May 2011

FOUNDATION INVESTIGATION AND DESIGN REPORT

High Fills and Deep Cut for Truck Climbing Lanes Rehabilitation of Highway 7 From 0.4 km West of Middlesex Road 50 to 0.85 km East of Perth County Line 9 (18 km) GWP 361-98-00, Agreement No. 3006-E-0092 Ministry of Transportation, Ontario - West Region

Submitted to:
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REPORT

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PART A

FOUNDATION INVESTIGATION REPORT

HIGH FILLS AND DEEP CUT FOR TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
FROM 0.4 KM WEST OF MIDDLESEX ROAD 50 TO
0.85 KM EAST OF PERTH COUNTY LINE 9 (18 KM)
GWP 361-98-00, AGREEMENT NO. 3006-E-0092
MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION

1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Delcan Corporation (Delcan) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations as part of the detailed design work for GWP 361-98-00. The project involves the detailed design for the rehabilitation of Highway 7 from 0.4 kilometres west of Middlesex Road 50 to 0.85 kilometres east of Perth Line for a distance of 18 kilometres and includes lane and shoulder widening in the area shown on the Key Plan, Figure 1.

This report addresses the deep cut and high fills, each in excess of 4.5 metres, associated with the rehabilitation of Highway 7 for the proposed truck climbing lanes at the approaches to the bridge over the North Branch of the Thames River. Truck climbing lanes will be required along Highway 7 from the intersection of Whalen Line at 11+430 to approximately 14+760, just east of Fairview Road.

The purpose of the detailed foundation investigation is to determine the subsurface conditions at the locations of the proposed works by drilling boreholes and carrying out in situ testing and laboratory testing on selected samples. The terms of reference for the scope of work are outlined in the MTO's Request for Proposal and Golder Associates' proposal P71-3160-P03 dated August 7, 2008. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated December 15, 2008.

Delcan provided Golder Associates with preliminary drawings for this project in digital format.

2.0 SITE DESCRIPTION

The rehabilitation of Highway 7 to be undertaken as GWP 361-98-00 extends from 0.4 kilometres west of Middlesex Road 50 to 0.85 kilometres east of Perth Line 9. The study area covered by this report extends from approximately Station 11+430 to approximately Station 14+760. The site location is shown on the Key Plan, Figure 1.

At the crossing of the North Branch of the Thames River, Highway 7 currently consists of a two-lane highway. The site is located in an area where the land use is primarily rural residential and agricultural with occasional woodlots bordering the alignment. Aggregate extraction pits are located north and south of Highway 7 west of the river.

The existing roadway was built in sections of cut ranging from 2 to 13 metres between Station 13+170 and 13+510. The highway was built on sections of fill from 2 to 9 metres high between Stations 12+500 and 13+010 and on sections of fill from 2 to 5 metres high between 13+120 and 13+240.

The topography adjacent to Highway 7 in the subject area can be described as moderately sloping land from elevation 315 to elevation 283 metres west of the North Branch of the Thames River. East of the river, the lands can be characterized as steeply sloping from elevation 283 to 317 metres. Photographs of the site are provided in Appendix B.

At the project start-up meeting on May 6, 2009, Delcan indicated that unstable slopes were present at the approaches to the bridge over the North Branch of the Thames River. Sections of the side slopes at Stations 12+694 Rt, 12+920 Lt, 12+980 Lt and 13+288 Rt were noted to be steeper than 2 horizontal to 1 vertical. A historic slumped area was noted near the mid-slope at Station 13+288.

2.1 Site Geology

The area of the proposed Highway 7 rehabilitation lies in the physiographic region of southern Ontario known as the Stratford Till Plain[1]. The Stratford Till Plain is roughly wedge shaped and extends from London to Blyth with a narrow projection towards Arthur. The relatively uniform silty clays were deposited as a product of the Huron ice lobe largely derived from the Lake Huron basin.

Based on the Ontario Department of Mines and Northern Affairs Map 1048 entitled “Pleistocene Geology of the Lucan Area” as well as Map 918 entitled “Quaternary Geology of the St. Marys Area”, the majority of the outlined section of Highway 7 is underlain by sandy silt to silty sand till as described on the mapping. The till is truncated by a narrow band of outwash material (alluvium) along the banks of the Thames River and immediately north of Wildwood Lake. East of the river, there is a substantial deposit of stratified drift largely consisting of sand and gravel. Smaller, localized pockets of clayey silt till are mapped throughout the study area. A deposit of lacustrine silt and clay is located at the most eastern extent of the outlined area.

The bedrock is reported to be microcrystalline limestone belonging to the Dundee and Lucas formations of Upper Silurian Age (Geological Survey of Canada, Map 1263A entitled “Geology, Toronto-Windsor Area”, dated 1969). The bedrock surface is at approximately elevation 270 metres in the region of the Thames River Bridge according to Ontario Department of Mines Map 291.

[1] L.J. Chapman and D.F. Putnam: The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, 1984.

3.0 INVESTIGATION PROCEDURES

The field work for this portion of the investigation was carried out on June 16, 17, 25 and 30 as well as July 2, 7, 8, 9 and 10, 2009, at which time eighteen boreholes, numbered 201 through 218, were drilled to depths of 3.5 to 19.7 metres.

The investigation was carried out using an all-terrain vehicle mounted CME 55 power auger and a truck mounted B57 power auger supplied and operated by a specialist drilling contractor. Samples of the overburden were obtained at 0.75 to 1.5 metre intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test procedures. The samplers used in the investigations limit the maximum particle size that can be sampled and tested to about 40 millimetres. Therefore, particles or objects that may exist within the soils that are larger than this dimension will not be sampled or represented in the grain size distributions. Larger particle sizes, including cobbles and boulders, are known to be present in the glacial till deposits as discussed in the text of this report. Dynamic cone penetration testing was conducted adjacent to borehole 211 in order to provide supplementary information about the clayey silt fill in the existing embankments. Groundwater conditions in the boreholes were observed throughout the drilling operations and a standpipe was installed in borehole 217 as detailed on the Record of Borehole sheet. On December 2, 2009, subsequent to the initial fieldwork, a standpipe was installed in borehole 201 and a standpipe and piezometer were installed in borehole 204. These installations are detailed on the respective Record of Borehole sheets.

The boreholes were backfilled in accordance with current MTO procedures and Ontario Regulation 372/07.

The field work was supervised on a full-time basis by an experienced member of our engineering staff who located the boreholes in the field, directed the drilling, sampling and in situ testing operations and logged the boreholes. The samples were identified in the field, placed in labelled containers and transported to our London laboratory for further examination and routine classification testing. Index and classification tests consisting of water content determinations, grain size distribution analyses and Atterberg limits determinations were carried out on selected samples. The results of the testing are shown on the Record of Borehole sheets and in Appendix A. The locations of the boreholes are shown on the Record of Borehole sheets and on Drawings 1 and 2. The table below summarizes the borehole locations, ground surface elevations at the borehole locations and borehole depths.

Borehole	Location (m)		Ground Surface Elevation (m)	Depth (m)
	Northing	Easting		
201	4 786 339	410 207	317.17	9.60
202	4 786 370	410 229	313.28	3.51
203	4 786 332	410 143	308.68	5.03
204	4 786 292	410 117	316.53	16.46
205	4 786 253	410 045	315.09	19.66
206	4 786 227	409 910	296.15	8.08
207	4 786 250	409 955	298.74	6.55
208	4 786 292	410 053	303.80	6.55

Borehole	Location (m)		Ground Surface Elevation (m)	Depth (m)
	Northing	Easting		
209	4 786 008	409 343	305.38	9.60
210	4 786 024	409 389	302.98	9.60
211	4 786 055	409 430	302.47	13.87
212	4 786 076	409 478	300.50	14.08
213	4 786 090	409 551	294.78	11.13
214	4 786 120	409 587	288.74	4.85
215	4 786 144	409 635	286.26	6.20
216	4 786 165	409 680	285.49	6.50
217	4 786 180	409 716	285.10	6.30
218	4 786 203	409 756	285.15	5.61

4.0 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the in situ testing and the laboratory testing carried out on selected samples, are given on the attached Record of Borehole sheets following the text of this report and in Appendix A. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous samples and observations of drilling resistance and, therefore, may represent transitions between soil types rather than exact planes of geological change. Further, the subsurface conditions will vary between and beyond the borehole locations.

The subsurface conditions in the high fill area west of the North Branch of the Thames River generally consist of surficial topsoil over up to 9 metres of typically cohesive embankment fill which is soft to very stiff. The existing embankment fills are underlain by stiff to hard silty clay till from elevation 302 to 296 metres, compact to dense sandy silt from elevation 297 to 291 metres, dense to very dense sandy silt till and very stiff clayey silt till from elevation 293 to 288 metres and silt from elevation 289 to 287 metres. Loose to very dense sand and gravel was encountered beneath the topsoil, sandy silt, sandy silt till and silt from elevation 292 to 285 metres. Near Station 12+880, the sand and gravel is underlain by compact to very dense sandy silt from elevation 284 metres. In the high fill area east of the river, the existing very soft to very stiff embankment fills are underlain by dense to very dense sandy silt till.

In the deep cut area, the surficial topsoil and fill is underlain by predominantly clayey silt till containing layers of very dense silt or silty sand and dense to very dense sandy silt till. Very dense sandy silt till and hard silty clay till was encountered below elevation 299 metres in the boreholes west of Station 13+350.

The locations and elevations of the boreholes, together with the interpreted stratigraphic profiles, are shown on the attached Drawings 1, 2 and 3. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized in the following sections.

4.1.1 Pavement Structure

Layers of asphaltic concrete were encountered at the pavement surface at borehole locations 203, 208 and 213. The asphalt ranged from 60 to 180 millimetres in thickness.The asphalt layers at boreholes 203, 208 and 213 were underlain by sand and gravel (pavement granulars) from elevations 308.6, 303.7 and 294.6 metres, respectively. Pavement granular materials were also encountered at the surface of borehole 202 which was advanced through the shoulder. The granular pavement layers were 0.2 to 0.7 metres thick.

4.1.2 Topsoil

Layers of topsoil from 100 to 610 millimetres thick were encountered from surface in boreholes 201, 204 through 207, 209 through 212 and 214 through 218. Layers of buried topsoil 610 and 460 millimetres thick were found beneath the fill layers in boreholes 210 and 211, respectively. The surface of the buried topsoil was at elevation 296.9 metres at borehole 210 and 293.2 metres at borehole 211.

The N values of the topsoil were 9 and 10 blows per 0.3 metres and the topsoil had water contents of 25 and 27 per cent. Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content for other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

4.1.3 Fill

Fill materials were encountered at the ground surface in borehole 202, beneath the pavement granulars in borehole 213 from elevation 294.2 metres and under the topsoil in boreholes 204 through 207, 209 through 212 and 215 from elevation 286.3 to elevation 316.3 metres. The fill ranged from 0.6 to 9.2 metres in thickness at the borehole locations and consisted primarily of clayey silt with layers of topsoil and/or silt.

The clayey silt fill was soft to very stiff with N values of 1 to 29 blows per 0.3 metres and water contents of 8 to 24 per cent. The silt fill was very loose to loose with N values of 2 to 6 blows per 0.3 metres and water contents of 19 to 23 per cent. The clayey silt fill is of low plasticity based on plastic limits of 13 to 19 per cent, liquid limits of 22 to 33 per cent and plasticity indices of 5 to 16 per cent. The results of the Atterberg limits determinations are shown on the Plasticity Chart, Figure A-7, and grain size distribution curves for samples of clayey silt fill recovered from the standard penetration testing are shown on Figure A-1 in Appendix A.

4.1.4 Clayey Silt Till

Firm to hard clayey silt till was encountered in boreholes 201 through 205, 208 and 213. At all of these locations, the clayey silt layers were found beneath fill and/or topsoil layers from elevation 289.6 to elevation 316.8 metres. Clayey silt till was also encountered below the silt in borehole 201 from elevation 308.6 metres and below the sandy silt till in borehole 204 from elevation 302.4 metres. Where fully penetrated, the clayey silt till ranged from 0.8 to 15.0 metres thick. Boreholes 201, 203 and 204 were terminated in clayey silt till deposits after exploring the layers for 1.1 to 4.7 metres. Cobbles and boulders were found in the clayey silt till layers in the boreholes 204 and 205. Although not specifically encountered at the other borehole locations, the presence of cobbles and boulders should be anticipated throughout the clayey silt till deposit.

The N values of the clayey silt till ranged from 7 to more than 100 blows per 0.3 metres indicating a generally very stiff to hard consistency. The water content of the clayey silt till varied from 6 to 20 per cent. The clayey silt till is of low plasticity based on liquid limits of 21 to 30 per cent, plastic limits of 12 to 14 per cent and plasticity indices of 9 to 16 per cent as determined in the Atterberg limits testing.

The Atterberg limits results for the clayey silt till are shown on Figure A-8 and grain size distribution curves for samples of clayey silt till recovered from the standard penetration testing are shown on Figure A-2 in Appendix A.

4.1.5 Silty Sand

Below the clayey silt till, borehole 202 encountered very dense silty sand at elevation 311.2 metres and was terminated in the silty sand after exploring it for some 1.4 metres. The silty sand was very dense with N values of 92 and 100 blows per 0.3 metres. The silty sand had a water content of 6 per cent. The results of the grain size distribution testing conducted on a sample of silty sand are presented on Figure A-3.

4.1.6 Silt

A layer of very loose to very dense silt was encountered in the clayey silt till stratum at elevation 310.3 metres in borehole 201 and beneath the surficial topsoil from elevation 288.6 metres in borehole 214. The silt layers were 1.7 to 1.8 metres thick. The N values of the silt ranged from 3 to greater than 100 blows per 0.3 metres with very loose silt found near the surface of borehole 214. The silt had a water content of 10 per cent.

4.1.7 Silty Clay Till

Layers of stiff to hard silty clay till were encountered in boreholes 207, 208 and 209. The silty clay till was found from elevation 297.4 to elevation 301.0 metres beneath layers of fill in boreholes 207 and 209 and beneath a layer of clayey silt till in borehole 208. Where fully penetrated in boreholes 207 and 208, the silty clay till was 3.3 and 0.8 metres thick, respectively. Borehole 209 was terminated in the silty clay till after exploring it for 5.2 metres.

The N values of the silty clay till varied from 8 to 64 blows per 0.3 metres indicating a generally stiff to hard consistency. The water content of the silty clay till ranged from 14 to 23 per cent. The silty clay till is of intermediate plasticity based on plastic limits of 16 to 17 per cent, liquid limits of 36 to 40 per cent and plasticity indices of 19 to 23 per cent.

The results of the Atterberg limits testing are shown on Figure A-8 and grain size distribution curves for samples of silty clay till recovered from the standard penetration testing are shown on Figure A-4. Although not specifically encountered in the boreholes, the presence of cobbles and boulders in the silty clay till strata should be expected.

4.1.8 Sandy Silt Till

Layers of compact to very dense sandy silt till were encountered in boreholes 204 through 208, 212 and 215. The surface of the sandy silt till was found between elevations 284.1 and 305.6 metres below layers of fill, sand, silty clay till and clayey silt till. Where fully penetrated, the sandy silt till varied from 0.8 to 3.2 metres thick. Boreholes 205 through 207 were terminated in sandy silt till deposits after exploring the layers for 1.4 to 3.8 metres. Cobbles and/or boulders were present in the sandy silt till in boreholes 205 and 212 and should be expected at all locations within the glacial till deposits.

The N values of the sandy silt till ranged from 20 to greater than 100 blows per 0.6 metres indicating a compact to very dense relative density. The sandy silt till had water contents that varied from 6 to 12 per cent.

4.1.9 Sandy Silt

Sandy silt deposits were encountered in boreholes 210, 211, 215 and 216 from elevation 280.3 to 296.3 metres. The sandy silt layer was 1.1 metres thick where fully penetrated in borehole 211. Boreholes 210, 215 and 216 were terminated in layers of sandy silt after exploring the layers from 1.3 to 2.9 metres. The sandy silt was compact to very dense with N values of 11 to more than 100 blows per 0.3 metres.

The water content of the sandy silt ranged from 7 to 19 per cent. The results of grain size distribution testing of a single sample of sandy silt are presented on Figure A-5.

4.1.10 Sand

The sandy silt till in borehole 206 was interlayered with a 0.2 metre thick layer of sand from elevation 291.0 metres. Based on the N values achieved near this elevation, the sand is inferred to be dense to very dense.

4.1.11 Sand and Gravel

Deposits of sand and gravel were found in boreholes 211 through 218. The sand and gravel layer in borehole 211 was observed to be silty. In boreholes 211 through 215, the sand and gravel was found beneath layers of fill, sandy silt, clayey silt till and sandy silt till from elevations 284.9 to 291.7 metres. At boreholes 216 through 218, the sand and gravel was encountered from elevations 285.0 to 285.4 metres beneath the surficial topsoil. Where fully penetrated in boreholes 215 and 216, the sand and gravel was 0.8 to 5.1 metres thick. Boreholes 211 through 214, 217 and 218 were terminated in sand and gravel after exploring the layers from 3.1 to 6.2 metres.

The N values of the sand and gravel ranged from 7 to more than 100 blows per 0.3 metres indicating a loose to very dense relative density. The natural water contents of the sand and gravel varied from 3 to 12 per cent.

The results of grain size testing on samples of sand and gravel recovered from the standard penetration testing are shown on Figure A-6.

4.2 Groundwater Conditions

Groundwater conditions were observed during and upon completion of drilling and a standpipe was installed in borehole 217. The encountered groundwater conditions are noted on the Record of Borehole sheets, on the profiles and sections on Drawings 1, 2 and 3 and are summarized in the following text and table.

