and a slight variation of P_c with depth. Therefore the two rows of data represent the range of values for the upper and lower half of the two strata. The parameters used for the settlement calculations are tabulated below.

Table 6.3.3 – Settlement Parameters – Woodlawn I/C Southeast Quadrant

Parameter	Southeast Quadrant	
	Upper Crust	Lower Silty Clay
Preconsolidation Pressure Range - P_c (kPa)	600 to 450 500 to 300	450 to 300 300
Coefficient of Compressibility - C_c	0.19 to 0.22	0.15 to 0.18
Recompression Index - C_r	0.03	0.02 to 0.025
Initial Void Ratio - e_0	0.9	0.62 – 0.70

Settlement analyses were undertaken for various embankment compositions and geometries and the estimated range of total settlements are provided in Table 6.3.4.

Table 6.3.4 – Estimated Total Consolidation Settlement

Type of Fill	Unit Weight of Fill (kN/m^3)	Side Slope Geometry	Settlement (mm)	
			Woodlawn E/W – 406N	406S – Woodlawn E/W
Local Earth Fill	19.0	3H:1V	105 – 125	120 – 140
Composite Embankment	19.5	2.5H:1V	110 – 125	125 – 145
SSM	20.0	2H:1V	110 – 125	125 – 145
Rock Fill	19.0	1.25H:1V	110 – 125	120 – 135

The embankment fill will also settle (fill compression) and this settlement is expected to be about 1% of the fill height for local earth fill, composite and SSM embankments. For rock fill, fill compression is expected to be:

- 0.5% of fill height for embankments up to 5 metres high,
- 0.75% of fill height for embankments of 5 to 10 metres high, and
- 1% of fill height for embankments of 10 to 15 m high.

The length of time required to complete consolidation settlement of the foundation strata is a function of the value of the coefficient of consolidation of the native silty clay strata and the assumed depth of drainage path. Given the very stiff to hard consistency, heavily over-consolidated and likely fractured nature of the desiccated upper crust, it is reasonable to assume that consolidation/recompression will occur quickly in the crust and that the rate of consolidation will be primarily controlled by the coefficient of consolidation and thickness of the underlying firm to stiff silty clay stratum. The coefficient of consolidation was estimated to range between $6.0 \times 10^{-3} \text{ cm}^2/\text{s}$ and $8.0 \times 10^{-3} \text{ cm}^2/\text{s}$.



Tabulated below is the predicted range of settlements at various time periods.

Ramp Woodlawn E/W – 406N					
Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	100 – 115	105 – 120	105 – 125	105 – 125	105 – 125
Composite Embankment	100 – 115	105 – 120	105 – 125	110 – 125	110 – 125
SSM	100 – 115	105 – 120	105 – 125	110 – 125	110 – 125
Rock Fill	100 – 115	105 – 120	105 – 125	110 – 125	110 – 125

Ramp 406S – Woodlawn E/W					
Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	110 – 125	120 – 135	120 – 140	120 – 140	120 – 140
Composite Embankment	110 – 125	120 – 135	120 – 140	125 – 145	125 – 145
SSM	110 – 125	120 – 135	120 – 140	125 – 145	125 – 145
Rock Fill	110 – 120	115 – 130	120 – 135	120 – 135	120 – 135

It is understood that the construction staging on this project is critical and it is required that paving operations commence as soon as possible with a target of 6 months after embankment construction. Given the uncertainty in accurately predicting the time rate of settlement, we recommend that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction. Surcharged embankments were analysed for stability in accordance with the recommended side slopes in Figures G3 to G6 and the analyses yielded factors of safety greater than a target factor of safety of 1.3.

6.4 SITE 3 – Woodlawn I/C Southwest Quadrant

6.4.1 General

Ramp Woodlawn E/W – 406S will be constructed in the southwest quadrant of the Woodlawn Road interchange. This ramp extends from Sta. 10+000 to Sta. 10+473 approximately and the design grade ranges from Elev. 184.0 m (Sta. 10+000) increasing to Elev. 191.0 m (Sta. 10+473). This ramp will also cross the Trillium Railway via a single span bridge. The maximum height of embankment fill is generally about 10 metres measured from existing grade.

6.4.2 Embankment Stability

The soil parameters used for the slope stability analyses are presented in Table 6.4.1.



Table 6.4.1 – Soil Parameters Woodlawn I/C Southwest Quadrant

Material Type	Short-Term Analysis			Long-Term Analysis		
	ϕ (degrees)	c (kPa)	γ (kN/m ³)	ϕ (degrees)	c (kPa)	γ (kN/m ³)
Local Earth Fill	31	0	19.0	31	0	19.0
Granular A	35	0	22.8	35	0	22.8
Select Subgrade Material	32	0	20.0	32	0	20.0
Rock Fill	42	0	19.0	42	0	19.0
Fill – Silty Clay	0	50	18.0	27	5	18.0
Upper Silty Clay	0	150	20.0	29	7	20.0
Lower Silty Clay	0	55-75	20.5	27	5	20.5
Silty Clay Till	0	200	21.0	29	5	21.0

Numerous stability analyses were conducted and the minimum factors of safety obtained for the various embankment options are summarized in Table 6.4.2. The slope stability models and results are also illustrated in Appendix D3.

Table 6.4.2 – Woodlawn I/C Southwest Quadrant

Embankment Composition	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Local Earth Fill Embankment	3H:1V	1.8 – 2.1	1.8 – 2.1
Composite Embankment	2.5H:1V	1.6 – 1.8	1.6 – 1.8
SSM Embankment	2H:1V	1.4 – 1.5	1.4 – 1.5
Rock Fill Embankment	2H:1V	1.4	1.4

The analysis indicates that embankments constructed at the recommended design side slopes will have acceptable factors of safety of 1.3 or greater with respect to both shallow surficial failures and deep seated failures in the underlying soils.

6.4.3 Embankment Settlement

There is a wide scatter of data and a slight variation of P_c with depth. Therefore the two rows of data represent the range of values for the upper and lower half of the two strata. The parameters used for the settlement calculations are tabulated below.

Table 6.4.3 – Settlement Parameters – Woodlawn I/C Southwest Quadrant

Parameter	Southwest Quadrant	
	Upper Crust	Lower Silty Clay
Preconsolidation Pressure Range - P_c (kPa)	600 to 500 500 to 400	500 to 250 400 to 250
Coefficient of Compressibility - C_c	0.19 to 0.22	0.15 to 0.18
Recompression Index - C_r	0.03	0.02 to 0.025
Initial Void Ratio - e_o	0.85	0.60 to 0.70

Settlement analyses were undertaken for various embankment compositions and geometries and the estimated range of total settlements are provided in Table 6.4.4.



Table 6.4.4 – Estimated Total Consolidation Settlement

Type of Fill	Unit Weight of Fill (kN/m ³)	Side Slope Geometry	Settlement (mm)
Local Earth Fill	19.0	3H:1V	120 – 150
Composite Embankment	19.5	2.5H:1V	125 – 155
SSM	20.0	2H:1V	125 – 155
Rock Fill	19.0	1.25H:1V	120 – 145

The embankment fill will also settle (fill compression) and this settlement is expected to be about 1% of the fill height for local earth fill, composite and SSM embankments. For rock fill, fill compression is expected to be:

- 0.5% of fill height for embankments up to 5 metres high,
- 0.75% of fill height for embankments of 5 to 10 metres high, and
- 1% of fill height for embankments of 10 to 15 m high.

The length of time required to complete consolidation settlement of the foundation strata is a function of the value of the coefficient of consolidation of the native silty clay strata and the assumed depth of drainage path. Given the very stiff to hard consistency, heavily over-consolidated and likely fractured nature of the desiccated upper crust, it is reasonable to assume that consolidation/recompression will occur quickly in the crust and that the rate of consolidation will be primarily controlled by the coefficient of consolidation and thickness of the underlying firm to stiff silty clay stratum. The coefficient of consolidation was estimated to range between $6.0 \times 10^{-3} \text{ cm}^2/\text{s}$ and $8.0 \times 10^{-3} \text{ cm}^2/\text{s}$.

Tabulated below is the range of predicted settlements at various time periods.

Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	110 – 130	120 – 145	120 – 150	120 – 150	120 – 150
Composite Embankment	110 – 130	120 – 145	125 – 150	125 – 155	125 – 155
SSM	110 – 130	120 – 145	125 – 150	125 – 155	125 – 155
Rock Fill	110 – 130	115 – 140	120 – 145	120 – 145	120 – 145

It is understood that the construction staging on this project is critical and it is required that paving operations commence as soon as possible with a target of 6 months after embankment construction. Given the uncertainty in predicting accurately the time rate of settlement, we recommend that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction. Surcharged embankments were analysed for stability in accordance with the recommended side slopes in Figures G3 to G6 and the analyses yielded factors of safety greater than a target factor of safety of 1.3.



6.5 SITE 4 – Highway 406 NBL & SBL

6.5.1 General

Both the north bound and south bound lanes of Highway 406 will cross over the Trillium Railway and Woodlawn Road via single span bridges and therefore embankments are required at this site. The design grade of Highway 406 NBL at the south limit (Sta. 11+950) will be Elev. 187.2 m increasing to about Elev. 193.0 m in the vicinity of the Trillium Railway (Sta. 12+410). This design grade is generally maintained up to Sta. 12+550 and then begins to decrease to about Elev. 190.3 m at the Woodlawn Road overpass (Sta. 12+725). The design grade continues to fall to the north and is at Elev. 182.0 m at the north limit, Sta. 13+220. The maximum height of embankment fill for the NBL is generally 10 metres measured from existing grade.

The design grade of Highway 406 SBL at the south limit (Sta. 11+850) will be at Elev. 187.7 m increasing to about Elev. 192.8 m in the vicinity of the Trillium Railway (Sta. 12+385). This grade profile elevation increases to Elev. 193.0 m at Sta. 12+510 and then begins to decrease to about Elev. 190.5 m at the Woodlawn Road overpass (Sta. 12+715). The grade profile continues to fall to the north and is at Elev. 181.0 m at the north limit, Sta. 13+180. The maximum height of embankment fill for the SBL is generally 10 metres measured from existing grade.

6.5.2 Embankment Stability

The soil parameters used for the slope stability analyses are presented in Table 6.5.1.

Table 6.5.1 – Soil Parameters Highway 406 NBL & SBL

Material Type	Short-Term Analysis			Long-Term Analysis		
	ϕ (degrees)	c (kPa)	γ (kN/m ³)	ϕ (degrees)	c (kPa)	γ (kN/m ³)
Local Earth Fill	31	0	19.0	31	0	19.0
Granular A	35	0	22.8	35	0	22.8
Select Subgrade Material	32	0	20.0	32	0	20.0
Rock Fill	42	0	19.0	42	0	19.0
Fill – Silty Clay	0	50	18.0	29	7	18.0
Upper Silty Clay	0	110 – 200	20.0	29	7	20.0
Lower Silty Clay	0	35 – 125	20.5	27	5	20.5
Silty Clay Till	0	200	21.0	29	5	21.0
Sand Till	45	0	21	45	0	21

Numerous stability analyses were conducted at selected sections of the alignment and the minimum factors of safety obtained for the various embankment options are summarized in Table 6.5.2. The slope stability models and results are also illustrated in Appendix D4.

Table 6.5.2 – Highway 406 NBL & SBL

Embankment Composition	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Local Earth Fill Embankment	3H:1V	1.7 – 2.3	1.8 – 2.3
Composite Embankment	2.5H:1V	1.6 – 2.2	1.6 – 2.2
SSM Embankment	2H:1V	1.4 – 1.6	1.4 – 1.6
Rock Fill Embankment	1.25H:1V	1.3 – 1.5	1.3 – 1.5



6.5.3 Embankment Settlement

There is a wide scatter of data and a slight variation of P_c with depth. Therefore the two rows of data represent the range of values for the upper and lower half of the two strata. The parameters used for the settlement calculations are tabulated below.

Table 6.5.3 – Settlement Parameters – Highway 406 NBL & SBL

Parameter	South East Quadrant	
	Upper Crust	Lower Silty Clay
Preconsolidation Pressure Range - P_c (kPa)	600 to 450 500 to 400	450 to 300 400 to 300
Coefficient of Compressibility - C_c	0.19 to 0.22	0.15 to 0.18
Recompression Index - C_r	0.03 to 0.04	0.020 to 0.029
Initial Void Ratio - e_0	0.9	0.6 to 0.65

Settlement analyses were undertaken for various embankment compositions and geometries and the estimated range of total settlements are provided in Table 6.5.4.

Table 6.5.4 – Estimated Total Consolidation Settlement

Type of Fill	Unit Weight of Fill (kN/m ³)	Side Slope Geometry	Settlement (mm)	
			Hwy. 406 NBL	Hwy. 406 SBL
Local Earth Fill	19.0	3H:1V	110 – 130	115 – 130
Composite Embankment	19.5	2.5H:1V	110 – 130	115 – 135
SSM	20.0	2H:1V	115 – 135	115 – 135
Rock Fill	19.0	1.25H:1V	110 – 130	115 – 130

The embankment fill will also settle (fill compression) and this settlement is expected to be about 1% of the fill height for local earth fill, composite and SSM embankments. For rock fill, short term fill compression is expected to be:

- 0.5% of fill height for embankments up to 5 metres high,
- 0.75% of fill height for embankments of 5 to 10 metres high, and
- 1% of fill height for embankments of 10 to 15 m high.

The length of time required to complete consolidation settlement of the foundation strata is a function of the value of the coefficient of consolidation of the native silty clay strata and the assumed depth of drainage path. Given the very stiff to hard consistency, heavily over-consolidated and likely fractured nature of the desiccated upper crust, it is reasonable to assume that consolidation/recompression will occur quickly in the crust and that the rate of consolidation will be primarily controlled by the coefficient of consolidation and thickness of the underlying firm to stiff silty clay stratum. The coefficient of consolidation was estimated to range between $6.0 \times 10^{-3} \text{ cm}^2/\text{s}$ and $1.2 \times 10^{-2} \text{ cm}^2/\text{s}$.



Tabulated below is the range of predicted settlements at various time periods.

Highway 406 NBL					
Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	95 – 110	100 – 120	110 – 125	110 – 130	110 – 130
Composite Embankment	95 – 110	105 – 120	110 – 125	110 – 130	110 – 130
SSM	95 – 110	105 – 120	110 – 130	110 – 130	115 – 135
Rock Fill	95 – 110	105 – 120	110 – 130	110 – 130	110 – 130

Highway 406 SBL					
Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	105 – 120	110 – 125	115 – 130	115 – 130	115 – 130
Composite Embankment	105 – 120	110 – 125	115 – 130	115 – 135	115 – 135
SSM	105 – 120	110 – 130	115 – 130	115 – 135	115 – 135
Rock Fill	105 – 120	110 – 125	115 – 130	115 – 130	115 – 130

It is understood that the construction staging on this project is critical and it is required that paving operations commence as soon as possible with a target of 6 months after embankment construction. Given the uncertainty in accurately predicting the time rate of settlement, we recommend that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction. Surcharged embankments were analysed for stability in accordance with the recommended side slopes in Figures G3 to G6 and the analyses yielded factors of safety greater than a target factor of safety of 1.3.

7 CONSTRUCTION STAGING

Initially it was thought that total consolidation settlements might interfere with construction staging of advance contracts, and might require special treatment (surcharging, light weight fill, wick drains). Detailed analysis was conducted to evaluate the settlement performance requirements.

It is anticipated that the areas where settlement will be critical will be where the embankments are the highest i.e. within 20 m away from the bridge abutments. After paving, a maximum allowable post construction settlement of about 25 mm in these areas would be considered acceptable for this project.

It is understood that the construction staging on this project is critical and it is required that paving operations commence as soon as possible with a target of 6 months after embankment construction. Our analyses indicates that after the first six months of embankment construction the remaining post construction settlement will be equal to or less than the acceptable maximum of 25 mm. Therefore other means/methods (light weight fill, wick drains) of accelerating the settlement are not warranted. However, a settlement monitoring program must be conducted to confirm the anticipated settlement performance. A special provision for the supply and installation of embankment monitoring equipment is provided in Appendix H.



Given the uncertainty in accurately predicting the time rate of settlement we recommended that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction. Refer to Figures G3 to G6 for typical surcharge arrangements. The material costs for various surcharge materials are provided in Appendix E.

Some of the high fill areas that require surcharging are located next to the Trillium Railway. At these locations we recommend that a temporary retaining structure (Figure G7) consisting of either gabion baskets (\$355/m³) or concrete blocks (\$630/m³) be used to retain the forward slopes at a slope of 1H:1V. This arrangement will require approval/acceptance by Trillium Railway and must comply with the AREMA code.

8 CONSTRUCTION CONSIDERATIONS

8.1 SITE 1 – Ramp East Main Street E – N

It is recommended that the topsoil, any deleterious material and soft/loose and other unsuitable soils be removed within an envelope given by an imaginary slope not steeper than 1H:1V and extending from the left to right toe of the proposed cut. After stripping, the exposed subgrade and face of the cut should be inspected, approved and properly compacted from the surface, using a suitably sized compactor. Refer to Appendix G1 for a schematic figure illustrating the envelope for removal of unsuitable material.

The subgrade should be compacted and proofrolled with a heavy rubber tire vehicle (such as a loaded gravel truck) and inspected for signs of rutting or displacement. Areas with rutting or displacement should be recompacted and retested or excavated and replaced with well-compacted clean fill.

If the silty clay soils at this site become wet they will be weakened when subjected to construction traffic and it may be infeasible to effect surface compaction. In wet weather an approximately 200 mm thick free draining granular layer would also be required to minimize disturbance and maintain trafficability of construction equipment.

Earth cuts should be constructed in accordance with OPSS 201, OPSS 180, OPSS 501 and OPSS 206, as amended by Special Provision “Amendment to OPSS 206, December 1993”, dated November 2002.

Surface water runoff and ground water will have to be controlled in order to facilitate construction operations in relatively dry conditions. The ground water flow will not be significant due to the relatively low permeability of the silty clay soils and a suitable system that could be employed is a system of gravity drainage and pumping from strategically located filtered sumps as and where required. Consideration can also be given to trenching around the perimeter of the excavation by constructing the roadway ditches as soon as possible. The design of the unwatering system should be the responsibility of the Contractor.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS 577. The



slopes and crests of the cut must also be provided with permanent erosion protection in accordance with OPSS 571 and/or OPSS 572.

It is also imperative that the cut be designed to prevent surface water runoff from flowing down the face of the slope. Consideration should therefore be given to grading and shaping the ground surface at the crest of the cut to accomplish this desired effect. Surface water runoff emanating from the top of the cut must be controlled and directed to roadside ditches via armoured outfalls/outlets.

8.2 SITE 2 – Woodlawn I/C Southeast Quadrant, SITE 3 – Woodlawn I/C Southwest Quadrant, SITE 4 – Highway 406 NBL & SBL

It is recommended that the topsoil, any deleterious material and soft/loose and other unsuitable soils be removed within an envelope given by an imaginary slope not steeper than 1H:1V from the toe of the proposed embankment. Refer to Appendix G1 for a schematic figure illustrating the envelope for removal of unsuitable material.

Borrow material must meet the requirements of OPSS 212, (2008). Rock fill shall consist of rock as defined in OPSS 206 excluding shale. Grading shall be undertaken in accordance with OPSS 201, (2007) and OPSS 206, (2009). Transition treatments (earth fill to rock fill and earth fill to granular fill) should be undertaken in accordance with OPSD 205.040. The recommended stripping depths of the proposed embankments are:

SITE 2 – WOODLAWN I/C SOUTHEAST QUADRANT

Location	From Station	To Station	Average Stripping Depth (m)
Ramp 406S – Woodlawn E/W	10+000	10+070	±0.2
	10+085	10+100	±0.0
	10+100	10+375	±0.2
Ramp Woodlawn W – 406N	10+025	10+300	±0.2

SITE 3 – WOODLAWN I/C SOUTHWEST QUADRANT

Location	From Station	To Station	Estimated Stripping Depth (m)
Ramp Woodlawn WE-S	10+000	10+200	±0.2
	10+200	10+250	±0.2
	10+250	10+310	±0.0
	10+330	10+380	±0.3
	10+380	10+475	±0.2

SITE 4 – HIGHWAY 406 NORTHBOUND

Location	From Station	To Station	Estimated Stripping Depth (m)
Highway 406 NBL	11+950	11+390	±0.2
	12+420	12+700	±0.2
	12+750	13+220	±0.2



SITE 4 – HIGHWAY 406 SOUTHBOUND

Location	From Station	To Station	Estimated Stripping Depth (m)
Highway 406 SBL	11+850	12+370	±0.2
	12+400	12+690	±0.2
	12+735	13+180	±0.2

After stripping, the exposed subgrade should be inspected, approved and properly compacted from the surface in accordance with OPSS 501. If the silty clay soils at this site become wet they will be weakened when subjected to construction traffic. To facilitate construction operations in inclement weather (when stripping to the recommended subgrade elevation) surface water runoff should be controlled by gravity drainage and a system of interceptor trenches. In wet weather an approximately 200 mm thick free draining granular layer would also be required to minimize disturbance and maintain trafficability of construction equipment.

Materials used for embankment construction should be placed in lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95 % of the material's Standard Proctor Maximum Dry Density (SPMDD). Embankment construction should be in accordance with OPSS 501 and OPSS 206. Bonding between new and existing embankment fill is required by benching as per OPSD 208.010.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS 577. Fill slopes must be provided with permanent erosion protection in accordance with OPSS 571 and/or OPSS 572.

It is also imperative that the designs include provisions for preventing the flow of surface water down the face of slopes. Consideration can be given to using a mountable curb and gutter arrangement to control and divert surface water away from the top of the slope. Surface water must be directed to armoured outfalls/outlets designed to drain into roadside ditches.

Construction operations could have adverse effects on the railway track. A NSSP is required for track monitoring and repairs and requires specific inputs from Trillium Railway.

9 SEISMIC CONSIDERATIONS

9.1.1 Liquefaction Potential

Liquefaction is not considered to be an issue at this site. The underlying silty clay and silt soils are not prone to liquefaction.





Rehman Abdul

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Senior Geotechnical Engineer



Michael Tanos.

Report Reviewed by:
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Review Principal



TABLES

TERRAPROBE INC.

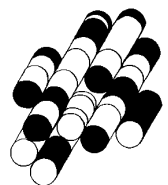
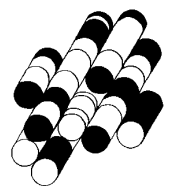


TABLE 1

DOCUMENT	TITLE
OPSS 180	Management of Excess Materials
OPSS 201	Construction Specification for Clearing, Close Cut Clearing, Grubbing and Removal of Surface and Piled Boulders.
OPSS 206	Construction Specification for Grading.
OPSS 212	Construction Specification of Borrow.
OPSS 501	Construction Specification for Compacting.
OPSS 571	Construction Specification for Sodding.
OPSS 572	Construction Specification for Seed and Cover.
OPSS 577	Construction Specification for Temporary Erosion and Sediment Control Measures.
OPSD 205.040	Transition Treatment, Earth Fill to Rock Fill and Earth Fill to Granular Fill.
OPSD 208.010	Benching of Earth Slopes.

APPENDICES

TERRAPROBE INC.



LIMITATIONS AND RISK

Procedures

The soil conditions were confirmed at the borehole and test pit locations only and conditions may vary between and beyond the boreholes. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of stratigraphic change.

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities.

Changes In Site And Scope

It must be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The design advice is based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, or there is any additional information relevant to the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructibility issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report

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EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS N.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0-12	12-25	25-50	50-100	100-200	>200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0-5	5-10	10-30	30-50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0-25	25-50	50-75	75-90	90-100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50-300mm	0.3m-1m	1m-3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_p	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{ov}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_s	kPa	REMOULDED SHEAR STRENGTH
S_i	1	SENSITIVITY = c_u / τ_s

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_p	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_u	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $(w_L - w_p)$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $(w - w_p) / I_p$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $(w - w_p) / I_p$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ²	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

EXPLANATORY SHEET FOR CORE LOG

Column Number

1. Elevation of borehole collar.
2. Depth of geotechnical boundary in borehole
3. Geologic symbol for rock or soil material
4. General description of geotechnical unit - qualitative description, including rock type(s), percentage rock types, frequency and sizes of interbeds, colour, texture.

Joint (discontinuity) Characteristics

5. Number of joint sets: a rock mass can be intersected by a number of joint sets of varying orientations.
6. Joint type: B = Bedding joint C = Cross joint
7. Orientation: only variations in dip can be identified in core; dip direction is from field mapping or oriented core:
F = Flat = 0 - 20° D = Dipping = 20 - 50° V = Vertical = 50 - 90°
8. Joint spacing: this is an approximate measure of spacing between joints in specific joint sets.

SPACING	> 3 m	1 m - 3 m	0.3 m - 1 m	50 mm - 300 mm	< 50 mm
	VERY WIDE	WIDE	MODERATE	CLOSE	VERY CLOSE

9. Roughness:

RU = Rough Undulating
SU = Smooth Undulating
LU = Slicksided Undulating

RP = Rough Planar
SP = Smooth Planar
LP = Slicksided Planar

10. Filling:

T = Tight, hard, non-softened
O = Oxidation surface staining only
SA = Slightly altered; clay-free
S = Sandy particles; clay-free
Si = Sandy and silty, minor clay
NC = Non-softening Clays; 5mm
SC = Swelling Clay fillings; 5mm

Approximate ϕ

25 - 35
25 - 30
25 - 30
20 - 25
16 - 24
6 - 12

11. Aperture: estimated size of joint opening.
12. Degree of weathered rock material:

DEGREE	DESCRIPTION
UNWEATHERED	NO SIGNS OF DISCOLOURATION OR OXIDIZATION
SLIGHTLY WEATHERED	PARTIAL DISCOLOURATION; FRACTURES (JOINTS), TYPICALLY OXIDIZED
MODERATELY WEATHERED	TOTAL DISCOLOURATION
HIGHLY WEATHERED	TOTAL DISCOLOURATION; TYPICALLY FRIABLE AND PITTED
COMPLETELY WEATHERED	RESEMBLE A SOIL; ROCK STRUCTURE - USUALLY PRESERVED

13. Strength of rock material:

		MPa
VERY HIGH STRENGTH	SPECIMEN CAN ONLY BE CHIPPED BY GEOLOGICAL HAMMER	> 200
HIGH STRENGTH	SPECIMEN REQUIRES A NUMBER OF BLOWS OF A GEOLOGICAL HAMMER TO FRACTURE IT; CANNOT BE SCRAPPED WITH POCKET KNIFE	50 - 200
MEDIUM STRENGTH	SPECIMEN CANNOT BE FRACTURED BY A SINGLE, FIRM BLOW OF GEOLOGICAL HAMMER; CAN BE SCRAPPED WITH POCKET KNIFE, NOT PEELED	15 - 50
LOW STRENGTH	SHALLOW INDENTATIONS MADE BY FIRM BLOW WITH POINT OF GEOLOGICAL HAMMER; CAN BE PEELED WITH POCKET KNIFE WITH DIFFICULTY	4 - 15
VERY LOW STRENGTH	CRUMBLES UNDER FIRM BLOW WITH POINT OF GEOLOGICAL HAMMER; CAN BE PEELED	1 - 4

14. Fracture frequency: number of natural joints occurring over a meter length of core. All natural joints are counted irrespective of the number of joint sets.

FRACTURE FREQUENCY	JOINT SPACING	LENGTH
0.3 m	VERY WIDE	> 3 m
0.3 - 1 m	WIDE	1 m - 3 m
1 - 3 m	MODERATE	0.03 m - 1 m
3 - 20 m	CLOSE	0.005 m - 0.03 m
20 m	VERY CLOSE	< 0.005 m

15. Run number and Core Recovery

(i) Drill run number

(ii) Total Core Recovery is the total length of core pieces, irrespective of their individual lengths obtained in a core run, and expressed as a percentage of the length of that core run.

16. Rock Quantity Designation (RQD): The total length of those pieces of sound core which are 0.01 metres or greater in length in a core run, expressed as a percentage of the total length of that core run. Sound pieces of rock are those pieces separated by natural breaks and not machine breaks or subsequent artificial breaks.

Rock Mass Classification (after Deare)

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
DESCRIPTION	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

17. Core and Casing sizes: changes of core and casing sizes are indicated.

18. Water recovery, level and tests:

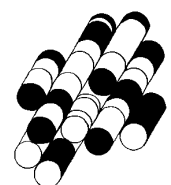
(i) percentage drill water recovery

(ii) water level depth

(iii) positions and results of tests, e.g., permeability and packer tests

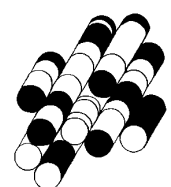
SITE 1

TERRAPROBE INC.



A1

TERRAPROBE INC.



METRIC

[illegible]

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

ONTARIO MOT 1-09-4135 EAST MAIN.GPJ ONTARIO MOT.GDT 06/21/10

RECORD OF BOREHOLE No EMN 10+125Lt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4761648.7 E:327547.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.18.10 CHECKED BY RA

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
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100							
166.4			13	SS	25		167								
16.2															
165.3	SILT some sand, trace clay, compact, brown, wet (GLACIAL TILL)		14	SS	13		166								
17.3	End of Borehole													0 16 78 6	
	Water level at 6.1m (not stabilized) and hole open to full depth on completion.														
	No sample recovery at SS7, SS8, and SS11. Sampler redriven and disturbed sample collected.														
	Unable to push vane beyond 10.1m.														
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.														
	Water Level Readings:														
	Date Depth(m) Elevation(m)														
	Jan.27.10 12.0 170.6														
	Feb.08.10 11.8 170.8														
	Feb.19.10 11.9 170.7														

ONTARIO MOT 1-05-4135 EAST MAIN GPJ ONTARIO MOT GDT 08/21/10

RECORD OF BOREHOLE No EMN 10+125Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4761674.9 E:327575.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.15.10 CHECKED BY RA

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						
182.5	Ground Surface							20 40 60 80 100						
182.4 0.1	60mm TOPSOIL							20 40 60 80 100						
	stiff		1	SS	9		182							

	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		2	SS	38		181							1 4 63 32
			3	SS	42		180							
			4	SS	35		179							
			5	SS	32		178						41	0 2 56 42
			6	SS	24		177							
			7	SS	16		176							
175.4 7.1	CLAYEY SILT very stiff, brown, damp to moist		8	SS	27		175			2.5				0 0 81 19
173.9 8.6	SILTY CLAY some sand, trace gravel, stiff to very stiff, brown, damp to moist (GLACIAL TILL)		9	SS	20		174							
			10	SS	29		173							
			11	TW	PH		172							2 21 57 20
			12	SS	11		171							
							170						21.1	
							169							
							168							5 18 57 20

ONTARIO MOT 1-09-4135 EAST MAIN.GPJ ONTARIO MOT.GDT 06/21/10

Continued Next Page

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

RECORD OF BOREHOLE No EMN 10+125Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4761674.9 E:327575.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.15.10 CHECKED BY RA

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																					
165.2			13	SS	19																																	
166																																						
165.2 17.3	End of Borehole		14	SS	28									1 11 63 25																								
<p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>No sample recovery at SS13. Sampler redriven and disturbed sample collected.</p> <p>Unable to push vane to 7.5m, 10.1m and 11.6m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Jan.19.10</td> <td>16.8</td> <td>165.7</td> </tr> <tr> <td>Jan.27.10</td> <td>16.1</td> <td>166.4</td> </tr> <tr> <td>Feb.08.10</td> <td>12.2</td> <td>170.3</td> </tr> <tr> <td>Feb.19.10</td> <td>10.1</td> <td>172.4</td> </tr> <tr> <td>Apr.16.10</td> <td>9.3</td> <td>173.2</td> </tr> <tr> <td>May.04.10</td> <td>9.4</td> <td>173.1</td> </tr> <tr> <td>May.06.10</td> <td>9.4</td> <td>173.1</td> </tr> </tbody> </table>															Date	Depth(m)	Elevation(m)	Jan.19.10	16.8	165.7	Jan.27.10	16.1	166.4	Feb.08.10	12.2	170.3	Feb.19.10	10.1	172.4	Apr.16.10	9.3	173.2	May.04.10	9.4	173.1	May.06.10	9.4	173.1
Date	Depth(m)	Elevation(m)																																				
Jan.19.10	16.8	165.7																																				
Jan.27.10	16.1	166.4																																				
Feb.08.10	12.2	170.3																																				
Feb.19.10	10.1	172.4																																				
Apr.16.10	9.3	173.2																																				
May.04.10	9.4	173.1																																				
May.06.10	9.4	173.1																																				

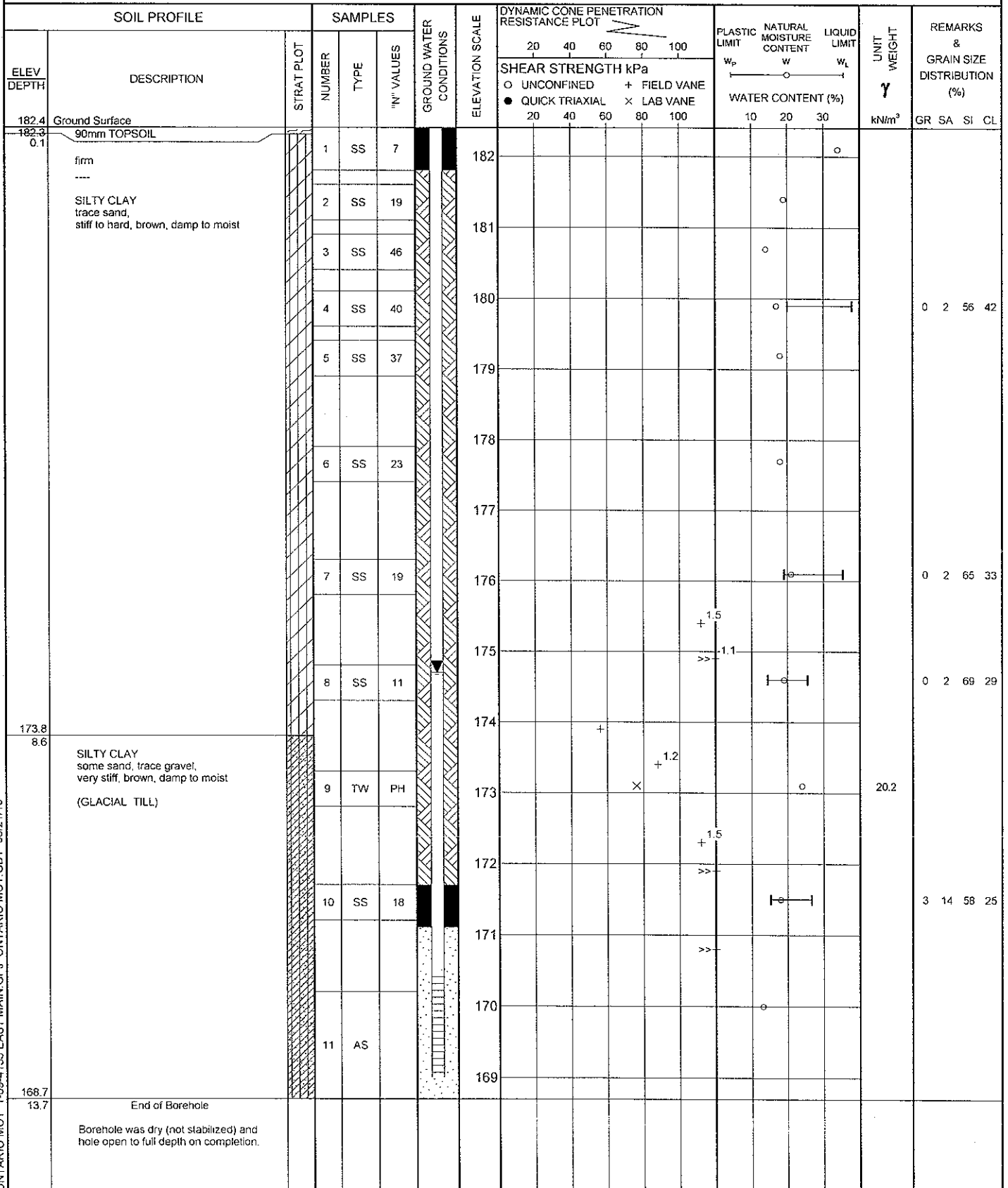
ONTARIO MOT 1-09-4135 EAST MAIN GPJ, ONTARIO MOT.GDT 06/21/10

RECORD OF BOREHOLE No EMN 10+175CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4761703.9 E:327562.8 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.19.10 CHECKED BY RA



ONTARIO MOT 1-09-4135 EAST MAIN GPJ ONTARIO MOT.GDT 06/21/10

Continued Next Page

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

RECORD OF BOREHOLE No EMN 10+175CL 2 OF 2 METRIC

W.P. 260-99-00 LOCATION Coords: N:4761703.9 E:327562.8 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.19.10 CHECKED BY RA

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																															
	<p>No sample recovery at SS7 and SS10. Sampler redriven and disturbed sample collected.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Jan.27.10</td> <td>13.5</td> <td>168.9</td> </tr> <tr> <td>Feb.08.10</td> <td>13.2</td> <td>169.2</td> </tr> <tr> <td>Feb.19.10</td> <td>12.8</td> <td>169.6</td> </tr> <tr> <td>Apr.16.10</td> <td>8.0</td> <td>174.4</td> </tr> <tr> <td>May.04.10</td> <td>7.6</td> <td>174.8</td> </tr> <tr> <td>May.06.10</td> <td>7.5</td> <td>174.9</td> </tr> <tr> <td>May.18.10</td> <td>7.7</td> <td>174.7</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Jan.27.10	13.5	168.9	Feb.08.10	13.2	169.2	Feb.19.10	12.8	169.6	Apr.16.10	8.0	174.4	May.04.10	7.6	174.8	May.06.10	7.5	174.9	May.18.10	7.7	174.7														
Date	Depth(m)	Elevation(m)																																					
Jan.27.10	13.5	168.9																																					
Feb.08.10	13.2	169.2																																					
Feb.19.10	12.8	169.6																																					
Apr.16.10	8.0	174.4																																					
May.04.10	7.6	174.8																																					
May.06.10	7.5	174.9																																					
May.18.10	7.7	174.7																																					

ONTARIO MOT 1-09-4135 EAST MAIN.GPJ ONTARIO MOT.GDT 06/21/10

RECORD OF BOREHOLE No EMN 10+225Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4761755.2 E:327550.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.21.10 CHECKED BY RA

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		W _p	W	W _L		
182.4	Ground Surface							20 40 60 80 100						
182.3	120mm TOPSOIL							20 40 60 80 100						
0.1	trace rootlets, firm		1	SS	7		182						50	0 1 38 61
	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		2	SS	34		181						42	0 2 55 43
			3	SS	48		180							1 2 58 39
			4	SS	39		179							
			5	SS	40		178							
			6	SS	34		177							
			7	SS	22		176							3 1 55 41
			8	TW	PH		175							
173.9	End of Borehole						174						20.0	
8.5	Borehole was dry (not stabilized) and hole open to full depth on completion. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Jan.27.10 dry Feb.08.10 dry Feb.19.10 dry													

ONTARIO MOT 1-09-4135 EAST MAIN GPJ ONTARIO MOT.GDT 06/21/10

RECORD OF BOREHOLE No EMN 10+225Rt

1 OF 1

METRIC

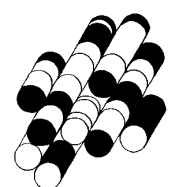
W.P. 280-99-00 LOCATION Coords: N:4761752.4 E:327566.5 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 01.20.10 CHECKED BY RA

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		W _p	W	W _L		
182.7	Ground Surface							○ UNCONFINED + FIELD VANE						
182.6	130mm TOPSOIL							● QUICK TRIAXIAL × LAB VANE						
0.1			1	SS	9									
	stiff						182							
	----		2	SS	48									
	SILTY CLAY						181							
	trace sand,		3	SS	52									0 2 50 48
	hard, brown, moist						180							
			4	SS	43									
			5	SS	39									0 2 57 41
							179							
			6	SS	36		178							
							177							
							176							
	----		7	SS	33									0 2 54 44
	stiff						175							
174.6	End of Borehole		8	TW	PH								22.3	
8.1														
	Borehole was dry (not stabilized) and hole open to full depth on completion.													
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.													
	Water Level Readings:													
	Date	Depth(m)	Elevation(m)											
	Jan.27.10	7.2	175.5											
	Feb.08.10	6.4	176.3											
	Feb.19.10	5.9	176.8											
	Apr.16.10	4.3	178.4											
	May.04.10	4.1	178.6											
	May.06.10	4.4	178.3											
	May.18.10	4.0	178.7											

ONTARIO MOT 1-09-4135 EAST MAIN GPJ ONTARIO MOT.GDT 08/21/10

B1

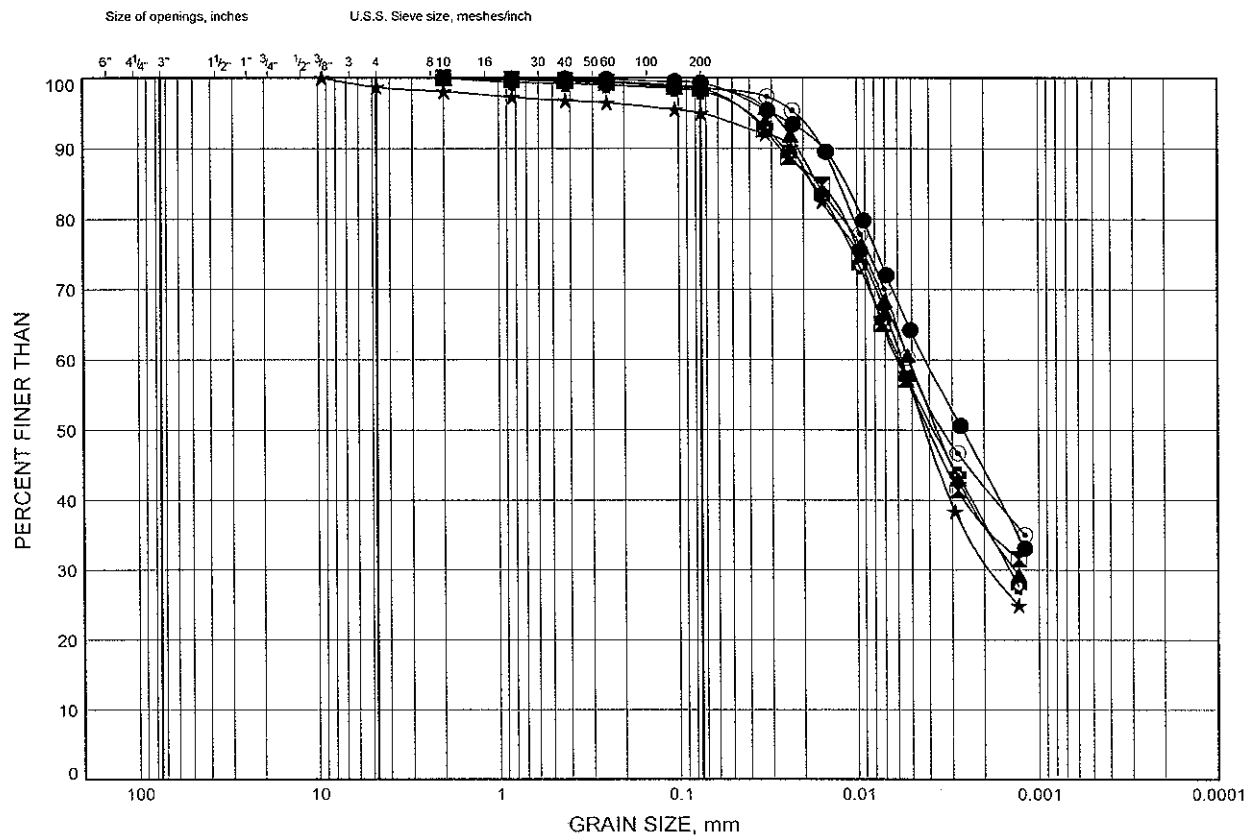
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B1-1

SILTY CLAY



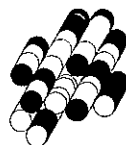
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	EMN 10+125Lt	1.7	180.9
■	EMN 10+125Lt	4.7	177.9
▲	EMN 10+125Lt	7.8	174.8
★	EMN 10+125Rt	1.0	181.5
⊙	EMN 10+125Rt	3.2	179.3
⊠	EMN 10+125Rt	4.7	177.8

Date June 2010

Project 1-09-4135



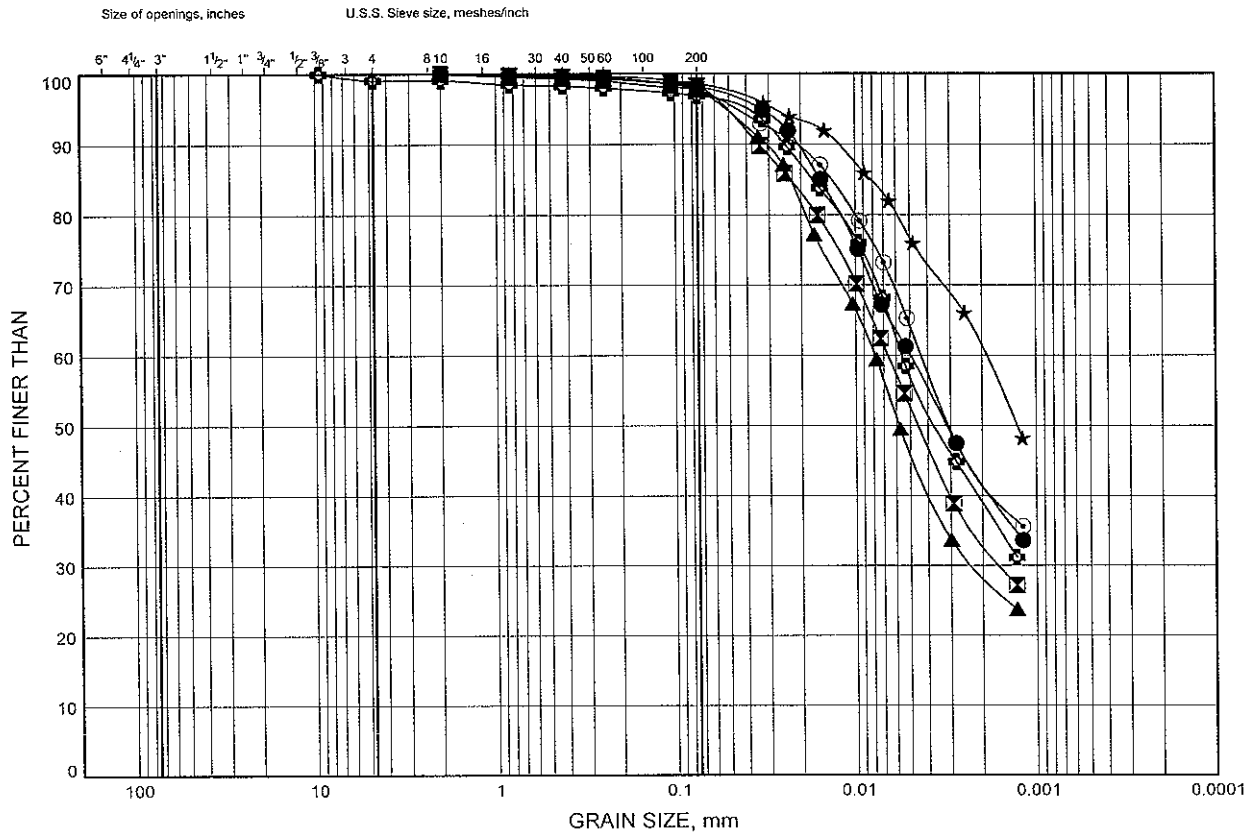
Prep'd DB

Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B1-2

SILTY CLAY

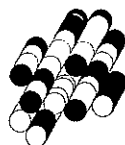


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+175CL	2.5	179.9
⊠	EMN 10+175CL	6.3	176.1
▲	EMN 10+175CL	7.8	174.6
★	EMN 10+225Lt	0.3	182.1
⊙	EMN 10+225Lt	1.7	180.7
⊛	EMN 10+225Lt	3.2	179.2

Date June 2010

Project 1-09-4135



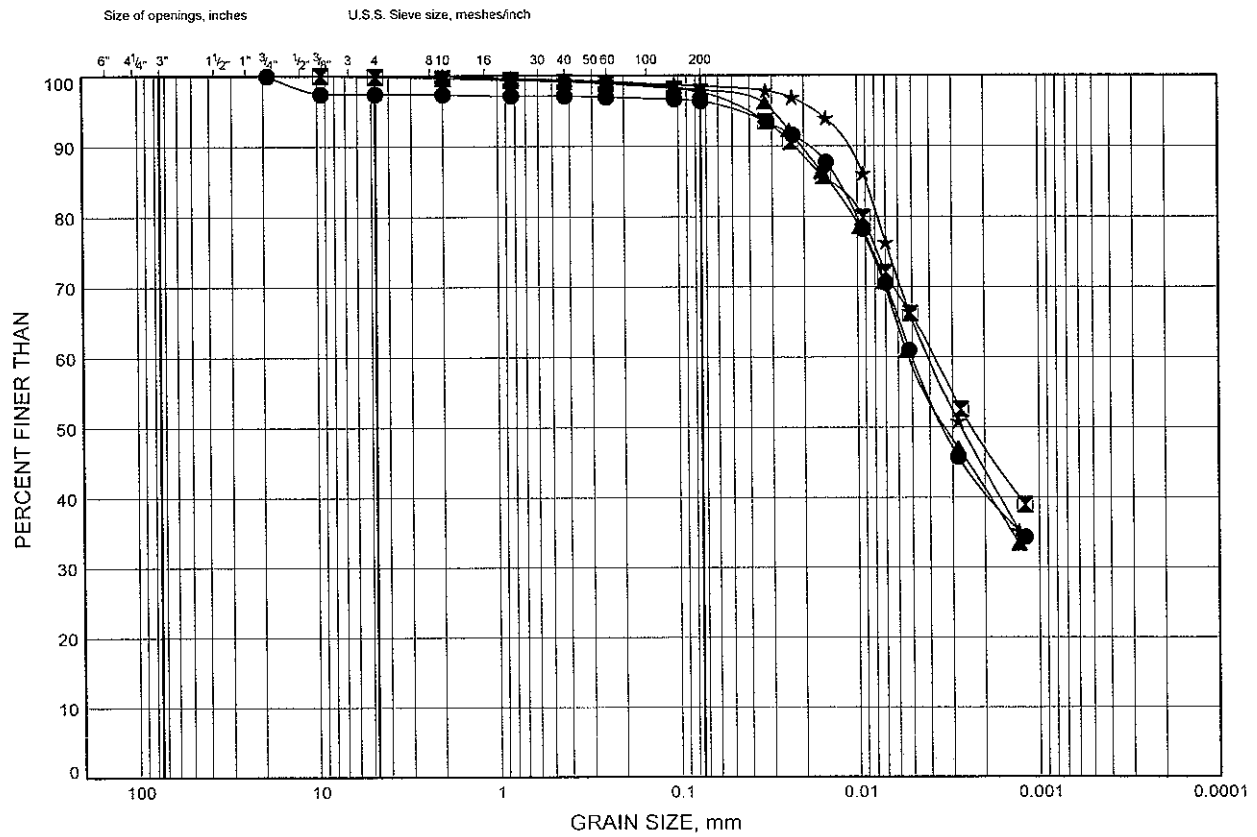
Prep'd DB

Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B1-3

SILTY CLAY

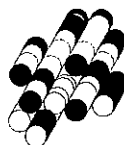


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	EMN 10+225Lt	6.3	176.1
⊠	EMN 10+225Rt	1.7	181.0
▲	EMN 10+225Rt	3.2	179.5
★	EMN 10+225Rt	6.3	176.4

Date June 2010
Project 1-09-4135

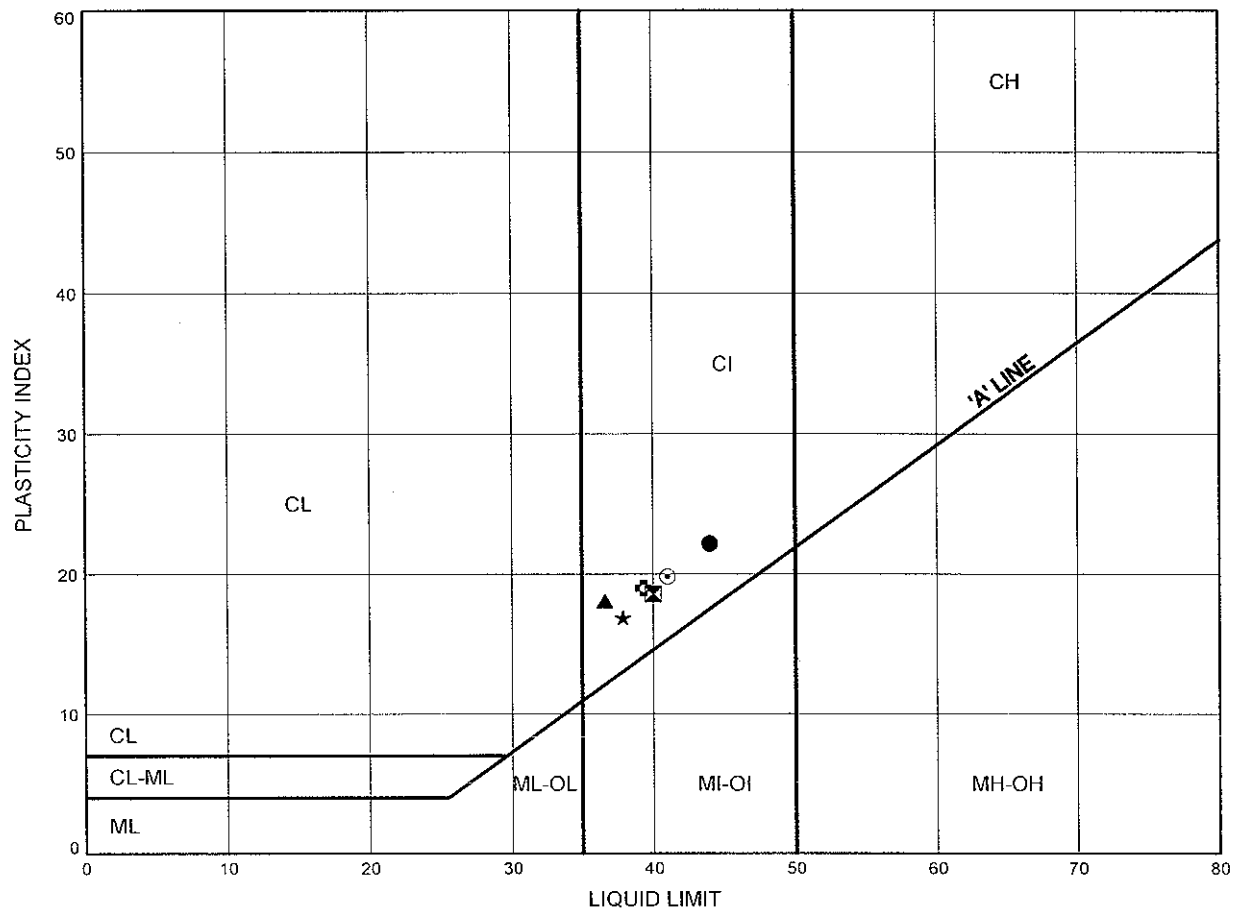


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

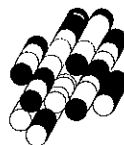
FIGURE B1-4

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+125Lt	1.7	180.9
⊠	EMN 10+125Lt	4.7	177.9
▲	EMN 10+125Lt	7.8	174.8
★	EMN 10+125Rt	1.0	181.5
⊙	EMN 10+125Rt	3.2	179.3
⊛	EMN 10+125Rt	4.7	177.8

Date June 2010
Project 1-09-4135

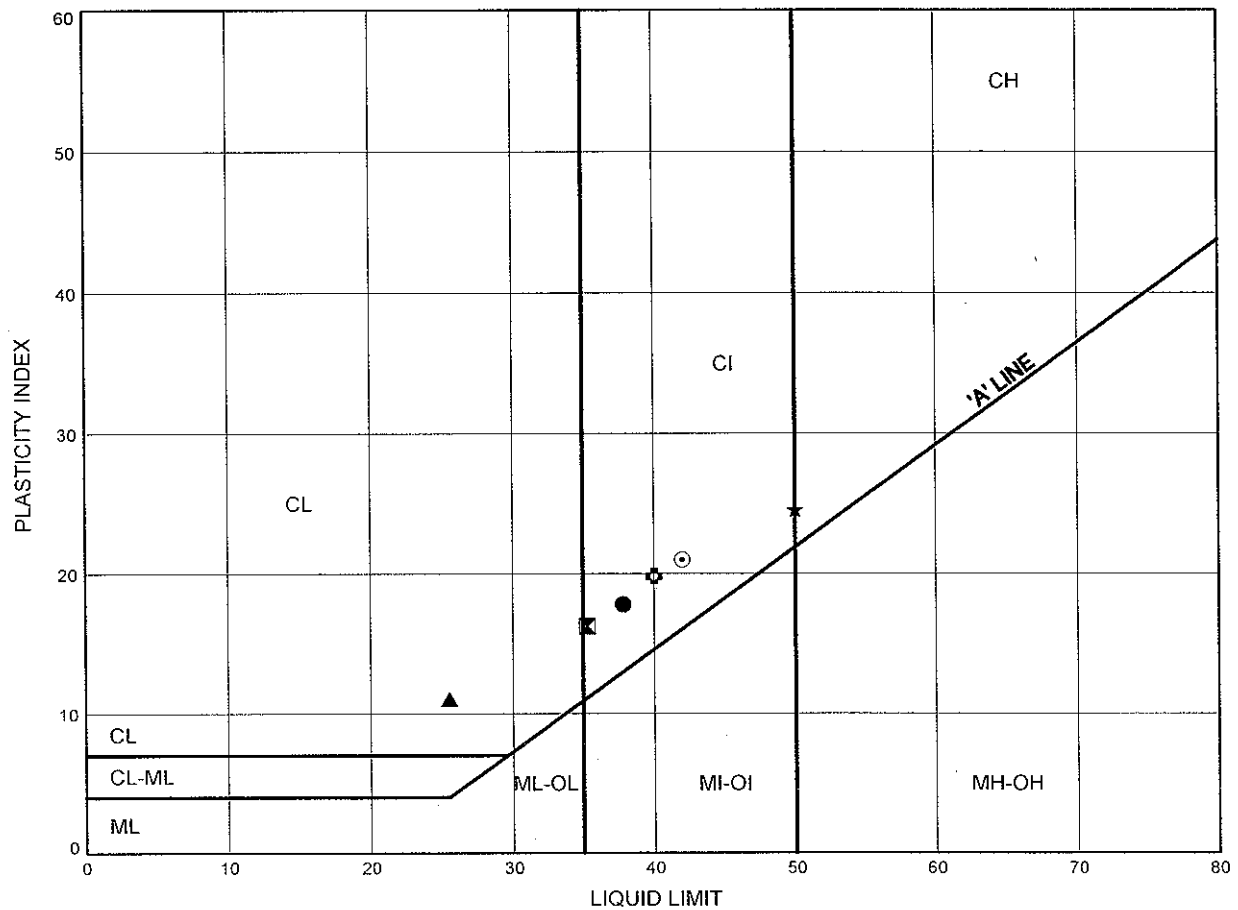


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-5

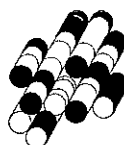
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+175CL	2.5	179.9
⊠	EMN 10+175CL	6.3	176.1
▲	EMN 10+175CL	7.8	174.6
★	EMN 10+225Lt	0.3	182.1
⊙	EMN 10+225Lt	1.7	180.7
⊛	EMN 10+225Lt	3.2	179.2

Date June 2010

Project 1-09-4135



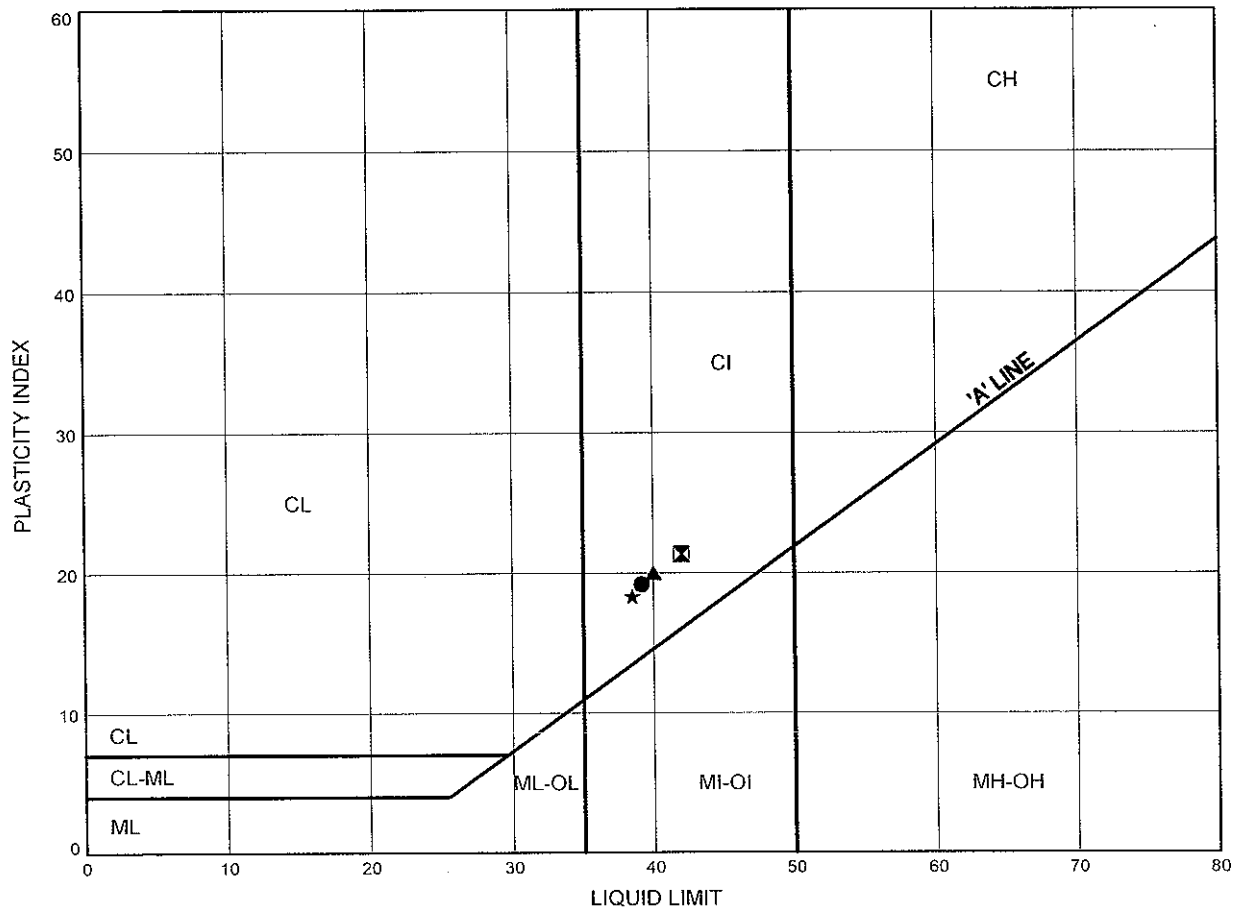
Prep'd DB

Chkd. HW

ATTERBERG LIMITS TEST RESULTS

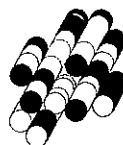
FIGURE B1-6

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+225Lt	6.3	176.1
⊠	EMN 10+225Rt	1.7	181.0
▲	EMN 10+225Rt	3.2	179.5
★	EMN 10+225Rt	6.3	176.4

Date June 2010
Project 1-09-4135

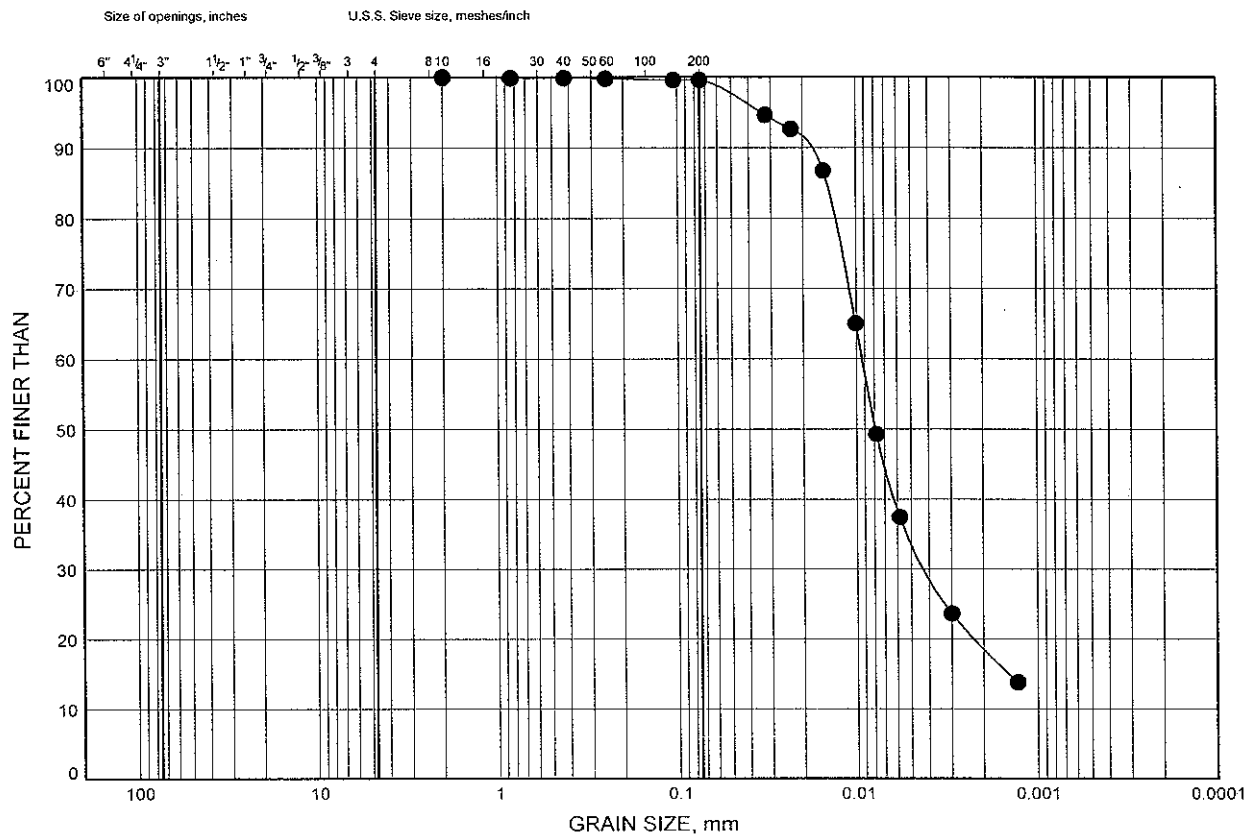


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B1-7

CLAYEY SILT



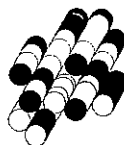
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

● EMN 10+125Rt 7.8 174.7

Date June 2010

Project 1-09-4135



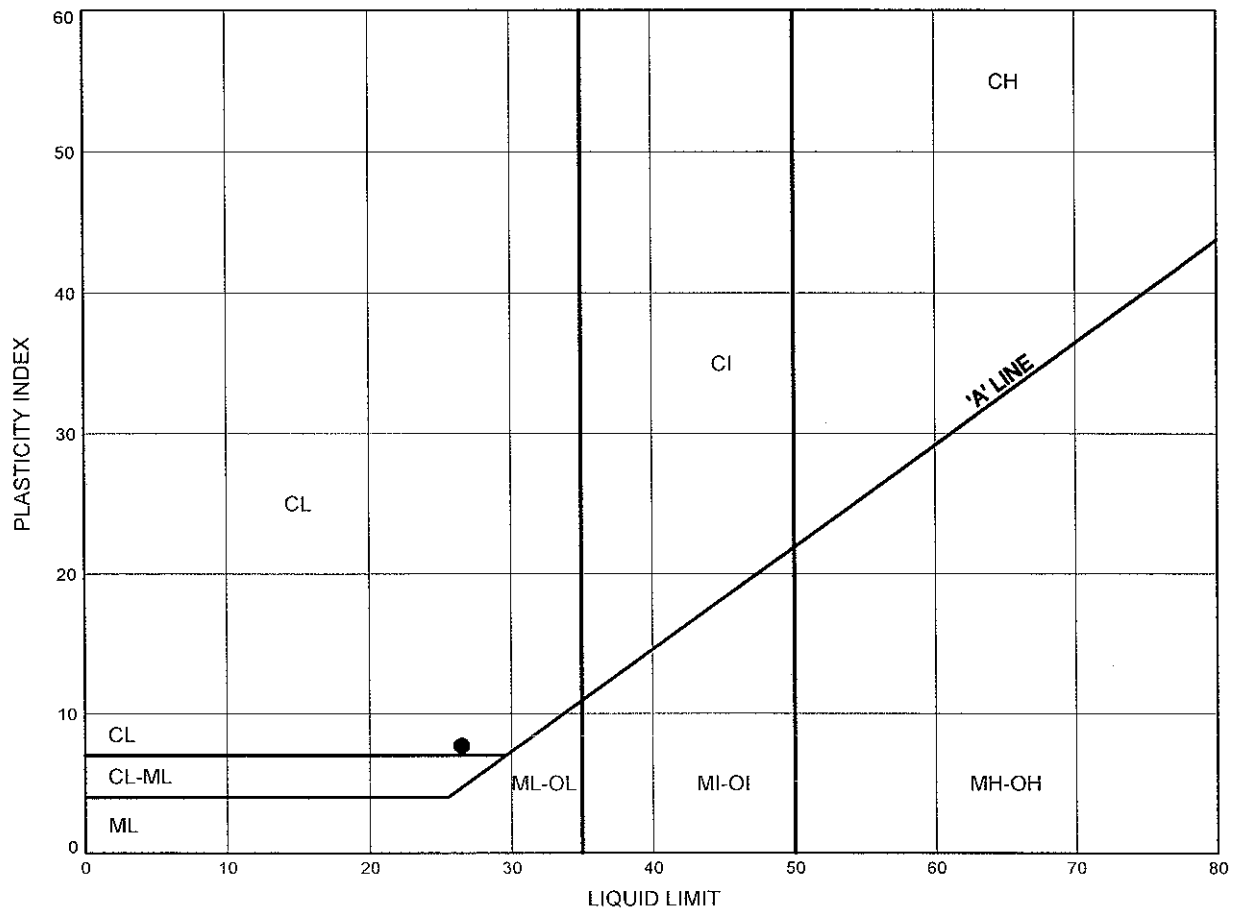
Prep'd DB

Chkd. HW

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-8

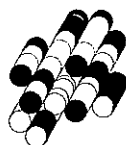
CLAYEY SILT



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+125Rt	7.8	174.7

ALTR 1-09-4135 EAST MAIN.GPJ 06/29/10

Date June 2010
Project 1-09-4135

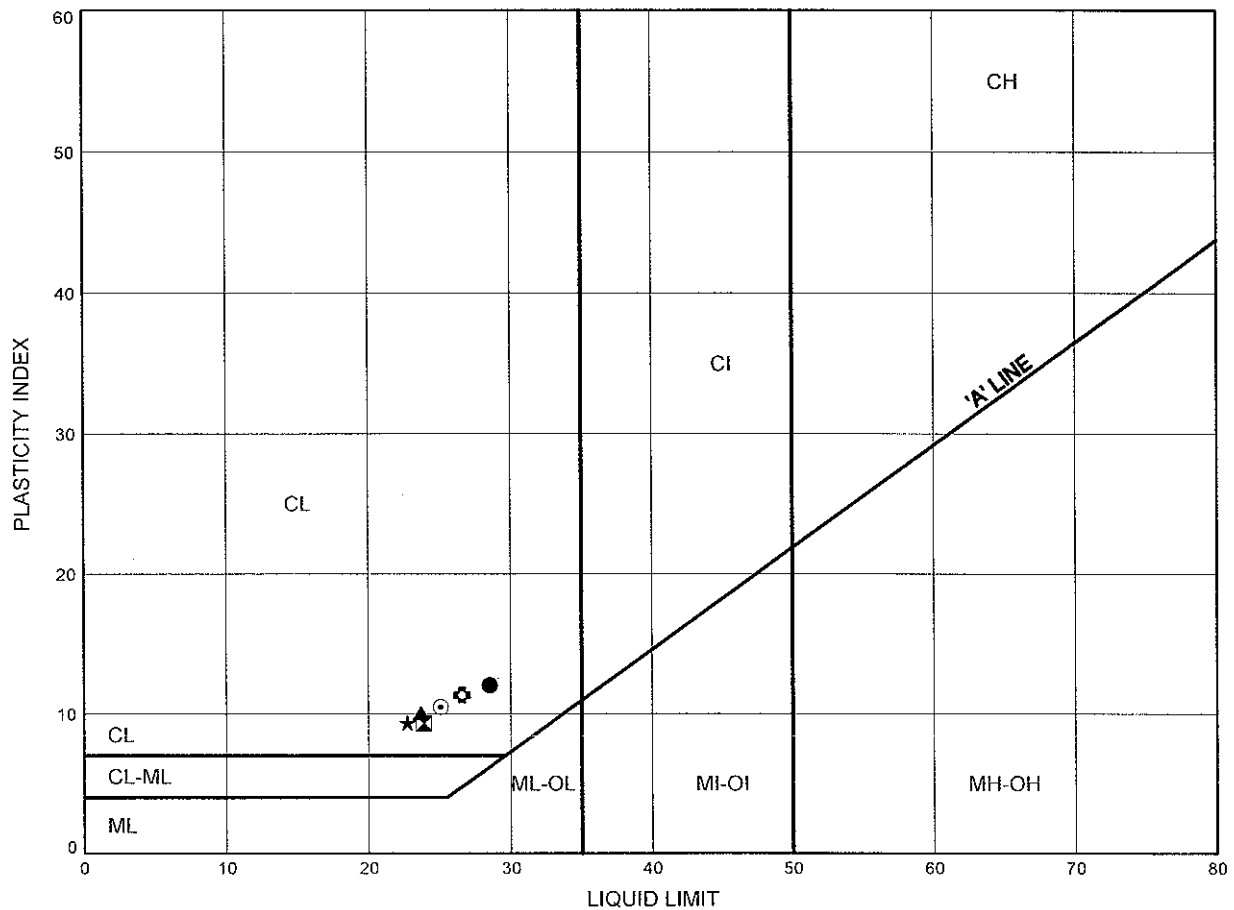


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

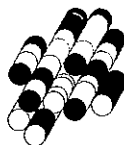
FIGURE B1-10

SILTY CLAY TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+125Lt	10.9	171.7
⊠	EMN 10+125Lt	13.9	168.7
▲	EMN 10+125Rt	10.9	171.6
★	EMN 10+125Rt	13.9	168.6
⊙	EMN 10+125Rt	17.0	165.5
⊛	EMN 10+175CL	10.9	171.5

Date June 2010
Project 1-09-4135

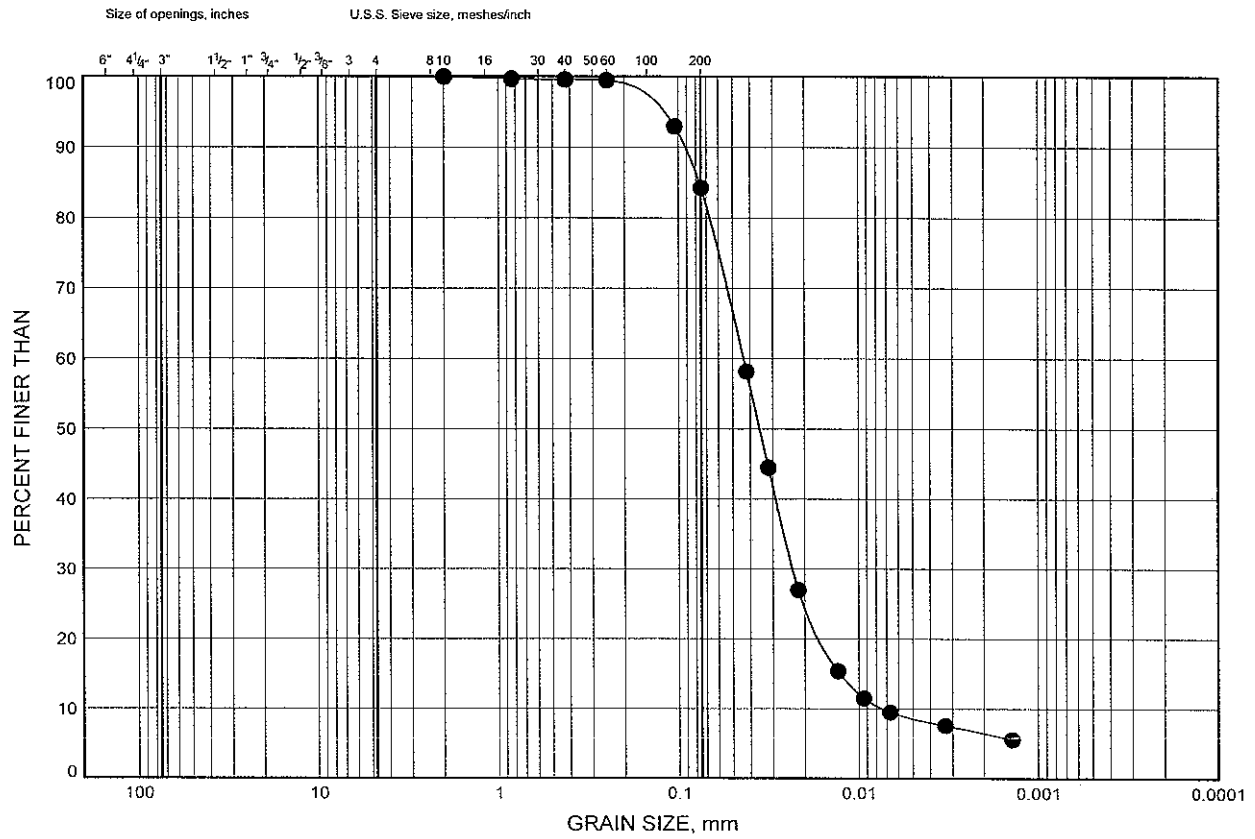


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B1-11

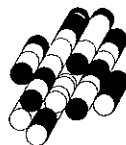
SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EMN 10+125Lt	17.0	165.6

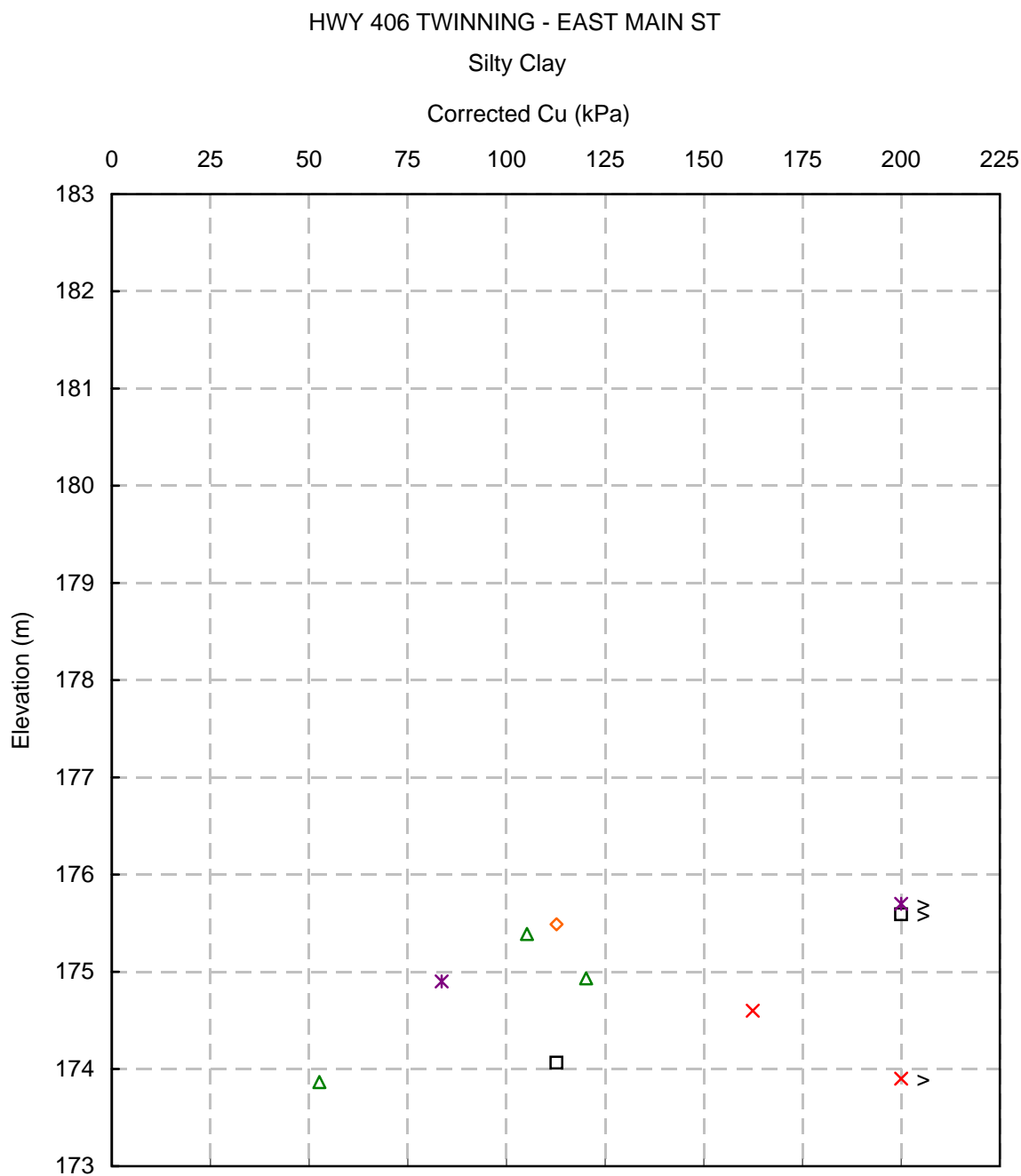
Date June 2010
Project 1-09-4135



Prep'd DB
Chkd HW

CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B1-12



□ EMN 10+125 LT ◇ EMN 10+125 RT △ EMN 10+175 CL × EMN 10+225 LT × EMN 10+225 RT

Field Shear Vane Correction

Applied Correction Factors

Morris & Williams (1994)

0.82 (Elev.>176m)

0.94 (Elev.<176m)

($\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57$)

Project No. : 1-09-4135

Date : September, 2010



Terraprobe Inc.

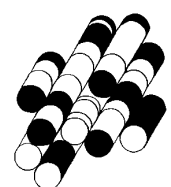
Prepared By : HW

Checked By : RA

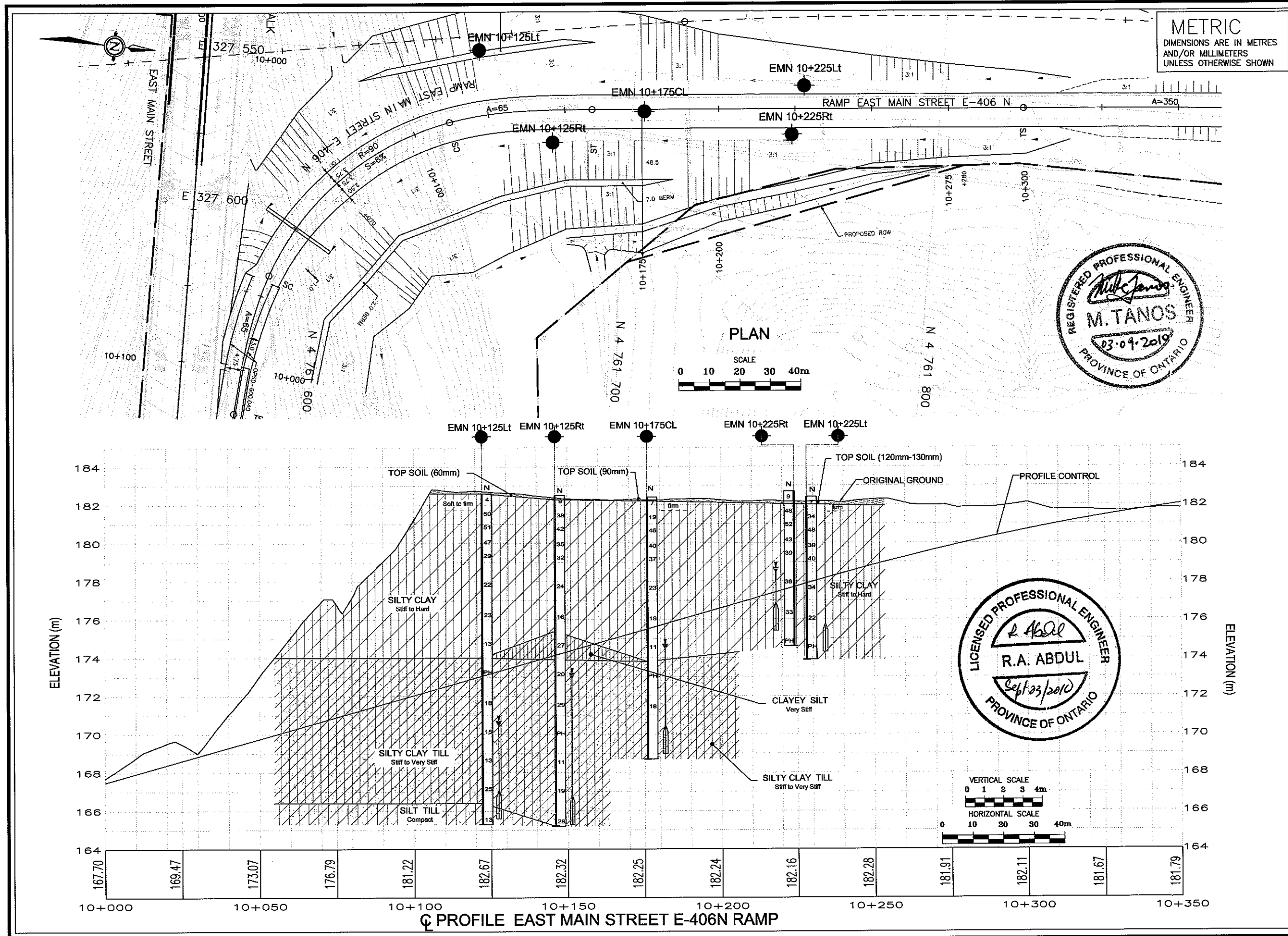
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C1

TERRAPROBE INC.



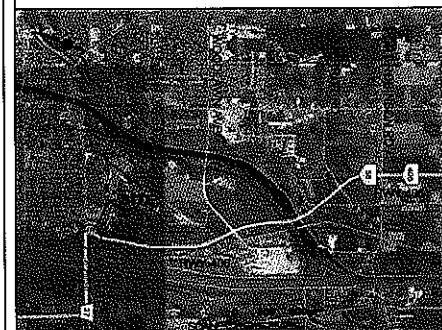
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CONT No
WP No 280-99-00

HIGHWAY 406 CUTS & FILLS
RAMP EAST MAIN STREET E-N
BOREHOLE LOCATIONS AND SOIL STRATA

Giffels Associates Limited
Consulting Engineers and Architects
An IBI Group Company



KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer (MAY, 2010)
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
EMN 10+125LI	182.6	4 761 648.7	327 547.1
EMN 10+125RI	182.5	4 761 674.9	327 575.3
EMN 10+175CL	182.4	4 761 703.9	327 562.8
EMN 10+225LI	182.4	4 761 755.2	327 550.3
EMN 10+225RI	182.7	4 761 752.4	327 566.5

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

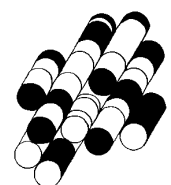
DATE	BY	DESCRIPTION
DESIGN R.A.	CODE CHBDC2006	LOAD
DRAWN K.C.	CHK R.A.	STRUCT

DATE SEPT. 2010

GEORES 30M3-263

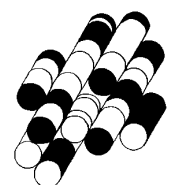
SITE 2

TERRAPROBE INC.



A2

TERRAPROBE INC.



RECORD OF BOREHOLE No S-EW 10+025Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763892.5 E:327500.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
DATUM Geodetic DATE 12.03.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
183.6 183.5 0.1	Ground Surface 70mm TOPSOIL						20 40 60 80 100								
	FILL - Silty Clay, trace to some sand, trace organics, occasional gravel inclusions, occasional concrete debris, stiff to hard, brown, damp to moist		1	SS	13										
			2	SS	93										
			3	SS	50										
			4	SS	15										
			5	SS	12										
			6	SS	14										
179.2 4.4	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		7	SS	25										
			8	SS	17										
			9	SS	21										
			10	SS	11										
		11	SS	15											
		12	TW	PH											
		13	SS	28											

Continued Next Page

+3, x3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 06/29/10

RECORD OF BOREHOLE No S-EW 10+025Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763892.5 E:327500.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
DATUM Geodetic DATE 12.03.09 CHECKED BY RA

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	WATER CONTENT (%)														
167.4	CLAYEY SILT TO SILTY CLAY sandy, some gravel, hard, brown, damp (GLACIAL TILL)		14	SS	26									15 34 38 13																		
16.2																																
			15	SS	81																											
164.8			16	SS	125																											
18.8	<p>End of Borehole</p> <p>Unable to push vane beyond 15.7m.</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Dec.08.09</td> <td>17.7</td> <td>165.9</td> </tr> <tr> <td>Dec.15.09</td> <td>16.1</td> <td>167.5</td> </tr> <tr> <td>Jan.04.10</td> <td>5.0</td> <td>178.6</td> </tr> <tr> <td>Jan.11.10</td> <td>3.9</td> <td>179.7</td> </tr> <tr> <td>Jan.19.10</td> <td>4.0</td> <td>179.6</td> </tr> </tbody> </table>														Date	Depth(m)	Elevation(m)	Dec.08.09	17.7	165.9	Dec.15.09	16.1	167.5	Jan.04.10	5.0	178.6	Jan.11.10	3.9	179.7	Jan.19.10	4.0	179.6
Date	Depth(m)	Elevation(m)																														
Dec.08.09	17.7	165.9																														
Dec.15.09	16.1	167.5																														
Jan.04.10	5.0	178.6																														
Jan.11.10	3.9	179.7																														
Jan.19.10	4.0	179.6																														

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 06/28/10

RECORD OF BOREHOLE No S-EW 10+050CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.4 E:327494.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.24.09 - 11.25.09 CHECKED BY RA

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 ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
183.4	Ground Surface							20 40 60 80 100							
183.3	120mm TOPSOIL							20 40 60 80 100							
0.1	FILL - Silty Clay, trace sand, trace gravel, trace organics, very stiff, brown, moist		1	SS	29		183								
182.7															
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	30		182								
			3	SS	31		181								
			4	SS	30		180								
			5	SS	20		179								
			6	SS	18		178								
							177								
			7	SS	20		176								
							175								
			8	SS	15		174								
							173								
			9	TW	PH		172								
							171								
			10	SS	13		170								
			11	SS	15										
169.8	End of Borehole														
13.6	Water level at 7.6m (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW9.														

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 09/29/10

Continued Next Page

+ 3 . x 3: Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE

2 OF 2

ORIGINATED BY AW

COMPILED BY DB

CHECKED BY RA

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

RECORD OF BOREHOLE No TSEW1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords. N:4763922.8 E:327487.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.08.10 - 01.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
183.5	Ground Surface							20 40 60 80 100	10 20 30					GR SA SI CL	
0.0	30mm TOPSOIL		1	SS	32		183				○			30 30 25 15	
182.8	FILL - Sand and Gravel, silty, some clay, dense, moist to wet														
0.7	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp to moist		2	SS	16		182				○				
			3	SS	27		181				○	50		0 3 40 57	
			4	SS	40		180				○				
			5	SS	34		179				○				
			6	SS	34		178				○				
			7	SS	42		177				○				
			8	SS	23		176				○				
			9	SS	24		175				○				
			10	SS	21		174				○				
			11	SS	16		173				○				
			12	TW	PH		172				○				
			13	SS	13		171				○				
			14	SS	13		170				○				
168.8							169				○				
14.7															

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 08/29/10

Continued Next Page

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

RECORD OF BOREHOLE No TSEW1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763922.8 E:327487.0 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.08.10 - 01.18.10 CHECKED BY RA

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						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								</						

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 08/29/10

Continued Next Page

+ 3 x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

3 OF 3

METRIC

[illegible]

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 06/29/10

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

RECORD OF BOREHOLE No TSEW2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763936.1 E:327490.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.05.10 - 01.07.10 CHECKED BY RA

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						
183.3	Ground Surface							20 40 60 80 100						
0.0	FILL - Sand, some gravel, some silt, compact, brown, wet		1	SS	25		183							10 76 (14)
182.6														
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, moist		2	SS	26		182							0 1 43 56
			3	SS	40									
			4	SS	31		181							0 2 37 61
			5	SS	26		180							
			6	SS	24		179							
			7	SS	22									
			8	SS	25		178							0 2 68 30
	dark brown		9	SS	20		177							
							176							
			10	TW	PH		175							commence casing and washboring
							174							1 3 66 30
			11	SS	12									Jan.05
							173							Jan.06
			12	SS	22		172							
			13	SS	23		171							
							170							
	reddish brown		14	SS	13									
							169							
168.6														
14.7														

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT GDT 06/29/10

Continued Next Page

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

2 OF 3

METRIC

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 05/29/10

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

RECORD OF BOREHOLE No TSEW2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763936.1 E:327490.9 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.05.10 - 01.07.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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	10 20 30			
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL x LAB VANE						

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 06/29/10

RECORD OF BOREHOLE No TSEW3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763960.8 E:327478.6 ORIGINATED BY LY
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.08.09 - 12.10.09 CHECKED BY RA

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						
183.3 0.0	Ground Surface						20 40 60 80 100	20 40 60 80 100						GR SA SI CL
182.6 0.7	FILL - Sand and Gravel, trace silt, loose, grey, dry		1	SS	6									
182.0 1.3	FILL - Silty Clay, some sand, some gravel, firm, grey, damp to moist		2	SS	5									
	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, moist		3	SS	18									
			4	SS	18									
			5	SS	24								45	0 2 46 52
			6	SS	24									
			7	SS	12									1 4 61 34
			8	SS	10									
			9	SS	14									
			10	SS	16									
			11	SS	9									0 4 64 32
			12	SS	9									4 5 67 24
		13	TW	PH								20.8	2 2 75 21	
		14	SS	12									3 3 70 24	
168.6 14.7														

Continued Next Page

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

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 06/29/10

2 OF 3

METRIC

DATUM	Geodetic	DATE	12.08.09 - 12.10.09	CHECKED BY	RA
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ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 06/29/10

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

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

RECORD OF BOREHOLE No TSEW4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763951.2 E:327473.9 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.02.09 - 12.07.09 CHECKED BY RA

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 (%)
183.5	Ground Surface							20 40 60 80 100							
0.0	FILL - Silty Clay, some sand, trace gravel, trace organics, stiff to very stiff, dark brown / brown, moist ---- firm		1	SS	11		183								
			2	SS	18										3 11 48 38
			3	SS	6										
181.4	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, damp to moist ---- some sand ----														
2.1			4	SS	14		181						41	0 1 54 45	
			5	SS	18		180								
			6	SS	19										
			7	SS	18		179								1 13 55 31
			8	SS	13		178								
			9	SS	11		177								
			10	SS	7		176								2 3 70 25
			11	SS	3		175								0 6 63 31
			12	SS	8		173								
	13	SS	9		171								1 2 70 27		
			14	TW	PH		170								
168.8							169								
14.7															

Continued Next Page

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

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT GDT 06/29/10

RECORD OF BOREHOLE No TSEW4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763951.2 E:327473.9 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.02.09 - 12.07.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	10 20 30							
								SHEAR STRENGTH kPa					W _p W W _L				
								○ UNCONFINED + FIELD VANE					WATER CONTENT (%)				
								● QUICK TRIAXIAL × LAB VANE									
								20 40 60 80 100					10 20 30				
								</									

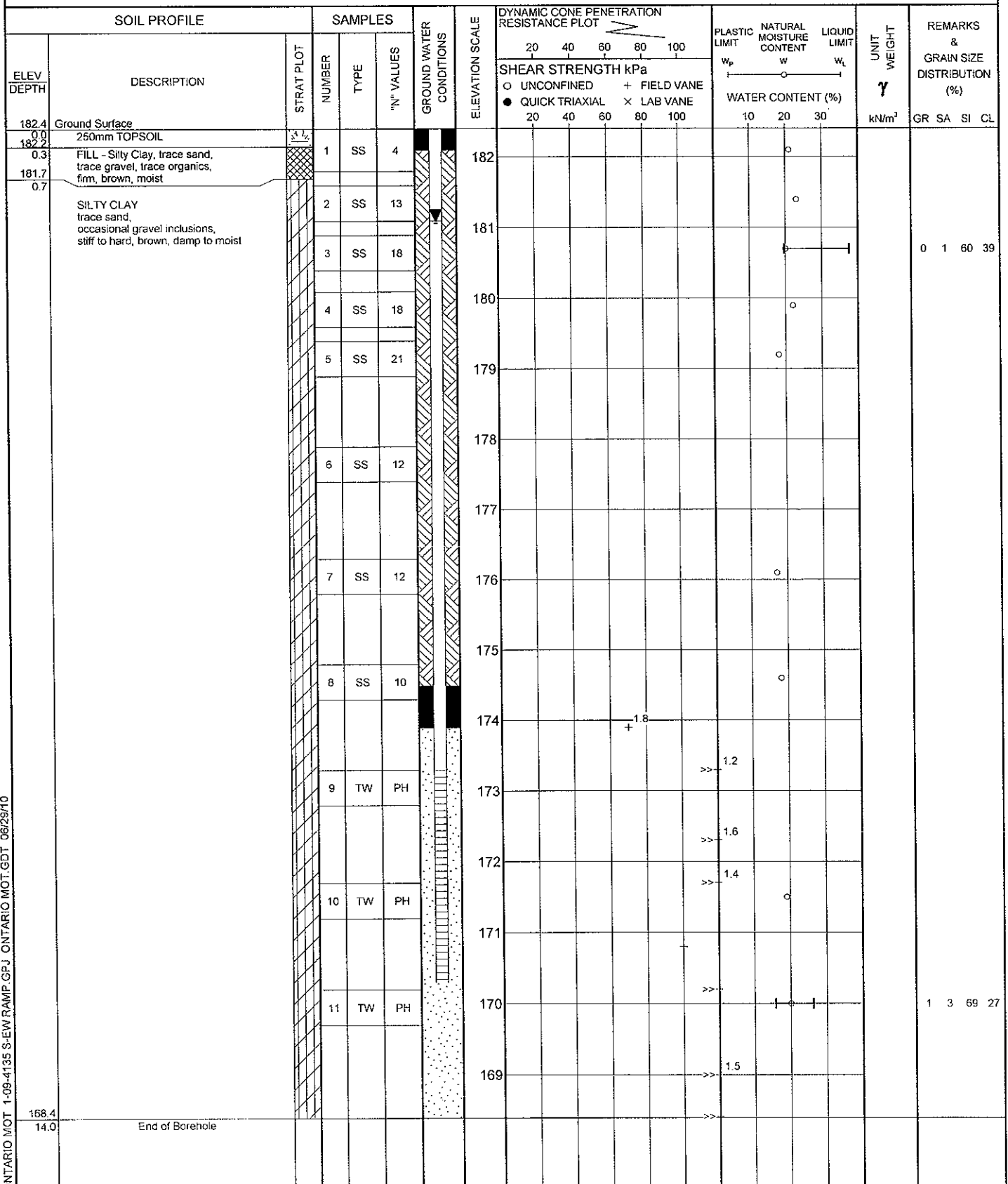
ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 06/29/10

RECORD OF BOREHOLE No S-EW 10+110CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763976.0 E:327471.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA



ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 06/29/10

Continued Next Page

3 x 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No S-EW 10+110CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763976.0 E:327471.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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	10	20	30	GR SA SI CL											
	<p>Borehole was open and dry (not stabilized) upon completion of drilling.</p> <p>No sample recovery at TW9 and TW10. Split spoon sampler driven and disturbed sample collected.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>2.7</td> <td>179.7</td> </tr> <tr> <td>Nov.20.09</td> <td>1.1</td> <td>181.3</td> </tr> <tr> <td>Nov.30.09</td> <td>1.6</td> <td>180.8</td> </tr> <tr> <td>Dec.08.09</td> <td>1.3</td> <td>181.1</td> </tr> <tr> <td>Jan.04.10</td> <td>1.3</td> <td>181.1</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	2.7	179.7	Nov.20.09	1.1	181.3	Nov.30.09	1.6	180.8	Dec.08.09	1.3	181.1	Jan.04.10	1.3	181.1													
Date	Depth(m)	Elevation(m)																														
Nov.09.09	2.7	179.7																														
Nov.20.09	1.1	181.3																														
Nov.30.09	1.6	180.8																														
Dec.08.09	1.3	181.1																														
Jan.04.10	1.3	181.1																														

ONTARIO MOT 1-09-4135 S-EW RAMP.GPJ ONTARIO MOT.GDT 09/29/10

RECORD OF BOREHOLE No S-EW 10+185Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764050.9 E:327459.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.03.09 CHECKED BY RA

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							w _p	w	w _L
								○ UNCONFINED	+ FIELD VANE								
								● QUICK TRIAXIAL	× LAB VANE								
								20	40	60	80	100					
								20	40	60	80	100					
182.4	Ground Surface																
182.3	100mm TOPSOIL																
0.1																	
	SILTY CLAY trace sand, stiff to very stiff, brown, moist		1	SS	8		182										
			2	SS	22								46	0 0 50 50			
			3	SS	21		181										
			4	SS	17		180							0 2 72 26			
			5	SS	21		179										
			6	SS	17		178							0 2 75 23			
			7	SS	14		176										
			8	SS	13		175							0 4 69 27			
			9	SS	12		173										
			10	SS	7		172							0 3 71 26			
			11	AS	-		170										
169.3	End of Borehole																
13.1	Borehole was dry (not stabilized) and hole open to full depth on completion.																

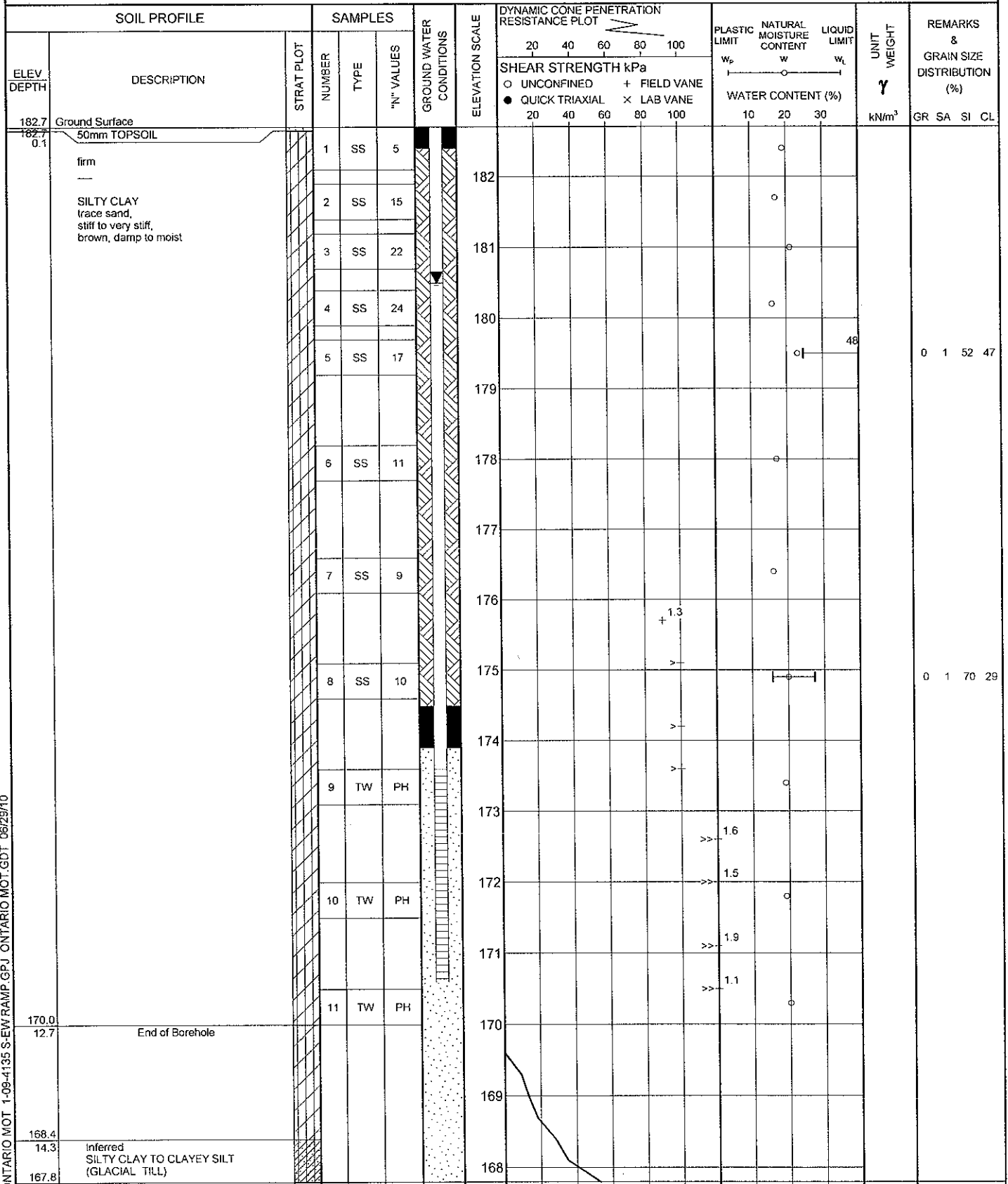
ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 06/29/10

RECORD OF BOREHOLE No S-EW 10+185Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764049.9 E:327468.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
DATUM Geodetic DATE 11.03.09 CHECKED BY RA



Continued Next Page

+ 3 x 3. Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No S-EW 10+185Rt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4764049.9 E:327458.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
DATUM Geodetic DATE 11.03.09 CHECKED BY RA

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																									
14.9	<p>End of Dynamic Cone Penetration Test</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>No sample recovery at TW9, TW10 and TW11. Sampler redriven and disturbed sample collected.</p> <p>Dynamic Cone Penetration Test performed from 13.1m to 14.9m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table><tr><th>Date</th><th>Depth(m)</th><th>Elevation(m)</th></tr><tr><td>Nov.09.09</td><td>9.5</td><td>173.2</td></tr><tr><td>Nov.20.09</td><td>3.2</td><td>179.5</td></tr><tr><td>Nov.30.09</td><td>2.8</td><td>179.9</td></tr><tr><td>Dec.08.09</td><td>2.5</td><td>180.2</td></tr><tr><td>Jan.04.10</td><td>2.2</td><td>180.5</td></tr><tr><td>Jan.19.10</td><td>2.2</td><td>180.5</td></tr></table>	Date	Depth(m)	Elevation(m)	Nov.09.09	9.5	173.2	Nov.20.09	3.2	179.5	Nov.30.09	2.8	179.9	Dec.08.09	2.5	180.2	Jan.04.10	2.2	180.5	Jan.19.10	2.2	180.5															
Date	Depth(m)	Elevation(m)																																			
Nov.09.09	9.5	173.2																																			
Nov.20.09	3.2	179.5																																			
Nov.30.09	2.8	179.9																																			
Dec.08.09	2.5	180.2																																			
Jan.04.10	2.2	180.5																																			
Jan.19.10	2.2	180.5																																			

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 08/29/10

RECORD OF BOREHOLE No S-EW 10+260CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764122.3 E:327485.4 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.03.09 CHECKED BY RA

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						
182.6	Ground Surface							20 40 60 80 100						
182.5 0.1	90mm TOPSOIL		1	SS	5		182							
	firm		2	SS	16		181							0 3 68 29
	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, moist		3	SS	27		180							
			4	SS	30		179							
			5	SS	35		178							1 2 70 27
			6	SS	13		177							
176.0 6.6	End of Borehole		7	SS	12		176							
	Borehole was dry (not stabilized) and hole open to full depth on completion.													

ONTARIO MOT 1-09-4135 S-EW RAMP GPJ ONTARIO MOT.GDT 09/29/10

ONTARIO MCT 1-09-4135 S-EW RAMP.GPJ ONTARIO MCT.GDT 08/29/10

RECORD OF BOREHOLE No W-N 10+200 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4764122.0 E:327436.5 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.02.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
181.5	Ground Surface							20 40 60 80 100							
184.4	100mm TOPSOIL														
0.1	FILL - Silty Clay, some sand, trace gravel, trace organics, soft to firm, brown, moist		1	SS	4		181						53	9 14 38 39	
180.8															
0.7	SILTY CLAY trace sand, stiff to very stiff, brown, damp		2	SS	12		180								
			3	SS	15										
179.4															
2.1	SILT - some clay, trace sand, frequent silty clay seams and partings, dense, brown, moist to wet		4	SS	32		179							0 1 88 11	
178.6															
2.9	very stiff		5	SS	19		178								

	SILTY CLAY trace sand, firm to stiff, brown, damp to moist		6	SS	6		177								
							176	1.5							
			7	SS	5		175	1.3						0 2 68 30	
							174	1.4							
			8	TW	PH			1.5							
							173	2.3							
			9	SS	1		172	1.7						2 2 70 26	
							171	2.5							
								2.0							
			10	AS	-		170	2.0							
								1.2							
169.9															
11.6	End of Borehole														
Borehole was dry (not stabilized) and hole open to full depth on completion. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Nov.09.09 7.0 174.5 Nov.20.09 1.9 179.6 Nov.30.09 1.4 180.1 Jan.04.10 1.3 180.2															

ONTARIO MOT 1-09-4135 W-N RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No W-N 10+200 Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4784129.9 E:327434.3 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.02.09 CHECKED BY RA

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						
181.5	Ground Surface							20 40 60 80 100						
181.4	100mm TOPSOIL							20 40 60 80 100						
180.8	FILL - Silty Clay, trace sand, trace organics, soft to firm, dark brown, moist		1	SS	4		181							
180.7														
179.4	SILTY CLAY trace sand, very stiff, brown, damp		2	SS	15		180							0 1 56 43
179.3			3	SS	17									
178.6	SILT frequent silty clay seams and partings, compact, brown, moist		4	SS	25		179							
178.5														
178.6	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		5	SS	30		178							0 3 66 31
178.5														
			6	SS	12		177							
			7	SS	3		176							
							175							
							174							
			8	SS	3									1 2 69 28
							173							
							172							
							171							
							170							
169.9	End of Borehole		10	AS	-									
11.6	Borehole was dry (not stabilized) and hole open to full depth on completion.													

ONTARIO MOT 1-09-4135 W-N RAMP GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No W-N 10+275 Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764158.5 E:327375.1 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.06.09 CHECKED BY RA

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

181.9	Ground Surface													
181.8	100mm TOPSOIL													
0.1	FILL - Sand and Gravel, some silt, trace clay, occasional silty clay lump, loose to compact, grey, damp to moist		1	SS	18									43 41 13 3
180.8			2	SS	8									
1.1	SILTY CLAY trace sand, trace gravel, firm to very stiff, brown, damp		3	SS	17									
			4	SS	15									1 1 66 32
179.0			5	SS	22									
2.9	SILT frequent silty clay seams and partings, compact, brown, moist to wet													
177.9			6	SS	6									
4.0	SILTY CLAY trace sand, firm to stiff, brown, damp to moist													0 7 61 32
			7	SS	9									
			8	SS	7									0 2 70 28
			9	TW	PH									
			10	SS	15									0 2 81 17
			11	SS	25									
169.5			12	SS	16									3 25 56 16
12.4	SILTY CLAY TO CLAYEY SILT sandy, trace gravel, very stiff, brown, damp to moist (GLACIAL TILL)													
167.7														
14.2	End of Borehole													
	Borehole was dry (not stabilized) and hole open to full depth on completion.													

