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FOUNDATION INVESTIGATION AND DESIGN REPORT

Proposed Noise Barrier Wall 2

Widening of Highway 7/8

**From 1.9 km West of Fischer-Hallman Road Interchange
Easterly to 0.8 km East of Courtland Avenue Interchange**

Kitchener

GWP 131-98-00

Ministry of Transportation, Ontario - West Region

Submitted to:

Mr. Jeff Matthews, P.Eng., Partner
Dillon Consulting Limited
1400-130 Dufferin Avenue
London, Ontario
N6A 5R2

REPORT



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LIST OF SYMBOLS

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
PROPOSED NOISE BARRIER WALL 2**

PART A

FOUNDATION INVESTIGATION REPORT

PROPOSED NOISE BARRIER WALL 2
WIDENING OF HIGHWAY 7/8
FROM 1.9 KM WEST OF FISCHER-HALLMAN ROAD
INTERCHANGE EASTERLY TO 0.8 KM EAST OF
COURTLAND AVENUE INTERCHANGE, KITCHENER
GWP 131-98-00
MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION



1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) has been retained by Dillon Consulting Limited (Dillon) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out the foundation investigations as part of the detail design work for GWP 131-98-00, the reconstruction and widening of Highway 7/8. This report presents the results of the foundation investigation conducted for the proposed noise barrier wall 2 which will be located immediately east of the Fischer-Hallman Road Interchange and extending beyond the Westmount Road overpass between Stations 10+050 Rt Fischer-Hallman Road S-E Ramp and 15+100 Rt Highway 7/8, to west of Homer Watson Boulevard.

The purpose of the 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, Golder Associates' proposal P81-3002 dated April 8, 2008, our letters dated July 21 and 22, 2008 and our revised scope of work letter dated April 13, 2010. The work was carried out in accordance with our Quality Control Plan for Foundation Engineering dated July 4, 2008.

Dillon provided Golder Associates with the location and extent of the noise barrier wall in plan for this project in digital format.



2.0 SITE DESCRIPTION

2.1 General

The project area of Highway 7/8 is located in the south-central area of Kitchener, Ontario. The project extends from 1.9 km west of Fischer-Hallman Road easterly to 0.8 km east of Courtland Avenue. The location of the noise barrier wall is shown on the Key Plan, Figure 1 and on the Noise Barrier Wall Location Plan, Figure 2.

This section of Highway 7/8 is currently a four lane divided highway oriented generally east-west. Four overpass structures for Westmount Road, Homer Watson Boulevard, Ottawa Street South and Courtland Avenue East, one underpass structure for Fischer-Hallman Road and an overhead structure for Canadian National Rail (CNR) tracks are situated within the project limits.

Noise barrier wall 2, to be constructed in conjunction with the widening, is to be located immediately east of the Fischer-Hallman Road Interchange and extending beyond the Westmount Road overpass between Stations 10+050 Rt Fischer-Hallman Road S-E Ramp and 15+100 Rt Highway 7/8 to west of Homer Watson Boulevard. The Fischer-Hallman S-E ramp stationing ends at 10+351.23 which is equivalent to Station 13+442.526 Highway 7/8 chainage. Mostly residential developments are located within the immediate vicinity of the site. The topography of the site area generally slopes eastwards with elevations ranging from 350 metres around the Fischer-Hallman Road S-E Ramp to 324 metres towards the Homer Watson Boulevard Interchange.

2.2 Site Geology

This project lies within the physiographic region of southwestern Ontario known as the Waterloo Hills¹. The soils generally consist of sandy hills; some are ridges of sandy till while others are kames or kame moraines, with outwash sands deposited in the valleys. Adjoining the sandy hills is the Grand River spillway system comprised of alluvial terraces of sand and gravel.

Based on the Ministry of Northern Development and Mines Map 2508 entitled "Quaternary Geology, Cambridge Area", the site is in an area of primarily ice contact sand, deposited in the Pleistocene era. Within the ice contact sand are pockets of Maryhill Till (clayey silt till) and Port Stanley Till (silt to sandy silt till).

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



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The Geologic Survey of Canada Map 1263A entitled "Geology, Toronto-Windsor Area, Ontario" indicates that the subcropping bedrock in the area of site is dolomite and mudstone of the Salina formation of Upper Silurian age. Based on the Ministry of Natural Resources Map P.1985 entitled "Bedrock Topography Series, Cambridge Area, Southern Ontario", the elevation of the bedrock surface along the proposed alignment ranges between 265 and 270 metres or some 65 to 75 metres below the ground surface.



3.0 INVESTIGATION PROCEDURES

The foundation investigation for the design of the proposed noise barrier wall 2 was carried out between May 17 through 20, and June 3 and 8, 2010 during which time twenty boreholes were drilled along the alignment of the proposed noise barrier wall 2. The borehole locations are shown on Drawing 1.

The boreholes (numbered 30 to 49, inclusive) were advanced to depths of 5.0 to 6.6 metres. This information was supplemented at the remaining locations along the proposed noise barrier wall alignment with boreholes advanced for other components of this project as follows:

- Borehole 805, 807, 809 and 811 (Geocres No. 40P7-62)
- Boreholes 903 and 904 (Geocres No.40P8-191)
- Boreholes 923, 923A and 923B (Geocres No.40P8-185)

The table below summarizes the borehole locations, ground surface elevations at the borehole locations and the borehole depths:

Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
	Northing	Easting	(m)	(m)
30	4 809 413	222 947	343.77	5.03
31	4 809 441	222 996	343.93	5.03
32	4 809 479	223 069	343.67	5.03
33	4 809 520	223 146	343.01	5.03
34	4 809 552	223 208	342.34	5.03
35	4 809 591	223 283	341.13	5.03
36	4 809 634	223 352	341.49	5.18
37	4 809 667	223 419	340.20	5.18
38	4 809 682	223 472	338.67	5.03
39	4 809 703	223 545	338.32	5.03
40	4 809 791	223 797	337.12	5.18
41	4 809 817	223 866	336.52	5.18
42	4 809 843	223 937	335.35	5.03
43	4 809 874	224 006	333.76	5.03
44	4 809 906	224 073	333.04	5.03
45	4 809 941	224 149	332.08	5.03
46	4 809 971	224 212	331.04	6.55
47	4 810 017	224 322	330.62	5.03
48	4 810 040	224 395	329.81	5.03
49	4 810 063	224 471	329.18	5.03
805	4 809 296	222 748	344.73	9.60



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Borehole	Location (m)		Ground Surface Elevation	Borehole Depth
807	4 809 343	222 813	342.58	9.60
809	4 809 376	222 877	343.20	9.60
811	4 809 224	222 763	350.34	10.36
903	4 809 755	223 682	337.86	11.28
904	4 809 772	223 737	337.34	10.36
923	4 809 987	224 253	330.39	8.08
923A	4 809 981	224 234	331.47	6.55
923B	4 809 998	224 273	331.11	6.55

The drilling was carried out using truck and track mounted CME 45 power augers supplied and operated by a specialist drilling contractor. In the boreholes, samples of the overburden were generally obtained at 0.75 metre intervals of depth using 50 millimetres outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) 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. In addition, in situ vane shear tests were carried out in the cohesive deposit encountered in borehole 44 and in the organic deposits in boreholes 923, 923A and 923B.

The groundwater conditions were observed throughout the drilling operations and upon completion of drilling, a 12.5 millimetre diameter standpipe was installed in borehole 44 to monitor the groundwater conditions. The boreholes were backfilled in accordance with current Ontario Ministry of Transportation (MTO) procedures and Ontario Regulation 372/07.

The field work was monitored on a full-time basis by experienced members of our engineering staff who located the boreholes in the field, monitored the drilling, sampling and in situ testing operations, logged the boreholes and surveyed the borehole locations and elevations. The samples were identified in the field, placed in labelled containers and transported to our London laboratory for further examination and 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 Drawing 1, attached.



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 and 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 sampling and observations of drilling resistance and represent transitions between soil types rather than exact planes of geological change. Subsurface conditions will vary between and beyond the borehole locations.

The boreholes drilled along the noise barrier wall alignment generally encountered highly complex and variable conditions consisting of asphaltic concrete pavement and/or topsoil and/or layers of granular and cohesive fill underlain by clayey silt, sandy silt, sand, silty sand, clayey silt till, silt, silty clay till, sand and gravel and sandy silt till.

The borehole locations are shown on Drawing 1. A detailed description of the subsurface conditions encountered in the boreholes is provided on the Record of Borehole sheets and is summarized below.

4.1.1 Pavements

Asphaltic concrete was encountered at the ground surface in boreholes 36, 37, 40, 41, 811, 903 and 904, overlying granular roadbase. The thickness of the asphalt layers ranged from 80 to 230 millimetres.

The granular roadbase material was found to be 220 to 320 millimetres thick. The thickness of the granular subbase was 150 to 330 millimetres. It should be noted that evidence of cobbles were observed when drilling through the granular subbase materials in boreholes 37, 40 and 41. In addition to the locations where asphalt was encountered, granular subbase materials of 270 to 470 millimetre thickness were also encountered beneath the topsoil in boreholes 47, 48, 49 and 923A.

4.1.2 Topsoil

Layers of topsoil were encountered at the ground surface in boreholes 30 through 35, 38, 39, 42 through 49, 805, 807, 809, 923, 923A and 923B. In boreholes 36, 37, 811, 904 and 923, buried topsoil layers were encountered underlying layers of fill at elevations 338.2, 337.3, 345.9, 329.7 and 327.0 metres, respectively. The thickness of the topsoil layers ranged from 90 to 670 millimetres. It should be noted that trace to some topsoil and organics were also encountered within the fill layers in boreholes 31, 37, 40, 41, 42, 46, 811, 903, 904, 923A and 923B.



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The buried topsoil had N values of 3 to 75 blows per 0.3 metres and water contents ranging from 12 to 38 per cent. Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content or 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 underlying the pavement structure or topsoil in boreholes 31, 34, 36, 37, 40 through 42, 46, 49, 811, 903, 904, 923, 923A and 923B from elevations 328.8 to 349.6 metres. The fill comprised layers of both granular and cohesive material. The granular fill layers were found in all of the above listed boreholes with the exception of boreholes 34 and 46 and generally comprised silty sand, sandy silt, sand, sand and gravel and silt. The thickness of the granular fill layers ranged from 0.3 to 3.3 metres.