Borehole	Ground Surface Elevation	Encountered Groundwater Level	
		Depth	Elevation
	(m)	(m)	(m)
201	317.17	Dry	Dry
202	313.28	Dry	Dry
203	308.68	Dry	Dry
204	316.53	Dry	Dry
205	315.09	Dry	Dry
206	296.15	Dry	Dry
207	298.74	Dry	Dry
208	303.80	Dry	Dry
209	305.38	Dry	Dry
210	302.98	Dry	Dry
211	302.47	Dry	Dry
212	300.50	Dry	Dry
213	294.78	Dry	Dry

Borehole	Ground Surface Elevation	Encountered Groundwater Level	
		Depth	Elevation
	(m)	(m)	(m)
214	288.74	Dry	Dry
215	286.26	2.7	283.6
216	285.49	2.7	282.8
217	285.10	2.9	282.2
218	285.15	2.7	282.5

Groundwater was not encountered during drilling at borehole locations 201 through 214 and the boreholes were dry upon completion. Groundwater was encountered in boreholes 215 to 218 at depths of 2.7 to 2.9 metres or between elevations 282.2 and 283.6 metres. The water level in the North Branch of the Thames River was measured at elevation 282.64 metres on August 12, 2009.

Based on the dry conditions encountered in boreholes 201, 204 and 205 during drilling and the original project schedule, it was considered that piezometer installation in these boreholes would not respond quickly enough to provide meaningful data. However, as a result of the deferral of the truck climbing lane construction, sufficient time was available to obtain relevant groundwater level data and the piezometers and standpipes were installed in these boreholes for long-term monitoring.

Standpipes were installed in boreholes 201 and 217 and a standpipe and piezometer were installed in borehole 204. Groundwater levels have been monitored approximately every three months from December 2009 to April 2011. The most recent reading of these installations was obtained on April 26, 2011 shortly before these installations were decommissioned. On that date, the groundwater level in the standpipes was measured at elevation 312.0 metres in borehole 201, elevation 314.6 metres in borehole 204 and elevation 284.3 metres in borehole 217. The groundwater level in the piezometer in borehole 204 was measured at elevation 309.5 metres. A summary of the measured groundwater levels at the three monitoring locations is presented in Table I below.

Table 1. Summary of Groundwater Level Monitoring

Borehole:	**201**		**204**				**217**	
Type of Installation:	Standpipe		Standpipe		Piezometer		Standpipe	
Ground Surface Elevation (m):	317.17		316.53		316.53		285.10	
Date	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
August 12, 2009	-	-	-	-	-	-	2.31	282.79
December 2, 2009	Dry	Dry	Dry	Dry	Dry	Dry	-	-
January 16, 2010	4.93	312.24	3.05	313.48	6.50	310.03	2.26	282.84
May 28, 2010	5.08	312.09	1.85	314.68	6.85	309.68	2.31	282.79
August 5, 2010	4.80	312.37	1.89	314.64	6.81	309.72	2.36	282.74
September 30, 2010	5.26	311.91	2.43	314.10	6.86	309.67	2.37	282.73
November 30, 2010	4.95	312.22	2.03	314.50	6.76	309.77	2.03	283.07
March 7, 2011	5.21	311.96	1.98	314.55	7.01	309.52	0.76	284.34
April 26, 2011	6.05	311.12	1.80	314.73	6.83	309.70	1.52	283.58

Based on colour changes in the native soils and the encountered and measured water levels, the groundwater level adjacent to the cut east of the river has been inferred to be at elevation 315 metres with downward gradient. West of the river along the Highway 7 alignment, the groundwater level is inferred to be at elevation 284 metres.

Groundwater levels are expected to fluctuate with seasonal and climatic variations as well as during construction.

5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Brent Urlin Drilling and Environmental Services Ltd., who is an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Michael Arthur under the direction of Mr. David J. Mitchell. The laboratory testing was carried out at Golder Associates' London laboratory under the direction of Mr. Chris M. Sewell. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories for testing Types C and D aggregates. This report was prepared by Ms. Dirka U. Prout, P.Eng. under the direction of the Team Leader Mr. Philip R. Bedell, P. Eng. This report was reviewed by Mr. Fintan J. Heffernan, P. Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

GOLDER ASSOCIATES LTD.

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PART B

FOUNDATION INVESTIGATION AND DESIGN REPORT

HIGH FILLS AND DEEP CUT FOR TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
FROM 0.4 KM WEST OF MIDDLESEX ROAD 50 TO
0.85 KM EAST OF PERTH COUNTY LINE 9 (18 KM)
GWP 361-98-00, AGREEMENT NO. 3006-E-0092
MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION

6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides our recommendations on the foundation design aspects of the high fill and the deep cut associated with the widening of Highway 7 for the proposed truck climbing lanes in the area of the bridge over the North Branch of the Thames River. The recommendations are based on our interpretation of the factual information obtained during the investigation and design information provided to date. It should be noted that the interpretation and recommendations are intended for use only by the design engineer. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

Highway 7 in the vicinity of the river valley is to be widened to accommodate truck climbing lanes between approximately Station 11+430 (Whalen Road) and Station 14+760. West of the river, a truck climbing lane will be provided in the westbound direction. Similarly, there will be a eastbound truck climbing lane east of the structure. The existing ditches will be lowered.

It is understood that the MTO has deferred work on the proposed truck climbing lanes. The design has not been finalized and, as a result, design assumptions were based on the existing cross-section and preliminary typical sections provided by Delcan. During finalization of the detail design, Golder Associates should be notified in order to confirm the suitability of the geotechnical recommendations contained within this report.

6.2 Deep Cut

Construction of the eastbound truck climbing lane and widened Highway 7 platform will require a widening of the 2 to 13 metre deep cut between approximately Stations 13+170 and 13+510. The current centreline profile of Highway 7 ranges from elevation 297.7 metres at Station 13+170 to elevation 313.1 metres at Station 13+510. Evidence of slumping was noted on the southern cut slope in the vicinity of Station 13+290. A detailed discussion on the stability of the existing and proposed cut slopes is presented in Section 6.6.

Boreholes 201 through 205, 207 and 208 were drilled within the area of the proposed cut. The generalized subsurface conditions encountered within the boreholes consisted of surficial asphalt, fill or topsoil overlying silty clay till, clayey silt till and/or sandy silt till. The clayey silt till/silty clay till ranged from firm to hard and the sandy silt till varied from dense to very dense. In the vicinity of Station 13+450 to 13+550, silt and silty sand were encountered from elevation 310 to 312 metres. The inferred groundwater level is assumed to be between elevations 305 and 314 metres.

The proposed Highway 7 widening requires cut slopes from 2 to approximately 14 metres high. The proposed highway profile has not been finalized at the time of writing and it was assumed that the highway grade changes would be minimal. Standard cut side slopes of 2 horizontal to 1 vertical are proposed.

The cut slopes are expected to intercept the groundwater surface.

6.3 High Fills

The two segments of high fills are located between approximately Stations 12+500 and Stations 13+010 and 13+120 and 13+140. The high fills are to be constructed to facilitate the widening of Highway 7 for the proposed truck climbing lanes.

6.3.1 Stations 12+500 through 13+010

This portion of Highway 7 was built on fill 2 to 9 metres high. The existing centreline grade in this section ranges from elevation 292.0 metres at Station 12+910 to elevation 308.3 metres at Station 12+500. The existing road profile will be slightly flattened and the road cross-section will be widened in order to incorporate the proposed truck climbing lanes. The proposed Highway 7 design was assumed to require embankment fills up to 10 metres high with side slopes of 2 horizontal to 1 vertical.

Boreholes 209 through 218 were drilled along this section of high fill. The existing fill consists both of materials placed for the original embankment construction, as represented by borehole 213, and those subsequently placed during operation of the sand and gravel extraction operation, as represented by boreholes 209 to 212, inclusive. The fills are predominantly cohesive in nature with the majority of the fill consisting of soft to very stiff silty clay and clayey silt with zones of topsoil, loose silt as well as sand and gravel associated with the pavement structure. It should be noted that topsoil was encountered beneath the fill between approximately Stations 12+575 and 12+675. Between Station 12+850 and the river, the existing embankments in the area of boreholes 216 through 218 are underlain by compact to very dense sand and gravel deposits that extend to depths of 3 to greater than 5.5 metres. In the vicinity of Stations 12+850 to 12+950, the sand and gravel is underlain by compact to very dense sandy silt. Between Stations 12+625 and 12+850, the 6 to 9 metre high fill embankments are underlain by 2 to 3 metres of loose to very dense silt, dense to very dense sandy silt till or very stiff clayey silt till. These deposits are underlain by loose to very dense but generally very dense sand and gravel. West of Station 12+625, the existing embankment fills are up to 9 metres and are constructed on stiff to hard silty clay till or compact to very dense sandy silt.

The groundwater level is at approximately elevation 283 metres near the river and rises in the higher ground to the east and west.

6.3.2 Stations 13+120 through 13+140

This portion of the highway consists of the east approach embankment for the North Thames River Bridge with fill heights ranging from 2 to 5 metres. The existing centreline profile of Highway 7 varies from elevation 295.5 metres at Station 13+120 to elevation 296.0 metres at Station 13+140. The road profile will be smoothed slightly and the highway widened for the proposed truck climbing lanes in this area. The proposed embankment widening will be up to 6 metres high with side slopes of 2 horizontal to 1 vertical.

Borehole 206 was drilled in this high fill section. The subsurface conditions encountered at the borehole location consisted of surficial topsoil overlying very soft to very stiff clayey silt fill which was 4.2 metres thick. Beneath the fill, a layer of dense to very dense sandy silt till containing a thin layer of sand was encountered. Groundwater or grey soils were not encountered in the borehole. Therefore, the groundwater level is inferred to be below the maximum depth of the exploration elevation of 288.1 metres.

6.4 Subgrade Preparation and Embankment Construction

All surficial topsoil, organic, loose, soft and/or otherwise deleterious materials should be stripped from areas of proposed high fill construction. The exposed subgrade should be proofrolled prior to fill placement under the direction of qualified geotechnical personnel. In addition, all surficial topsoil and any wet, soft, organic and/or deleterious materials should be removed from the proposed widening areas. It is not considered necessary to remove the topsoil buried under existing embankment areas. Grading and fill construction should be conducted in accordance with MTO Special Provision 206S03.

The roadway fill should consist of an approved earth borrow, an approved granular borrow such as Select Subgrade Material (SSM) or Granular B, Type I. Boreholes drilled through the embankment fills indicated that the existing embankments consist mainly of clayey silt till and silty clay till with some granular layers.

Embankment fill materials should be placed in maximum 300 millimetre thick loose lifts and properly benched into the existing embankments in accordance with Ontario Provincial Standard Drawing (OPSD) 208.010 and compacted. Upon completion of filling to the pavement subgrade level, the embankment side slopes should be trimmed to a final inclination of 2 horizontal to 1 vertical or flatter. Embankment fills greater than 8 metres in height should be provided with a minimum 2 metre wide bench at mid-height.

6.5 Settlement

Westbound Truck Climbing Lanes

The high fill section of the westbound Truck Climbing Lanes will extend from approximate Station 12+500 to Station 13+010. The roadway will be widened to provide a 3.75 metre wide lane, 3.0 metre wide shoulder and 0.5 metre wide rounding in each direction with a 1.70 metre wide westbound truck climbing lane. A grade raise in the order of 0.5 metres has been proposed for the high fill area west of Station 13+000. Minimal to no grade raise is proposed east of Station 13+000 in order to maintain the road profile in the vicinity of the Thames River Bridge. The existing ground surface at the left side of the road platform between Station 12+500 and 12+740 slopes very gently. Therefore, until approximate Station 12+740, widening of the left side of the road will be achieved by raising the grade for a distance of about 9.0 metres left of the road centreline. On the right side of the road platform, the grade raise will extend to 7.5 metres south of the road centerline, effectively extending the south side of the road prism by 0.5 metres. Beyond Station 12+740, the road will be widened symmetrically approximately 0.5 to 1.0 metres on each side.

Eastbound Truck Climbing Lanes

The high fill section of the proposed eastbound truck climbing lanes extends from Stations 13+120 to 13+140. It is not anticipated that the grade will be increased due to the proximity to the bridge structure. The lane configuration will be identical to west bound section except the truck climbing lane will be in the eastbound lane. Details as to how the road prism will be modified in this area have not been provided to date.

6.5.1 Analyses

Settlements resulting from new embankment construction were estimated from settlement analyses which utilized information from the existing boreholes and the design information provided to date. One dimensional

settlement analyses were conducted using Hough's method for the areas of predominately granular soils and conventional settlement analysis for areas with cohesive foundation soils. The settlement analyses were conducted at four critical sections (Stations 12+550, 12+640, 13+000 and 13+120), representing the highest fill sections or locations adjacent to the structure. Where granular foundation soils exist, the fill embankments were modelled using the existing Highway 7 cross-sections at the stations noted and extended to encompass the proposed truck lanes. In the area of predominately cohesive soil (at Station 12+550), the fill section was modelled as a 100 metre long section having the dimensions of the proposed widened embankment and side slopes inclined at 2 horizontal to 1 vertical.

The consolidation properties of the soils were inferred from soil index properties. The following table shows the estimated total post-construction foundation settlements below the embankment at selected stations.

Station	Approximate Fill Height	Estimated Settlement
	(m)	(mm)
12+550	7	40
12+640	10	15
13+000	10	10
13+120	6	10

It is anticipated that the settlement related to the widened embankment will be largely immediate considering that the foundation soils consist of compact to very dense granular deposits or stiff to hard overconsolidated cohesive soils. It is anticipated that in the abutment areas, the proposed widening will have negligible impact on the piled foundations of the bridge.

Settlement due to compression of the new and existing embankment fill materials would be additional to the above values and some post construction differential settlement should be expected. Settlement of the new fill is expected to be both immediate and negligible since granular fill has been proposed and magnitudes of the intended grade raises and extents of the widenings are quite low. Total settlement of the existing embankment fill is expected to be 10 millimetres or less. Negligible consolidation settlement of the existing cohesive embankment fills is predicted.

It is anticipated that the overall post-construction settlements will be within the MTO guidelines.

6.6 Stability

6.6.1 Existing Slopes

A survey of cut slopes along the proposed truck climbing lanes was conducted by members of our engineering staff. Seven sections of slope varying from 4.9 to 12.3 metres in height were examined. Four of the slopes were found to have sections that were inclined greater than 2 horizontal to 1 vertical. No evidence of wet areas or seepage was observed on the slopes inspected.

Evidence of instability was observed at one of the four slopes with oversteepened sections as defined as slopes greater than 2 horizontal to 1 vertical. Minor slumping was noted near the mid-slope at Station 13+288 Rt where the inclination of the oversteepened slope section was approximately 30 degrees (º). The movements in the distressed area did not appear to be recent. The steepest slope section observed was at Station 12+920 Rt

where the lower two-thirds of the slope was inclined at 36º. The observations taken during the site visit are summarized in the following table:

Location	Overall Cut-Slope		Oversteepened Section		
	Total Height	Approximate Slope Inclination	Distance From Crest		Approximate Slope
	(m)	(º)	From (m)	To (m)	(º)
12+640 Rt	6.9	26	-	-	-
12+694 Rt	7.2	27	0	6.9	29
12+770 Rt	4.9	21	-	-	-
12+920 Rt	6.7	28	4.1	12.5	36
13+300 Rt	6.9	25	-	-	-
12+980 Lt	7.4	24	0	8.1	28
13+288 Rt	12.2	23	11.7	16.1	30

Two critical sections were selected for a slope stability analysis using SLOPE/W, a commercially available software package for limit equilibrium stability analyses. The first was at approximately Station 12+694 Rt within the existing high fill area and the second was at approximately Station 13+288 Rt within the existing deep cut area. Slope stability analyses were run for both sections utilizing the existing slope configurations as well as the borehole data and resulted in factors of safety of approximately 1.2 under current conditions. Although both slope sections were found to be globally stable, the factor of safety for the localized oversteepened sections was found to be less than 1.3. Graphical results of the slope stability analyses are presented in Appendix C.

Based on the slope stability analysis, a local factor of safety of 1.3 is achievable for the embankment at Station 12+694 Rt provided that the slopes are flattened/trimmed to 2 horizontal to 1 vertical or flatter.

A local factor of safety of 1.3 is achievable, based on the slope stability analysis, at Station 13+288 Rt provided that the cut slopes are flattened/trimmed to 2 horizontal to 1 vertical or flatter. In addition to the recommendations in Section 6.4, any loosened or disturbed materials should be removed and recompacted within the areas where distresses have occurred or replaced with compacted granular fill. A 2 metre wide bench should be added at mid-height for slopes more than 8 metres in height.

It is our understanding that the proposed improvements to Highway 7 have been deferred. In the absence of rehabilitation to the areas of concern, continued slope instability should be expected (especially during prolonged wet periods). As a result, a slope monitoring program is warranted for these areas.

6.6.2 High Fills and Deep Cuts

The drawings provided by Delcan show side slope inclinations of approximately 2 horizontal to 1 vertical along the majority of existing roadway embankment and cut areas. It has been assumed that the proposed high fill embankments and deep cut areas will also be constructed with similar side slopes. To model the proposed Highway 7 improvements, the existing road cross sections were widened by 4 metres in both directions for the truck climbing lanes.

A factor of safety against instability of 1.3 is achievable for the proposed widened embankment slopes between approximately Stations 12+500 and 13+010 provided that any oversteepened area(s) or area(s) with existing instability are first remediated prior to placement of the widening fills as outlined in Section 6.6.1. From

approximately Stations 13+120 to 13+140, the proposed high fill embankments will have a factor of safety of at least 1.3 against instability for slopes of 2 horizontal to 1 vertical provided that the embankment is built as outlined above.

