



February, 2014

FOUNDATION INVESTIGATION REPORT

High Fills and Deep Cuts
Highway 401/Holt Road Interchange
Site 21-159
Clarington, Ontario
G.W.P. 2101-08-00

Submitted to:
URS Canada Inc.
4th Floor
30 Leek Crescent
Richmond Hill, Ontario
L4B 4N4

REPORT



GEOCRES No.: 30M15-158
Report Number: 09-1111-0019

Distribution:

5 Copies - MTO - Central Region
1 Copy - MTO - Foundations Section
2 Copies - URS Canada Inc.
2 Copies - Golder Associates Ltd.





Table of Contents

PART A – FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
3.0 INVESTIGATION PROCEDURES	2
3.1 Previous Investigations.....	2
3.2 Current Investigation.....	2
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS	5
4.1 Regional Geology	5
4.2 Subsurface Conditions.....	5
4.3 High Fill Area 1 – Holt Road STA 10+050 to STA 10+170	5
4.3.1 Asphalt	6
4.3.2 Topsoil	6
4.3.3 Sand Fill	6
4.3.4 Clayey Silt Fill	6
4.3.5 Clayey Silt Till	6
4.3.6 Groundwater Conditions	7
4.4 High Fill Area 2 – E-N/S Ramp – STA 9+850 to STA 9+970	7
4.4.1 Topsoil	7
4.4.2 Sandy Silt Fill	8
4.4.3 Clayey Silt Fill	8
4.4.4 Silt and Sand Till	8
4.4.5 Groundwater Conditions	8
4.5 High Fill Area 3 –E-N/S Ramp – STA 10+200 to STA 10+500	9
4.5.1 Topsoil	9
4.5.2 Clayey Silt Fill	9
4.5.3 Clayey Silt	9
4.5.4 Silty Sand, Silt and Sand to Sand and Gravel.....	10
4.5.5 Silt and Sand to Sand Till.....	10



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

4.5.6	Clayey Silt Till	11
4.5.7	Groundwater Conditions	11
4.6	High Fill Area 4 –N/S-E Ramp - STA 9+610 to STA 9+740	11
4.6.1	Topsoil	12
4.6.2	Sandy Silt to Sand and Gravel Fill	12
4.6.3	Clayey Silt Fill	12
4.6.4	Sand and Gravel	12
4.6.5	Silt and Sand Till	13
4.6.6	Clayey Silt Till	13
4.6.7	Groundwater Conditions	14
4.7	High Fill Area 5 – N/S-W Ramp - STA 9+670 to STA 9+740	14
4.7.1	Topsoil	14
4.7.2	Silty Sand	14
4.7.3	Silt and Sand Till	14
4.7.4	Groundwater Conditions	15
4.8	High Fill Area 6 – W- N/S Ramp STA 11+550 to STA 11+580	15
4.8.1	Asphalt	15
4.8.2	Sand Fill	15
4.8.3	Clayey Silt Fill	16
4.8.4	Topsoil	16
4.8.5	Clayey Silt Till	16
4.8.6	Groundwater Conditions	16
4.9	Deep Cut Area 7 – South Service Road STA 13+160 to STA 13+265	17
4.9.1	Topsoil	17
4.9.2	Clayey Silt Fill	17
4.9.3	Silt to Silt and Sand Till	18
4.9.4	Groundwater Conditions	18
4.10	Deep Cut Area 8 – South Service Road (Soil Disposal Mound), STA 11+850 to STA12+500	18
4.10.1	Topsoil	19
4.10.2	Fill (Soil Disposal Mound)	19
4.10.3	Clayey Silt Till	20



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

4.10.4	Groundwater Conditions	21
4.11	Analytical Testing.....	22
5.0	CLOSURE.....	22

REFERENCES

Drawing 1 – Highway 401/Holt Road Interchange Reconfiguration, Index Plan
List of Symbols and Abbreviations

APPENDIX A High Fill Area 1 – Holt Road, STA 10+050 to 10+170

Drawing A1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure A1 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure A2 – Plasticity Chart – Clayey Silt (FILL)

Figure A3 – Grain Size Distribution Test Results – Clayey Silt (TILL)

Figure A4 – Plasticity Chart – Clayey Silt (TILL)

APPENDIX B High Fill Area 2 – E-N/S Ramp, STA 9+850 to 9+970

Drawing B1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure B1 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure B2 – Plasticity Chart – Clayey Silt (FILL)

Figure B3 – Grain Size Distribution Test Results – Sand and Silt (TILL)

Figure B4 – Plasticity Chart – Sand and Silt (TILL)

APPENDIX C High Fill Area 3 – E-N/S Ramp, STA 10+200 to 10+500

Drawing C1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure C1 – Grain Size Distribution Test Results – Clayey Silt with Sand (FILL)

Figure C2 – Plasticity Chart – Clayey Silt (FILL)

Figure C3 – Grain Size Distribution Test Results – Clayey Silt

Figure C4 – Plasticity Chart – Clayey Silt

Figure C5 – Grain Size Distribution Test Results – Silt and Sand

Figure C6 – Grain Size Distribution Test Results – Sand to Silt and Sand (TILL)

Figure C7 – Plasticity Chart – Silt and Sand (TILL)

Figure C8 – Grain Size Distribution Test Results – Clayey Silt (TILL)

Figure C9 – Plasticity Chart – Clayey Silt (TILL)

APPENDIX D High Fill Area 4 –N/S-E Ramp, STA 9+610 to 9+740

Drawing D1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure D1 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure D2 – Plasticity Chart – Clayey Silt (FILL)

Figure D3 – Grain Size Distribution Test Results – Silt and Sand (TILL)

Figure D4 – Plasticity Chart – Silt and Sand (TILL)

Figure D5 – Grain Size Distribution Test Results – Clayey Silt (TILL)

Figure D6 – Plasticity Chart – Clayey Silt (TILL)



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

APPENDIX E High Fill Area 5 – N/S-W Ramp, STA 9+670 to 9+740

Drawing E1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure E1 – Grain Size Distribution Test Results – Silt and Sand (TILL)

Figure E2 – Plasticity Chart – Silt and Sand (TILL)

APPENDIX F High Fill Area 6 – W- N/S Ramp, STA 11+550 to 11+580

Drawing F1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure F1 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure F2 – Plasticity Chart – Clayey Silt (FILL)

Figure F3 – Grain Size Distribution Test Results – Clayey Silt (TILL)

Figure F4 – Grain Size Distribution Test Results – Silt (TILL)

APPENDIX G Deep Cut Area 7 – South Service Road, STA 13+160 to 13+265

Drawing G1 – Borehole Locations and Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure G1 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure G2 – Plasticity Chart – Clayey Silt (FILL)

Figure G3 – Grain Size Distribution Test Results – Silt to Silt and Sand (TILL)

Figure G4 – Plasticity Chart – Silt to Silt and Sand (TILL)

APPENDIX H Deep Cut Area 8 – South Service Road (Soil Disposal Mound), STA 11+850 to 12+500

Drawing H1 – Borehole Locations and Soil Strata

Drawing H2 – Borehole Soil Strata

Record of Borehole Sheets

Laboratory Test Results

Figure H1 – Grain Size Distribution Test Results – Sandy Silt to Silt and Sand (FILL)

Figure H2 – Plasticity Chart – Sandy Silt (FILL) (Soil Disposal Mound)

Figure H3 – Grain Size Distribution Test Results – Clayey Silt (FILL)

Figure H4 – Plasticity Chart – Clayey Silt to Silty Clay (FILL)

Figure H5 – Laboratory Compaction Test – Soil Disposal Mound (FILL)

Figure H6 – Grain Size Distribution Test Results – Clayey Silt (TILL)

Figure H7 – Plasticity Chart – Clayey Silt (TILL)

APPENDIX I Analytical Test Results

APPENDIX J Borehole Records – Previous Investigation



PART A

**FOUNDATION INVESTIGATION REPORT
HIGH FILLS AND DEEP CUTS
HIGHWAY 401/HOLT ROAD INTERCHANGE – SITE 21-159
CLARINGTON, ONTARIO
G.W.P. 2101-08-00**



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by URS Canada Inc. (URS) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the Highway 401/Holt Road Interchange reconfiguration in the Town of Clarington, Regional Municipality of Durham, Ontario.

This report addresses the results of the subsurface investigation carried out for the high fills and deep cuts required for the construction of new interchange ramps and realigned Holt Road and South Service Road.

The Terms of Reference and scope of work for the foundation engineering services are outlined in MTO's Request for Proposal (RFP) for Assignment No. 2008-E-0059 dated March 2009 and associated clarifications, and in Section 6.8 of the *Technical Proposal* for this assignment. Golder's Scope of Work for this assignment was developed based on the proposed ramp and service road profiles provided by URS at the preliminary design stage of this assignment and is summarised in Golder's Scope Change Letters dated January 24, August 7, and August 23, 2013.

2.0 SITE DESCRIPTION

The existing Highway 401/Holt Road Underpass Interchange is located near the entrance to the Darlington Nuclear Power Plant, approximately 10 km east of Oshawa, Ontario.

Based on the drawings of the proposed new Highway 401/Holt Road Interchange provided by URS (Drawing No. 2013-10-24-Hwy401-HoltRd_profile and 2013-10-24-Hwy401-HoltRd_plan), the existing Holt Road will be realigned and a new bridge structure will be constructed about 30 m to the east of the existing bridge with associated interchange ramps, as shown on Drawing 1. Further, it is understood that the South Service Road will be realigned to the south as part of the interchange reconfiguration, to accommodate the future Highway 407 East Durham Link that connects to Highway 401 immediately to the west of the site.

In general, the terrain in the area of the proposed new interchange is relatively flat to gently rolling, with the natural ground surface within the limits of the project ranging between about Elevation 111 m and 116 m, with the exception of the existing soil disposal mound on OPG property between Park Road and Solina Road which is up to about Elevation 132 m, and an existing fill mound east of Park Road on the south side of the existing South Service Road which is up to about Elevation 131 m.

The Highway 401 grade in the vicinity of the existing and the new Holt Road Interchange is at about Elevation 112 m. The existing Holt Road Underpass approach embankments have been constructed of earth fill, up to about 6.5 m high, with the Holt Road surface at about Elevation 118.5 m. The existing approach embankment side slopes are inclined at approximately 2 horizontal to 1 vertical (2H:1V). The current interchange configuration permits access only to Holt Road from the eastbound Highway 401 and to Highway 401 westbound from Holt Road.

The high fill and deep cut areas are located along the proposed interchange ramps and along the proposed realigned Holt Road and South Service Road. The approximate locations, extent and depths/height of these high fill and deep cut sections are summarized below and shown on Drawing 1.



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

High Fill/ Deep Cut Area	Approximate Location	Horizontal Distance (m)	Average Fill/Cut Depth (m)
1 - High Fill	Holt Road STA 10+050 to 10+170	120	4.5 to 9
2 - High Fill	E-N/S Ramp –STA 9+850 to 9+970	120	2 to 4.5
3 - High Fill	E-N/S Ramp –STA 10+200 to 10+500	300	3 to 4.5
4 - High Fill	N/S-E Ramp –STA 9+610 to 9+740	130	4.5 to 6.8
5 - High Fill	N/S-W Ramp –STA 9+670 to 9+740	70	3 to 4
6 - High Fill	W-N/S Ramp –STA 11+550 to 11+580	30	4.5 to 5.5
7 - Deep Cut	South Service Road STA 13+160 to 13+265	105	6 to 9
8 - Deep Cut	South Service Road (Soil Disposal Mound) STA 11+850 to 12+500	650	12 to 17

The ramp and service road alignments and profiles have been revised since the preliminary design stage and some areas are no longer considered to be “high fills” based on MTO Foundations criteria, however the results of the subsurface investigation in these areas are also included in this report.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigations

During a previous investigation carried out by Ecoplans Ltd. (Ecoplans) in 2010, a total of 15 boreholes and/or monitoring wells were advanced/installed in the vicinity of the proposed South Service Road deep cut Area 8. The subsurface information obtained during the current borehole investigation presented in Appendices A to H as noted in Section 3.2 has been supplemented with the borehole and monitoring well records from the previous investigation which are included in Appendix J.

3.2 Current Investigation

The field work for this investigation was carried out by Golder during the period between May 27 and August 22, 2013, and consisted of drilling and sampling forty one (41) boreholes (Boreholes 13-1 to 13-21, 13-23 to 13-41 and 13-50) to depths ranging from 4.6 m to 18.7 m below existing ground surface. The approximate borehole locations are summarized below and shown on Drawings A1 to H1, in Appendices A to H respectively. The results of chemical analyses on composite soil samples are presented in Appendix I.

The boreholes were drilled by conventional track and truck mounted drill rigs supplied and operated by KC Drilling Ltd. of Innisfil, Ontario and Strong Soil Search Inc. of Claremont, Ontario. The boreholes were advanced through the overburden using 108 mm, 120 mm and 150 mm solid stem augers. In general, samples of the overburden soils were obtained at intervals of depth ranging from 0.75 m to 1.5 m using a 50 mm outer diameter (O.D.) split-spoon sampler operated by automatic hammers on the drill rigs, performed in accordance with Standard Penetration Testing (SPT) procedures, as specified in ASTM Method D1586.

The groundwater conditions were observed in the open boreholes during and immediately following the drilling operations and are described on the Record of Borehole sheets in the corresponding appendices. It should be



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

noted that groundwater elevations as encountered in the boreholes may not be representative of static groundwater levels since the groundwater levels in the boreholes may not have stabilized on completion of drilling. Furthermore, groundwater elevations will vary depending on seasonal fluctuations in precipitation and on local soil permeability. All boreholes were abandoned by backfilling to the surface with bentonite upon completion in accordance with Ontario Regulation 903 (as amended).

The soil cuttings from the borehole drilled on OPG property were collected and contained in steel drums which were temporarily stored on-site while analytical testing was completed to categorize the soil for disposal. Following the receipt of the analytical results (included in Appendix I) the soil drums were removed from site by Detox Environmental Services Inc.

The boreholes were advanced to depths up to 18.7 m below existing ground surface, generally penetrating below ground surface to a depth equivalent to the proposed height of the embankment fill or to fifty percent of the depth of a cut below the base of the proposed cut and a minimum of 3 m into competent material.

The proposed centreline of each roadway and ramp alignment was staked at 50 m intervals in the field by URS prior to drilling. The as-drilled borehole locations, in stations and offsets, were measured in reference to the centreline alignment and were subsequently converted into MTM NAD 83 coordinates using the base drawing provided by URS in AutoCAD format. Borehole elevations were surveyed by a member of our technical staff in reference to the surveyed ground surface elevations at the centreline median. For locations where the centreline elevations were not surveyed in close proximity to the as-drilled boreholes, ground surface elevations at the centreline were obtained from the contour plan provided by URS (ACAD-X-base.dwg, received January 2009) and confirmed for elevations relative to the boreholes surveyed to the staked locations. The borehole locations shown on Drawings A1 to H1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum.

Summary of Borehole Locations and Elevations

High Fill/Deep Cut Area Number and Location	Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)	Reference
High Fill Area 1 - Holt Road STA 10+050 to 10+170	BH 13-1	4860691.2	367324.1	111.0	9.2	Appendix A
	BH 13-2	4860647.0	367303.2	116.3	7.7	
	BH 13-3	4860654.6	367347.6	110.9	7.7	
	BH 13-4	4860579.7	367324.9	113.5	4.7	
	BH 13-15	4860637.2	367352.9	111.1	7.7	
	BH 13-23	4860626.5	367292.1	113.2	6.2	
	BH 13-50	4860895.0	367316.0	111.0	9.2	
High Fill Area 2 - E-N/S Ramp – STA 9+850 to 9+970	BH 13-12	4860902.8	367970.2	95.1	6.2	Appendix B
	BH 13-13	4860887.0	367915.3	98.0	6.3	
	BH 13-14	4860876.8	367861.3	98.5	6.3	
High Fill Area 3 - E-N/S Ramp – STA 10+200 to 10+500	BH 13-5	4860837.2	367583.1	102.7	4.7	Appendix C
	BH 13-6	4860859.5	367541.4	102.9	6.2	
	BH 13-7	4860886.7	367489.8	104.0	7.8	



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

High Fill/Deep Cut Area Number and Location	Borehole Number	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)	Reference
	BH 13-8	4860903.2	367447.8	105.6	7.8	
	BH 13-9	4860920.2	367399.7	107.2	4.6	
	BH 13-10	4860950.2	367357.9	108.4	6.2	
	BH 13-11	4860938.7	367308.4	109.7	4.7	
High Fill Area 4 - N/S-E Ramp – STA 9+610 to 9+740	BH 13-15	4860637.2	367352.9	111.1	7.7	Appendix D
	BH 13-16	4860658.9	367387.0	110.1	7.7	
	BH 13-17	4860692.5	367411.1	110.0	6.2	
	BH 13-18	4860727.4	367436.9	108.7	4.6	
High Fill Area 5 - N/S-W Ramp – STA 9+670 to 9+740	BH 13-19	4860918.3	367294.0	110.0	4.6	Appendix E
	BH 13-20	4860925.5	367329.7	109.1	6.2	
	BH 13-21	4860898.2	367353.9	108.7	4.7	
High Fill Area 6 - W-N/S Ramp – STA 11+550 to 11+580	BH 13-2	4860647.0	367303.2	116.3	7.7	Appendix F
	BH 13-23	4860626.5	367292.1	113.2	6.2	
Deep Cut Area 7 - South Service Road STA 13+160 to 13+265	BH 13-39	4860503.8	367085.2	131.0	7.9	Appendix G
	BH 13-40	4860481.2	367127.2	131.0	12.3	
	BH 13-41	4860463.4	367175.4	126.4	8.0	
Deep Cut Area 8 - South Service Road (Soil disposal mound) STA 11+850 to 12+500	BH 13-24	4860345.0	365782.0	112.5	9.4	Appendix H
	BH 13-25	4860299.2	365845.5	123.2	18.7	
	BH 13-26	4860322.0	365891.5	123.5	17.1	
	BH 13-27	4860307.0	365920.0	126.6	17.2	
	BH 13-28	4860335.0	365939.0	123.8	17.1	
	BH 13-29	4860399.0	365975.0	113.1	7.6	
	BH 13-30	4860327.0	366044.0	129.4	17.2	
	BH 13-31	4860387.0	366081.0	118.9	9.6	
	BH 13-32	4860336.0	366145.0	130.5	9.2	
	BH 13-33	4860348.0	366194.0	129.4	17.1	
	BH 13-34	4860350.0	366245.0	131.8	17.1	
	BH 13-35	4860464.0	366268.0	117.9	6.4	
	BH 13-36	4860427.0	366329.0	120.9	6.6	
	BH 13-37	4860429.0	366380.0	119.0	5.8	
	BH 13-38	4860467.0	366422.0	119.8	5.5	

Prepared by: MWK, Checked by KJB

The field work was observed by members of our engineering and technical staff who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Mississauga geotechnical laboratory



where the samples underwent further detailed visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples. The results of the laboratory classification testing are included in the associated appendices and are summarized on the Record of Borehole sheets.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 401 is located within the Iroquois Plain physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)¹ and *Urban Geology of Canadian Cities* (Karrow and White, 1998)². The Iroquois Plain, extending around the western shores of Lake Ontario, is comprised of the flat to undulating lakebed and beaches of the former glacial Lake Iroquois, which occupied this area during the last glacial recession.

The surficial soils in this area of the Iroquois Plain are typically comprised of glaciolacustrine clays, silts and sands to gravelly sands, which are underlain by an extensive till deposit that is mapped in this area as the Bowmanville Till. Within the area approximately bounded by Holt Road and Morgan's Road, the surficial glaciolacustrine deposits are absent or of limited thickness and the Bowmanville Till unit is frequently present immediately below the ground surface. Between these limits, an extensive surficial deposit of clayey silt to silty clay is present over the Bowmanville Till (Karrow and White, 1998). More recent alluvial deposits of gravel, sand, silt and/or clay are present in the valleys associated with Bowmanville Creek, Soper Creek, Wilmot Creek and Graham Creek.

The overburden soils are underlain by limestone bedrock of the Lindsay Formation, Simcoe Group (Geological Survey of Canada, 1991).³

4.2 Subsurface Conditions

Reference is made to Appendices A to H which include the Borehole Location and Soil Strata Drawings, the Record of Boreholes and the laboratory test results for High Fill/Deep Cut Areas 1 to 8, respectively. An overall description of the stratigraphy at each site is given in the following sections. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

The stratigraphic boundaries shown on the Record of Boreholes and on the interpreted stratigraphic sections (Drawings A1, B1, C1, D1, E1, F1, G1, H1 and H2) are inferred from non-continuous sampling and therefore represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

4.3 High Fill Area 1 – Holt Road STA 10+050 to STA 10+170

The plan and profile along the centreline of the new Holt Road alignment showing the borehole locations and interpreted stratigraphy between about STA 10+050 and STA 10+170 are shown on Drawing A1 in Appendix A.

¹ Chapman, L.J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

² Karrow, P. F., and White, O. L., 1998. *Urban Geology of Canadian Cities*. Geological Association of Canada Special Paper No. 42. St. John's, Nfld.

³ Ontario Geological Society, 1991. *Geology of Ontario*. Special Volume 4, Part 1. Eds. P.C. Thurston, H.R. Williams, R.H. Sutcliffe and G.M. Stott. Ministry of Northern Development and Mines, Ontario.



The proposed roadway embankment will be up to about 9 m high relative to existing grade. A total of seven (7) boreholes (Boreholes 13-1 to 13-4, 13-15, 13-23 and 13-50) were completed to investigate the subsurface conditions within this High Fill Area. The topography of this section of proposed roadway is generally flat and low-lying, encompassing a wet grassy area.

In general, the subsurface soils along the new Holt Road alignment in this area consist of a surficial layer of topsoil, in places underlain by clayey silt fill, underlain by a till deposit comprised of clayey silt with sand. At Borehole 13-2, which was drilled through the existing Holt Road embankment, encountered asphalt at ground surface underlain by cohesive and non-cohesive fill which was underlain by the till deposit.

4.3.1 Asphalt

An approximately 150 mm thick layer of asphalt was encountered at ground surface in Borehole 13-2 which was drilled through the existing Holt Road embankment.

4.3.2 Topsoil

A 0.3 m to 0.5 m thick surficial layer of topsoil was encountered at the ground surface in Boreholes 13-1, 13-3, 13-4, 13-15, 13-23 and 13-50.

4.3.3 Sand Fill

A fill deposit consisting of brown sand, some gravel, trace silt was encountered below the asphalt in Borehole 13-2. The surface of this deposit was encountered at a depth of about 0.2 m below ground surface (Elevation 116.1 m) and its thickness is about 0.6 m.

The natural water content measured on one sample of this deposit is about 3 per cent.

4.3.4 Clayey Silt Fill

A fill deposit consisting of brown sandy clayey silt, to clayey silt, trace to some sand, trace to some gravel, containing trace organics was encountered below the granular fill in Borehole 13-2, and beneath the topsoil in Boreholes 13-1, 13-3, 13-15 and 13-50. The surface of this deposit was encountered at depths between about 0.3 m and 0.8 m below ground surface (Elevation 110.6 m to 115.5 m) and its thickness ranges from about 0.4 m to 4.8 m.

Standard Penetration Test SPT 'N'-values recorded within the cohesive fill range between 16 blows and 106 blows per 0.3 m of penetration suggesting that the clayey silt fill has a very stiff to hard consistency.

The natural water content measured on samples of this fill deposit range from about 13 per cent to 22 per cent.

Grain size distribution test results of three samples from this deposit are shown on Figure A1 in Appendix A.

Atterberg limits tests were carried out on two specimens of the clayey silt fill deposit and measured liquid limits of 20 per cent and 27 per cent, plastic limits of 13 per cent and 14 per cent and plasticity indices of 7 per cent and 14 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure A2 in Appendix A and indicate that the material is a clayey silt of low plasticity.

4.3.5 Clayey Silt Till

A till deposit consisting of brown to grey clayey silt with sand, trace to some gravel, was encountered below the topsoil or fill deposits (where present) in all of the boreholes advanced within this high fill section. The clayey silt



till deposit contains cobbles and boulders at various depths as inferred from grinding of the augers during drilling operations. The surface of this deposit was encountered between about 0.4 m and 5.6 m below ground surface (Elevation 109.7 m to 113.1 m) and it was not fully penetrated in any of the boreholes to depths of up to 9.2 m below ground surface (Elevation 101.8 m).

SPT 'N'-values recorded within this till deposit range between 21 blows per 0.3 m of penetration and 100 blows per 0.03 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration, suggesting that the clayey silt till has a very stiff to hard, but generally hard consistency.

The natural water content measured on samples of this till deposit ranges from about 5 per cent to 14 per cent.

Grain size distribution test results of fourteen samples from this deposit are shown on Figure A3 in Appendix A.

Atterberg limits tests were carried out on six specimens of the clayey silt till deposit and measured liquid limits ranging from 13 per cent to 28 per cent, plastic limits ranging from 10 per cent to 14 per cent, and plasticity indices ranging from 2 per cent to 14 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure A4 in Appendix A and indicate that the material is a clayey silt of low plasticity with zones that may be classified as silt of slight plasticity.

4.3.6 Groundwater Conditions

In general, the samples taken in the boreholes were moist. Water levels observed in the boreholes during or upon completion of drilling range from about Elevation 105.5 m to Elevation 112.6 m, measured at depths between about 0.9 m to 7.3 m below ground surface.

It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.4 High Fill Area 2 – E-N/S Ramp – STA 9+850 to STA 9+970

The plan and profile along the centreline of the new E-N/S Ramp alignment showing the borehole locations and interpreted stratigraphy between about STA 9+850 and STA 9+970 are shown on Drawing B1 in Appendix B. The proposed ramp embankment will be up to about 4.5 m high relative to existing grade. A total of three (3) boreholes (Boreholes 13-12 to 13-14) were completed to investigate the subsurface conditions within this potential high fill area. The topography of this section of proposed ramp is flat and low-lying, encompassing a farm field and wooded area.

In general, the subsurface soils along the new E-N/S ramp alignment in this area consist of a surficial layer of topsoil underlain by deposits of cohesive and non-cohesive fill which are in turn underlain by a sand and silt till deposit.

4.4.1 Topsoil

A 0.4 m thick surficial layer of topsoil was encountered at the ground surface in all of the boreholes advanced within this high fill embankment section.

SPT 'N'-values measured within the topsoil deposit range between 13 blows and 16 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.



4.4.2 Sandy Silt Fill

A fill deposit consisting of brown sandy silt, some gravel, trace clay trace organics was encountered below the topsoil in Borehole 13-13. The top of this deposit was encountered at about Elevation 97.6 m and its thickness is about 0.3 m.

4.4.3 Clayey Silt Fill

A fill deposit consisting of brown clayey silt with sand to some sand, trace gravel trace organics, was encountered below the granular fill in Borehole 13-13, and below the topsoil in Boreholes 13-12 and 13-14. The top of this deposit varies between about Elevation 98.1 m and 94.7 m and its thickness ranges from about 0.6 m to 1.0 m.

SPT 'N'-values recorded within the cohesive fill are 13 blows and 19 blows per 0.3 m of penetration suggesting that the clayey silt fill has a stiff to very stiff consistency.

The natural water content measured on two samples of this fill deposit is about 14 per cent and 18 per cent.

Grain size distribution test results of two samples of this deposit are shown on Figure B1 in Appendix B.

Atterberg limits tests were carried out on two specimens of the cohesive fill deposit and measured liquid limits of about 24 per cent and 29 per cent, plastic limits of about 15 per cent and plasticity indices of about 10 per cent and 14 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B2 in Appendix B and indicate that the material is classified clayey silt of low plasticity.

4.4.4 Silt and Sand Till

A till deposit consisting of silt and sand, trace to some gravel, trace to some clay, was encountered below the cohesive fill deposit in all of the boreholes advanced within this high fill section. The presence of cobbles and boulders within the fill deposit is inferred from grinding of the augers as the boreholes were advanced. The top of this deposit varies between about Elevation 97.5 m and 93.7 m and it was not fully penetrated in any of the boreholes to depths of up to 6.3 m below ground surface (Elevation 88.9 m).

SPT 'N'-values recorded within this till deposit range between 53 blows per 0.3 m of penetration and 63 blows per 0.05 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration indicating that the silt and sand till has a very dense relative density.

The natural water content measured on samples of this till deposit ranges from about 5 per cent to 8 per cent.

Grain size distribution test results of six samples from this deposit are shown on Figure B3 in Appendix B.

Atterberg limits tests were carried out on three specimens of the sand and silt till deposit and measured liquid limits ranging from about 12 per cent to 13 per cent, plastic limits of about 10 per cent, and plasticity indices ranging from about 2 per cent to 4 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure B4 in Appendix B and indicate that the fines material is a silt of slight plasticity.

4.4.5 Groundwater Conditions

In general, the samples taken in the boreholes were moist. Water levels observed in the boreholes during or upon completion of drilling range from about Elevation 94.6 m to 92.1 m, measured at depths between about 3.0 m to 5.9 m below ground surface.



It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.5 High Fill Area 3 –E-N/S Ramp – STA 10+200 to STA 10+500

The plan and profile along the centreline of the new Highway 401/Holt Road E-N/S Ramp alignment showing the borehole locations and interpreted stratigraphy between about STA 10+200 and STA 10+500 are shown on Drawing C1 in Appendix C. The proposed ramp embankment will be up to about 4.5 m high relative to existing grade. A total of seven (7) boreholes (Boreholes 13-5 to 13-11) were completed to investigate the subsurface conditions within this high fill area. The topography of this section of proposed roadway is generally flat and low-lying, encompassing a farm field.

In general, the subsurface soils along the new E-N/S ramp alignment in this area consist of a surficial layer of topsoil underlain by a deposit of clayey silt to silty sand which is underlain by till deposits consisting of silt and sand and clayey silt with sand.

4.5.1 Topsoil

A 0.2 m to 0.7 m thick deposit of topsoil was encountered at the ground surface in all of the boreholes advanced within this high fill area.

SPT 'N'-values measured within the topsoil deposit range between 2 blows and 23 blows per 0.3 m of penetration suggesting a soft to very stiff consistency.

4.5.2 Clayey Silt Fill

A fill deposit consisting of brown clayey silt with sand, some gravel containing rootlets and trace organics, was encountered below the topsoil in Borehole 13-5, located adjacent to the existing Highway 401 Westbound lanes embankment. The surface of this deposit was encountered at about 0.4 m below ground surface (Elevation 102.4 m) and its thickness is about 0.8 m.

One SPT 'N'-value recorded within this cohesive fill deposit is 32 blows per 0.3 m of penetration suggesting a hard consistency.

The natural water content measured on one sample of this fill deposit is about 17 per cent.

The result of a grain size distribution test of one sample from this deposit is shown on Figure C1 in Appendix C.

An Atterberg limits test was carried out on one specimen of the clayey silt fill deposit and measured a liquid limit of 22 per cent, a plastic limit of 12 per cent, and a plasticity index of 10 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure C2 in Appendix C and indicates that the material is a clayey silt of low plasticity.

4.5.3 Clayey Silt

A cohesive soil deposit consisting of brown clayey silt, some sand, trace to some gravel, trace organics (i.e. rootlets), was encountered below the topsoil in Boreholes 13-6 to 13-8. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this



deposit was encountered between about 0.5 m and 0.7 m below ground surface (Elevation 105.1 m to 102.2 m) and its thickness ranges from about 0.6 m to 0.9 m.

SPT 'N'-values recorded within this deposit range between 8 blows and 24 blows per 0.3 m of penetration suggesting that the clayey silt deposit has a stiff to very stiff consistency.

The natural water content measured on samples of this deposit ranges from about 24 per cent to 27 per cent.

The grain size distribution test results of three samples from this deposit are shown on Figure C3 in Appendix C.

Atterberg limits tests were carried out on three specimens of the clayey silt deposit and measured liquid limits ranging from about 30 per cent to 32 per cent, plastic limits ranging from about 12 per cent to 14 per cent, and the plasticity indices ranging from about 17 per cent to 18 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C4 in Appendix C and indicate that the material is a clayey silt of low plasticity.

4.5.4 Silty Sand, Silt and Sand to Sand and Gravel

A granular deposit consisting of silt and sand to sand and gravel, trace to some clay, was encountered below the clayey silt deposit in Borehole 13-7 and a silty sand deposit was encountered below the topsoil in Borehole 13-10. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of these granular deposits was encountered at depths of about 0.2 m and 1.1 m below ground surface (Elevation 108.3 m and 102.9 m, respectively) and the thickness of the deposits is about 0.5 m and 3.2 m in Boreholes 13-10 and 13-7, respectively.

SPT 'N'-values recorded within these granular deposits range between 31 blows per 0.3 m of penetration and 100 blows or greater per 0.03 m of penetration in the silt and sand to sand and gravel deposit and 31 blows per 0.3 m of penetration in the silty sand deposit, indicating a dense to very dense relative density.

The natural water content measured on samples of the silty sand to sand and gravel deposit range from about 1 per cent to 7 per cent.

The grain size distribution test result of one sample of the silt and sand deposit from Borehole 13-7 is shown on Figure C5 in Appendix C.

4.5.5 Silt and Sand to Sand Till

A till deposit consisting of silt and sand to sand, trace to some gravel, trace to some clay, containing cobbles and boulders, was encountered below the cohesive fill deposit in Borehole 13-5, below the clayey silt deposit in Boreholes 13-6 and 13-8 and below the silty sand deposit in Borehole 13-10. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered between about 0.7 m and 1.4 m below ground surface (Elevations 107.7 m to 101.5 m) and its thickness was between 3.0 m and 4.8 m in Boreholes 13-10 and 13-8, respectively, where it was fully penetrated, and is 3.5 m and 4.8 m thick in Boreholes 13-5 and 13-6 where it was not fully penetrated.

SPT 'N'-values recorded within this till deposit range between 57 blows per 0.3 m of penetration and 100 blows per 0.08 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration, indicating that the silt and sand to sand till deposit has a very dense relative density.

The natural water content measured on samples of this till deposit range from about 4 per cent to 14 per cent.



Grain size distribution test results of five samples from this deposit are shown on Figure C6 in Appendix C.

Atterberg limits tests were carried out on three specimens of the silt and sand till deposit and measured liquid limits ranging from about 12 per cent to 14 per cent, plastic limits ranging from about 10 per cent to 11 per cent, and plasticity indices ranging from about 2 per cent to 3 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C7 in Appendix C and indicate that the fines portion of this deposit consist of a silt of slight plasticity.

4.5.6 Clayey Silt Till

A till deposit consisting of brown to grey clayey silt with sand to trace sand, trace to some gravel, was encountered below the sand and gravel in Borehole 13-7, below the topsoil in Boreholes 13-9 and 13-11 and below the silt and sand to sand till in Boreholes 13-8 and 13-10. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered between about 0.4 m and 6.2 m below ground surface (Elevation 109.3 m to 99.4 m) and the deposit is between 1.6 m and 4.3 m thick but was not fully penetrated in any of the boreholes to depths of up to 7.8 m below ground surface (Elevation 96.2 m).

SPT 'N'-values recorded within this till deposit range between 96 blows per 0.3 m of penetration and 100 blows per 0.05 m of penetration, indicating that the clayey silt till has a hard consistency.

The natural water content measured on samples of this till deposit range from about 4 per cent to 18 per cent.

The grain size distribution test results of six samples from this deposit are shown on Figure C8 in Appendix C.

Atterberg limits tests were carried out on seven specimens of the clayey silt till deposit and measured liquid limits ranging from about 13 per cent to 34 per cent, plastic limits ranging from about 9 per cent to 14 per cent and plasticity indices ranging from about 4 per cent to 20 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C9 in Appendix C and indicate that the material is classified as clayey silt of low plasticity.

4.5.7 Groundwater Conditions

In general, the samples taken in the boreholes were moist. Water levels observed in the boreholes during or upon completion of drilling range from about Elevation 104.7 m to 99.0 m, measured at depths between about 0.9 m and 3.7 m below ground surface. Boreholes 13-9 and 13-11 were dry upon completion of drilling.

It should be noted that the water levels measured during or on completion of drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.6 High Fill Area 4 –N/S-E Ramp - STA 9+610 to STA 9+740

The plan and profile along the centreline of the new Highway 401/Holt Road N/S-E Ramp alignment showing the borehole locations and interpreted stratigraphy between about STA 9+610 and STA 9+740 are shown on Drawing D1 in Appendix D. The proposed ramp embankment will be up to about 7 m high relative to existing grade. A total of four (4) boreholes (Boreholes 13-15 to 13-18) were completed to investigate the subsurface



conditions within this high fill area. The topography of this section of proposed ramp is generally flat and low-lying, encompassing a wet grassy area and the existing South Service Road alignment.

In general, the subsurface soils along the new N/S-E Ramp alignment in this area consist of a layer of topsoil underlain by deposits of sandy silt to sand and gravel fill and/or clayey silt fill, which are underlain by a clayey silt with sand till deposit or a silt and sand till deposit.

4.6.1 Topsoil

A 0.2 m to 0.4 m thick layer of topsoil was encountered at the ground surface in all of the boreholes advanced within this high fill area.

4.6.2 Sandy Silt to Sand and Gravel Fill

A granular fill deposit consisting of sandy silt, trace gravel to sand and gravel, trace to some silt, trace clay, trace organics, was encountered below the topsoil in Boreholes 13-18 and 13-17. The surface of this granular deposit was encountered at depths of 0.2 m and 0.3 m below ground surface (Elevation 109.8 m and 108.4 m) and its thickness is 1.9 m and 0.5 m in Boreholes 13-17 and 13-18, respectively.

SPT 'N'-values recorded within this granular fill deposit range between 16 blows and 58 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The natural water content measured on one sample of the sand and gravel portion of the fill deposit is 8 per cent.

4.6.3 Clayey Silt Fill

A fill deposit consisting of brown clayey silt, some sand to sandy, trace to some gravel, was encountered below the granular fill in Borehole 13-17, and below the topsoil in Boreholes 13-15 and 13-16. The surface of this deposit was encountered between about 0.4 m and 2.1 m below ground surface (Elevation 110.7 m to 107.9 m) and its thickness ranges from about 0.4 m to 1.0 m.

SPT 'N'-values recorded within this cohesive fill range between 13 blows and 28 blows per 0.3 m of penetration suggesting that the fill deposit has a stiff to hard consistency.

The natural water content measured on samples of this fill deposit range from about 14 per cent to 18 per cent.

The grain size distribution test results of three samples from this deposit are shown on Figure D1 in Appendix D.

Atterberg limits tests were carried out on three specimens of the clayey silt fill deposit and measured liquid limits ranging from about 22 per cent to 27 per cent, plastic limits ranging from about 10 per cent to 13 per cent, and plasticity indices ranging from about 9 per cent to 17 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D2 in Appendix D and indicate that the material is a clayey silt of low plasticity.

4.6.4 Sand and Gravel

A deposit of sand and gravel some silt, trace clay, containing cobbles and boulders, was encountered below the fill deposits in Borehole 13-17. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered at a depth of about 2.9 m below ground surface (Elevation 107.1 m) and its thickness is about 2.5 m.



SPT 'N'-values recorded within this granular deposit are 100 blows per 0.13 m of penetration and 100 blows per 0.05 m of penetration, indicating a very dense relative density.

The natural water content measured on a sample of this sand and gravel deposit is about 3 per cent.

4.6.5 Silt and Sand Till

A till deposit consisting of brown to grey silt and sand, trace to some clay, trace to some gravel, was encountered below the fill deposit in Borehole 13-18. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered at about 0.8 m below ground surface (Elevation 107.9 m) and it was not fully penetrated up to a depth of 4.6 m below ground surface (Elevation 104.1 m).

SPT 'N'-values recorded within this till deposit range between 32 blows per 0.3 m of penetration and 100 blows or greater per 0.05 m of penetration indicating a dense to very dense relative density.

The natural water content measured on samples of this till deposit range from about 5 per cent to 9 per cent.

Grain size distribution test results of two samples of the silt and sand till deposit are shown on Figure D3 in Appendix D.

Atterberg limits tests were carried out on two specimens of the silt and sand till deposit and measured liquid limits of 13 per cent and 15 per cent, plastic limits of 10 per cent, and plasticity indices of 3 per cent and 5 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D4 in Appendix D and indicate that the material is a slightly plastic silt.

4.6.6 Clayey Silt Till

A till deposit consisting of brown to grey clayey silt with sand, trace to some gravel, was encountered below the topsoil, sand and gravel, or fill deposits (where present) in Boreholes 13-15 to 13-17. The surface of this deposit was encountered between about 0.8 m and 5.4 m below ground surface (Elevation 109.7 m to 104.6 m) and it was not fully penetrated in any of the boreholes to depths of up to 7.7 m below ground surface (Elevation 102.4 m).

SPT 'N'-values recorded within this till deposit range between 54 blows per 0.3 m of penetration and 100 blows or greater per 0.1 m of penetration, suggesting a hard consistency.

The natural water content measured on samples of this till deposit range from about 5 per cent to 9 per cent.

Grain size distribution test results of seven samples of the clayey silt till deposit are shown on Figure D5 in Appendix D.

Atterberg limits tests were carried out on three specimens of the clayey silt till deposit and measured liquid limits ranging from about 14 per cent to 16 per cent, plastic limits of about 10 per cent, and plasticity indices ranging from 4 per cent to 6 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure D6 in Appendix D and indicate that the material is a clayey silt of low plasticity.



4.6.7 Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. Water levels observed in the boreholes during or upon completion of drilling range from about Elevation 108.2 m to 105.8 m, measured at depths between about 1.8 m and 4.3 m below ground surface. Borehole 13-18 was dry upon completion of drilling.

It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.7 High Fill Area 5 – N/S-W Ramp - STA 9+670 to STA 9+740

The plan and profiles along the centreline of the new Highway 401/Holt Road N/S-W Ramp alignment showing the borehole locations and interpreted stratigraphy between about STA 9+670 and STA 9+740 are shown on Drawing E1 in Appendix E. The proposed ramp embankment will be up to about 4 m high relative to existing grade. A total of three (3) boreholes (Boreholes 13-19 to 13-21) were completed to investigate the subsurface conditions within this high fill area. The topography of this section of proposed ramp is generally flat and low-lying, encompassing a farm field.

In general, the subsurface soils along the new N/S-W Ramp alignment in this area consist of a layer of topsoil underlain by a deposit of silty sand which is underlain by a silt and sand till deposit.

4.7.1 Topsoil

A 0.2 m to 0.3 m thick surficial layer of topsoil was encountered at the ground surface in all of the boreholes advanced within this high fill area.

4.7.2 Silty Sand

A granular deposit consisting of silty sand trace gravel, trace clay, trace organics (rootlets), was encountered below the topsoil in Boreholes 13-19 and 13-20. The surface of this deposit was encountered at depths of 0.3 m and 0.2 m below ground surface (Elevation 109.7 m and 108.9 m) and the deposit is 1.2 m and 0.5 m thick in Boreholes 13-19 and 13-20, respectively.

SPT 'N'-values recorded within this granular deposit range between 16 blows and 73 blows per 0.3 m of penetration, indicating that the silty sand deposit has a compact to very dense relative density.

The natural water content measured on one sample of this silty sand deposit is about 11 per cent.

4.7.3 Silt and Sand Till

A till deposit consisting of sand and silt, trace to some gravel, trace to some clay, was encountered below the silty sand deposit in Boreholes 13-19 and 13-20 and below the topsoil in Borehole 13-21. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered between about 0.2 m and 1.5 m below ground surface (between Elevations 108.5 m and 108.4 m) and the deposit is between 3.1 m and 5.5 m thick but was not fully penetrated in any of the boreholes advanced within this high fill area.



SPT 'N'-values recorded within this till deposit range between 27 blows per 0.3 m of penetration and 50 blows per 0.05 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration indicating that the sand and silt till deposit has a compact to very dense, but generally very dense, relative density.

The natural water content measured on samples of this till deposit range from about 4 per cent to 9 per cent.

The grain size distribution test results of six samples from this deposit are shown on Figure E1 in Appendix E.

Atterberg limits tests were carried out on two specimens of the sand and silt till deposit. One test indicated that the material is non-plastic and one test measured a liquid limit of 14 per cent, a plastic limit of 10 per cent, and a corresponding plasticity index of 4 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure E2 and on the Record of Borehole sheets in Appendix E and indicate that the fines material of the deposit consists of non-plastic silt to silt of slight plasticity.

4.7.4 Groundwater Conditions

In general, the samples taken in the boreholes were moist. The open boreholes were all noted to be dry upon completion of drilling to depths of up to 6.2 m (Elevation 102.9 m).

It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.8 High Fill Area 6 – W- N/S Ramp STA 11+550 to STA 11+580

The plan and profile along the centreline of the new Highway 401/Holt Road W-N/S Ramp alignment showing the borehole locations and interpreted stratigraphy between about STA 11+550 and STA 11+580 are shown on Drawing F1 in Appendix F. The proposed ramp embankment will be up to about 5.5 m high relative to existing grade. A total of two (2) boreholes (Boreholes 13-23 and 13-2) were completed to investigate the subsurface conditions within this high fill area. The topography of this section of proposed roadway is generally flat and low-lying, encompassing a wet grassy field with areas of shallow standing water near the existing Holt Road drainage ditches.

In general, the subsurface soils along the new ramp alignment in this area consist of asphalt at ground surface underlain by cohesive and non-cohesive fill which is underlain by a clayey silt till deposit at the borehole drilled through the existing Holt Road embankment and a layer of topsoil underlain by a deposit of clayey silt till at the toe of the embankment..

4.8.1 Asphalt

An approximately 150 mm thick layer of asphalt was encountered at ground surface in Borehole 13-2.

4.8.2 Sand Fill

A fill deposit consisting of brown sand, some gravel, trace silt was encountered below the asphalt in Borehole 13-2. The surface of this deposit was encountered at a depth of about 0.2 m below ground surface (Elevation 116.1 m) and its thickness is about 0.6 m.

The natural water content measured on one sample of this fill deposit is about 3 per cent.



4.8.3 Clayey Silt Fill

A fill deposit consisting of brown to grey clayey silt, some sand to sandy, trace to some gravel trace organics (rootlets), was encountered below the granular fill in Borehole 13-2. The surface of this deposit was encountered at a depth of about 0.8 m below ground surface (Elevation 115.5 m) and its thickness is about 4.8 m.

SPT 'N'-values recorded within the cohesive fill deposit range between 23 blows and 106 blows per 0.3 m of penetration suggesting that the clayey silt fill deposit has a very stiff to hard consistency.

The natural water content measured on two samples of this fill deposit are 13 per cent and 15 per cent.

The grain size distribution test results of two samples from this fill deposit are shown on Figure F1 in Appendix F.

An Atterberg limits test carried out on one specimen of the clayey silt fill deposit measured a liquid limit of about 20 per cent, a plastic limit of about 13 per cent, and a plasticity index of about 7 per cent. The result of the Atterberg limits test is shown on the plasticity chart on Figure F2 in Appendix F and indicates that the material is a clayey silt of low plasticity.

4.8.4 Topsoil

A 0.5 m thick surficial layer of topsoil was encountered at the ground surface in Borehole 13-23.

4.8.5 Clayey Silt Till

A till deposit consisting of brown to grey clayey silt with sand, trace to some gravel, was encountered below the topsoil or fill deposits (where present) in both of the boreholes advanced within this high fill section. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of this deposit was encountered at depths of about 0.5 m and 5.6 m below ground surface (Elevation 112.7 m and 110.7 m) and the thickness of the deposit is 5.7 m and 1.1 m in Boreholes 13-23 and 13-2, respectively, but the deposit was not fully penetrated in either borehole.

SPT 'N'-values recorded within this till deposit range between 36 blows per 0.3 m of penetration and 100 blows per 0.03 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration, suggesting that the clayey silt till deposit has hard a consistency.

The natural water content measured on samples of this till deposit ranges from about 5 per cent to 9 per cent.

The grain size distribution test results of three samples from this deposit are shown on Figure F3 in Appendix F.

Atterberg limits tests were carried out on two specimens of the clayey silt till deposit and measured liquid limits of about 14 per cent and 15 per cent, plastic limits of about 10 per cent, and plasticity indices of about 4 per cent and 5 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure F4 in Appendix F and indicate that the material is a clayey silt of low plasticity.

4.8.6 Groundwater Conditions

In general, the samples taken in the boreholes were moist to wet. The water levels observed in Boreholes 13-23 and 13-2 during or upon completion of drilling were at about Elevation 108.6 m, measured at depths of about 4.9 m and 7.3 m below ground surface in the respective boreholes.



It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.9 Deep Cut Area 7 – South Service Road STA 13+160 to STA 13+265

The plan and profile along the centreline of the new South Service Road alignment extending to the west of the new Holt Road alignment showing the borehole locations and interpreted stratigraphy between about STA 13+160 and STA 13+265 are shown on Drawing G1 in Appendix G. A cut up to about 9 m deep will be required to achieve the proposed roadway profile within this area. A total of three (3) boreholes (Boreholes 13-39 to 13-41) were completed to investigate the subsurface conditions within this cut area. The topography of this section of proposed roadway is relatively elevated compared to the adjacent land east and west of the proposed cut area. As described in Part C of the as built report for the Darlington Nuclear Power Plant (Ontario Hydro, 1981) this deep cut extends through a soil mound described to have been constructed primarily of “topsoil” stripped from other areas of the OPG site as part of the construction of the switch yard and tower pads in 1978 and 1979. No details are given in the report on the construction (i.e. method of placement, compaction, etc.) or soil classification of the “topsoil” mound.

In general, the subsurface soils along the new South Service Road alignment in the proposed cut area consist of a layer of topsoil underlain by a deposit of clayey silt fill, trace organics, which is underlain by a sand and silt to sandy silt till deposit.

4.9.1 Topsoil

A 0.4 m to 0.5 m thick surficial layer of topsoil was encountered at the ground surface in the three boreholes advanced within this deep cut area.

SPT ‘N’-values measured within the topsoil layer range from 8 blows to 13 blows per 0.3 m of penetration, suggesting a stiff consistency.

The natural water content measured on two samples of the topsoil layer are about 20 per cent and 22 per cent.

4.9.2 Clayey Silt Fill

A fill deposit consisting of clayey silt with sand, trace gravel, trace organics was encountered below the topsoil in all of the boreholes advanced within this cut area. The surface of this fill deposit was encountered at depths between about 0.4 m and 0.5 m below ground surface (between Elevations 130.5 m to 126.0 m) and the thickness of the deposit ranges from about 2.3 m to 3.9 m.

SPT ‘N’-values measured within this fill deposit range between 7 blows and 32 blows per 0.3 m of penetration, suggesting that the clayey silt fill deposit has a firm to hard consistency.

The natural water content measured on samples of the clayey silt fill deposit ranges from 18 per cent to 27 per cent with the higher moisture content indicative of observed higher organic content.

The grain size distribution test results of four samples from this deposit are shown on Figure G1 in Appendix G.

An Atterberg limits test was carried out on one specimen of the clayey silt fill deposit and measured a liquid limit of about 29 per cent, a plastic limit of about 17 per cent, and a plasticity index of about 12 per cent. The result of



the Atterberg limits test are shown on the plasticity chart on Figure G2 in Appendix G and indicate that the material is classified as a clayey silt of low plasticity.

4.9.3 Silt to Silt and Sand Till

A till deposit consisting of silt to sandy silt to silt and sand, trace to some gravel, trace to some clay, was encountered below the fill deposit in the three boreholes advanced within this cut area. The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of the till deposit was encountered at depths between about 2.7 m and 4.4 m below ground surface (between Elevations 123.7 m and 126.6 m) and the thickness of the deposit is between 3.5 m and 7.9 m but the deposit was not fully penetrated in any of the boreholes.

SPT 'N'-values measured within this till deposit range between 45 blows per 0.3 m of penetration and 100 blows per 0.13 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration, indicating that the silt to silt and sand till deposit has a dense to very dense, but generally very dense, relative density.

The natural water content measured on samples of this till deposit range from about 6 per cent to 15 per cent.

The grain size distribution test results of five samples from this deposit are shown on Figure G3 in Appendix G.

Atterberg limits tests were carried out on four specimens of the silt to silt and sand till deposit. One test indicates that the fines portion of the sample is non-plastic. Three tests measured liquid limits ranging from about 13 per cent to 19 per cent, plastic limits ranging from about 10 per cent to 15 per cent and plasticity indices ranging from about 1 per cent to 4 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure G4 in Appendix G and indicate that the fines portion of the till samples consists of silt of slight plasticity.

4.9.4 Groundwater Conditions

In general, the samples taken in the boreholes were moist. Water levels observed in the boreholes during or upon completion of drilling range from about Elevation 125.5 m to 120.3 m, measured at a depth ranging from about 5.5 m to 7.7 m below ground surface.

It should be noted that the water levels measured during or on completion of the drilling operations have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.10 Deep Cut Area 8 – South Service Road (Soil Disposal Mound), STA 11+850 to STA12+500

The plan and profile along the proposed cut side slope of the new South Service Road alignment showing the borehole locations and interpreted stratigraphy between about STA 11+850 and STA 12+500 are shown on Drawing H1, and various cross-sections through the cut area are shown on Drawing H2, in Appendix H. A cut of up to about 17 m deep will be required to achieve the proposed roadway profile within this area which is located within the soil disposal mound on OPG property. A total of fifteen (15) boreholes (Boreholes 13-24 to 13-38) were completed to investigate the subsurface conditions within this cut area.

With reference to the draft proposed South Service Road West (Solina Road to Park Road) realignment plan and typical cross sections provided by URS (Drawings 1 to 3, dated September 2013), the ground surface at the



crest of the existing OPG soil disposal mound parallel to the proposed cut ranges from about Elevation 125 m to Elevation 130 m with slope heights ranging from about 12 m to 17 m high relative to the ground surface along the existing South Service Road. The existing north facing slope of the soil disposal mound is inclined at 4 Horizontal to 1 Vertical (4H:1V) with 2 m wide benches located about every 5 metres vertical height.

As described in the as-built report for the Darlington Nuclear Power Plant (Ontario Hydro, 1981), the existing soil disposal mound consists of soil excavated for construction of the Darlington Nuclear Power facility. The as-built report indicates that the soil mound was constructed as a means of disposing of deleterious material or overburden not suited or required for construction or backfilling of structures. The proposed cut area for the South Service Road alignment is located along the northern portion of the soil disposal mound (i.e. north of the interface, as shown on Figure 1 of the as-built report) where interglacial soils (i.e. fine sand and silt) were deposited. The soil mound in this area was constructed by end dumping the interglacial soils and allowing the piles to air dry for 3 to 4 days, then levelling the piles into approximately 1 m thick lifts. During winter conditions the soil piles did not drain effectively due to freezing, and as a result the contractor was allowed to end-dump soil in approximately 3 m thick lifts. The as-built report indicates that compaction of the soil that was spread in 1 m thick lifts achieved approximately 88 per cent of the Standard Proctor Maximum Dry Density. The as-built report indicates that, during construction, water was observed to be continually flowing from the pile at the base of the north face and that boils at the top of the pile were occurring during soil placement. In order to control erosion caused by water seepage, shot-rock was placed at specified locations on the face of the soil disposal mound.

The ground cover on the existing soil disposal mound slope consists of grasses and small shrubs, with sparse small trees as observed during site visits in 2012 and during the recent borehole drilling in 2013. Areas of dense tree cover are present at the toe and base of the north facing slope and along the existing Waterfront Trail, parallel to and south of the existing South Service Road.

In general, the subsurface soils along the new South Service Road alignment in this area consist of a surficial fill deposit consisting of silt and sand to clayey silt with sand, containing interlayers/pockets of sand and silty clay throughout. The fill is generally underlain by a till deposit comprised of hard clayey silt with sand.

4.10.1 Topsoil

A 0.7 m and 0.5 m thick layer of dark brown topsoil was encountered at the ground surface in Boreholes 13-37 and 13-38, respectively.

The SPT 'N'-values measured within the topsoil layer are 34 blows and 9 blows per 0.3 m penetration, suggesting a stiff to hard consistency.

The natural water content measured on two samples of the topsoil layer are about 4 per cent and 11 per cent.