The granular fill was very loose to dense with standard penetration test N values of 2 to 48 blows per 0.3 metres. The water contents generally ranged from 1 to 18 per cent with the exception of eight water contents which were measured on granular fill samples that contained a trace to some topsoil and organics. These water contents ranged from 18 to 27 per cent at elevations 338.7 metres in borehole 37, 347.9 metres in borehole 811, 331.0 metres in borehole 903, 327.3 to 328.9 metres in borehole 923, 329.2 metres in borehole 923A and 328.8 metres in borehole 923B. An Atterberg limits test was carried out for a granular fill sample that contained clayey silt seams, which was confirmed to be non-plastic in borehole 904 at elevation 334.3 metres.

In boreholes 34 and 46, cohesive fill layers were found underlying topsoil. Cohesive fill layers, predominantly comprising clayey silt and silty clay were also found within the granular fill layers in boreholes 31, 36, 37, 40, 41, 42, 811, 903 and 904. The thickness of the cohesive fill layers ranged from 0.3 to 3.3 metres. Borehole 40 was terminated in the fill layers and about 2.3 metres of the lower cohesive fill layer was explored before termination of the borehole.

The cohesive fill was soft to hard with N values ranging from 3 to 75 blows per 0.3 metres and water contents ranging from 10 to 23 per cent. The cohesive fill layer were of low plasticity based on the Atterberg limits tests carried out on samples obtained from the standard penetration test. The plastic limit, liquid limit and plasticity index ranges were 13 to 20, 19 to 33 and 5 to 17 per cent, respectively. The Atterberg limits results for the test performed on the cohesive fill layers are presented on Figure A-10.

The results of the grain size testing conducted on granular and cohesive fill layers are presented on Figures A-1 and 2, respectively. It should be noted that insufficient sample was obtained in borehole 34 at elevation 341.6 metres for conducting a grain size distribution analysis. A replacement grain size distribution analysis was undertaken for the cohesive fill sample at elevation 340.6 metres.



4.1.4 Peat

Seemingly localized deposits of peat were encountered in boreholes 923, 923A and 923B from elevations 326.7 and 327.9 metres. The peat was found underlying topsoil and/or layers of fill. The peat was described as fibrous, soft to very stiff and black. The peat layers were 0.9 to 2.3 metres thick.

The peat had N values of 3 to 7 blows per 0.3 metres, indicating a soft to firm consistency. In situ shear vane test results undertaken at depth gave undrained shear strengths ranging from 108 kilopascals to in excess of 144 kilopascals. The water contents ranged from 183 to 347 per cent.

4.1.5 Clayey Silt

Layers of clayey silt were encountered in boreholes 34, 39, 41, 44, 805, 807, 809, 811 and 923 from elevation 324.5 to 344.6 metres. The clayey silt layers were found underlying sand in boreholes 34 and 807, topsoil in boreholes 39, 805 and 809, fill in borehole 41, silt in boreholes 44 and 811 and peat in borehole 923. The clayey silt layers were interlayered with silty sand and sandy silt layers in boreholes 805 and 809, respectively. It should also be noted that sandy silt, sand and silty sand seams, as well as silt layers were observed in between the clayey silt layers in boreholes 41, 44, 805, 807, 809 and 923. The clayey silt layers were 0.2 to 4.4 metres thick. Boreholes 41, 44 and 807 were terminated in the clayey silt after exploring it for 0.8 to 2.1 metres.

The clayey silt had N values of 3 to 27 blows per 0.3 metres indicating a soft to very stiff consistency. An in situ shear vane test confirmed the undrained shear strength to be in excess of 144 kilopascals in borehole 44 at elevation 330.6 metres. Water contents in the clayey silt ranged from 13 to 26 per cent. The clayey silt was of low plasticity based on plastic limits, liquid limits and plasticity indices ranging from 11 to 17, 18 to 30 and 6 to 14 per cent, respectively. The Atterberg limits results for tests performed on samples of clayey silt are shown on Figure A-11.

The results of the grain size testing conducted on selected clayey silt samples obtained during the standard penetration testing are presented on Figure A-3.

4.1.6 Sandy Silt

Sandy silt layers were encountered in boreholes 30, 32 through 38, 43, 45, 46, 48 and 809 from elevation 328.4 to 343.6 metres. The sandy silt layers were found underlying topsoil in boreholes 30, 32, 33, 35, 36, 37 and 45, fill in boreholes 34 and 46, silty clay till in borehole 38, silty fine sand in boreholes 43 and 48, and clayey silt in borehole 809. The thickness of the sandy silt layers ranged from 0.5 to 4.6 metres. Boreholes 32, 35 and 36 were terminated in the sandy silt after exploring it for 1.1 to 4.9 metres.

The N values measured in the sandy silt ranged from 4 to 46 blows per 0.3 metres, indicating a loose to dense relative density. The water contents generally ranged from 10 to 18 per cent, with the exception of the water



contents measured in borehole 35, which were marginally higher, ranging from 19 to 24 per cent. An Atterberg limits test undertaken for a sandy silt sample with some clay from borehole 33 at elevation 341.5 metres confirmed the material to be non-plastic.

The results of grain size analyses conducted on samples of the sandy silt obtained during standard penetration testing are presented on Figure A-4.

4.1.7 Sand

Loose to very dense sand layers were encountered in boreholes 31, 34, 39, 43, 45, 48, 49, 807, 903, 904 and 923B from elevation 327.0 to 341.8 metres. The predominantly fine grained sand layers were generally found underlying fill, sandy silt, clayey silt, silty sand, clayey silt till or peat. The sand was interlayered with silty fine sand from elevation 339.7 metres in borehole 807. The thickness of the sand layers ranged from 0.8 to 1.8 metres. Boreholes 31, 45, 48, 49, 903 and 904 were terminated in the sand after exploring it for 0.6 to 3.7 metres.

N values in the sand layers varied from 6 to 50 blows per 0.3 metres. The water contents generally ranged from 2 to 13 per cent. Water contents of the sand below the encountered groundwater level in boreholes 807 and 903 varied from 12 to 18 per cent.

The grain size distribution curves for sand samples obtained during standard penetration testing are presented on Figure A-5.

4.1.8 Silty Sand

Layers of loose to very dense silty sand and silty fine sand were encountered in boreholes 30, 37 through 39, 43, 46 through 48, 805, 807, 809, 923 and 923A from elevations 323.7 to 342.5 metres. The silty sand was found underlying topsoil, fill, sandy silt, sand, clayey silt and peat. In boreholes 48, 805 and 807, the silty sand deposits were found to be interlayered with sandy silt, and clayey silt and sand, respectively. Sandy silt, silt and clayey silt layers were also observed in the silty sand in boreholes 46, 47 and 923A, respectively. With the exception of boreholes 48 and 807, the above listed boreholes were all terminated in the silty sand after exploring it for 0.6 to 5.2 metres. Where fully penetrated, the thickness of the silty sand layers ranged from 0.6 to 2.8 metres.

The silty sand had N values of 4 to 52 blows per 0.3 metres. The water contents varied from 3 to 20 per cent.

The results of grain size testing conducted on silty sand samples obtained during standard penetration testing are presented on Figure A-6.



4.1.9 Clayey Silt Till

Clayey silt till was encountered underlying a layer of silt in borehole 811 from elevation 343.6 metres and below the topsoil in borehole 904 from elevation 329.1 metres. The clayey silt till was 1.5 to 2.0 metres thick.

The stiff to very stiff clayey silt till had N values of 11 to 20 blows per 0.3 metres and water contents of 12 and 13 per cent. The Atterberg limits tests indicated that the clayey silt till is of low plasticity. The plasticity limit, liquid limit and plasticity indices for two samples of clayey silt till were 13 and 14, 21 and 24 and 8 and 10 per cent, respectively. The Atterberg limits results for the tests performed on the clayey silt till samples are shown on Figure A-11.

The results of the grain size testing conducted on clayey silt till samples obtained during standard penetration testing are presented on Figure A-7. Although not specifically encountered in the boreholes, cobbles and boulders should be anticipated in the clayey silt till due to the depositional history of this material.

4.1.10 Silt

Loose to compact layers of silt were encountered in boreholes 33, 34, 42, 44 and 923B from elevations 325.2 to 345.5 metres. The silt layers were found underlying topsoil, sandy silt, clayey silt, sand and gravel and sand. Clayey silt layers were also observed in the silt in borehole 923B at depth. Where fully penetrated, the silt layers were 0.3 to 1.0 metres thick. Boreholes 33, 34 and 923B were terminated in the silt layers after exploring them for 0.6 to 2.1 metres.

The silt had N values of 7 to 29 blows per 0.3 metres and a water content of 18 per cent.

A grain size distribution curve for a silt sample recovered during standard penetration testing is shown on Figure A-8.

4.1.11 Silty Clay Till

A layer of very stiff silty clay till was found underlying topsoil in borehole 38 from elevation 338.5 metres. The silty clay till layer was found to be 3.5 metres thick.

The silty clay till had N values of 19 to 26 blows per 0.3 metres. The water content was 19 per cent. The silty clay till is of intermediate plasticity based on an Atterberg limits test, giving a plastic limit, liquid limit and plasticity index of 17, 36 and 19 per cent, respectively. The results of the Atterberg limits test are presented on Figure A-11.

A grain size distribution curve for the silty clay till is presented on Figure A-9. Although not specifically found in the borehole, cobbles and boulders should be expected in silty clay till deposits due to the depositional history of the material.



4.1.12 Sand and Gravel

A layer of dense sand and gravel, 0.8 metres thick, was encountered in borehole 42 from elevation 332.5 metres. The sand and gravel was found underlying layers of fill and overlying silt. An N value of 37 blows per 0.3 metres was measured for the sand and gravel.

4.1.13 Sandy Silt Till

Sandy silt till was encountered at depth in boreholes 42 and 811 from elevations 331.4 and 340.6 metres, respectively. The sandy silt till was explored for at least 0.6 to 1.1 metres before termination of the borehole. Although not specifically found in the borehole, cobbles and boulders should be expected in sandy silt till deposits due to the depositional history of the material.

N values of 12 to 15 blows per 0.3 metres were measured indicating the stratum to be of compact relatively density.

4.2 Groundwater Conditions

The groundwater conditions in the current boreholes were monitored during and upon completion of drilling. The observed groundwater conditions are noted on the Record of Borehole sheets and are summarized in the following text and tables.