Continued Next Page

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

ONTARIO MOT 1-09-4135 W-N RAMP GP J ONTARIO MOT GDT 07/02/10

RECORD OF BOREHOLE No W-N 10+275 Rt 2 OF 2 METRIC

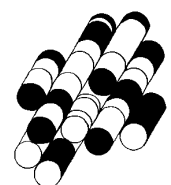
W.P. 280-99-00 LOCATION Coords: N:4764158.5 E:327375.1 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.06.09 CHECKED BY RA

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															
	<p>Consolidation test performed on TW 9.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>10.8</td> <td>171.1</td> </tr> <tr> <td>Nov.19.09</td> <td>2.8</td> <td>179.1</td> </tr> <tr> <td>Nov.30.09</td> <td>2.7</td> <td>179.2</td> </tr> <tr> <td>Dec.08.09</td> <td>2.5</td> <td>179.4</td> </tr> <tr> <td>Jan.04.10</td> <td>2.5</td> <td>179.4</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	10.8	171.1	Nov.19.09	2.8	179.1	Nov.30.09	2.7	179.2	Dec.08.09	2.5	179.4	Jan.04.10	2.5	179.4													
Date	Depth(m)	Elevation(m)																														
Nov.09.09	10.8	171.1																														
Nov.19.09	2.8	179.1																														
Nov.30.09	2.7	179.2																														
Dec.08.09	2.5	179.4																														
Jan.04.10	2.5	179.4																														

ONTARIO MOT 1-09-4135 W-N RAMP.GPJ ONTARIO MOT.GDT 07/02/10

B2

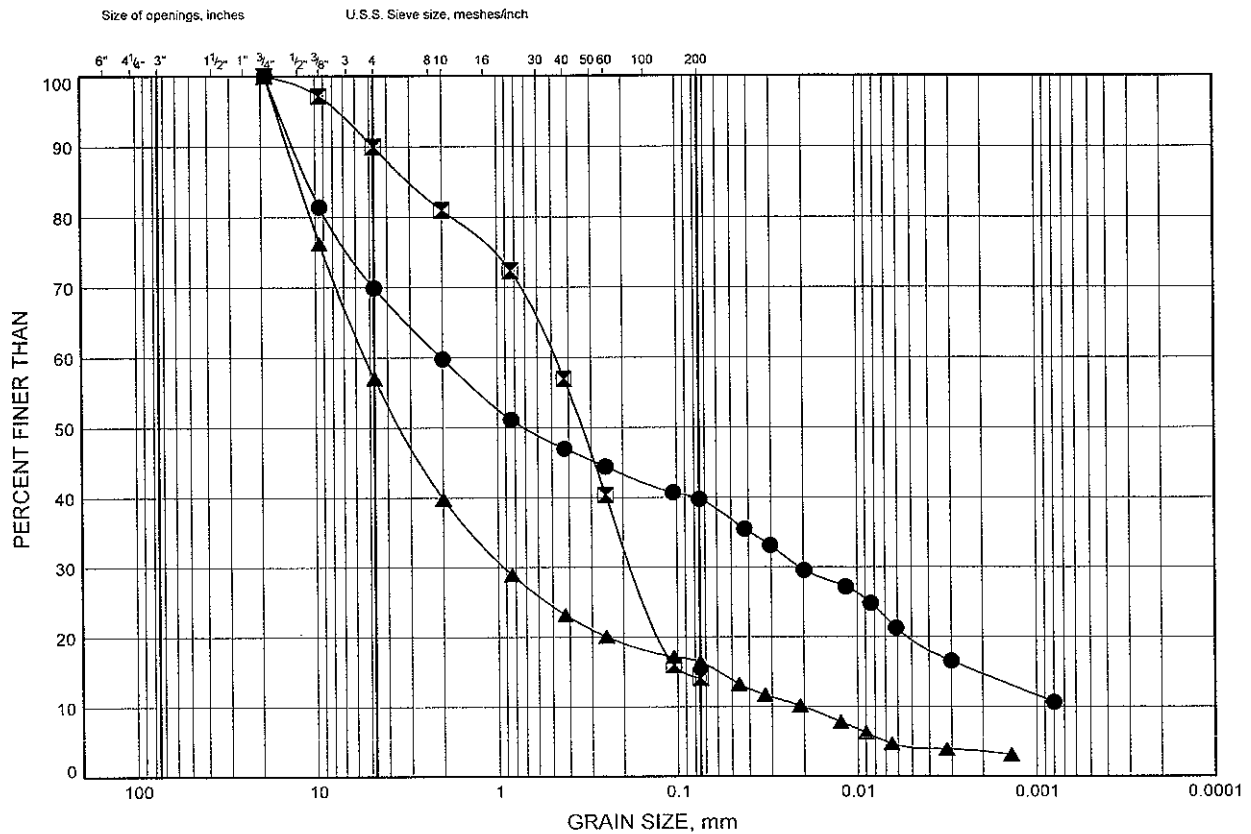
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B2-1

FILL - Sand and Gravel



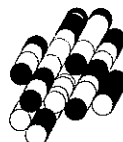
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TSEW1	0.3	183.2
⊠	TSEW2	0.3	183.0
▲	W-N 10+275 Rt	0.3	181.6

Date July 2010

Project 1-09-4135



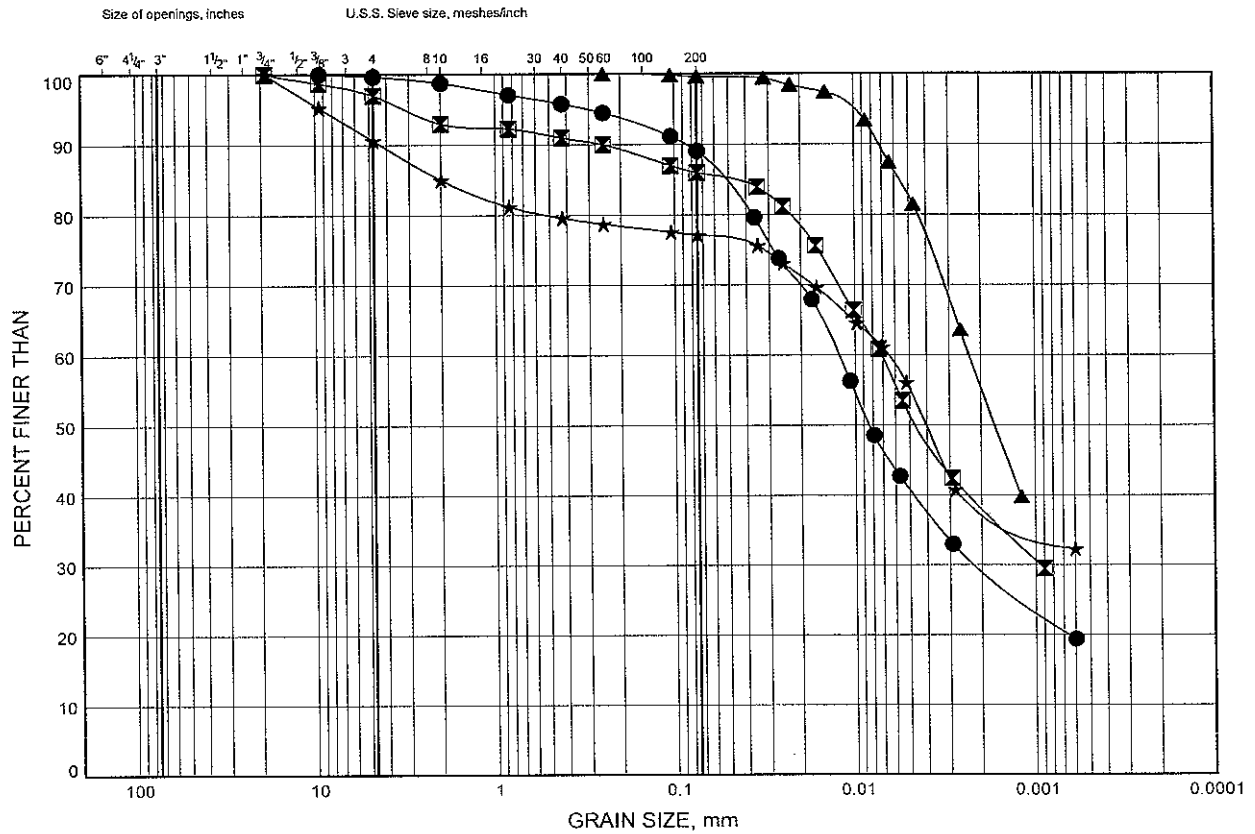
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-2

FILL - Silty Clay

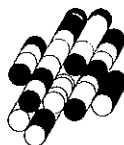


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

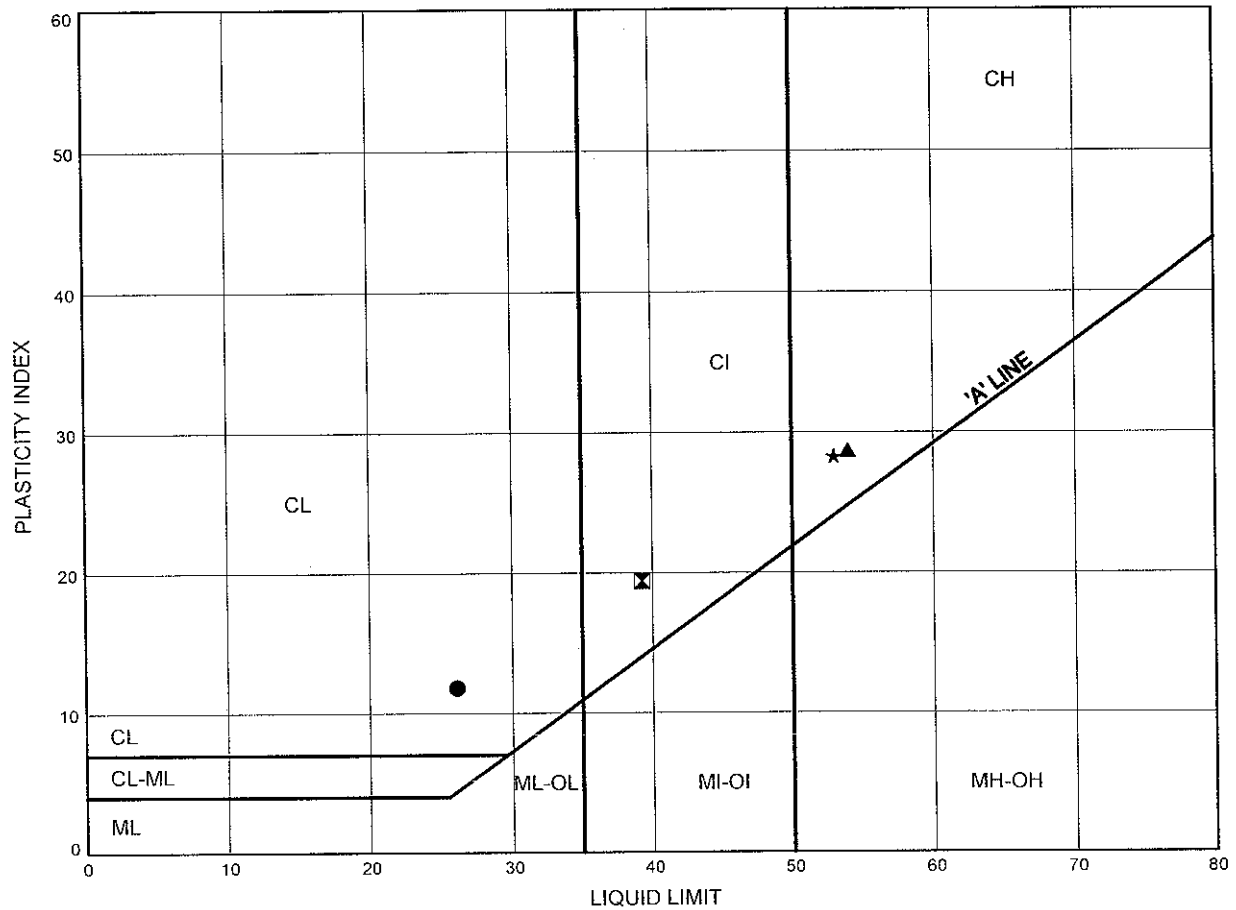
●	S-EW 10+025Rt	1.7	181.9
⊠	TSEW4	1.0	182.5
▲	W-N 10+125CL	0.3	181.0
★	W-N 10+200 Lt	0.3	181.2

Date July 2010
Project 1-09-4135



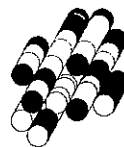
Prep'd DB
Chkd. MP

FIGURE B2-3



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+025Rt	1.7	181.9
⊠	TSEW4	1.0	182.5
▲	W-N 10+125CL	0.3	181.0
★	W-N 10+200 Lt	0.3	181.2

Date July 2010
Project 1-09-4135

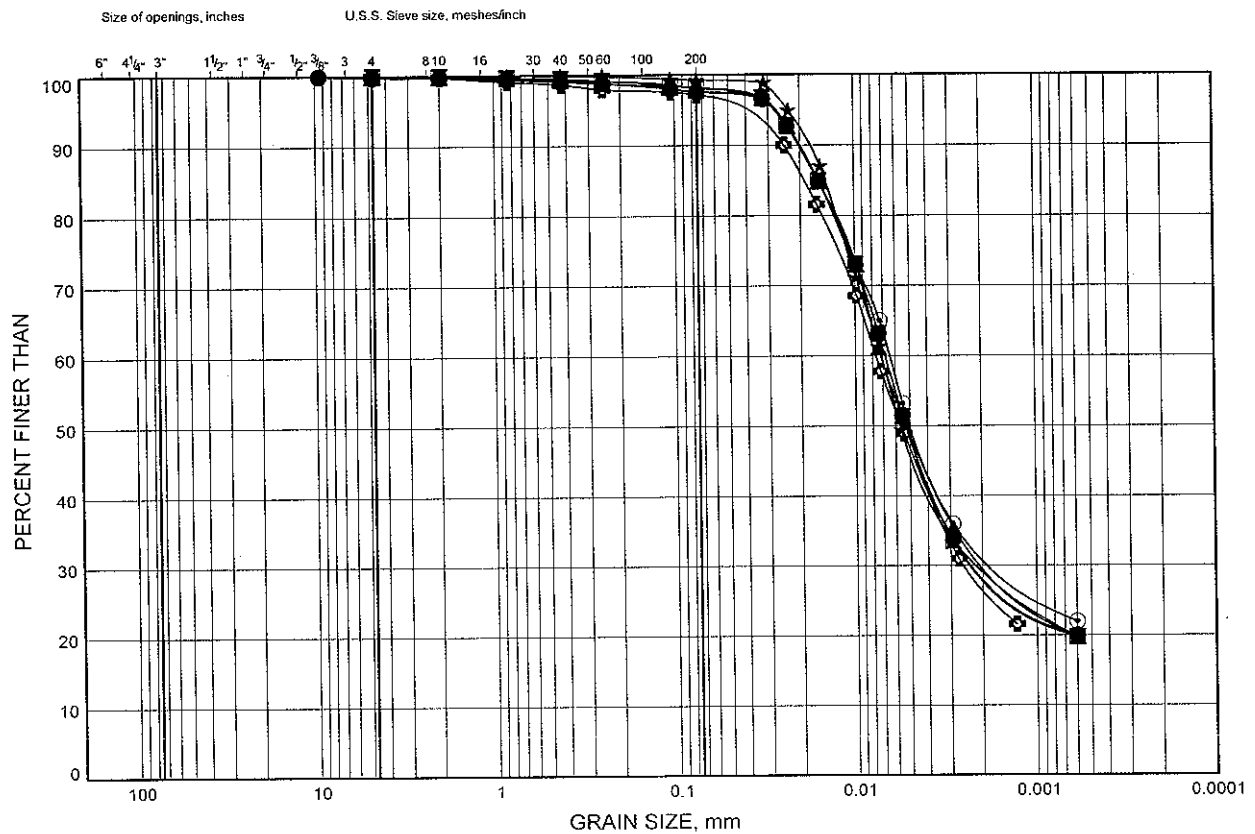


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GRAIN SIZE DISTRIBUTION

FIGURE B2-4

SILTY CLAY

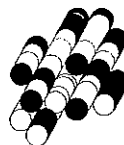


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL · BOREHOLE DEPTH (m) ELEVATION (m)

●	S-EW 10+025Rt	6.3	177.3
⊠	S-EW 10+025Rt	9.3	174.3
▲	S-EW 10+025Rt	13.9	169.7
★	S-EW 10+050CL	3.2	180.2
⊙	S-EW 10+050CL	6.3	177.1
⊛	S-EW 10+050CL	9.3	174.1

Date July 2010
Project 1-09-4135

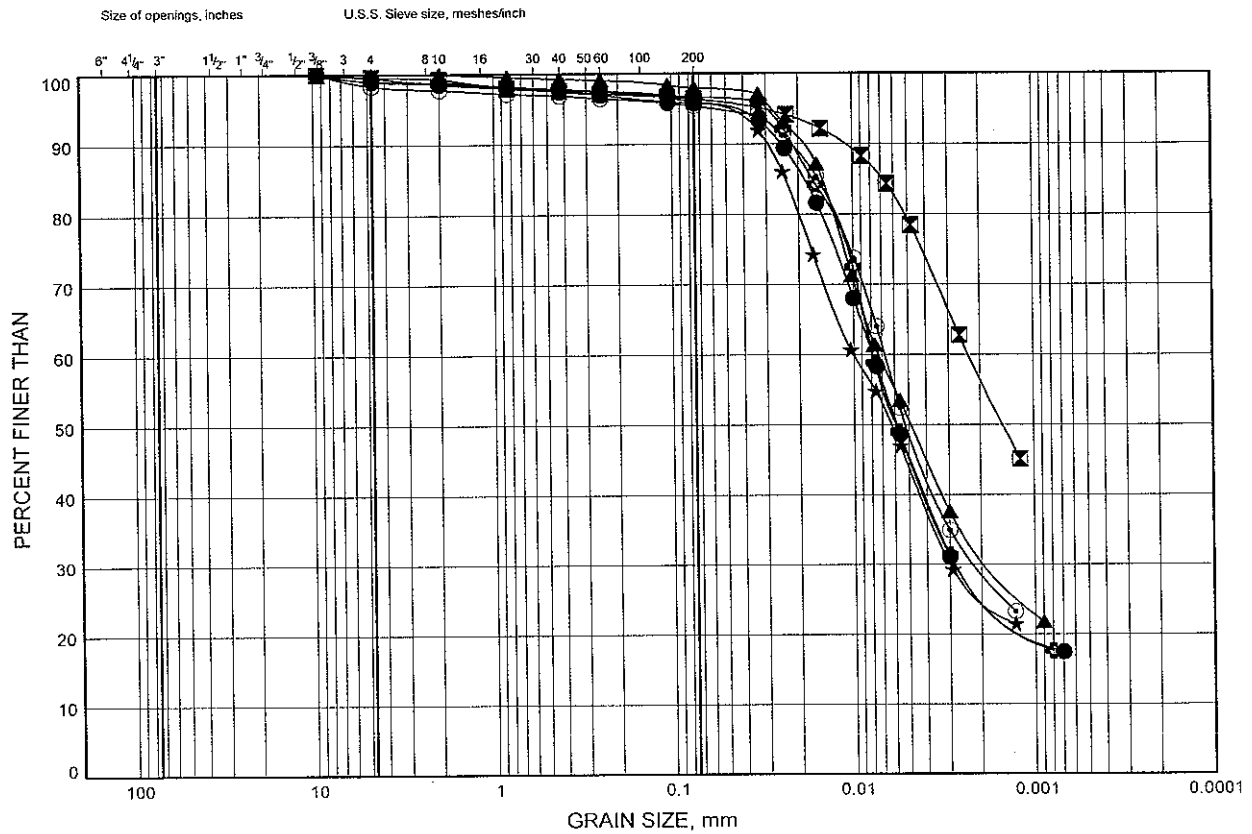


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GRAIN SIZE DISTRIBUTION

FIGURE B2-5

SILTY CLAY

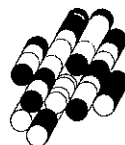


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	S-EW 10+050CL	10.9	172.5
⊠	TSEW1	1.7	181.8
▲	TSEW1	4.0	179.5
★	TSEW1	6.3	177.2
⊙	TSEW1	9.3	174.2
⊕	TSEW1	12.4	171.1

Date July 2010
Project 1-09-4135

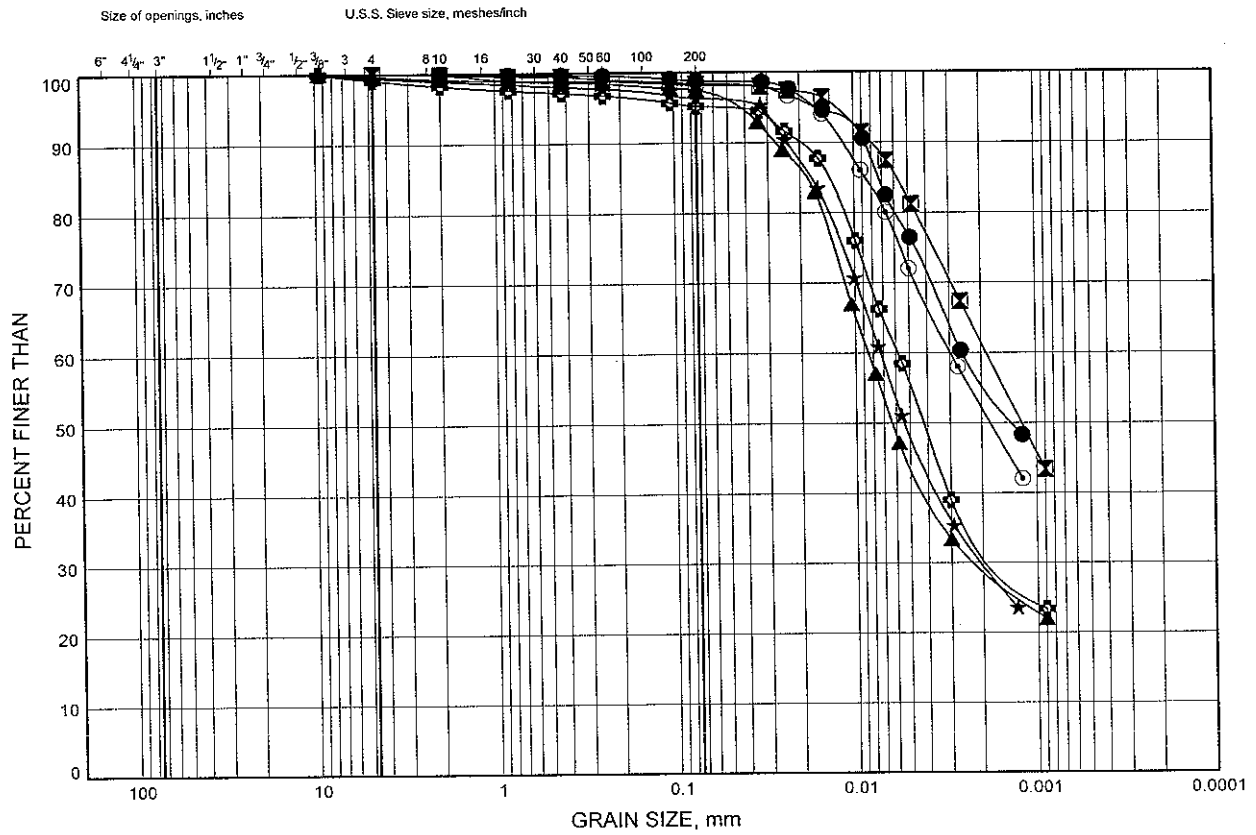


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GRAIN SIZE DISTRIBUTION

FIGURE B2-6

SILTY CLAY



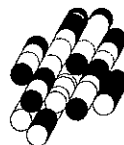
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
--------	----------	-----------	---------------

●	TSEW2	1.0	182.3
⊠	TSEW2	2.5	180.8
▲	TSEW2	5.5	177.8
★	TSEW2	9.3	174.0
⊙	TSEW3	3.2	180.1
⊕	TSEW3	4.7	178.6

Date July 2010

Project 1-09-4135



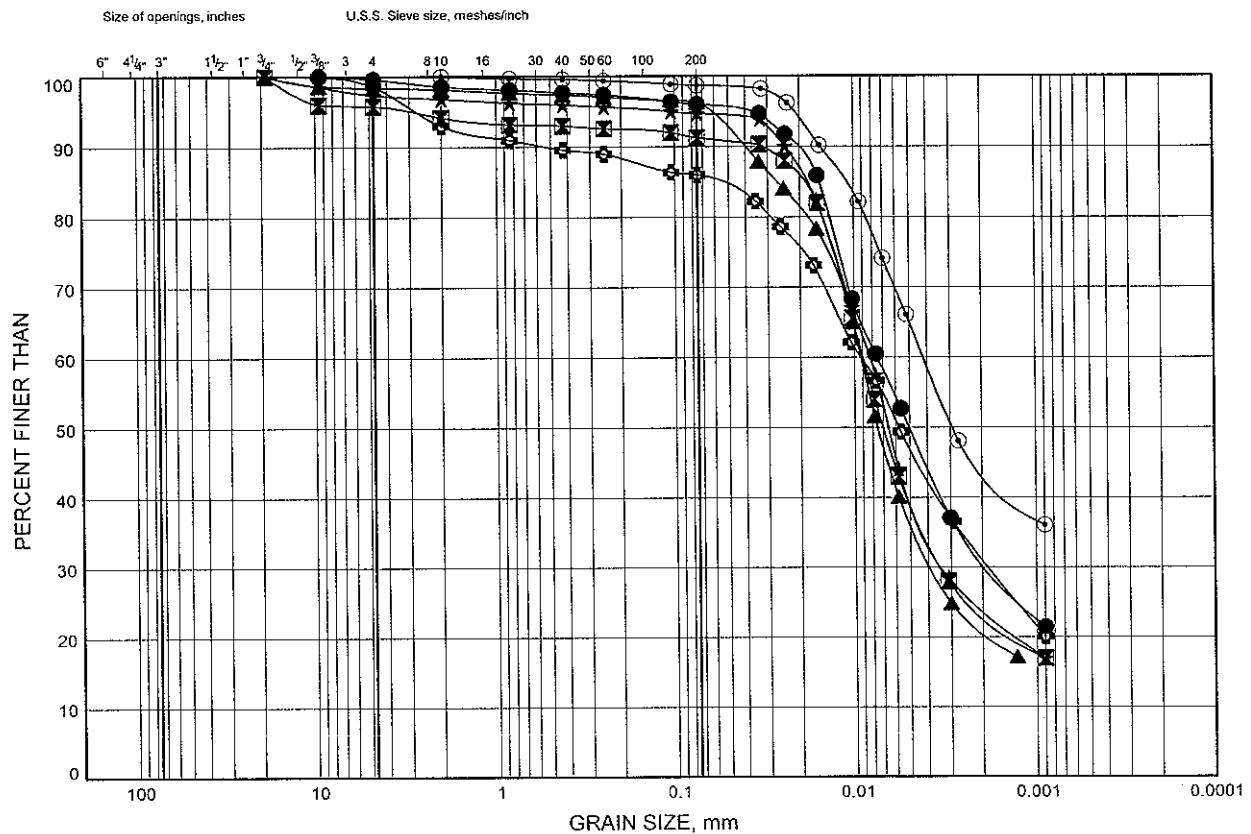
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-7

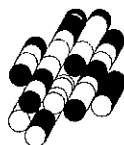
SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	9.3	174.0
⊠	TSEW3	10.9	172.4
▲	TSEW3	12.4	170.9
★	TSEW3	13.9	169.4
⊙	TSEW4	2.5	181.0
⊛	TSEW4	4.7	178.8

Date July 2010
Project 1-09-4135

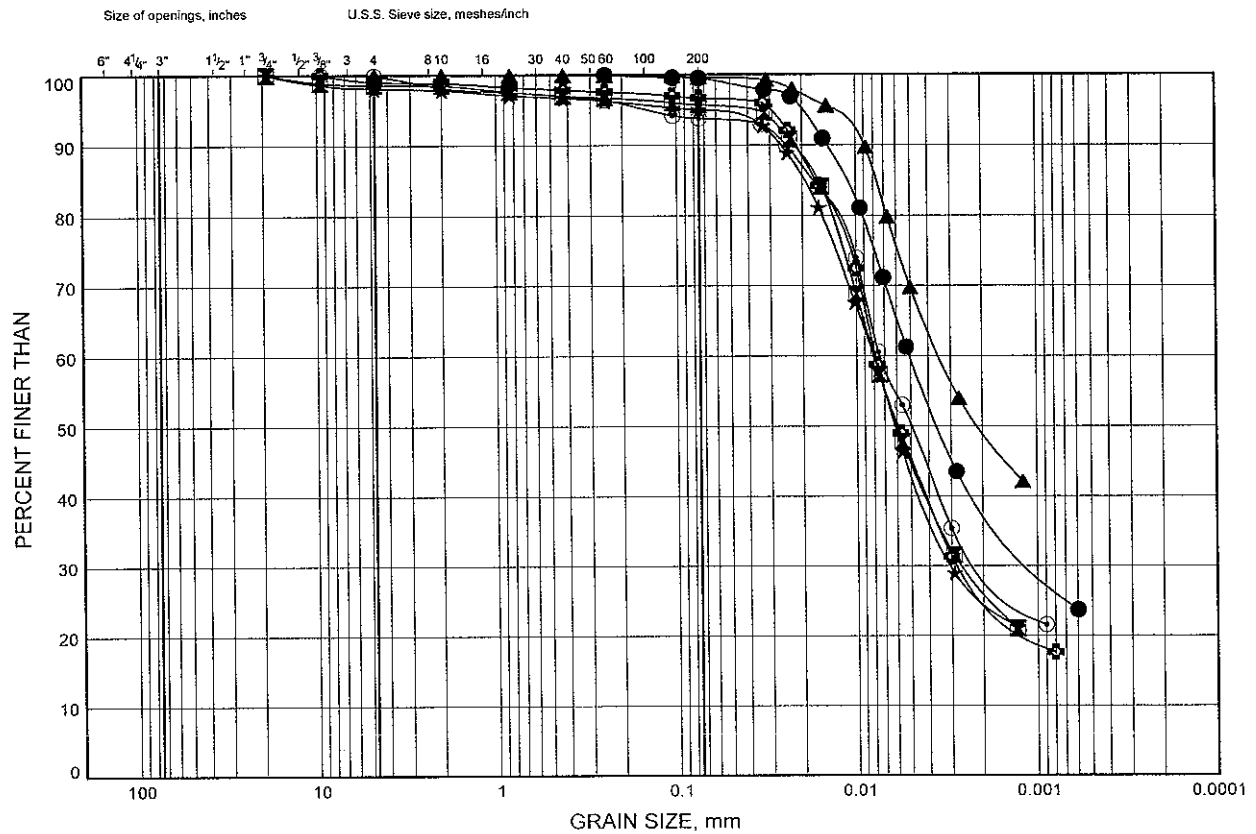


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-8

SILTY CLAY

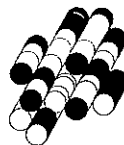


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	S-EW 10+110CL	1.7	180.7
⊠	S-EW 10+110CL	12.4	170.0
▲	S-EW 10+185Lt	1.0	181.4
★	TSEW4	7.8	175.7
⊙	TSEW4	9.3	174.2
⊛	TSEW4	12.4	171.1

Date July 2010
Project 1-09-4135

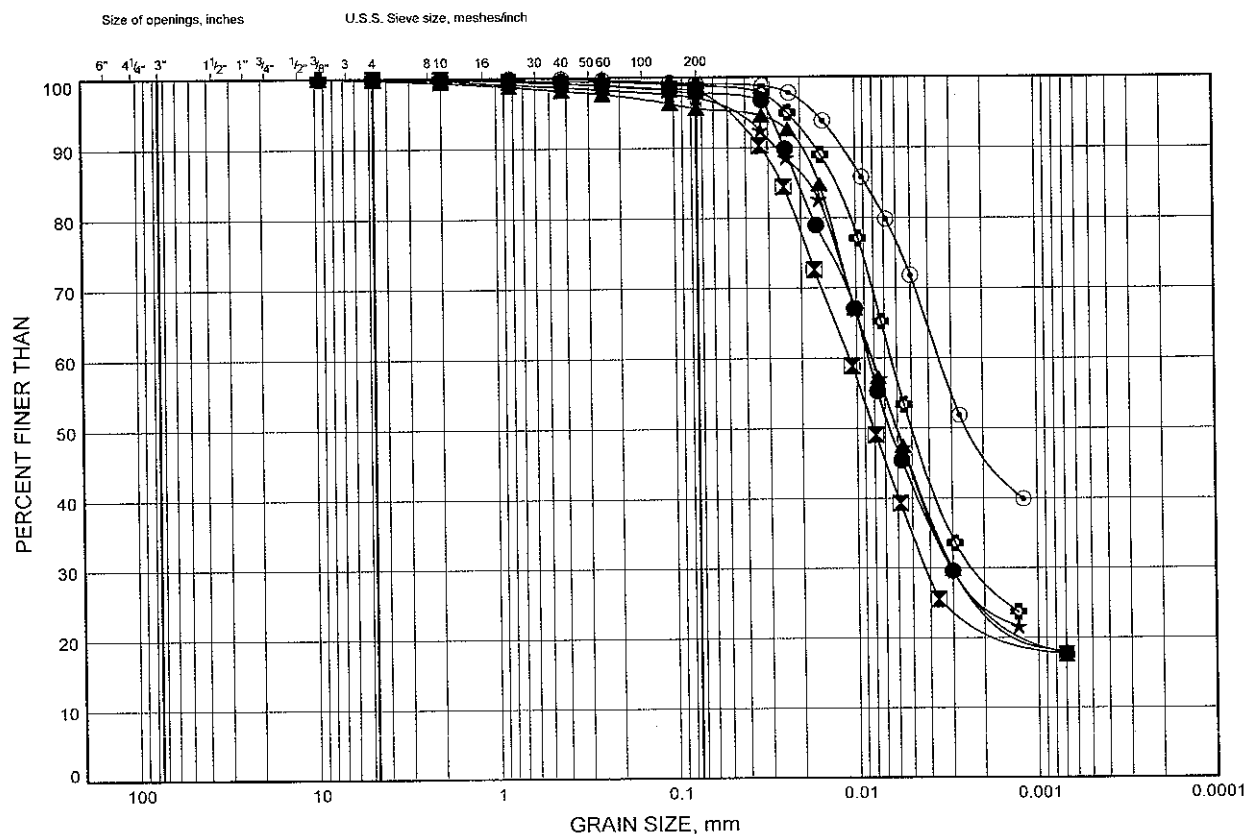


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Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-9

SILTY CLAY

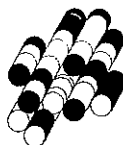


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	S-EW 10+185Lt	2.5	179.9
■	S-EW 10+185Lt	4.7	177.7
▲	S-EW 10+185Lt	7.8	174.6
★	S-EW 10+185Lt	10.9	171.5
⊙	S-EW 10+185Rt	3.2	179.5
⊠	S-EW 10+185Rt	7.8	174.9

Date July 2010
Project 1-09-4135

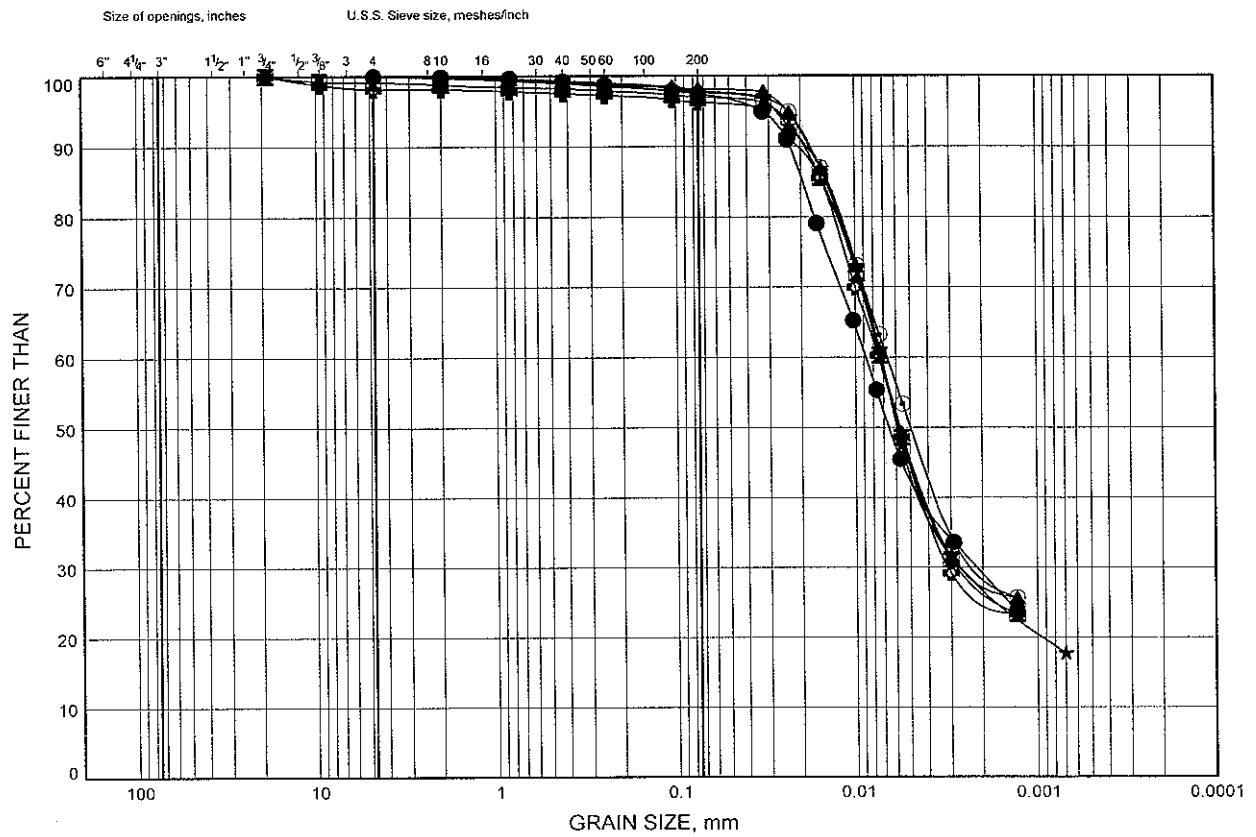


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-10

SILTY CLAY



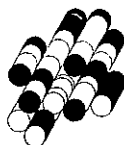
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	S-EW 10+260CL	1.7	180.9
⊠	S-EW 10+260CL	4.7	177.9
▲	W-N 10+125CL	3.2	178.1
★	W-N 10+125CL	6.3	175.0
⊙	W-N 10+200 Lt	6.3	175.2
⊛	W-N 10+200 Lt	9.3	172.2

Date July 2010

Project 1-09-4135



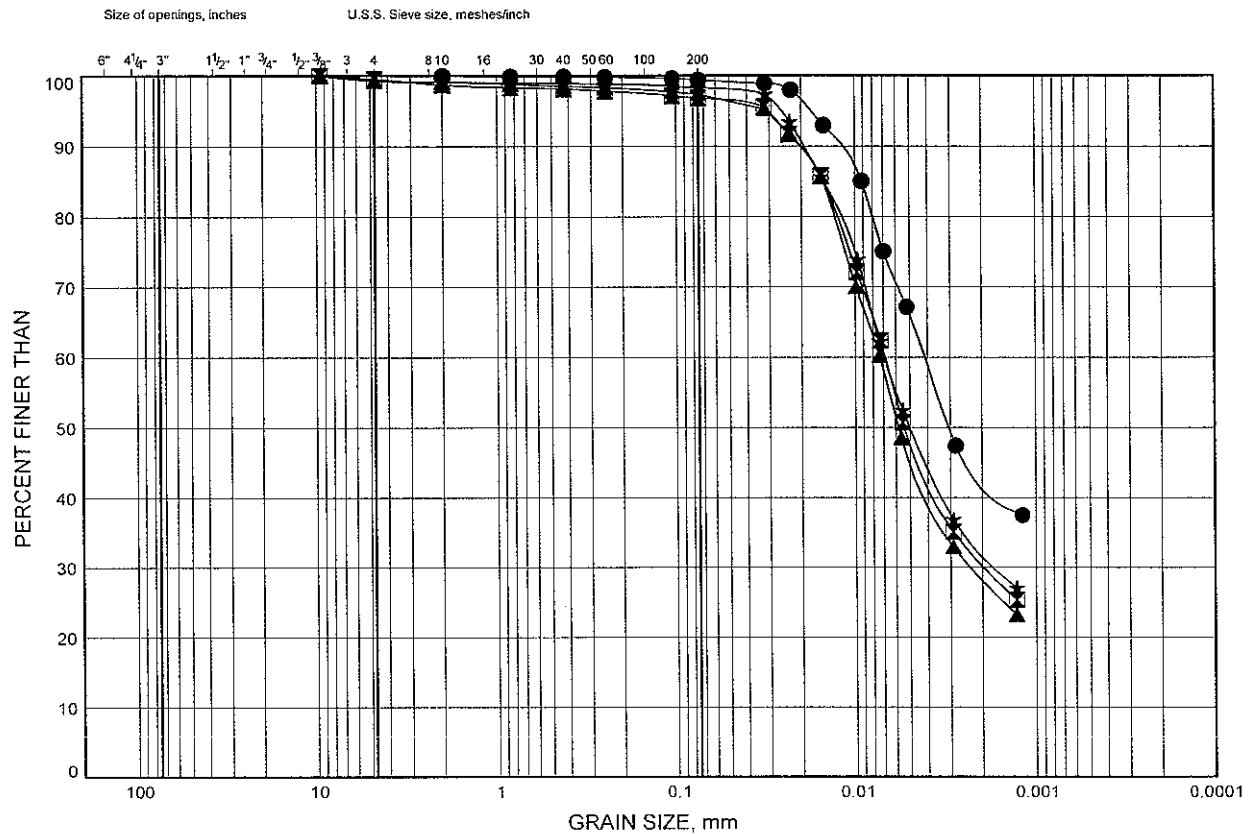
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-11

SILTY CLAY

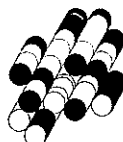


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	W-N 10+200 Rt	1.7	179.8
⊠	W-N 10+200 Rt	3.2	178.3
▲	W-N 10+200 Rt	7.8	173.7
★	W-N 10+275 Rt	2.5	179.4

Date July 2010
Project 1-09-4135

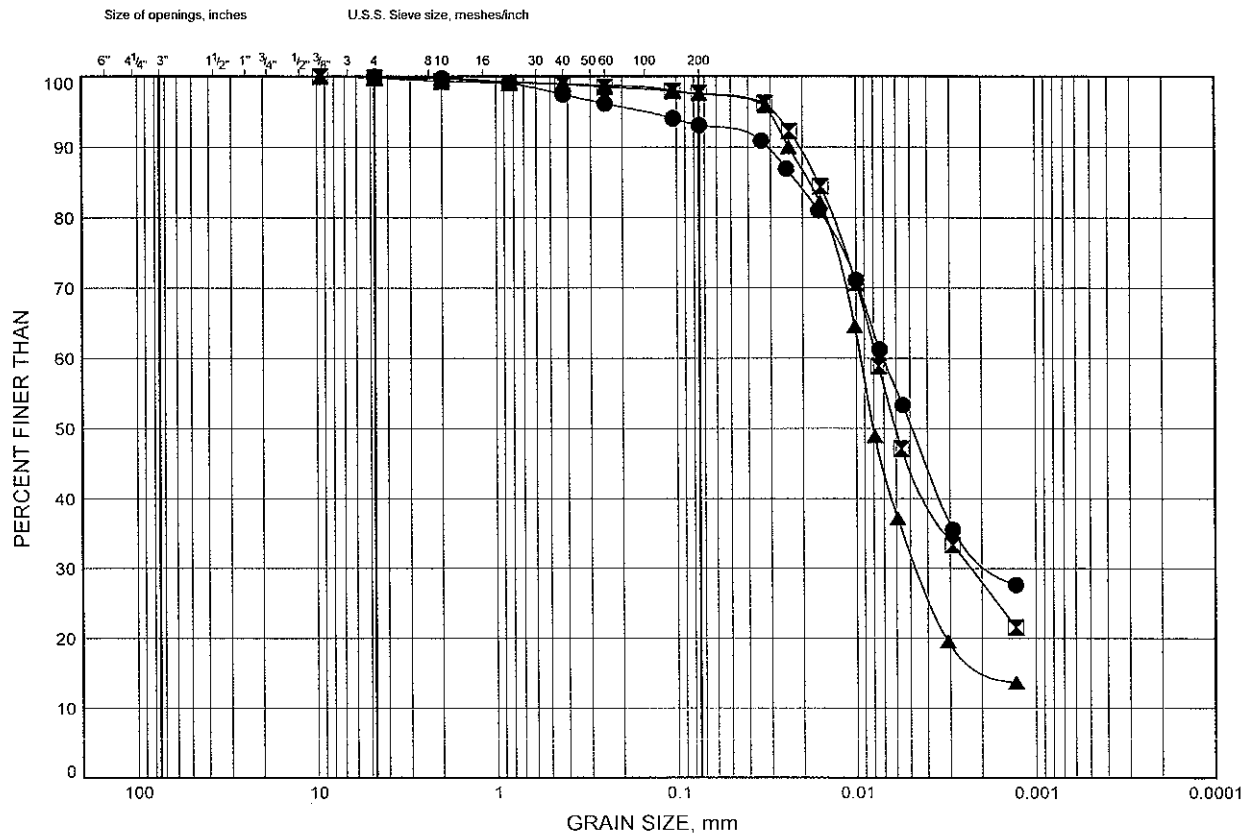


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-12

SILTY CLAY



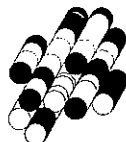
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	W-N 10+275 Rt	4.7	177.2
⊠	W-N 10+275 Rt	7.8	174.1
▲	W-N 10+275 Rt	10.9	171.0

Date July 2010

Project 1-09-4135

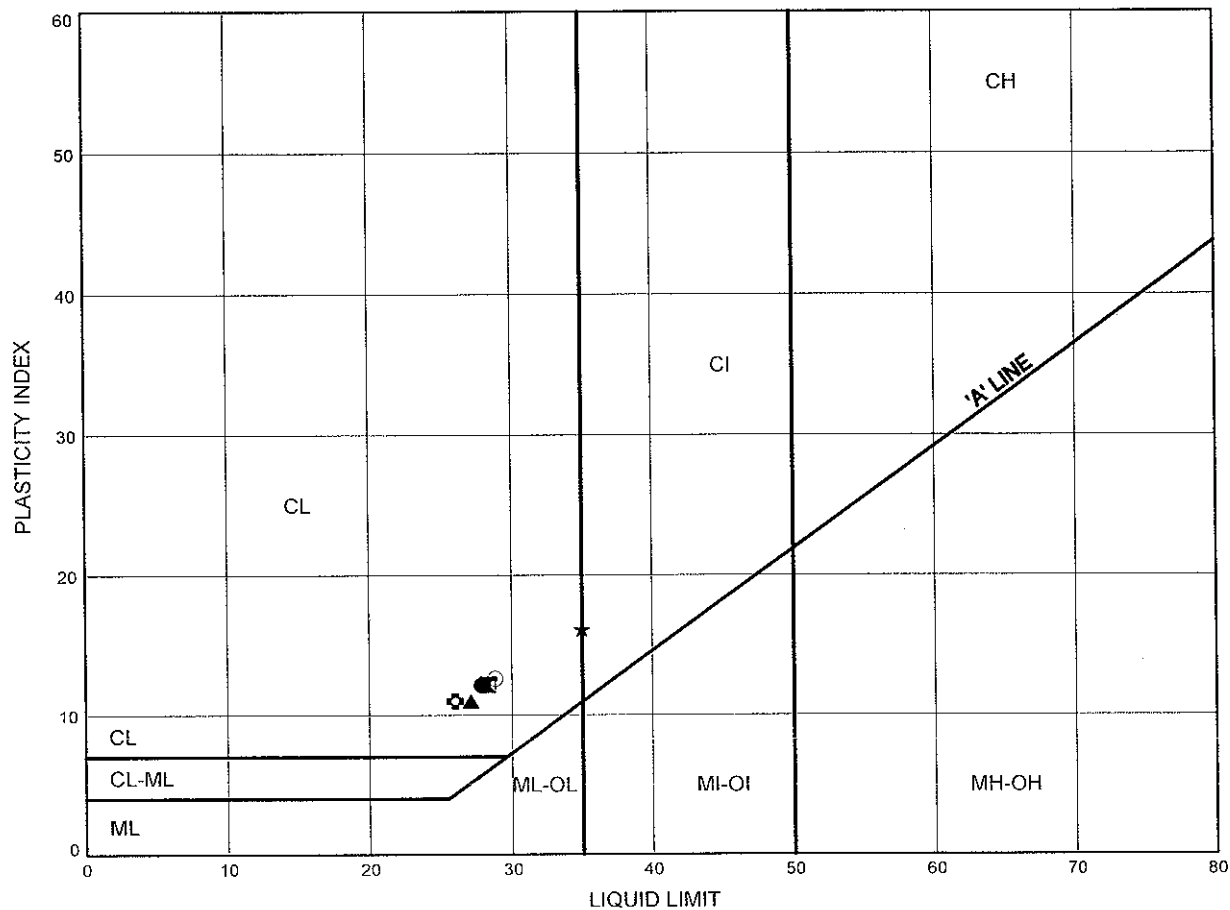


Prep'd DB

Chkd. MP

FIGURE B2-13

SILTY CLAY

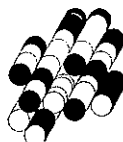


SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+025Rt	6.3	177.3
⊠	S-EW 10+025Rt	9.3	174.3
▲	S-EW 10+025Rt	13.9	169.7
★	S-EW 10+050CL	3.2	180.2
⊙	S-EW 10+050CL	6.3	177.1
⊠	S-EW 10+050CL	9.3	174.1

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+025Rt	6.3	177.3
⊠	S-EW 10+025Rt	9.3	174.3
▲	S-EW 10+025Rt	13.9	169.7
★	S-EW 10+050CL	3.2	180.2
⊙	S-EW 10+050CL	6.3	177.1
⊠	S-EW 10+050CL	9.3	174.1

Date July 2010

Project 1-09-4135



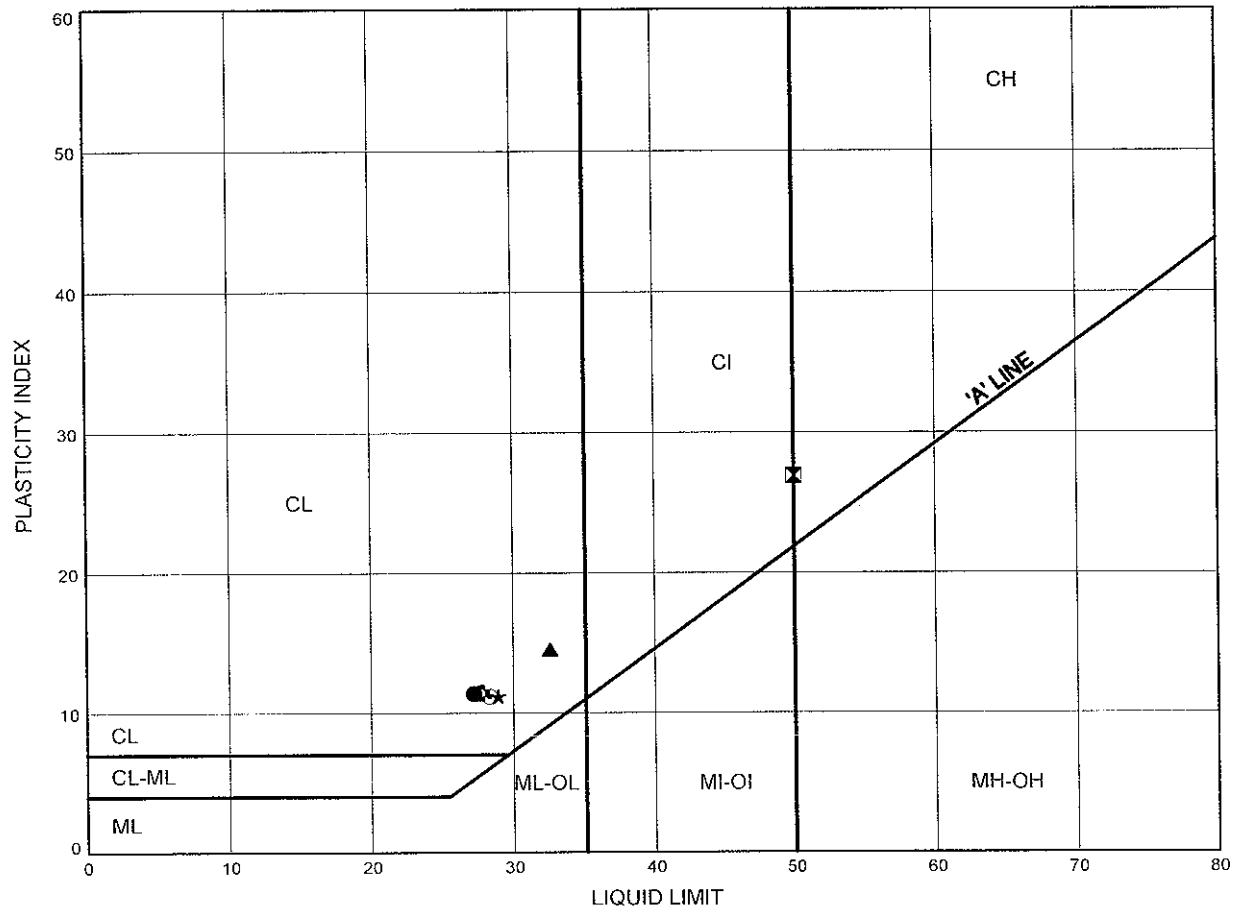
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

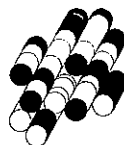
FIGURE B2-14

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+050CL	10.9	172.5
⊠	TSEW1	1.7	181.8
▲	TSEW1	4.0	179.5
★	TSEW1	6.3	177.2
⊙	TSEW1	9.3	174.2
⊛	TSEW1	12.4	171.1

Date July 2010
Project 1-09-4135

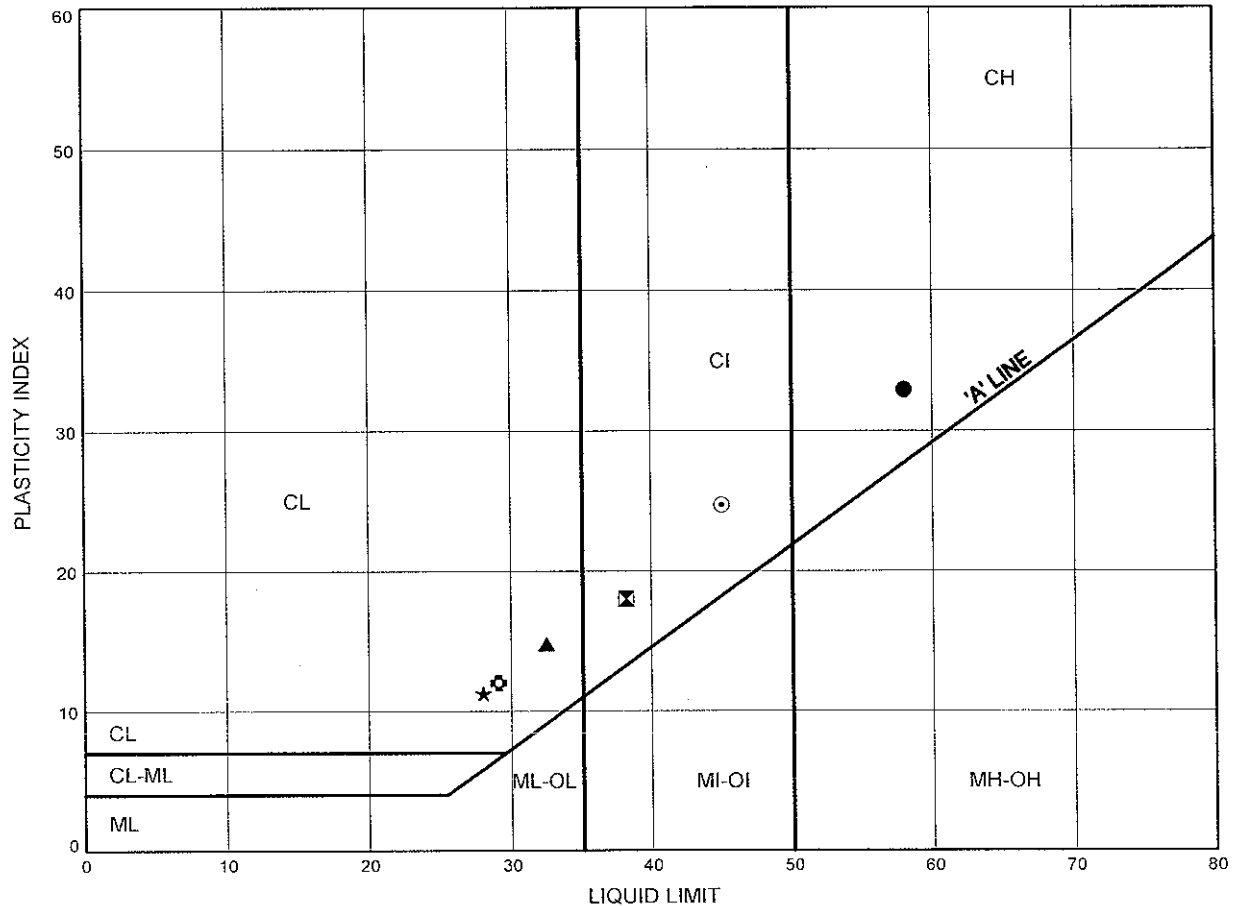


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

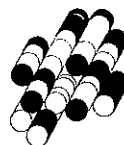
FIGURE B2-15

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW2	1.0	182.3
⊠	TSEW2	2.5	180.8
▲	TSEW2	5.5	177.8
★	TSEW2	9.3	174.0
⊙	TSEW3	3.2	180.1
⊛	TSEW3	4.7	178.6

Date July 2010
Project 1-09-4135

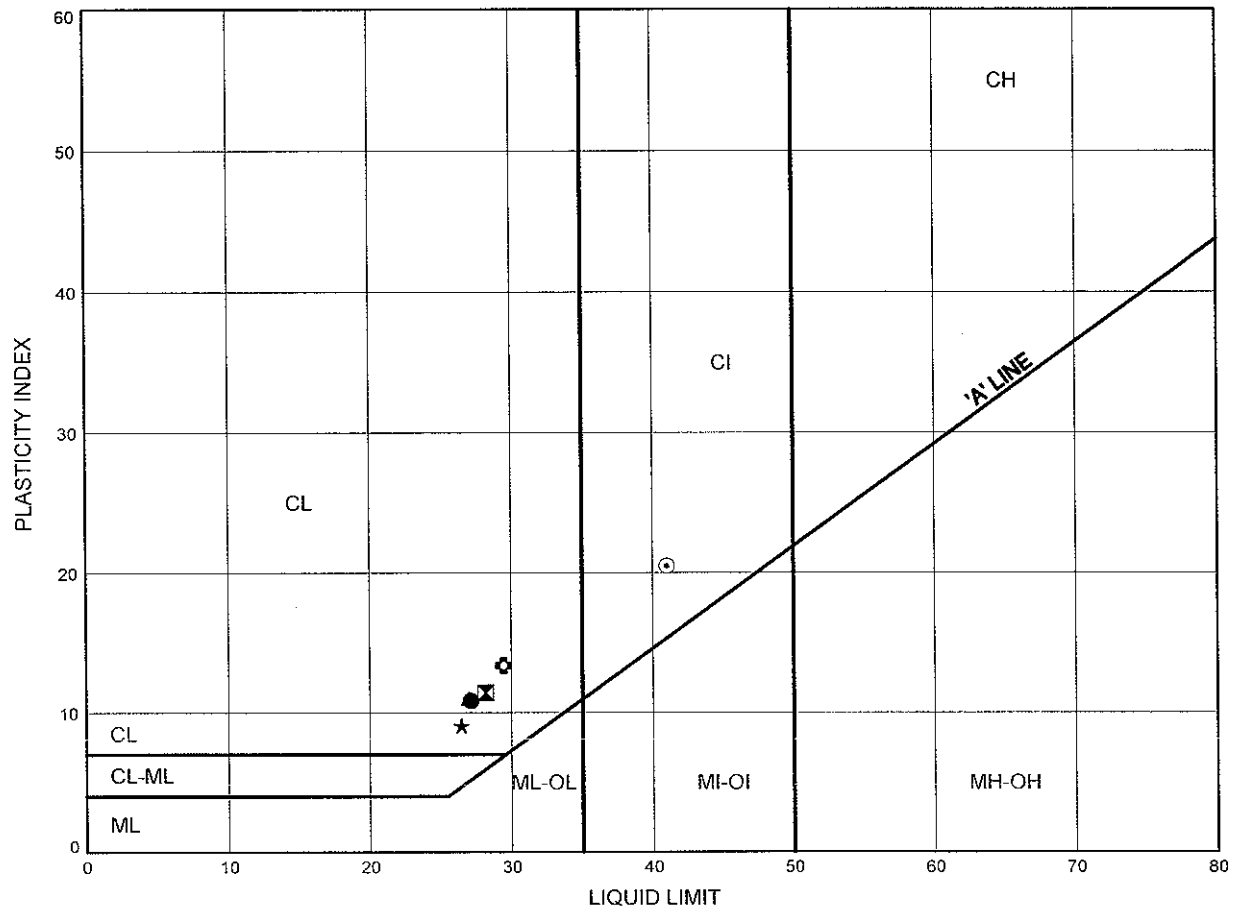


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

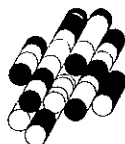
FIGURE B2-16

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	9.3	174.0
⊠	TSEW3	10.9	172.4
▲	TSEW3	12.4	170.9
★	TSEW3	13.9	169.4
⊙	TSEW4	2.5	181.0
⊛	TSEW4	4.7	178.8

Date July 2010
Project 1-09-4135

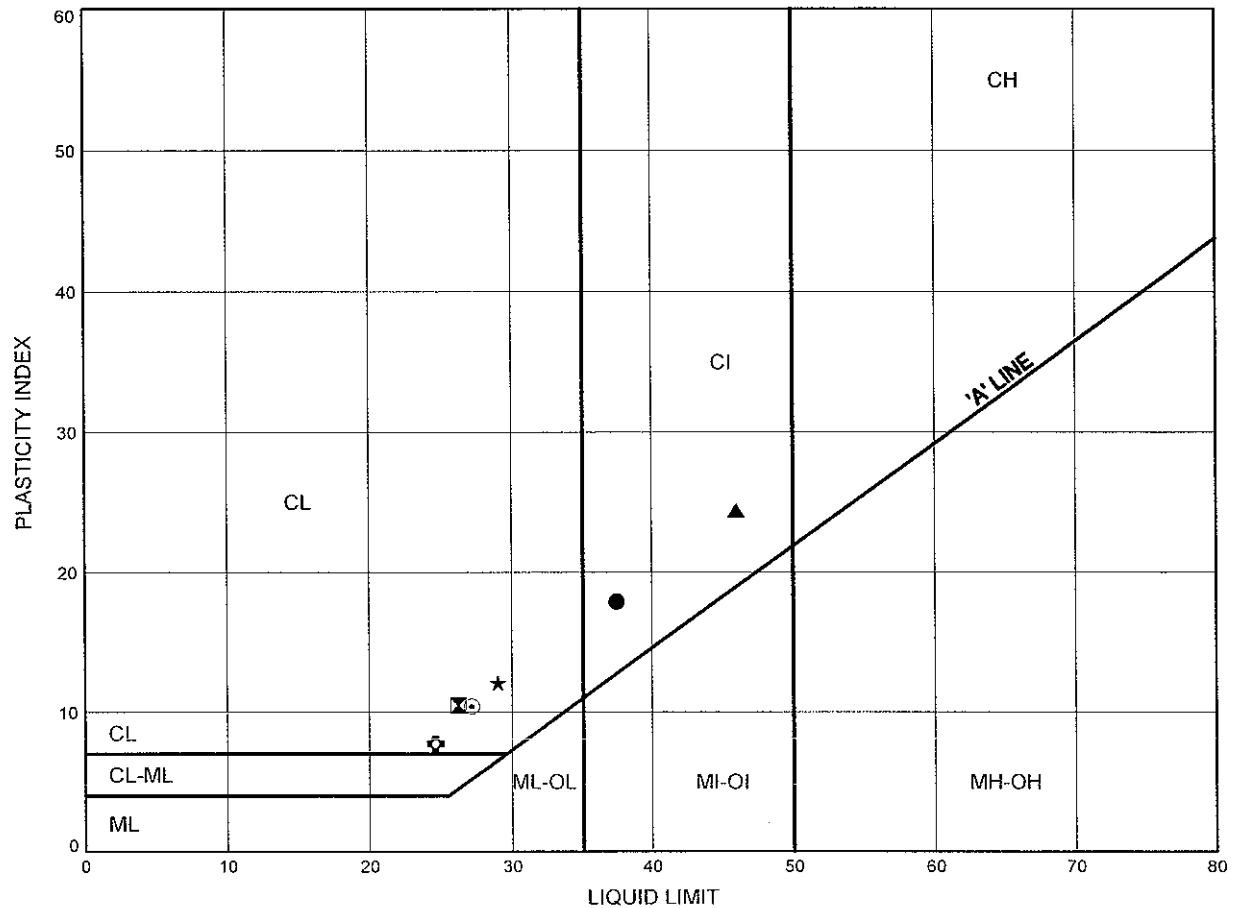


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-17

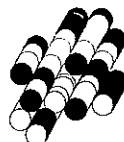
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+110CL	1.7	180.7
⊠	S-EW 10+110CL	12.4	170.0
▲	S-EW 10+185L	1.0	181.4
★	TSEW4	7.8	175.7
⊙	TSEW4	9.3	174.2
⊛	TSEW4	12.4	171.1

Date July 2010

Project 1-09-4135



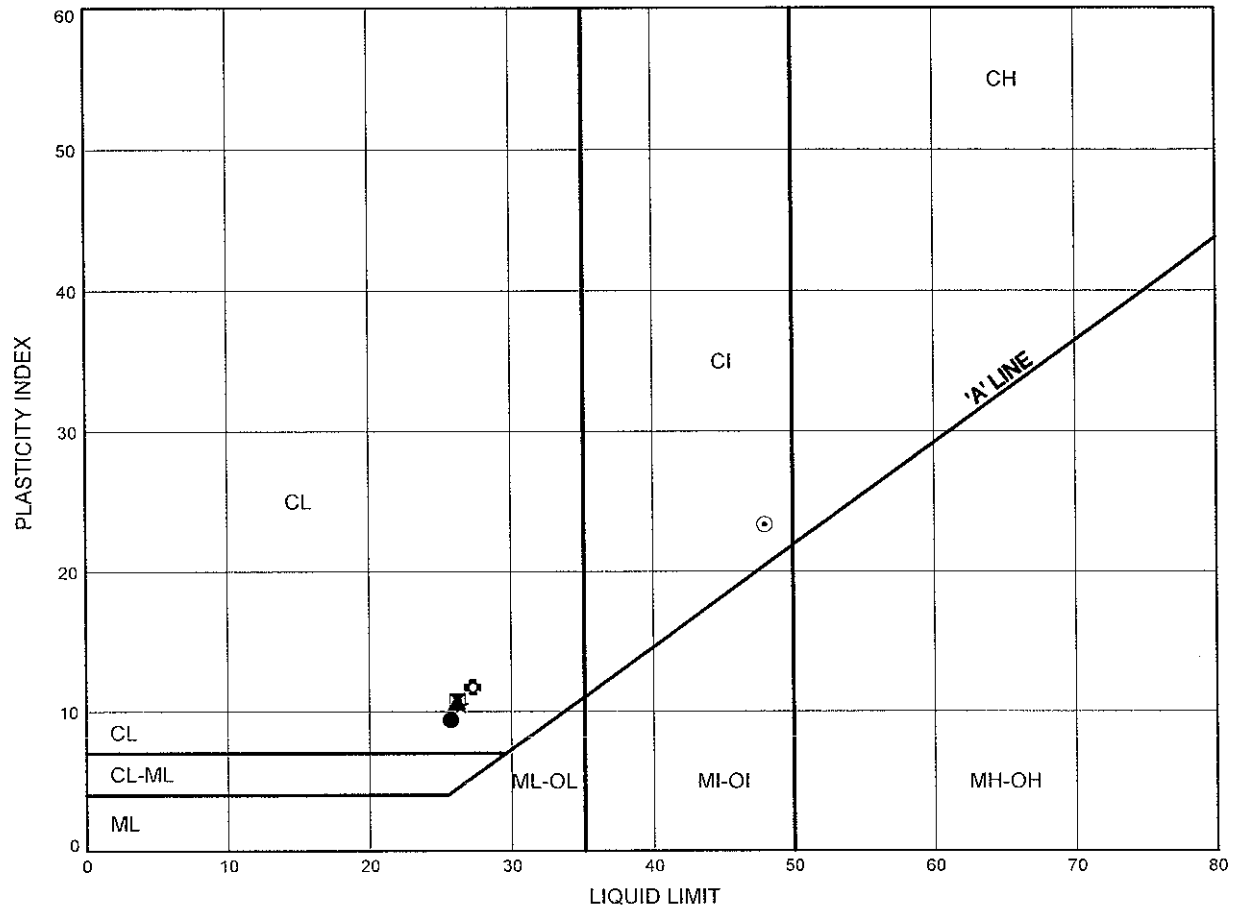
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

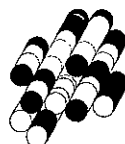
FIGURE B2-18

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+185Lt	2.5	179.9
⊠	S-EW 10+185Lt	4.7	177.7
▲	S-EW 10+185Lt	7.8	174.6
★	S-EW 10+185Lt	10.9	171.5
⊙	S-EW 10+185Rt	3.2	179.5
⊛	S-EW 10+185Rt	7.8	174.9

Date July 2010
Project 1-09-4135

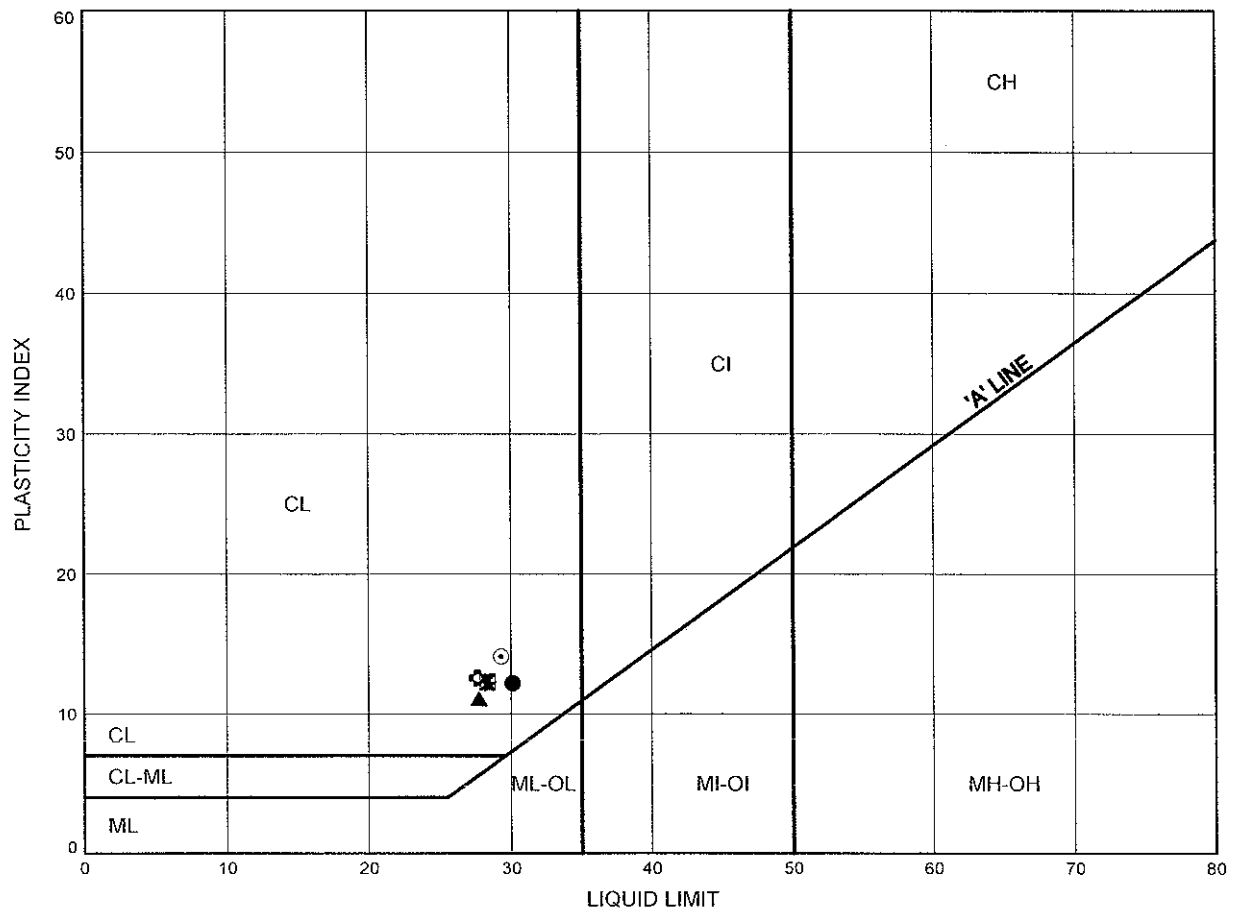


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

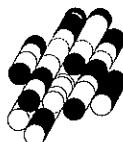
FIGURE B2-19

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+260CL	1.7	180.9
⊠	S-EW 10+260CL	4.7	177.9
▲	W-N 10+125CL	3.2	178.1
★	W-N 10+125CL	6.3	175.0
⊙	W-N 10+200 Lt	6.3	175.2
⊛	W-N 10+200 Lt	9.3	172.2

Date July 2010
Project 1-09-4135

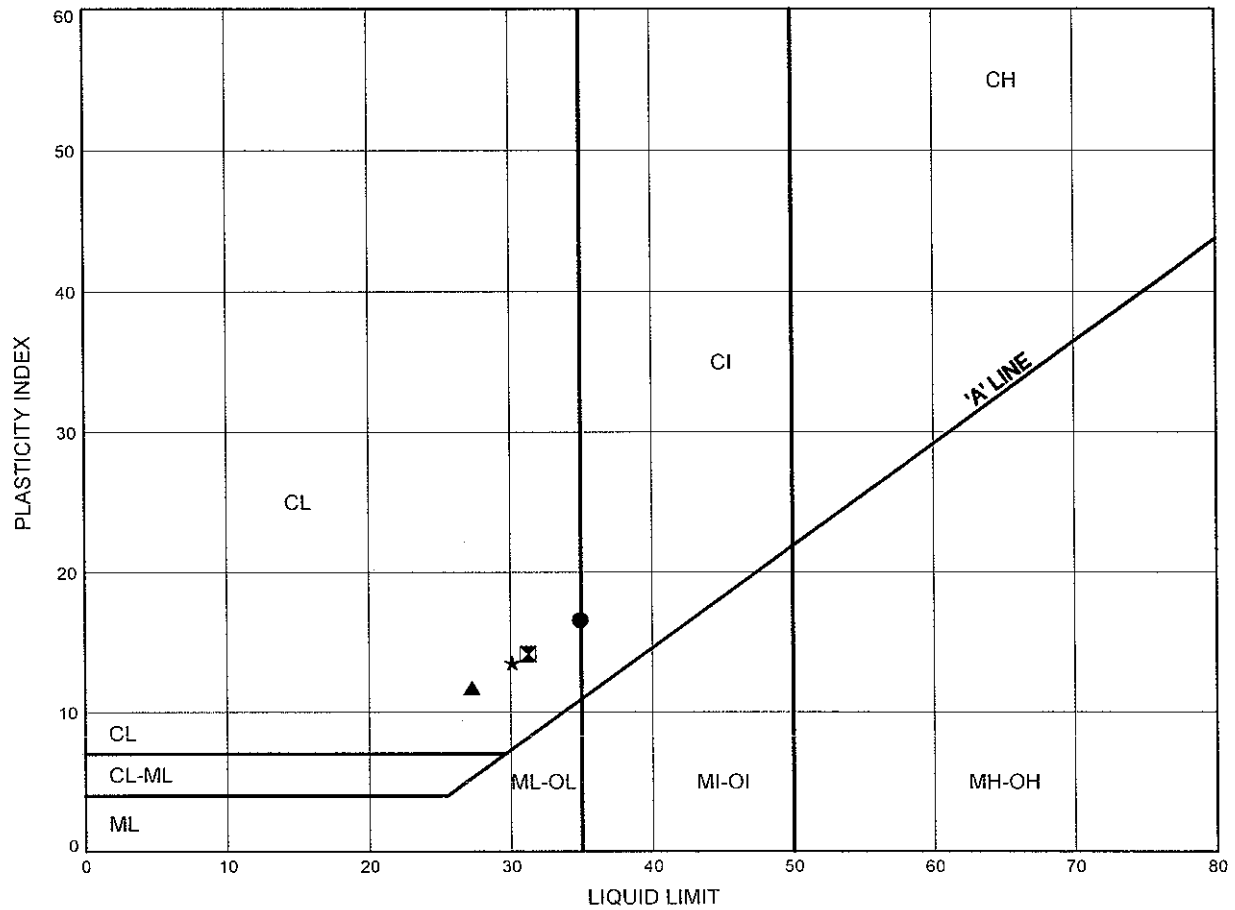


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

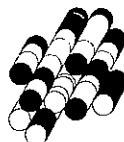
FIGURE B2-20

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	W-N 10+200 Rt	1.7	179.8
⊠	W-N 10+200 Rt	3.2	178.3
▲	W-N 10+200 Rt	7.8	173.7
★	W-N 10+275 Rt	2.5	179.4

Date July 2010
Project 1-09-4135

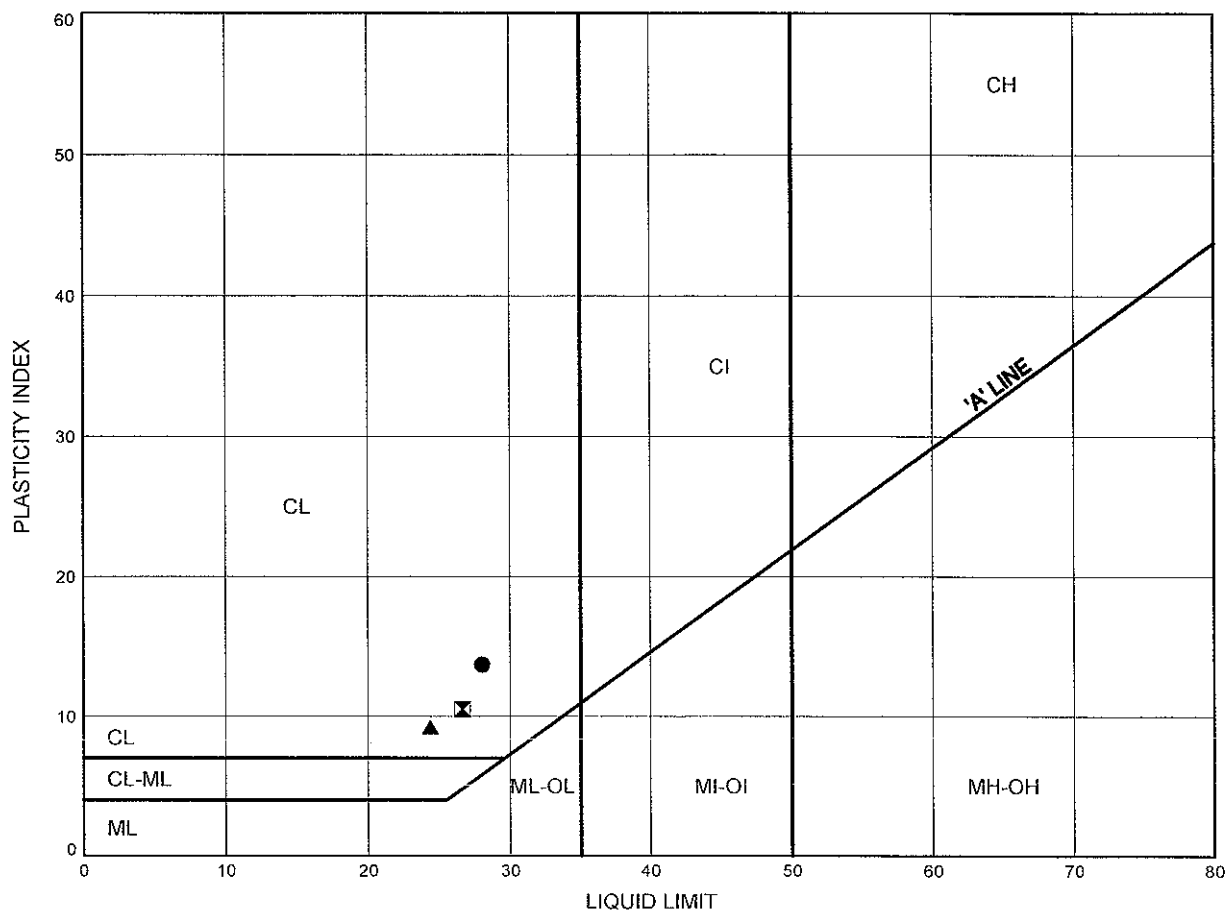


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

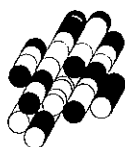
FIGURE B2-21

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	W-N 10+275 Rt	4.7	177.2
⊠	W-N 10+275 Rt	7.8	174.1
▲	W-N 10+275 Rt	10.9	171.0

Date July 2010
Project 1-09-4135

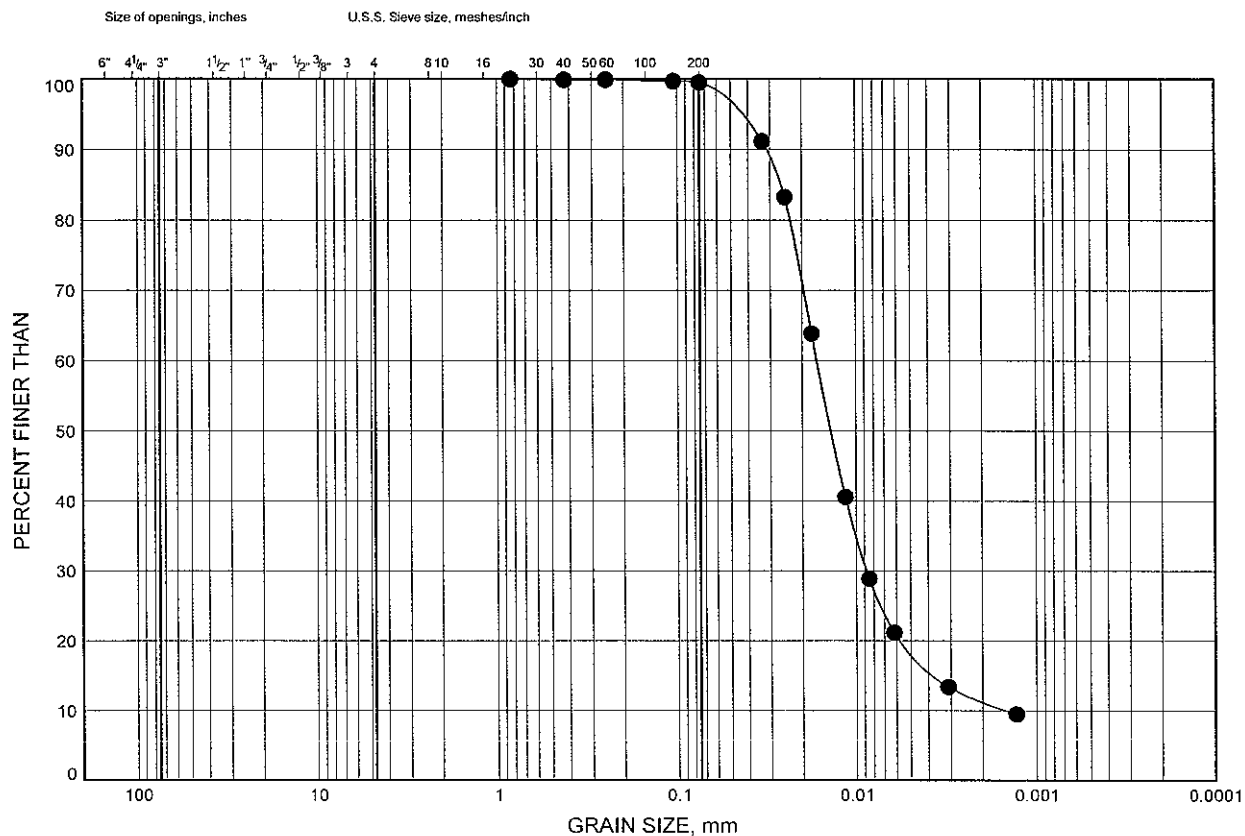


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-22

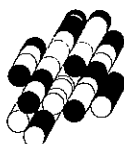
SILT



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	W-N 10+200 Lt	2.5	179.0

Date July 2010
Project 1-09-4135

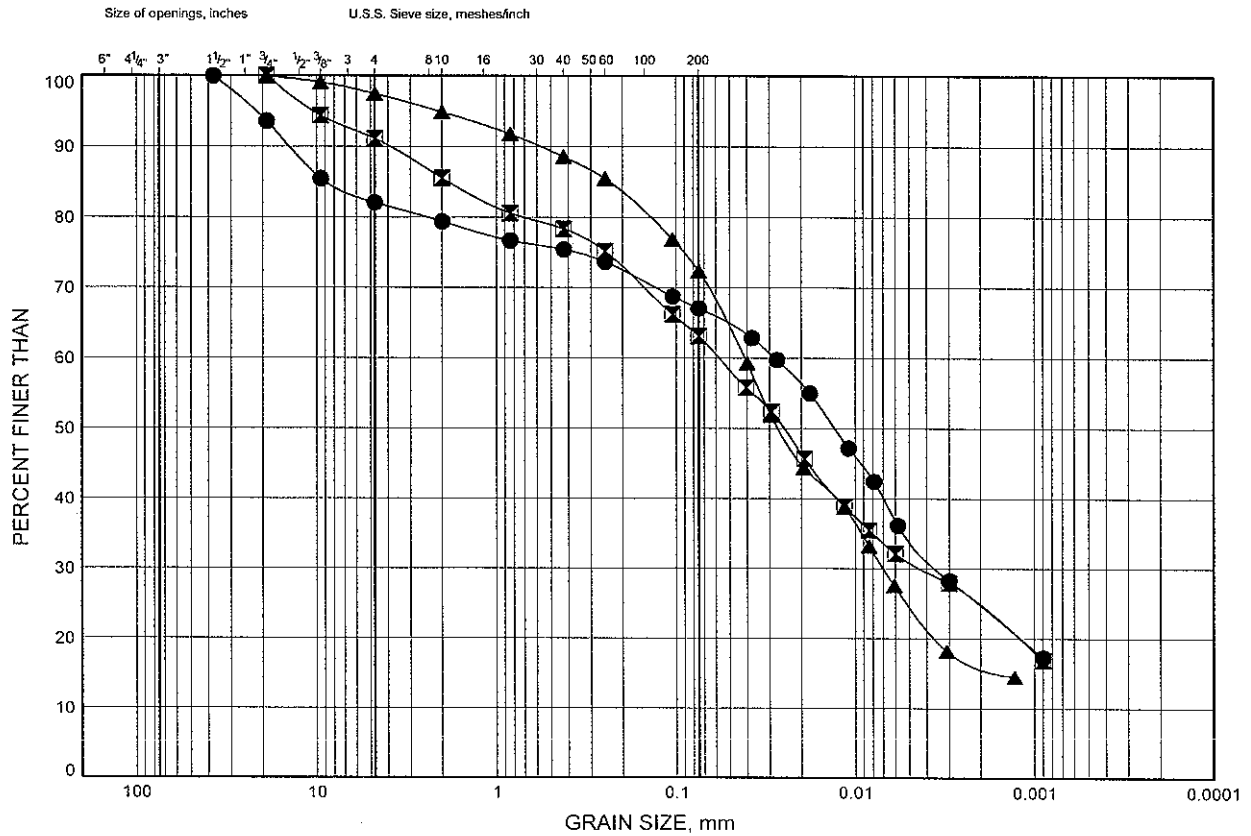


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-24

SILTY CLAY TO CLAYEY SILT TILL



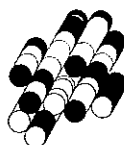
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

● TSEW4 18.5 165.0
 ✕ TSEW4 26.1 157.4
 ▲ W-N 10+275 Rt 13.9 168.0

Date July 2010

Project 1-09-4135



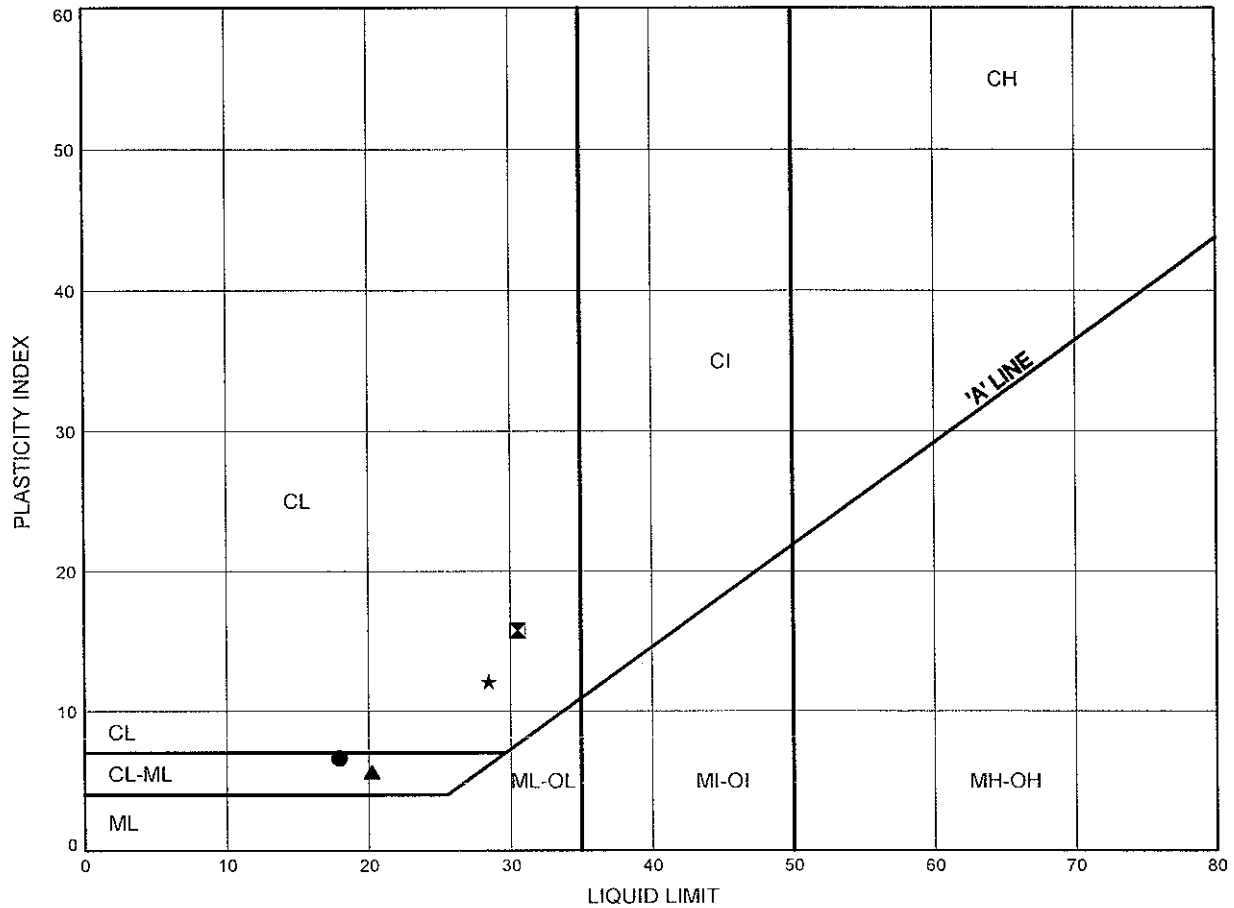
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-25

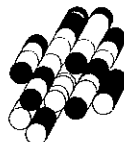
SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+025Rt	17.0	166.6
⊠	TSEW1	26.1	157.4
▲	TSEW2	18.5	164.8
★	TSEW2	26.1	157.2

Date July 2010

Project 1-09-4135



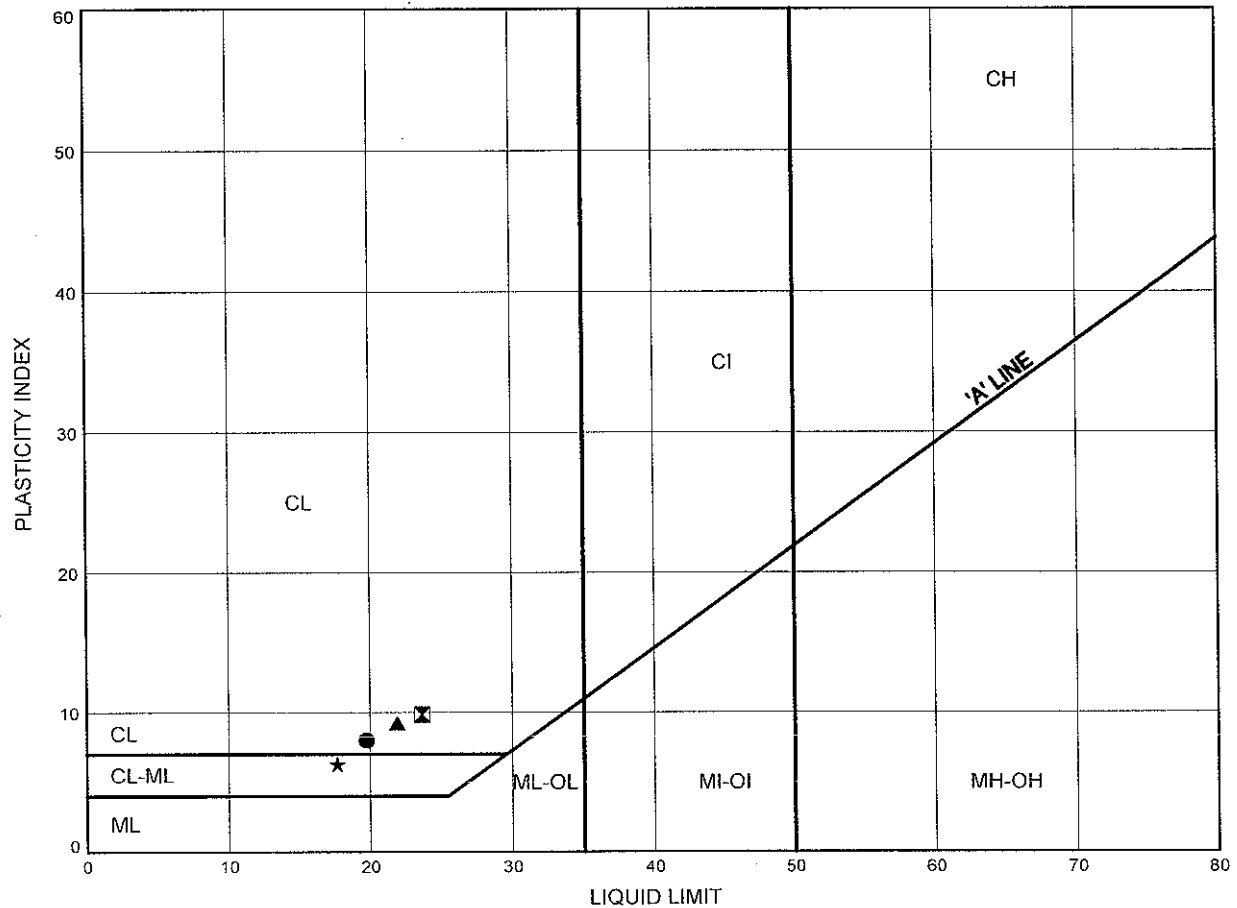
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

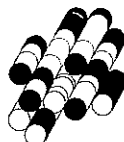
FIGURE B2-26

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	26.1	157.2
⊠	TSEW4	18.5	165.0
▲	TSEW4	26.1	157.4
★	W-N 10+275 Rt	13.9	168.0

Date July 2010
Project 1-09-4135

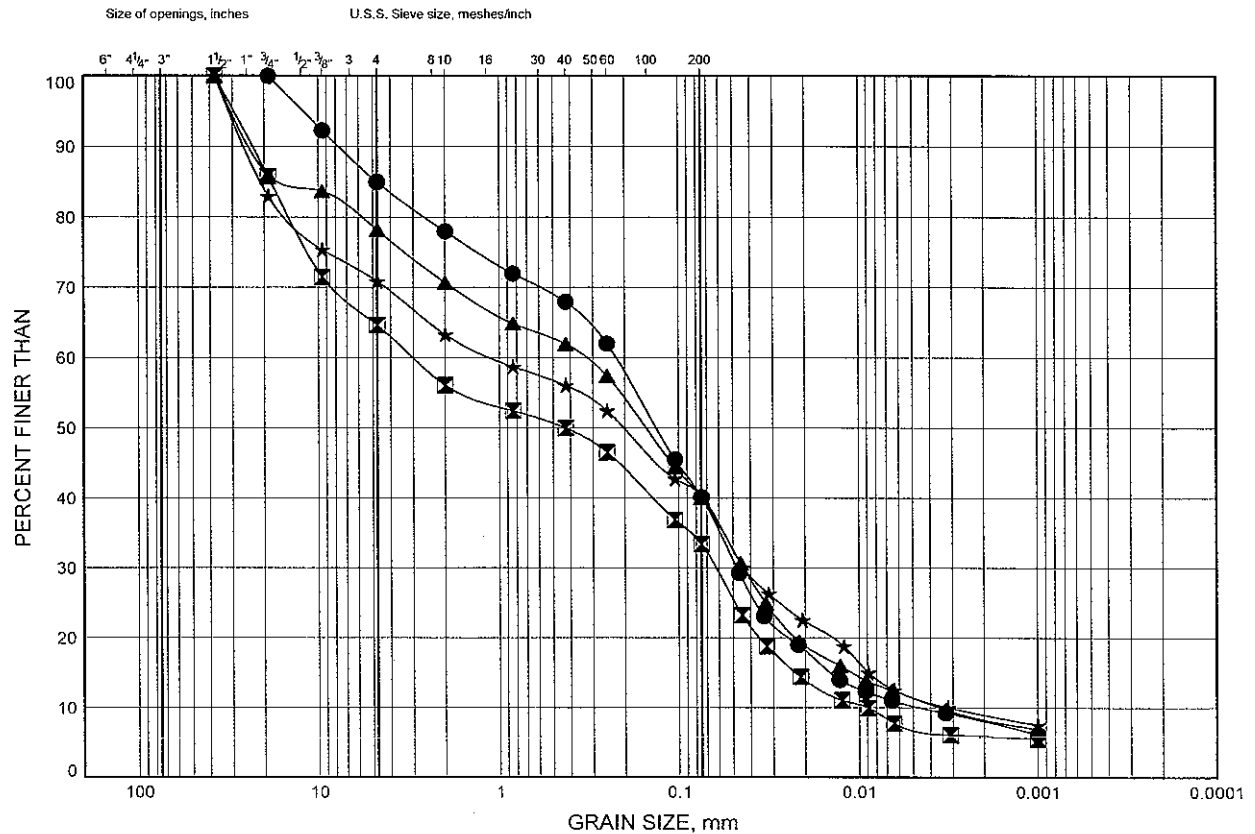


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-27

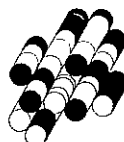
SILTY SAND TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	20.0	163.3
⊠	TSEW3	23.1	160.2
▲	TSEW4	20.0	163.5
★	TSEW4	23.1	160.4

Date July 2010
Project 1-09-4135



Prep'd DB
Chkd MP

FIGURE B2-28

Size of openings, inches: 6", 4 1/4", 3", 1 1/2", 1", 3/4", 1/2", 3/8", 3/16", 1/8", 1/16", 1/32", 1/64"

U.S.S. Sieve size, meshes/inch: 10, 20, 30, 40, 60, 100, 200

PERCENT FINER THAN

GRAIN SIZE, mm: 100, 10, 1, 0.1, 0.01, 0.001, 0.0001

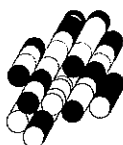
Grain Size (mm)	Percent Finer (%) - Square Markers	Percent Finer (%) - Circular Markers
100	100	-
4.75	100	100
2.0	78	82
0.85	72	58
0.425	66	37
0.25	55	26
0.15	48	21
0.075	42	18
0.0425	32	15
0.025	29	14
0.015	21	-
0.0075	17	-
0.00425	14	-
0.0025	11	-
0.0015	10	-
0.00075	9	-
0.000425	8	-
0.00025	5	-

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW1	29.2	154.3
⊗	TSEW3	27.6	155.7

Date July 2010

Project 1-09-4135

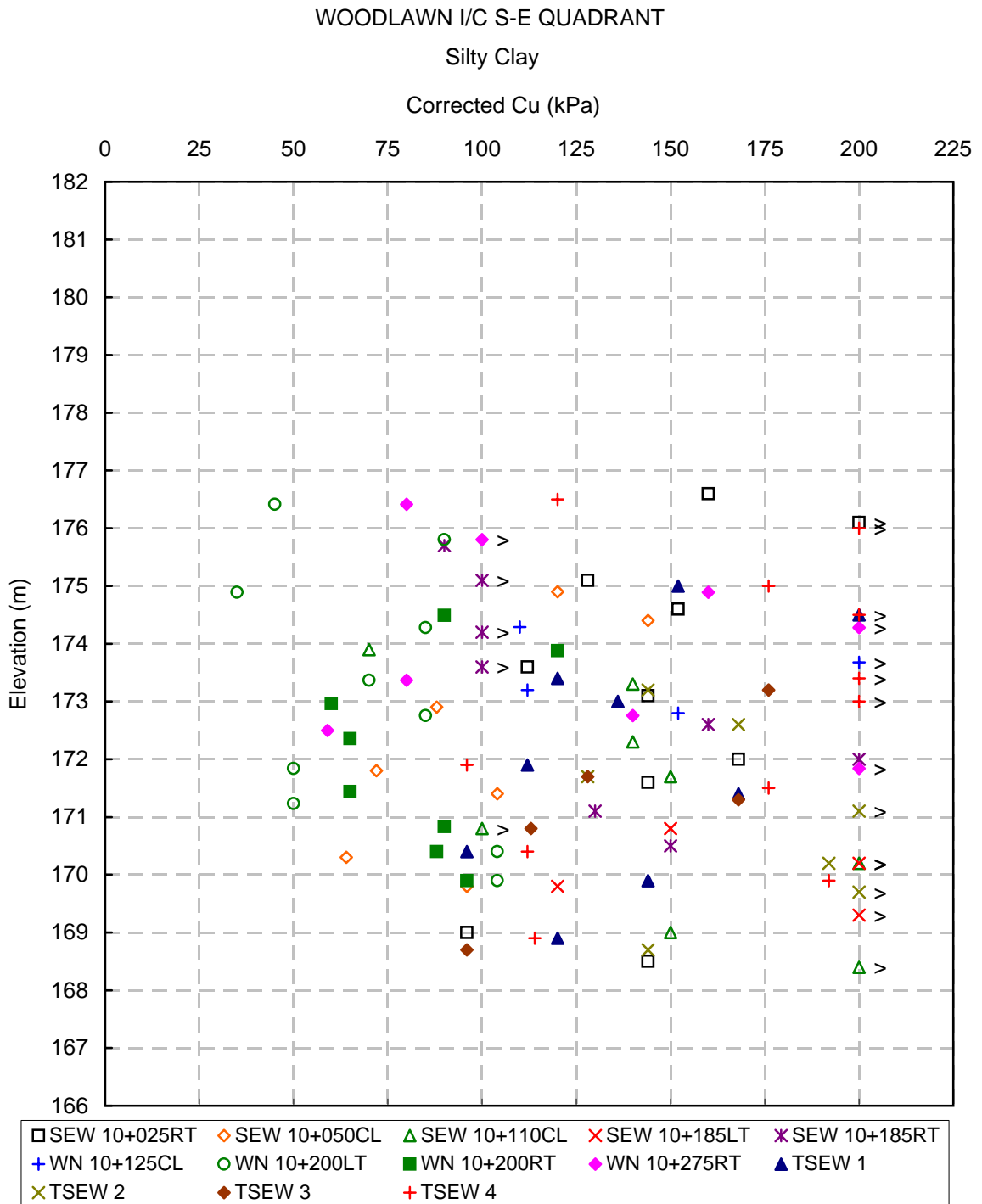


Prep'd DB

Chkd. MP

CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B2-29



Field Shear Vane Correction

Applied Correction Factors

Morris & Williams (1994)

0.89 (Elev.>178m)

1.00 (Elev.<178m)

($\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57$)

Project No. : 1-09-4135

Date : September, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

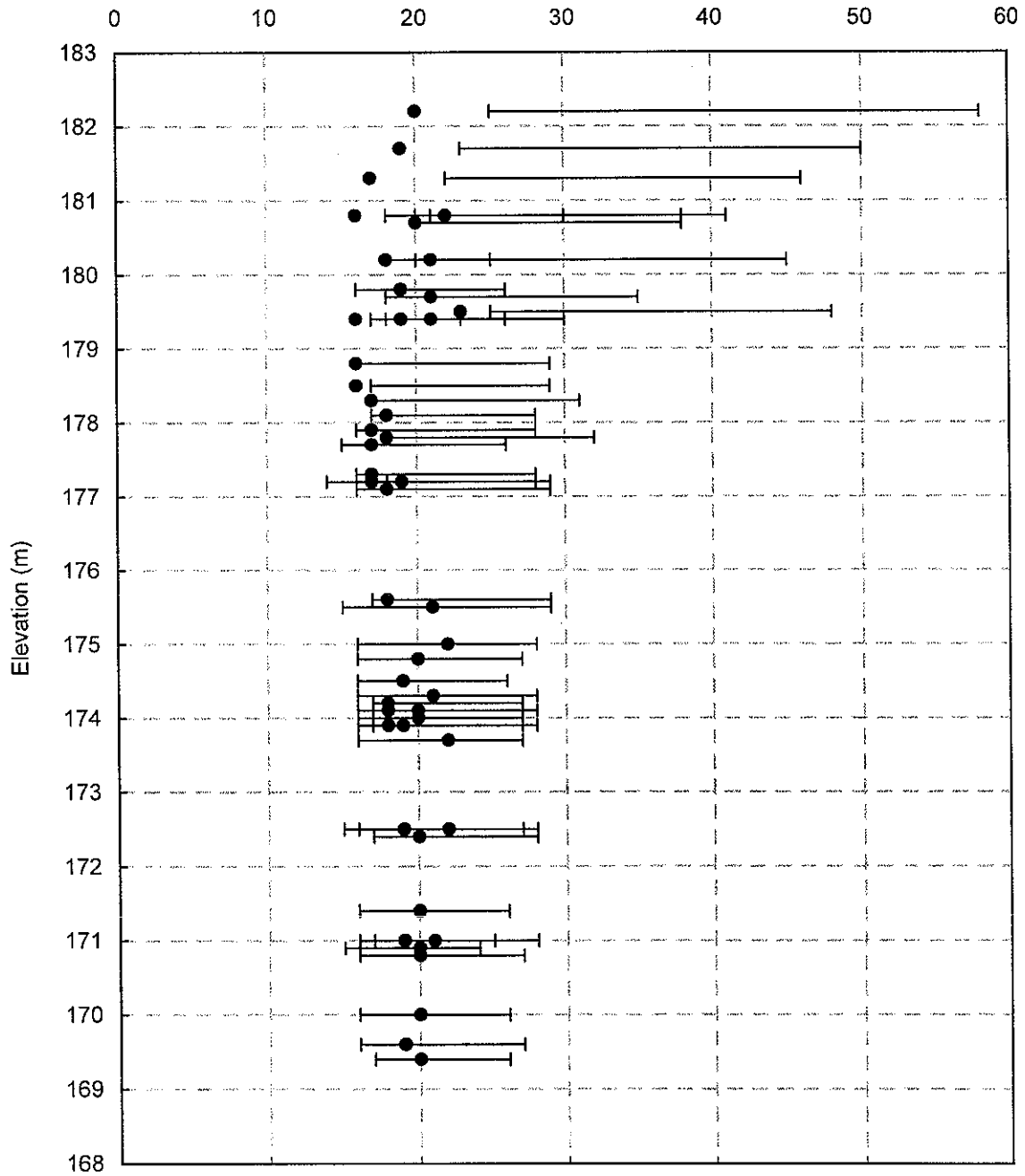
ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B2-30

HWY 406 TWINNING - WOODLAWN I/C S-E QUADRANT

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

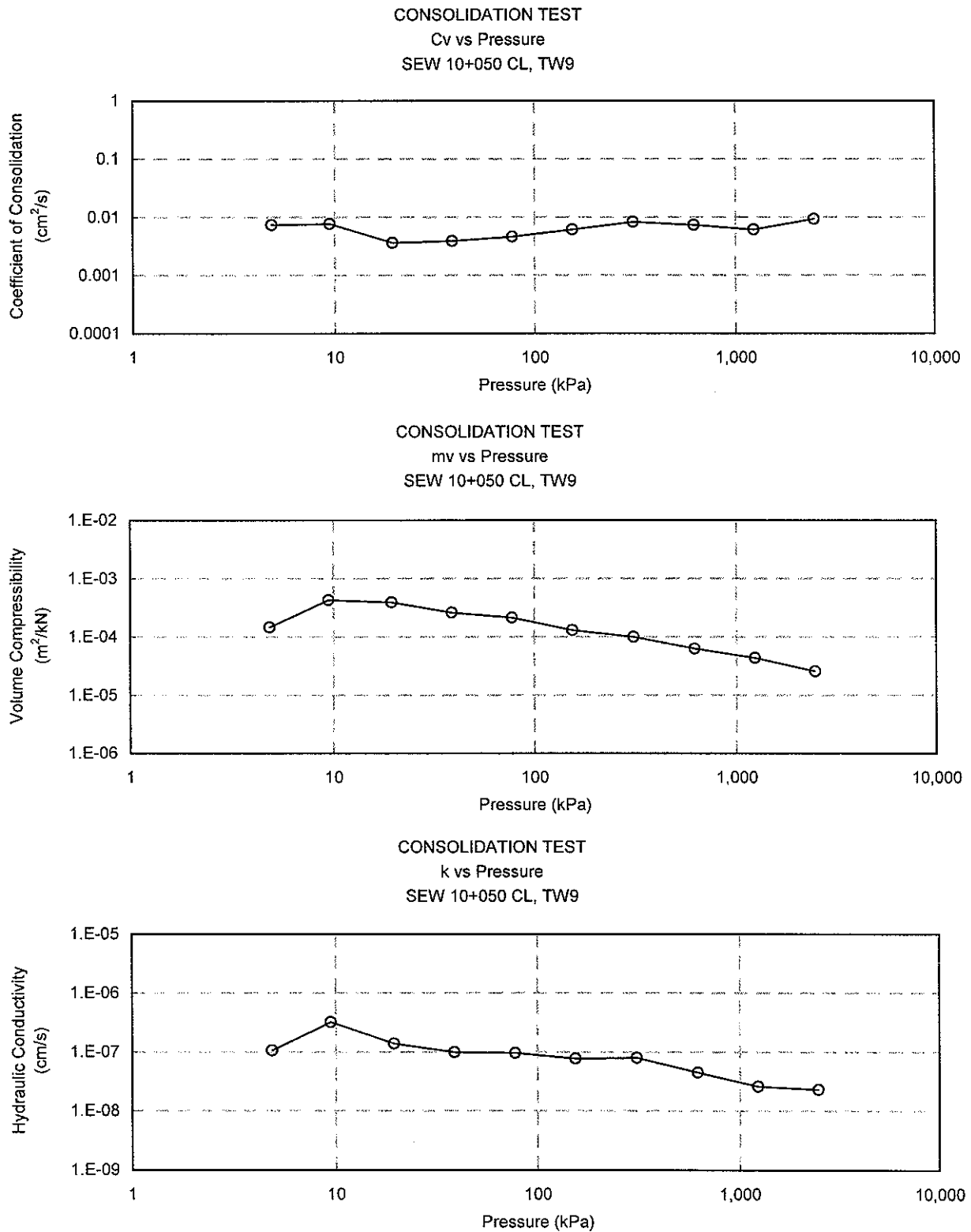
Date : June, 2010



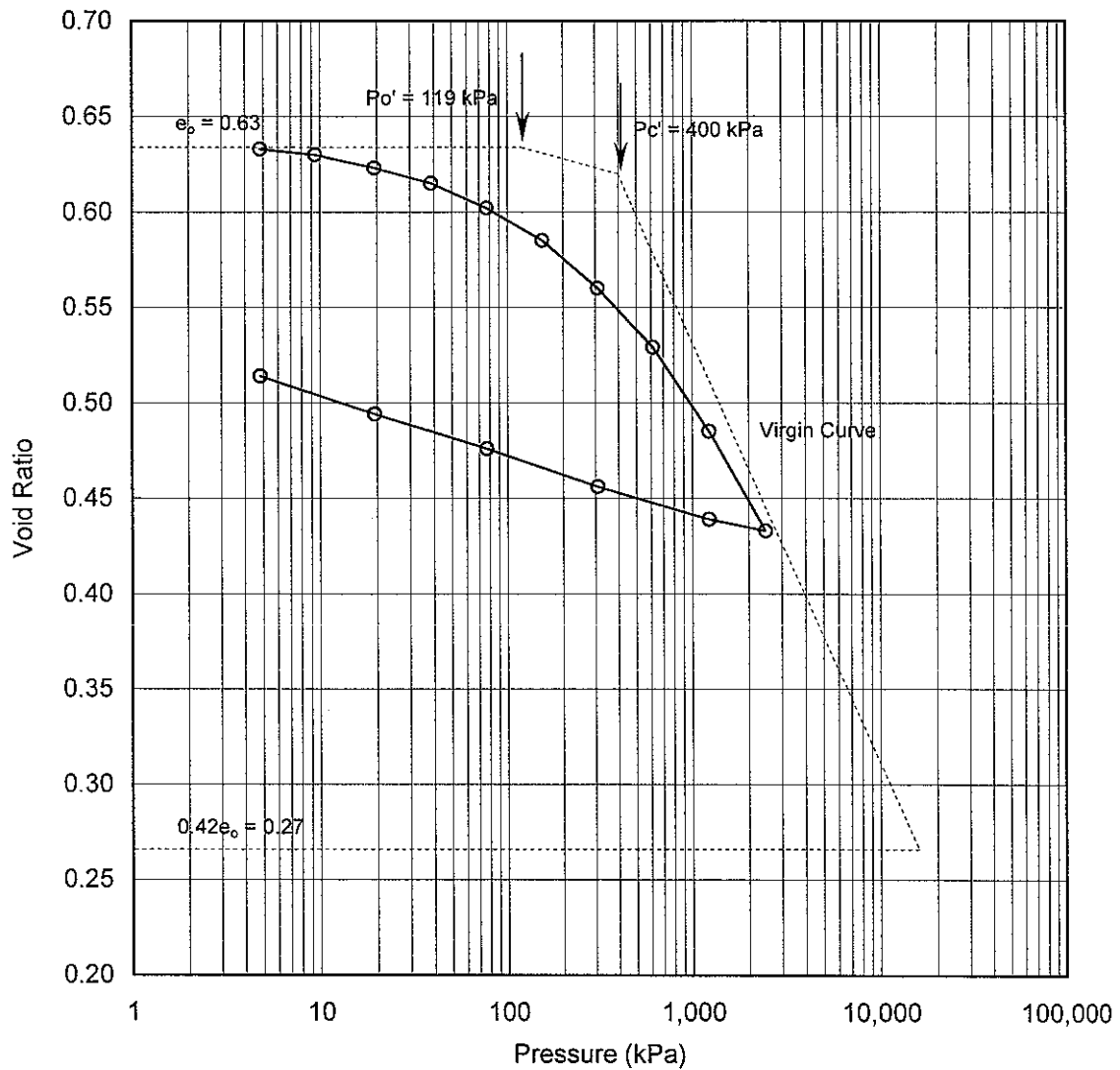
Terraprobe Inc.

Prepared By : HW

Checked By : RA



CONSOLIDATION TEST
e vs Pressure
SEW 10+050 CL, TW9



Soil Type : Silty Clay

$e_o =$	0.63	$\omega_L =$	27%	$P_o' =$	119 kPa
$\omega =$	22%	$\omega_P =$	16%	$P_c' =$	400 kPa
$\gamma =$	20.4 kN/m ³	$PI =$	11%	$C_c =$	0.221
$G_s =$	2.78			$Cr =$	0.027

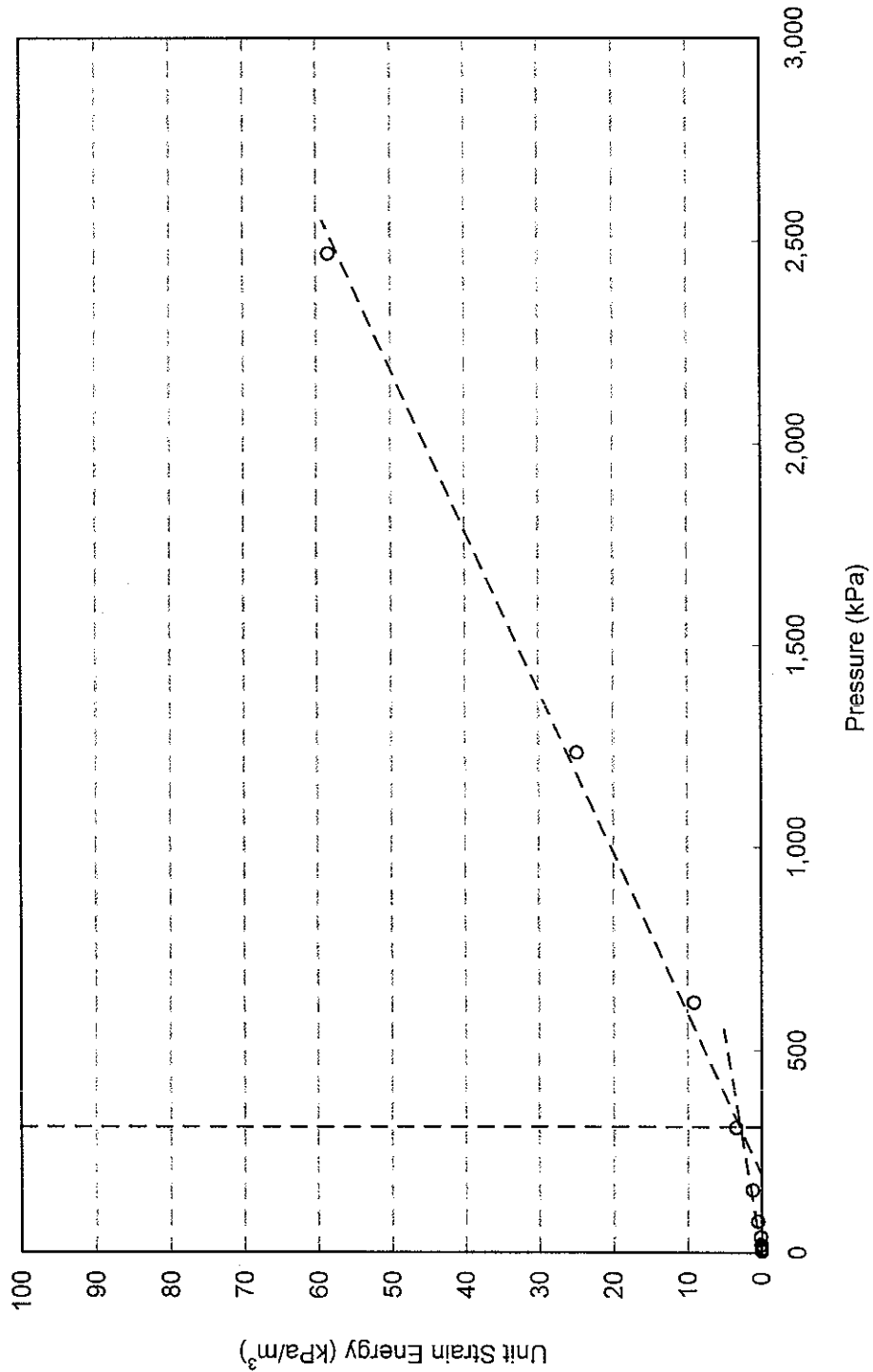
Project No. : 1-09-4135
Date : June 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
SEW 10+050 CL, TW9



Project No. : 1-09-4135

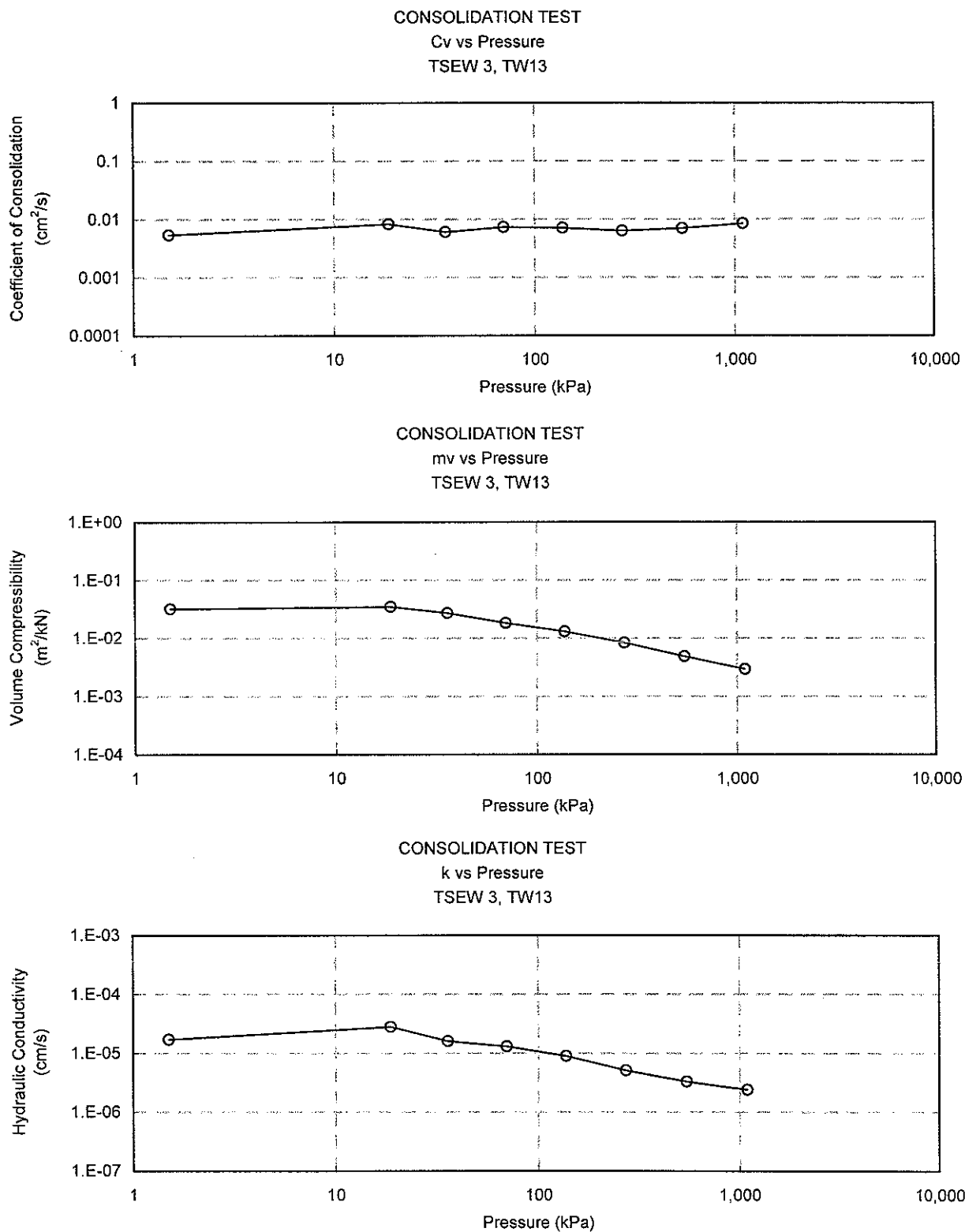
Date : June 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA



C:\Documents and Settings\Hong\My Documents\Project 2009\1-09-4135 - HWY 406 Foundation\High Flow\Woodlawn S-E Quadrant\TSEW Ramp\1-09-4135 Consolidation Results-SEW.xls

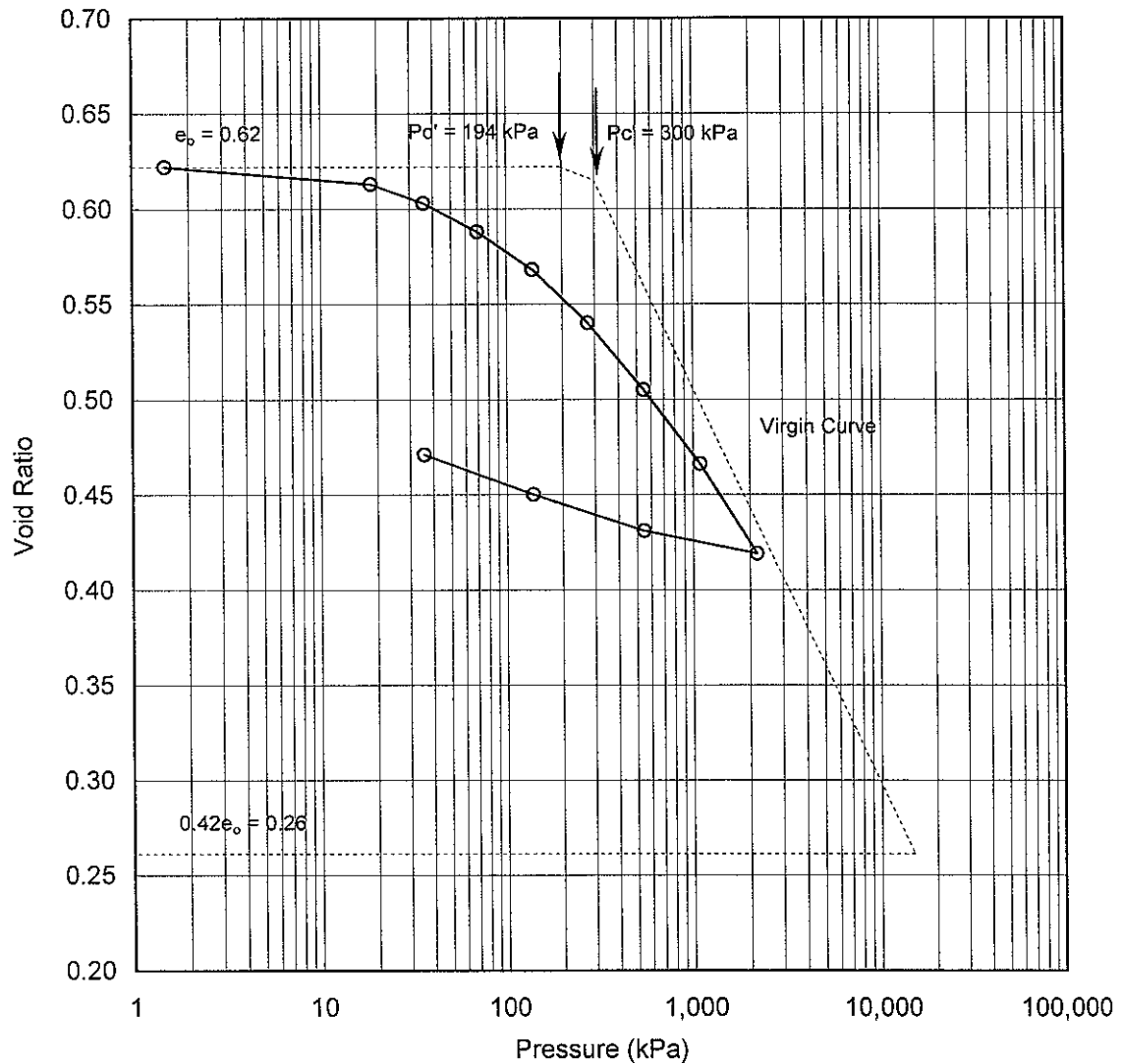
Project No. : 1-09-4135
Date : June 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
TSEW 3, TW13



Soil Type : Silty Clay

$e_o =$	0.62	$\omega_L =$	27%	$P_{o'} =$	194 kPa
$\omega =$	20%	$\omega_P =$	16%	$P_{c'} =$	300 kPa
$\gamma =$	20.8 kN/m ³	$PI =$	10%	$C_c =$	0.208
$G_s =$	2.75			$Cr =$	0.037

Project No. : 1-09-4135
Date : June 2010



Terraprobe Inc.