The slope stability analysis shows that a factor of safety of at least 1.3 is achievable for the deep cuts between approximately Station 13+170 and Station 13+480 provided that the slopes are cut to 2 horizontal to 1 vertical and surface water is directed away from the slope face.

6.7 Excavations and Temporary Cut Slopes

Excavations for cut slopes in the deep cut areas will encounter surficial topsoil and fill and extensive deposits of stiff to hard clayey silt till. Cobbles and boulders are present in the clayey silt till and excavation may be difficult in the hard till soils. The deep cut excavations may extend below the groundwater level. Due to the cohesive nature of the cut slope material, seepage volumes are expected to be low; however, higher volumes may be experienced where granular seams and layers within the clayey silt till are intercepted. It is anticipated that the encountered groundwater can be adequately controlled using properly filtered sumps and gravel sheeting, where required. A Non-Standard Special Provision (NSSP) should be added to the Contract document to alert the Contractor that the hard clayey silt till contains cobbles and boulders and granular seams and layers which may be saturated. The hard clayey silt till may be difficult to excavate. In addition, during construction of cut slopes within the clayey silt till, more aggressive groundwater control techniques, such as those previously described, will be required if saturated granular seams/layers are encountered.

Temporary erosion and sediment control measures should be implemented during construction in accordance with Ontario Provincial Standard Specification (OPSS) 577. Mid-height or intermediate height benches some 2 metres wide would be required in high fill or deep cut areas where the overall slope height is greater than 8 and 6 metres, respectively. Careful ditching and drainage works should be provided behind the cut and at the mid-height or intermediate height benches to control surface flows and minimize erosion. The completed slope should be topsoiled and provided with an erosion control blanket.

All excavations should be carried out in accordance with the guidelines outlined in the latest edition of the Ontario Occupational Health and Safety Act and Regulations For Construction Projects. The fill materials at this site would be classified as Type 3 soils as would any cohesionless materials below the groundwater level. The native clayey materials, properly dewatered cohesionless materials and tills would be classified as Type 2 soils.

Any temporary excavation support system(s) required should be designed and constructed in accordance with Special Provision 539S01. The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in SP 105S19.

The support systems may be designed using the following parameters:

Soil Type	Coefficient of Earth Pressure			Internal Angle of Friction (degrees)	Unit Weight (kN/m^3)
	Active, K_a	At Rest, K_o	Passive, K_p		
Clayey Silt or Silt Fill	0.36	0.53	2.8	28	20
Clayey Silt Till	0.33	0.50	3.0	30	21
Silty Clay Till	0.36	0.53	2.8	28	21
Sandy Silt Till	0.31	0.47	3.2	32	21
Sand and Gravel	0.30	0.46	3.3	33	22

The earth pressure coefficients noted above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are present, the coefficients should be adjusted accordingly.

7.0 CLOSURE

This report was prepared by Ms. Dirka U. Prout, P.Eng. under the direction of the Team Leader Mr. Philip R. Bedell, P.Eng. This report was reviewed by Mr. Fintan J. Heffernan, P.Eng., the Designated MTO Contact and Quality Control Auditor for this assignment.

GOLDER ASSOCIATES LTD.

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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
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
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.) split spoon 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, 60º 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 cm^2 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) Cohesionless Soils

Density Index (Relative Density)	N 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	c_u, s_u 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.

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
F	factor of safety
V	volume
W	weight

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
v	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	liquid limit
w_p	plastic limit
I_p	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_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
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 δ
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

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

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

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 201

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
DIST _____ HWY 7
DATUM GEODETIC

LOCATION N 4786338.5 ;E 410206.5
BOREHOLE TYPE POWER AUGER, SOLID STEM
DATE June 6, 2009 and December 2,2009.

ORIGINATED BY MA
COMPILED BY LMK
CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
317.17	GROUND SURFACE							
0.00 / 316.83	TOPSOIL, silty, Brown							
0.34	CLAYEY SILT TILL, some sand, trace gravel, with silt layers, Very stiff to hard, Brown to grey at about elev. 313.5m	1	SS	22				
		2	SS	20				
		3	SS	28	4	30	39	27
		4	SS	50				
		5	SS	41				
		6	SS	45				
		7	SS	48	2	22	50	26
		8	SS	104/225mm				
310.31								
6.86	SILT, trace sand, trace gravel, trace clay with cobbles, Very dense, Grey	9	SS	100/225mm				
308.64								
8.53	CLAYEY SILT TILL, trace sand, trace gravel, Hard, Grey	10	SS	63				
307.57								
9.60	END OF BOREHOLE Borehole dry during drilling on June 16, 2009. Standpipe dry on December 2, 2009. Water level measured in Standpipe at elev. 312.24m on Jan. 16, 2010. Water level measured in Standpipe at elev. 312.12m on Apr. 26, 2011. (For additional water levels see Table I)							

ELEVATION SCALE: 317, 316, 315, 314, 313, 312, 311, 310, 309, 308

GROUND WATER CONDITIONS: Cuttings; Bentonite; Sand; Standpipe

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

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

○ $^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

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RECORD OF BOREHOLE No 202

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786370.0 ;E 410228.9
ORIGINATED BY MA
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE June 17, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
313.28	GROUND SURFACE										
0.00	FILL, sand and gravel, trace silt, crushed Brown						313				
0.21											
0.46	FILL, sand and gravel, trace silt, cobbles Brown		1	SS	27						
	CLAYEY SILT TILL, trace to some sand, trace gravel Very stiff Grey						312				
311.15			2	SS	26						
2.13	SILTY SAND, some gravel, trace clay Very dense Grey						311		○		23 34 34 9
309.77			3	SS	100						
			4	SS	92		310				
3.51	END OF BOREHOLE Borehole dry during drilling on June 17, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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London, Ontario

RECORD OF BOREHOLE No 203

1 OF 1

METRIC

PROJECT 08-1132-159-0 | W.P. 361-98-00 | DIST _____ HWY 7 | DATUM GEODETIC

LOCATION N 4786331.6 ;E 410143.1 | BOREHOLE TYPE POWER AUGER, SOLID STEM | DATE June 17, 2009

ORIGINATED BY MA | COMPILED BY LMK | CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
308.68	PAVEMENT SURFACE										
	ASPHALT										
0.15	FILL, sand and gravel, some silt, crushed Brown										
0.30	FILL, sand and gravel, some silt with cobbles Brown		1	SS	24		308				
	CLAYEY SILT TILL, trace to some sand, trace gravel, with sand and gravel layers from about elev. 305.1m to about elev. 304.5m Very stiff to hard Brown to grey at about elev. 305.0m		2	SS	38		307				
			3	SS	40		306				
			4	SS	40				○		8 37 36 19
			5	SS	85		305				
303.65			6	SS	73		304				
5.03	END OF BOREHOLE Borehole dry during drilling on June 17, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

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RECORD OF BOREHOLE No 204

1 OF 2

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
DIST ____ HWY 7
DATUM GEODETIC
LOCATION N 4786292.1 ;E 410116.5
BOREHOLE TYPE POWER AUGER, AIR ROTARY, MUD ROTARY
DATE June 17, 2009 and December 2,2009.
ORIGINATED BY MA
COMPILED BY LMK
CHECKED BY ____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
316.53	GROUND SURFACE										
0.00	TOPSOIL, sandy, with gravel										
0.21	Brown										
	FILL, clayey silt, trace sand, trace gravel										
315.71	Brown										
0.82	CLAYEY SILT TILL, some sand, trace gravel Stiff to hard Brown to grey at about elev. 312.9m		1	SS	8		316				
			2	SS	7		315				
			3	SS	19	Bentonite	314				
			4	SS	54		313				
			5	SS	30	Cuttings	312				
			6	SS	35						2 26 46 26
			7	SS	44	Standpipe	311				
			8	SS	59		310				
			9	SS	43		309				
			10	SS	49						
			11	SS	63		308				
			12	SS	44	Cuttings	307				6 28 40 26
			13	SS	43						
			14	SS	83		306				
305.56											
10.97	SANDY SILT TILL, some clay, trace gravel Dense to very dense Grey		15	SS	48		305				
			16	SS	53						
						Bentonite	304				
			17	SS	100/100mm		303				
302.36						Sand					
14.17	CLAYEY SILT TILL, some sand, trace gravel with cobbles, boulders Hard Grey					Piezometer	302				

Continued Next Page

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

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London, Ontario

RECORD OF BOREHOLE No 204

2 OF 2 **METRIC**

PROJECT 08-1132-159-0 | W.P. 361-98-00 | LOCATION N 4786292.1 ;E 410116.5 | ORIGINATED BY MA
DIST _____ HWY 7 | BOREHOLE TYPE POWER AUGER, AIR ROTARY, MUD ROTARY | COMPILED BY LMK
DATUM GEODETIC | DATE June 17, 2009 and December 2,2009. | CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P w w_L	γ kN/m³	GR SA SI CL
	CLAYEY SILT TILL, some sand, trace gravel with cobbles, boulders Hard Grey		18	SS	92		301				5 32 41 22
300.07 16.46	END OF BOREHOLE Borehole dry during drilling on June 17, 2009. Piezometer dry on December 2, 2009. Standpipe dry on December 2, 2009. Water level measured in Piezometer at elev. 310.03m on Jan. 16, 2010. Water level measured in Standpipe at elev. 313.48m on Jan. 16, 2010. Water level measured in Piezometer at elev. 309.70m on Apr. 26, 2011. Water level measured in Standpipe at elev. 314.73m on Apr. 26, 2011. (For additional water levels see Table I)		19	SS	100/ 0mm						

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 205

1 OF 2

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786252.9 ;E 410045.4
ORIGINATED BY MA
DIST HWY 7
BOREHOLE TYPE POWER AUGER, MUD ROTARY
COMPILED BY LMK
DATUM GEODETIC
DATE June 25, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
315.09	GROUND SURFACE							
0.00	TOPSOIL, silty, trace sand, trace gravel Brown							
0.27	FILL, clayey silt, trace sand, trace gravel, trace topsoil Brown							
314.27	CLAYEY SILT TILL, some sand, trace to some gravel, with silt seams, cobbles and boulders Stiff to hard Brown changing to grey below about elev. 311.7m	1	SS	9				
0.82		2	SS	12				
		3	SS	48				
		4	SS	53				
		5	SS	63	4	19	50	27
		6	SS	63				
		7	SS	69				
		8	SS	56				
		9	SS	37				
		10	SS	34	11	26	40	23
		11	SS	26				
		12	SS	45				
		13	SS	57				
		14	SS	53				
		15	SS	59	1	13	60	26
		16	SS	33				
		17	SS	57				
		18	SS	73				

ELEVATION SCALE: 315, 314, 313, 312, 311, 310, 309, 308, 307, 306, 305, 304, 303, 302, 301

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

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

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 205

2 OF 2

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786252.9 ;E 410045.4
ORIGINATED BY MA
DIST HWY 7
BOREHOLE TYPE POWER AUGER, MUD ROTARY
COMPILED BY LMK
DATUM GEODETIC
DATE June 25, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			19	SS	53		300		○		
299.24											
15.85	SANDY SILT TILL, trace to some clay, trace gravel, with cobbles, boulders Very dense Brown to grey		20	SS	100/ 0mm		299				
							298				
			21	SS	100/ 100mm		297		○		
							296				
295.43			22	SS	105/ 150mm				○		
19.66	END OF BOREHOLE Borehole dry during drilling on June 25, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 206

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786227.4 ;E 409909.9
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE June 30, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
296.15	GROUND SURFACE										
0.00	TOPSOIL, silty Black						296				
0.23	FILL, clayey silt, some sand, some gravel Very soft to very stiff Brown and grey		1	SS	16				○		
			2	SS	2		295				
			3	SS	1		294		○		
			4	SS	5		293		⊢○⊣		11 21 40 28
			5	SS	11		292		○		
291.73											
4.42	SANDY SILT TILL, trace clay, trace gravel Dense Brown		6	SS	42						
290.97							291				
5.18	SAND, fine, trace silt										
5.41	SANDY SILT TILL, trace clay, trace gravel Very dense Brown		7	SS	100				○		
			8	SS	85		290				
							289				
288.07			9	SS	78				○		
8.08	END OF BOREHOLE Borehole dry during drilling on June 30, 2009.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 207

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786249.7 ;E 409955.0
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE June 30, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
298.74	GROUND SURFACE										
0.00	TOPSOIL, silty										
0.15	Black FILL, clayey silt, some topsoil, trace sand, trace gravel Firm Grey and black		1	SS	7		298				
297.37											
1.37	SILTY CLAY TILL, trace sand, trace gravel Stiff to hard Grey		2	SS	9		297				
			3	SS	31		296				1 9 28 62
			4	SS	38						
			5	SS	64		295				
294.10											
4.64	SANDY SILT TILL, trace clay, trace gravel Very dense Brown		6	SS	102/250mm		294				
			7	SS	100/125mm		293				
292.19			8	SS	100						
6.55	END OF BOREHOLE Borehole dry during drilling on June 30, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 208

1 OF 1 **METRIC**

PROJECT 08-1132-159-0 | W.P. 361-98-00 | DIST | HWY 7 | DATUM GEODETIC

LOCATION N 4786292.1 ;E 410052.5 | BOREHOLE TYPE POWER AUGER, SOLID STEM | DATE July 2, 2009

ORIGINATED BY MK | COMPILED BY LMK | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
303.80	PAVEMENT SURFACE										
0.06	ASPHALT										
	FILL, sand and gravel Brown										
303.04											
0.76	CLAYEY SILT TILL, some sand, trace gravel Very stiff to hard Grey		1	SS	27		303		○		
			2	SS	130		302				
			3	SS	80		301				
			4	SS	41				○—|		7 21 35 37
			5	SS	42		300				
299.38											
4.42	SILTY CLAY TILL, trace sand, trace gravel Hard Grey		6	SS	31		299		○		
298.62											
5.18	SANDY SILT TILL, trace gravel with cobbles Very dense Grey		7	SS	67		298				
297.25			8	SS	62				○		
6.55	END OF BOREHOLE Borehole dry during drilling on July 2, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 209

1 OF 1 **METRIC**

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786008.2 ;E 409342.5
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 2, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
305.38	GROUND SURFACE										
0.00	TOPSOIL, clayey										
0.12	Brown										
	FILL, silt, some clay, some sand, trace gravel Very loose to loose Brown		1	SS	3		305				
			2	SS	2		304				
			3	SS	6		303				
302.49											
2.89	FILL, topsoil, silty										
302.10	Black		4	SS	7		302				
3.28	FILL, silty clay, trace sand, trace gravel Firm to stiff Brown		5	SS	9						
300.96							301				
4.42	SILTY CLAY TILL, trace sand, trace gravel Stiff to hard Brown to grey at about elev. 298.4m		6	SS	8						4 22 39 35
			7	SS	18		300				
			8	SS	22		299				
			9	SS	27		298				12 21 33 34
			10	SS	40		297				
295.78							296				
9.60	END OF BOREHOLE Borehole dry during drilling on July 2, 2009.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 210

1 OF 1

METRIC

PROJECT 08-1132-159-0 | W.P. 361-98-00 | DIST _____ HWY 7 | DATUM GEODETIC

LOCATION N 4786023.6 ;E 409388.9 | BOREHOLE TYPE POWER AUGER, SOLID STEM | DATE July 2, 2009

ORIGINATED BY MK | COMPILED BY LMK | CHECKED BY _____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
302.98	GROUND SURFACE										
0.00	TOPSOIL, clayey										
0.12	Brown										
	FILL, clayey silt, some sand, trace gravel Firm to stiff Brown and grey		1	SS	9		302				
			2	SS	5		301		○		
			3	SS	6						
			4	SS	8		300		⊢●		3 21 43 33
299.33											
3.65	FILL, silt, some sand Loose										
3.90	Grey		5	SS	4		299				
	FILL, clayey silt, some sand, trace gravel Firm to stiff Brown		6	SS	14		298		○⊢●		5 23 40 32
			7	SS	10						
296.88							297				
6.10	TOPSOIL, clayey Stiff Black		8	SS	10				○		
296.27							296				
6.71	SANDY SILT, some clay, trace to some gravel Compact Brown		9	SS	11		295				
			10	SS	22		294		○		
293.38									⊖		
9.60	END OF BOREHOLE Borehole dry during drilling on July 2, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 211

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786055.1 ;E 409429.7
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 2, 2009 - July 3, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
302.47	GROUND SURFACE			
0.00	TOPSOIL, clayey Brown			
0.13	FILL, clayey silt, some sand, trace gravel with cobbles, silty sand and gravel layers Firm to very stiff Brown	1	SS	10
		2	SS	7
		3	SS	8
		4	SS	29
		5	SS	13
		6	SS	4
		7	SS	6
		8	SS	6
		9	SS	6
293.18				
9.29	TOPSOIL, clayey Stiff	10	SS	9
292.72	Black and brown			
9.75	SANDY SILT, some clay, some gravel Dense Brown	11	SS	30
291.65				
10.82	SILTY SAND AND GRAVEL, some clay Loose to compact Brown	12	SS	7
		13	SS	16
288.60				
13.87	END OF BOREHOLE Borehole dry during drilling on July 2 & 3, 2009.			