4.10.2 Fill (Soil Disposal Mound)

A deposit of fill was encountered from ground surface in Boreholes 13-24 to 13-36 and below the topsoil in Boreholes 13-37 and 13-38. The fill deposit is comprised of an heterogeneous mixture, pockets and layers of both cohesive and non-cohesive soils. The cohesive fill generally consists of clayey silt with sand and pockets of silty clay, and the non-cohesive fill generally consists of sandy silt to sand and silt to silty sand, trace to some gravel. In Borehole 13-29, a 0.8 m thick surficial layer of cobbles and boulders (rockfill) was encountered at the ground surface. Trace organics, were frequently encountered in the upper 1 m to 1.5 m depth of the fill and increased organic content (i.e. wood fragments) was encountered in Borehole 13-35. The overall thickness of



the fill deposit ranges from 1.4 m to greater than 17.2 m at the borehole locations, although several of the boreholes did not fully penetrate the fill mound.

The fill mound can be roughly described as consisting of an upper deposit of sandy silt to silt and sand to sand, underlain by an intermediate layer of clayey silt with sand and a lower layer of sandy silt, in places underlain by a lower layer of clayey silt to silty clay, as shown in the profile and cross-sections on Drawings H1 and H2 in Appendix H.

SPT 'N'-values recorded within the portions of the mound comprised of non-cohesive fill range between 7 blows per 0.3 m of penetration and 50 blows per 0.08 m of penetration, indicating that the non-cohesive fill deposits have a loose to very dense relative density, but typically a dense to very dense relative density. SPT 'N'-values recorded within the portion of the mound comprised of cohesive fill range between 6 blows per 0.3 m of penetration and 50 blows per 0.05 m of penetration, suggesting that the cohesive fill has firm to hard, but typically a hard consistency.

The natural water content measured on samples of the fill deposits range from about 4 per cent to 16 per cent for the non-cohesive fill and from about 8 per cent to 20 per cent for the cohesive fill. Moisture contents of 23 per cent and 50 per cent were measured on a pocket of silty clay and organics in Borehole 13-29 and 13-35 respectively.

The grain size distribution test results of sixteen samples from the non-cohesive portions of the fill deposit are shown on Figure H1 in Appendix H.

Two Atterberg Limits tests on samples of the sandy silt fill indicate a non-plastic condition on one sample and measured a liquid limit of about 15 per cent, a plastic limit of about 12 per cent and a plasticity index of about 3 per cent as presented on Figure H2 in Appendix H.

The grain size distribution test results of sixteen samples from the cohesive portions of the fill deposit are shown on Figure H3 in Appendix H.

Atterberg limits tests were carried out on eleven specimens of the cohesive fill deposit and measured liquid limits ranging from about 16 per cent to 38 per cent, plastic limits ranging from 9 per cent to 16 per cent and plasticity indices ranging from 2 per cent to 23 per cent. The results of the Atterberg limits tests on samples of the cohesive fill are shown on the plasticity chart on Figure H4 in Appendix H and indicate that the cohesive fill soils typically consist of clayey silt of low plasticity with two test results indicating silty clay (pockets) in Borehole 13-25 and 13-29 of intermediate plasticity.

A portion of the soil samples not tested for soil classification were combined and mixed thoroughly to create a bulk/composite sample of the overall fill deposit for Standard Proctor maximum dry density testing. The moisture content of the composite sample was about 11 per cent and the results of the Standard Proctor maximum dry density test indicate that the maximum dry density of the composite sample is 1,989 kg/m³ at an optimum moisture content of about 10 per cent. The results of the Standard Proctor maximum dry density test are shown on Figure H5 in Appendix H.

4.10.3 Clayey Silt Till

A till deposit consisting of brown to grey clayey silt with sand, trace to some gravel to gravelly, was encountered below the fill deposit in all of the boreholes that penetrated the soil disposal mound within this cut section



(Boreholes 13-24 to 13-29, 13-31, 13-35 and 13-38). The presence of cobbles and boulders within this deposit is inferred from grinding of augers as the boreholes were advanced. The surface of the till deposit was encountered between about 1.4 m and 14.6 m below ground surface (Elevation 109.4 m to 117.1 m) and the thickness of the deposit ranges from 1.1 m to 8 m but the deposit was not fully penetrated in any of the boreholes to depths of up to 18.7 m below ground surface (Elevation 101.7 m).

SPT 'N'-values recorded within the clayey silt till deposit range between 30 blows per 0.3 m of penetration and 50 blows per 0.05 m of penetration, but are generally greater than 100 blows per 0.3 m of penetration, suggesting that the clayey silt till has hard consistency.

The natural water content measured on samples of the till deposit range from about 6 per cent to 18 per cent.

Grain size distribution test results of eight samples from the clayey silt till deposit are shown on Figure H6 in Appendix H.

Atterberg limits tests were carried out on three specimens of the clayey silt till deposit and measured liquid limits ranging from about 16 per cent to 17 per cent, plastic limits range from about 10 per cent to 12 per cent and plasticity indices ranging from about 5 per cent to 6 per cent. The results of the Atterberg limits tests are shown on the plasticity chart on Figure H7 in Appendix H and indicate that the material is classified as clayey silt of low plasticity.

4.10.4 Groundwater Conditions

The groundwater level within Deep Cut Area 8 ranges from about Elevation 121 m at the east limit of the soil disposal mound to about Elevation 117 m at the west limit of the soil disposal mound based on the recorded water level measurements in the monitoring wells by Ecoplans in January 2010 as presented below, and based on water levels recorded in the open boreholes during Golder's 2013 geotechnical investigation (as noted on the Record of Borehole sheets in Appendix H). The groundwater level near the toe of the north facing slope of the disposal mound (i.e. adjacent to the existing South Service Road) ranges from about Elevation 118 m at the east limit to about Elevation 112 m at the west limit of the mound based on the recorded water level measurements in January 2010 taken by Ecoplans. The water levels measured in the monitoring wells by Ecoplans suggest that groundwater has "perched" or stabilized within the soil disposal mound up to about 5 m higher than the groundwater level measured in the surrounding grade.

Monitoring Well ID*	Measurements by Ecoplans (January 2010)	Measurements by Golder (July 2013)
MW1S	115.3	116.5
MW1D	116.7	115.0
MW2S	118.7	118.6
MW2D	118.8	118.8
MW3S	120.5	120.3
MW3D	120.5	120.3
MW4	118.5	118.3
MW5	114.3	114.2
MW6	112.1	112.8

*Water level readings in monitoring wells installed by Ecoplans (2010)



FOUNDATION INVESTIGATION AND DESIGN REPORT HIGHWAY 401/HOLT ROAD INTERCHANGE -DEEP CUTS AND HIGH FILLS

It should be noted that the water levels measured during or on completion of the drilling operations (i.e. the water levels shown on the Record of Boreholes in Appendix H) have not stabilized and do not accurately reflect the groundwater table elevation at this site. Further, the water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season and periods of precipitation.

4.11 Analytical Testing

Soil cuttings from the boreholes drilled on OPG property (i.e. Deep Cut Areas 7 and 8) were contained in steel drums which were temporarily stored on-site while analytical testing was completed to categorize the soil for disposal purposes.

Three composite soil samples collected from the drums containing the soil cuttings were tested for the suite of metals noted in Schedule 4 of MOE's Registration Guidance Manual for Generators of Liquid Industrial and Hazardous Waste (MOE, June 2011) using the Toxicity Characteristic Leaching Procedure (TCLP) Regulation 558. The samples were submitted to AGAT Laboratories in Mississauga, Ontario for TCLP analyses of metals.

Based on the results of the chemical analyses (as shown in Appendix I), the samples tested meet the current MOE Schedule 4 standards for the metals selected for testing, and the soil samples are be classified as non-toxic based on the TCLP quality criteria.

Following the receipt of the analytical results which are included in Appendix I the soil drums were removed from OPG property by Detox Environmental Services Inc. for disposal,

5.0 CLOSURE

This report was prepared by Mr. Matthew Kelly, P.Eng., a Geotechnical Engineer with Golder and reviewed by Mr. Kevin Bentley, P.Eng. Mr. Jorge M.A. Costa, P.Eng., Golder's MTO's Designated Contact for this project conducted an independent quality control review of this report.

GOLDER ASSOCIATES LTD.

Matthew Kelly, P.Eng.,
Geotechnical Engineer

Kevin Bentley, P.Eng.,
Geotechnical Engineer, Associate

Jorge, M. A. Costa, P.Eng.,
Designated MTO Foundations Contact, Principal
MWK/KJB/JMAC/jj

n:\active\2009\1111\09-1111-0019 urs - hwy 401 holt rd - clarington\reporting\detail design\deep cuts and high fills\final\part a only\09-1111-0019 fir 14feb11 holt road_cuts and fills .docx



REFERENCES

Bowles, J. E., 1984. *Physical and Geotechnical Properties of Soils*, Second Edition. McGraw Hill Book Company, New York.

Chapman, L. J., and Putnam, D.F., 1984. *The Physiography of Southern Ontario*, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

Ecoplans. *Phase II Environmental Site Assessment, OPG Darlington Soil Mound, Darlington Nuclear Site, Town of Clarington, Ontario*. July, 2010

Karrow, P. F., and White, O. L., 1998. *Urban Geology of Canadian Cities*. Geological Association of Canada Special Paper No. 42. St. John's, Nfld.

Ontario Geological Society, 1991. *Geology of Ontario*. Special Volume 4, Part 1. Eds. P.C. Thurston, H. R. Williams, R. H. Sutcliffe and G. M. Stott. Ministry of Northern Development and Mines, Ontario.

Ontario Hydro, *Darlington G.S. 'A' as Built Report For: Disposal Mound, Earth Embankment, Switchyard and Tower Pads, Principal Soil Excavation Areas*. Report No. 81212. May 29, 1981

Ontario Water Resources Act

Ontario Regulation 372/97 Amendment to Ontario Regulation 903

Ontario Regulation 903/90 Wells

ASTM International

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

CONT No.
GWP No.2101-08-00

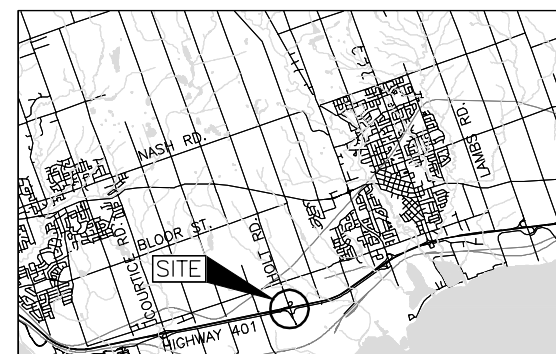
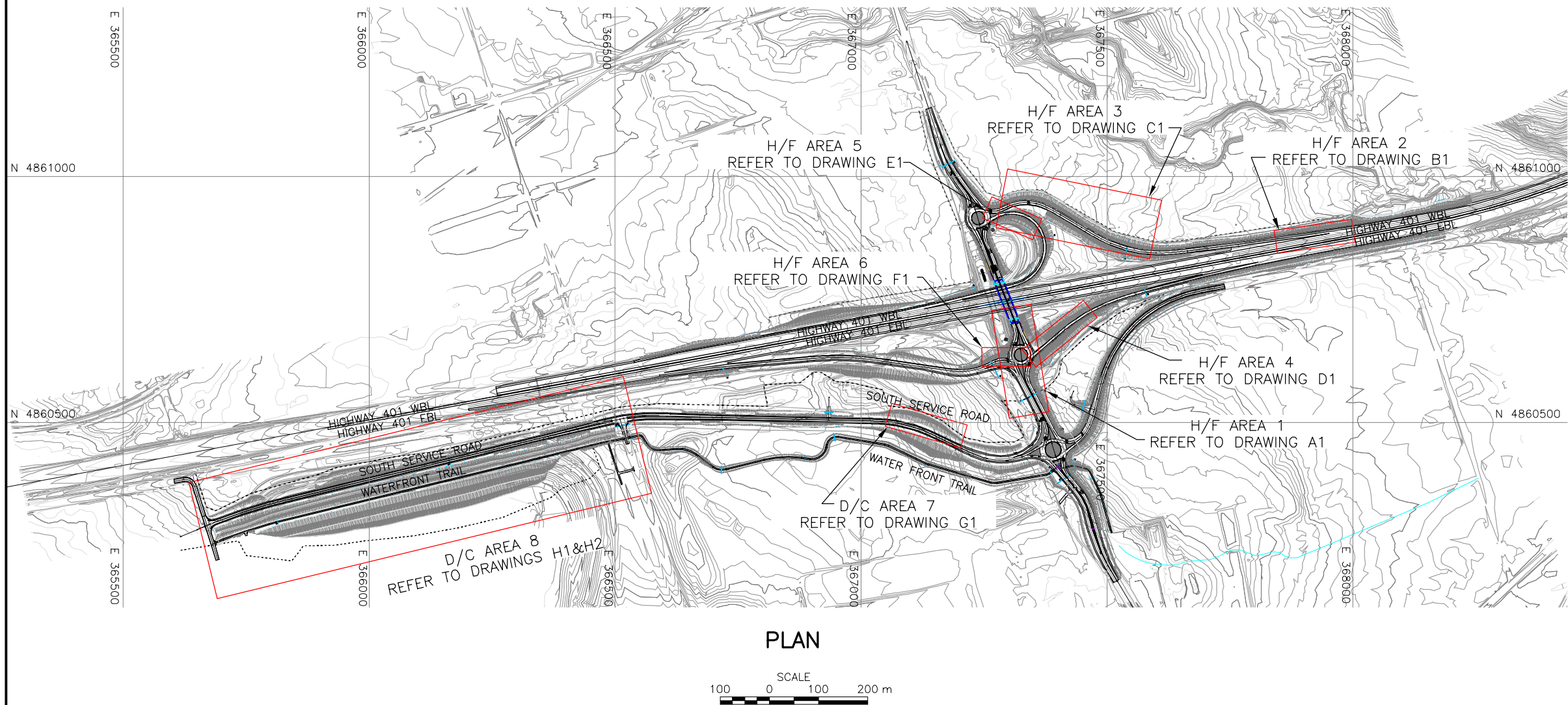


HIGHWAY 401/HOLT ROAD
INTERCHANGE RECONFIGURATION
INDEX PLAN

SHEET




Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



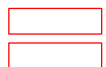
KEY PLAN

SCALE

2 4 km



LEGEND



H/F High Fill Area

D/C Deep Cut Area

NOTES

This drawing is for general information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The complete Foundation Investigation Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no.
2013-10-24-Hwy401-HoltRd_plan.dwg, received October 23, 2013

NO.	DATE	BY	REVISION	
Geocres No. 30M15-158				
HWY. 401		PROJECT NO. 09-1111-0019		DIST.
SUBM'D.		CHKD. MWK	DATE: Oct. 2013	SITE: 21-159
DRAWN: JFC		CHKD. KJD	APPD. JMCA	DWG. 1



LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a)	Index Properties
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Density Index	N
Relative Density	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	C_u, S_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

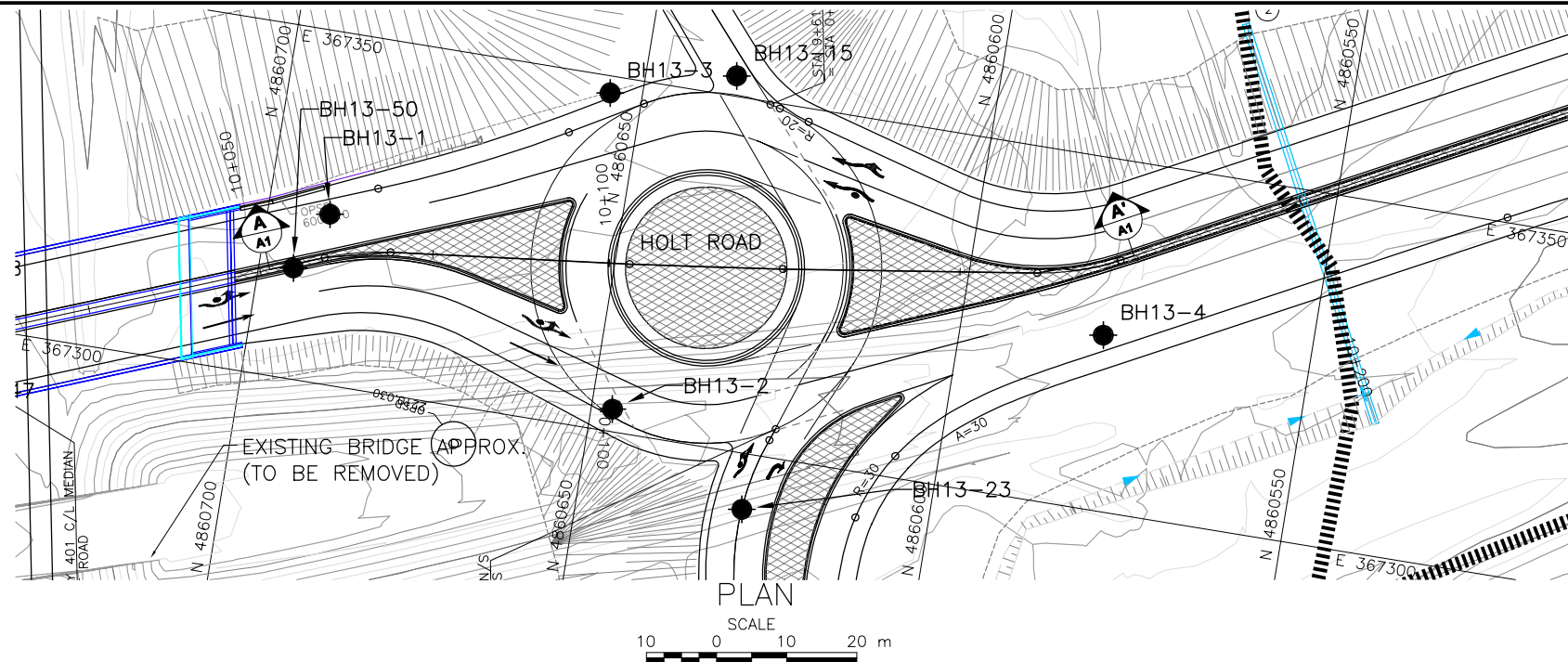
V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand



APPENDIX A

High Fill Area 1 - Holt Road, STA 10+050 to 10+170



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2101-08-00

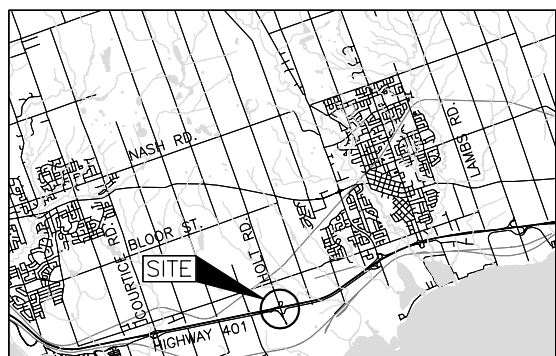


HIGHWAY 401
HIGH FILL AREA 1-HOLT ROAD
(STA 10+050 TO 10+170)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- ≡ WL during or upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-1	111.0	4860691.2	367324.1
BH13-2	116.3	4860647.0	367303.2
BH13-3	110.9	4860654.6	367347.6
BH13-4	113.5	4860579.7	367324.9
BH13-15	111.1	4860637.2	367352.9
BH13-23	113.2	4860626.5	367292.1
BH13-50	111.0	4860695.1	367315.7

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

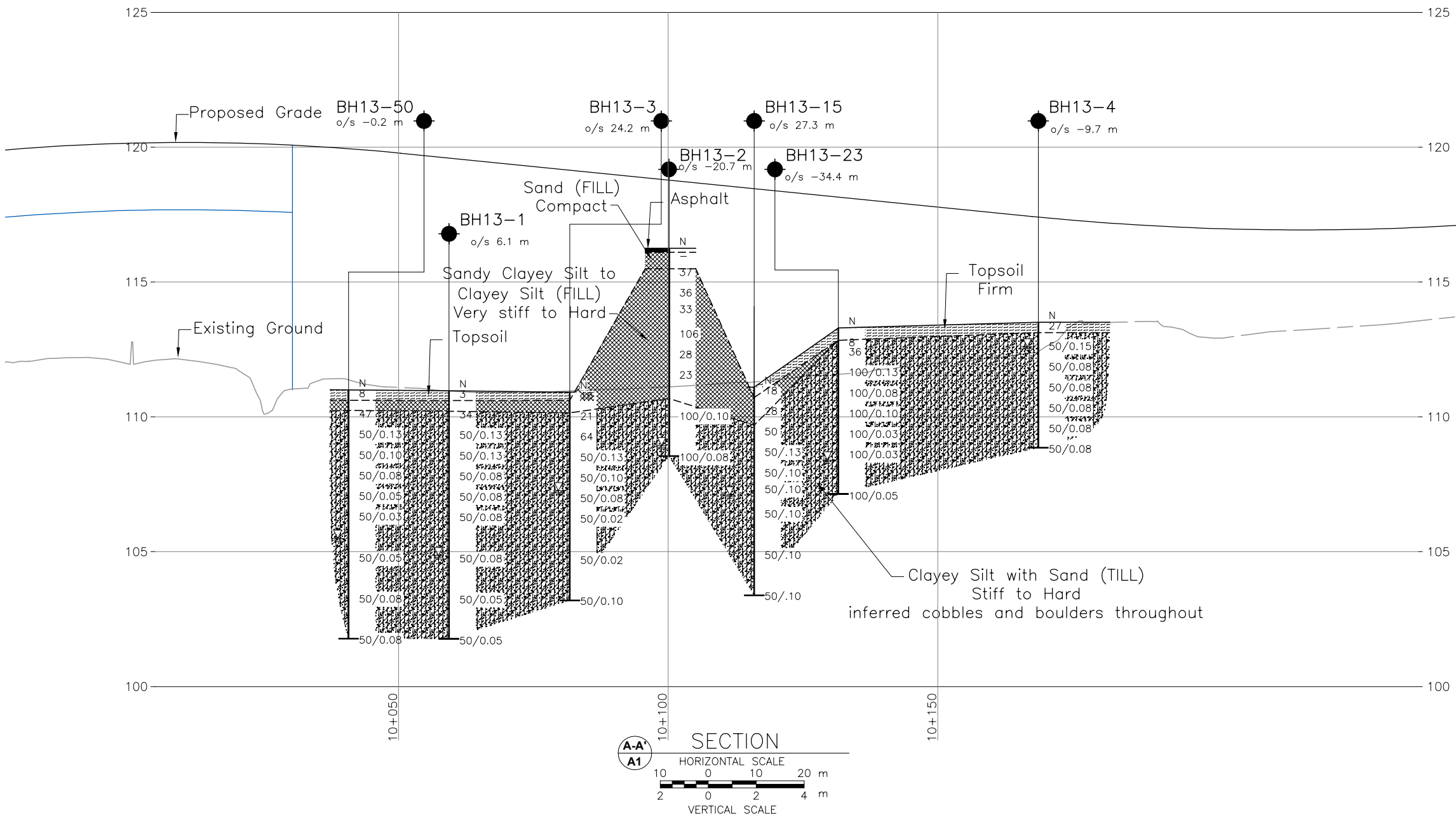
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg and 2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013

NO.	DATE	BY	REVISION
Geores No. 30M15-158			
HWY. 401		PROJECT NO. 09-1111-0019	
SUBM'D.		CHKD. MWK	DATE: Oct. 2013
DRAWN: JFC		CHKD. KJB	SITE: 21-159
		APPD. JMAC	DWG. A1



PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-1		SHEET 1 OF 1		METRIC	
G.W.P. 2101-08-00		LOCATION N 4860691.2 ; E 367324.1		ORIGINATED BY JLC			
DIST _____ HWY 401		BOREHOLE TYPE 120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY BM			
DATUM Geodetic		DATE May 27, 2013		CHECKED BY MWK			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT 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 (%)				GR	SA	SI	CL
								20	40	60	80	100	w _p	w	w _L					
111.0	GROUND SURFACE																			
0.0	TOPSOIL		1	SS	3															
110.6																				
110.2	Clayey silt, some sand, trace gravel (FILL) Brown Moist		2	SS	34															
0.8	CLAYEY SILT with SAND to some sand, trace to some gravel, inferred cobbles throughout (TILL) Hard Brown to grey Moist		3	SS	50/0.13												3	15	49	33
			4	SS	50/0.13												12	39	37	12
			5	SS	50/0.08															
			6	SS	50/0.08															
			7	SS	50/0.08															
			8	SS	50/0.08															
			9	SS	50/0.05															
			10	SS	50/0.05															
101.8	END OF BOREHOLE																			
9.2	NOTES: 1. Water level at a depth of 6.1 m below ground surface (Elev. 104.9 m) upon completion of drilling. 2. Borehole caved to a depth of 6.1 m below ground surface (Elev. 104.9 m) upon completion of drill																			

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT		RECORD OF BOREHOLE		No BH13-2		SHEET 1 OF 1		METRIC								
G.W.P. 09-1111-0019		LOCATION		N 4860647.0 ; E 367303.2		ORIGINATED BY		JLC								
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY								
DATUM		Geodetic		DATE		May 30, 2013		CHECKED BY								
								MWK								
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								
116.3	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
0.2	Sand, some gravel, trace silt (FILL)		1	AS	-											
115.5	Brown Moist		2	SS	37											
0.8	Sandy clayey silt to clayey Silt, some sand, trace to some gravel, trace organics and containing rootlets (FILL)		3	SS	36											
	Very stiff to hard Brown to grey Moist		4	SS	33											
			5	SS	106											
			6	SS	28											
			7	SS	23											
110.7																
5.6	CLAYEY SILT with SAND trace to some gravel, inferred cobbles throughout (TILL)		8	SS	100/0.10											
	Hard Grey Wet															
108.6																
7.7	END OF BOREHOLE		9	SS	100/0.08											
NOTES:																
1. Water level at a depth of 7.3 m below ground surface (Elev. 109.0 m) during drilling.																
2. Borehole caved at a depth of 7.6 m below ground surface (Elev. 108.7 m) upon completion of drilling.																

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-3		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860654.6 ; E 367347.6</u>		ORIGINATED BY <u>JLC</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>120 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>May 28, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT 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 (%)					
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED									
110.9	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL		1	SS	16													
110.6																		
0.3	Clayey silt, some sand, trace to some gravel (FILL) Very stiff Brown Moist		2	SS	21													
110.1																		
0.8	CLAYEY SILT with SAND, trace to some gravel, inferred cobbles and boulders at 4.6 m depth (TILL) Very stiff to hard Brown to grey Moist		3	SS	64													
			4	SS	50/0.13													
			5	SS	50/0.10													
			6	SS	50/0.08													
			7	SS	50/0.02													
	Augers grinding on inferred cobbles and boulders		8	SS	50/0.02													
			9	SS	50/0.10													
103.2																		
7.7																		

PROJECT		RECORD OF BOREHOLE		No BH13-4		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860579.7 ; E 367324.9		ORIGINATED BY		JLC									
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY									
DATUM		Geodetic		DATE		May 27, 2013		CHECKED BY									
								MWK									
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									
113.5	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL							20	40	60	80	100					
113.1			1	SS	27		113										
0.4	CLAYEY SILT with SAND trace gravel, inferred cobbles and boulders (TILL) Hard Brown to grey Moist		2	SS	50/0.15		112										16 38 34 12
			3	SS	50/0.08		111										9 43 38 10
	Augers grinding on inferred cobbles and boulders between depths of 2.13 m and 4.6 m		4	SS	50/0.08		110										
			5	SS	50/0.08		109										
	Augers grinding on inferred cobbles and boulders at a depth of 3.8 m		6	SS	50/0.08												
108.9	END OF BOREHOLE		7	SS	50/0.08												
4.7	NOTES: 1. Water level at a depth of 0.9 m below ground surface (Elev. 112.6 m) during drilling. 2. Borehole caved to a depth of 3.4 m below ground surface (Elev. 110.1 m) upon completion of drilling.																

PROJECT		09-1111-0019		RECORD OF BOREHOLE No BH13-15		SHEET 1 OF 1		METRIC						
G.W.P.		2101-08-00		LOCATION		N 4860637.2 ; E 367352.9		ORIGINATED BY JLC						
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY BM						
DATUM		Geodetic		DATE		May 31, 2013		CHECKED BY MWK						
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						
111.1	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	TOPSOIL		1	SS	18									
110.7														
0.4	Sandy clayey silt, trace gravel (FILL) Very stiff Brown Moist		2	SS	28									4 24 43 29
109.7														
1.4	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders at 4.6 m depth (TILL) Hard Brown to grey Moist		3	SS	50									
			4	SS	50/13									4 39 42 15
			5	SS	50/10									
			6	SS	50/10									
			7	SS	50/10									
			8	SS	50/10									
			9	SS	50/10									
103.4	END OF BOREHOLE													
7.7	NOTES: 1. Water level at a depth of 4.0 m below ground surface (Elev. 107.1 m) upon completion of drilling. 2. Borehole caved to a depth of 7.2 m below ground surface (Elev. 103.9 m) upon completion of drill													

PROJECT		RECORD OF BOREHOLE		No BH13-23		SHEET 1 OF 1		METRIC						
G.W.P. 09-1111-0019		LOCATION		N 4860626.5 ; E 367292.1		ORIGINATED BY		JLC						
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY						
DATUM		Geodetic		DATE		May 30, 2013		CHECKED BY						
								MWK						
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						
113.2	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	TOPSOIL													
112.7	Firm													
0.5	Dark brown Moist		1	SS	8		113							
	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders throughout (TILL)		2	SS	36		112							
	Hard		3	SS	100/0.13									20 47 22 11
	Brown to grey Moist		4	SS	100/0.08		111							
			5	SS	100/0.10		110							3 43 37 17
			6	SS	100/0.05		109							
			7	SS	100/0.05		108							
107.1	END OF BOREHOLE		8	SS	100/0.05		107							
6.2	NOTE: 1. Water level in open borehole at a depth of 4.9 m below ground surface (Elev. 108.3 m) upon completion of drilling.													

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-50		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860695.0 ; E 367316.0</u>		ORIGINATED BY <u>JLC</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>120 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>May 27, 2013</u>		CHECKED BY <u>MWK</u>			

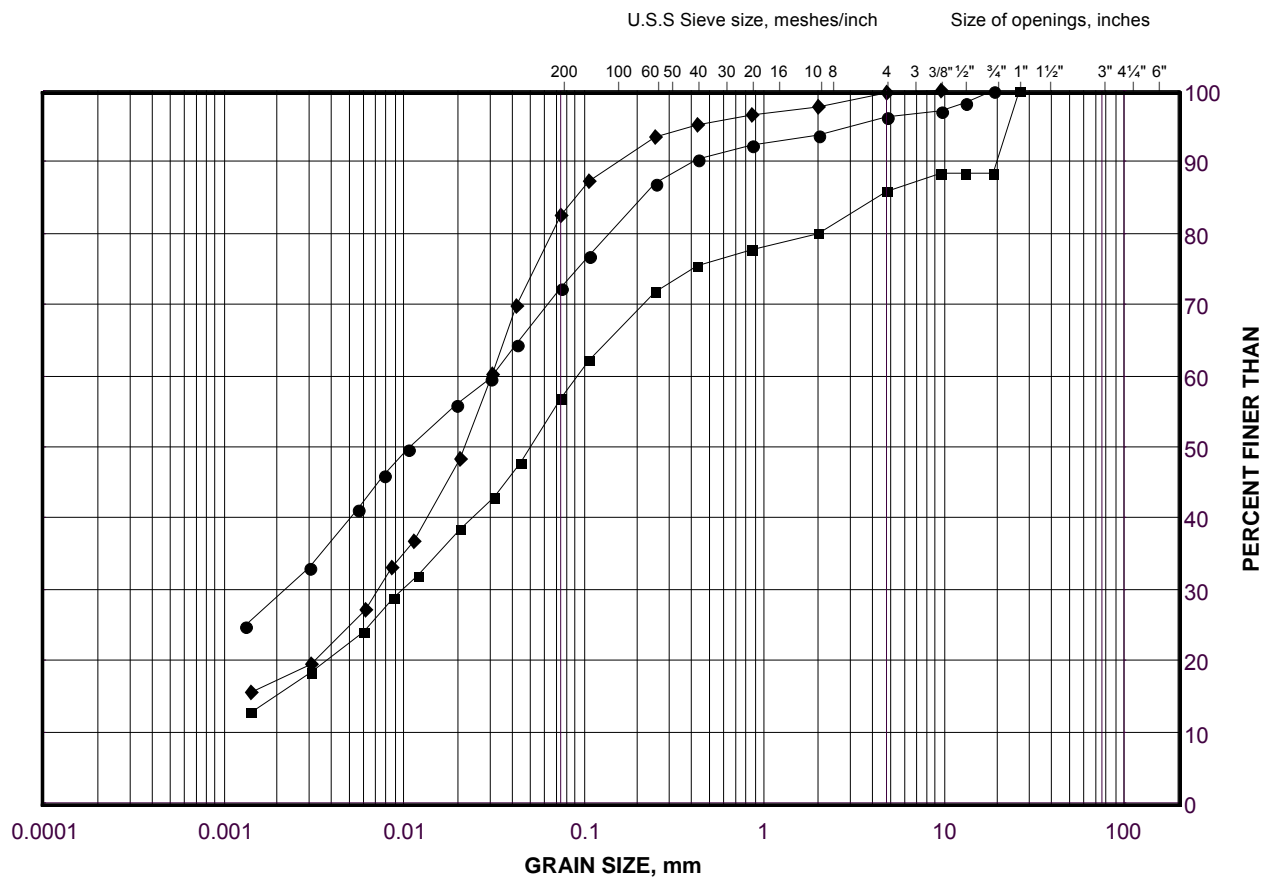
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	w _p	w	w _L	GR						SA
111.0	GROUND SURFACE							20	40	60	80	100									
0.0	TOPSOIL		1	SS	8																
110.6	Loose Brown Moist																				
110.2	Clayey silt, some sand, trace gravel, trace organics (FILL) Dark brown Moist		2	SS	47		110							○				5	37	41	17
0.8	CLAYEY SILT with SAND, trace to some gravel, occasional silt seams (TILL) Hard Brown to grey Moist		3	SS	50/0.13		109							○				2	39	44	15
			4	SS	50/0.10		108							○							
			5	SS	50/0.08		107							○				10	42	35	13
			6	SS	50/0.06		106														
			7	SS	50/0.03		105							○	H						
			8	SS	50/0.05		104							○	H						
			9	SS	50/0.08		103							○							
			10	SS	50/0.08		102							○							
101.8	END OF BOREHOLE																				
9.2	NOTES: 1. Water level at a depth of 5.5 m below ground surface (Elev. 105.5 m) during drilling. 2. Borehole caved to a depth of 6.1 m below ground surface (Elev. 104.9 m) upon completion of drilling.																				

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

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt Fill

FIGURE A1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

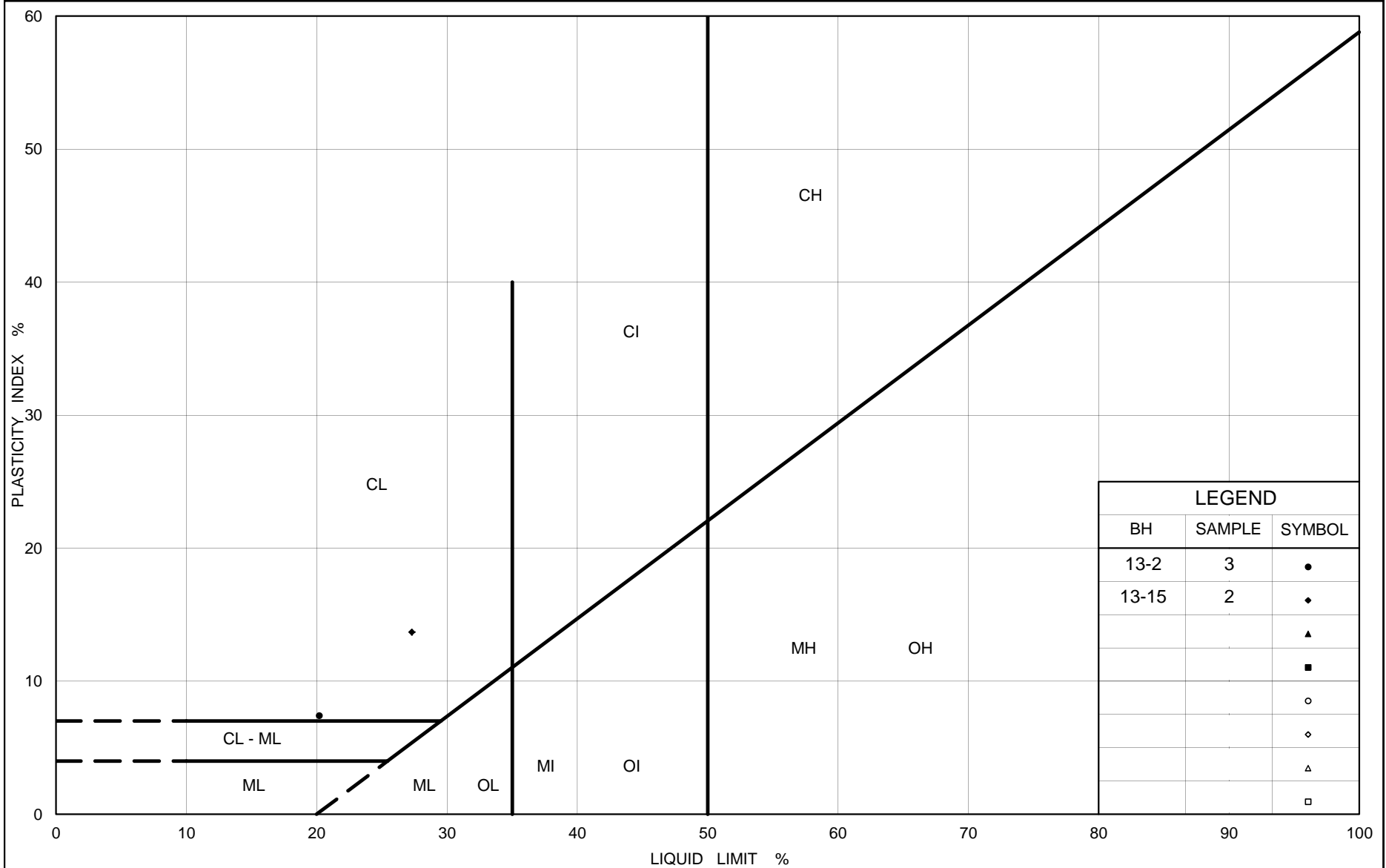
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-15	2	110.1
■	13-2	3	114.5
◆	13-2	5	113.0

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. A2

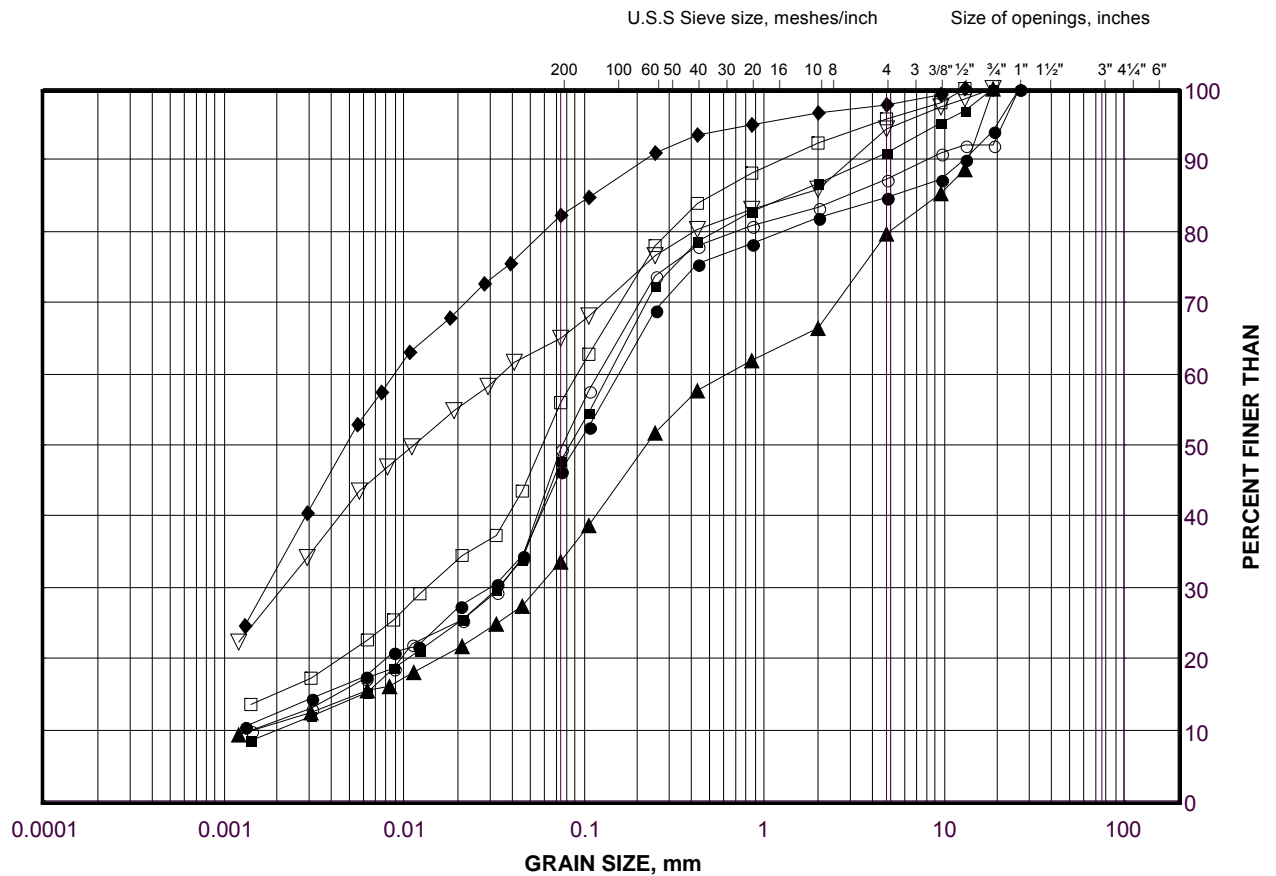
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE A3A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-4	2	112.7
■	13-4	3	111.9
◆	13-1	3	109.4
▲	13-23	3	111.6
▽	13-3	3	109.2
○	13-1	4	108.6
□	13-15	4	108.8

Project Number: 09-1111-0019

Checked By: _____

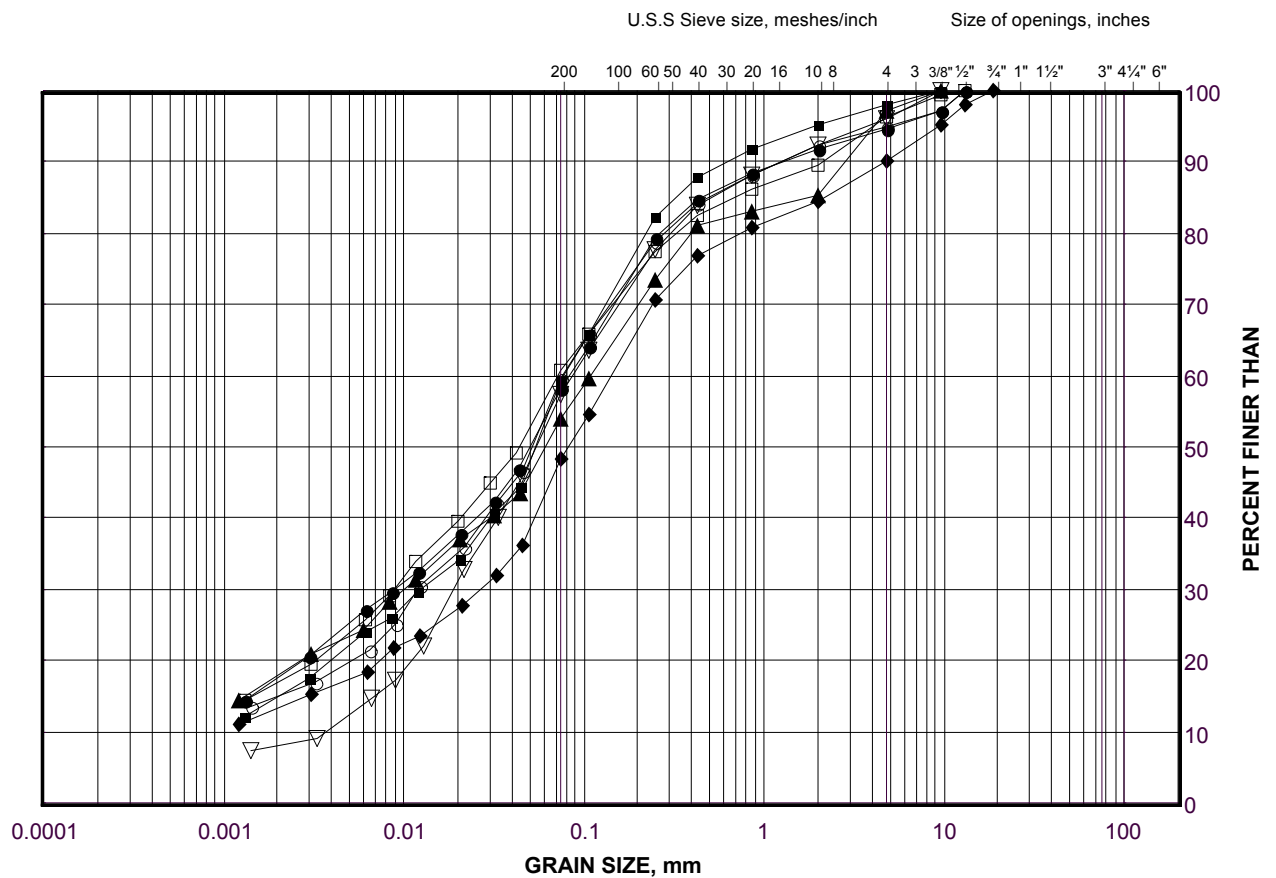
Golder Associates

Date: 06-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE A3B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

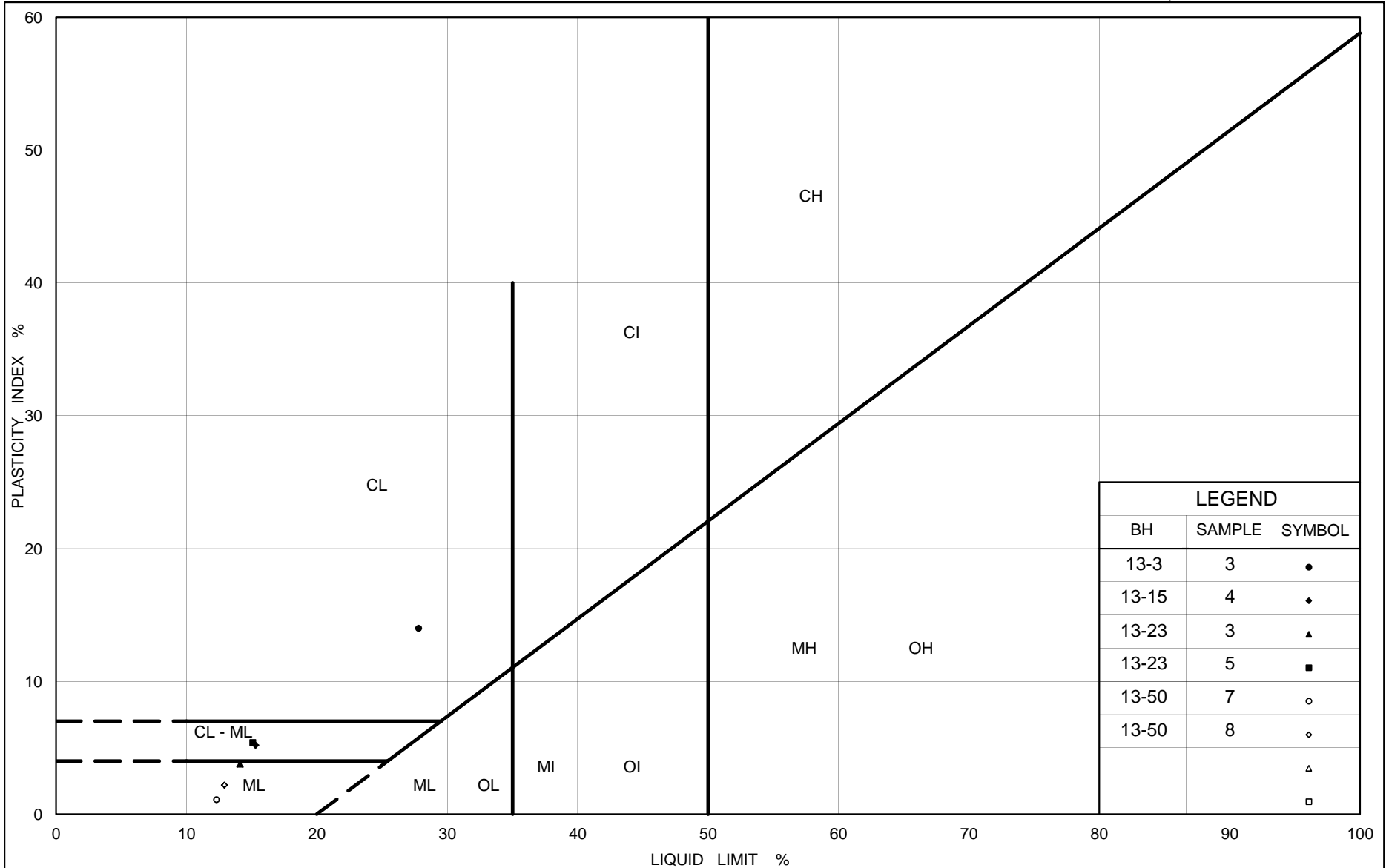
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-50	2	110.0
■	13-50	3	109.4
◆	13-50	5	107.9
▲	13-23	5	110.1
▽	13-3	7	106.4
○	13-2	8	110.1
□	13-3	9	103.2

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 12-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (TILL)

Figure No. A4

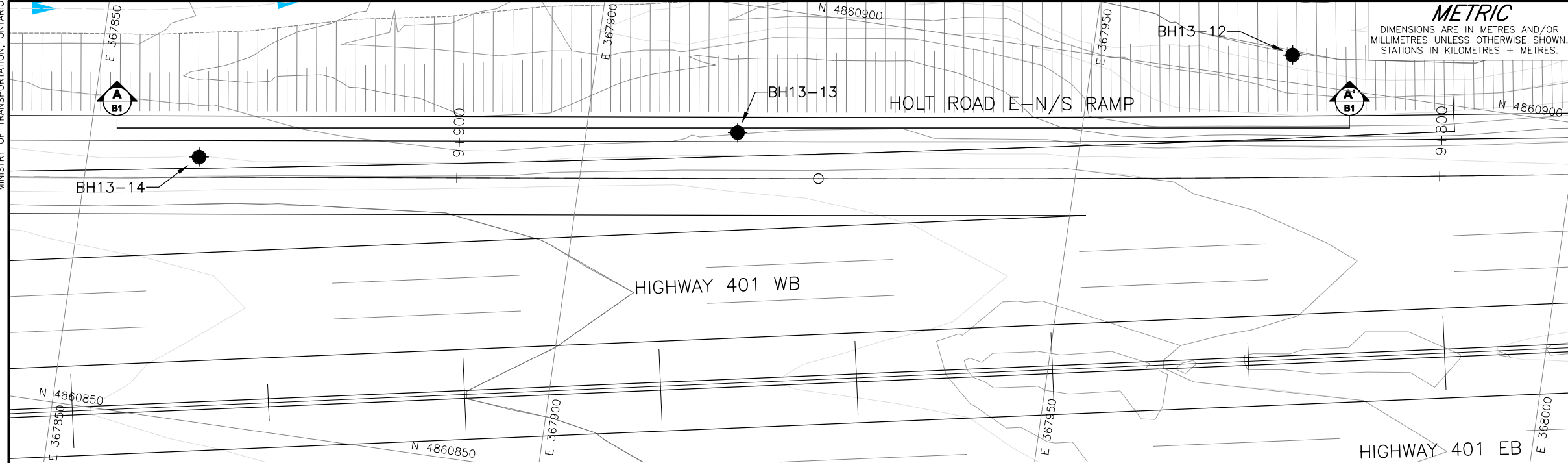
Project No. 09-1111-0019

Checked By:

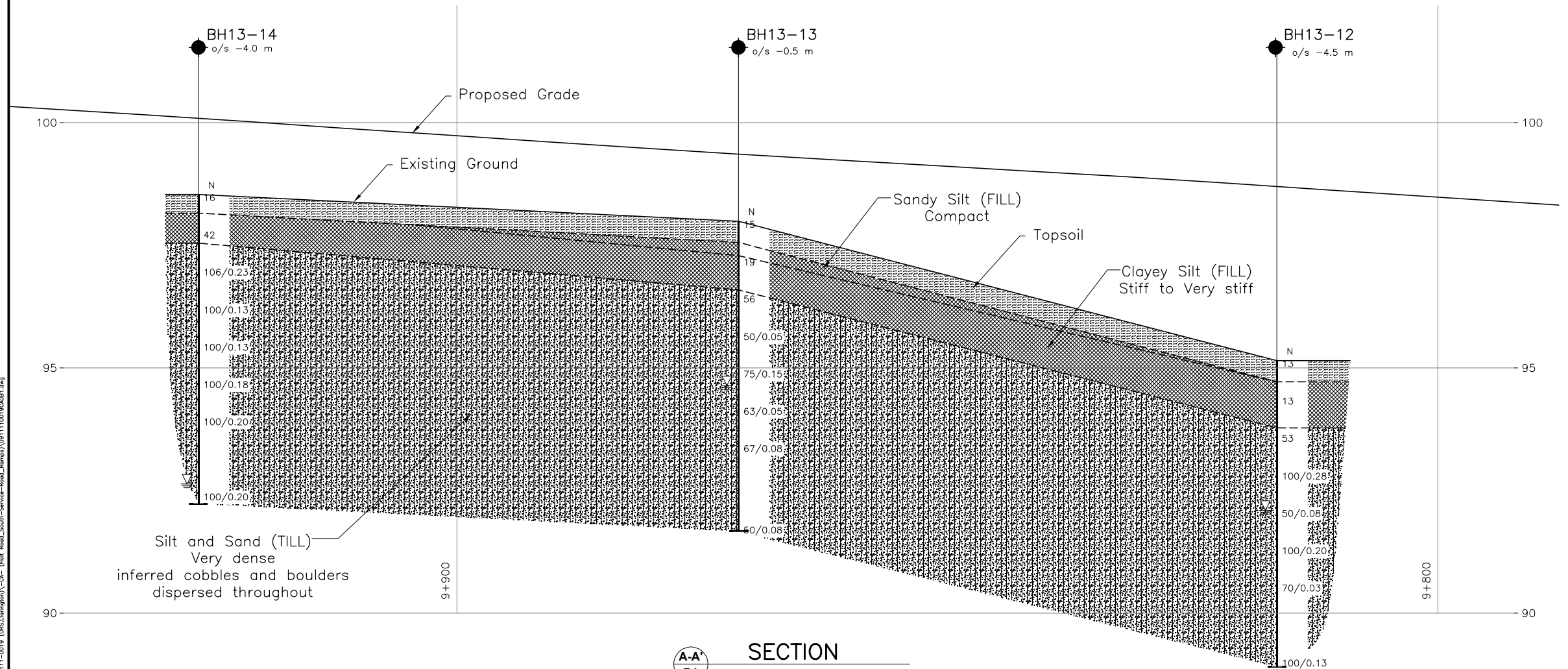


APPENDIX B

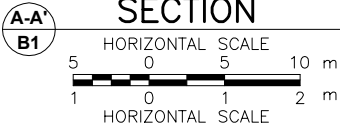
High Fill Area 2 - E-N/S Ramp, STA 9+850 to 9+970



PLAN



SECTION



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2101-08-00

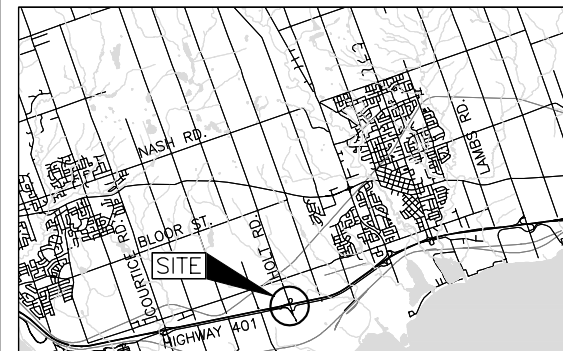


HIGHWAY 401
HIGH FILL AREA 2-HOLT ROAD E-N/S RAMP
(STA 9+850 TO 9+970)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- ≡ WL during or upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
BH13-12	95.1	4860902.8	367970.2
BH13-13	98.0	4860887.0	367915.3
BH13-14	98.5	4860876.8	367861.3

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg and 2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013

NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
HWY. 401	PROJECT NO. 09-1111-0019		DIST.
SUBM'D.	CHKD. MWK	DATE: Oct. 2013	SITE: 21-159
DRAWN: JFC	CHKD. KJB	APPD. JMAC	DWG. B1

PROJECT		RECORD OF BOREHOLE		No BH13-12		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860902.8 ; E 367970.2		ORIGINATED BY		JLC									
DIST _____ HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY		BM									
DATUM Geodetic		DATE		May 31, 2013		CHECKED BY		MWK									
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									
95.1	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL		1A	SS	13		95										
94.7			1B														
0.4	Clayey silt, some sand, trace gravel, containing organics (FILL) Stiff Brown Moist		2	SS	13		94										
93.7																	
1.4	SILT and SAND, trace to some gravel, trace to some clay, inferred cobbles and boulders throughout (TILL) Very dense Brown to grey Moist		3A	SS	53		93										
			3B														
			4	SS	100/0.28		92										
			5	SS	50/0.08		91										
			6	SS	100/0.20		90										
			7	SS	70/0.08		89										
88.9	END OF BOREHOLE		8	SS	100/0.13												
6.2	NOTES: 1. Water level at a depth of 3.0 m below ground surface (Elev. 92.1 m) during drilling. 2. Borehole caved at a depth of 4.9 m below ground surface (Elev. 90.2 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE		No BH13-13		SHEET 1 OF 1		METRIC								
G.W.P. 09-1111-0019		LOCATION		N 4860887.0 ; E 367915.3		ORIGINATED BY		JLC								
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY								
DATUM		Geodetic		DATE		May 31, 2013		CHECKED BY								
								MWK								
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								
98.0	GROUND SURFACE															
0.0	TOPSOIL															
97.6			1	SS	15											
97.3	Sandy silt, some gravel, trace clay, containing organics (FILL)															
0.7	Compact Dark brown Moist		2	SS	19											
96.6																
1.4	Clayey silt, some sand (FILL)															
	Very stiff Brown Moist		3	SS	56											
	SILT and SAND, some gravel, some clay, inferred cobbles and boulders throughout (TILL)		4	SS	50/0.05											
	Very dense Brown to grey Moist		5	SS	75/0.15											
			6	SS	63/0.05											
			7	SS	67/0.08											
91.7			8	SS	50/0.08											
6.3	END OF BOREHOLE															
NOTE:																
1. Water level at a depth of 3.4 m below ground surface (Elev. 94.6 m) during drilling.																