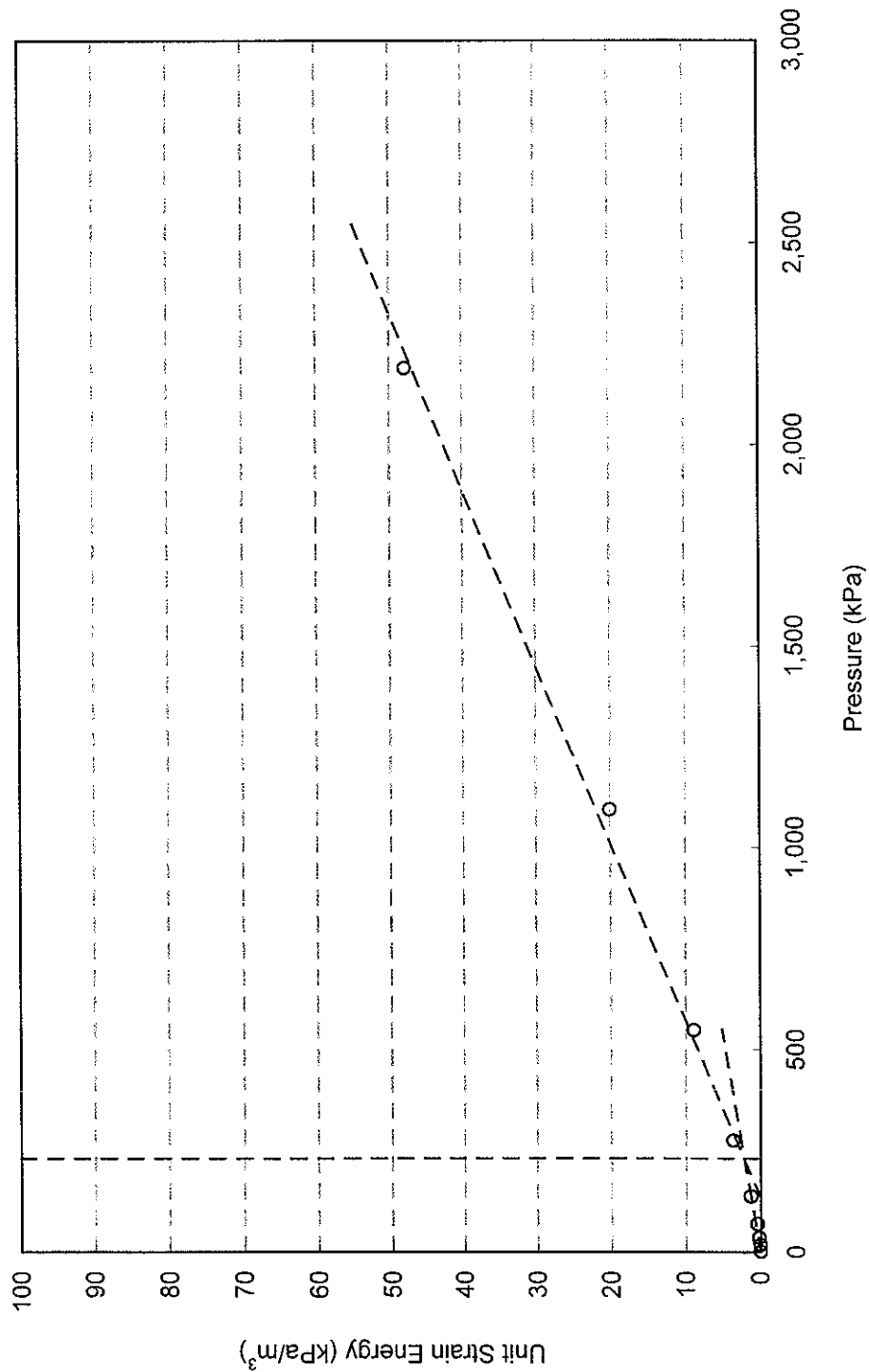
Prepared By : HW
Checked By : RA

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HWY 406 TWINNING - WOODLAWN S-EW RAMP

FIGURE B2-36

CONSOLIDATION TEST Unit Strain Energy vs Pressure TSEW 3, TW13



Project No. : 1-09-4135

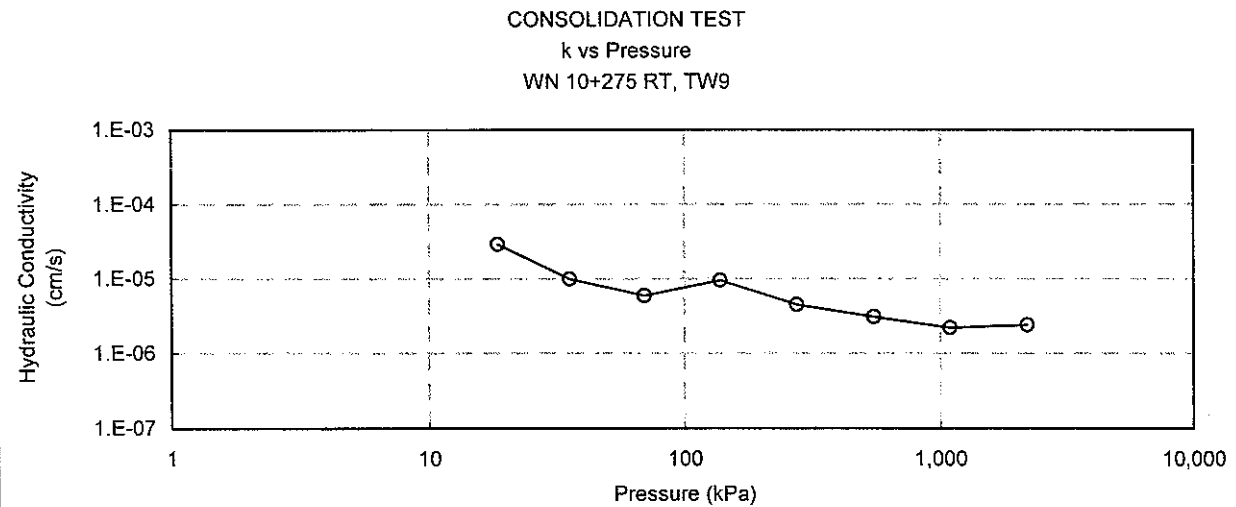
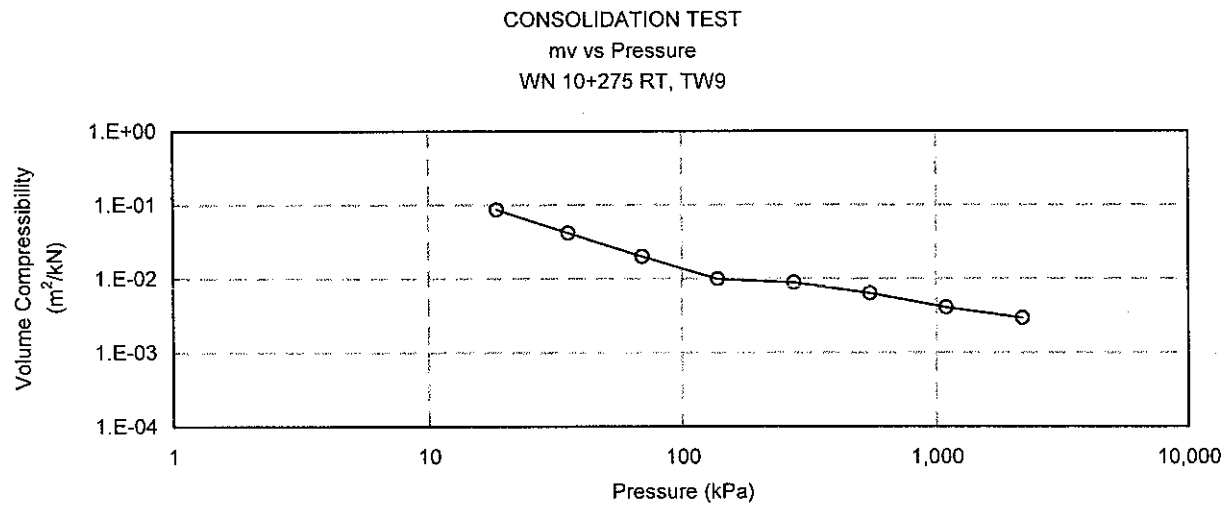
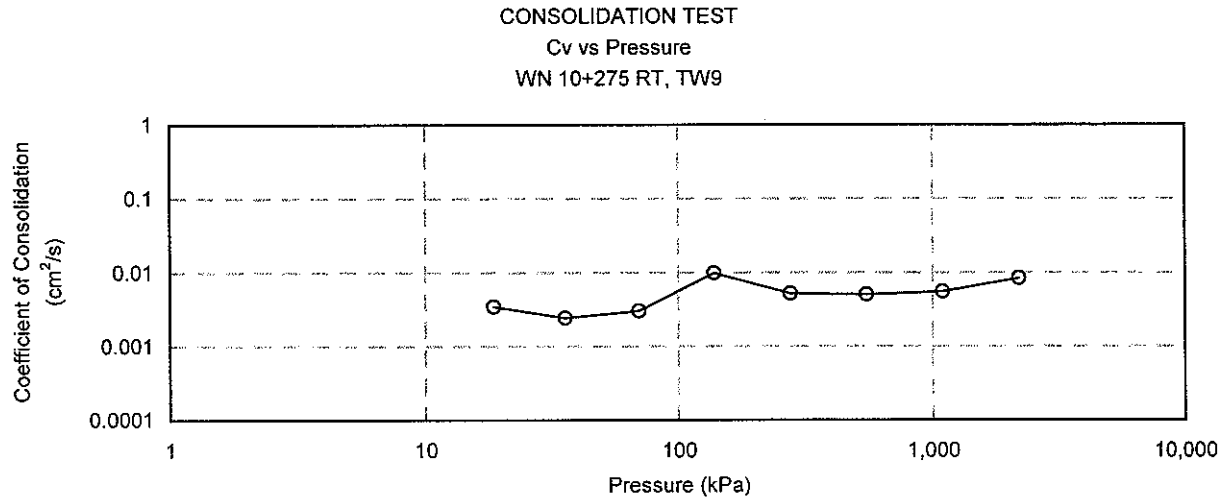
Date : June 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA



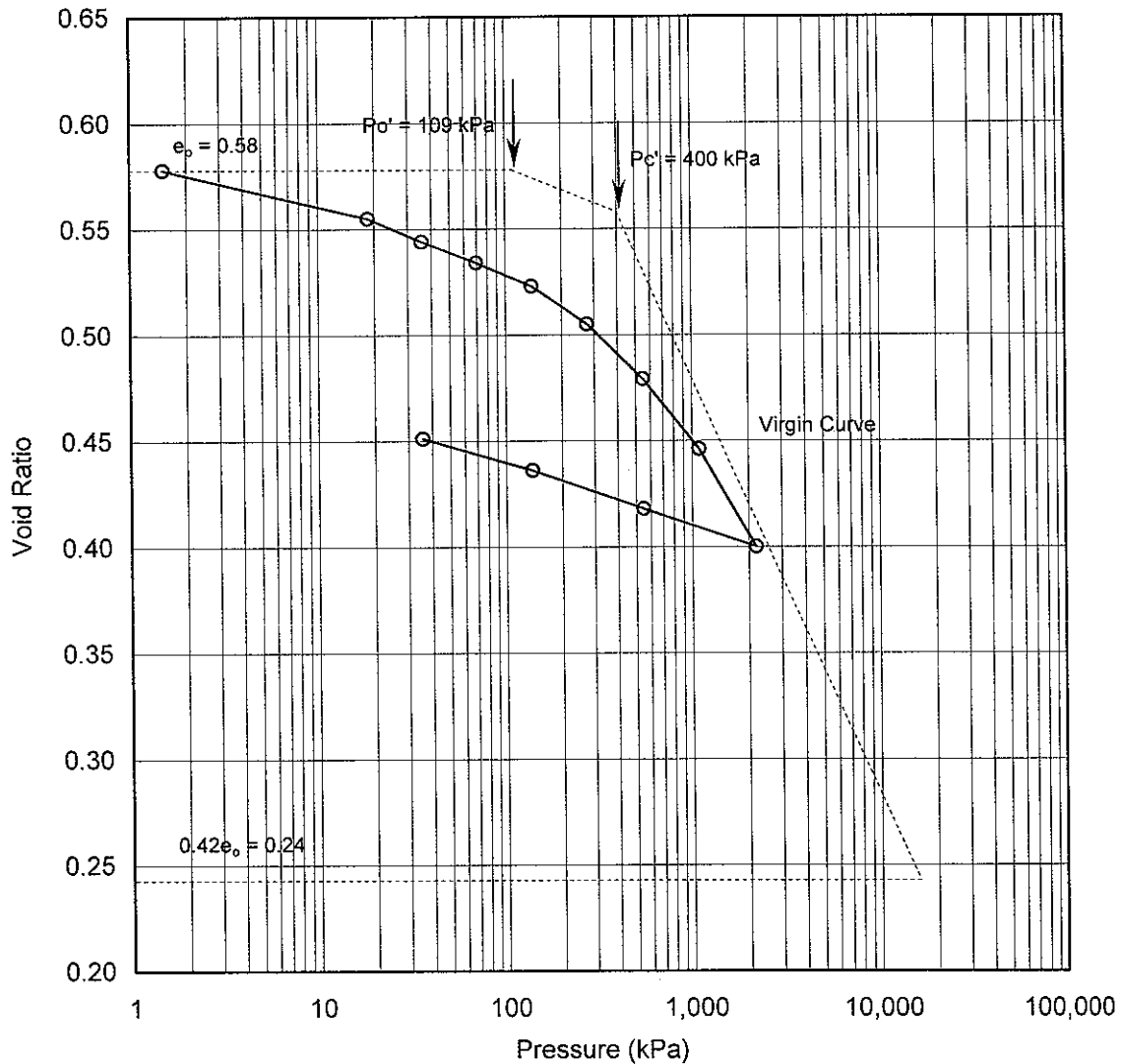
Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
WN 10+275 RT, TW9



Soil Type : Silty Clay

$e_o =$	0.58	$\omega_L =$	29%	$P_o' =$	108 kPa
$\omega =$	21%	$\omega_p =$	18%	$P_c' =$	400 kPa
$\gamma =$	20.6 kN/m ³	PI =	12%	Cc =	0.197
Gs =	2.74			Cr =	0.035

Project No. : 1-09-4135
Date : July 2010



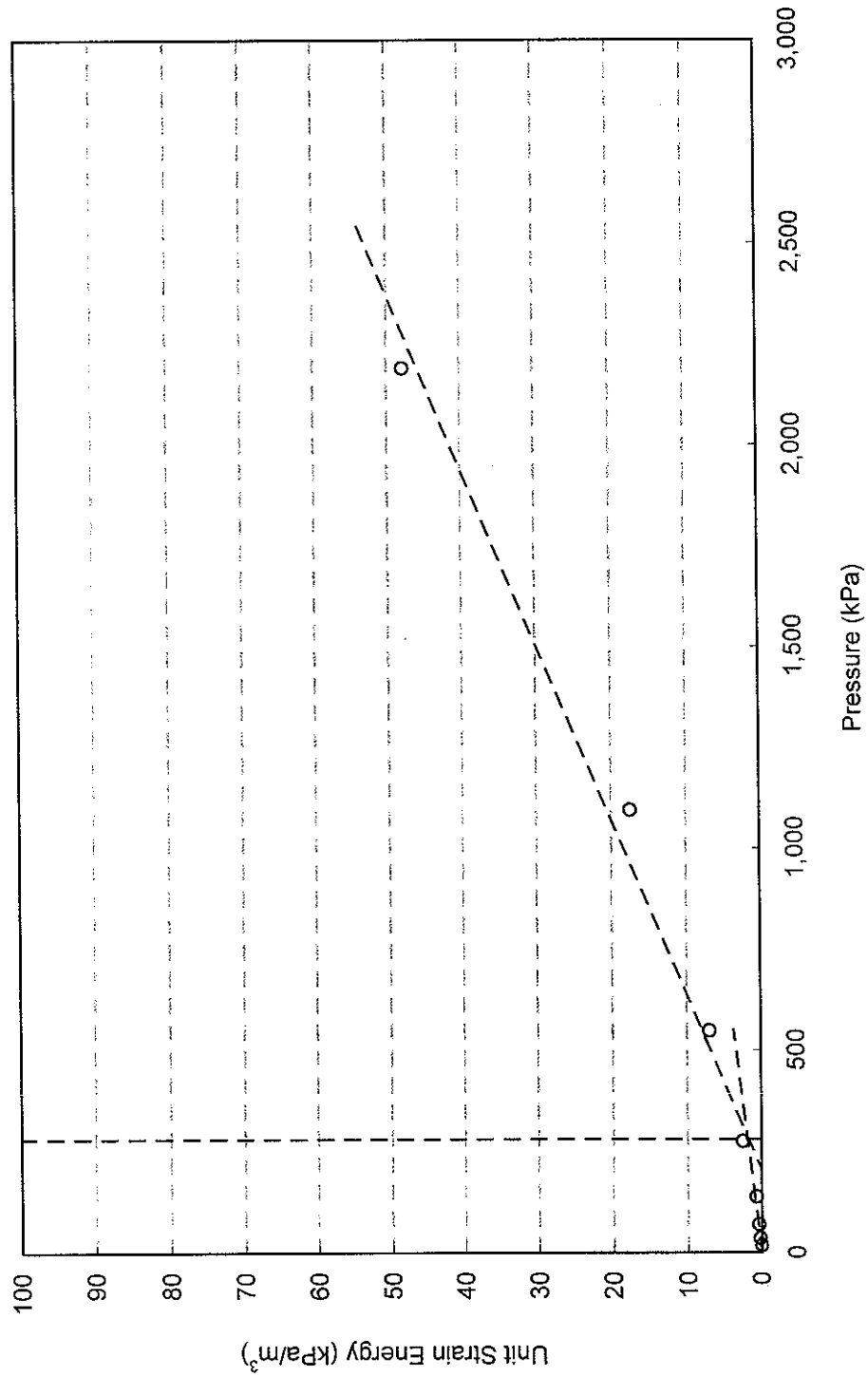
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - WOODLAWN W-N RAMP

FIGURE B2-39

CONSOLIDATION TEST Unit Strain Energy vs Pressure WN 10+275 RT, TW9



Project No. : 1-09-4135

Date : July 2010



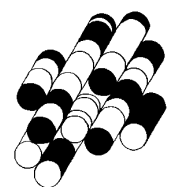
Terraprobe Inc.

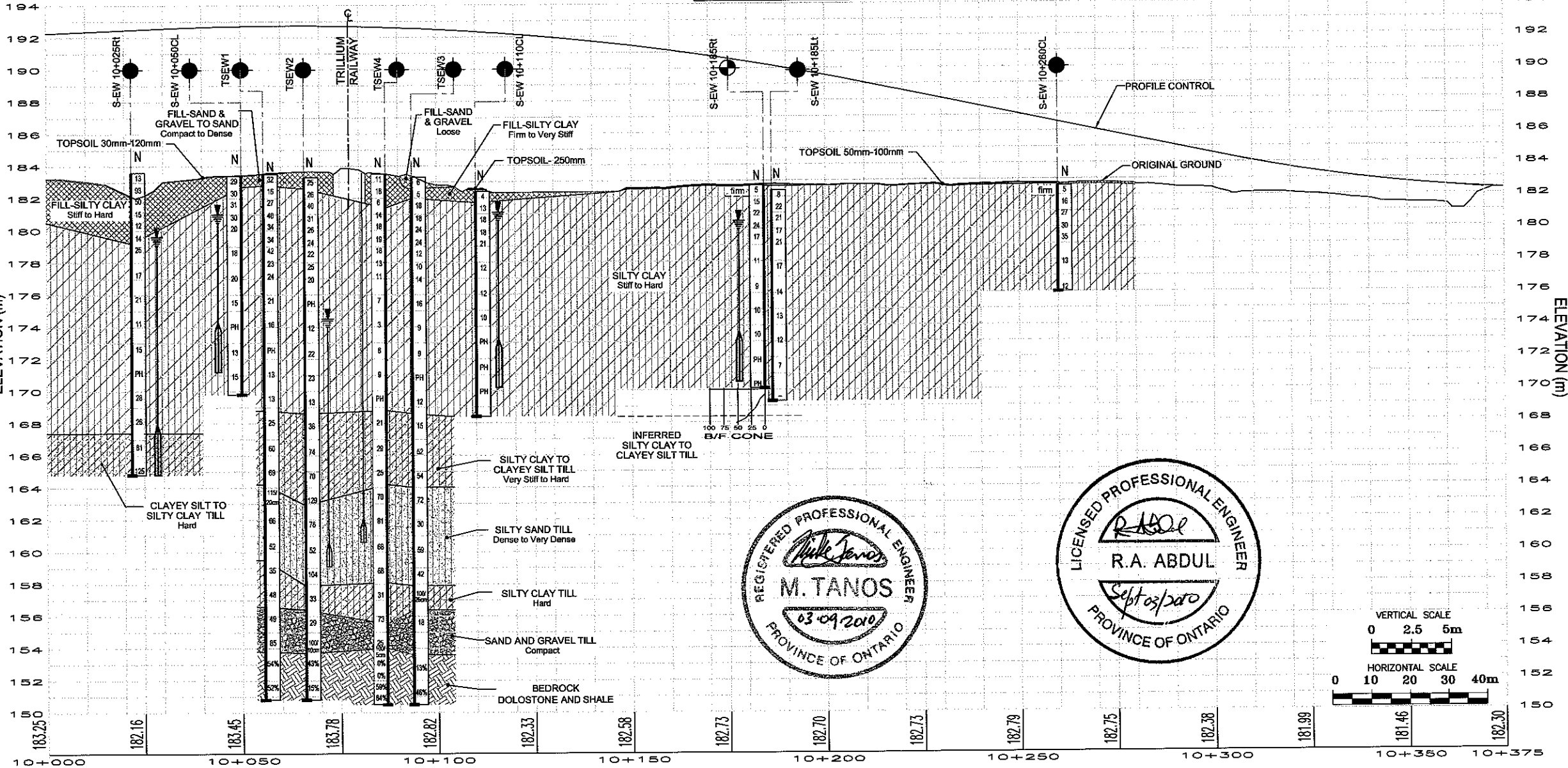
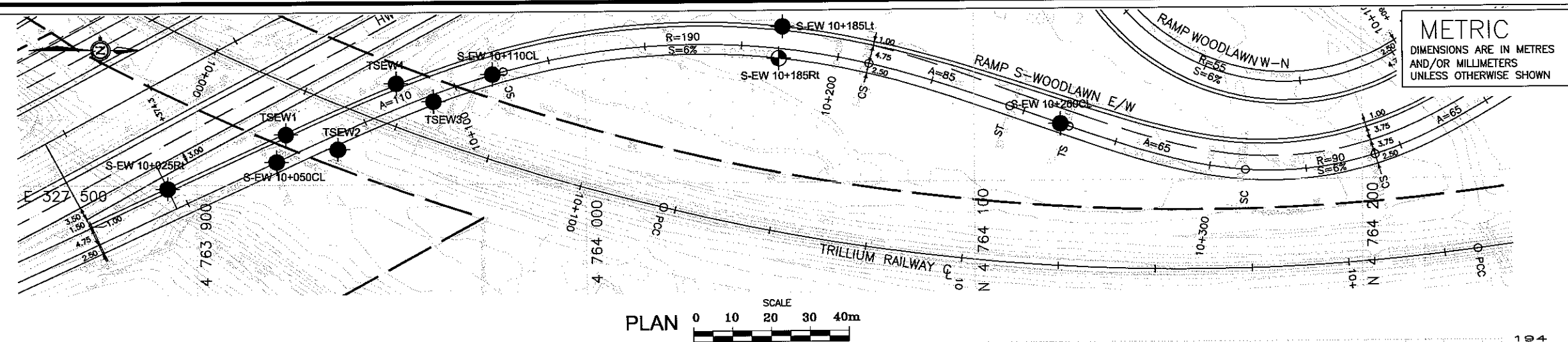
Prepared By : HW

Checked By : RA

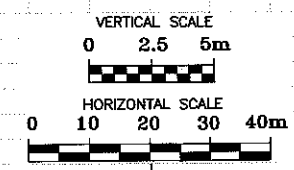
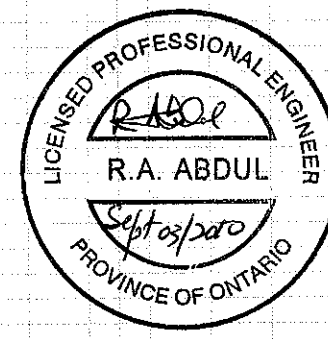
C2

TERRAPROBE INC.





Q PROFILE RAMP 406 S-WOODLAWN E/W



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

CONT No
WP No 280-99-00

HIGHWAY 406
RAMP 406 S-WOODLAWN E/W
BOREHOLE LOCATIONS AND SOIL STRATA

Giffels Associates Limited
Consulting Engineers and Architects
An IBI Group Company

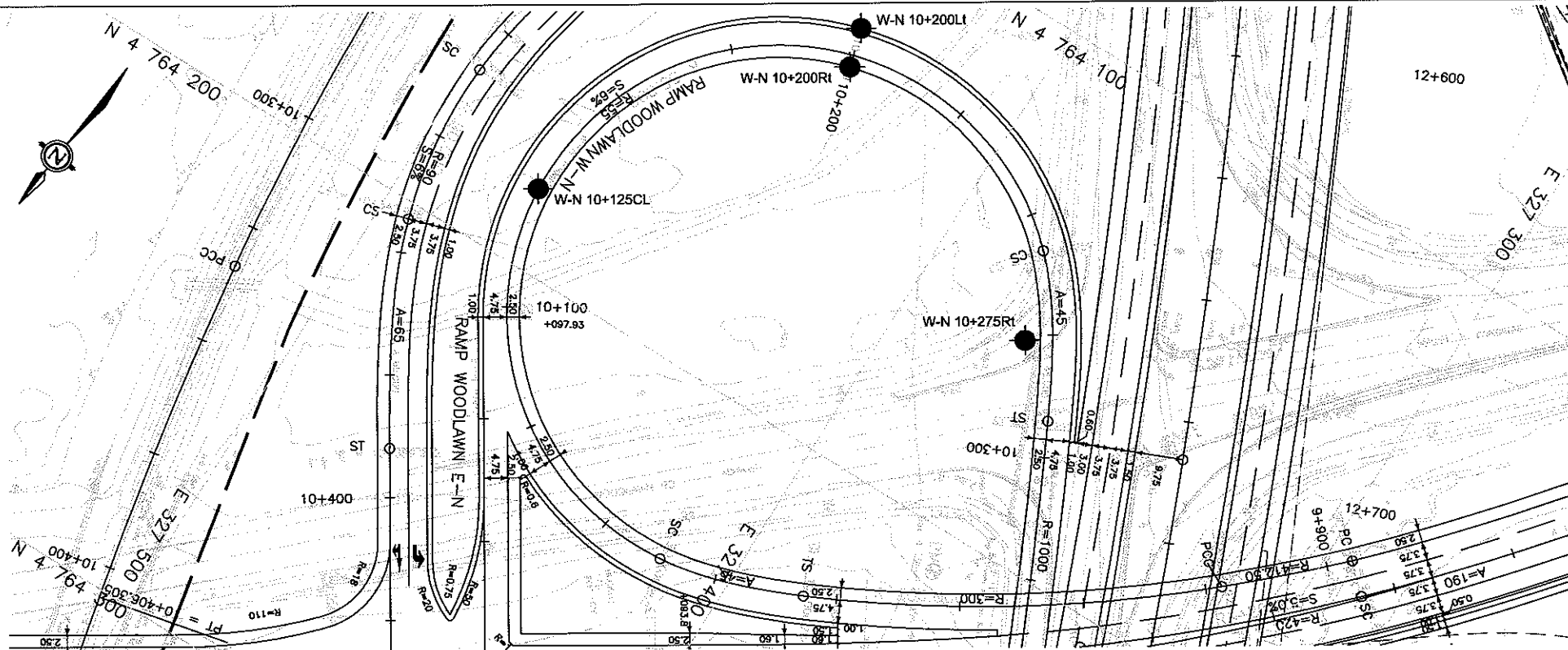


LEGEND	
	Bore Hole
	Dynamic Cone Penetration Test
	Bore Hole And Cone
	Blows/0.3m (Std Pen Test, 475 J/blow)
	Blows/0.3m (60° Cone, 475 J/blow)
	WL at Time of Investigation
	WL in Piezometer (MAY. 2010)
	Piezometer
	90% Rock Quality Designation
	Auger Refusal

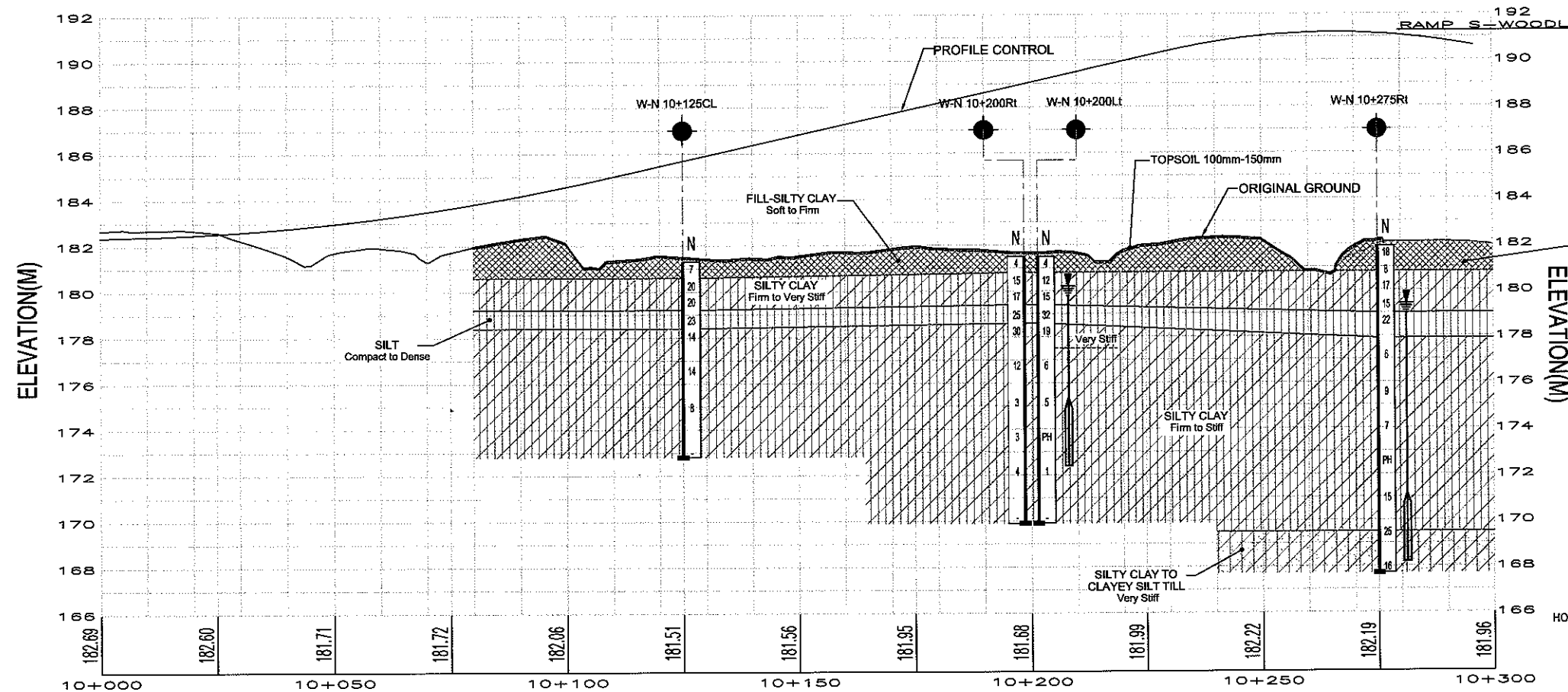
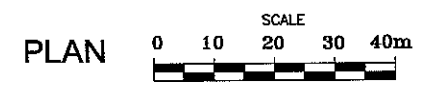
No	ELEV.	COORDINATES	
		NORTHING	EASTING
S-EW 10+025Rt	183.6	4 763 892.5	327 500.9
S-EW 10+050CL	183.4	4 763 920.4	327 494.1
S-EW 10+110CL	182.4	4 763 976.0	327 471.7
S-EW 10+185Lt	182.4	4 764 050.9	327 459.8
S-EW 10+185Rt	182.7	4 764 049.9	327 468.0
S-EW 10+280CL	182.6	4 764 122.3	327 485.4
TSEW1	183.5	4 763 922.8	327 487.0
TSEW2	183.3	4 763 936.1	327 490.9
TSEW3	183.3	4 763 960.8	327 478.6
TSEW4	183.5	4 763 951.2	327 473.9

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

REVISIONS		DESCRIPTION	
DATE	BY		
DESIGN R.A.	CODE CH8DC2008	LOAD	DATE SEPT. 2010
DRAWN K.C.	CHK R.A.	STRUCT	GEODRES 30M3-263

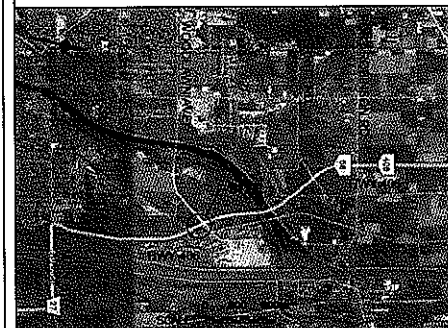


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETERS
UNLESS OTHERWISE SHOWN



Q PROFILE RAMP WOODLAWN W-406 N

CONT No	WP No 280-99-00	SHEET 1 OF
HIGHWAY 406 RAMP WOODLAWN W-406 N BOREHOLE LOCATIONS AND SOIL STRATA		
Giffels Associates Limited Consulting Engineers and Architects An IBI Group Company		



KEY PLAN	
LEGEND	
●	Bore Hole
⊕	Dynamic Cone Penetration Test
⊙	Bore Hole And Cone
'N'	Blows/0.3m (Std Pen Test, 475 J/blow)
CONE	Blows/0.3m (60' Cone, 475 J/blow)
≡	WL at Time of Investigation
⊥	WL in Piezometer (JAN. 2010)
⊥	Piezometer
90%	Rock Quality Designation
A/R	Auger Refusal

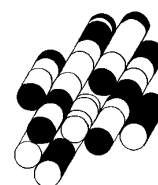
No	ELEV.	COORDINATES	
		NORTHING	EASTING
W-N 10+125CL	181.3	4 764 184.2	327 474.8
W-N 10+200L	181.5	4 764 122.0	327 436.5
W-N 10+200R	181.5	4 764 129.9	327 434.3
W-N 10+275R	181.9	4 764 158.5	327 375.1

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

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	R.A.	CODE	CHBDC2006
DRAWN	K.C.	CHK	R.A.
		LOAD	DATE SEPT. 2010
		STRUCT	GEOCRIS 30M3-263

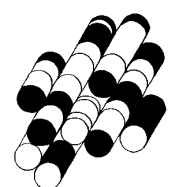
SITE 3

TERRAPROBE INC.



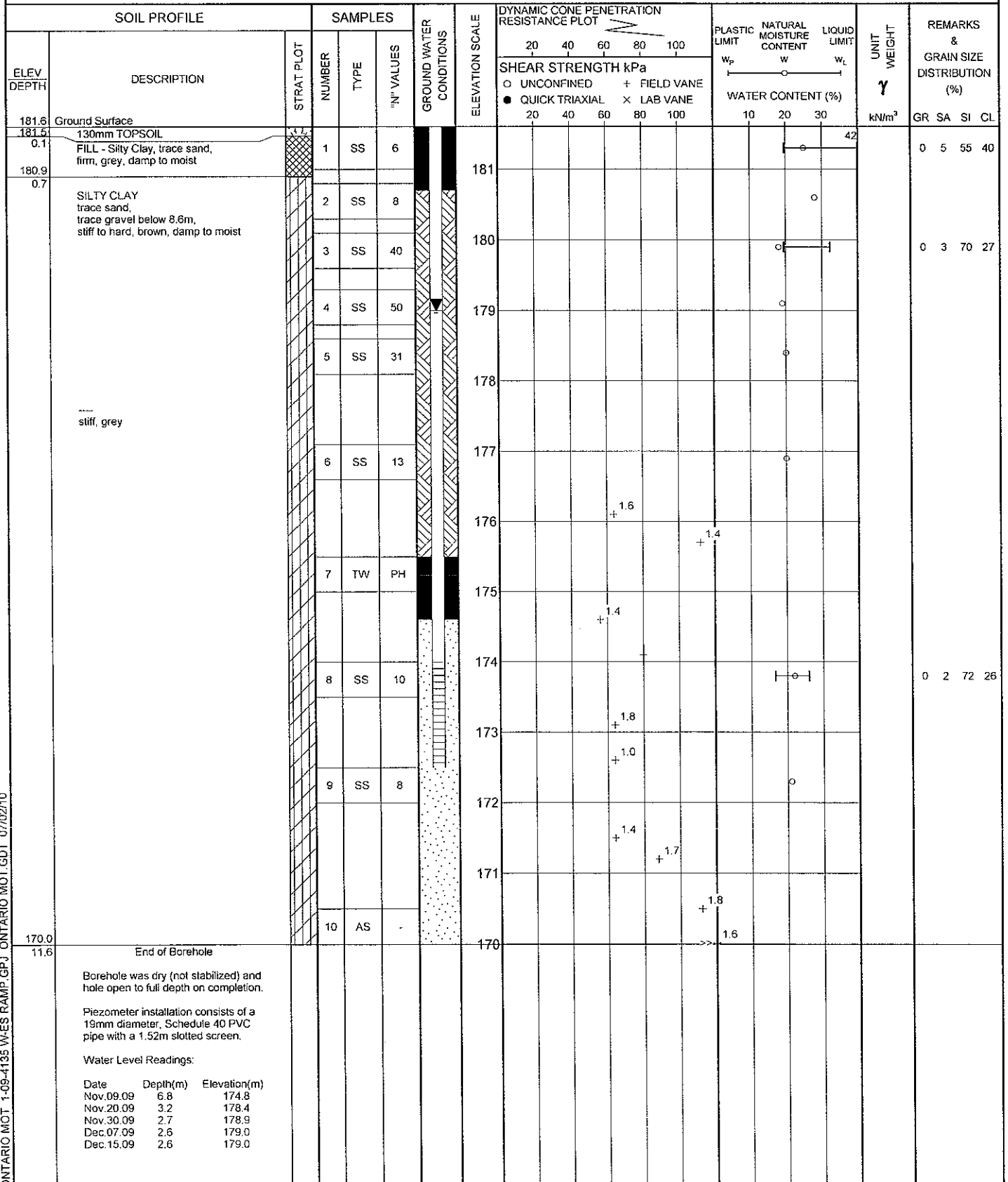
A3

TERRAPROBE INC.



RECORD OF BOREHOLE No WE-S 10+200Lt 1 OF 1 METRIC

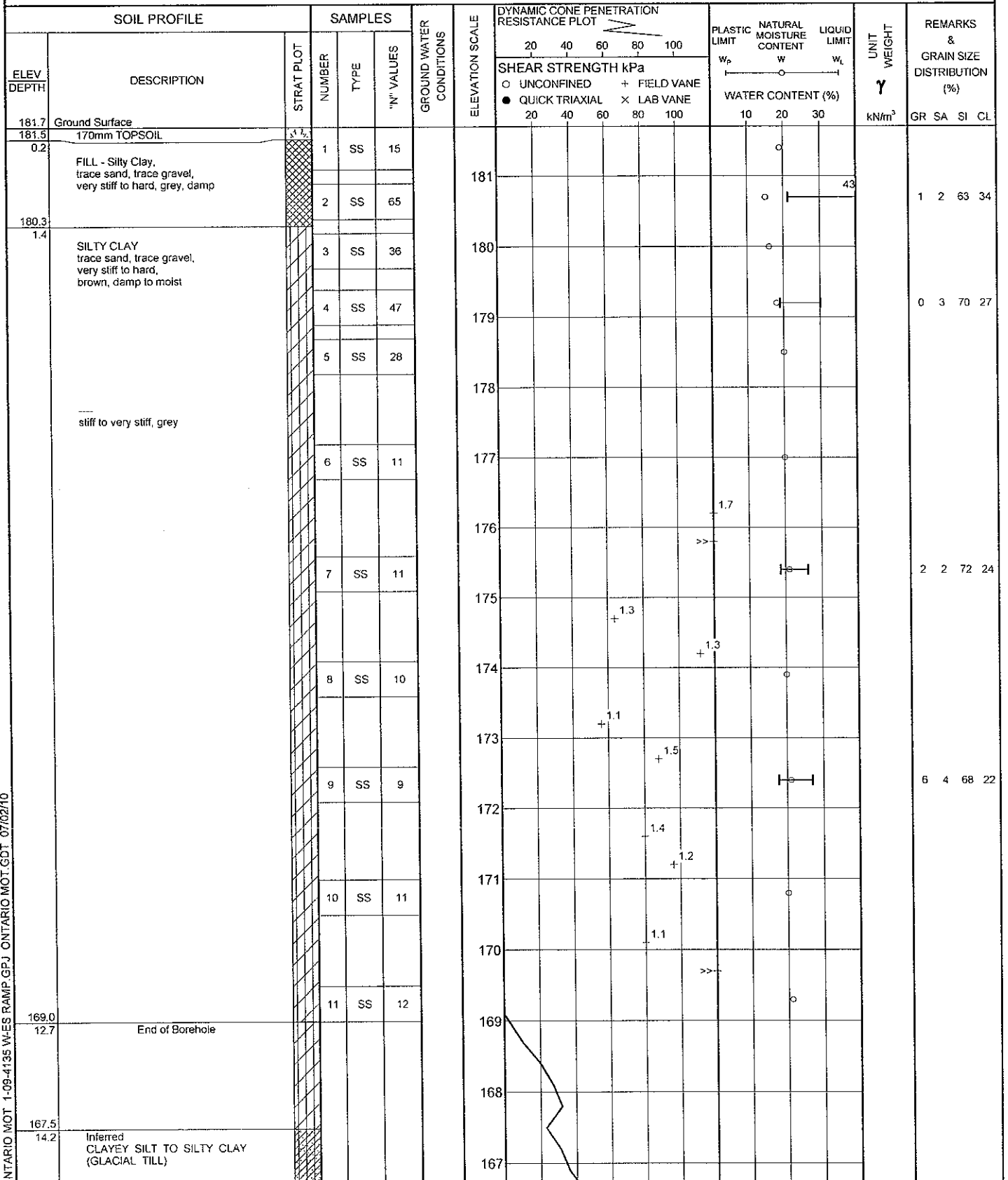
W.P. 280-99-00 LOCATION Coords: N:4763971.1 E:327388.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA



ONTARIO MOT 1-09-4135 W-ES RAMP GP J ONTARIO MOT GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+200Rt 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763968.5 E:327379.8 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / DCPT COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA



ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

Continued Next Page

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

RECORD OF BOREHOLE No WE-S 10+200Rt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763968.5 E:327379.8 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / DCPT COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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					
166.0	Inferred CLAYEY SILT TO SILTY CLAY (GLACIAL TILL) (continued)													
15.7	End of DCPT Borehole was dry (not stabilized) and hole open to full depth on completion. Dynamic Cone Penetration Test performed from 12.7m to 15.7m.													

ONTARIO MOT 1-09-4135 WE-S RAMP GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+250CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763928.5 E:327408.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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 ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
182.1	Ground Surface						20 40 60 80 100		10 20 30						
182.0 0.1	80mm TOPSOIL		1	SS	6										
	firm														
	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown to 4.0m, grey below, damp to moist		2	SS	23										
			3	SS	29										
			4	SS	44										
			5	SS	37									1 6 60 33	
	stiff to very stiff		6	SS	19										
			7	SS	9									5 4 66 25	
			8	SS	18										
			9	SS	12										
			10	SS	12									0 3 73 24	
			11	AS	-										
169.0 13.1	End of Borehole														
	Borehole was dry (not stabilized) and hole open to full depth on completion.														

ONTARIO MOT 1-09-4135 W-ES RAMP GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+295CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763888.2 E:327432.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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						
182.8	Ground Surface							20 40 60 80 100						
0.0	FILL - Silty Clay, trace sand, stiff to very stiff, brown, damp to moist		1	SS	8		182							
181.4			2	SS	27									
1.4	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		3	SS	32		181							
			4	SS	45		180							0 3 66 31
			5	SS	40									
			6	SS	67		178							
			7	SS	32									
	grey		8	SS	33		177							
			9	SS	37		175							2 4 66 28
			10	TW	PH		174							
							173							
							172							
171.6	End of Borehole		11	SS	17									
11.2	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 10.													

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No TEW1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763851.9 E:327450.6 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.23.09 - 01.08.10 CHECKED BY RA

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					
182.5	Ground Surface													
182.3	230mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, trace organics, firm, brown, damp to moist		1	SS	7		182						62	0 3 33 64
181.8														
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	27		181							
			3	SS	34									
			4	SS	54		180							0 3 70 27
			5	SS	35		179							
			6	SS	31		178							
			7	SS	18		177			1.4				1 4 65 30
			8	TW	PH		176							
			9	SS	22		175			1.6				
			10	SS	18		174			1.7				0 3 70 27
			11	SS	16		173							
			12	SS	19		172							
			13	SS	32		171							
							170							
							169							
							168							

Continued Next Page

+ 3 x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No TEW1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763851.9 E:327450.6 ORIGINATED BY MP
 DIST - HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.23.09 - 01.08.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
167.3 15.2	CLAYEY SILT TO SILTY CLAY sandy, trace to some gravel, hard, brown, damp (GLACIAL TILL)		14	SS	33		167								
			15	SS	79		166								11 30 43 16
	occasional cobbles		16	SS	170		165								
163.3 19.2	SAND and gravel, trace to some silt, very dense, grey, wet		17	SS	94		164								commence casing and washboring Dec.23 ----- Jan.05
162.5 20.0	CLAYEY SILT sandy, trace to some gravel, hard, brown, damp (GLACIAL TILL)						163								
161.2 21.3	SAND gravelly, trace clay, trace silt, dense to very dense, grey, wet		18	SS	70		162								
159.4 23.1	SILTY CLAY some gravel, trace to some sand, hard, brown, damp (GLACIAL TILL)		19	SS	34		161								32 56 10 2
158.3 24.2	SAND AND SILT some gravel, trace clay, occasional cobbles, very dense, brown, moist to wet (GLACIAL TILL)		20	SS	75		160								
			21	SS	99		159								15 40 38 7
			22	SS	125		158								
153.7 28.8	BEDROCK		1	RUN	NQ		157								Jan.05 ----- Jan.08
							156								
							155								RUN#1 TCR=88% SCR=78% ROD=48%
							154								
							153								

ONTARIO MOT 1-09-4135 W-ES RAMP GPJ ONTARIO MOT.GDT 07/02/10

Continued Next Page

3 x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TEW1										3 OF 3		METRIC															
W.P. 280-99-00		LOCATION		Coords: N:4763851.9 E:327450.6				ORIGINATED BY MP																			
DIST		HWY 406		BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring				COMPILED BY DB																			
DATUM Geodetic		DATE		12.23.09 - 01.08.10				CHECKED BY RA																			
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										
150.5	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		2	RUN	NQ										RUN#2 TCR=82% SCR=68% RQD=31%												
32.0																											
	<p>End of Borehole</p> <p>Borehole was open to 20.7m on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Jan.19.10</td> <td>3.2</td> <td>179.3</td> </tr> <tr> <td>Jan.27.10</td> <td>2.4</td> <td>180.1</td> </tr> <tr> <td>Feb.08.10</td> <td>2.4</td> <td>180.1</td> </tr> </tbody> </table>															Date	Depth(m)	Elevation(m)	Jan.19.10	3.2	179.3	Jan.27.10	2.4	180.1	Feb.08.10	2.4	180.1
Date	Depth(m)	Elevation(m)																									
Jan.19.10	3.2	179.3																									
Jan.27.10	2.4	180.1																									
Feb.08.10	2.4	180.1																									

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No TEW2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763860.7 E:327455.5 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.18.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	GR SA SI CL			
182.7	Ground Surface													
0.0 182.4	300mm TOPSOIL		1	SS	8									
0.3 182.0	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown, moist													
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	27									
			3	SS	28									
			4	SS	28									0 1 52 47
			5	SS	42									
			6	SS	36									
			7	SS	14									
			8	SS	19									
			9	SS	17									
			10	SS	22									
			11	TW	PH									
			12	TW	PH									
			13	SS	21									4 5 66 24
167.8														

Continued Next Page

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

ONTARIO MOT 1-09-4135 W-ES RAMP GPJ ONTARIO MOT.GDT 07/02/10

METRIC

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

RECORD OF BOREHOLE No TEW2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763860.7 E:327455.5 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.18.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
150.9	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		2	RUN	NQ		152										RUN#2 TCR=100% SCR=98% RQD=78%
31.8	End of Borehole Borehole filled with drill water upon completion of coring. Unable to push vane beyond 14.9m. Borehole sealed with bentonite slurry to ground surface.		3	RUN	NQ		151										RUN#3 TCR=82% SCR=66% RQD=39%

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No TEW3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763877.2 E:327436.9 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.07.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								20 40 60 80 100							
								20 40 60 80 100							
182.6	Ground Surface														
182.5	120mm TOPSOIL														
0.1	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown, moist		1	SS	8										
181.9	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	33										
0.7			3	SS	26										
			4	SS	31										
			5	SS	25									0 2 55 43	
			6	SS	33										
			7	SS	26									0 3 65 32	
			8	SS	31										
			9	SS	33										
			10	SS	38									3 3 66 28	
			11	SS	32										
		12	SS	23									0 3 69 28		
		13	TW	PH											

	stiff														

			14	SS	22										

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

Continued Next Page

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

RECORD OF BOREHOLE No TEW3

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763877.2 E:327436.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.07.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
							20 40 60 80 100								
166.8			15	SS	26		167								
15.8	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace gravel, hard, brown, damp to moist (GLACIAL TILL)		16	SS	61		166							4 13 62 21	
			17	SS	42		165								
			18	SS	38		164								
			19	SS	31		163								
			20	SS	38		162								
			21	SS	100/ 13cm		161							5 30 46 19	
157.9	SILTY SAND some gravel to gravelly, trace clay, compact to dense, brown, damp to moist (GLACIAL TILL)		22	SS	29		160							Dec.07	
24.7			23	SS	38		159							Dec.08	
							158								
							157								
							156								
							155							25 38 29 8	
							154							Dec.08	
153.7	----- frequent cobbles						153							Dec.09	
28.9	BEDROCK		1	RUN	NQ									RUN#1 TCR=52% SCR=40% RQD=0%	
														RUN#2 TCR=95% SCR=83% RQD=49%	

Continued Next Page

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

ONTARIO MOT. 1-09-4135 W-ES RAMP GPJ ONTARIO MOT. GDT 07/02/10

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 C
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20			
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100		WATER CONTENT (%) 10 20 30		

[illegible]

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

RECORD OF BOREHOLE No TEW4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763885.4 E:327439.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.15.09 CHECKED BY RA

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 (%)
182.6	Ground Surface							20	40	60	80	100				
182.5	110mm TOPSOIL							20	40	60	80	100				
0.1	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	9		182									
181.9	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	47		181									0 2 58 40
0.7			3	SS	55		180									
			4	SS	49		179									
			5	SS	55		178									0 3 67 30
			6	SS	42		177									
			7	SS	41		176									
			8	SS	30		175									
			9	SS	30		174									
			10	SS	24		173									0 7 69 24
			11	SS	24		172									Dec.10 Dec.11
			12	SS	12		171									
			13	SS	19		170									
			14	TW	PH		169									
168.0						168										
14.6																

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

Continued Next Page

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

METRIC

001. 0005H. 5	001. 0005H. 5			DYNAMIC CONE PENETRATION			
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ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10


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

RECORD OF BOREHOLE No TEW4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763885.4 E:327439.2 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.15.09 CHECKED BY RA

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								
							20	40	60	80	100					
							○ UNCONFINED	+ FIELD VANE								
							● QUICK TRIAXIAL	× LAB VANE								
							20	40	60	80	100	10	20	30		
151.2	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE. Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		3	RUN	NQ											RUN#3 TCR=100% SCR=74% RGD=22%
31.4	End of Borehole															
	Borehole filled with drill water upon completion of coring.															
	Unable to push vane beyond 14.9m.															
	No sample recovery at SS10, SS16, SS20, SS21, SS23. Sampler redriven and disturbed sample collected.															
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.															
	Water Level Readings:															
	Date Depth(m) Elevation(m)															
	Jan.11.10 10.2 172.4															
	Jan.19.10 10.6 172.0															
	Jan.27.10 10.5 172.1															
	Feb.08.10 10.6 172.0															

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+345CL 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763845.9 E:327457.4 ORIGINATED BY AW
 DIST - HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.04.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
182.8	Ground Surface							20 40 60 80 100	10 20 30						
0.0	290mm TOPSOIL		1	SS	10										
182.5															
0.3	FILL - Silty Clay, with organics and rootlets, trace sand, stiff, grey / black, moist														
182.1															
0.7															
	Weathered		2	SS	32										
	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		3	SS	32										
			4	SS	47									0 1 65 34	
			5	SS	26										
	stiff to very stiff, grey														
			6	SS	11										
			7	SS	16										
			8	SS	17									0 2 75 23	
			9	SS	*										

Continued Next Page

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

ONTARIO MOT 1-08-4135 W-ES RAMP.GPJ, ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+345CL 2 OF 2 METRIC

W.P. 280-88-00 LOCATION Coords: N:4763845.9 E:327457.4 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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																	
	<p>* TW sampling attempted at 9.1m. No recovery, split spoon sample collected.</p> <p>Consolidation test performed on TW 10.</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.19.09</td> <td>4.0</td> <td>178.8</td> </tr> <tr> <td>Nov.30.09</td> <td>3.4</td> <td>179.4</td> </tr> <tr> <td>Dec.07.09</td> <td>3.1</td> <td>179.7</td> </tr> <tr> <td>Dec.15.09</td> <td>3.0</td> <td>179.8</td> </tr> <tr> <td>Jan.11.10</td> <td>2.6</td> <td>180.2</td> </tr> <tr> <td>Jan.27.10</td> <td>2.7</td> <td>180.1</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.19.09	4.0	178.8	Nov.30.09	3.4	179.4	Dec.07.09	3.1	179.7	Dec.15.09	3.0	179.8	Jan.11.10	2.6	180.2	Jan.27.10	2.7	180.1												
Date	Depth(m)	Elevation(m)																																
Nov.19.09	4.0	178.8																																
Nov.30.09	3.4	179.4																																
Dec.07.09	3.1	179.7																																
Dec.15.09	3.0	179.8																																
Jan.11.10	2.6	180.2																																
Jan.27.10	2.7	180.1																																

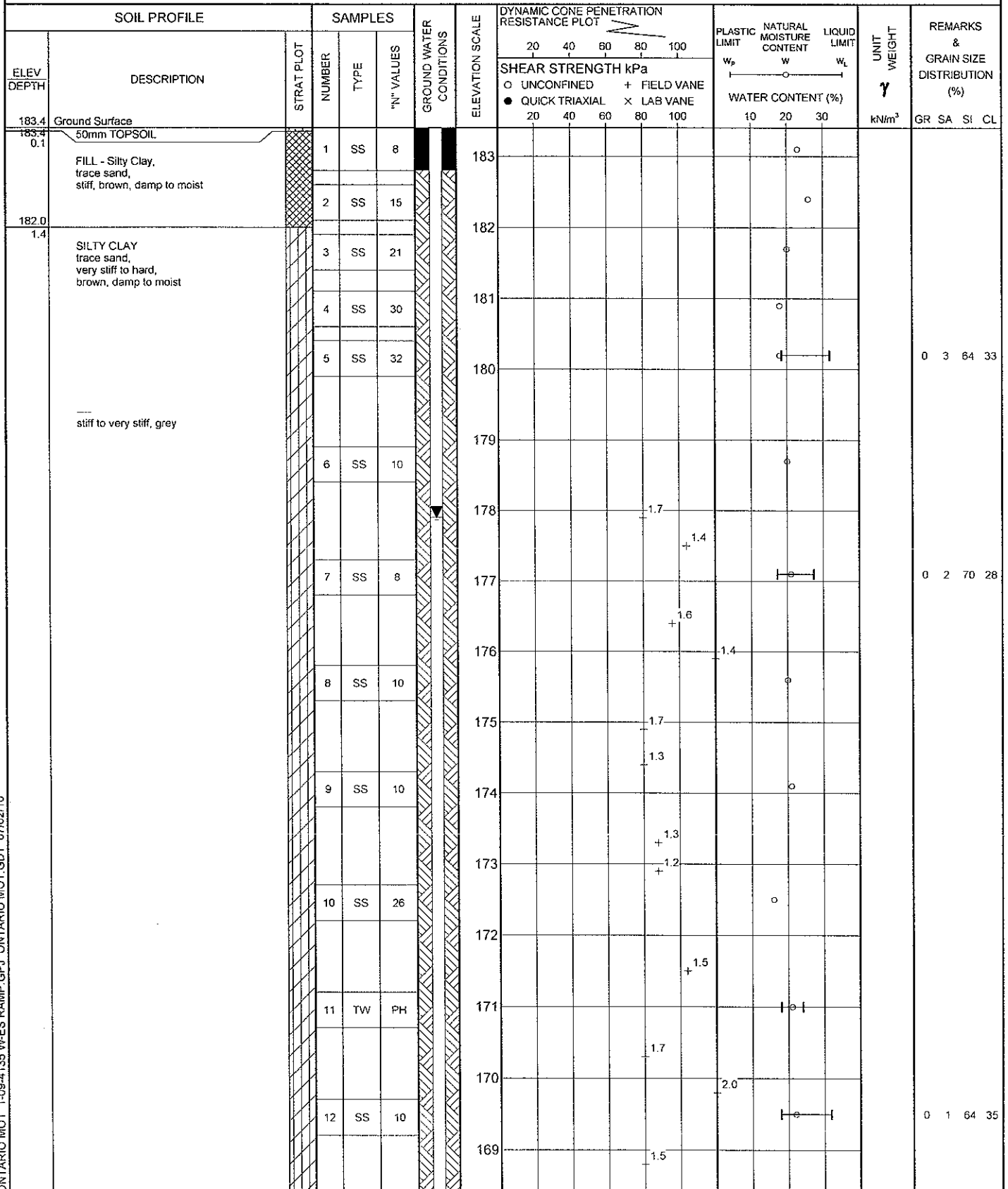
ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+360Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763814.3 E:327476.6 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.12.09 CHECKED BY RA



ONTARIO MOT 1-09-4135 W-ES RAMP GPJ. ONTARIO MOT. GDT. 07/02/10

Continued Next Page

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

RECORD OF BOREHOLE No WE-S 10+360Lt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763814.3 E:327476.6 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.12.09 CHECKED BY RA

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												
167.3	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist (continued)		13	SS	18		168																											
16.1	CLAYEY SILT trace to some sand, trace gravel, hard, grey / brown, damp (GLACIAL TILL)		14	SS	54		167																											
			15	SS	116		166																											
			16	SS	91		165																											
163.1	End of Borehole						164																											
20.3	<p>Unable to push vane below 16.1m.</p> <p>Consolidation test performed on TW 11.</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.20.09</td> <td>6.3</td> <td>177.1</td> </tr> <tr> <td>Nov.30.09</td> <td>7.7</td> <td>175.7</td> </tr> <tr> <td>Dec.15.09</td> <td>5.9</td> <td>177.5</td> </tr> <tr> <td>Jan.04.10</td> <td>5.7</td> <td>177.7</td> </tr> <tr> <td>Jan.11.10</td> <td>5.5</td> <td>177.9</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.20.09	6.3	177.1	Nov.30.09	7.7	175.7	Dec.15.09	5.9	177.5	Jan.04.10	5.7	177.7	Jan.11.10	5.5	177.9															
Date	Depth(m)	Elevation(m)																																
Nov.20.09	6.3	177.1																																
Nov.30.09	7.7	175.7																																
Dec.15.09	5.9	177.5																																
Jan.04.10	5.7	177.7																																
Jan.11.10	5.5	177.9																																

ONTARIO MOT 1-09-4135 W-ES RAMP.GPJ ONTARIO MOT.GDT 07/02/10

RECORD OF BOREHOLE No WE-S 10+425Lt 1 OF 1 METRIC

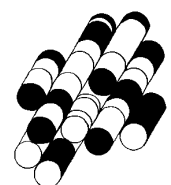
W.P. 280-99-00 LOCATION Coords: N:4763780.6 E:327503.9 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.13.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
185.8	Ground Surface					20 40 60 80 100									
185.7	140mm TOPSOIL					20 40 60 80 100									
0.1	FILL - Silty Clay, trace sand, firm to stiff, grey / brown, damp to moist		1	SS	9		185							0 4 53 43	
	some organics, grey / black		2	SS	9		184								
			3	SS	7		183								
			4	SS	8		182								
182.9	Weathered		5	SS	17		181							0 1 53 46	
2.9	SILTY CLAY trace sand, very stiff, brown, damp to moist		6	SS	34		180								
			7	SS	21		179								
	firm to stiff		8	SS	15		178								
			9	SS	10		177								
			10	SS	10		176								
			11	AS	-		175							0 3 70 27	
172.7	End of Borehole						174								
13.1	Borehole was dry (not stabilized) and hole open to full depth on completion.						173								

ONTARIO MOT 1-09-4135 WES RAMP GP J. ONTARIO MOT.GDT 07/02/10

B3

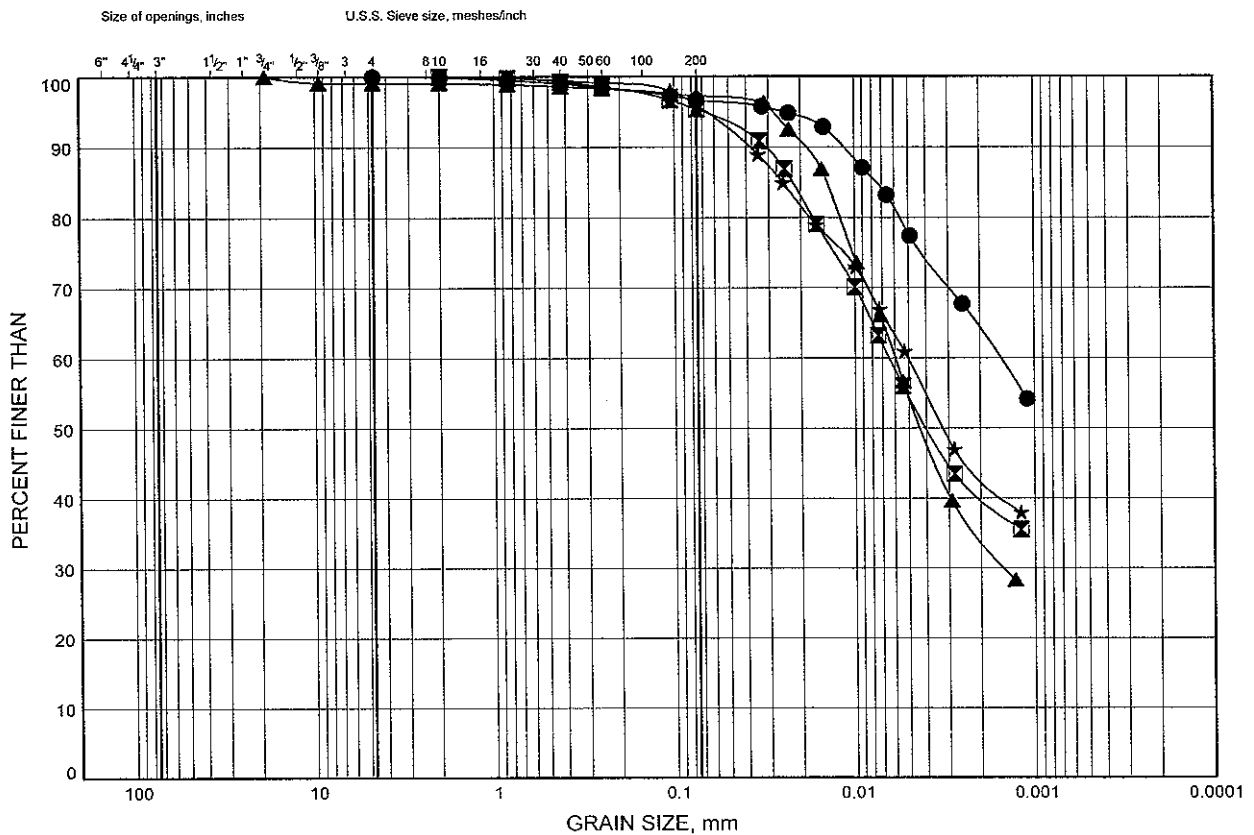
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B3-1

FILL - Silty Clay



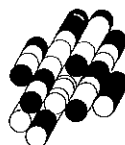
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
--------	----------	-----------	---------------

●	TEW1	0.3	182.2
⊠	WE-S 10+200Lt	0.3	181.3
▲	WE-S 10+200Rt	1.0	180.7
★	WE-S 10+425Lt	1.0	184.8

Date July 2010

Project 1-09-4135



Prep'd DB

Chkd HW

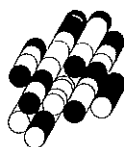
FIGURE B3-2

The Plasticity Chart (Figure 2) is a graph of Plasticity Index (PI) on the y-axis (0 to 60) versus Liquid Limit (LL) on the x-axis (0 to 80). The chart is divided into regions for soil classification by several lines. A diagonal line labeled 'A' line is also shown. Data points are plotted as follows:

Symbol	Liquid Limit (LL)	Plasticity Index (PI)
Square with 'x'	42	22
Triangle	43	22
Star	49	25
Solid Circle	62	35

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	0.3	182.2
⊗	WE-S 10+200Lt	0.3	181.3
▲	WE-S 10+200Rt	1.0	180.7
★	WE-S 10+425Lt	1.0	184.8

Date July 2010
Project 1-09-4135

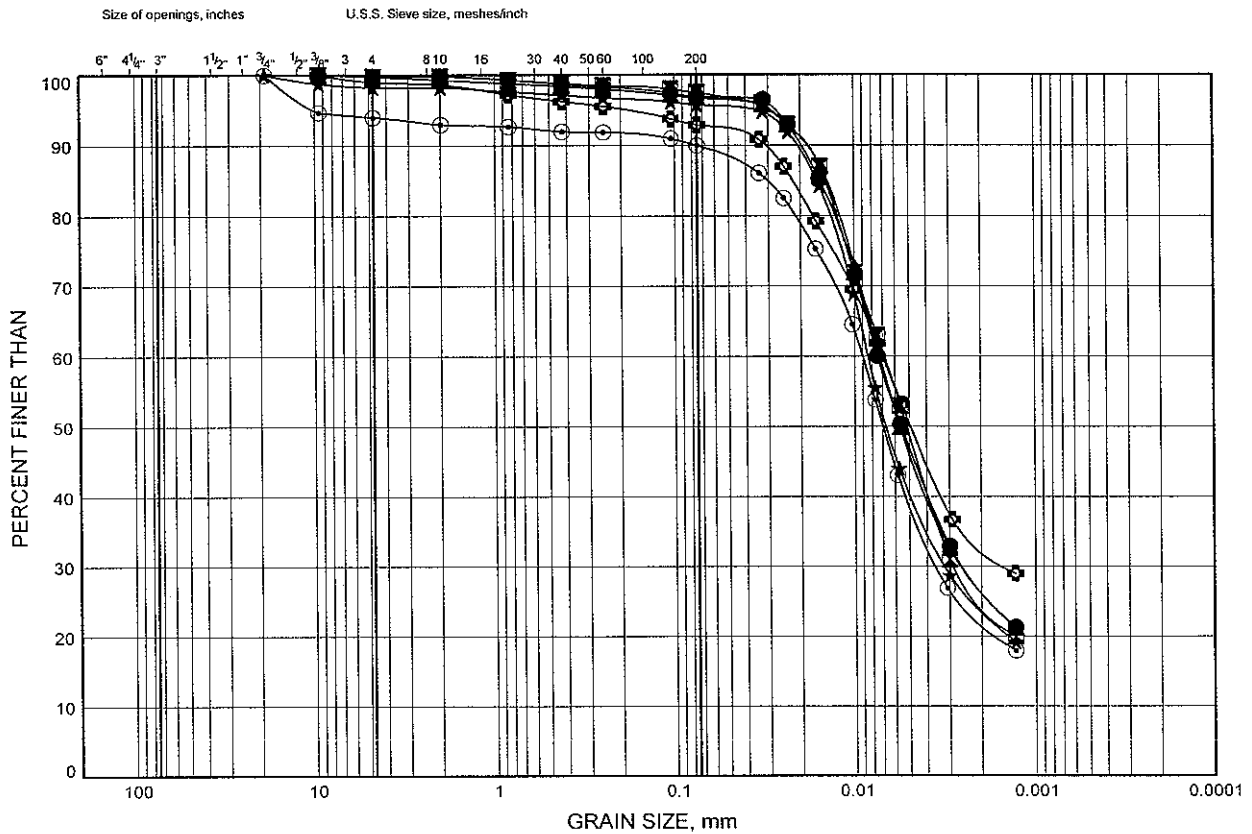


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-3

SILTY CLAY

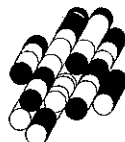


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WE-S 10+200Lt	1.7	179.9
⊠	WE-S 10+200Lt	7.8	173.8
▲	WE-S 10+200Rt	2.5	179.2
★	WE-S 10+200Rt	6.3	175.4
⊙	WE-S 10+200Rt	9.3	172.4
⊛	WE-S 10+250CL	3.2	178.9

Date July 2010
Project 1-09-4135

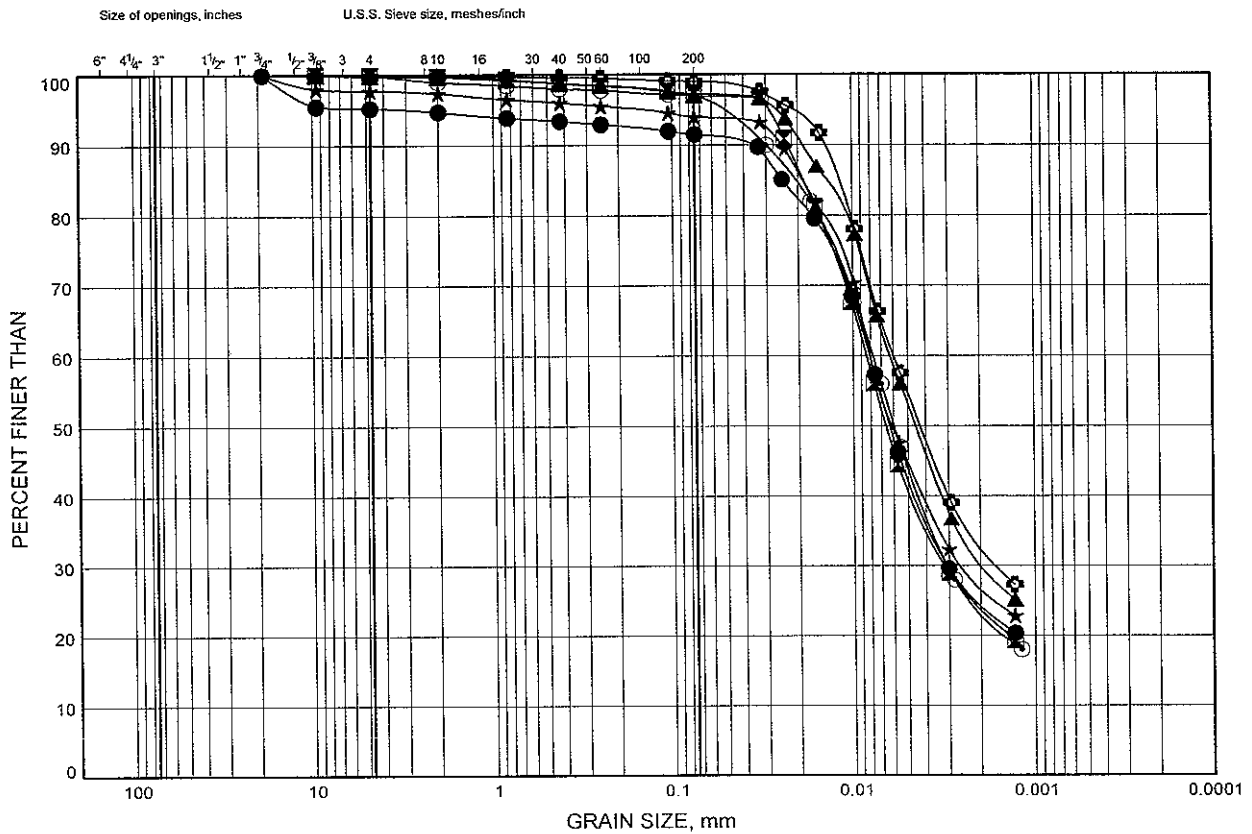


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-4

SILTY CLAY

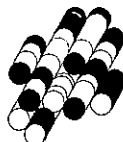


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WE-S 10+250CL	6.3	175.8
⊠	WE-S 10+250CL	10.9	171.2
▲	WE-S 10+295CL	2.5	180.3
★	WE-S 10+295CL	7.8	175.0
⊙	WE-S 10+295CL	9.3	173.5
⊛	WE-S 10+345CL	2.5	180.3

Date July 2010
Project 1-09-4135

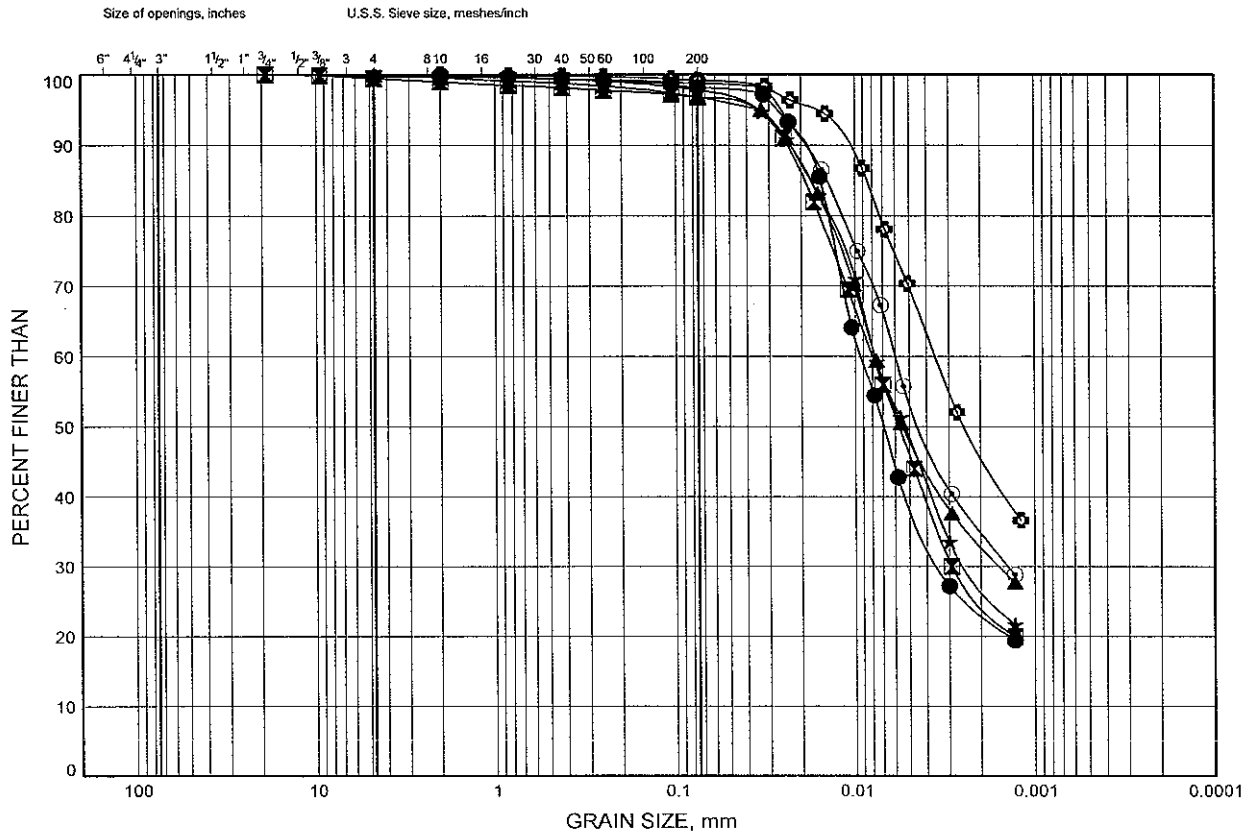


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-5

SILTY CLAY



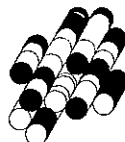
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WE-S 10+345CL	7.8	175.0
⊠	WE-S 10+345CL	10.9	171.9
▲	WE-S 10+360Lt	3.2	180.2
★	WE-S 10+360Lt	6.3	177.1
⊙	WE-S 10+360Lt	13.9	169.5
⊛	WE-S 10+425Lt	4.7	181.1

Date July 2010

Project 1-09-4135



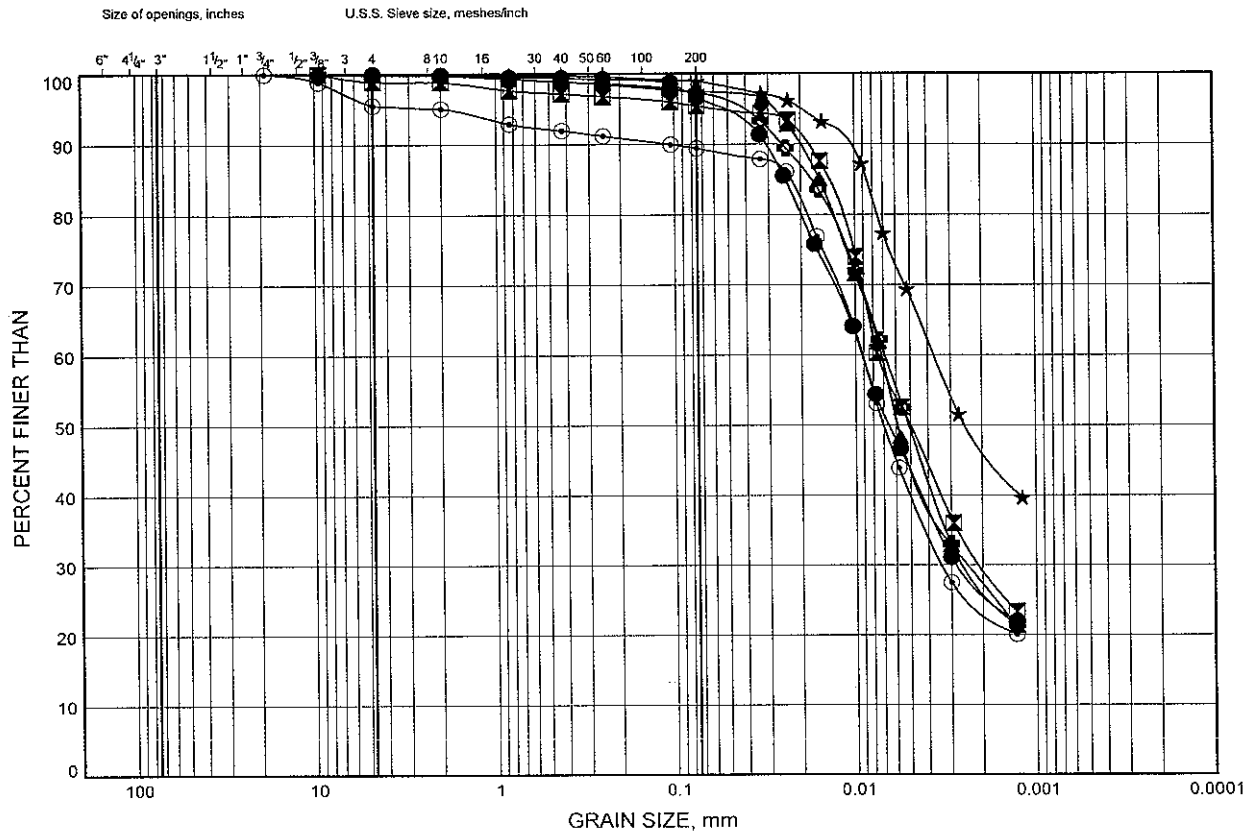
Prep'd DB

Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-6

SILTY CLAY

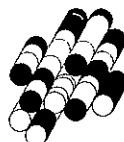


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TEW1	2.5	180.0
⊠	TEW1	4.7	177.8
▲	TEW1	9.3	173.2
★	TEW2	2.5	180.2
⊙	TEW2	13.9	168.8
⊕	WE-S 10+425Lt	10.9	174.9

Date July 2010
Project 1-09-4135

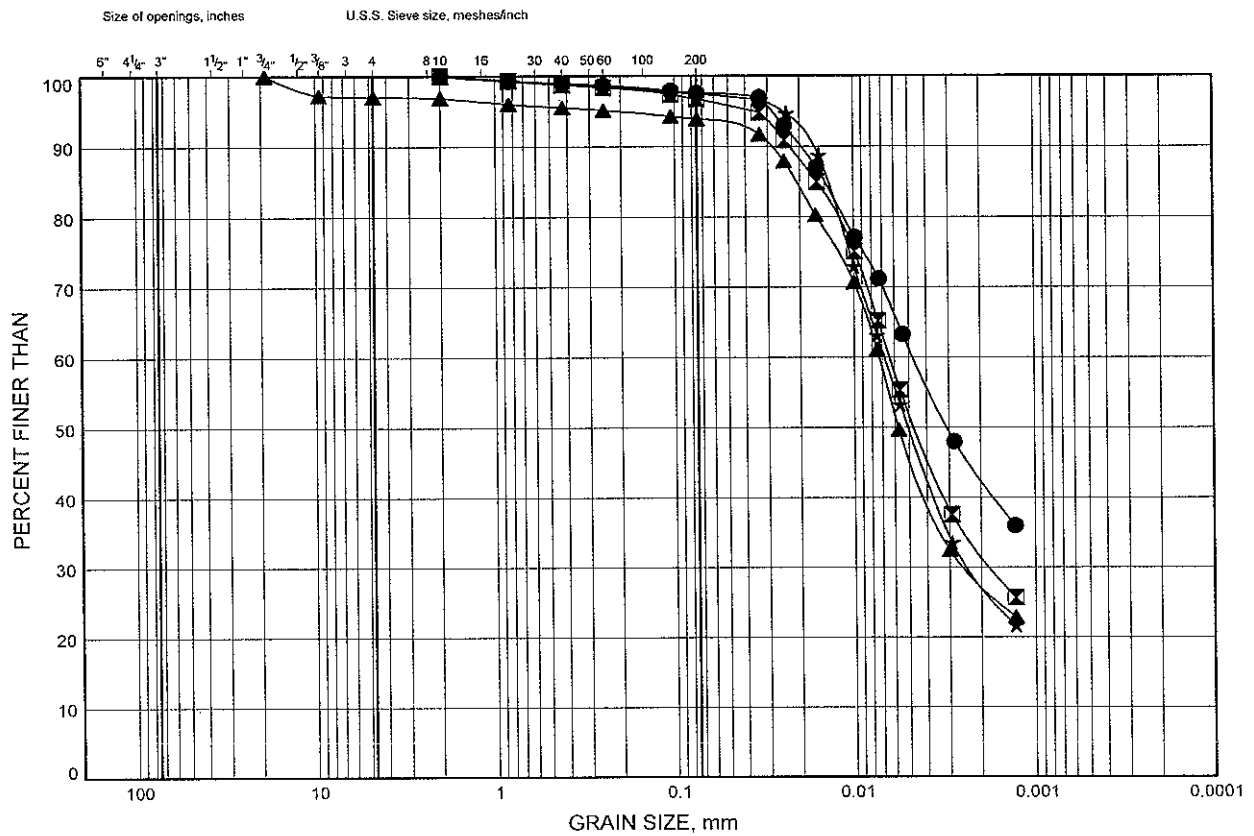


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-7

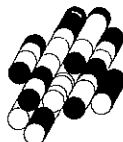
SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW3	3.2	179.4
⊠	TEW3	4.7	177.9
▲	TEW3	7.8	174.8
★	TEW3	10.9	171.7

Date July 2010
Project 1-09-4135

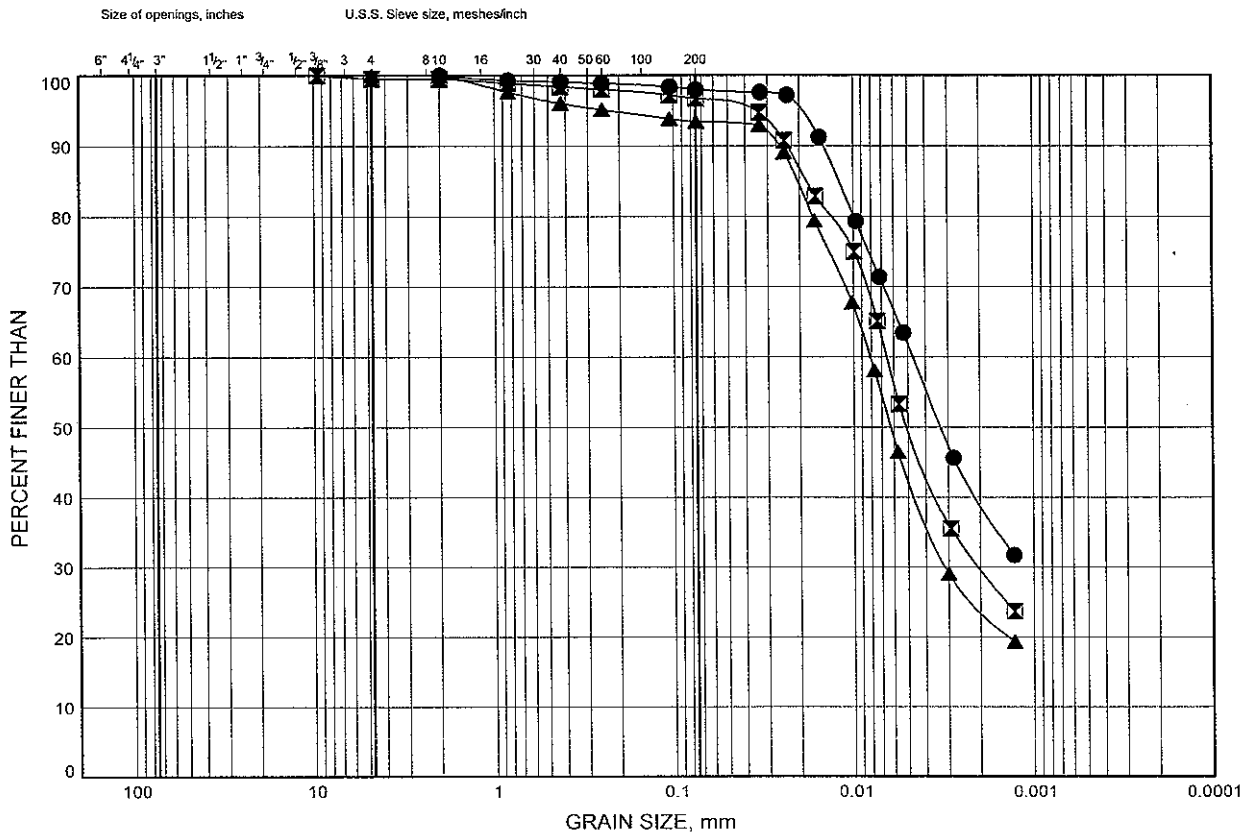


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-8

SILTY CLAY

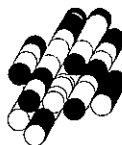


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TEW4	1.0	181.6
⊠	TEW4	4.7	177.9
▲	TEW4	9.3	173.3

Date July 2010
Project 1-09-4135

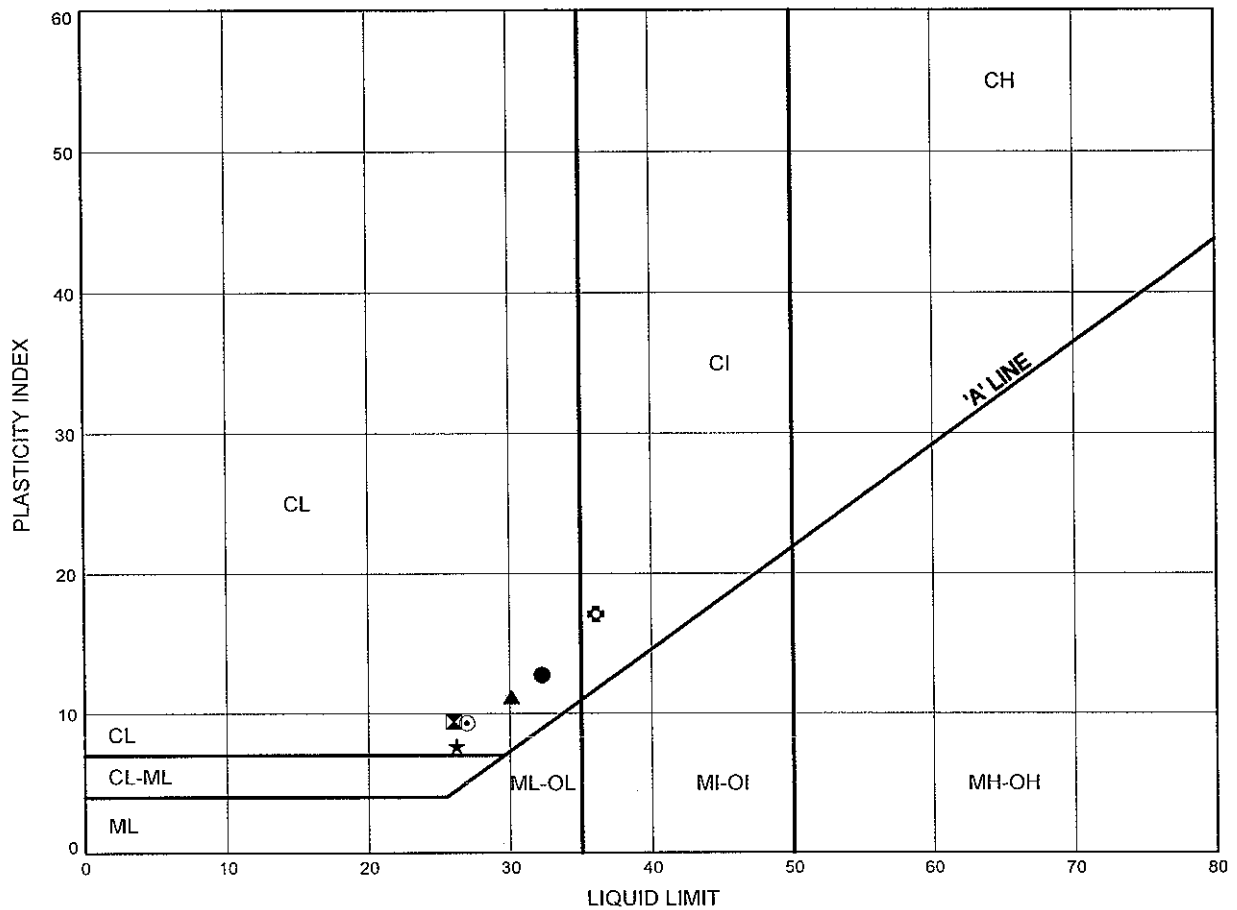


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-9

SILTY CLAY

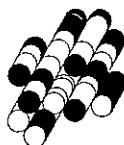


SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WE-S 10+200Lt	1.7	179.9
⊠	WE-S 10+200Lt	7.8	173.8
▲	WE-S 10+200Rt	2.5	179.2
★	WE-S 10+200Rt	6.3	175.4
⊙	WE-S 10+200Rt	9.3	172.4
⊛	WE-S 10+250CL	3.2	178.9

Date July 2010

Project 1-09-4135



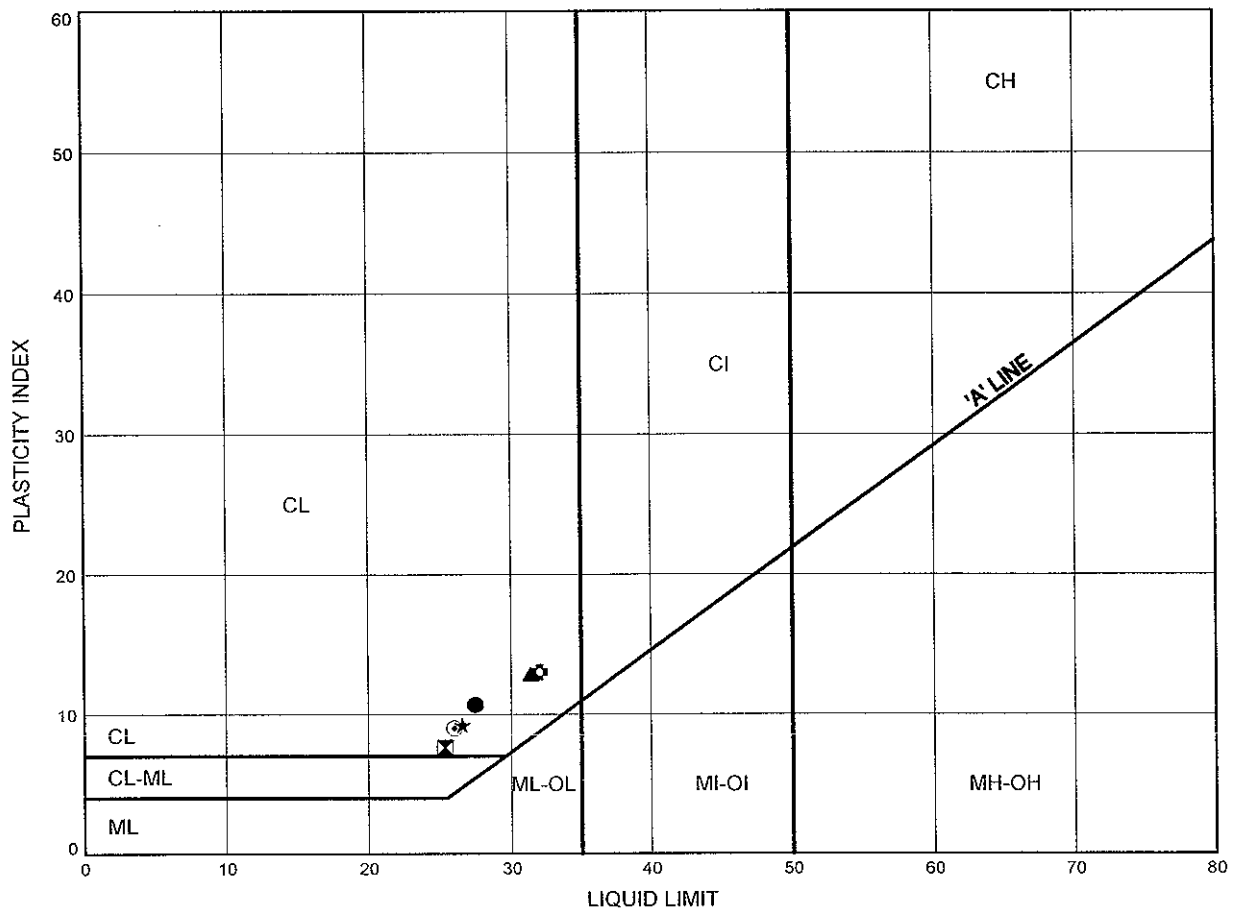
Prep'd DB

Chkd. HW

ATTERBERG LIMITS TEST RESULTS

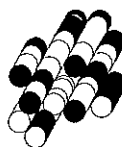
FIGURE B3-10

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WE-S 10+250CL	6.3	175.8
⊠	WE-S 10+250CL	10.9	171.2
▲	WE-S 10+295CL	2.5	180.3
★	WE-S 10+295CL	7.8	175.0
⊙	WE-S 10+295CL	9.3	173.5
⊛	WE-S 10+345CL	2.5	180.3

Date July 2010
Project 1-09-4135

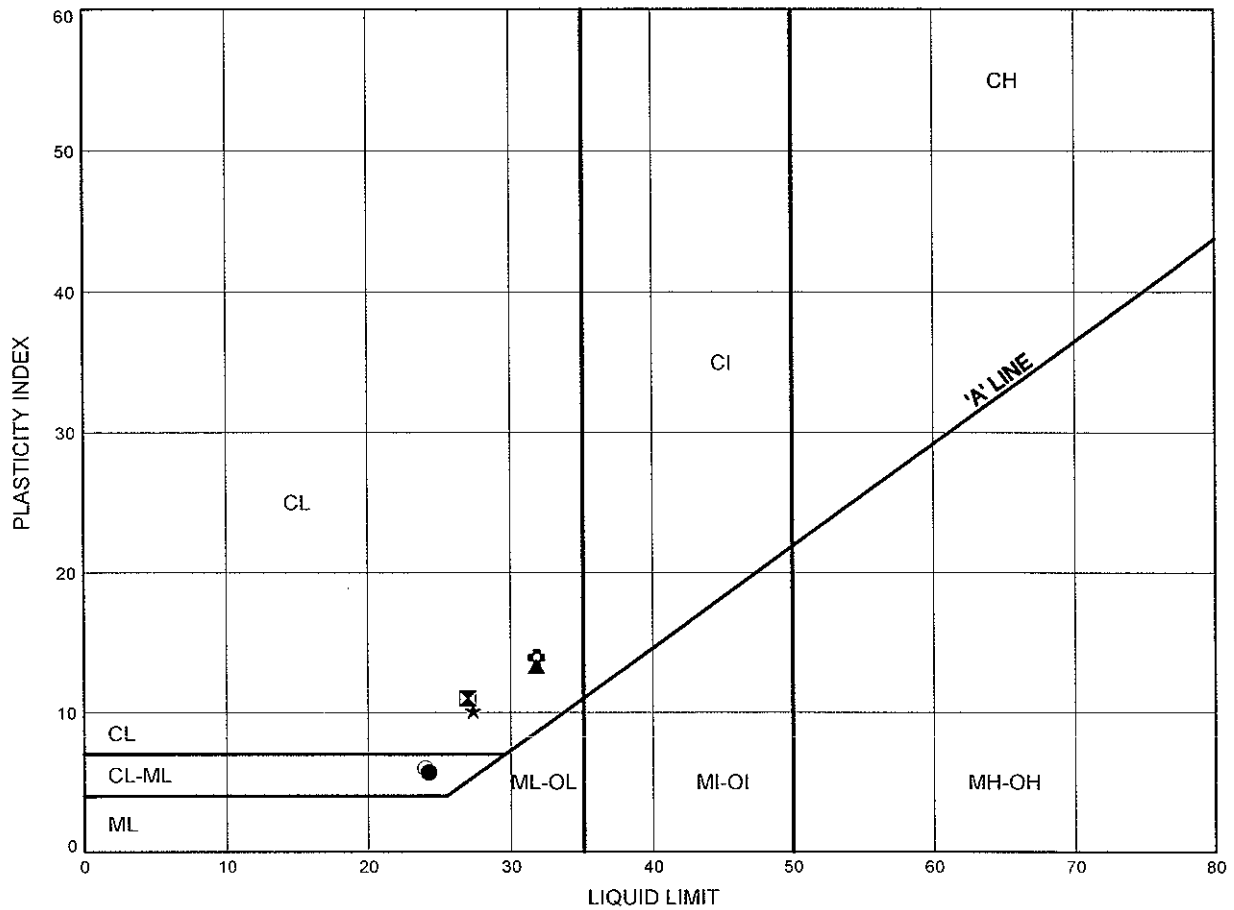


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

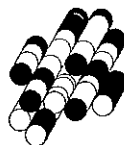
FIGURE B3-11

SILTY CLAY



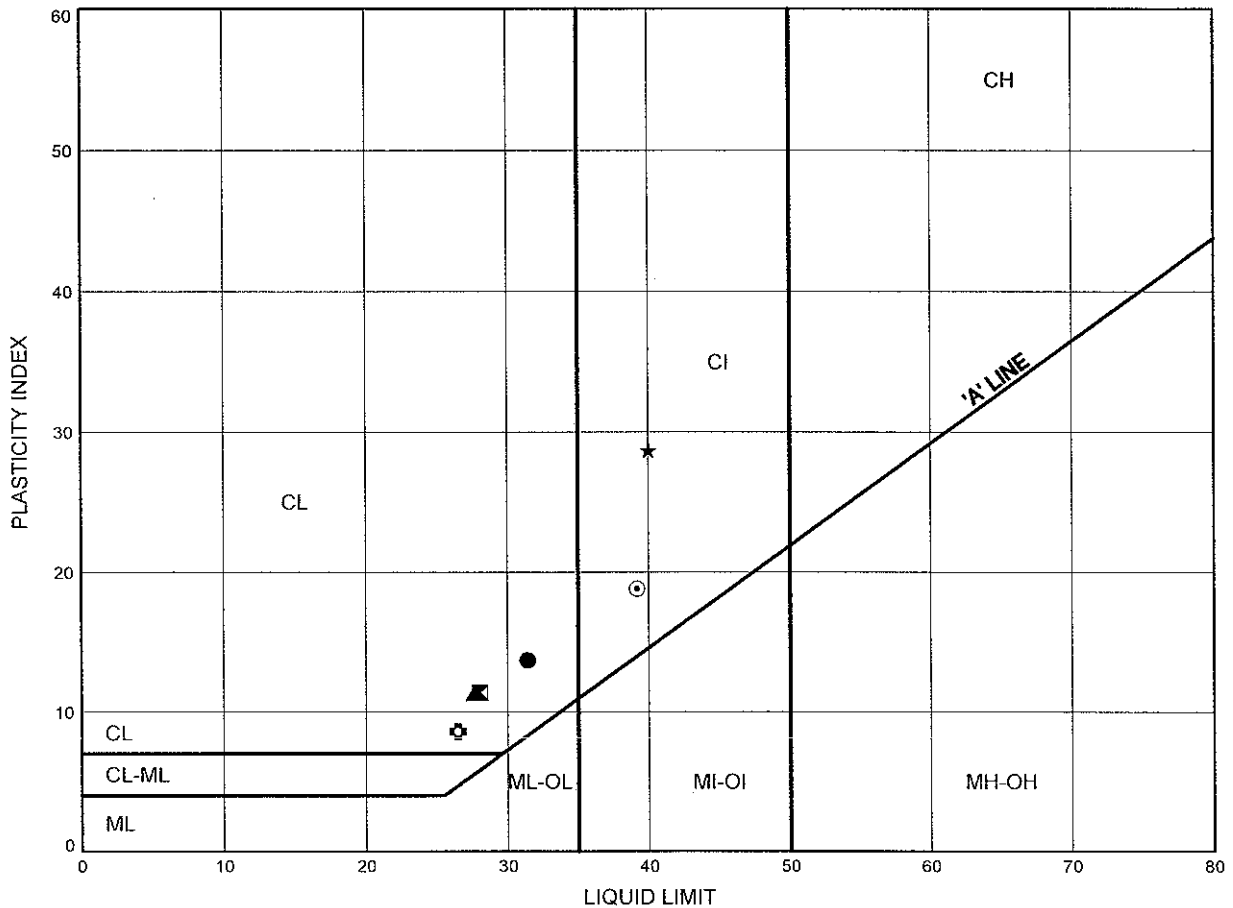
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WE-S 10+345CL	7.8	175.0
⊠	WE-S 10+345CL	10.9	171.9
▲	WE-S 10+360Lt	3.2	180.2
★	WE-S 10+360Lt	6.3	177.1
⊙	WE-S 10+360Lt	12.4	171.0
⊛	WE-S 10+360Lt	13.9	169.5

Date July 2010
Project 1-09-4135



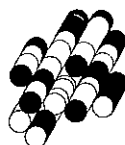
Prep'd DB
Chkd. HW

FIGURE B3-12



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	2.5	180.0
⊠	TEW1	4.7	177.8
▲	TEW1	9.3	173.2
★	TEW2	2.5	180.2
⊙	WE-S 10+425Lt	4.7	181.1
⊛	WE-S 10+425Lt	10.9	174.9

Date July 2010
Project 1-09-4135

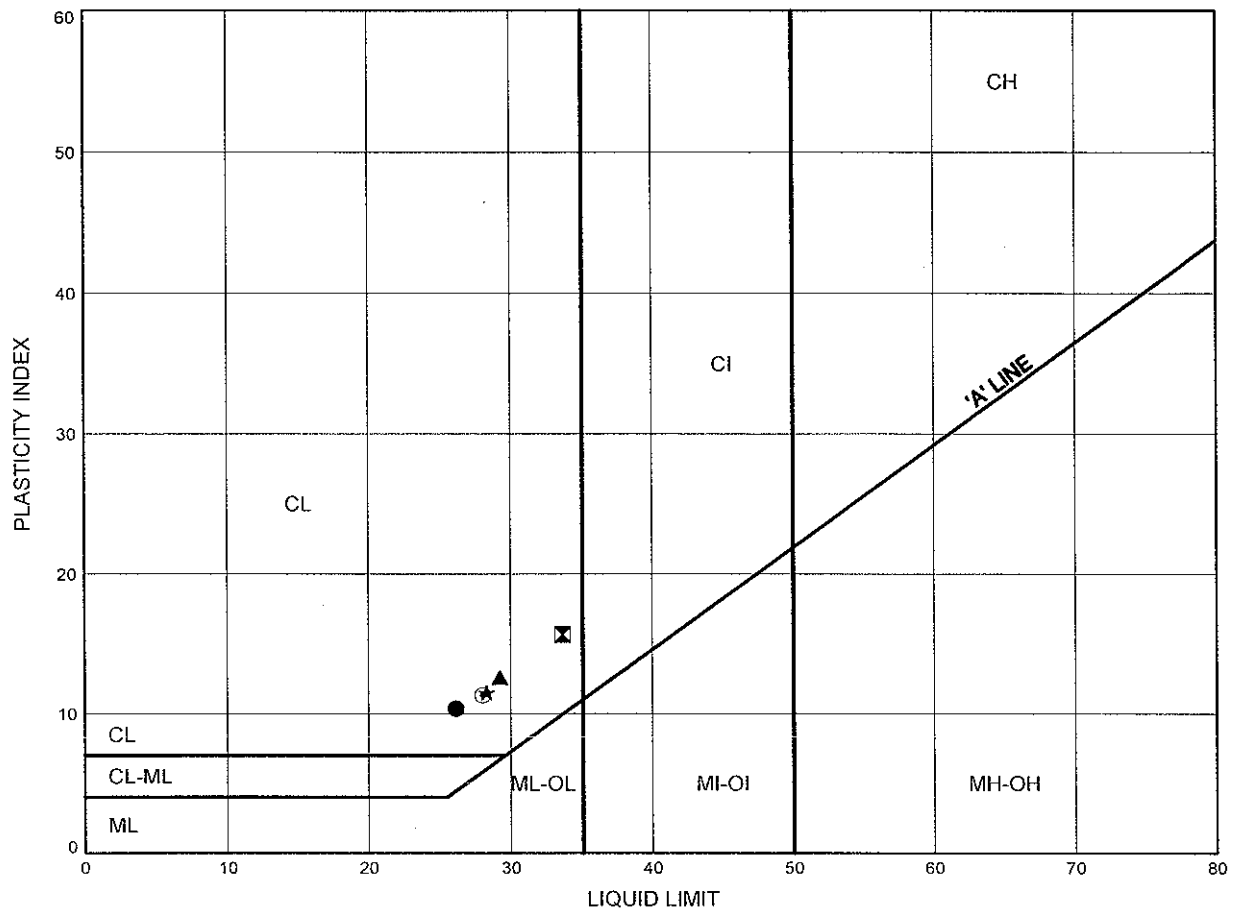


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

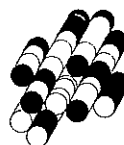
FIGURE B3-13

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW2	13.9	168.8
⊠	TEW3	3.2	179.4
▲	TEW3	4.7	177.9
★	TEW3	7.8	174.8
⊙	TEW3	10.9	171.7

Date July 2010
Project 1-09-4135

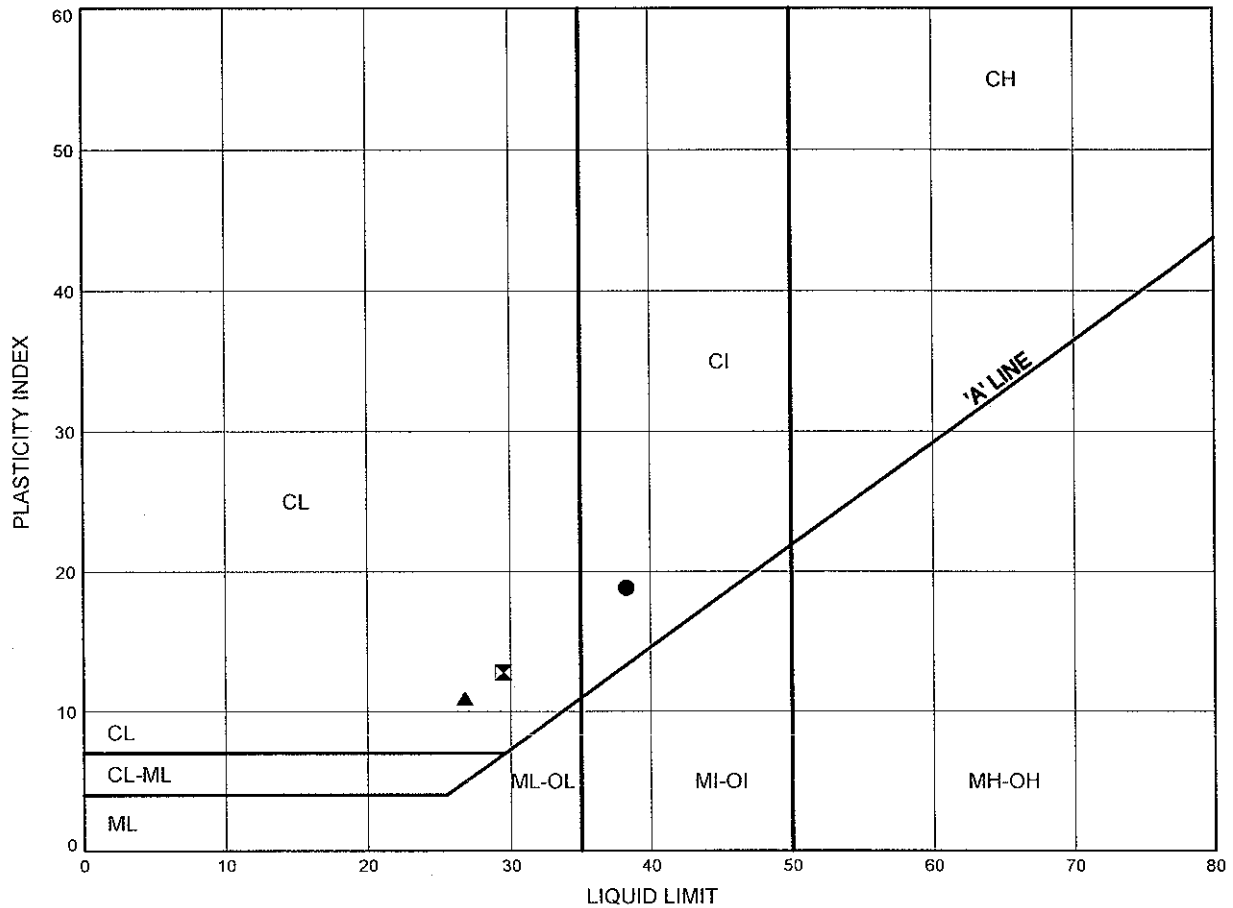


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

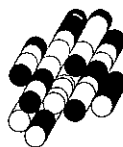
FIGURE B3-14

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW4	1.0	181.6
⊠	TEW4	4.7	177.9
▲	TEW4	9.3	173.3