Borehole	Ground Surface Elevation	Encountered Groundwater Level	
		Depth	Elevation
	(m)	(m)	(m)
30	343.77	Dry	Below 339.0
31	343.93	Dry	Below 339.0
32	343.67	Dry	Below 339.0
33	343.01	Dry	Below 338.0
34	342.34	Dry	Below 337.5
35	341.13	2.1	339.0
36	341.49	Dry	Below 336.5
37	340.20	Dry	Below 335.0
38	338.67	Dry	Below 334.0



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Borehole	Ground Surface Elevation (m)	Encountered Groundwater Level	
		Depth	Elevation
		(m)	(m)
39	338.32	Dry	Below 333.5
40	337.12	Dry	Below 332.0
41	336.52	Dry	Below 331.5
42	335.35	Dry	Below 330.5
43	333.76	Dry	Below 329.0
44	333.04	3.0	330.0
45	332.08	Dry	Below 327.0
46	331.04	Dry	Below 325.0
47	330.62	Dry	Below 325.5
48	329.81	Dry	Below 325.0
49	329.18	Dry	Below 324.5
805	344.73	Dry	Below 335.5
807	342.58	2.9	339.7
809	343.20	Dry	Below 334.0
811	350.34	5.1	345.2
903	337.86	8.4	329.5
904	337.34	9.8	327.5
923	330.39	6.7	323.7
923A	331.47	Dry	Below 325.0
923B	331.11	2.3	328.8

During the fieldwork, groundwater was encountered between elevation 323.7 and 345.2 metres in boreholes 35, 44, 807, 811, 903, 904, 923 and 923B. The majority of the remaining boreholes were dry, and were advanced to a depth of approximately 5 metres and terminated in sands or silts. With the exception of boreholes 42 and 46, grey soils were not encountered in any of the boreholes which were dry upon completion. As a result, the groundwater level is inferred to be below the bottom of any borehole that was dry and did not intercept grey soils. The fills in the vicinity of borehole 923B likely contain perched groundwater since grey soils were not encountered above elevation 324.5 metres in boreholes 923 or 923A.



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A 12.5 millimetre diameter standpipe was installed in borehole 44. The standpipe installed in borehole 44 was found to be dry upon installation and at two subsequent readings

Borehole	Ground Surface Elevation (m)	Installation	Measured Groundwater Elevation (m)		
			Upon Installation	June 1, 2010	Oct. 13, 2010
44	333.04	Slotted Standpipe	Dry to 378.8	Dry to 328.8	Dry to 328.8

The groundwater levels encountered in the boreholes along the proposed Fischer Hallman S-E Ramp appear to be inconsistent. The groundwater level has been inferred at elevation 345 metres near Station 10+050, near elevation 340 metres between Station 10+070 and Station 10+220 and below elevation 339 metres east of Station 10+220.

East of Fischer-Hallman Road, the groundwater level has been inferred to be at a depth of 5 metres or greater. The groundwater level elevations have been inferred to vary as follows:

- Stations 13+200 to 13+440 Rt Highway 7/8 - below 340 metres
- Stations 13+440 to 13+600 Rt Highway 7/8 - below 339 metres
- Stations 13+600 to 13+760 Rt Highway 7/8 - below 338 metres
- Stations 13+760 to 13+850 Rt Highway 7/8 - 339 metres
- Stations 13+850 to 14+050 Rt Highway 7/8 - below 336 metres
- Stations 14+050 to 14+160 Rt Highway 7/8 - below 333 metres
- Stations 14+160 to 14+270 Rt Highway 7/8 - 329 metres
- Stations 14+270 to 14+330 Rt Highway 7/8 - 328 metres
- Stations 14+330 to 14+470 Rt Highway 7/8 - below 332 metres
- Stations 14+470 to 14+550 Rt Highway 7/8 - below 330 metres
- Stations 14+550 to 14+620 Rt Highway 7/8 - below 328 metres
- Stations 14+620 to 14+700 Rt Highway 7/8 - below 330 metres
- Stations 14+700 to 14+780 Rt Highway 7/8 - below 325 metres
- Stations 14+780 to 15+100 Rt Highway 7/8 - below 325 metres

The above-noted groundwater levels are not necessarily considered to be representative of the long-term, stabilized groundwater conditions as the readings were taken for a short duration only. The groundwater levels are expected to fluctuate due to climatic and seasonal variations.



5.0 MISCELLANEOUS

This investigation was carried out using equipment supplied and operated by Aardvark Drilling Ltd., who is an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Michael Arthur, Mr. Matthew Rhody and Mr. Mathew Riopelle 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 the Project Engineer, 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.

ORIGINAL SIGNED

Dirka U. Prout, P.Eng.
Project Engineer

ORIGINAL SIGNED

Philip R. Bedell, P.Eng.
Senior Consultant

ORIGINAL SIGNED

Fintan J. Heffernan, P.Eng.
MTO Designated Contact

DUP/PRB/FJH/ly/sll

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
PROPOSED NOISE BARRIER WALL 2**

PART B

FOUNDATION DESIGN REPORT

PROPOSED NOISE BARRIER WALL 2

WIDENING OF HIGHWAY 7/8

FROM 1.9 KM WEST OF FISCHER-HALLMAN ROAD INTERCHANGE

EASTERLY TO 0.8 KM EAST OF COURTLAND AVENUE INTERCHANGE

KITCHENER

GWP 131-98-00

MINISTRY OF TRANSPORTATION, ONTARIO - WEST REGION



6.0 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical parameters and recommendations for the geotechnical aspects of the design for the proposed noise barrier wall 2 along Highway 7/8 between 10+050 Rt Fischer-Hallman Road S-E Ramp and 15+100 Rt Highway 7/8. The proposed noise barrier wall is to be shoulder mounted.

The design parameters and recommendations have been developed based on interpretation of the factual data obtained from the boreholes advanced at the site. The interpretation and recommendations provided are intended to provide the designers with sufficient information to design the proposed noise barrier wall foundations. Where comments are made on construction, they are provided in order to highlight those aspects that could affect the design, or for which special provisions or operational constraints may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect the equipment selection, proposed construction methods, scheduling and the like.

6.2 Noise Barrier Wall Foundation Design

The noise barrier wall foundation should be designed and constructed in accordance with MTO's SP599F01. It is recommended that the noise barrier wall be supported using conventional augered caissons with a diameter of 0.6 to 0.9 metres. Geotechnical design parameters for design of the caisson foundations are provided in Table I following the text of this report, based on the soil conditions encountered along the proposed noise barrier wall alignments. The stratigraphy presented in Table I has been simplified for the purposes of the noise barrier wall foundation design.

Where both an undrained shear strength, c_u and an effective friction angle, ϕ' , have been given for a specific stratum, the caisson design should be checked for both the drained and undrained condition, and the larger of the two calculated caisson depths shall govern.

Portions of the caisson that will be embedded in discrete layers of organic materials, such as buried topsoil or peat layers found in boreholes 36, 37, 811, 904, 923, 923A and 923B near Stations 10+050 Rt Fischer-Hallman Road S-E Ramp, 13+880, 13+955, 14+290 and 14+ 850 Rt Highway 7/8, respectively, should be neglected in the design. The passive resistance in the upper 1.4 metres below the ground should be neglected to account for frost action. In addition, for foundation design, full passive resistance will be mobilized only where the ground surface in front and behind the caisson is level. Where sloping ground is present adjacent to the noise barrier wall, the K_p values used in the calculation should be adjusted to account for the presence of the sloping ground.



FOUNDATION INVESTIGATION AND DESIGN REPORT PROPOSED NOISE BARRIER WALL 2

The ground behind the proposed noise barrier wall will slope downwards at 3 horizontal to 1 vertical within the following approximate station ranges:

- Station 10+050 Rt to 10+065 Rt Fischer-Hallman Road S-E Ramp;
- Station 10+240 Rt to 10+315 Rt Fischer-Hallman Road S-E ; and
- Station 14+300 Rt to 15+100 Rt Highway 7/8.

The ground behind the proposed noise barrier wall will slope downwards at 2 horizontal to 1 vertical within the following approximate station ranges:

- Station 10+065 Rt to 10+090 Rt Fischer-Hallman Road S-E Ramp;
- Station 10+175 Rt to 10+240 Rt Fischer-Hallman Road S-E ; and
- Station 13+825 Rt to 14+300 Rt Highway 7/8.

Adjusted K_p values are provided in Table I for these areas. The adjusted K_p value is to be applied to that portion of the caisson that is above the elevation of the ground surface at the toe of the slope; below this elevation, the full K_p is to be applied.

The existing Westmount Road overpass is located between approximate Stations 14+140 and 14+183 Lt. Due to the right-of-way restrictions and to accommodate the embankment widening and grade raise, it has been proposed to construct Retained Soil System (RSS) retaining walls and/or slopes along the Fischer-Hallman S-E Ramp from approximately Station 10+090 to 10+175 and east of the Westmount Road Overpass structure from about Station 13+950 to 14+300 Highway 7/8. The design of the noise wall foundations should be coordinated with the design of the RSS walls/slopes in order to avoid interference with the reinforcing elements.

It may be necessary to use deeper or larger diameter caissons at locations with deep fills containing zones of loose granular fill or firm cohesive fill. At some locations, the deep fills are underlain by peat and/or topsoil. These locations are:

- Adjacent to the Culvert Site No. 33-283C between Stations 14+200 and 14+400 Rt Highway 7/8. Based on the information from boreholes 40, 903 and 904, the fill and buried topsoil in this area extends to approximate elevation 328 metres or a depth of about 10 metres.
- Between Stations 14+820 and 14+875 Rt Highway 7/8. Based on the information from boreholes 923, 923A and 923B, the loose granular fill in this area is approximately 3 metres deep and is underlain by organics (peat and topsoil) 0.9 to 2.6 metres thick extending to elevations 324.5 to 327 metres.



6.3 Construction Considerations

Excavations for the construction of the noise barrier wall foundations will penetrate the surficial fill and will extend through deposits of clayey silt till, sandy silt, sand and gravel, sand and silty sand. The sands are predominantly fine to medium grained and uniform in composition. The sands, silts and clayey silt tills at this site are susceptible to disturbance during caisson excavation and construction. In addition, excavation of granular materials below the groundwater level is likely to be required along selected sections of the proposed noise barrier wall 2.