GROUND WATER CONDITIONS

ELEVATION SCALE: 302, 301, 300, 299, 298, 297, 296, 295, 294, 293, 292, 291, 290, 289

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

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

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

End of penetration test at elev. 290.28m
149 Blows for last 300mm

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
9	21	54	16

$+^3, \times^3$: Numbers refer to Sensitivity
$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 212

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786075.7 ;E 409477.6
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM, HOLLOW STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 7, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
300.50	GROUND SURFACE										
0.00	TOPSOIL, clayey Black						300				
0.13	FILL, clayey silt, trace to some sand, trace so some gravel, with sandy silt layers Firm to very stiff Brown		1	SS	6						
			2	SS	9		299		○		
			3	SS	17		298				
			4	SS	6				○		
			5	SS	10		297				
			6	SS	6		296		⊖		14 22 48 16
			7	SS	5		295				
			8	SS	4						
293.49							294				
7.01	SANDY SILT TILL, some clay, trace gravel, with cobbles Dense to very dense Brown		9	SS	39		293				
			10	SS	100/250mm		292		○		
290.45							291				
10.05	SAND AND GRAVEL, some silt, trace clay Very dense Brown		11	SS	100/125mm		290				
			12	SS	54		289		○		50 32 13 5
286.42			13	SS	100/200mm		288				
14.08	END OF BOREHOLE Borehole dry during drilling on July 7, 2009.						287				

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 213

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
DIST ____ HWY 7
DATUM GEODETIC
LOCATION N 4786090.4 ;E 409551.4
BOREHOLE TYPE POWER AUGER, SOLID STEM, HOLLOW STEM
DATE July 8, 2009
ORIGINATED BY MK
COMPILED BY LMK
CHECKED BY ____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
294.78	PAVEMENT SURFACE										
0.00	ASPHALT										
0.18	FILL, sand and gravel Brown										
294.17											
0.61	FILL, clayey silt, some sand, trace gravel Firm to very stiff Brown and grey		1	SS	21		294				
			2	SS	9		293				
			3	SS	12		292				
			4	SS	8						
			5	SS	7		291				3 23 42 32
290.36											
4.42	FILL, clayey silt, with topsoil, trace sand Stiff Grey and black		6	SS	8		290				
289.60											
5.18	CLAYEY SILT TILL, trace sand, trace gravel Very stiff Brown		7	SS	26		289				
288.84											
5.94	SAND AND GRAVEL, trace to some silt, trace clay Compact to very dense Brown		8	SS	54		288				
			9	SS	106/250mm		287				
			10	SS	24		286				48 39 8 5
							285				
			11	SS	94		284				
283.65											
11.13	END OF BOREHOLE Borehole dry during drilling on July 8, 2009.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 214

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786120.1 ;E 409587.3
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 9, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
288.74	GROUND SURFACE										
0.10	TOPSOIL, silty Brown										
	SILT, some clay, trace sand Very loose to dense Brown		1	SS	3		288				
286.85			2	SS	39		287				
1.89	SAND AND GRAVEL, trace silt, trace clay with cobbles Very dense Brown		3	SS	70		286				
			4	SS	100/225mm						65 28 5 2
			5	SS	100/250mm		285				
283.89			6	SS	100/275mm		284				
4.85	END OF BOREHOLE Borehole dry during drilling on July 9, 2009.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 215

1 OF 1 **METRIC**

PROJECT 08-1132-159-0 | W.P. 361-98-00 | LOCATION N 4786143.5 ;E 409634.5 | ORIGINATED BY MK
DIST | HWY 7 | BOREHOLE TYPE POWER AUGER, SOLID STEM | COMPILED BY LMK
DATUM GEODETIC | DATE July 9, 2009 | CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
286.26	GROUND SURFACE										
0.00	TOPSOIL, silty						286				
0.13	Brown FILL, clayey silt, some topsoil, trace sand, trace gravel Stiff Brown and black		1	SS	14						
284.89							285				
1.37	SAND AND GRAVEL, trace to some silt, trace clay Very dense Brown		2	SS	100/225mm				○		50 36 9 5
284.13							284				
2.13	SANDY SILT TILL, some clay, trace gravel, with silt layers Compact to dense Brown		3	SS	20	▽					
			4	SS	34		283		○		
282.60											
3.66	SANDY SILT, some clay, trace gravel Dense to very dense Grey		5	SS	42		282				
			6	SS	53				○		6 37 39 18
			7	SS	79		281		○		
280.06			8	SS	60/100mm						
6.20	END OF BOREHOLE Groundwater encountered at about elev. 283.6m during drilling on July 9, 2009.										

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

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 216

1 OF 1

METRIC

PROJECT 08-1132-159-0 | LOCATION N 4786164.7 ;E 409679.8 | ORIGINATED BY MK

W.P. 361-98-00 | DIST — | HWY 7 | BOREHOLE TYPE POWER AUGER, SOLID STEM | COMPILED BY LMK

DATUM GEODETIC | DATE July 9, 2009 | CHECKED BY —

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
285.49	GROUND SURFACE										
0.10	TOPSOIL, silty, Brown						285				
	SAND AND GRAVEL, trace to some silt with cobbles, Compact to very dense, Brown		1	SS	22				○		
			2	SS	28		284				
			3	SS	81	▽	283		○		23 60 10 7
			4	SS	87						
			5	SS	66/ 25mm		282		○		
			6	SS	28		281				
280.31											
5.18	SANDY SILT, trace clay, Compact to very dense, Brown to grey at about elev. 279.6m		7	SS	22		280		○		
			8	SS	100/ 250mm						
278.99							279				
6.50	END OF BOREHOLE Groundwater encountered at about elev. 282.8m during drilling on July 9, 2009.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 217

1 OF 1

METRIC

PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786180.3 ;E 409715.8
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 9, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
285.10	GROUND SURFACE										
0.00	TOPSOIL, silty, Brown						285				
0.13	SAND AND GRAVEL, trace to some silt, with cobbles, Very dense, Brown										
			1	SS	100/225mm				○		
							284				
			2	SS	92				○		36 48 11 5
							283				
			3	SS	54						
							282				
			4	SS	58						
			5	SS	73		281				
			6	SS	83						
							280				
			7	SS	50						
278.80			8	SS	100/200mm		279				
6.30	END OF BOREHOLE										

Bentonite
Backfill
Standpipe

Groundwater encountered at about elev. 282.2m during drilling on July 9, 2009.

Water level measured in Standpipe at elev. 282.79m on August 12, 2009.

Water level measured in Standpipe at elev. 282.84m on Jan. 16, 2010.

Water level measured in Standpipe at elev. 283.58m on Apr. 26, 2011.

(For additional water levels see Table I)

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

$\circ^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11

Golder Associates
London, Ontario

RECORD OF BOREHOLE No 218

1 OF 1

METRIC

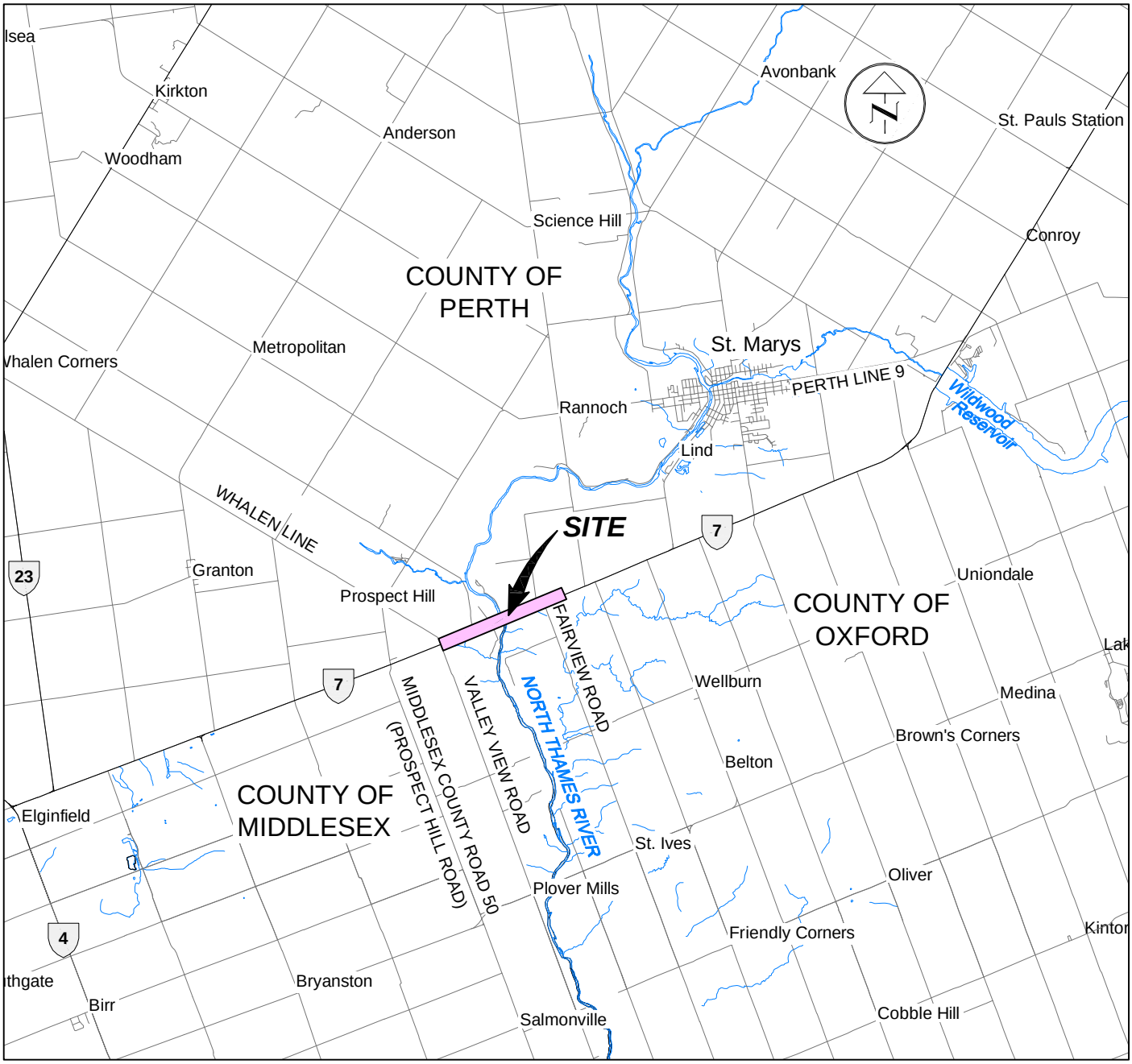
PROJECT 08-1132-159-0
W.P. 361-98-00
LOCATION N 4786202.6 ;E 409755.5
ORIGINATED BY MK
DIST HWY 7
BOREHOLE TYPE POWER AUGER, SOLID STEM, HOLLOW STEM
COMPILED BY LMK
DATUM GEODETIC
DATE July 10, 2009
CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
285.15	GROUND SURFACE										
0.00	TOPSOIL, silty						285				
0.15	Brown SAND AND GRAVEL, trace to some silt with cobbles Dense to very dense Brown		1	SS	61				○		
			2	SS	57		284				
			3	SS	80	▽	283		○		49 33 12 6
			4	SS	53		282				
			5	SS	48		281		○		
			6	SS	63						
279.54			7	SS	100/275mm		280		○		
5.61	END OF BOREHOLE Groundwater encoutnered at about elev. 282.5m during drilling on July 10, 2009.										

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

$\bigcirc^{3\%}$ STRAIN AT FAILURE

LDN_MTO_06 08-1132-159-0.GPJ LDN_MTO.GDT 10/05/11



SCALE IN METRES

0 3000 6000

1:150000

REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2005.4.

NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES REHABILITATION OF HIGHWAY 7 GWP 361-98-00

TITLE

KEY PLAN

Golder Associates LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-F02001
			SCALE	AS SHOWN
CADD	DMB/DCH	Oct. 19/09	REV.	0
CHECK				

FIGURE 1

Drawing file: 0811321590-2000-F02001.dwg Dec 04, 2009 - 10:40am

MINISTRY OF TRANSPORTATION, ONTARIO

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

SOUTH BOUNDARY CONCESSION LOT 30
TOWNSHIP OF BLANSHARD
COUNTY OF PERTH

SOUTH BOUNDARY CONCESSION LOT 29

TOWNSHIP OF WEST NISSOURI
COUNTY OF MIDDLESEX

LOT 36 CONCESSION 2

LOT 36 CONCESSION 3

HIGHWAY 7

NORTH BRANCH THAMES RIVER

MATCH LINE A (SEE DWG 2)

GRAVEL ROAD ALLCE

STEEL & CONC BRIDGE

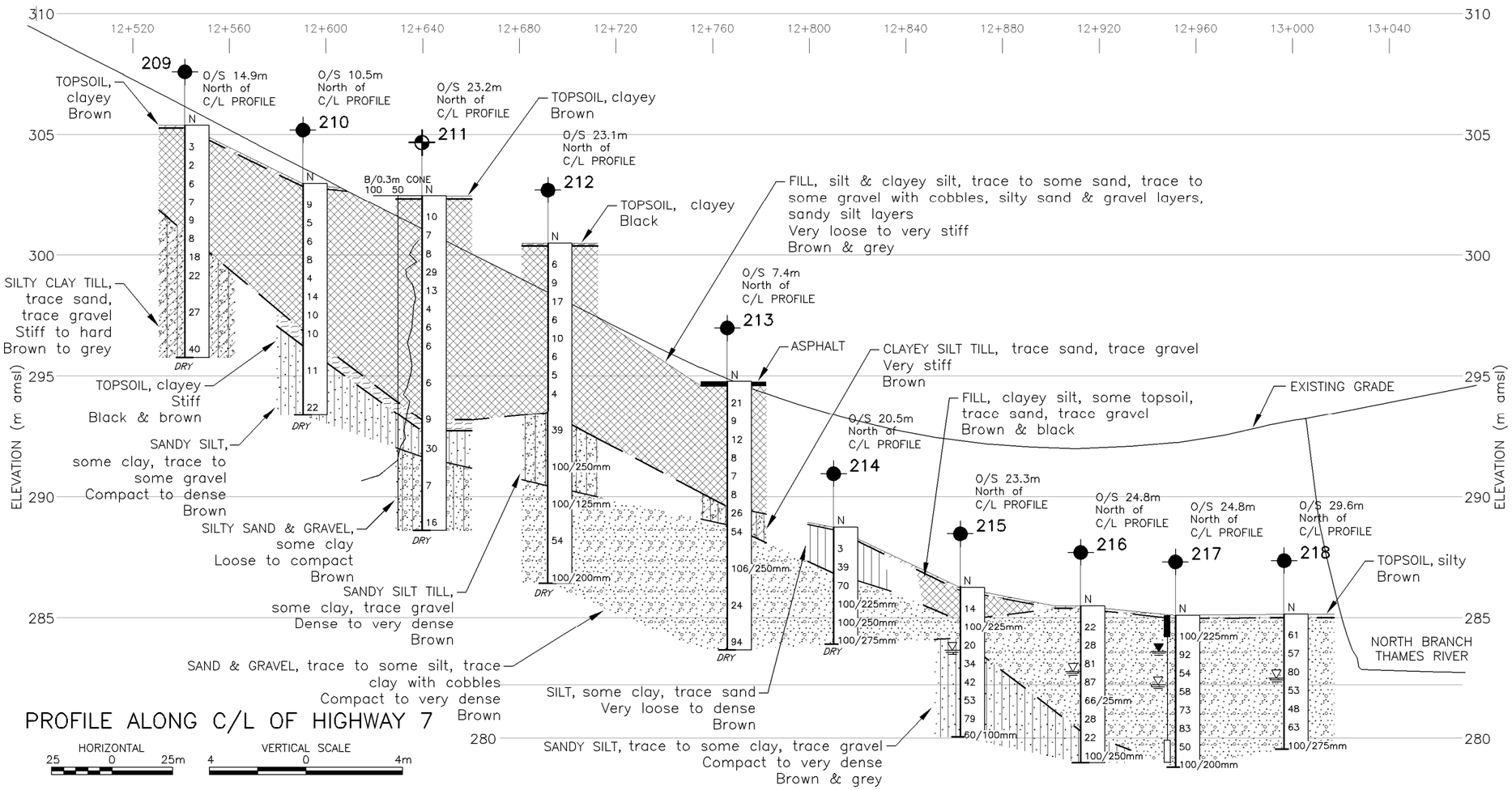
760 x 24.11 CSP

880 x 29.33 CSP

REMOVE by P-3525-19

REMOVE by P-3525-19

PLAN
SCALE
20 0 20 m



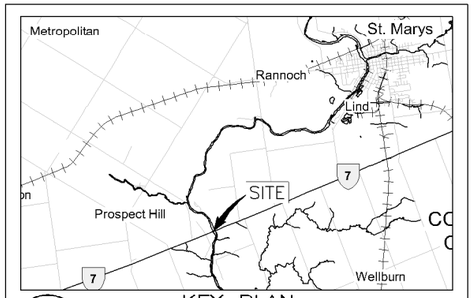
CONT No.
WP No. 361-98-00

SHEET

HIGH FILLS AND DEEP CUT
TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
BOREHOLE LOCATIONS & SOIL STRATA

Golder Associates

Golder Associates Ltd.
LONDON, ONTARIO, CANADA



LEGEND

- Borehole – Current Investigation
- Borehole with Cone – Current Investigation
- N 16 Standard Penetration Test Value Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Seal
- Standpipe
- DRY Borehole dry during drilling
- WL upon completion of drilling
- Measured WL April 26, 2011.