Date July 2010
Project 1-09-4135

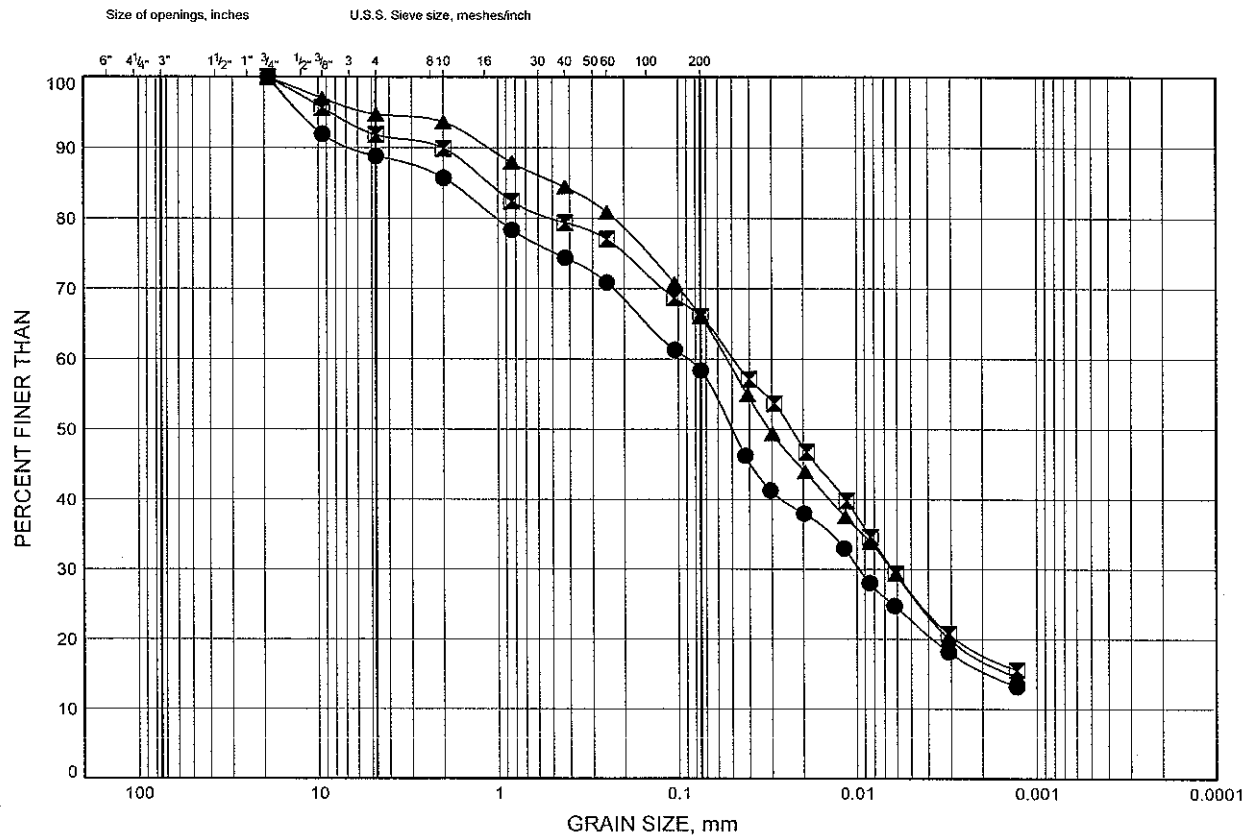


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-15

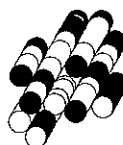
CLAYEY SILT TO SILTY CLAY TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	17.0	165.5
⊠	TEW2	15.4	167.3
▲	WE-S 10+360Lt	18.5	164.9

Date July 2010
Project 1-09-4135

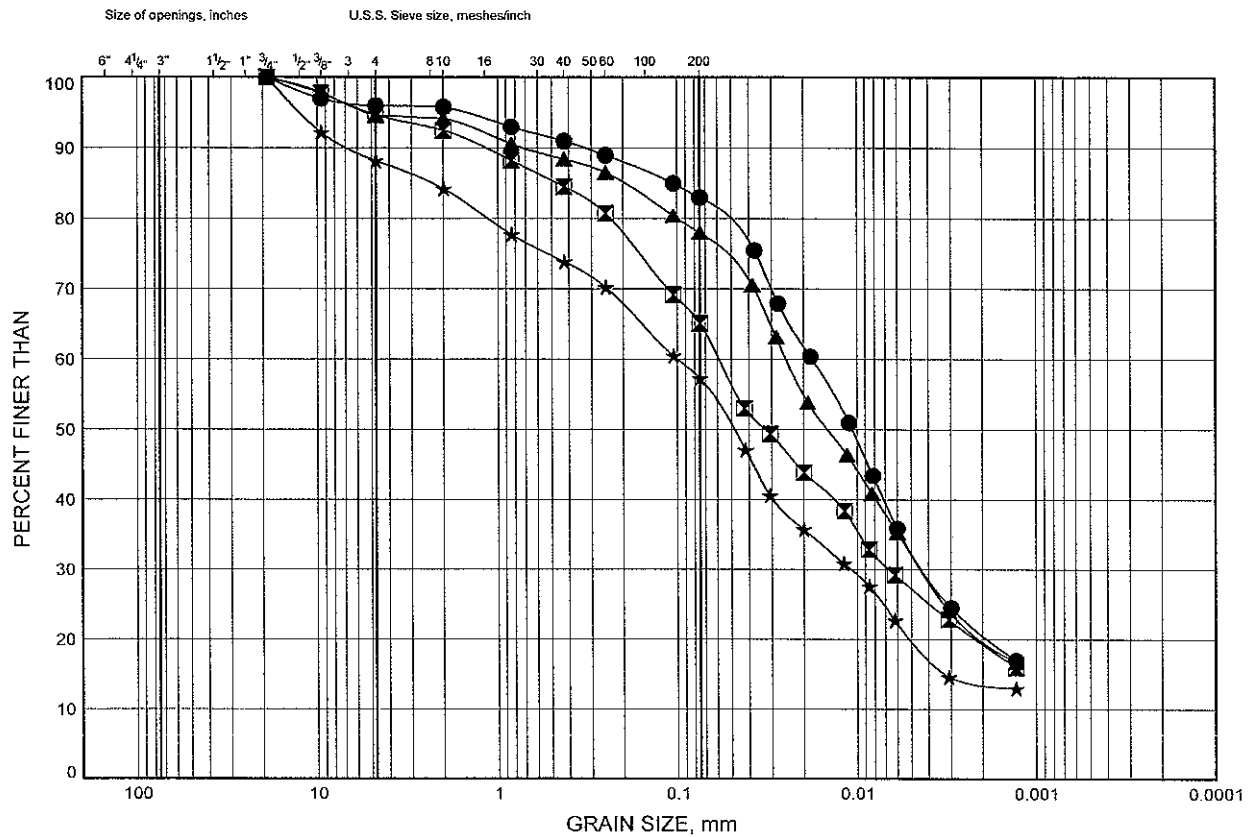


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-16

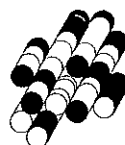
CLAYEY SILT TO SILTY CLAY TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW3	17.0	165.6
■	TEW3	21.5	161.1
▲	TEW4	15.4	167.2
★	TEW4	20.0	162.6

Date July 2010
Project 1-09-4135

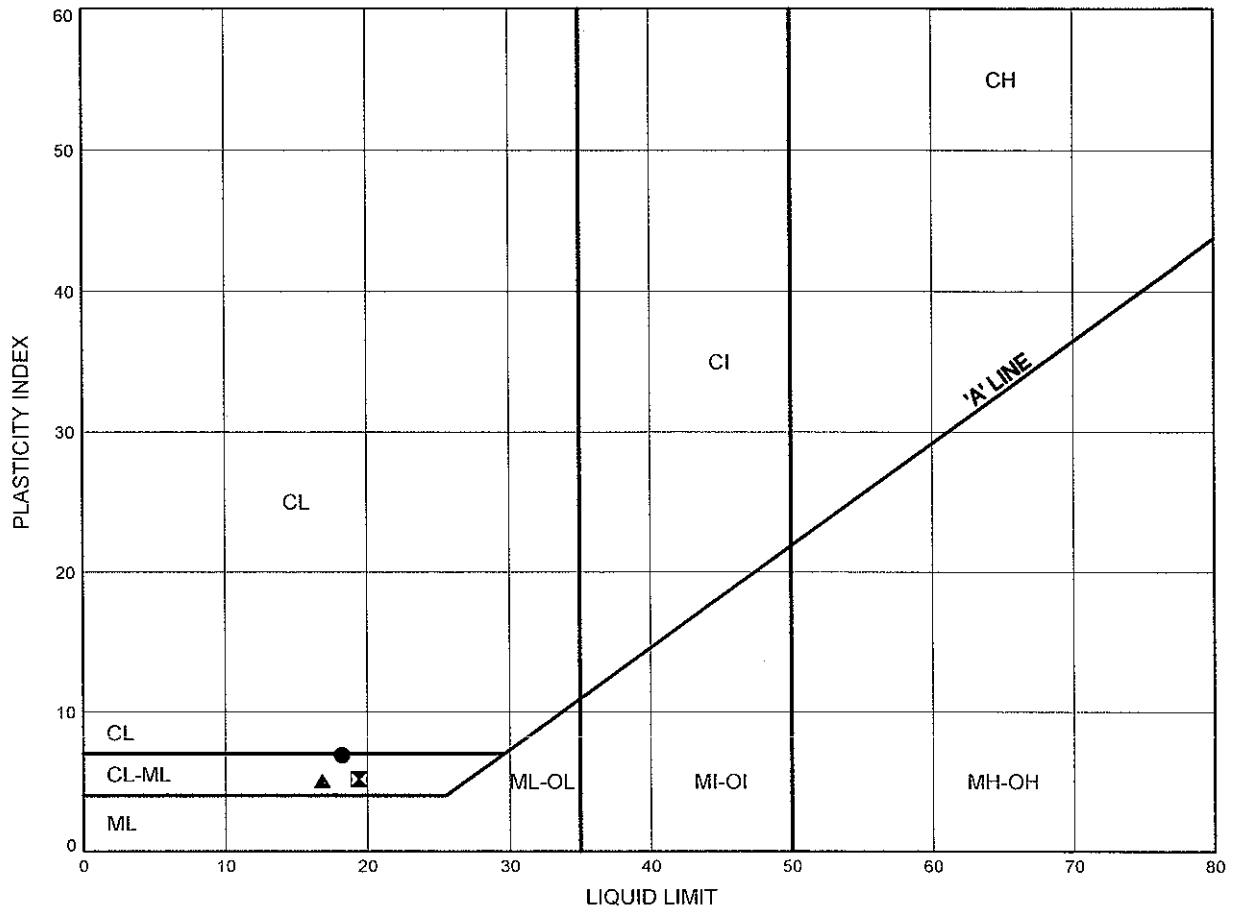


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

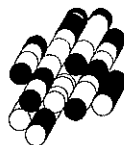
FIGURE B3-17

CLAYEY SILT TO SILTY CLAY TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	17.0	165.5
⊠	TEW2	15.4	167.3
▲	WE-S 10+360Lt	18.5	164.9

Date July 2010
Project 1-09-4135

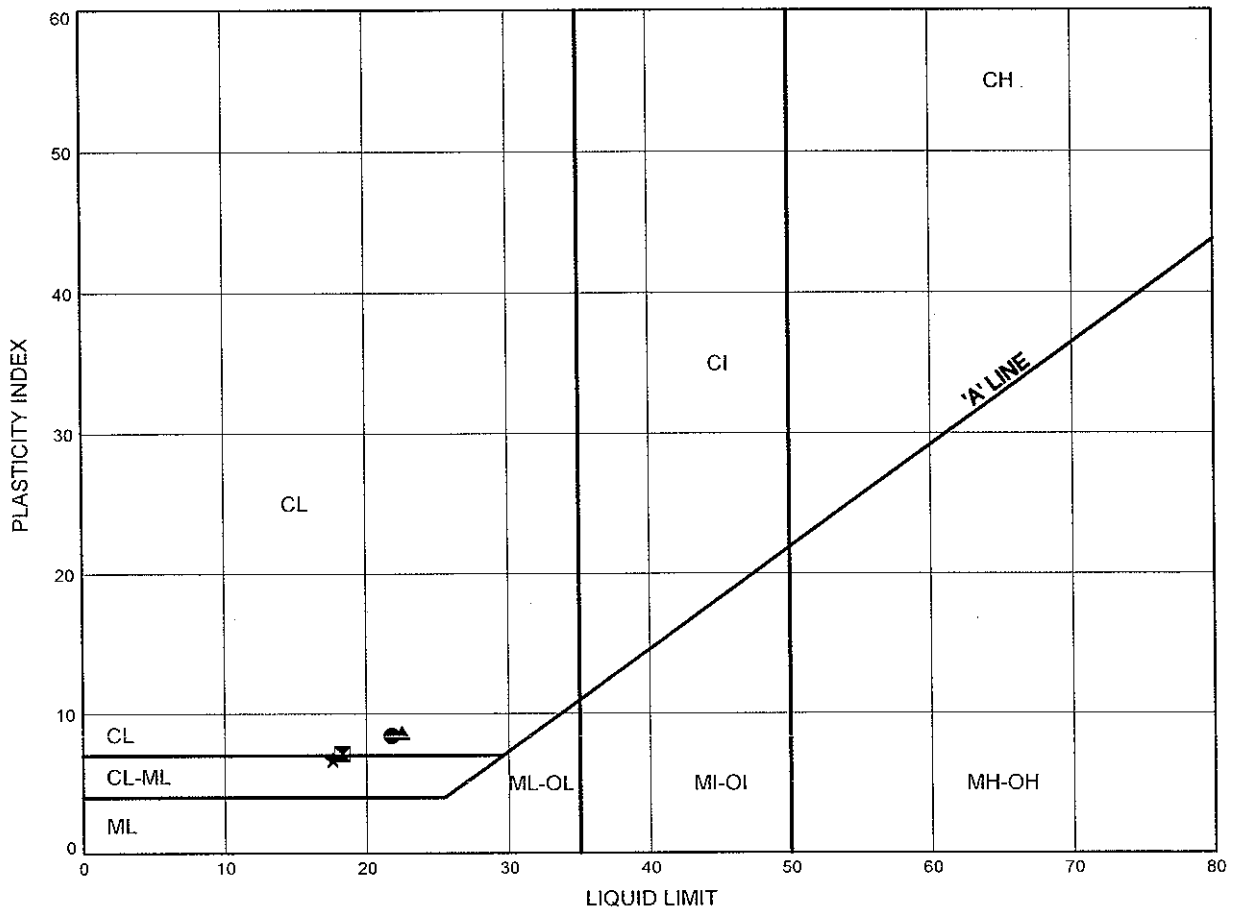


Prep'd DB
Chkd. HW

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-18

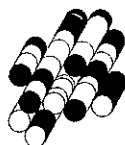
CLAYEY SILT TO SILTY CLAY TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW3	17.0	165.6
⊠	TEW3	21.5	161.1
▲	TEW4	15.4	167.2
★	TEW4	20.0	162.6

ALTR 1-09-4135 W-ES RAMP.GPJ 07/02/10

Date July 2010
Project 1-09-4135



Prep'd DB
Chkd. HW

FIGURE B3-19

Size of openings, inches

U.S.S. Sieve size, meshes/inch

PERCENT FINER THAN

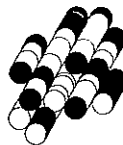
GRAIN SIZE, mm

Grain Size (mm)	U.S.S. Sieve Size (meshes/inch)	Size of Opening (inches)	Percent Finer (%)
100	10	2.0	100
75	20	1.18	95
60	25	0.85	82
40	40	0.425	68
30	60	0.25	50
20	80	0.18	35
15	100	0.15	28
10	20	0.075	22
7.5	25	0.06	14
6	30	0.05	12
4.75	40	0.0375	9
3.75	40	0.0375	8
3.0	60	0.025	7
2.5	60	0.025	6
2.0	80	0.018	5
1.5	100	0.015	4
1.18	20	0.015	3
0.85	25	0.0118	2
0.6	30	0.0085	1

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	21.5	161.0

Date July 2010
Project 1-09-4135

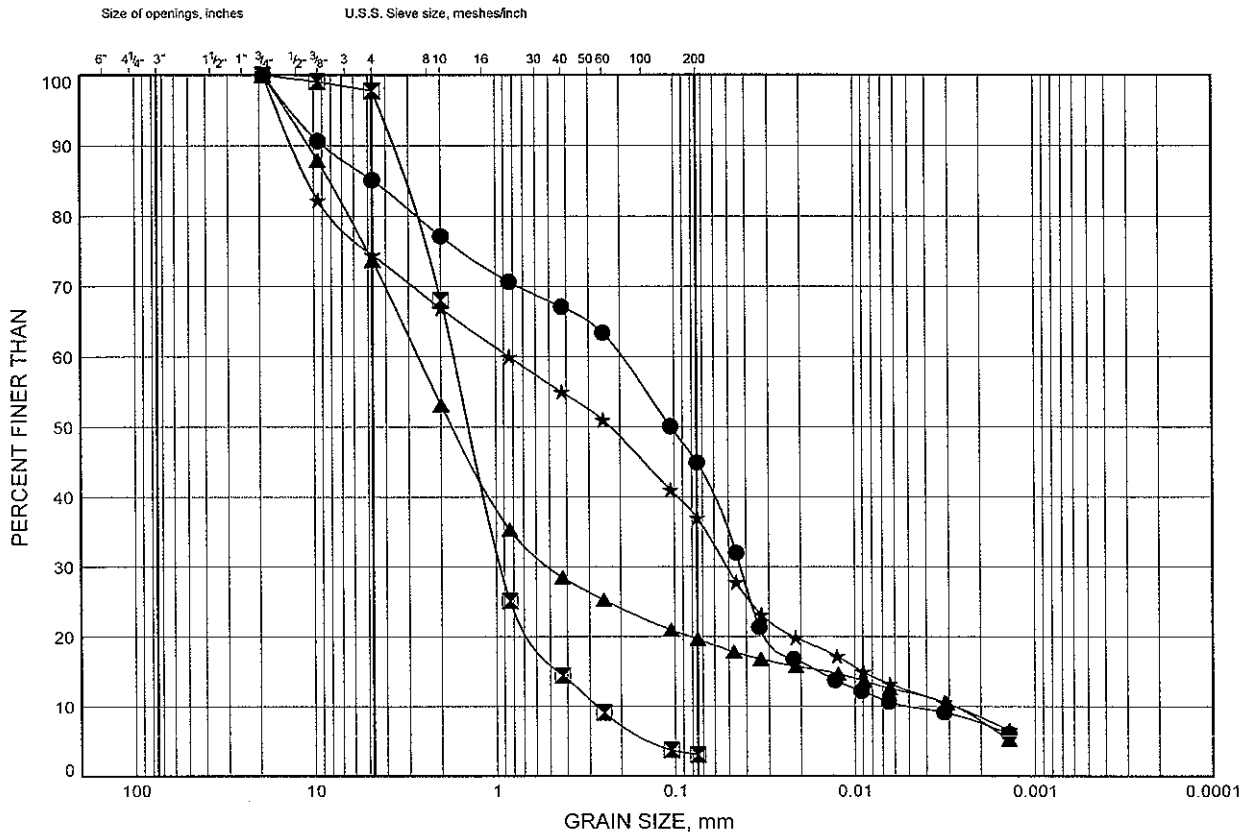


Prep'd DB
Chkd. HW

GRAIN SIZE DISTRIBUTION

FIGURE B3-20

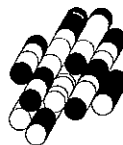
SILTY SAND TO SAND AND SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	26.2	156.3
⊠	TEW2	24.6	158.1
▲	TEW2	27.6	155.1
★	TEW3	27.6	155.0

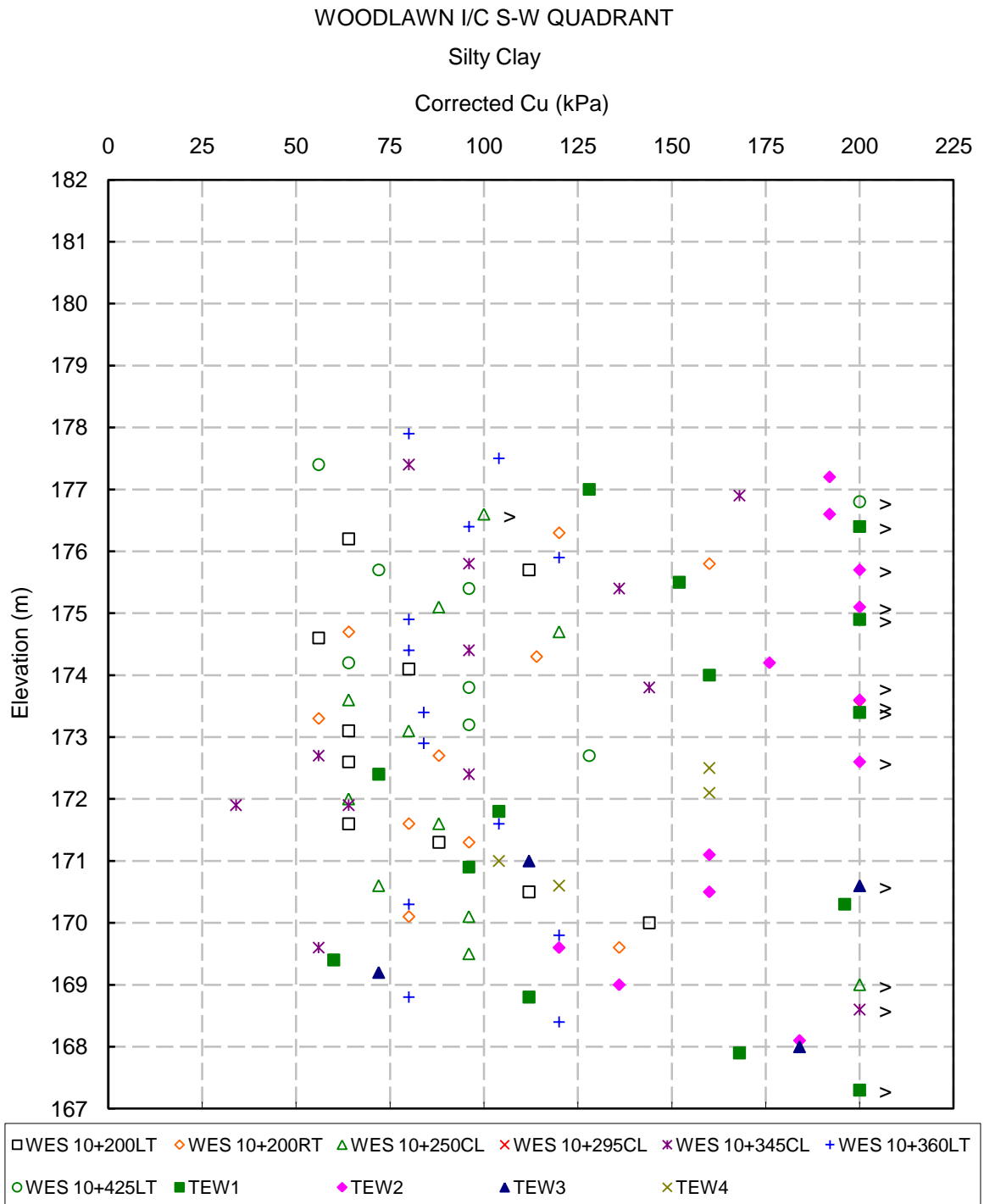
Date July 2010
Project 1-09-4135



Prep'd DB
Chkd. HW

CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B3-21



Field Shear Vane Correction

Morris & Williams (1994)
($\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57$)

Applied Correction Factors

0.90 (Elev.>178m) 1.00 (Elev.<178m)

Project No. : 1-09-4135

Date : September, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

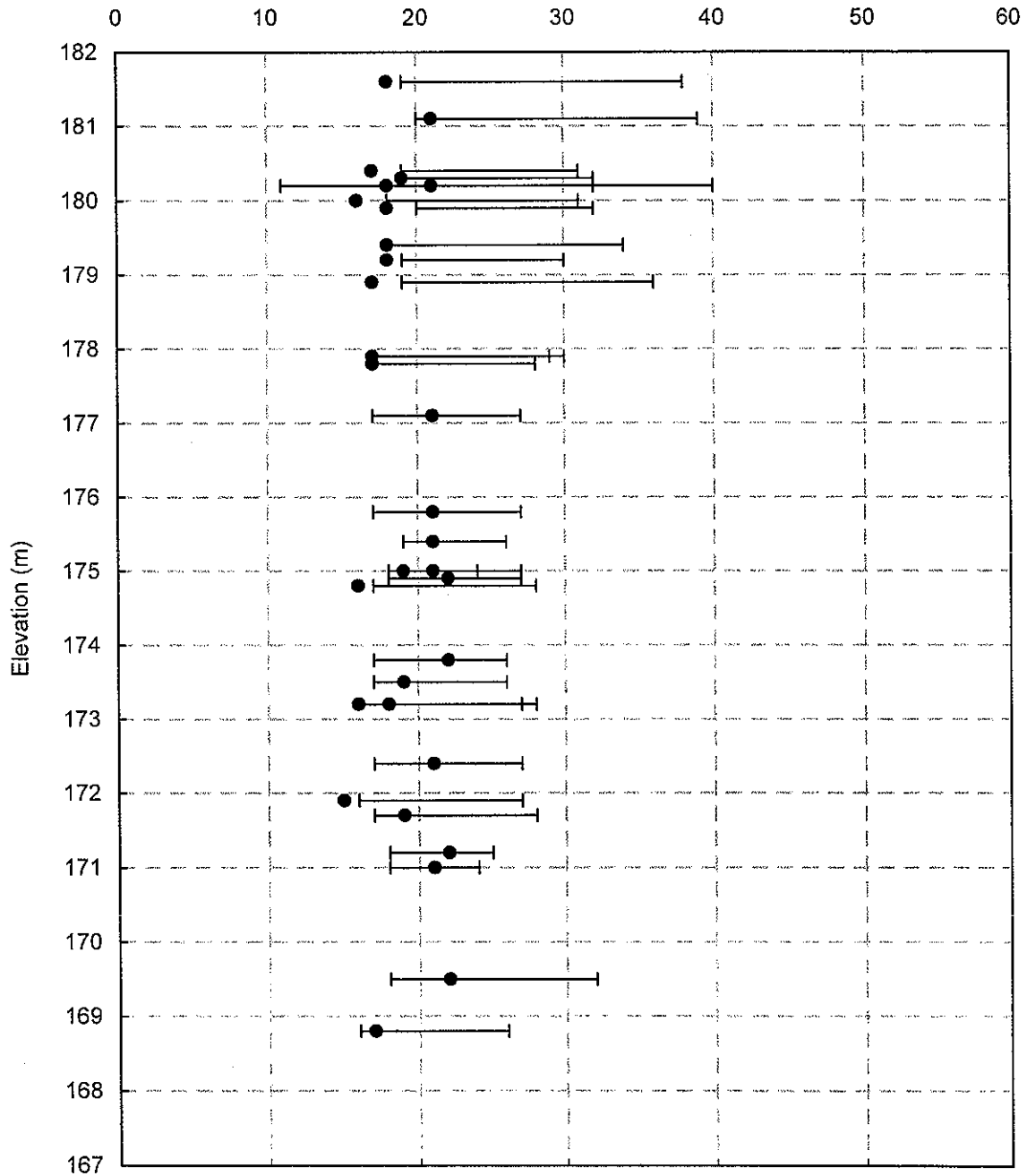
ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B3-22

HWY 406 TWINNING - WOODLAWN I/C S-W QUADRANT

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

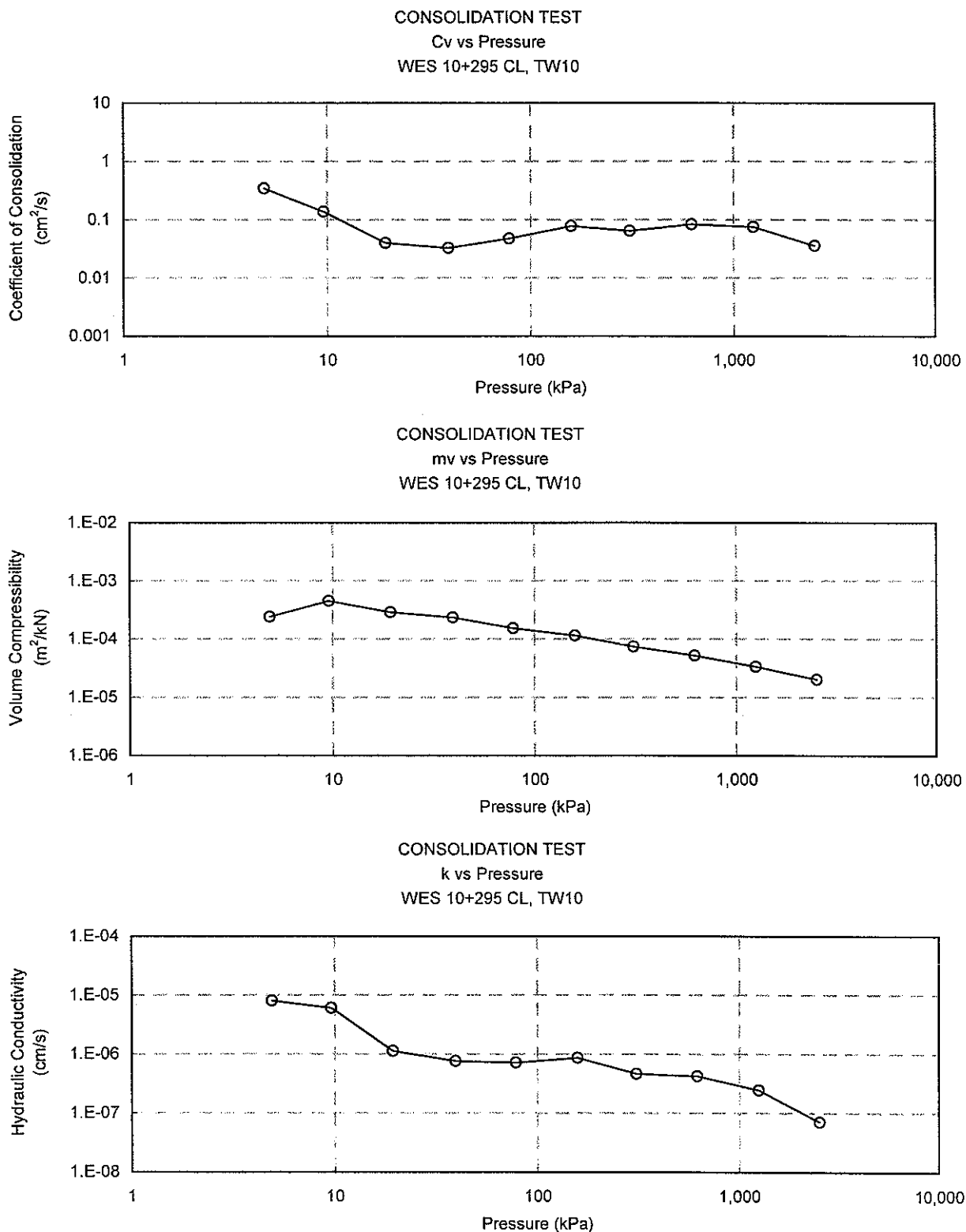
Date : June, 2010



Terraprobe Inc.

Prepared By : HW

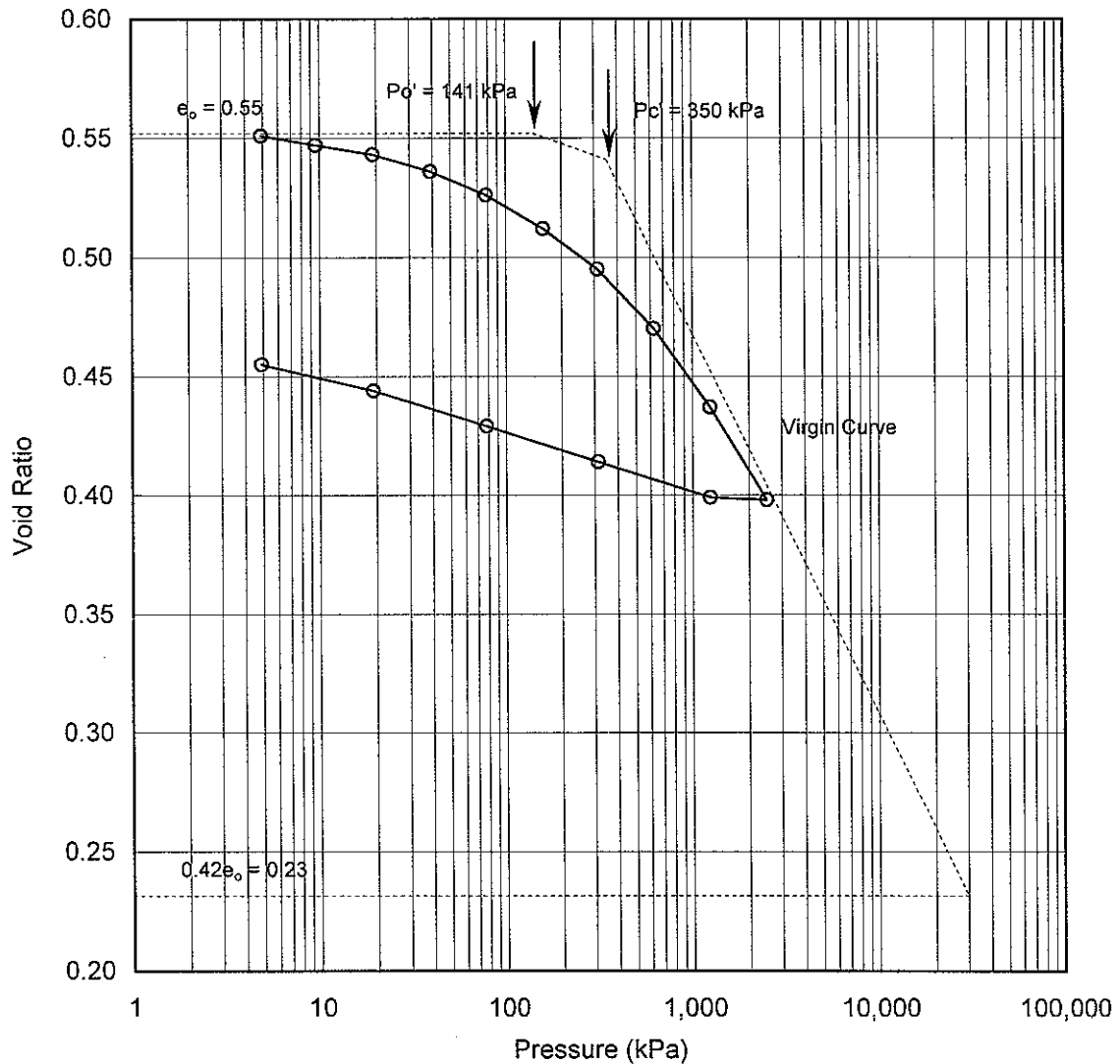
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

WES 10+295 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.55	$\omega_L =$	26%	$P_o' =$	141 kPa
$\omega =$	19%	$\omega_P =$	17%	$P_c' =$	350 kPa
$\gamma =$	20.8 kN/m ³	PI =	9%	Cc =	0.160
Gs =	2.77			Cr =	0.028

Project No. : 1-09-4135

Date : June 2010

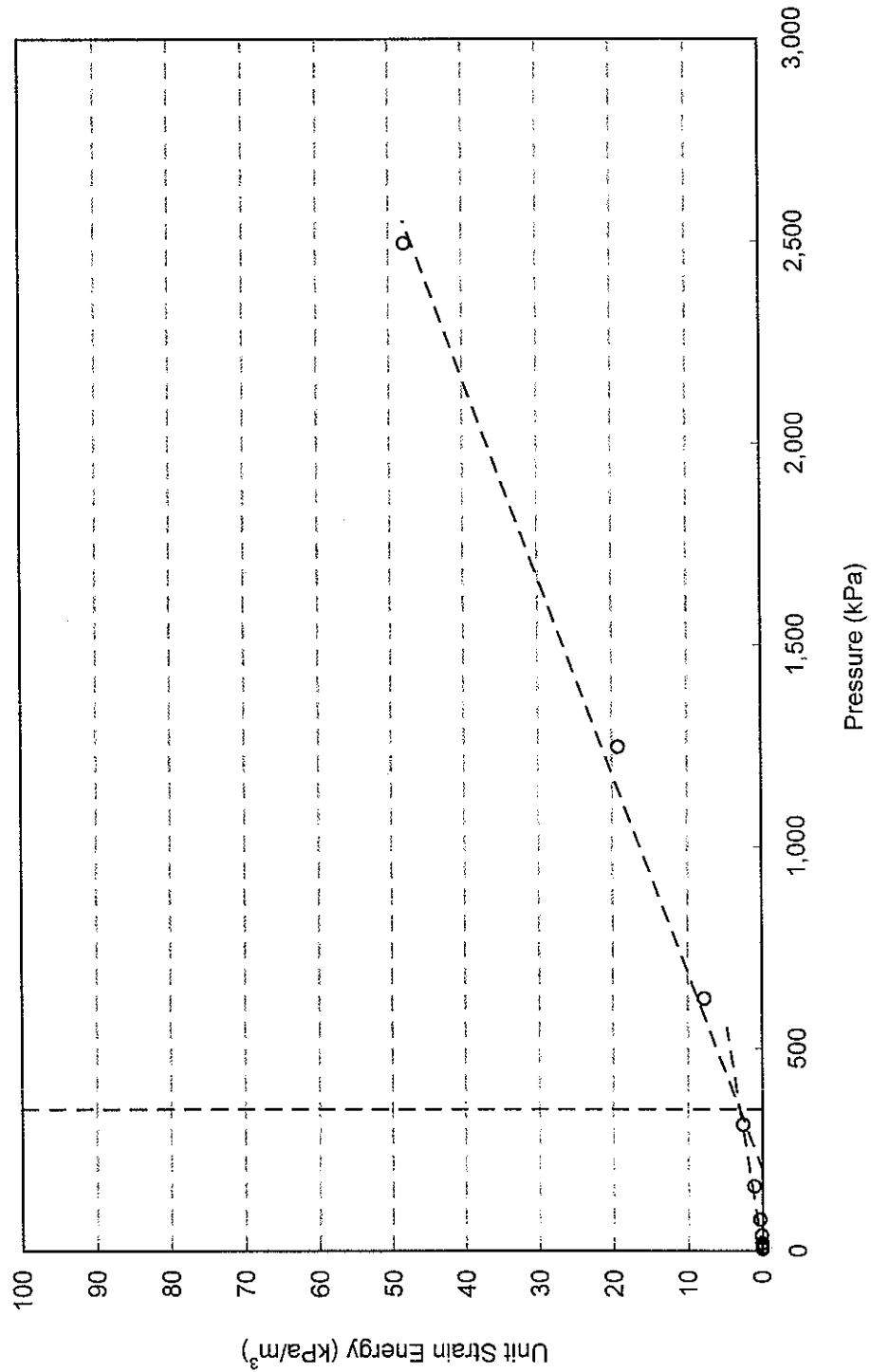


Terraprobe Inc.

Prepared By : HW

Checked By : RA

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
WES 10+295 CL, TW10



Pc = 350 kPa

Project No. : 1-09-4135

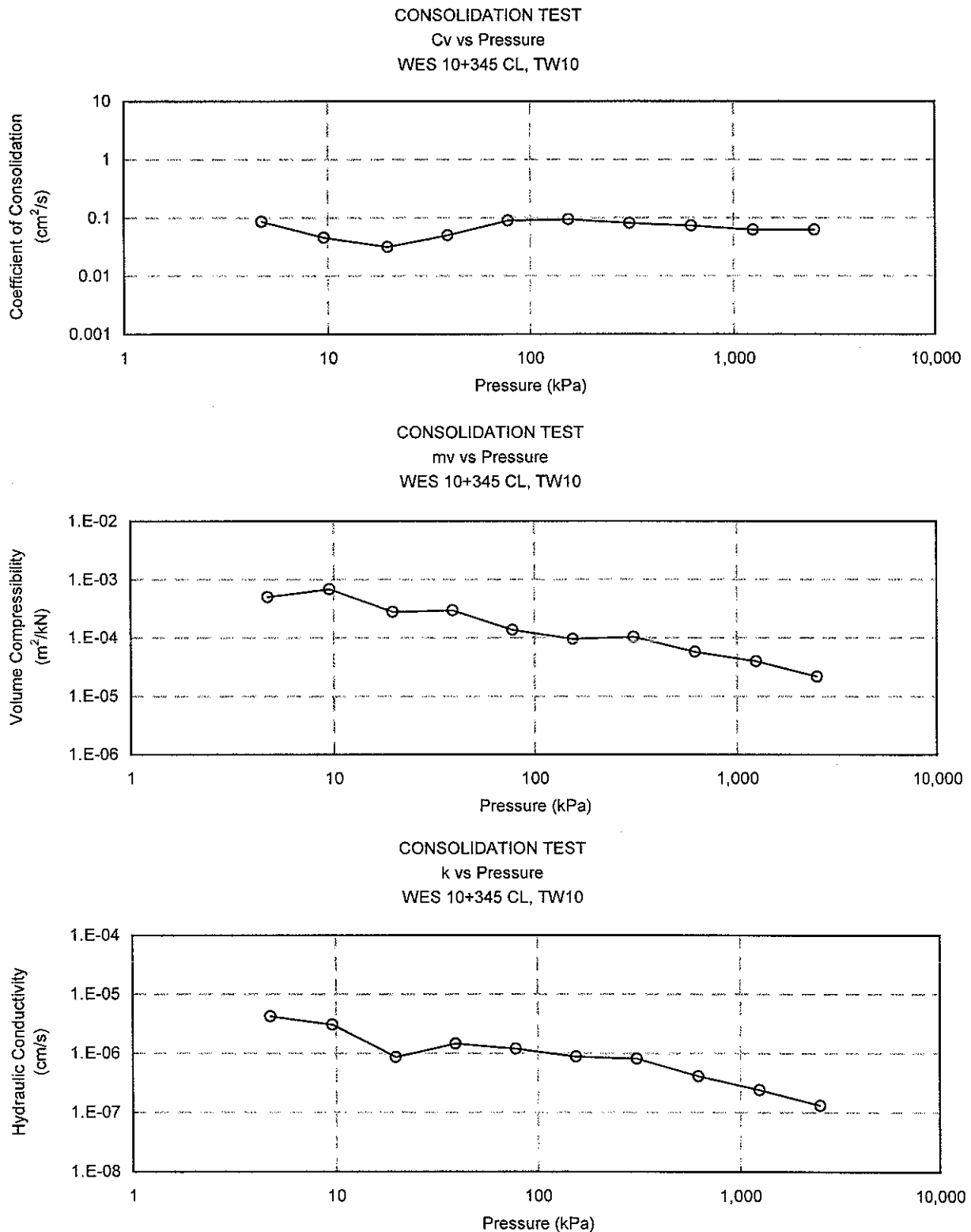
Date : June 2010



Terraprobe Inc.

Prepared By : HW

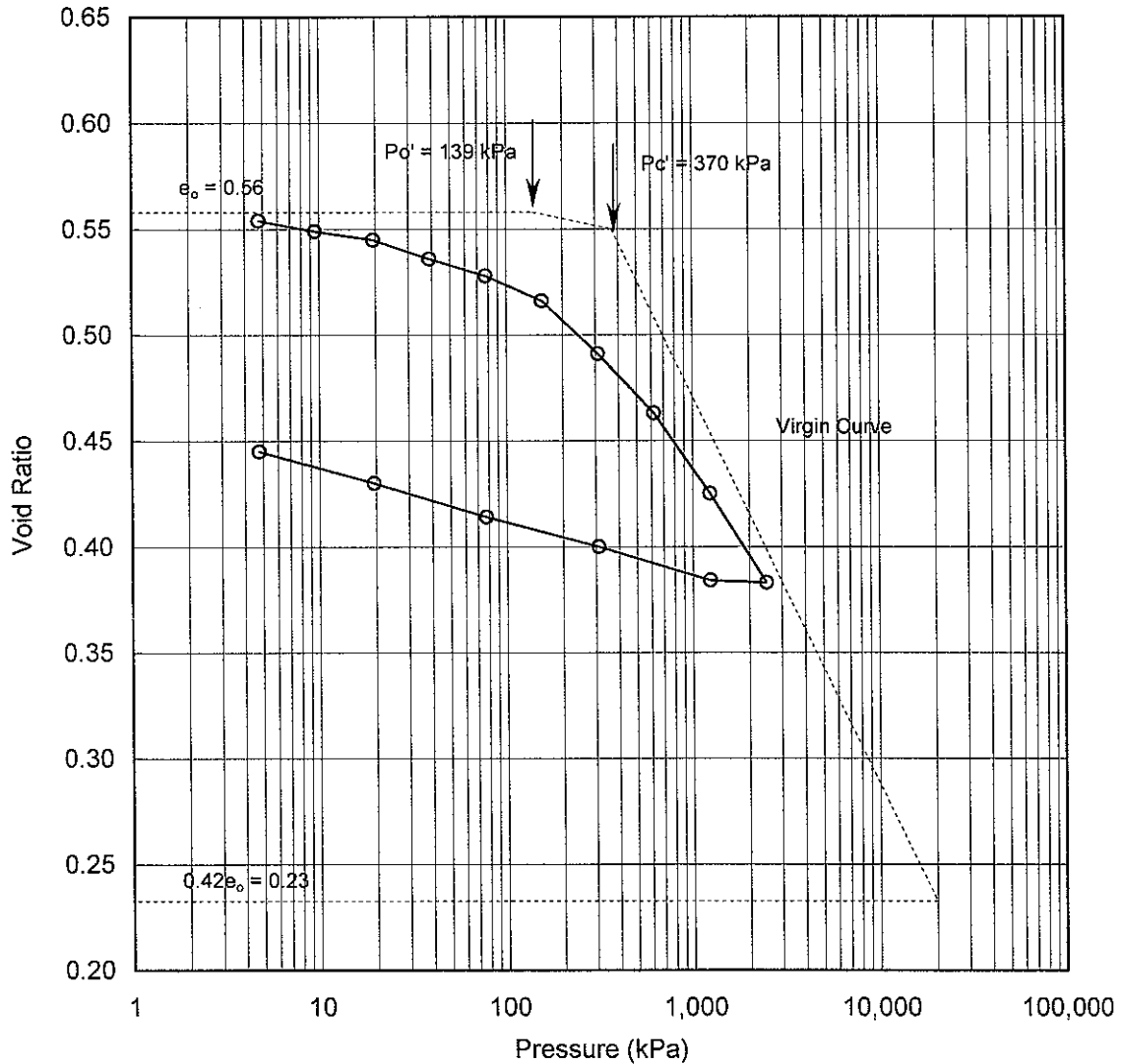
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

WES 10+345 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.56	$\omega_L =$	27%	$P_o' =$	139 kPa
$\omega =$	15%	$\omega_P =$	16%	$P_c' =$	370 kPa
$\gamma =$	20.7 kN/m ³	PI =	11%	Cc =	0.183
Gs =	2.70			Cr =	0.019

Project No. : 1-09-4135
Date : June 2010



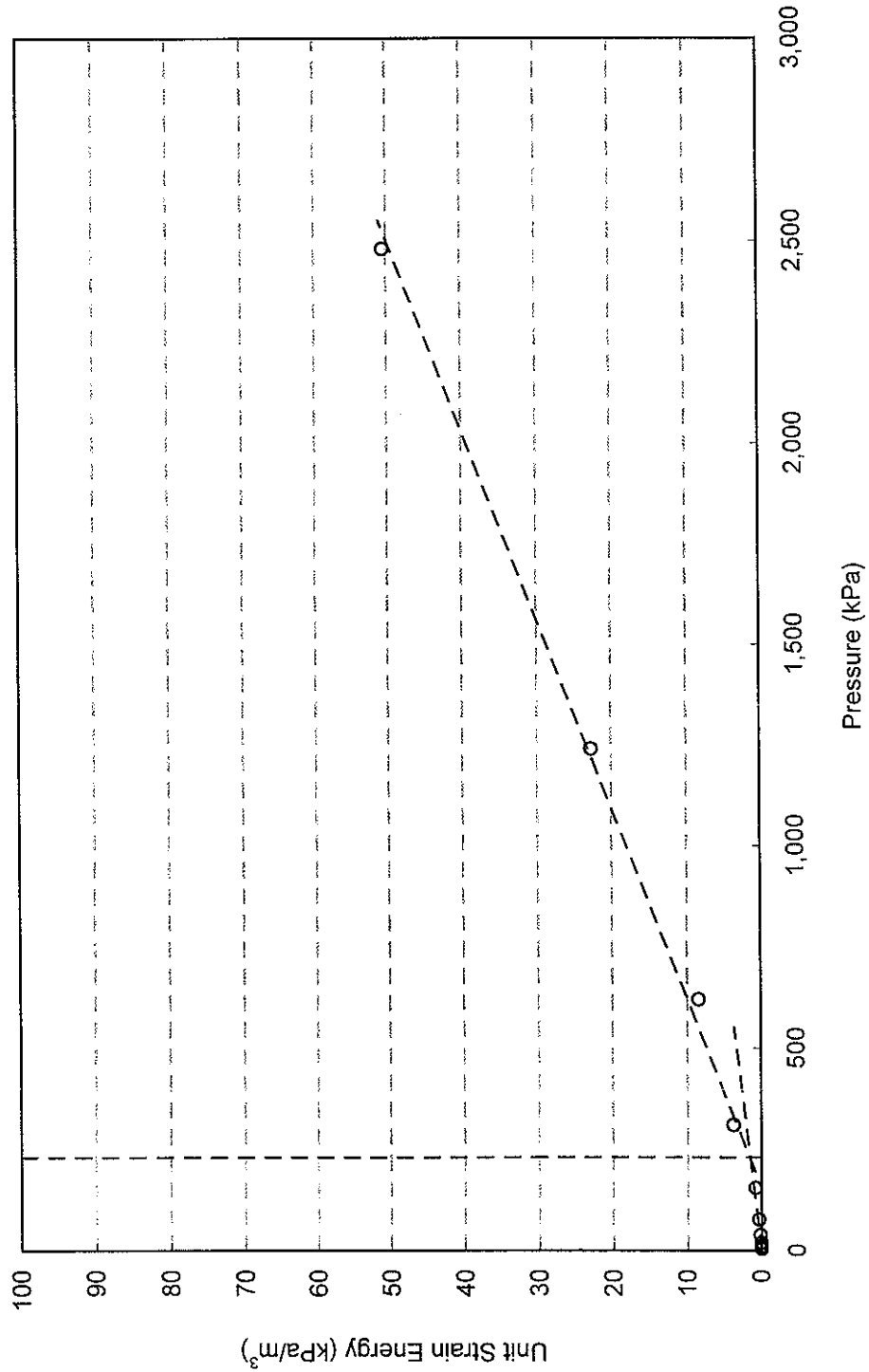
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - WOODLAWN EW-S RAMP

FIGURE B3-28

CONSOLIDATION TEST Unit Strain Energy vs Pressure WES 10+345 CL, TW10



$P_c = 230 \text{ kPa}$

Project No. : 1-09-4135

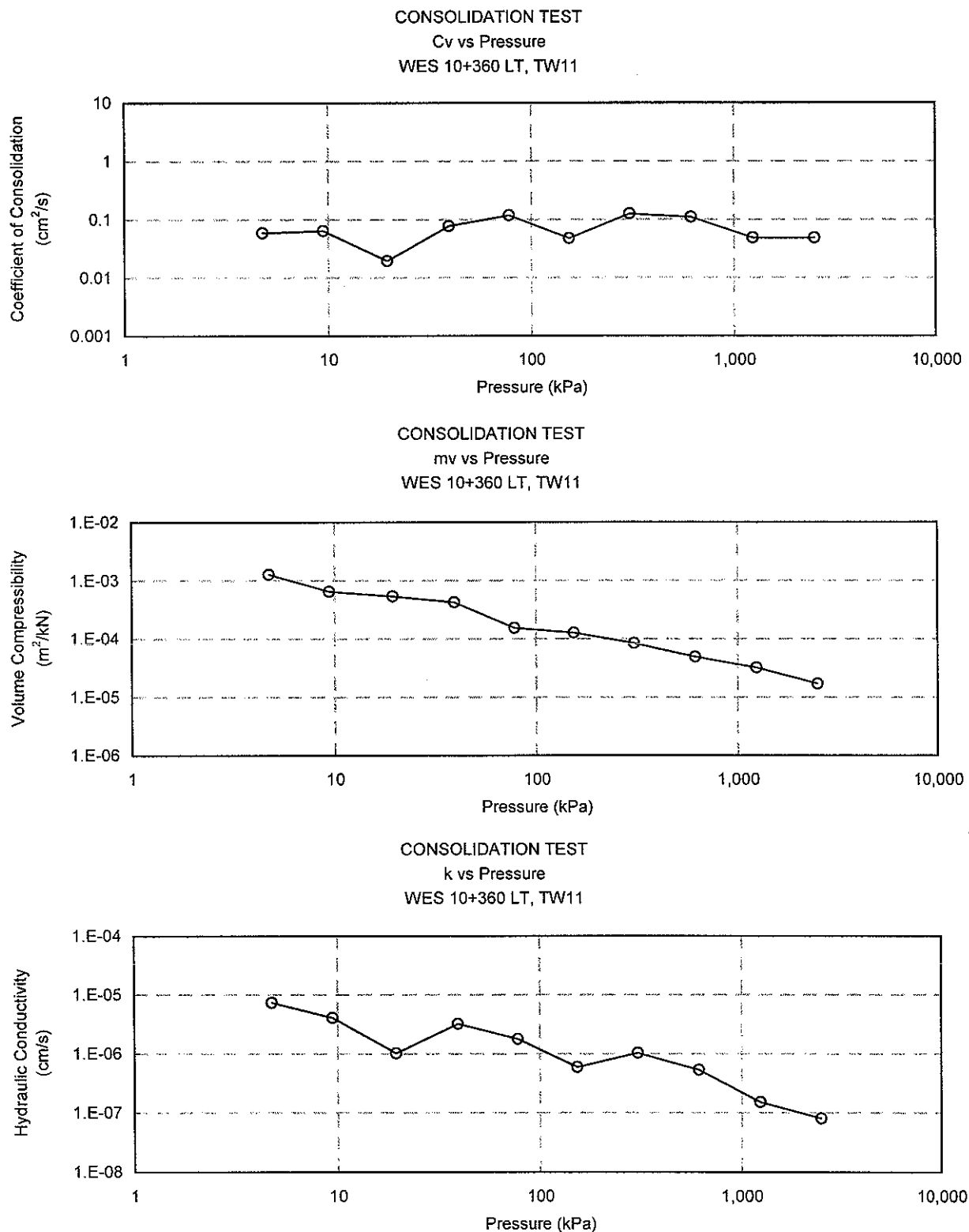
Date : June 2010



Terraprobe Inc.

Prepared By : HW

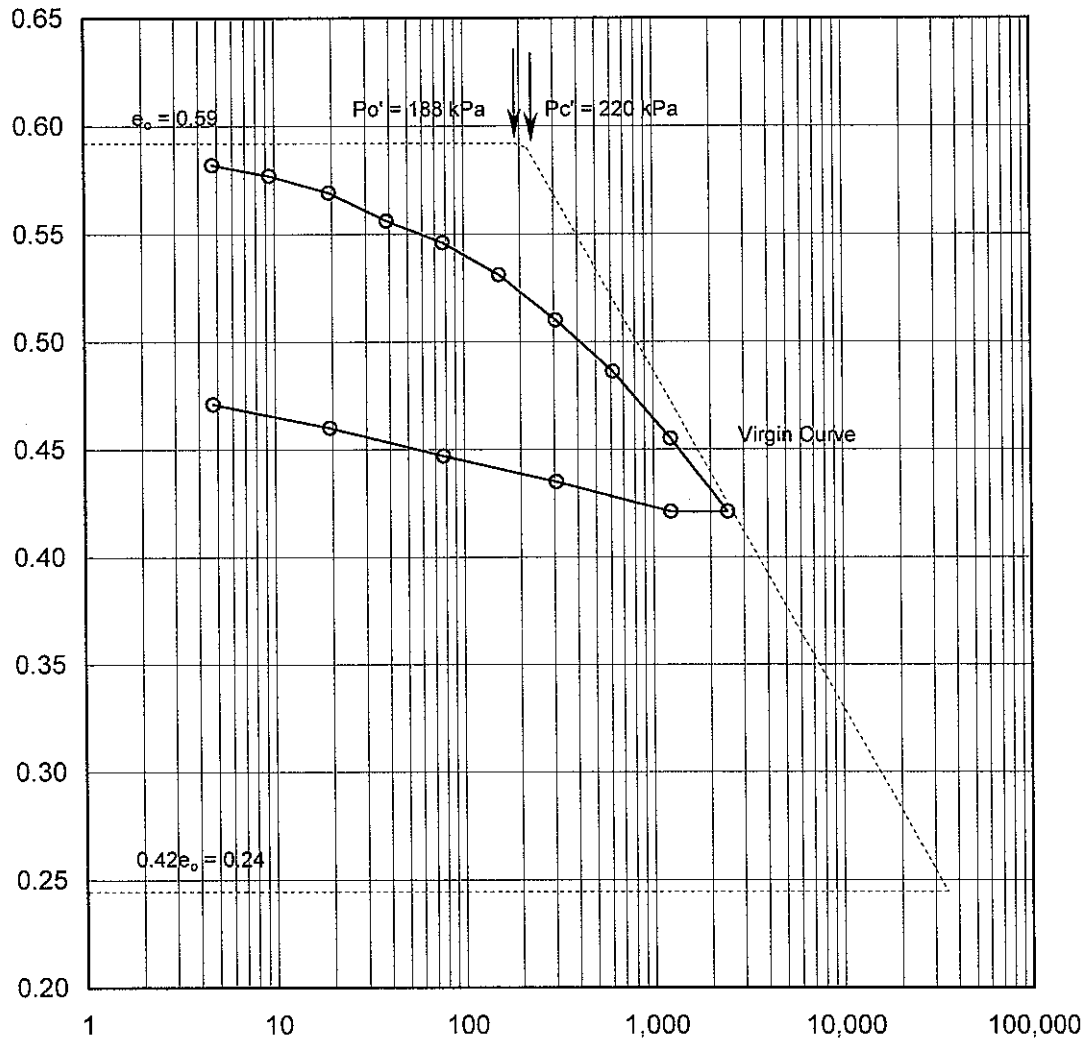
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

WES 10+360 LT, TW11



Soil Type : Silty Clay

$e_o =$	0.59	$\omega_L =$	24%	$P_o' =$	188 kPa
$\omega =$	21%	$\omega_P =$	18%	$P_c' =$	220 kPa
$\gamma =$	20.5 kN/m ³	$PI =$	6%	$C_c =$	0.157
$G_s =$	2.75			$Cr =$	0.029

Project No. : 1-09-4135

Date : June 2010



Terraprobe Inc.

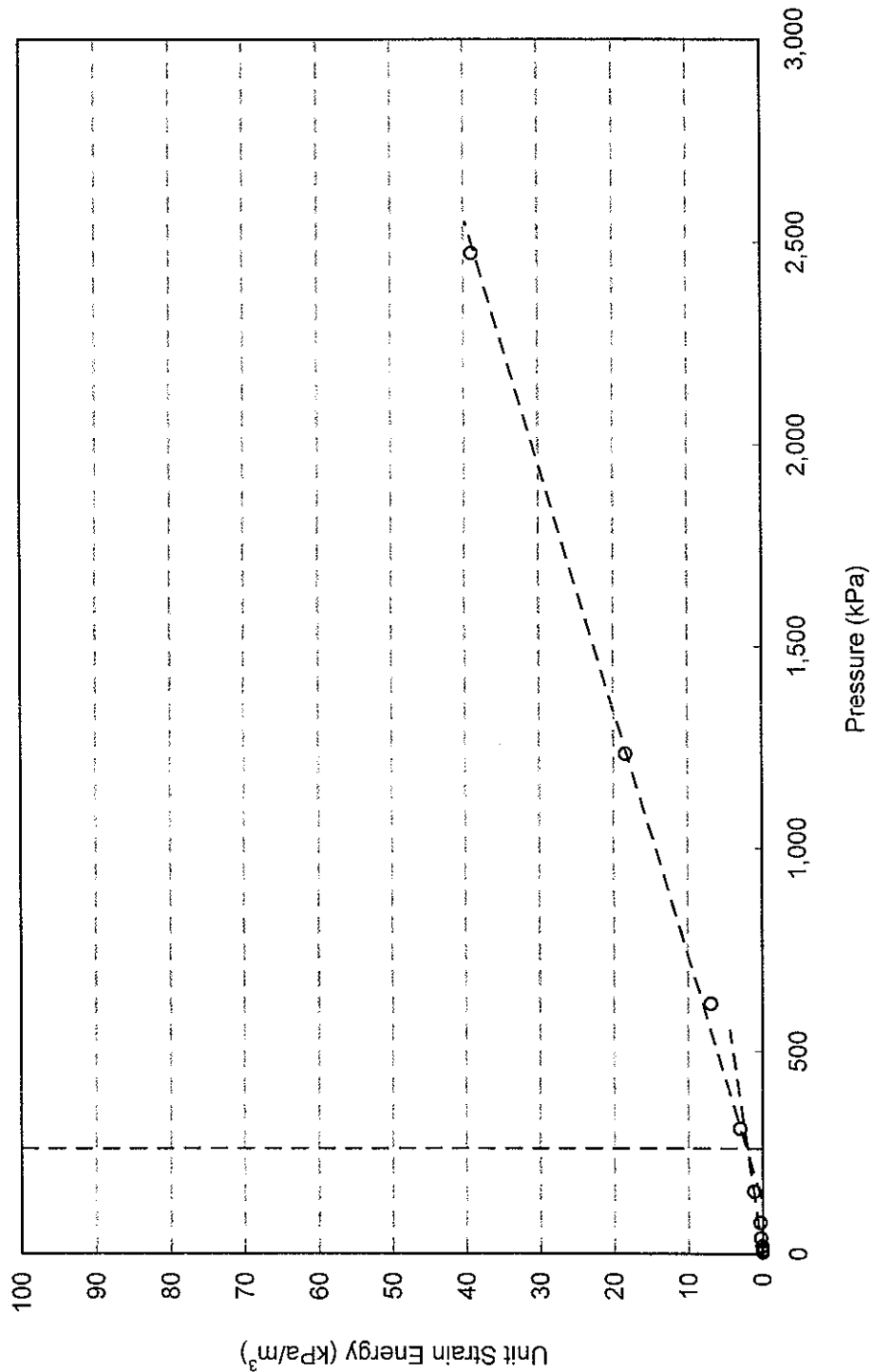
Prepared By : HW

Checked By : RA

HWY 406 TWINNING - WOODLAWN EW-S RAMP

FIGURE B3-31

CONSOLIDATION TEST Unit Strain Energy vs Pressure WES 10+360 LT, TW11



Pc = 260 kPa

Project No. : 1-09-4135

Date : June 2010



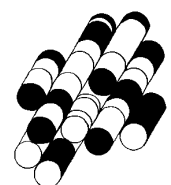
Terraprobe Inc.

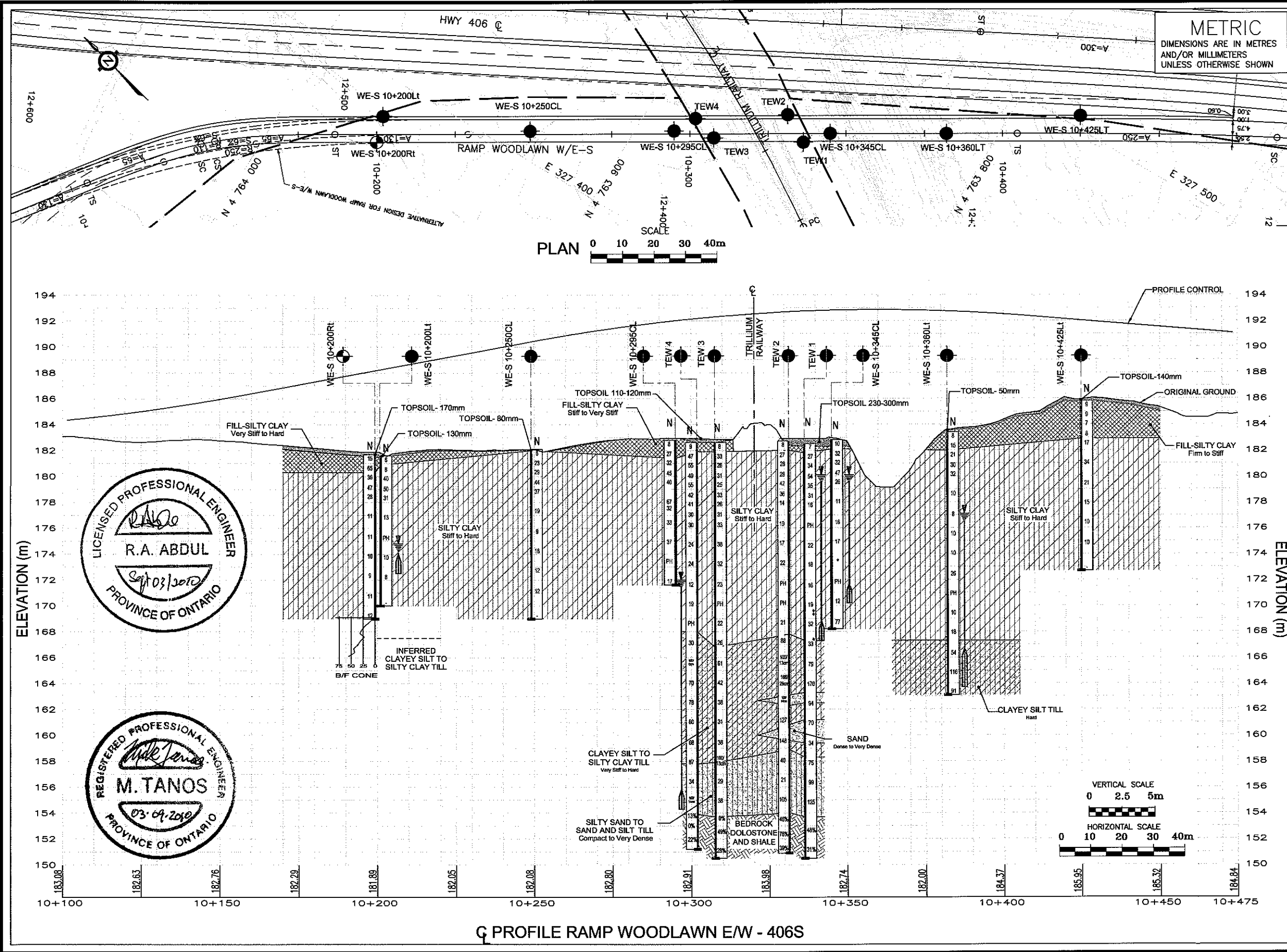
Prepared By : HW

Checked By : RA

C3

TERRAPROBE INC.





CONT No
WP No 280-99-00

HIGHWAY 406
RAMP WOODLAWN WE-S
BOREHOLE LOCATIONS AND SOIL STRATA

Giffels Associates Limited
Consulting Engineers and Architects An IBI
Group Company

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

SHEET
1 OF

KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- Rock Quality Designation
- Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
TEW1	182.5	4 763 851.9	327 450.6
TEW2	182.7	4 763 860.7	327 455.5
TEW3	182.6	4 763 877.2	327 436.9
TEW4	182.6	4 763 885.4	327 439.2
WE-S 10+200 LT	181.6	4 763 971.1	327 388.0
WE-S 10+200 RT	181.7	4 763 968.5	327 379.8
WE-S 10+250 CL	182.1	4 763 928.5	327 408.3
WE-S 10+295 CL	182.8	4 763 889.2	327 432.2
WE-S 10+345 CL	182.8	4 763 845.9	327 457.4
WE-S 10+360 LT	183.4	4 763 814.3	327 476.6
WE-S 10+425 LT	185.8	4 763 780.6	327 503.9

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

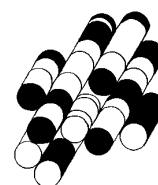
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.C	CHK R.A	STRUCT	GEORES 30M3-263

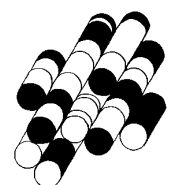
SITE 4

TERRAPROBE INC.



A4

TERRAPROBE INC.



RECORD OF BOREHOLE No NBL 12+075CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763620.5 E:327614.8
 DIST HWY 405 BOREHOLE TYPE Solid Stem Augers
 DATUM Geodetic DATE 11.24.09
 ORIGINATED BY AW
 COMPILED BY KL
 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
184.6	Ground Surface							20 40 60 80 100							
184.5 0.1	60mm TOPSOIL		1	SS	5		184							GR SA SI CL	
183.9 0.7	FILL - Silty Clay, trace sand, trace organics, firm, brown, damp to moist														
	SILTY CLAY trace sand, stiff, brown, damp to moist		2	SS	11		183								
			3	SS	14		182								
	very stiff to hard		4	SS	36		181								
			5	SS	30		180								
			6	SS	18		179								
178.8 5.8	End of Borehole														
Borehole was dry (not stabilized) and hole open to full depth on completion.															
Resistance to augering from 0.6-0.8m.															
Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.															
Water Level Readings:															
Date	Depth(m)	Elevation(m)													
Nov.20.09	4.2	180.4													
Dec.08.09	1.2	183.4													
Jan.04.10	1.5	183.1													
Jan.19.10	1.8	182.8													

RECORD OF BOREHOLE No NBL 12+150Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763692.1 E:327588.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY KL
DATUM Geodetic DATE 11.26.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20	40	60							80	100
								○ UNCONFINED	+	FIELD VANE								
						● QUICK TRIAXIAL	x	LAB VANE										
185.3	Ground Surface						185											
0.0	420mm FILL - Sand and Gravel, trace silt, dense, grey, damp to moist		1	SS	48													
184.9																		
0.4	some sand, trace gravel		2	SS	51		184											
			3	SS	21													
	----						183											
	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		4	SS	16													
			5	SS	13		182											
			6	SS	26													
			7	SS	40		181											
							180											
			8	SS	29		179											
							178											
			9	SS	15		177											
			10	SS	9		176											
							175											
174.2	End of Borehole		11	SS	12													
11.1	Borehole was dry (not stabilized) and hole open to full depth on completion.																	

ONTARIO MOT 1-09-4135 NBL2 GPJ ONTARIO MOT GDT 07/09/10

RECORD OF BOREHOLE No NBL 12+150Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763696.8 E:327598.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY KL
DATUM Geodetic DATE 11.24.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
								20 40 60 80 100								10 20 30		
183.5 0.0	Ground Surface		1	SS	3		183											
	FILL - Silty Clay, trace sand, trace organics, soft to stiff, dark brown / brown, damp to moist		2	SS	10													
182.1 1.4							182											
	SILTY CLAY trace sand, very stiff, brown, damp to moist		3	SS	28													
			4	SS	24		181											
			5	SS	26		180											
							179											
			6	SS	19		178											
							177											
			7	SS	17		176											
							175											
	trace gravel		8	SS	15													
174.4 9.1	End of Borehole																	
	Borehole was dry (not stabilized) and hole open to full depth on completion.																	

ONTARIO MOT 1-99-4135 NBL2.GPJ ONTARIO MOT GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+300Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763822.6 E:327512.4 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
 DATUM Geodetic DATE 11.23.09 - 11.24.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE							
183.1	Ground Surface						20 40 60 80 100	20 40 60 80 100							
182.9	220mm TOPSOIL														
0.2	FILL - Silty Clay, trace sand, trace organics, firm, brown, damp		1	SS	5									GR SA SI CL	
182.4															
0.7	hard		2	SS	36									0 1 36 63	
			3	SS	33										
			4	SS	31										
			5	SS	23									0 2 62 36	
	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		6	SS	14										
			7	SS	13									0 3 65 32	
			8	TW	PH										
	trace gravel		9	SS	12									1 3 69 27	
172.6	End of Borehole														
10.5	Borehole was dry (not stabilized) and hole open to full depth on completion.														

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No NBL 12+300Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords. N:4763834.3 E:327536.7 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY KL
DATUM Geodetic DATE 11.24.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
182.7	Ground Surface						20 40 60 80 100		10 20 30						
0.0	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown, damp to moist		1	SS	8										
182.0															
0.7	very stiff to hard		2	SS	30		182								
			3	SS	27		181								
			4	SS	33		180								
			5	SS	17		179								
	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		6	SS	12		178								
							177								
			7	TW	PH		176								
							175								
			8	SS	10		174								
							173								
	firm, trace gravel		9	SS	6		172								
							171								
			10	AS	-		170								
169.4			11	SS	22										
13.3	End of Borehole														
	Borehole was dry (not stabilized) and hole open to full depth on completion.														
	Dynamic Cone Penetration Test (DCPT) performed from 11.6m to 12.8m.														

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

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

RECORD OF BOREHOLE No NBL 12+375Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763888.1 E:327476.6 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.18.09 CHECKED BY RA

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	20 40 60 80 100		
183.3	Ground Surface												
183.2	130mm TOPSOIL												
0.1	FILL - Silty Clay, trace to some sand, trace to some gravel, trace organics, occasional cobbles, very stiff, dark brown / brown, moist		1	SS	19		183						15 18 41 26
			2	SS	26		182						
			3	SS	28		181						
181.2	SILTY CLAY trace sand, stiff to very stiff, brown, moist		4	SS	26		180						
2.1			5	SS	20		179						
			6	SS	26		178						0 4 69 27
			7	SS	16		177						
			8	SS	12		176						0 3 68 29
			9	TW	PH		175						
			10	SS	12		174						3 3 66 28
							173						
							172						0 3 71 26
171.3	End of Borehole												
12.0	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 9.												

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

Continued Next Page

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

METRIC

ONTARIO MORTUARY - 07/09/10
1-09-4133 NBLZ: GFJ
ONTARIO MORTUARY - 07/09/10[illegible]

RECORD OF BOREHOLE No TN1

1 OF 3

METRIC

W.P. 260-99-00 LOCATION Coords: N:4763901.9 E:327473.4 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
183.5	Ground Surface						20 40 60 80 100							GR SA SI CL	
183.5 0.1	50mm TOPSOIL		1	SS	16										
	FILL - Silty Sand, some gravel, trace organics, compact, black / brown, moist		2	SS	14									13 65 (22)	
182.1			3	SS	24										
1.4	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		4	SS	33								45	0 1 41 58	
			5	SS	36										
			6	SS	36										
			7	SS	21									1 4 54 41	
			8	SS	32										
			9	SS	22										
			10	SS	19									0 2 68 30	
														commence casing and washboring	
			11	SS	15										
			12	SS	20									1 7 69 23	
			13	TW	PH										
			14	SS	23										
168.8															
14.7															

Continued Next Page

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

ONTARIO MOT 1-98-4135 NBL2 GPJ ONTARIO MOT GDT 07/06/10

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
								20 40 60 80 100										20 40 60 80 100	
153.0 30.5	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		153									RUN#1 TCR=95% SCR=87% RQD=59%			
			2	RUN	NQ		151										RUN#2 TCR=93% SCR=83% RQD=67%		
150.0 33.6	End of Borehole Borehole open to full depth and filled with drill water upon completion of drilling. Unable to push vane to 16.4m and 28.6m. Borehole sealed with bentonite slurry to ground surface.						150												

RECORD OF BOREHOLE No TN2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.1 E:327481.1 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 02.05.10 - 02.17.10 CHECKED BY RA

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							
184.2	Ground Surface							20 40 60 80 100							GR SA SI CL
0.0	800mm FILL - Sandy Gravel, trace silt, very dense, grey, dry		1	SS	19		184								
183.4															
0.8	FILL - Silty Clay, trace to some sand, trace to some gravel, trace organics, very stiff to hard, brown / dark brown, damp to moist		2	SS	35		183								13 12 53 22
			3	SS	18										
182.1															
2.1	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		4	SS	37		182								
			5	SS	42		181							43	0 2 44 54
			6	SS	32		180								Jan.26
			7	SS	19										Feb.05
			8	SS	21		179								
			9	SS	17		178								0 2 60 38
							177								
			10	SS	19		176								
			11	SS	10		175								0 5 65 30
							174								
			12	SS	11		173								
							172								
			13	TW	PH		171								
							170								
			14	SS	16										1 3 72 24
169.5															
14.7															

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

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

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
153.7 30.5	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		24	SS	100/ 15cm	154									Feb.12				
1			RUN	NQ	153									Feb.17					
2			RUN	NQ	152									RUN#1 TCR=0% SCR=0% RQD=0%					
3			RUN	NQ	151									RUN#2 TCR=71% SCR=66% RQD=16%					
4			RUN	NQ										RUN#3 TCR=100% SCR=78% RQD=44%					
150.1 34.1	End of Borehole Borehole filled with drill water upon completion of drilling. No sample recovery at SS9. Sampler redriven and disturbed sample collected. Unable to push vane to 16.1m. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Apr.16.10 2.6 181.6 Apr.29.10 1.6 182.6 May.04.10 6.2 178.0 May.06.10 6.2 178.0													RUN#4 TCR=93% SCR=92% RQD=54%					

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

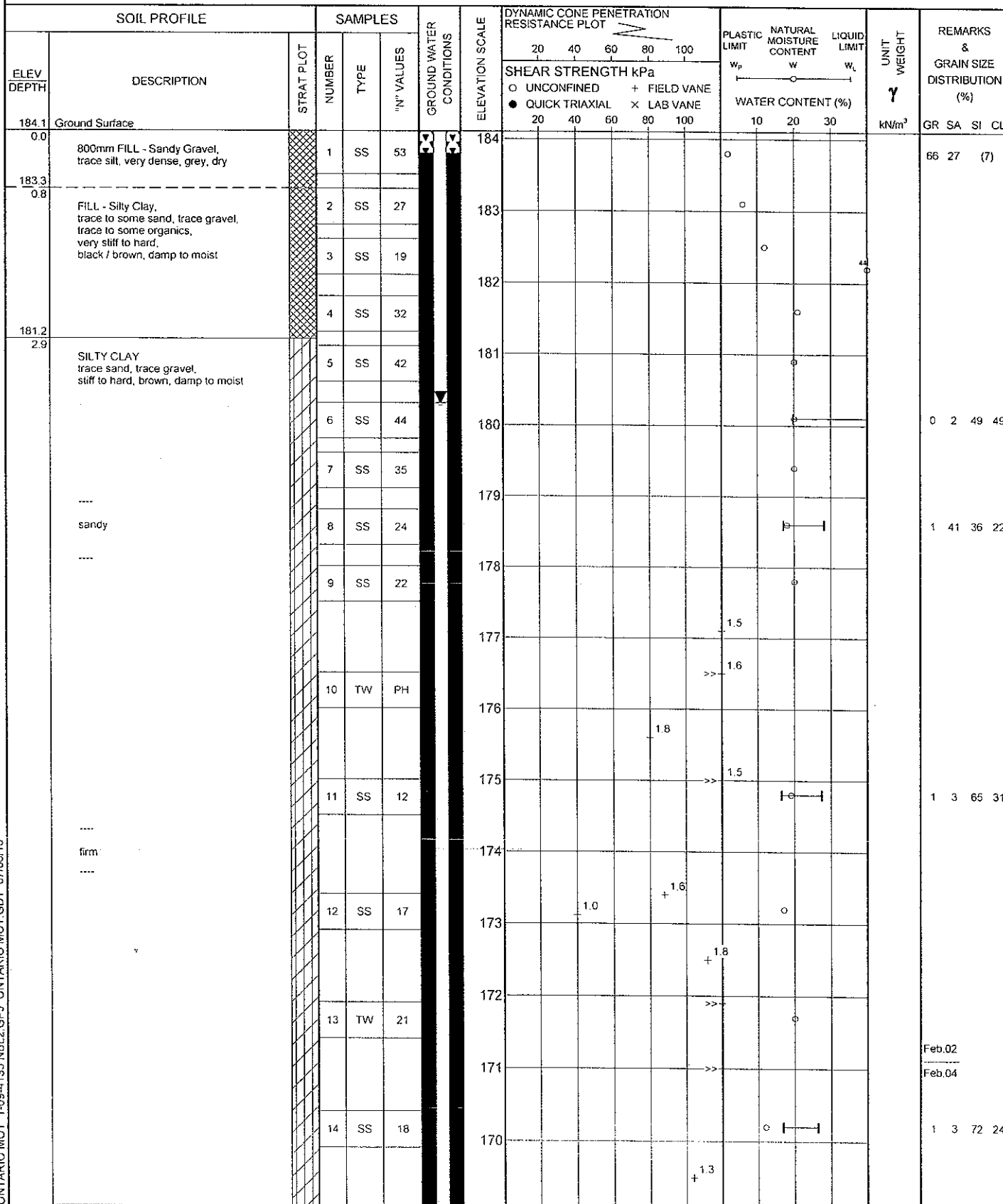
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N 4763930.0 E 327463.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.02.10 - 02.11.10 CHECKED BY RA



ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No TN3

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N-4763930.0 E-327463.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.02.10 - 02.11.10 CHECKED BY RA

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								
168.9 15.2	SILTY CLAY some sand, trace gravel, very stiff to hard, brown, damp to moist (GLACIAL TILL)		15	SS	27		169		1.2				
			16	SS	26		168		1.6				
			17	SS	74		167		1.4				4 17 56 23
			18	SS	100		166		1.8				
			19	120	100/ 13cm		165						
162.5 21.6	SANDY SILT TO SILTY SAND some gravel, trace clay, dense to very dense, brown, moist (GLACIAL TILL)		20	SS	71		164						
			21	SS	48		163						commence casing and washboring
			22	SS	43		162						Feb.04 Feb.08
157.2 26.9	CLAYEY SILT TO SILTY CLAY trace sand, trace gravel, hard, brown, moist (GLACIAL TILL)		23	SS	112		161						Feb.08 Feb.09
156.4 27.7	SAND AND GRAVEL silty, trace clay, very dense, brown, moist (GLACIAL TILL)		24	SS	108		160						
154.5 29.6	BEDROCK						159						31 33 29 7 Feb.09 Feb.11

ONTARIO MOT 1-09-4135 NBL2 GPJ ONTARIO MOT.GDT 07/06/10

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


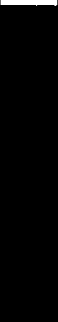
RECORD OF BOREHOLE No TN3

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763930.0 E:327463.7 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 02.02.10 - 02.11.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100	20 40 60 80 100	10 20 30								

150.9 33.2	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		154									RUN#1 TCR=91% SCR=72% RQD=8%
			2	RUN	NQ		153									RUN#2 TCR=95% SCR=78% RQD=17%
			3	RUN	NQ		152									RUN#3 TCR=98% SCR=84% RQD=16%
							151									
	End of Borehole Borehole was open to 21.3m and filled with drill water on completion of drilling. Unable to push vane to 13.3m. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Apr.16.10 3.9 180.2 Apr.29.10 4.7 179.4 May.04.10 8.7 175.4 May.06.10 9.4 174.7 May.18.10 3.8 180.3															

RECORD OF BOREHOLE No TN4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763941.4 E:327469.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.26.10 - 02.17.10 CHECKED BY RA

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										
184.0	Ground Surface						20	40	60	80	100	10	20	30	GR SA SI CL			
0.0	740mm FILL - Gravel, some sand, trace to some silt, dense, grey, damp		1	SS	41							○			72 17 (11)			
183.3																		
0.7	FILL - Silty Clay, some gravel, trace sand, trace organics, stiff, dark brown / brown, damp to moist		2	SS	10							○						
			3	SS	15								○					
181.9																		
2.1	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		4	SS	29							○	44		0 3 47 50			
			5	SS	36							○						
			6	SS	50							○			0 3 74 23			
			7	SS	43							○						
			8	SS	23							○			Jan.26 Feb.05 0 3 65 32			
			9	SS	17							○						
			10	SS	23							○						
			11	SS	9							○			0 3 66 31			
			12	TW	PH													
			13	SS	16							○						
			14	SS	17							○						
169.3																		
14.7																		

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

Continued Next Page

+ 3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN4

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords. N:4763941.4 E:327469.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.26.10 - 02.17.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	SILTY CLAY some sand to sandy, trace gravel, very stiff to hard, brown, damp (GLACIAL TILL)		15	SS	35		168										
			16	SS	30		167										4 22 54 20
			17	SS	87		166										
			18	SS	84		164										
163.6 20.4	SANDY SILT TO SILTY SAND some gravel to gravelly, trace to some clay, very dense, brown, moist to wet (GLACIAL TILL)		19	SS	96		163										Feb.05 Feb.12
			20	SS	129		161										27 28 34 11
			21	SS	109		160										
			22	SS	65		158										
157.5 26.5	SILTY CLAY trace sand, hard, brown, moist (GLACIAL TILL)		23	SS	40		156										0 4 54 42
155.6 28.4	SAND AND SILT some gravel, trace to some clay, very dense, brown, wet (GLACIAL TILL)		24	SS	60		155										19 39 32 10

ONTARIO MOT 1-09-4135 NBL2 GPJ ONTARIO MOT.GOT 07/06/10

Continued Next Page

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

RECORD OF BOREHOLE No TN4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763941.4 E:327469.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.26.10 - 02.17.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
153.4 30.6	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		153										Feb.12
							152										Feb.17
			2	RUN	NQ		151										RUN#1 TCR=36% SCR=7% RQD=0%
			3	RUN	NQ		150										RUN#2 TCR=59% SCR=45% RQD=7%
149.0 35.0	End of Borehole						149										RUN#3 TCR=97% SCR=71% RQD=27%
	Borehole filled with drill water upon completion of coring.																
	Borehole sealed with bentonite slurry to ground surface																

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+440Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763962.9 E:327465.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
183.0	Ground Surface															
182.9	130mm TOPSOIL															
0.1			1	SS	6											
	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm to stiff, brown, damp to moist		2	SS	12											
			3	SS	13											
			4	SS	14											
180.1																
2.9	SILTY CLAY trace sand, occasional gravel inclusions, stiff to very stiff, brown, moist		5	SS	17											
			6	SS	26											
			7	SS	15											
			8	SS	25											
			9	SS	10											
			10	TW	PH											
			11	SS	12											
169.6	End of Borehole															
13.4	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 10.															

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

Continued Next Page

+ 3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+440Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763962.9 E:327465.8 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.04.09 CHECKED BY RA

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																					
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>8.2</td> <td>174.8</td> </tr> <tr> <td>Nov.19.09</td> <td>2.1</td> <td>180.9</td> </tr> <tr> <td>Nov.30.09</td> <td>1.9</td> <td>181.1</td> </tr> <tr> <td>Dec.08.09</td> <td>1.9</td> <td>181.1</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	8.2	174.8	Nov.19.09	2.1	180.9	Nov.30.09	1.9	181.1	Dec.08.09	1.9	181.1													
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Nov.09.09	8.2	174.8																											
Nov.19.09	2.1	180.9																											
Nov.30.09	1.9	181.1																											
Dec.08.09	1.9	181.1																											

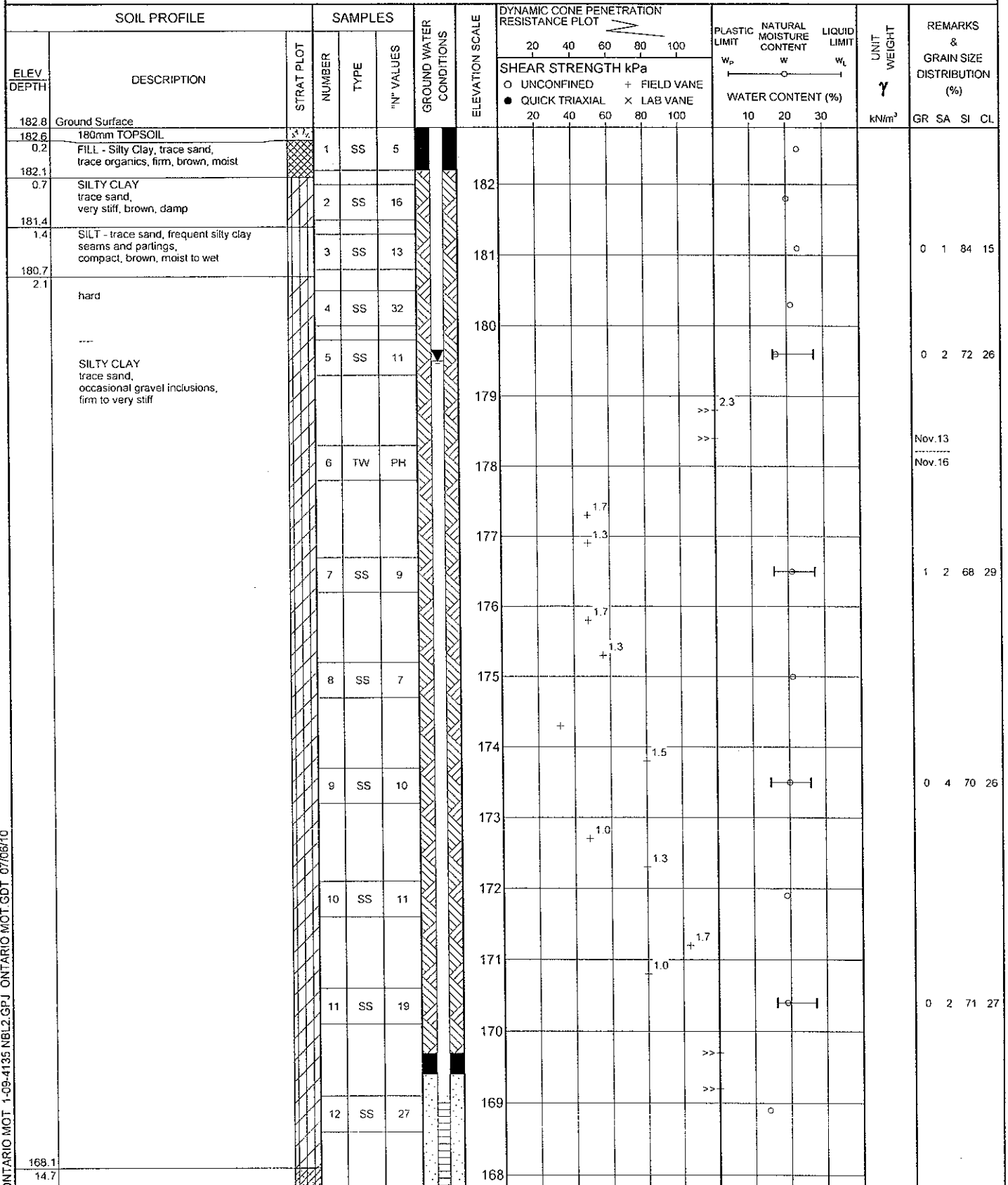
ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+525Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764023.2 E:327410.0 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
DATUM Geodetic DATE 11.13.09 - 11.16.09 CHECKED BY RA



Continued Next Page

+ 3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+525Lt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764023.2 E:327410.0 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
DATUM Geodetic DATE 11.13.09 - 11.16.09 CHECKED BY RA

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																											
167.1	SILTY CLAY TO CLAYEY SILT some sand, some gravel, hard, brown, damp (GLACIAL TILL)		13	SS	36									11 20 49 20																					
15.7	End of Borehole						167																												
166.6																																			
16.2	End of Dynamic Cone Penetration Test																																		
<p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Sampler wet at 9.1m.</p> <p>Dynamic cone penetration test performed from 15.8m to 16.2m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.30.09</td> <td>9.4</td> <td>173.4</td> </tr> <tr> <td>Dec.07.09</td> <td>6.2</td> <td>176.6</td> </tr> <tr> <td>Dec.15.09</td> <td>4.7</td> <td>178.1</td> </tr> <tr> <td>Jan.04.10</td> <td>3.4</td> <td>179.4</td> </tr> <tr> <td>Jan.11.10</td> <td>3.3</td> <td>179.5</td> </tr> <tr> <td>Jan.19.10</td> <td>3.3</td> <td>179.5</td> </tr> </tbody> </table>															Date	Depth(m)	Elevation(m)	Nov.30.09	9.4	173.4	Dec.07.09	6.2	176.6	Dec.15.09	4.7	178.1	Jan.04.10	3.4	179.4	Jan.11.10	3.3	179.5	Jan.19.10	3.3	179.5
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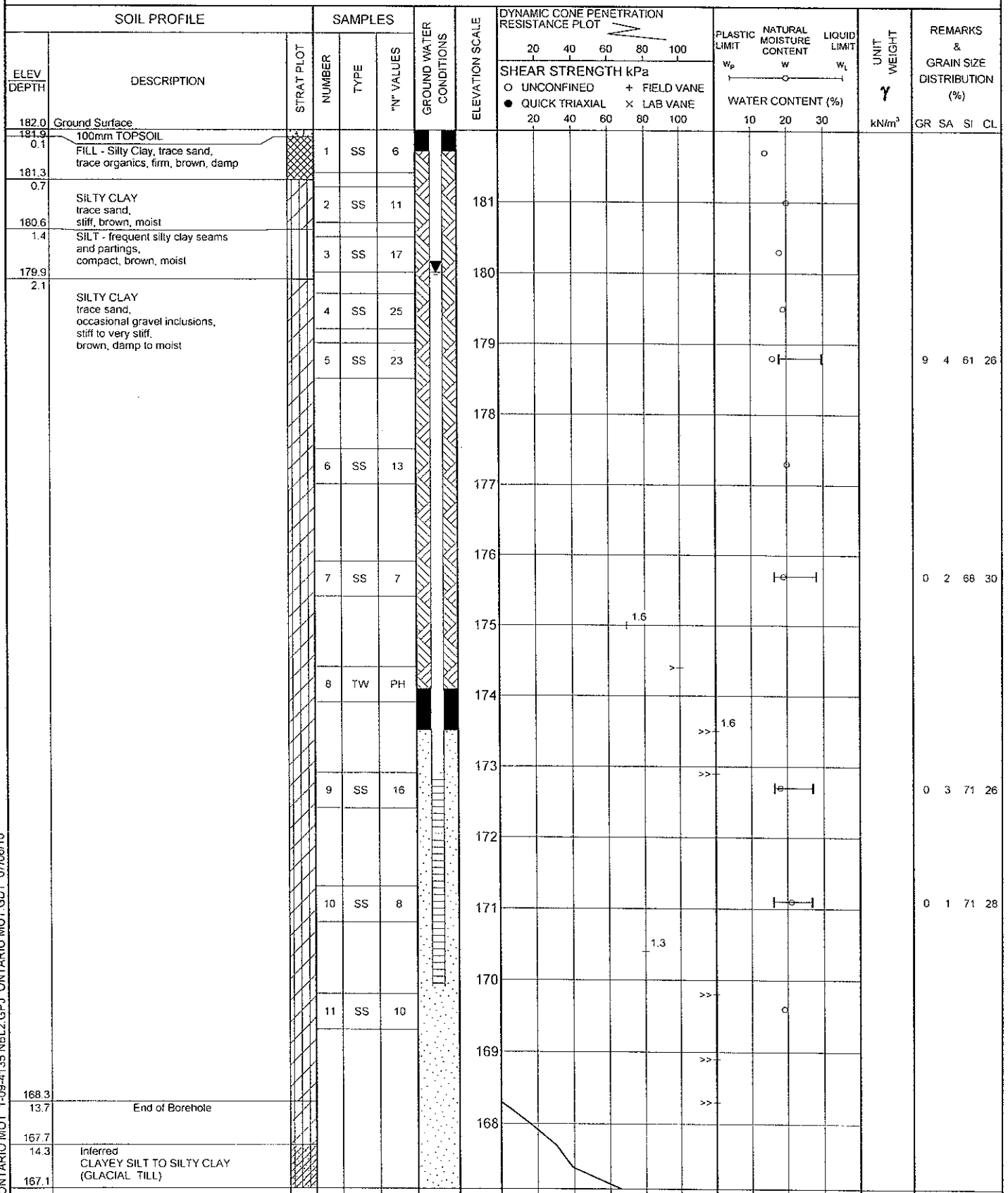
ONTARIO MOT. 1-89-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No NBL 12+525Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N-4764039.4 E-327429.4 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
 DATUM Geodetic DATE 11.05.09 CHECKED BY RA



Continued Next Page

+ 3, x 3. Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+525Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764039.4 E:327429.4 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB
DATUM Geodetic DATE 11.05.09 CHECKED BY RA

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 (%)																	
14.9	<p>End of Dynamic Cone Penetration Test</p> <p>Dynamic Cone Penetration Test (DCPT) performed from 13.7m to 14.9m.</p> <p>Resistance to augering from 8.5m to 9.1m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>10.8</td> <td>171.2</td> </tr> <tr> <td>Nov.19.09</td> <td>4.6</td> <td>177.4</td> </tr> <tr> <td>Nov.30.09</td> <td>2.4</td> <td>179.6</td> </tr> <tr> <td>Dec.08.09</td> <td>2.0</td> <td>180.0</td> </tr> <tr> <td>Jan.04.10</td> <td>2.0</td> <td>180.0</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	10.8	171.2	Nov.19.09	4.6	177.4	Nov.30.09	2.4	179.6	Dec.08.09	2.0	180.0	Jan.04.10	2.0	180.0													
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Dec.08.09	2.0	180.0																														
Jan.04.10	2.0	180.0																														

RECORD OF BOREHOLE No NBL 12+595Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764099.0 E:327404.2 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.05.09 CHECKED BY RA

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									
								20 40 60 80 100									
181.6	Ground Surface																
0.0	25mm TOPSOIL		1	SS	6		181										
180.9	FILL - Silty Clay, trace sand, trace organics, firm, brown, moist																
0.7	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		2	SS	17		180										
179.5			3	SS	14												
2.1	SILT - trace sand, frequent silty clay partings, compact, brown, moist		4	SS	22		179							0 1 87 12			
179.0			5	SS	15									0 2 67 31			
2.6	stiff to very stiff						178										
	----						177										
	SILTY CLAY trace sand, occasional gravel inclusions, firm to stiff, brown, damp to moist		6	SS	7												
							176	2.2									
			7	SS	5				1.2					0 2 71 27			
							175										
							174	1.5									
			8	SS	5			1.4									
							173	2.0									
							172	1.2						1 2 70 27			
			9	SS	6												
							171	1.8									
							170	1.5									
			10	SS	5												
							169	1.6									
							168	1.5						6 11 59 24			
			11	SS	7												
168.4								1.3									
13.2	SILTY CLAY TO CLAYEY SILT sandy, some gravel, very stiff, brown, damp (GLACIAL TILL)		12	SS	22									13 26 44 17			
167.4																	
14.2	End of Borehole																
	Borehole was dry (not stabilized) and hole open to full depth on completion.																

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

1 OF 2

METRIC

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Continued Next Page

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

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+645Lt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764124.9 E:327356.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.18.09 CHECKED BY RA

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																							
	<p>Unable to push vane beyond 7.0m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>10.3</td> <td>173.0</td> </tr> <tr> <td>Nov.19.09</td> <td>3.9</td> <td>179.4</td> </tr> <tr> <td>Nov.30.09</td> <td>5.9</td> <td>177.4</td> </tr> <tr> <td>Dec.08.09</td> <td>3.0</td> <td>180.3</td> </tr> <tr> <td>Dec.15.09</td> <td>3.0</td> <td>180.3</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	10.3	173.0	Nov.19.09	3.9	179.4	Nov.30.09	5.9	177.4	Dec.08.09	3.0	180.3	Dec.15.09	3.0	180.3												
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ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

+ 3, x 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+645Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764140.0 E:327381.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.05.09 CHECKED BY RA

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						
181.0	Ground Surface							20 40 60 80 100						
180.8 0.2	FILL - Sand and Silt, some clay, trace gravel, trace organics, loose, black, wet		1	SS	5			20 40 60 80 100		10	20	30		
180.3 0.7	FILL - Silty Clay, trace sand, trace organics, firm, brown, moist													
	SILTY CLAY trace sand, very stiff, brown, damp to moist		2	SS	16									
			3	SS	25									
178.9 2.1	SILT trace sand, frequent silty clay seams and partings, compact, brown, moist		4	SS	22									
			5	SS	20									0 2 80 18
177.0 4.0	SILTY CLAY trace sand, trace gravel, firm to very stiff, brown, moist													
			6	SS	7									
			7	SS	9									1 2 69 28
			8	SS	27									9 5 64 22
			9	SS	7									
			10	TW	PH									
			11	SS	11									
167.9 13.1	End of Borehole													
	Borehole was dry (not stabilized) and hole open to full depth on completion. Unable to push vane beyond 13.1m.													

Continued Next Page

+ 3, x 3

Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+645Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764140.0 E:327381.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.05.09 CHECKED BY RA

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										
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.30.09</td> <td>2.2</td> <td>178.8</td> </tr> <tr> <td>Dec.08.09</td> <td>2.0</td> <td>179.0</td> </tr> <tr> <td>Jan.04.10</td> <td>1.5</td> <td>179.5</td> </tr> <tr> <td>Jan.11.10</td> <td>1.8</td> <td>179.2</td> </tr> <tr> <td>Jan.19.10</td> <td>1.9</td> <td>179.1</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.30.09	2.2	178.8	Dec.08.09	2.0	179.0	Jan.04.10	1.5	179.5	Jan.11.10	1.8	179.2	Jan.19.10	1.9	179.1													
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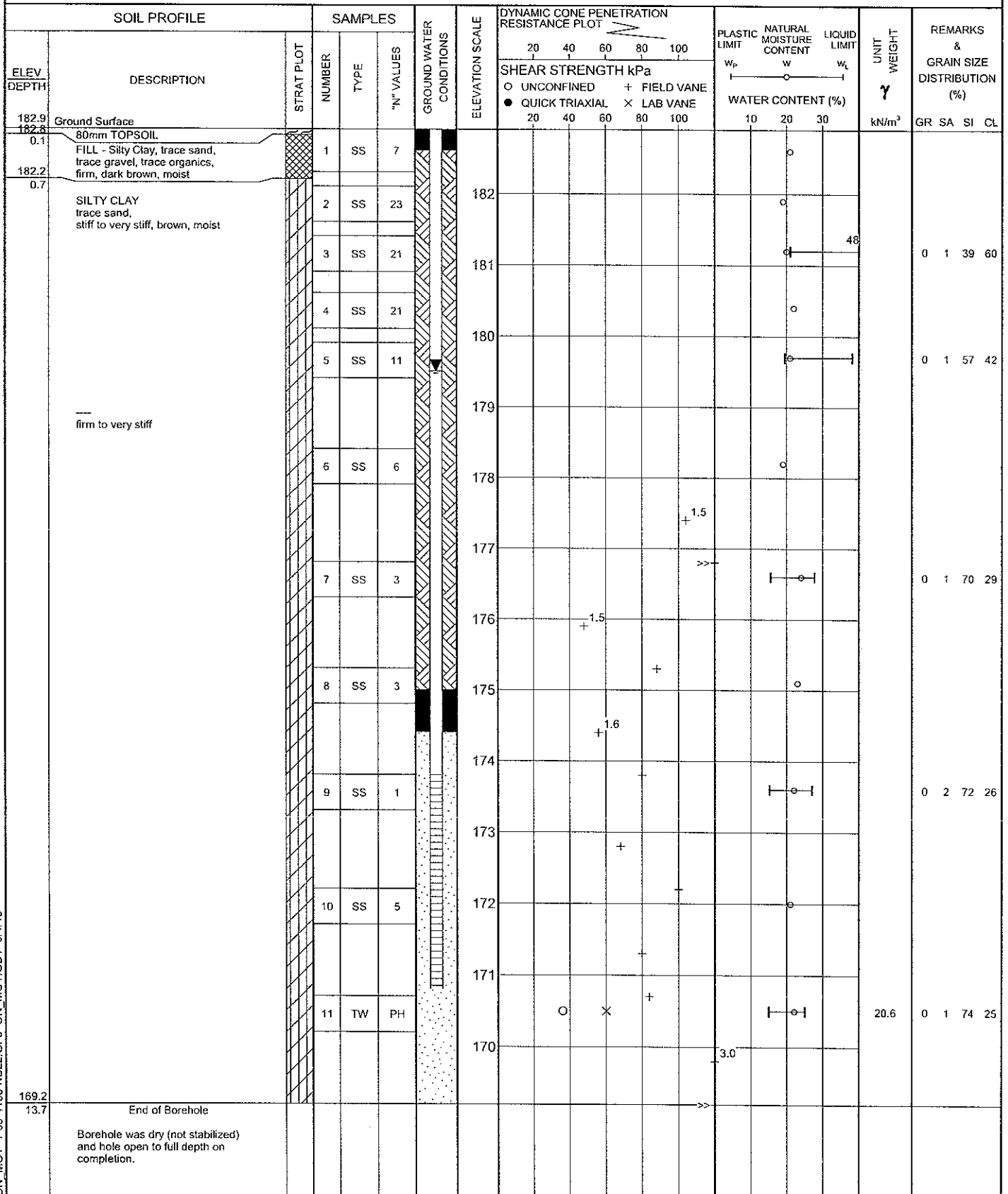
ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+695Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764175.1 E:327333.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.18.09 CHECKED BY RA



Continued Next Page

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

RECORD OF BOREHOLE No WN1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N:4764187.0 E:327332.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.16.10 - 02.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
183.1	Ground Surface						20 40 60 80 100								
183.0 0.1	80mm TOPSOIL		1	SS	13		183								
	FILL - Silty Clay, trace sand, trace organics, stiff to very stiff, brown, moist		2	SS	23		182							0 2 35 63	
			3	SS	24										
181.0 2.1	SILTY CLAY trace sand, stiff to very stiff, brown, moist		4	SS	25		181								
			5	SS	14		180							0 1 54 45	
			6	SS	15		179								
178.7 4.4	SILT frequent silty clay seams and partings, compact, brown, moist		7	SS	16		178							0 0 80 20	
177.9 5.2	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		8	SS	11		177							0 3 65 32	
			9	SS	11		176								
			10	SS	11		175							0 9 70 21	
			11	TW	PH		174								
			12	SS	8		173							0 2 71 27	
			13	SS	9		172								
			14	SS	10		171							0 2 70 28	
168.4 14.7							170								
							169								

Continued Next Page

1 3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N:4764187.0 E:327332.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.16.10 - 02.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
165.3	SILTY CLAY TO CLAYEY SILT some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		15	SS	18		168							5 17 57 21
17.8	SILTY SAND TO SANDY SILT trace to some clay, trace to some gravel, very dense, brown, damp (GLACIAL TILL)		16	SS	32		167							
			17	SS	42		166							14 33 42 11
			18	SS	28		165							Feb.16
			19	SS	172/ 23cm		164							Feb.17
			20	SS	167/ 25cm		163							
			21	SS	138		162							
			22	SS	100/ 15cm		161							
			23	SS	100/ 2.5cm		160							
155.7	----- frequent dolostone inclusions		1	RUN	NQ		159							8 39 41 12
27.4	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs						158							Feb.17
							157							Feb.18
							156							RUN#1 TCR=72% SCR=67% RQD=34%
							155							
							154							

Continued Next Page

+ 3 . x 3 : Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT GDT 07/06/10

RECORD OF BOREHOLE No WN2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327354.1 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
181.6	Ground Surface													
181.5	150mm TOPSOIL													
0.2			1	SS	8		181							
	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		2	SS	16		180							0 2 55 43
			3	SS	16									
179.3			4	SS	19		179							0 1 80 19
2.3	SILT trace sand, frequent silty clay seams and partings, compact, brown, moist		5	SS	12		178							
178.1			6	SS	6		177							0 3 64 33
3.5	SILTY CLAY trace sand, trace gravel, firm to very stiff, brown, moist		7	SS	7									
			8	SS	6		176	1.2						1 5 65 29
			9	SS	2		175	2.3						
			10	TW	PH		174	1.7						
			11	SS	8		173	1.6						Dec.10 Dec.11 1 2 73 24
			12	SS	9		172	1.8						
			13	SS	25		171	1.7						
168.4							170	1.6						
13.2	SILTY CLAY TO CLAYEY SILT some sand, trace gravel, very stiff to hard, brown, damp (GLACIAL TILL)						169	1.5						
							168	1.4						8 19 54 19
							167							

Continued Next Page

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

ONTARIO MOT 1-09-4135.NBL2.GPJ ONTARIO MOT.GDT 07/08/10

METRIC

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

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327354.1 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

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																			
	<p>Borehole open to full depth and filled with drill water upon completion of drilling.</p> <p>No sample recovery at SS7. Sampler redriven and disturbed sample collected.</p> <p>Resistance to augering from 18.2m to 19.2m, 22.9m to 23.2m and at 25.1m.</p> <p>Unable to push vane beyond 13.1m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.9m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Jan.04.10</td> <td>5.2</td> <td>176.4</td> </tr> <tr> <td>Jan.11.10</td> <td>4.2</td> <td>177.4</td> </tr> <tr> <td>Jan.19.10</td> <td>5.2</td> <td>176.4</td> </tr> <tr> <td>Jan.27.10</td> <td>5.2</td> <td>176.4</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Jan.04.10	5.2	176.4	Jan.11.10	4.2	177.4	Jan.19.10	5.2	176.4	Jan.27.10	5.2	176.4											
Date	Depth(m)	Elevation(m)																									
Jan.04.10	5.2	176.4																									
Jan.11.10	4.2	177.4																									
Jan.19.10	5.2	176.4																									
Jan.27.10	5.2	176.4																									

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764212.0 E:327314.7 ORIGINATED BY KB
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.18.10 - 02.22.10 CHECKED BY RA

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					
182.1	Ground Surface						182							
0.0	FILL - Sand and Gravel, some silt, trace clay, dense, grey, damp		1	SS	48		182			o				41 44 13 2
181.4							181							
0.7	firm		2	SS	6		181				o			
							180							
	SILTY CLAY trace sand, trace gravel, very stiff, brown, damp		3	SS	22		180				o			
			4	SS	14		179							
			5	SS	27		179				o			
178.4							178							
3.7	SILT trace sand, frequent silty clay seams and partings, compact, brown, damp		6	SS	26		178				o			0 1 84 15
			7	SS	9		177							
177.4							177				o			
4.7	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		8	SS	12		176							
			9	SS	10		176				o			
							175			>>				
			10	SS	11		174							0 3 70 27
							173							
			11	SS	8		173							1 3 69 27
							172				1.9			
							171							
							170							
			12	TW	PH		170							
							169							
			13	SS	17		169							
							168							1 2 72 25
167.8			14	SS	60		168				o			
14.3														

Continued Next Page

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

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN3

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764212.0 E:327314.7 ORIGINATED BY KB
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 02.18.10 - 02.22.10 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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	10 20 30	10 20 30	10 20 30																		
30.0	<p>End of Borehole</p> <p>Borehole open to full depth and filled with drill water upon completion of drilling.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Apr.16.10</td> <td>7.7</td> <td>174.4</td> </tr> <tr> <td>Apr.29.10</td> <td>3.9</td> <td>178.2</td> </tr> <tr> <td>May.04.10</td> <td>5.2</td> <td>176.9</td> </tr> <tr> <td>May.06.10</td> <td>4.8</td> <td>177.3</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Apr.16.10	7.7	174.4	Apr.29.10	3.9	178.2	May.04.10	5.2	176.9	May.06.10	4.8	177.3														
Date	Depth(m)	Elevation(m)																												
Apr.16.10	7.7	174.4																												
Apr.29.10	3.9	178.2																												
May.04.10	5.2	176.9																												
May.06.10	4.8	177.3																												

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764228.4 E:327343.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NO Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.14.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	+ FIELD VANE							● QUICK TRIAXIAL	× LAB VANE	
182.5	Ground Surface						20	40	60	80	100				GR SA SI CL			
182.4	150mm TOPSOIL						20	40	60	80	100							
0.2	soft		1	SS	3													
	FILL - Silty Clay, trace sand, trace gravel, firm to stiff, brown, damp		2	SS	6										0 2 67 31			
			3	SS	9													
			4	SS	8										5 3 56 36			
			5	SS	5													
178.8																		
3.7	SILT trace clay, trace sand, frequent silty clay seams and partings, compact, brown, damp		6	SS	16													
			7	SS	22													
177.6																		
4.9	SILTY CLAY trace to some gravel, trace sand, stiff to very stiff, brown, damp		8	SS	5										17 10 37 36			
			9	SS	10													
			10	TW	PH													
			11	SS	9										1 2 72 25			
			12	SS	8										1 3 73 23			
															Dec.14			
			13	SS	12										Dec.15			
			14	SS	12										1 8 68 23			
167.8																		
14.7																		

Continued Next Page

+ 3. x 3. Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WN4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764228.4 E:327343.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.14.09 - 12.15.09 CHECKED BY RA

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	20	40	60	80	100	W _p	W		
	<p>Borehole open to full depth and filled with drill water upon completion of drilling.</p> <p>Borehole sealed with bentonite slurry to ground surface.</p> <p>Resistance to augering at 22.9m and 24.3m.</p> <p>Unable to push vane beyond 13.1m and 14.2m.</p>															

ONTARIO MOT 1-89-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+750Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764237.5 E:327341.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
DATUM Geodetic DATE 12.02.09 CHECKED BY RA

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						
182.8	Ground Surface							20 40 60 80 100						
182.7	60mm TOPSOIL							○ UNCONFINED + FIELD VANE						
0.1	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	9			● QUICK TRIAXIAL × LAB VANE						
182.1								20 40 60 80 100						
0.7	SILTY CLAY trace sand, very stiff to hard, brown, moist		2	SS	39		182						49	0 4 39 57
			3	SS	41		181						43	0 2 47 51
			4	SS	35		180							
			5	SS	25		179							
			6	SS	23		178							0 2 55 43
			7	SS	18		177		1.4					
			8	SS	10		176		2.9					
	stiff		9	TW	PH		175		1.5					
			10	SS	12		174		1.1					
			11	SS	13		173		1.1					
	trace gravel						172		1.5					
							171		1.3					
							170		1.3					1 2 69 28
169.1	End of Borehole								1.3					
13.7														

Continued Next Page

+ 3 × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 NBL 2 GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+750Rt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4764237.5 E:327341.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
DATUM Geodetic DATE 12.02.09 CHECKED BY RA

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						10 20 30													
	<p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Dec.15.09</td> <td>5.1</td> <td>177.7</td> </tr> <tr> <td>Jan.04.10</td> <td>2.7</td> <td>180.1</td> </tr> <tr> <td>Jan.11.10</td> <td>2.7</td> <td>180.1</td> </tr> <tr> <td>Jan.19.10</td> <td>2.8</td> <td>180.0</td> </tr> </tbody> </table> <p>Consolidation test performed on TW 9.</p>	Date	Depth(m)	Elevation(m)	Dec.15.09	5.1	177.7	Jan.04.10	2.7	180.1	Jan.11.10	2.7	180.1	Jan.19.10	2.8	180.0												
Date	Depth(m)	Elevation(m)																										
Dec.15.09	5.1	177.7																										
Jan.04.10	2.7	180.1																										
Jan.11.10	2.7	180.1																										
Jan.19.10	2.8	180.0																										

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No NBL 12+835Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764311.2 E:327301.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY KL
DATUM Geodetic DATE 11.26.09 CHECKED BY RA

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	20 40 60 80 100	20 40 60 80 100		
181.2	Ground Surface													
0.0	460mm FILL - Gravelly Sand, some silt, trace clay, compact, grey, damp		1	SS	29		181							30 51 16 3
180.7														
0.5	SILTY CLAY stiff to very stiff, brown, damp to moist		2	SS	26		180							
			3	SS	18									
			4	SS	15		179							0 0 64 36
			5	SS	8		178							
177.2														
4.0	CLAYEY SILT hard, brown, damp		6	SS	34		177							
							176							
175.6														
5.6	SILTY CLAY trace sand, stiff to very stiff, brown, damp		7	SS	22		175							
							174							
			8	SS	14		173							0 3 71 26
172.2														
9.0	End of Borehole													
	Borehole was dry (not stabilized) and hole open to full depth on completion.													

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+835Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764316.1 E:327316.7 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.02.09 CHECKED BY RA

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					
182.9 0.0	Ground Surface		1	SS	23									
181.5 1.4	FILL - Silty Clay, trace sand, trace organics, very stiff to hard, brown, damp		2	SS	39		182							
			3	SS	30		181							
	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		4	SS	25		180							
			5	SS	29		179							
			6	SS	18		178							
177.3 5.6	CLAYEY SILT very stiff, brown, damp		7	SS	15		177							
175.8 7.1	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		8	SS	18		176							
			9	SS	12		175							
	trace gravel		10	SS	9		174							
			11	AS	-		173							
169.8 13.1	End of Borehole						172							
	Borehole was dry (not stabilized) and hole open to full depth on completion.						171							
							170							

ONTARIO MOT. 1-99-4135 NBL2 GPJ. ONTARIO MOT. GDT. 07/06/10

Continued Next Page

+ 3 . × 3 : Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+835Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764316.1 E:327316.7 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.02.09 CHECKED BY RA

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																							
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.09.09</td> <td>6.7</td> <td>176.2</td> </tr> <tr> <td>Nov.19.09</td> <td>2.7</td> <td>180.2</td> </tr> <tr> <td>Nov.30.09</td> <td>2.5</td> <td>180.4</td> </tr> <tr> <td>Dec.08.09</td> <td>2.3</td> <td>180.6</td> </tr> <tr> <td>Dec.15.09</td> <td>2.3</td> <td>180.6</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.09.09	6.7	176.2	Nov.19.09	2.7	180.2	Nov.30.09	2.5	180.4	Dec.08.09	2.3	180.6	Dec.15.09	2.3	180.6																
Date	Depth(m)	Elevation(m)																																	
Nov.09.09	6.7	176.2																																	
Nov.19.09	2.7	180.2																																	
Nov.30.09	2.5	180.4																																	
Dec.08.09	2.3	180.6																																	
Dec.15.09	2.3	180.6																																	

ONTARIO MOT 1-09-4135 NBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No NBL 12+910CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764385.0 E:327289.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.02.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							w _p w w _L		
182.7	Ground Surface						20	40	60	80	100	10	20	30	GR SA SI CL		
0.0	40mm TOPSOIL		1	SS	6								○				
182.0	FILL - Silty Clay, trace sand, trace organics, firm, brown, moist																
0.7	SILTY CLAY trace sand, occasional sand seams, very stiff to hard, brown, moist		2	SS	36								○				
			3	SS	39								○		42	0 1 43 56	
			4	SS	36								○				
			5	SS	19								○				
			6	SS	15								○				
	stiff		7	SS	12								○			0 1 55 44	
			8	SS	13								○				
			9	SS	9								○				
			10	SS	9								○			0 3 69 28	

ONTARIO MOT 1-09-4135 NBL2 GPJ ONTARIO MOT GDT 07/08/10

RECORD OF BOREHOLE No NBL 12+985Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N-4764453.0 E-327257.8 ORIGINATED BY AW
DIST HWY 405 BOREHOLE TYPE Solid Stem Augers COMPILED BY KL
DATUM Geodetic DATE 11.27.09 CHECKED BY RA

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									
								20 40 60 80 100									
181.1	Ground Surface																
0.0	460mm FILL - Sand and Gravel, some silt, trace clay, compact, grey, damp		1	SS	25											38 43 15 4	
180.6	hard		2	SS	43												
0.5	----		3	SS	26												
	SILTY CLAY trace sand, occasional gravel inclusions, stiff to very stiff, brown, damp to moist		4	SS	23												
			5	SS	25											0 1 53 46	
			6	SS	20												
			7	SS	17											2 5 66 27	
173.6	End of Borehole																
7.5	Borehole was dry (not stabilized) and hole open to full depth on completion.																