Excavation of granular materials below the groundwater table may be required in the vicinity of Stations 10+175 Rt Fischer-Hallman S-E Ramp and Station 13+800 Rt Highway 7/8. With proactive dewatering, a temporary liner will be required to support the sides of the excavation and permit cleaning and inspection of the base. Careful cleaning of the base of the caisson should be carried out prior to placement of concrete to remove all loosened or disturbed materials. Alternatively, the foundations could be installed using mud drilling techniques (augered with the hole filled with bentonite slurry) and placement of concrete by tremie. Surface water run off should be directed away from the excavation. It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to alert the Contractor about the requirements for support of augered excavation and measures to deal with excavation of saturated granular soils below the groundwater level.

The caissons should be constructed and inspected in accordance with Ontario Provisional Standard Specifications 903 and SP599F01. Following construction, the Quality Verification Engineer shall submit a Certificate of Conformance confirming that the noise barrier wall foundations have been constructed in general conformance with the Contract Documents.



7.0 MISCELLANEOUS

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.

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ORIGINAL SIGNED

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TABLE I

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

Widening of Highway 7/8
GWP 131-98-00

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Undrained Shear Strength, c_u^1 (kPa)	Effective Angle of Friction, ϕ'^1 (°)	Coefficient of Passive Pressure, K_p^2 Level Ground/ 2H:1V/3H:1V	Coefficient of Active Pressure, K_a Level Ground	Unit Weight ³ (kNm ⁻³)	
								Bulk γ	Effective, γ'
10+050 to 10+070 Fischer-Hallman Road S-E Ramp Borehole 811	Loose to compact granular fill / firm to hard cohesive	349.0 to 346.0	345	-	30	3.0/1.1/1.6	0.33	19.0	9.0
	Loose to compact silt/stiff clayey silt	345.5 to 343.5		-	30	3.0/1.1/1.6	0.33	21.0	11.0
	Stiff to very stiff clayey silt till	Below 343.5		150	30	3.0/1.1/1.6	0.33	21.0	11.0
10+070 to 10+130 Fischer-Hallman Road S-E Ramp Borehole 805	Firm to very stiff clayey silt	343.0 to 339	335	100	28	2.8/1.0/N/A	0.36	19.5	9.5
	Compact to very dense silty sand	Below 339		-	32	3.3/1.2/N/A	0.31	19.5	9.5
10+130 to 10+220 Fischer-Hallman Road S-E Ramp Borehole 807	Compact to dense sand to silty sand	341.5 to 335.0	340	-	31	3.1/1.2/N/A	0.32	19.0	9.0
	Very stiff clayey silt	Below 335.0		150	28	2.8/1.0/N/A	0.36	19.0	9.0

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Undrained Shear Strength, c_u^1 (kPa)	Effective Angle of Friction, ϕ'^1 (°)	Coefficient of Passive Pressure, K_p^2 Level Ground/ 2H:1V/3H:1V	Coefficient of Active Pressure, K_a Level Ground	Unit Weight ³ (kNm ⁻³)	
								Bulk γ	Effective, γ'
10+220 to 10+300 Fischer-Hallman Road S-E Ramp Borehole 809	Stiff to very stiff clayey silt	342 to 341	Below 334	150	28	2.8/1.0/1.5	0.36	19.0	9.0
	Compact sandy silt	341 to 339.5		-	29	2.9/1.1/1.6	0.35	19.0	9.0
	Compact to dense silty sand	Below 339.5		-	33	3.4/1.8/1.8	0.30	19.5	9.5
10+300 to 10+350 Fischer-Hallman Road S-E Ramp Borehole 30	Compact to dense sandy silt	342.5 to 341.0	Below 339	-	32	3.3/N/A/1.8	0.31	19.0	9.0
	Dense to very dense silty sand	Below 341.0		-	33	3.4/N/A/1.8	0.29	20.0	10.0
13+440 to 13+530 Highway 7/8 Borehole 31	Very stiff cohesive fill	342.5 to 341.5	Below 339	150	28	2.8/N/A/N/A	0.36	19.0	9.0
	Compact to dense sand	Below 341.5		-	32	3.3/N/A/N/A	0.31	20.0	10.0
13+530 to 13+600 Highway 7/8 Borehole 32	Compact sandy silt	Below 342.5	Below 339	-	30	3.0/N/A/N/A	0.33	19.0	9.0
13+600 to 13+690 Highway 7/8 Borehole 33	Loose to compact sandy silt	341.5 to 340.0	Below 338	-	28	2.8/N/A/N/A	0.36	18.5	8.5
	Compact silt	Below 340.0		-	30	3.0/N/A/N/A	0.33	18.0	8.0
13+690 to 13+760 Highway 7/8 Borehole 34	Very stiff cohesive fill	341.0 to 340.0	Below 338	150	28	2.8/N/A/N/A	0.36	19.0	9.0
	Loose to compact sandy silt to sand	340.0 to 338.0		-	30	3.0/N/A/N/A	0.33	18.5	8.5
	Compact silt	Below 338.0		-	32	3.3/N/A/N/A	0.31	19.0	9.0

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Undrained Shear Strength, c_u^1 (kPa)	Effective Angle of Friction, ϕ'^1 (°)	Coefficient of Passive Pressure, K_p^2 Level Ground/ 2H:1V/3H:1V	Coefficient of Active Pressure, K_a Level Ground	Unit Weight ³ (kNm ⁻³)	
								Bulk γ	Effective, γ'
13+760 to 13+850 Highway 7/8 Borehole 35	Loose to compact sandy silt	Below 340	339	-	29	2.9/1.5/N/A	0.35	18.5	8.5
13+850 to 13+930 Highway 7/8 Borehole 36	Stiff to very stiff cohesive fill	340.0 to 338.3	Below 336	150	26	2.6/N/A/N/A	0.39	19.0	9.0
	Compact sandy silt	Below 337.5		-	30	3.0/1.7/N/A	0.33	19.0	9.0
13+930 to 13+990 Highway 7/8 Borehole 37	Compact to dense granular fill	339.0 to 337.3	Below 335	-	30	3.3/1.9/N/A	0.33	19.0	9.0
	Compact sandy silt to silty sand	336.5 to 336.5		-	30	3.3/1.9/N/A	0.33	19.0	9.0
				-					
13+990 to 14+050 Highway 7/8 Borehole 38	Very stiff silty clay till	337.5 to 335.0	Below 334	200	30	3.0/1.7/N/A	0.33	20.0	10.0
	Compact sandy silt to silty fine sand	Below 335.0		-	30	3.0/1.7/N/A	0.33	19.0	9.0
14+050 to 14+160 Highway 7/8 Borehole 39	Very stiff clayey silt	337.0 to 335.5	Below 333	200	28	2.8/1.4/N/A	0.36	20.0	20.0
	Dense silty sand to sand	Below 335.5		-	33	3.4/2.1/N/A	0.30	19.0	19.0
14+160 to 14+270 Highway 7/8 Borehole 903	Firm to stiff cohesive fill / compact granular fill	336.5 to 328.0	329	150	27	2.7/0.9//N/A	0.38	18.0	8.0
	Loose sand	Below 328.0		-	30	3.0/1.7/N/A	0.33	19.0	9.0
14+270 to 14+330 Highway 7/8 Borehole 904	Firm to stiff cohesive fill	336.0 to 330.0	328	150	27	2.7/0.9/1.5	0.38	18.0	8.0
	Stiff to very stiff clayey silt till	329.0 to 327.5		150	30	3.0/1.1/1.6	0.33	20.0	10.0
	Compact sand	Below 327.5		-	31	3.1/1.2/1.7	0.32	19.0	9.0

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Undrained Shear Strength, c_u^1 (kPa)	Effective Angle of Friction, ϕ'^1 (°)	Coefficient of Passive Pressure, K_p^2 Level Ground/ 2H:1V/3H:1V	Coefficient of Active Pressure, K_a Level Ground	Unit Weight ³ (kNm ⁻³)	
								Bulk γ	Effective, γ'
14+330 to 14+400 Highway 7/8 Borehole 40	Compact granular fill	336.0 to 334.0	Below 332	-	29	2.9/N/A/1.6	0.35	19.0	9.0
	Firm to stiff cohesive fill	Below 334.0		150	26	2.6/N/A/1.4	0.39	18.0	8.0
14+400 to 14+470 Highway 7/8 Borehole 41	Compact granular fill	335.0 to 334.5	Below 332	-	30	3.0/N/A/1.6	0.33	19.0	9.0
	Stiff cohesive fill	334.5 to 332.0		100	27	2.7/N/A/1.5	0.38	18.5	8.5
	Stiff clayey silt	Below 332.0		100	27	2.7/N/A/1.5	0.38	19.5	9.5
14+470 to 14+550 Highway 7/8 Borehole 42	Stiff cohesive fill	334.0 to 332.5	Below 330	150	26	2.6/N/A/1.4	0.39	18.5	8.5
	Dense sand and gravel	332.5 to 332.0		-	35	3.7/N/A/2.0	0.27	21.0	11.0
	Compact sandy silt till	Below 332.0		-	32	3.3/N/A/1.8	0.31	21.0	11.0
14+550 to 14+620 Highway 7/8 Borehole 43	Compact sandy silt to sand	332.5 to	Below 328	-	30	3.0/N/A/1.6	0.33	18.5	8.5
	Compact silty sand	Below 331.0		-	30	3.0/N/A/1.6	0.33		
14+620 to 14+700 Highway 7/8 Borehole 44	Stiff clayey silt	Below 331.5	Below 330	100	28	2.8/N/A/1.5	0.36	19.0	9.0
14+700 to 14+780 Highway 7/8 Borehole 45	Compact to dense sand	Below 331.0	Below 327	-	32	3.3/N/A/1.8	0.31	19.0	9.0
14+780 to 14+825 Highway 7/8 Borehole 46	Loose to compact sandy silt	Below 329.5	Below 325	-	29	2.9/N/A/1.6	0.35	18.5	8.5

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

Station and Borehole	Soil Type	Elevation Interval (m)	Design Groundwater Elevation (m)	Undrained Shear Strength, c_u^1 (kPa)	Effective Angle of Friction, ϕ'^1 (°)	Coefficient of Passive Pressure, K_p^2 Level Ground/ 2H:1V/3H:1V	Coefficient of Active Pressure, K_a Level Ground	Unit Weight ³ (kNm ⁻³)	
								Bulk γ	Effective, γ'
14+825 to 14+910 Highway 7/8 Boreholes 923, 923A and 923B	Loose granular fill	330.0 to 327.0	Below 325	-	27	2.7/N/A/1.5	0.38	18.5	8.5
	Soft to very stiff peat	327.0 to 324.5		-	-	-	-	11	1.0
	Loose to compact silty sand	Below 324.5		-	28	2.8/1.4/1.5	0.36	18.5	8.5
14+910 to 14+970 Highway 7/8 Borehole 47	Compact silty sand	Below 329.0	Below 325	-	31	3.1/N/A/1.7	0.32	19.0	9.0
14+970 to 15+050 Highway 7/8 Borehole 48	Compact sandy silt to sand	328.5 to Below 325.0	Below 325	-	31	3.1/N/A/1.7	0.32	18.5	8.5
15+050 to 15+100 Highway 7/8 Borehole 49	Compact granular fill	328.0 to 327.0	Below 325	-	29	2.9/N/A/1.6	0.35	18.5	8.5
	Compact to dense sand	Below 327.0		-	32	3.3/N/A/1.8	0.31	19.0	9.0