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10)	
		NORTHING	EASTING
209	305.38	4 786 008.2	409 342.5
210	302.98	4 786 023.6	409 388.9
211	302.47	4 786 055.1	409 429.7
212	300.50	4 786 075.7	409 477.6
213	294.78	4 786 090.4	409 551.4
214	288.74	4 786 120.1	409 587.3
215	286.26	4 786 143.5	409 634.5
216	285.49	4 786 164.7	409 679.8
217	285.10	4 786 180.3	409 715.8
218	285.15	4 786 202.6	409 755.5

NOTES

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

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

Stratigraphy has been simplified for clarity. Please refer to Record of Boreholes and Sections for further detail.

REFERENCE

Base plans provided in digital format by DELCAN

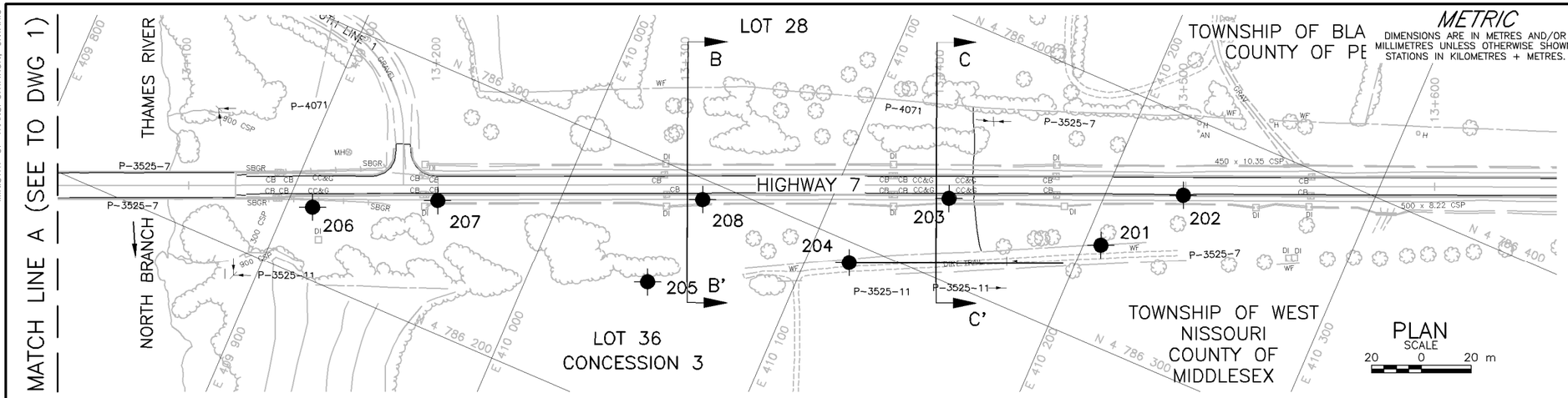
NO.	DATE	BY	REVISION

Geocres No. 40P3-49

HWY. 7		PROJECT NO. 08-1132-159-0	DIST.
SUBM'D. DUP	CHKD.	DATE: Oct. 22/09	SITE:
DRAWN: DCH	CHKD.	APPD.	DWG. 1

PLOT DATE: May 10, 2011
FILENAME: N:\active\2009\1132 - Geotechnical\1132-100-01\08-1132-159-0 DELCAN - GWP 361-98-00 - HWY 7 REHAB\Drafting\AutoCAD files\08113215900-2000-D01001.dwg

MINISTRY OF TRANSPORTATION, ONTARIO



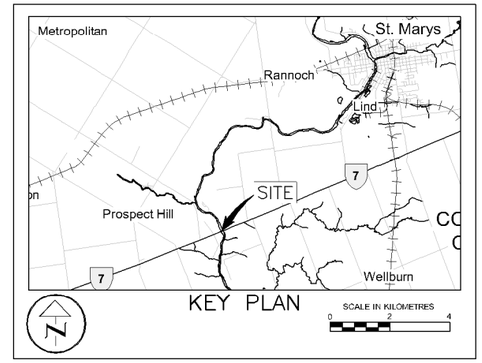
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
WP No. 361-98-00

SHEET

HIGH FILLS AND DEEP CUT TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
BOREHOLE LOCATIONS & SOIL STRATA

Golder Associates Ltd.
LONDON, ONTARIO, CANADA



LEGEND

- Borehole – Current Investigation
- N 16 — Standard Penetration Test Value, Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Seal
- Standpipe
- DRY — Borehole dry during drilling
- WL upon completion of drilling
- Measured WL April 26, 2011.

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10)	
		NORTHING	EASTING
201	317.17	4 786 338.5	410 206.5
202	313.28	4 786 370.0	410 228.9
203	308.68	4 786 331.6	410 143.1
204	316.53	4 786 292.1	410 116.5
205	315.09	4 786 252.9	410 045.4
206	296.15	4 786 249.7	409 909.9
207	298.74	4 786 249.7	409 955.0
208	303.80	4 786 292.1	410 052.5

NOTES

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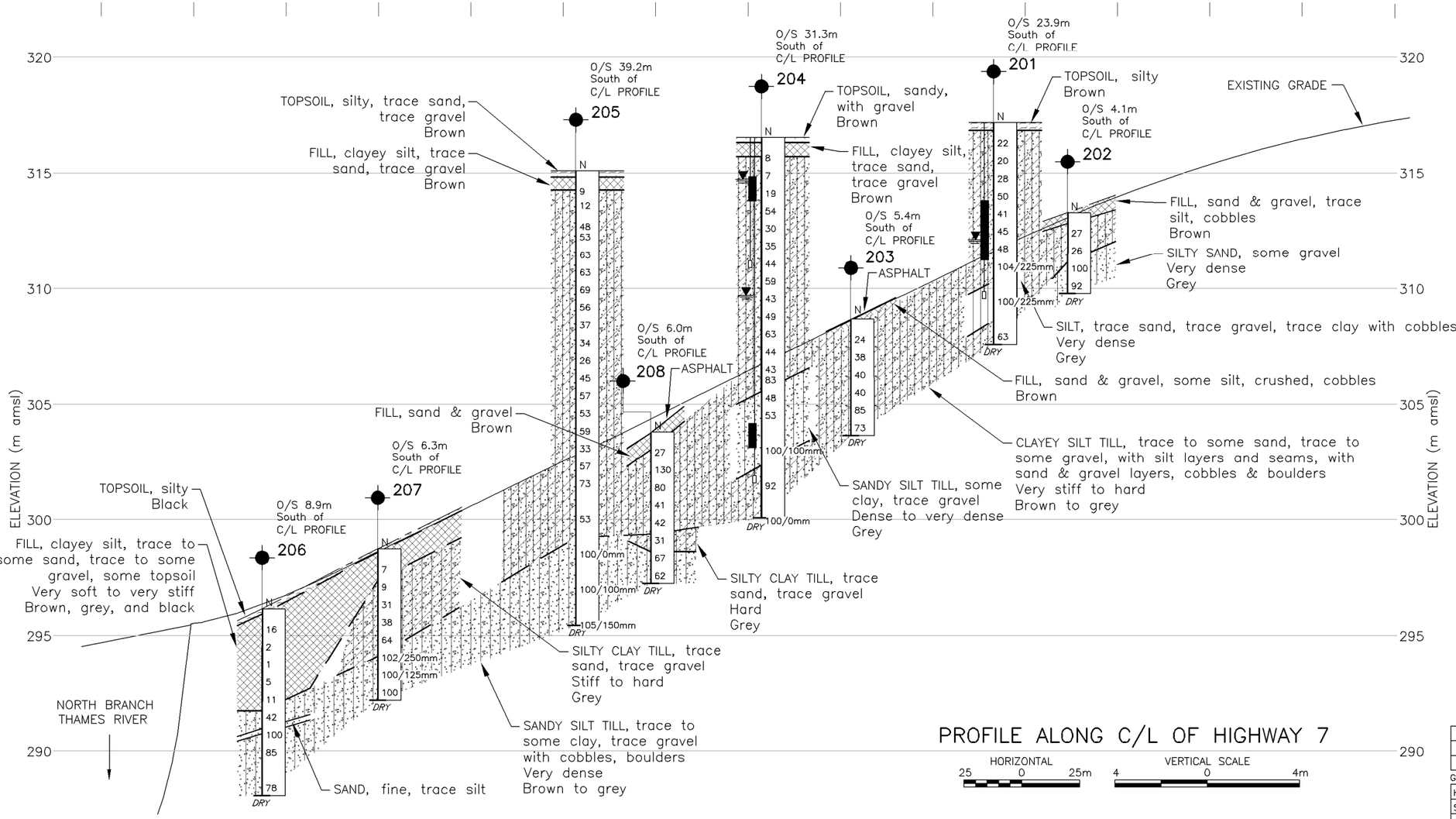
Stratigraphy has been simplified for clarity. Please refer to Record of Boreholes and Sections for further detail.

REFERENCE

Base plans provided in digital format by DELCAN



PROFILE ALONG C/L OF HIGHWAY 7

HORIZONTAL SCALE 25 0 25m
VERTICAL SCALE 4 0 4m

NO.	DATE	BY	REVISION

Geocres No. 40P3-49

HWY. 7	PROJECT NO. 08-1132-159-0		DIST.
SUBM'D. DUP	CHKD.	DATE: Oct. 22/09	SITE:
DRAWN: DCH	CHKD.	APPD.	DWG. 2

PLOT DATE: May 10, 2011
FILENAME: N:\active\2008\1132 - Geotechnical\1132-100-0\08-1132-159-0 DELCAN - GWP 361-98-00 - HWY 7 REHAB\Drafting\AutoCAD files\08113321590-2000-000001.dwg

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

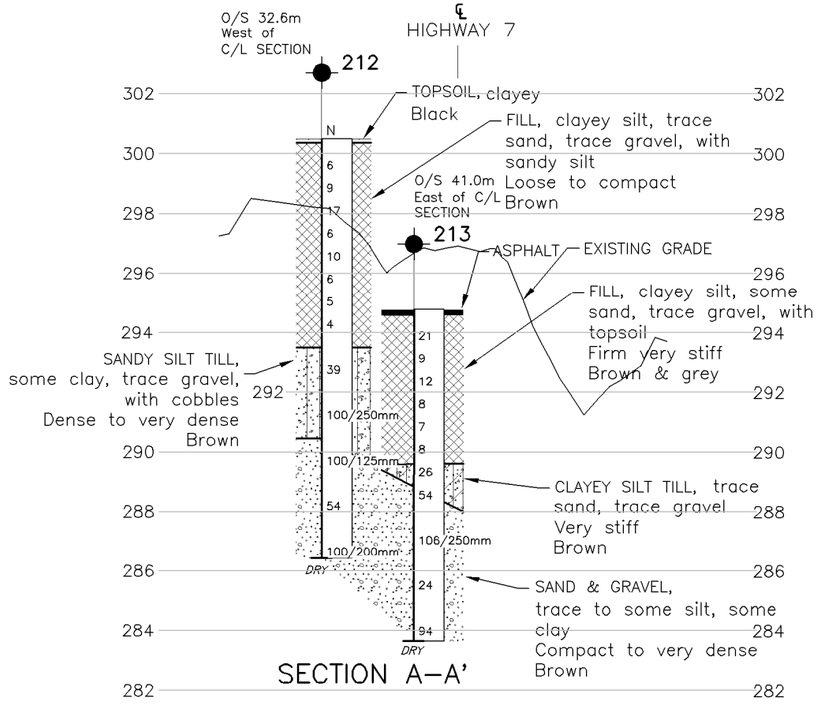
CONT No.
WP No. 361-98-00

HIGH FILLS AND DEEP CUT TRUCK CLIMBING LANES

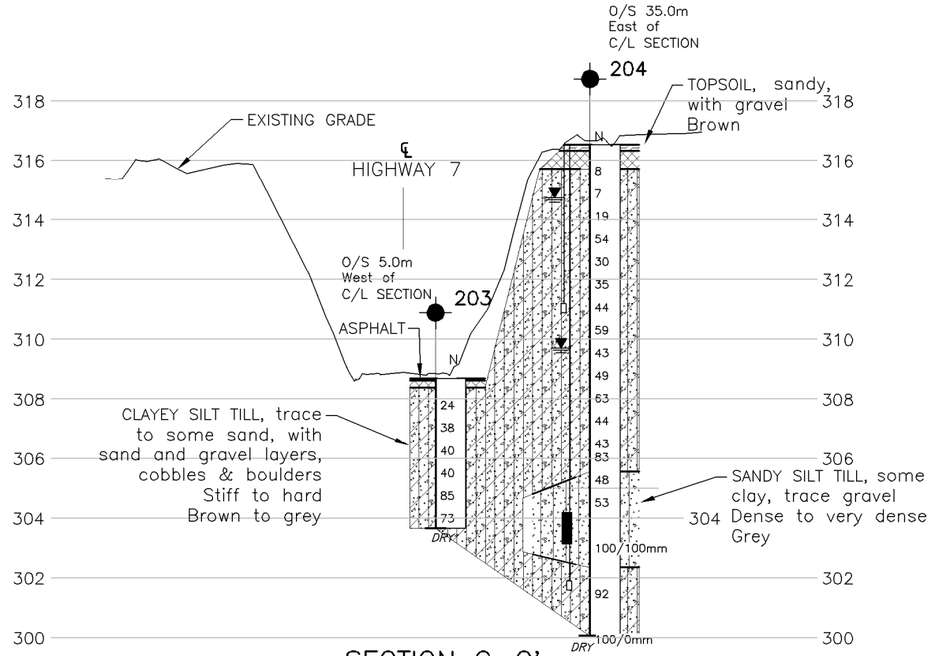
REHABILITATION OF HIGHWAY 7
SOIL STRATA

SHEET

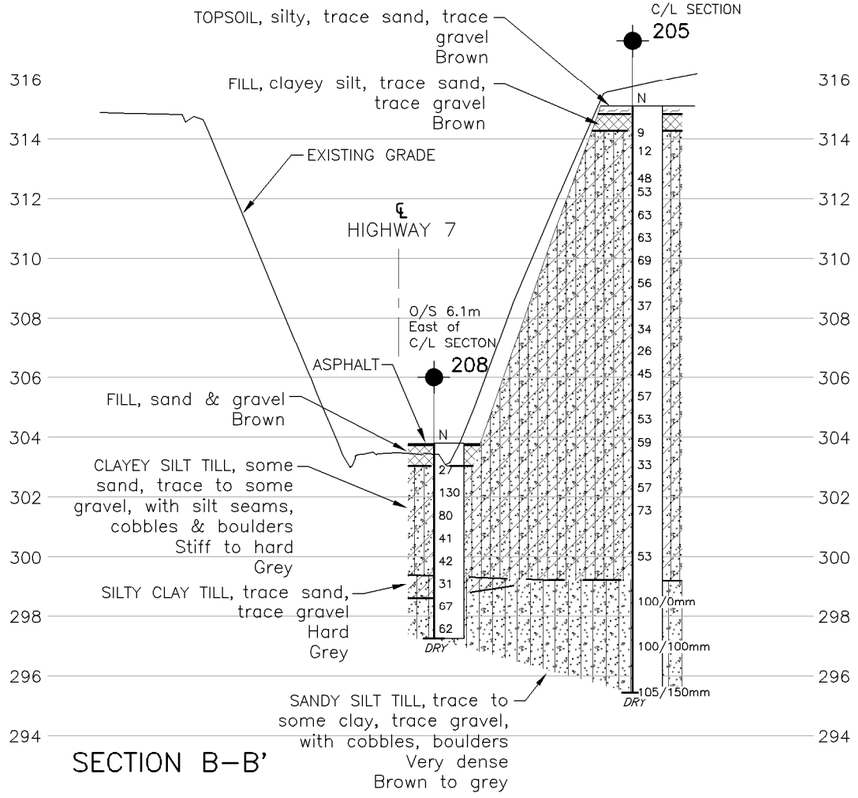
Golder Associates Ltd.
LONDON, ONTARIO, CANADA



SECTION A-A'



SECTION C-C'



SECTION B-B'

HORIZONTAL 20 0 20m
VERTICAL SCALE 4 0 4m

LEGEND

- Borehole – Current Investigation
- N 16 — Standard Penetration Test Value: Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- Seal
- Standpipe
- DRY — Borehole dry during drilling
- WL upon completion of drilling
- Measured WL April 26, 2011.

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10) NORTHING	EASTING
212	300.50	4 786 075.7	409 477.6
213	294.78	4 786 090.4	409 551.4
203	308.68	4 786 331.6	410 143.1
204	316.53	4 786 292.1	410 116.5
205	315.09	4 786 252.9	410 045.4
208	303.80	4 786 292.1	410 052.5

NOTES

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

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

Stratigraphy has been simplified for clarity. Please refer to Record of Boreholes and Sections for further detail.