RECORD OF BOREHOLE No NBL 12+985Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764455.6 E:327271.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.03.09 CHECKED BY RA

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					
182.3	Ground Surface						20	40	60	80	100		
182.2	120mm TOPSOIL												
0.1	FILL - Silty Clay, trace sand, trace organics, very stiff, brown / dark brown, moist		1	SS	16								
181.6													
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	42								
			3	SS	42								0 2 44 54
			4	SS	30								
			5	SS	32								0 1 44 55
	stiff		6	SS	14								0 0 56 44
176.8	End of Borehole												
5.5	Borehole was dry (not stabilized) and hole open to full depth on completion. Unable to push vane beyond 5.5m. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Nov.19.09 3.1 179.2 Nov.30.09 2.9 179.4 Dec.08.09 2.5 179.8 Dec.15.09 1.9 180.4 Jan.04.10 1.9 180.4												

RECORD OF BOREHOLE No SBL 12+185Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763707.6 E:327535.6 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.13.09 - 11.16.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
183.2	Ground Surface							20 40 60 80 100						
183.0	180mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, some organics, soft, black, moist		1	SS	2								59	0 2 40 58
182.5														
0.7	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		2	SS	30									
			3	SS	29								48	0 1 43 56
			4	SS	24									
			5	SS	19									
			6	SS	15									0 2 68 30
			7	SS	12									
			8	SS	8									0 5 64 31

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

1 OF 1

METRIC

ORIGINATED BY AW

COMPILED BY DB

CHECKED BY RA

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

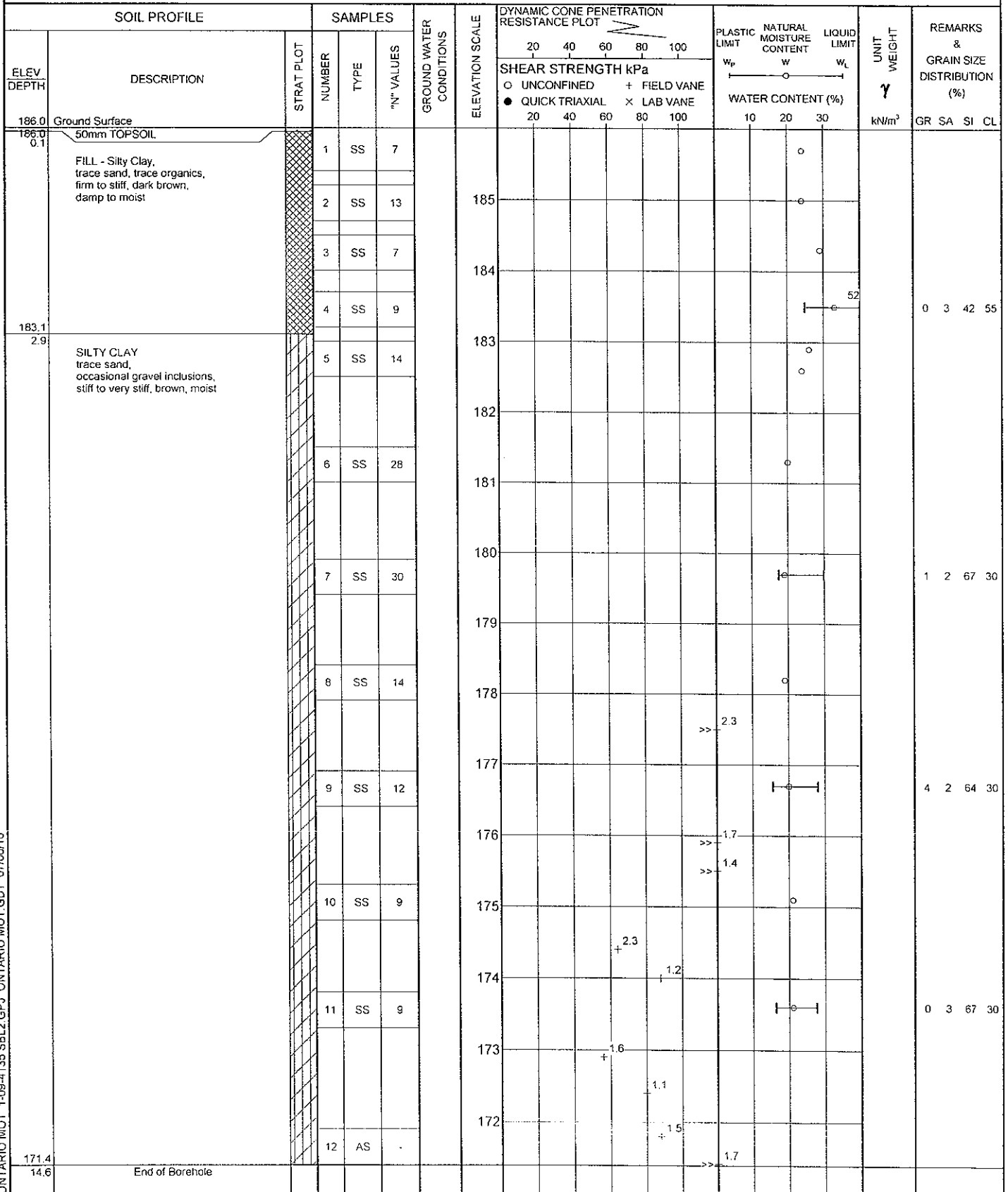
+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SBL 12+260CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N.4763783.4 E.327515.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA



ONTARIO MOT 1-09-4135 SBL2 GPJ ONTARIO MOT.GDT 07/06/10

Continued Next Page

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

RECORD OF BOREHOLE No SBL 12+260CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763783.4 E:327515.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Borehole was dry (not stabilized) and hole open to full depth on completion.																

ONTARIO MOT 1-08-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+360CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763866.5 E:327470.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

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					
182.9	Ground Surface						20 40 60 80 100	○ UNCONFINED + FIELD VANE					
182.9 0.0	40mm TOPSOIL		1	SS	19		20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE					
182.2	FILL - Silty Clay, trace to some sand, trace gravel, trace organics, very stiff, dark brown, moist		2	SS	25								
182.2 0.7	SILTY CLAY trace sand, stiff to very stiff, brown, moist		3	SS	14								
			4	SS	23								
			5	SS	18								
			6	SS	15								
			7	SS	19								
			8	SS	12								
			9	SS	10								
			10	TW	PH								
			11	SS	21								
170.2 12.7	End of Borehole												
	Water level at 9.8m (not stabilized) and hole open to full depth on completion.												
	Consolidation test performed on TW 10.												

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2 GPJ ONTARIO MOT GDT 07/08/10

RECORD OF BOREHOLE No SBL 12+360CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763866.5 E:327470.3 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

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																										
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.19.09</td> <td>5.0</td> <td>177.9</td> </tr> <tr> <td>Nov.30.09</td> <td>2.6</td> <td>180.3</td> </tr> <tr> <td>Dec.07.09</td> <td>2.4</td> <td>180.5</td> </tr> <tr> <td>Dec.15.09</td> <td>2.3</td> <td>180.6</td> </tr> <tr> <td>Jan.04.10</td> <td>2.1</td> <td>180.8</td> </tr> <tr> <td>Jan.11.10</td> <td>2.1</td> <td>180.8</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.19.09	5.0	177.9	Nov.30.09	2.6	180.3	Dec.07.09	2.4	180.5	Dec.15.09	2.3	180.6	Jan.04.10	2.1	180.8	Jan.11.10	2.1	180.8																
Date	Depth(m)	Elevation(m)																																				
Nov.19.09	5.0	177.9																																				
Nov.30.09	2.6	180.3																																				
Dec.07.09	2.4	180.5																																				
Dec.15.09	2.3	180.6																																				
Jan.04.10	2.1	180.8																																				
Jan.11.10	2.1	180.8																																				

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

METRIC

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

RECORD OF BOREHOLE No TS1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords. N:4763865.7 E:327459.1 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.11.10 - 01.13.10 CHECKED BY RA

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		
166.9			14	SS	16		167					
15.7	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace to some gravel, hard, brown, damp to moist (GLACIAL TILL) ----- occasional to frequent cobbles		15	SS	164		166					12 24 48 16
			16	SS	110		165					
			17	SS	100/ 10cm		164					
161.8							163					
20.8	SAND gravelly, some silt, frequent cobbles, very dense, grey, wet		18	SS	175		162					32 56 (12)
161.0	CLAYEY SILT some gravel, trace sand, hard, brown, damp (GLACIAL TILL)						161					
160.2			19	SS	98		160					
22.4	SAND gravelly, trace silt, occasional cobbles, dense to very dense, grey, moist to wet						159					
157.8			20	SS	40		158					
24.8	CLAYEY SILT sandy, trace gravel, hard, brown, damp (GLACIAL TILL)		21	SS	38		157					Jan 12 Jan 13
							156					1 23 57 19
155.7			22	SS	100/ 13cm		155					
26.9	SAND AND GRAVEL trace to some silt, frequent cobbles, very dense, grey / brown, moist (GLACIAL TILL)						154					RUN#1 TCR=75% SCR=16% RQD=16%
154.2			1	RUN	NQ		153					RUN#2 TCR=100% SCR=90% RQD=76%
28.4	BEDROCK		2	RUN	NQ							

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT GDT 07/08/10

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity \bigcirc 3% STRAIN AT FAILURE

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 (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa				WATER CONTENT (%)						
						20	40	60	80	100	10	20	30	GR	SA	SI	CL	
151.4 31.2	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs. End of Borehole Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Jan.19.10 10.6 172.0 Jan.27.10 10.4 172.2 Feb.08.10 10.5 172.1 Borehole sealed with bentonite slurry from 31.2m to 28.1m and from 25.0m to ground surface.		3	RUN	NQ													RUN#3 TCR=96% SCR=81% RQD=72%

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

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

RECORD OF BOREHOLE No TS2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N:4763881.2 E:327466.3 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 11 30 09 - 12 08 09 CHECKED BY RA

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							
183.3 0.0	Ground Surface							20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	10 20 30	10 20 30	10 20 30	γ	GR SA SI CL
	FILL - Silty Clay, trace sand, trace gravel, trace organics, stiff to very stiff, dark brown / brown, damp to moist		1	SS	12		183								
			2	SS	12		182								3 7 58 32
			3	SS	21										
181.2 2.1	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		4	SS	32		181								Nov.30 Dec.03
			5	SS	61		180								
			6	SS	25		179								
			7	SS	25		178								
			8	SS	21		177								1 3 66 30
			9	SS	15		176								
							175								
							174								0 3 67 30
							173								
							172								
							171								
							170								
							169								
			10	SS	13										
			11	SS	16										
			12	SS	14										
			13	SS	14										
			14	SS	18										
			15	TW	PH										

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No TS2

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords. N:4763881.2 E:327466.3 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 11.30.09 - 12.08.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
168.1							168							8 15 50 27
15.2	SILTY CLAY trace to some sand, trace gravel, very stiff to hard, brown, damp to moist (GLACIAL TILL)		16	SS	22									Dec.03
							167							Dec.04
			17	SS	26									
							166							
	----- frequent wet sand and gravel inclusions -----		18	SS	121									
							165							
			19	SS	47									
							164							
							163							
162.5							162							
20.8	SAND gravelly, some silt, dense, brown, wet		20	SS	50									31 57 (12)
							161							
160.9							160							
22.4	CLAYEY SILT and sand, trace gravel, very stiff, brown, damp (GLACIAL TILL)		21	SS	30									7 39 38 16
							159							
159.4							158							
23.9	SAND gravelly, trace silt, dense, grey, moist to wet		22	SS	47									Dec.04
							157							Dec.07
157.1			23	SS	61									
26.2	CLAYEY SILT sandy, trace gravel, hard, brown, damp (GLACIAL TILL)						156							
156.2							155							
27.1	SAND AND GRAVEL some silt, trace to some clay, occasional cobbles, very dense, brown / grey, moist (GLACIAL TILL)		24	SS	77									
							154							
153.9			25	SS	155/ 18cm									Dec 07
29.4	BEDROCK													Dec.08

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

METRIC

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

RECORD OF BOREHOLE No TS3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N:4763891.8 E:327445.1 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NO Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.15.09 - 12.16.09 CHECKED BY RA

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	10	20	30	GR	SA	SI	CL			
182.5	Ground Surface																			
0.0	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm, brown, moist		1	SS	5		182													
181.8																				
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	46															
			3	SS	39		181										0	2	36	62
			4	SS	32		180													
			5	SS	36		179													
			6	SS	44		178										0	6	61	33
			7	SS	46		177													
			8	SS	28		176													
			9	SS	29		175										0	3	64	33
			10	SS	19		174													
			11	TW	PH		173													
			12	SS	18		172													
			13	SS	18		171													
			14	SS	26		170													
							169													
							168													
167.8																				
14.7																				

Continued Next Page

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


ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No TS3

3 OF 3

METRIC

W.P. 290-99-00 LOCATION Coords: N:4763891.8 E:327445.1 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.15.09 - 12.16.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
							20	40	60	80	100									
	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		2	RUN	NQ												GR SA SI CL SCR=56% RQD=22%			
			3	RUN	NQ													RUN#3 TCR=92% SCR=82% RQD=34%		
149.9 32.6			End of Borehole																	
	Unable to push vane beyond 13.3m and 14.4m. No sample recovery at SS19. Borehole sealed with bentonite slurry to ground surface.																			

ONTARIO MOT 1-08-4135 SBL2 GPJ ONTARIO MOT.GDT 07/06/70

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No TS4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N 4763903.8 E 327455.3 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

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
182.4	Ground Surface															
0.0	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm, brown, moist		1	SS	6											
181.7			2	SS	51											
0.7	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		3	SS	36											
			4	SS	39											
			5	SS	52											
			6	SS	29											
			7	SS	26											
			8	SS	16											
			9	TW	PH											
			10	SS	14											
			11	SS	27											
			12	SS	13											
			13	SS	17											
167.7																
14.7																

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No TS4

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763903.8 E:327455.3 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

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					
	CLAYEY SILT TO SILTY CLAY some sand, some gravel, frequent cobbles, stiff to hard, brown, damp (GLACIAL TILL)		14	SS	10		167							4			16 19 49 16
			15	SS	100/ 28cm		166										
164.3 18.1	SAND AND GRAVEL trace to some silt, trace clay, occasional cobbles, very dense, grey, damp to moist (GLACIAL TILL)		16	SS	77		164										
			17	SS	80		163										
			18	SS	76		162										
			19	SS	100/ 28cm		161										
158.5 23.9	CLAYEY SILT trace sand, trace gravel, very stiff, brown, damp (GLACIAL TILL)		20	SS	25		160										
157.0 25.4	GRAVEL AND SAND some silt, occasional cobbles, very dense, grey, moist to wet (GLACIAL TILL)		21	SS	100/ 25cm		159										
			22	SS	100/ 18cm		158										
154.1 28.4	BEDROCK		1	RUN	NO		157										
							156										
							155										45 41 (14)
							154										Dec.21
							153										RUN#1 TCR=90% SCR=72% ROD=41%
																	RUN#2

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No TS4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763903.8 E:327455.3 ORIGINATED BY LY
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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							20	40	60	80	100	WATER CONTENT (%)					10	20	30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+410CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763911.8 E:327444.8
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers
 DATUM Geodetic DATE 11.18.09
 ORIGINATED BY PK
 COMPILED BY DB
 CHECKED BY RA

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					
182.5	Ground Surface						20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL
182.3	180mm TOPSOIL												
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	13								
181.8													
0.7	SILTY CLAY trace sand, stiff to hard, brown, moist		2	SS	45								
			3	SS	36								0 3 62 35
			4	SS	39								
			5	SS	40								
			6	SS	20								0 4 66 30
			7	SS	20								
			8	SS	14								
	trace gravel		9	TW	PH							20.4	1 3 70 26
			10	SS	11								0 2 72 26
			11	SS	16								
168.9	End of Borehole												
13.6	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 9.												

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2 GPJ ONTARIO MOT GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+410CL

2 OF 2

METRIC

W.P. 260-99-00 LOCATION Coords: N:4763911.8 E:327444.8 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.18.09 CHECKED BY RA

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	W _p	W	W _L													
	<p>No sample recovery at SS8. Sampler redriven and disturbed sample collected.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.30.09</td> <td>1.7</td> <td>180.8</td> </tr> <tr> <td>Dec.07.09</td> <td>1.4</td> <td>181.1</td> </tr> <tr> <td>Dec.15.09</td> <td>1.3</td> <td>181.2</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.30.09	1.7	180.8	Dec.07.09	1.4	181.1	Dec.15.09	1.3	181.2															
Date	Depth(m)	Elevation(m)																										
Nov.30.09	1.7	180.8																										
Dec.07.09	1.4	181.1																										
Dec.15.09	1.3	181.2																										

ONTARIO MOT. 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+485Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763974.6 E:327403.3 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.17.09 - 11.18.09 CHECKED BY RA

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					
182.0	Ground Surface													
181.8	200mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, trace gravel, trace organics, stiff, brown, damp		1	SS	9									
181.3	occasional gravel inclusions, hard		2	SS	41		181							
0.7			3	SS	31		180							
			4	SS	49		179							1 2 69 28
			5	SS	34		178							
			6	SS	12		177							0 2 73 25
	SILTY CLAY trace sand, firm to very stiff, brown, damp to moist		7	SS	12		176	1.8						
			8	SS	13		175	1.9						
			9	SS	11		174	1.2						0 2 72 26
			10	TW	PH		173	1.3						
			11	SS	17		172	1.4						
			12	SS	22		171	1.3						
							170	1.0						
							169	1.7						
168.8	SILTY CLAY TO CLAYEY SILT trace sand, very stiff, brown, damp to moist (GLACIAL TILL)						168	1.2						0 3 76 21
13.2														

Continued Next Page

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

ONTARIO MOT. 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

2 OF 2

METRIC

SOIL PROFILE	SAMPLES		DYNAMIC CONE PENETRATION			
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[illegible]

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

RECORD OF BOREHOLE No SBL 12+485Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763980.3 E:327413.8 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
181.8	Ground Surface															
181.6	200mm TOPSOIL															
0.2	FILL - Silty Clay, trace sand, trace to some organics, stiff, black, damp		1	SS	10											
181.1																
0.7	very stiff to hard		2	SS	29	181										
			3	SS	28	180										
			4	SS	39	179										
			5	SS	34	178										
			6	SS	13	177										
			7	SS	18	176										
			8	TW	PH	175										
			9	SS	12	174										
			10	SS	13	173										
			11	SS	13	172										
			12	SS	21	171										
168.6						170										
13.2	SILTY CLAY TO CLAYEY SILT sandy, trace gravel, very stiff, brown, damp to moist (GLACIAL TILL)					169										
						168										
						167										

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+485Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763980.3 E:327413.8 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

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								
199.7 15.1	<p>End of Borehole</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>No sample recovery at SS6 and SS10. Sampler redriven and disturbed sample collected.</p> <p>Resistance to augering from 11.1m to 11.6m.</p>															

ONTARIO MOT 1-09-4135 SBL2 GPJ ONTARIO MOT GDT 07/06/10

METRIC

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

RECORD OF BOREHOLE No SBL 12+525CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764013.1 E:327390.2 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.19.09 CHECKED BY RA

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

+ 3 x 3

Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SBL 12+600Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764077.3 E:327349.6 ORIGINATED BY PK
DIST HWY 405 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.13.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
182.7	Ground Surface						20 40 60 80 100								
182.5	200mm TOPSOIL														
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	8										
182.0															
0.7	SILTY CLAY trace sand, occasional gravel inclusions, hard, brown, damp to moist		2	SS	45		182								
	occasional silt partings		3	SS	30		181						52	1 1 40 58	
			4	SS	33		180								
	firm to very stiff		5	SS	14		179						49	0 1 47 52	
			6	SS	20		178								
			7	TW	PH		177								
			8	SS	11		176								
			9	SS	9		175							2 2 65 31	
			10	SS	10		174								
			11	SS	18		173								
							172								
							171								
							170							0 3 71 26	
169.1	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion.														
13.6	No sample recovery at SS10. Sampler redriven and disturbed sample collected.														

+ 3 × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No SBL 12+600Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords. N:4764082.6 E:327360.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.12.09 CHECKED BY RA

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						
182.1	Ground Surface							20 40 60 80 100						
181.9	200mm TOPSOIL							20 40 60 80 100						
0.2	FILL - Silty Clay, trace sand, trace organics, firm, black, moist		1	SS	5		182	○ UNCONFINED + FIELD VANE						
181.4								● QUICK TRIAXIAL x LAB VANE						
0.7														
	occasional silt partings		2	SS	17		181							0 1 76 23
			3	SS	15		180							
	SILTY CLAY trace sand, occasional gravel inclusions, firm to very stiff, brown, damp to moist		4	SS	22		179							
			5	SS	24		178							
			6	SS	21		177							1 3 71 25
			7	SS	13		176							
			8	TW	PH		175							
			9	TW	PH		174							
			10	SS	12		173							0 2 71 27
			11	SS	16		172							0 2 71 27
168.5	End of Borehole						171							
13.6	Borehole was dry (not stabilized) and hole open to full depth on completion.						170							
							169							

Continued Next Page

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

ONTARIO MOT. 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+600Rt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764082.6 E:327360.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.12.09 CHECKED BY RA

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									
	No sample recovery at TW8. Split spoon sampler driven and disturbed sample collected. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Nov.19.09 6.4 175.7 Nov.30.09 8.3 173.8 Dec.08.09 2.7 179.4 Jan.04.10 1.4 180.7 Jan.11.10 1.8 180.3 Jan.19.10 1.6 180.5																

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+650CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764126.1 E:327334.4 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.18.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA Si CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
183.7	Ground Surface														
183.7	50mm TOPSOIL														
183.5	FILL - Silty Clay, trace sand, trace gravel, trace organics, stiff, brown, moist		1	SS	10									17 57 18 8	
183.0	FILL - Sand, some silt, some gravel, trace clay, compact, grey, damp		2	SS	7										
182.3	FILL - Silty Clay, trace sand, trace gravel, firm, brown, moist														
179.7	SILTY CLAY trace sand, very stiff, brown, damp		3	SS	19										
			4	SS	15										
			5	SS	15								42	0 1 46 53	
178.1	SILT - frequent silty clay seams and partings, compact, brown, moist		6	SS	14										
	SILTY CLAY trace sand, occasional gravel inclusions, firm to very stiff, brown, damp to moist		7	SS	8										
			8	SS	6										
			9	SS	11									1 3 70 26	
			10	SS	5										
			11	SS	7									0 3 72 25	
169.1	End of Borehole		12	AS	-										
14.6															

Continued Next Page

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

ONTARIO MOT. 1-09-4135 SBL2 GPJ ONTARIO MOT. GDT 07/06/10

RECORD OF BOREHOLE No SBL 12+650CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords. N:4764126.1 E:327334.4 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.18.09 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
					20	40	60	80	100	10	20	30				
	Borehole was dry (not stabilized) and hole open to full depth on completion.															

RECORD OF BOREHOLE No SBL 12+685CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N 4764160.4 E 327319.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

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					
182.7	Ground Surface						20 40 60 80 100						
0.0	470mm FILL - Sand and Gravel, some silt, trace clay, compact, grey, damp		1	SS	11								41 42 13 4
182.2													
0.5	SILTY CLAY trace sand, occasional gravel inclusions, very stiff, brown, moist		2	SS	18								
			3	SS	15								
			4	SS	16								0 1 50 49
			5	SS	19								
			6	SS	15								
	stiff		7	SS	13								0 2 68 30
			8	SS	11								
			9	SS	8								1 5 68 26
			10	TW	PH								0 3 70 27
170.5	End of Borehole												
12.2	Borehole was dry (not stabilized) and hole open to full depth on completion. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Piezometer destroyed after drilling. Consolidation test performed on TW 10.												

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No WS1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764163.6 E:327303.9 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.19.10 - 04.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.7	Ground Surface													
182.6 0.1	80mm TOPSOIL		1	SS	7		182							
	FILL - Silty Clay, trace sand, firm to hard, brown, damp		2	SS	28								53	0 2 36 62
			3	SS	37		181							
180.6 2.1	SILTY CLAY trace sand, trace gravel, hard, brown, damp		4	SS	32		180							
			5	SS	33									
			6	SS	52		179							
178.3 4.4	SILT trace sand, trace gravel, frequent silty clay seams and partings, dense, brown, damp		7	SS	47		178							1 2 75 22
			8	SS	39		177							
176.8 5.9	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		9	SS	15		176							
			10	SS	23		175							0 5 83 12
			11	SS	25		174							0 4 62 34
			12	TW	PH		173							
			13	SS	41		172							
			14	SS	28		171							1 3 72 24
168.0 14.7							170							
							169							
							168							

Continued Next Page

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

ONTARIO MOT 1-08-4135 SEL2.GPJ ONTARIO MOT.GDT 07/06/10

METRIC

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

METRIC

+ 3, x 3. Numbers refer to Sensitivity

RECORD OF BOREHOLE No WS2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N:4764174.7 E:327313.4 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.28.10 - 02.01.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa						
							○ UNCONFINED	+ FIELD VANE					
							● QUICK TRIAXIAL	× LAB VANE					
183.1	Ground Surface						20 40 60 80 100						
0.0	firm		1	SS	7								
	SILTY CLAY trace sand, trace gravel, hard, brown, damp		2	SS	38								2 3 37 58
			3	SS	43								
			4	SS	36								0 1 51 48
			5	SS	29								
			6	SS	24								
178.7													
4.4	SILT trace sand, frequent silty clay seams and partings, dense, brown, damp		7	SS	37								0 1 79 20
			8	SS	36								
177.2													
5.9	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, damp to moist		9	SS	21								0 5 68 27
			10	SS	22								
			11	TW	PH								
			12	SS	10								0 3 70 27
			13	SS	15								0 2 72 26
			14	SS	28								
168.4													
14.7													

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2 GPJ ONTARIO MOT GDT 07/08/10

METRIC

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No WS2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764174.7 E:327313.4 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.28.10 - 02.01.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
						20	40	60	80	100			
29.9	<p>End of Borehole</p> <p>No sample recovery at SS12. Sampler redriven and disturbed sample collected.</p> <p>Unable to push vane beyond 12m.</p> <p>Borehole open to full depth and filled with drill water upon completion of drilling.</p> <p>Borehole sealed with bentonite slurry to ground surface.</p>												

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT GDT 07/06/10

RECORD OF BOREHOLE No WS3

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords N.4764192.6 E.327292.7 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.20.10 - 01.22.10 CHECKED BY RA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	w _p	w	w _L	
183.0	Ground Surface												
183.0 0.1	50mm TOPSOIL		1	SS	17								
	FILL - Silty Clay, trace sand, very stiff to hard, brown, damp		2	SS	23		182						
			3	SS	36		181						0 3 36 61
			4	SS	43								
180.1			5	SS	39		180						0 1 53 46
2.9	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		6	SS	30		179						
			7	SS	24		178						0 1 65 34
			8	SS	20		177						
			9	TW	PH								
							176			1.6			Jan 20
													Jan 21
			10	SS	9		175			1.5			1 5 63 31
							174		2.5				
			11	SS	13		173		1.9				
							172		1.0				
			12	SS	17		171			1.5			8 5 65 22
							170			1.6			
			13	SS	23		169			1.5			0 4 67 29
			14	SS	23								
168.3										1.4			
14.7													

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2.GPJ, ONTARIO MOT GDT 07/08/10

METRIC

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

RECORD OF BOREHOLE No WS4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords N.4764202.3 E.327305.2 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 01.28.10 - 02.01.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa															
								○ UNCONFINED + FIELD VANE															
								● QUICK TRIAXIAL × LAB VANE															
							20	40	60	80	100	WATER CONTENT (%)		10	20	30	GR	SA	SI	CL			
182.7	Ground Surface																						
0.0	25mm TOPSOIL		1	SS	13																		
	FILL - Silty Clay, trace sand, trace gravel, stiff to very stiff, brown, damp to moist		2	SS	17																		
			3	SS	13																		
180.6																							
2.1	SILTY CLAY trace sand, trace gravel, hard, brown, damp		4	SS	45																		
			5	SS	45																		
			6	SS	43																		
			7	SS	61																		
177.7	SILT trace clay, trace sand, frequent silty clay seams and partings, very dense, brown, damp		8	SS	64																		
5.0																							
176.8	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		9	SS	37																		
5.9																							
				10	SS	37																	
			11	SS	20																		
			12	TW	PH																		
			13	SS	25																		
			14	SS	23																		
168.0																							
14.7																							

Continued Next Page

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

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No WS4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327305.2 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 01.28.10 - 02.01.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
	Water level at approx. 9.1m (not stabilized) and hole open to full depth on completion. Unable to push vane beyond 14.7m. Resistance to augering from 25.0m to 25.8m. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Feb 08.10 4.7 178.0 Apr. 16.10 2.1 180.6 Apr. 29.10 5.1 177.6 May 04.10 5.7 177.0 May 06.10 4.1 178.6 May 18.10 5.9 176.8																

RECORD OF BOREHOLE No SBL 12+750CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords. N:4764219.9 E:327296.2 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.10.09 CHECKED BY RA

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							
								20 40 60 80 100							
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100							
182.9	Ground Surface														
182.7	200mm TOPSOIL														
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, dark brown, moist		1	SS	8										
182.2															
0.7	SILTY CLAY trace sand, very stiff to hard, brown, moist		2	SS	24		182								
			3	SS	37		181								
			4	SS	46		180								
			5	SS	33		179								
			6	SS	20		178								
			7	SS	27		177								
			8	SS	34		176								
			9	SS	21		175								
			10	TW	PH		174								
							173								
							172								
171.6	End of Borehole														
11.3															
	Water level at 10.4m (not stabilized) and hole open to full depth on completion.														
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.														
	Water Level Readings:														
	Date Depth(m) Elevation(m)														
	Nov.19.09 4.6 178.3														
	Nov.30.09 7.8 175.1														
	Dec.08.09 4.1 178.8														
	Dec.15.09 3.2 179.7														
	Jan.04.10 2.7 180.2														
	Jan.11.10 2.7 180.2														
	Jan.19.10 2.6 180.3														
	Consolidation test performed on TW 10														

ONTARIO MOT 1-09-4135 SBL2.GPJ, ONTARIO MOT.GDT 07/06/10

+ 3. × 3

Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SBL 12+825Lt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords. N:4764289.3 E:327265.5 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.09.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE								
						● QUICK TRIAXIAL × LAB VANE										
183.0	Ground Surface							20 40 60 80 100								
182.8	180mm TOPSOIL															
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	8											
182.3																
0.7	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	36		182									
			3	SS	25		181									
			4	SS	38											
			5	SS	26		180							0 0 60 40		
			6	SS	29		179									
			7	SS	37		178									
			8	SS	17		177									
175.7	End of Borehole						176							1 7 68 24		
7.3	Water level at 6.1m (not stabilized) and hole open to full depth on completion.															

+ 3 x 3

Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SBL 12+825Rt

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764290.1 E:327278.0 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.10.09 CHECKED BY RA

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							
182.3	Ground Surface							20 40 60 80 100							GR SA SI CL
182.1	200mm TOPSOIL														
0.2	FILL - Silty Clay, trace sand, trace organics, very stiff, dark brown, moist		1	SS	15		182								0 1 41 58
181.6															
0.7	SILTY CLAY trace sand, very stiff to hard, brown, moist		2	SS	30		181						48		
			3	SS	56										
			4	SS	33		180								0 1 47 52
			5	SS	18		179								
							178								
			6	SS	31		177								
			7	SS	17		176								0 2 70 28
			8	SS	22		175								
	firm to stiff							1.3							
174.1									2.1						
8.2	End of Borehole														
	Borehole was dry (not stabilized) and hole open to full depth on completion.														
	No sample recovery at SS7 and SS8. Sampler redriven and disturbed sample collected.														

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/08/10

RECORD OF BOREHOLE No SBL 12+900CL

1 OF 1

METRIC

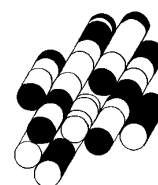
W.P. 280-99-00 LOCATION Coords: N:4764364.1 E:327251.1 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.10.09 CHECKED BY RA

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						
182.7	Ground Surface							20 40 60 80 100						
182.5	180mm TOPSOIL							20 40 60 80 100						
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	15		182							
182.0														
0.7	SILTY CLAY trace sand, occasional sand seams, very stiff to hard, brown, moist		2	SS	38		181							0 1 61 38
			3	SS	32		180							
			4	SS	27		179							
			5	SS	33		178							
							177							1 3 76 20
			6	SS	32									
			7	SS	30									
	firm to very stiff													
176.0	End of Borehole						176							
6.7	Borehole was dry (not stabilized) and hole open to full depth on completion. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Nov.19.09 2.5 180.2 Nov.30.09 2.3 180.4 Dec.08.09 2.0 180.7 Dec.15.09 1.5 181.2 Jan.04.10 1.7 181.0 Jan.11.10 1.9 180.8 Jan.19.10 1.7 181.0													

ONTARIO MOT 1-09-4135 SBL2.GPJ ONTARIO MOT.GDT 07/06/10

B4

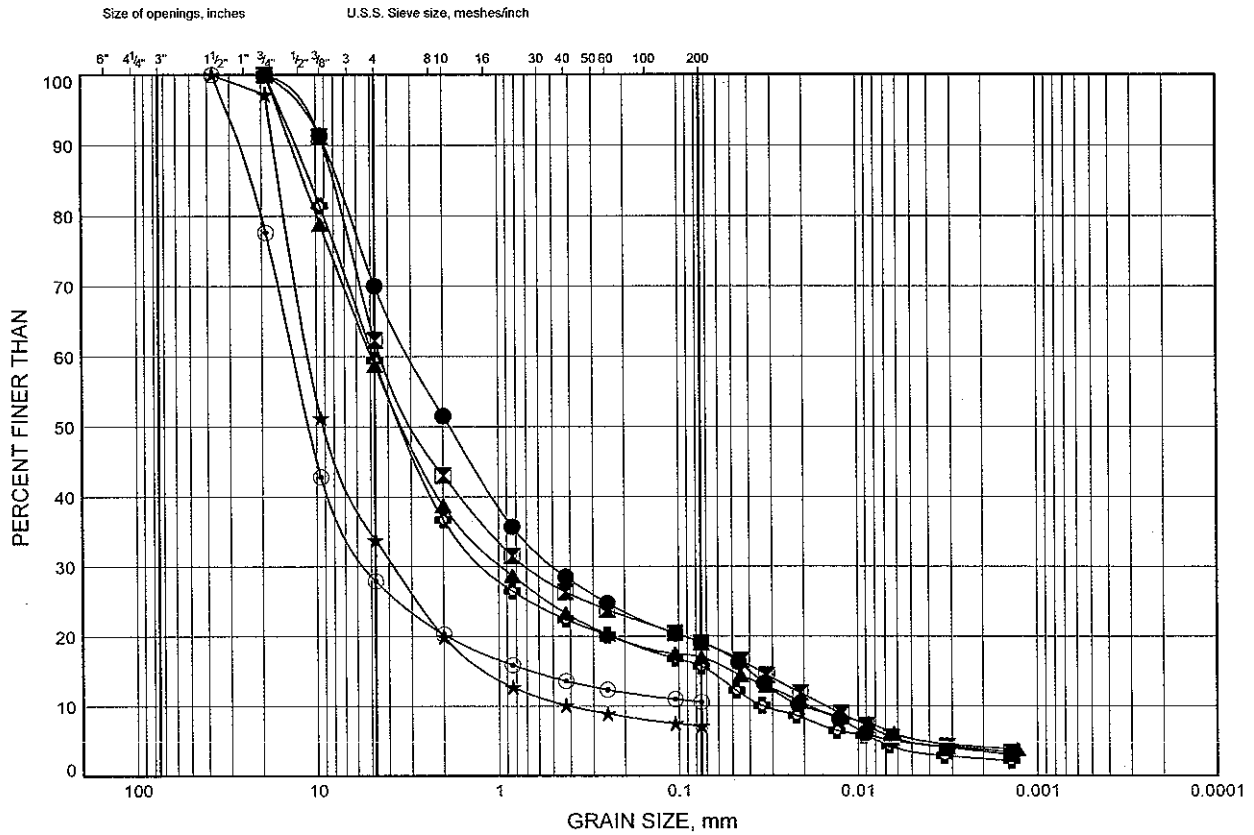
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B4-1

FILL - Sandy Gravel to Gravelly Sand



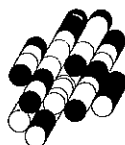
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+835Lt	0.3	180.9
⊠	NBL 12+985Lt	0.3	180.8
▲	SBL 12+685CL	0.3	182.4
★	TN3	0.3	183.8
⊙	TN4	0.3	183.7
⊛	WN3	0.3	181.8

Date July 2010

Project 1-09-4135



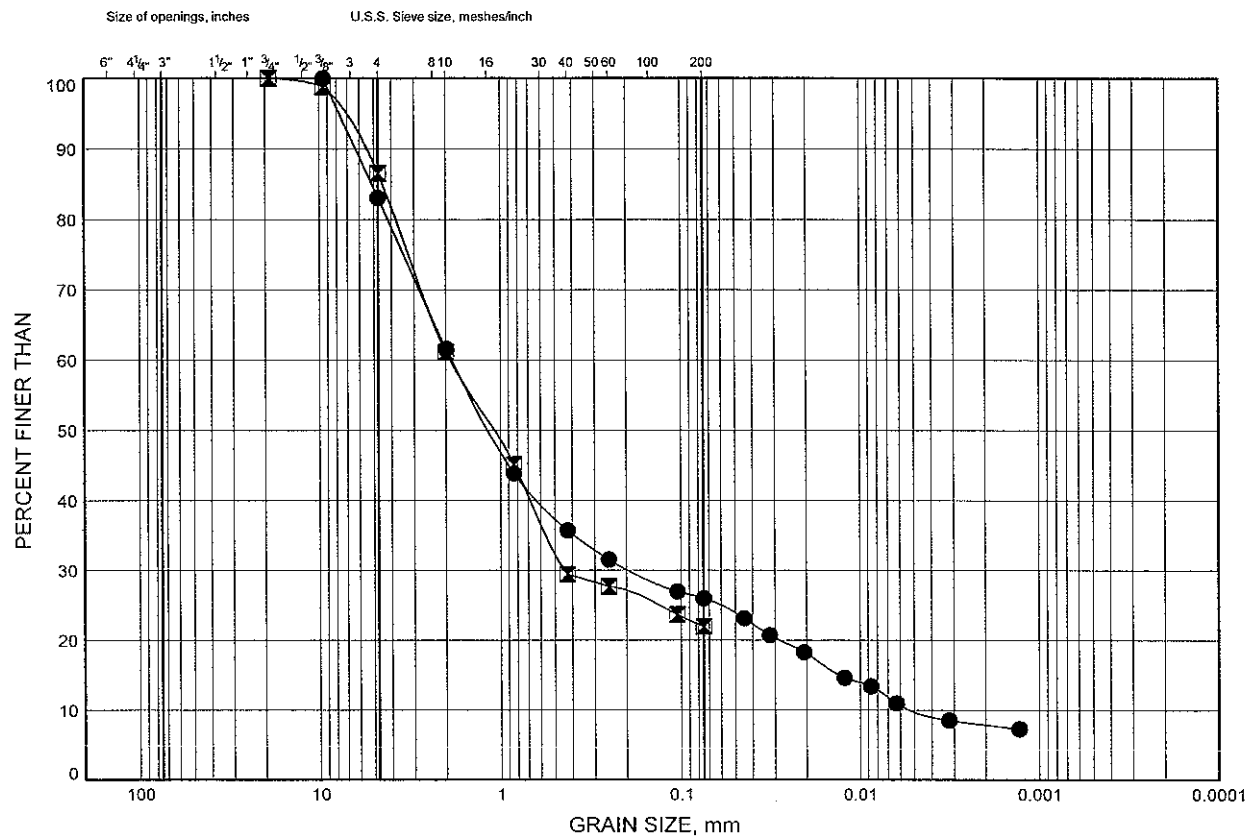
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-2

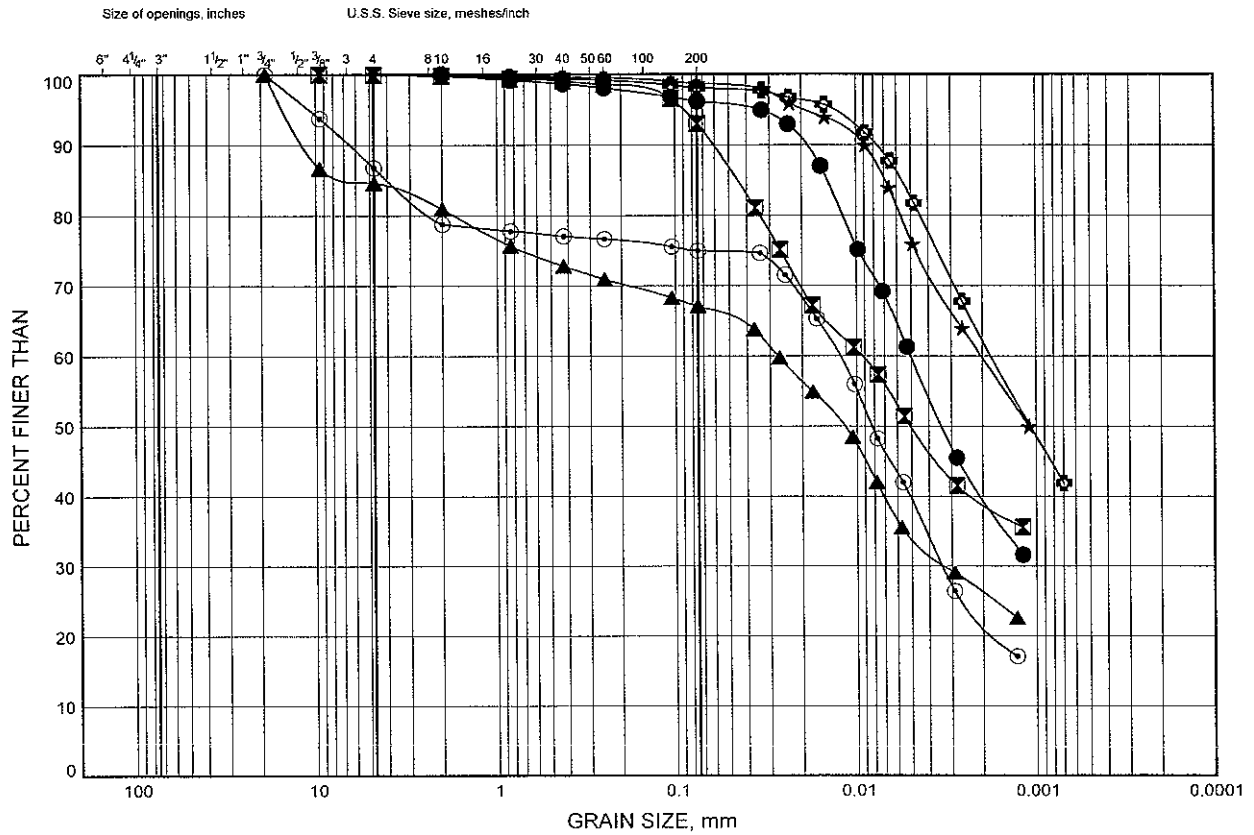
FILL - Silty Sand to Sand and Silt



GRAIN SIZE DISTRIBUTION

FIGURE B4-3

FILL - Silty Clay



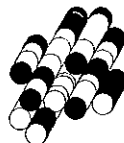
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+075CL	0.3	184.3
⊠	NBL 12+150Rt	1.0	182.5
▲	NBL 12+375Lt	1.0	182.3
★	NBL 12+645Lt	1.7	181.6
⊙	TN2	1.0	183.2
⊗	WN1	1.0	182.1

Date July 2010

Project 1-09-4135



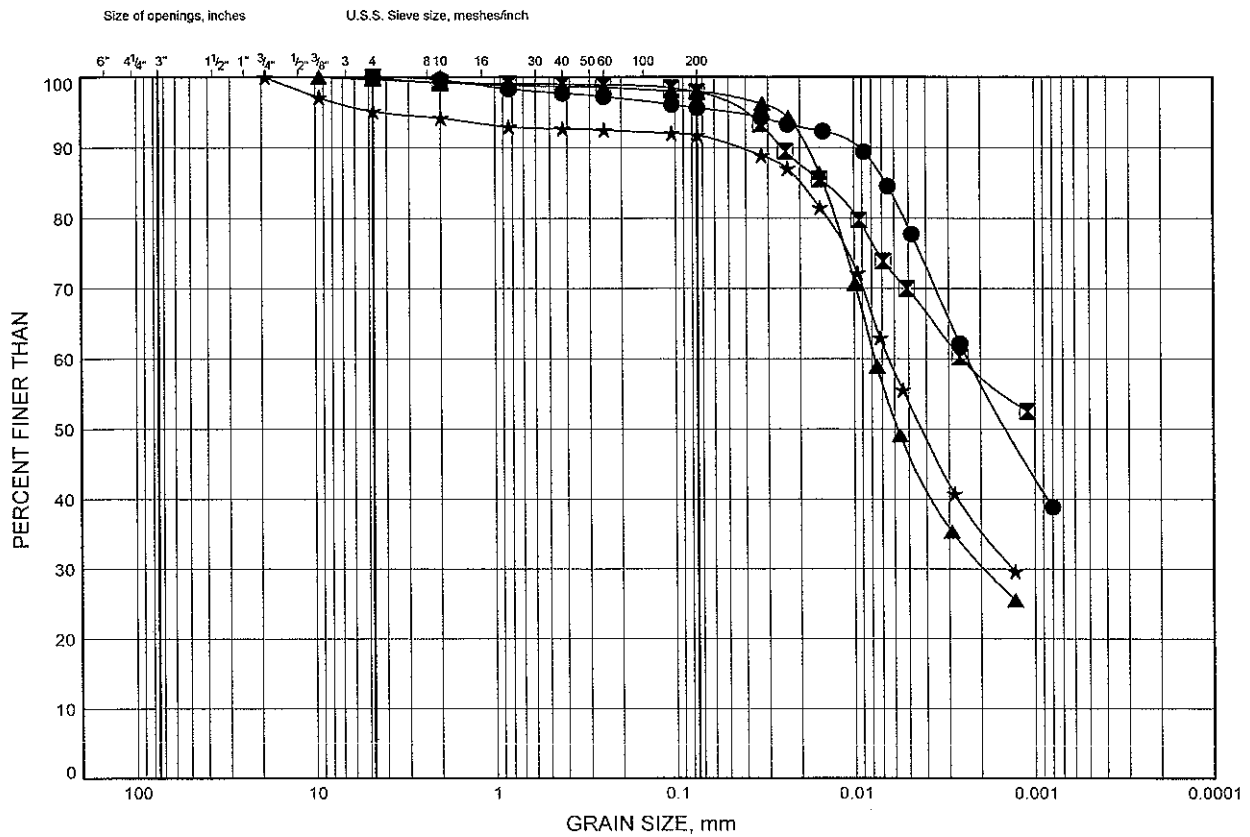
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-4

FILL - Silty Clay



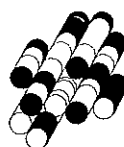
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+750Rt	0.3	182.5
⊠	SBL 12+185Lt	0.3	182.9
▲	WN4	1.0	181.5
★	WN4	2.5	180.0

Date July 2010

Project 1-09-4135



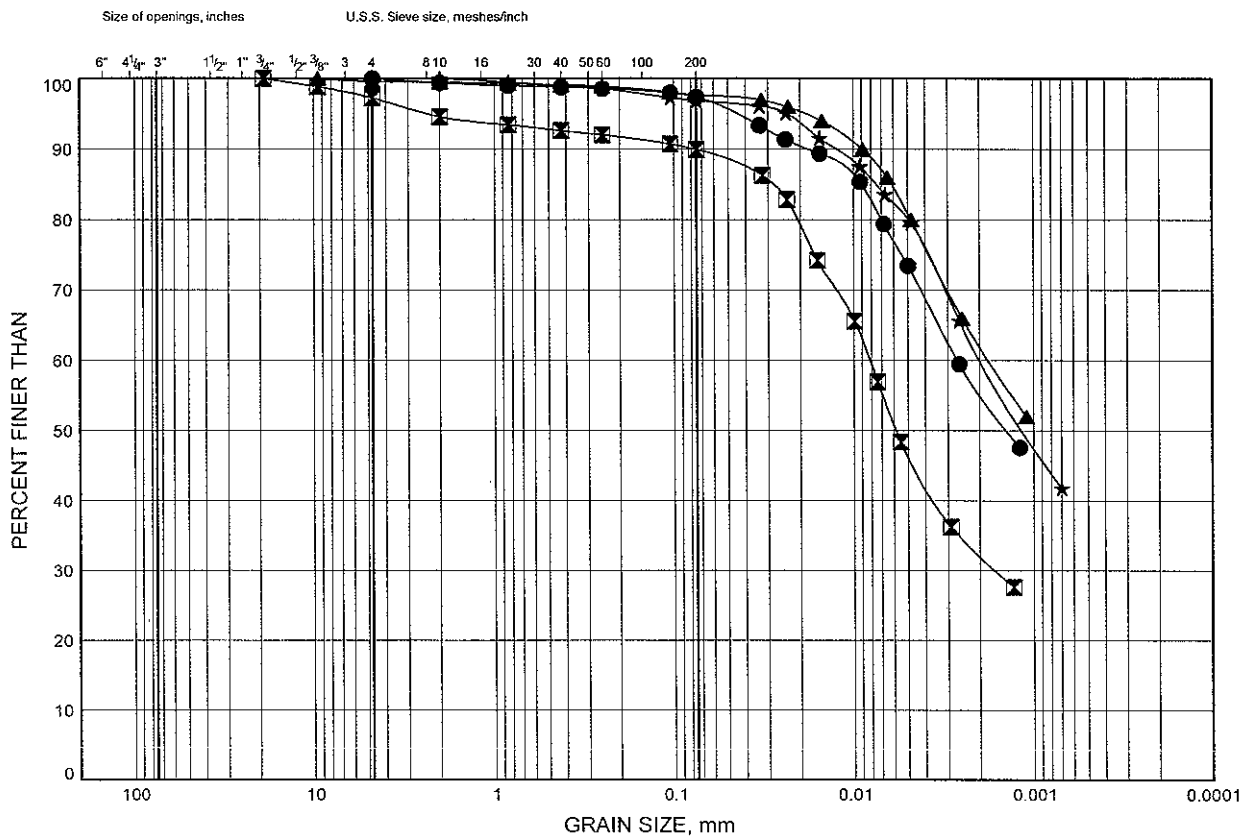
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-5

FILL - Silty Clay

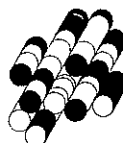


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+260CL	2.5	183.5
⊠	TS2	1.0	182.3
▲	WS1	1.0	181.7
★	WS3	1.7	181.3

Date July 2010

Project 1-09-4135



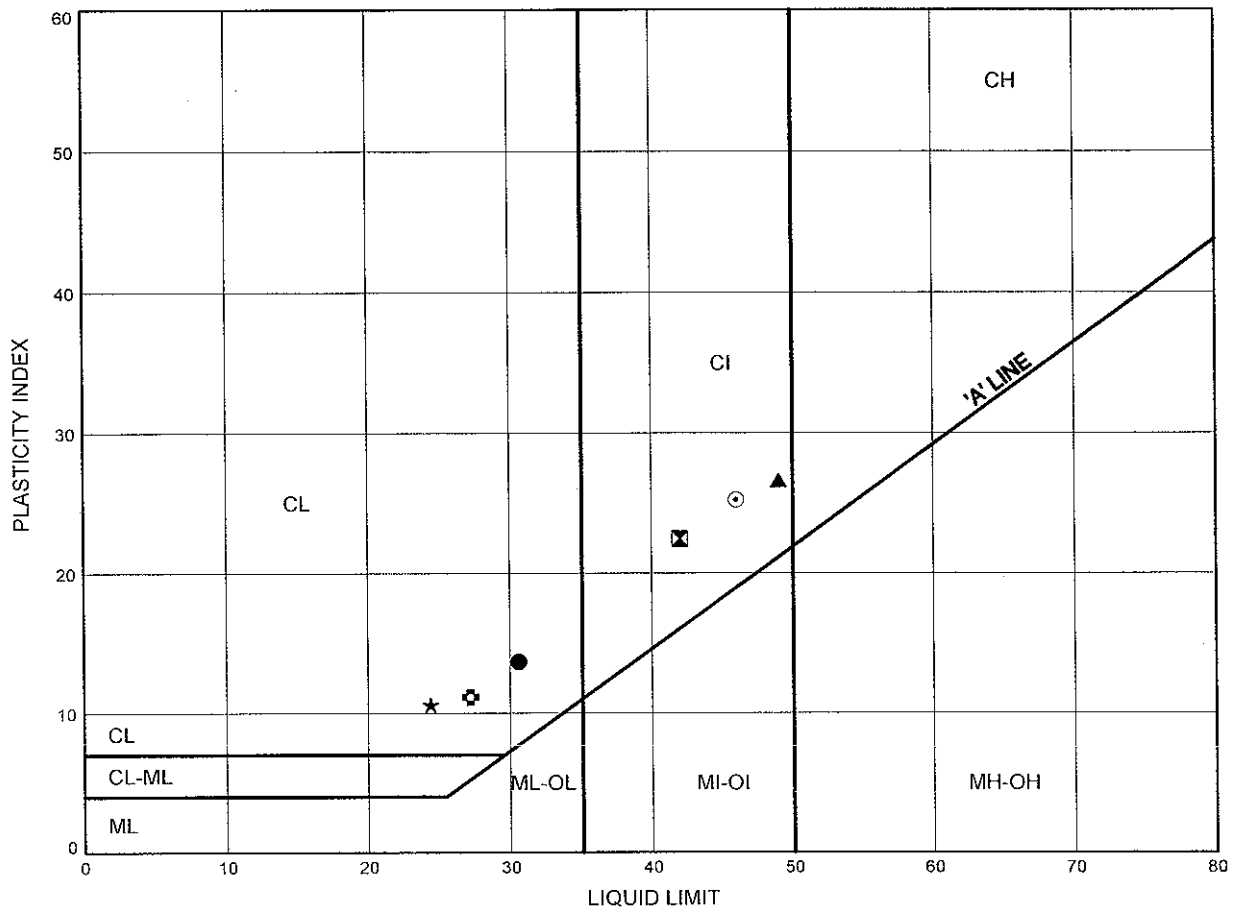
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-6

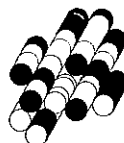
FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+075CL	0.3	184.3
⊠	NBL 12+150Rt	1.0	182.5
▲	NBL 12+645Lt	1.7	181.6
★	TN2	1.0	183.2
⊙	WN1	1.0	182.1
⊛	WN4	1.0	181.5

Date July 2010

Project 1-09-4135



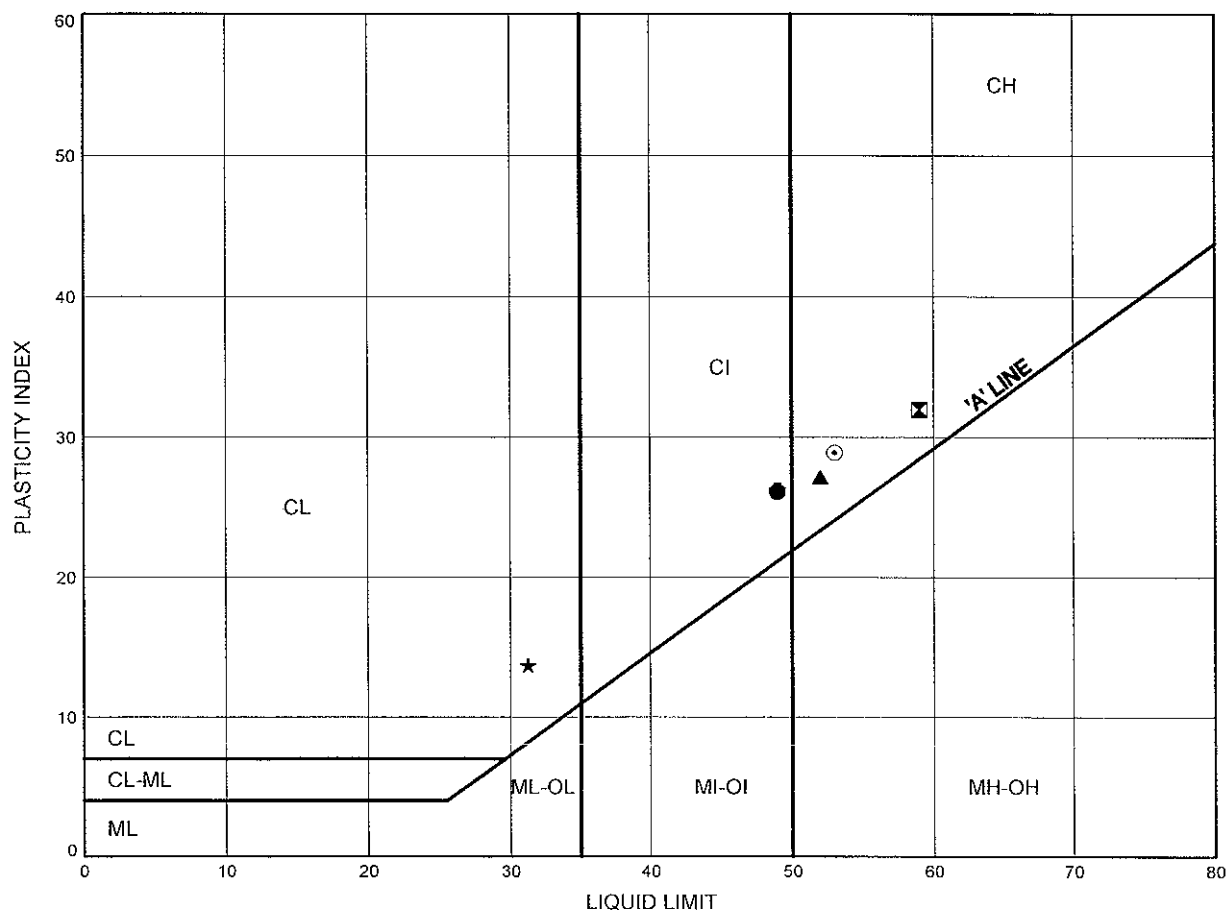
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-7

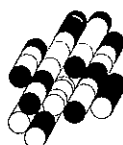
FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	0.3	182.5
⊠	SBL 12+185Lt	0.3	182.9
▲	SBL 12+260CL	2.5	183.5
★	TS2	1.0	182.3
⊙	WS1	1.0	181.7
⊕	WS3	1.7	181.3

Date July 2010

Project 1-09-4135



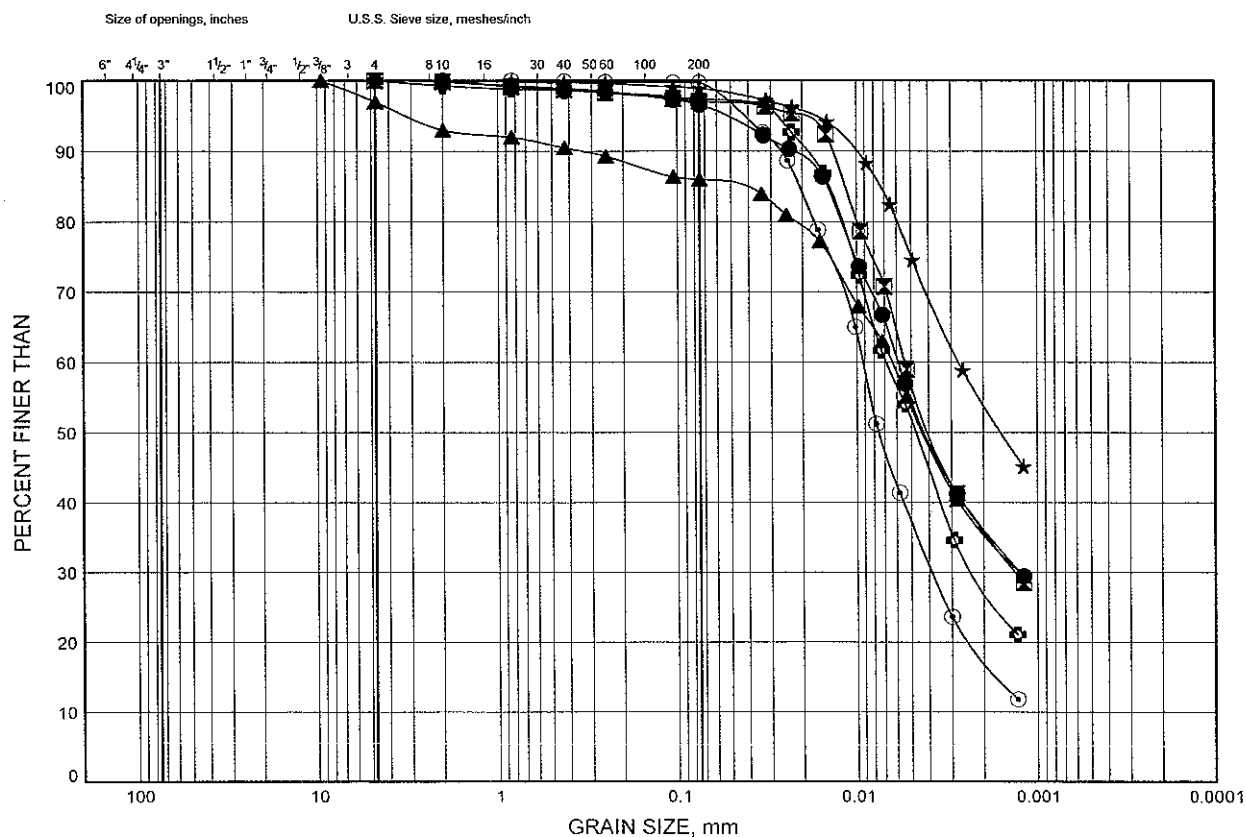
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-8

SILTY CLAY



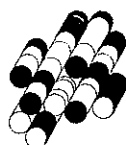
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+075CL	2.5	182.1
⊠	NBL 12+075CL	4.9	179.7
▲	NBL 12+150Lt	1.7	183.6
★	NBL 12+150Lt	4.0	181.3
⊙	NBL 12+150Lt	6.3	179.0
⊛	NBL 12+150Lt	9.3	176.0

Date July 2010

Project 1-09-4135



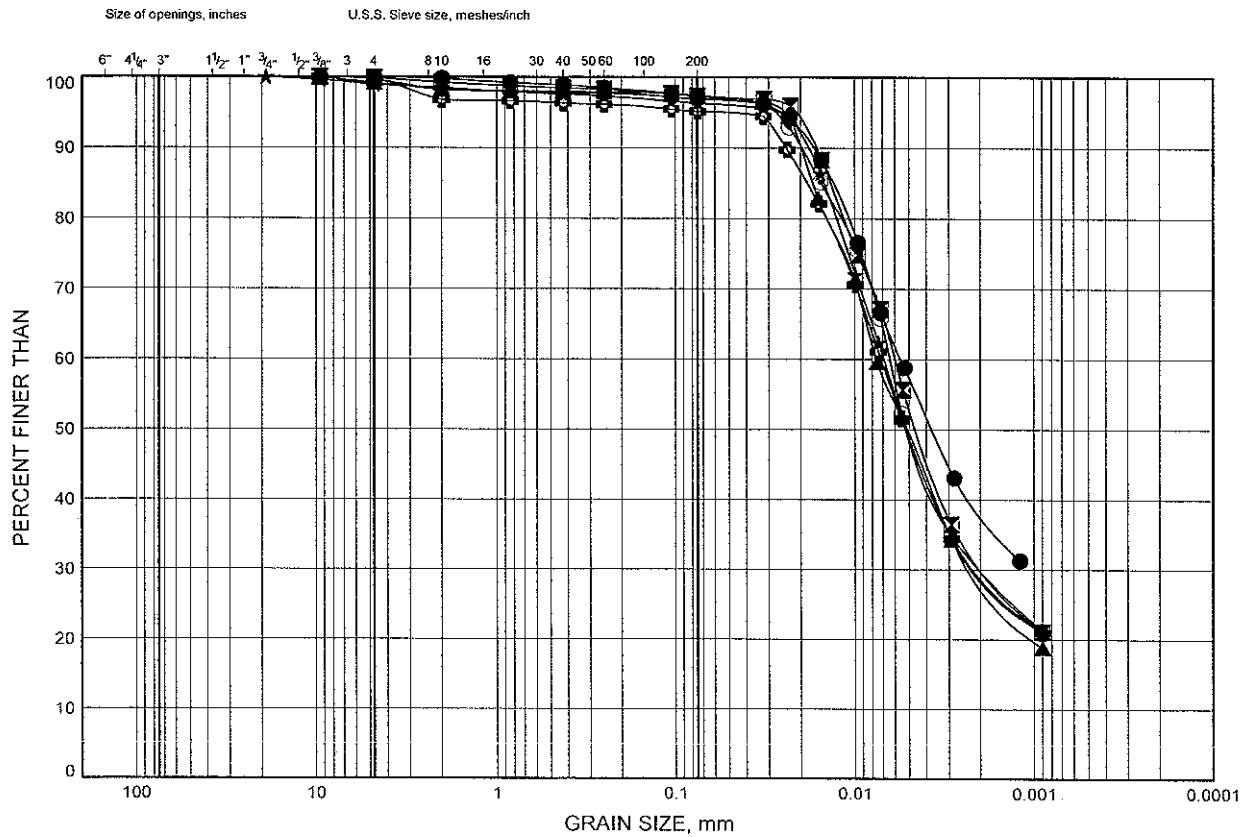
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-9

SILTY CLAY



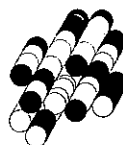
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+150Rt	2.5	181.0
⊠	NBL 12+150Rt	4.7	178.8
▲	NBL 12+150Rt	7.9	175.6
★	NBL 12+225CL	4.7	180.2
⊙	NBL 12+225CL	7.8	177.1
⊛	NBL 12+225CL	10.9	174.0

Date July 2010

Project 1-09-4135



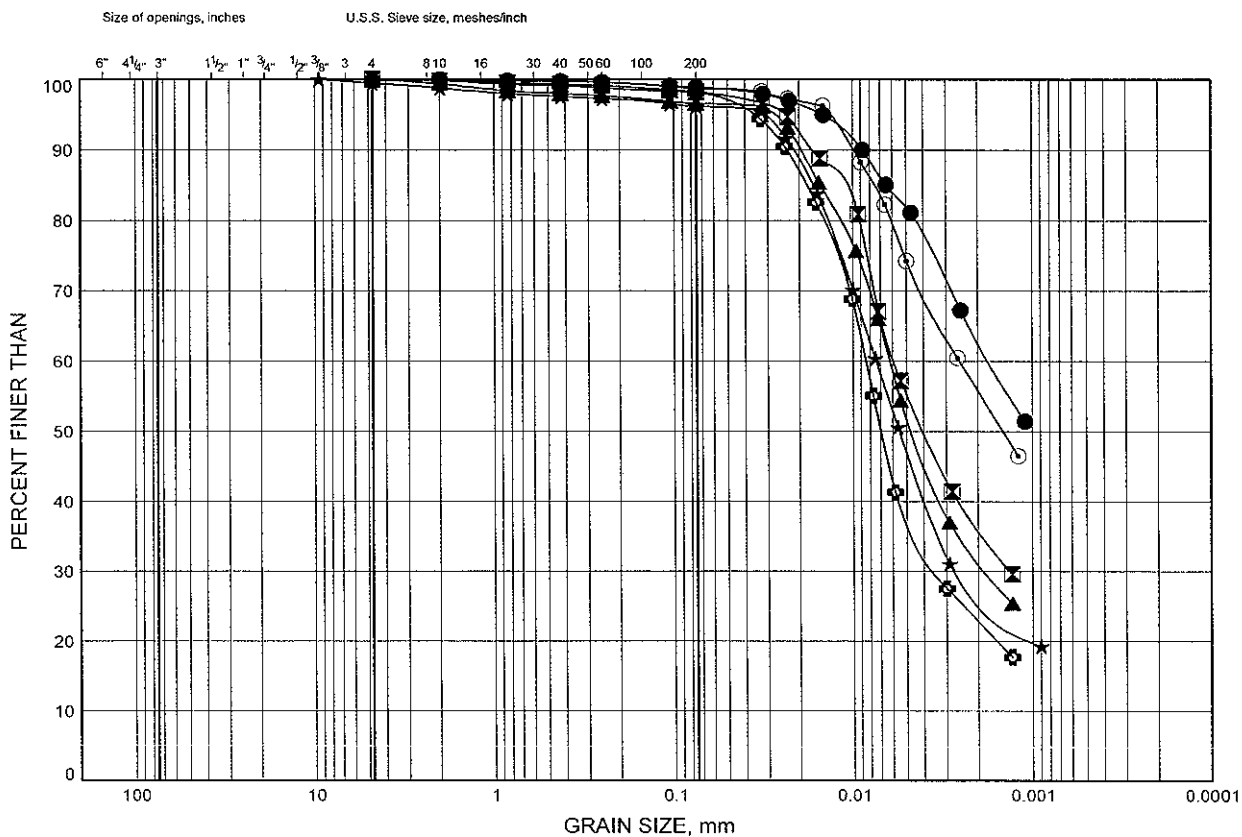
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-10

SILTY CLAY

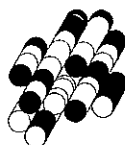


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+300Lt	1.1	182.0
⊠	NBL 12+300Lt	3.2	179.9
▲	NBL 12+300Lt	6.3	176.8
★	NBL 12+300Lt	9.3	173.8
⊙	NBL 12+300Rt	1.0	181.7
⊛	NBL 12+300Rt	4.7	178.0

Date July 2010

Project 1-09-4135



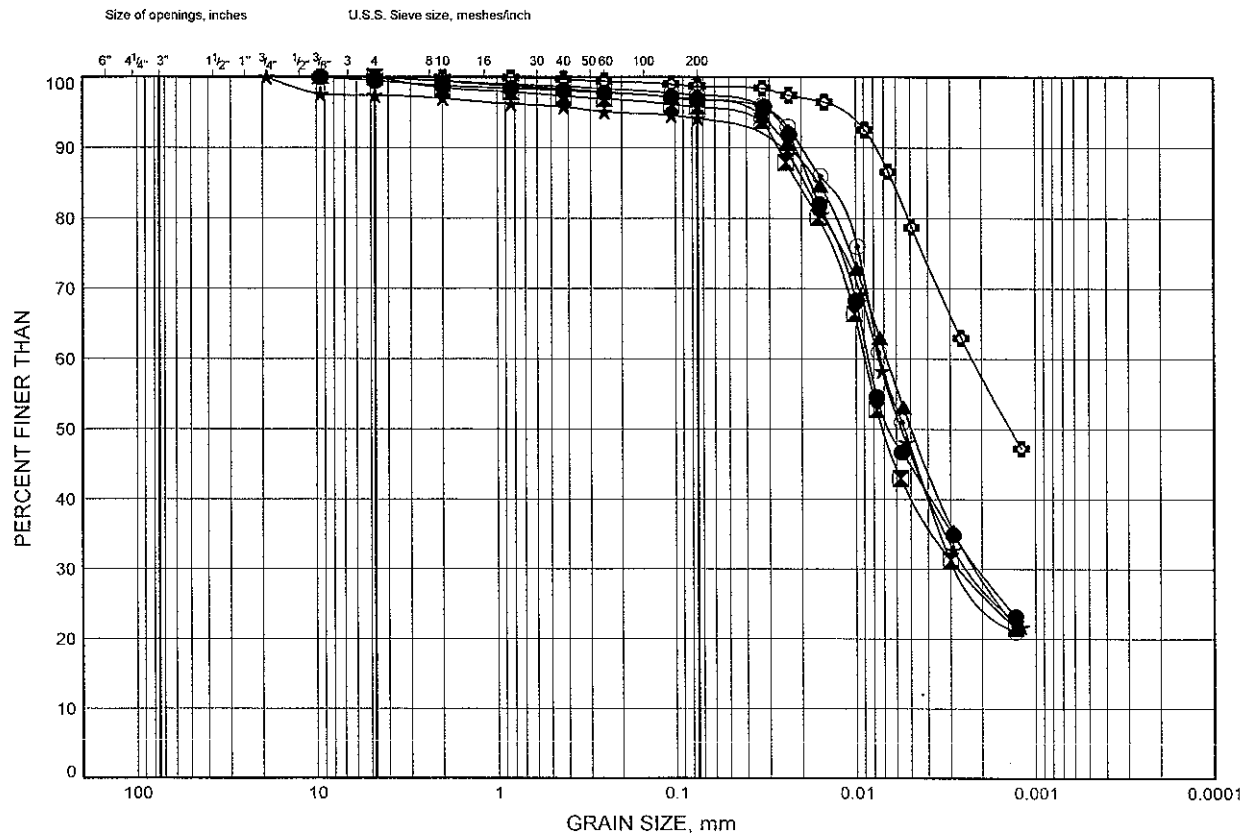
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-11

SILTY CLAY

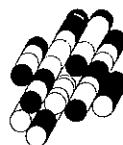


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+300Rt	9.3	173.4
⊠	NBL 12+375Lt	4.7	178.6
▲	NBL 12+375Lt	7.8	175.5
★	NBL 12+375Lt	9.3	174.0
⊙	NBL 12+375Lt	10.9	172.4
⊕	TN1	2.5	181.0

Date July 2010

Project 1-09-4135



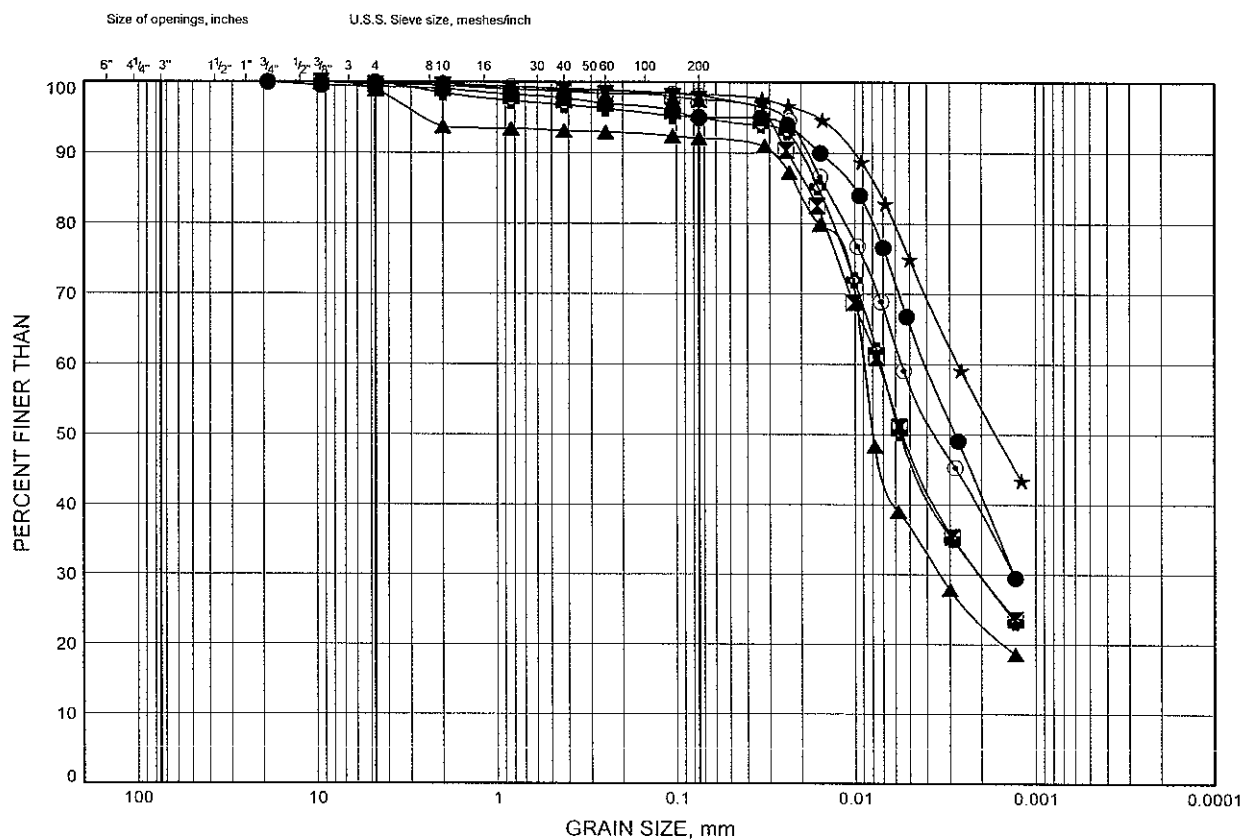
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-12

SILTY CLAY



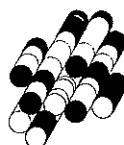
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TN1	4.7	178.8
⊠	TN1	7.8	175.7
▲	TN1	10.9	172.6
★	TN2	3.2	181.0
⊙	TN2	5.5	178.7
⊕	TN2	9.3	174.9

Date July 2010

Project 1-09-4135



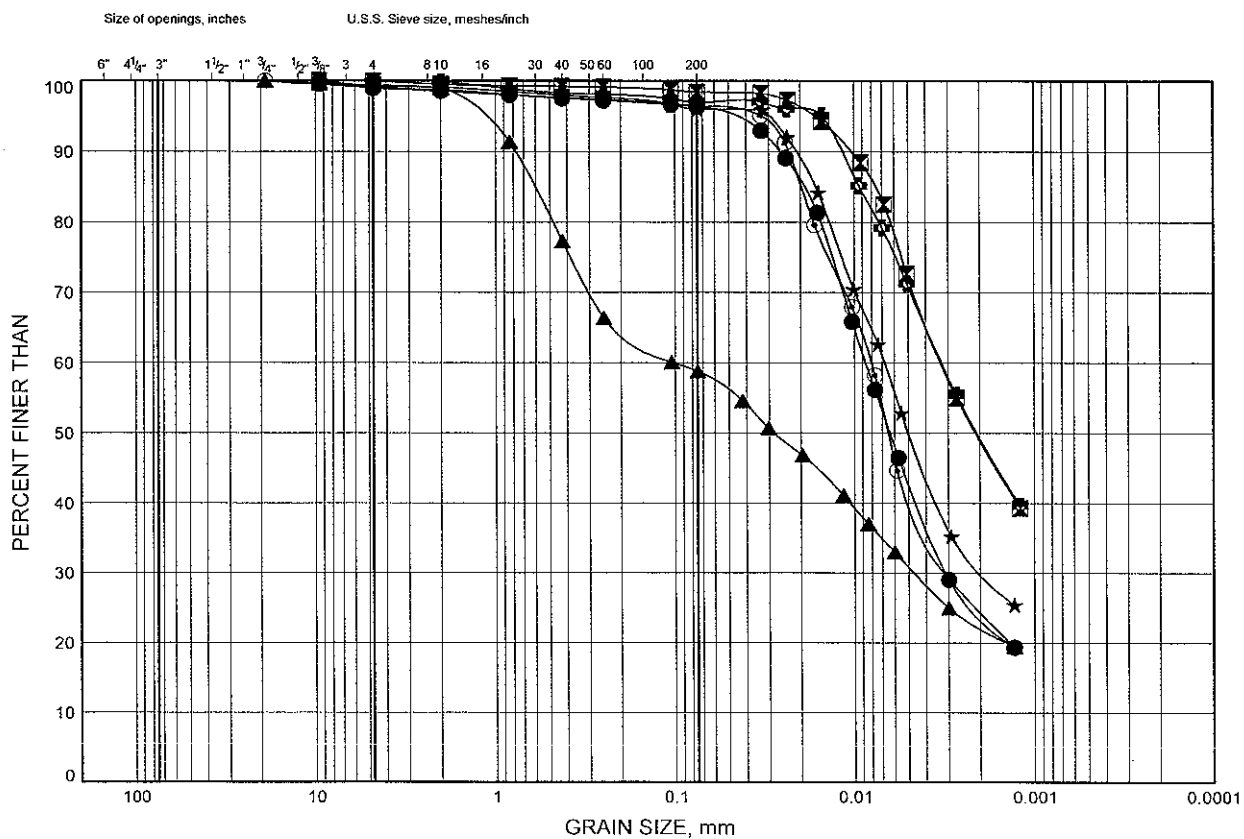
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-13

SILTY CLAY

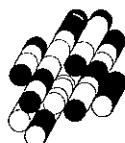


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN2	13.9	170.3
⊠	TN3	4.0	180.1
▲	TN3	5.5	178.6
★	TN3	9.3	174.8
⊙	TN3	13.9	170.2
⊕	TN4	2.5	181.5

Date July 2010

Project 1-09-4135



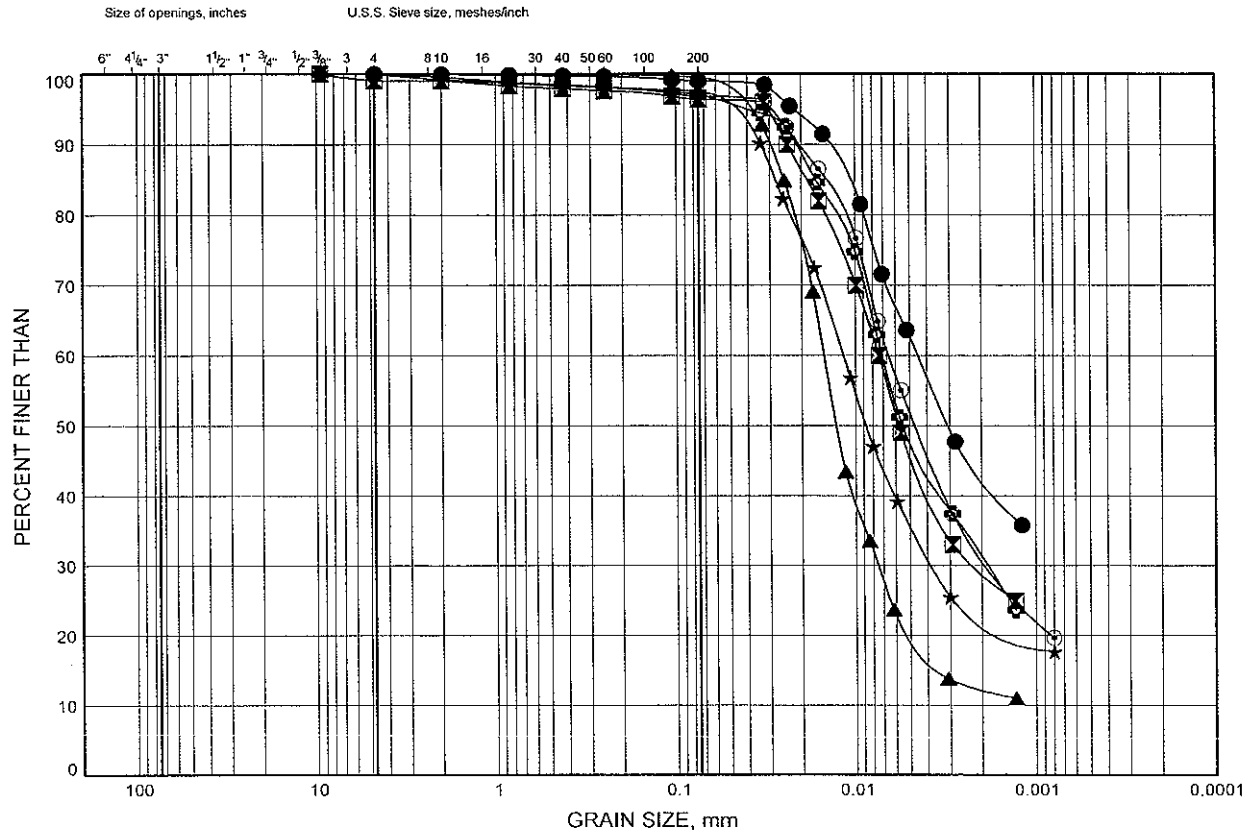
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-14

SILTY CLAY



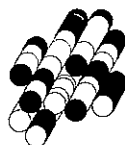
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+440Rt	3.2	179.8
⊠	NBL 12+440Rt	6.3	176.7
▲	NBL 12+440Rt	7.8	175.2
★	TN4	4.0	180.0
⊕	TN4	5.5	178.5
⊗	TN4	9.3	174.7

Date July 2010

Project 1-09-4135



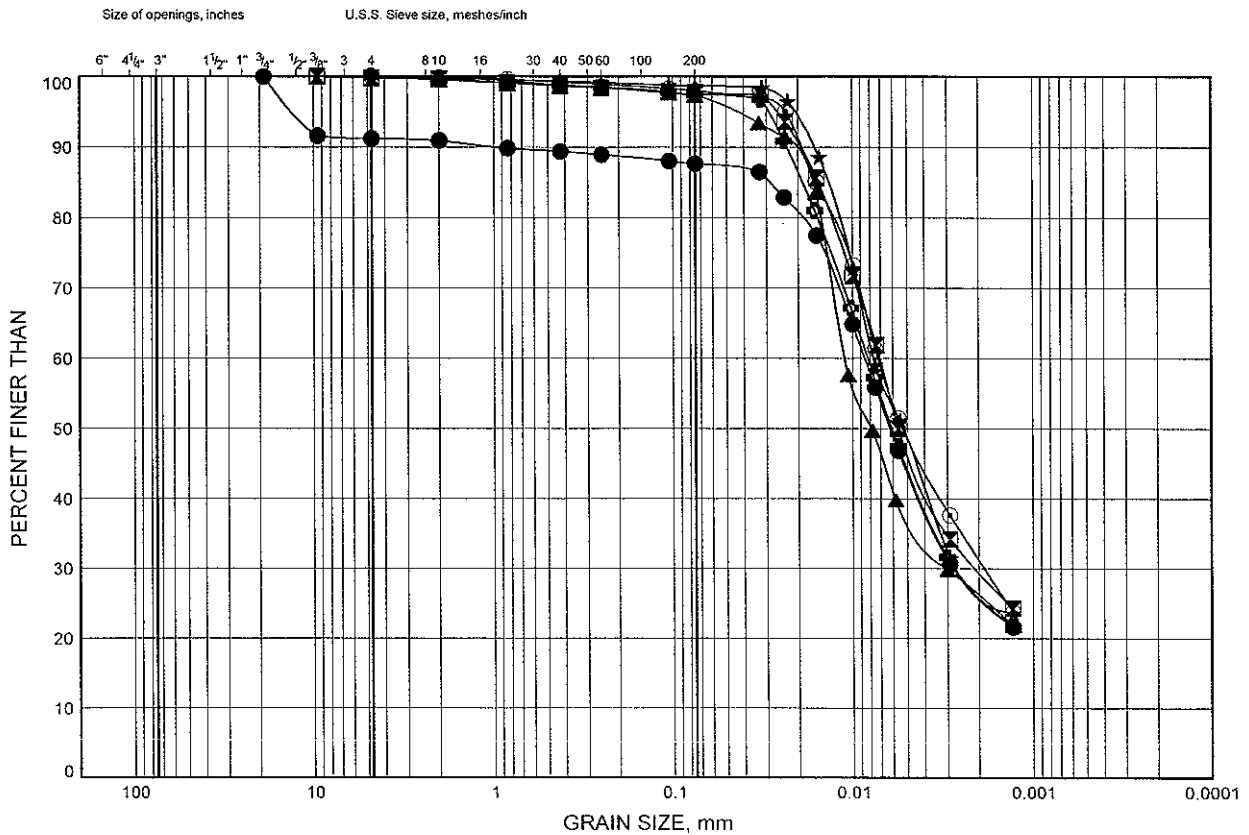
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-16

SILTY CLAY



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+525Rt	3.2	178.8
⊠	NBL 12+525Rt	6.3	175.7
▲	NBL 12+525Rt	9.3	172.7
★	NBL 12+525Rt	10.9	171.1
⊙	NBL 12+595Rt	3.2	178.4
⊛	NBL 12+595Rt	6.3	175.3

Date July 2010

Project 1-09-4135



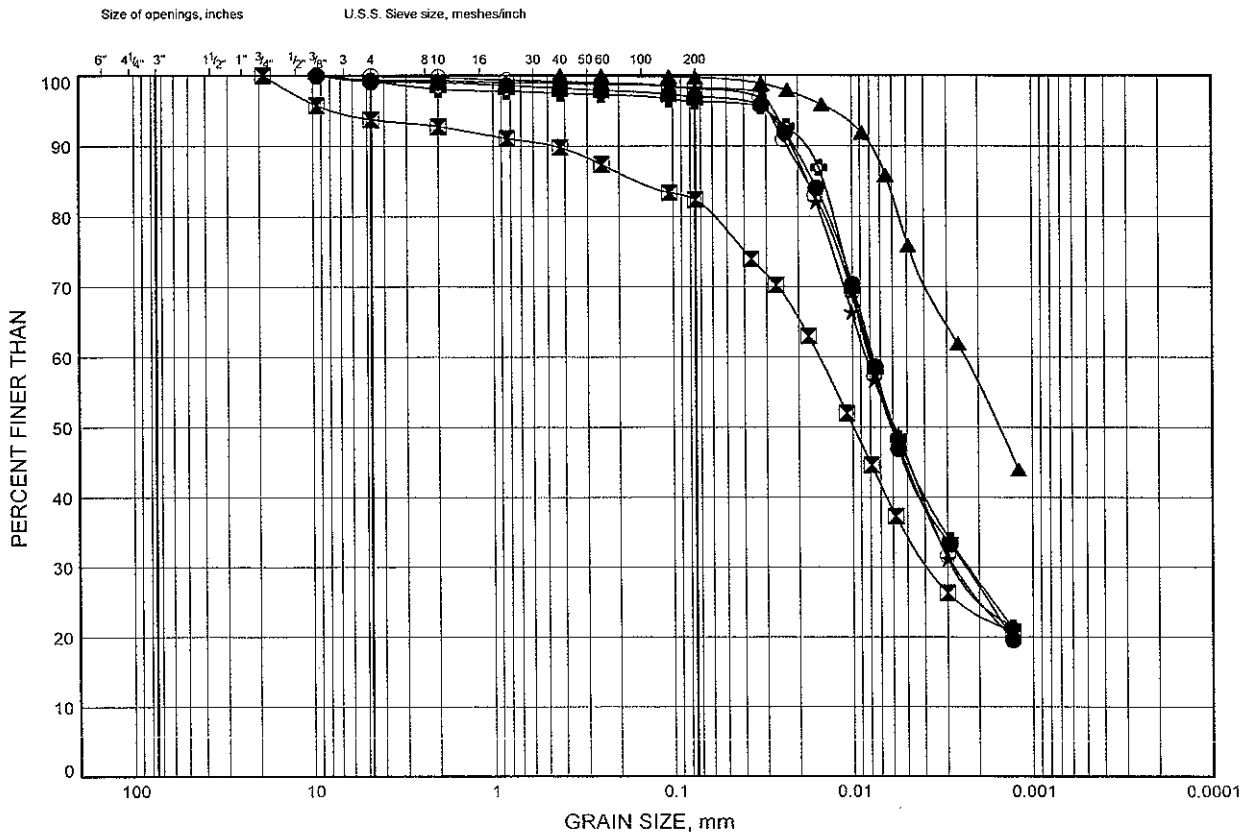
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GRAIN SIZE DISTRIBUTION

FIGURE B4-17

SILTY CLAY



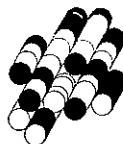
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+595Rt	9.3	172.3
⊠	NBL 12+595Rt	12.4	169.2
▲	NBL 12+645Lt	2.5	180.8
★	NBL 12+645Lt	7.8	175.5
⊙	NBL 12+645Lt	9.3	174.0
⊛	NBL 12+645Lt	12.4	170.9

Date July 2010

Project 1-09-4135



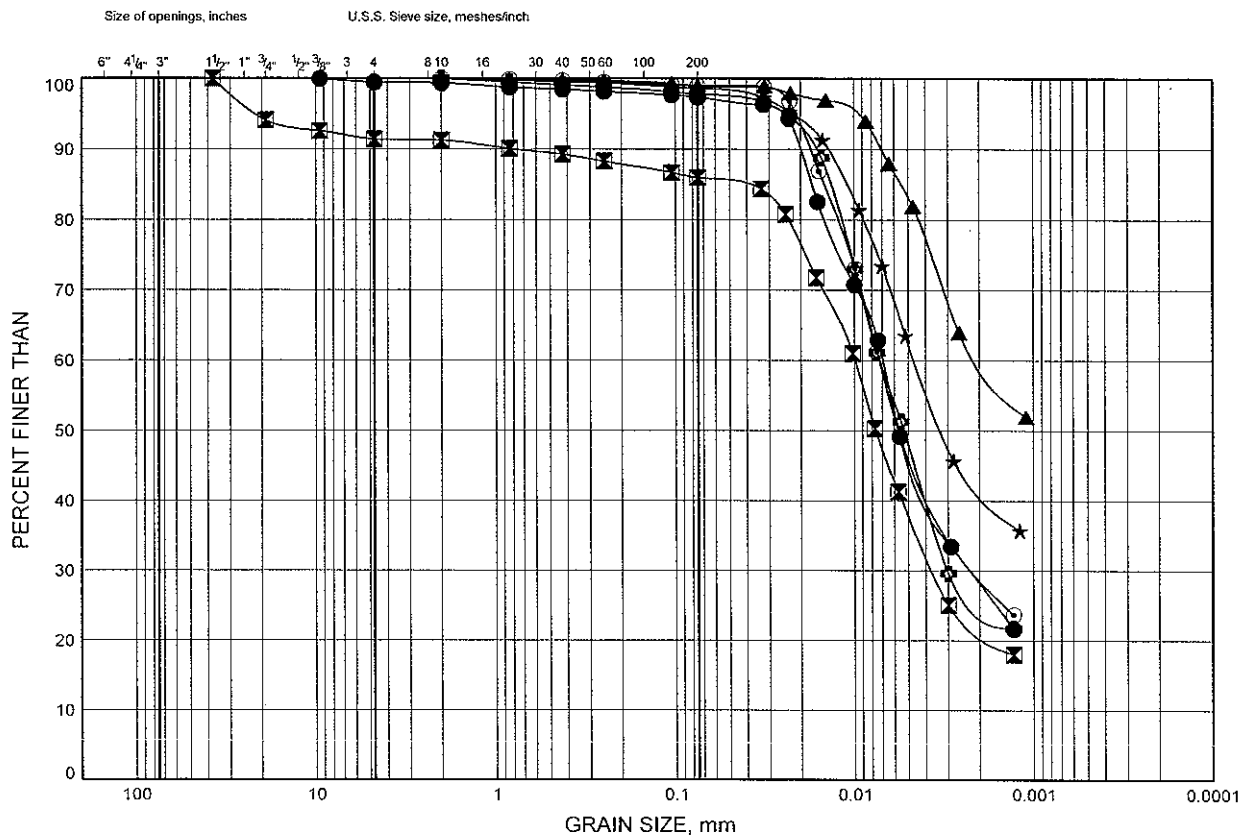
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-18

SILTY CLAY



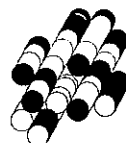
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+645Rt	6.3	174.7
⊠	NBL 12+645Rt	7.8	173.2
▲	NBL 12+695Lt	1.7	181.2
★	NBL 12+695Lt	3.2	179.7
⊙	NBL 12+695Lt	6.3	176.6
⊛	NBL 12+695Lt	9.3	173.6

Date July 2010

Project 1-09-4135



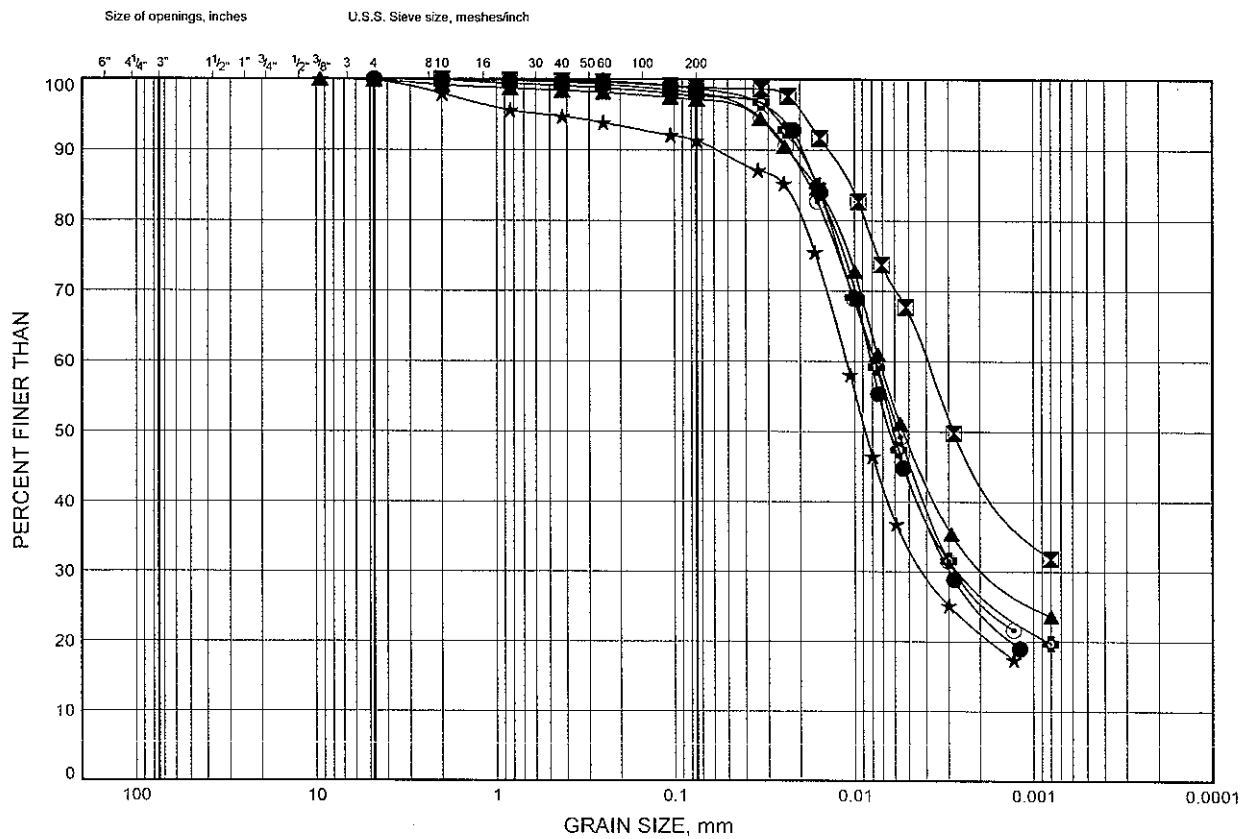
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-19

SILTY CLAY



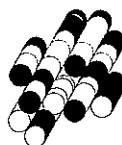
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+695Lt	12.4	170.5
⊠	WN1	3.2	179.9
▲	WN1	6.3	176.8
★	WN1	7.8	175.3
⊙	WN1	10.9	172.2
⊛	WN1	13.9	169.2

Date July 2010

Project 1-09-4135



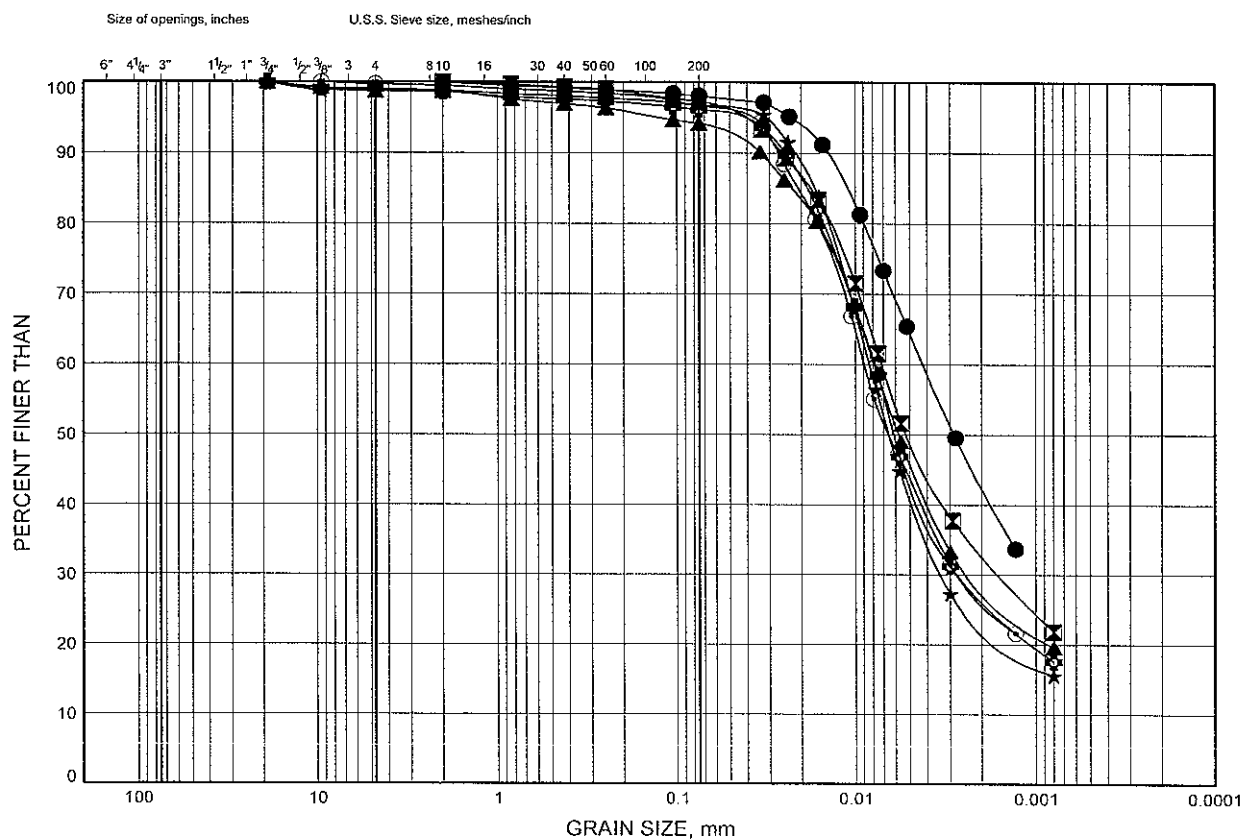
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GRAIN SIZE DISTRIBUTION

FIGURE B4-20

SILTY CLAY

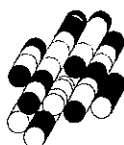


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN2	1.0	180.6
⊠	WN2	4.0	177.6
▲	WN2	6.3	175.3
★	WN2	10.9	170.7
⊙	WN3	7.8	174.3
⊕	WN3	9.3	172.8

Date July 2010

Project 1-09-4135



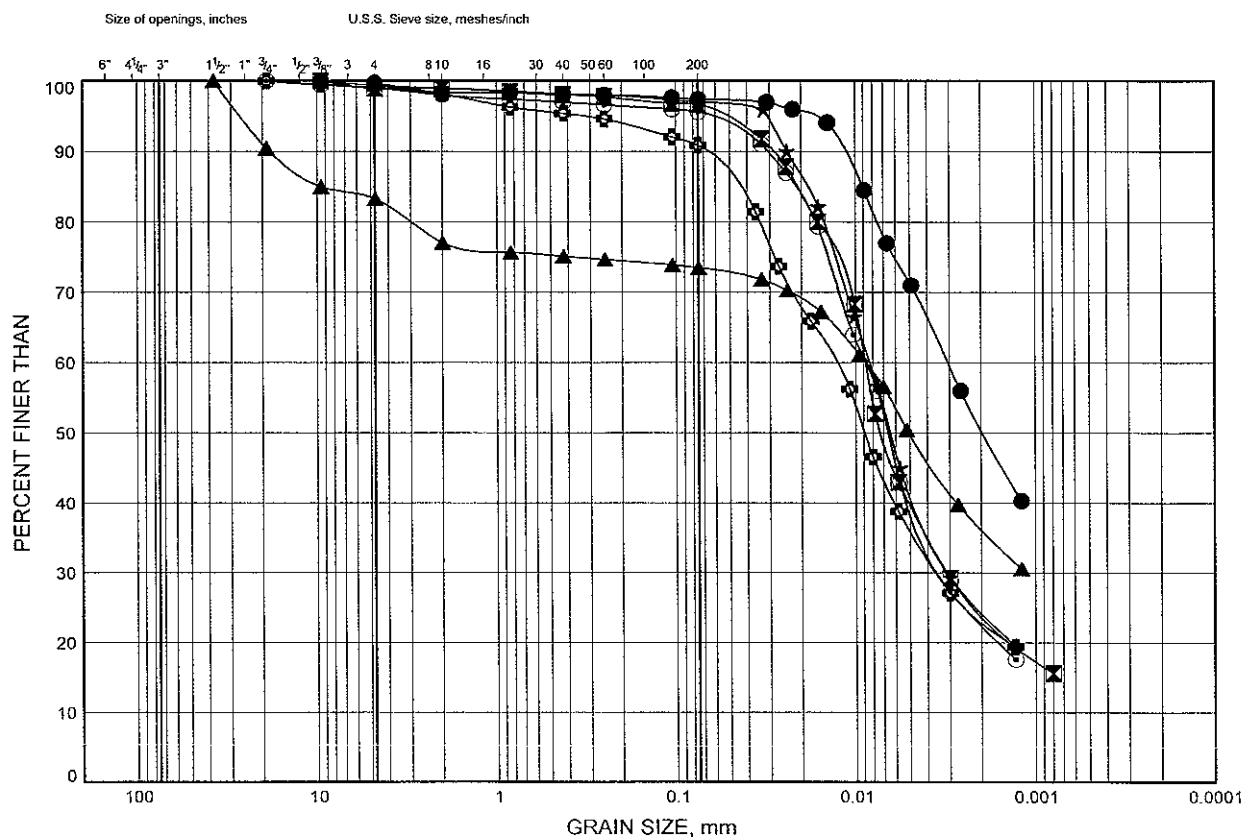
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GRAIN SIZE DISTRIBUTION

FIGURE B4-21

SILTY CLAY



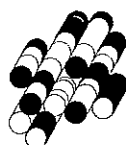
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+750Rt	1.7	181.1
⊠	WN3	12.4	169.7
▲	WN4	5.5	177.0
★	WN4	9.3	173.2
⊙	WN4	10.9	171.6
⊛	WN4	13.9	168.6

Date July 2010

Project 1-09-4135



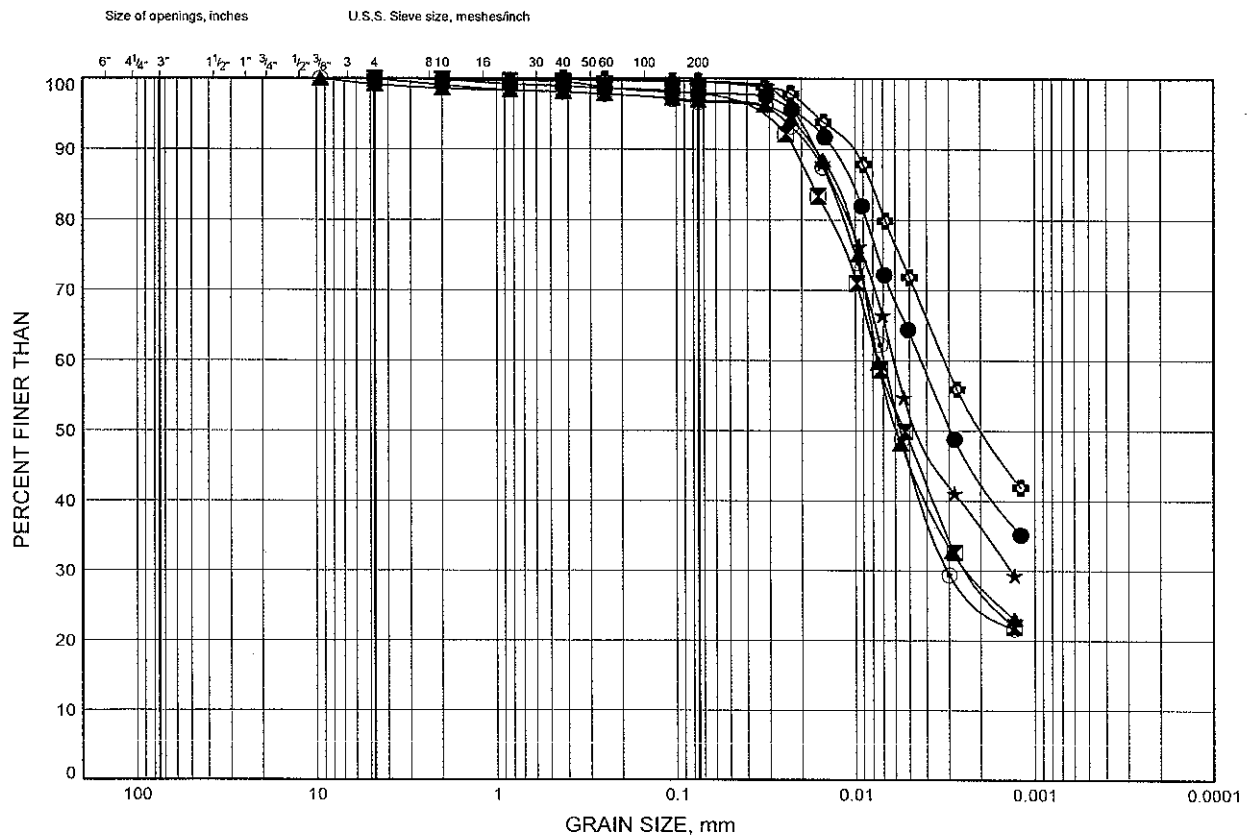
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GRAIN SIZE DISTRIBUTION

FIGURE B4-22

SILTY CLAY



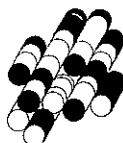
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+750Rt	4.7	178.1
⊠	NBL 12+750Rt	9.3	173.5
▲	NBL 12+750Rt	12.4	170.4
★	NBL 12+835Lt	2.5	178.7
⊙	NBL 12+835Lt	7.8	173.4
⊕	NBL 12+835Rt	3.2	179.7

Date July 2010

Project 1-09-4135



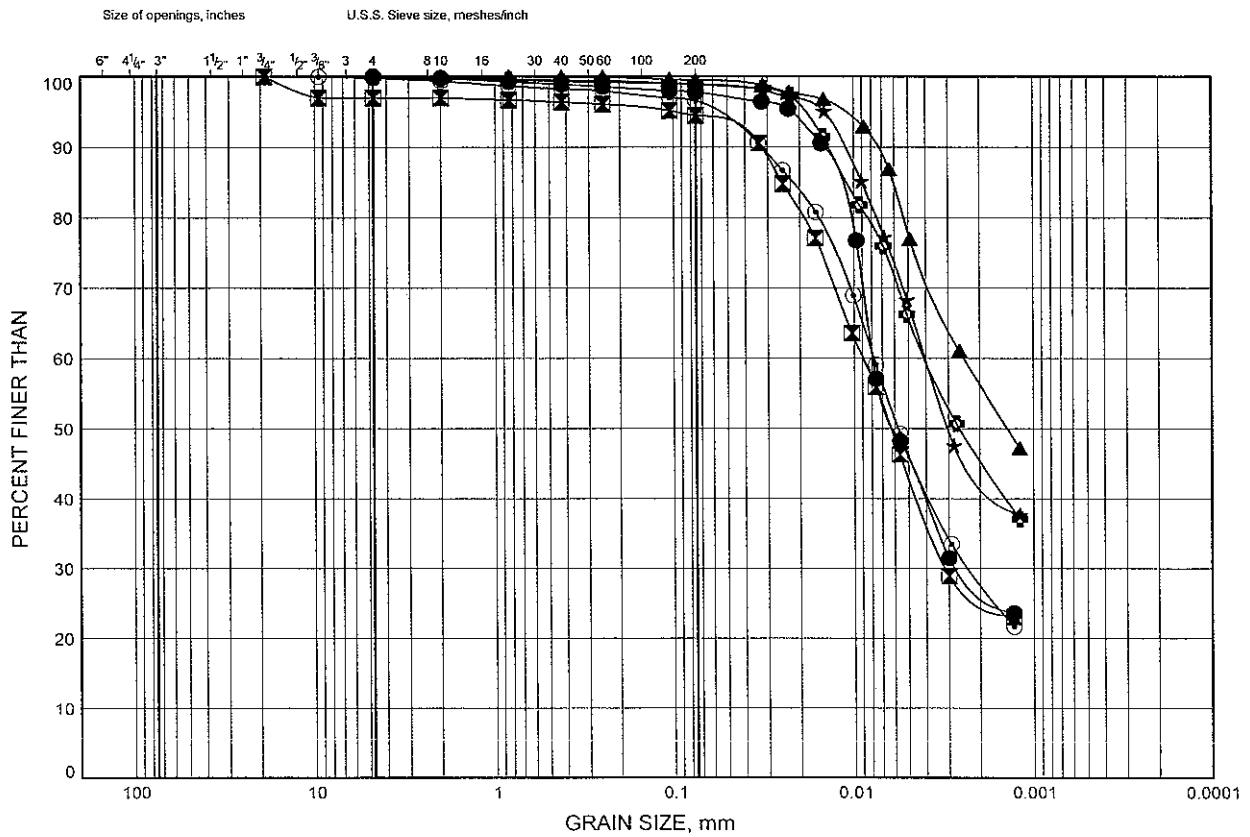
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-23

SILTY CLAY



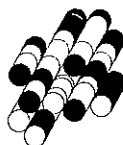
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+835Rt	9.3	173.6
⊠	NBL 12+835Rt	10.9	172.0
▲	NBL 12+910CL	1.7	181.0
★	NBL 12+910CL	4.7	178.0
⊙	NBL 12+910CL	9.3	173.4
⊕	NBL 12+985Lt	3.2	177.9

Date July 2010

Project 1-09-4135



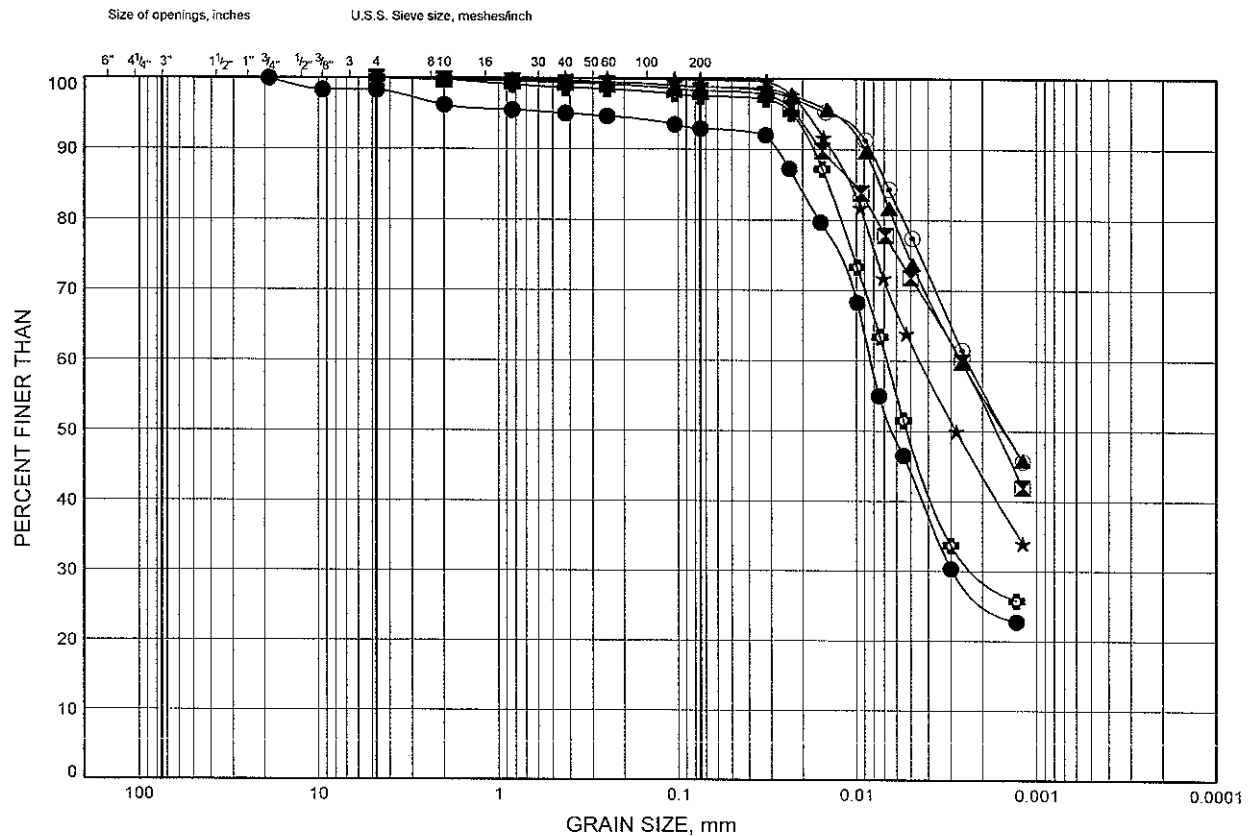
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-24