**FOUNDATION DESIGN PARAMETERS
PROPOSED NOISE BARRIER WALL 2**

NOTES:

1. Where both c_u and γ' have been given for a specific stratum, the foundation design should be checked for both the drained and undrained conditions and the larger of the two calculated foundation depths shall govern.
2. Passive earth pressure coefficient (K_p) values are provided for level ground. Where sloping ground is present, adjacent to the noise barrier wall, adjusted K_p values must be used in the foundation design. The ground behind the proposed noise barrier wall will slope downwards at 3 horizontal to 1 vertical within the following approximate station ranges:
 - Station 10+050 Rt to 10+065 Rt Fischer-Hallman Road S-E Ramp;
 - Station 10+240 Rt to 10+315 Rt Fischer-Hallman Road S-E Ramp; and
 - Station 14+300 Rt to 15+100 Rt Highway 7/8.The ground behind the proposed noise barrier wall will slope downwards at 2 horizontal to 1 vertical in all other areas except Station 10+090 Lt to 10+175 Rt Fischer-Hallman Road S-E Ramp and between Station 10+315 Rt and 13+825 Rt Highway 7/8.
3. Below the groundwater level, the effective unit weight of the soil (γ') should be used.
4. The resistance provided to the caisson by organic materials should be neglected.
5. This table is to be read in conjunction with the accompanying report.

Prepared By: MSWL

Checked By: DUP

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

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

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.)

(b) Cohesive Soils

Consistency

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

Dynamic Cone Penetration Resistance; N_d :

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

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

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
ν	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

w	water content
w_l	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 $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

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

- 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)

RECORD OF BOREHOLE No 30

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809413.0 ; E 222947.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE June 8, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE								● QUICK TRIAXIAL		× LAB VANE
343.77	GROUND SURFACE						20	40	60	80	100						GR SA SI CL			
0.00	TOPSOIL, silty Black																			
0.18	SANDY SILT, some clay Compact to dense Brown		1	SS	18															
			2	SS	20												0 35 45 20			
			3	SS	46															
340.87	SILTY SAND, trace clay Dense to very dense Brown		4	SS	52															
2.90			5	SS	44												0 50 44 6			
			6	SS	33															
338.74	END OF BOREHOLE																			
5.03	Borehole dry during drilling on June 8, 2010.																			

RECORD OF BOREHOLE No 31

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809440.5 ; E 222996.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 18, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
								20 40 60 80 100									
343.93		GROUND SURFACE															
0.00		TOPSOIL, silty															
0.13		Black															
343.32		FILL, silty sand															
0.61		Brown															
342.94		FILL, silty clay, trace sand															
0.99		Hard	1	SS	44		343										
		Brown															
342.41		FILL, sandy silt, trace gravel, trace															
1.52		organics															
		Dense	2	SS	23		342										
		Brown															
341.80		FILL, clayey silt, with silt seams,															
2.13		trace sand															
		Very stiff	3	SS	17		341										
		SAND, fine, trace to some silt															
		Compact to dense															
		Brown	4	SS	25		340										
			5	SS	40		340										
			6	SS	50		339										
338.90																	
5.03		END OF BOREHOLE															
		Borehole dry during drilling on May 18, 2010.															

RECORD OF BOREHOLE No 32

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809479.0 ; E 223068.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 18, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE		
343.67	GROUND SURFACE																	
0.00	TOPSOIL, silty Black																	
0.18	SANDY SILT, trace gravel, trace clay Compact Brown		1	SS	23													
			2	SS	26													
			3	SS	24													
			4	SS	29													
			5	SS	29													
			6	SS	26													
338.64	END OF BOREHOLE																	
5.03	Borehole dry during drilling on May 18, 2010.																	

RECORD OF BOREHOLE No 33

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809519.5 ; E 223145.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 18, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
343.01	GROUND SURFACE						343	20	40	60	80	100					GR SA SI CL			
0.00	TOPSOIL, silty Black																			
0.23	SANDY SILT, some clay, trace gravel Loose to compact Brown		1	SS	4		342													
			2	SS	4										○ non-plastic		0 41 44 15			
			3	SS	11		341													
340.11																				
2.90	SILT, some sand, trace to some clay, trace gravel Compact Brown		4	SS	17		340							○			0 10 80 10			
			5	SS	13		339													
			6	SS	17		338													
337.98	END OF BOREHOLE																			
5.03	Borehole dry during drilling on May 18, 2010.																			

RECORD OF BOREHOLE No 34

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809551.5 ; E 223208.0

ORIGINATED BY MR

DIST HWY 7/8


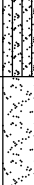

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF/LMK

DATUM GEODETIC

DATE May 18, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)						
342.34	GROUND SURFACE						20 40 60 80 100							GR SA SI CL	
0.00	TOPSOIL, silty						342							0 8 44 48	
0.15	Black														
	FILL, clayey silt, trace sand		1	SS	29										
	Very stiff														
	Grey	2	SS	23											
340.21															
2.13	SANDY SILT, trace gravel, trace clay						341						0 36 56 8		
	Compact														
	Brown		3	SS	24										
339.44															
2.90	SAND, fine to coarse, trace silt, trace clay							340							0 96 1 3
	Loose to compact														
	Brown	4	SS	12											
338.29															
4.05	CLAYEY SILT, trace sand							339							
337.92	Firm														
4.42	Brown														
337.31	SILT, some clay, trace sand, trace gravel						338								
5.03	Compact		6	SS	29										
	Brown														
	END OF BOREHOLE														
	Borehole dry during drilling on May 18, 2010.														

RECORD OF BOREHOLE No 35

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809590.5 ; E 223282.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 18, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE									
341.13	GROUND SURFACE																			
0.00	TOPSOIL, silty Black																			
0.23	SANDY SILT, some clay Loose to compact Brown to grey at about elev. 337.5m		1	SS	9	▽										0 33 55 12				
			2	SS	10															
			3	SS	11															
			4	SS	8															
			5	SS	11															
			6	SS	7															
336.10	END OF BOREHOLE																			
5.03	Groundwater encountered at about elev. 339.0m during drilling on May 18, 2010.																			

RECORD OF BOREHOLE No 36

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809633.7 ; E 223352.4

ORIGINATED BY MA

DIST HWY 7/8

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF/LMK

DATUM GEODETIC

DATE May 20, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)					
341.49	ROAD SURFACE						20	40	60	80	100						
0.00	ASPHALT																
0.15	FILL, sand and gravel, crushed																
0.40	FILL, sand, some gravel																
0.67	Brown																
0.94	FILL, clayey silt		1	SS	4												
340.12	Firm																
1.37	Brown																
	FILL, sandy silt		2	SS	10												
	Loose																
	Brown																
	FILL, clayey silt, trace to some sand, trace gravel, with silt layers		3	SS	19												
	Stiff to hard																
	Brown																
338.23			4	SS	75												
3.26	TOPSOIL, sandy silt, trace to some clay, trace gravel																
337.56	Compact to very dense																
3.93	Black		5	SS	13												
	SANDY SILT, trace clay, trace gravel																
	Compact																
	Brown		6	SS	16												
336.31																	
5.18	END OF BOREHOLE																
	Borehole dry during drilling on May 20, 2010.																

RECORD OF BOREHOLE No 37

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809666.6 ; E 223419.0 ORIGINATED BY MA
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 20, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
340.20	ROAD SURFACE																			
0.00	ASPHALT																			
0.15	FILL, sand and gravel, crushed																			
0.40	FILL, sand and gravel, cobbles																			
339.47	Brown																			
0.73	FILL, clayey silt, trace sand, trace gravel		1	SS	20															
338.83	Very stiff																			
1.37	Brown																			
	FILL, sandy silt, trace to some clay, trace topsoil		2	SS	40											0 41 48 11				
	Compact to dense																			
	Brown																			
			3	SS	24															
337.30	TOPSOIL, silty																			
2.90	Black																			
336.79	Compact		4	SS	16															
3.41	SANDY SILT, trace clay																			
	Compact																			
	Brown		5	SS	12											0 24 67 9				
335.78																				
4.42	SILTY FINE SAND																			
	Compact																			
	Brown		6	SS	29															
335.02																				
5.18	END OF BOREHOLE																			
	Borehole dry during drilling on May 20, 2010.																			

RECORD OF BOREHOLE No 38

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809681.6 ; E 223471.7 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 19, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
338.67	GROUND SURFACE							20	40	60	80	100						
0.00	TOPSOIL, silty Black																	
0.13	SILTY CLAY TILL, trace to some sand, trace gravel Very stiff Brown		1	SS	26		338											
			2	SS	20		337										0 10 46 44	
			3	SS	20		336											
			4	SS	19		335											
335.01																		
3.66	SANDY SILT, trace clay, trace gravel Compact Brown		5	SS	12		334										1 47 43 9	
334.25																		
4.42	SILTY FINE SAND Compact Brown		6	SS	10													
333.64																		
5.03	END OF BOREHOLE																	
	Borehole dry during drilling on May 19, 2010.																	

RECORD OF BOREHOLE No 39

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809703.0 ; E 223544.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 19, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED	+	FIELD VANE								
							● QUICK TRIAXIAL	×	LAB VANE	WATER CONTENT (%)								
							20	40	60	80	100		10	20	30			
338.32	GROUND SURFACE																	
0.00	TOPSOIL, silty																	
337.92	Dark grey																	
0.40	CLAYEY SILT, trace to some sand, trace gravel Stiff to very stiff Brown		1	SS	8													
			2	SS	21													
			3	SS	26													
335.42																		
2.90	SAND, fine to medium, trace silt, trace clay Dense Brown		4	SS	34													
334.66																		
3.66	SILTY FINE SAND Dense Brown		5	SS	38													
333.29			6	SS	38													
5.03	END OF BOREHOLE																	
	Borehole dry during drilling on May 19, 2010.																	