REFERENCE

Base plans provided in digital format by DELCAN

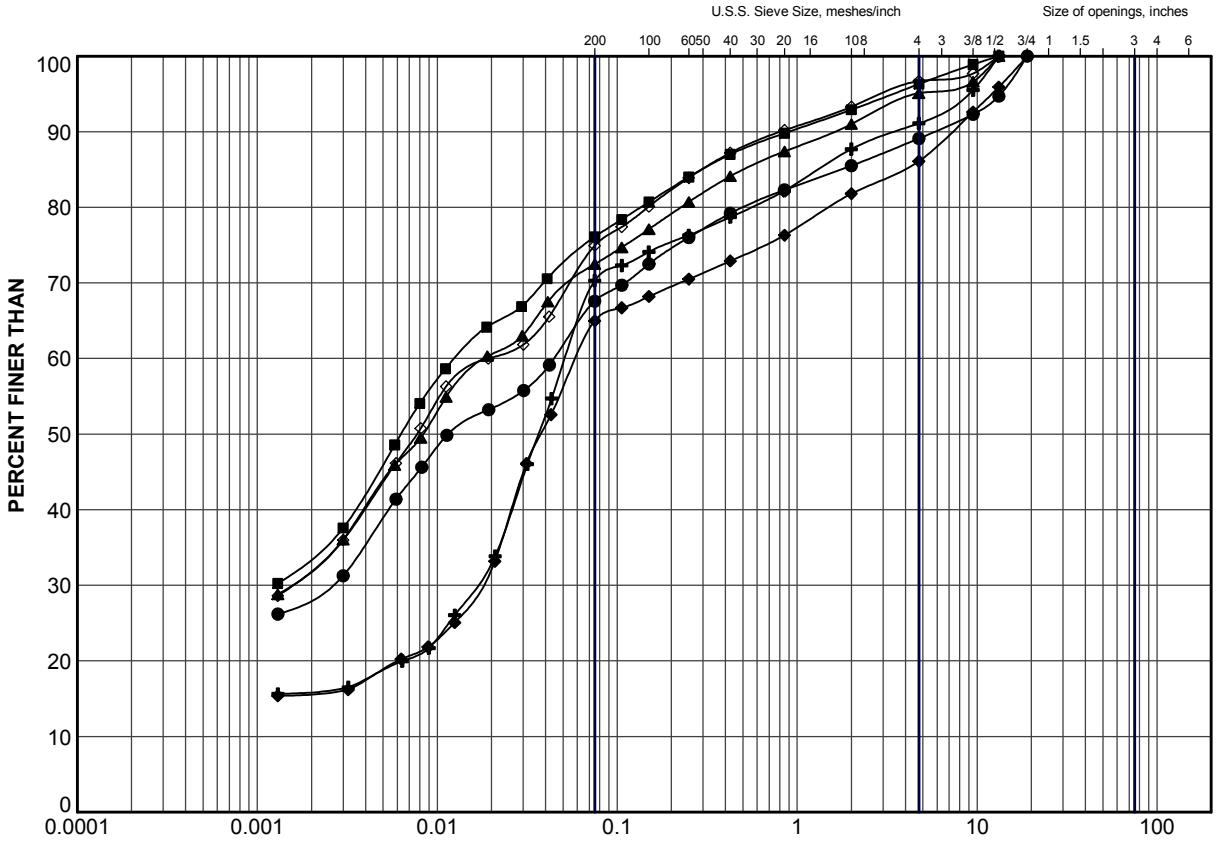
NO.	DATE	BY	REVISION

Geocres No. 40P3-49

HWY. 7		PROJECT NO. 08-1132-159-0		DIST.
SUBM'D. DUP	CHKD.	DATE: Oct. 22/09		SITE:
DRAWN: DCH	CHKD.	APPD.		DWG. 3

APPENDIX A

Laboratory Test Data



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	206	4	292.9
■	210	4	299.7
▲	210	6	298.2
✚	211	6	297.7
◆	212	6	295.7
◇	213	5	290.7

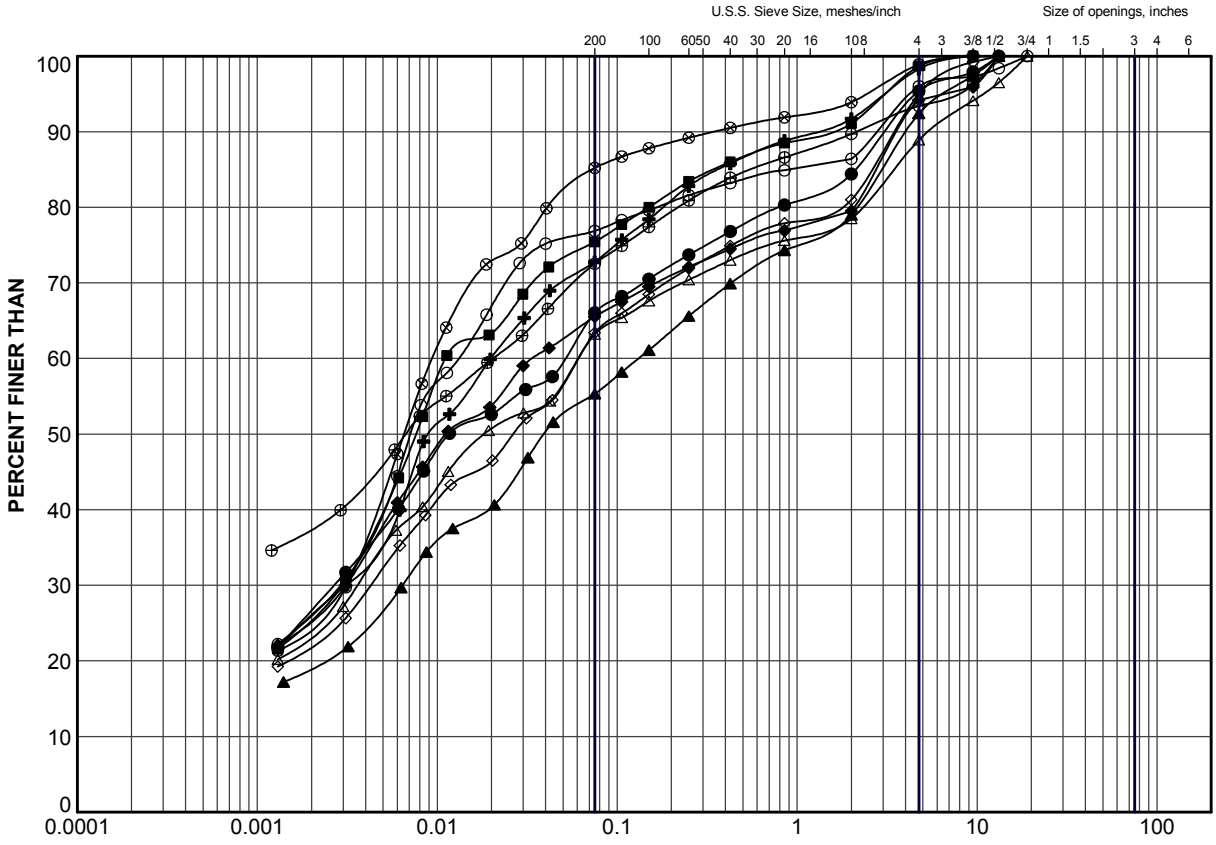
PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
GRAIN SIZE DISTRIBUTION
FILL

Golder Associates
LONDON, ONTARIO

PROJECT No. 08-1132-159-0			FILE No. 0811321590-2000-R020A1	
			SCALE N/A	REV.
DRAWN	DMB	Sep 25/09	FIGURE A-1	
CHECK				

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	201	3	314.7
■	201	7	311.6
▲	203	4	305.4
✚	204	6	311.7
◆	204	12	307.2
◇	204	18	301.4
○	205	5	311.4
△	205	10	307.5
⊗	205	15	303.7
⊕	208	4	300.5

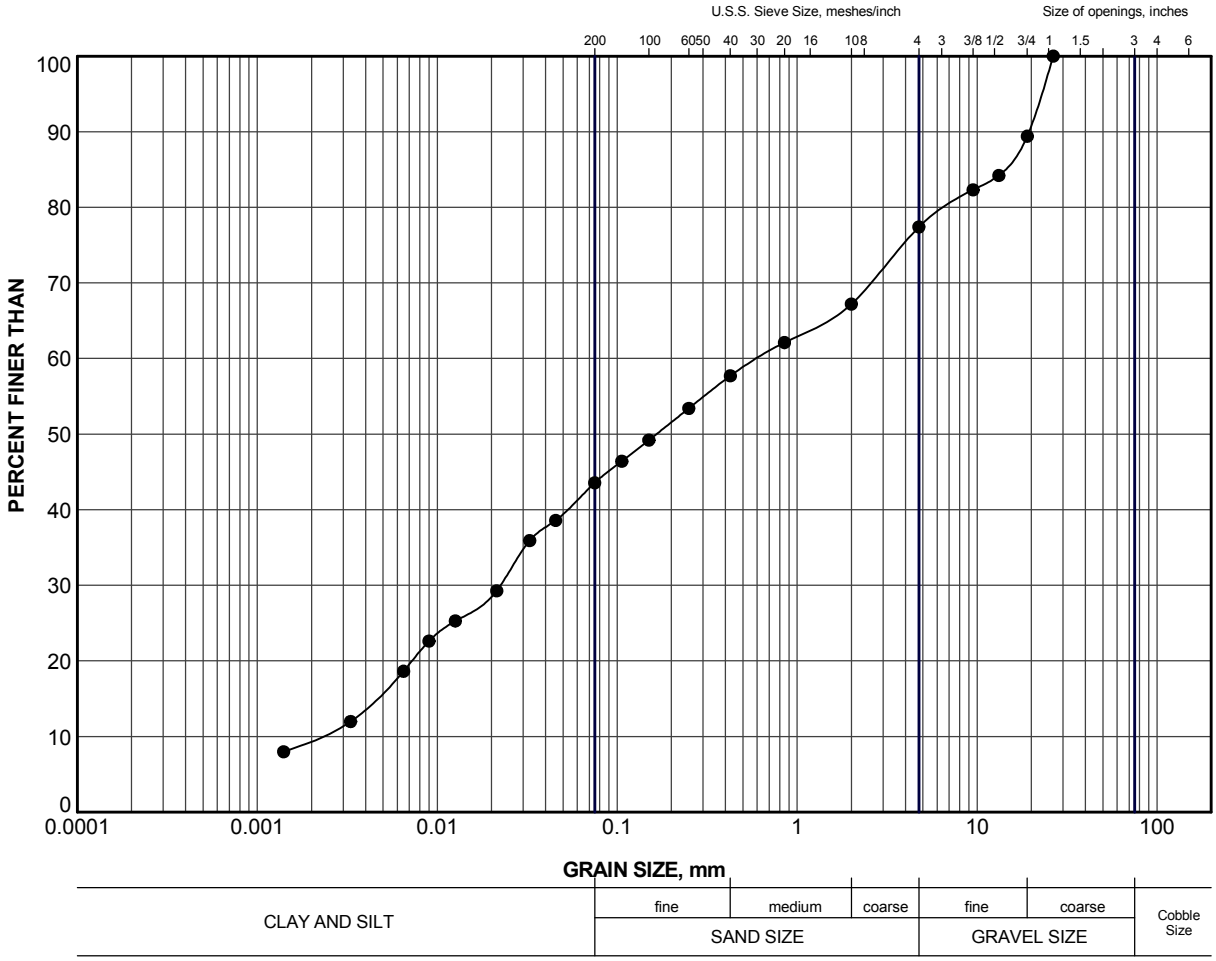
PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
GRAIN SIZE DISTRIBUTION
CLAYEY SILT TILL

Golder Associates
LONDON, ONTARIO

PROJECT No. 08-1132-159-0			FILE No. 0811321590-2000-R020A2	
			SCALE N/A	REV.
DRAWN	DMB	Sep 25/09	FIGURE A-2	
CHECK				

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	202	3	310.8

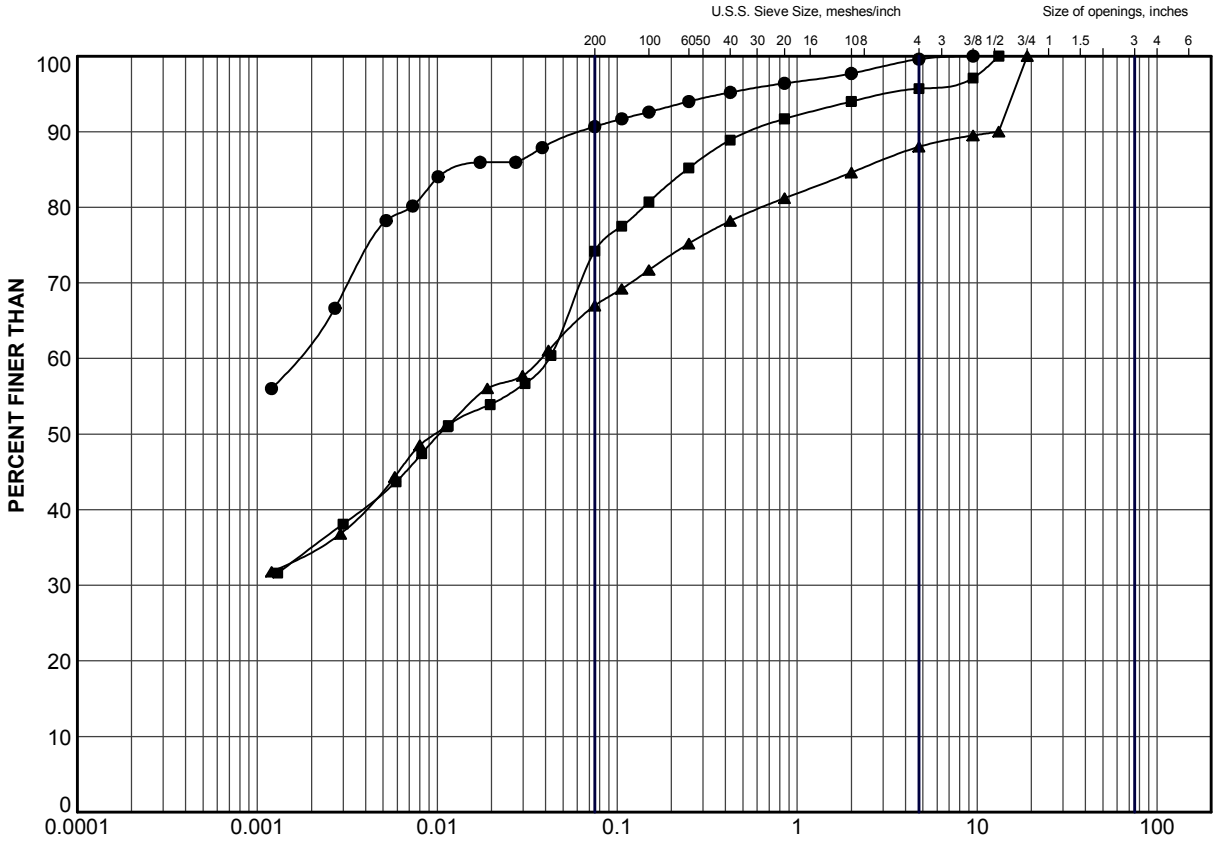
PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
GRAIN SIZE DISTRIBUTION
SILTY SAND

Golder Associates
LONDON, ONTARIO

PROJECT No. 08-1132-159-0			FILE No. 0811321590-2000-R020A3	
			SCALE N/A	REV.
DRAWN	DMB	Sep 25/09	FIGURE A-3	
CHECK				

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	207	3	296.2
■	209	6	300.6
▲	209	9	297.5

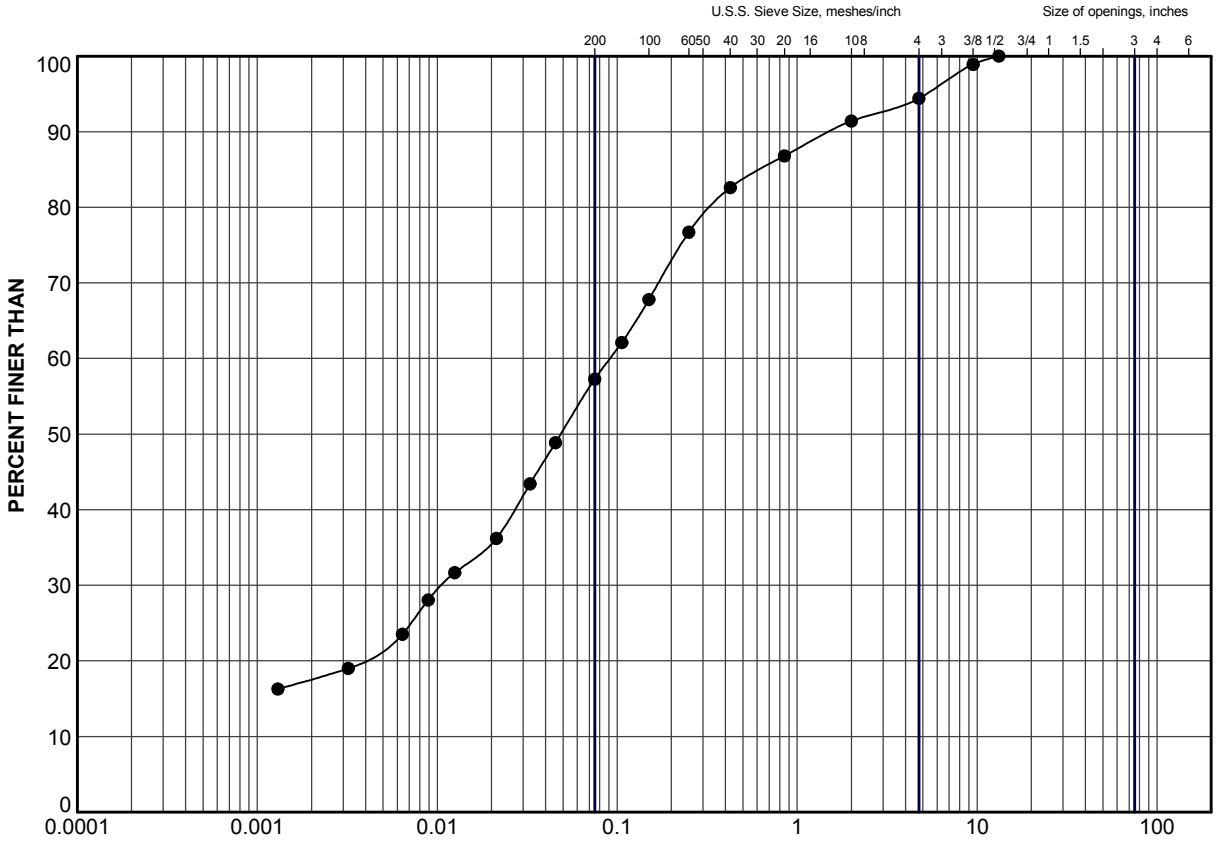
PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
GRAIN SIZE DISTRIBUTION
SILTY CLAY TILL