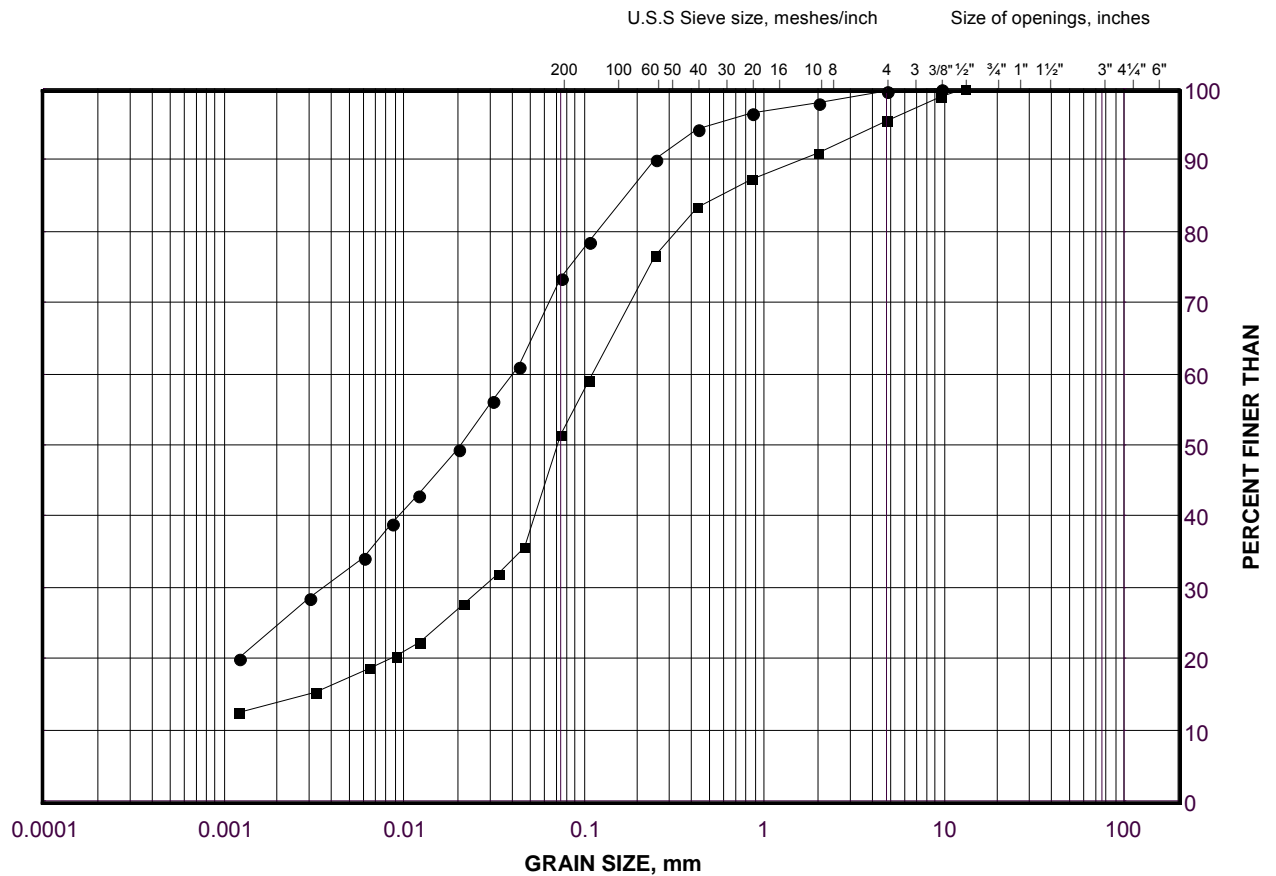
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTGTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE B1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

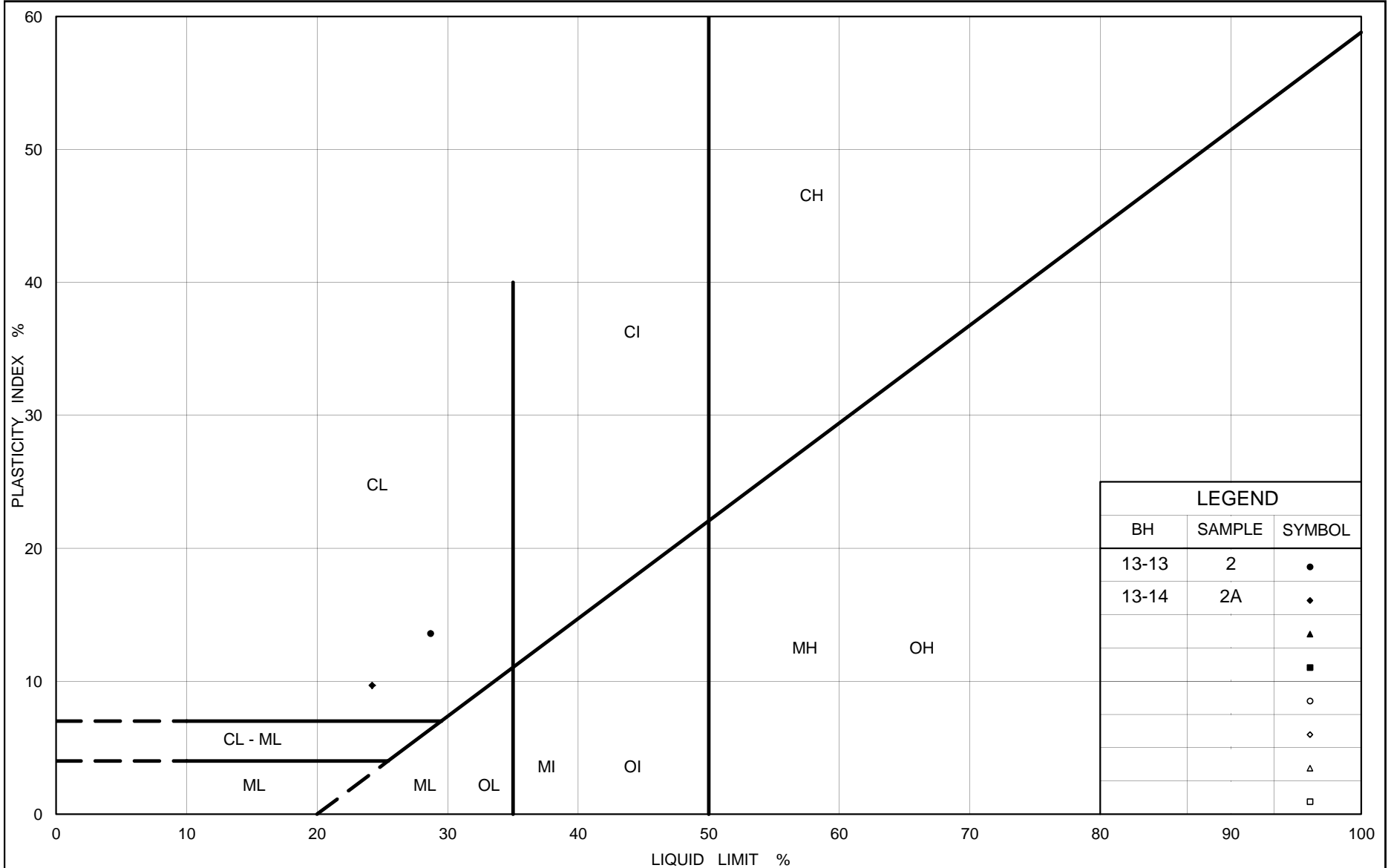
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-13	2	97.0
■	13-14	2A	97.7

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. B2

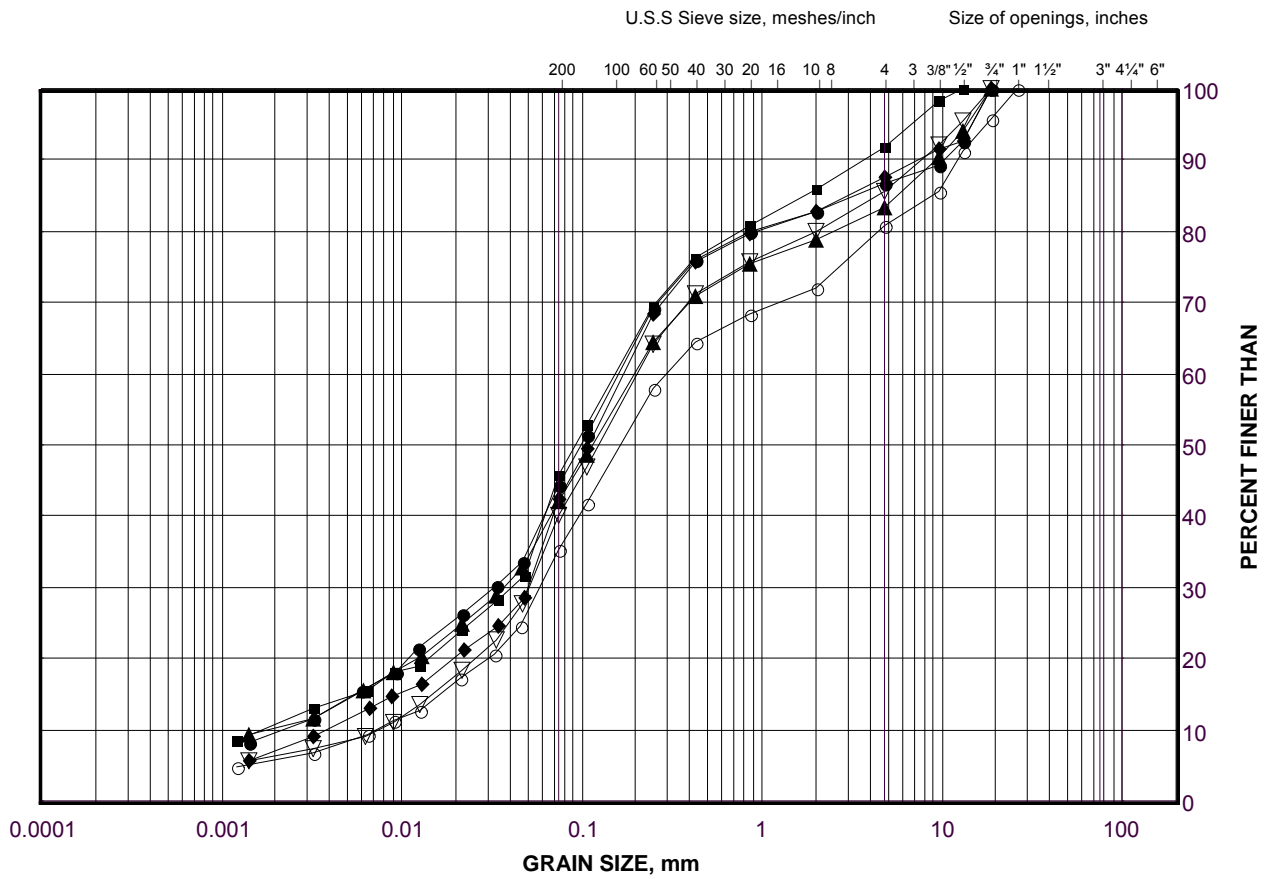
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silt and Sand (TILL)

FIGURE B3



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

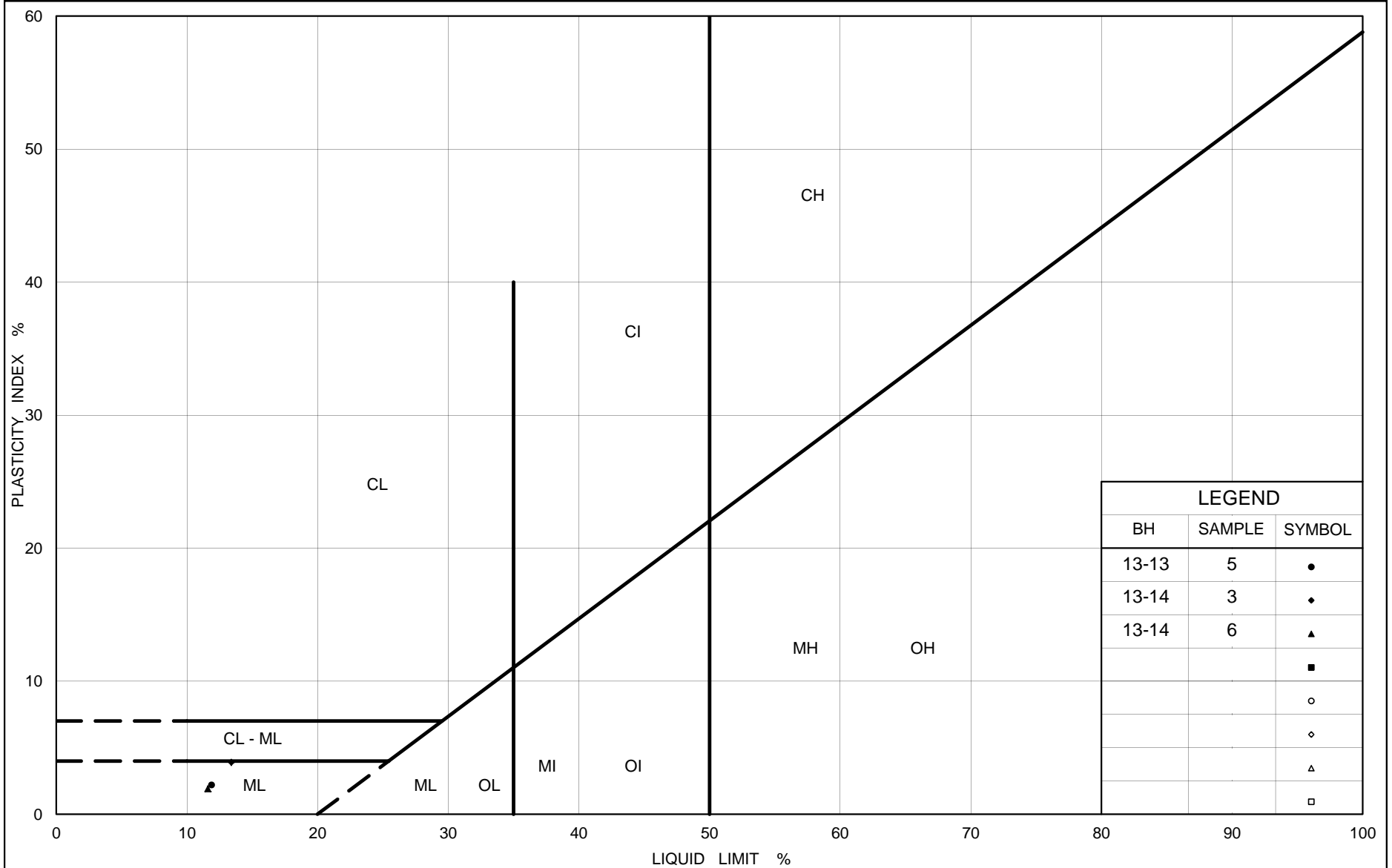
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-12	3B	93.3
■	13-14	4	96.2
◆	13-13	4	95.7
▲	13-12	4	92.7
▽	13-13	7	93.4
○	13-13	8	91.7

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt and Sand (TILL)

Figure No. B4

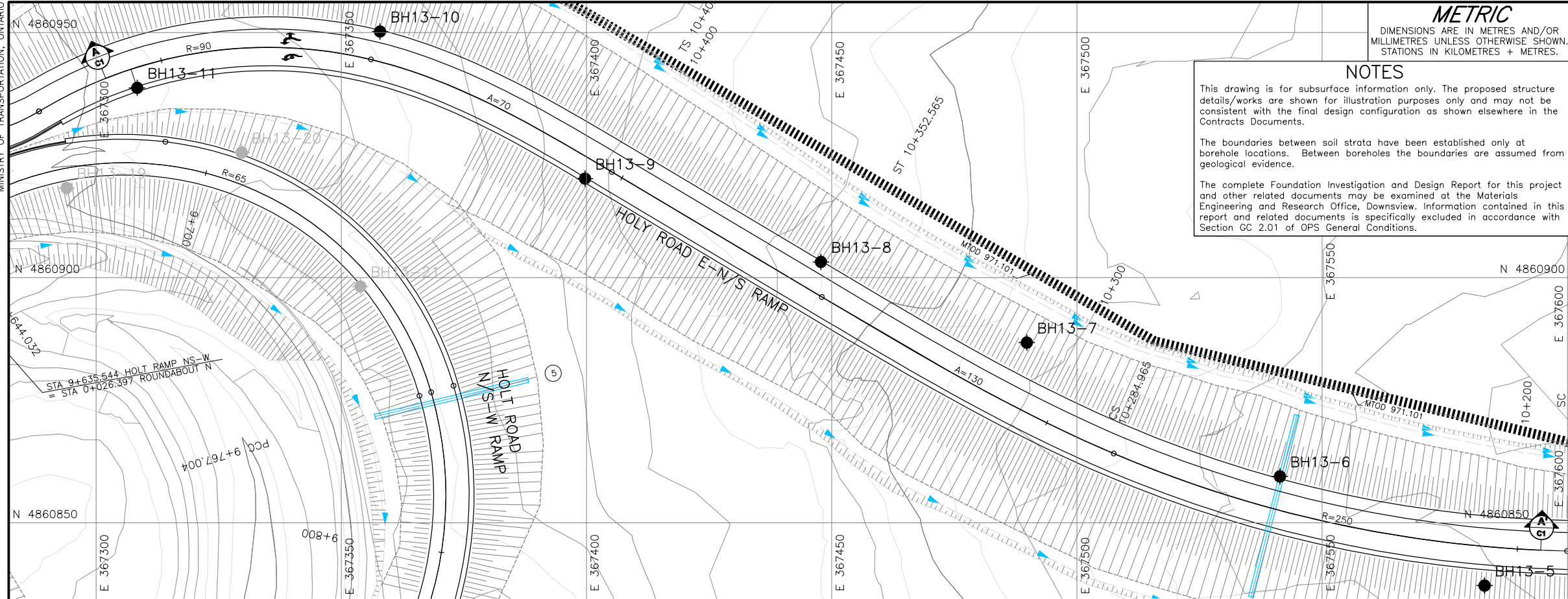
Project No. 09-1111-0019

Checked By:

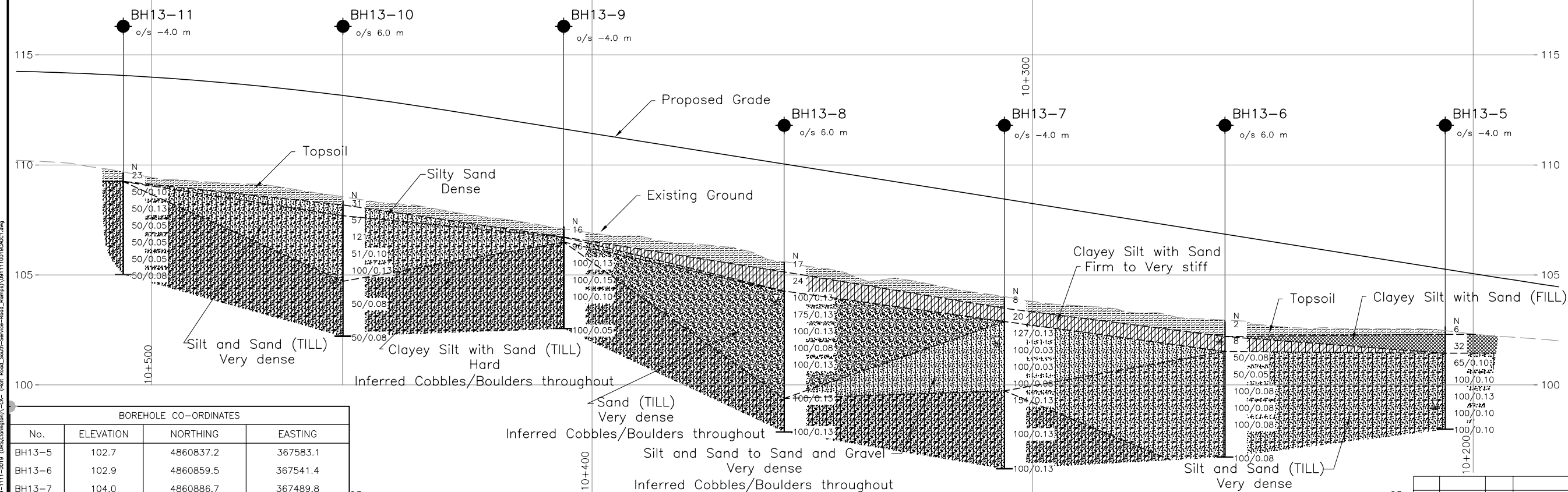


APPENDIX C

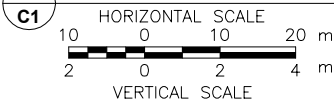
High Fill Area 3 - E-N/S Ramp, STA 10+200 to 10+500



PLAN



SECTION



REFERENCE

Base plan provided in digital format by URS, drawing file no.
2013-10-24-Hwy401-HoltRd_plan.dwg and
2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2101-08-00

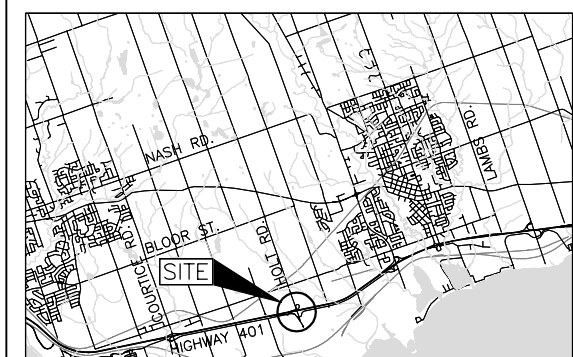
HIGHWAY 401

HIGH FILL AREA 3-HOLT ROAD E-N/S RAMP
(STA 10+200 TO 10+500)

BOREHOLE LOCATIONS AND SOIL STRATA



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN
SCALE



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- ▽ WL during or upon completion of drilling


NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
HWY. 401		PROJECT NO. 09-1111-0019	
SUBM'D.		CHKD. MWK	DATE: Oct. 2013
DRAWN: JFC		CHKD. KJB	APPD. JMAC
		DIST. SITE: 21-159	
		DWG. C1	

PROJECT		RECORD OF BOREHOLE		No BH13-5		SHEET 1 OF 1		METRIC						
G.W.P. 2101-08-00		LOCATION		N 4860837.2 ; E 367583.1		ORIGINATED BY		JLC						
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY						
DATUM		Geodetic		DATE		May 31, 2013		CHECKED BY						
								MWK						
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						
102.7	GROUND SURFACE							20 40 60 80 100						
0.0	TOPSOIL		1A		6									
102.4			1B	SS										
0.4	Clayey silt, with sand, some gravel, containing rootlets and trace organics (FILL) Firm to hard Brown Moist		2	SS	32									5 32 43 20
101.5														
1.2	SILT and SAND, trace to some gravel, trace to some clay, inferred cobbles and boulders throughout (TILL) Very dense Brown to grey Moist		3	SS	85/0/10									
			4	SS	100/0/10									8 47 33 12
			5	SS	100/0/10									
			6	SS	100/0/10									
			7	SS	100/0/10									
98.0	END OF BOREHOLE													
4.7	NOTE: 1. Water level at a depth of 3.7 m below ground surface (Elev. 99.0 m) during drilling.													

PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-6		SHEET 1 OF 1		METRIC															
G.W.P. 2101-08-00		LOCATION N 4860859.5 ; E 367541.4		ORIGINATED BY JLC																	
DIST _____ HWY 401		BOREHOLE TYPE 120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY BM																	
DATUM Geodetic		DATE June 3, 2013		CHECKED BY MWK																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
102.9	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 10 20 30			kN/m ³					
0.0	TOPSOIL		1	SS	2																
102.2			2	SS	8		102													0 21 47 32	
0.7	Sandy CLAYEY SILT, trace gravel Firm to stiff Brown Moist																				
101.5			3	SS	50/0.08		101														
1.4	SILT and SAND, some gravel, trace to some clay, inferred cobbles and boulders throughout (TILL) Very dense Brown to grey Moist		4	SS	50/0.05		100													15 41 34 10	
			5	SS	100/0.08		99														
			6	SS	100/0.08		98														
			7	SS	100/0.08		97													18 46 27 9	
96.7			8	SS	100/0.08																
6.2	END OF BOREHOLE																				
NOTES:																					
1. Water level at a depth of 0.9 m below ground surface (Elev. 102.0 m) during drilling.																					
2. Borehole caved to a depth of 4.3 m below ground surface (Elev. 98.6 m) upon completion of drilling.																					

PROJECT		RECORD OF BOREHOLE		No BH13-7		SHEET 1 OF 1		METRIC						
G.W.P. 09-1111-0019		LOCATION		N 4860886.7 ; E 367489.8		ORIGINATED BY		JLC						
DIST _____ HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY		BM						
DATUM Geodetic		DATE		June 3, 2013		CHECKED BY		MWK						
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						
104.0	GROUND SURFACE													
0.0	TOPSOIL		1	SS	8									
103.5			2A	SS	20									13 31 38 18
102.9	CLAYEY SILT, with SAND some gravel, trace organics and containing rootlets Very stiff Brown Moist		3	SS	127/0.13									6 45 37 12
101.8	SILT and SAND, trace to some clay, trace to some gravel, inferred cobbles and boulders throughout Very dense Brown Moist		4	SS	100/0.09									
101.1			5	SS	100/0.09									
100.4	SAND and GRAVEL, trace clay, trace silt Very dense Brown Moist		6	SS	100/0.09									
99.7			7	SS	154/0.13									2 15 38 45
99.0	CLAYEY SILT, trace to some sand, trace gravel, inferred cobbles and boulders throughout (TILL) Hard Grey Moist		8	SS	100/0.13									
98.3			9	SS	100/0.13									
97.6														
96.2	END OF BOREHOLE													
7.8	NOTES: 1. Water level at a depth of 2.1 m below ground surface (Elev. 101.9 m) during drilling. 2. Borehole caved to a depth of 7.0 m below ground surface (Elev. 97.0 m) upon completion of drilling.													

PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-8		SHEET 1 OF 1		METRIC																	
G.W.P. 2101-08-00		LOCATION N 4860903.2 ; E 367447.8		ORIGINATED BY JLC																			
DIST HWY 401		BOREHOLE TYPE 120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY BM																			
DATUM Geodetic		DATE June 3, 2013		CHECKED BY MWK																			
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID			UNIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL				
105.6	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p W W _L 10 20 30			kN/m ³							
0.0	TOPSOIL		1	SS	17																		
105.1			2	SS	24		105													2	31	37	30
0.5	CLAYEY SILT, with SAND, some gravel, trace organics, inferred cobbles and boulders at 0.8 m depth																						
104.2	Very stiff		3	SS	100/0.13		104																
1.4	Brown to dark brown		4	SS	175/0.13		103																
	Moist		5	SS	100/0.13		102													21	66	8	5
	SAND, some gravel to gravelly, trace to some silt, trace clay, inferred cobbles and boulders throughout (TILL)		6	SS	100/0.08		101																
	Very dense		7	SS	100/0.13		100																
	Brown		8	SS	100/0.13		99																
	Moist to wet		9	SS	100/0.13		98																
99.4																							
6.2	CLAYEY SILT, trace sand, trace gravel, inferred cobbles and boulders (TILL)																						
	Hard																						
	Grey																						
	Moist																						
97.9																							
7.8	END OF BOREHOLE																						
NOTES:																							
1. Water level at a depth of 1.8 m below ground surface (Elev. 103.8 m) during drilling.																							
2. Borehole caved to a depth of 2.3 m below ground surface (Elev. 103.3 m) upon completion of drilling.																							

PROJECT		RECORD OF BOREHOLE		No BH13-9		SHEET 1 OF 1		METRIC										
G.W.P. 09-1111-0019		LOCATION		N 4860920.2 ; E 367399.7		ORIGINATED BY		JLC										
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY										
DATUM		Geodetic		DATE		June 2, 2013		CHECKED BY										
								MWK										
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 (%)
107.2	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL		1A	SS	16													
106.7	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders at 1.5 m to 4.6 m depth (TILL) Very stiff to hard Brown to grey Moist Augers grinding on inferred cobbles and boulders at 1.5 m to 4.6 m depth		1B															
0.5			2	SS	96													
			3	SS	100/0.13													
			4	SS	100/0.13													
			5	SS	100/0.10													
102.6	END OF BOREHOLE		6	SS	100/0.05													
4.6	NOTES: 1. Borehole was dry upon completion of drilling. 2. Borehole caved at a depth of 3.9 m below ground surface (Elev. 103.3 m) upon completion of drilling.																	

PROJECT		RECORD OF BOREHOLE		No BH13-10		SHEET 1 OF 1		METRIC						
G.W.P. 2101-08-00		LOCATION		N 4860950.2 ; E 367357.9		ORIGINATED BY		JLC						
DIST		HWY 401		BOREHOLE TYPE		108 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY						
DATUM		Geodetic		DATE		June 4, 2013		CHECKED BY						
								MWK						
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						
108.4	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	TOPSOIL													
0.2	Silty SAND, trace clay, trace gravel, containing rootlets		1	SS	31		108							
107.7	Dense Brown Moist		2	SS	57									
0.7	SILT and SAND, trace to some clay, trace to some gravel (TILL) Very dense Brown Moist		3	SS	121		107							
			4	SS	51/0.10		106							9 43 40 8
			5	SS	100/0.13		105							
104.7	CLAYEY SILT with SAND, some gravel (TILL) Hard Grey Moist to wet		6	SS	50/0.08		104							17 35 32 16
3.7							103							
102.2	END OF BOREHOLE		7	SS	50/0.08									
6.2	NOTE: 1. Water level at a depth of 3.7 m below ground surface (Elev. 104.7 m) during drilling.													

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-11		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860938.7 ; E 367308.4</u>		ORIGINATED BY <u>JLC</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>108 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 4, 2013</u>		CHECKED BY <u>MWK</u>			

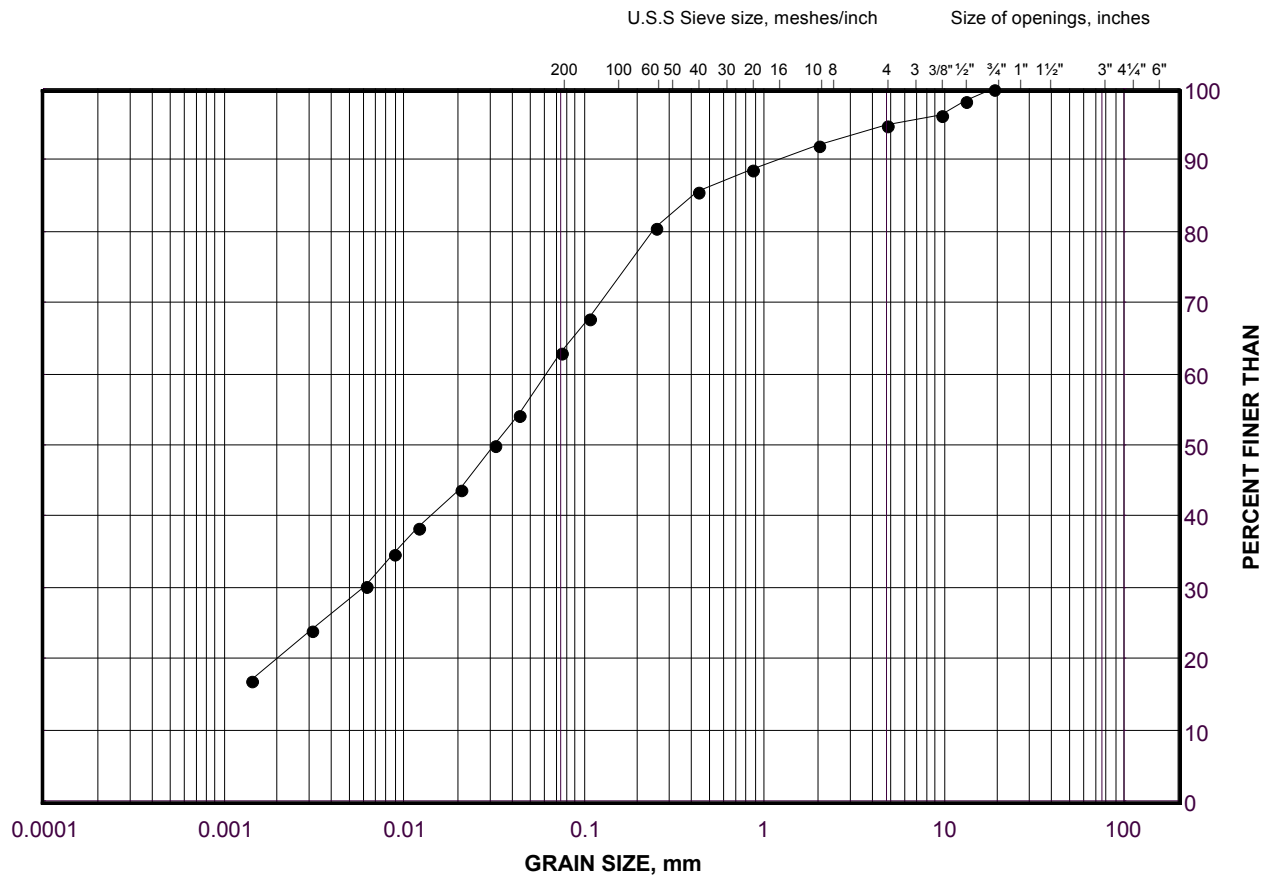
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>	<div><div></div><div></div><div></div></div>					
109.7	GROUND SURFACE																			
0.0	TOPSOIL		1	SS	23															
109.3	Very stiff																			
0.4	Dark brown																			
	Moist																			
	CLAYEY SILT with SAND, trace to some gravel, inferred cobbles and boulders at 1.5 m to 4.7 m depth (TILL)		2	SS	50/0.10															
	Hard																			
	Brown		3	SS	50/0.13															
	Moist																			
	Augers grinding on inferred cobbles and boulders		4	SS	50/0.05															
			5	SS	50/0.05															
			6	SS	50/0.05															
105.1	END OF BOREHOLE		7	SS	50/0.08															
4.7																				
	NOTE: 1. Open borehole was dry upon completion of drilling.																			

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

GRAIN SIZE DISTRIBUTION TEST RESULT

Clayey Silt with Sand (FILL)

FIGURE C1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

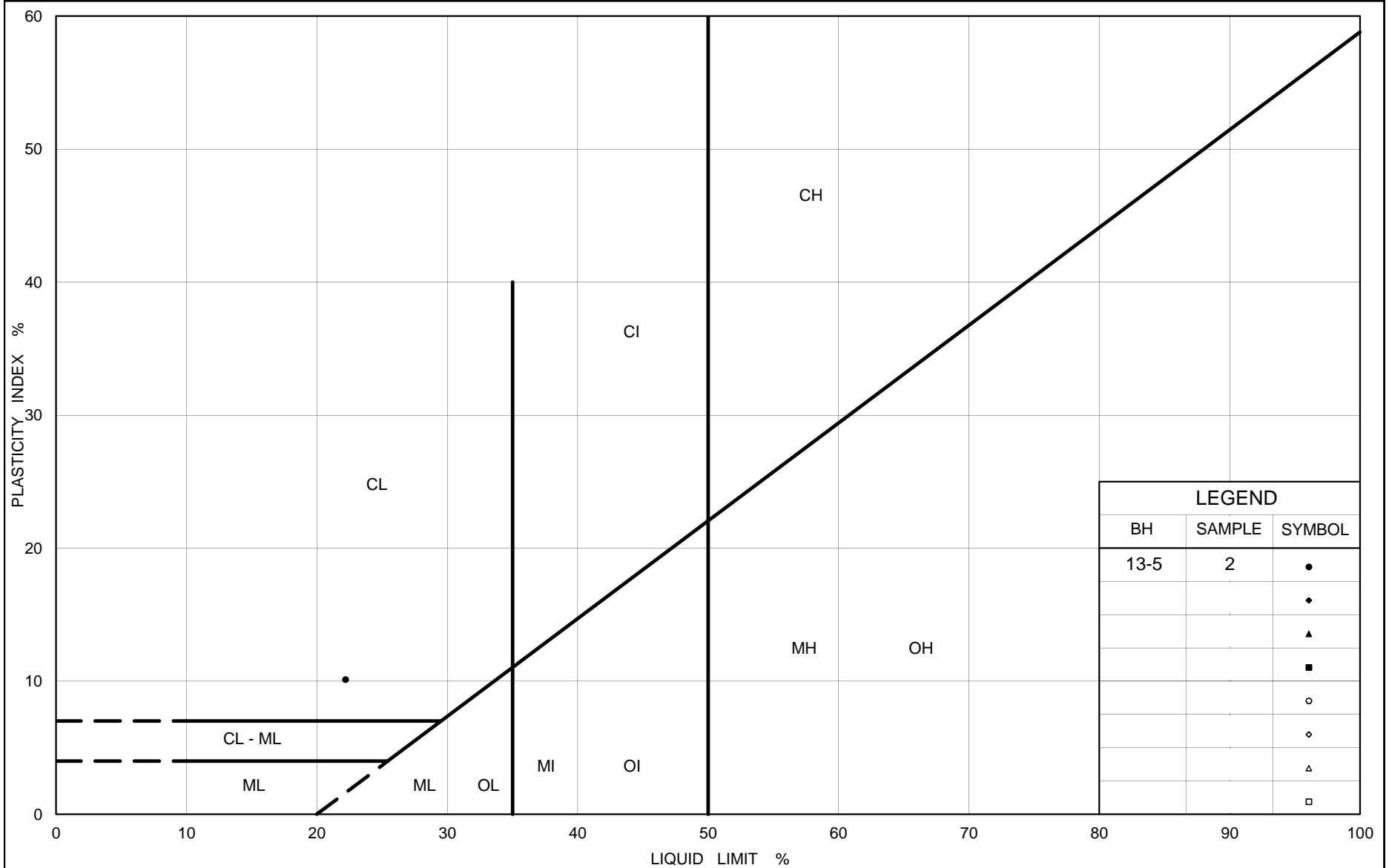
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	13-5	2	101.7

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. C2

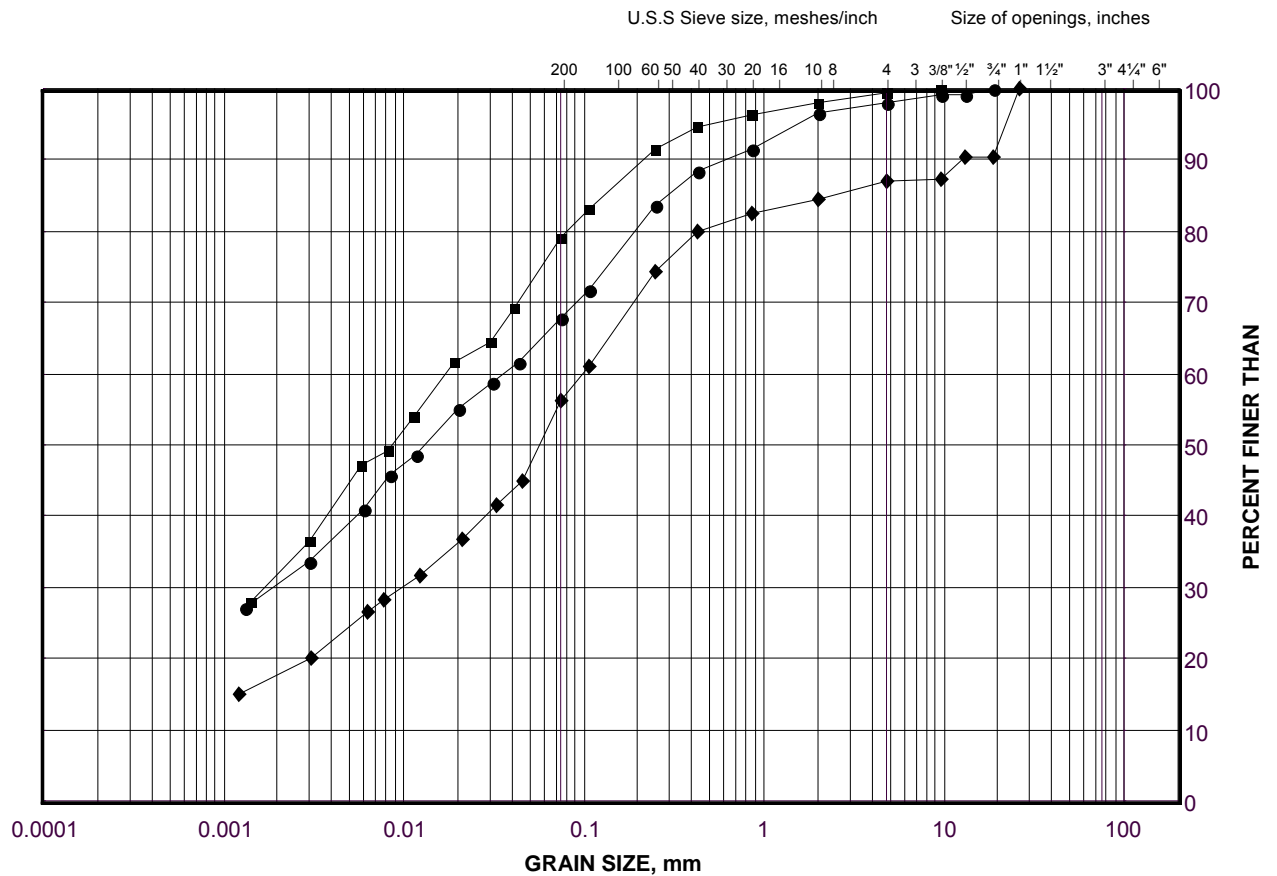
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt

FIGURE C3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

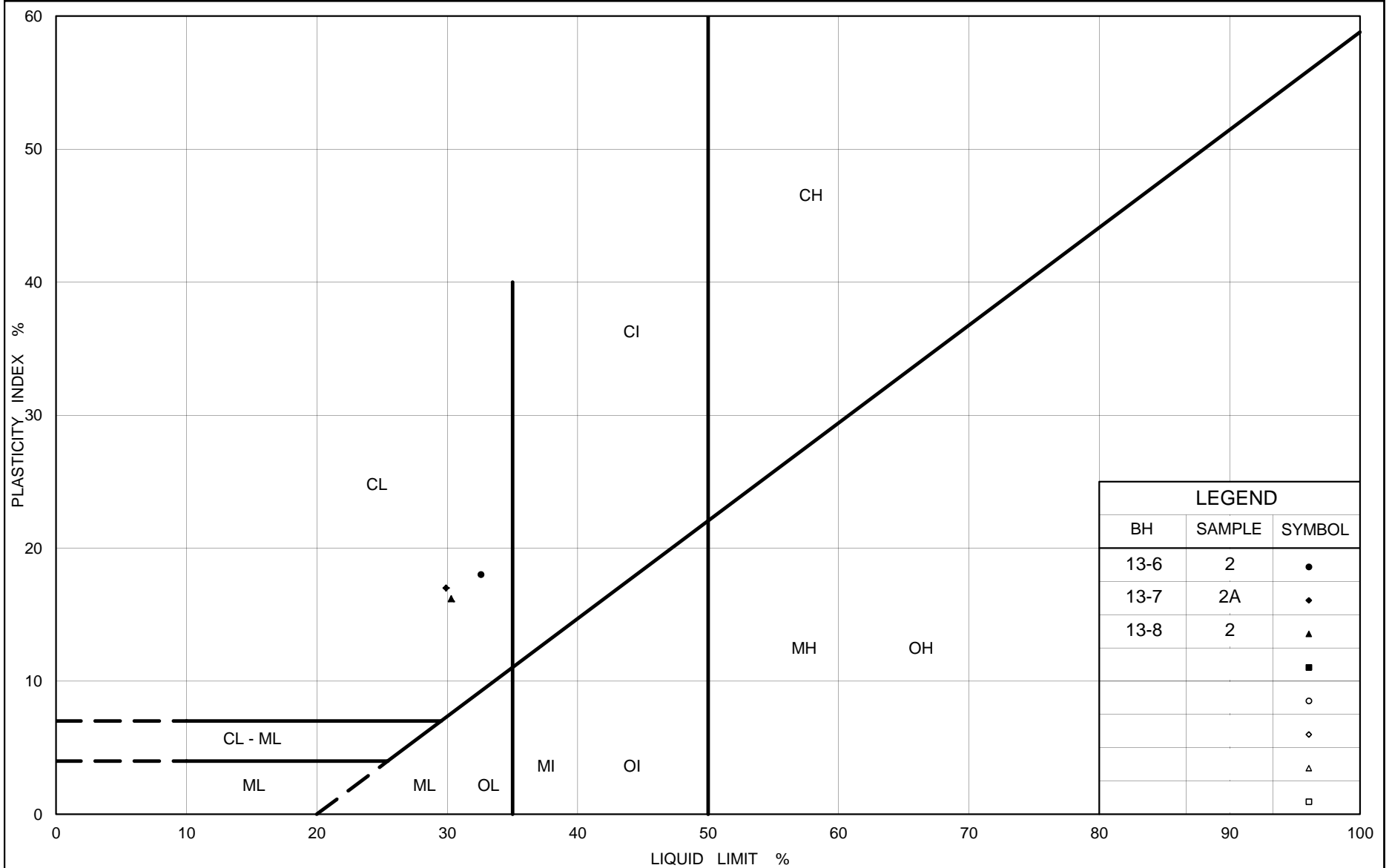
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-8	2	104.6
■	13-6	2	101.9
◆	13-7	2A	103.1

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt

Figure No. C4

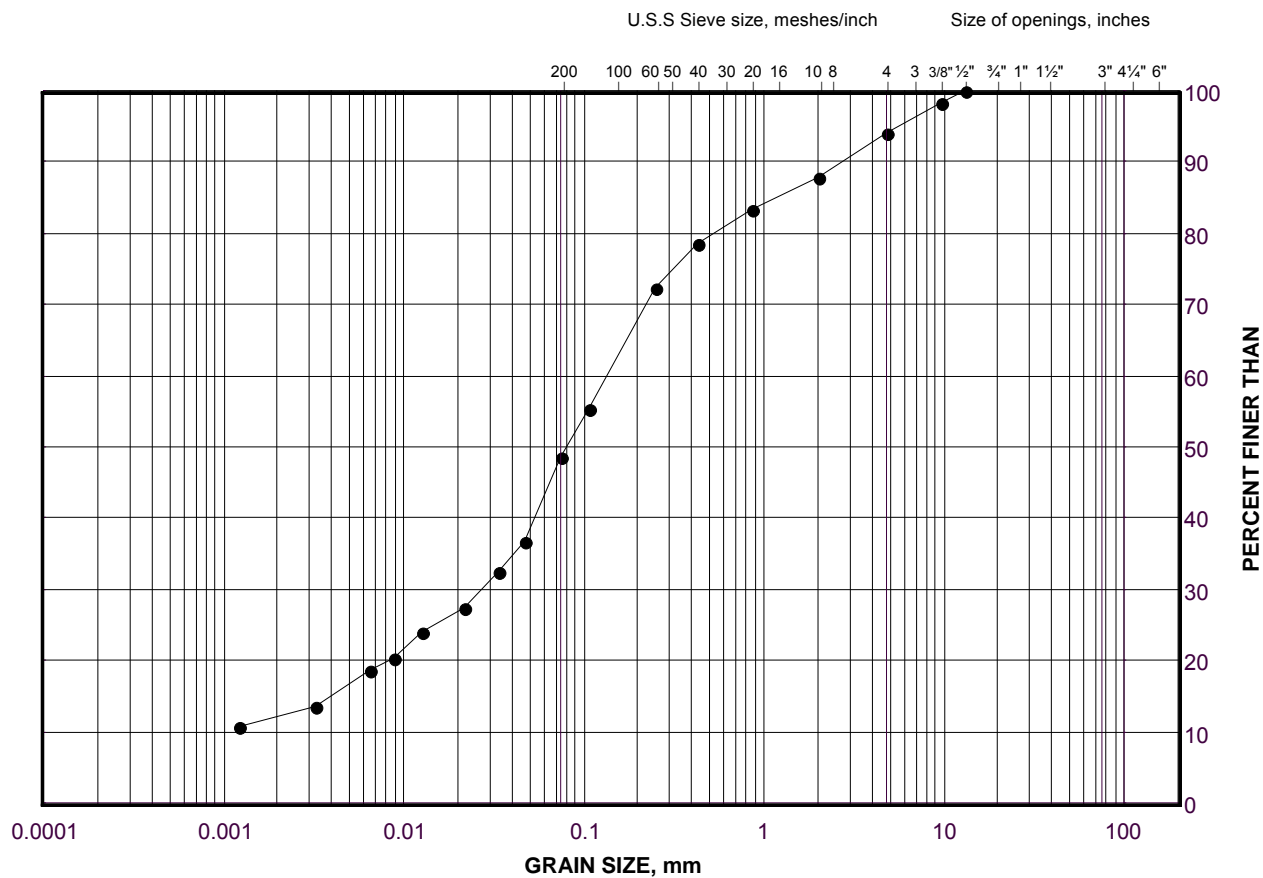
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULT

Silt and Sand

FIGURE C5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	13-7	3	102.4

Project Number: 09-1111-0019

Checked By: _____

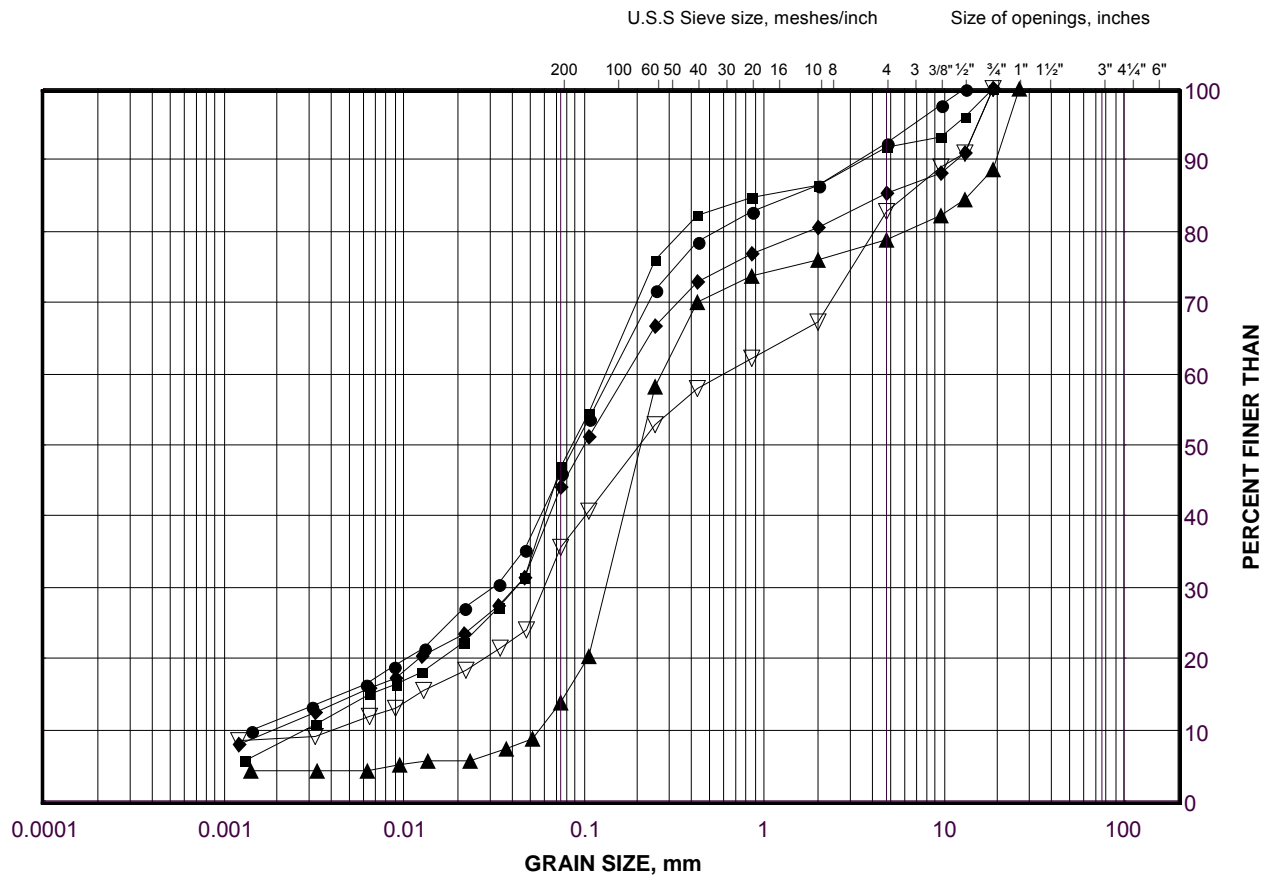
Golder Associates

Date: 01-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sand to Silt and Sand (TILL)