RECORD OF BOREHOLE No 40

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809791.3 ; E 223797.1 ORIGINATED BY MA
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 17, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
								20	40	60	80	100					
337.12	ROAD SURFACE																
0.08	ASPHALT						337										
336.72	FILL, sand and gravel, crushed Brown																
0.40	FILL, sand and gravel, with cobbles Brown																
0.55	FILL, clayey silt, some sand, trace gravel, trace topsoil		1	SS	11		336										3 34 42 21
335.75	Stiff Grey																
1.37	FILL, sandy silt, some clayey silt seams, trace gravel, trace topsoil below about elev. 335.0m		2	SS	12		335										0 26 45 29
	Compact Brown																
334.22																	
2.90	FILL, clayey silt, trace to some sand, trace silty sand layers		4	SS	7		334										
	Firm to stiff Brown to grey																
			5	SS	11		333										0 9 56 35
332.70																	
4.42	FILL, clayey silt, trace topsoil, trace sand, trace gravel																
	Stiff Grey		6	SS	14		332										
331.94																	
5.18	END OF BOREHOLE																
	Borehole dry during drilling on May 17, 2010.																

RECORD OF BOREHOLE No 41

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809816.9 ; E 223865.7 ORIGINATED BY MA
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 18, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
336.52	ROAD SURFACE												kN/m ³	GR SA SI CL
0.08	ASPHALT													
0.37	FILL, sand and gravel, crushed Brown						336							
0.67	FILL, sand and gravel, with cobbles Brown													
	FILL, sandy silt, trace sand and gravel seams		1	SS	11						○			
335.15	Compact Brown													
	FILL, sand, fine to medium, trace silt		2	SS	14		335				○			
334.54	Compact Brown										○			
1.98	FILL, clayey silt, some sand, trace silt seams, trace gravel													
	Stiff Brown		3	SS	11		334				○			0 16 55 29
333.62	FILL, clayey silt, trace topsoil, trace sandy silt layers													
2.90	Stiff Brown to grey		4	SS	9		333				○			
			5	SS	9						○			
332.10														
4.42	CLAYEY SILT, trace sand, trace sandy silt seams						332							
331.34	Stiff Brown		6	SS	11						○			
5.18	END OF BOREHOLE													
	Borehole dry during drilling on May 18, 2010.													

RECORD OF BOREHOLE No 42

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809842.9 ; E 223937.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 19, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20	40	60	80	100						WATER CONTENT (%)		
						○ UNCONFINED + FIELD VANE														
						● QUICK TRIAXIAL × LAB VANE														
335.35	GROUND SURFACE						335										1 16 56 27			
0.00	TOPSOIL, sandy																			
0.18	Dark grey																			
	FILL, silty sand, trace topsoil		1	SS	14															
	Compact																			
	Brown																			
333.98									334											
1.37	FILL, clayey silt, trace to some sand, trace topsoil, trace gravel		2	SS	13															
	Stiff																			
	Brown																			
			3	SS	14															
332.45							333													
2.90	SAND AND GRAVEL, trace silt																			
	Dense																			
	Brown		4	SS	37															
331.69								332												
3.66	SILT, trace sand																			
	Compact																			
	Brown																			
	SANDY SILT TILL, trace to some clay, trace gravel		5	SS	15															
	Compact																			
	Brown becoming grey below about elev. 330.9m																			
			6	SS	13		331													
330.32																				
5.03	END OF BOREHOLE																			
	Borehole dry during drilling on May 19, 2010.																			

RECORD OF BOREHOLE No 43

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809873.5 ; E 224005.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 19, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE									
333.76	GROUND SURFACE																			
0.00	TOPSOIL, silty																			
0.15	Dark brown																			
	SILTY FINE SAND																			
	Loose																			
	Brown		1	SS	4		333													
332.39																				
1.37	SANDY SILT																			
331.93	Compact		2	SS	16		332													
1.83	Brown																			
	SAND, fine to medium, trace silt,																			
	trace clay																			
	Compact		3	SS	17		331										0 92 4 4			
	Brown																			
330.86																				
2.90	SILTY SAND, trace clay		4	SS	22		330													
	Compact																			
	Brown																			
			5	SS	21		329										0 69 29 2			
328.73			6	SS	28		329													
5.03	END OF BOREHOLE																			
	Borehole dry during drilling on May 19, 2010.																			

RECORD OF BOREHOLE No 44

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809905.6 ; E 224073.4

ORIGINATED BY MR

DIST HWY 7/8

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF

DATUM GEODETIC

DATE May 19, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
333.04	GROUND SURFACE						20	40	60	80	100					
0.10	TOPSOIL, silty Dark brown															
331.97	SILT, some sand, trace clay Loose Grey		1	SS	7											
1.07	CLAYEY SILT, trace sand, with silt layers Stiff Grey		2	SS	9											
			3	SS	10											
			4	SS	10											
328.01	END OF BOREHOLE		5	SS	12											
5.03	Groundwater encountered at about elev. 330.0m during drilling on May 19, 2010. Standpipe dry following installation on May 19, 2010. Standpipe dry to elev. 328.77 on June 1, 2010 and Oct. 13, 2010.															

RECORD OF BOREHOLE No 45

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809941.0 ; E 224149.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 19, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								20	40	60	80	100						WATER CONTENT (%)		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE														
332.08	GROUND SURFACE						332													
0.00	TOPSOIL, silty																			
0.18	Dark brown																			
	SANDY SILT		1	SS	18															
	Compact																			
	Brown																			
330.71							331													
1.37	SAND, fine to medium, trace to some silt, trace clay		2	SS	31															
	Compact to dense																			
	Brown																			
			3	SS	25															
			4	SS	21		329													
			5	SS	25															
			6	SS	20		328													
327.05																				
5.03	END OF BOREHOLE																			
	Borehole dry during drilling on May 19, 2010.																			

RECORD OF BOREHOLE No 46

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809971.0 ; E 224212.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 20, 2010 and June 3, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE									
331.04	GROUND SURFACE							20	40	60	80	100								
0.00	TOPSOIL, silty						331													
0.18	Dark brown																			
	FILL, clayey silt, trace sand, trace gravel, trace topsoil		1	SS	5															
	Firm Brown																			
329.67																				
1.37	SANDY SILT, trace to some clay, trace gravel		2	SS	6									○			0 34 54 12			
	Loose to compact Brown																			
			3	SS	9															
			4	SS	12		328													
			5	SS	15		327													
			6	SS	9		326													
			7	SS	11									○			0 37 53 10			
325.10																				
5.94	SILTY FINE SAND, with sandy silt layers						325													
324.49	Compact Grey		8	SS	13															
6.55	END OF BOREHOLE																			
	Borehole dry during drilling on May 20, 2010.																			

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

RECORD OF BOREHOLE No 47

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4810017.0 ; E 224322.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 20, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE		
330.62	GROUND SURFACE																	
0.00	TOPSOIL, silty																	
0.15	Dark brown																	
0.43	FILL, sand and gravel																	
	Brown																	
	SILTY FINE SAND, with silt layers,		1	SS	16													
	trace clay																	
	Compact		2	SS	16													
	Brown																	
			3	SS	17													
		4	SS	14														
		5	SS	11														
		6	SS	12														
325.59	END OF BOREHOLE																	
5.03	Borehole dry during drilling on May 20, 2010.																	

RECORD OF BOREHOLE No 48

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4810040.3 ; E 224394.5 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 20, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE									
329.81	GROUND SURFACE							20	40	60	80	100								
0.00	TOPSOIL, silty																			
0.15	Dark brown																			
329.17	FILL, sand and gravel																			
0.64	Brown																			
328.44	SILTY FINE SAND, with silt layers		1	SS	18		329													
	Compact																			
	Brown																			
1.37	SANDY SILT, trace clay		2	SS	24		328										0 39 56 5			
	Compact																			
	Brown																			
			3	SS	20		327													
326.76																				
3.05	SILTY SAND, trace clay		4	SS	26		326										0 63 31 6			
	Compact to dense																			
	Brown																			
			5	SS	37		325													
325.39																				
4.42	SAND, fine to medium, trace silt																			
	Dense																			
	Brown		6	SS	31		325													
324.78																				
5.03	END OF BOREHOLE																			
	Borehole dry during drilling on May 20, 2010.																			

RECORD OF BOREHOLE No 49

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4810063.2 ; E 224471.3 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE May 20, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20						40	60	80
329.18	GROUND SURFACE																			
0.00	TOPSOIL, silty						329													
0.13	Dark brown																			
0.40	FILL, sand and gravel																			
	Brown																			
	FILL, sandy silt, trace to some clay, trace gravel, with sand layers		1	SS	22		328													
	Compact																			
	Brown		2	SS	11															
327.05																				
2.13	SAND, fine, some silt						327													
	Compact																			
	Brown		3	SS	15															
326.28																				
2.90	SAND, fine to coarse, trace silt, trace clay, trace gravel						326													
	Dense																			
	Brown		4	SS	42															
			5	SS	31		325													
			6	SS	35															
324.15																				
5.03	END OF BOREHOLE																			
	Borehole dry during drilling on May 20, 2010.																			

PROJECT 08-1132-084-1		RECORD OF BOREHOLE No 805		1 OF 1		METRIC	
W.P. 131-98-00		LOCATION N 4809296.0 ; E 222748.0		ORIGINATED BY MR			
DIST _____ HWY 7/8		BOREHOLE TYPE POWER AUGER / HOLLOW STEM		COMPILED BY WDF/LMK			
DATUM GEODETIC		DATE May 12, 2010		CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L		
344.73	GROUND SURFACE						20	40	60	80	100						
0.00	TOPSOIL, silty Black																
0.18	CLAYEY SILT, trace sand, trace gravel, with silty sand seams Firm to very stiff Brown		1	SS	6												
			2	SS	14												
			3	SS	16												
			4	SS	15												
			5	SS	8												
340.16																	
4.57	SILTY FINE SAND, trace gravel Loose Brown		6	SS	5												
339.70																	
5.03	CLAYEY SILT, trace gravel, with sand seams Stiff Brown		7	SS	11												
338.79																	
5.94	SILTY FINE SAND, trace clay Loose to compact Brown		8	SS	8												
337.64			9	SS	15												
7.09	CLAYEY SILT Very stiff Brown to grey																
7.32	SILTY SAND, trace clay Dense to very dense Brown		10	SS	34												
			11	SS	38												
			12	SS	59												
335.13																	
9.60	END OF BOREHOLE																
	Borehole dry during drilling on May 12, 2010.																