Golder Associates
LONDON, ONTARIO

PROJECT No.		08-1132-159-0	FILE No.	0811321590-2000-R020A4
			SCALE	N/A REV.
DRAWN	DMB	Sep 25/09		
CHECK			**FIGURE A-4**	

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	215	6	281.5

PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

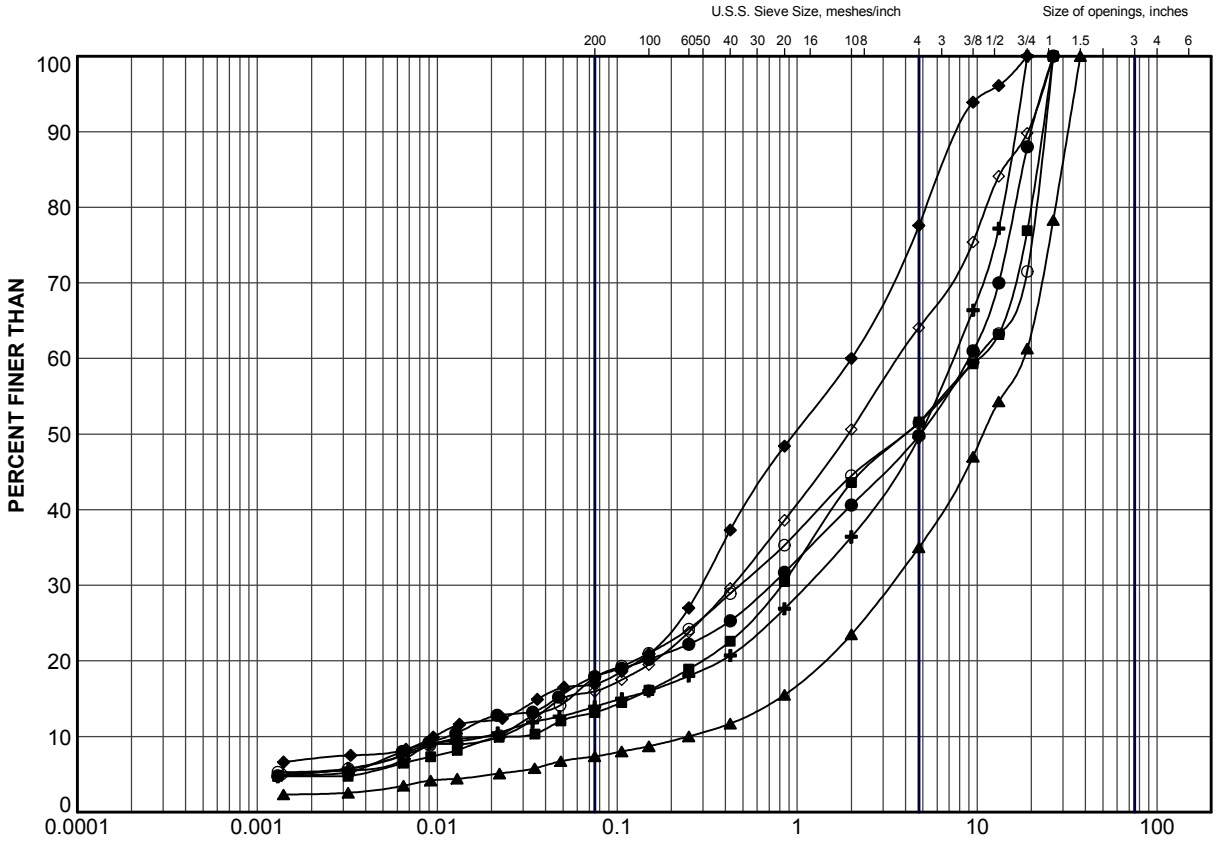
TITLE
GRAIN SIZE DISTRIBUTION
SANDY SILT

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-R020A5
			SCALE	N/A
DRAWN	DMB	Sep 25/09	REV.	
CHECK				

FIGURE A-5

LDN_MTO_NEW GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	212	12	288.1
■	213	10	285.4
▲	214	4	285.5
✚	215	2	284.5
◆	216	3	283.0
◇	217	2	283.4
○	218	3	282.6

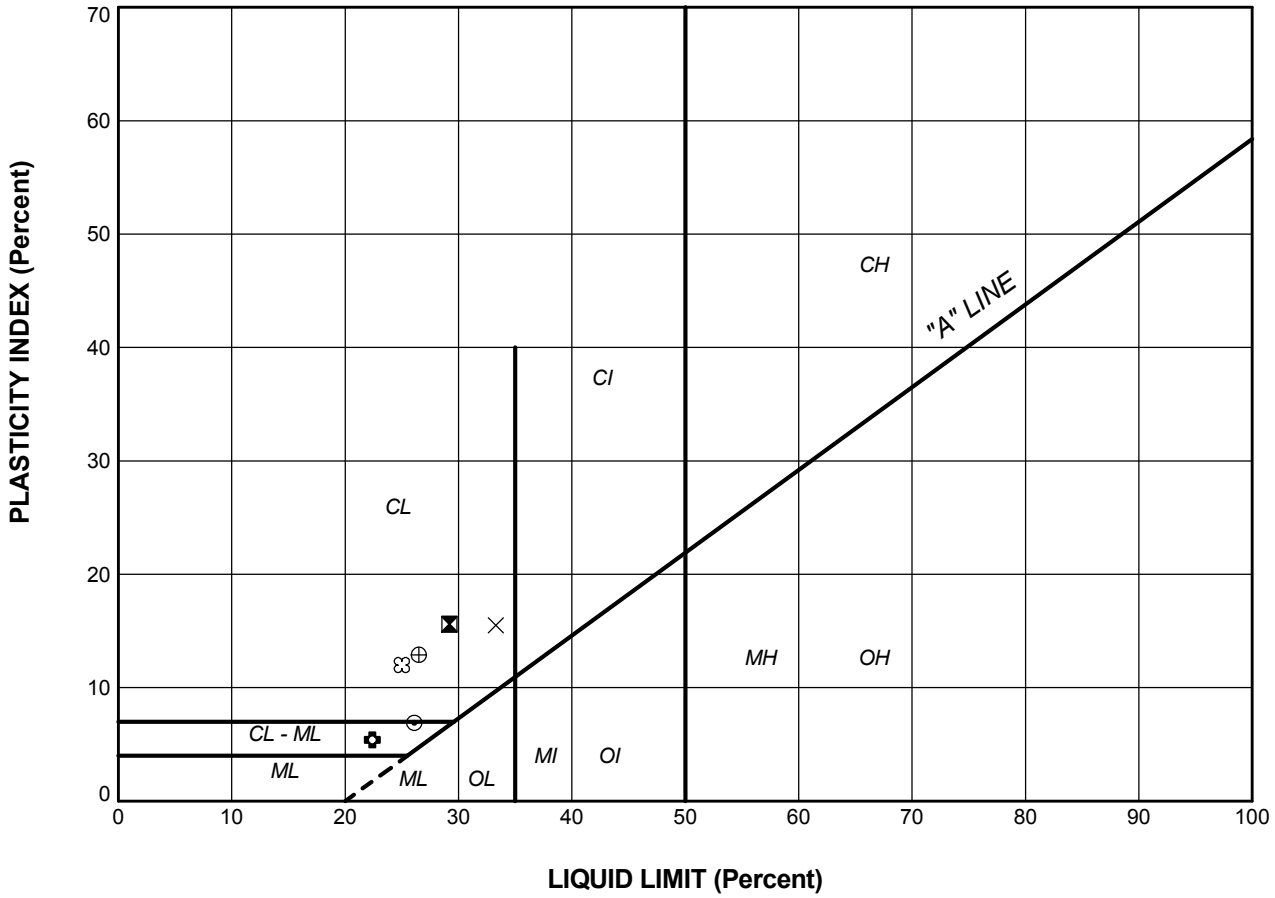
PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
GRAIN SIZE DISTRIBUTION
SAND AND GRAVEL

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-R020A6
			SCALE	N/A
DRAWN	DMB	Sep 25/09	REV.	
CHECK			**FIGURE A-6**	

LDN_MTO_NEW GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
FILL					
⊕	206	4	26.5	13.6	12.9
⊠	210	4	25.0	13.0	12.0
⊠	210	6	29.2	13.6	15.6
⊙	211	6	26.1	19.2	6.9
✿	212	6	22.4	17.0	5.4
×	213	5	33.3	15.4	17.9

PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

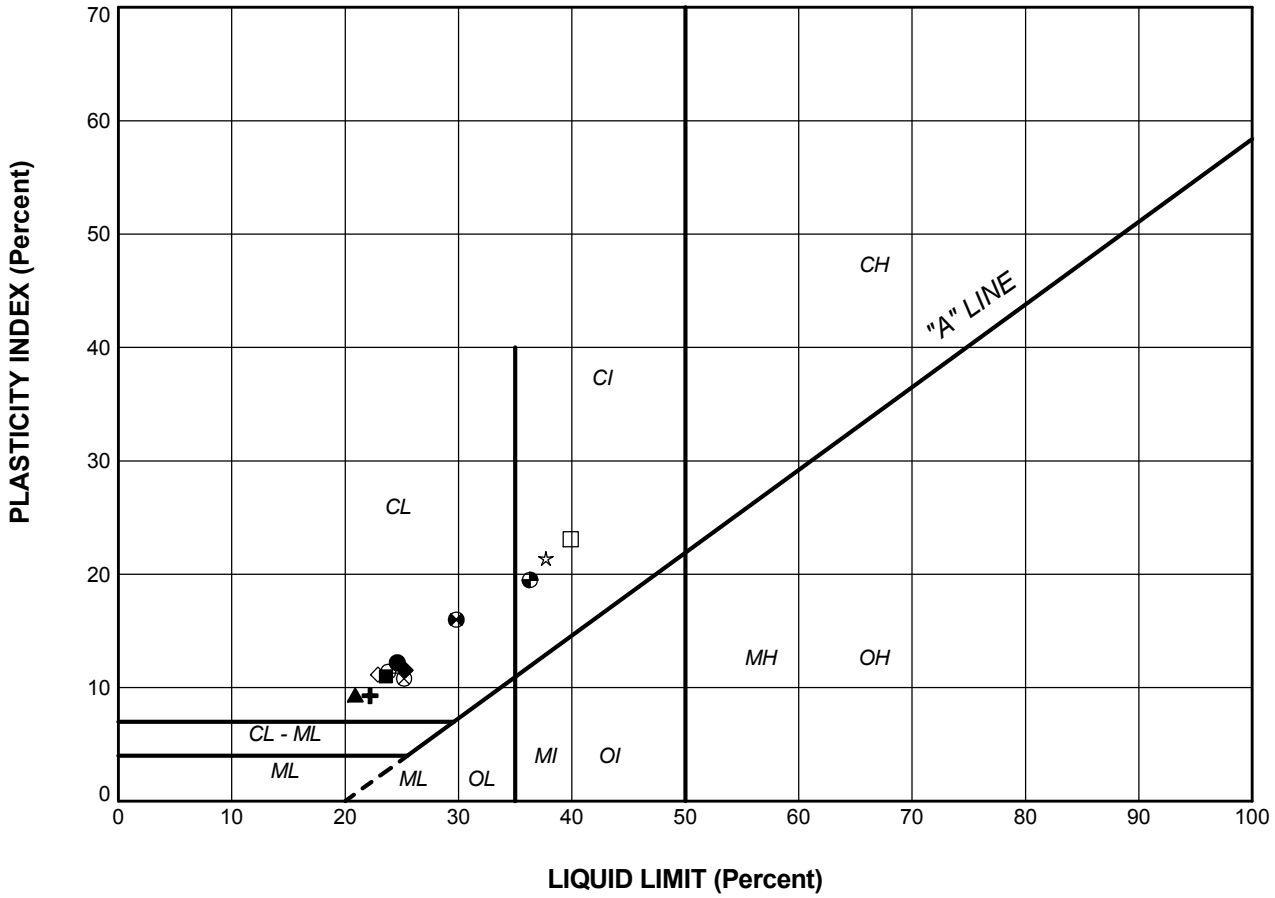
TITLE

PLASTICITY CHART
FILL

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No. 0811321590-2000-R020A7
			SCALE N/A REV.
DRAWN	DMB/DCH	Oct 5/09	
CHECK			FIGURE A-7

MTO_PI_25 GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
CLAYEY SILT TILL					
●	201	3	24.6	12.4	12.2
■	201	7	23.6	12.6	11.0
▲	203	4	20.9	11.6	9.4
✚	204	6	22.2	12.9	9.3
◆	204	12	25.3	13.8	11.6
◇	204	18	22.9	11.8	11.2
○	205	5	23.8	12.4	11.4
△	205	10	24.7	12.9	11.9
⊗	205	15	25.2	14.4	10.8
◓	208	4	29.8	13.8	16.0
SILTY CLAY TILL					
□	207	3	39.9	16.8	23.1
◕	209	6	36.3	16.8	19.5
☆	209	9	37.7	16.3	21.4

PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
PLASTICITY CHART
CLAYEY SILT TILL & SILTY CLAY TILL

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No. 0811321590-2000-R020A8
			SCALE N/A REV.
DRAWN	DMB/DCH	Oct 5/09	
CHECK			FIGURE A-8

MTO_PI_25 GLDR_LDN.GDT

APPENDIX B

Photographs

Photograph 1: Existing high fill, Station 12+600, looking east.

Photograph 2: Existing high fill, Station 12+700, looking west.

Photograph 3: Area of deep cut, Station 13+200, looking east.

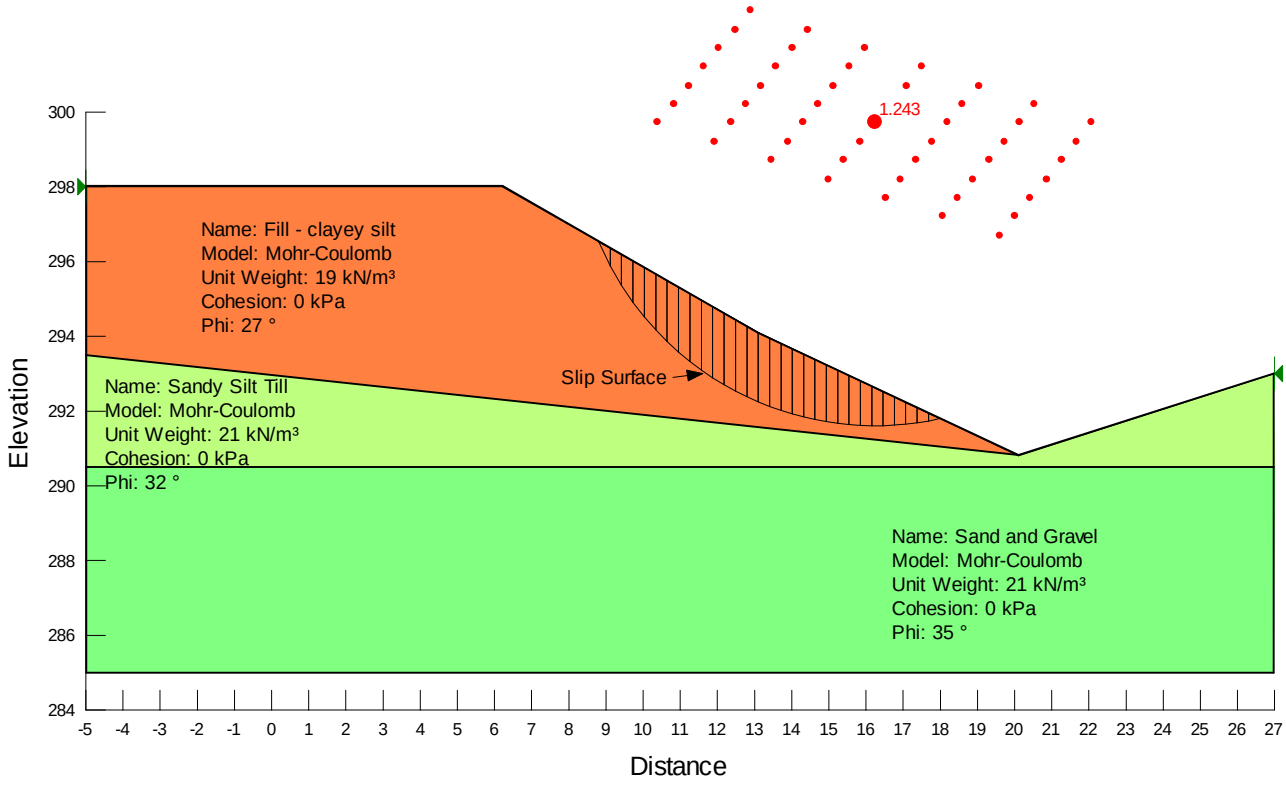
Photograph 4: South Slope, Station 13+400.

Photograph 5: South Slope, Station 13+350.