FIGURE C6



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

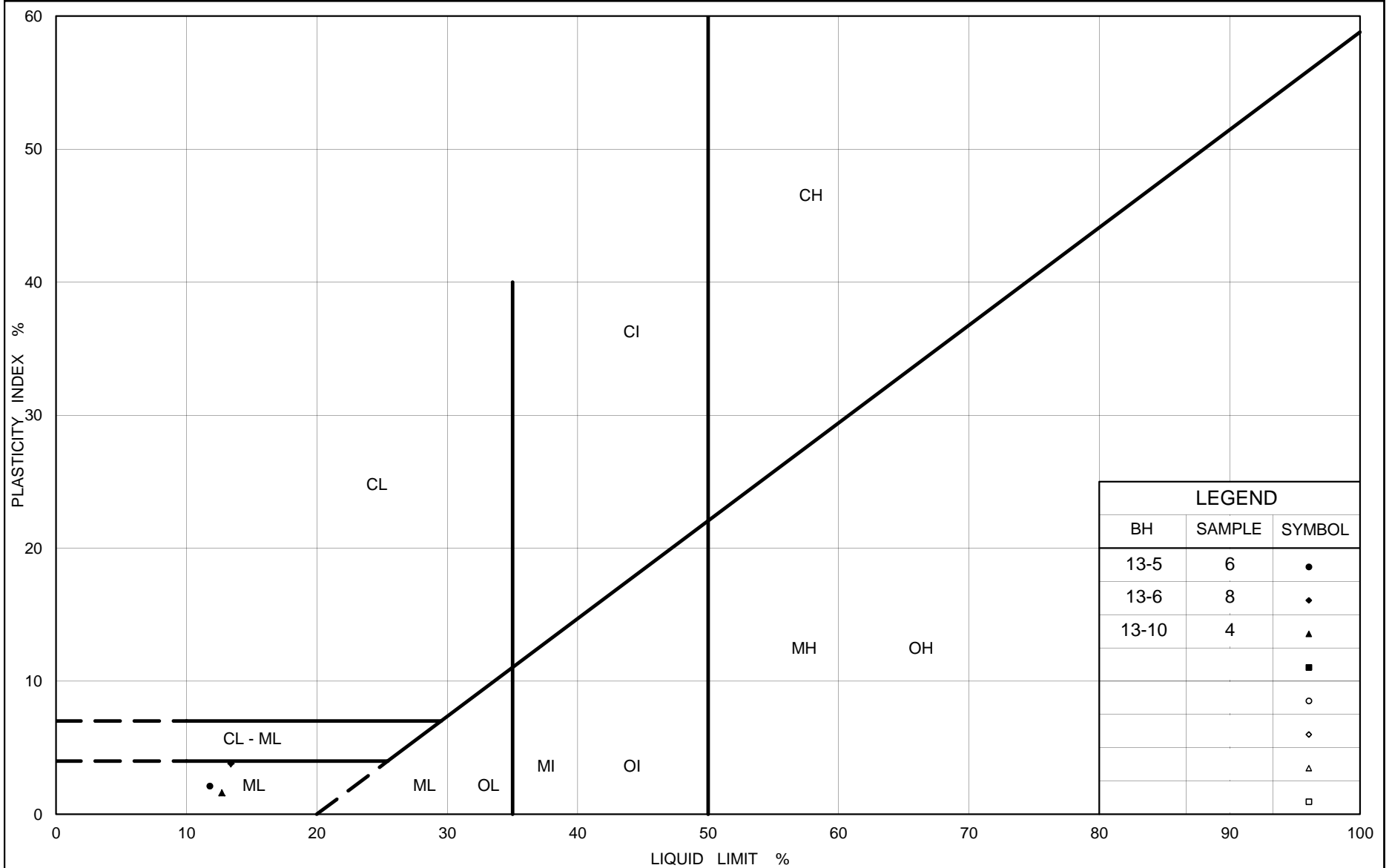
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-5	4	100.3
■	13-10	4	106.1
◆	13-6	4	100.6
▲	13-8	5	102.5
▽	13-6	7	98.3

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt and Sand (TILL)

Figure No. C7

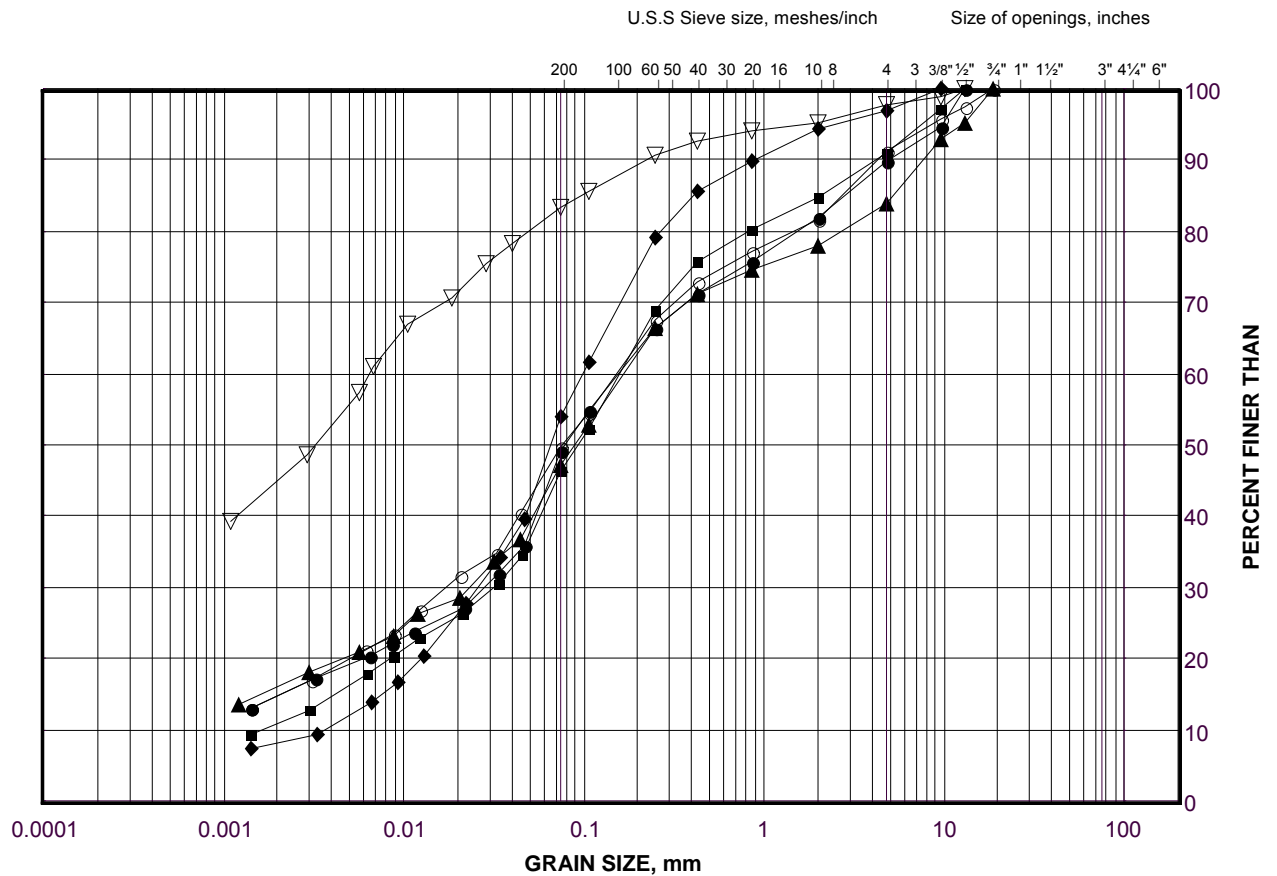
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE C8



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

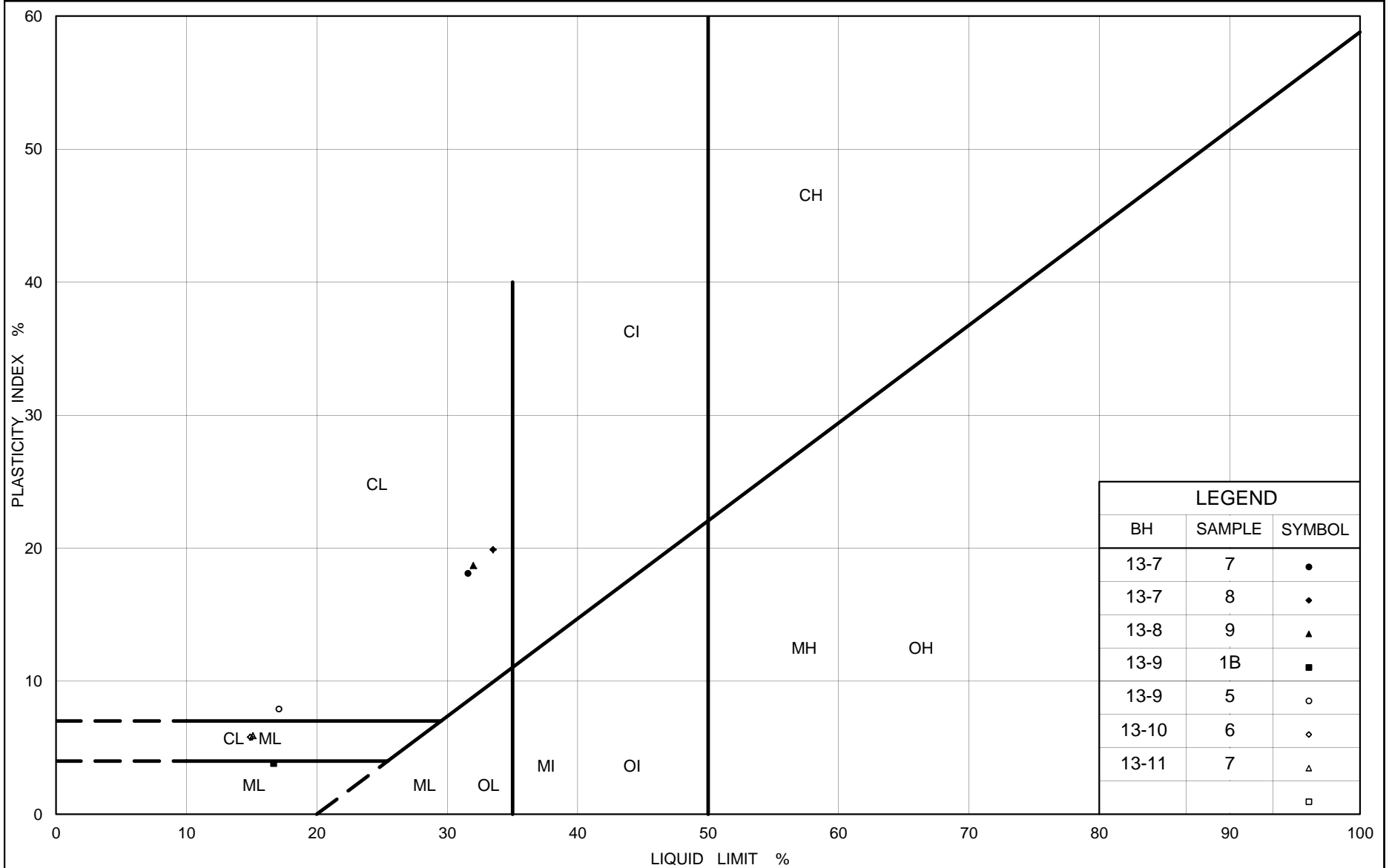
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-9	1B	106.8
■	13-11	4	107.4
◆	13-9	4	104.8
▲	13-10	6	103.8
▽	13-7	7	99.3
○	13-11	7	105.1

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (TILL)

Figure No. C9

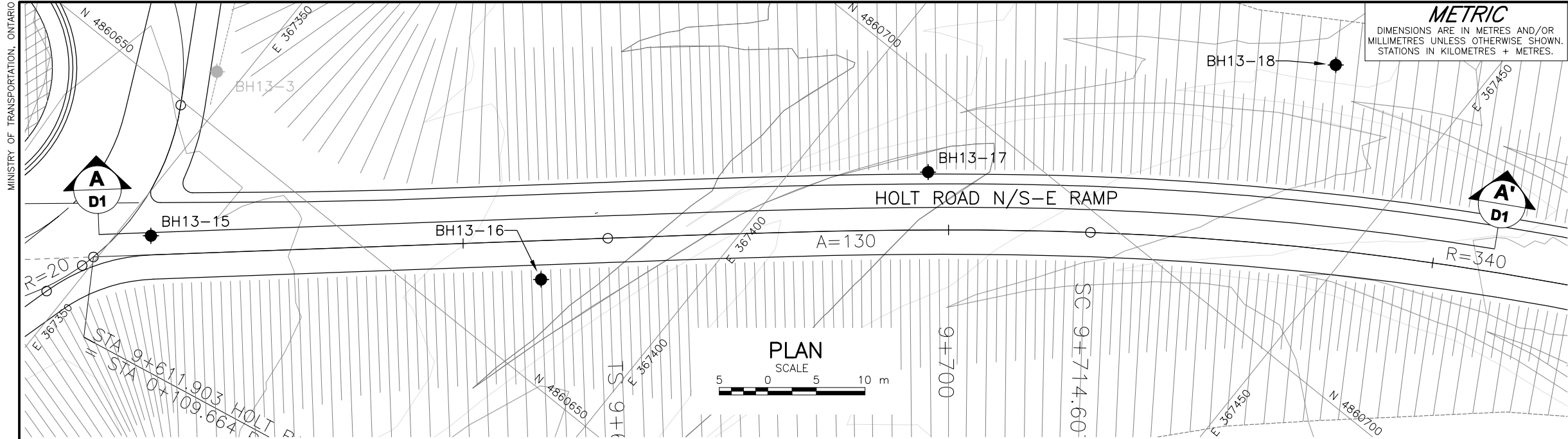
Project No. 09-1111-0019

Checked By:



APPENDIX D

High Fill Area 4 - N/S-E Ramp, STA 9+610 to 9+740



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2101-08-00

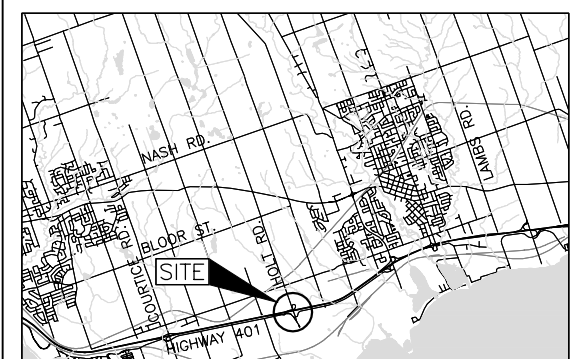
HIGHWAY 401
HIGH FILL AREA 4-HOLT ROAD N/S-E RAMP
(STA 9+610 TO 9+740)

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE
0 2 4 km

LEGEND

- Borehole - Current Investigation
- Standard Penetration Test Value
- Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL during or upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-15	111.1	4860637.2	367352.9
BH13-16	110.1	4860658.9	367387.0
BH13-17	110.0	4860692.5	367411.1
BH13-18	108.7	4860727.4	367436.9

NOTES

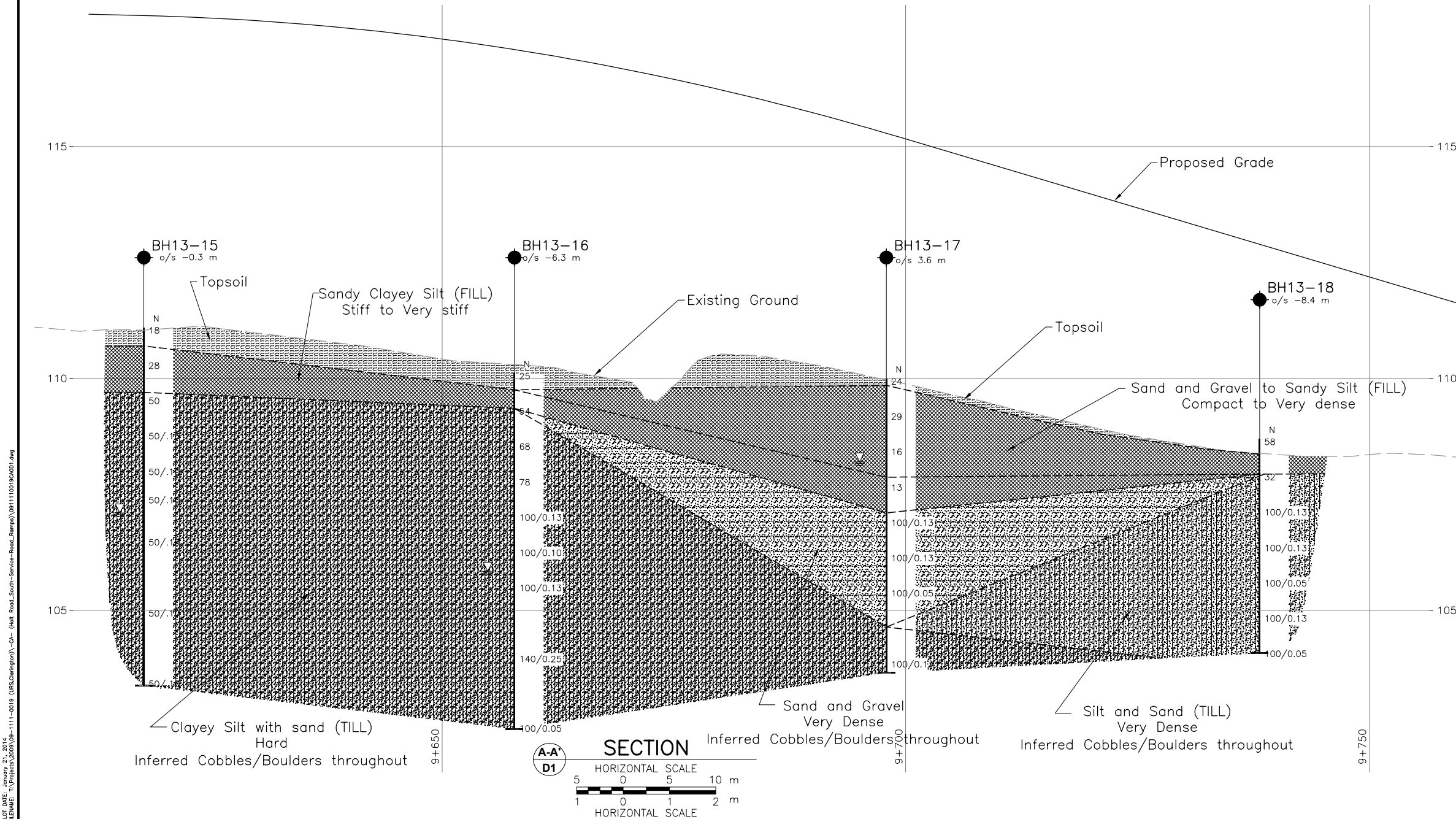
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg and 2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013



SECTION

HORIZONTAL SCALE
0 5 10 m
HORIZONTAL SCALE
0 1 2 m

PROJECT		RECORD OF BOREHOLE		No BH13-15		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860637.2 ; E 367352.9		ORIGINATED BY		JLC									
DIST _____ HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY		BM									
DATUM Geodetic		DATE		May 31, 2013		CHECKED BY		MWK									
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									
111.1	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL		1	SS	18												
110.7																	
0.4	Sandy clayey silt, trace gravel (FILL) Very stiff Brown Moist		2	SS	28												4 24 43 29
109.7																	
1.4	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders at 4.6 m depth (TILL) Hard Brown to grey Moist		3	SS	50												
			4	SS	50/13												4 39 42 15
			5	SS	50/10												
			6	SS	50/10												
			7	SS	50/10												
			8	SS	50/10												
			9	SS	50/10												
103.4	END OF BOREHOLE																
7.7	NOTES: 1. Water level at a depth of 4.0 m below ground surface (Elev. 107.1 m) upon completion of drilling. 2. Borehole caved to a depth of 7.2 m below ground surface (Elev. 103.9 m) upon completion of drill																

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

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

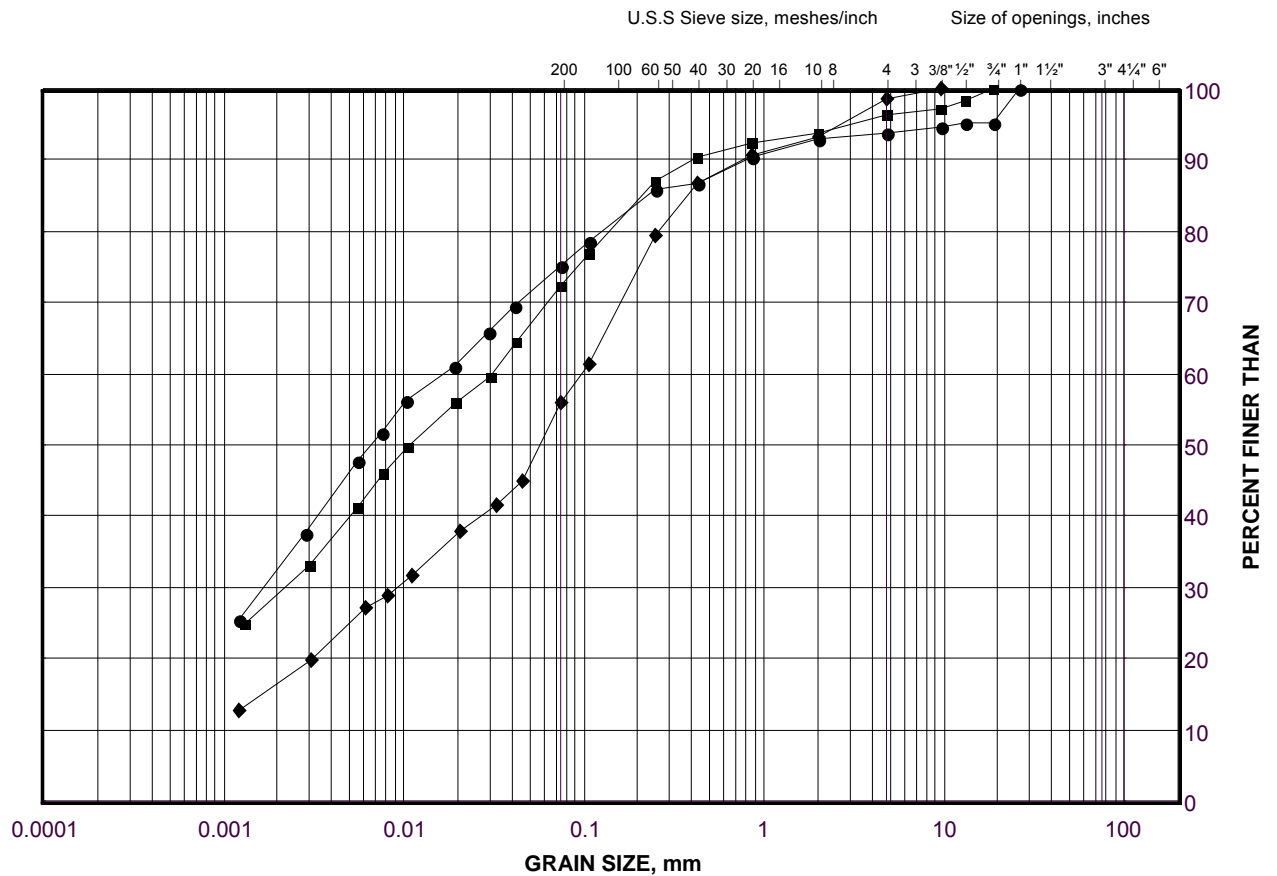
PROJECT		RECORD OF BOREHOLE		No BH13-17		SHEET 1 OF 1		METRIC										
G.W.P. 09-1111-0019		LOCATION		N 4860692.5 ; E 367411.1		ORIGINATED BY		JLC										
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY										
DATUM Geodetic		DATE		May 20, 2013		CHECKED BY		MWK										
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 (%)			
110.0	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL							20	40	60	80	100						
0.2	Sand and gravel, trace to some silt, trace clay (FILL) Compact Brown Moist		1	SS	24													
			2	SS	29													
			3	SS	16													
107.9																		
2.1	Sandy clayey silt, trace gravel, inferred cobbles and boulders throughout (FILL) Stiff Brown Moist		4	SS	13													
107.1																		
2.9	SAND and GRAVEL, some silt, trace clay, inferred cobbles and boulders throughout Very dense Grey Wet		5	SS	100/0.13													
			6	SS	100/0.13													
			7	SS	100/0.05													
104.6																		
5.4	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders throughout (TILL) Hard Grey Wet		8	SS	100/0.1													
103.8																		
6.2	END OF BOREHOLE																	
NOTES: 1. Water level at a depth of 1.8 m below ground surface (Elev. 108.2 m) during drilling. 2. Borehole caved at a depth of 1.9 m below ground surface (Elev. 108.1 m) upon completion of drilling.																		

PROJECT		RECORD OF BOREHOLE		No BH13-18		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860727.4 ; E 367436.9		ORIGINATED BY		JLC									
DIST _____ HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY		BM									
DATUM Geodetic		DATE		May 30, 2013		CHECKED BY		MWK									
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									
108.7	GROUND SURFACE																
0.0	TOPSOIL		1	SS	58												
108.4																	
0.3	Sandy silt, trace gravel, trace organics (FILL)																
107.9	Very dense																
0.8	Brown Moist		2	SS	32												
	SILT and SAND, trace to some clay, trace to some gravel, inferred cobbles and boulders throughout (TILL)		3	SS	100/0.13												
	Dense to very dense		4	SS	100/0.13												
	Brown to grey Moist		5	SS	100/0.05												
			6	SS	100/0.13												
			7	SS	100/0.05												
104.1	END OF BOREHOLE																
4.6	NOTE: 1. Borehole dry upon completion of drilling. 2. Borehole caved at a depth of 4.3 m below ground surface (Elev. 104.4 m) upon completion of drilling.																

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE D1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

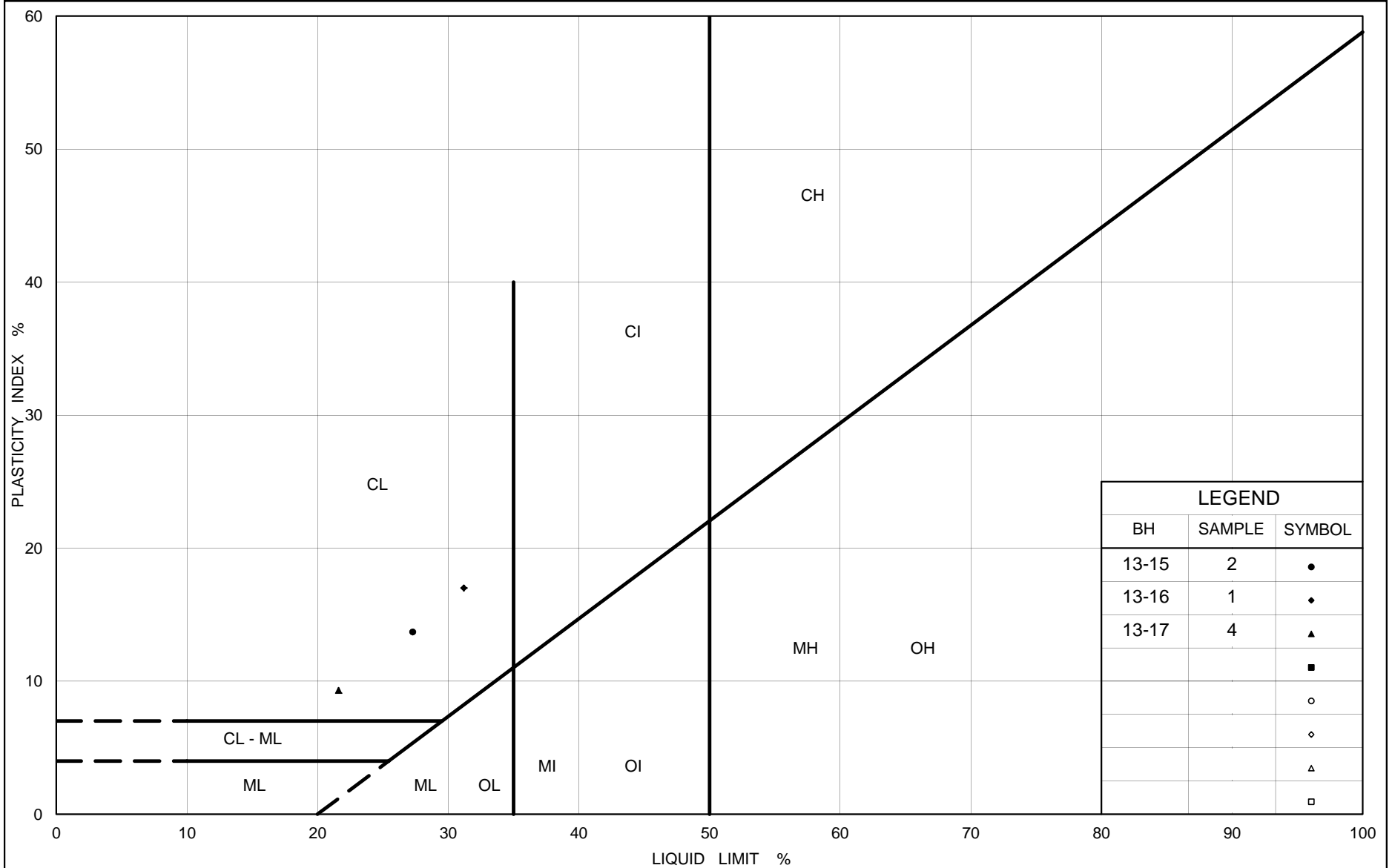
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-16	1	109.6
■	13-15	2	110.1
◆	13-17	4	107.5

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. D2

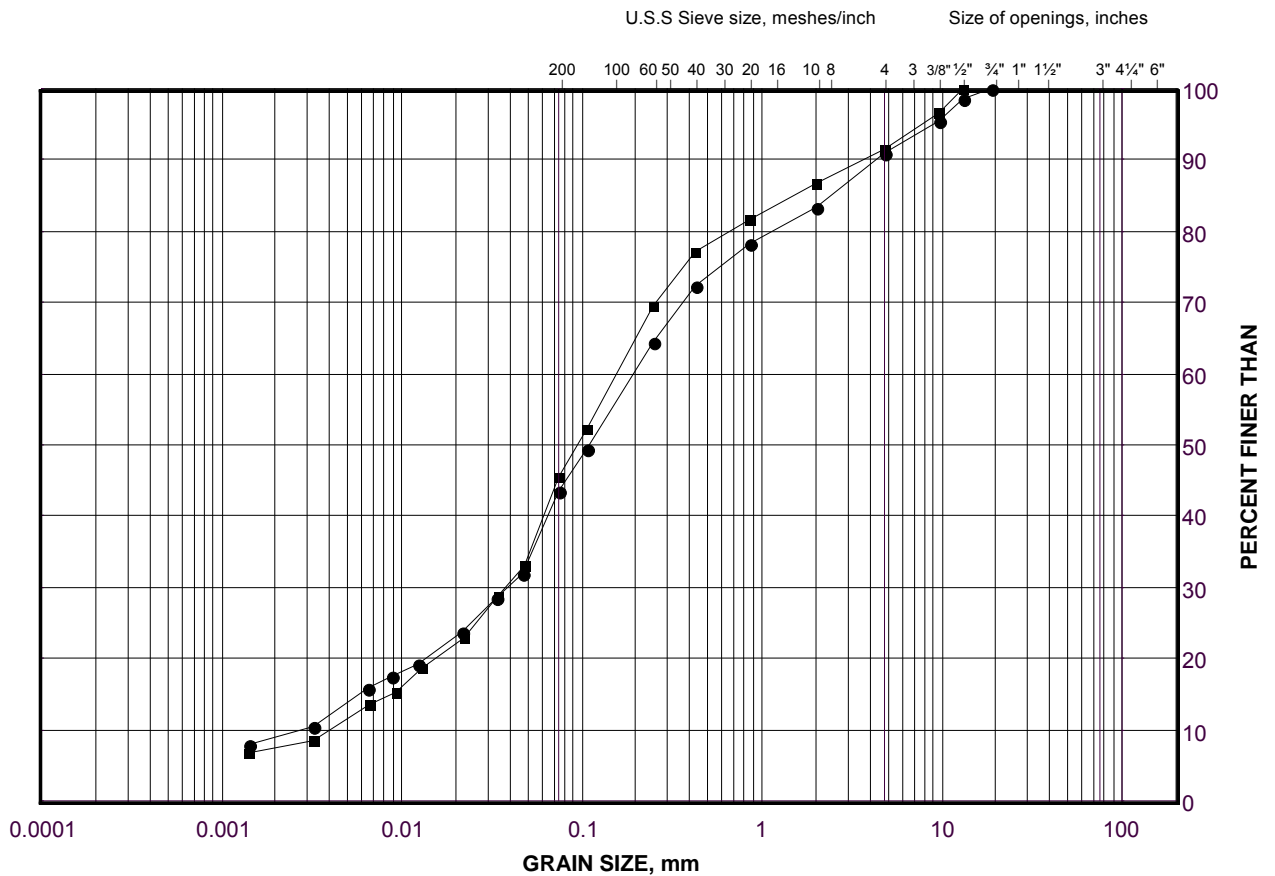
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silt and Sand (TILL)

FIGURE D3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

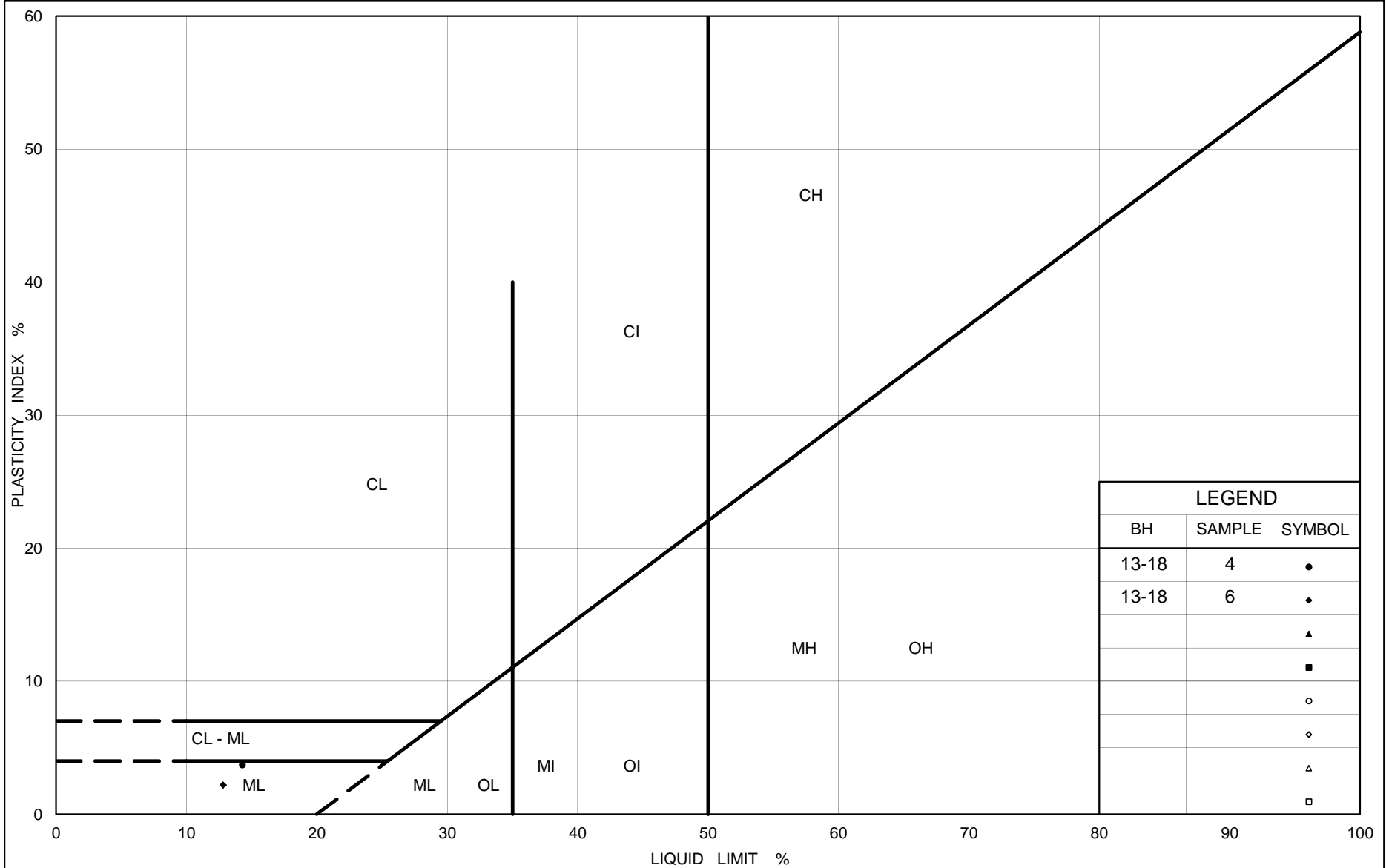
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-18	4	106.3
■	13-18	6	104.8

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 06-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt and Sand (TILL)

Figure No. D4

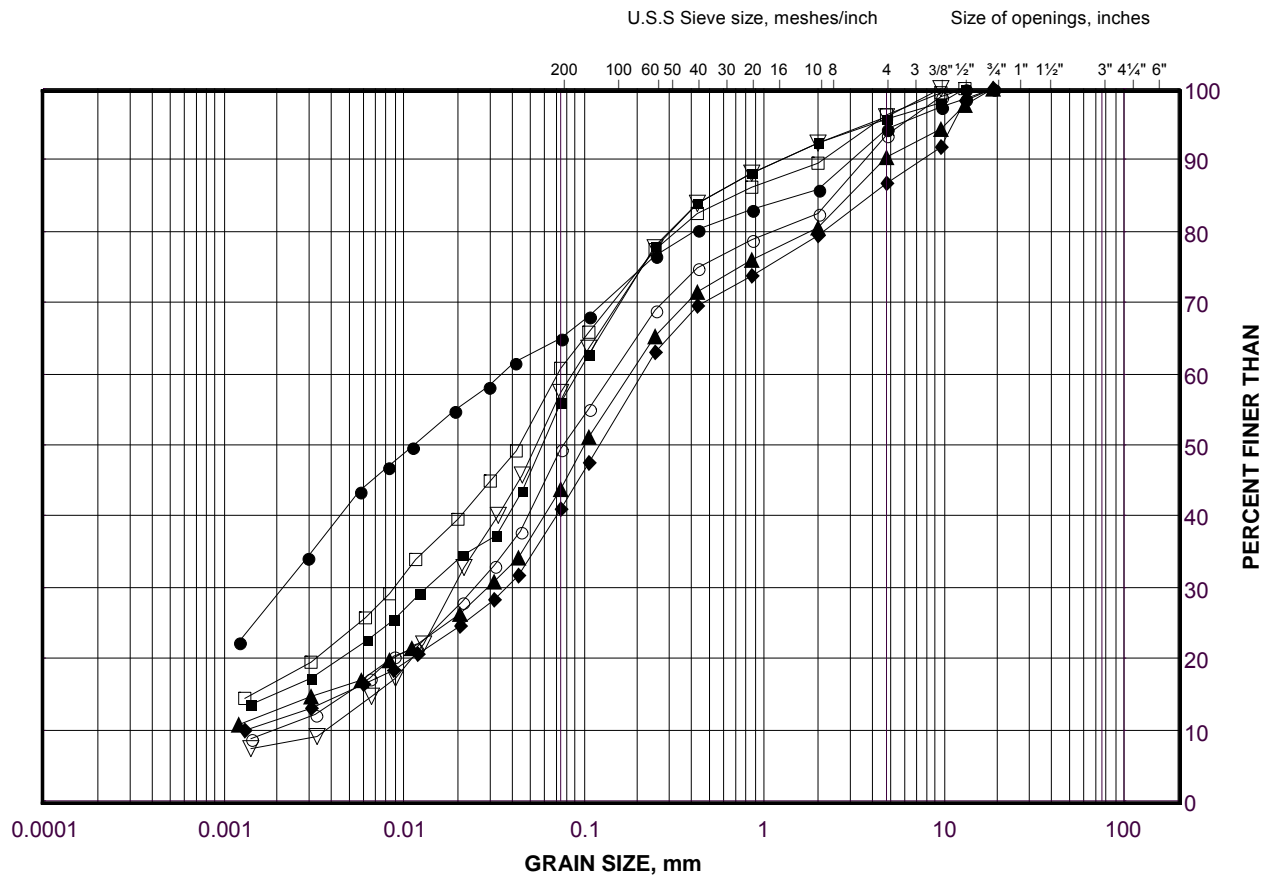
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE D5



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

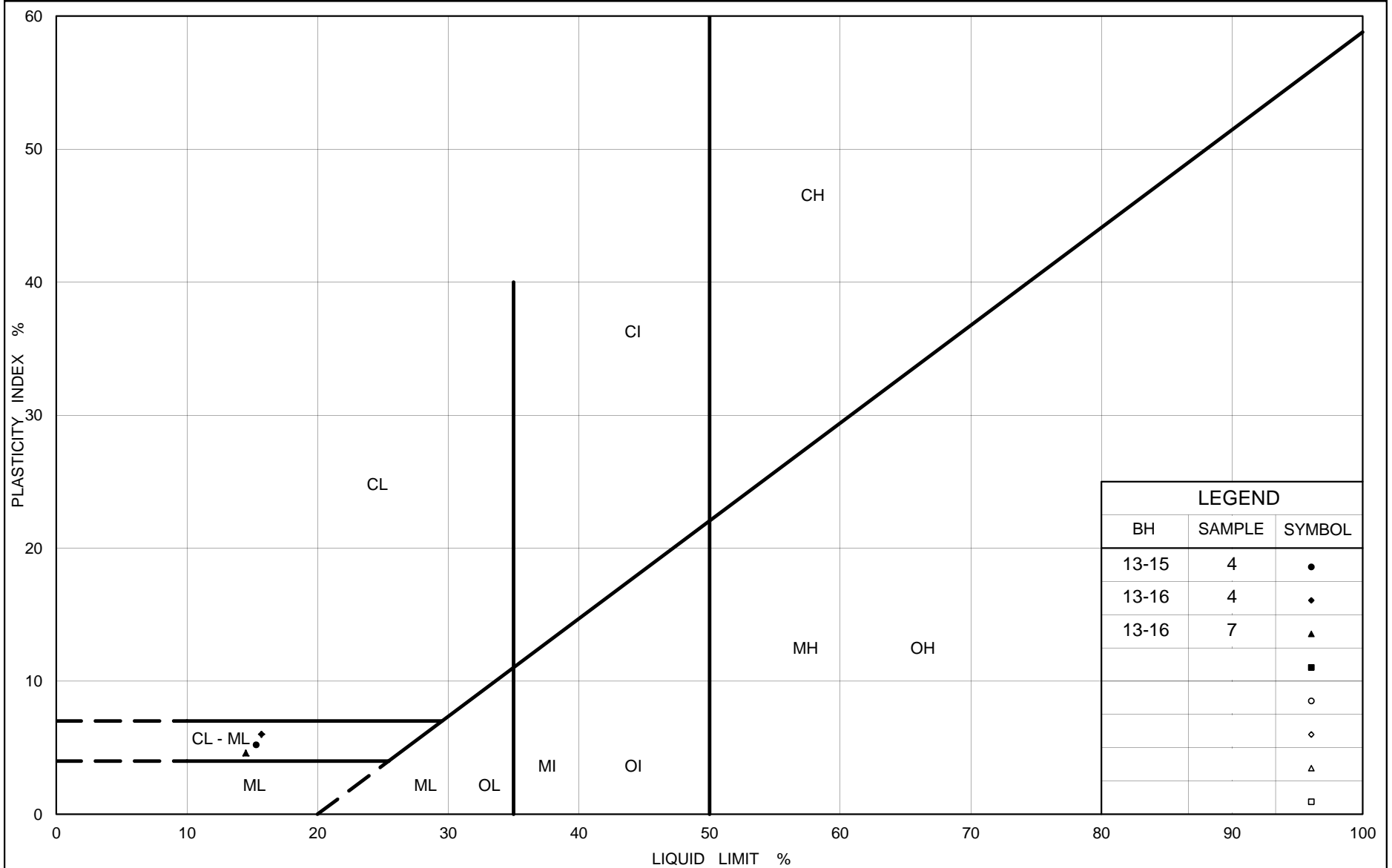
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-3	3	109.2
■	13-15	4	108.8
◆	13-16	5	107.0
▲	13-16	7	105.5
▽	13-3	7	106.4
○	13-17	8	103.8
□	13-3	9	103.2

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 06-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (TILL)

Figure No. D6

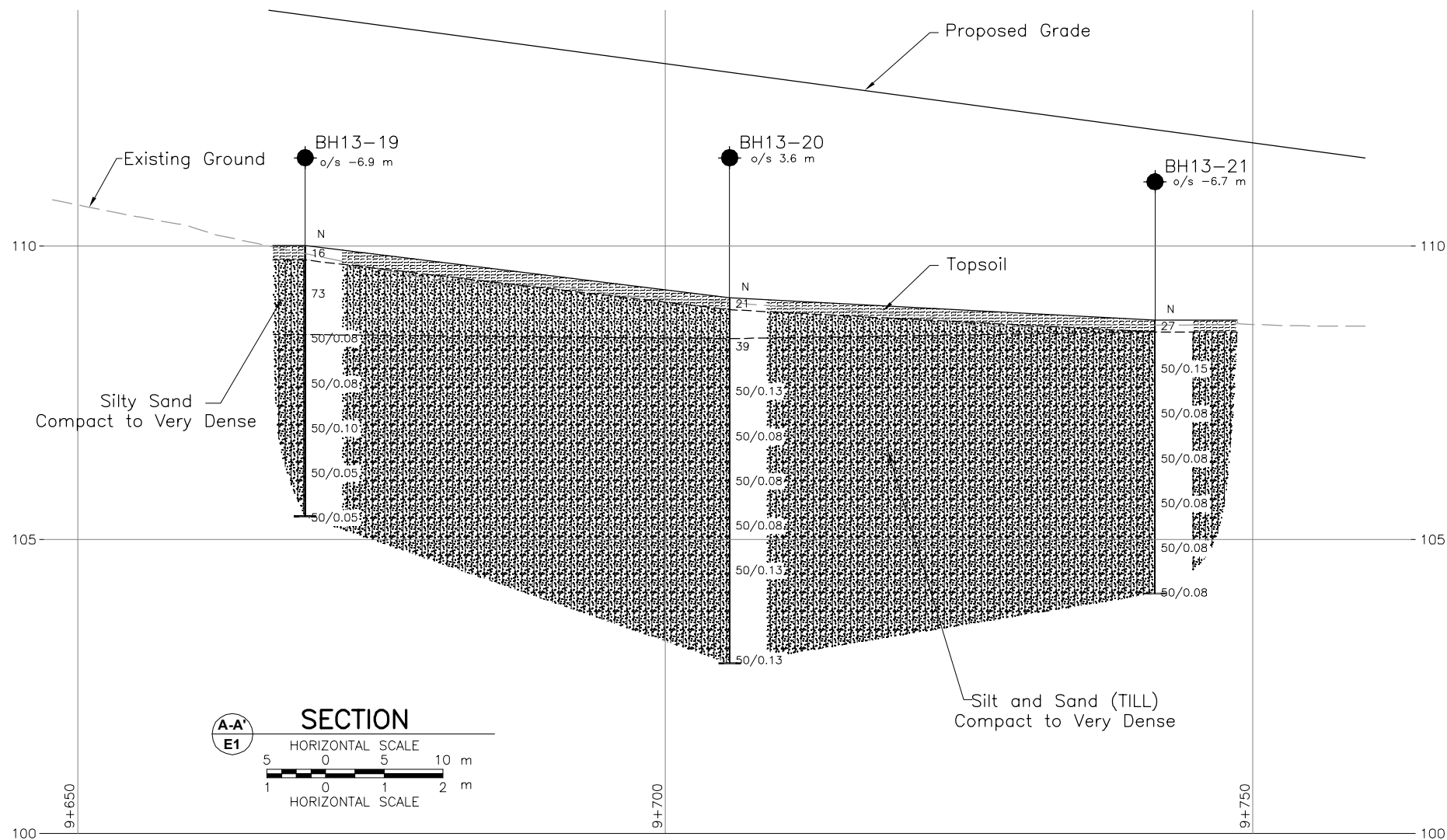
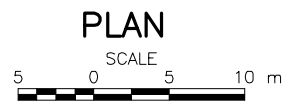
Project No. 09-1111-0019

Checked By:



APPENDIX E

High Fill Area 5 - N/S-W Ramp, STA 9+670 to 9+740



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

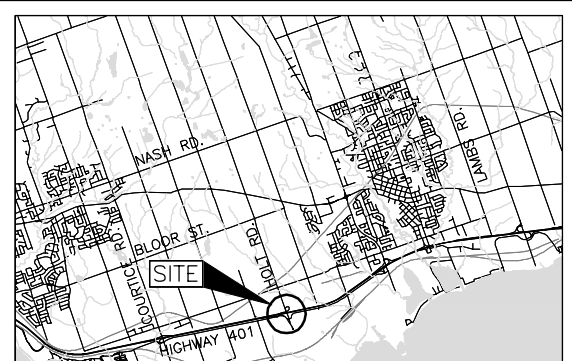
CONT No.
GWP No. 2101-08-00



<p align="center">HIGHWAY 401 HIGH FILL AREA 5-HOLT ROAD N/S-W RAMP (STA 9+670 TO 9+740)</p> <p>BOREHOLE LOCATIONS AND SOIL STRATA</p>	
--	--




Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

-  Borehole – Current Investigation
 N Standard Penetration Test Value
 16 Blows/0.3m unless otherwise stated
 (Std. Pen. Test, 475 j/blow)

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-19	110.0	4860918.3	367294.0
BH13-20	109.1	4860925.5	367329.7
BH13-21	108.7	4860898.2	367353.9

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no.
2013-10-24-Hwy401-HoltRd_plan.dwg and
2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013

NO.	DATE	BY	REVISION				
Geocres No. 30M15-158							
HWY. 401			PROJECT NO. 09-1111-0019			DIST.	
SUBM'D.		CHKD. MWK	DATE: Oct. 2013		SITE: 21-159		
DRAWN: JFC		CHKD. KJB	APPD. JMAC		DWG. E1		

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-19		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860918.3 ; E 367294.0</u>		ORIGINATED BY <u>JLC</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>108 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>June 4, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
110.0	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

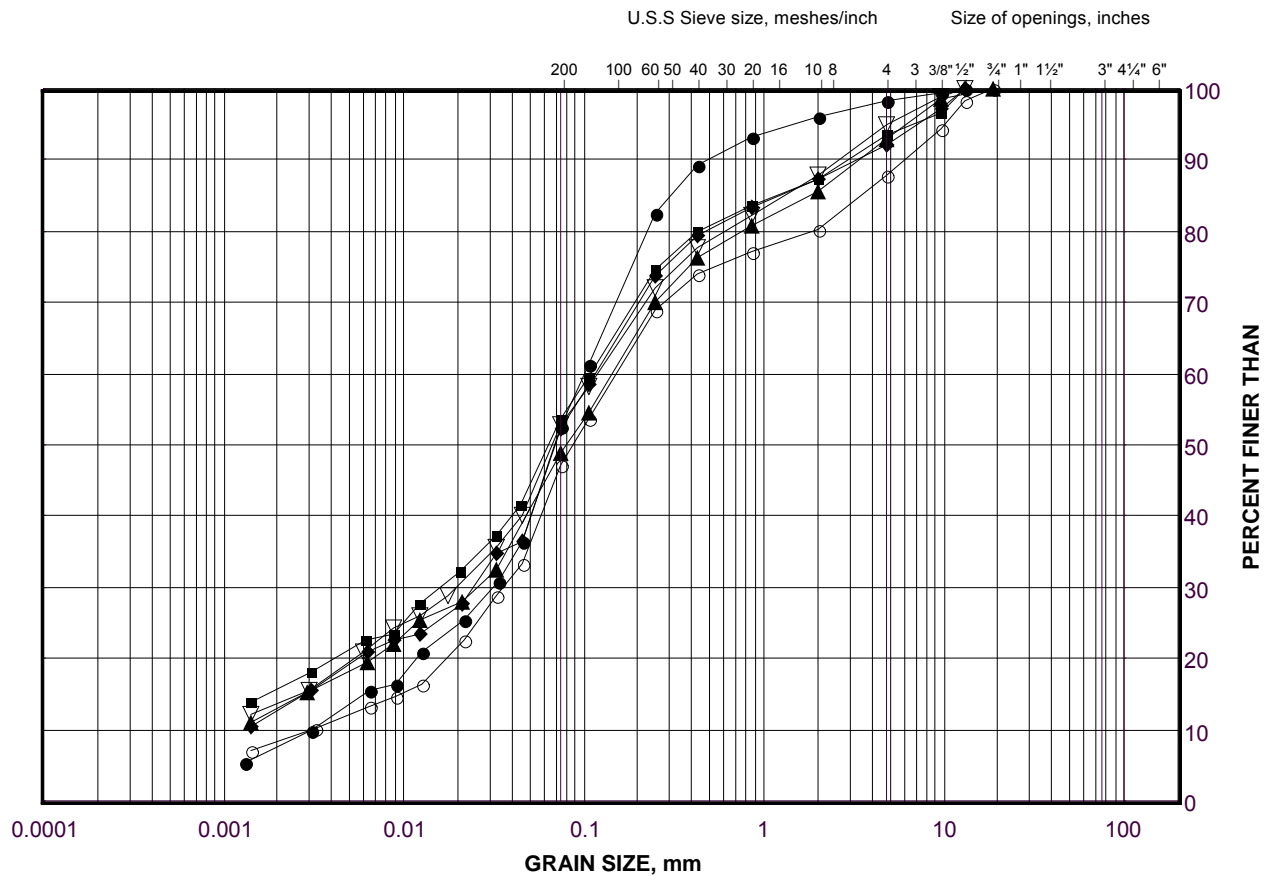
PROJECT		RECORD OF BOREHOLE		No BH13-20		SHEET 1 OF 1		METRIC								
G.W.P. 09-1111-0019		LOCATION		N 4860925.5 ; E 367329.7		ORIGINATED BY		JLC								
DIST		HWY 401		BOREHOLE TYPE		108 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY								
DATUM		Geodetic		DATE		May 31, 2013		CHECKED BY								
								MWK								
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								
109.1	GROUND SURFACE															
0.0	TOPSOIL															
0.2	Silty SAND, some gravel, trace clay, containing rootlets		1	SS	21											
108.4	Compact Brown Moist		2	SS	39											
0.7	SILT and SAND, trace to some clay, trace to some gravel (TILL) Dense to very dense Brown Moist		3	SS	50/0.13											
			4	SS	50/0.08											
			5	SS	50/0.08											
			6	SS	50/0.08											
			7	SS	50/0.13											
			8	SS	50/0.13											
102.9	END OF BOREHOLE															
6.2	NOTE: 1. Open borehole was dry upon completion of drilling.															

PROJECT		RECORD OF BOREHOLE		No BH13-21		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860898.2 ; E 367353.9		ORIGINATED BY		JLC									
DIST		HWY 401		BOREHOLE TYPE		108 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY									
DATUM Geodetic		DATE		June 4, 2013		CHECKED BY		MWK									
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									
108.7	GROUND SURFACE																
0.0	TOPSOIL																
0.2	SILT and SAND, trace to some gravel, some clay, inferred cobbles and boulders at 2.1 m to 4.6 m depth (TILL) Compact to very dense Brown Moist ----- Auger grinding on inferred cobbles and boulders at 2.1 m to 4.6 m depth		1	SS	27												
			2	SS	50/0.15												
			3	SS	50/0.08												
			4	SS	50/0.08												
			5	SS	50/0.08												
			6	SS	50/0.08												
104.1	END OF BOREHOLE		7	SS	50/0.08												
4.7	NOTE: 1. Open borehole was dry upon completion of drilling.																