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 14/01/11

RECORD OF BOREHOLE No 807

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809343.0 ; E 222813.0

ORIGINATED BY MR

DIST HWY 7/8






BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF/LMK

DATUM GEODETIC

DATE May 12, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)										
342.58	GROUND SURFACE					▽		20	40	60	80	100		10	20	30	GR	SA	SI	CL			
0.00	TOPSOIL, silty																						
0.13	Black																						
	SILTY FINE SAND, trace to some clay, trace gravel																						
	Dense		1	SS	32																		
	Brown																						
			2	SS	32											○				0	59	31	10
			3	SS	36																		
339.68																							
	SAND, some silt, trace clay																						
	Compact																						
	Brown			4	SS	26																	
			5	SS	26										○					0	86	11	3
338.01																							
	SILTY FINE SAND, trace to some clay																						
	Compact																						
	Brown			6	SS	25																	
			7	SS	22																		
			8	SS	25										○					0	61	29	10
335.87																							
	SAND, fine to medium, trace silt																						
	Compact																						
	Brown			9	SS	28																	
335.11																							
	CLAYEY SILT, with silty sand seams																						
	Very stiff																						
	Grey			10	SS	21																	
			11	SS	21																		
			12	SS	24																		
332.98																							
	END OF BOREHOLE																						
9.60																							
	Groundwater encountered at about elev. 339.7m during drilling on May 12, 2010.																						

RECORD OF BOREHOLE No 809

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809375.5 ; E 222877.0 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF/LMK
DATUM GEODETIC DATE May 17, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20						40	60	80
343.20	GROUND SURFACE																			
0.00	TOPSOIL, silty																			
0.15	Black																			
	CLAYEY SILT, with sand seams, trace gravel Stiff to very stiff Brown		1	SS	13															
			2	SS	23															
341.07																	0 17 54 29			
2.13	SANDY SILT, trace clay, trace gravel Compact Brown		3	SS	17															
			4	SS	11															
339.54																				
3.66	CLAYEY SILT, with sand seams, trace gravel Very stiff Brown		5	SS	27															
338.78																				
4.42	SILTY FINE SAND, trace gravel, trace clay Compact to dense Brown		6	SS	34								○				1 60 39 0			
			7	SS	29															
			8	SS	30															
			9	SS	32								○				0 60 37 3			
			10	SS	38															
			11	SS	35															
			12	SS	32															
333.60	END OF BOREHOLE																			
9.60	Borehole dry during drilling on May 17, 2010.																			

LDN_MTO_06_08-1132-084-1.GPJ LDN_MTO.GDT 14/01/11

RECORD OF BOREHOLE No 811

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809223.6 ; E 222763.0

ORIGINATED BY MR

DIST HWY 7/8

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF/LMK

DATUM GEODETIC

DATE June 2, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w _p w w _L				
350.34	ROAD SURFACE					20	40	60	80	100	10	20	30	GR	SA	SI	CL
0.00	ASPHALT																
0.23	FILL, sand and gravel, crushed Brown																
0.40	FILL, sand and gravel Brown																
349.61	FILL, sand and gravel Brown		1	SS	35												
0.73	FILL, clayey silt, some sand, trace gravel																
348.97	Hard Brown		2	SS	48												
1.37	FILL, sand and gravel, some silt Dense Brown																
348.21	FILL, clayey silt, trace sand Firm Brown		3	SS	7												
2.13	TOPSOIL, silty Loose to compact Brown																
347.90	FILL, sand and gravel, some silt, trace clay Loose to compact		4	SS	28												
2.44	FILL, sand and gravel, some silt, trace clay Loose to compact		5	SS	9												
346.99	TOPSOIL, silty Loose Brown and black																
3.35	SILT, some sand, trace clay Loose Brown and grey		6	SS	9												
345.92	CLAYEY SILT, trace sand Stiff Brown and grey		7	SS	8												
4.42	SILT, some clay, trace sand Compact Brown		8	SS	13												
345.46	CLAYEY SILT TILL, some sand, trace gravel Very stiff Grey		9	SS	15												
4.88																	
344.85			10	SS	16												
5.49																	
344.40			11	SS	17												
5.94																	
343.63			12	SS	15												
6.71																	
340.59																	
9.75			13	SS	12												
339.98																	
10.36																	
	END OF BOREHOLE																
	Groundwater encountered at about elev. 345.2m during drilling on June 2, 2010.																

PROJECT 08-1132-084-1		RECORD OF BOREHOLE No 903		1 OF 1 METRIC	
W.P. 131-98-00	LOCATION N 4809755.1 ; E 223682.3	ORIGINATED BY MA			
DIST HWY 7/8	BOREHOLE TYPE POWER AUGER / HOLLOW STEM	COMPILED BY WDF			
DATUM GEODETIC	DATE May 13, 2010	CHECKED BY			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	GR SA SI CL		
337.86	ROAD SURFACE													
0.00	ASPHALT													
0.12	FILL, sand and gravel, trace silt, crushed													
0.40	Brown													
0.67	FILL, sand and gravel, trace silt, with cobbles		1	SS	14									
	Brown													
	FILL, clayey silt, trace gravel, with sand seams, trace topsoil		2	SS	12									
	Stiff to very stiff													
	Brown to grey													
			3	SS	22									
334.96														
2.90	FILL, silty sand, with clayey silt seams													
334.48	Loose		4	SS	8									
3.38	Brown													
3.66	FILL, sand, fine to medium, some gravel													
	Loose		5	SS	6									
	Brown													
333.17	FILL, clayey silt, trace gravel, trace silty sand layers													
4.69	Firm		6	SS	8									
	Brown													
332.31	FILL, silty sand, trace gravel, trace sandy silt seams													
5.55	Very loose to loose		7	SS	3									
331.92	Brown													
5.94	FILL, clayey silt, trace gravel, trace topsoil													
	Soft		8	SS	3									
	Brown													
331.15	FILL, sandy silt, some clay, trace gravel, trace topsoil													
6.71	Very loose		9	SS	7									
	Grey													
330.39	FILL, topsoil, silty sand, trace gravel													
7.47	Loose													
	Black		10	SS	29									
	FILL, silty sand, trace gravel													
329.48	Compact													
	Brown													
8.38	FILL, sand, fine to medium, trace to some silt, trace gravel, trace topsoil, clay tile fragments		11	SS	9									
	Loose to compact													
	Brown		12	SS	15									
328.11														
9.75	SAND, fine to medium, trace to some silt, trace gravel													
	Loose		13	SS	9									
	Brown													
			14	SS	6									
326.58														
11.28	END OF BOREHOLE													
	Groundwater encountered at about elev. 329.5m during drilling on May 13, 2010.													

LDN_MTO_06 08-1132-084-1.GPJ LDN_MTO.GDT 14/01/11

RECORD OF BOREHOLE No 904

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809772.0 ; E 223736.8

ORIGINATED BY MA

DIST HWY 7/8

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF

DATUM GEODETIC

DATE May 17, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE										
								● QUICK TRIAXIAL		× LAB VANE										
337.34	ROAD SURFACE						20	40	60	80	100	10	20	30						
0.00	ASPHALT																			
0.12	FILL, sand and gravel, trace silt, crushed																			
0.34	Brown																			
0.61	FILL, sand and gravel, trace silt, with cobbles		1	SS	14							○								
335.97	Brown																			
1.37	FILL, clayey silt, with sandy silt seams, trace sand, trace gravel		2	SS	10							○								
335.51	Stiff											○								
1.83	Brown																			
334.78	FILL, silty sand, fine to medium		3	SS	13							○								
2.56	Compact											○								
	Brown																			
	FILL, clayey silt, trace sand, trace topsoil, trace gravel		4	SS	9							○	non-plastic		3 20 58 19					
	Stiff																			
	Brown																			
333.53	FILL, sandy silt, with clayey silt seams, trace gravel		5	SS	7							○								
3.81	Loose to compact																			
	Brown																			
	FILL, clayey silt, with sandy silt seams, trace gravel, trace topsoil		6	SS	11							○								
	Firm to very stiff																			
	Brown																			
			7	SS	7								□ —		0 22 58 20					
			8	SS	12								○							
330.24	FILL, sand, fine to medium, some silt, trace gravel, trace topsoil		9	SS	16								○							
7.10	Compact																			
329.72	Brown																			
7.62	TOPSOIL, sandy silt		10	SS	9								○							
329.11	Loose																			
8.23	Black																			
	CLAYEY SILT TILL, some sand, trace gravel		11	SS	11								□ —		1 30 49 20					
	Stiff to very stiff																			
	Grey																			
			12	SS	20															
327.59																				
9.75	SAND, medium to coarse, trace gravel																			
326.98	Compact		13	SS	19															
10.36	Grey																			
	END OF BOREHOLE																			
	Groundwater encountered at about elev. 327.5m during drilling on May 17, 2010.																			

RECORD OF BOREHOLE No 923

1 OF 1

METRIC

PROJECT 08-1132-084-1

W.P. 131-98-00

LOCATION N 4809987.1 ; E 224253.2

ORIGINATED BY MR

DIST HWY 7/8

BOREHOLE TYPE POWER AUGER / HOLLOW STEM

COMPILED BY WDF

DATUM GEODETIC

DATE May 20, 2010

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE									
330.39	GROUND SURFACE							20 40 60 80 100		10 20 30								
0.10	TOPSOIL, silty Brown FILL, sandy silt, some clay, trace gravel, trace topsoil Loose Brown						330											
			1	SS	7													
							329											
			2	SS	5													
							328							7 34 44 15				
			3	SS	6													
327.04																		
3.35	TOPSOIL, silty		4	SS	3		327											
326.73	Loose Black																	
3.66	PEAT, fibrous Soft to very stiff Black		5	SS	7								347					
							326						315					
			6	SS	3													
							325		2.3 2.1									
324.45																		
5.94	CLAYEY SILT, trace sand, with silt layers Soft Grey		7	SS	3		324											
323.68																		
6.71	SILTY SAND, fine to medium, trace clay, trace gravel Compact Grey		8	SS	10									3 72 21 4				
							323											
			9	SS	14													
322.31																		
8.08	END OF BOREHOLE Groundwater encountered at about elev. 323.7m during drilling on May 20, 2010.																	