SILTY CLAY



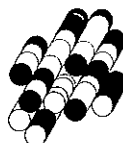
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+985Lt	6.3	174.8
⊠	NBL 12+985Rt	1.7	180.6
▲	NBL 12+985Rt	3.2	179.1
★	NBL 12+985Rt	4.7	177.6
⊙	SBL 12+185Lt	1.7	181.5
⊛	SBL 12+185Lt	4.7	178.5

Date July 2010

Project 1-09-4135



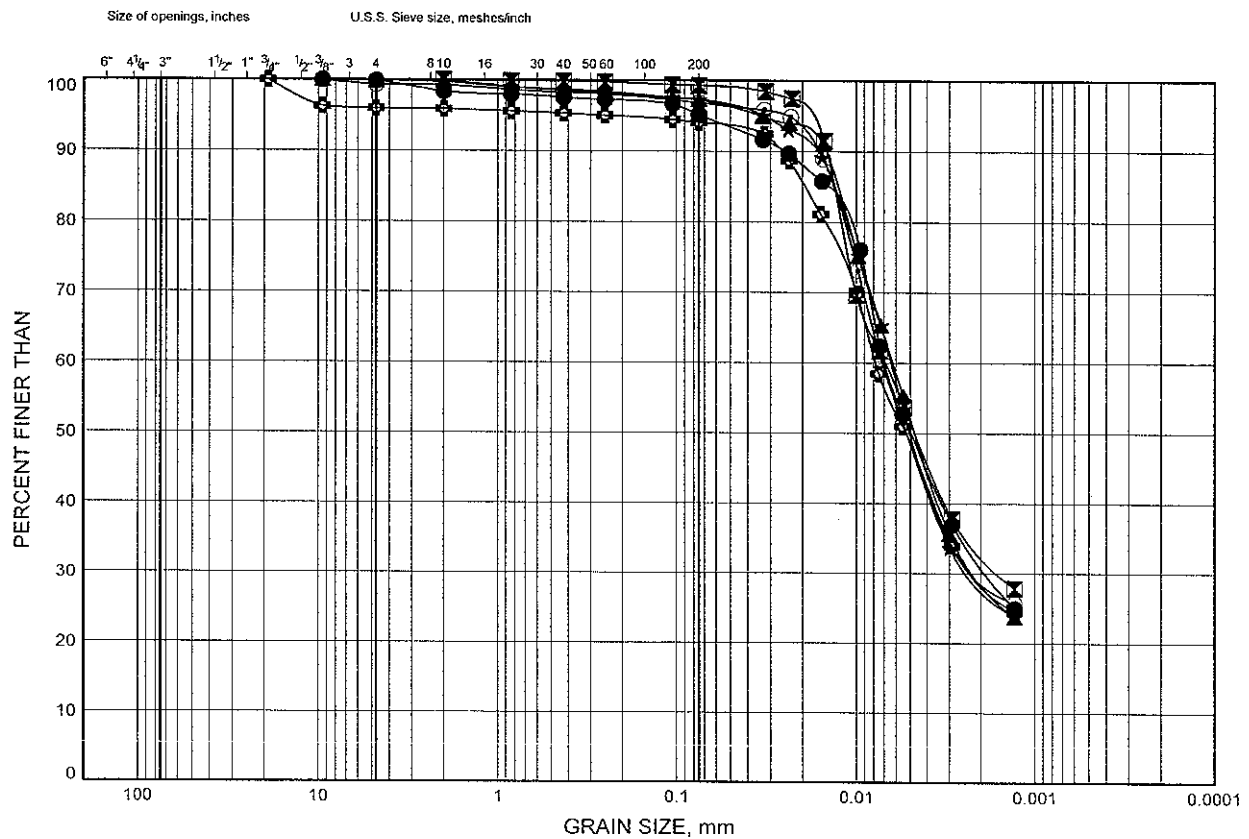
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-25

SILTY CLAY



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

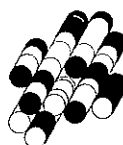
SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+185Lt	7.8	175.4
⊠	SBL 12+185Rt	2.5	181.1
▲	SBL 12+185Rt	4.7	178.9
★	SBL 12+185Rt	7.8	175.8
⊙	SBL 12+260CL	6.3	179.7
⊛	SBL 12+260CL	9.3	176.7

GSD 1-09-4135 SITE4.GPJ 07/06/10

Date July 2010

Project 1-09-4135



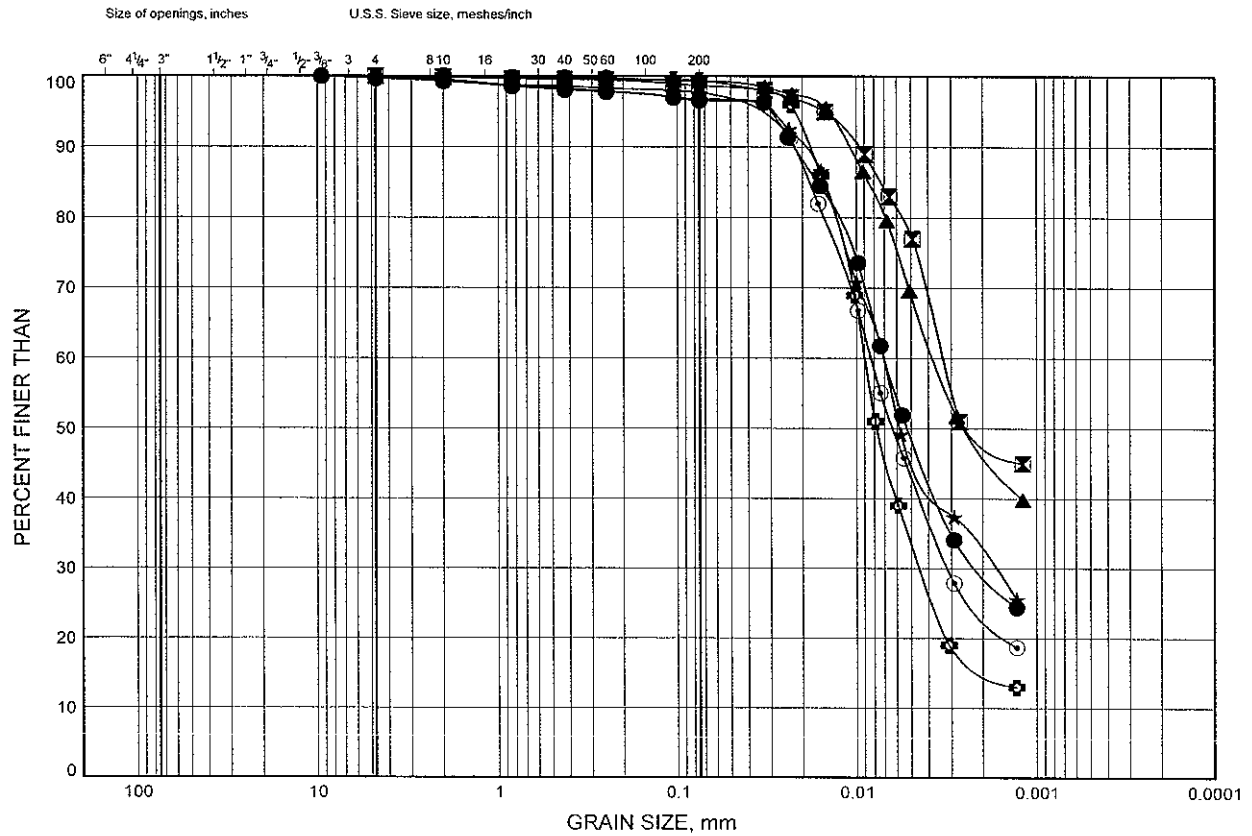
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-26

SILTY CLAY



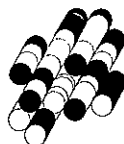
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+260CL	12.4	173.6
⊠	SBL 12+360CL	1.0	181.9
▲	SBL 12+360CL	3.2	179.7
★	SBL 12+360CL	7.8	175.1
⊙	SBL 12+360CL	10.9	172.0
⊛	SBL 12+360CL	12.4	170.5

Date July 2010

Project 1-09-4135



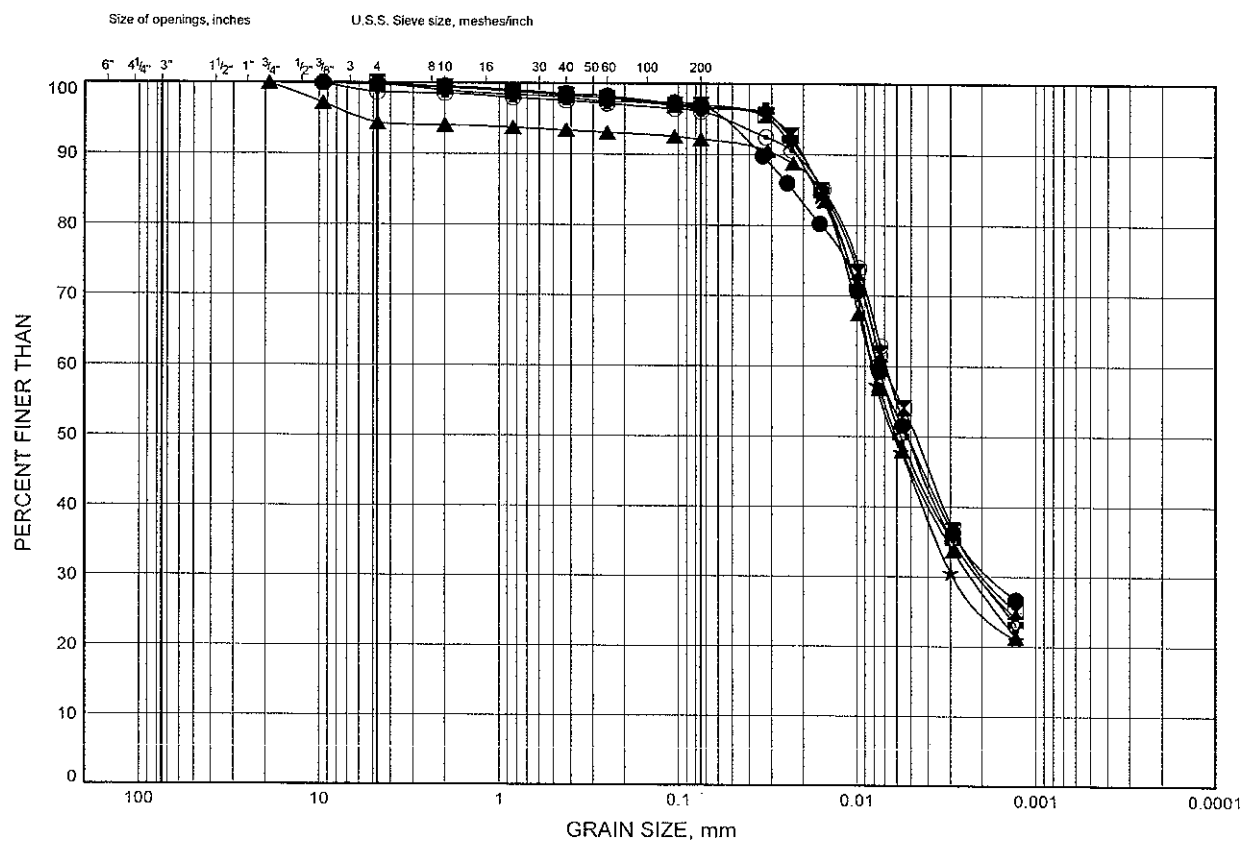
Prep'd BD

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-27

SILTY CLAY

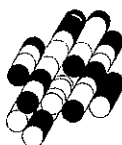


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS1	2.5	180.1
⊠	TS1	4.7	177.9
▲	TS1	9.3	173.3
★	TS1	13.9	168.7
⊙	TS2	5.5	177.8
⊕	TS2	9.3	174.0

Date July 2010

Project 1-09-4135



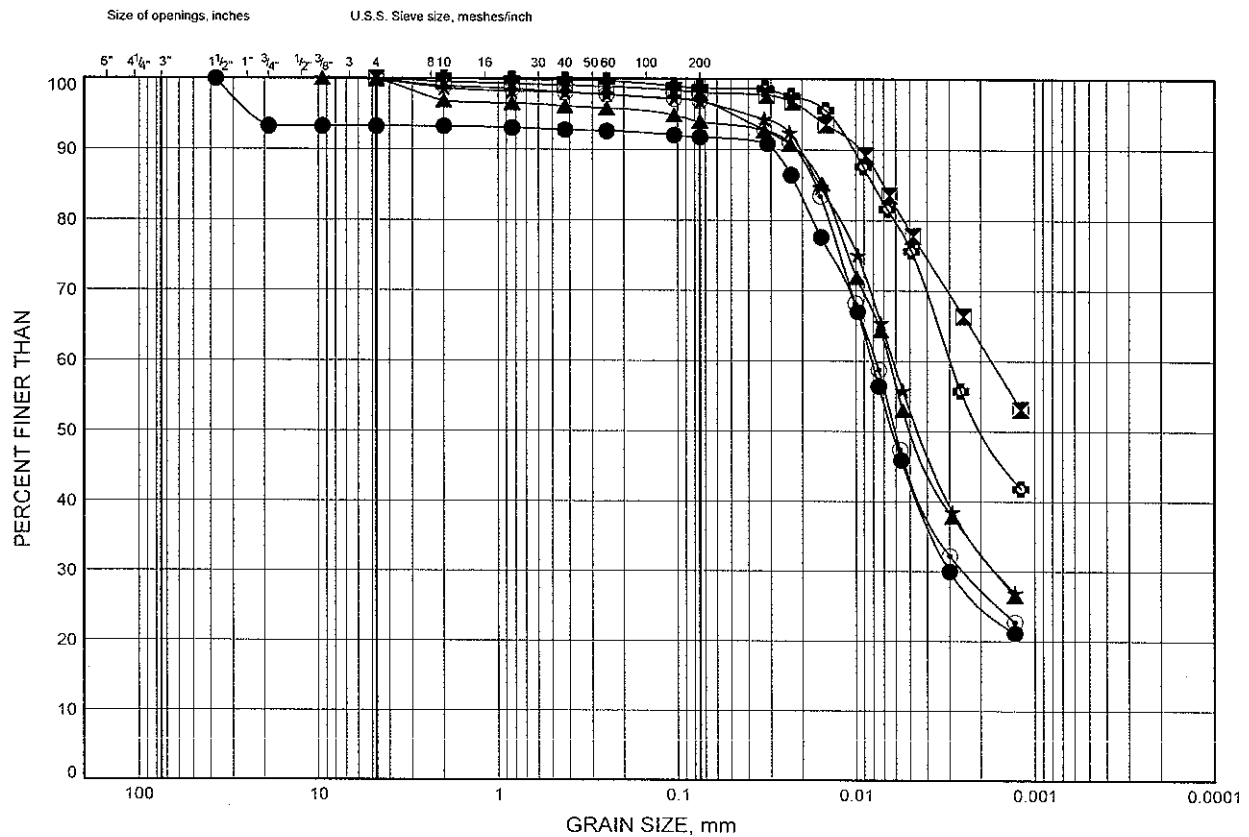
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-28

SILTY CLAY



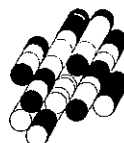
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TS2	13.9	169.4
⊠	TS3	1.7	180.8
▲	TS3	4.0	178.5
★	TS3	6.3	176.2
⊙	TS3	10.9	171.6
⊕	TS4	1.0	181.4

Date July 2010

Project 1-09-4135



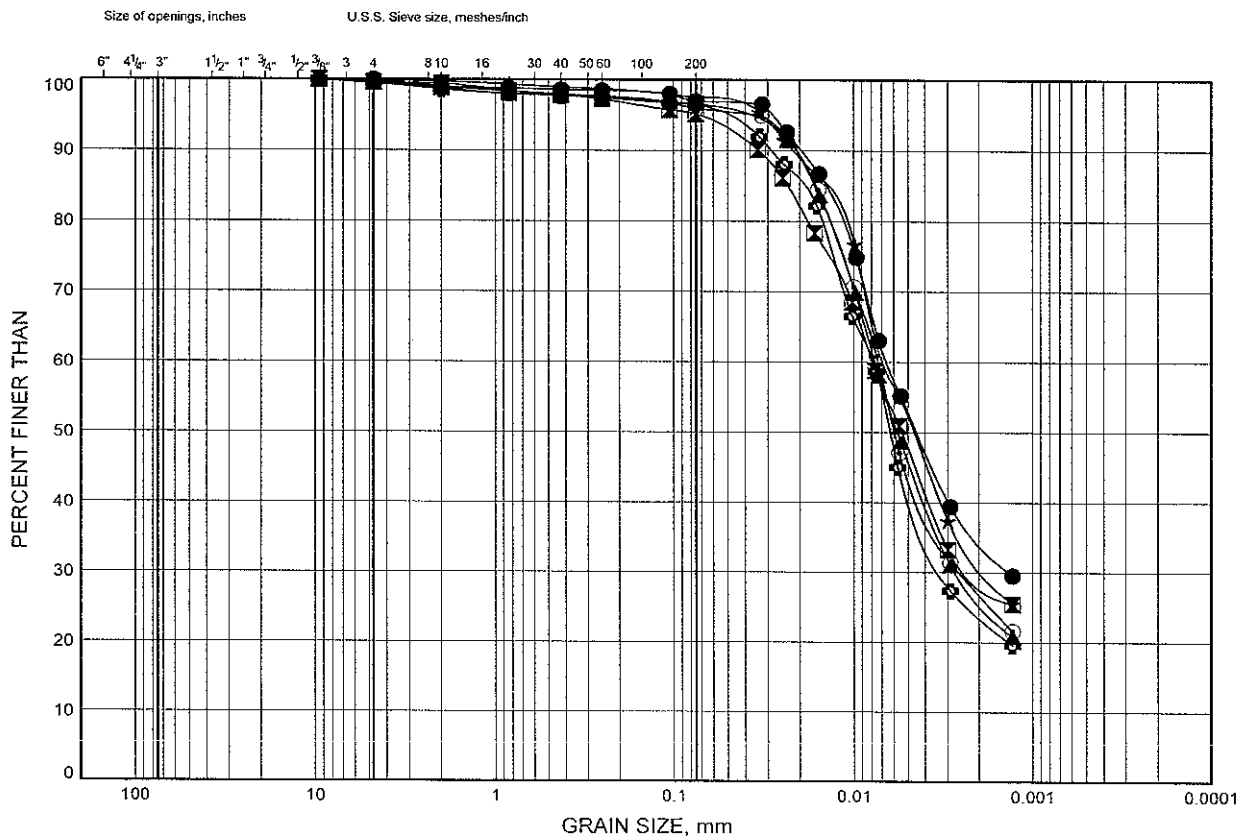
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-29

SILTY CLAY

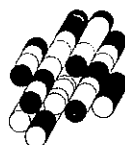


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+410CL	1.7	180.8
⊠	SBL 12+410CL	4.7	177.8
▲	SBL 12+410CL	9.3	173.2
★	TS4	3.2	179.2
⊙	TS4	6.3	176.1
⊛	TS4	9.3	173.1

Date July 2010

Project 1-09-4135



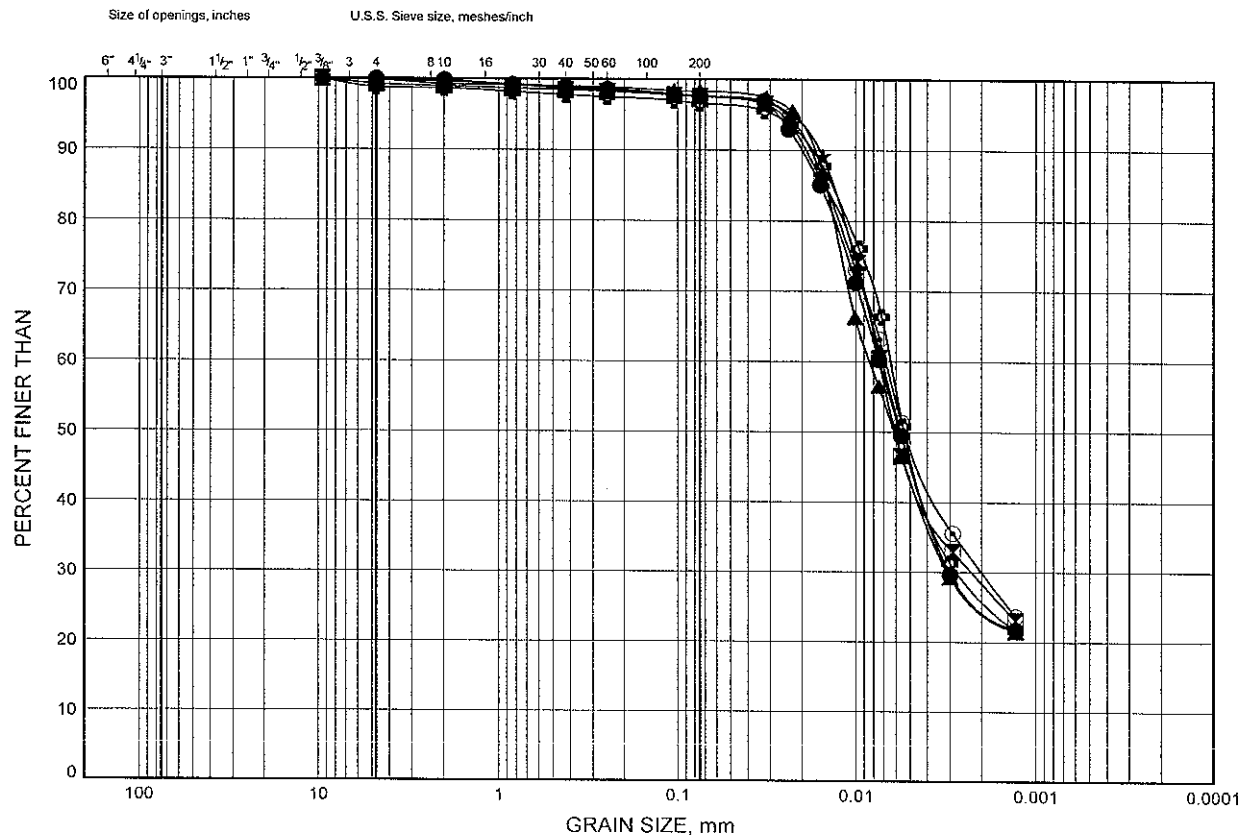
Prep'd DB

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GRAIN SIZE DISTRIBUTION

FIGURE B4-30

SILTY CLAY



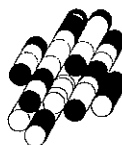
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+410CL	10.9	171.6
⊠	SBL 12+485Lt	2.5	179.5
▲	SBL 12+485Lt	4.7	177.3
★	SBL 12+485Lt	7.8	174.2
⊙	SBL 12+485Rt	3.2	178.6
⊛	SBL 12+485Rt	9.3	172.5

Date July 2010

Project 1-09-4135



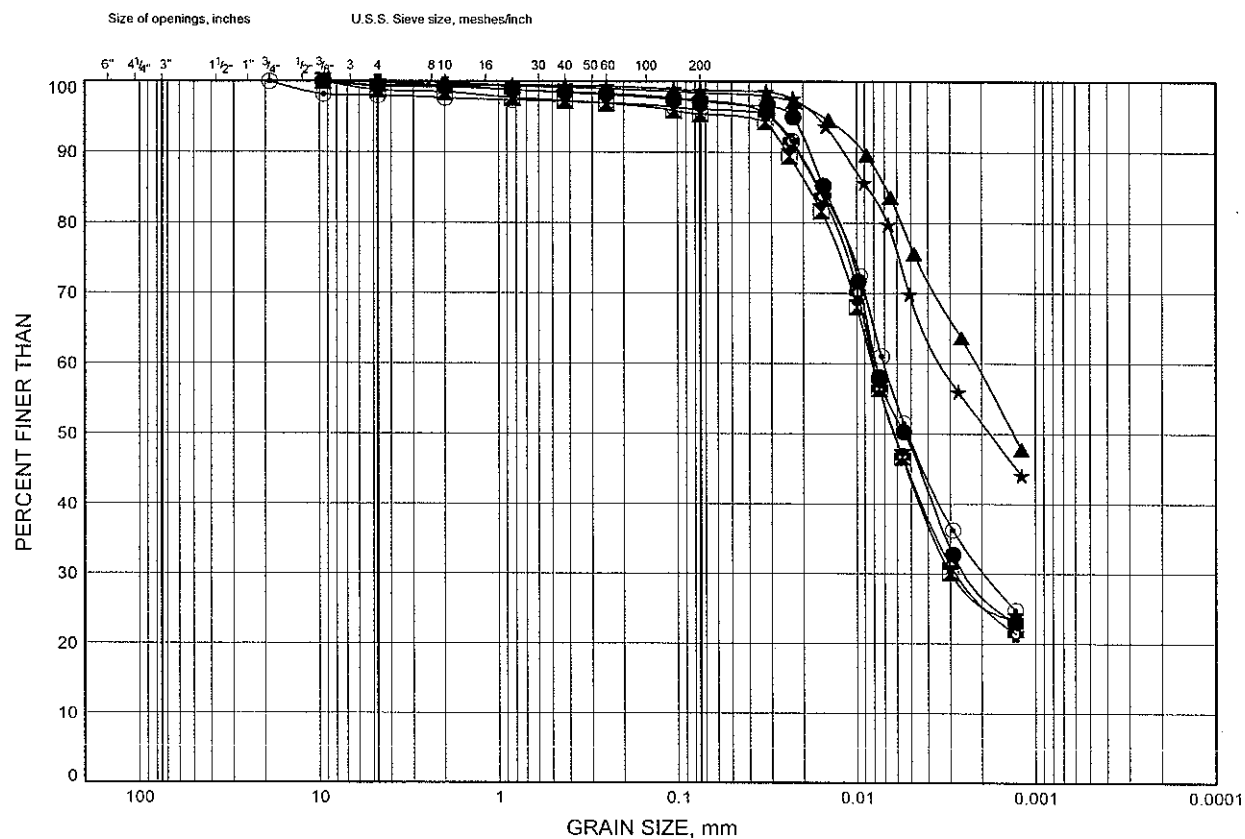
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-31

SILTY CLAY



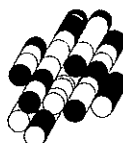
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+525CL	4.7	177.1
⊠	SBL 12+525CL	9.3	172.5
▲	SBL 12+600Lt	1.7	181.0
★	SBL 12+600Lt	3.2	179.5
⊙	SBL 12+600Lt	9.3	173.4
⊕	SBL 12+600Lt	12.4	170.3

Date July 2010

Project 1-09-4135



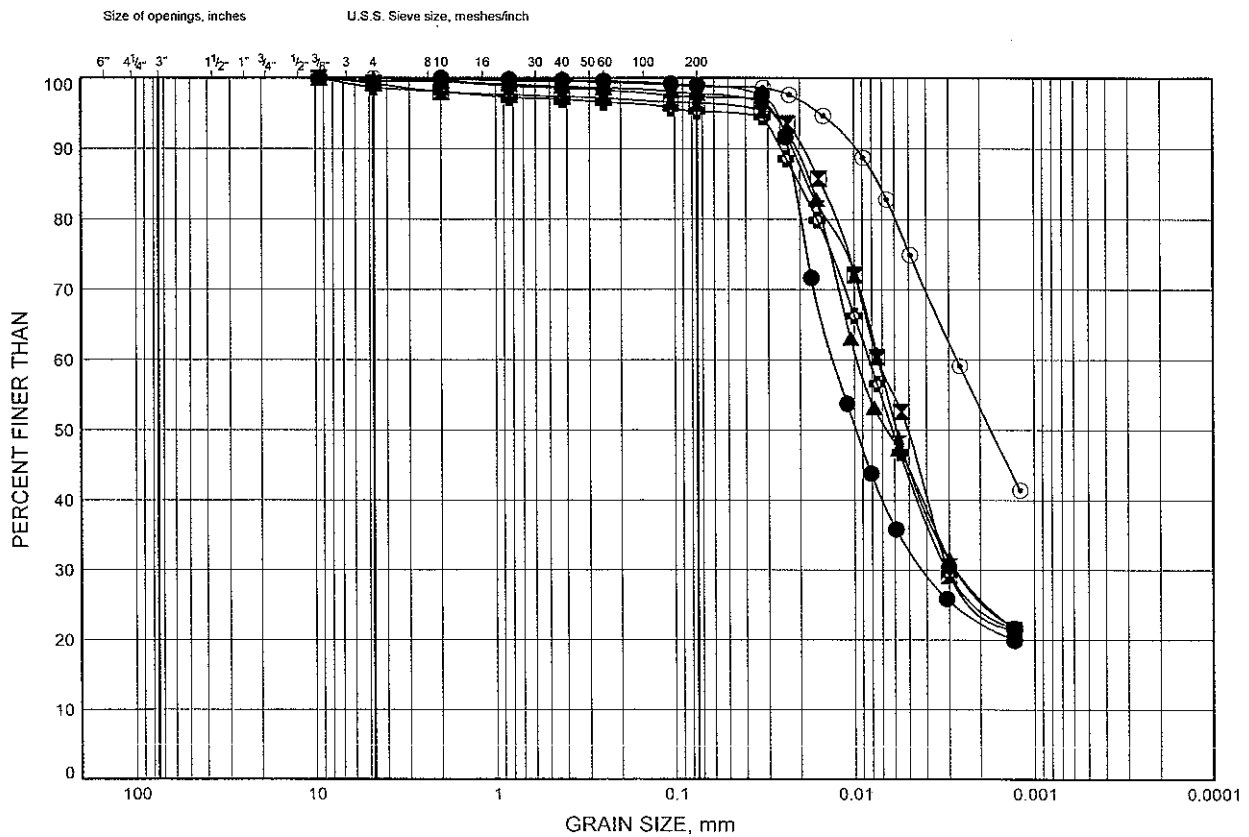
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-32

SILTY CLAY

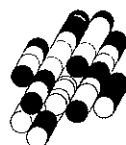


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+600Rt	1.0	181.1
⊠	SBL 12+600Rt	4.7	177.4
▲	SBL 12+600Rt	10.9	171.2
★	SBL 12+600Rt	12.4	169.7
⊙	SBL 12+650CL	3.2	180.5
⊛	SBL 12+650CL	9.3	174.4

Date July 2010

Project 1-09-4135



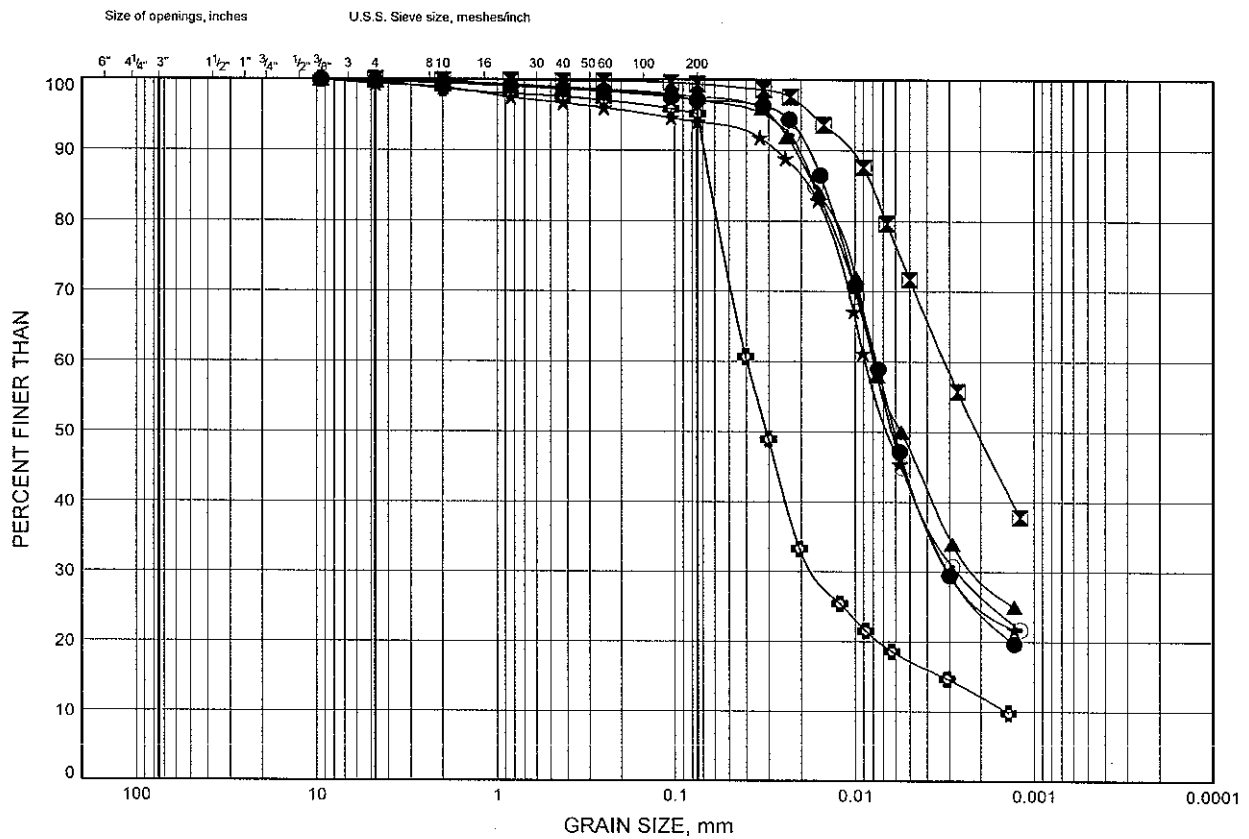
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-33

SILTY CLAY



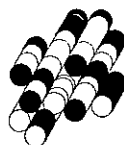
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+650CL	12.4	171.3
⊠	SBL 12+685CL	2.5	180.2
▲	SBL 12+685CL	6.3	176.4
★	SBL 12+685CL	9.3	173.4
⊙	SBL 12+685CL	10.9	171.8
⊛	WS1	7.8	174.9

Date July 2010

Project 1-09-4135



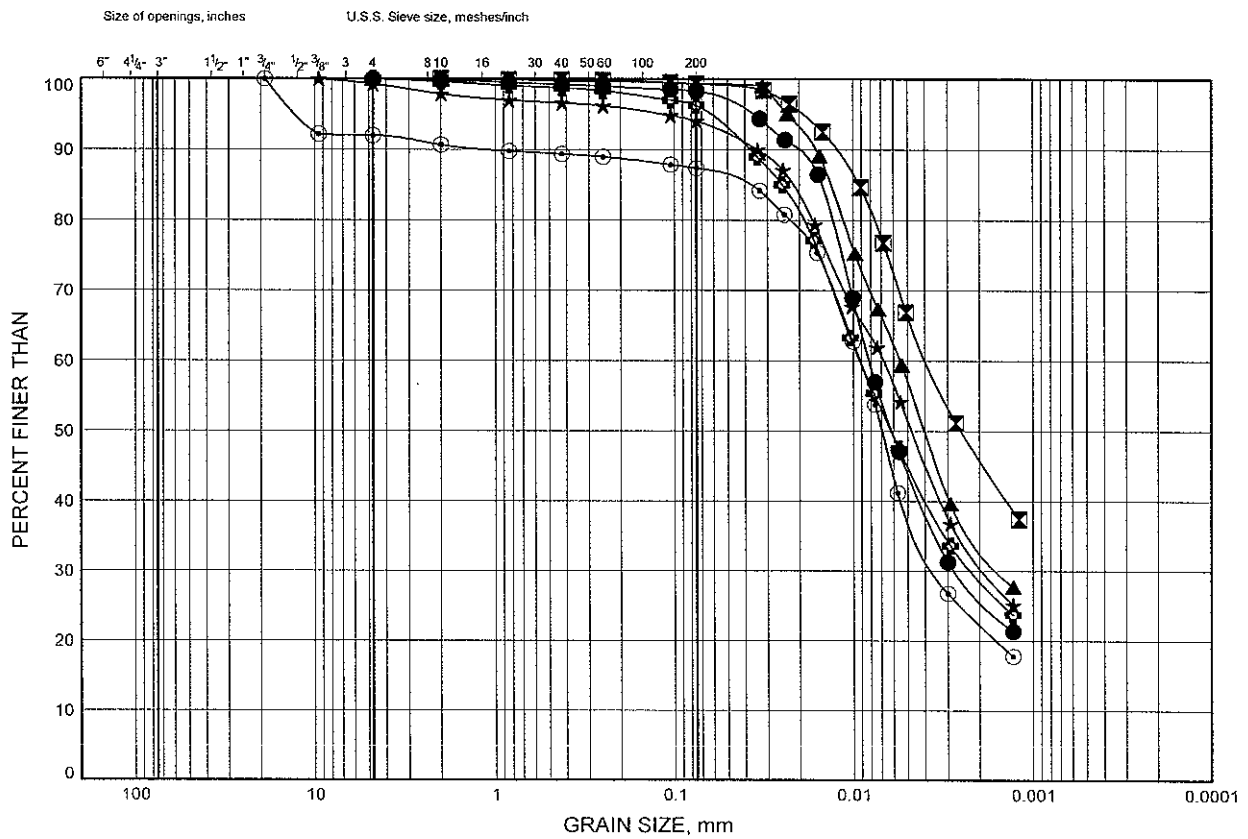
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-35

SILTY CLAY

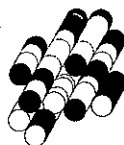


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS2	12.4	170.7
⊠	WS3	3.2	179.8
▲	WS3	4.7	178.3
★	WS3	7.8	175.2
⊙	WS3	10.9	172.1
⊕	WS3	13.9	169.1

Date July 2010

Project 1-09-4135



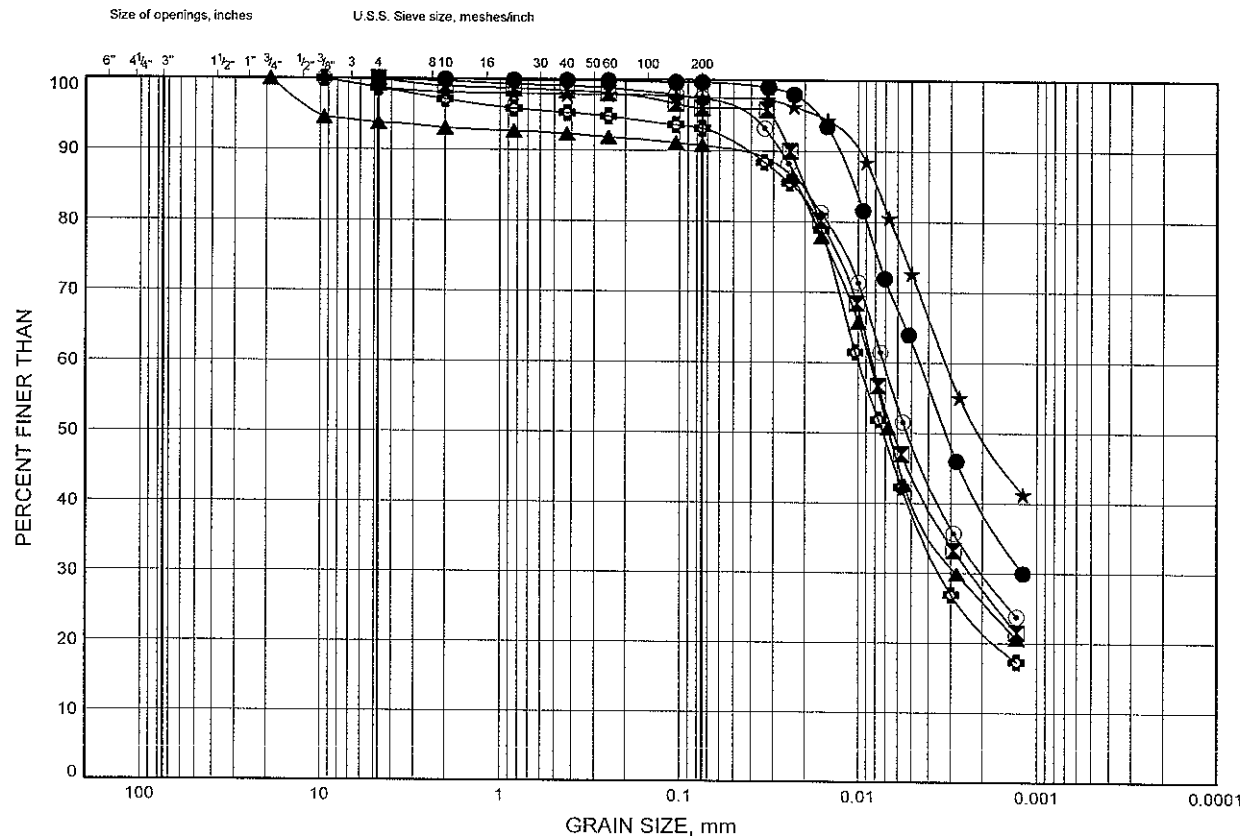
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-36

SILTY CLAY



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

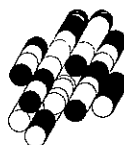
SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+750CL	3.2	179.7
⊠	SBL 12+750CL	7.8	175.1
▲	SBL 12+750CL	10.1	172.8
★	WS4	2.5	180.2
⊙	WS4	9.3	173.4
⊗	WS4	12.4	170.3

GSD 1-09-4135 SITE4.GPJ 07/07/10

Date July 2010

Project 1-09-4135



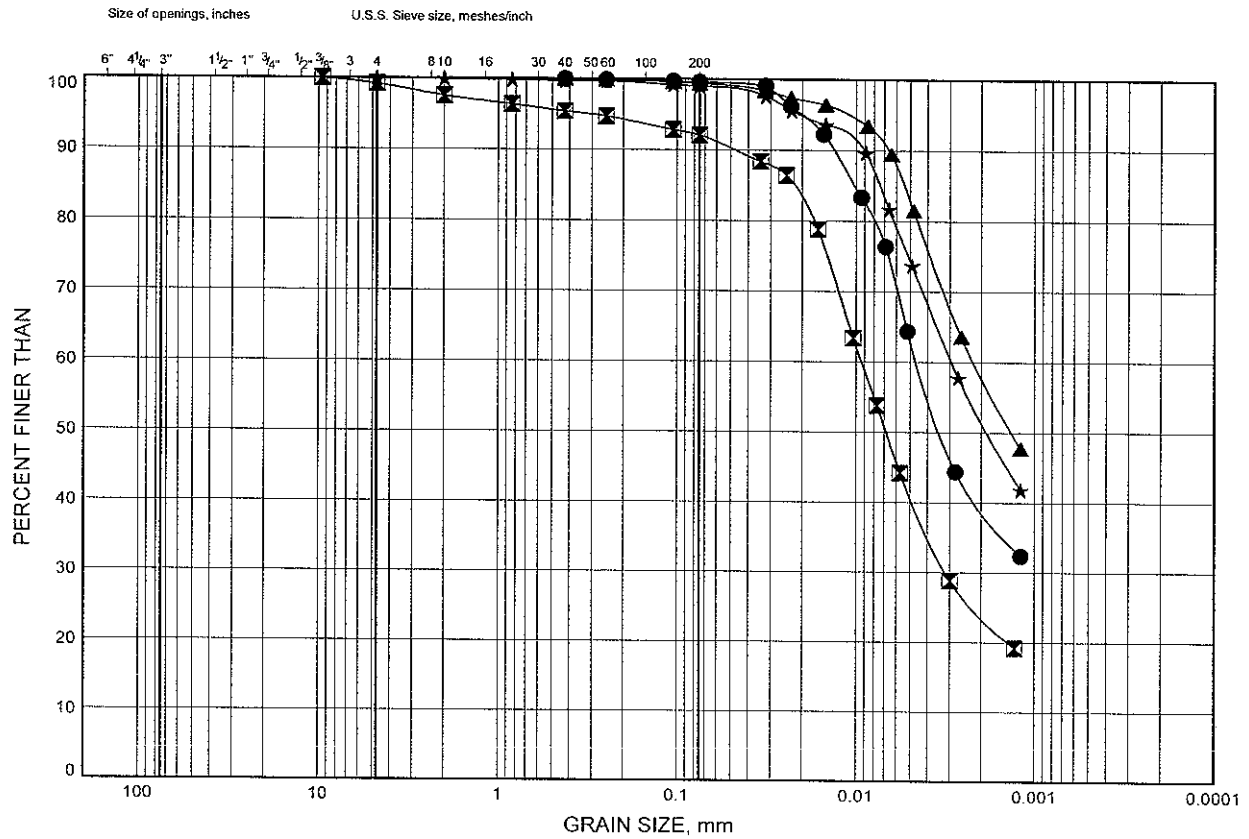
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-37

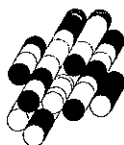
SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+825Lt	3.2	179.8
⊠	SBL 12+825Lt	7.1	175.9
▲	SBL 12+825Rt	1.0	181.3
★	SBL 12+825Rt	2.5	179.8

Date July 2010
Project 1-09-4135

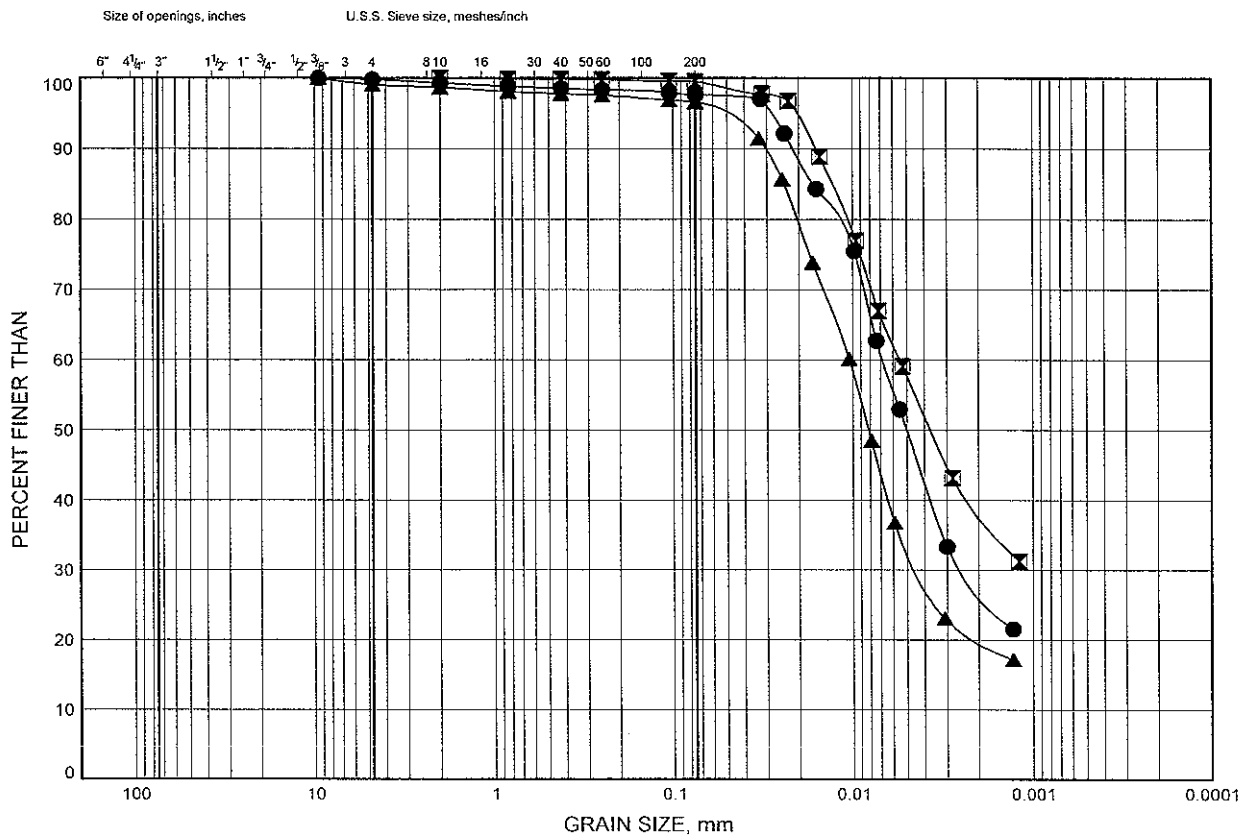


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GRAIN SIZE DISTRIBUTION

FIGURE B4-38

SILTY CLAY



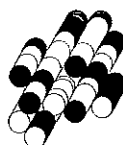
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+825Rt	6.3	176.0
⊠	SBL 12+900CL	1.7	181.0
▲	SBL 12+900CL	5.5	177.2

Date July 2010

Project 1-09-4135



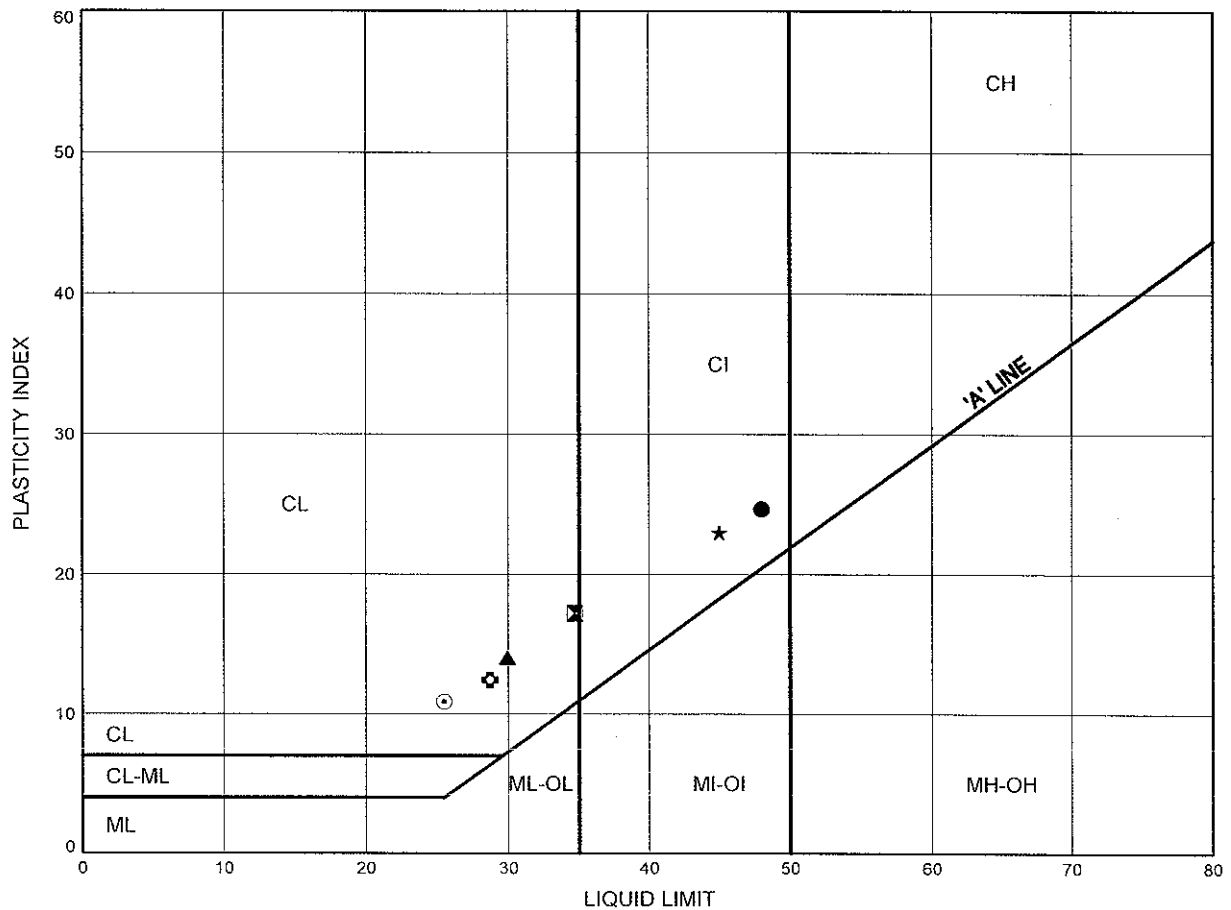
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ATTERBERG LIMITS TEST RESULTS

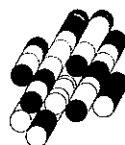
FIGURE B4-39

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+075CL	2.5	182.1
⊠	NBL 12+075CL	4.9	179.7
▲	NBL 12+150Lt	1.7	183.6
★	NBL 12+150Lt	4.0	181.3
⊙	NBL 12+150Lt	6.3	179.0
⊛	NBL 12+150Lt	9.3	176.0

Date July 2010
Project 1-09-4135



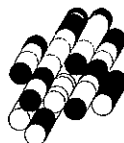
Prep'd DB
Chkd. MP

FIGURE B4-40

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+150Rt	2.5	181.0
⊗	NBL 12+150Rt	4.7	178.8
▲	NBL 12+150Rt	7.9	175.6
★	NBL 12+225CL	4.7	180.2
⊙	NBL 12+225CL	7.8	177.1
⊕	NBL 12+225CL	10.9	174.0

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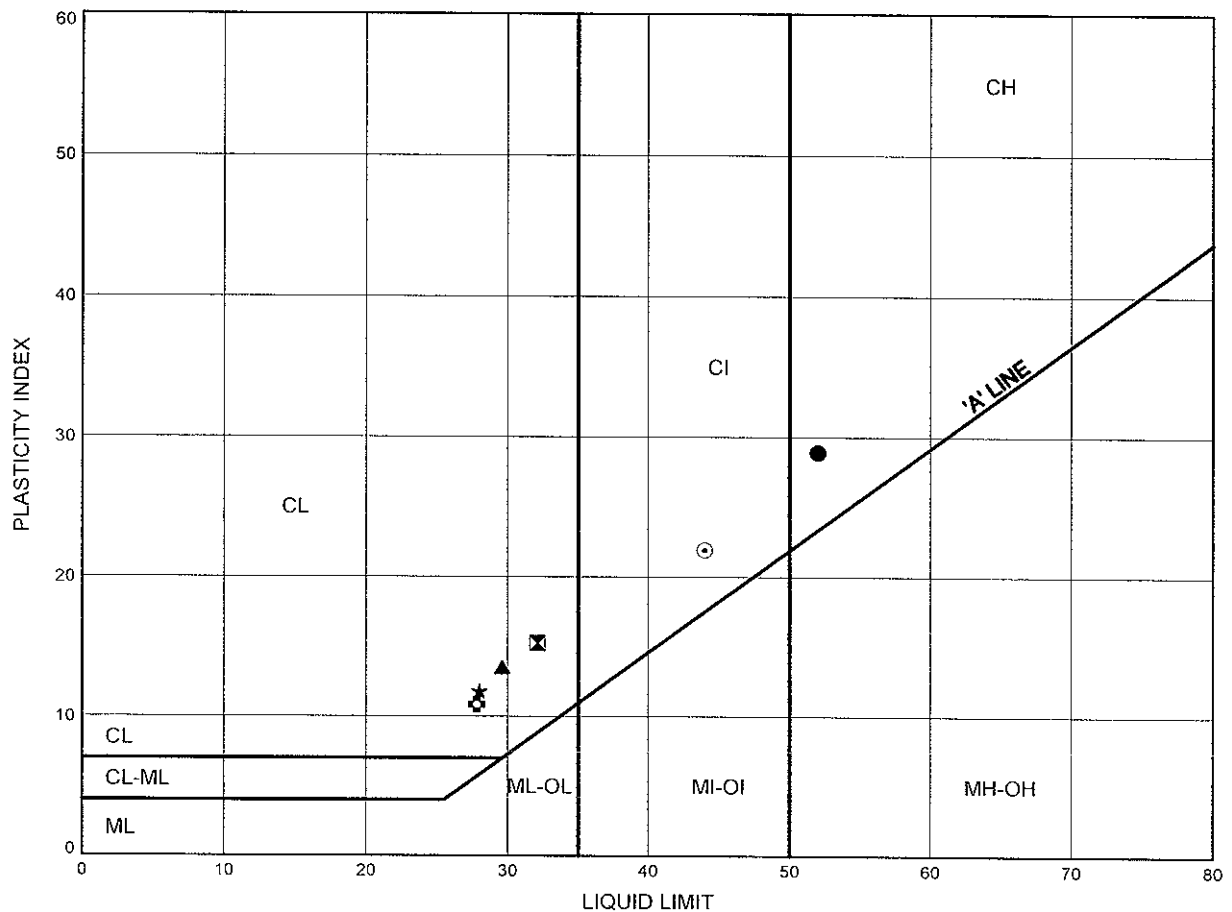
Chkd. MP



ATTERBERG LIMITS TEST RESULTS

FIGURE B4-41

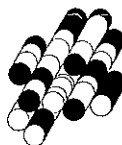
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+300Lt	1.1	182.0
⊠	NBL 12+300Lt	3.2	179.9
▲	NBL 12+300Lt	6.3	176.8
★	NBL 12+300Lt	9.3	173.8
⊙	NBL 12+300Rt	1.0	181.7
⊛	NBL 12+300Rt	4.7	178.0

Date July 2010

Project 1-09-4135



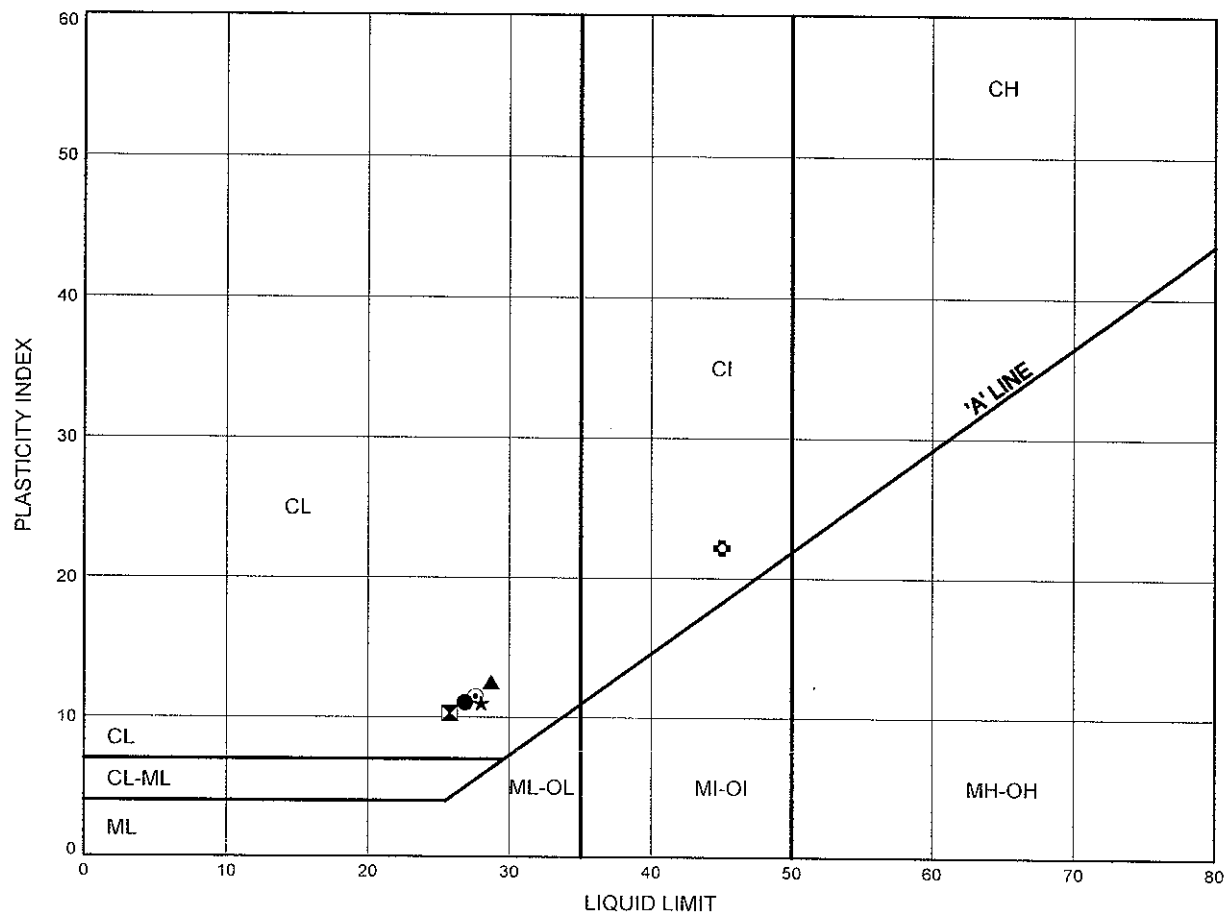
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-42

SILTY CLAY



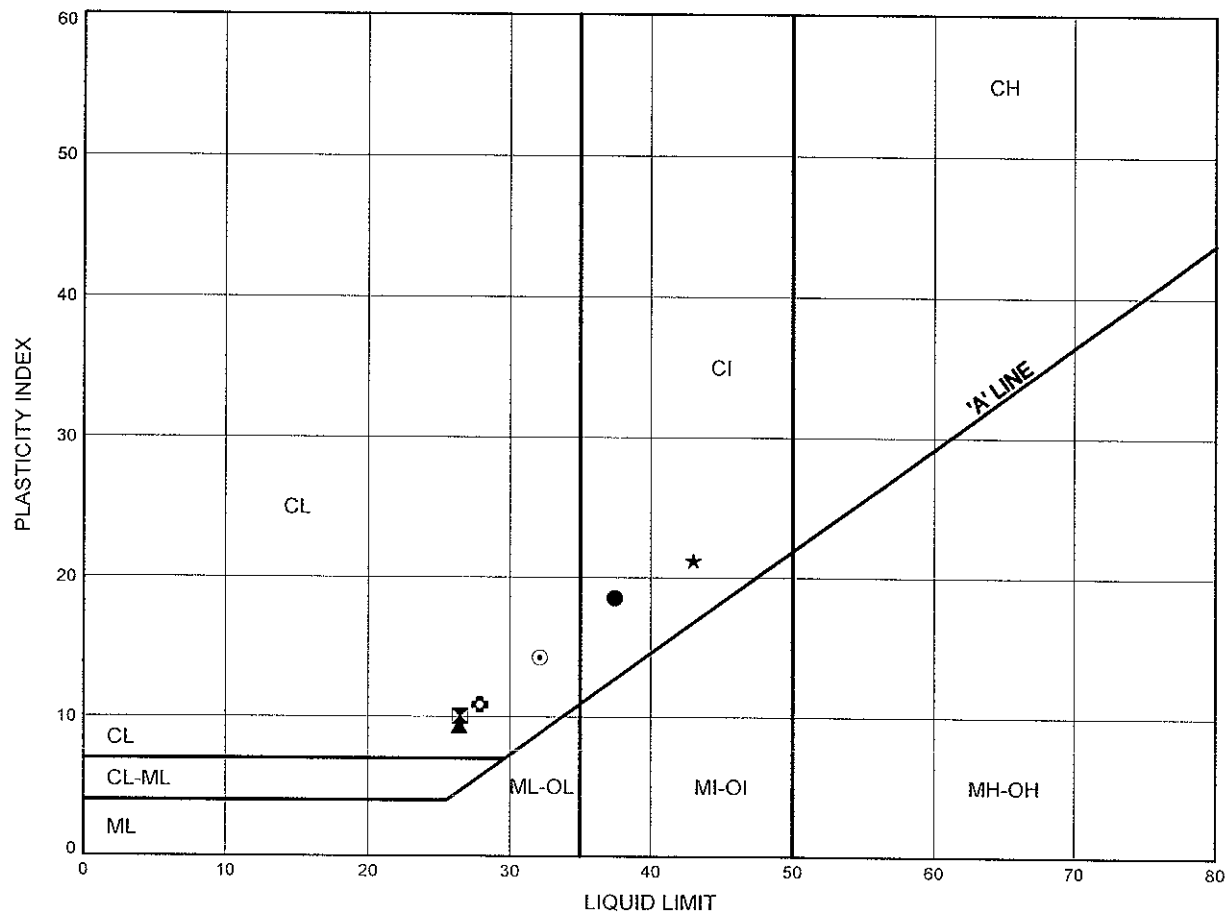
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+300Rt	9.3	173.4
⊠	NBL 12+375Lt	4.7	178.6
▲	NBL 12+375Lt	7.8	175.5
★	NBL 12+375Lt	9.3	174.0
⊙	NBL 12+375Lt	10.9	172.4
⊛	TN1	2.5	181.0



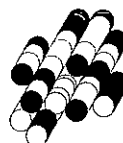
ATTERBERG LIMITS TEST RESULTS

FIGURE B4-43

SILTY CLAY



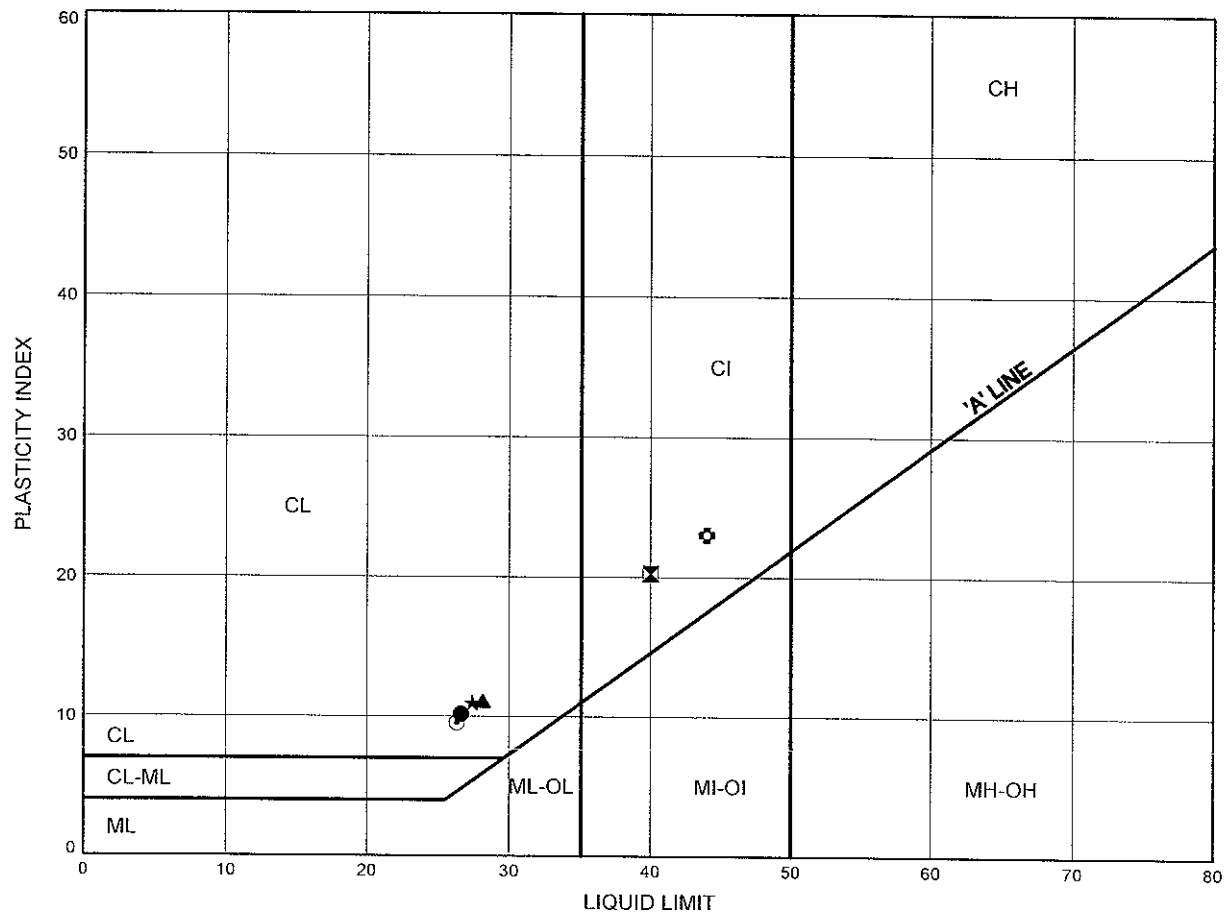
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	4.7	178.8
⊠	TN1	7.8	175.7
▲	TN1	10.9	172.6
★	TN2	3.2	181.0
⊙	TN2	5.5	178.7
⊛	TN2	9.3	174.9



ATTERBERG LIMITS TEST RESULTS

FIGURE B4-44

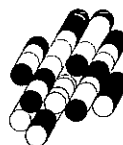
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN2	13.9	170.3
⊠	TN3	4.0	180.1
▲	TN3	5.5	178.6
★	TN3	9.3	174.8
⊙	TN3	13.9	170.2
⊛	TN4	2.5	181.5

Date July 2010

Project 1-09-4135



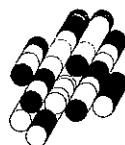
Prep'd DB

Chkd. MP

FIGURE B4-45

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+440Rt	3.2	179.8
⊗	NBL 12+440Rt	6.3	176.7
▲	NBL 12+440Rt	7.8	175.2
★	TN4	4.0	180.0
⊙	TN4	5.5	178.5
⊛	TN4	9.3	174.7

Project 1-09-4135

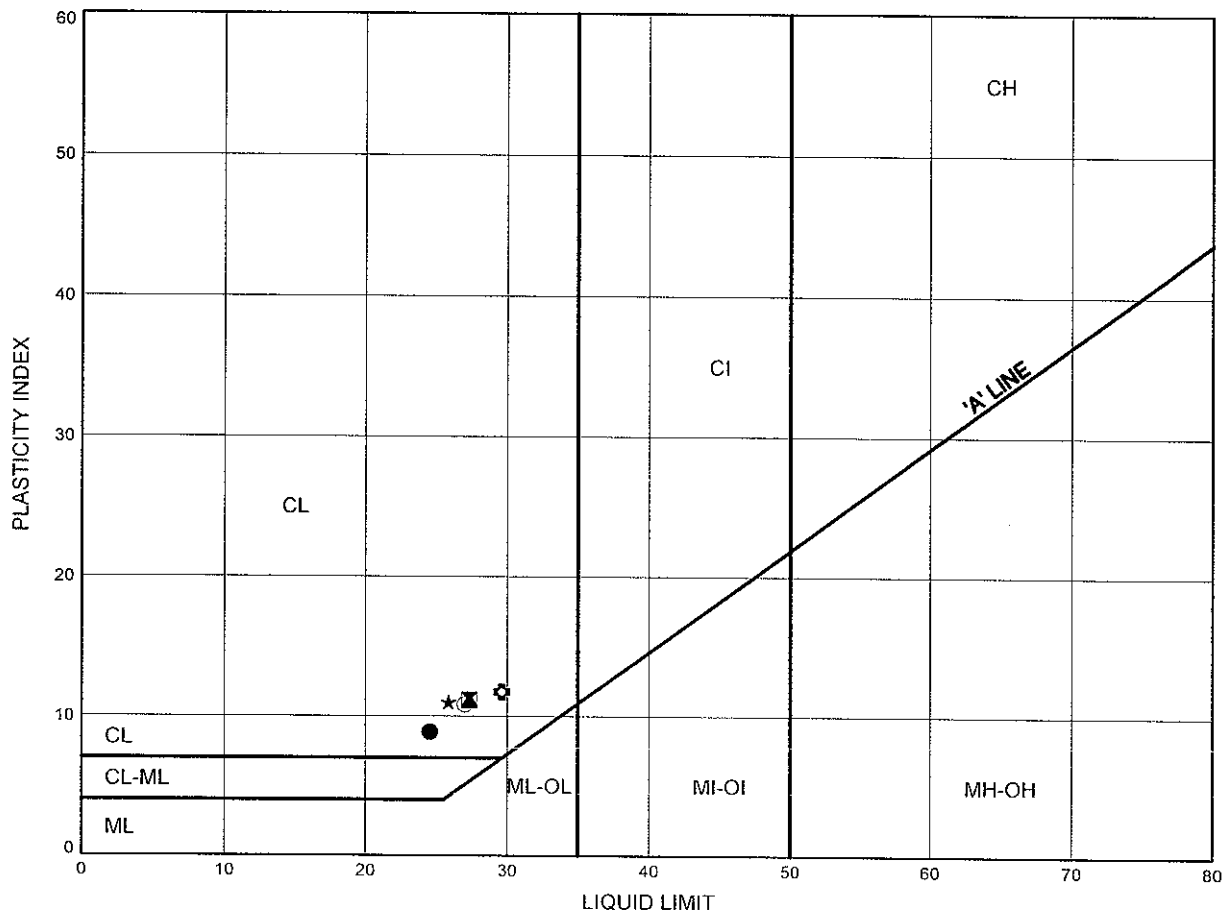


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ATTERBERG LIMITS TEST RESULTS

FIGURE B4-46

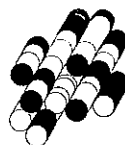
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+440Rt	12.4	170.6
⊠	NBL 12+525Lt	3.2	179.6
▲	NBL 12+525Lt	6.3	176.5
★	NBL 12+525Lt	9.3	173.5
⊙	NBL 12+525Lt	12.4	170.4
⊛	NBL 12+525Rt	3.2	178.8

Date July 2010

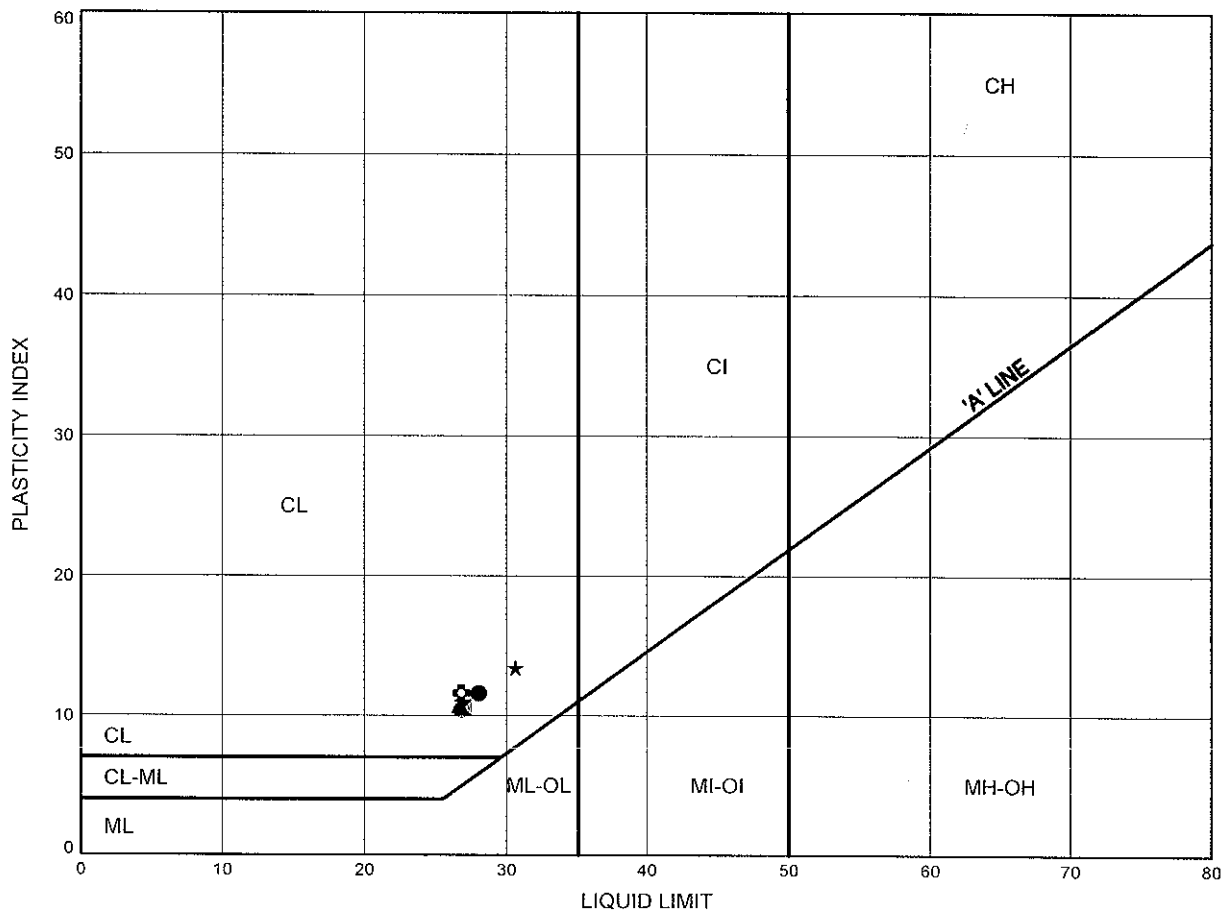
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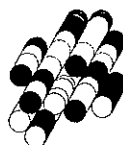
FIGURE B4-47



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+525Rt	6.3	175.7
⊠	NBL 12+525Rt	9.3	172.7
▲	NBL 12+525Rt	10.9	171.1
★	NBL 12+595Rt	3.2	178.4
⊙	NBL 12+595Rt	6.3	175.3
⊗	NBL 12+595Rt	9.3	172.3

Date July 2010

Project 1-09-4135

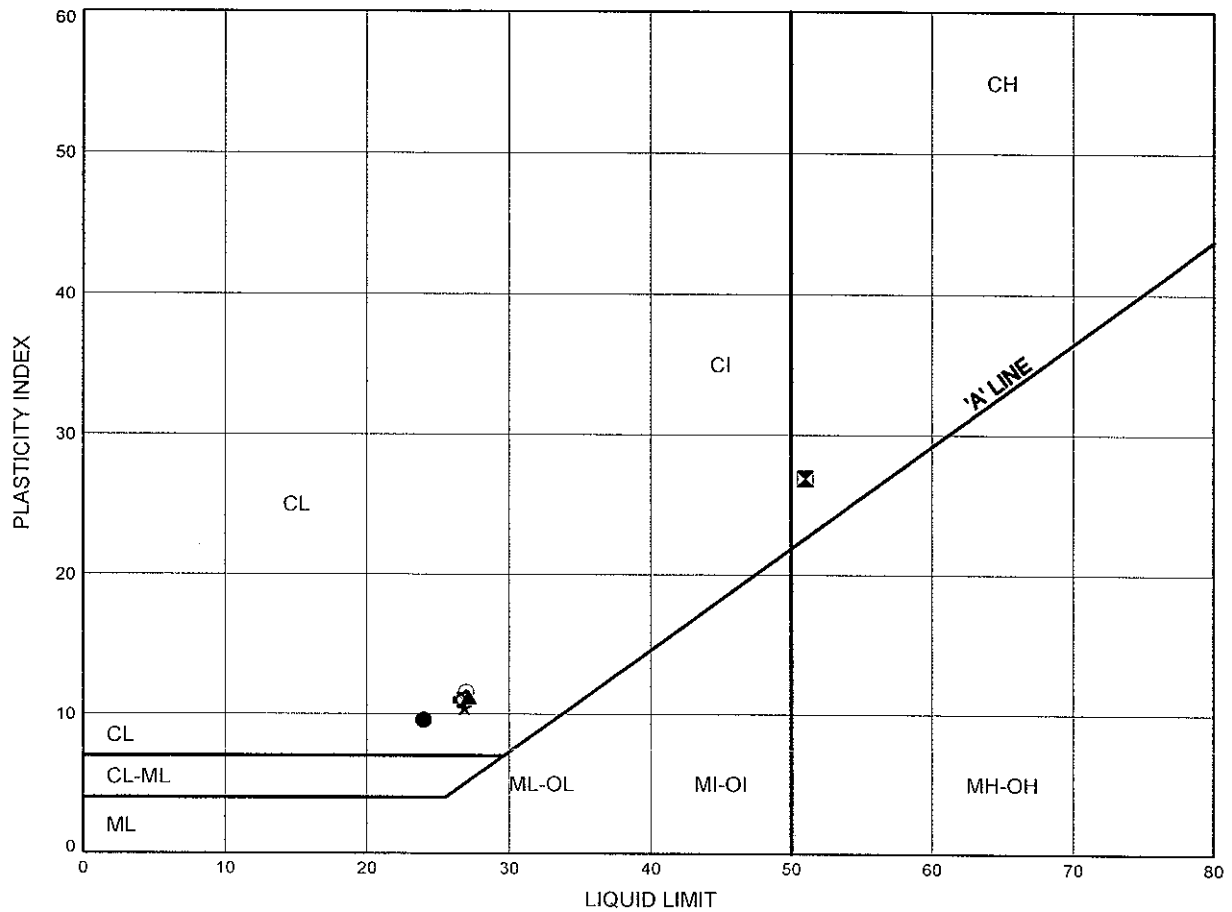


Prep'd DB

Chkd. MP

FIGURE B4-48

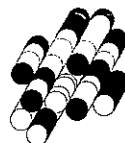
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+595Rt	12.4	169.2
⊠	NBL 12+645Lt	2.5	180.8
▲	NBL 12+645Lt	7.8	175.5
★	NBL 12+645Lt	9.3	174.0
⊙	NBL 12+645Lt	12.4	170.9
⊗	NBL 12+645Rt	6.3	174.7

Date July 2010

Project 1-09-4135



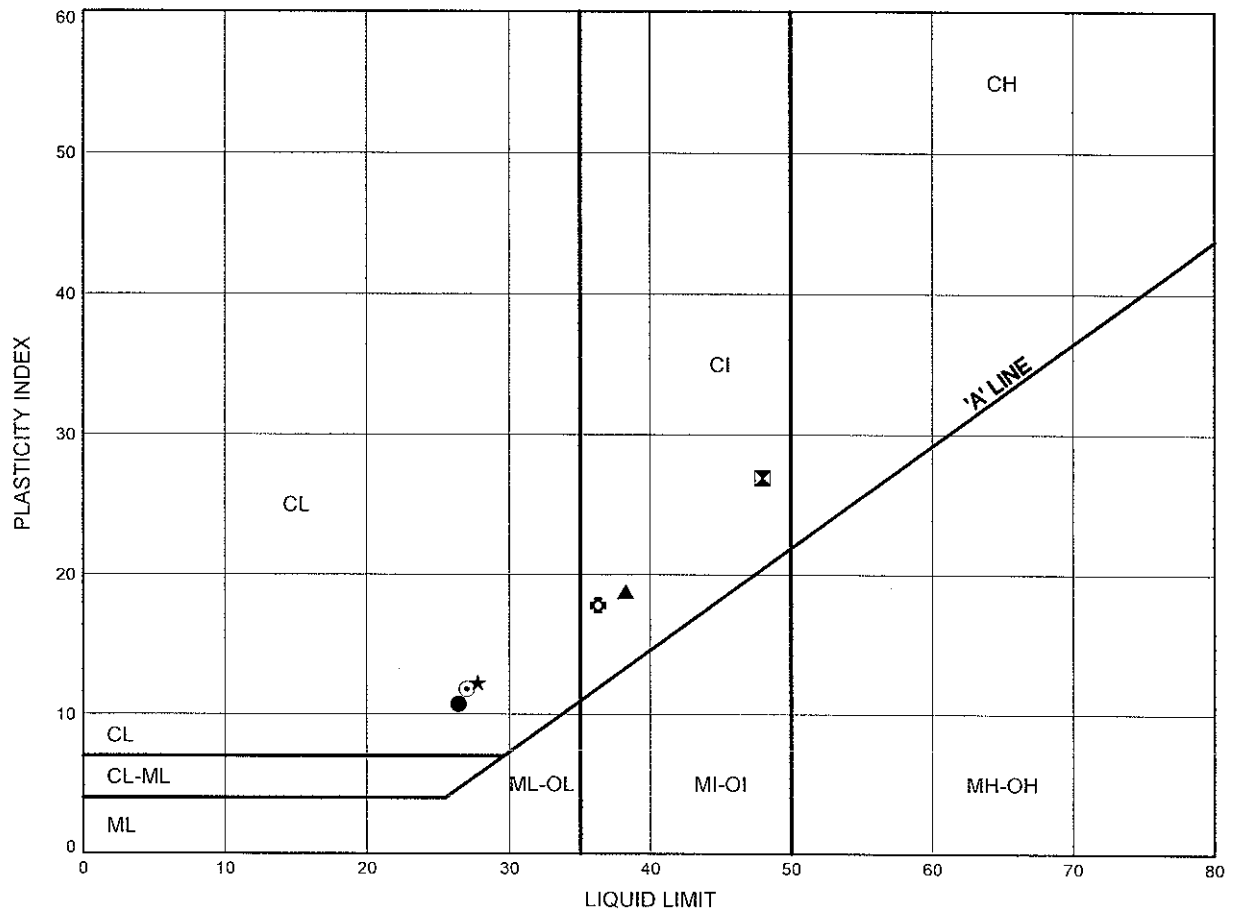
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-49

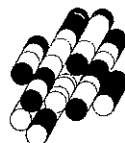
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+645Rt	7.8	173.2
⊠	NBL 12+695Lt	1.7	181.2
▲	NBL 12+695Lt	3.2	179.7
★	NBL 12+695Lt	6.3	176.6
⊙	NBL 12+695Lt	9.3	173.6
⊕	WN1	3.2	179.9

Date July 2010

Project 1-09-4135



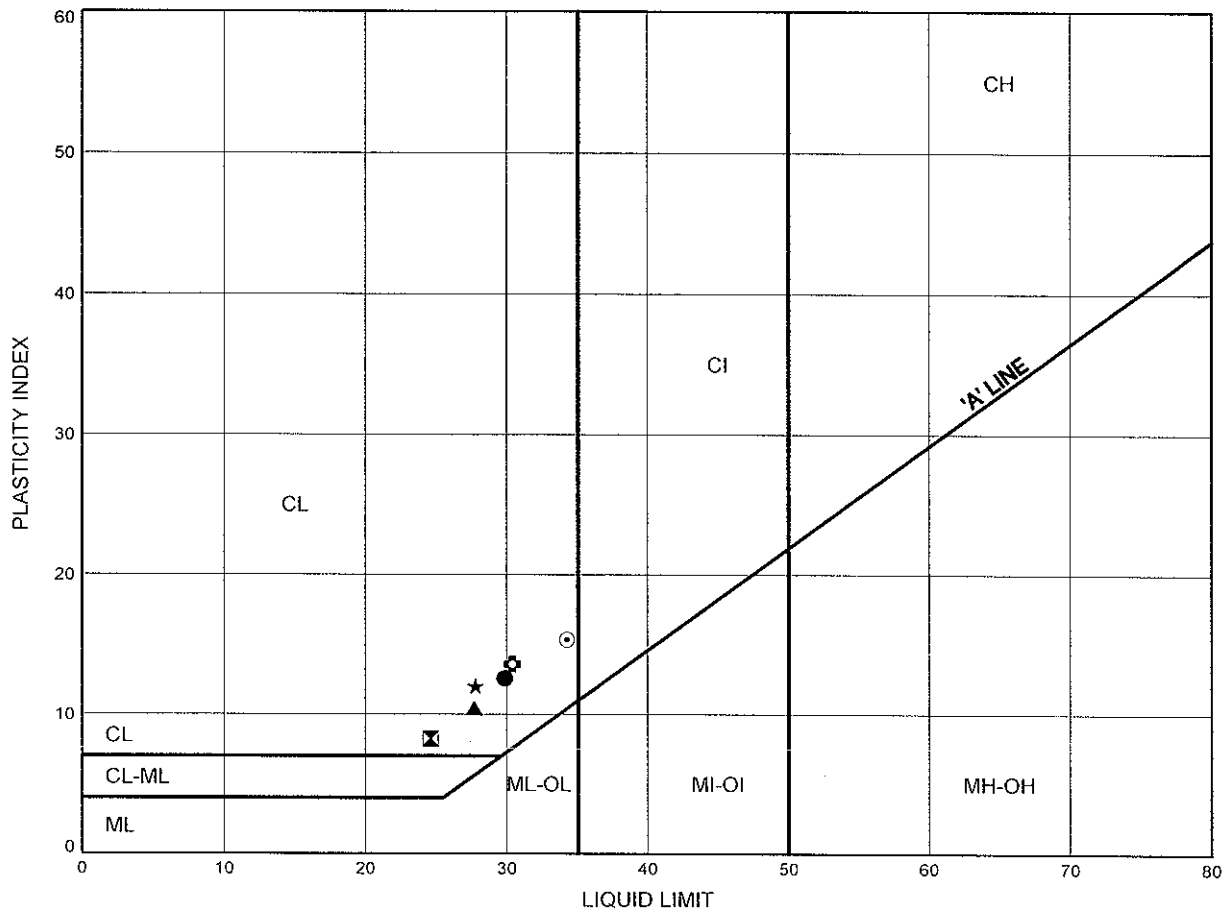
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-50

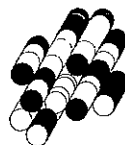
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN1	6.3	176.8
⊠	WN1	7.8	175.3
▲	WN1	10.9	172.2
★	WN1	13.9	169.2
⊙	WN2	1.0	180.6
⊕	WN2	4.0	177.6

Date July 2010

Project 1-09-4135



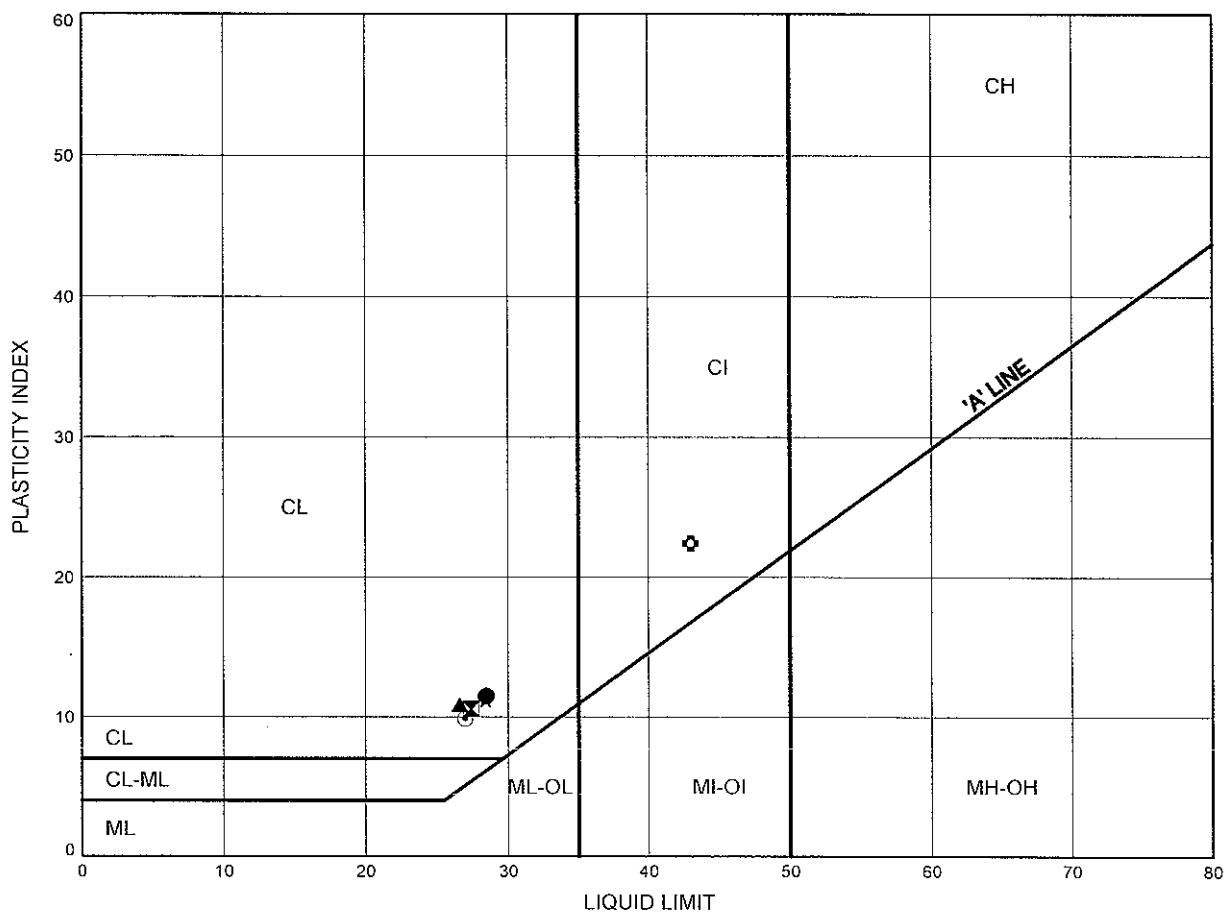
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-51

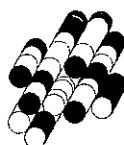
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN2	6.3	175.3
⊠	WN2	10.9	170.7
▲	WN3	7.8	174.3
★	WN3	9.3	172.8
⊙	WN3	12.4	169.7
⊛	WN4	5.5	177.0

Date July 2010

Project 1-09-4135



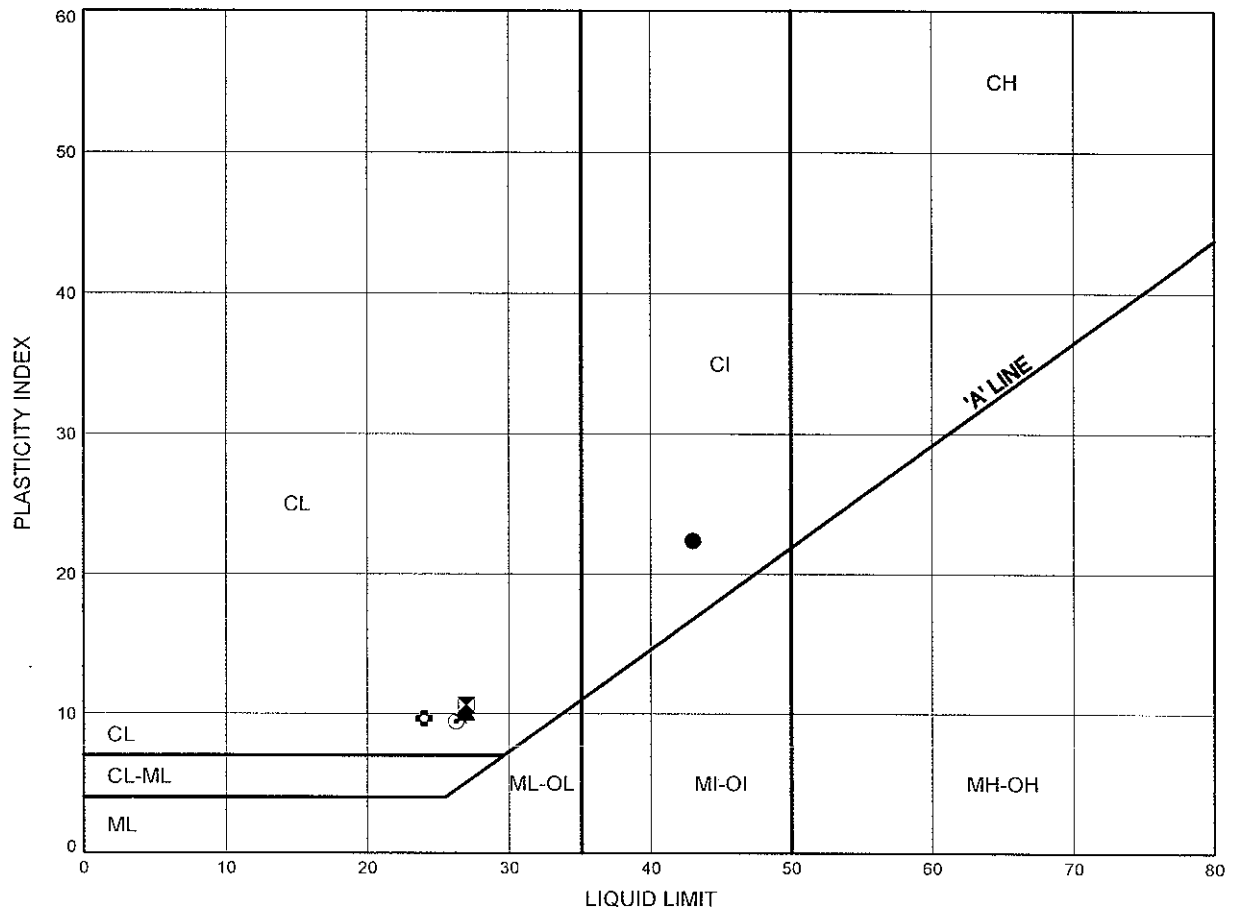
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-52

SILTY CLAY

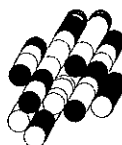


SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+750Rt	1.7	181.1
⊠	NBL 12+750Rt	4.7	178.1
▲	NBL 12+750Rt	9.3	173.5
★	WN4	9.3	173.2
⊙	WN4	10.9	171.6
⊛	WN4	13.9	168.6

Date July 2010

Project 1-09-4135



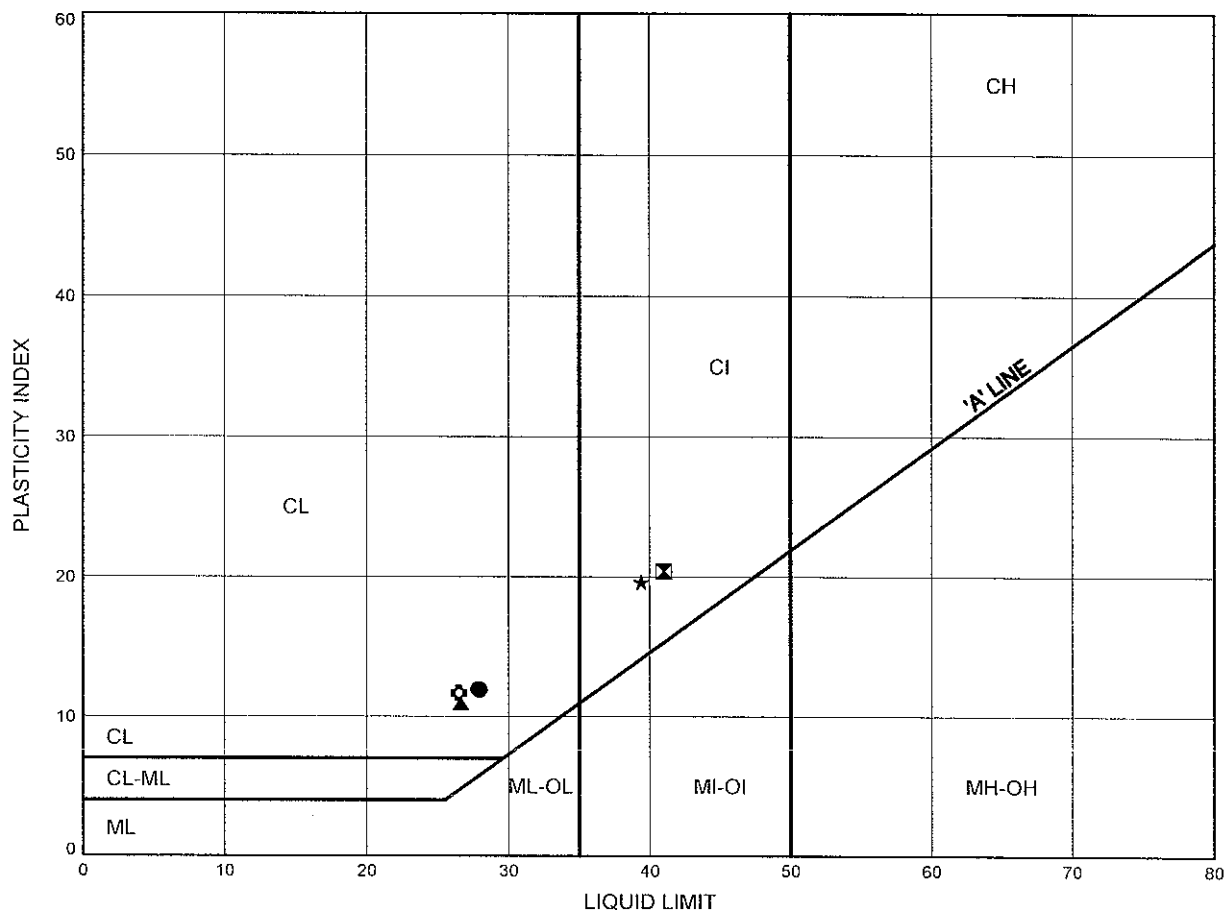
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-53

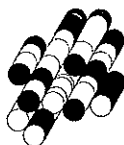
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	12.4	170.4
⊠	NBL 12+835Lt	2.5	178.7
▲	NBL 12+835Lt	7.8	173.4
★	NBL 12+835Rt	3.2	179.7
⊙	NBL 12+835Rt	9.3	173.6
⊛	NBL 12+835Rt	10.9	172.0

Date July 2010

Project 1-09-4135



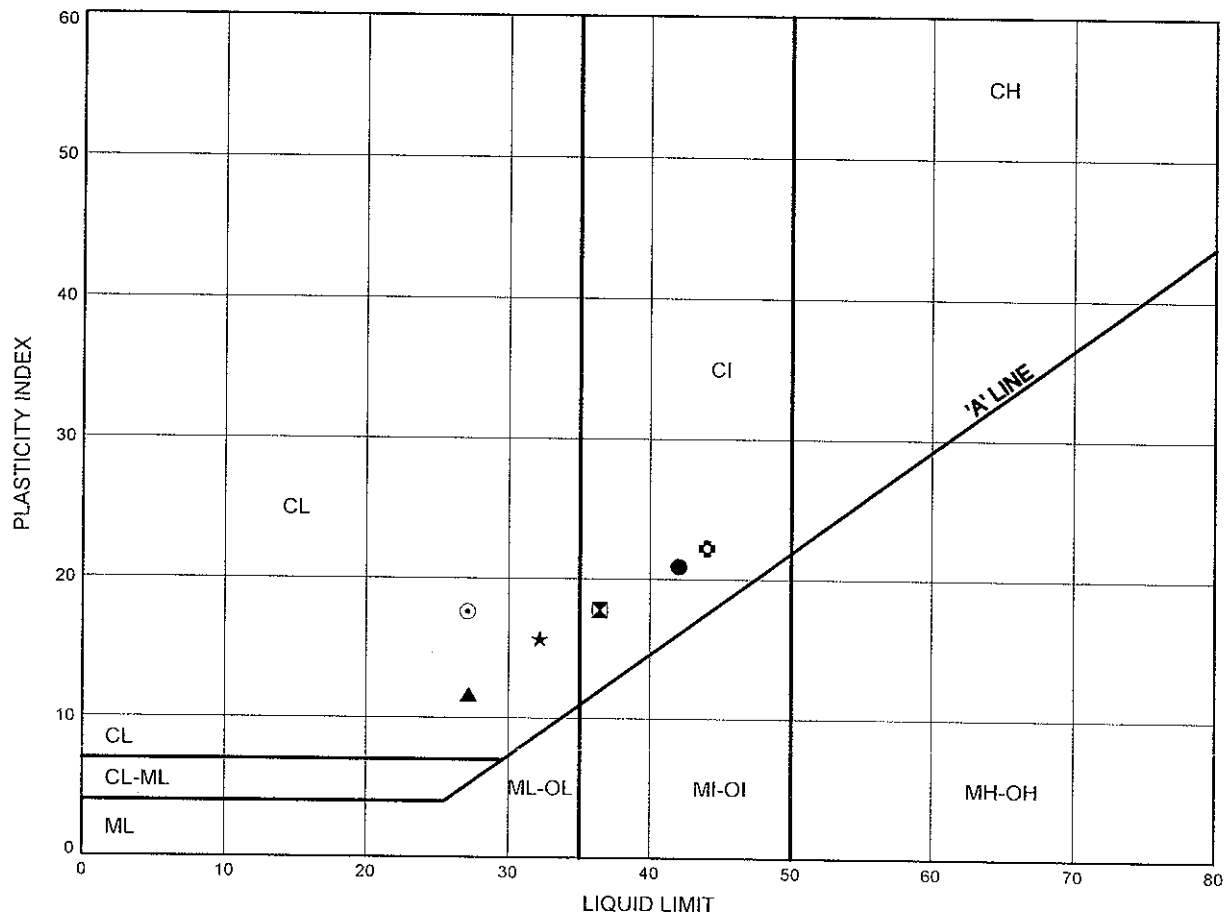
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-54

SILTY CLAY



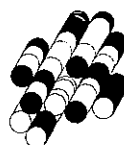
SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+910CL	1.7	181.0
⊠	NBL 12+910CL	4.7	178.0
▲	NBL 12+910CL	9.3	173.4
★	NBL 12+985Lt	3.2	177.9
⊙	NBL 12+985Lt	6.3	174.8
⊕	NBL 12+985Rt	1.7	180.6

ALTR 1-09-4135 SITE4.GPJ 07/07/10

Date July 2010

Project 1-09-4135



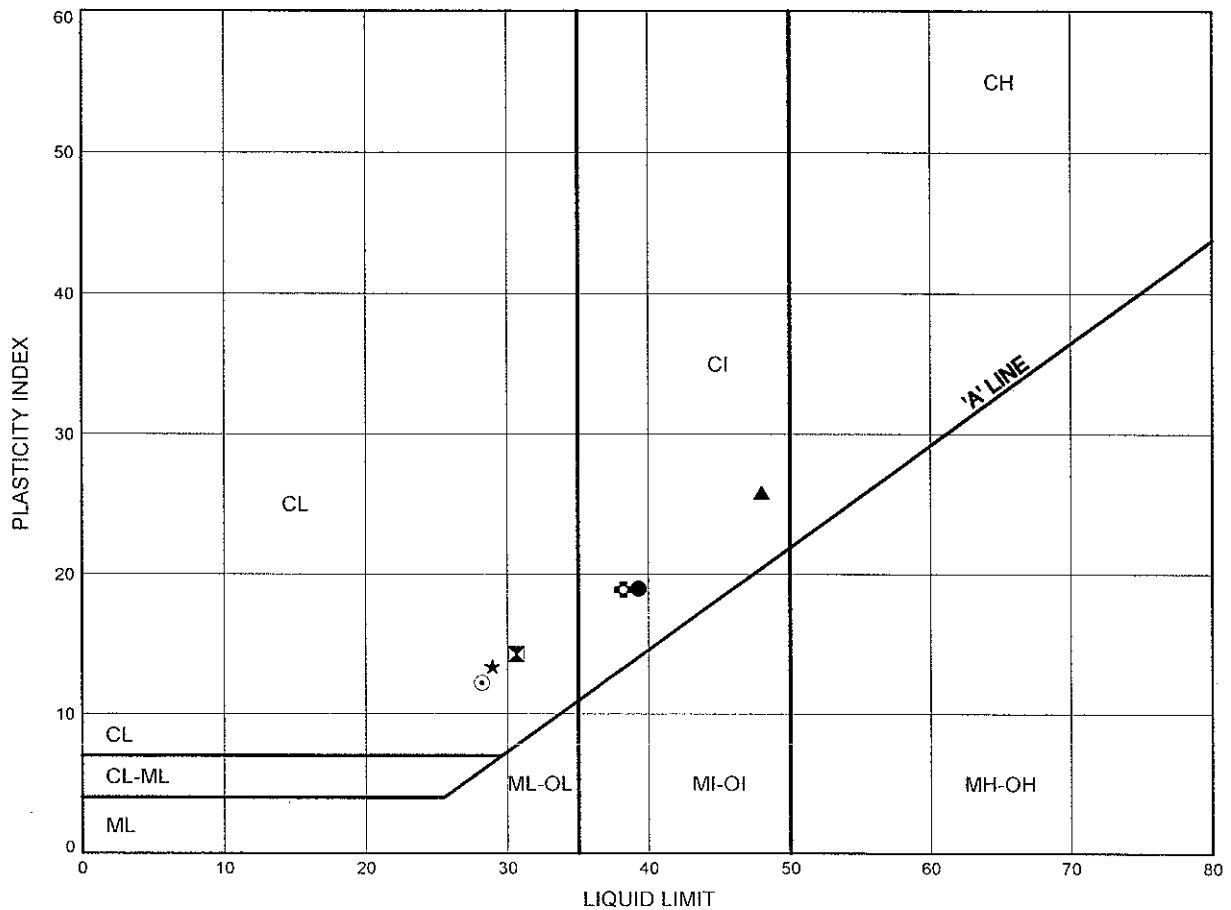
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-55

SILTY CLAY

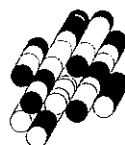


SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+985Rt	3.2	179.1
⊠	NBL 12+985Rt	4.7	177.6
▲	SBL 12+185Lt	1.7	181.5
★	SBL 12+185Lt	4.7	178.5
⊙	SBL 12+185Lt	7.8	175.4
⊛	SBL 12+185Rt	2.5	181.1

Date July 2010

Project 1-09-4135



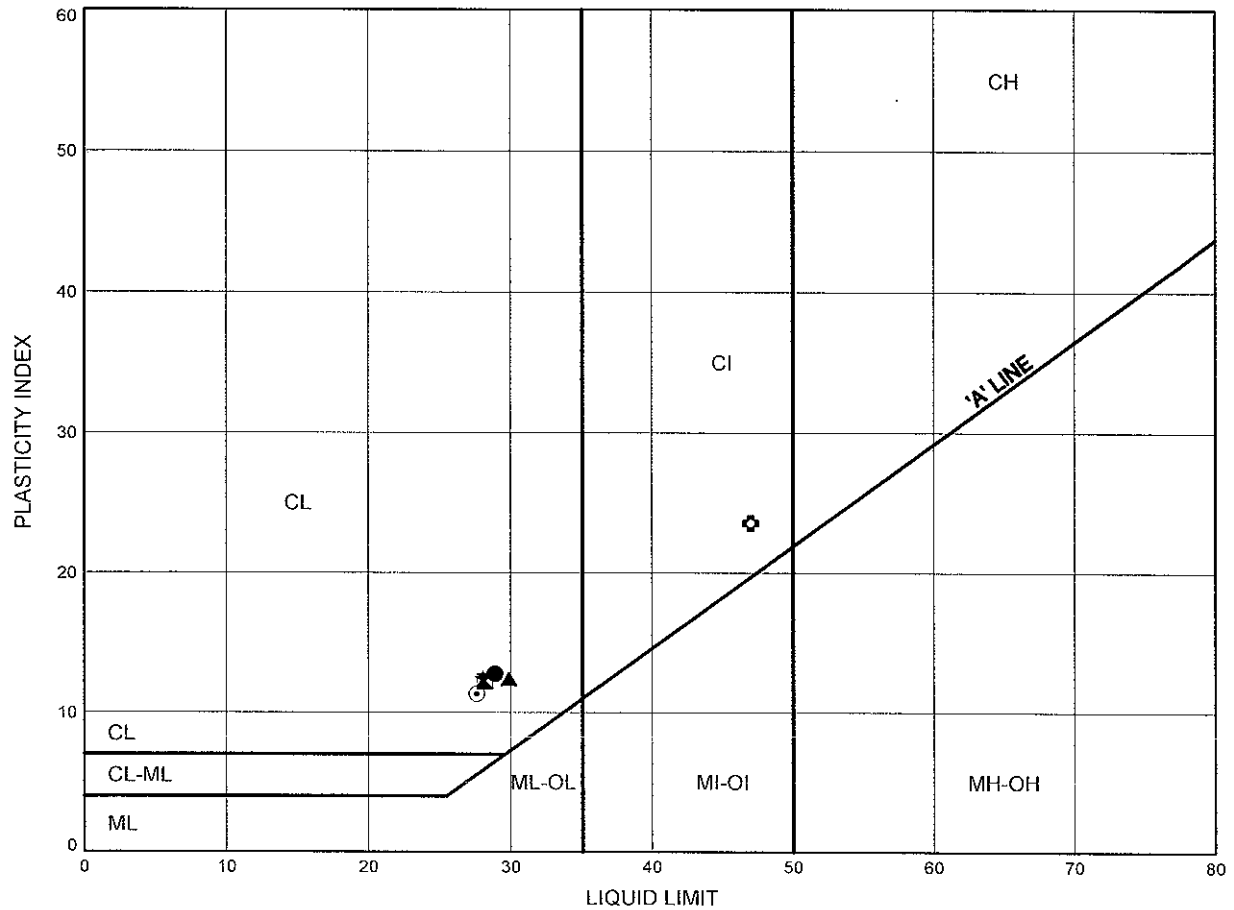
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-56

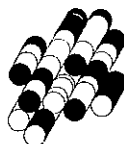
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+185Rt	4.7	178.9
⊠	SBL 12+185Rt	7.8	175.8
▲	SBL 12+260CL	6.3	179.7
★	SBL 12+260CL	9.3	176.7
⊙	SBL 12+260CL	12.4	173.6
⊕	SBL 12+360CL	1.0	181.9

Date July 2010

Project 1-09-4135



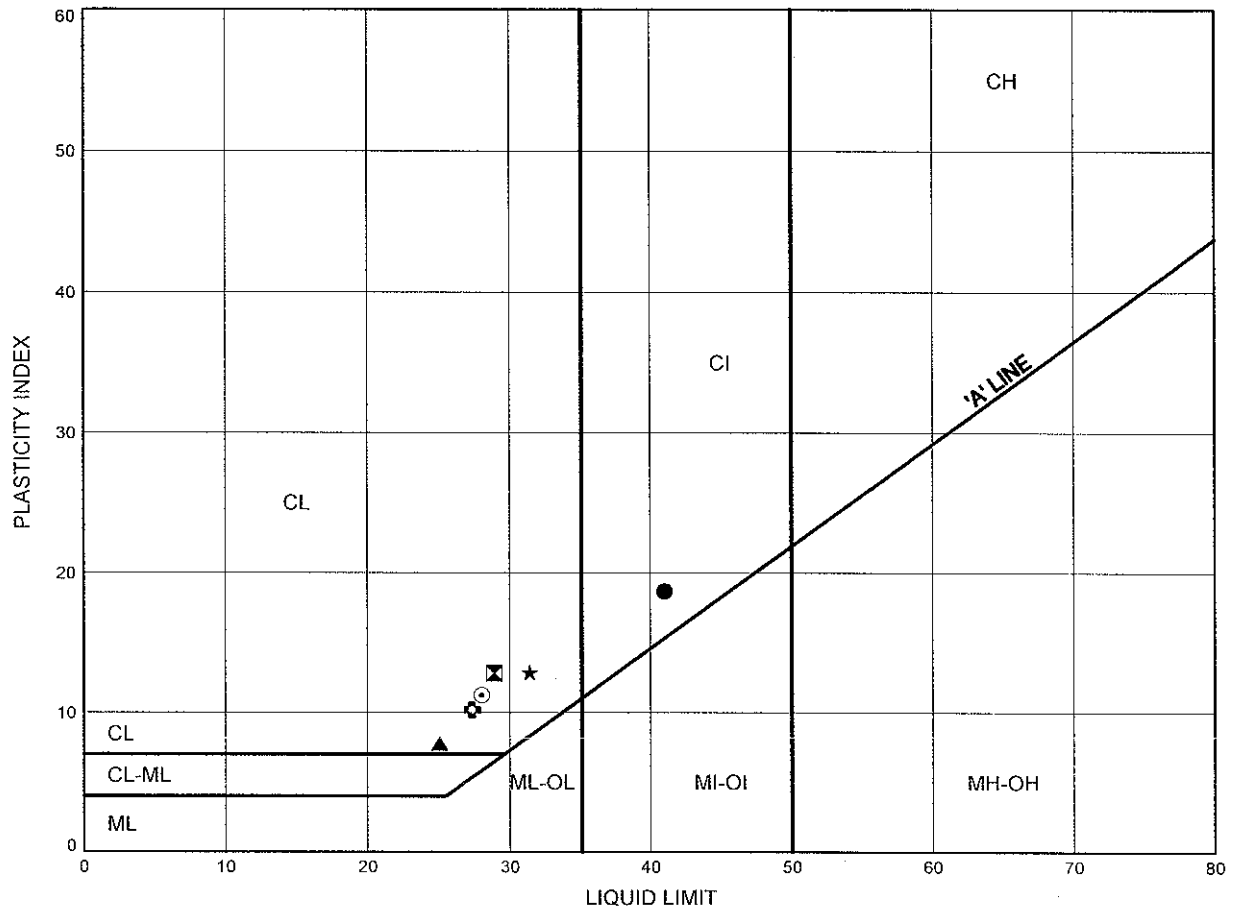
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-57

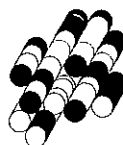
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+360CL	3.2	179.7
⊠	SBL 12+360CL	7.8	175.1
▲	SBL 12+360CL	12.4	170.5
★	TS1	2.5	180.1
⊙	TS1	4.7	177.9
⊛	TS1	9.3	173.3