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silt and Sand (TILL)

FIGURE E1



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

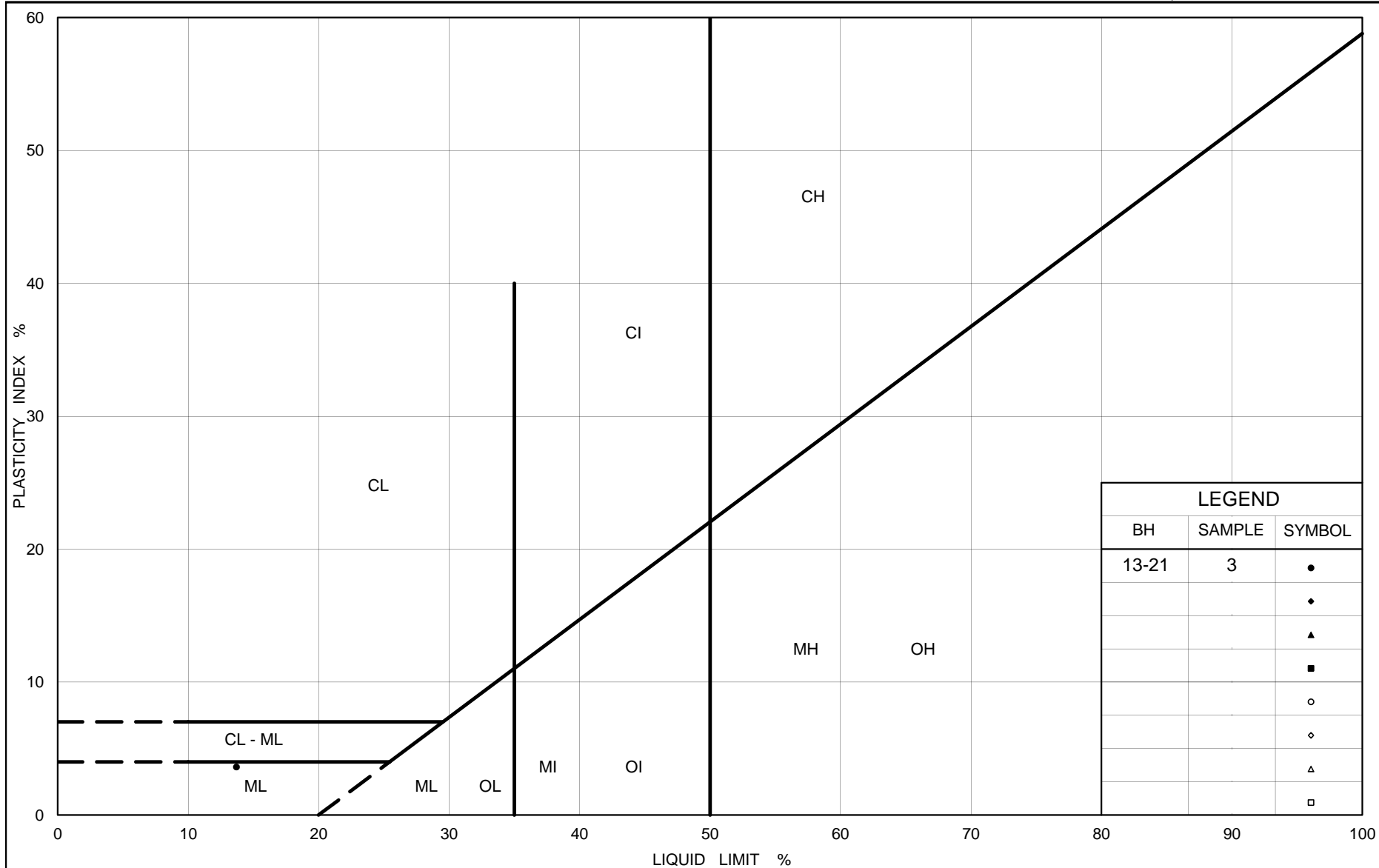
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-20	2	108.1
■	13-21	3	107.2
◆	13-19	5	106.9
▲	13-21	7	104.1
▽	13-19	7	105.4
○	13-20	8	102.9

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt and Sand (TILL)

Figure No. E2

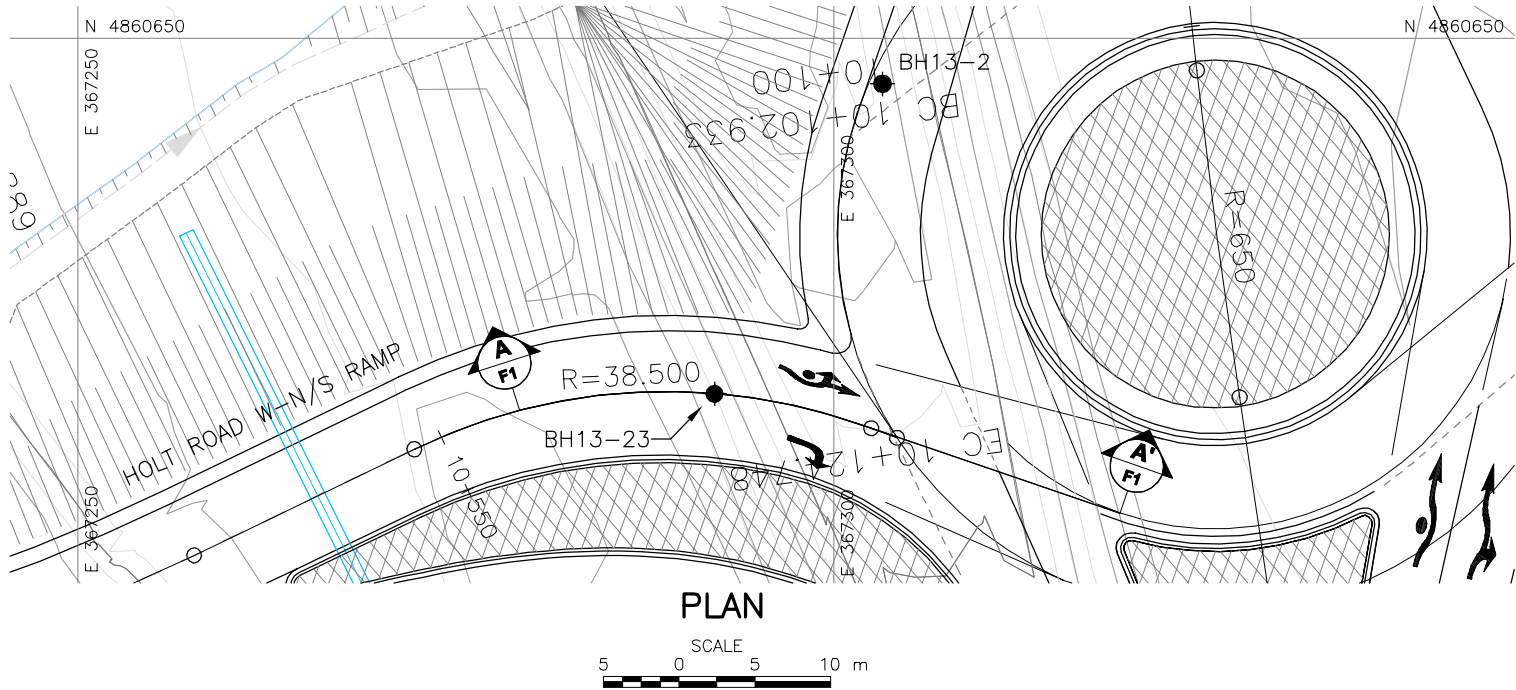
Project No. 09-1111-0019

Checked By:



APPENDIX F

High Fill Area 6 - W- N/S Ramp, STA 11+550 to 11+580



METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2101-08-00

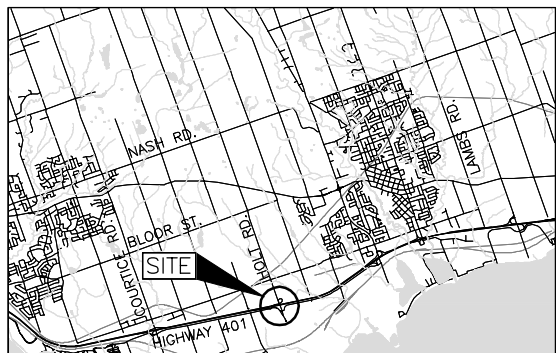


HIGHWAY 401
DEEP CUT AREA 6-HOLT ROAD W-N/S RAMP
(STA 10+550 TO 10+580)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



KEY PLAN

SCALE
2 0 2 4 km

LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- ≡ WL during or upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-2	116.3	4860647.0	367303.2
BH13-23	113.2	4860626.5	367292.1

NOTES

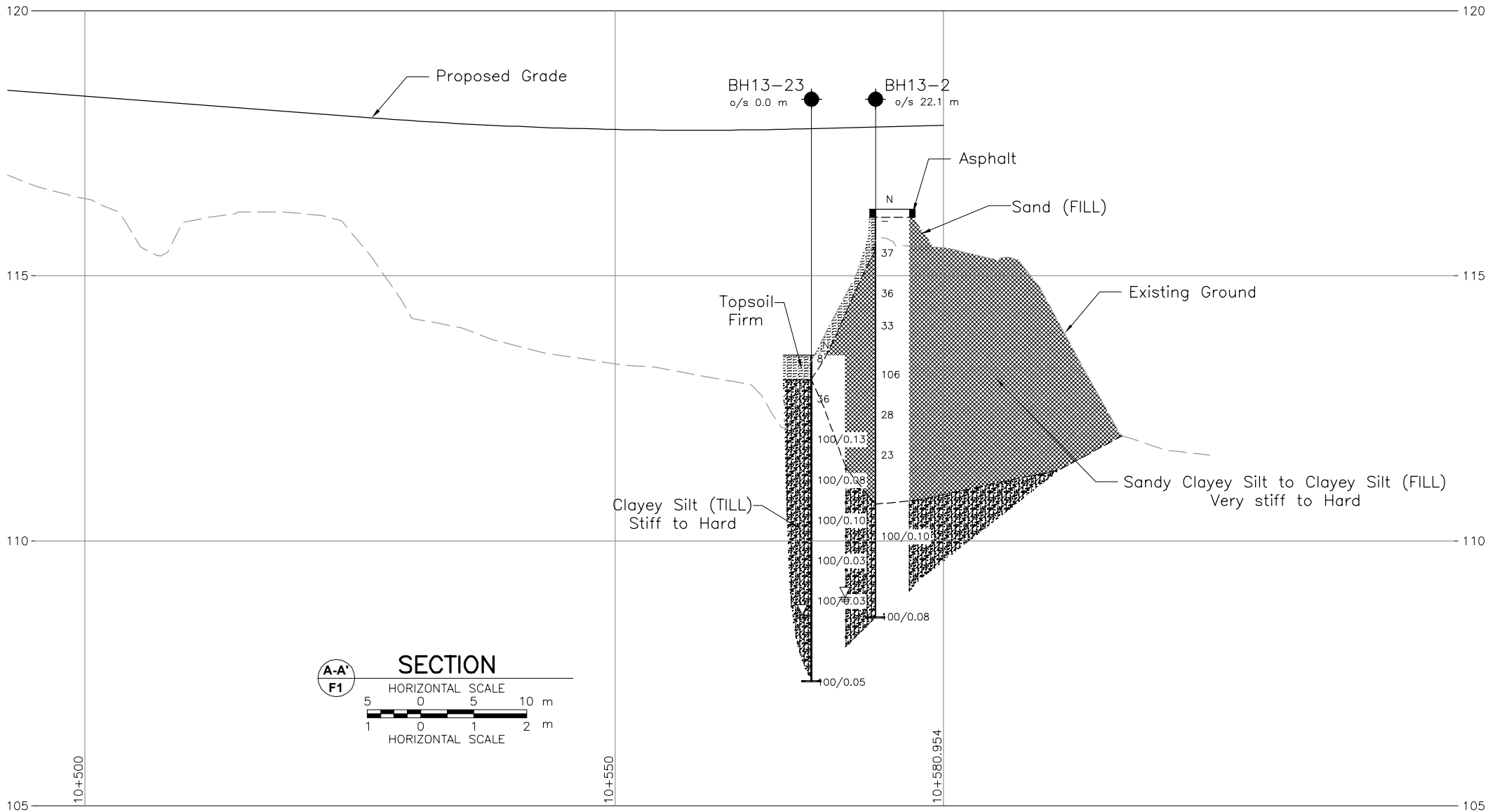
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg and 2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013



A-A'
F1

SECTION

HORIZONTAL SCALE
5 0 5 10 m
1 0 1 2 m
HORIZONTAL SCALE

NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
HWY. 401	PROJECT NO. 09-1111-0019		DIST.
SUBM'D.	CHKD. MWK	DATE: Oct. 2013	SITE: 21-159
DRAWN: JFC	CHKD. KJB	APPD. JMAC	DWG. F1

PROJECT		RECORD OF BOREHOLE		No BH13-2		SHEET 1 OF 1		METRIC								
G.W.P. 2101-08-00		LOCATION		N 4860647.0 ; E 367303.2		ORIGINATED BY		JLC								
DIST		HWY 401		BOREHOLE TYPE		120 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY								
DATUM		Geodetic		DATE		May 30, 2013		CHECKED BY								
								MWK								
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								
116.3	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
0.2	Sand, some gravel, trace silt (FILL)		1	AS	-											
115.5	Brown Moist		2	SS	37											
0.8	Sandy clayey silt to clayey Silt, some sand, trace to some gravel, trace organics and containing rootlets (FILL)		3	SS	36											
	Very stiff to hard		4	SS	33											
	Brown to grey Moist		5	SS	106											
			6	SS	28											
			7	SS	23											
110.7																
5.6	CLAYEY SILT with SAND trace to some gravel, inferred cobbles throughout (TILL)		8	SS	100/0/10											
	Hard Grey Wet															
108.6																
7.7	END OF BOREHOLE		9	SS	100/0/0											
NOTES:																
1. Water level at a depth of 7.3 m below ground surface (Elev. 109.0 m) during drilling.																
2. Borehole caved at a depth of 7.6 m below ground surface (Elev. 108.7 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE		No BH13-23		SHEET 1 OF 1		METRIC													
G.W.P.		LOCATION		ORIGINATED BY		JLC															
DIST		BOREHOLE TYPE		COMPILED BY		BM															
DATUM		DATE		CHECKED BY		MWK															
PROJECT 09-1111-0019		N 4860626.5 ; E 367292.1																			
2101-08-00		120 mm O.D. Continuous Flight Solid Stem Power Auger																			
Geodetic		May 30, 2013																			
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
113.2	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30											
0.0	TOPSOIL																				
112.7	Firm		1	SS	8		113														
0.5	Dark brown Moist		2	SS	36		112														
	CLAYEY SILT with SAND trace to some gravel, inferred cobbles and boulders throughout (TILL)		3	SS	100/0.13		111														
	Hard		4	SS	100/0.08		110														
	Brown to grey Moist		5	SS	100/0.10		109														
			6	SS	100/0.09		108														
			7	SS	100/0.09		107														
107.1	END OF BOREHOLE		8	SS	100/0.09																
6.2	NOTE:																				
	1. Water level in open borehole at a depth of 4.9 m below ground surface (Elev. 108.3 m) upon completion of drilling.																				

Clayey Silt (FILL)

U.S.S Sieve size, meshes/inch

Size of openings, inches

PERCENT FINER THAN

GRAIN SIZE, mm

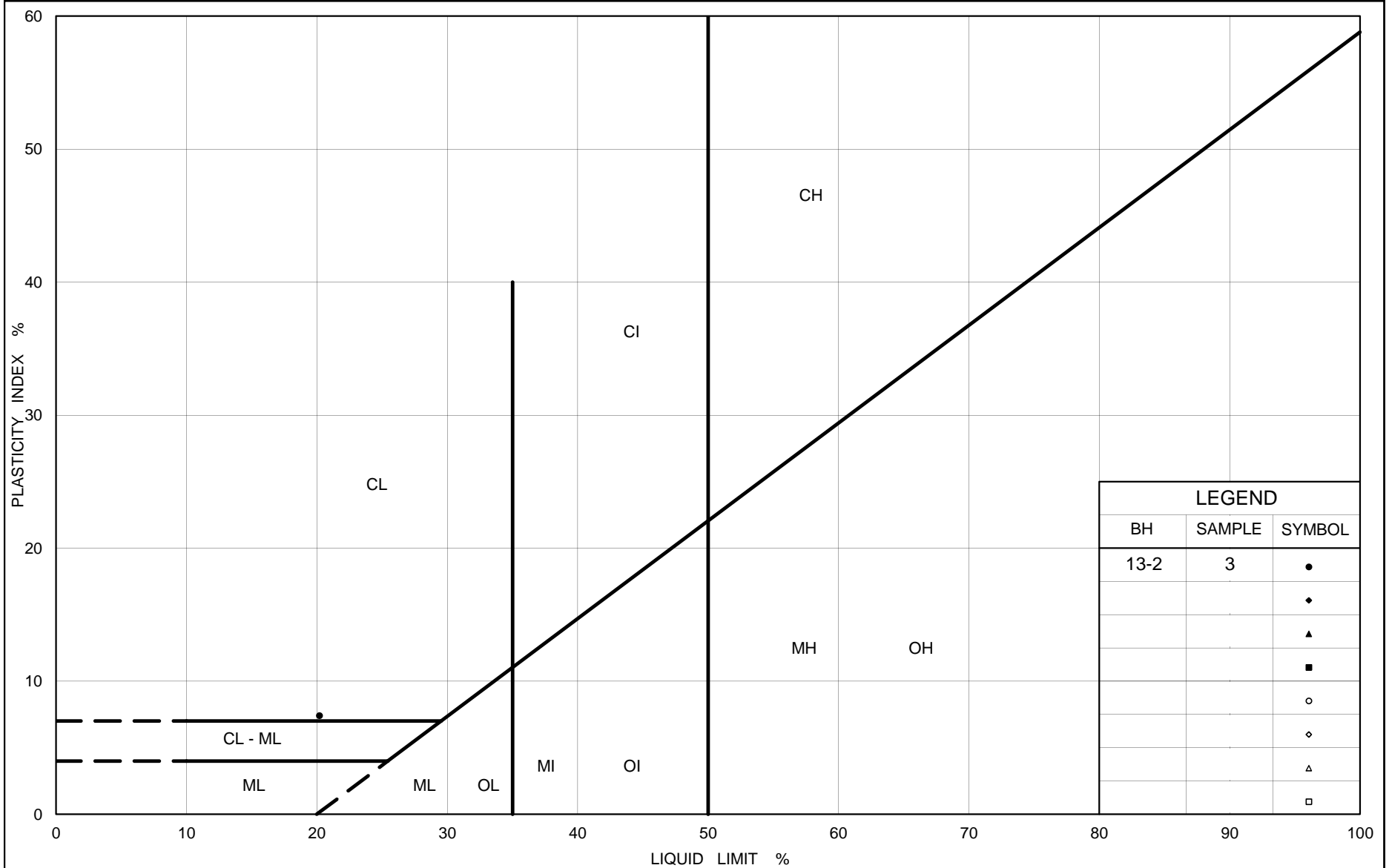
Grain Size (mm)	Percent Finer Than (%) - Upper Curve (Squares)	Percent Finer Than (%) - Lower Curve (Circles)
0.0075	18	15
0.015	25	22
0.03	35	30
0.06	45	40
0.12	60	55
0.25	75	70
0.5	85	78
1.0	90	82
2.0	95	85
4.0	98	88
8.0	100	90
16.0	100	92
32.0	100	92
64.0	100	92
128.0	100	92
256.0	100	92
512.0	100	92
1024.0	100	92
2048.0	100	92
4096.0	100	92
8192.0	100	92
16384.0	100	92
32768.0	100	92
65536.0	100	92
131072.0	100	92
262144.0	100	92
524288.0	100	92
1048576.0	100	92
2097152.0	100	92
4194304.0	100	92
8388608.0	100	92
16777216.0	100	92
33554432.0	100	92
67108864.0	100	92
134217728.0	100	92
268435456.0	100	92
536870912.0	100	92
1073741824.0	100	92
2147483648.0	100	92
4294967296.0	100	92
8589934592.0	100	92
17179869184.0	100	92
34359738368.0	100	92
68719476736.0	100	92
137438953472.0	100	92
274877906944.0	100	92
549755813888.0	100	92
1099511627776.0	100	92
2199023255552.0	100	92
4398046511104.0	100	92
8796093022208.0	100	92
17592186044416.0	100	92
35184372088832.0	100	92
70368744177664.0	100	92
140737488355328.0	100	92
281474976710656.0	100	92
562949953421312.0	100	92
1125899906842624.0	100	92
2251799813685248.0	100	92
4503599627370496.0	100	92
9007199254740992.0	100	92
18014398509481984.0	100	92
36028797018963968.0	100	92
72057594037927936.0	100	92
144115188075855872.0	100	92
288230376151711744.0	100	92
576460752303423488.0	100	92
1152921504606846976.0	100	92
2305843009213693952.0	100	92
4611686018427387904.0	100	92
9223372036854775808.0	100	92
18446744073709551616.0	100	92
36893488147419103232.0	100	92
73786976294838206464.0	100	92
147573952589676412928.0	100	92
295147905179352825856.0	100	92
590295810358705651712.0	100	92
1180591620717411303424.0	100	92
2361183241434822606848.0	100	92
4722366482869645213696.0	100	92
9444732965739290427392.0	100	92
18889465931478580854784.0	100	92
37778931862957161709568.0	100	92
75557863725914323419136.0	100	92
151115727451828646838272.0	100	92
302231454903657293676544.0	100	92
604462909807314587353088.0	100	92
120892581961462917		

SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

●	13-2	3	114.5
■	13-2	5	113.0

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. F2

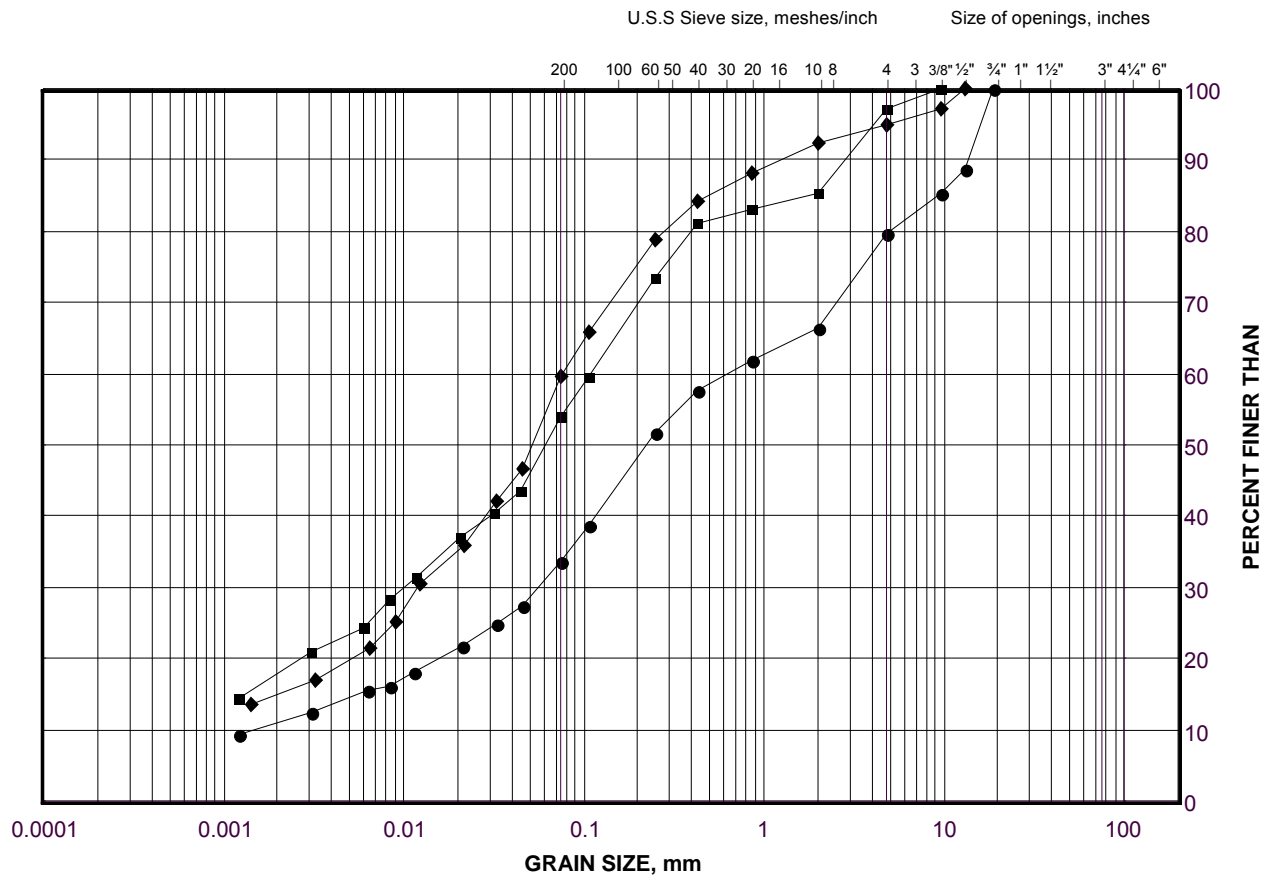
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE F3



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

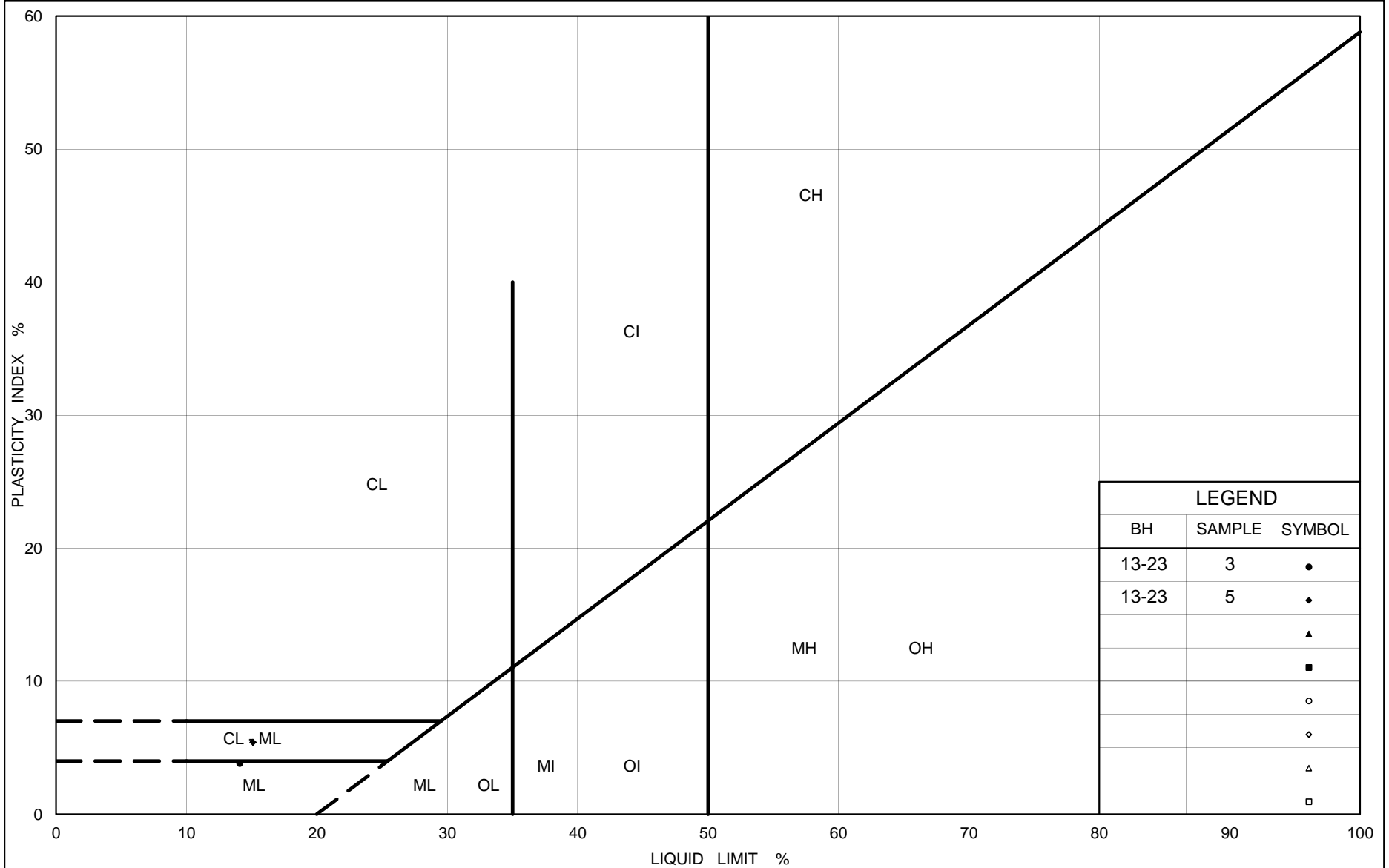
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-23	3	111.6
■	13-23	5	110.1
◆	13-2	8	110.1

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 06-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART Silt (TILL)

Figure No. F4

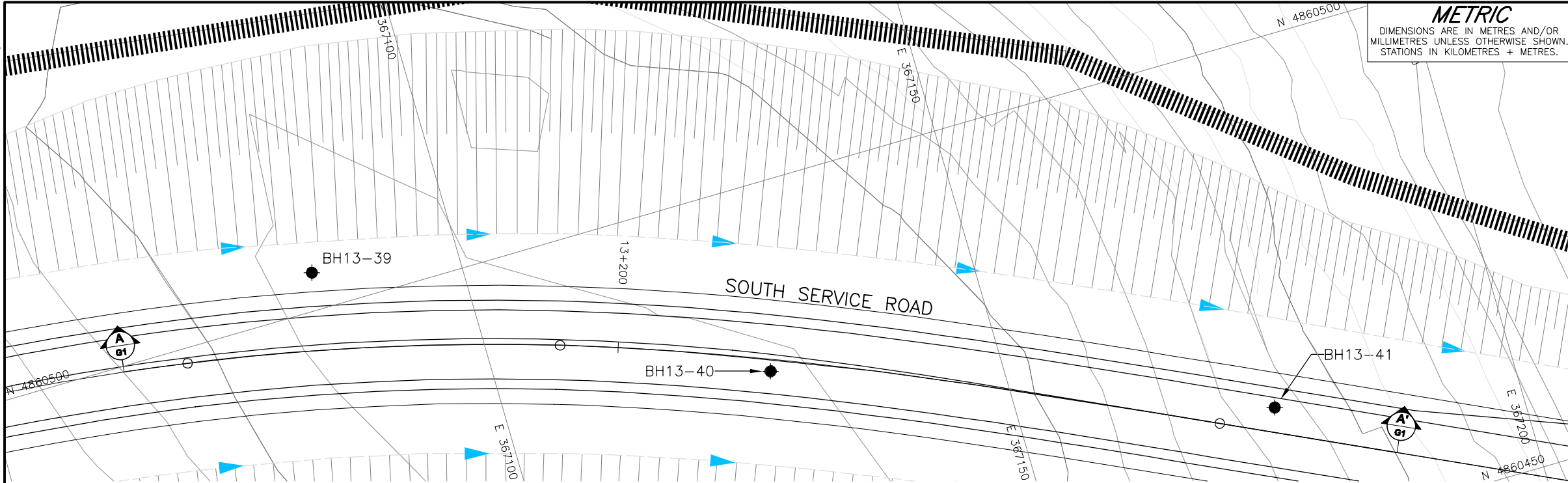
Project No. 09-1111-0019

Checked By:

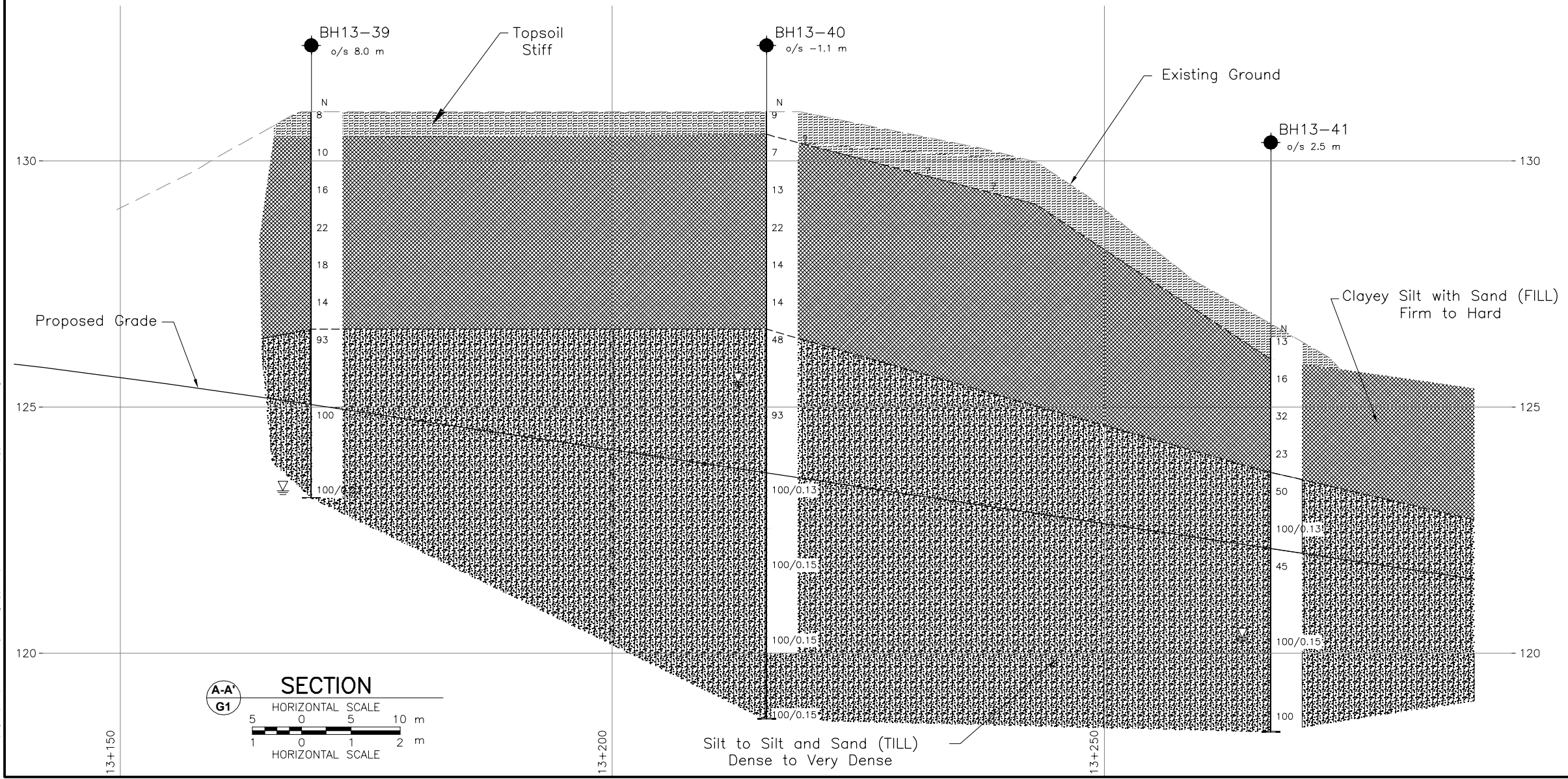


APPENDIX G

Deep Cut Area 7 - South Service Road, STA 13+160 to 13+265



PLAN
SCALE
5 0 5 10 m



A-A'
G1
SECTION
HORIZONTAL SCALE
5 0 5 10 m
1 0 1 2 m
HORIZONTAL SCALE

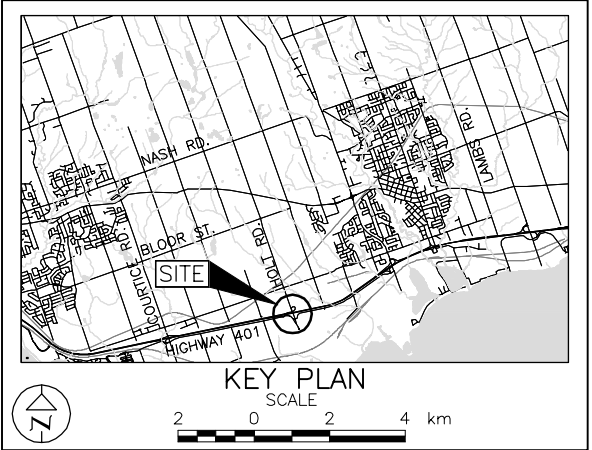
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No.2101-08-00

SHEET

HIGHWAY 401
DEEP CUT AREA 7-SOUTH SERVICE ROAD
(STA 13+160 TO 13+265)
BOREHOLE LOCATIONS AND SOIL STRATA

Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow)
- WL during or upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-39	131.0	4860503.8	367085.2
BH13-40	131.0	4860481.2	367127.2
BH13-41	126.4	4860463.4	367175.4

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg,
2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013 and Existing Ground Surface cut from Topo drawing file no. ACAD-X-base.dwg, received September 9, 2013.

NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
HWY. 401	PROJECT NO. 09-1111-0019		DIST.
SUBM'D.	CHKD. MWK	DATE: Oct. 2013	SITE: 21-159
DRAWN: JFC	CHKD. KJD	APPD. JMAC	DWG. G1

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

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT		RECORD OF BOREHOLE		No BH13-40		SHEET 1 OF 1		METRIC																	
G.W.P.		LOCATION		ORIGINATED BY		JLC																			
DIST		BOREHOLE TYPE		COMPILED BY		BM																			
DATUM		DATE		CHECKED BY		MWK																			
PROJECT 09-1111-0019		N 4860481.2 ; E 367127.2																							
G.W.P. 2101-08-00		LOCATION																							
DIST		BOREHOLE TYPE 120 mm O.D. Continuous Flight Solid Stem Power Auger																							
DATUM Geodetic		DATE June 11, 2013																							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																			
131.0	0.0	GROUND SURFACE																							
130.5	0.5	TOPSOIL Stiff Dark brown Moist		1	SS	9																			
		Clayey silt with sand, trace gravel, trace organics (FILL) Firm to very stiff Dark brown to brown Moist		2	SS	7																			
				3	SS	13																			
				4	SS	22																			
				5	SS	14																			
				6	SS	14																			
126.6	4.4	SILT and SAND, trace to some clay, trace to some gravel, inferred cobbles and boulders throughout (TILL) Dense to very dense Grey to brown Dry to moist		7	SS	48																			
				8	SS	93																			
				9	SS	100/0.15																			
122.5	8.5	Sandy SILT, trace clay, trace gravel, inferred cobbles and boulders throughout (TILL) Very dense Brown Dry to moist		10	SS	100/0.15																			
				11	SS	100/0.15																			
				12	SS	100/0.15																			
118.7	12.3	END OF BOREHOLE																							
		NOTES:																							
		1. Water level at a depth of 5.5 m below ground surface (Elev. 125.5 m) during drilling.																							
		2. Borehole caved at a depth of 6.1 m below ground surface (Elev. 124.9 m) upon completion of drilling.																							

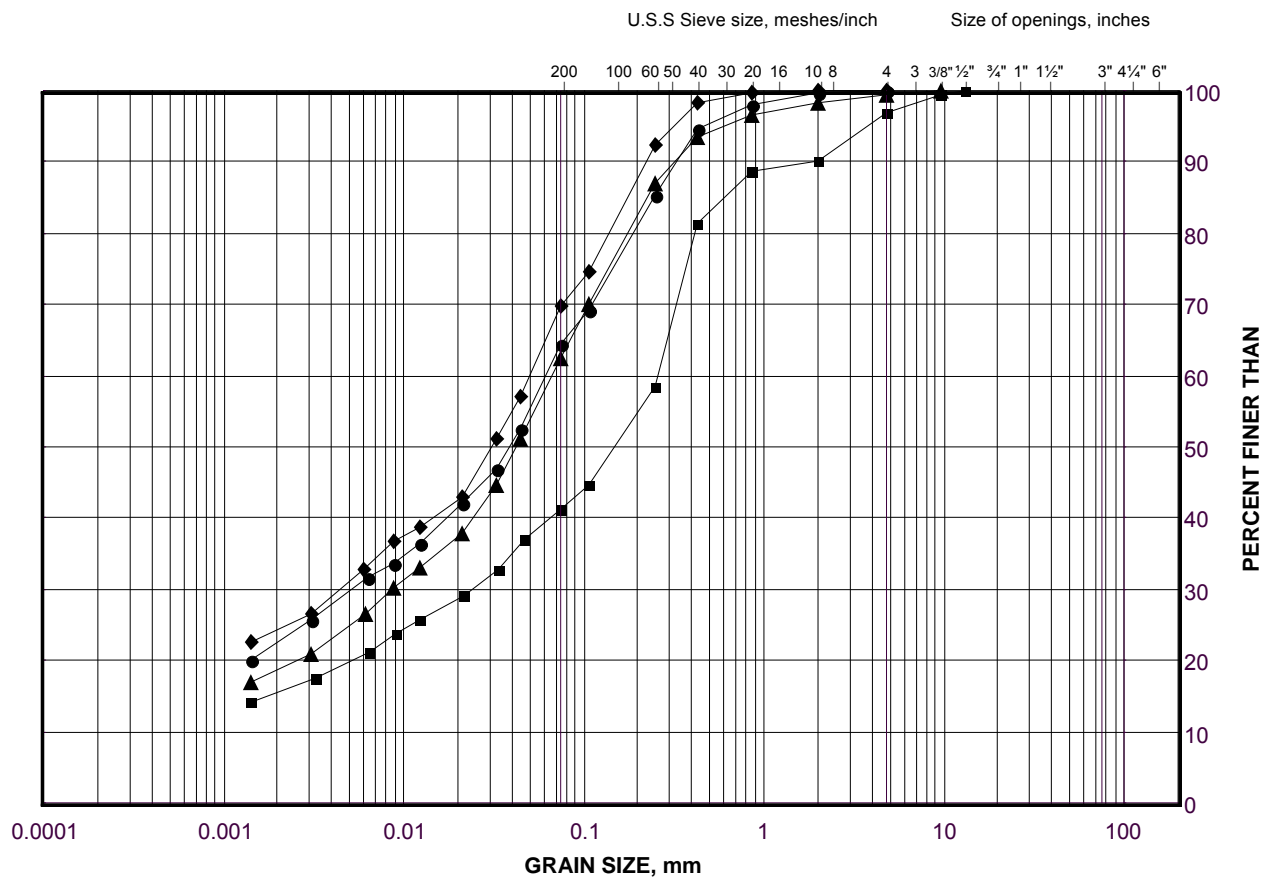
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE G1



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

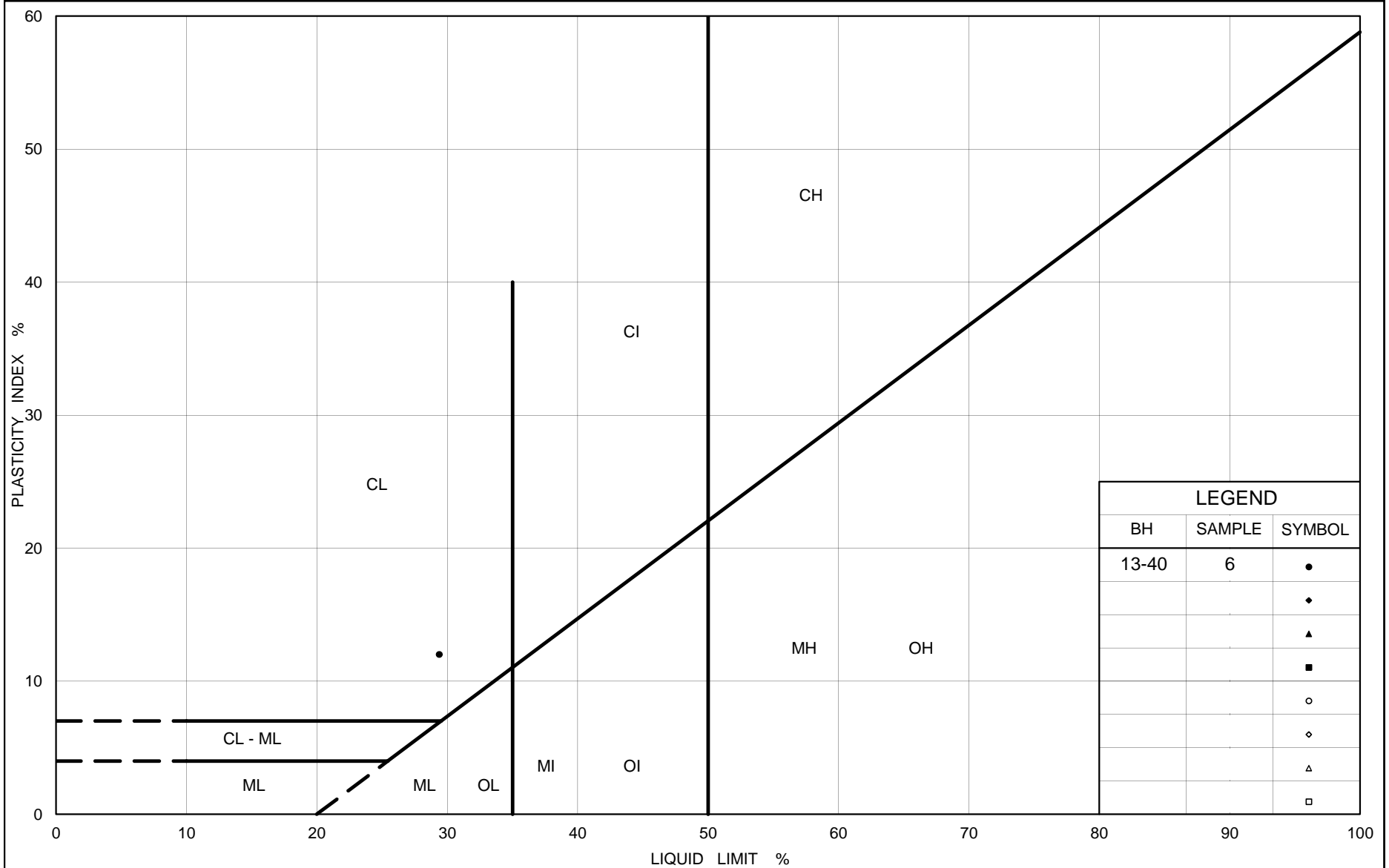
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-39	3	129.3
■	13-41	3	124.7
◆	13-40	4	128.5
▲	13-40	6	126.9

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 06-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (FILL)

Figure No. G2

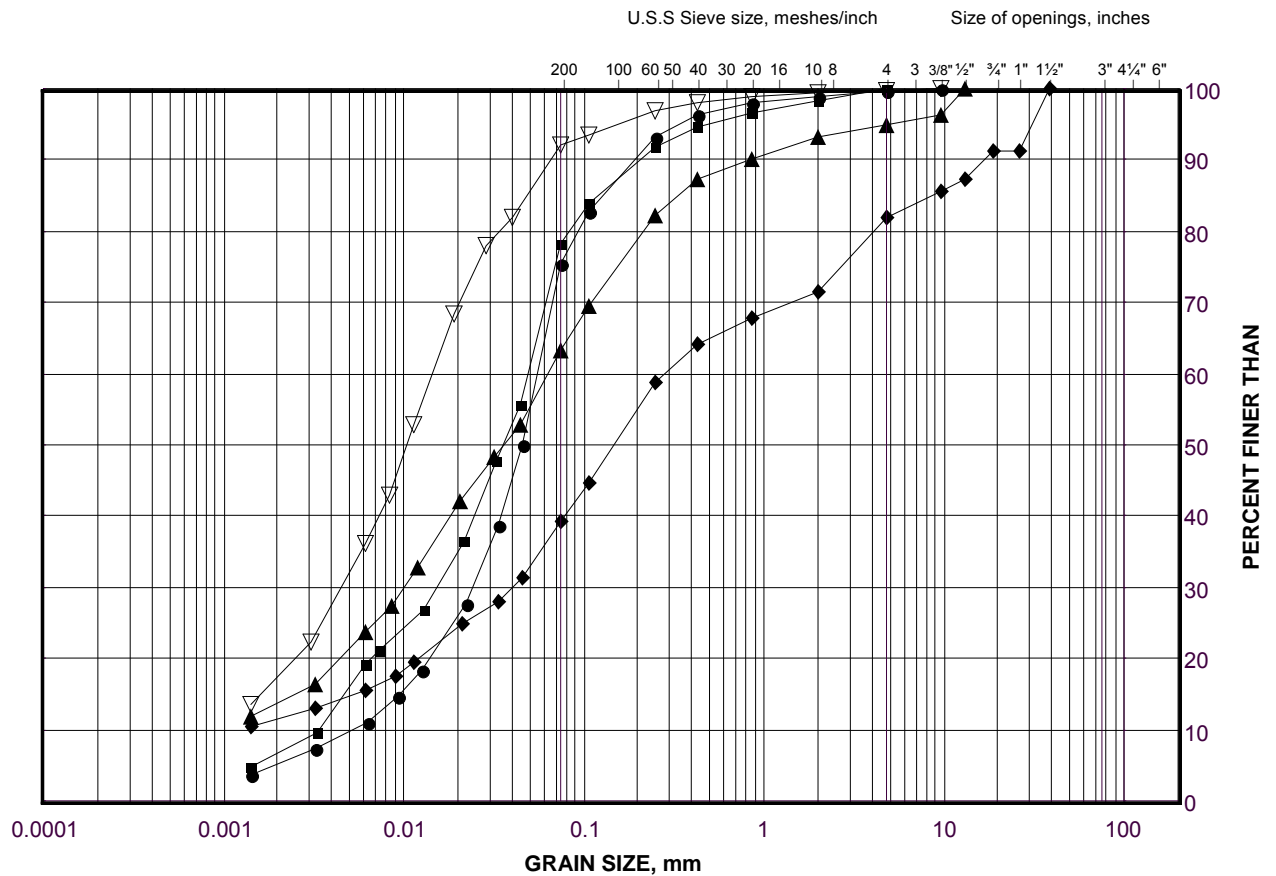
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Silt to Silt and Sand (TILL)

FIGURE G3



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

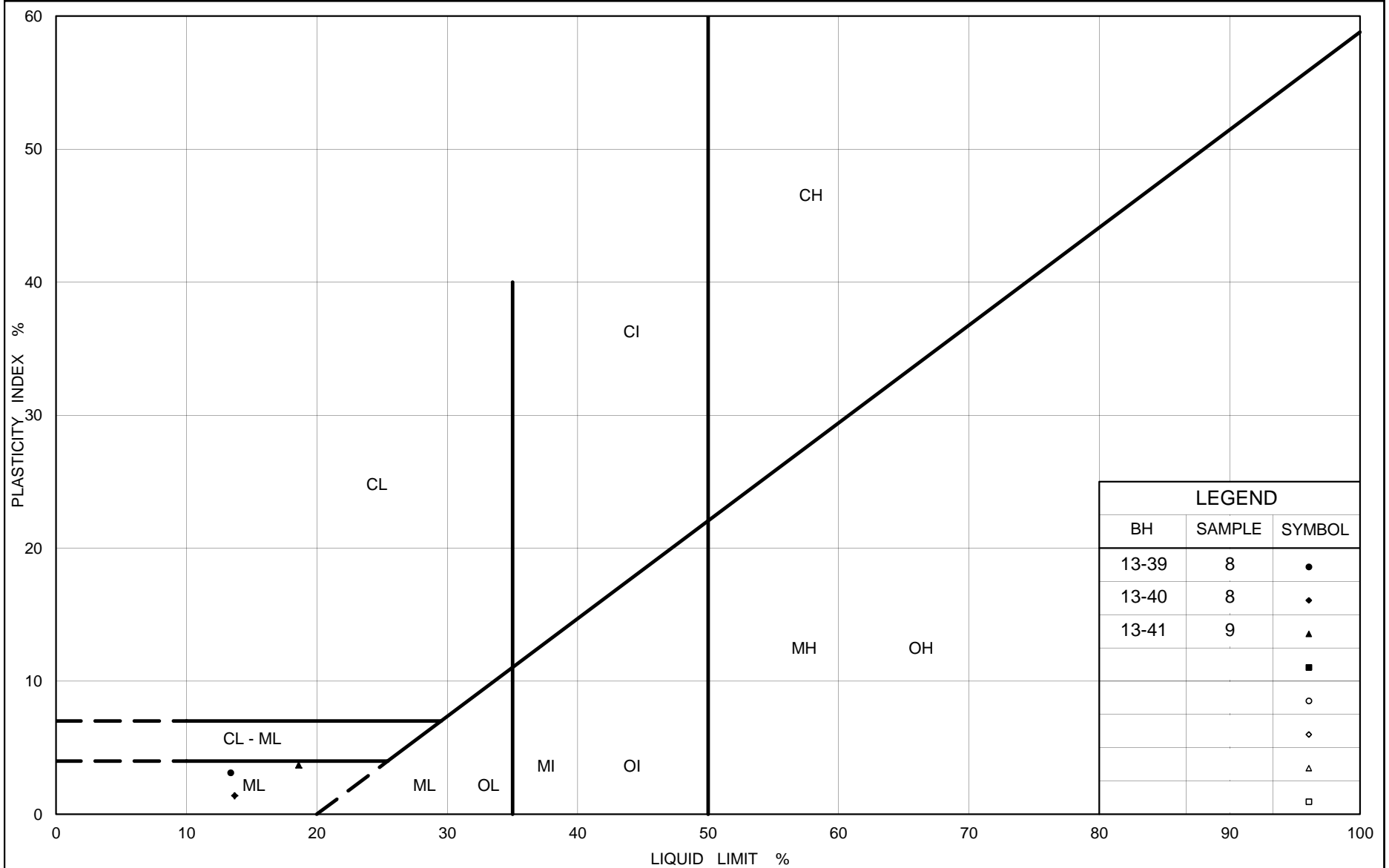
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-40	11	120.3
■	13-41	7	121.6
◆	13-39	8	124.7
▲	13-40	8	124.7
▽	13-41	9	118.6

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 01-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt to Silt and Sand (TILL)

Figure No. G4

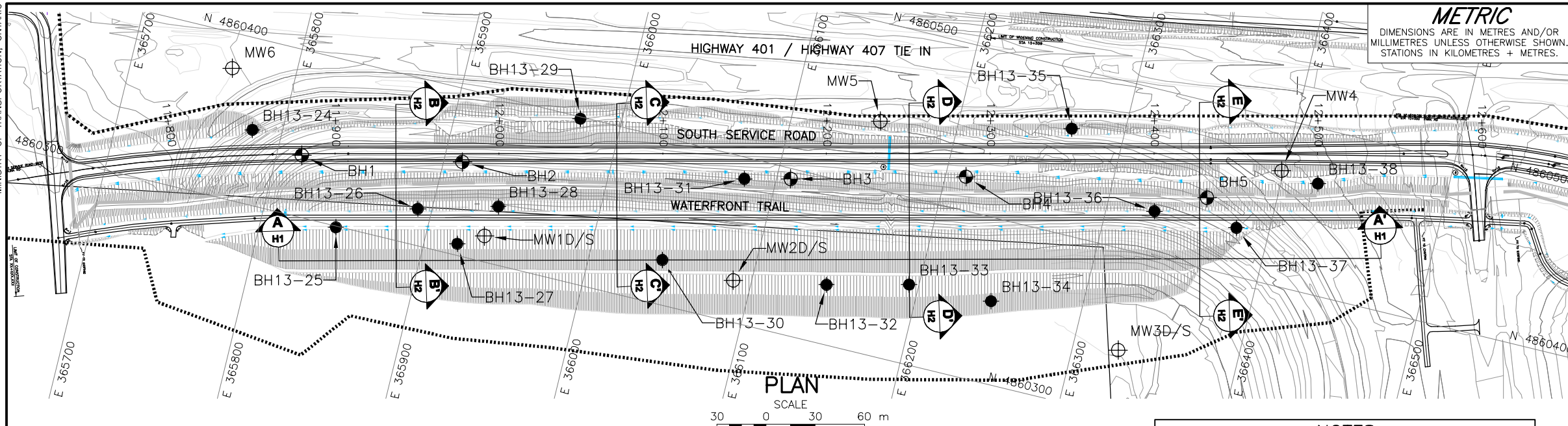
Project No. 09-1111-0019

Checked By:



APPENDIX H

**Deep Cut Area 8 - South Service Road (Soil Disposal Mound),
STA 11+850 to 12+500**

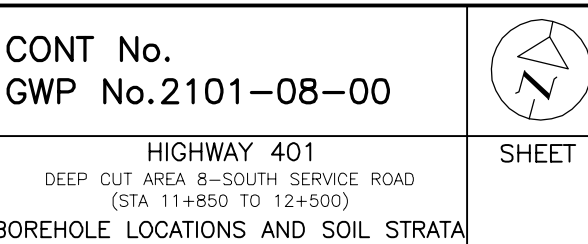
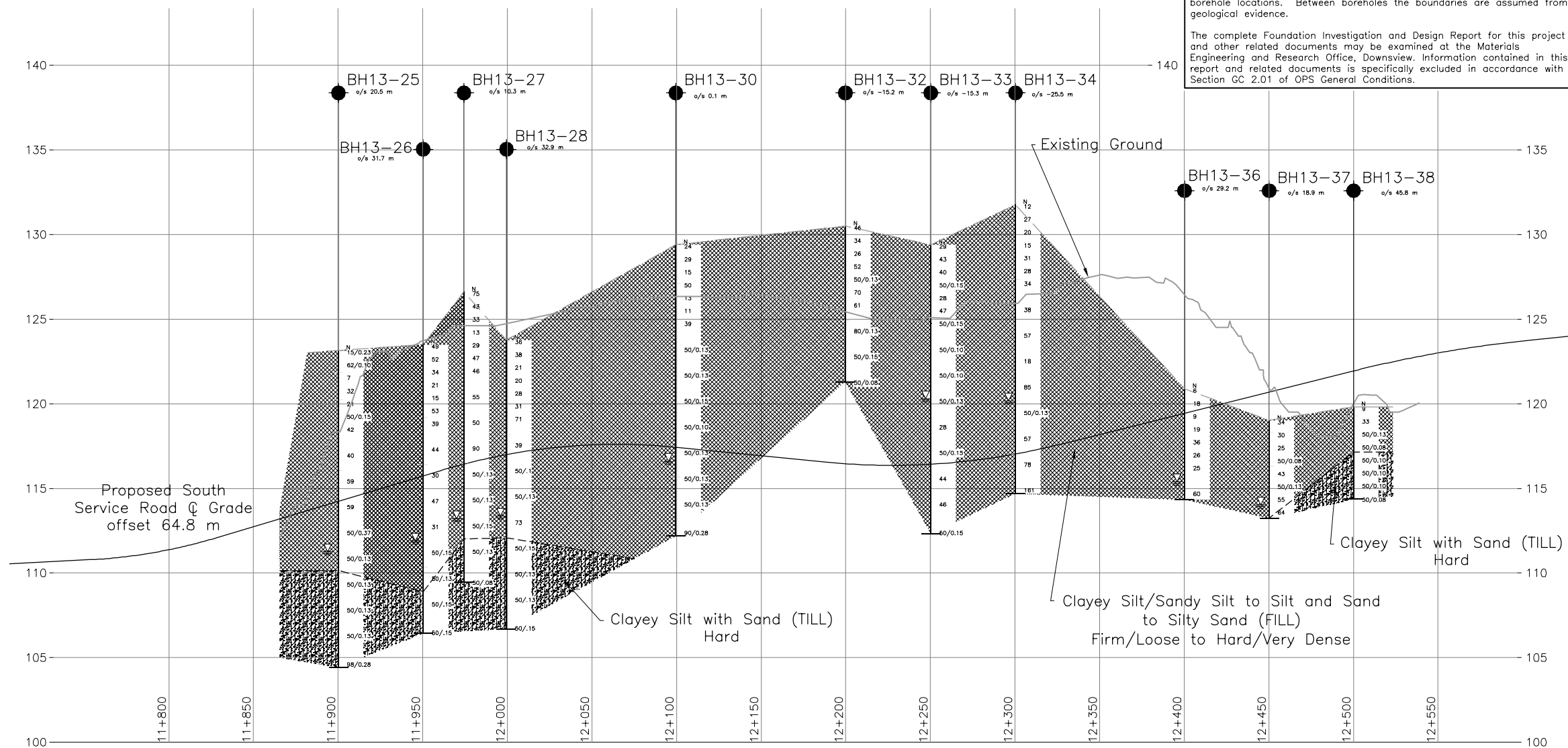


NOTES

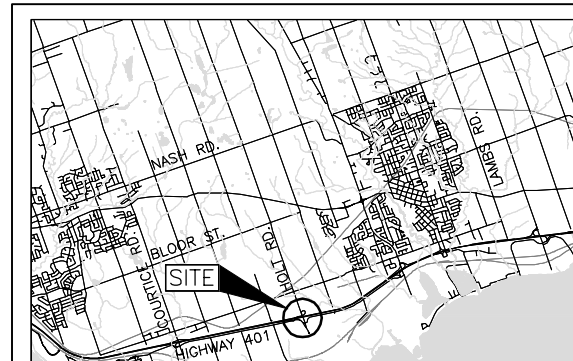
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.