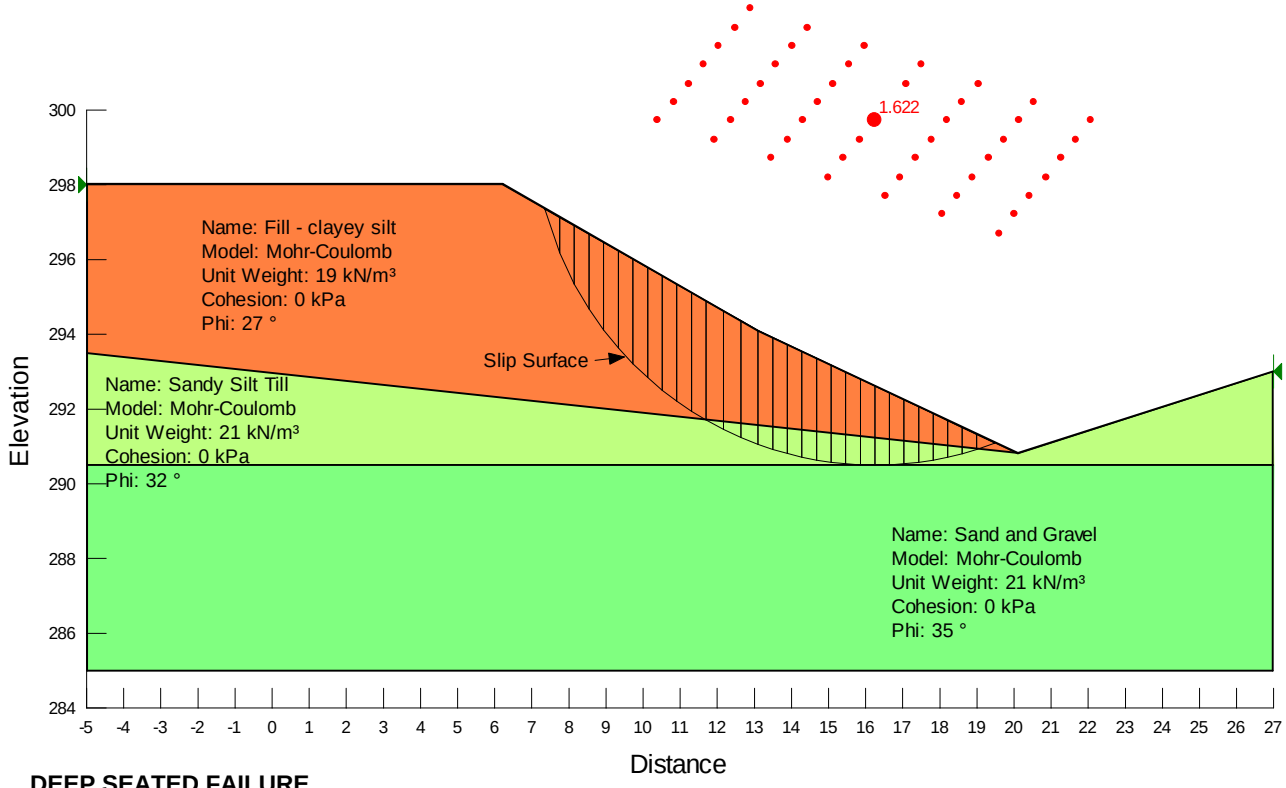
Photograph 6: South Slope, Station 13+250.

APPENDIX C

Results of Slope Stability Analyses



SHALLOW FAILURE



DEEP SEATED FAILURE

PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBNING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

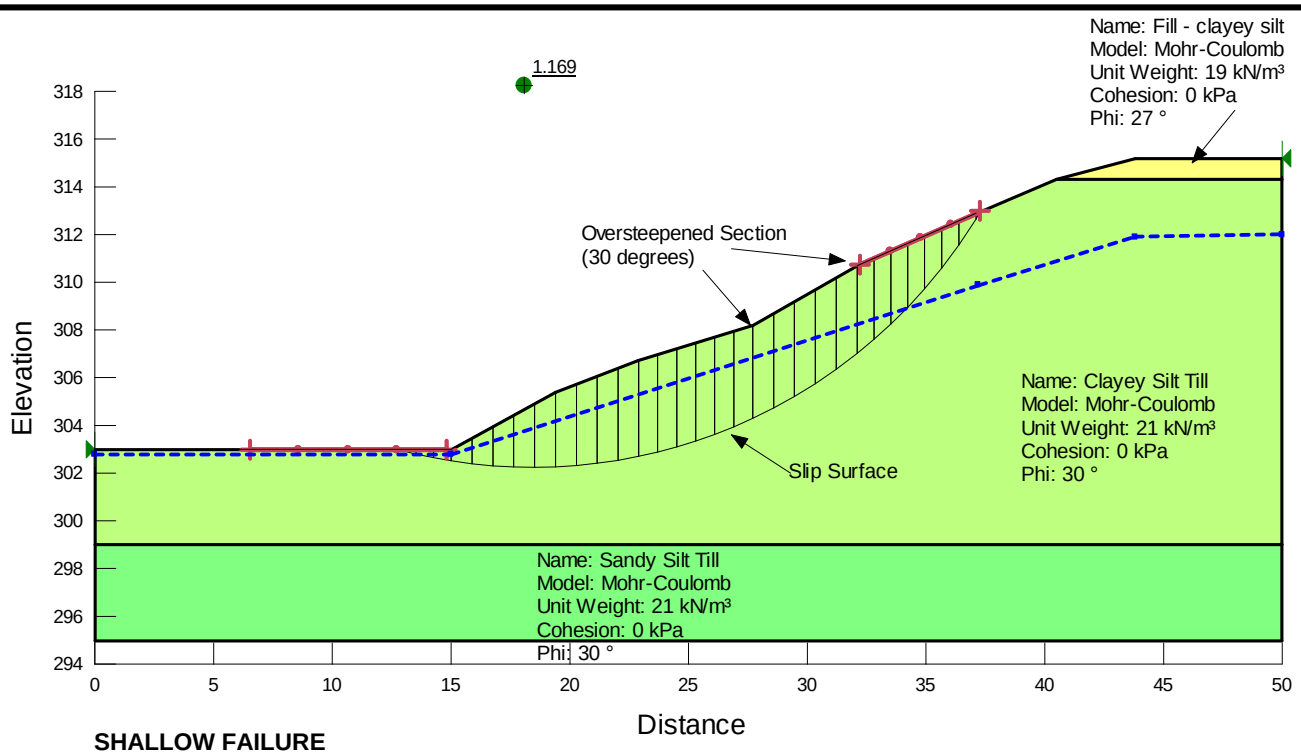
TITLE
RESULTS OF SLOPE STABILITY ANALYSIS
EXISTING SLOPE - STATION 12+694

Golder Associates
LONDON, ONTARIO

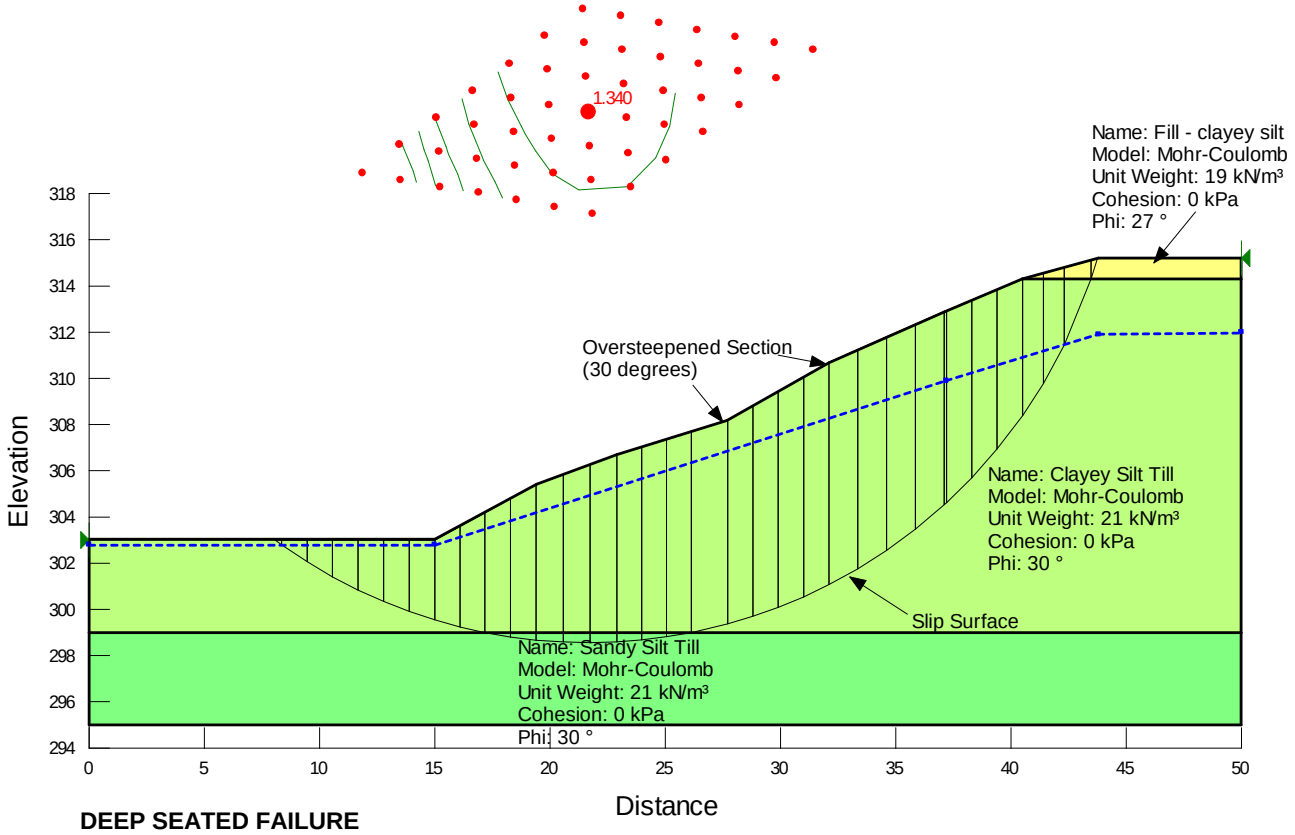
PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-R020C1
			SCALE	AS SHOWN REV. 0
DRAWN	WDF	May 04/11		
CHECK				

Figure C-1

N:\active\2008\1132 - Geotechnical\1132-100-0\08-1132-159-0 DELCAN - GWP 361-98-00 - HWY 7 REHAB\Drafting\Grapher\0811321590-2000-R020C1.grf



SHALLOW FAILURE



DEEP SEATED FAILURE

PROJECT

HIGH FILLS AND DEEP CUTS - TRUCK CLIMBNING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE

RESULTS OF SLOPE STABILITY ANALYSIS EXISTING SLOPE - STATION 13+288

Golder Associates
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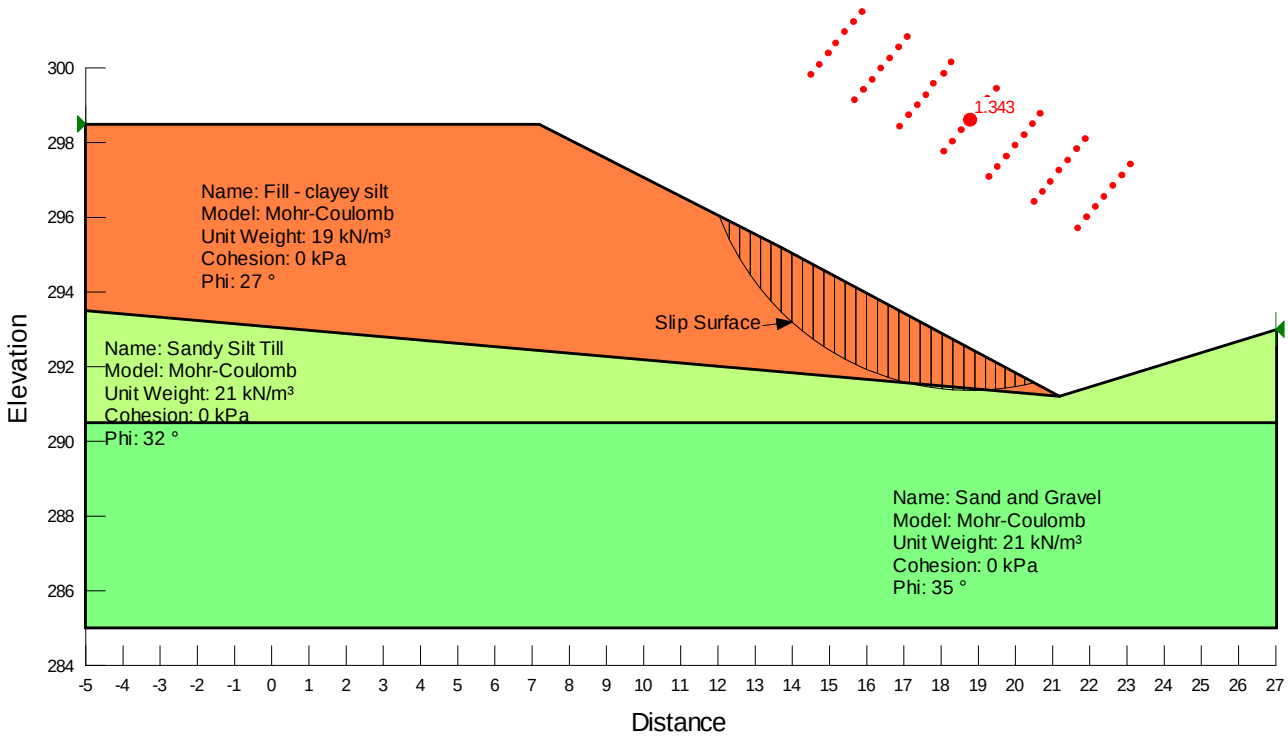
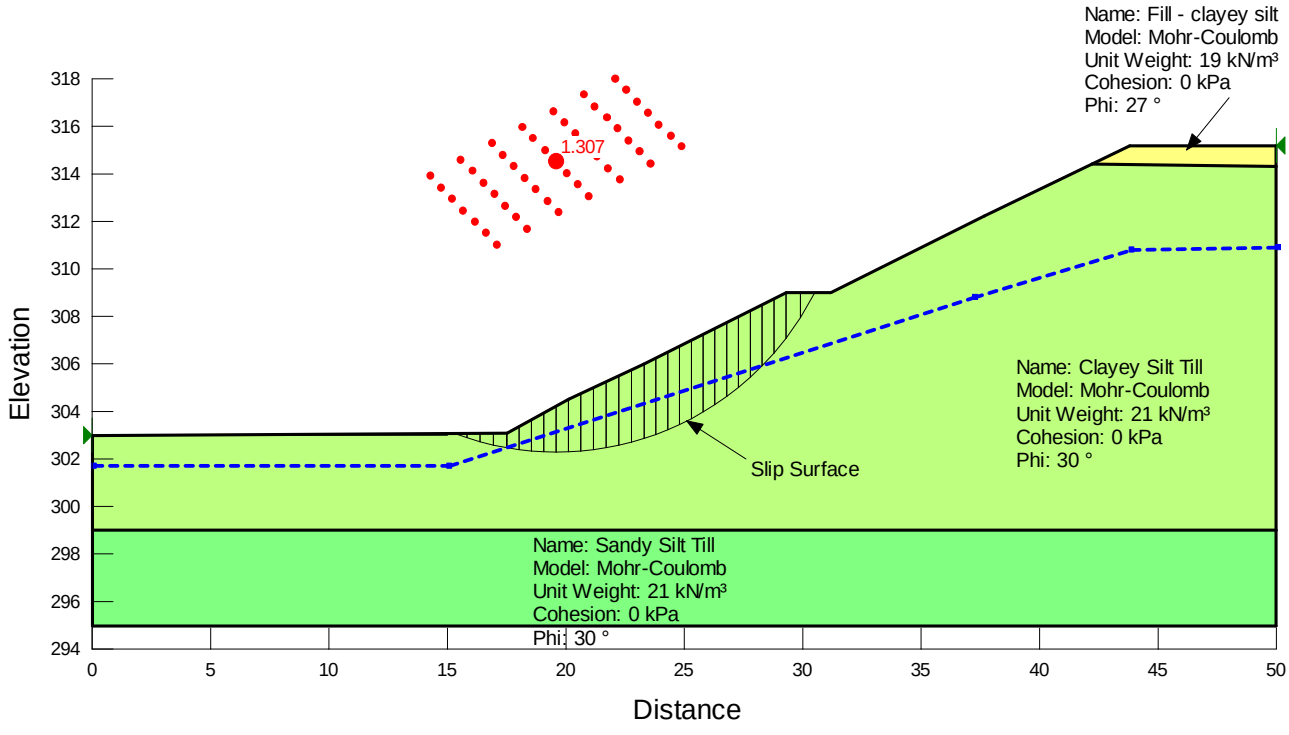
PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-R020C2
			SCALE	AS SHOWN REV. 0
DRAWN	WDF	May 04/11		
CHECK				

Figure C-2

N:\active\2008\1132 - Geotechnical\1132-100-0\08-1132-159-0 DELCAN - GWP 361-98-00 - HWY 7 REHAB\Drafting\Grapher\0811321590-2000-R020C2.grf



STATION 12+694 RT



STATION 13+288 RT

PROJECT
HIGH FILLS AND DEEP CUTS - TRUCK CLIMBNING LANES
REHABILITATION OF HIGHWAY 7
GWP 361-98-00

TITLE
RESULTS OF SLOPE STABILITY ANALYSIS
PROPOSED SLOPES

Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-159-0		FILE No.	0811321590-2000-R020C3
			SCALE	AS SHOWN REV. 0
DRAWN	WDF	May 04/11		
CHECK				

Figure C-3

N:\active\2008\1132 - Geotechnical\1132-100-0\08-1132-159-0 DELCAN - GWP 361-98-00 - HWY 7 REHAB\Drafting\Grapher\0811321590-2000-R020C3.grf

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