Date July 2010

Project 1-09-4135



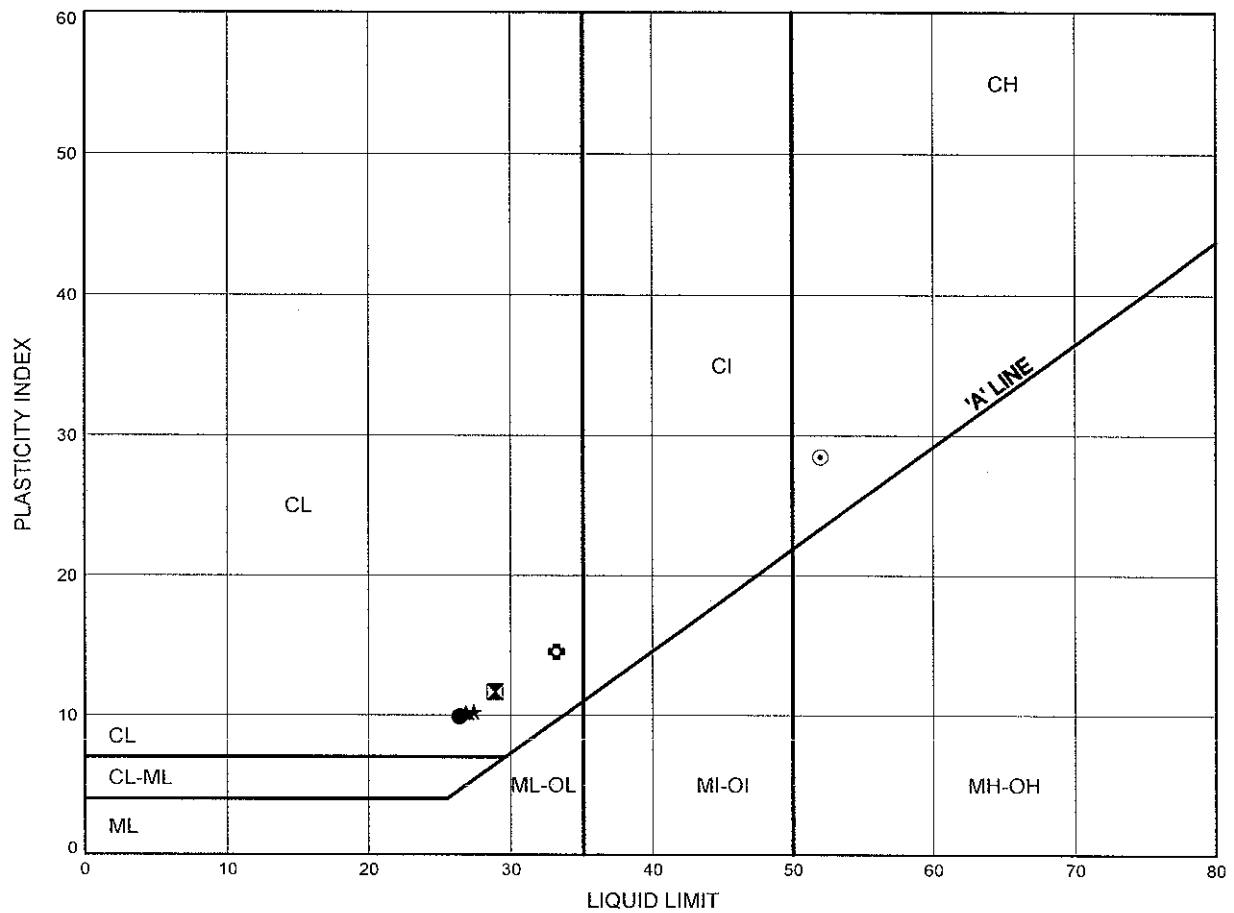
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-58

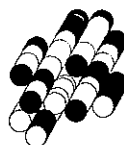
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS1	13.9	168.7
⊠	TS2	5.5	177.8
▲	TS2	9.3	174.0
★	TS2	13.9	169.4
⊙	TS3	1.7	180.8
⊛	TS3	4.0	178.5

Date July 2010

Project 1-09-4135



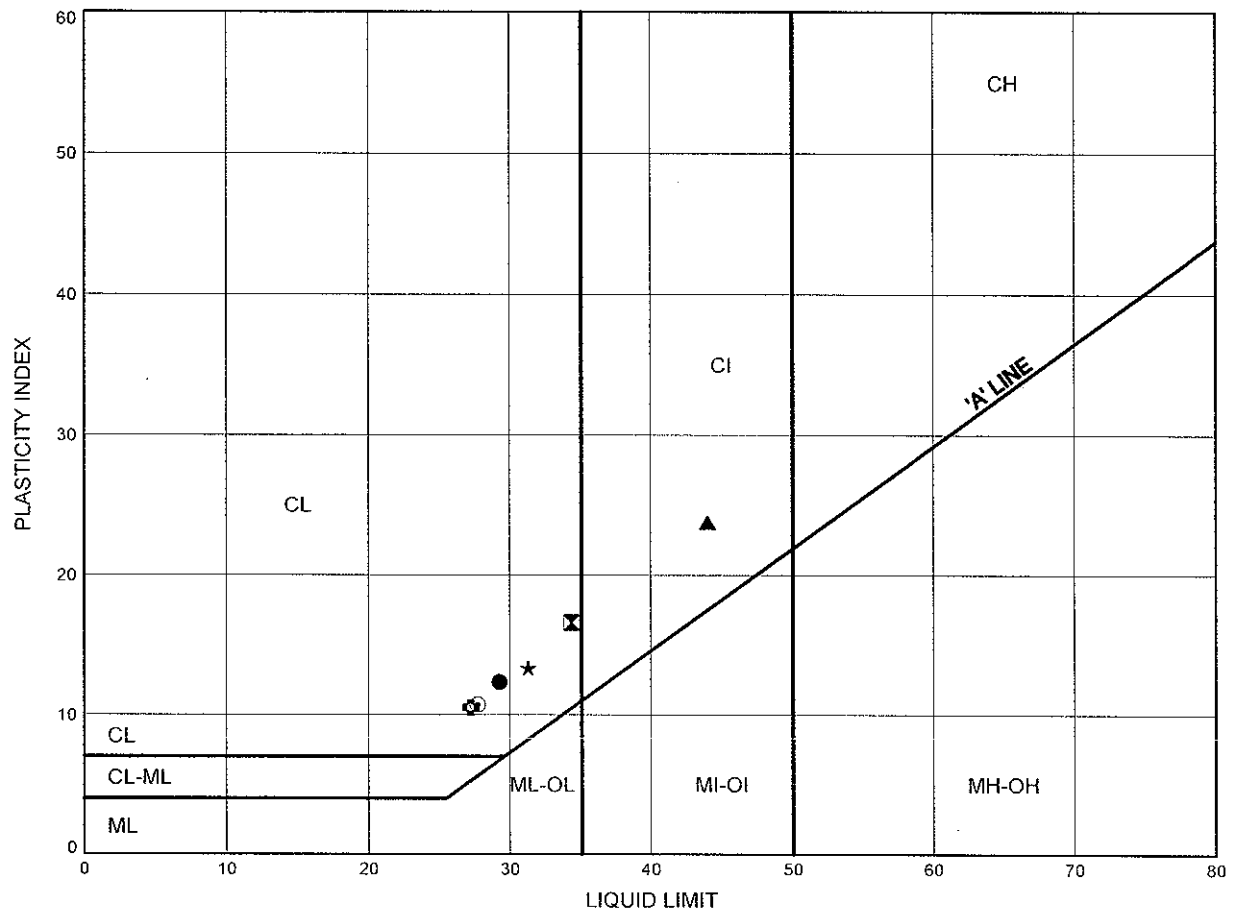
Prep'd DB

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ATTERBERG LIMITS TEST RESULTS

FIGURE B4-59

SILTY CLAY

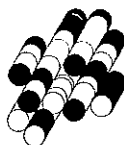


SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TS3	6.3	176.2
⊠	TS3	10.9	171.6
▲	TS4	1.0	181.4
★	TS4	3.2	179.2
⊕	TS4	6.3	176.1
⊗	TS4	9.3	173.1

Date July 2010

Project 1-09-4135



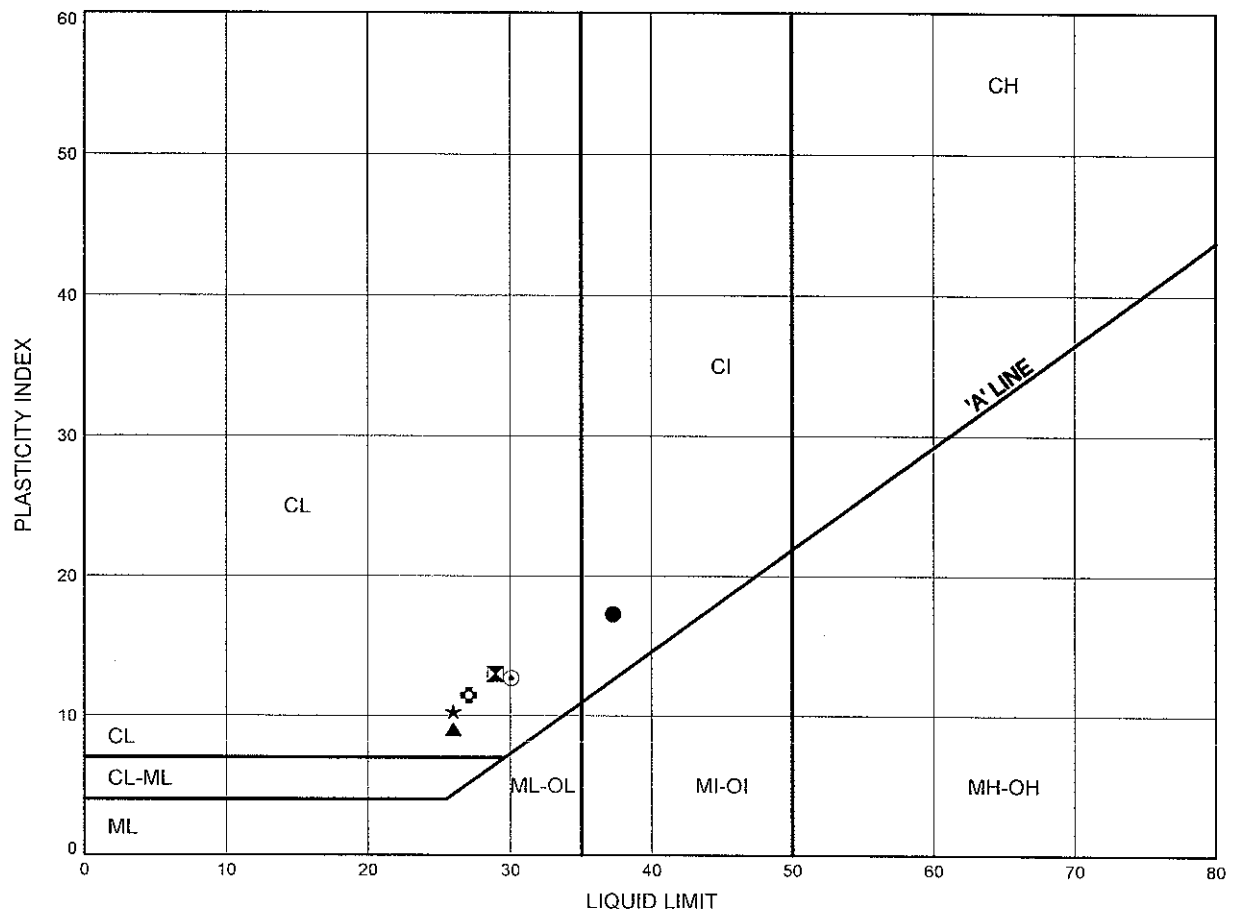
Prep'd DB

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ATTERBERG LIMITS TEST RESULTS

FIGURE B4-60

SILTY CLAY

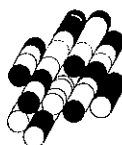


SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+410CL	1.7	180.8
⊠	SBL 12+410CL	4.7	177.8
▲	SBL 12+410CL	9.3	173.2
★	SBL 12+410CL	10.9	171.6
⊙	SBL 12+485Lt	2.5	179.5
⊕	SBL 12+485Lt	4.7	177.3

ALTR 1-09-4135 SITE4.GPJ 07/07/10

Date July 2010

Project 1-09-4135



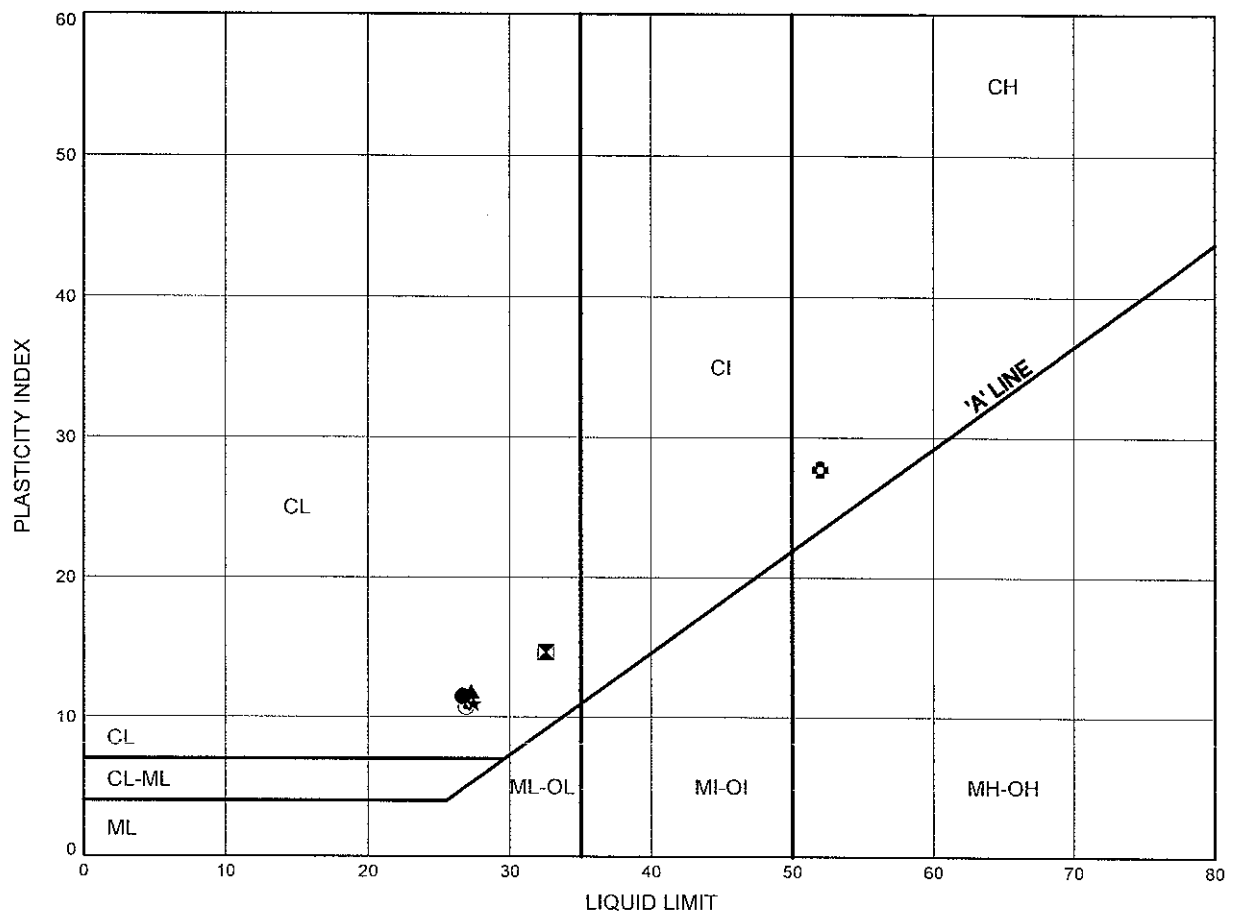
Prep'd DB

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ATTERBERG LIMITS TEST RESULTS

FIGURE B4-61

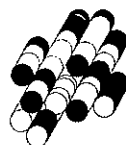
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+485Lt	7.8	174.2
⊠	SBL 12+485Rt	3.2	178.6
▲	SBL 12+485Rt	9.3	172.5
★	SBL 12+525CL	4.7	177.1
⊙	SBL 12+525CL	9.3	172.5
⊛	SBL 12+600Lt	1.7	181.0

Date July 2010

Project 1-09-4135



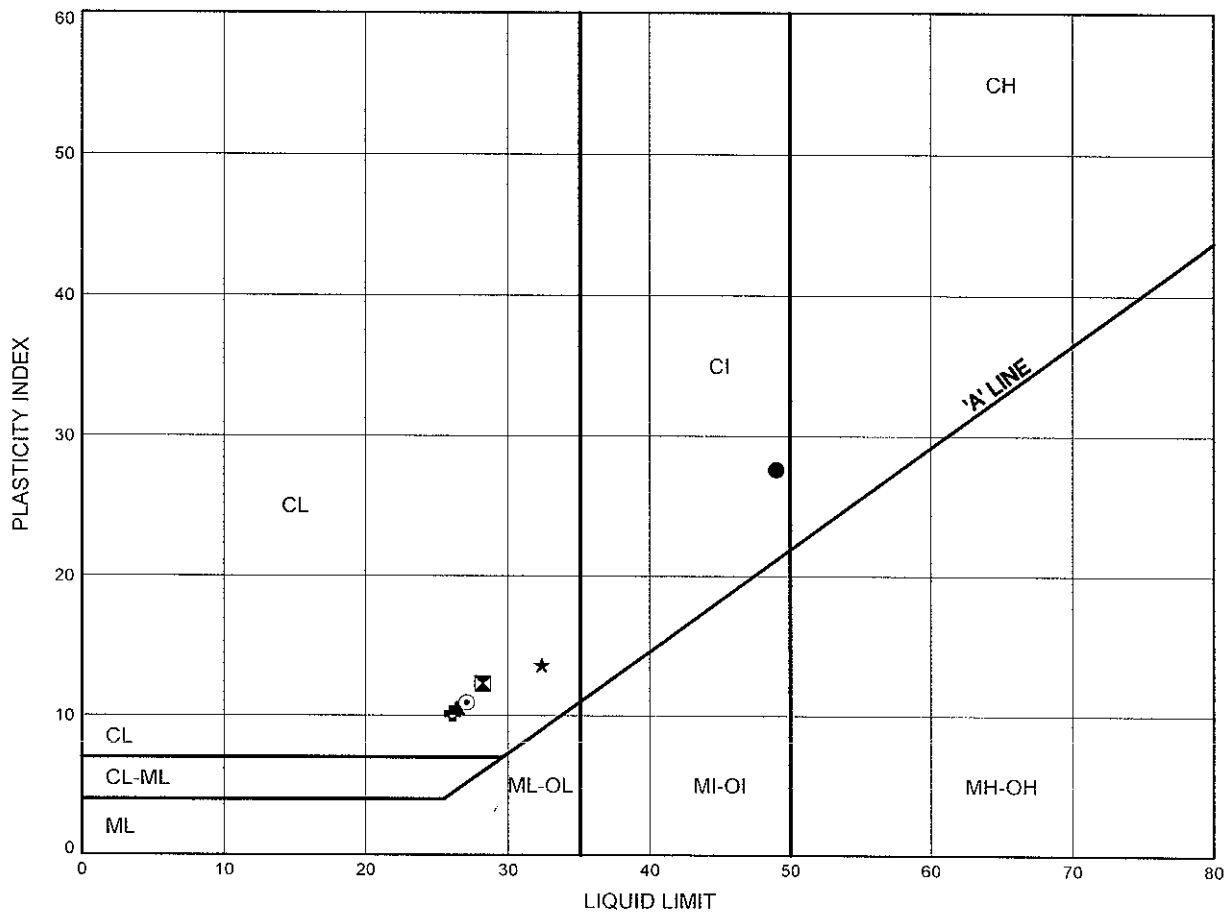
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-62

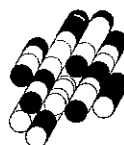
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+600Lt	3.2	179.5
⊠	SBL 12+600Lt	9.3	173.4
▲	SBL 12+600Lt	12.4	170.3
★	SBL 12+600Rt	1.0	181.1
⊙	SBL 12+600Rt	4.7	177.4
⊛	SBL 12+600Rt	10.9	171.2

Date July 2010

Project 1-09-4135



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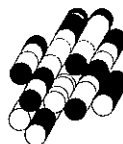
Chkd. MP

FIGURE B4-63

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+600Rt	12.4	169.7
⊠	SBL 12+650CL	3.2	180.5
▲	SBL 12+650CL	9.3	174.4
★	SBL 12+650CL	12.4	171.3
⊙	SBL 12+685CL	2.5	180.2
⊕	SBL 12+685CL	6.3	176.4

Prep'd DB.....

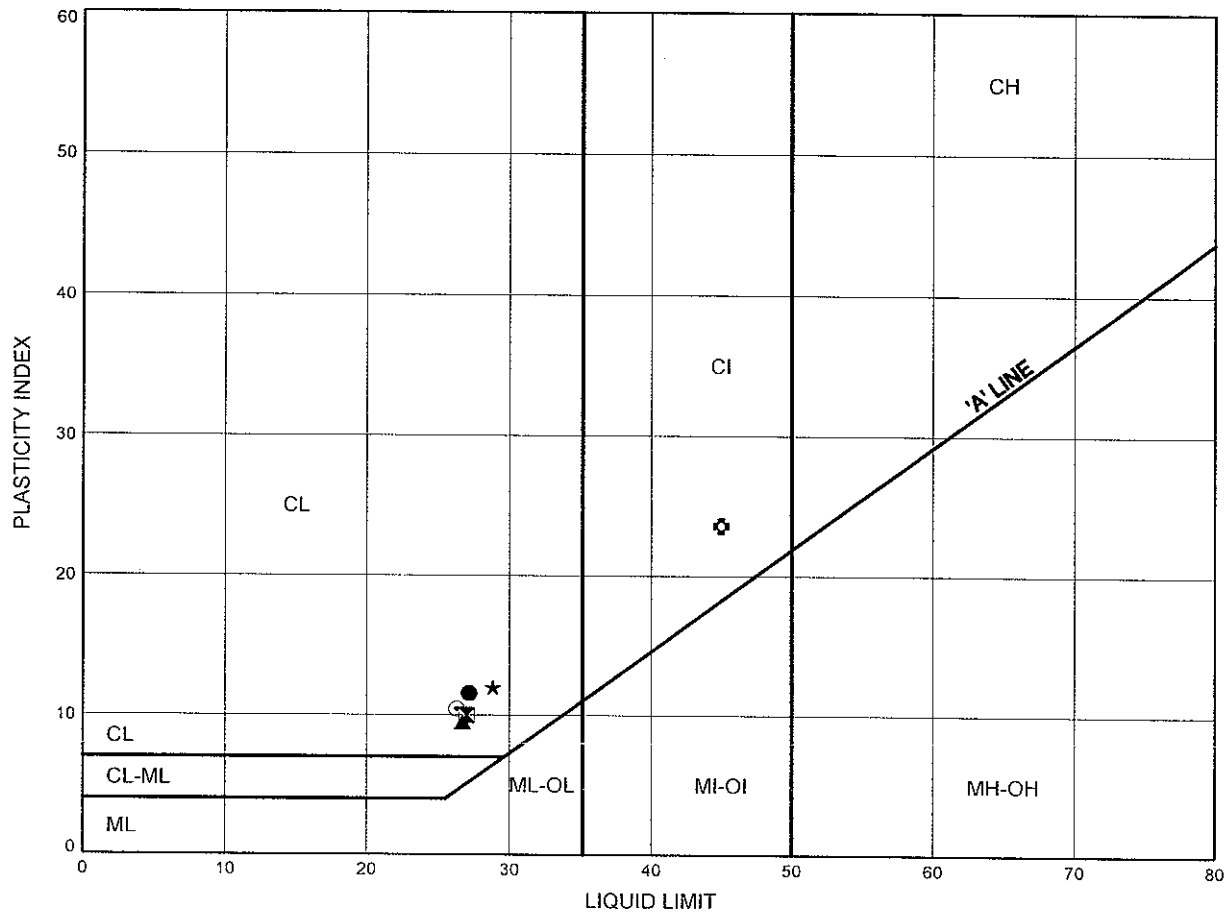
Chkd.MP.....



ATTERBERG LIMITS TEST RESULTS

FIGURE B4-64

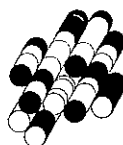
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+685CL	9.3	173.4
⊠	SBL 12+685CL	10.9	171.8
▲	WS1	7.8	174.9
★	WS1	9.3	173.4
⊙	WS1	13.9	168.8
⊗	WS2	1.0	182.1

Date July 2010

Project 1-09-4135



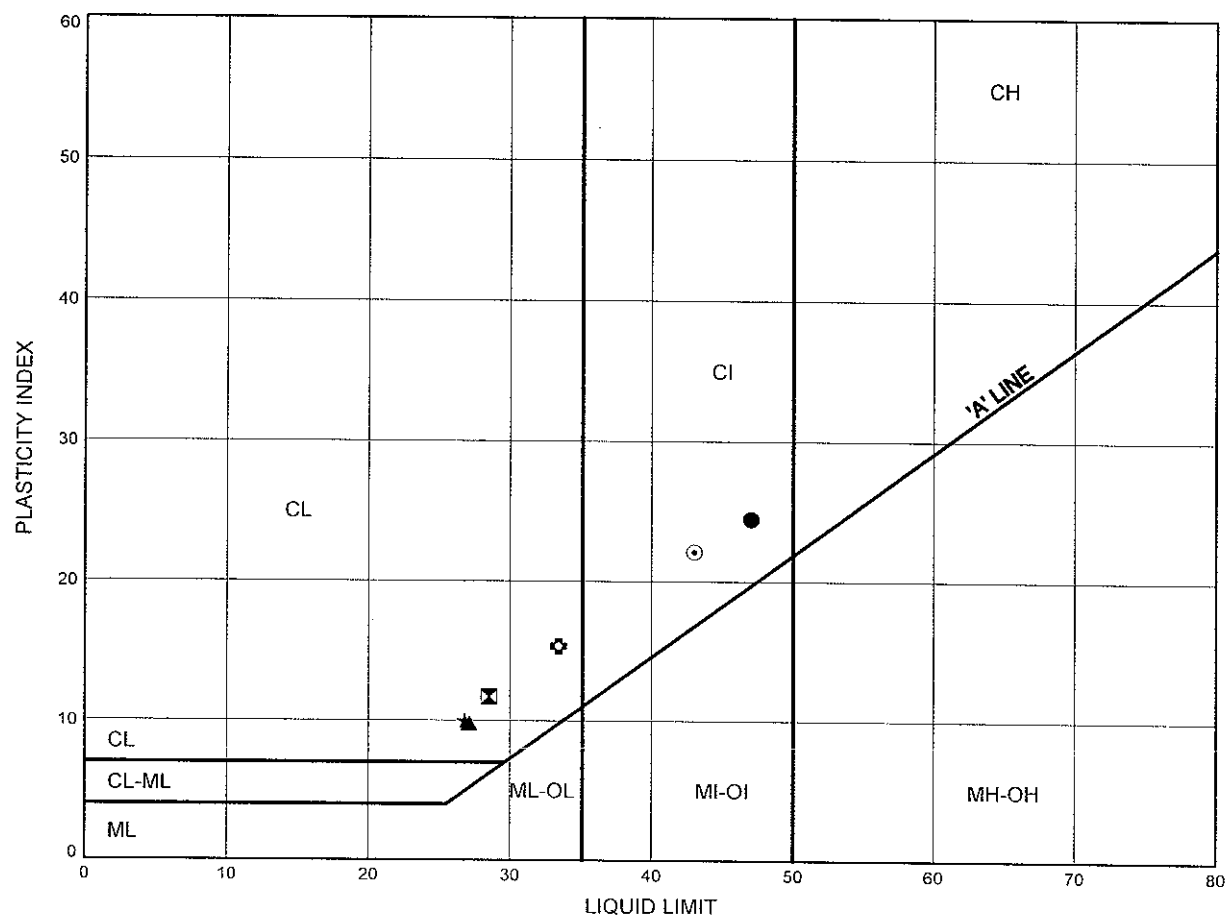
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-65

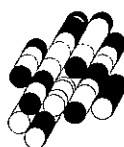
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS2	2.5	180.6
⊠	WS2	6.3	176.8
▲	WS2	10.9	172.2
★	WS2	12.4	170.7
⊙	WS3	3.2	179.8
⊛	WS3	4.7	178.3

Date July 2010

Project 1-09-4135



Prep'd DB

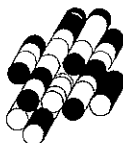
Chkd. MP

FIGURE B4-66

[illegible]

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS3	7.8	175.2
⊠	WS3	10.9	172.1
▲	WS3	13.9	169.1
★	WS4	2.5	180.2
⊙	WS4	9.3	173.4
⊕	WS4	12.4	170.3

Project 1-09-4135

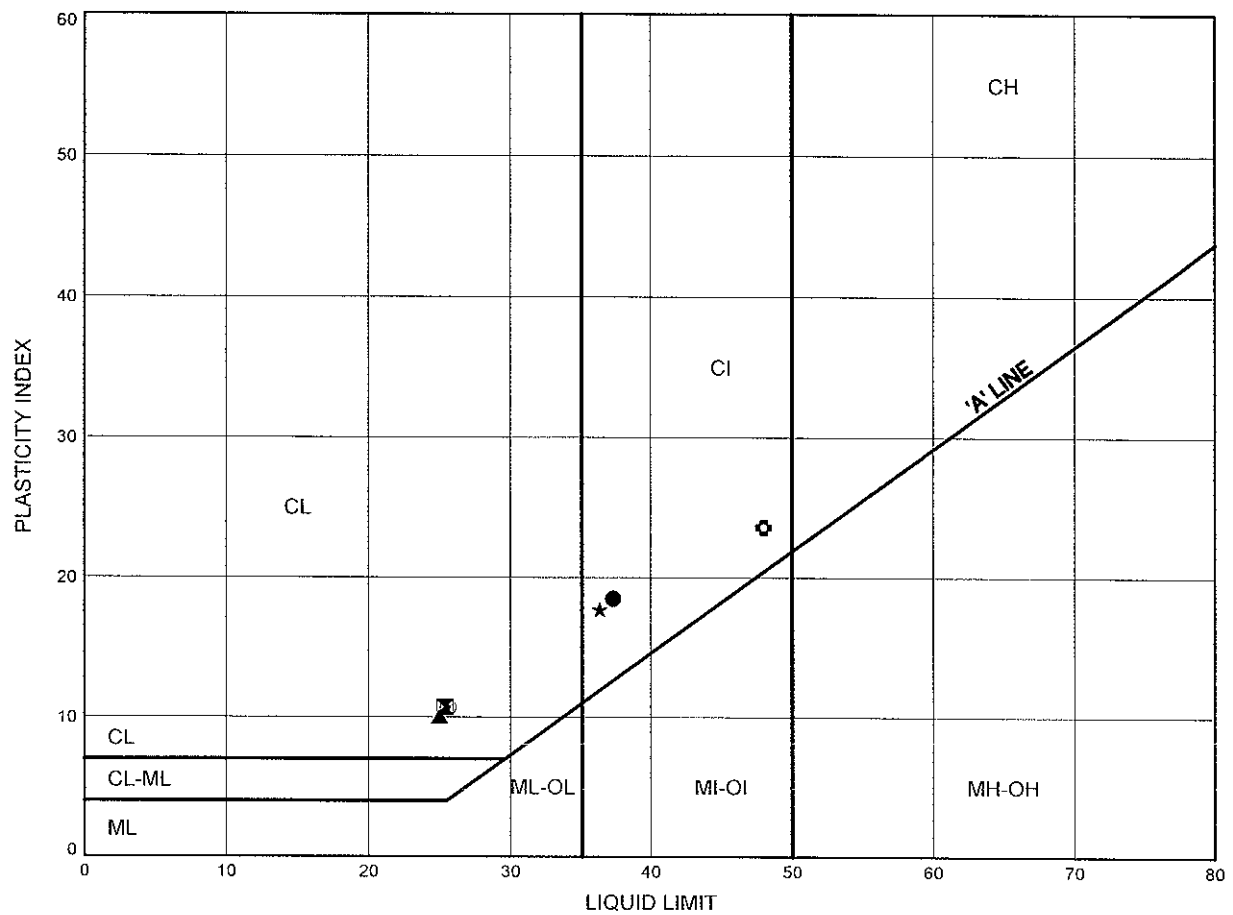


Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-67

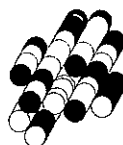
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+750CL	3.2	179.7
⊠	SBL 12+750CL	7.8	175.1
▲	SBL 12+750CL	10.1	172.8
★	SBL 12+825Lt	3.2	179.8
⊙	SBL 12+825Lt	7.1	175.9
⊛	SBL 12+825Rt	1.0	181.3

Date July 2010

Project 1-09-4135



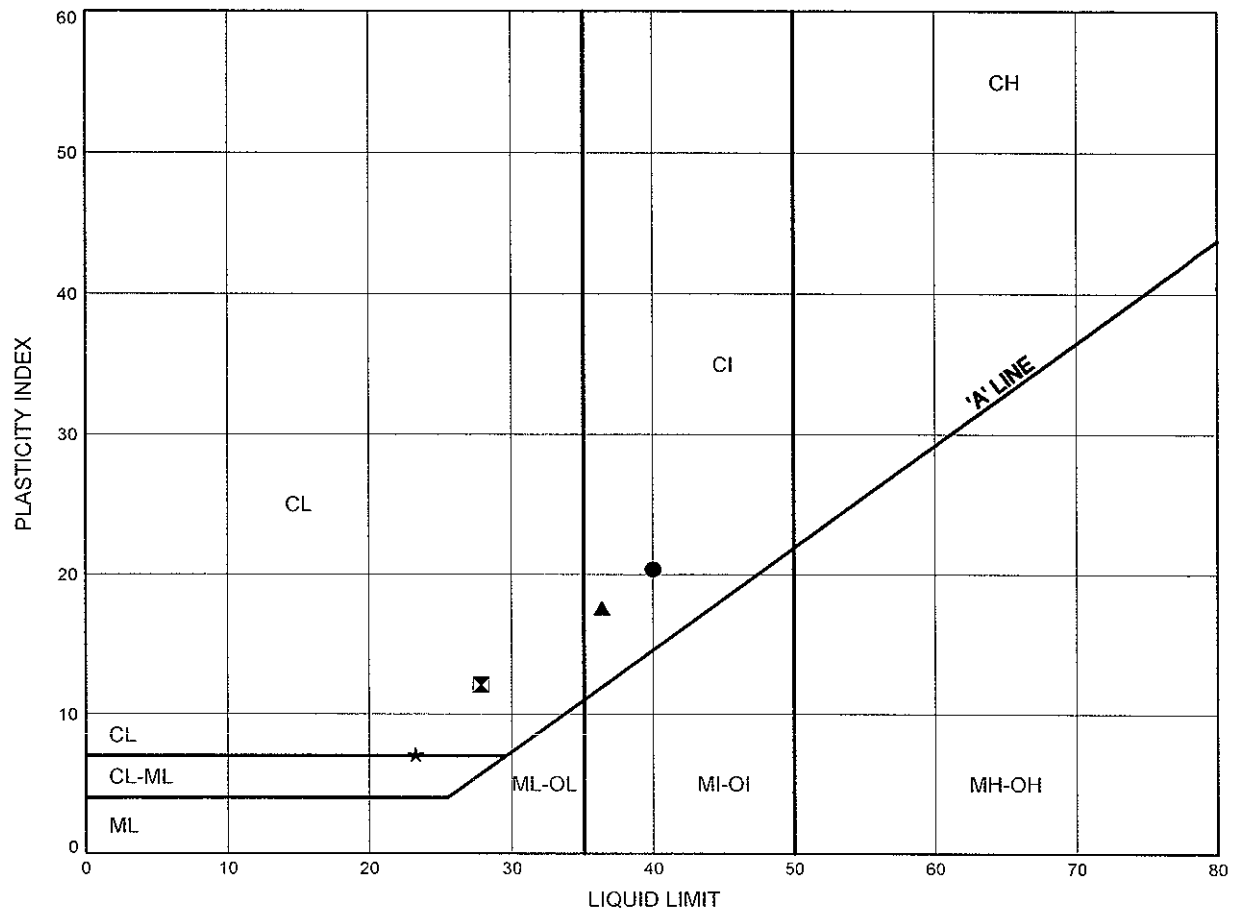
Prep'd DB

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ATTERBERG LIMITS TEST RESULTS

FIGURE B4-68

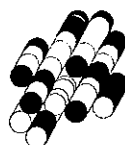
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+825Rt	2.5	179.8
⊠	SBL 12+825Rt	6.3	176.0
▲	SBL 12+900CL	1.7	181.0
★	SBL 12+900CL	5.5	177.2

Date July 2010

Project 1-09-4135



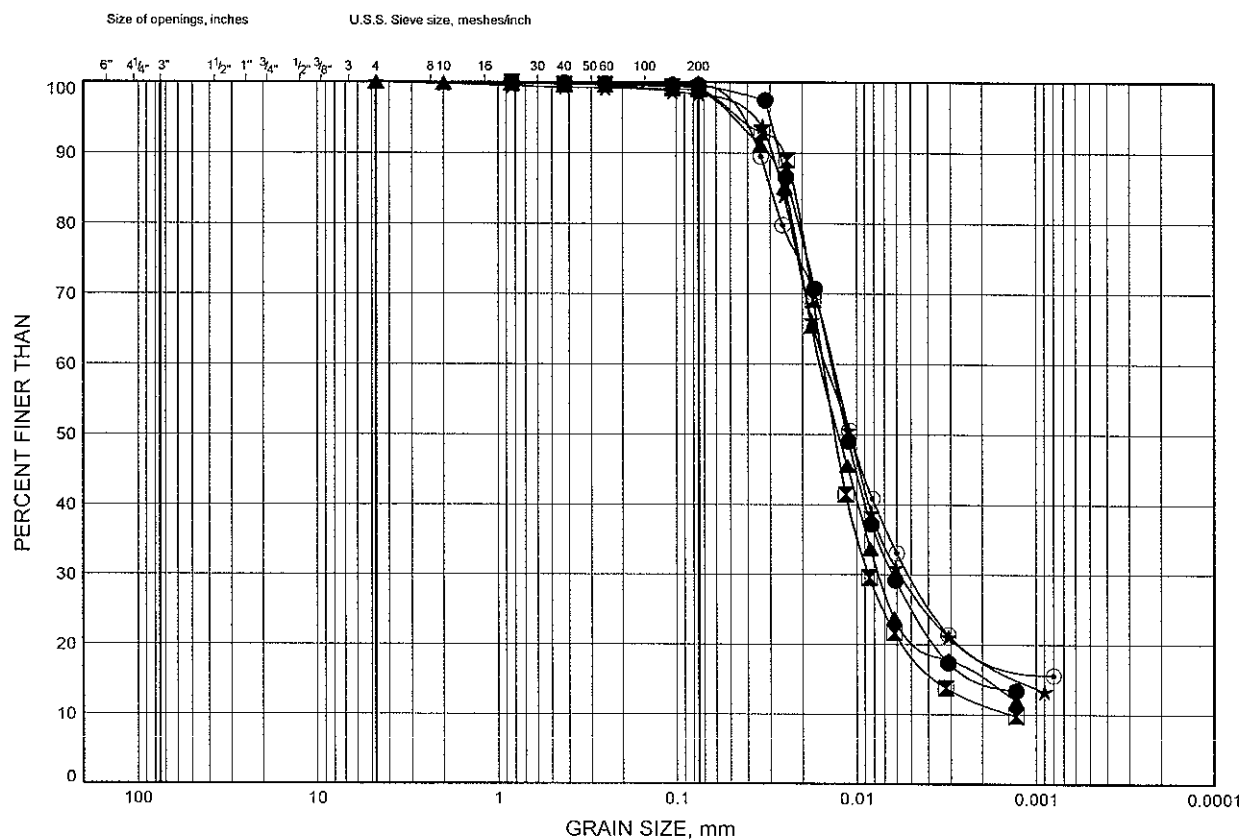
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-69

SILT



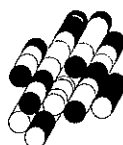
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+525Lt	1.7	181.1
⊠	NBL 12+595Rt	2.5	179.1
▲	NBL 12+645Lt	4.7	178.6
★	NBL 12+645Rt	3.2	177.8
⊙	WN1	4.7	178.4

Date July 2010

Project 1-09-4135



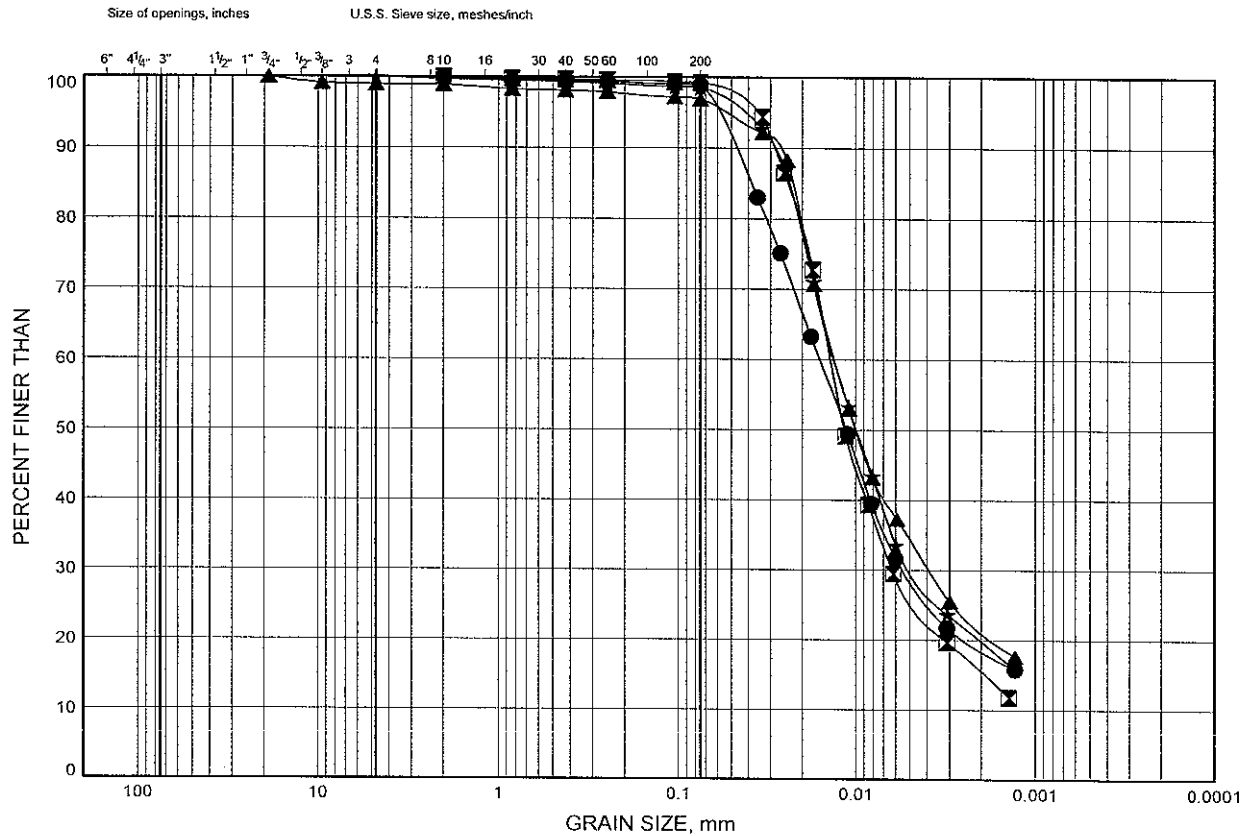
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-70

SILT



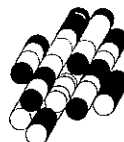
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WN2	2.5	179.1
⊠	WN3	4.0	178.1
▲	WS1	4.7	178.0
★	WS2	4.7	178.4

Date July 2010

Project 1-09-4135



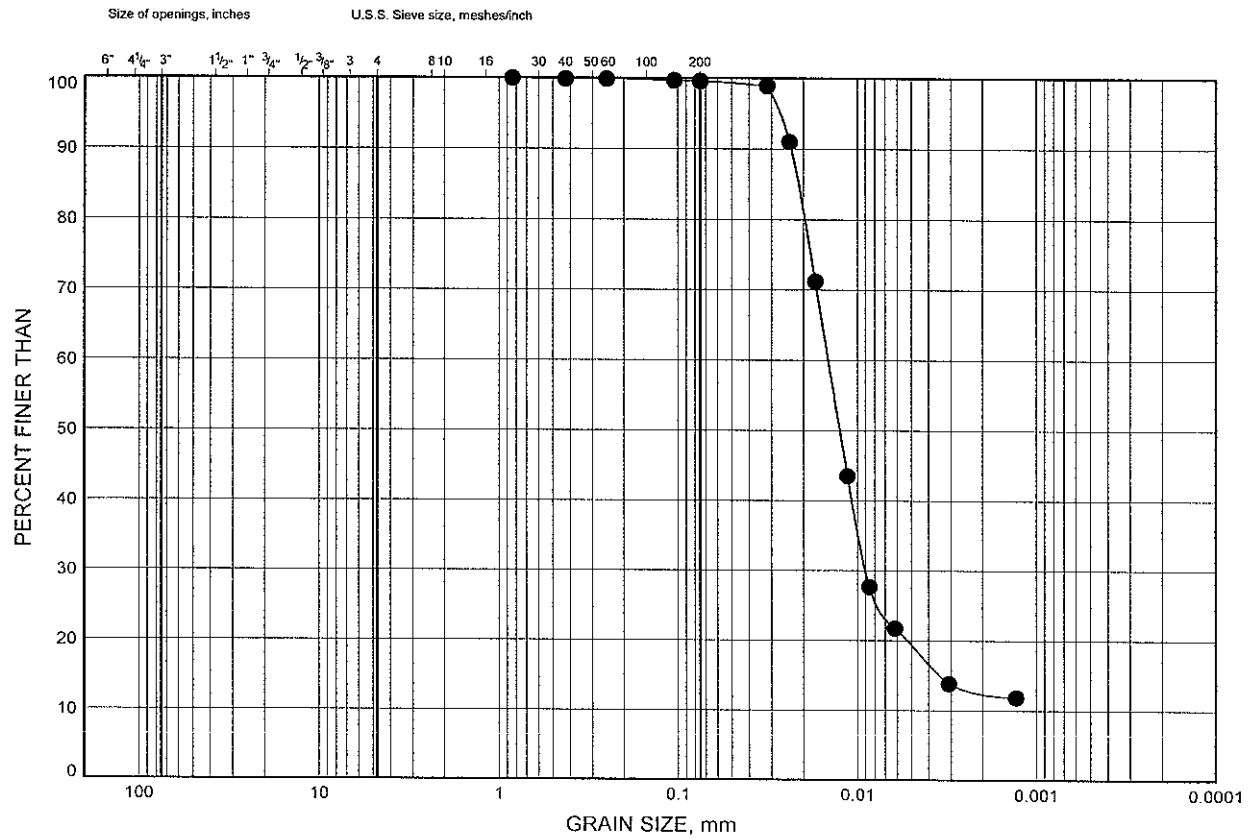
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-71

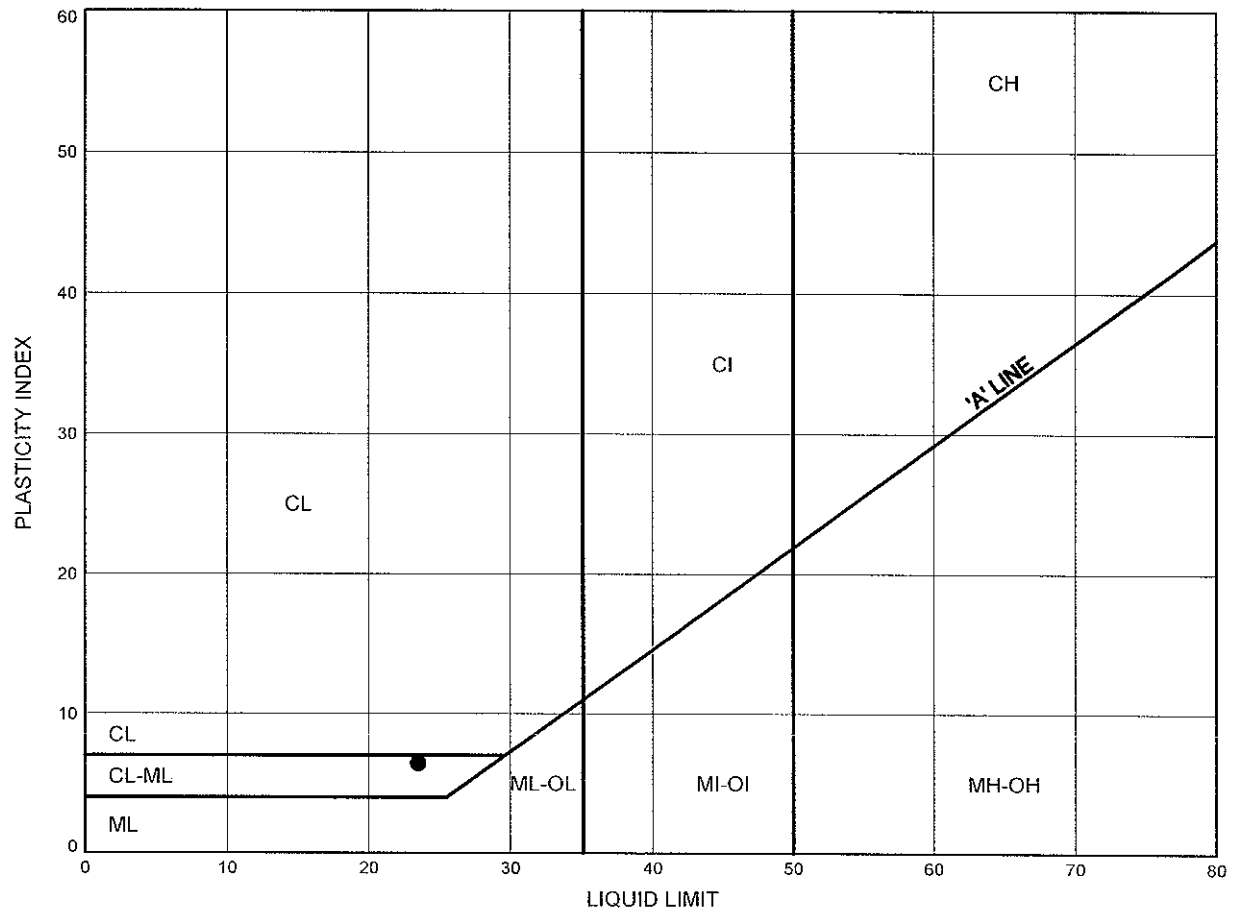
CLAYEY SILT



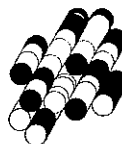
ATTERBERG LIMITS TEST RESULTS

FIGURE B4-72

CLAYEY SILT



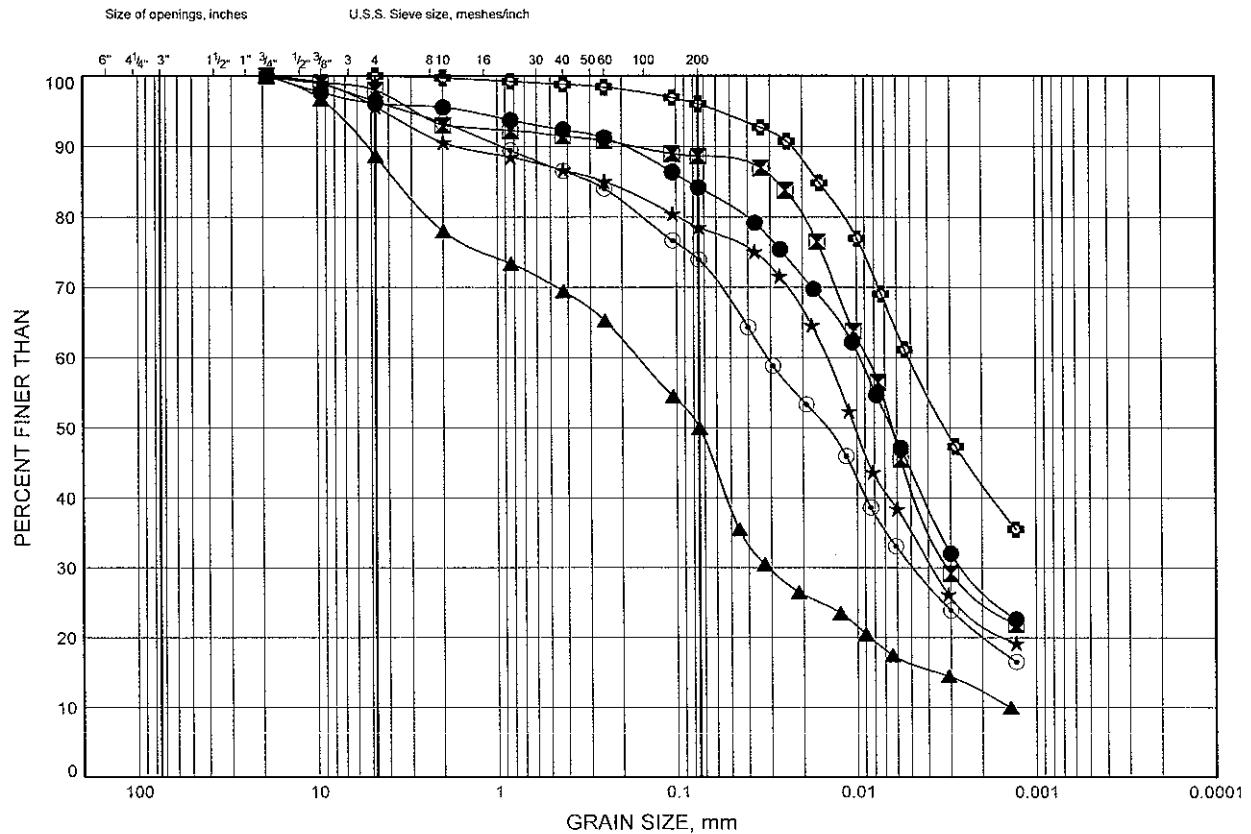
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+835Rt	6.3	176.6



GRAIN SIZE DISTRIBUTION

FIGURE B4-73

SILTY CLAY TO CLAYEY SILT TILL

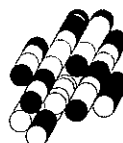


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	15.4	168.1
⊠	TN2	15.4	168.8
▲	TN2	26.1	158.1
★	TN3	17.0	167.1
⊙	TN4	17.0	167.0
⊛	TN4	27.6	156.4

Date July 2010

Project 1-09-4135



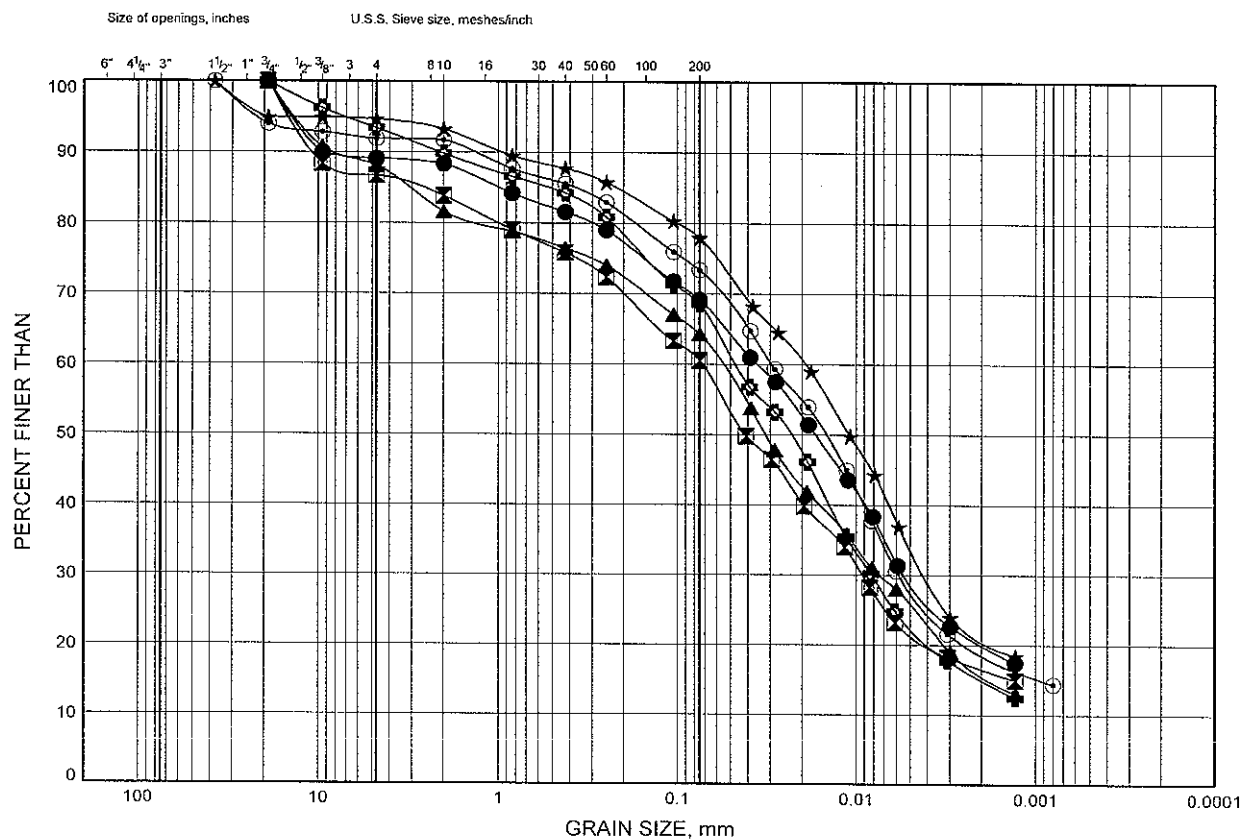
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-74

SILTY CLAY TO CLAYEY SILT TILL



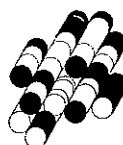
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	NBL 12+525Lt	15.4	167.4
⊠	NBL 12+595Rt	13.9	167.7
▲	TS1	17.0	165.6
★	WN1	15.4	167.7
⊙	WN2	13.9	167.7
⊗	WN3	15.4	166.7

Date July 2010

Project 1-09-4135



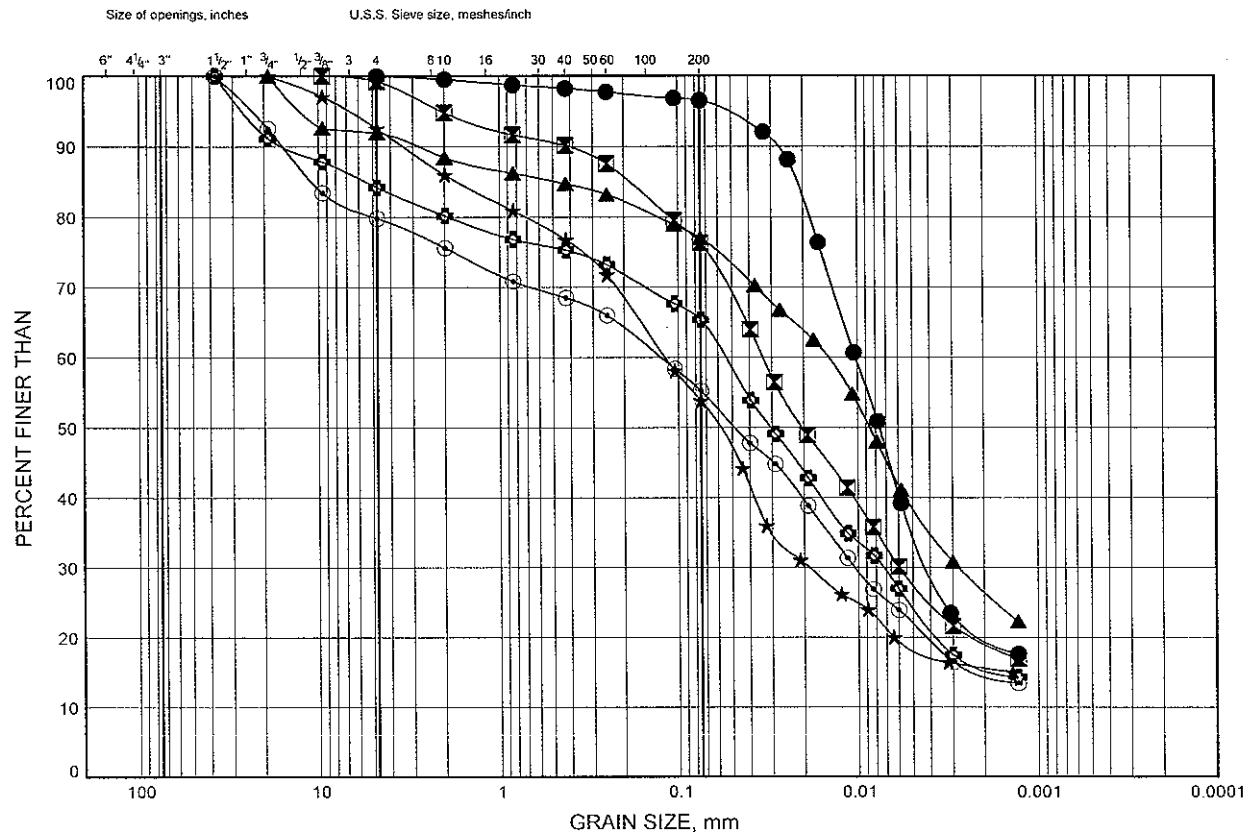
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-75

SILTY CLAY TO CLAYEY SILT TILL



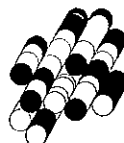
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+485Lt	13.9	168.1
⊠	TS1	26.1	156.5
▲	TS2	15.4	167.9
★	TS2	23.1	160.2
⊙	TS3	18.5	164.0
⊗	TS4	15.4	167.0

Date July 2010

Project 1-09-4135



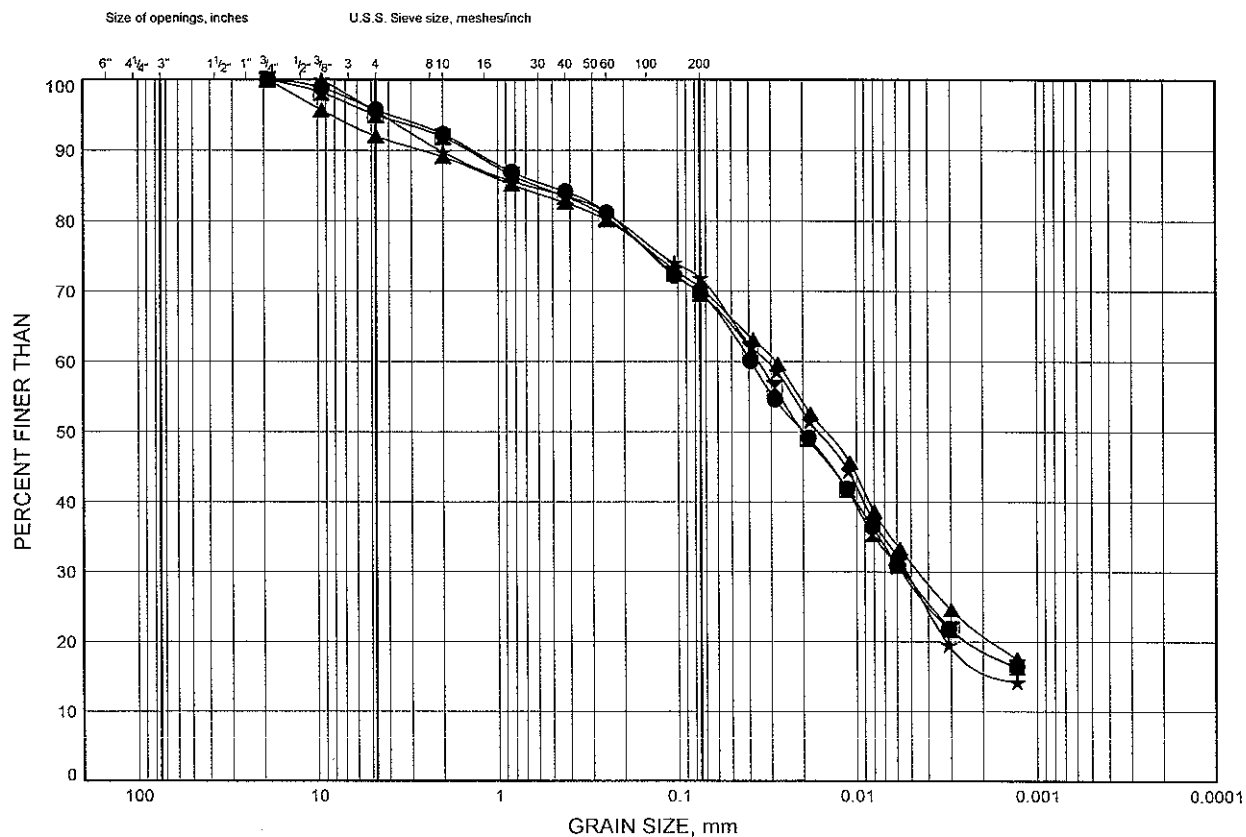
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-76

SILTY CLAY TO CLAYEY SILT TILL



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	SBL 12+485Rt	13.9	167.9
⊠	SBL 12+525CL	13.9	167.9
▲	SBL 12+525CL	15.4	166.4
★	WS1	15.4	167.3

Date July 2010

Project 1-09-4135



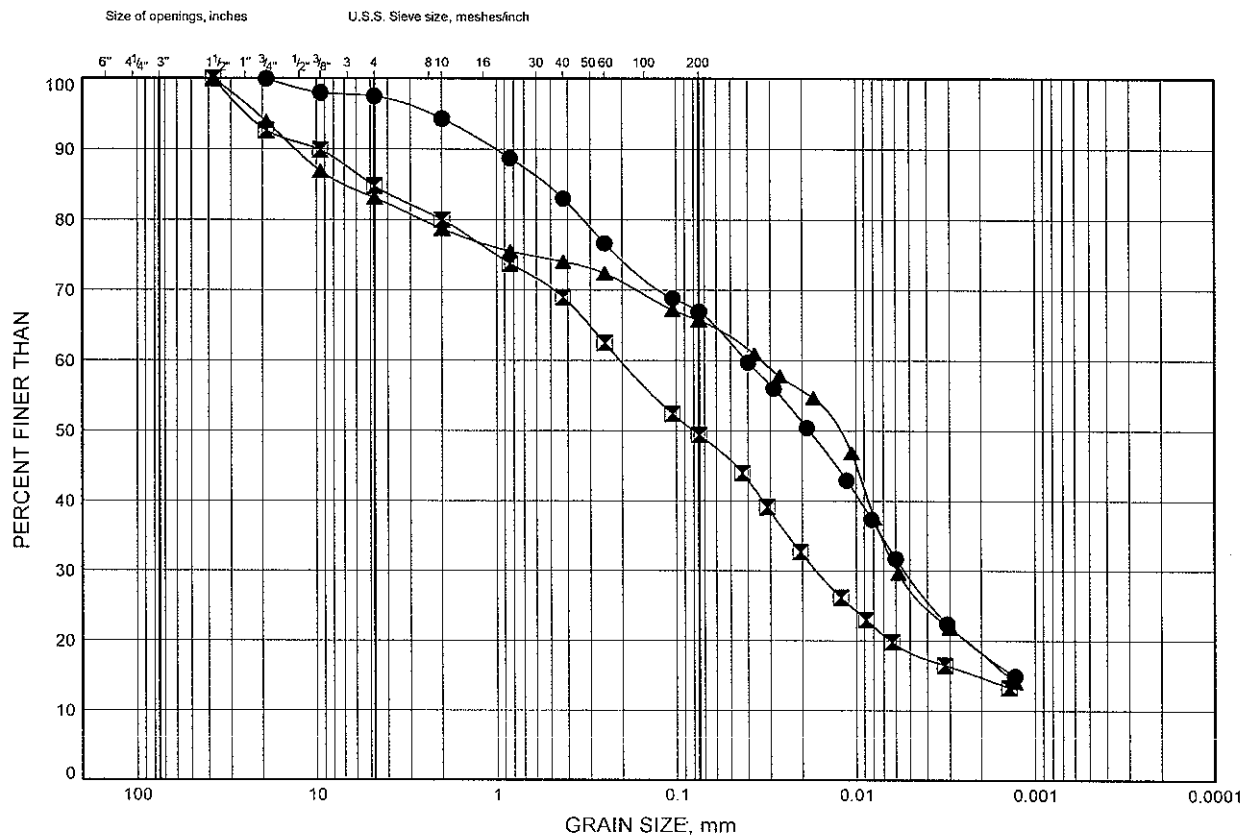
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-77

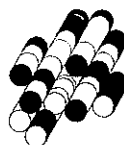
SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS1	21.5	161.2
⊠	WS2	21.5	161.6
▲	WS4	15.4	167.3

Date July 2010

Project 1-09-4135



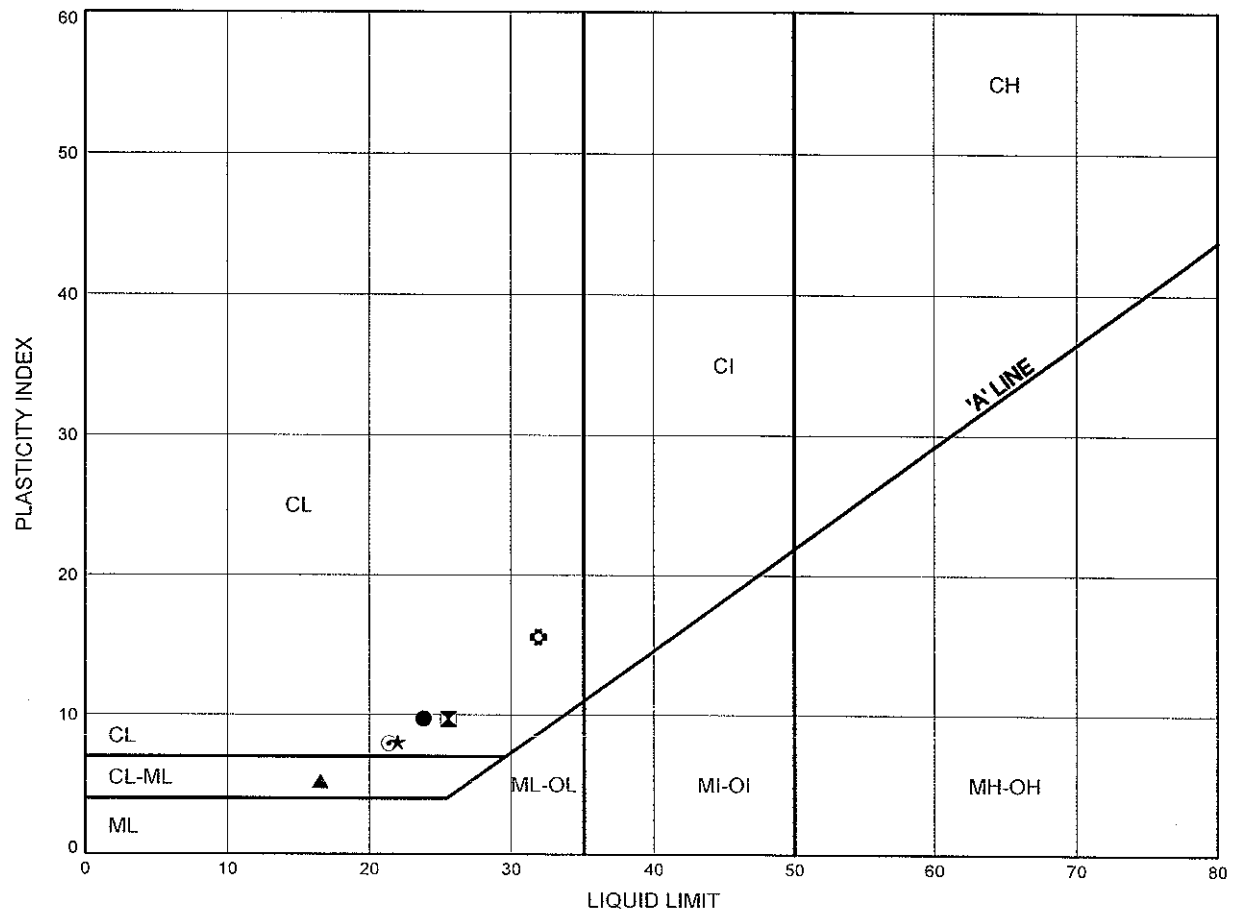
Prep'd DB

Chkd. MP

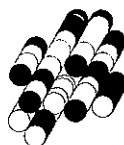
ATTERBERG LIMITS TEST RESULTS

FIGURE B4-78

SILTY CLAY TO CLAYEY SILT TILL



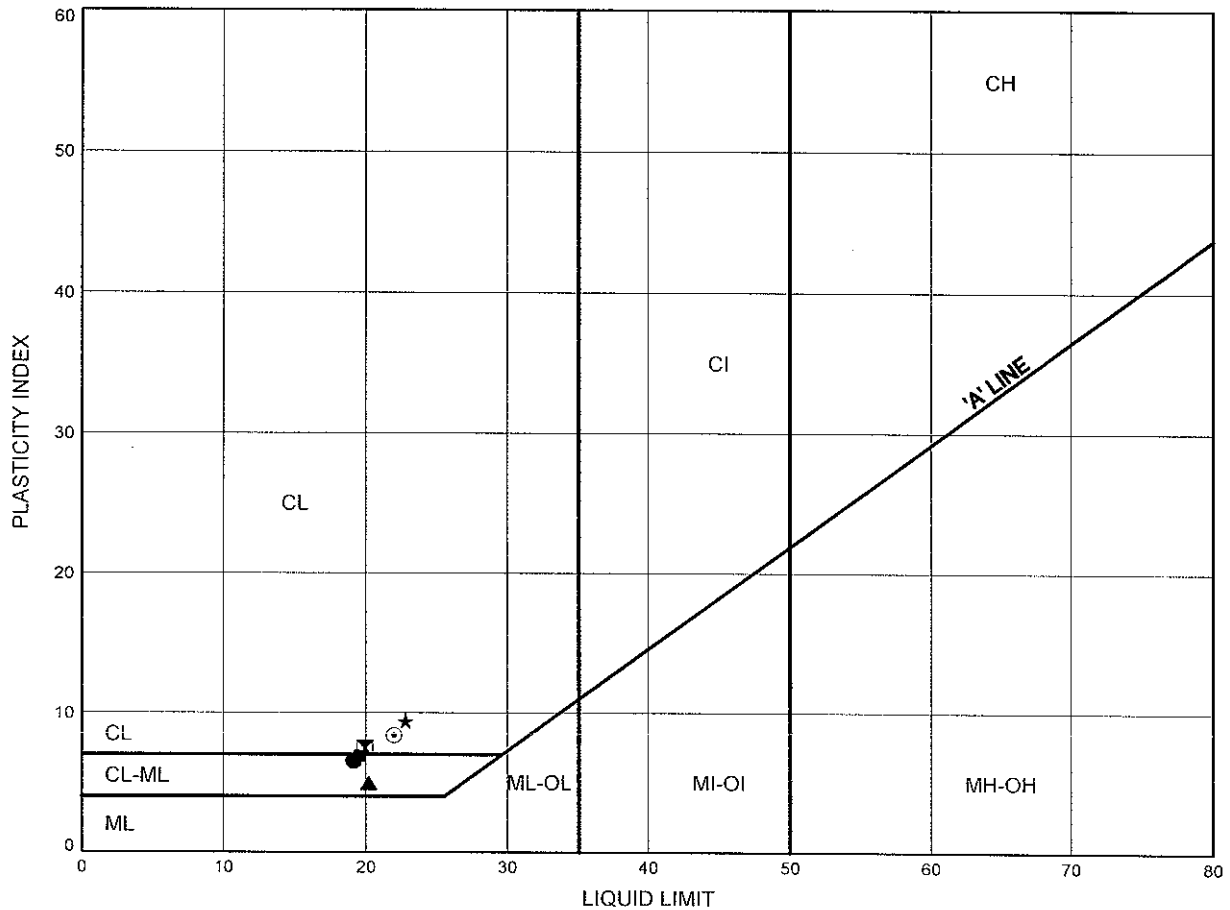
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	15.4	168.1
⊠	TN2	15.4	168.8
▲	TN2	26.1	158.1
★	TN3	17.0	167.1
⊙	TN4	17.0	167.0
⊛	TN4	27.6	156.4



ATTERBERG LIMITS TEST RESULTS

FIGURE B4-79

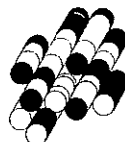
SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+525Lt	15.4	167.4
⊠	NBL 12+595Rt	13.9	167.7
▲	TS1	17.0	165.6
★	WN1	15.4	167.7
⊙	WN2	13.9	167.7
⊕	WN3	15.4	166.7

Date July 2010

Project 1-09-4135



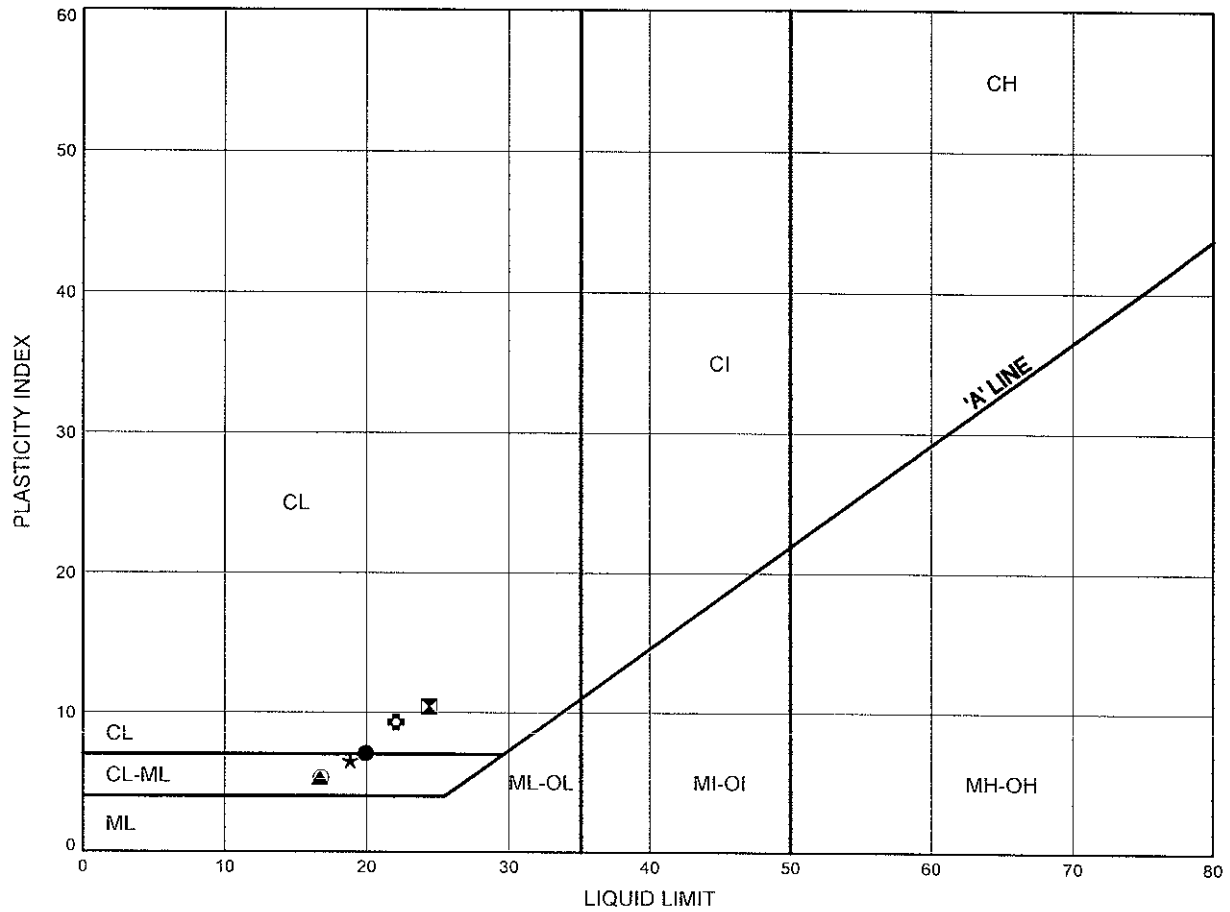
Prep'd DB

Chkd. MP

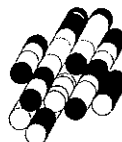
ATTERBERG LIMITS TEST RESULTS

FIGURE B4-80

SILTY CLAY TO CLAYEY SILT TILL



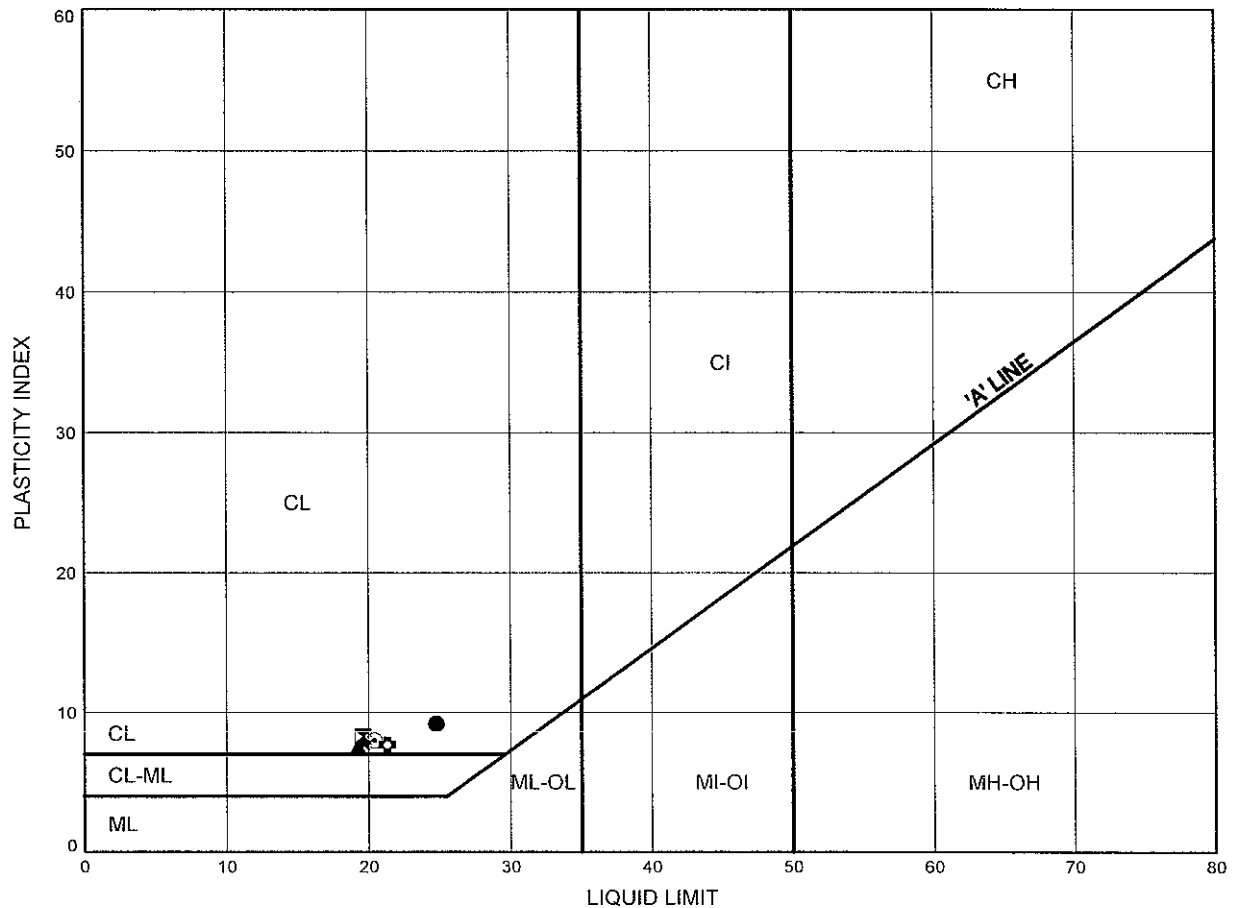
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS1	26.1	156.5
⊠	TS2	15.4	167.9
▲	TS2	23.1	160.2
★	TS3	18.5	164.0
⊙	TS3	23.1	159.4
⊕	TS3	26.1	156.4



ATTERBERG LIMITS TEST RESULTS

FIGURE B4-81

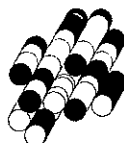
SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+485Lt	13.9	168.1
⊠	SBL 12+485Rt	13.9	167.9
▲	SBL 12+525CL	13.9	167.9
★	SBL 12+525CL	15.4	166.4
⊙	TS4	15.4	167.0
⊛	WS1	15.4	167.3

Date July 2010

Project 1-09-4135



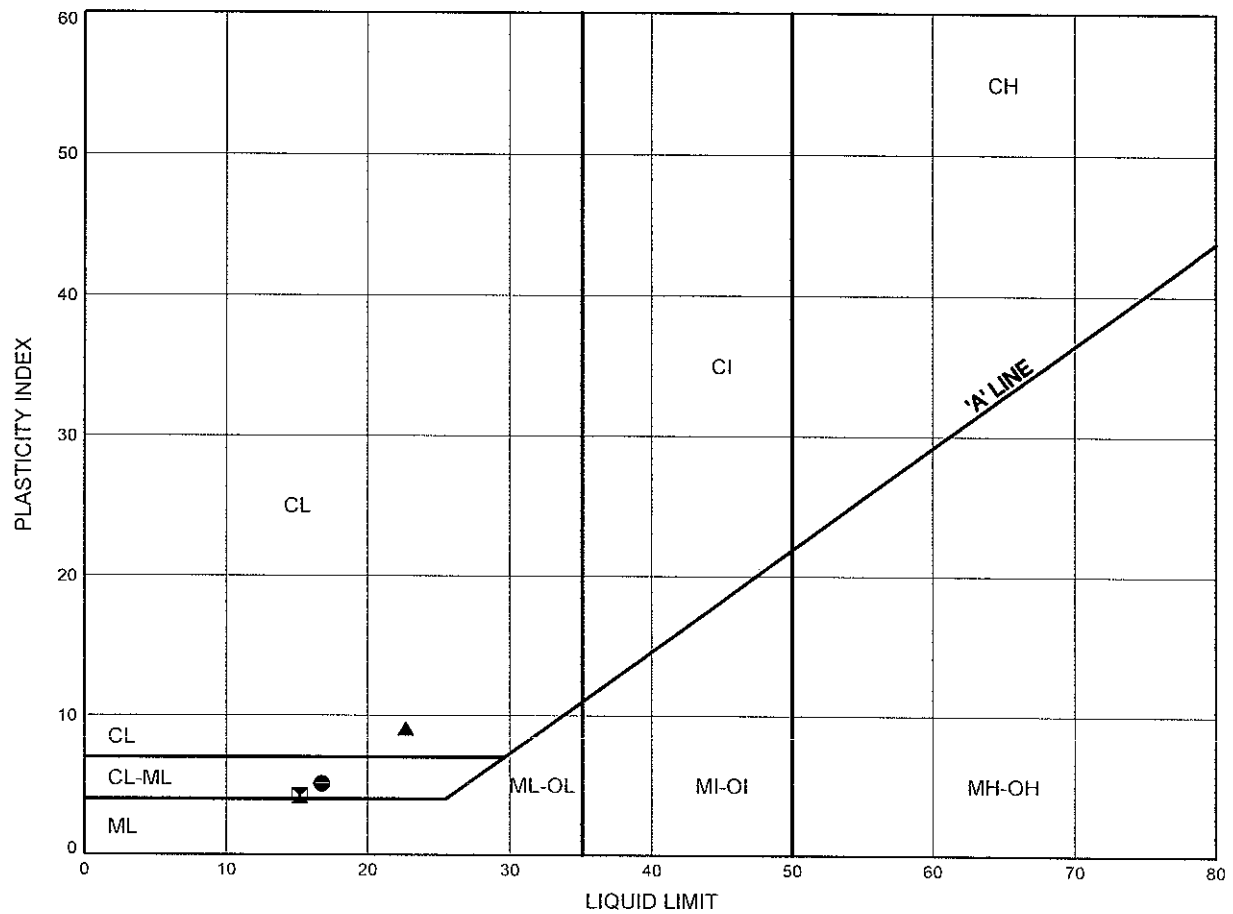
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-82

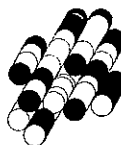
SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS1	21.5	161.2
⊠	WS2	21.5	161.6
▲	WS4	15.4	167.3

Date July 2010

Project 1-09-4135



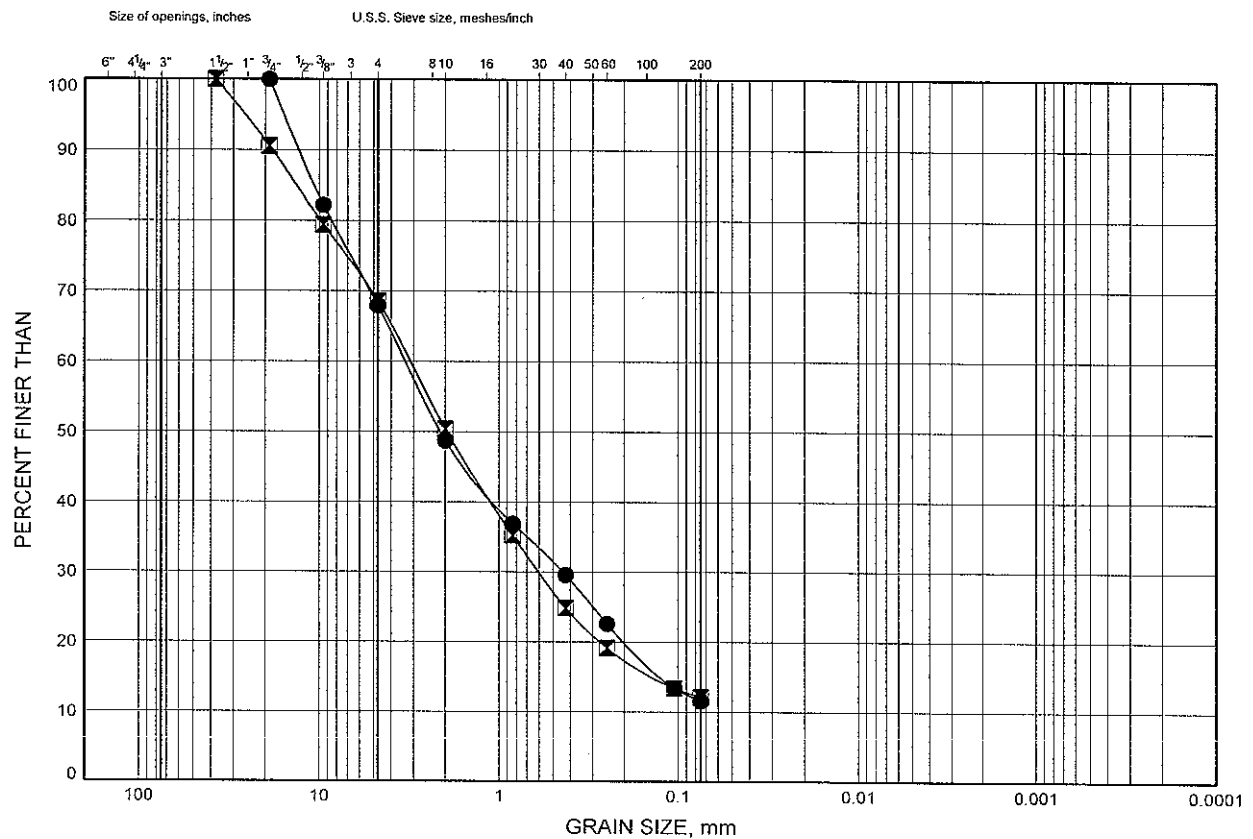
Prep'd DB

Chkd MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-83

SAND

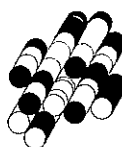


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS1	21.4	161.2
■	TS2	21.5	161.8

Date July 2010

Project 1-09-4135



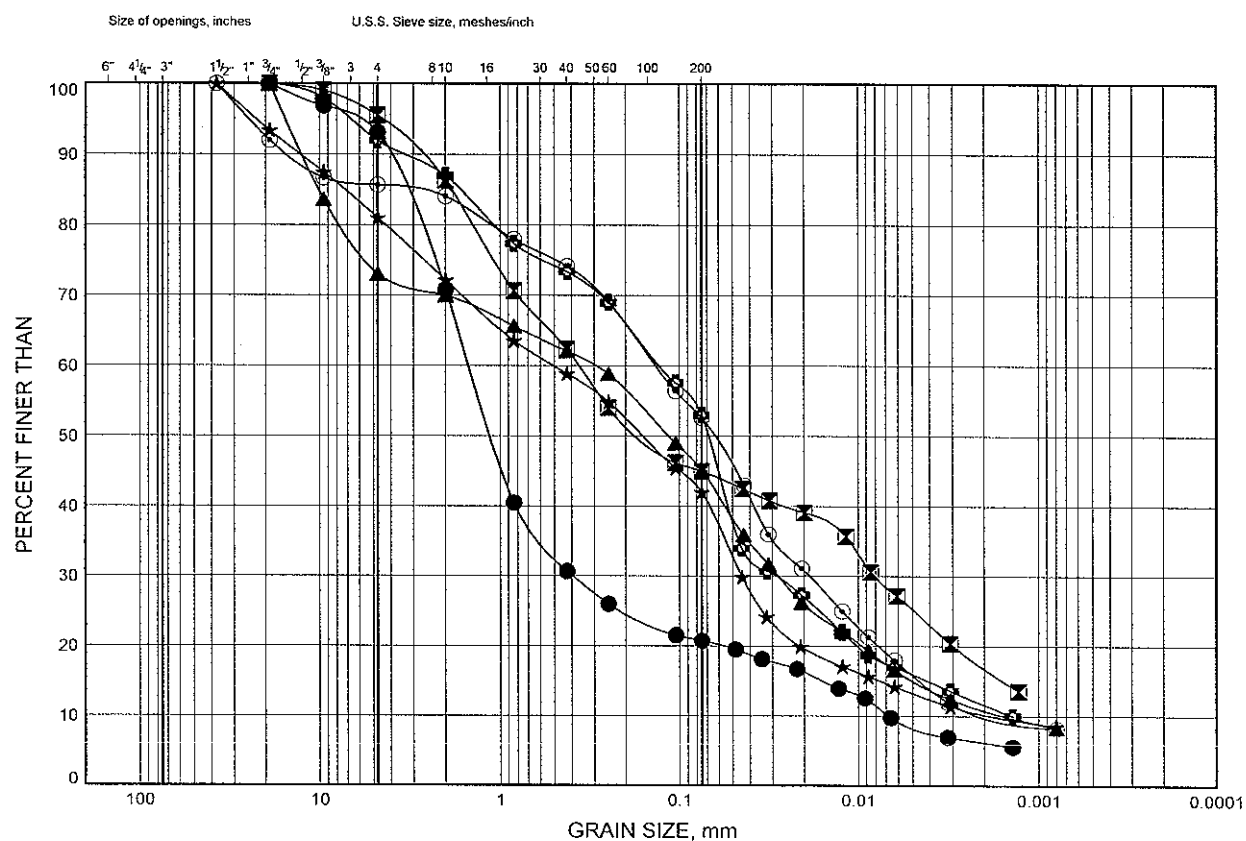
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-84

SANDY SILT TO SILTY SAND TILL



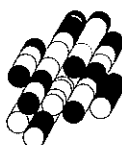
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TN1	20.0	163.5
⊠	TN1	24.6	158.9
▲	TN4	21.5	162.5
★	TN4	29.2	154.8
⊙	WN1	18.5	164.6
⊕	WN1	24.6	158.5

Date July 2010

Project 1-09-4135



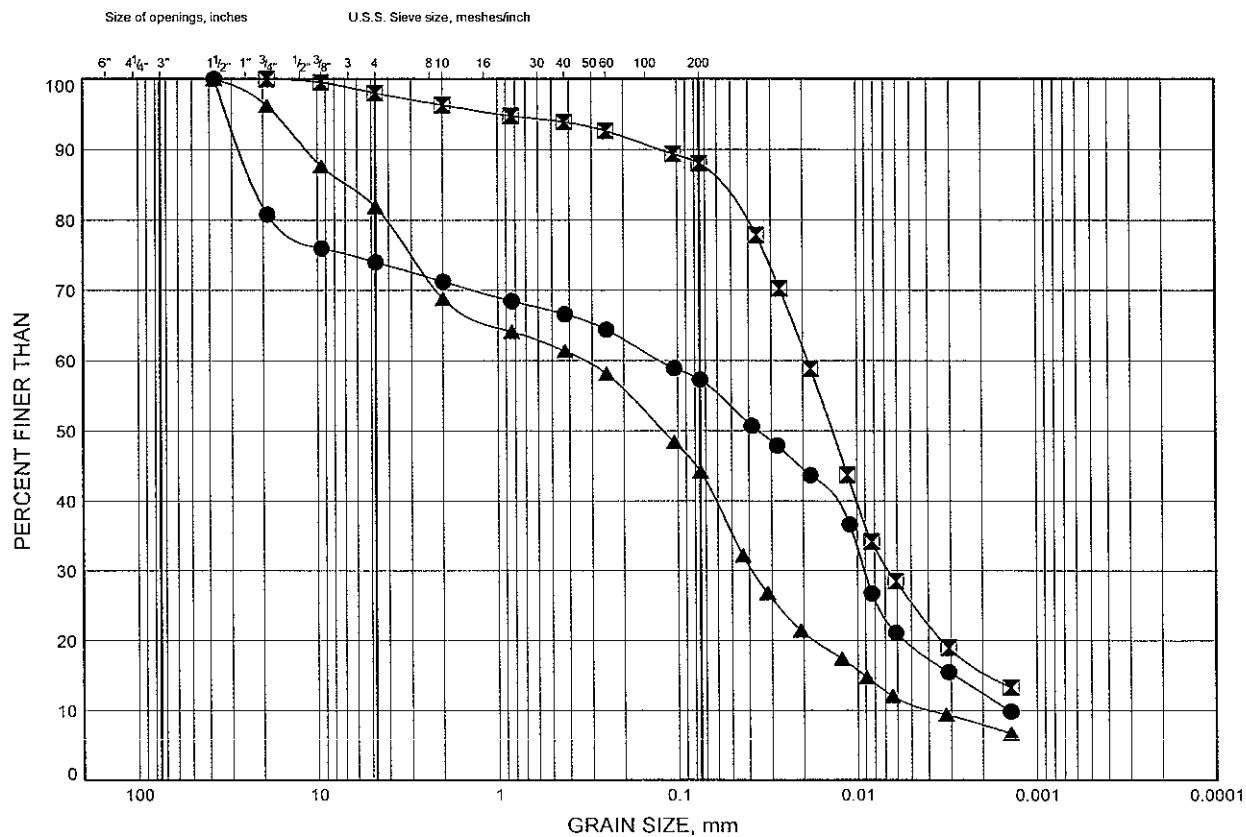
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-86

SANDY SILT TO SILTY SAND TILL

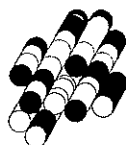


SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WS2	18.5	164.6
⊠	WS3	18.5	164.5
▲	WS4	23.1	159.6

Date July 2010

Project 1-09-4135



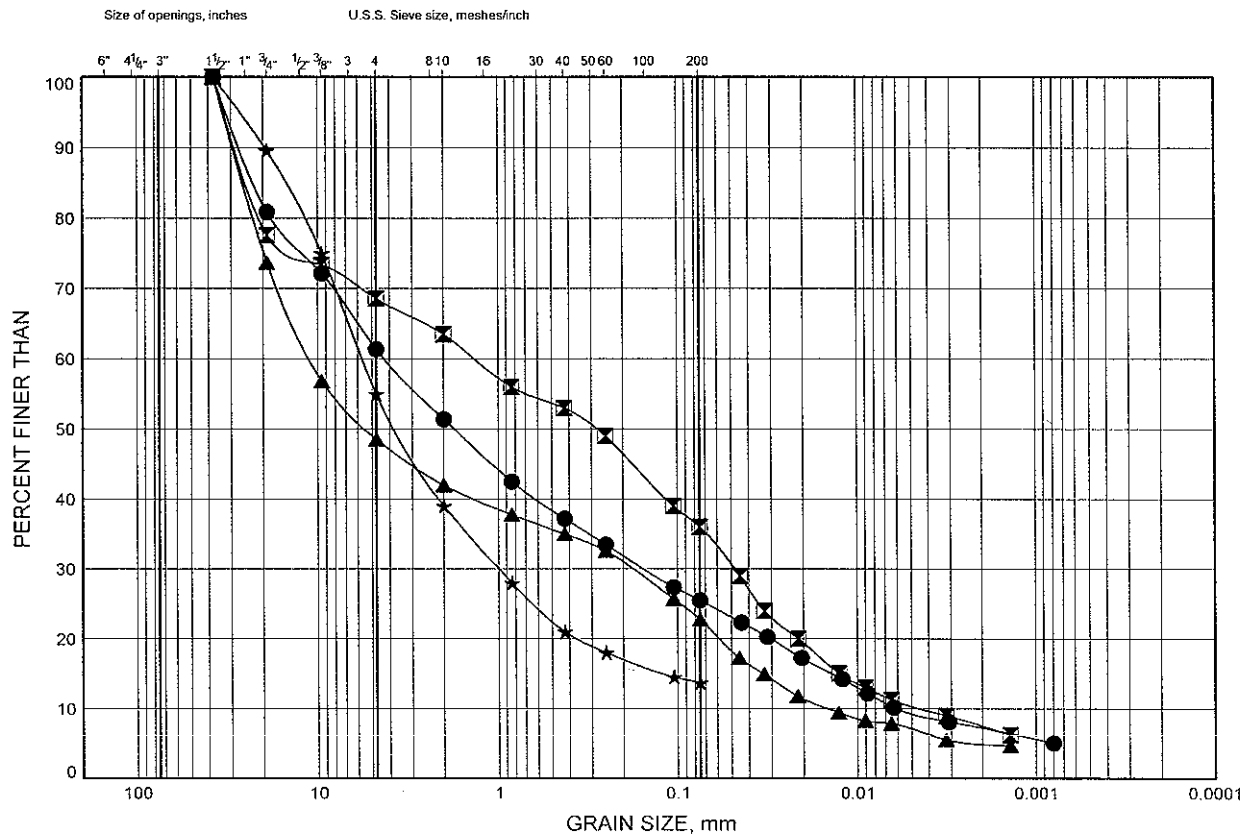
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-87

SANDY GRAVEL TO SAND AND GRAVEL TILL

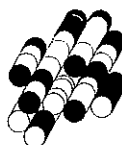


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN2	29.2	155.0
⊠	TN3	29.2	154.9
▲	TS3	27.6	154.9
★	TS4	27.5	154.9

Date July 2010

Project 1-09-4135



Prep'd DB

Chkd. MP

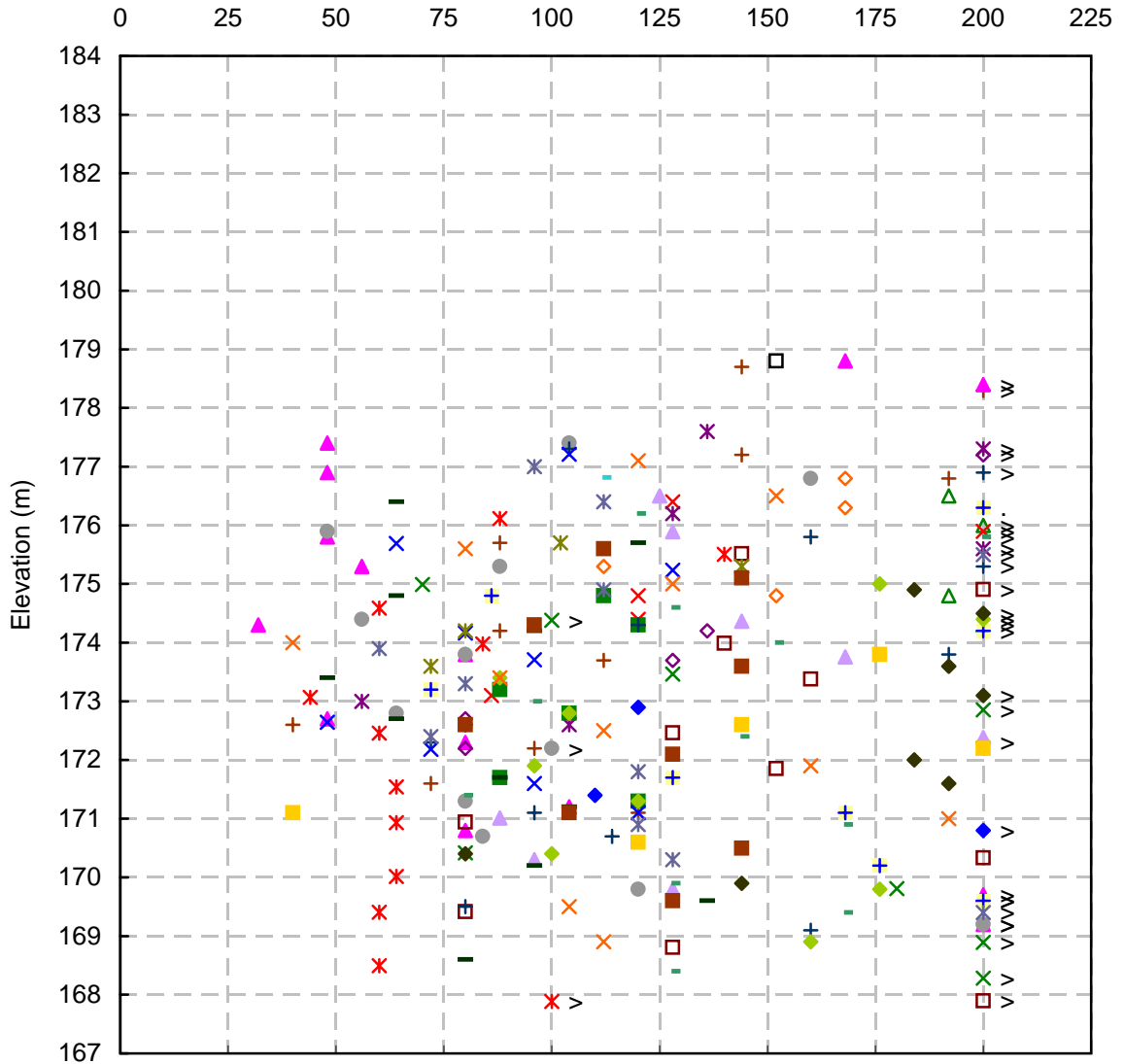
CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B4-88

HWY 406 TWINNING - NBL

Silty Clay

Corrected Cu (kPa)



□ NBL 12+075 CL	◇ NBL 12+150 LT	△ NBL 12+150 RT	× NBL 12+225 CL	× NBL 12+300 LT
+ NBL 12+300 RT	■ NBL 12+375 LT	◆ NBL 12+440 RT	△ NBL 12+525 LT	× NBL 12+525 RT
× NBL 12+595 RT	+ NBL 12+645 LT	□ NBL 12+645 RT	△ NBL 12+750 RT	+ NBL 12+750 RT
◇ NBL 12+835 LT	△ NBL 12+835 RT	× NBL 12+910 CL	× NBL 12+985 LT	△ NBL 12+985 RT
◆ TN1	■ TN2	× TN3	× TN4	△ WN1
— WN2	◆ WN3	■ WN4		

Field Shear Vane Correction

Morris & Williams (1994)

$$(\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57)$$

Applied Correction Factors

0.85 (Elev.>179m)

1.00 (Elev.<179m)

Project No. : 1-09-4135

Date : September, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

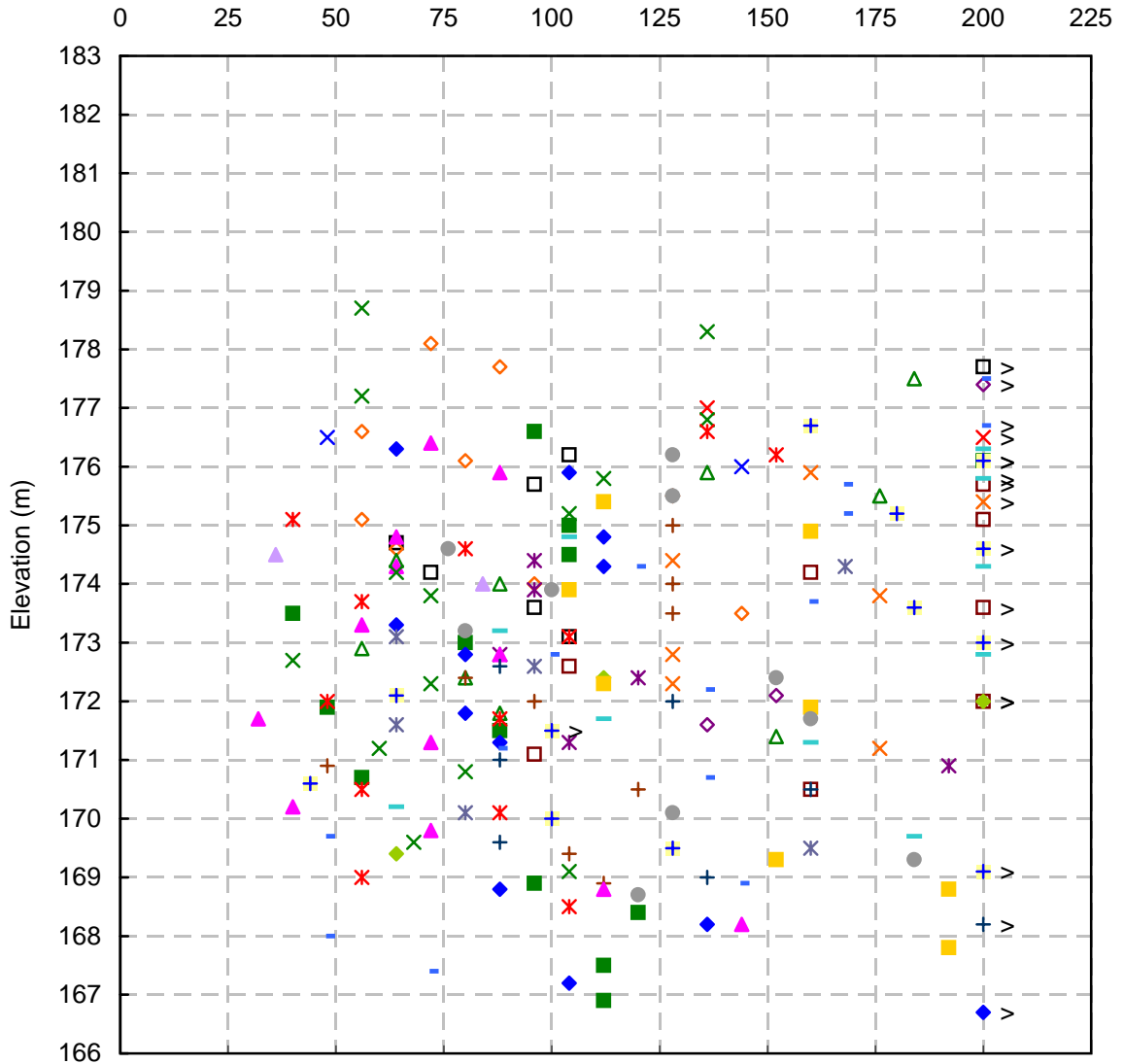
CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B4-89

HWY 406 TWINNING - SBL

Silty Clay

Corrected Cu (kPa)



□ SBL 12+185 LT	◇ SBL 12+185 RT	△ SBL 12+260 CL	× SBL 12+355 CL	× SBL 12+360 CL
+ SBL 12+410 CL	■ SBL 12+485 LT	◆ SBL 12+485 RT	▲ SBL 12+525 CL	× SBL 12+600 LT
× SBL 12+600 RT	+ SBL 12+650 CL	□ SBL 12+685 CL	◇ SBL 12+750 CL	▲ SBL 12+825 RT
× SBL 12+900 CL	- TS1	- TS2	◆ TS3	■ TS4
× WS1	× WS2	● WS3	+ WS4	

Field Shear Vane Correction

Morris & Williams (1994)
 $(\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57)$

Applied Correction Factors

0.80 (Elev.>179m) 1.00 (Elev.<179m)

Project No. : 1-09-4135

Date : September, 2010



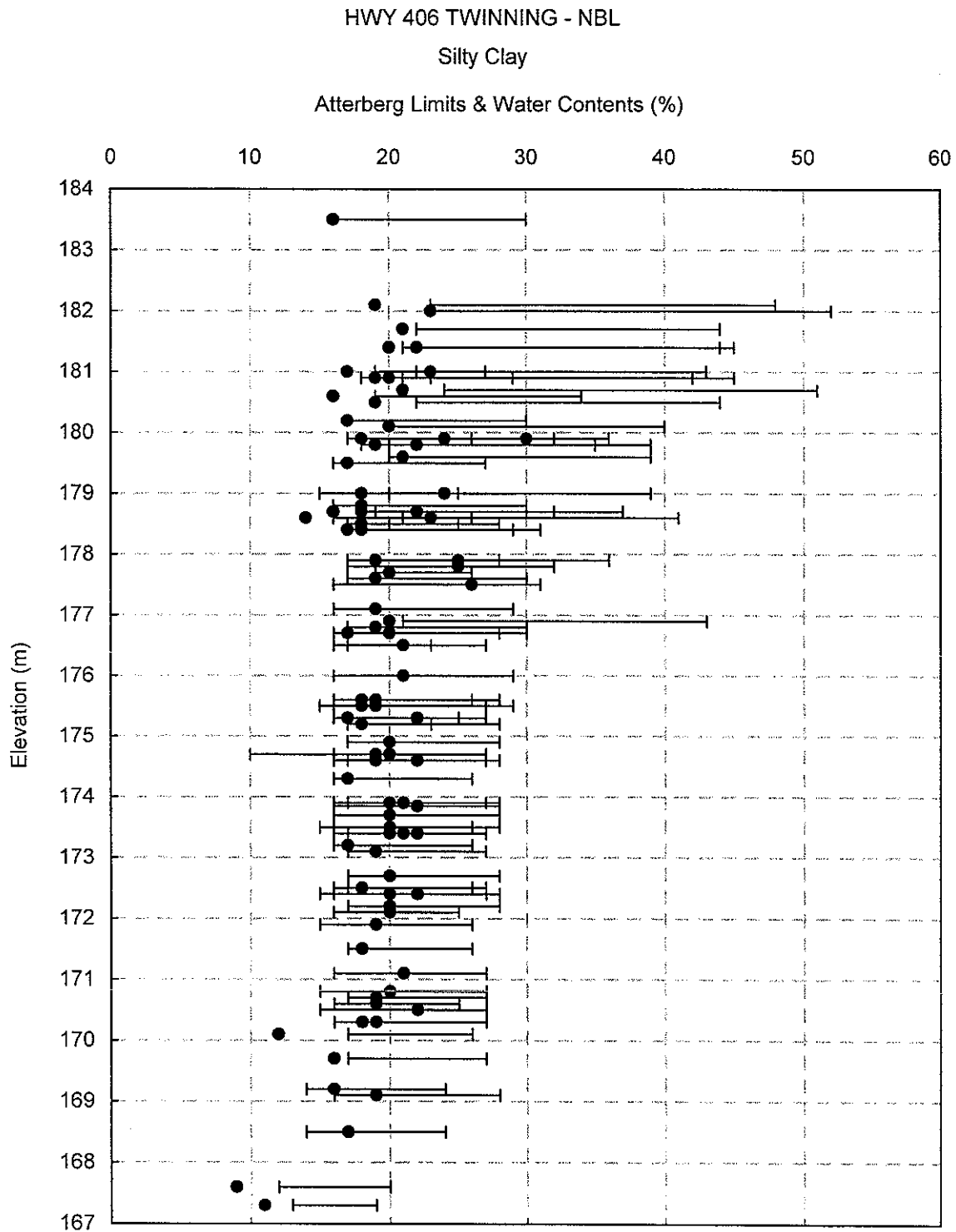
Terraprobe Inc.