The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.



Golder Associates Ltd.
MISSISSAUGA, ONTARIO, CANADA



LEGEND

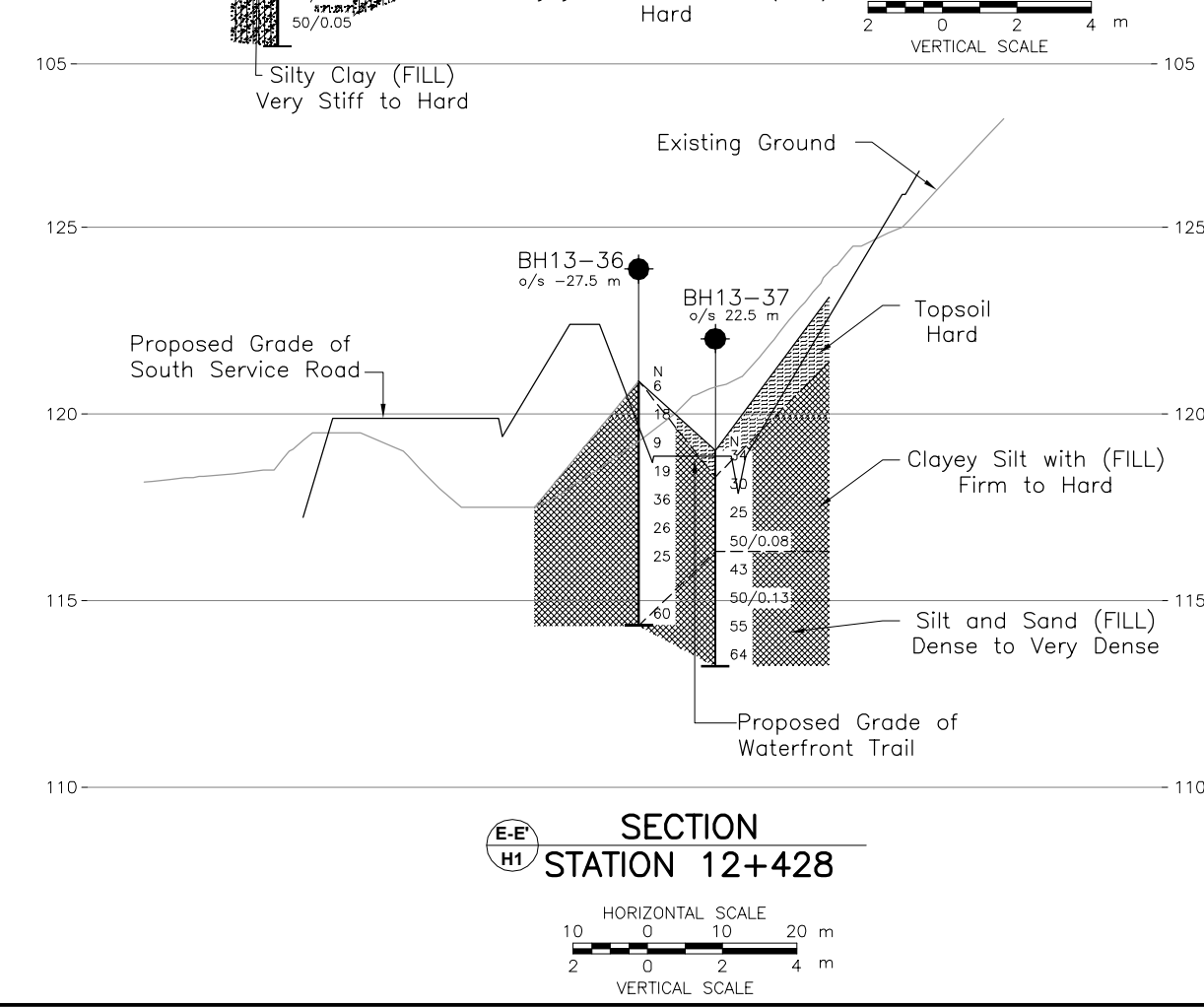
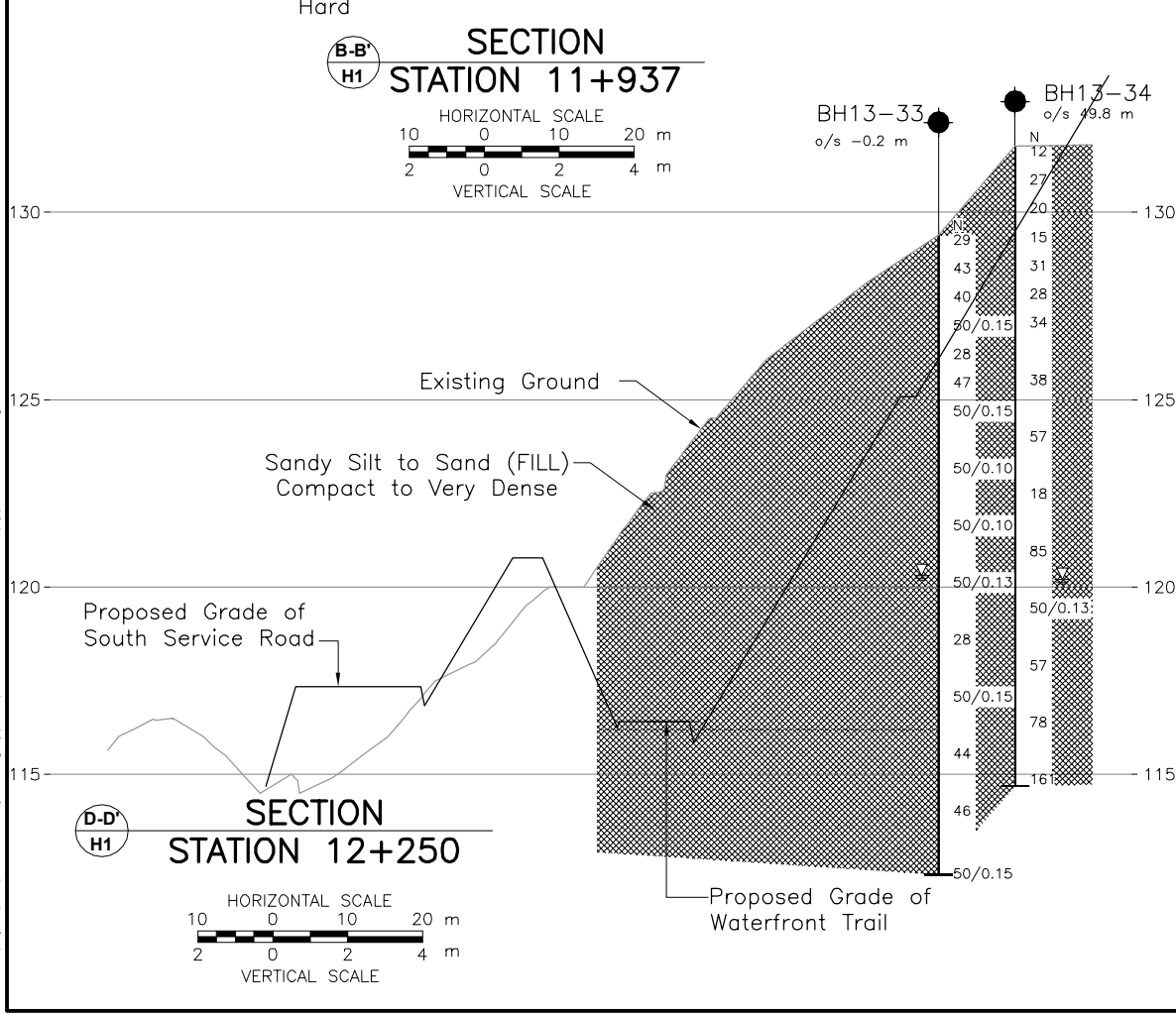
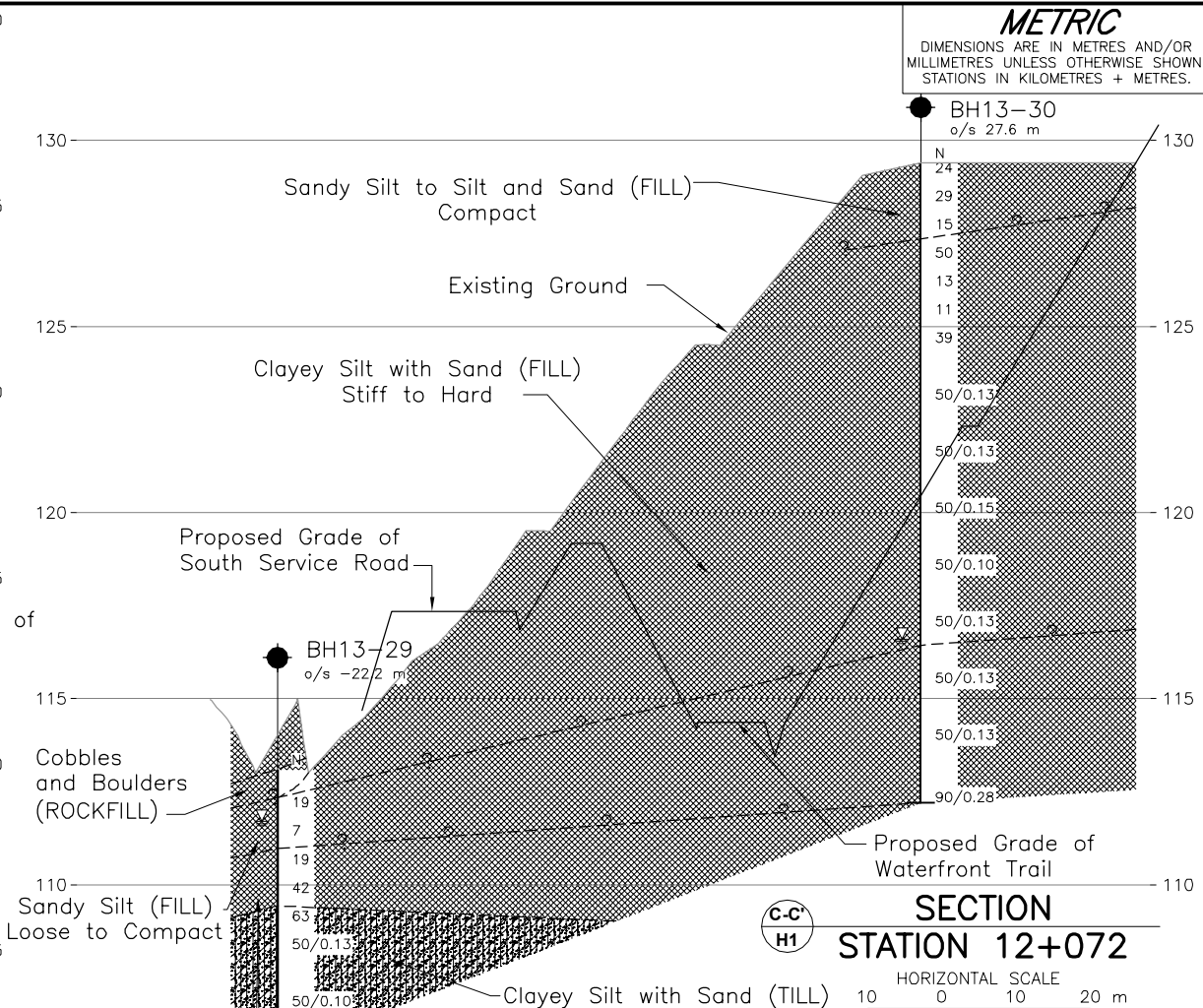
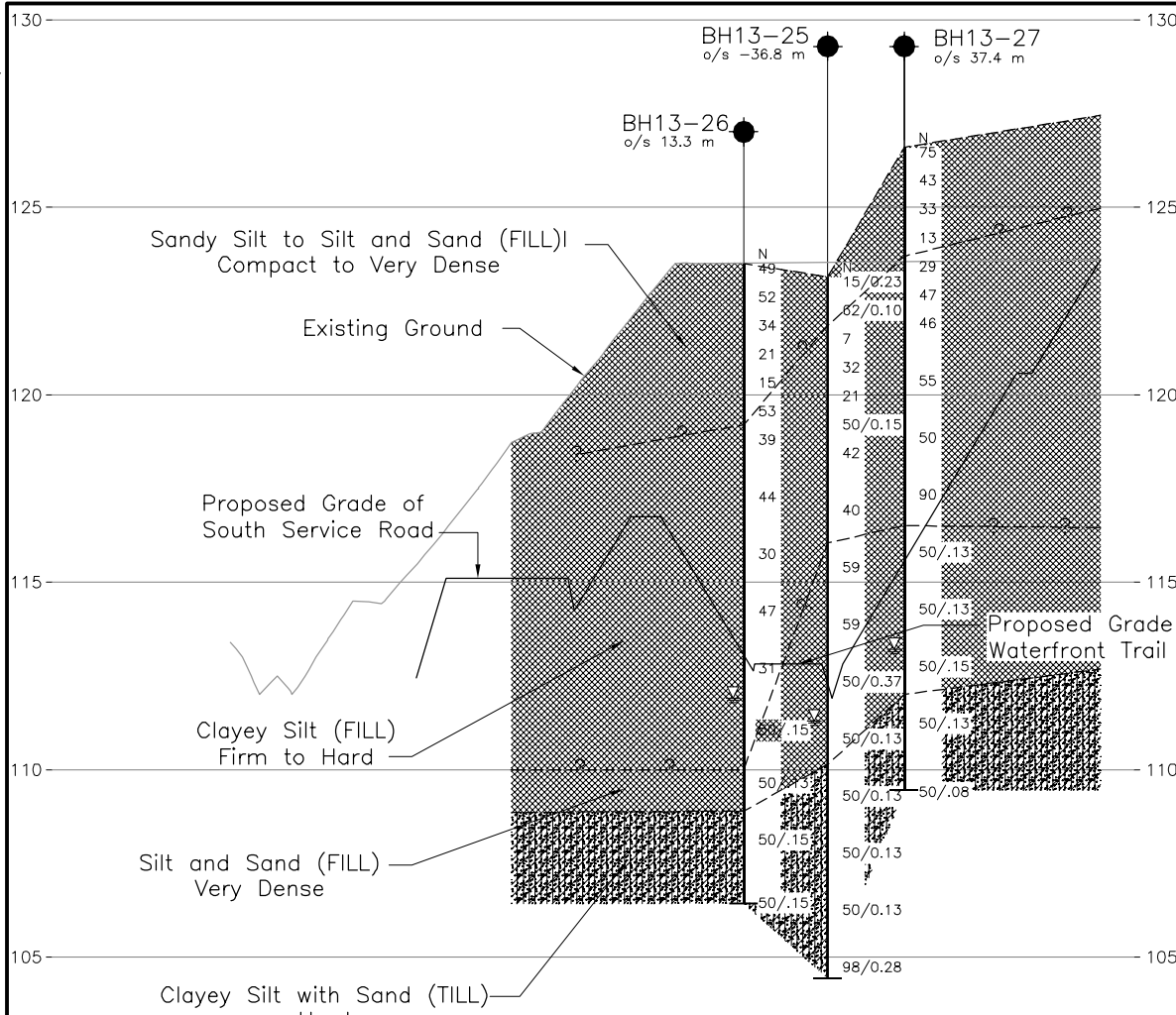
- | | |
|---|--|
|  | Borehole – Current Investigation |
|  | Existing Borehole (Ecoplans, 2010) |
|  | Existing Monitoring Well (Ecoplans, 2010) |
| N | Standard Penetration Test Value |
| 16 | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |
|  | WL during or upon completion of drilling |

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH13-24	112.5	4860345.0	365782.0
BH13-25	123.2	4860299.2	365845.5
BH13-26	123.5	4860322.0	365891.5
BH13-27	126.6	4860307.0	365920.0
BH13-28	123.8	4860335.0	365939.0
BH13-29	113.1	4860399.0	365975.0
BH13-30	129.4	4860327.0	366044.0
BH13-31	118.9	4860387.0	366081.0
BH13-32	130.5	4860336.0	366145.0
BH13-33	129.4	4860348.0	366194.0
BH13-34	131.8	4860350.0	366245.0
BH13-35	117.9	4860464.0	366268.0
BH13-36	120.9	4860427.0	366329.0
BH13-37	119.0	4860429.0	366380.0
BH13-38	119.8	4860467.0	366422.0

REFERENCE

Base plan provided in digital format by URS, drawing file no. 2013-10-24-Hwy401-HoltRd_plan.dwg, 2013-10-24-Hwy401-HoltRd_profile.dwg, received October 23, 2013 and Existing Ground Surface cut from Topo drawing file no. ACAD-X-base.dwg, received September 9, 2013.

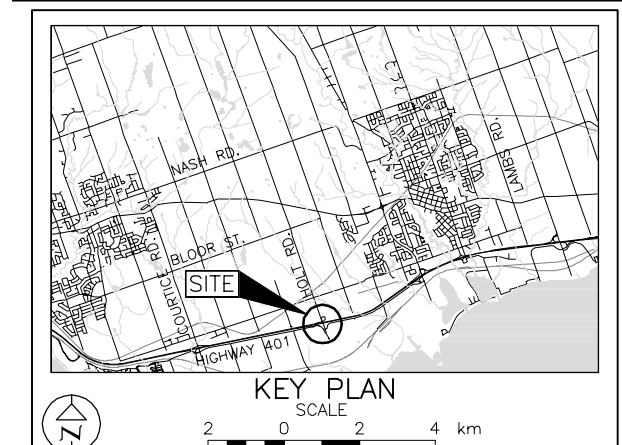
NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
Hwy. 401	PROJECT NO. 09-1111-0019		DIST.
SUBM'D.	CHKD. MWK	DATE: 01/10/2013	SITE: 21-159
DRAWN: JFC/GY	CHKD. KJD	APPD. JMAC	DWG. H1



CONT No.
GWP No. 2101-08-00

HIGHWAY 401
DEEP CUT AREA 8-SOUTH SERVICE ROAD
SOIL STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL during or upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
BH13-25	123.2	4860299.2	365845.5
BH13-26	123.5	4860322.0	365891.5
BH13-27	126.6	4860307.0	365920.0
BH13-29	113.1	4860399.0	365975.0
BH13-30	129.4	4860327.0	366044.0
BH13-33	129.4	4860348.0	366194.0
BH13-34	131.8	4860350.0	366245.0
BH13-36	120.9	4860427.0	366329.0
BH13-37	119.0	4860429.0	366380.0

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Original Ground Surface cut from digital file provided by URS
 ACAD-X-base.dwg, received September 9, 2013.





NO.	DATE	BY	REVISION
Geocres No. 30M15-158			
HWY. 401		PROJECT NO. 09-1111-0019 DIST.	
SUBM'D.	CHKD. MWK	DATE: Oct. 2013	SITE: 21-159
DRAWN: JFC	CHKD. KJB	APPD. JMAC	DWG. H2

PROJECT		RECORD OF BOREHOLE		No BH13-24		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860345.0 ; E 365782.0		ORIGINATED BY		KT									
DIST		HWY 401		BOREHOLE TYPE		150 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY									
DATUM		Geodetic		DATE		August 15, 2013		CHECKED BY									
								MWK									
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									
112.5	GROUND SURFACE																
0.0	Silt and sand, some gravel, some clay, containing rootlets and trace organics (FILL) Compact to dense Greyish brown Moist		1	SS	20												18 34 34 14
111.1			2	SS	42												
1.4	CLAYEY SILT with sand, some gravel to gravelly (TILL) Hard Greyish brown Moist		3	SS	49												
			4	SS	82												
			5	SS	59												
	Oxidation staining from 3.1 m to 8.1 m depths		6	SS	50/0.06												
			7	SS	40												26 34 27 13
			8	SS	50/0.28												
			9	SS	50/0.28												
103.1	END OF BOREHOLE		10	SS	50/0.13												
9.4	NOTE: 1. Open borehole dry upon completion of drilling.																

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-25		SHEET 2 OF 2		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860299.2 ; E 365845.5</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>August 22, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED						WATER CONTENT (%)						
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100									
	CLAYEY SILT with SAND some gravel (TILL) Hard Brownish grey Moist		14	SS	50/0.13										○						
					15	SS	50/0.13														
104.5			16	SS	98/0.28										○	┌				18 42 27 13	
18.7	END OF BOREHOLE																				
	NOTE: 1. Water level in open borehole at a depth of 11.9 m below ground surface (Elev. 111.3 m) upon completion of drilling.																				

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-26		SHEET 1 OF 2		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860322.0 ; E 365891.5</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>August 22, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED									
											WATER CONTENT (%) 10 20 30						
123.5	GROUND SURFACE																
0.0	Silt and sand, trace clay to clayey, trace gravel, trace rootlets (FILL) Compact to very dense Greyish brown Moist		1	SS	49								○				
			2	SS	52												
			3	SS	34									○			
			4	SS	21												
			5	SS	15									○			
			6	SS	53												
119.2																	
4.3	Silty clay, some sand, trace gravel (FILL) Hard Grey Moist		7	SS	39								⦿				
			8	SS	44												
116.4																	
7.1	Clayey silt, some sand (FILL) Hard Grey Moist to wet		9	SS	30								⦿				
			10	SS	47												
			11	SS	31									○			
			12	SS	50/15												
			13	SS	50/13												
			14														
110.3																	
13.2	Silt and sand, trace clay (FILL) Very dense Grey Moist to Wet		13	SS	50/13								○				
			14														
108.9																	
14.6																	

Continued Next Page


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

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-26		SHEET 2 OF 2		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860322.0 ; E 365891.5</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>August 22, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)								
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100		10	20	30					
106.4 17.1	CLAYEY SILT with SAND trace gravel (TILL) Hard Brown to grey Moist		14	SS	50/15		108														
							107														
	END OF BOREHOLE		15	SS	50/15																
	NOTE: 1. Water level encountered at a depth of 11.6 m below ground surface (Elev. 111.9 m) during drilling.																				

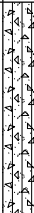
PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-27		SHEET 1 OF 2		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860307.0 ; E 365920.0</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>August 22, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT 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 (%)				GR	SA	SI	CL	
								20	40	60	80	100	w _p	w	w _L						
126.6	GROUND SURFACE																				
0.0	Clayey silt, trace to some sand, trace organics (rootlets) in upper 1.5 m, containing pockets of silty clay (FILL) Stiff to hard Brown to grey Moist to wet		1	SS	75																
			2	SS	43																
			3	SS	33																
			4	SS	13																
			5	SS	29																
	6	SS	47																		
	7	SS	46																		

Continued Next Page

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

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT		RECORD OF BOREHOLE		No BH13-27		SHEET 2 OF 2		METRIC								
G.W.P. 09-1111-0019		LOCATION		N 4860307.0 ; E 365920.0		ORIGINATED BY		KT								
DIST		HWY 401		BOREHOLE TYPE		150 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY								
DATUM		Geodetic		DATE		August 22, 2013		CHECKED BY								
								MWK								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
	--- CONTINUED FROM PREVIOUS PAGE ---															
	CLAYEY SILT with SAND, trace to some gravel (TILL) Hard Brown to grey Moist to wet		14	SS	50/13											12 43 31 14
109.5																
17.2	END OF BOREHOLE		15	SS	50/08											
	NOTE: 1. Water level encountered at a depth of 13.4 m (Elev. 113.2 m) below ground surface during drilling.															

PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-28		SHEET 1 OF 2		METRIC	
G.W.P. 2101-08-00		LOCATION N 4860335.0 ;E 365939.0		ORIGINATED BY		KT	
DIST HWY 401		BOREHOLE TYPE 150 mm O.D. Continuous Flight Solid Stem Power Auger		COMPILED BY		BM	
DATUM Geodetic		DATE August 22, 2013		CHECKED BY		MWK	

[illegible]

Continued Next Page

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

○ 3% STRAIN AT FAILURE

PROJECT <u>09-1111-0019</u>	RECORD OF BOREHOLE No BH13-28	SHEET 2 OF 2	METRIC
G.W.P. <u>2101-08-00</u>	LOCATION <u>N 4860335.0 ; E 365939.0</u>	ORIGINATED BY <u>KT</u>	
DIST <u> </u> HWY <u>401</u>	BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>	COMPILED BY <u>BM</u>	
DATUM <u>Geodetic</u>	DATE <u>August 22, 2013</u>	CHECKED BY <u>MWK</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT			UNIT WEIGHT γ kN/m³	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 × REMOULDED									
							20 40 60 80 100 20 40 60 80 100					10 20 30 10 20 30					
--- CONTINUED FROM PREVIOUS PAGE ---																	
106.7 17.1	CLAYEY SILT with SAND trace gravel (TILL) Hard Brown to grey Moist		14	SS	50/13		108										
	END OF BOREHOLE		15	SS	50/15		107										
	NOTE: 1. Water level encountered at a depth of 10.4 m below ground surface (Elev. 113.4 m) during drilling.																

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-29		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860399.0 ; E 365975.0</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Power Auger</u>		COMPILED BY <u>BM</u>			
DATUM <u>Geodetic</u>		DATE <u>August 22, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
113.1	GROUND SURFACE																
0.0	Cobbles and boulders (ROCK FILL)																
112.3	Sandy silt, trace gravel, trace organics (FILL) Loose to compact Grey Wet		1	SS	19												
0.8			2	SS	7												
111.0	Silty clay, some sand (FILL) Very stiff to hard Brownish grey Moist		3	SS	19												
2.1			4	SS	42												
109.4	CLAYEY SILT with SAND some gravel to gravelly (TILL) Hard Brownish grey Moist		5	SS	63												
3.7			6	SS	50/0.13												
			7	SS	50/0.10												
			8	SS	50/0.05												
105.5	END OF BOREHOLE																
7.6	NOTE: 1. Water level in open borehole at a depth of 1.4 m below ground surface (Elev. 111.7 m) during drilling.																

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


PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-30				SHEET 2 OF 2		METRIC									
G.W.P. 2101-08-00		LOCATION N 4860327.0 ; E 366044.0				ORIGINATED BY KT											
DIST _____ HWY 401		BOREHOLE TYPE 150 mm O.D. Continuous Flight Solid Stem Auger				COMPILED BY MAS											
DATUM Geodetic		DATE August 19, 2013				CHECKED BY MWK											
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					W _p W W _L				
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100					10 20 30 WATER CONTENT (%)				GR SA SI CL	
112.2	Silt and sand, trace to some clay (FILL) Very dense Brownish grey Moist to wet		14	SS	50/0.13		114										0 32 64 4
113							113										
17.2	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 12.8 m below ground surface (Elev. 116.6 m) upon completion of drilling.		15	SS	90/0.28												

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-31		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860387.0 ; E 366081.0</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Auger</u>		COMPILED BY <u>BM/MAS</u>			
DATUM <u>Geodetic</u>		DATE <u>August 23, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL		
								20	40	60	80	100	W _p	W	W _L							
118.9	GROUND SURFACE																					
0.0	Sandy silt, trace gravel (FILL) Compact to dense Greyish brown Moist		1	SS	22	▽	118								○				0 23 64 13			
			2	SS	39																	
117.5									117													
1.4	Clayey silt with to some sand, trace gravel (FILL) Very stiff to hard Brownish grey to grey Moist		3	SS	50													○				
			4	SS	35																	
			5	SS	17					116												
			6	SS	61															○		
			7	SS	34						115											
												114										
		8	SS	33		113																
																		○				
							112															
		9	SS	29				111														
110.4									110													
8.5	CLAYEY SILT with SAND trace to some gravel (TILL) Hard Grey Moist																					
		10	SS	45														○				
109.3																						
9.6	END OF BOREHOLE																					
	NOTE: 1. Water level in open borehole at a depth of 4.3 m below ground surface (Elev. 114.6 m) upon completion of drilling.																					

PROJECT		RECORD OF BOREHOLE		No BH13-32		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860336.0 ; E 366145.0		ORIGINATED BY		KT									
DIST		HWY 401		BOREHOLE TYPE		150 mm O.D. Continuous Flight Solid Stem Auger		COMPILED BY									
DATUM		Geodetic		DATE		August 19, 2013		CHECKED BY									
								MWK									
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									
130.5	GROUND SURFACE							20	40	60	80	100					
0.0	Sandy clayey silt, trace gravel (FILL) Stiff Brownish grey Moist		1	SS	46												
			2	SS	34												
			3	SS	26												
			4	SS	52												
			5	SS	50/0.13												
127.0	Silt and sand, trace clay (FILL) Very dense brownish grey Moist		6	SS	70												
3.5			7	SS	61												
			8	SS	80/0.13												
			9	SS	50/0.15												
			10	SS	50/0.08												
121.3	END OF BOREHOLE																
9.2	NOTE: 1. Open borehole dry upon completion of drilling.																

PROJECT <u>09-1111-0019</u>	RECORD OF BOREHOLE No BH13-33	SHEET 2 OF 2	METRIC
G.W.P. <u>2101-08-00</u>	LOCATION <u>N 4860348.0 ; E 366194.0</u>	ORIGINATED BY <u>KT</u>	
DIST <u> </u> HWY <u>401</u>	BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Auger</u>	COMPILED BY <u>MAS</u>	
DATUM <u>Geodetic</u>	DATE <u>August 16, 2013</u>	CHECKED BY <u>MWK</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L				
								○ UNCONFINED + FIELD VANE					WATER CONTENT (%)				
								● QUICK TRIAXIAL × REMOULDED									
						20 40 60 80 100					10 20 30						
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Sandy silt, trace to some clay, trace to some gravel, containing pockets of clayey silt (FILL) Compact to very dense Grey to brownish grey Moist						114										
			14	SS	46		113										
112.3			15	SS	50/0.15												
17.1	END OF BOREHOLE														0 22 59 19		
	NOTE: 1. Water level in open borehole at a depth of 9.1 m below ground surface (Elev. 120.3 m) upon completion of drilling.																

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-34		SHEET 1 OF 2		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860350.0 ; E 366245.0</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Auger</u>		COMPILED BY <u>BM/MAS</u>			
DATUM <u>Geodetic</u>		DATE <u>August 15, 2013</u>		CHECKED BY <u>MWK</u>			

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 (%)				GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
131.8	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

Continued Next Page


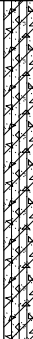
+ ³, × ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT 09-1111-0019		RECORD OF BOREHOLE No BH13-34				SHEET 2 OF 2		METRIC								
G.W.P. 2101-08-00		LOCATION N 4860350.0 ; E 366245.0				ORIGINATED BY KT										
DIST _____ HWY 401		BOREHOLE TYPE 150 mm O.D. Continuous Flight Solid Stem Auger				COMPILED BY BM/MAS										
DATUM Geodetic		DATE August 15, 2013				CHECKED BY MWK										
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					W _p W W _L			
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					10 20 30 WATER CONTENT (%)				
	Silty sand (FILL) Very dense Grey Moist to wet		14	SS	78											
114.7			15	SS	161											
17.1	END OF BOREHOLE															
	NOTE: 1. Water level in open borehole at a depth of 11.6 m below ground surface (Elev. 120.2 m) upon completion of drilling.															

GTA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

PROJECT <u>09-1111-0019</u>		RECORD OF BOREHOLE No BH13-35		SHEET 1 OF 1		METRIC	
G.W.P. <u>2101-08-00</u>		LOCATION <u>N 4860464.0 ; E 366268.0</u>		ORIGINATED BY <u>KT</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>150 mm O.D. Continuous Flight Solid Stem Auger</u>		COMPILED BY <u>MAS</u>			
DATUM <u>Geodetic</u>		DATE <u>August 15, 2013</u>		CHECKED BY <u>MWK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W	W _L		
117.9	GROUND SURFACE																
0.0	Silt and sand, some clay, trace gravel, trace and containing rootlets (FILL) Compact Brown to dark brown Moist		1	SS	15												
			2	SS	22												
	Trace wood fragments from 1.5 m to 2.0 m depth		3	SS	15												
			4	SS	25												
115.0																	
2.9	CLAYEY SILT with SAND some gravel (TILL) Hard Brownish grey Moist		5	SS	30												
			6	SS	50/0.13												
			7	SS	50/0.13												
111.5																	
6.4	END OF BOREHOLE		8	SS	50/0.13												
	NOTE: 1. Water level in open borehole at a depth of 4.6 m below ground surface (Elev. 113.3 m) upon completion of drilling.																

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

GTGA-MTO 001 09-1111-0019.GPJ GAL-GTA.GDT 01/21/14

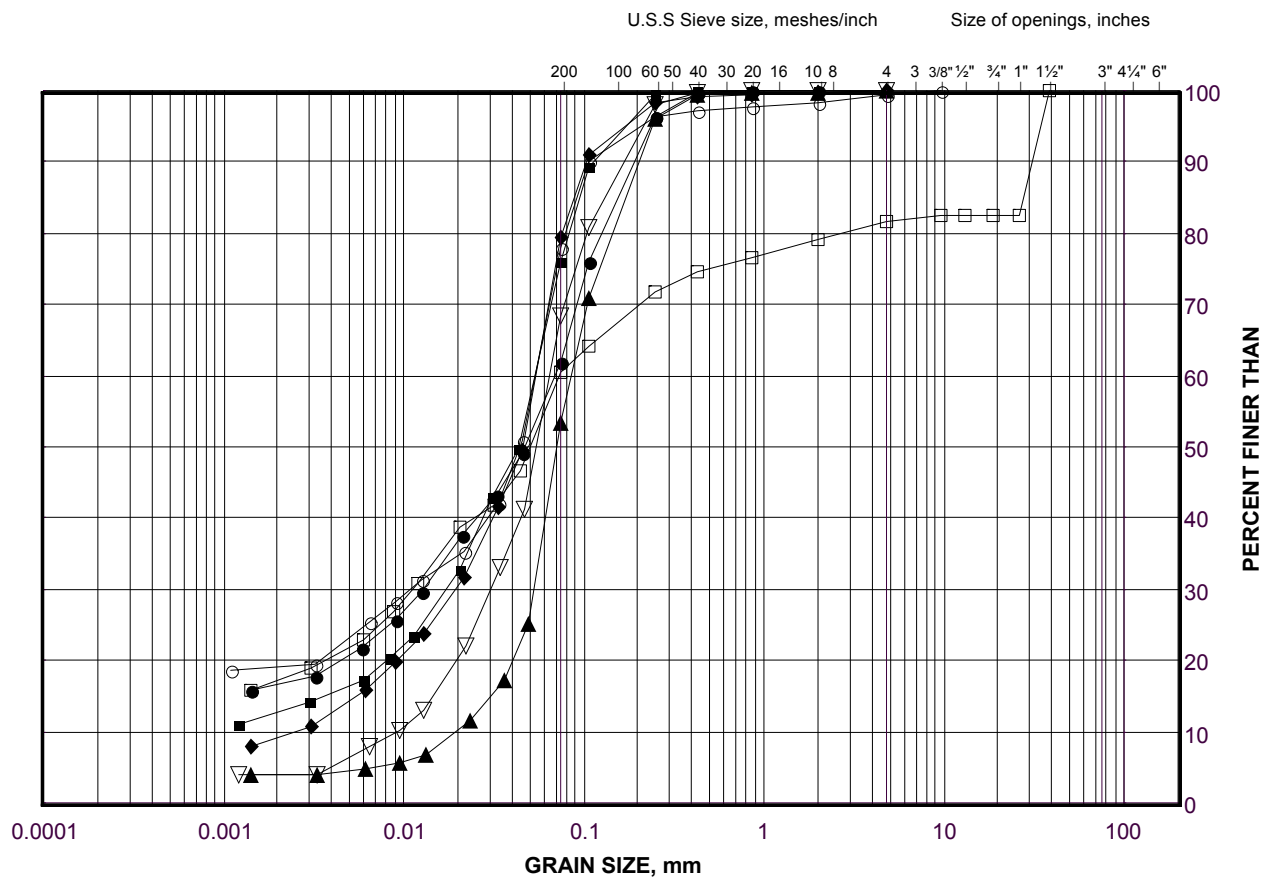
PROJECT		RECORD OF BOREHOLE		No BH13-37		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860429.0 ; E 366380.0		ORIGINATED BY		KT									
DIST		HWY 401		BOREHOLE TYPE		150 mm O.D. Continuous Flight Solid Stem Auger		COMPILED BY									
DATUM Geodetic		DATE		August 14, 2013		CHECKED BY		MWK									
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									
119.0	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL Hard Dark brown Moist		1	SS	34												
118.3																	
0.7	Clayey silt, trace to some sand, trace gravel (FILL) Very stiff to hard Brownish grey Moist		2	SS	30												
			3	SS	25												
			4	SS	50/0.08												
116.3																	
2.7	Silt and sand, some clay, some gravel (FILL) Dense to very dense Brownish grey Moist		5	SS	43												
			6	SS	50/0.13												
			7	SS	55												
			8	SS	64												
113.2	END OF BOREHOLE																
5.8	NOTES: 1. Water level in open borehole at a depth of 5.0 m below ground surface (Elev. 114.0 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE		No BH13-38		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-0019		LOCATION		N 4860467.0 ; E 366422.0		ORIGINATED BY		KT									
DIST		HWY 401		BOREHOLE TYPE		150 mm O.D. Continuous Flight Solid Stem Auger		COMPILED BY									
DATUM Geodetic		DATE		August 14, 2013		CHECKED BY		MWK									
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									
119.8	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL		1	SS	9												
119.3	Stiff Dark brown Moist		2	SS	33												
0.5	Silt and sand, some clay, trace gravel (FILL) Dense to very dense Brown to brownish grey Moist		3	SS	50/0.13												
			4	SS	50/0.08												
117.1			5	SS	50/0.10												
2.7	CLAYEY SILT with SAND trace gravel (TILL) Hard Brownish grey to grey Moist		6	SS	50/0.10												
			7	SS	50/0.10												
114.3			8	SS	50/0.08												
5.5	END OF BOREHOLE																
NOTES:																	
1. Open borehole dry upon completion of drilling.																	

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sandy Silt to Silt and Sand (FILL)

FIGURE H1A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-25	12	110.9
■	13-27	12	114.4
◆	13-33	13	115.4
▲	13-26	13	109.8
▽	13-30	14	114.1
○	13-33	15	112.4
□	13-33	2	128.4

Project Number: 09-1111-0019

Checked By: _____

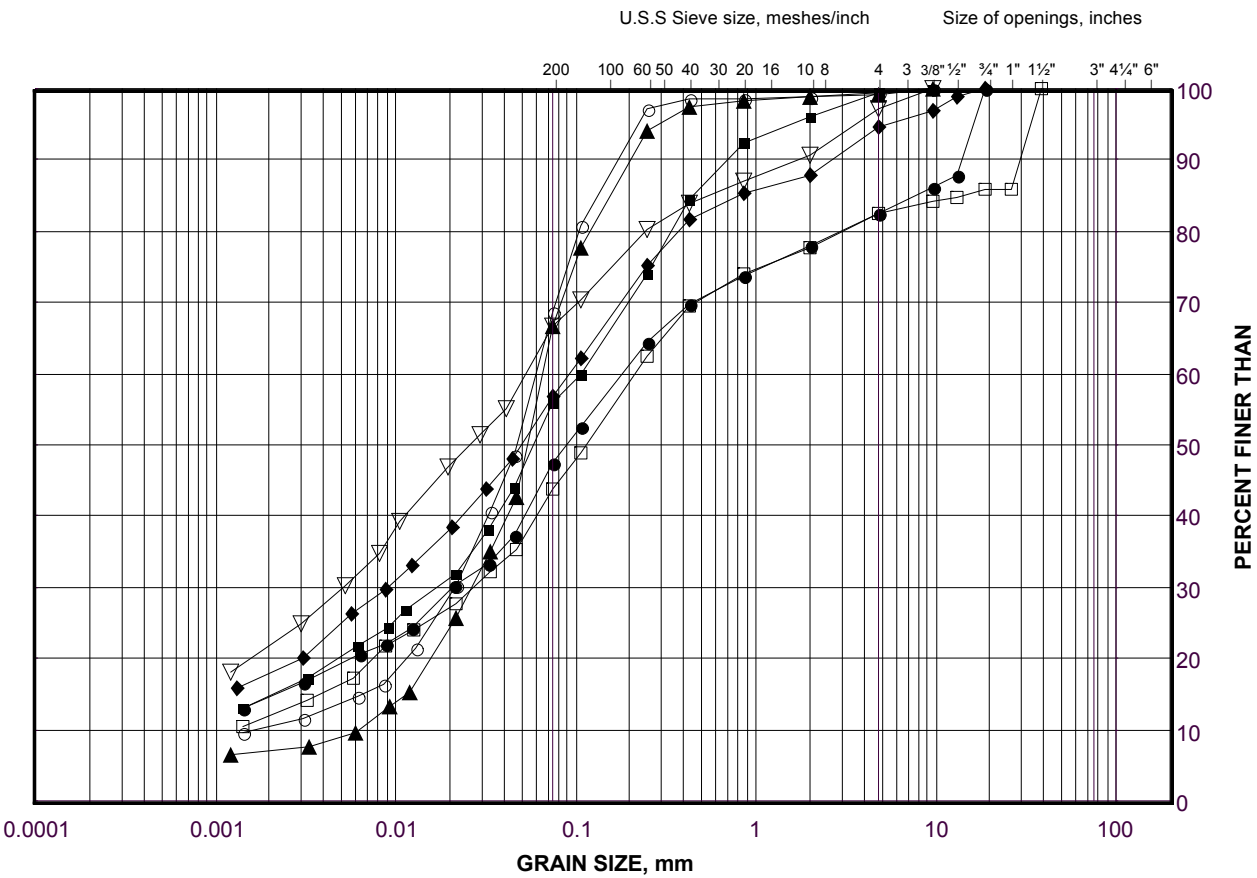
Golder Associates

Date: 12-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sandy Silt to Silt and Sand (FILL)

FIGURE H1B



SILT AND CLAY SIZES				FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED				SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-24	2	111.5
■	13-35	3	116.2
◆	13-38	3	118.2
▲	13-30	3	127.7
▽	13-26	5	120.2
○	13-32	6	126.5
□	13-37	6	115.2

Project Number: 09-1111-0019

Checked By: _____

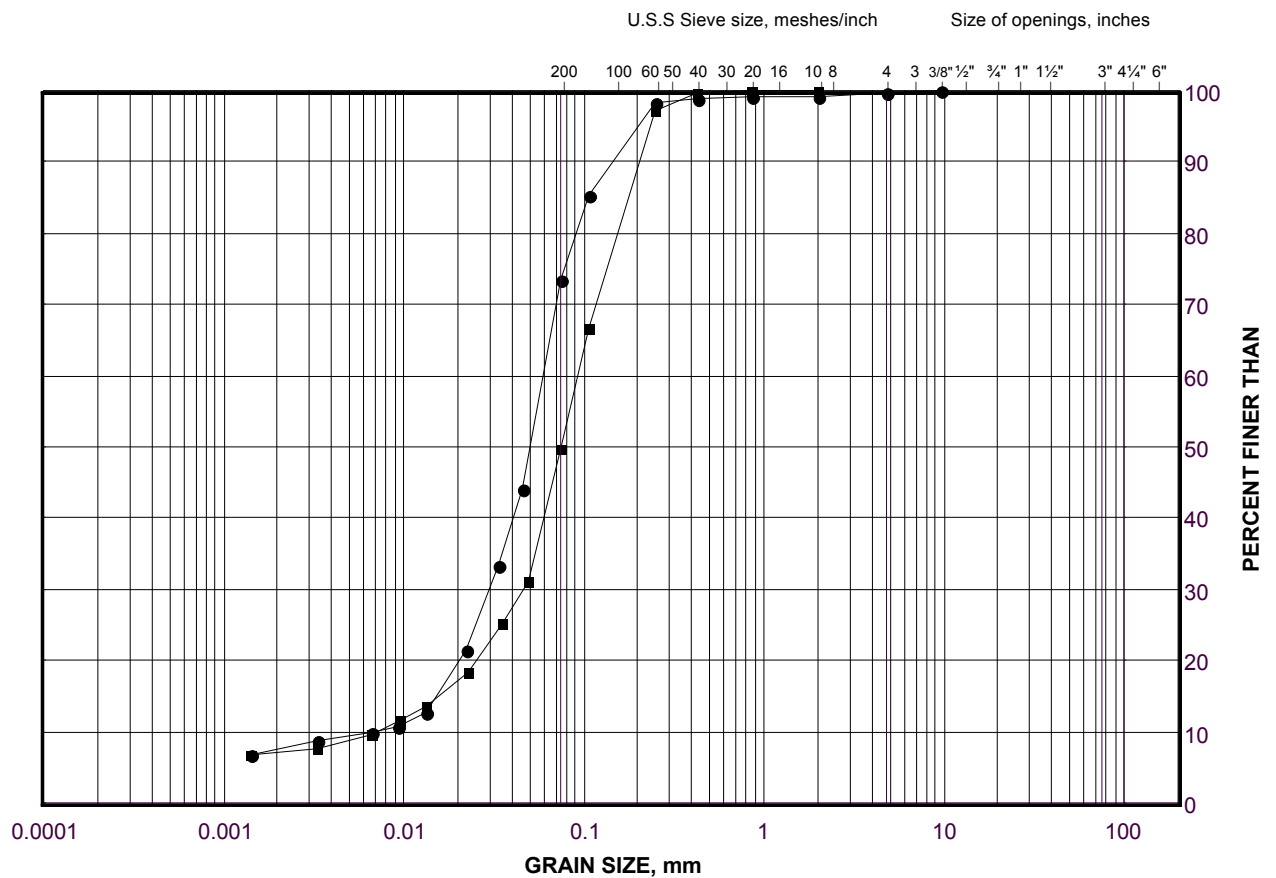
Golder Associates

Date: 12-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Sandy Silt to Silt and Sand (FILL)

FIGURE H1C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

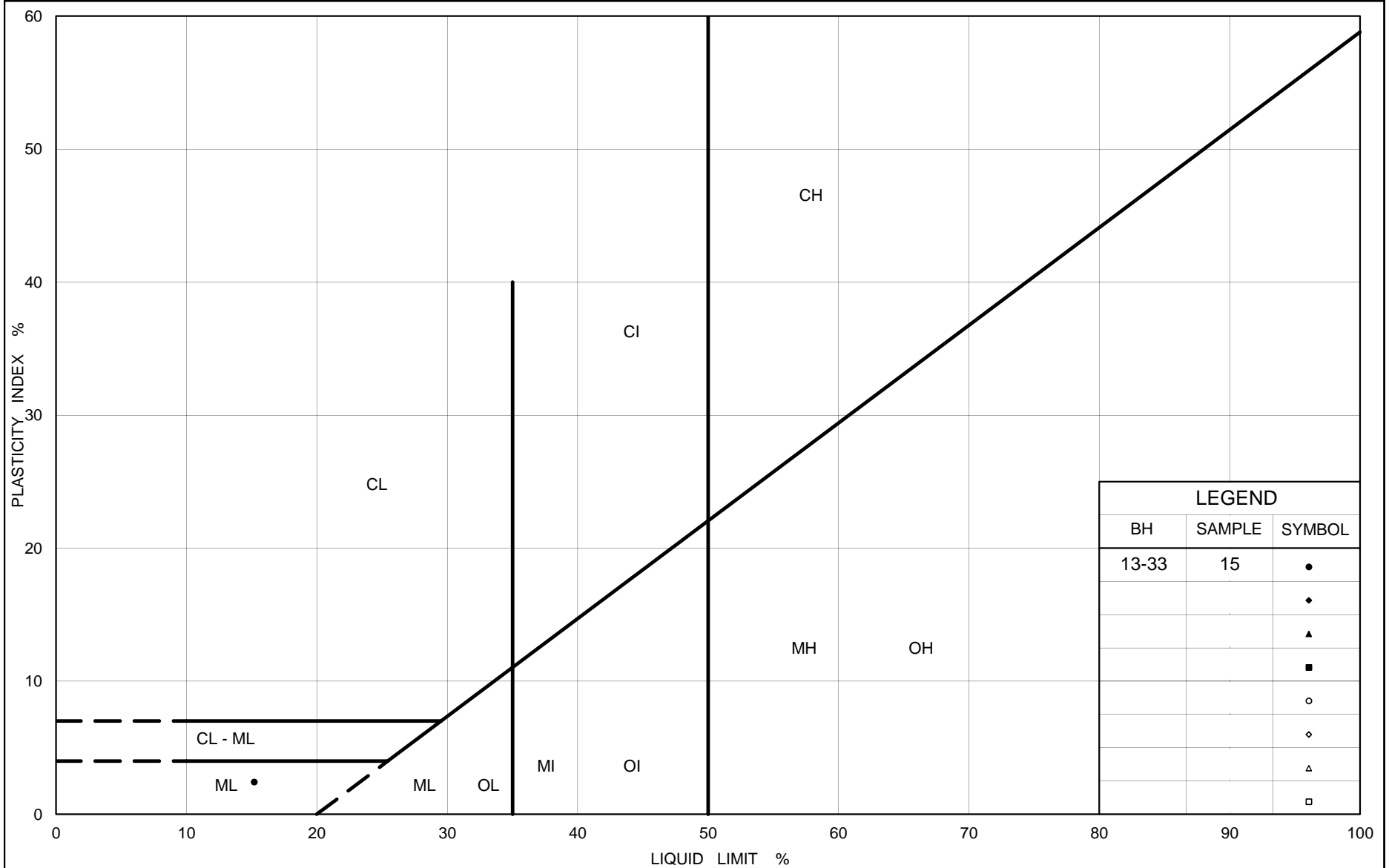
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-33	7	124.7
■	13-32	9	122.8

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 12-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Sandy Silt (FILL) (Soil Disposal Mound)

Figure No. H2

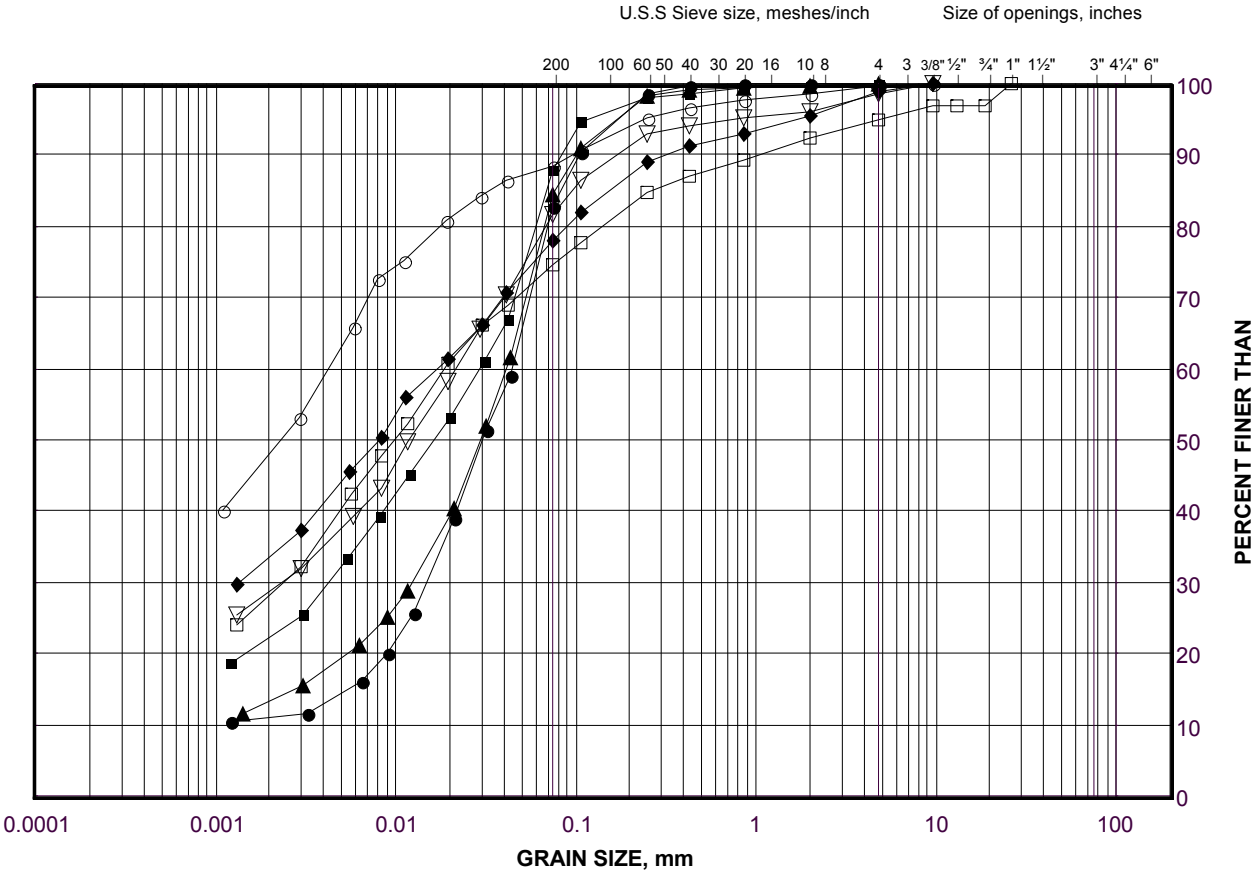
Project No. 09-1111-0019

Checked By:

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE H3A



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-30	10	120.2
■	13-30	12	117.2
◆	13-32	2	129.5
▲	13-36	2	119.9
▽	13-37	3	117.3
○	13-29	3	110.6
□	13-28	4	121.3

Project Number: 09-1111-0019

Checked By: _____

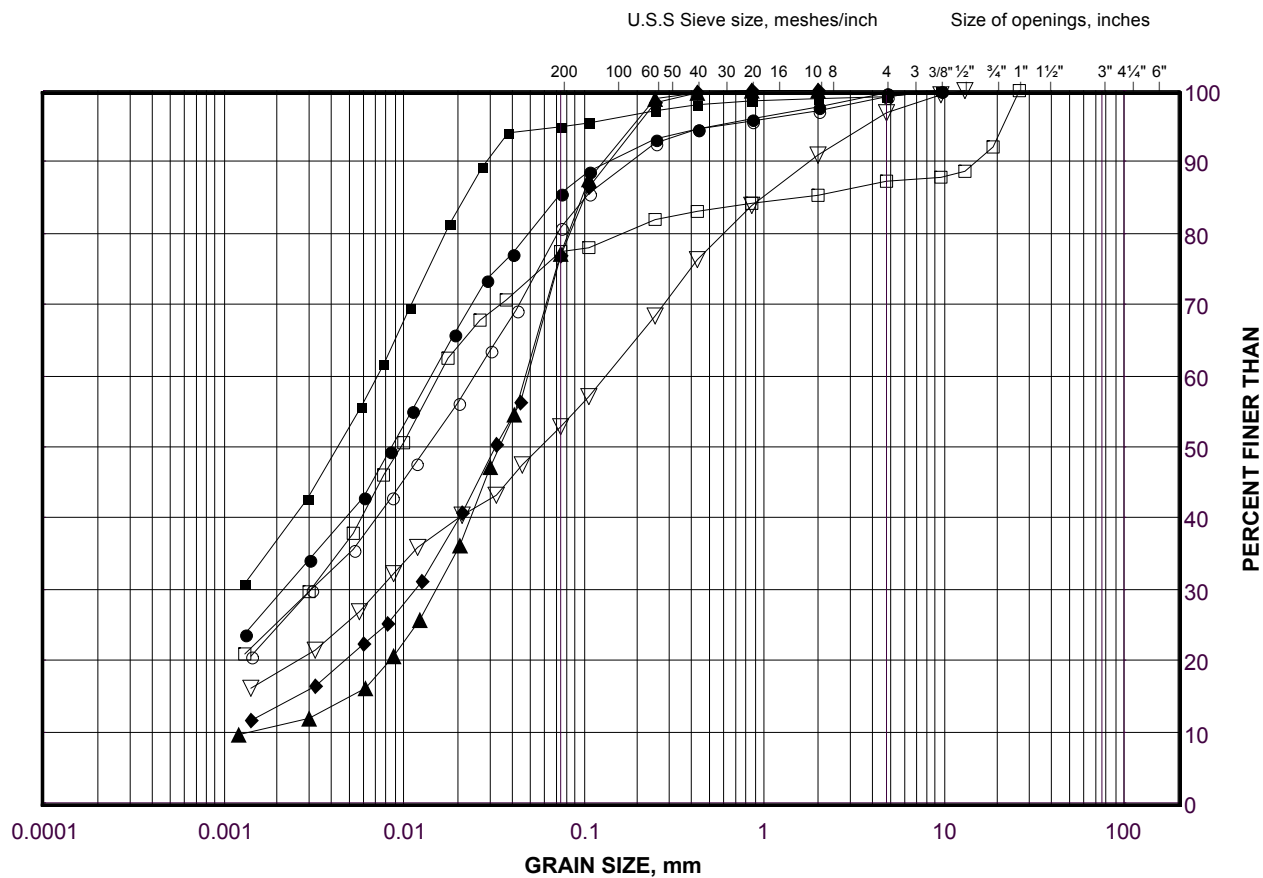
Golder Associates

Date: 12-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE H3B



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-25	4	120.7
■	13-27	4	124.1
◆	13-31	4	116.4
▲	13-28	5	120.5
▽	13-30	5	126.1
○	13-36	6	116.8
□	13-25	6	119.3

Project Number: 09-1111-0019

Checked By: _____

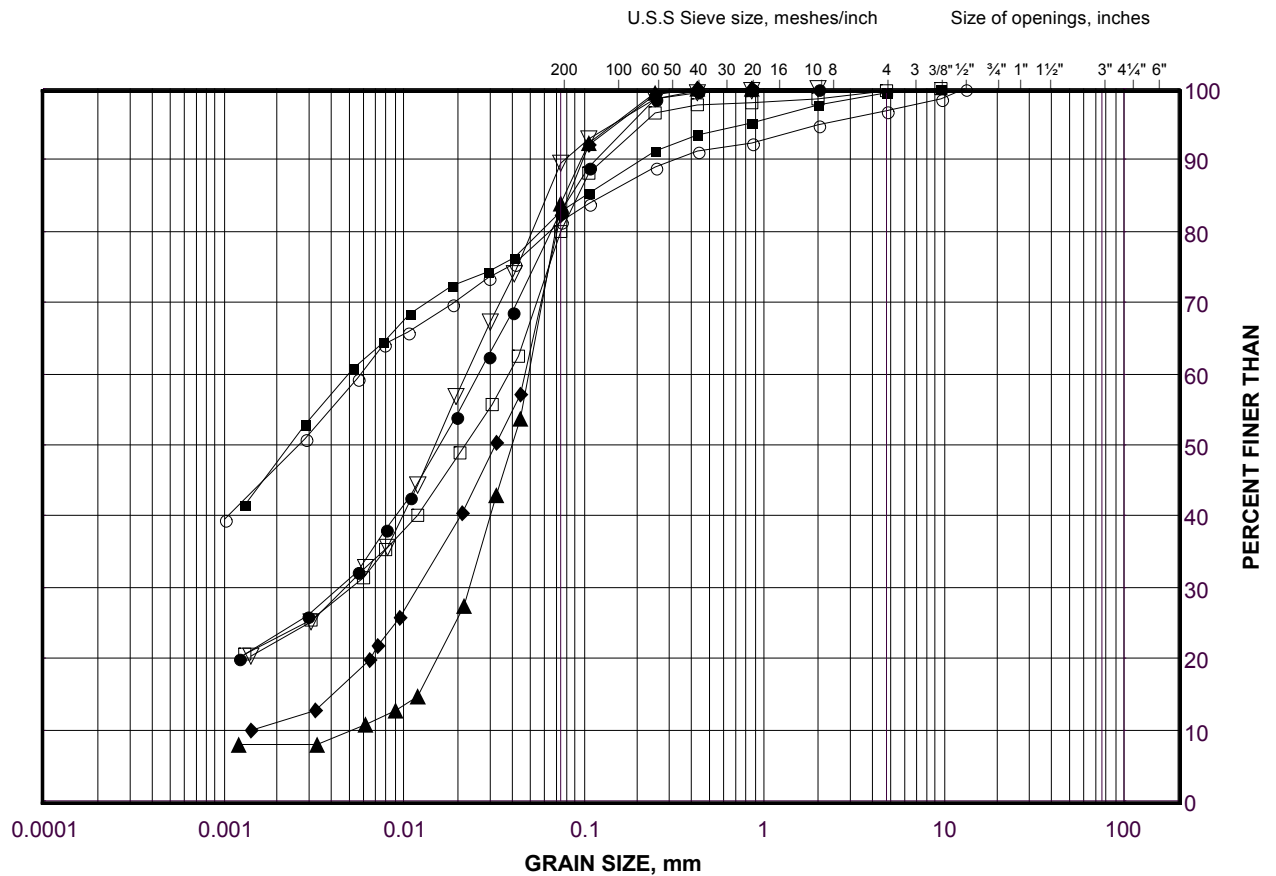
Golder Associates

Date: 12-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (FILL)

FIGURE H3C



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

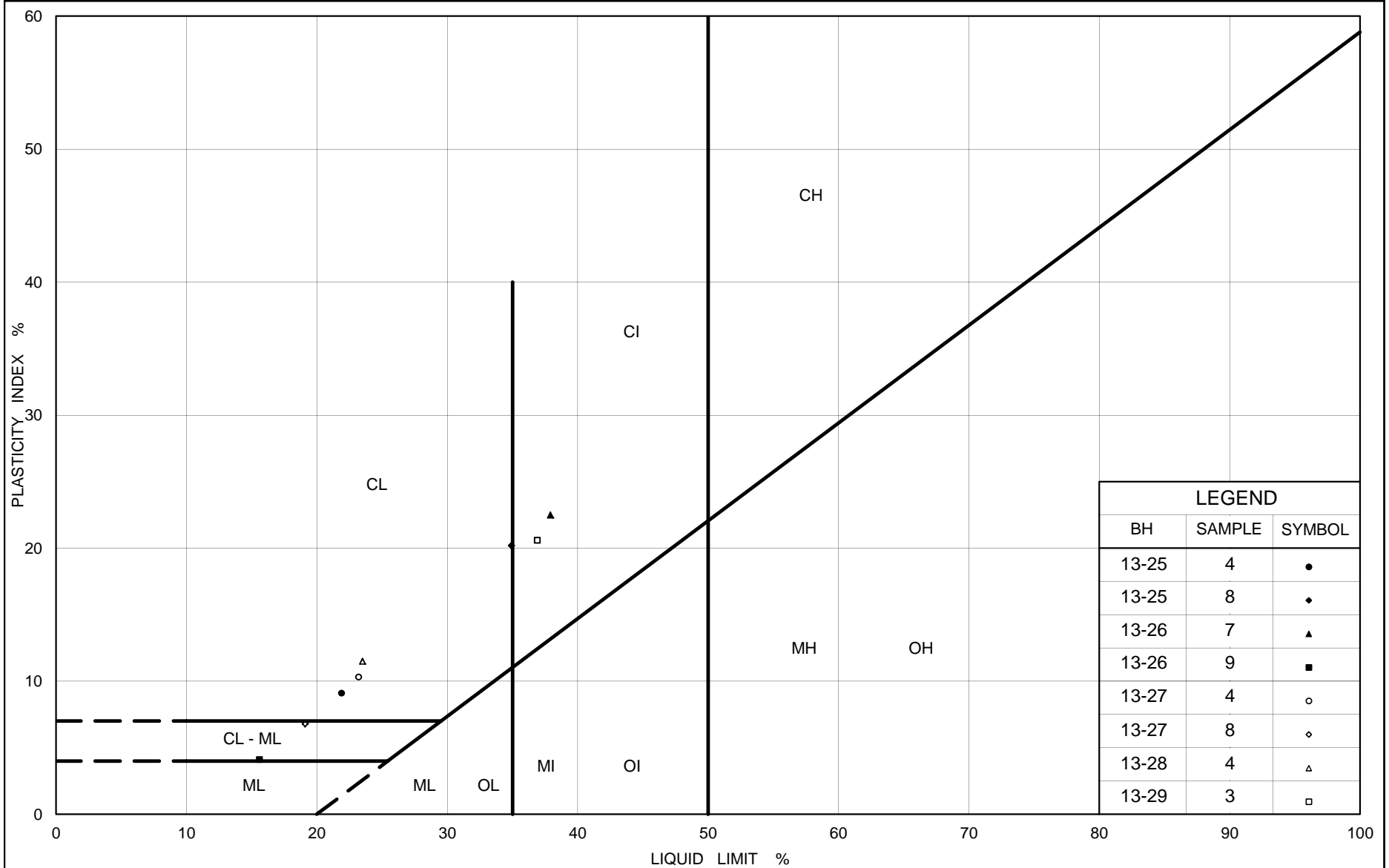
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-28	7	119.0
■	13-26	7	118.7
◆	13-31	8	112.6
▲	13-30	8	123.2
▽	13-27	8	120.3
○	13-25	8	116.8
□	13-26	9	115.7

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 12-Nov-13



Ministry of Transportation

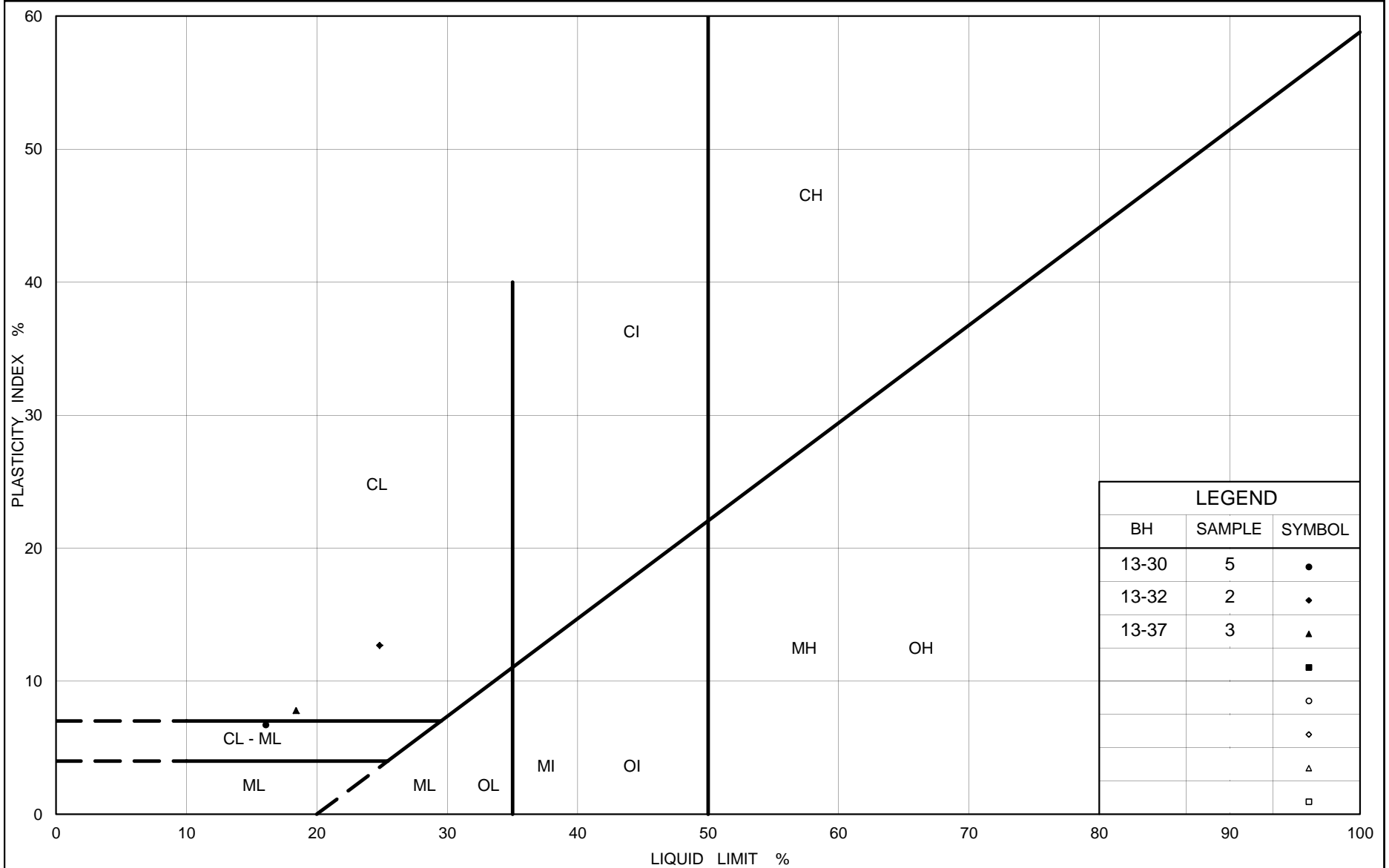
Ontario

PLASTICITY CHART Clayey Silt to Silty Clay (FILL)

Figure No. H4A

Project No. 09-1111-0019

Checked By:



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt to Silty Clay (FILL)

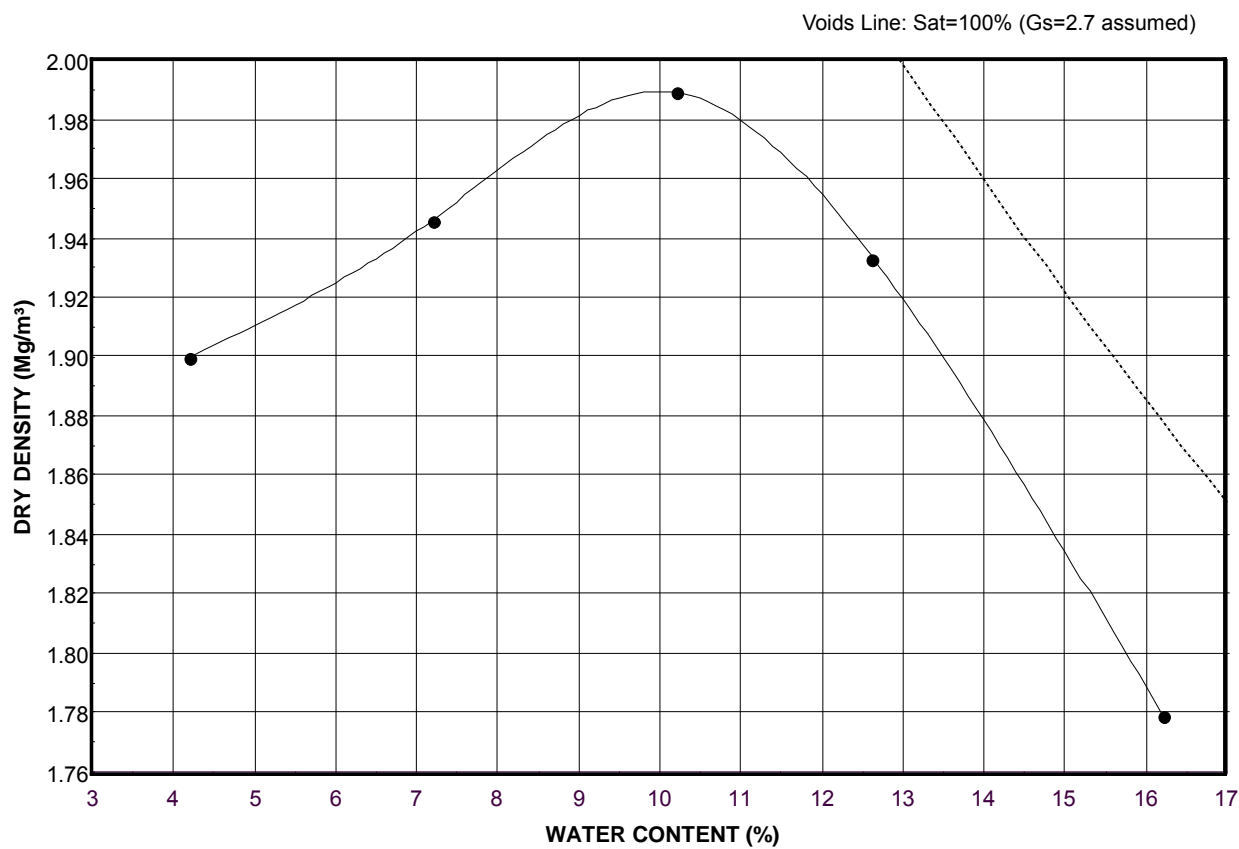
Figure No. H4B

Project No. 09-1111-0019

Checked By:

LABORATORY COMPACTION TEST
Soil Disposal Mound Fill

FIGURE H5



Standard
Proctor Test Results

Sample:
Combined Samples

Source:
Unknown

Max Dry Density:
1.989 Mg/m³

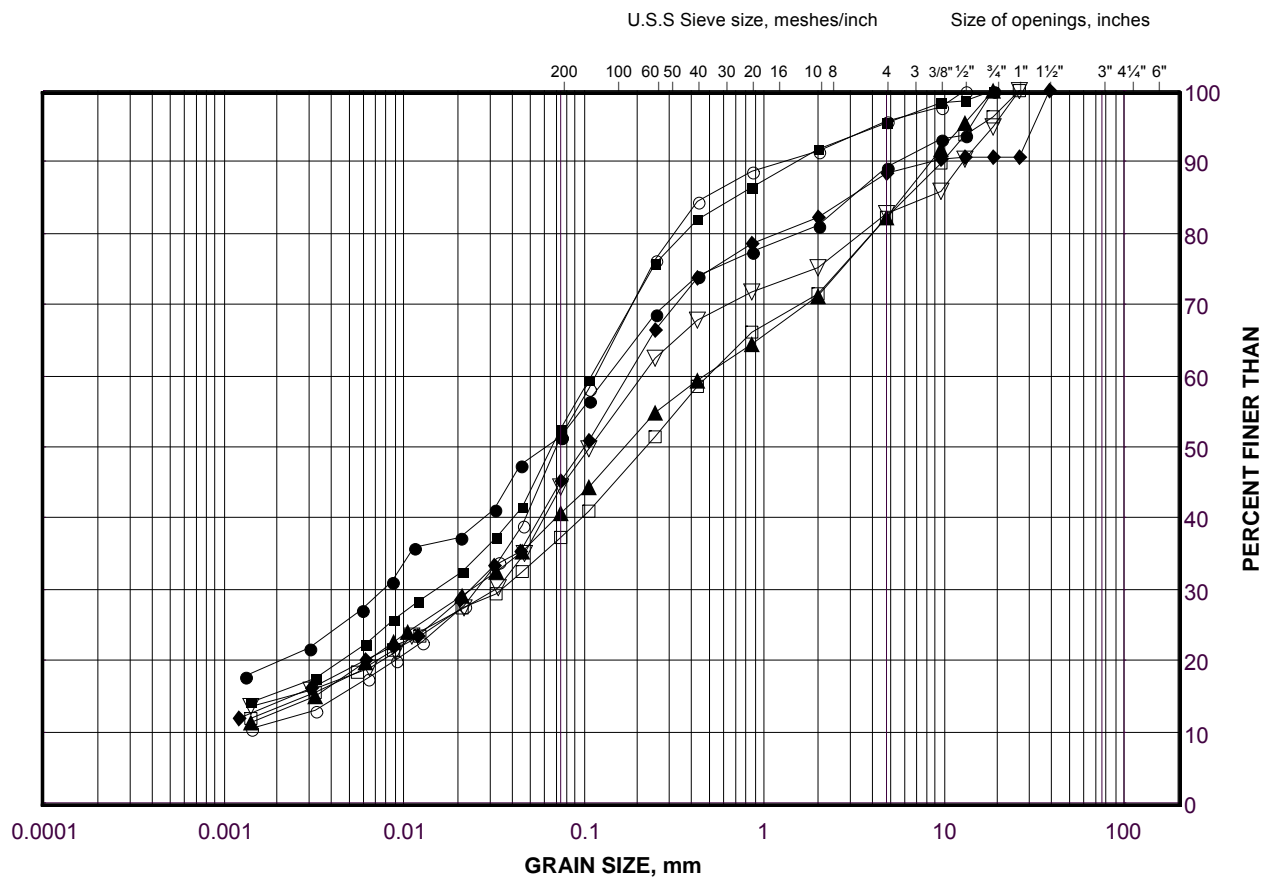
Optimum Water
Content: 10.1%

Natural Water
Content: 11.1%

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE H6A



SILT AND CLAY SIZES	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-31	10	109.5
■	13-28	12	111.5
◆	13-27	14	111.3
▲	13-25	16	104.7
▽	13-29	6	108.5
○	13-38	6	116.0
□	13-35	6	114.0

Project Number: 09-1111-0019

Checked By: _____

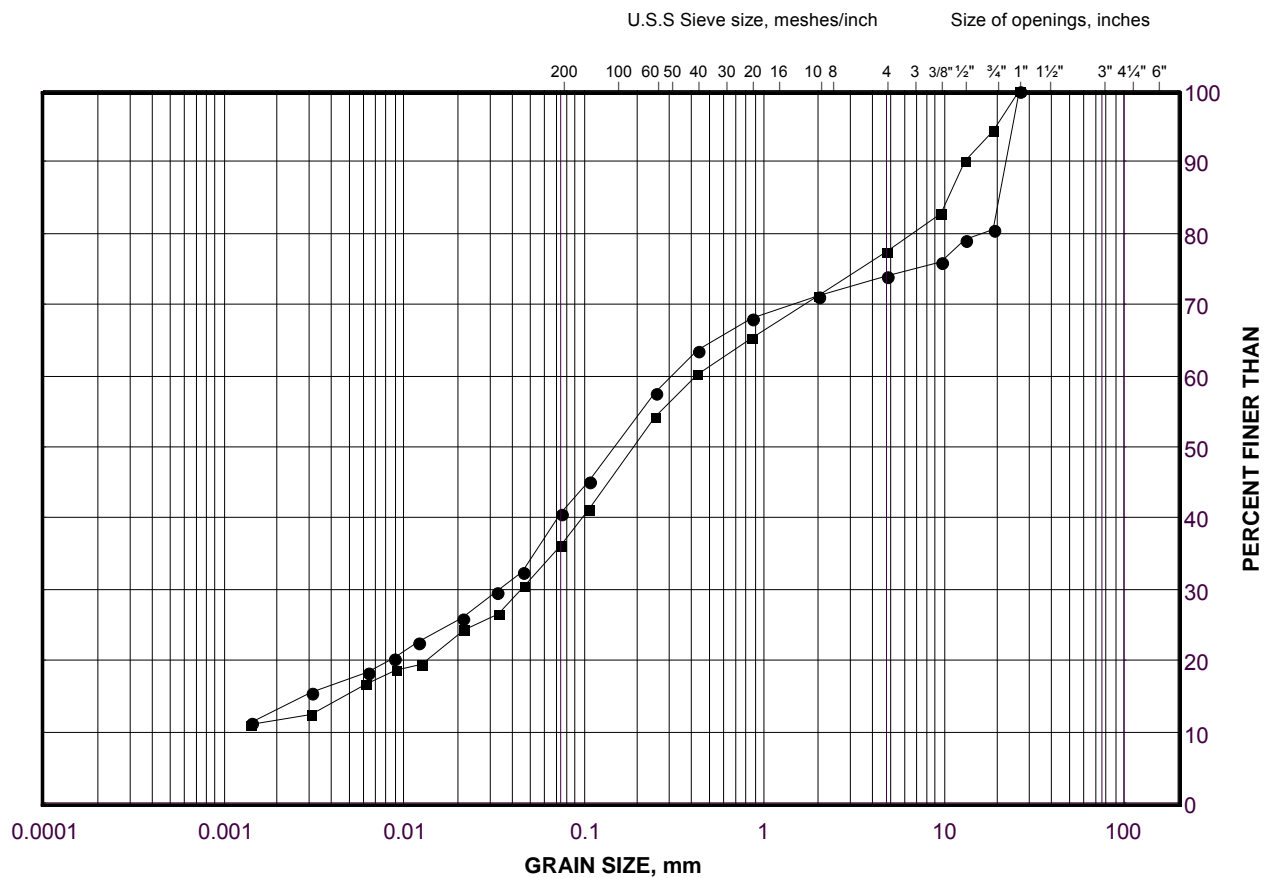
Golder Associates

Date: 12-Nov-13

GRAIN SIZE DISTRIBUTION TEST RESULTS

Clayey Silt (TILL)

FIGURE H6B



SILT AND CLAY SIZES		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED		SAND SIZE			GRAVEL SIZE		SIZE

LEGEND

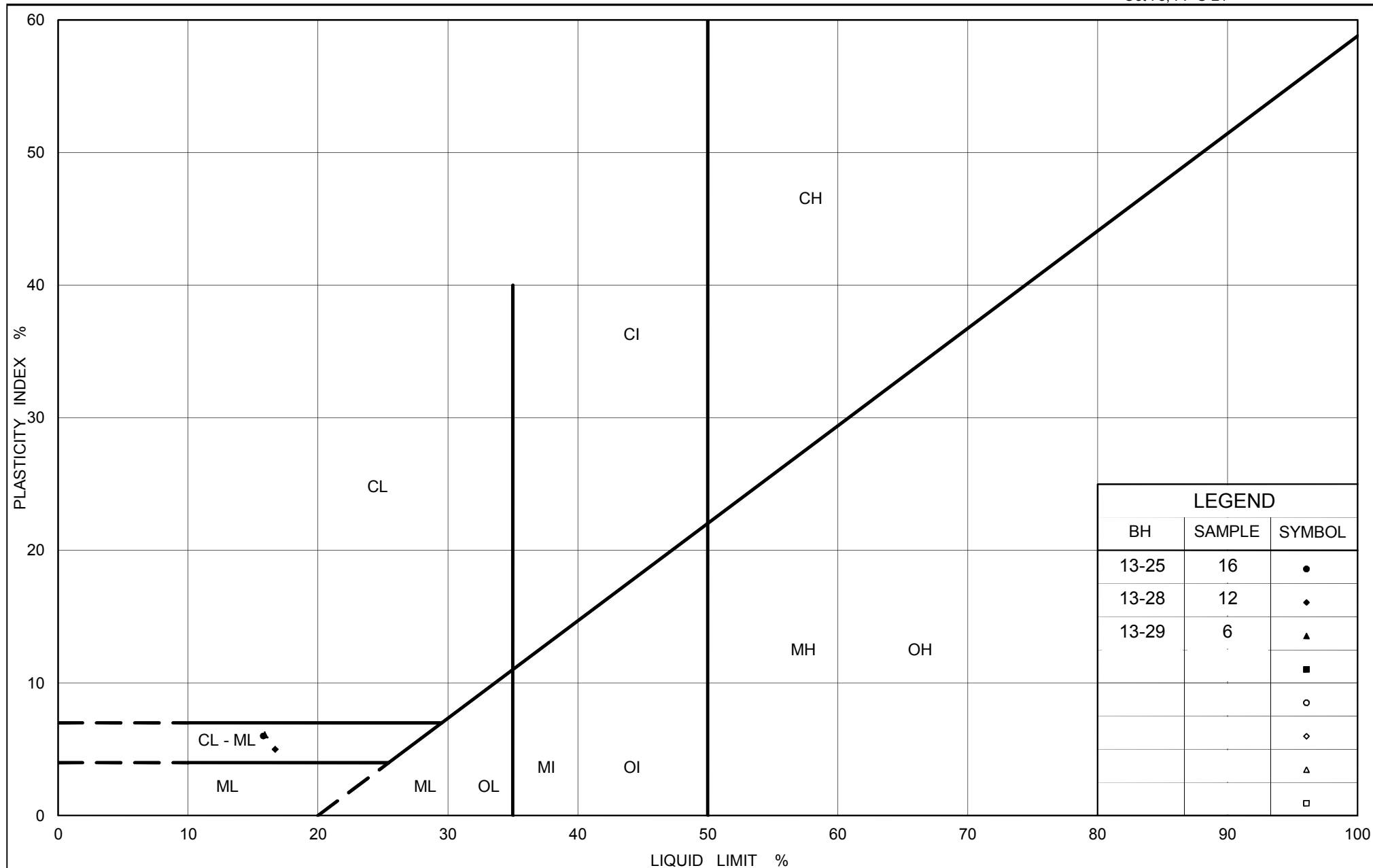
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	13-24	7	107.7
■	13-29	8	106.2

Project Number: 09-1111-0019

Checked By: _____

Golder Associates

Date: 12-Nov-13



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (TILL)

Figure No. H7

Project No. 09-1111-0019

Checked By:



APPENDIX I

Analytical Test Results

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Robin Nowensky

PROJECT NO: Holt Rd

AGAT WORK ORDER: 13T735876

SOIL ANALYSIS REVIEWED BY: Anthony Dapaah, PhD (Chem), Inorganic Lab Manager

DATE REPORTED: Jul 24, 2013

PAGES (INCLUDING COVER): 4

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 13T735876

PROJECT NO: Holt Rd

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Robin Nowensky

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2013-07-12

DATE REPORTED: 2013-07-24

		SAMPLE DESCRIPTION:		DRUM 1	DRUM 2	DRUM 3
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		7/5/2013	7/5/2013	7/5/2013
Parameter	Unit	G / S	RDL	4545308	4545309	4545310
Arsenic Leachate	mg/L	2.5	0.010	<0.010	<0.010	<0.010
Barium Leachate	mg/L	100	0.100	0.287	0.277	0.380
Boron Leachate	mg/L	500	0.050	<0.050	<0.050	<0.050
Cadmium Leachate	mg/L	0.5	0.010	<0.010	<0.010	<0.010
Chromium Leachate	mg/L	5.0	0.010	<0.010	<0.010	<0.010
Lead Leachate	mg/L	5.0	0.010	<0.010	<0.010	<0.010
Mercury Leachate	mg/L	0.1	0.01	<0.01	<0.01	<0.01
Selenium Leachate	mg/L	1.0	0.010	<0.010	<0.010	<0.010
Silver Leachate	mg/L	5.0	0.010	<0.010	<0.010	<0.010
Uranium Leachate	mg/L	10.0	0.050	<0.050	<0.050	<0.050
Fluoride Leachate	mg/L	150	0.05	0.07	0.07	0.09
Cyanide Leachate	mg/L	20.0	0.05	<0.05	<0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70	<0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Regulation 558

Certified By:

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 13T735876

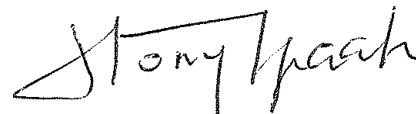
PROJECT NO: Holt Rd

ATTENTION TO: Robin Nowensky

Soil Analysis

RPT Date: Jul 24, 2013			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	1		< 0.010	< 0.010	0.0%	< 0.010	100%	90%	110%	97%	80%	120%	98%	70%	130%
Barium Leachate	1		0.835	0.789	5.7%	< 0.100	99%	90%	110%	99%	80%	120%	106%	70%	130%
Boron Leachate	1		< 0.050	< 0.050	0.0%	< 0.050	105%	90%	110%	80%	80%	120%	80%	70%	130%
Cadmium Leachate	1		< 0.010	< 0.010	0.0%	< 0.010	102%	90%	110%	110%	80%	120%	113%	70%	130%
Chromium Leachate	1		< 0.010	< 0.010	0.0%	< 0.010	100%	90%	110%	93%	80%	120%	84%	70%	130%
Lead Leachate	1		0.015	0.012	22.2%	< 0.010	97%	90%	110%	104%	80%	120%	108%	70%	130%
Mercury Leachate	1		< 0.01	< 0.01	0.0%	< 0.01	92%	90%	110%	94%	80%	120%	95%	70%	130%
Selenium Leachate	1		< 0.010	< 0.010	0.0%	< 0.010	101%	90%	110%	105%	80%	120%	106%	70%	130%
Silver Leachate	1		< 0.010	< 0.010	0.0%	< 0.010	101%	90%	110%	107%	80%	120%	111%	70%	130%
Uranium Leachate	1		< 0.050	< 0.050	0.0%	< 0.050	102%	90%	110%	95%	80%	120%	98%	70%	130%
Fluoride Leachate	1		0.12	0.12	0.0%	< 0.05	106%	90%	110%	107%	90%	110%	94%	70%	130%
Cyanide Leachate	1		< 0.05	< 0.05	0.0%	< 0.05	99%	90%	110%	95%	90%	110%	105%	70%	130%
(Nitrate + Nitrite) as N Leachate	1		< 0.70	< 0.70	0.0%	< 0.70	94%	80%	120%	105%	80%	120%	98%	70%	130%

Certified By:



Method Summary

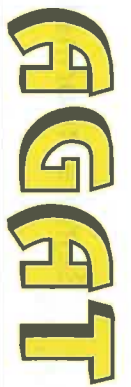
CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 13T735876

PROJECT NO: Holt Rd

ATTENTION TO: Robin Nowensky

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Arsenic Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Barium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Boron Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cadmium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Chromium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Lead Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Mercury Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Selenium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Silver Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Uranium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Fluoride Leachate	INOR-93-6018	EPA SW-846-1311 & SM4500-F- C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA SW-846-1311 & MOE 3015 & SM 4500 CN- I	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & SM 4500 - NO3- I	LACHAT FIA



Laboratories

www.agatlabs.com • webeath.agatlabs.com

5835 Coopers Avenue

Mississauga, ON

L4Z 1Y2

Laboratory Use Only

Arrival Temperature: 37.4.1 4.2

AGAT WO #: 135735876

Lab Temperature: 20.7 3.6 3.5

Notes:

Chain of Custody Record

P: 905.712.5100 • F: 905.712.5122 • TF: 800.856.6261

Client Information

Company: GOLDER ASSOC.

Contact: ROBIN NOWENSKY

Address: WHITBY

Phone: 905-723-2727 Fax:

Project: HOLT RD. (501 & DEWIS)

AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☒ Regulation 153/04 (reg. 511 Annual)

Table 1 Indicate one

☐ Ind/Com

☐ Res/Park

☐ Agriculture

Soil Texture (check one)

☐ Coarse ☐ Fine

☐ Sewer Use

Region 1 Indicate one

☐ Sanitary

☐ Storm

☐ Prov. Water Quality Objectives (PWQO)

☐ None

☐ Regulation 558

☐ CCME

☐ Other (specify)

Turnaround Time Required (TAT) Required*

Regular TAT

☒ 5 to 7 Working Days

Rush TAT (please provide prior notification)

Rush Surcharges Apply

☐ 3 Working Days

☐ 2 Working Days

☐ 1 Working Day

OR Date Required (Rush surcharges may apply):

Invoice To

Company: Same: Yes ☒ No ☐

Contact:

Address:

Legend Matrix

GW Ground Water O Oil

SW Surface Water P Paint

SD Sediment S Soil

Report Information - reports to be sent to:

1. Name: Robin Nowensky

Email:

2. Name: Devon Withersdye

Email:

Is this a drinking water sample?

(potable water intended for human consumption)

☐ Yes ☒ No

If "Yes", please use the Drinking Water Chain of Custody Form

Is this submission for a Record of Site Condition?

☐ Yes ☒ No

*TAT is exclusive of weekends and statutory holidays

Contact: _____						If "Yes", please use the									
Address: _____						Drinking Water Chain of Custody Form									
Legend Matrix						Report Information – reports to be sent to:									
GW Ground Water		O Oil		1. Name: _____		_____									
SW Surface Water		P Paint		Email: _____		_____									
SD Sediment		S Soil		2. Name: _____		_____									
				Email: _____		_____									
Sample Identification						Date Sampled		Time Sampled		Sample Matrix		# of Containers		Comments Site/Sample Information	
DEUM 1						July 5		1400		S		1			
DEUM 2						↓		↓		↓		1			
DEUM 3															

Samples Relinquished By (Print Name and Sign):

Date/Time: July 12/13 1400

Samples Received By (Print Name and Sign):

Date/Time: 7-12-13 1400

Samples Relinquished By (Print Name and Sign):

Date/Time: 3-50

Page 1 of 1

Samples Relinquished By (Print Name and Sign):

Date/Time: July 12/13 1400

Samples Received By (Print Name and Sign):

Date/Time: 7-12-13 1400

Samples Relinquished By (Print Name and Sign):

Date/Time: 3-50

Page 1 of 1



APPENDIX J

Borehole Records - Previous Investigation

Figure No. **A-1**

LOG OF BOREHOLE **MW1D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/21/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

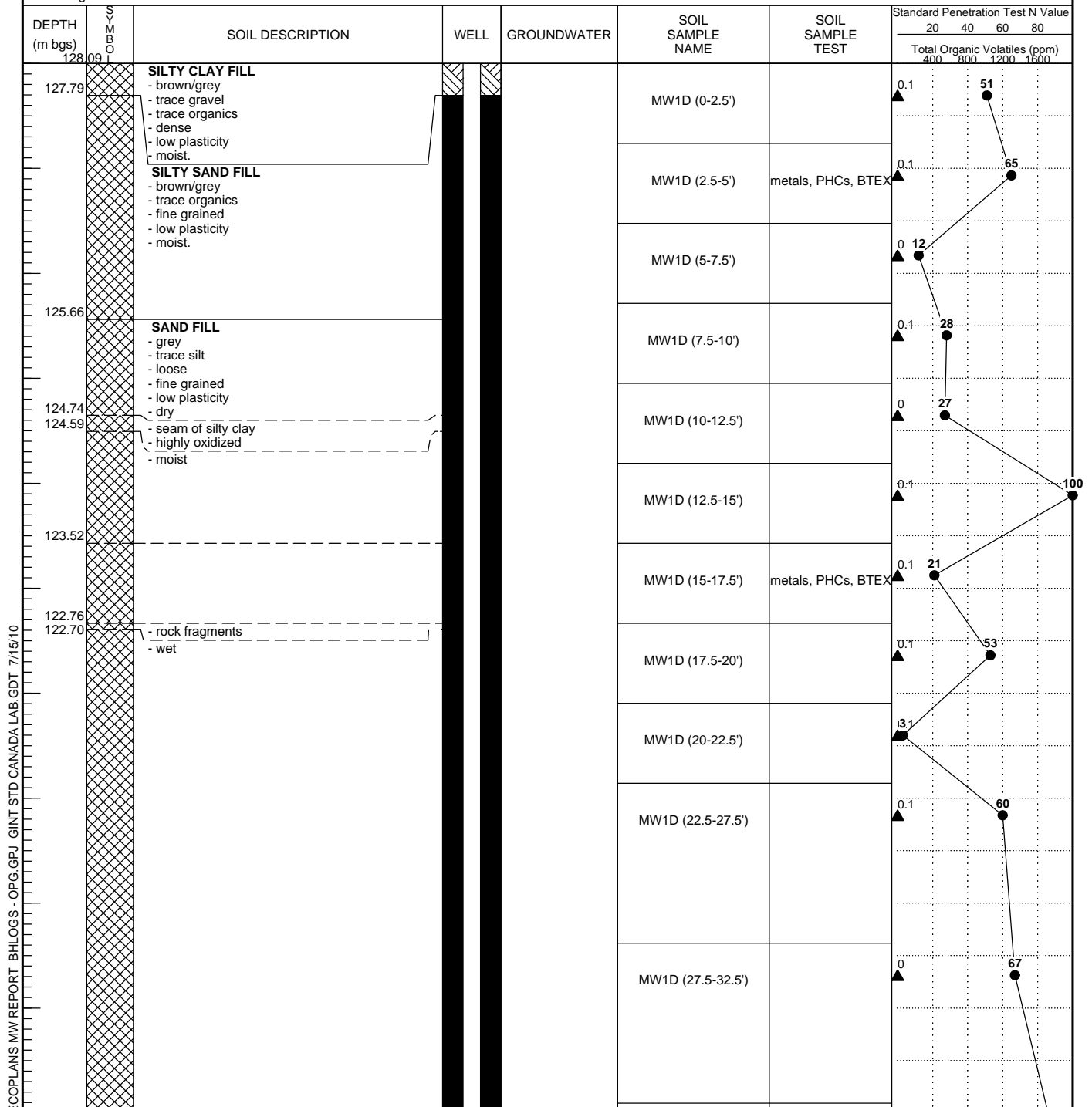


Figure No. **A-1**

LOG OF BOREHOLE **MW1D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/21/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value

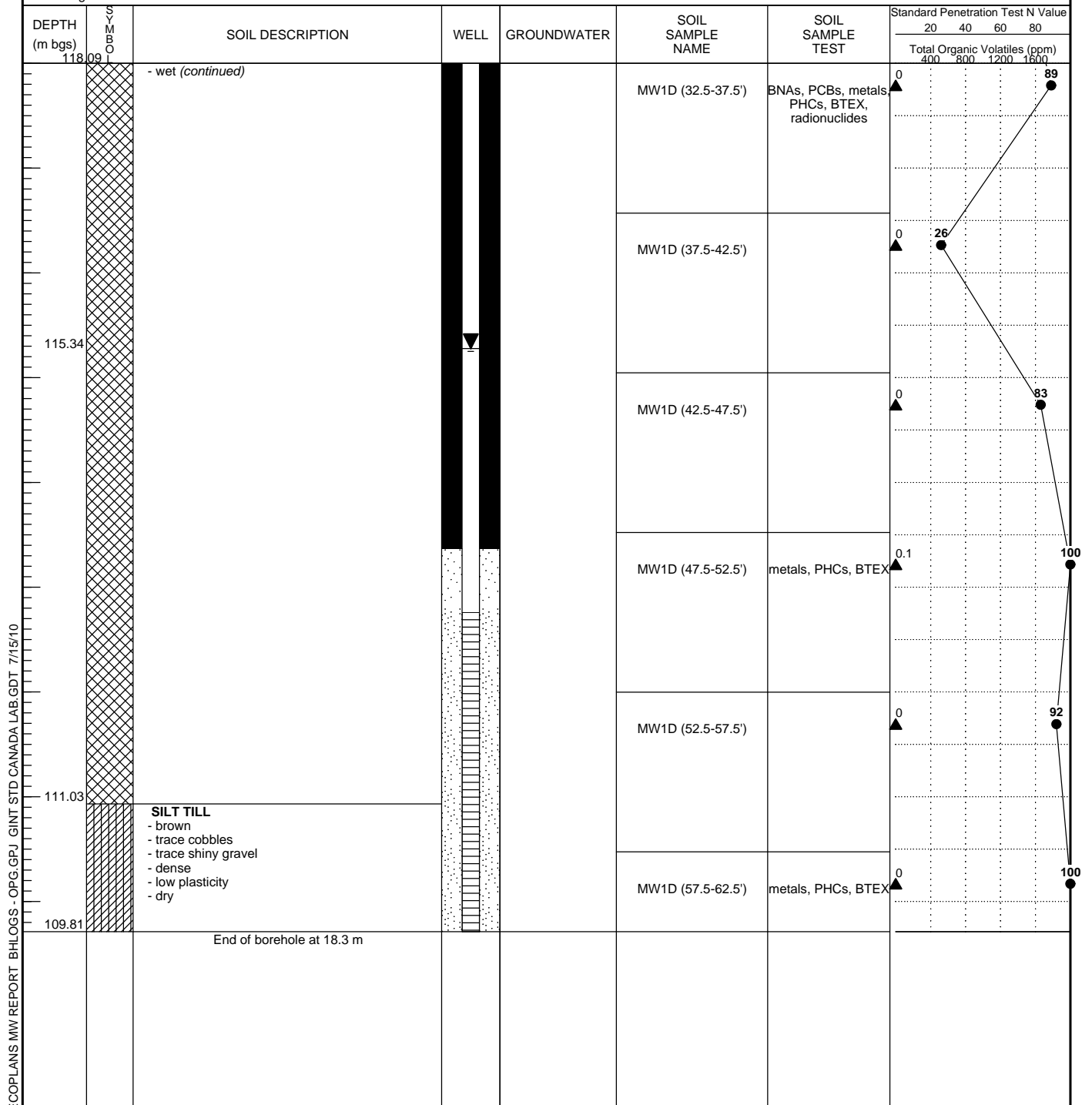
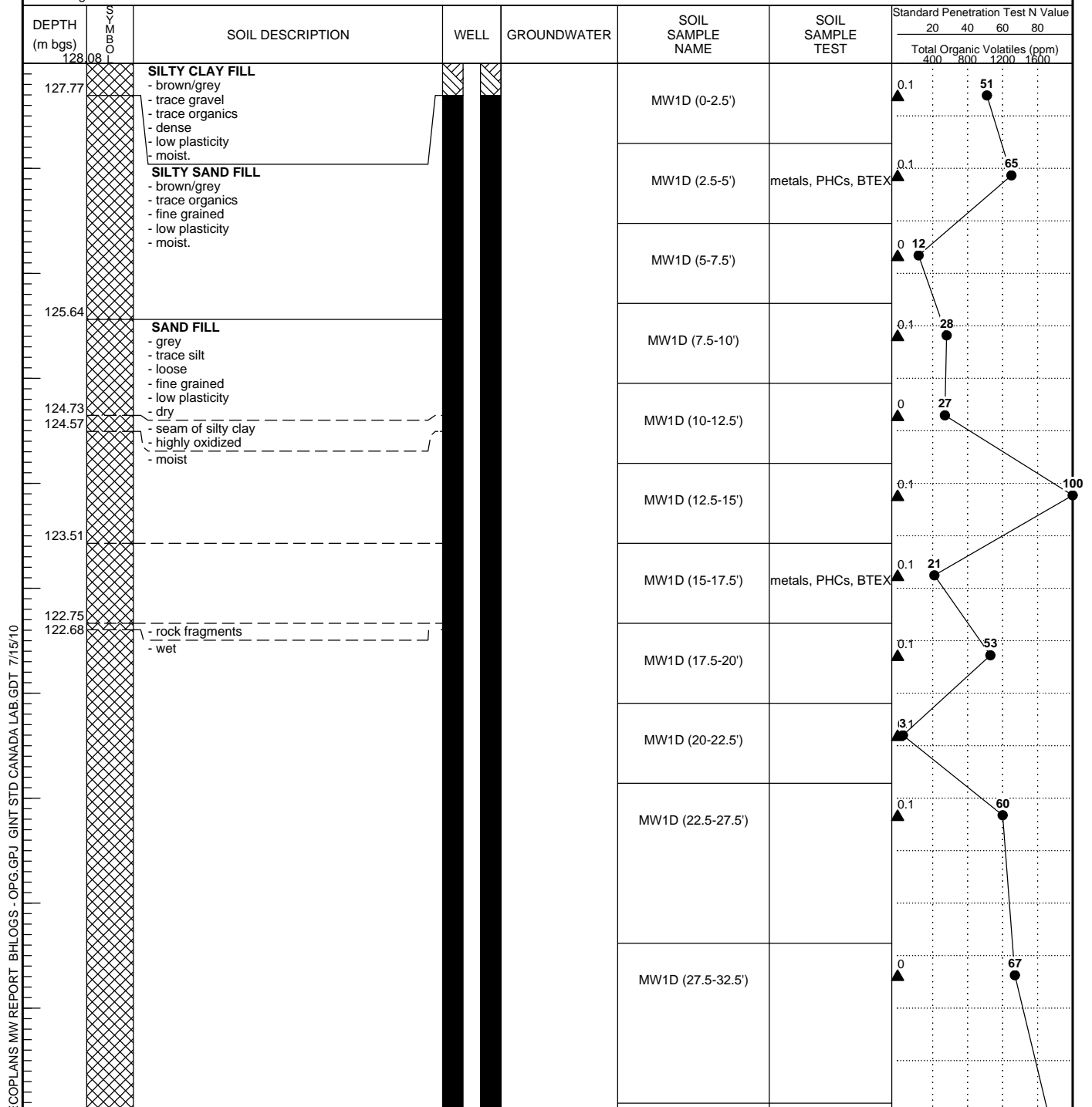


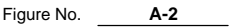
Figure No. **A-2**

LOG OF BOREHOLE **MW1S**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/21/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)





Project No. 550286

Project: Highway 407 East Extension

Location: OPG Darlington Soil Mound

Date Drilled: 1/21/10

Drill Type: CME 75 - Track Mount

Drilling Contractor: Lantech Drilling Services Inc.