Prepared By : HW

Checked By : RA

ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B4-90



Project No. : 1-09-4135

Date : July, 2010



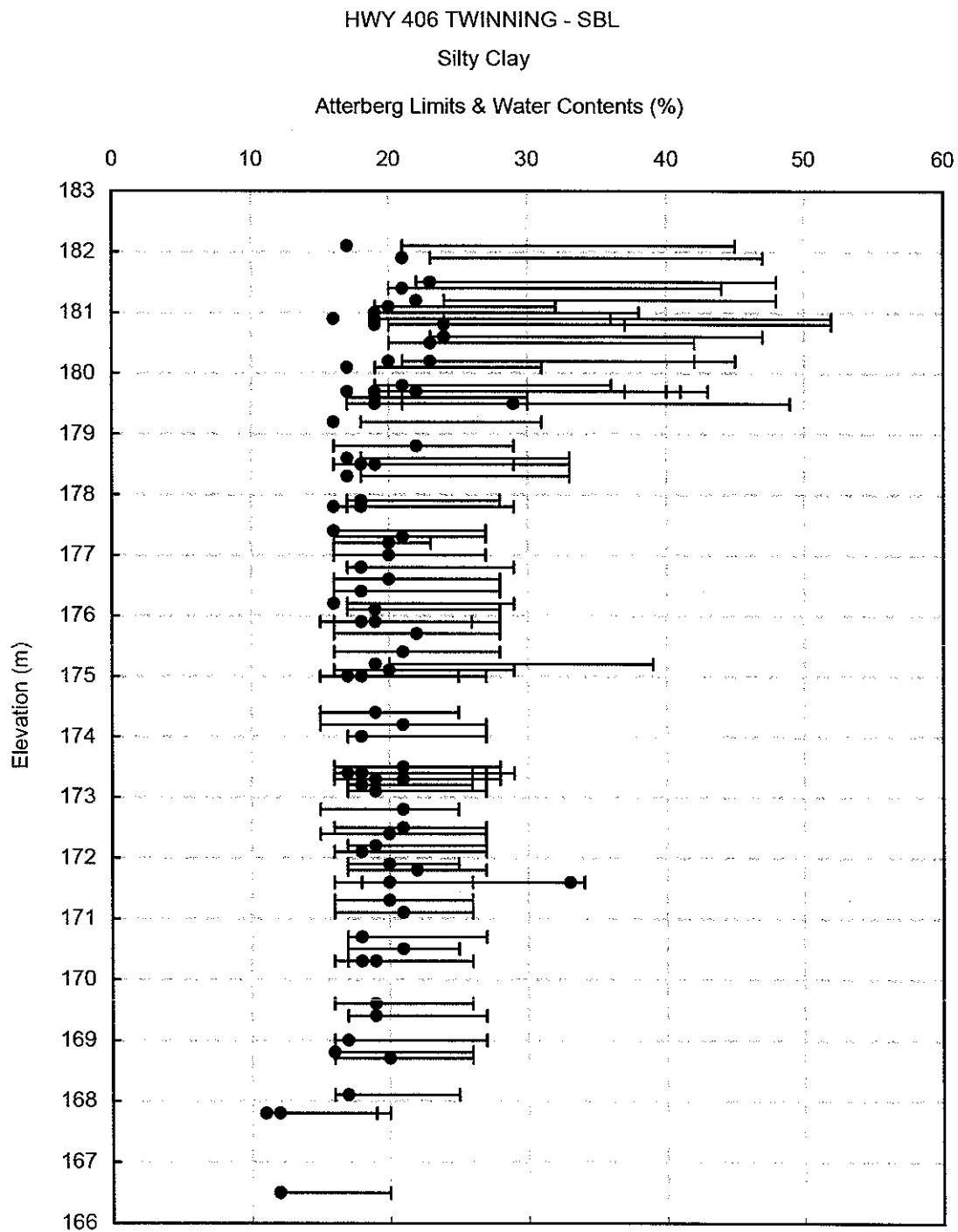
Terraprobe Inc.

Prepared By : HW

Checked By : RA

ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B4-91

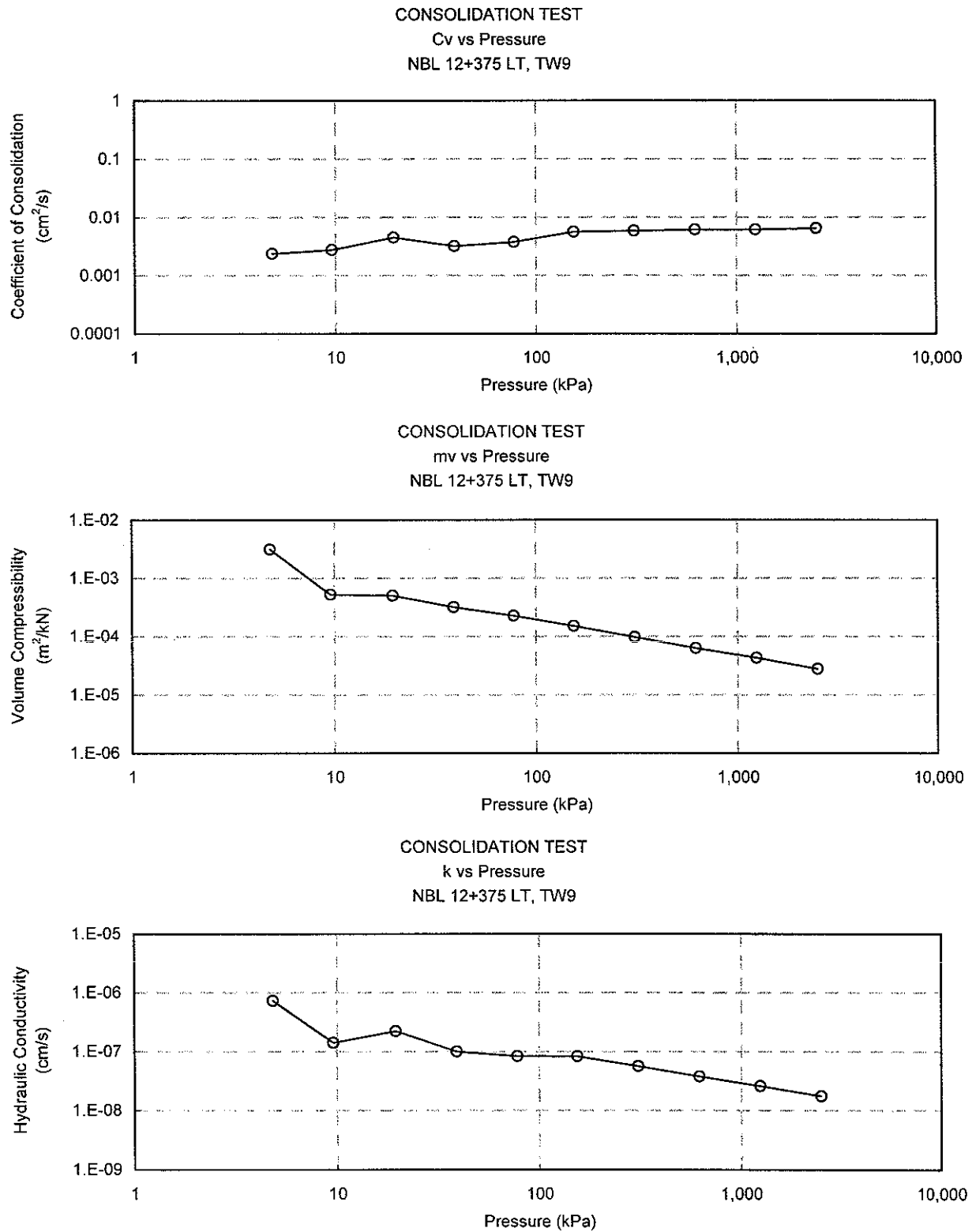


C:\Documents and Settings\Hongliu\My Documents\Project 2008\1-09-4135 - HWY 406 Foundations\High Fill\SBL\1-09-4135 Soil Parameter Estimation-SBL Combined.xls

Project No. : 1-09-4135
Date : July, 2010



Prepared By : HW
Checked By : RA



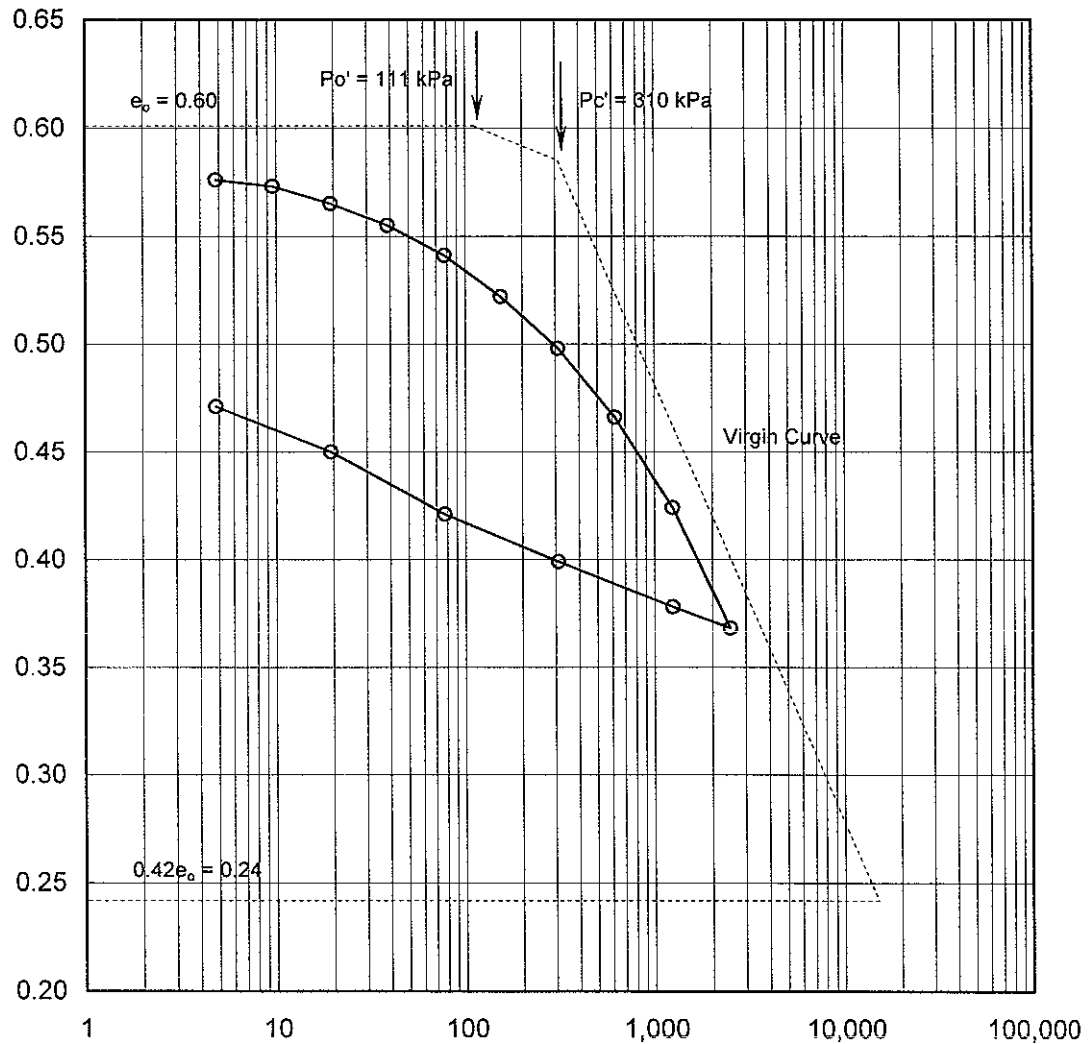
Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
NBL 12+375 LT, TW9



Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

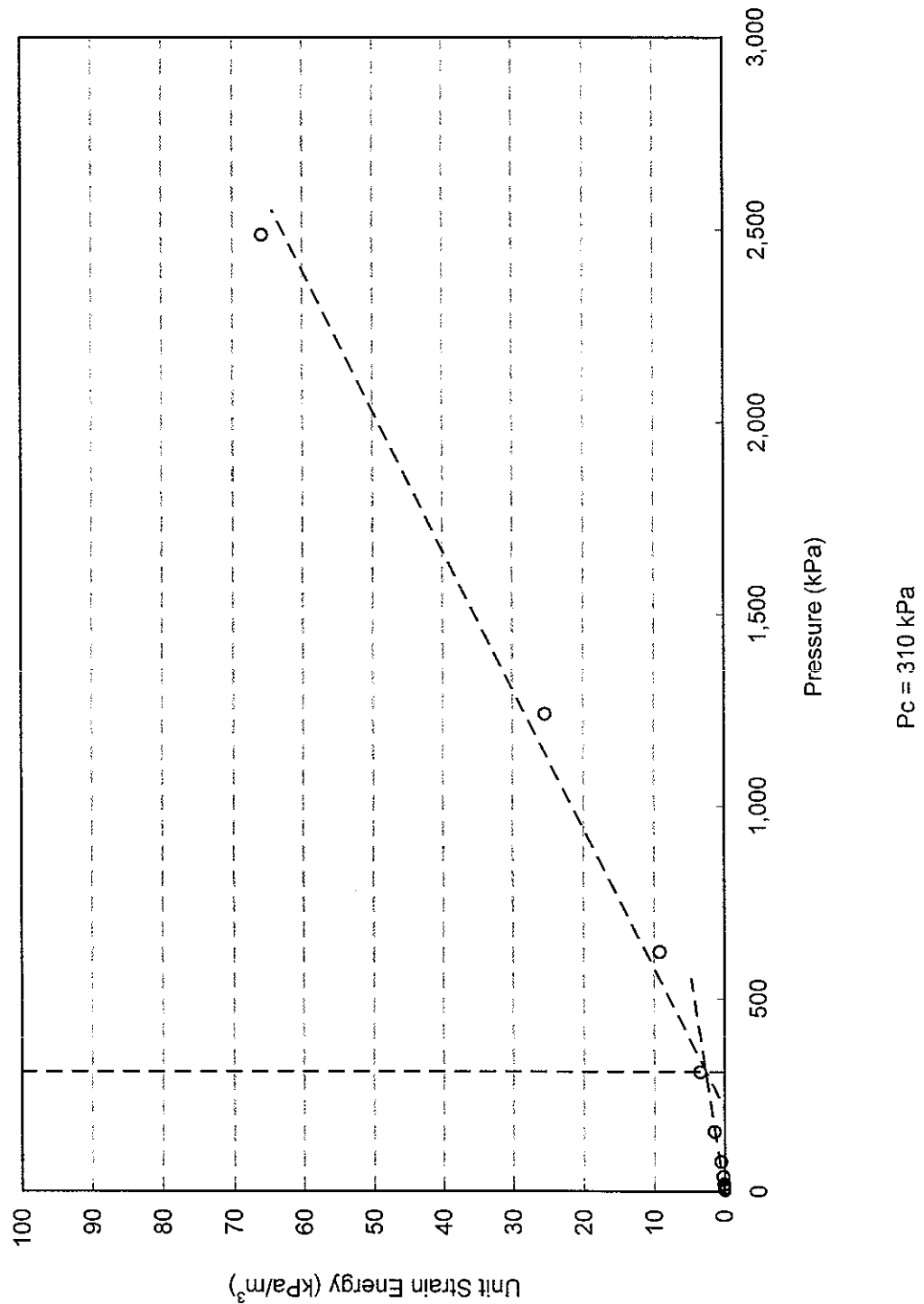
C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\High Fills (Woodlawn)\1-09-4135 Consolidation Results-TN.xls

HWY 406 TWINNING - TRILLIUM RAILWAY NORTH

FIGURE B4-94

CONSOLIDATION TEST

Unit Strain Energy vs Pressure
NBL 12+375 LT, TW9

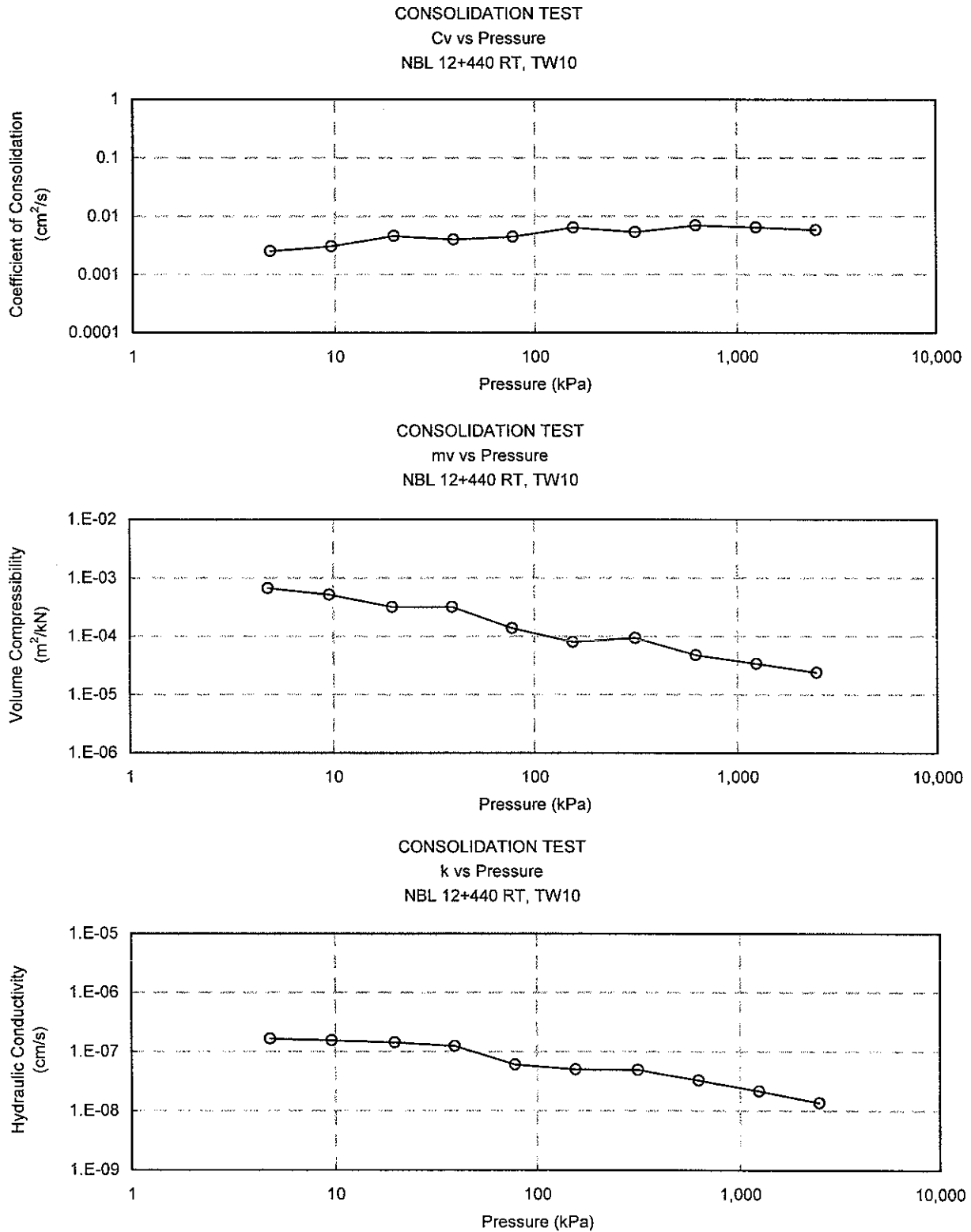


Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

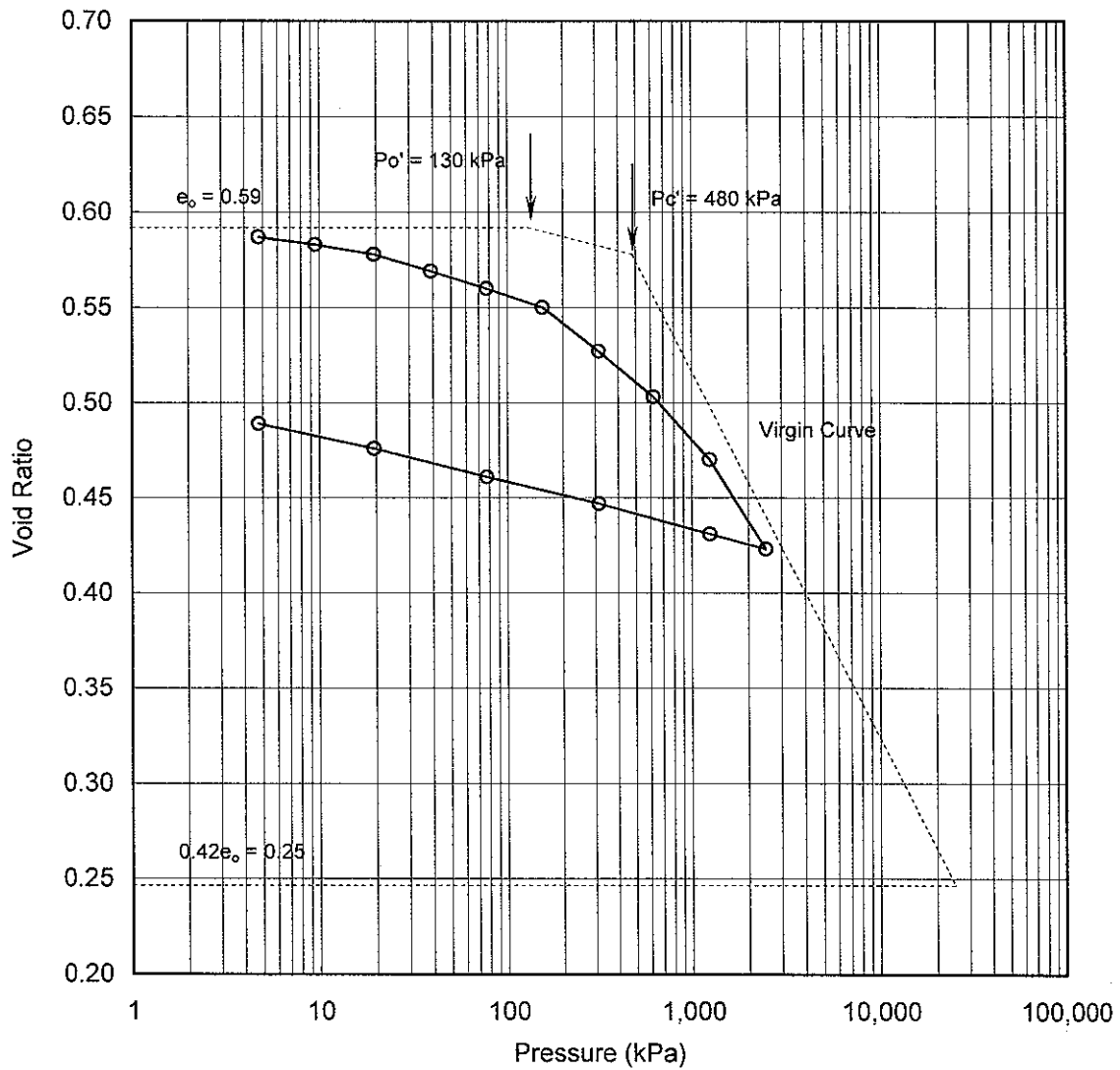
Prepared By : HW
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

NBL 12+440 RT, TW10



Soil Type : Silty Clay

$e_o =$	0.59	$\omega_L =$	25%	$P_o' =$	130 kPa
$\omega =$	21%	$\omega_P =$	15%	$P_c' =$	480 kPa
$\gamma =$	20.7 kN/m ³	PI =	10%	Cc =	0.193
Gs =	2.79			Cr =	0.025

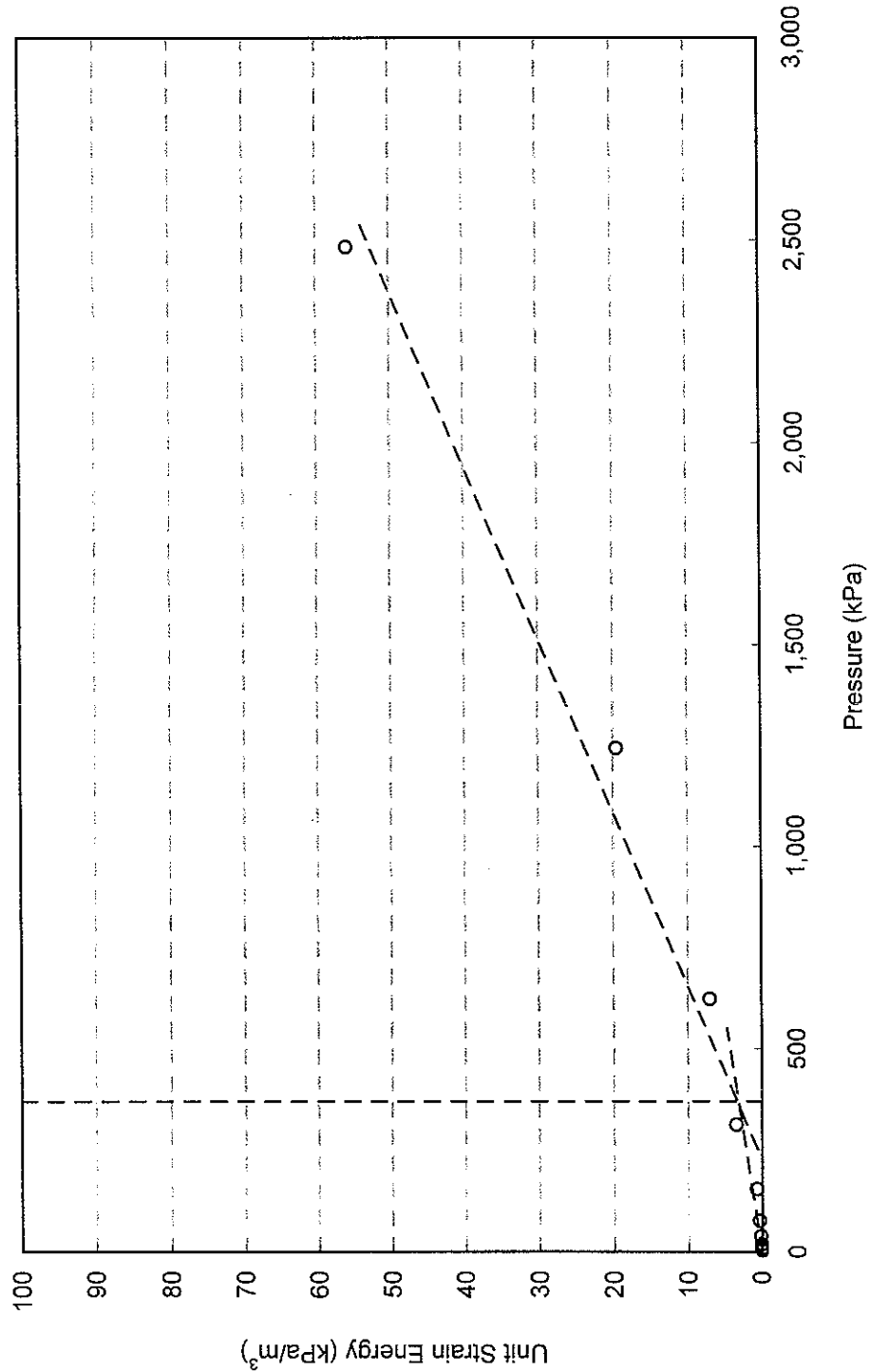
Project No. : 1-09-4135
 Date : July 2010



Terraprobe Inc.

Prepared By : HW
 Checked By : RA

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
NBL 12+440 RT, TW10



Project No. : 1-09-4135

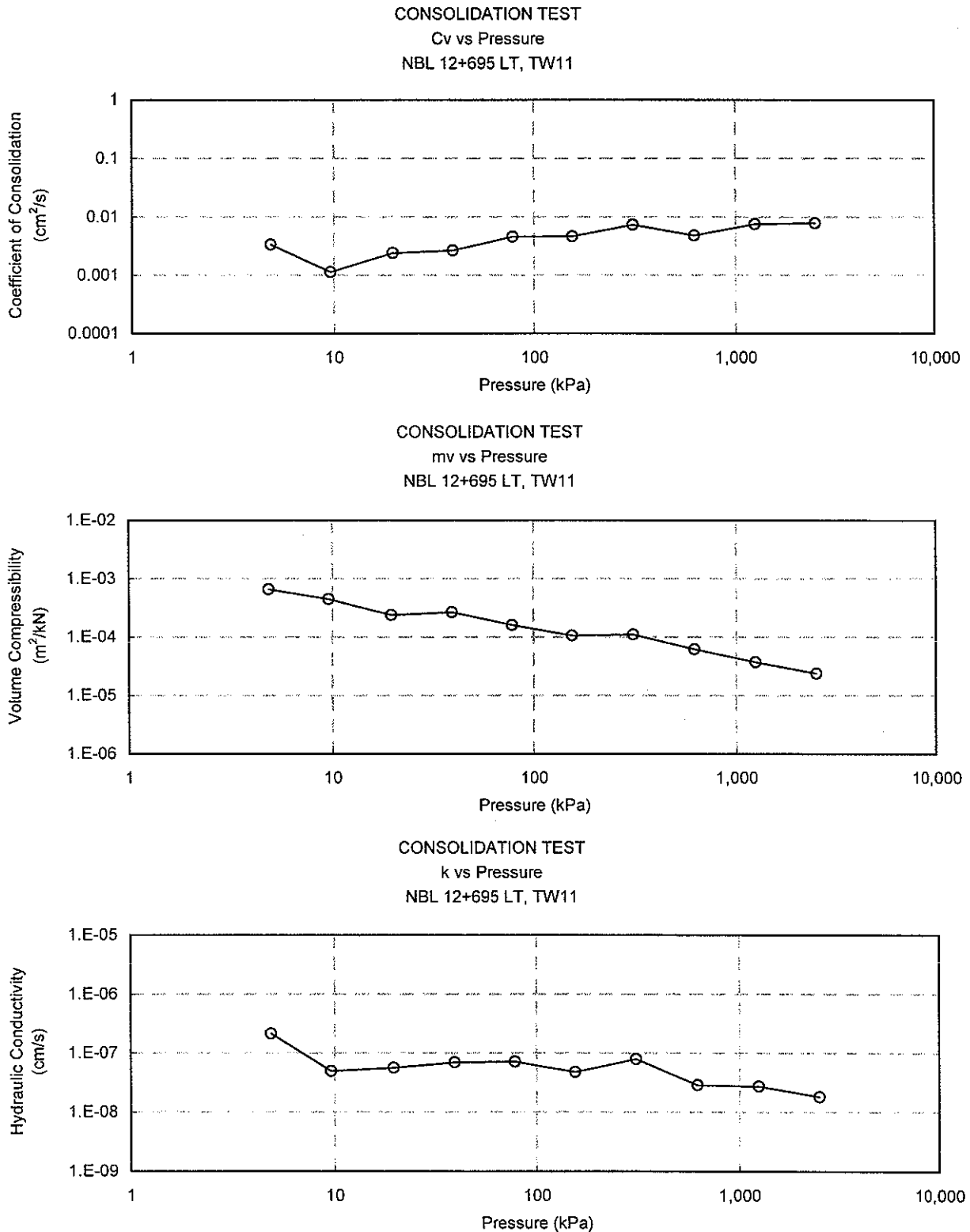
Date : July 2010



Terraprobe Inc.

Prepared By : HW

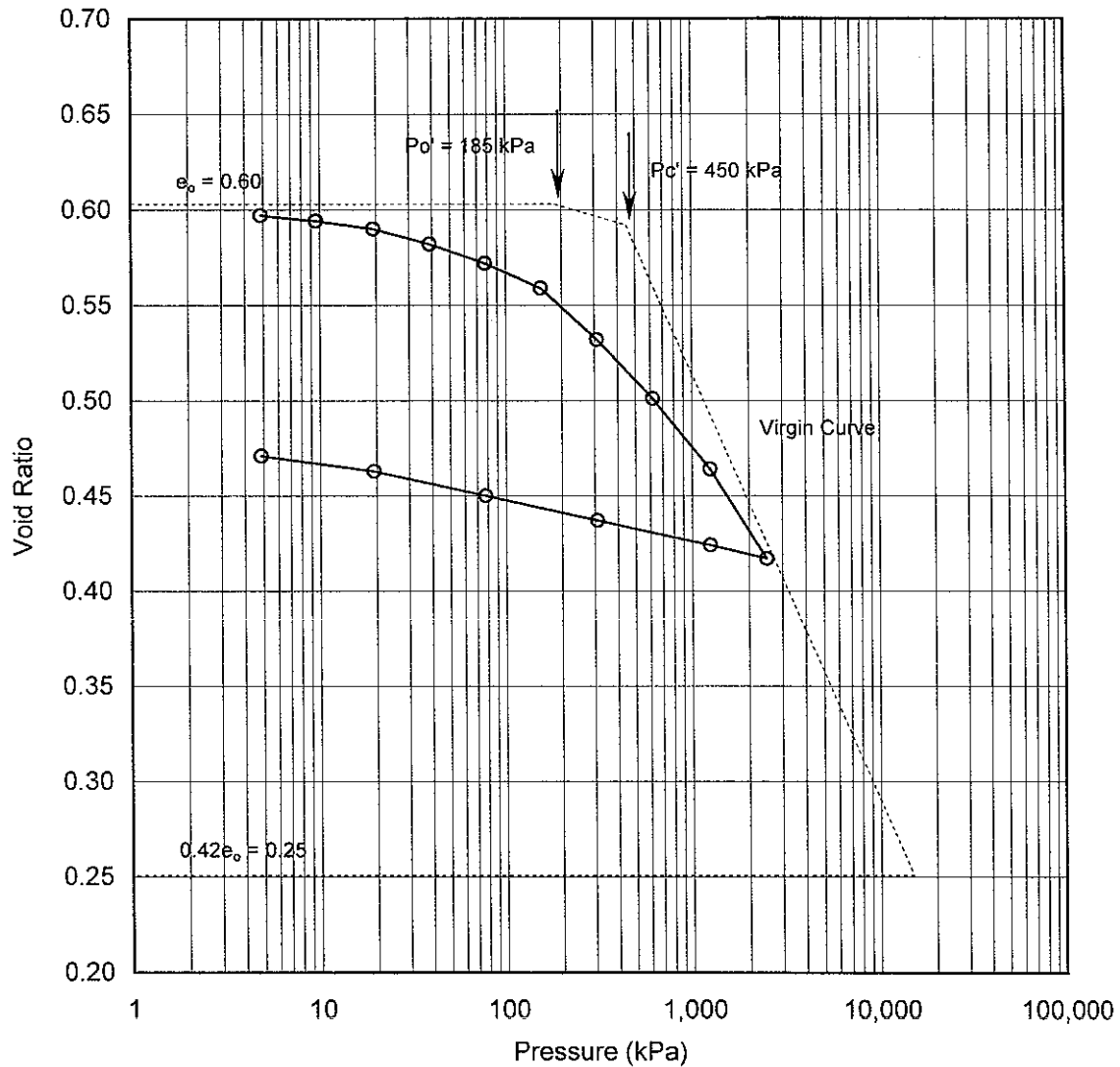
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

NBL 12+695 LT, TW11



Soil Type : Silty Clay

$e_o =$	0.60	$\omega_L =$	25%	$P_o' =$	185 kPa
$\omega =$	22%	$\omega_P =$	15%	$P_c' =$	450 kPa
$\gamma =$	20.6 kN/m ³	PI =	10%	Cc =	0.224
Gs =	2.76			Cr =	0.028

Project No. : 1-09-4135
 Date : September 2010



Terraprobe Inc.

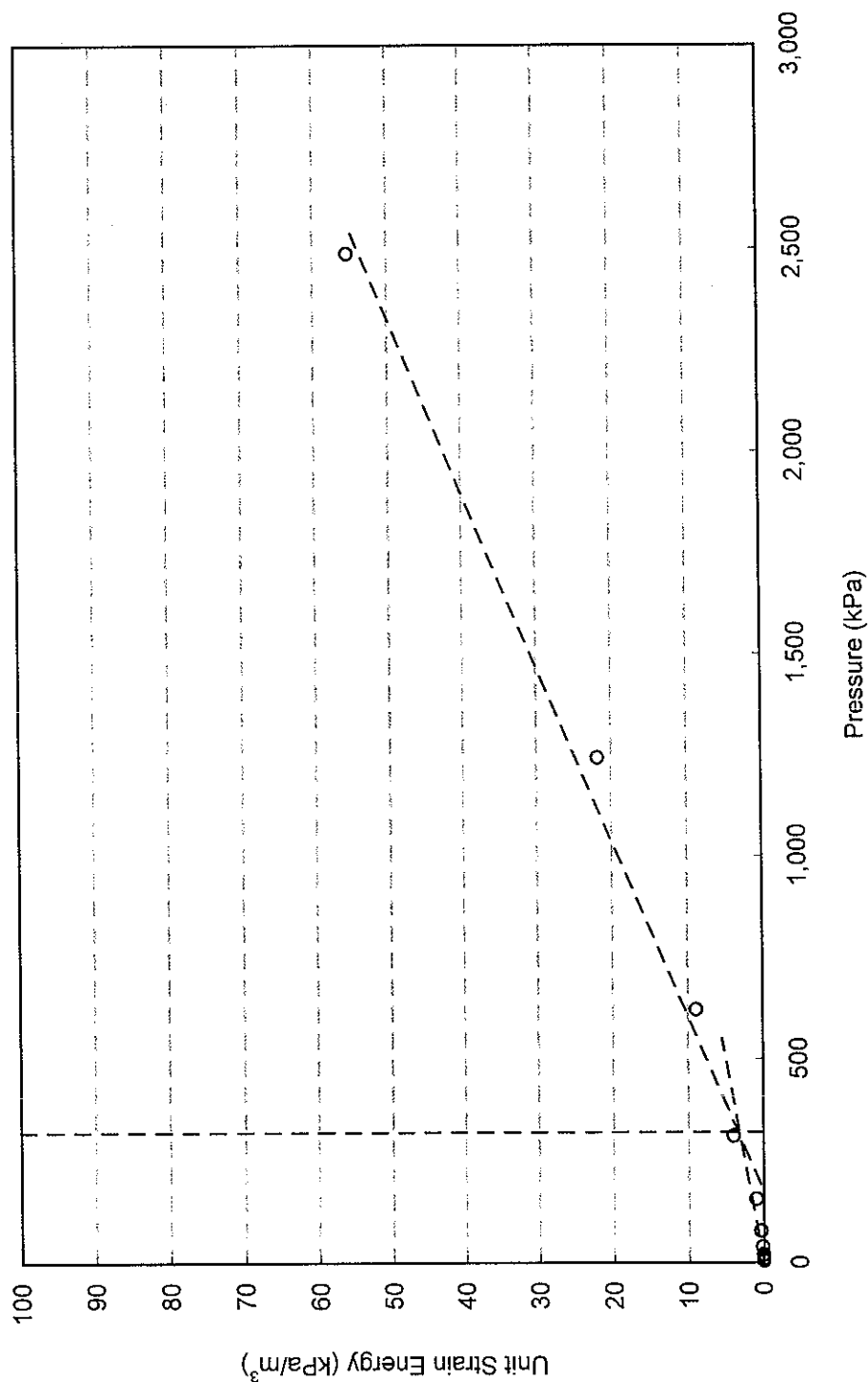
Prepared By : HW
 Checked By : RA

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\High Fills (Woodlawn)\1-09-4135 Consolidation Results-WN.xls

HWY 406 TWINNING - WOODLAWN OVERPASS (NBL)

FIGURE B4-100

CONSOLIDATION TEST Unit Strain Energy vs Pressure NBL 12+695 LT, TW11



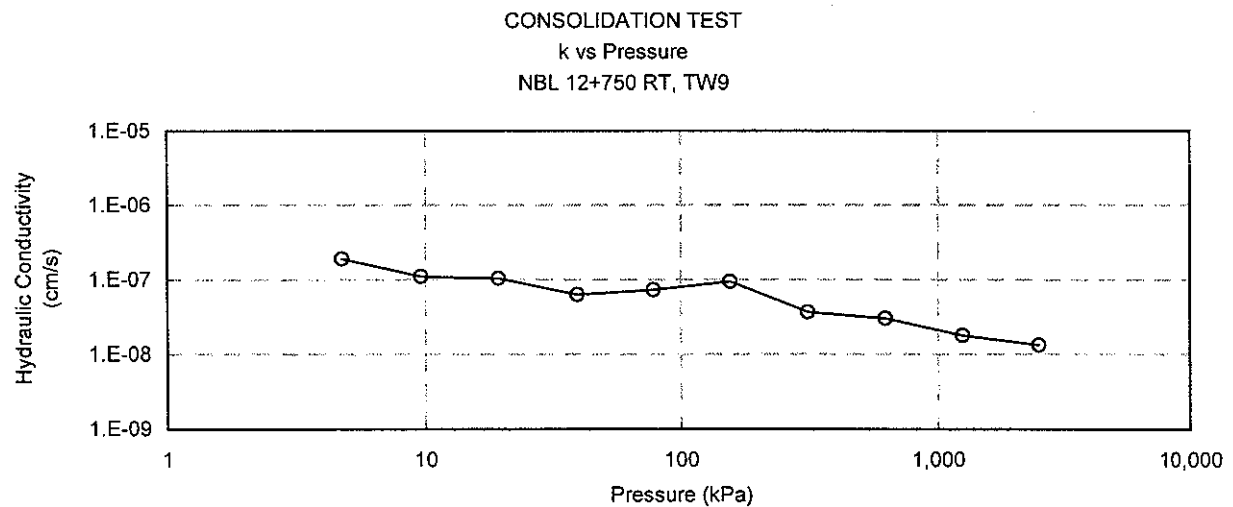
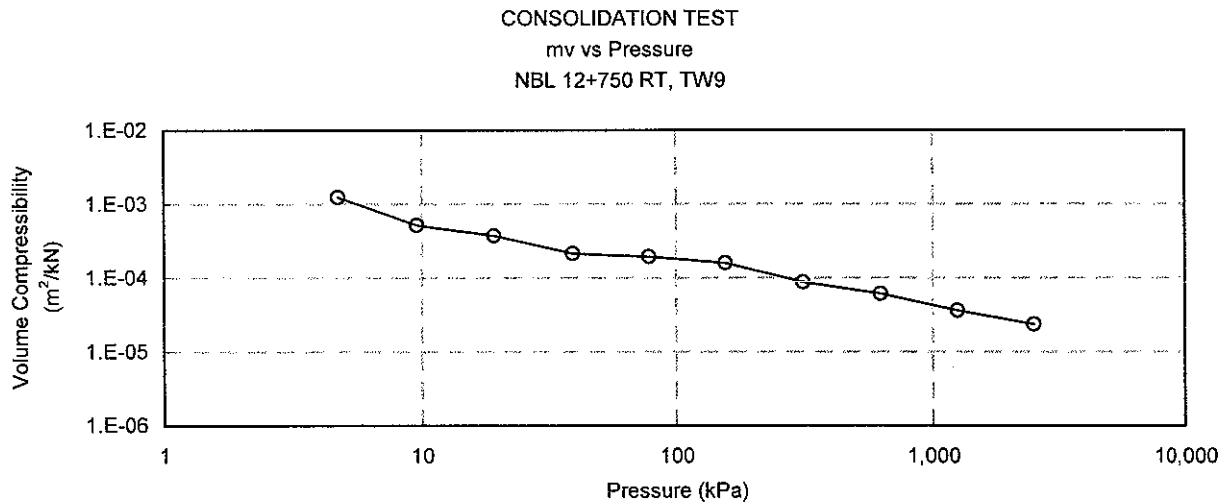
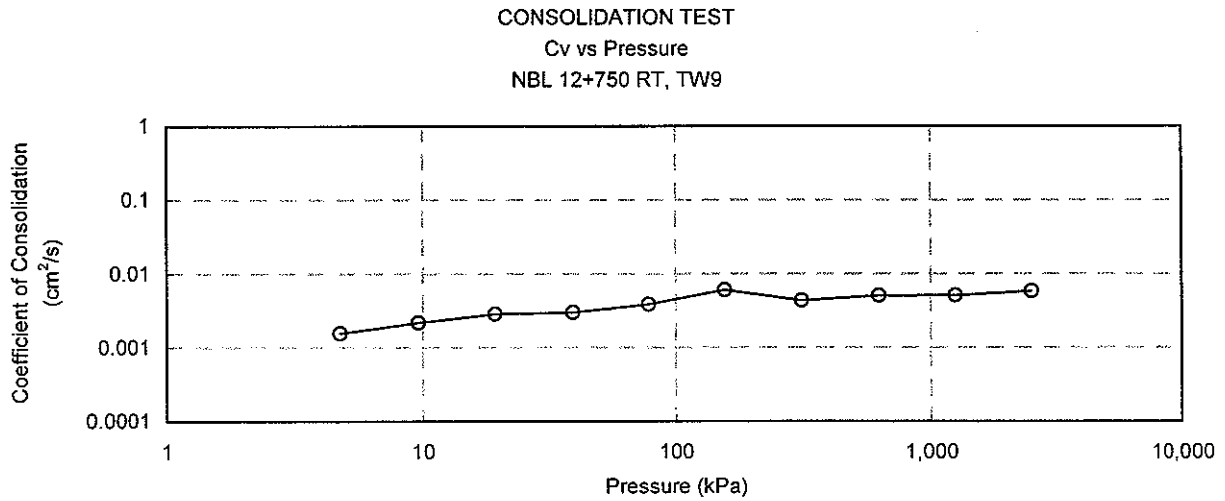
Pc = 320 kPa

Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA



Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

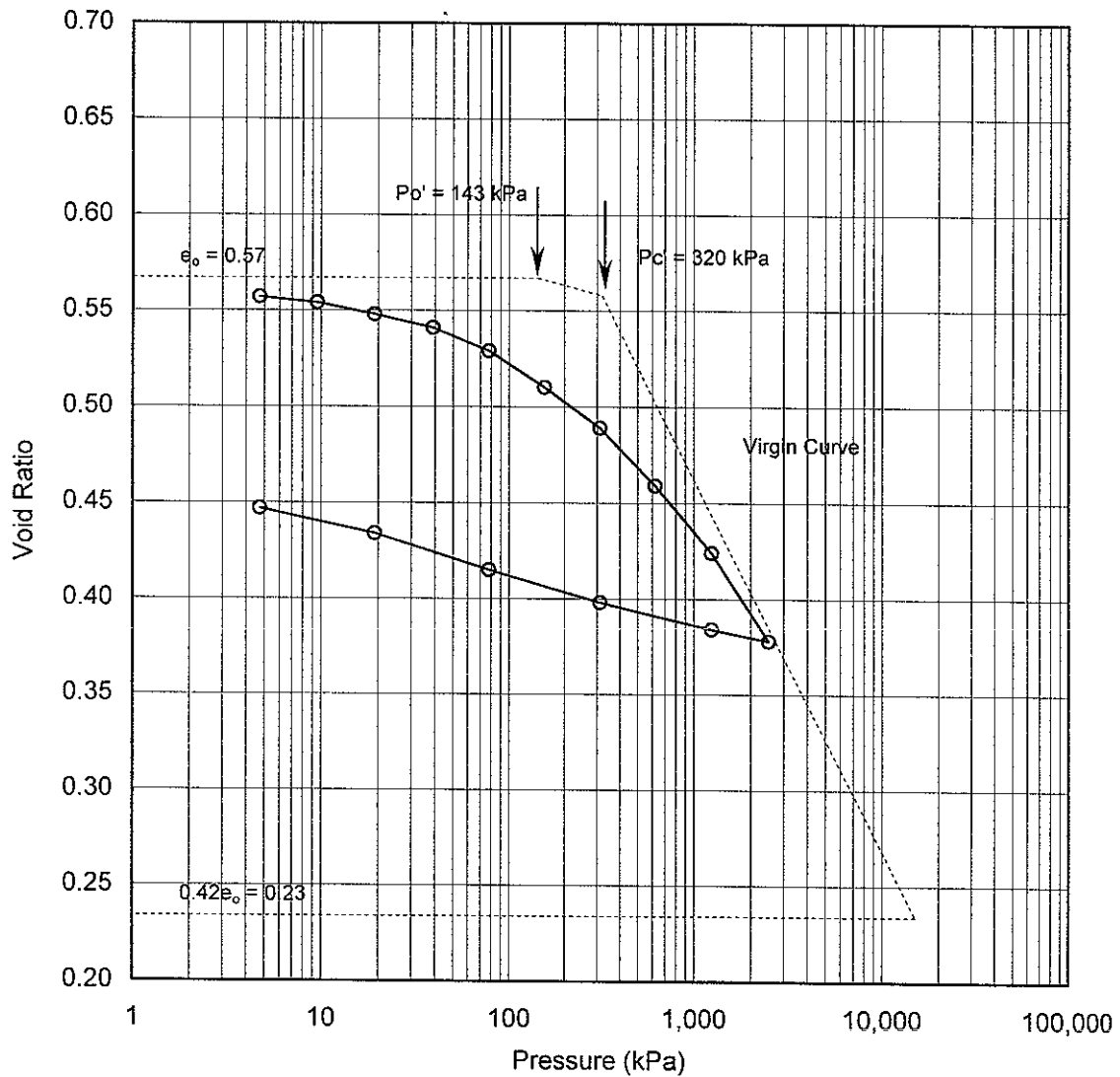
Prepared By : HW
Checked By : RA

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\High Falls (Woodlawn)\1-09-4135 Consolidation Results-WN.xls

CONSOLIDATION TEST

e vs Pressure

NBL 12+750 RT, TW9



Soil Type : Silty Clay

$e_o =$	0.57	$\omega_L =$	27%	$P_o' =$	143 kPa
$\omega =$	21%	$\omega_p =$	17%	$P_c' =$	320 kPa
$\gamma =$	20.8 kN/m ³	$PI =$	10%	$C_c =$	0.194
$G_s =$	2.74			$Cr =$	0.026

Project No. : 1-09-4135
 Date : September 2010



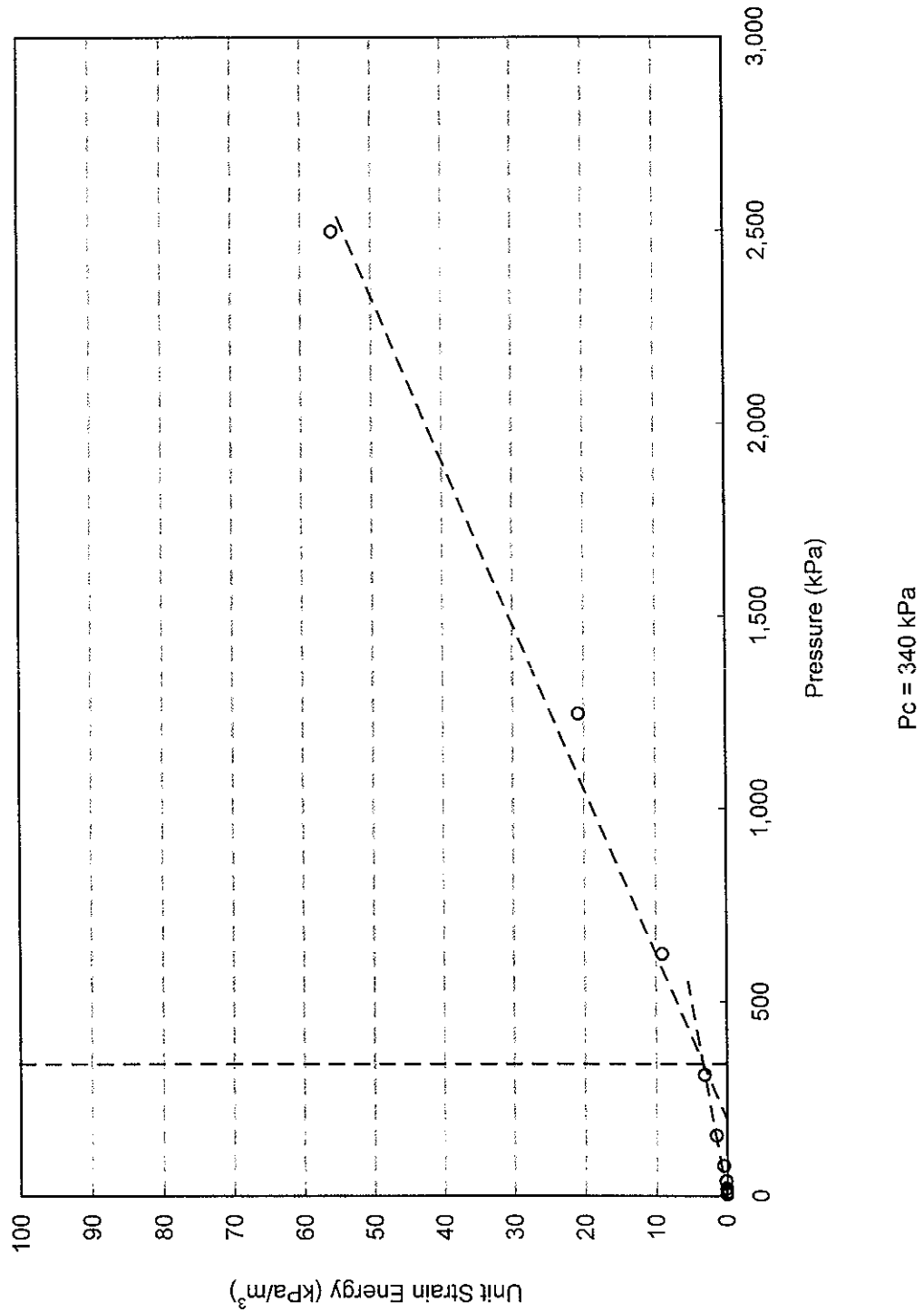
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - WOODLAWN OVERPASS (NBL)

FIGURE B4-103

CONSOLIDATION TEST Unit Strain Energy vs Pressure NBL 12+750 RT, TW9

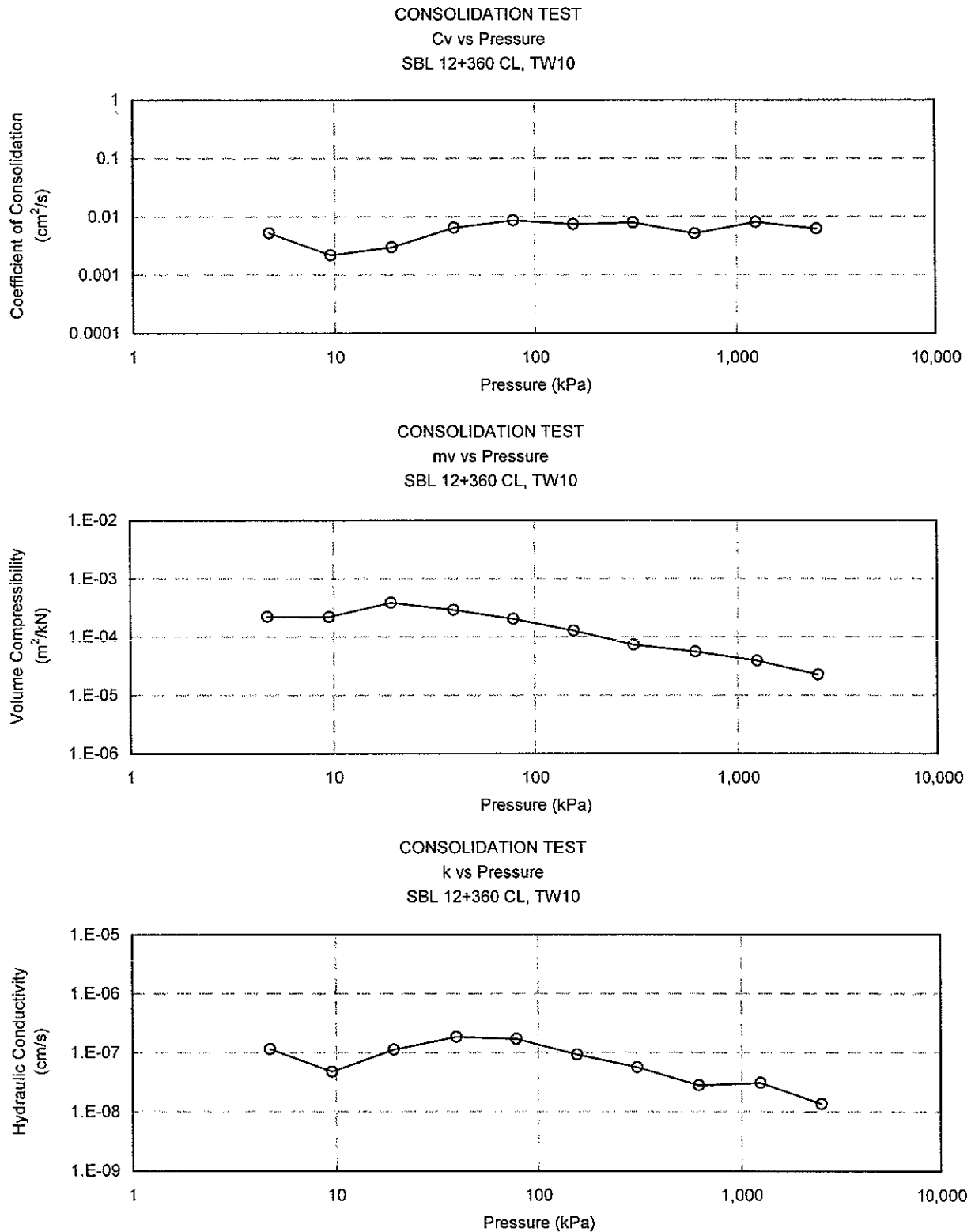


Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

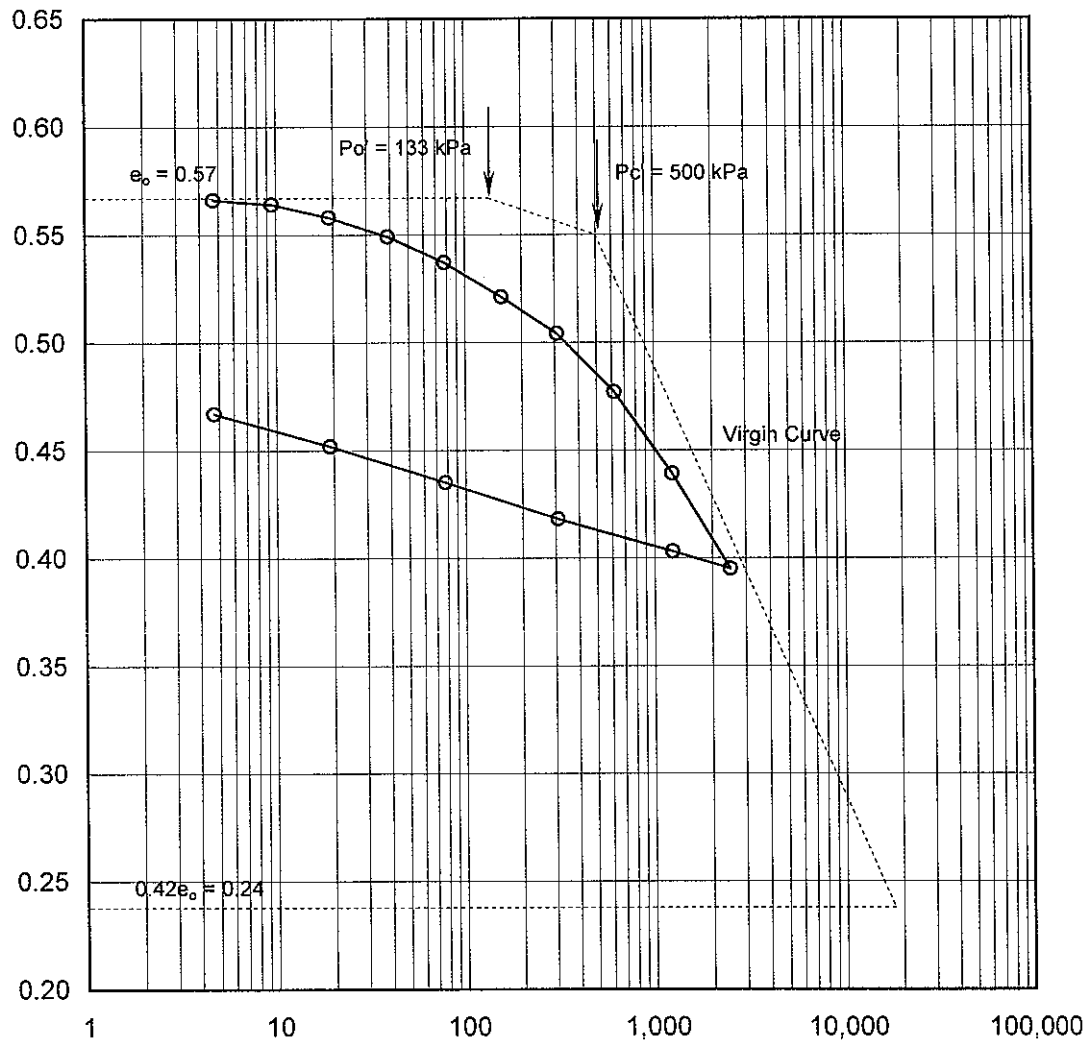
Prepared By : HW
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

SBL 12+360 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.57	$\omega_L =$	25%	$P_o' =$	133 kPa
$\omega =$	21%	$\omega_P =$	17%	$P_c' =$	500 kPa
$\gamma =$	20.7 kN/m ³	$PI =$	8%	$C_c =$	0.201
$G_s =$	2.74			$Cr =$	0.030

Project No. : 1-09-4135
 Date : July 2010



Terraprobe Inc.

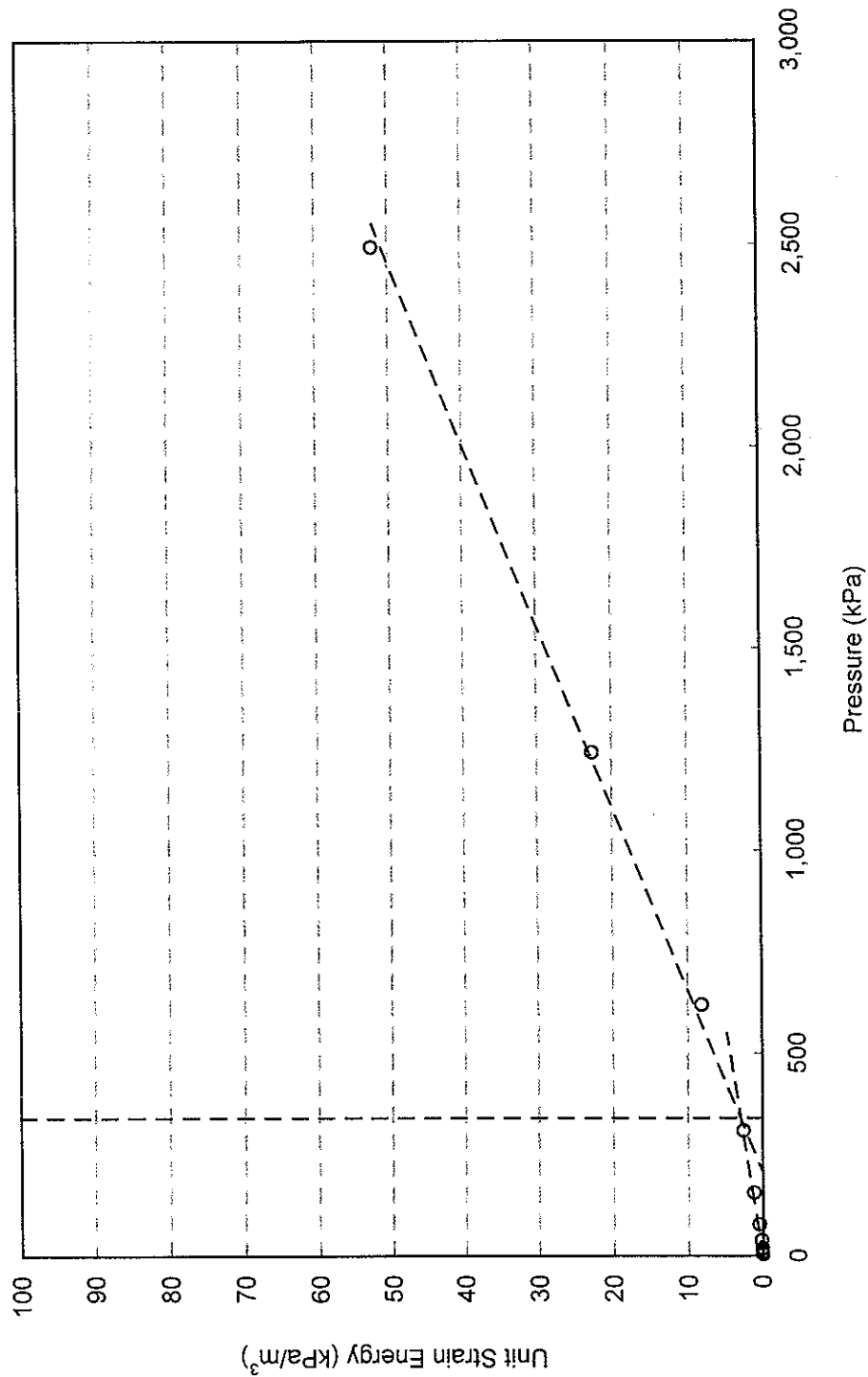
Prepared By : HW
 Checked By : RA

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HWY 406 TWINNING - TRILLIUM RAILWAY SOUTH

FIGURE B4-106

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+360 CL, TW10



$P_c = 340$ kPa

Project No. : 1-09-4135

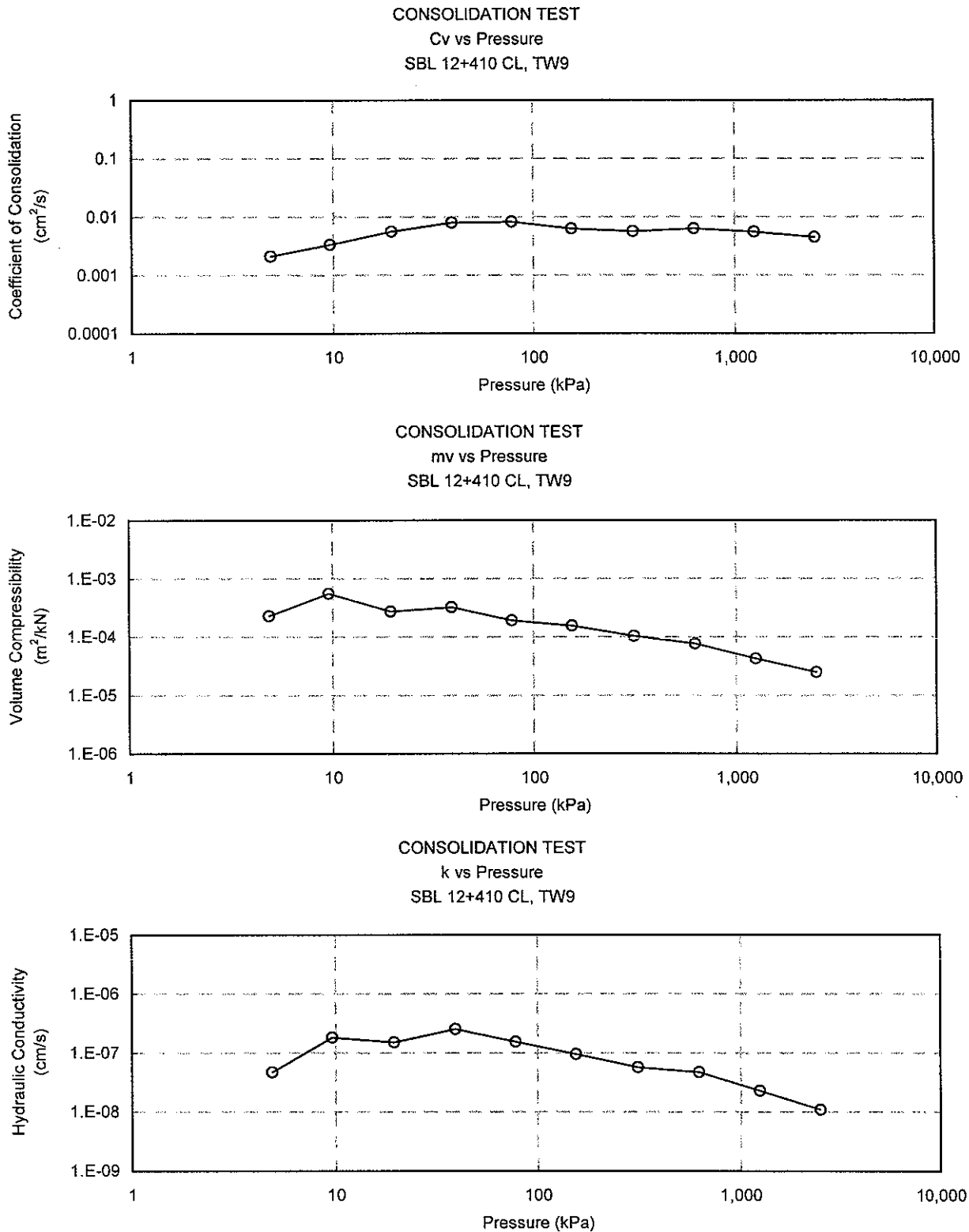
Date : July 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA



Project No. : 1-09-4135
Date : July 2010



Terraprobe Inc.

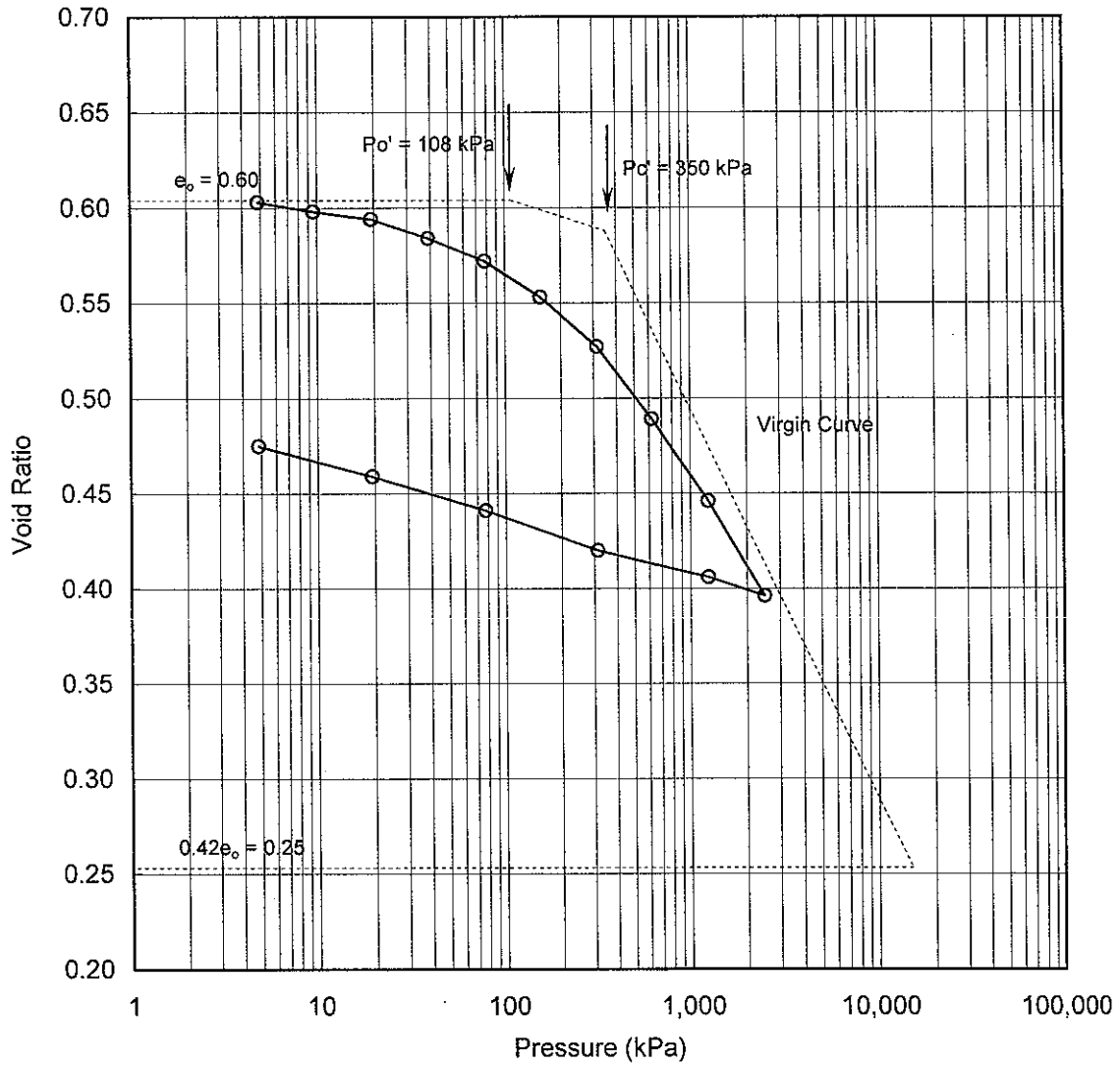
Prepared By : HW
Checked By : RA

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\High Fills (Woodlawn)\1-09-4135 Consolidation Results-TS.xls

CONSOLIDATION TEST

e vs Pressure

SBL 12+410 CL, TW9



Soil Type : Silty Clay

$e_o =$	0.60	$\omega_L =$	26%	$P_o' =$	108 kPa
$\omega =$	21%	$\omega_P =$	17%	$P_c' =$	350 kPa
$\gamma =$	20.4 kN/m ³	PI =	9%	Cc =	0.205
Gs =	2.76			Cr =	0.031

Project No. : 1-09-4135
 Date : July 2010



Terraprobe Inc.

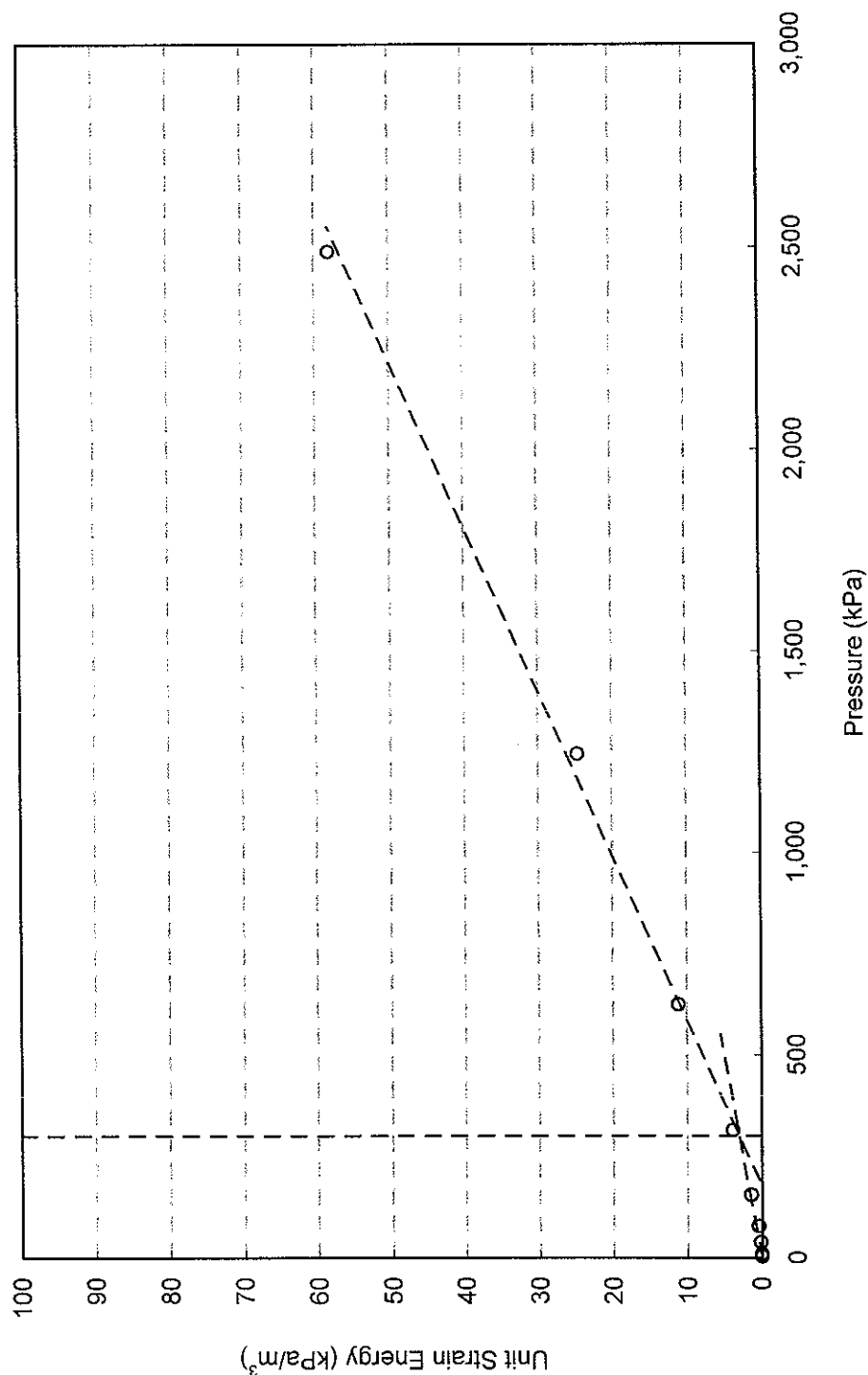
Prepared By : HW
 Checked By : RA

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2008\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\High Fills (Woodlawn)\1-09-4135 Consolidation Results-TS.xls

HWY 406 TWINNING - TRILLIUM RAILWAY SOUTH

FIGURE B4-109

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+410 CL, TW9



Project No. : 1-09-4135

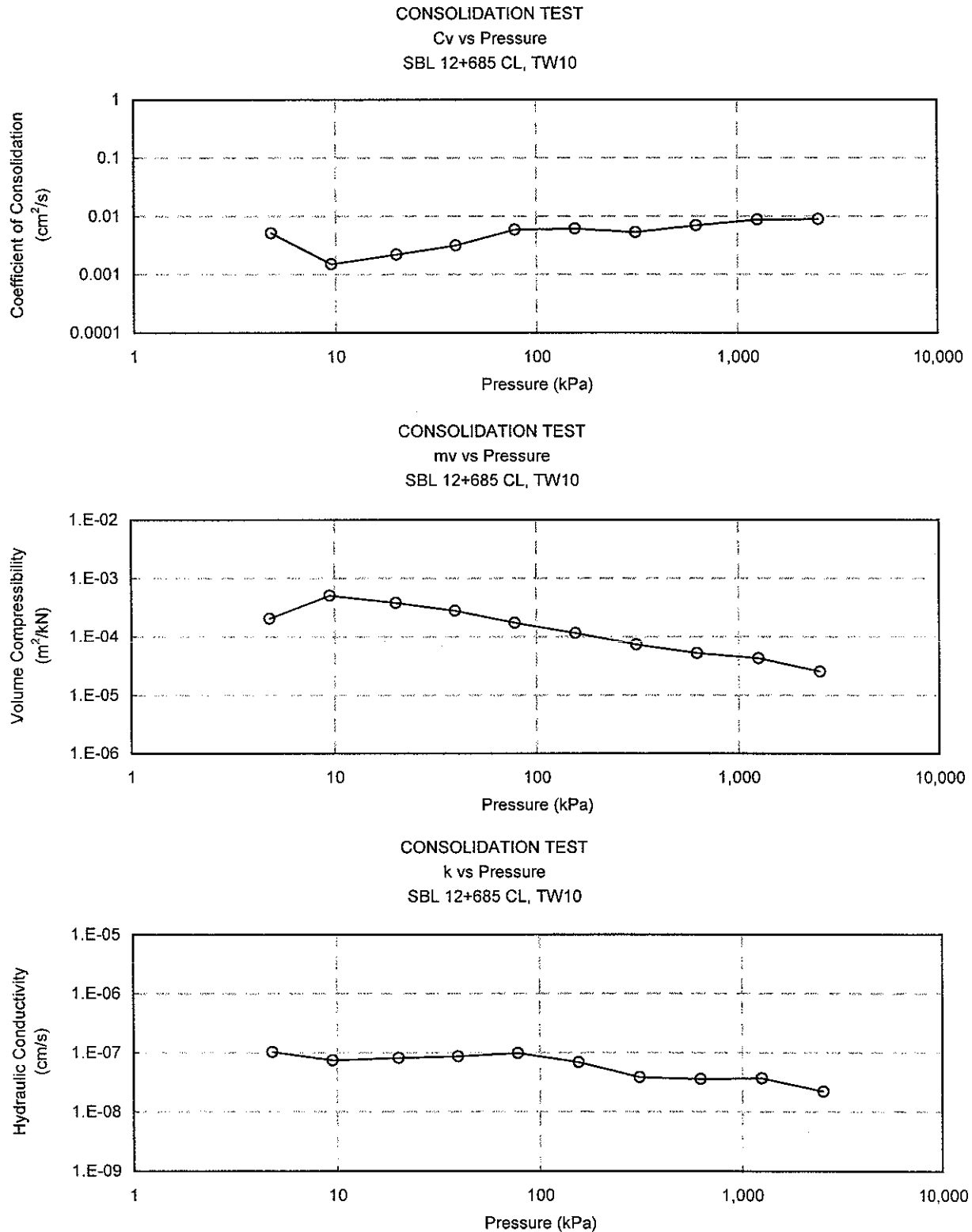
Date : July 2010



Terraprobe Inc.

Prepared By : HW

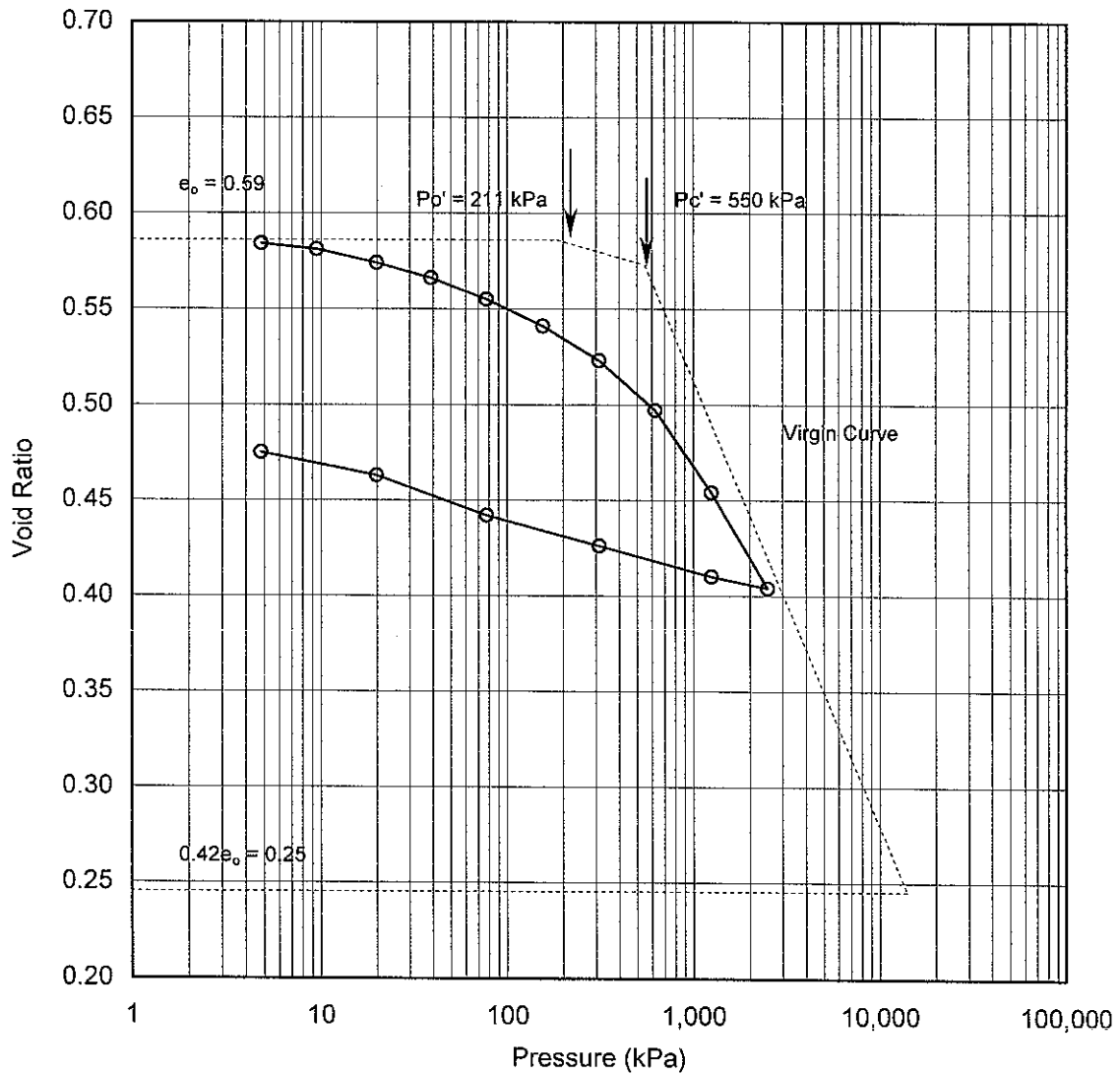
Checked By : RA



CONSOLIDATION TEST

e vs Pressure

SBL 12+685 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.59	$\omega_L =$	27%	$P_o' =$	211 kPa
$\omega =$	22%	$\omega_p =$	17%	$P_c' =$	550 kPa
$\gamma =$	20.7 kN/m ³	PI =	10%	Cc =	0.233
Gs =	2.75			Cr =	0.027

Project No. : 1-09-4135
 Date : September 2010



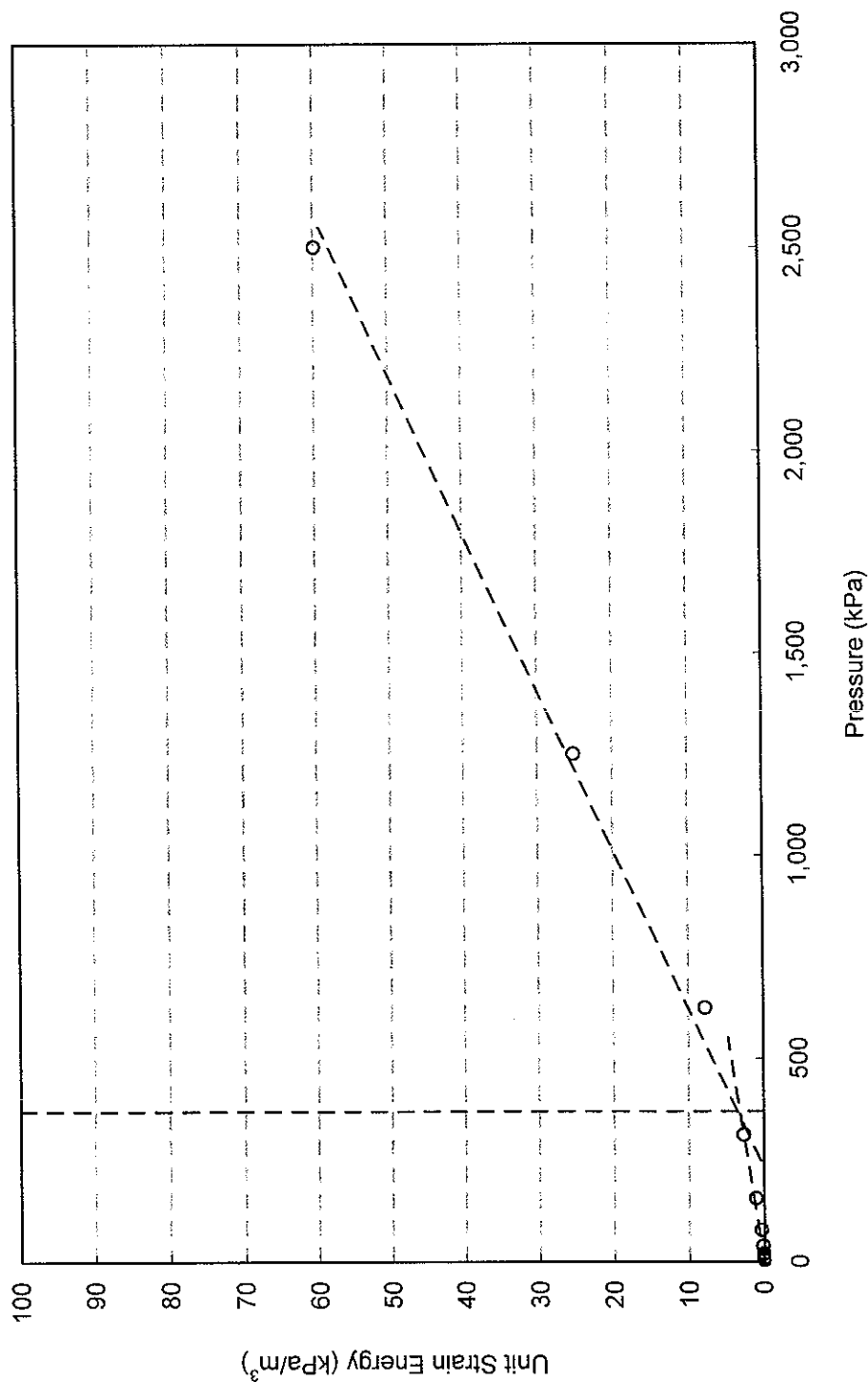
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - WOODLAWN OVERPASS (SBL)

FIGURE B4-112

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+685 CL, TW10



$P_c = 370 \text{ kPa}$

Project No. : 1-09-4135

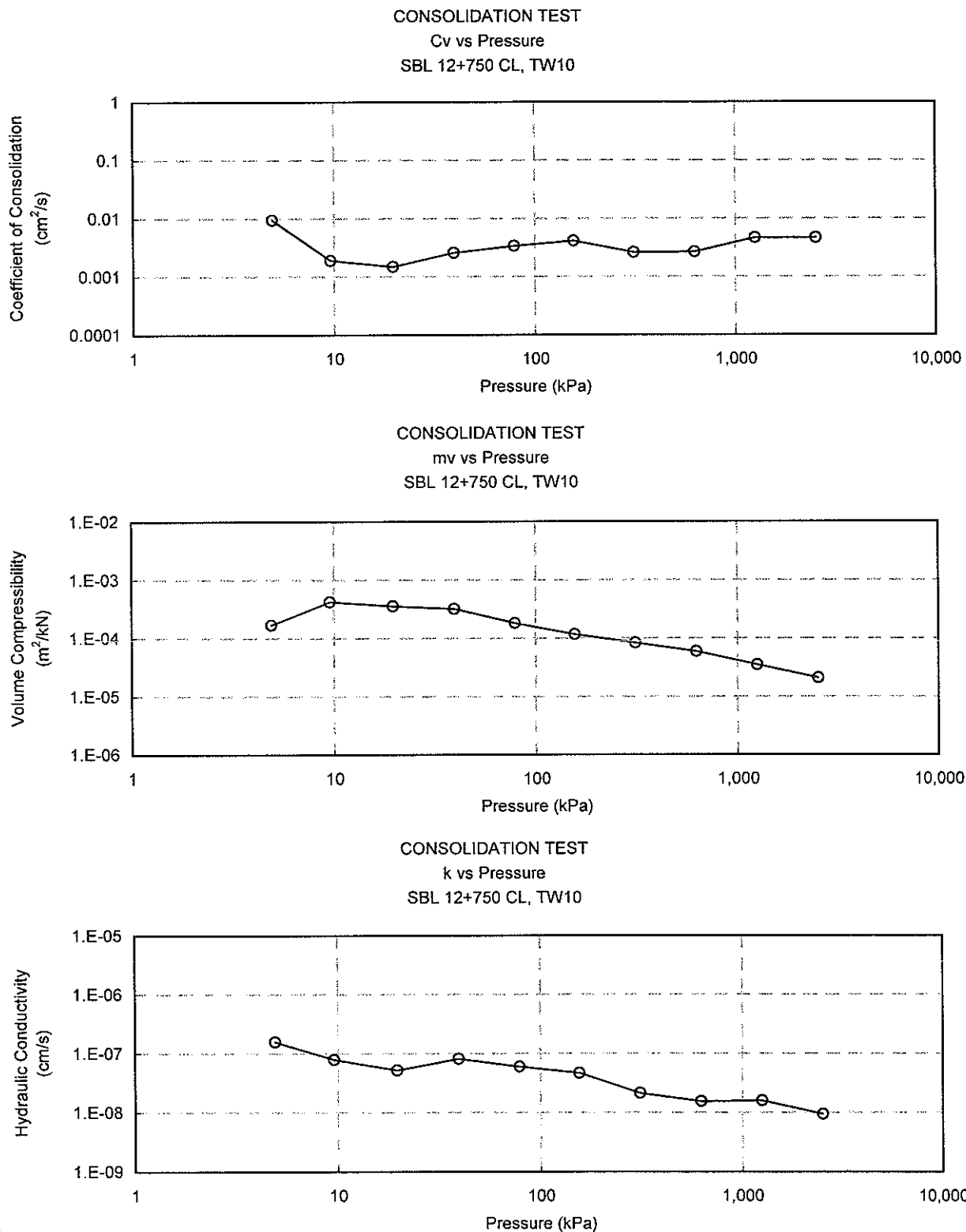
Date : July 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA



Project No. : 1-09-4135
Date : July 2010



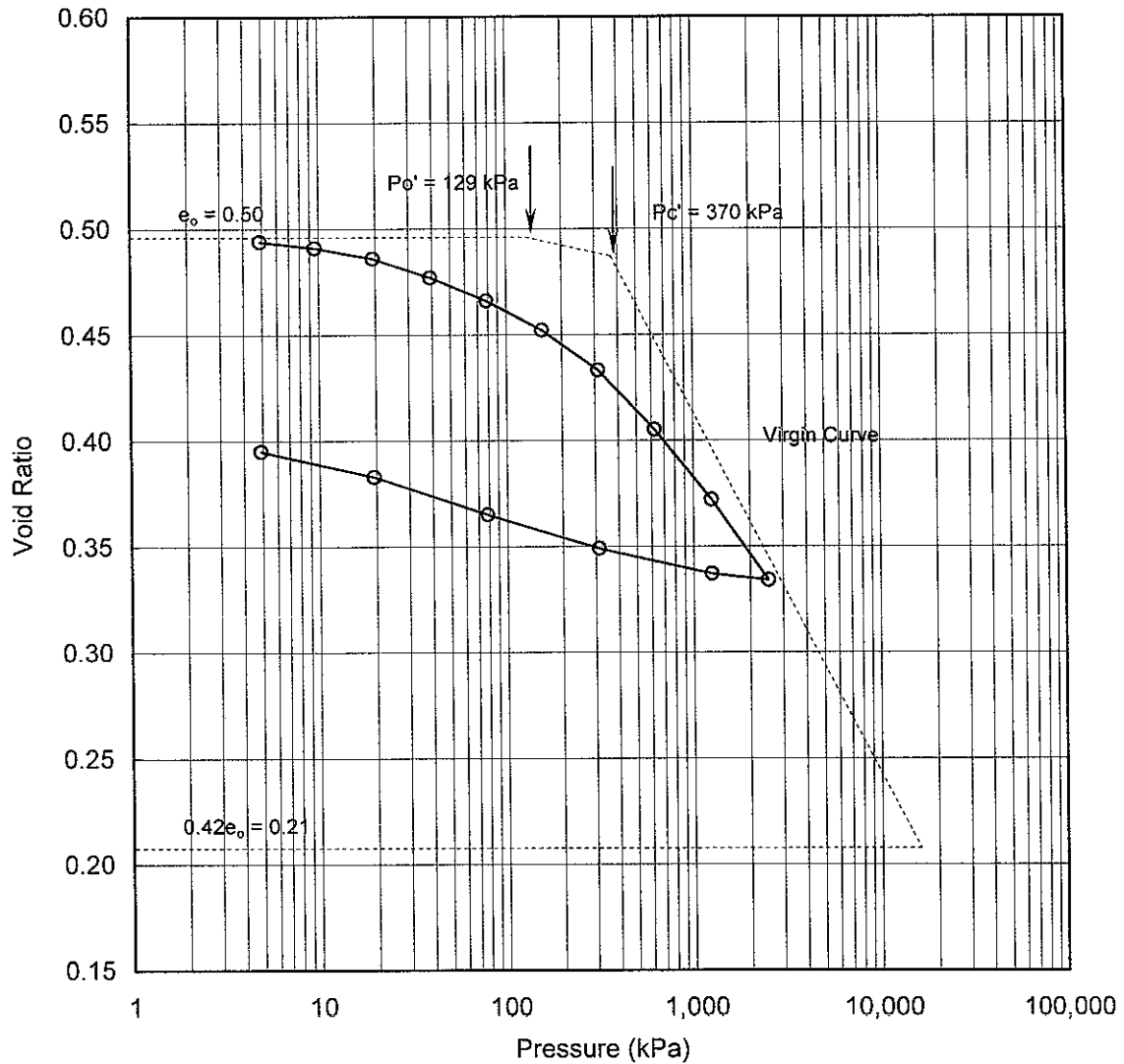
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

SBL 12+750 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.50	$\omega_L =$	25%	$P_o' =$	129 kPa
$\omega =$	19%	$\omega_P =$	15%	$P_c' =$	370 kPa
$\gamma =$	21.1 kN/m ³	$PI =$	10%	$C_c =$	0.171
$G_s =$	2.70			$Cr =$	0.020

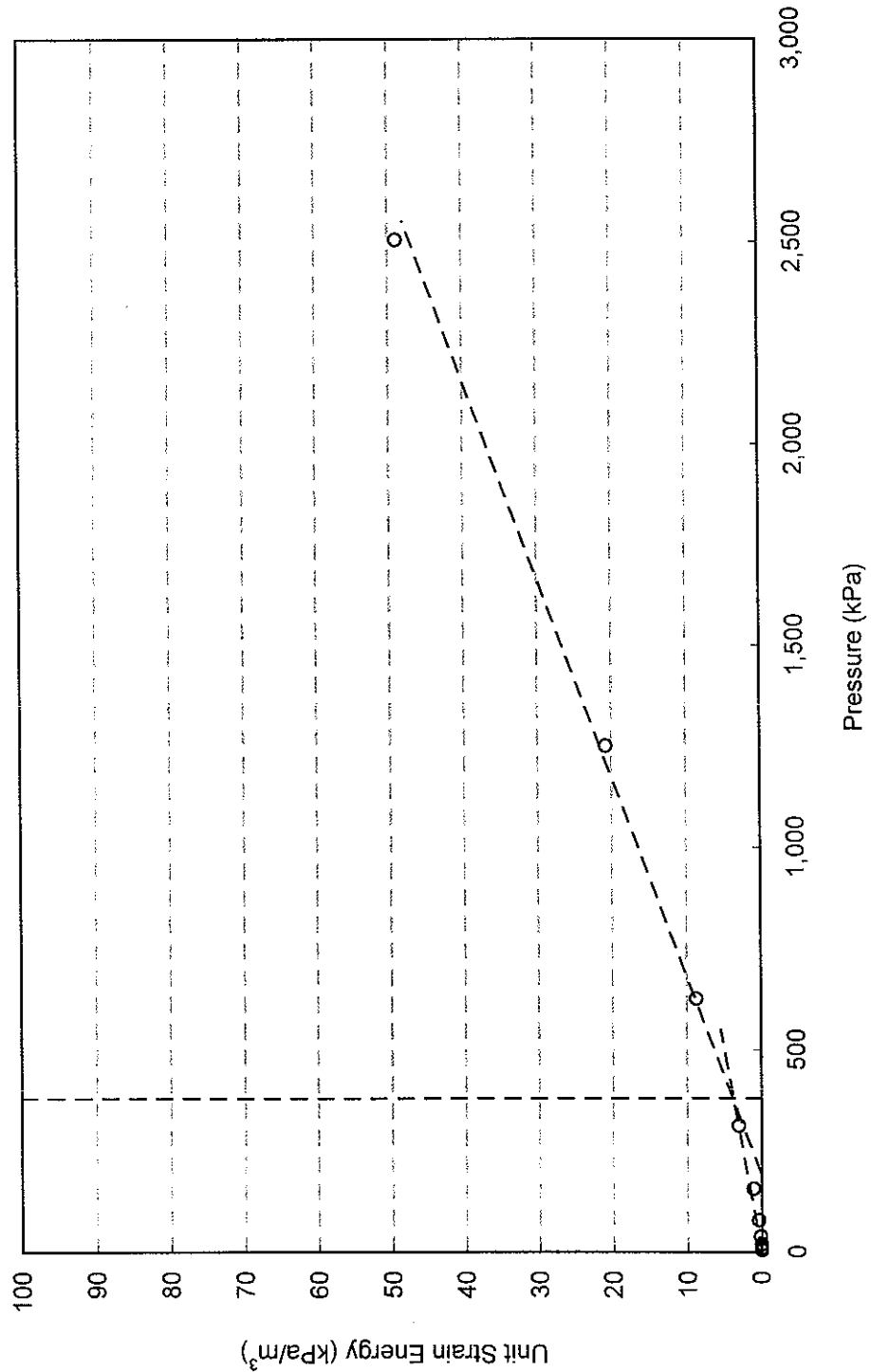
Project No. : 1-09-4135
 Date : July 2010



Terraprobe Inc.

Prepared By : HW
 Checked By : RA

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
SBL 12+750 CL, TW10



Pc = 380 kPa

Project No. : 1-09-4135

Date : July 2010



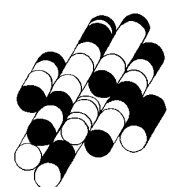
Terraprobe Inc.

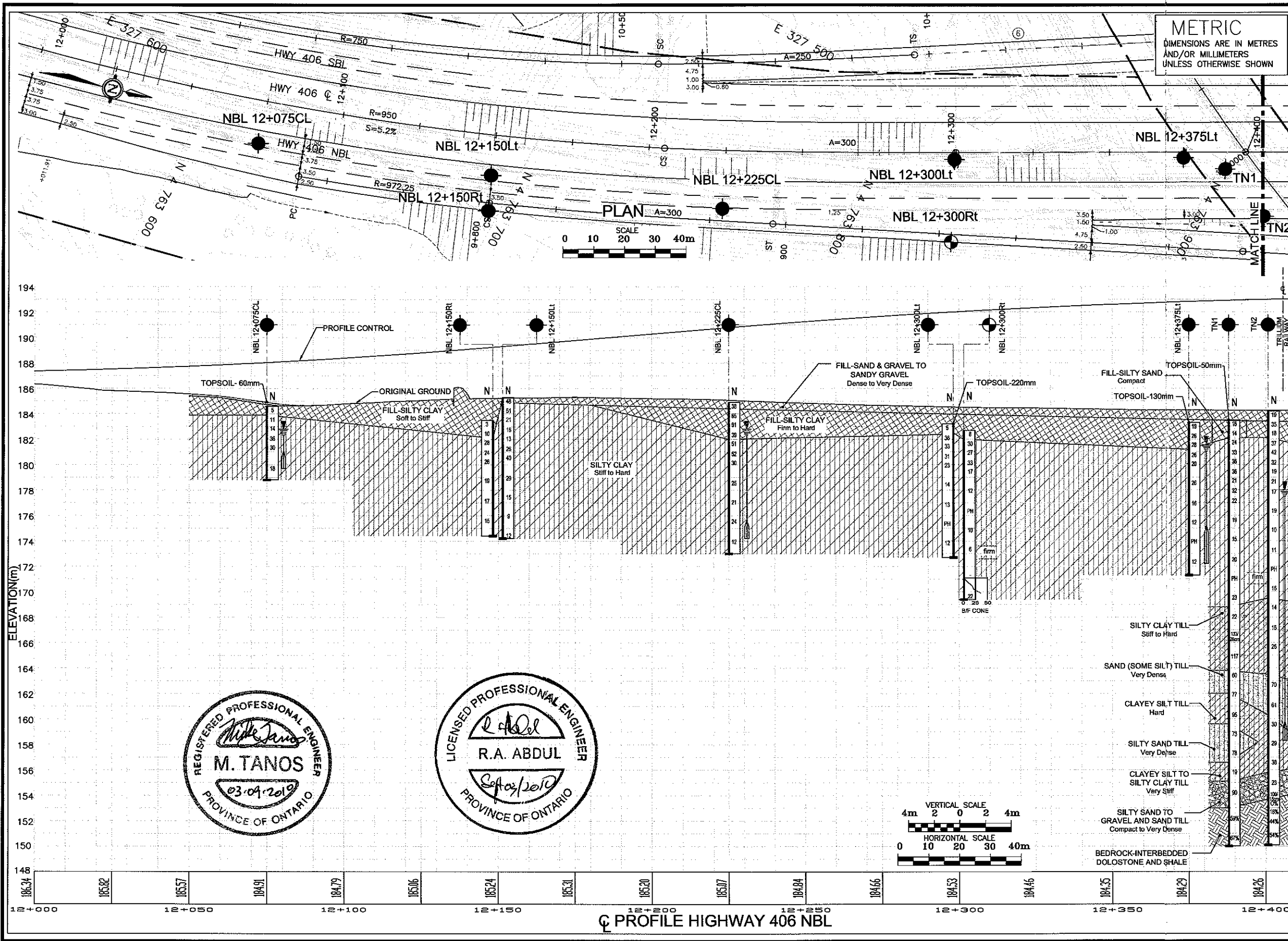
Prepared By : HW

Checked By : RA

C4

TERRAPROBE INC.





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

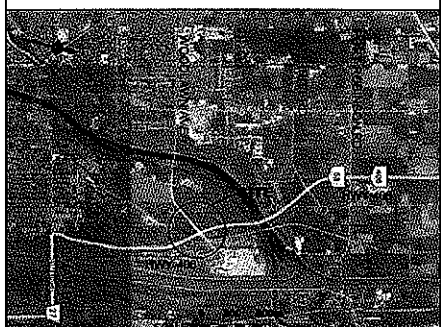
CONT No
WP No 280-99-00



HIGHWAY 406 NBL
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
2 OF 7

Giffels Associates Limited
Consulting Engineers and Architects
An IBI Group Company



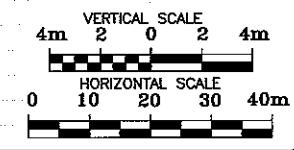
KEY PLAN

- LEGEND
- Bore Hole
 - Dynamic Cone Penetration Test
 - Bore Hole And Cone
 - Blows/0.3m (Std Pen Test, 475 J/blow)
 - Blows/0.3m (60' Cone, 475 J/blow)
 - WL at Time of Investigation
 - WL in Piezometer (MAY. 2010)
 - Piezometer
 - 90% Rock Quality Designation
 - A/R Auger Refusal

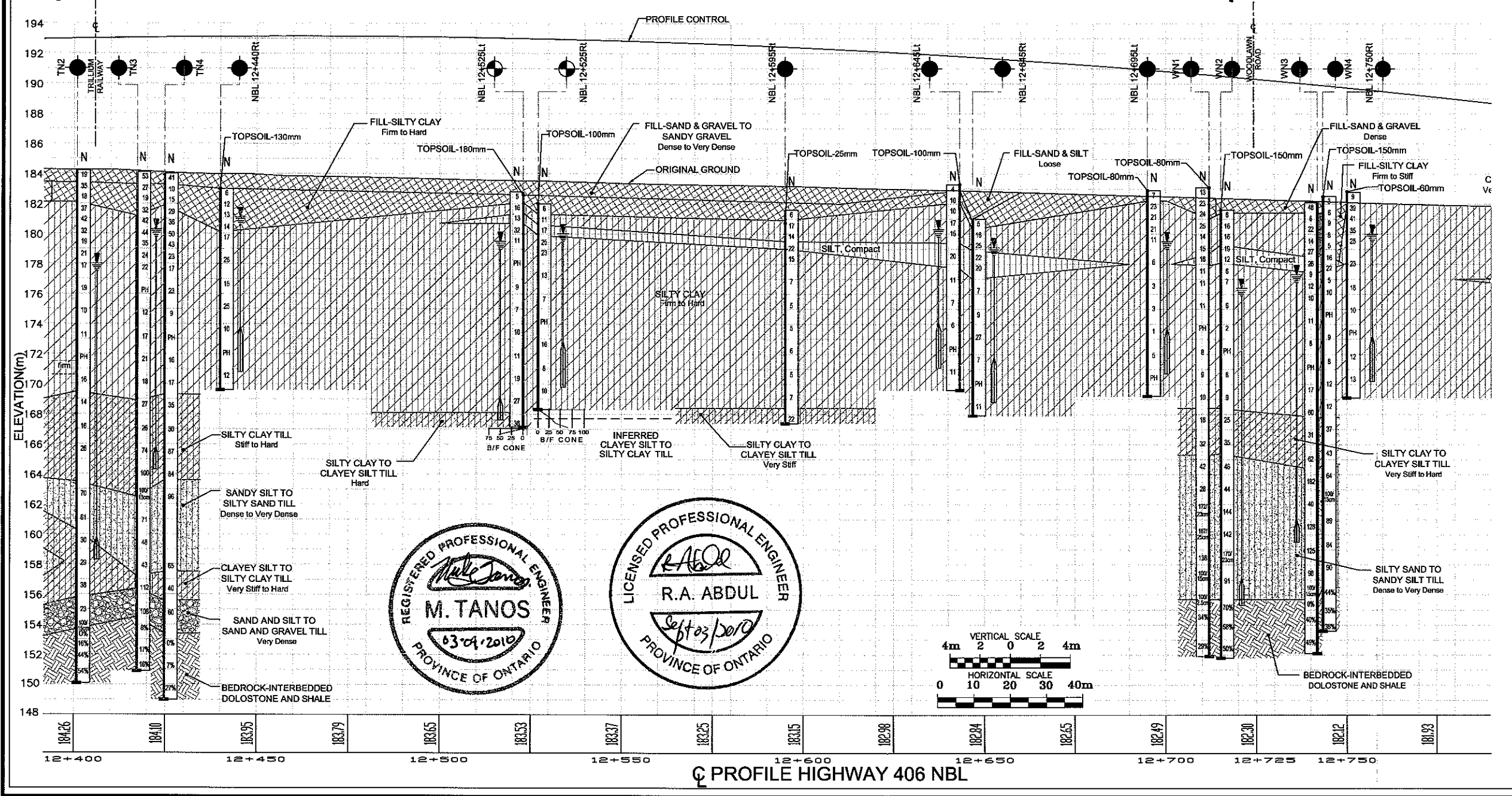
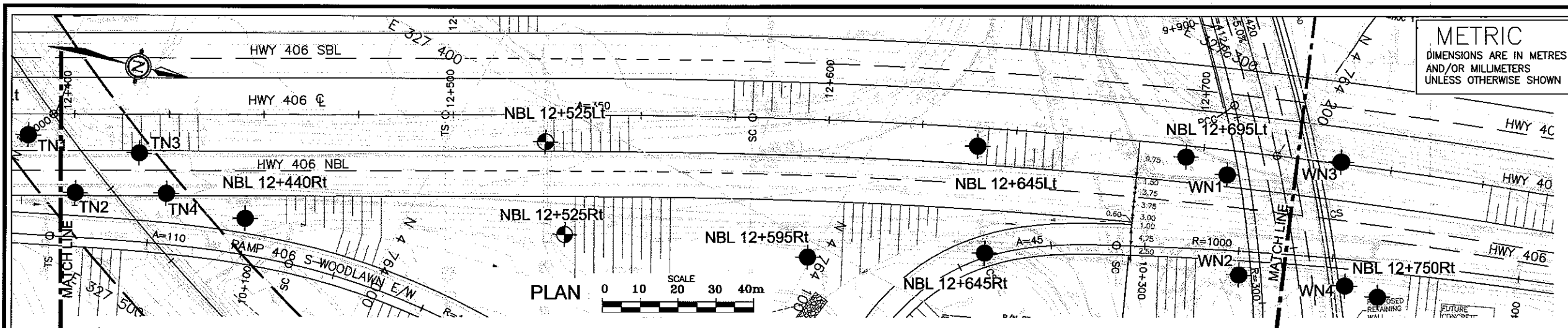
No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL 12+075CL	184.5	4 763 620.5	327 614.8
NBL 12+150Lt	185.3	4 763 692.1	327 588.2
NBL 12+150Rt	183.5	4 763 696.9	327 598.9
NBL 12+225CL	184.9	4 763 763.5	327 562.3
NBL 12+300Lt	183.1	4 763 822.6	327 512.4
NBL 12+300Rt	182.7	4 763 834.3	327 536.7
NBL 12+375Lt	183.3	4 763 888.1	327 476.6
TN1	183.5	4 763 901.9	327 473.4
TN2	184.2	4 763 920.1	327 481.1

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

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN R.A.	CODE CHBDC2008	LOAD	DATE SEPT. 2010
DRAWN K.C.	CHK R.A.	STRUCT	GEODCS 30M3-263



CL PROFILE HIGHWAY 406 NBL



CONT No

WP No 280-99-00

HIGHWAY 406 NBL

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

3 OF 7

Giffels Associates Limited

Consulting Engineers and Architects

An IBI Group Company

Terraprobe

Consulting Geotechnical & Environmental Engineering

Construction Materials Engineering, Inspection & Testing

KEY PLAN

LEGEND

●

 Bore Hole

⊙

 Dynamic Cone Penetration Test

⊙

 Bore Hole And Cone

'N'

 Blows/0.3m (Std Pen Test, 475 J/blow)

CONE

 Blows/0.3m (60' Cone, 475 J/blow)

≡

 WL at Time of Investigation

≡

 WL in Piezometer (MAY. 2010)

⊙

 Piezometer

90%

 Rock Quality Designation

A/R

 Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL 12+440Rt	183.0	4 763 962.9	327 465.8
NBL 12+525Lt	182.8	4 764 023.2	327 410.0
NBL 12+525Rt	182.0	4 764 039.4	327 429.4
NBL 12+595Rt	181.6	4 764 099.0	327 404.2
NBL 12+645Lt	183.3	4 764 124.9	327 356.9
NBL 12+645Rt	181.0	4 764 140.0	327 381.0
NBL 12+695Lt	182.9	4 764 175.1	327 333.0
NBL 12+750Rt	182.8	4 764 237.5	327 341.9
TN2	184.2	4 763 920.1	327 481.1
TN3	184.1	4 763 930.0	327 463.7
TN4	184.0	4 763 941.4	327 469.8
WN1	183.1	4 764 187.0	327 332.0
WN2	181.6	4 764 202.3	327 354.1
WN3	182.1	4 764 212.0	327 314.7
WN4	182.5	4 764 228.4	327 343.4

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

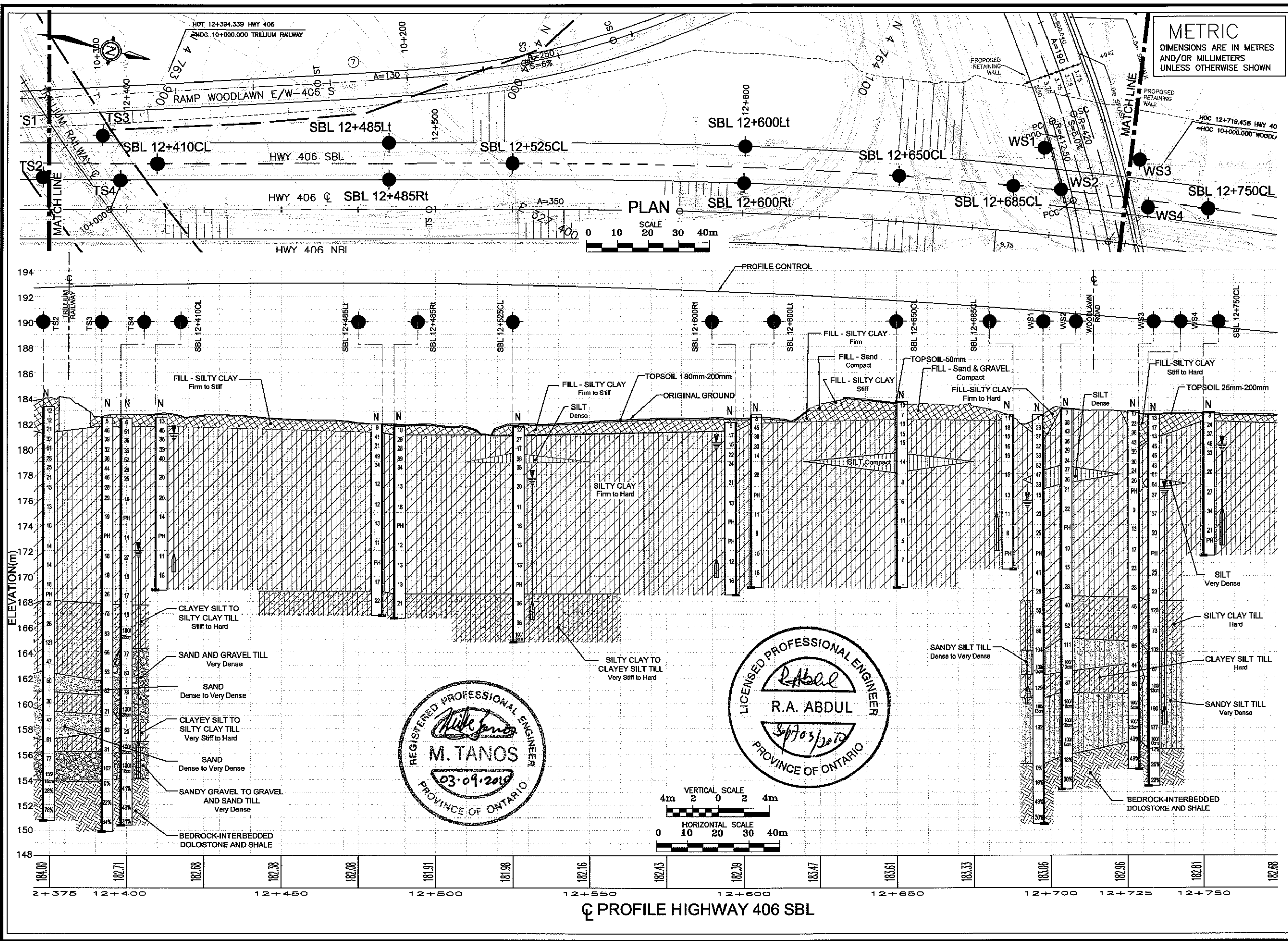
REVISIONS

DATE	BY	DESCRIPTION
DESIGN R.A.	CODE CHBDC2006	LOAD
DRAWN K.C.	CHK R.A.	STRUCT

DATE SEPT. 2010

GEOCRES 30M3-263

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CONT No
WP No 280-99-00

HIGHWAY 406 SBL
BOREHOLE LOCATIONS AND SOIL STRATA

Giffels Associates Limited
Consulting Engineers and Architects
An IBI Group Company

SHEET
6 OF 7

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60" Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer (MAY, 2010)
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
SBL 12+485L1	182.0	4 763 974.6	327 403.3
SBL 12+485R1	181.8	4 763 980.3	327 413.8
SBL 12+525CL	181.8	4 764 013.1	327 390.2
SBL 12+600L1	182.7	4 764 077.3	327 349.6
SBL 12+600R1	182.1	4 764 082.6	327 360.4
SBL 12+650CL	183.7	4 764 126.1	327 334.4
SBL 12+685CL	182.7	4 764 160.4	327 319.7
SBL 12+750CL	182.9	4 764 219.9	327 296.2
TS3	182.5	4 763 891.8	327 445.1
TS4	182.4	4 763 903.8	327 455.3
WS1	182.7	4 764 163.6	327 303.9
WS2	183.1	4 764 174.7	327 313.4
WS3	183.0	4 764 192.6	327 292.7
WS4	182.7	4 764 202.3	327 305.2

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RA	CODE	CHB02006	LOAD	DATE	SEPT. 2010
DRAWN	K.C.	CHK	RA	STRUCT	GEOCRES 30M3-263	

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