- SPT (N) Value

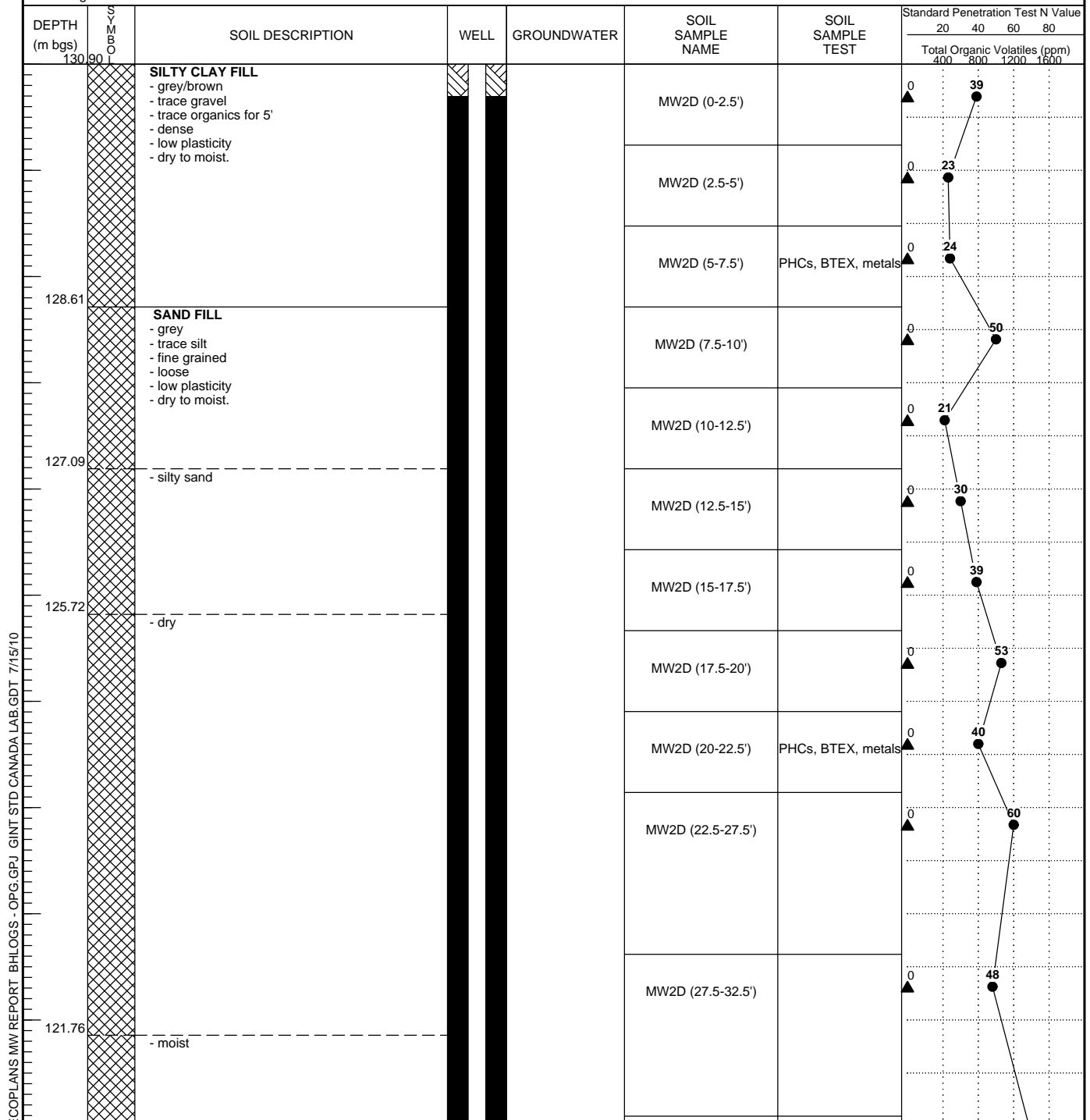
ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

Figure No. **A-3**

LOG OF BOREHOLE **MW2D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/19/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

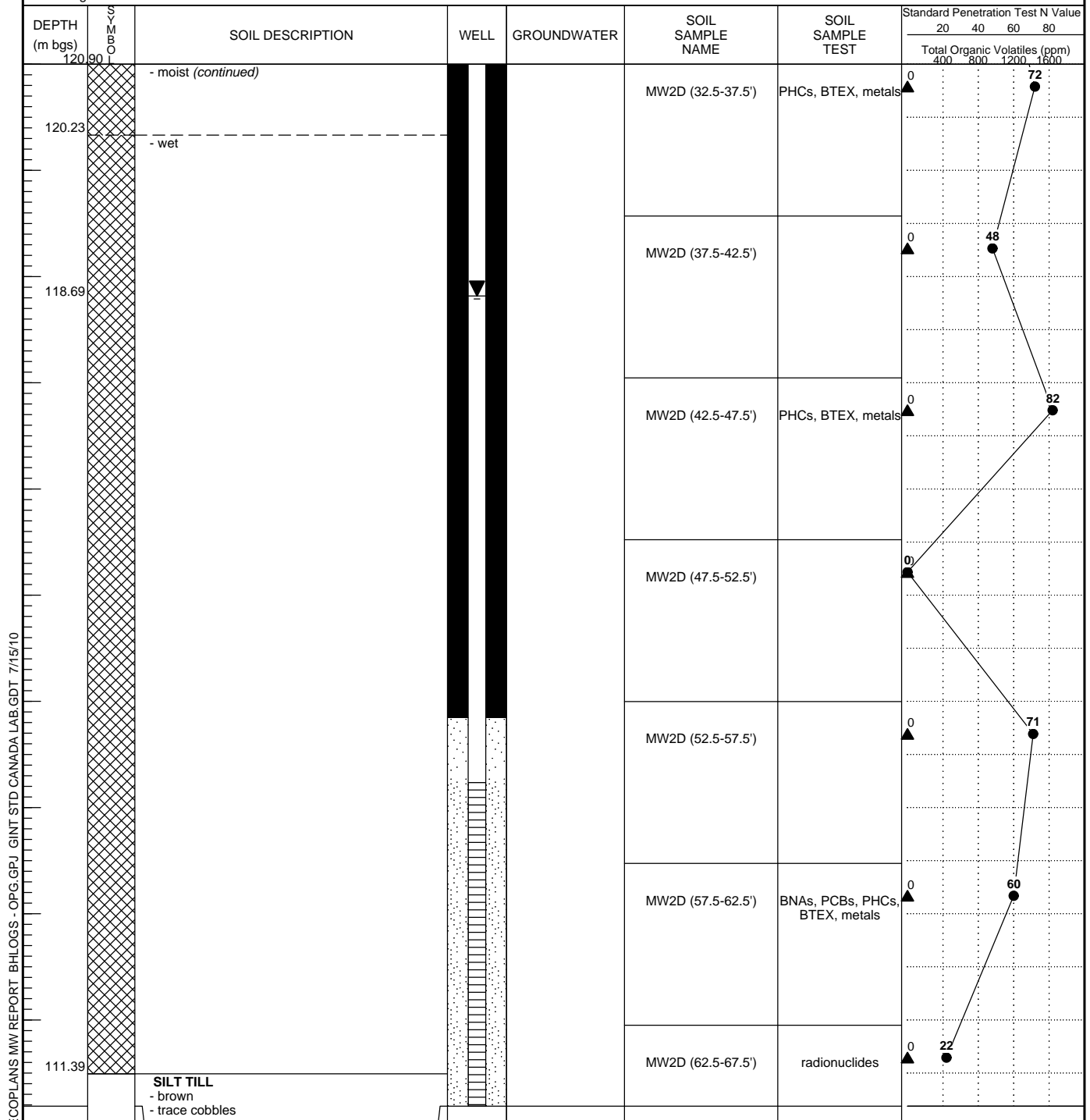


ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

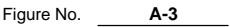
Figure No. **A-3****LOG OF BOREHOLE MW2D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/19/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value



ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10



Project No. 550286
Project: Highway 407 East Extension
Location: OPG Darlington Soil Mound
Date Drilled: 1/19/10
Drill Type: CME 75 - Track Mount
Drilling Contractor Lantech Drilling Services Inc.

- SPT (N) Value

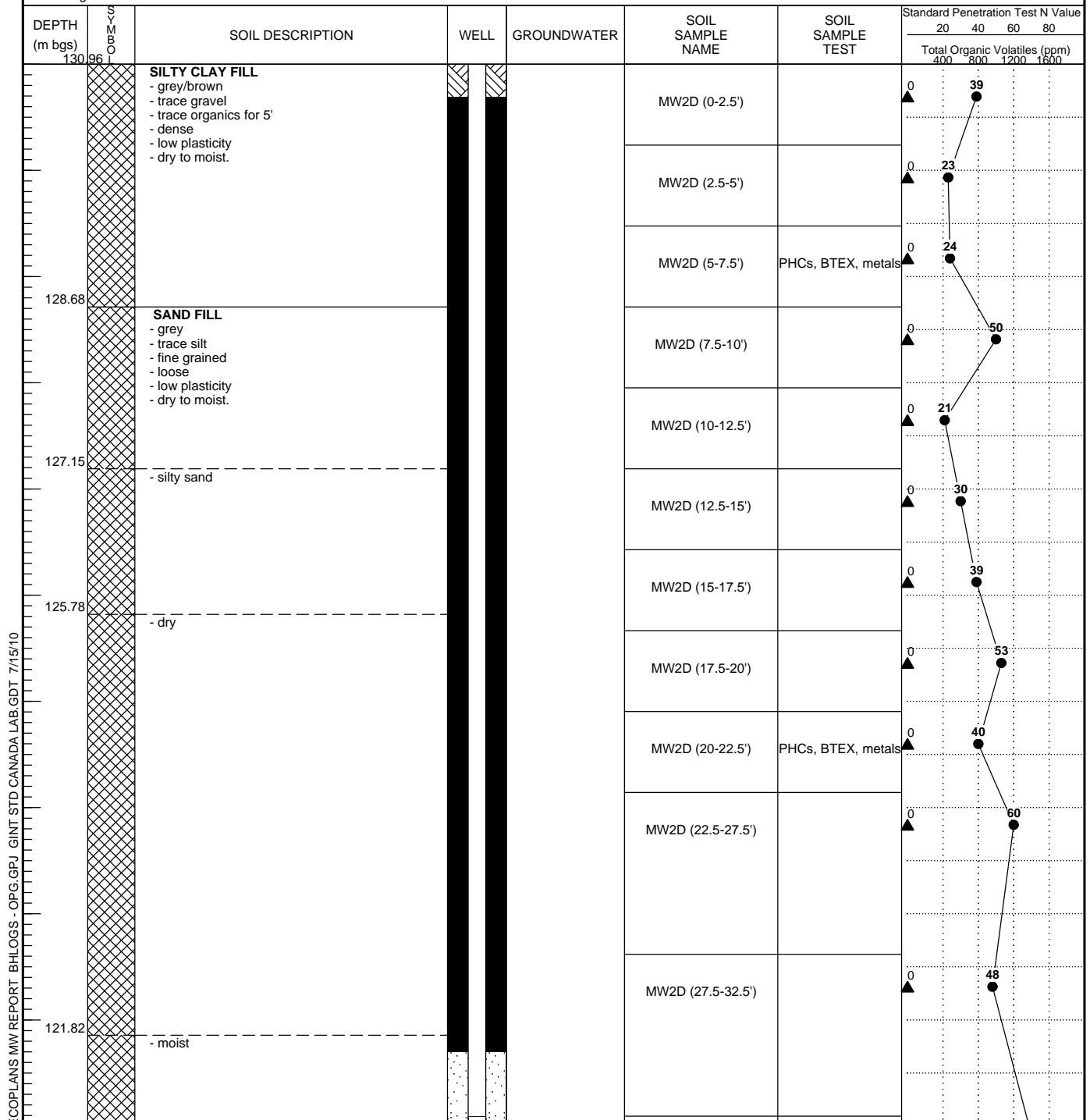
ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

Figure No. **A-4**

LOG OF BOREHOLE MW2S

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/20/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)



Project No. **550286**

Project: **Highway 407 East Extension**

Location: **OPG Darlington Soil Mound**

Date Drilled: **1/20/10**

Drill Type: **CME 75 - Track Mount**

Drilling Contractor **Lantech Drilling Services Inc.**

- SPT (N) Value

ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

Figure No. **A-5**

LOG OF BOREHOLE **MW3D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/18/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

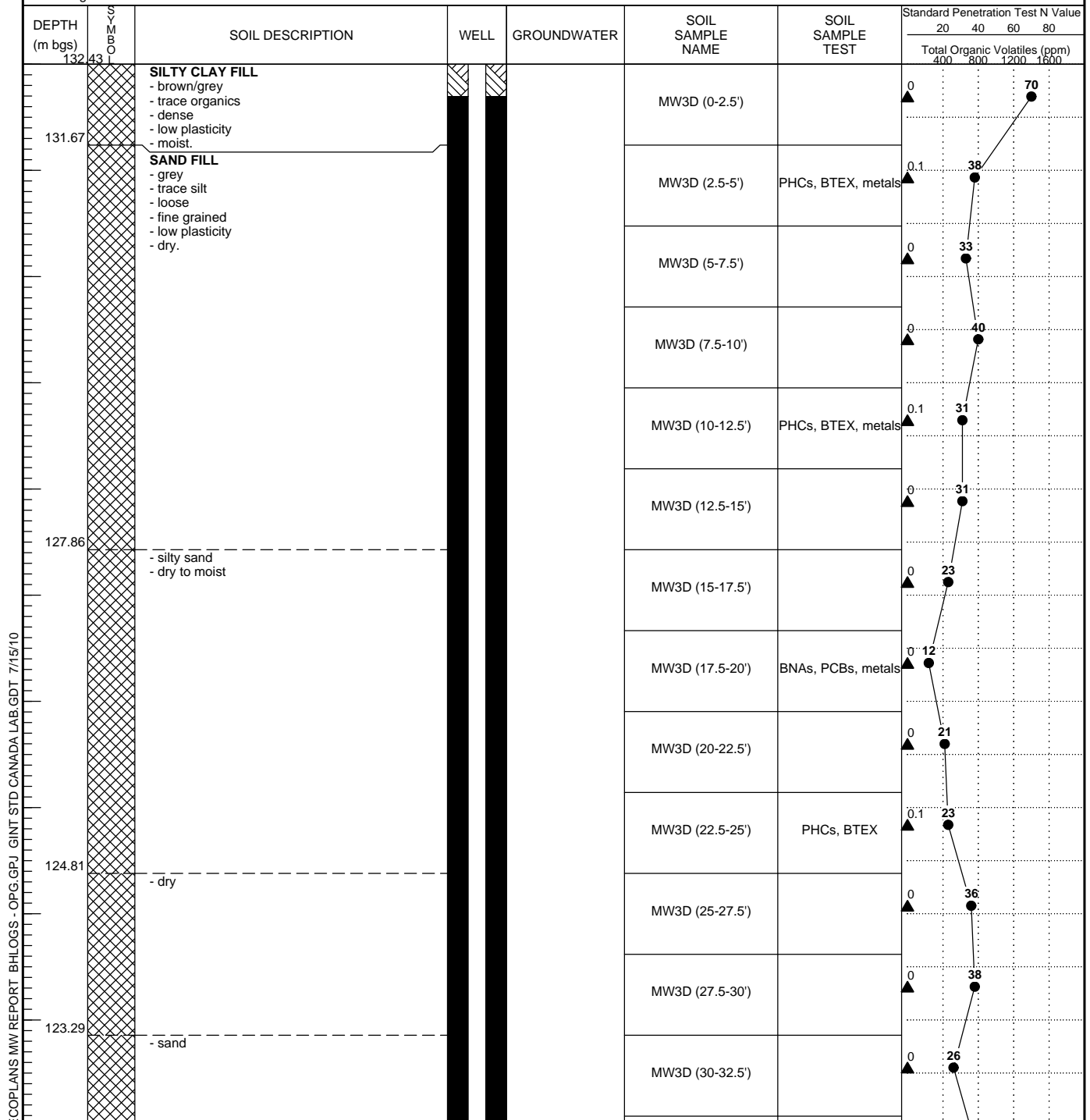
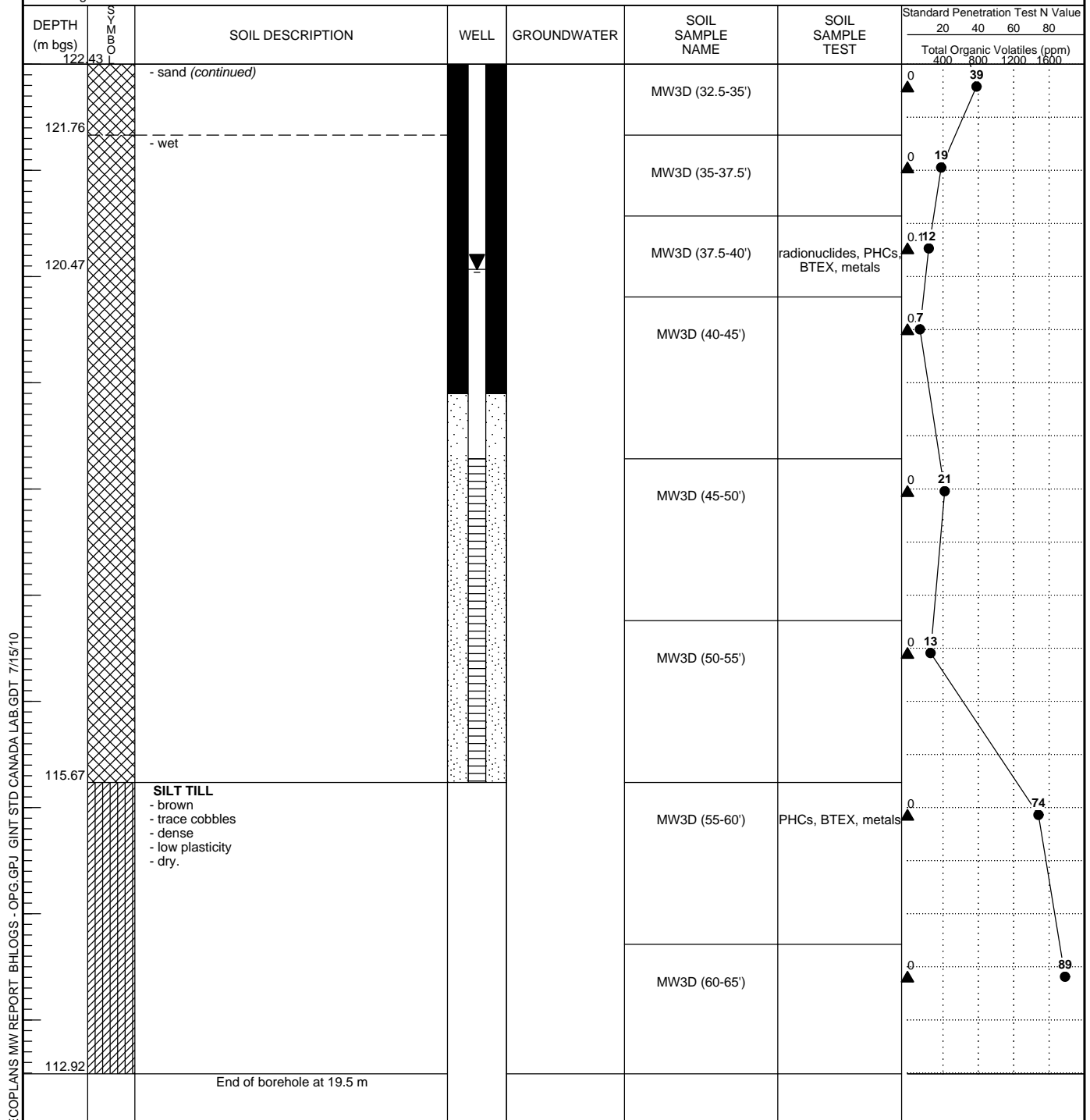


Figure No. **A-5****LOG OF BOREHOLE MW3D**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/18/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value



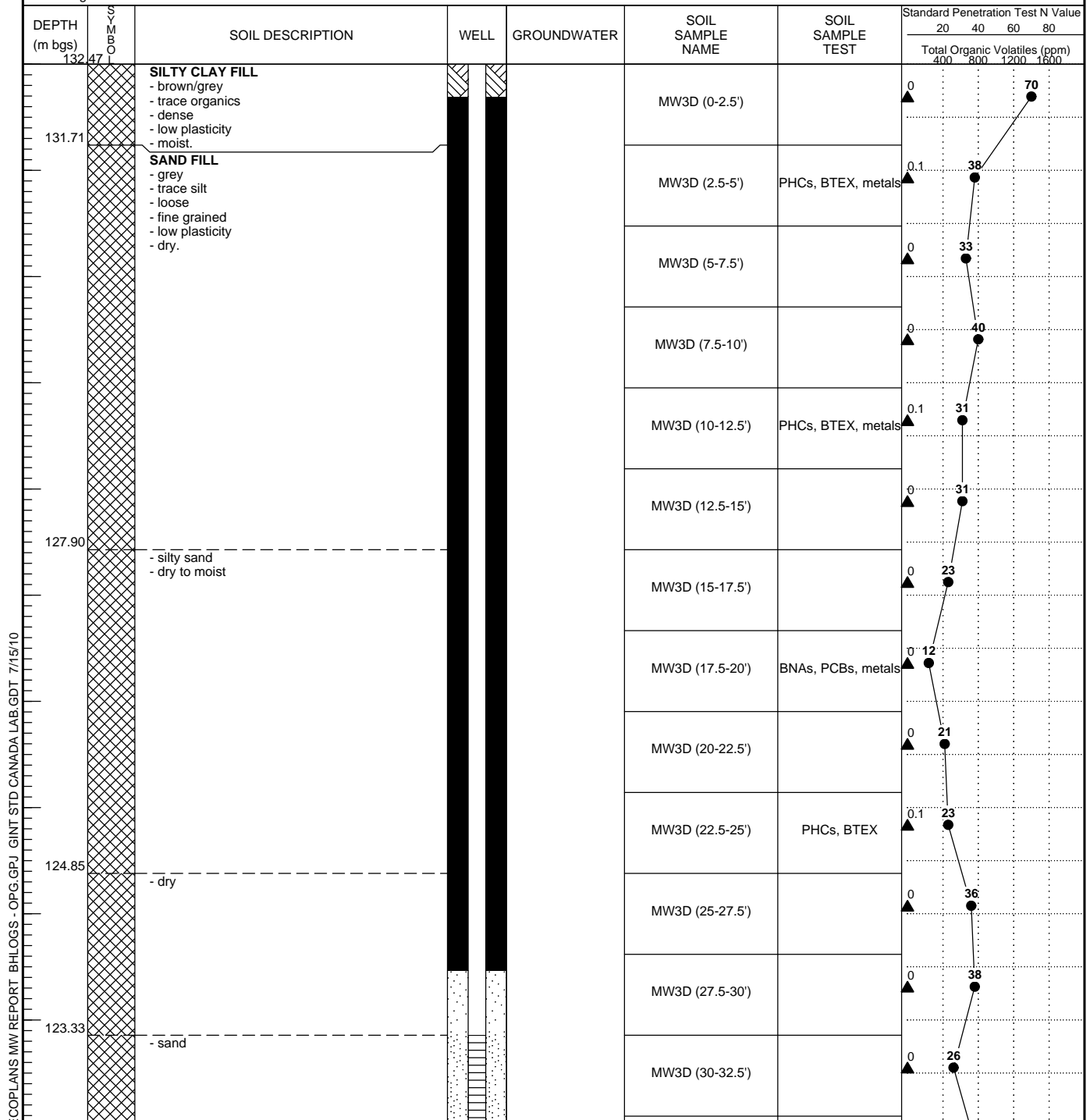
ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

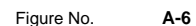
Figure No. **A-6**

LOG OF BOREHOLE **MW3S**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/18/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)





Project No.	550286
Project:	Highway 407 East Extension
Location:	OPG Darlington Soil Mound
Date Drilled:	1/18/10
Drill Type:	CME 75 - Track Mount
Drilling Contractor	Lantech Drilling Services Inc.

- SPT (N) Value

ECOPLANS MW REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

Figure No. **A-7**

LOG OF BOREHOLE **MW4**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/26/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

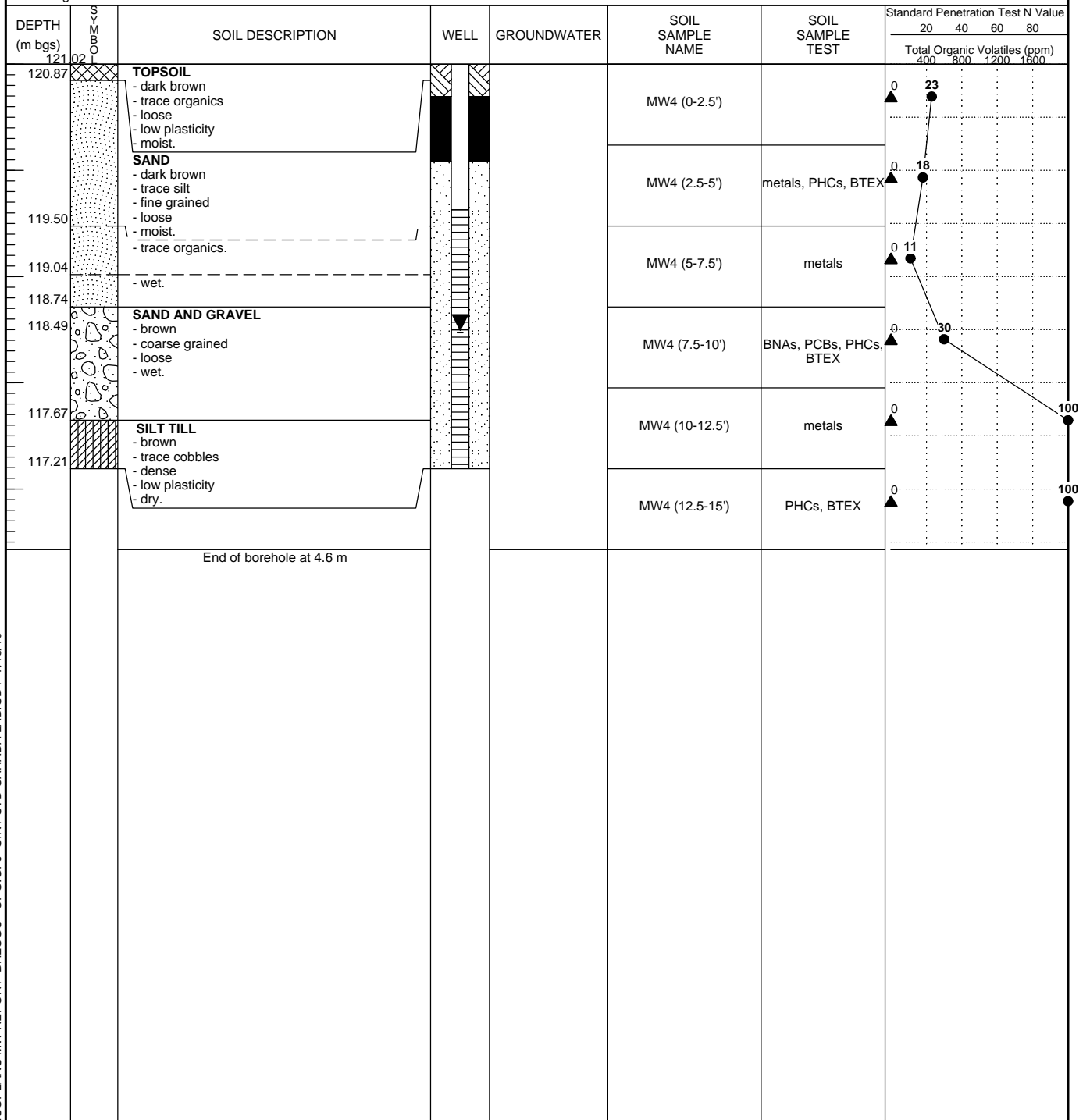


Figure No. **A-8**

LOG OF BOREHOLE **MW5**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/26/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

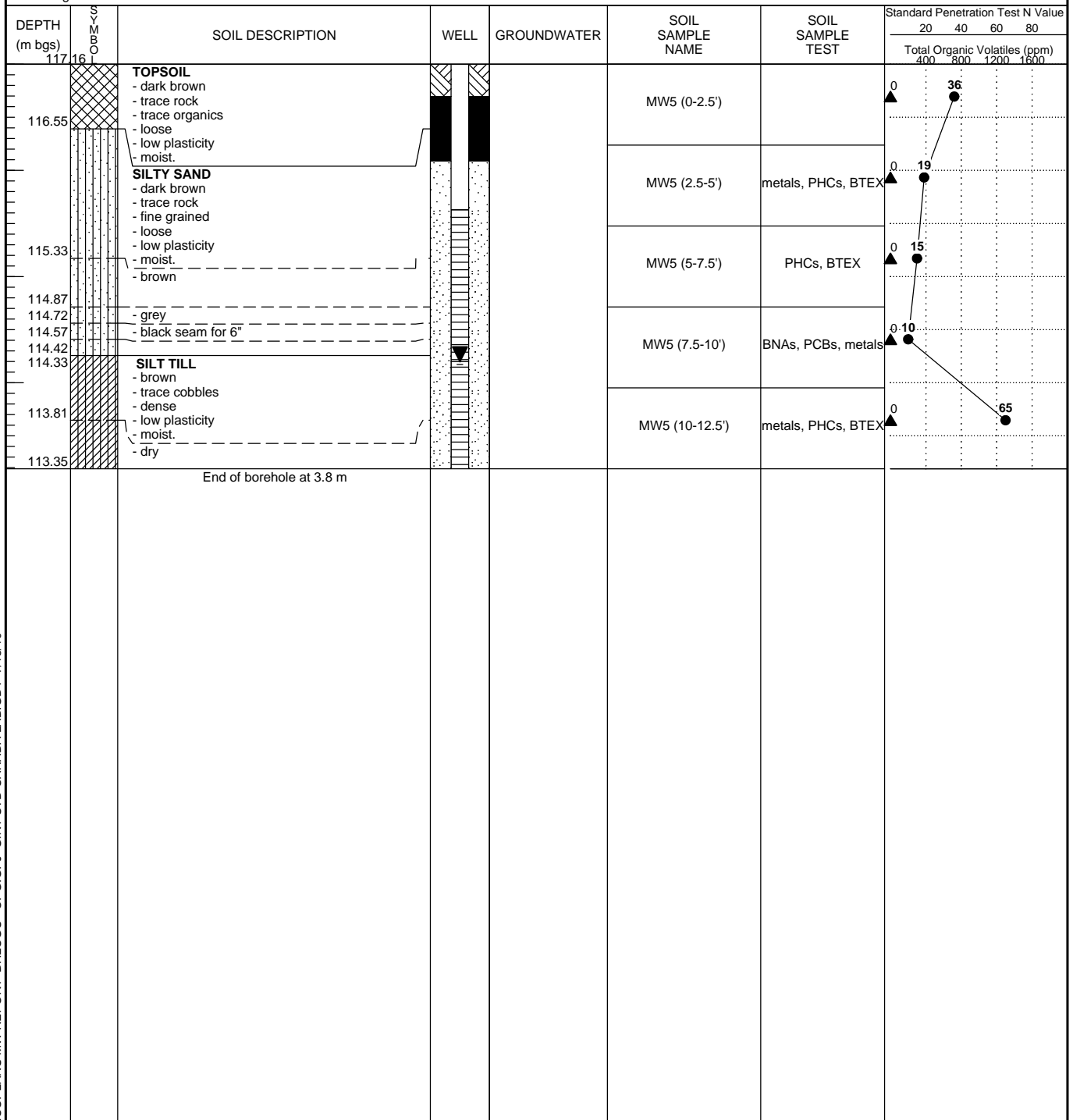


Figure No. **A-9**

LOG OF BOREHOLE MW6

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/27/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

- SPT (N) Value
▲ Total Organic Volatiles (ppm)

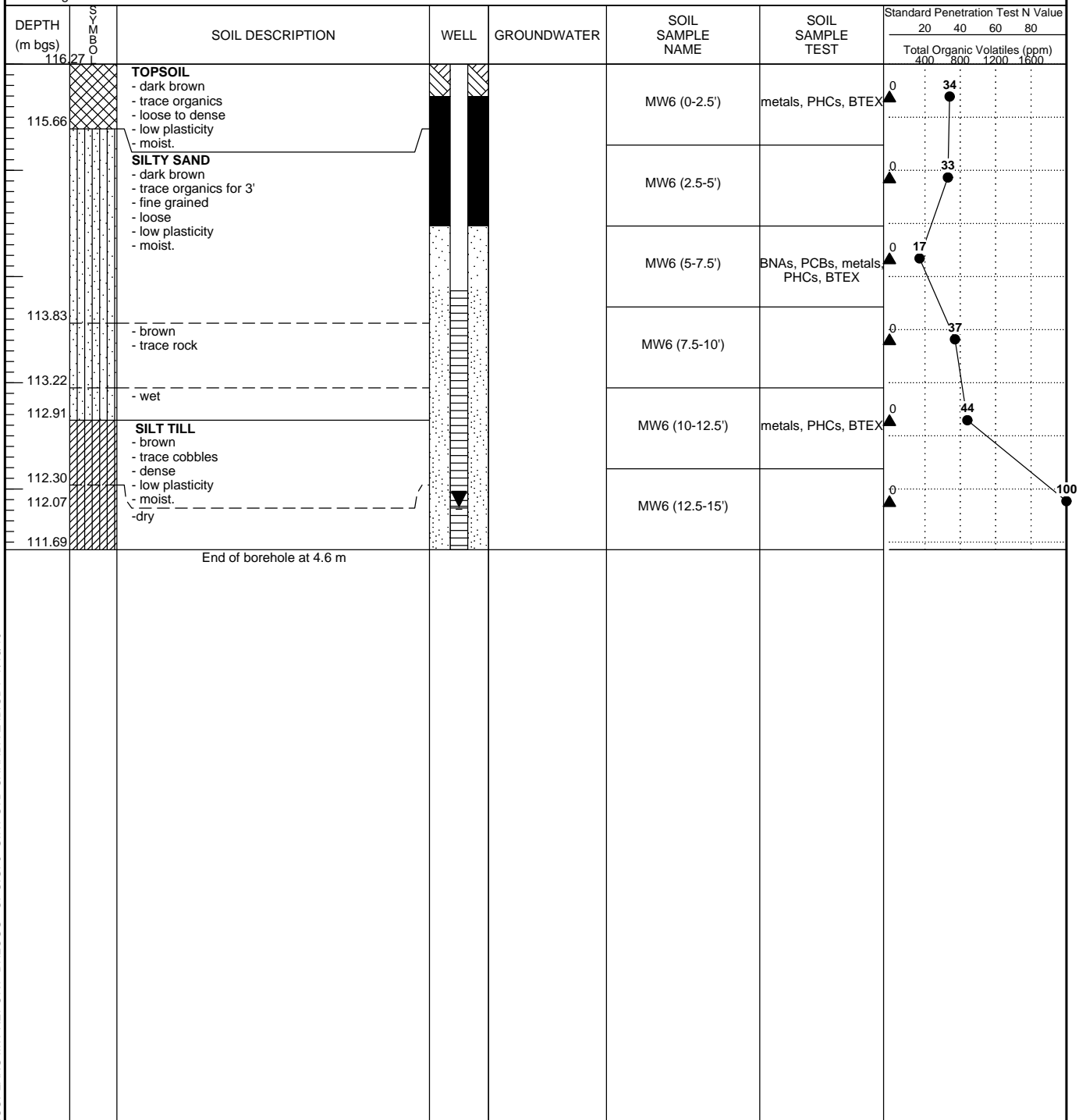


Figure No. **A-10**

LOG OF BOREHOLE **MW7**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound**
Date Drilled: **1/27/10**
Drill Type: **CME 75 - Track Mount**
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)

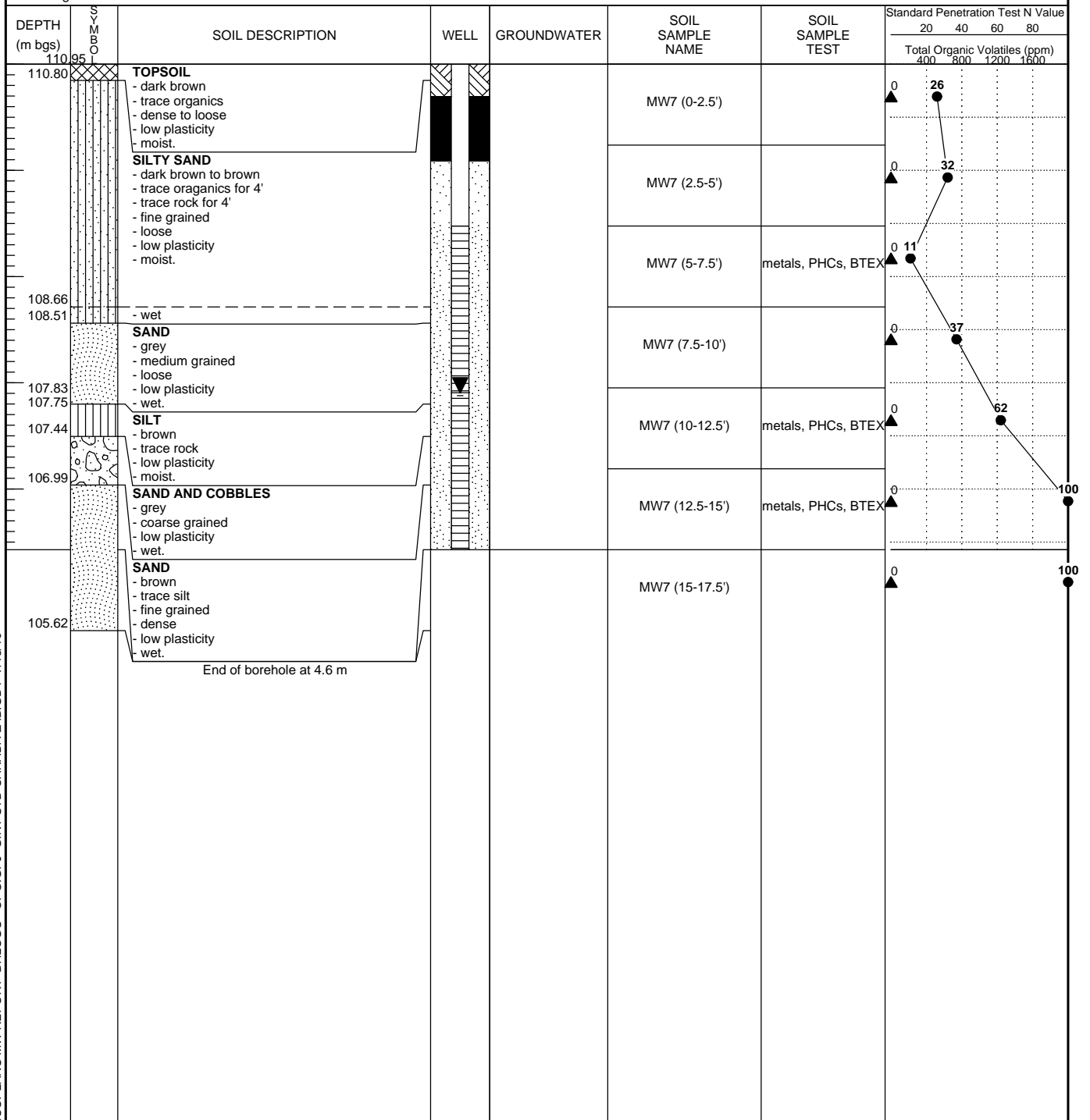


Figure No. **A-11**

LOG OF BOREHOLE **BH1**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound** Co-ordinates **681476E, 4861023N**
Date Drilled: **1/25/10** Logged By: _____
Drill Type: **CME 75 - Track Mount** Checked By: _____
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)

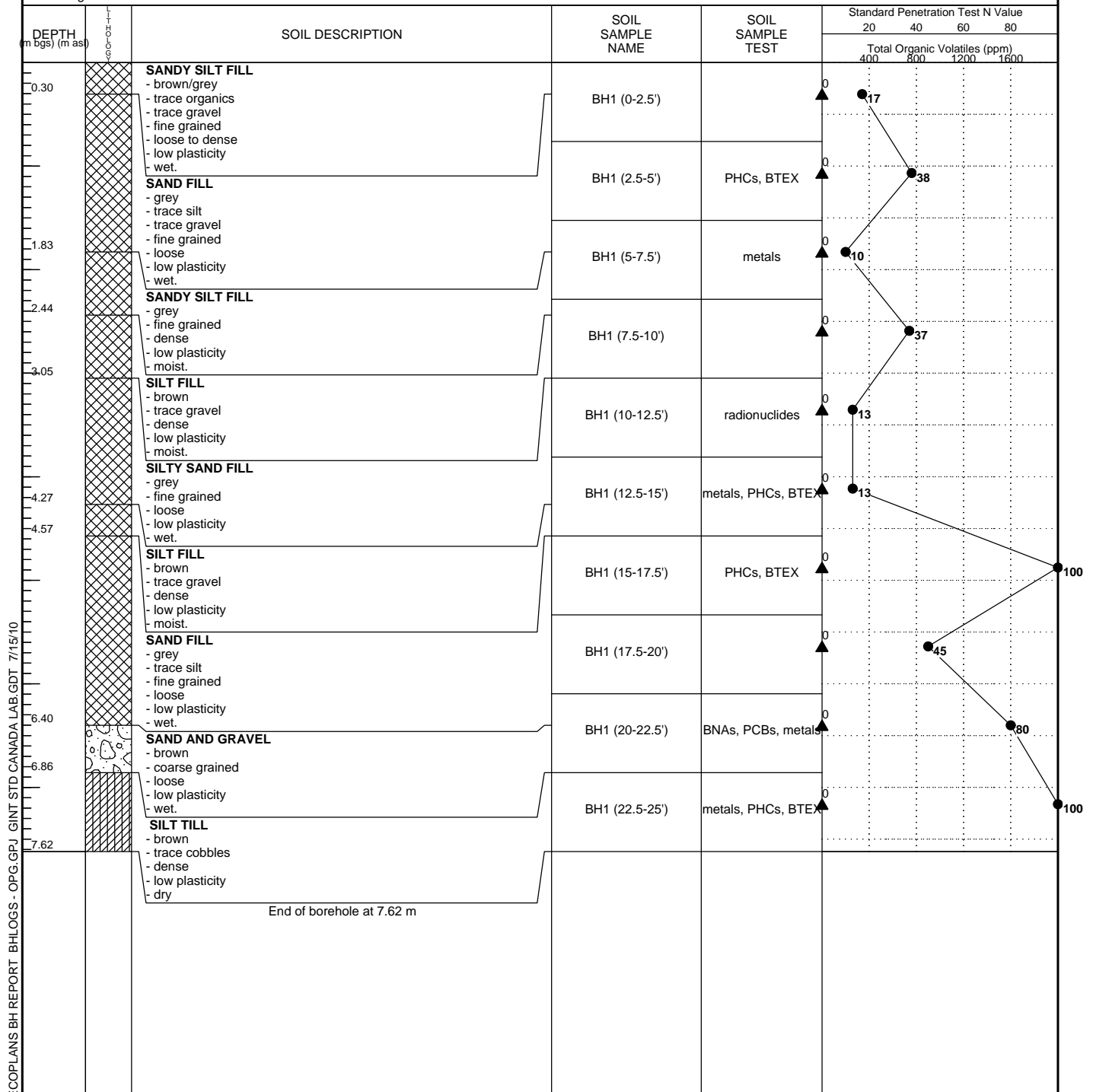


Figure No. **A-12**

LOG OF BOREHOLE **BH2**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound** Co-ordinates: **681626E, 4861070N**
Date Drilled: **1/25/10** Logged By: _____
Drill Type: **CME 75 - Track Mount** Checked By: _____
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)

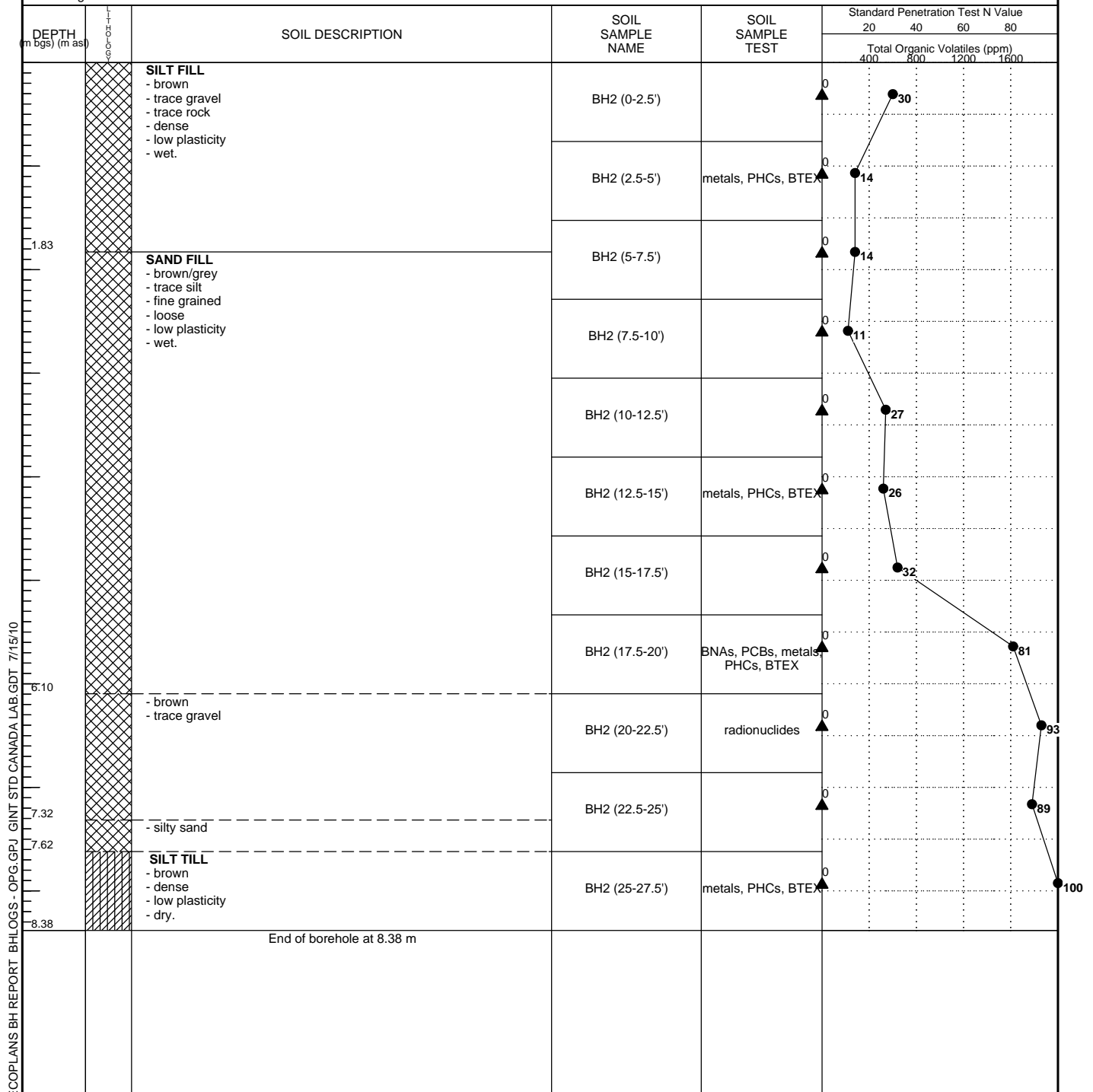
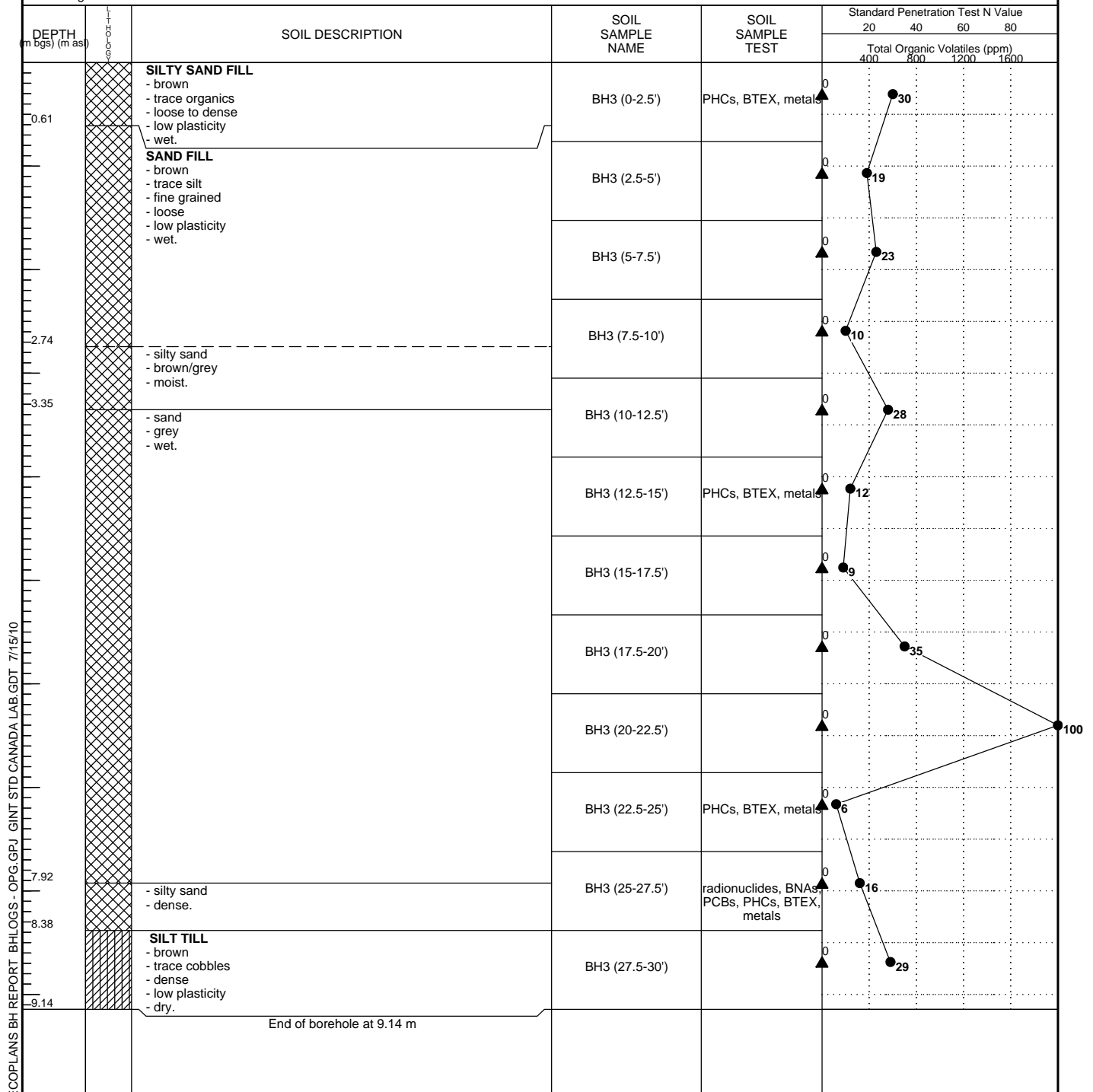


Figure No. **A-13**

LOG OF BOREHOLE **BH3**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound** Co-ordinates **681786E, 4861104N**
Date Drilled: **1/25/10** Logged By: _____
Drill Type: **CME 75 - Track Mount** Checked By: _____
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)



ECOPLANS BH REPORT BHLOGS - OPG.GPJ GINT STD CANADA LAB.GDT 7/15/10

Figure No. **A-14**

LOG OF BOREHOLE **BH4**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound** Co-ordinates **681923E, 4861134N**
Date Drilled: **1/26/10** Logged By: _____
Drill Type: **CME 75 - Track Mount** Checked By: _____
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)

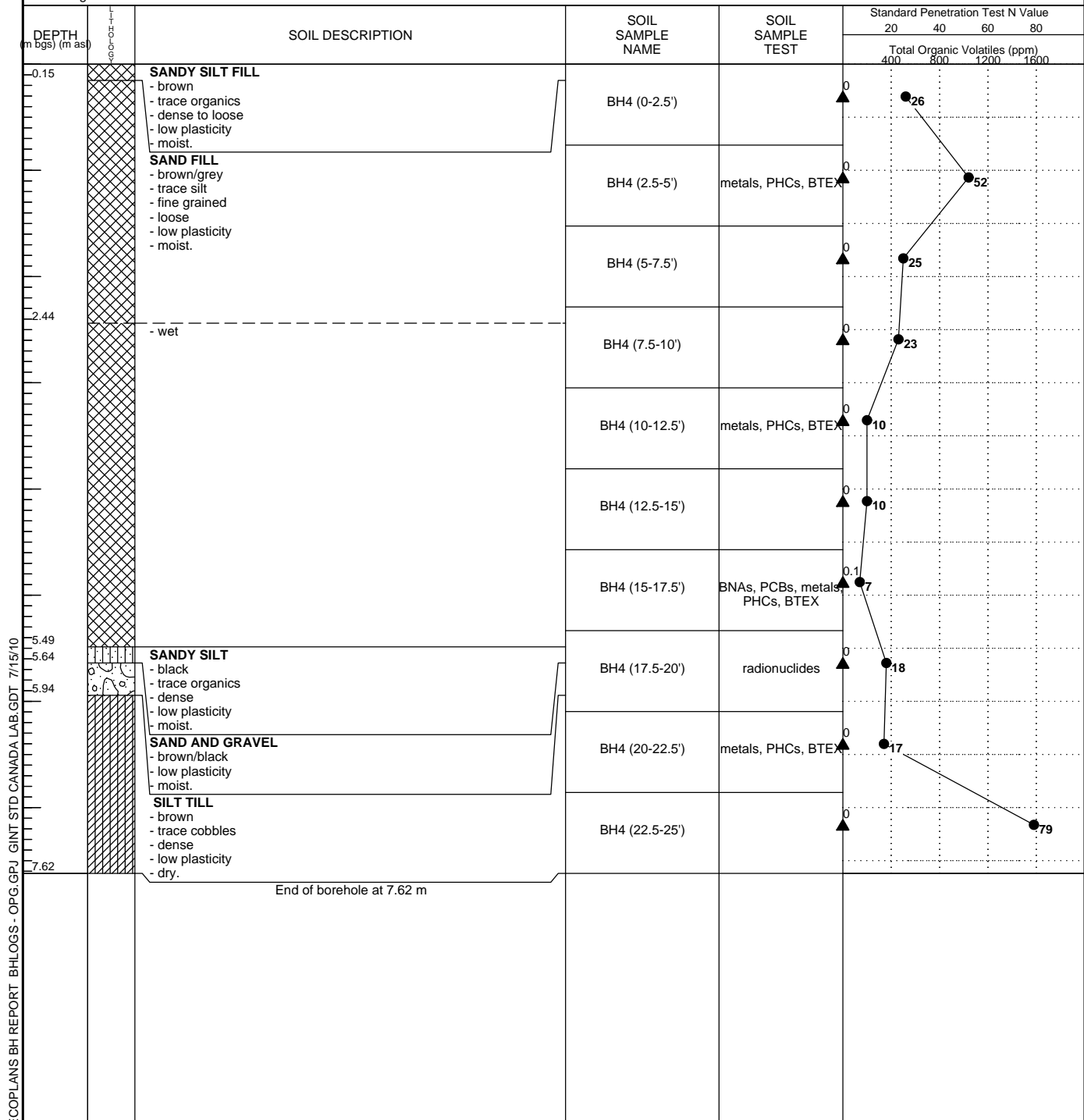
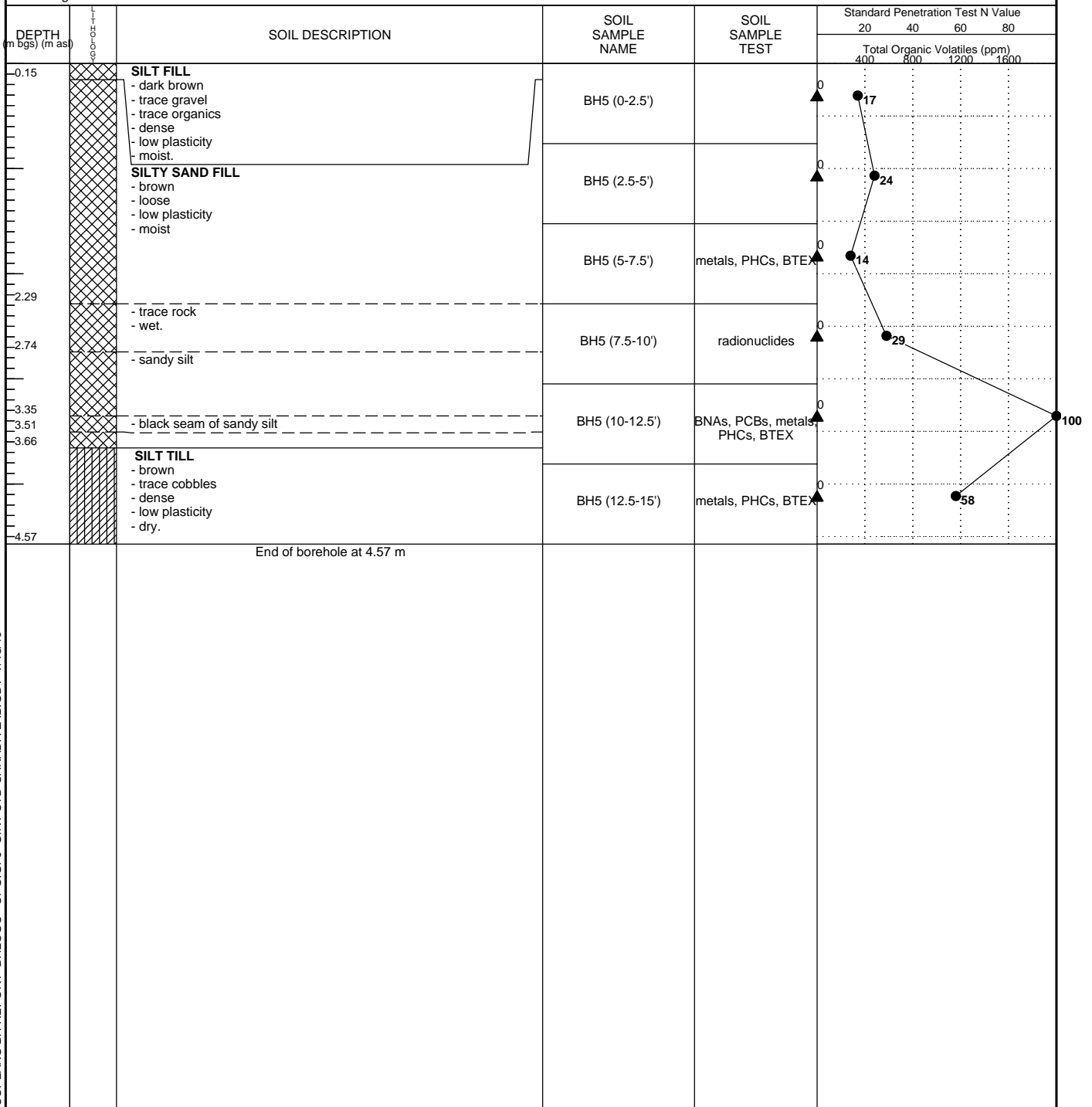


Figure No. **A-15**

LOG OF BOREHOLE **BH5**

Project No. **550286**
Project: **Highway 407 East Extension**
Location: **OPG Darlington Soil Mound** Co-ordinates: **682052E, 4861159N**
Date Drilled: **1/26/10** Logged By: _____
Drill Type: **CME 75 - Track Mount** Checked By: _____
Drilling Contractor: **Lantech Drilling Services Inc.**

● SPT (N) Value
▲ Total Organic Volatiles (ppm)



At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