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

RECORD OF BOREHOLE No 923A

1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809981.4 ; E 224233.9 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE June 2, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE														
331.47	GROUND SURFACE							20	40	60	80	100						GR	SA	SI	CL	
0.09	TOPSOIL, silty Black						331															
330.86	FILL, sand and gravel, trace silt Brown																					
0.61	FILL, silty fine sand, trace gravel Loose Brown		1	SS	7																	
330.10								330														
1.37	FILL, silt, some clay, some sand, trace organics, with sand pockets Loose to very loose Brown		2	SS	5																	
			3	SS	2			329														
328.57																						
2.90	PEAT, fibrous Soft to very stiff Black		4	SS	4		328										183					
							327															
327.05																						
4.42	SILTY FINE SAND, with clayey silt layers Loose to compact Brown		5	SS	7		326															
			6	SS	12		325															
325.53																						
5.94	SILTY FINE SAND, Compact Brown		7	SS	13																	
324.92																						
6.55	END OF BOREHOLE																					
	Borehole dry during drilling on June 2, 2010.																					


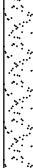
+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 923B

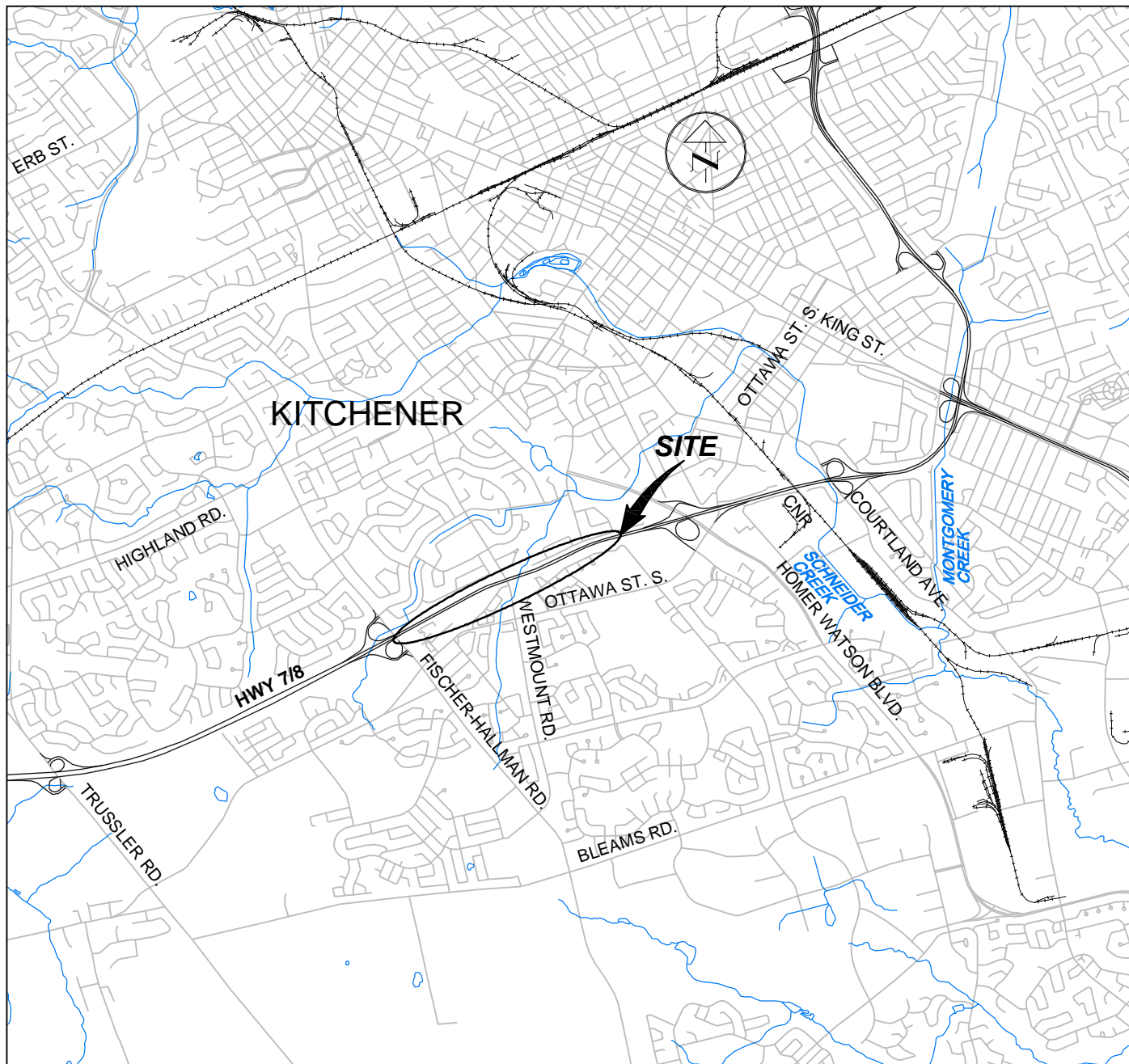
1 OF 1

METRIC

PROJECT 08-1132-084-1
W.P. 131-98-00 LOCATION N 4809998.3 ; E 224272.9 ORIGINATED BY MR
DIST HWY 7/8 BOREHOLE TYPE POWER AUGER / HOLLOW STEM COMPILED BY WDF
DATUM GEODETIC DATE June 3, 2010 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						WATER CONTENT (%)
331.11	GROUND SURFACE					▽	20	40	60	80	100	10	20	30			
0.00	TOPSOIL, silty																
0.12	Dark brown																
	FILL, silty sand, trace gravel, trace topsoil		1	SS	15												
	Very loose to compact		2	SS	11												
	Brown		3	SS	2												
327.91	PEAT, fibrous		4	SS	4												
3.20	Soft to very stiff																
	Black																
327.00	SAND, fine to medium, trace silt, trace gravel		5	SS	3												
4.11	Very loose to compact		6	SS	17												
	Brown		7	SS	9												
325.17	SILT, trace clay, trace sand, with clayey silt layers																
5.94	Loose																
324.56	Brown																
6.55	END OF BOREHOLE																
	Groundwater encountered at about elev. 328.8m during drilling on June 3, 2010.																

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



SCALE IN METRES
0 1000 2000
1:50000

REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2005.4.

NOTE

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

PROJECT

**PROPOSED NOISE BARRIER WALL 2
WIDENING OF HIGHWAY 7/8
GWP 131-98-00**

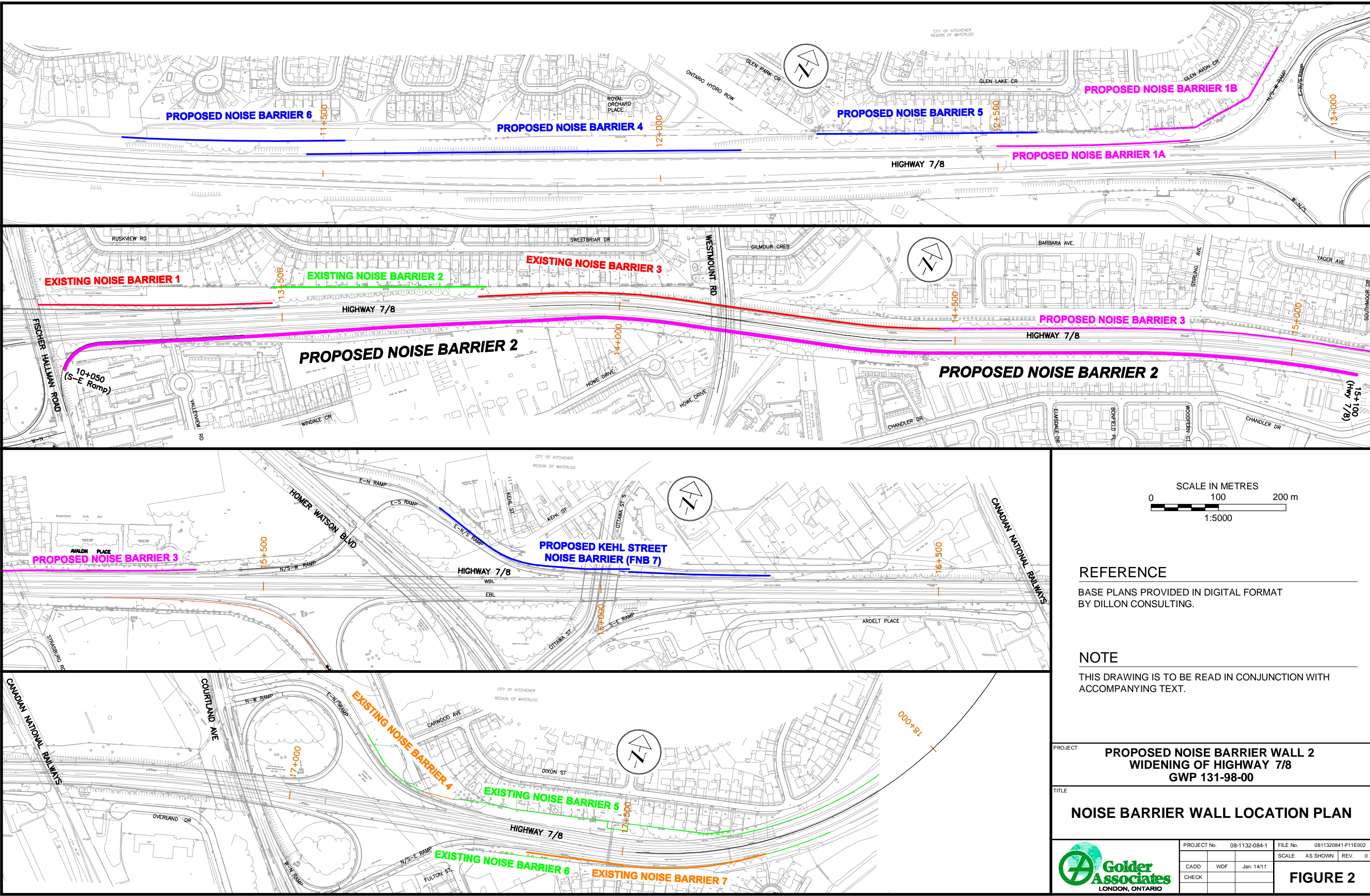
TITLE

KEY PLAN



PROJECT No. 08-1132-084-1			FILE No. 0811320841-F11E001		
			SCALE AS SHOWN		REV.
CADD	WDF	Jan. 14/11	FIGURE 1		
CHECK					

Drawing file: 0811320841-F11E002.dwg Jan 14, 2011 - 2:12pm




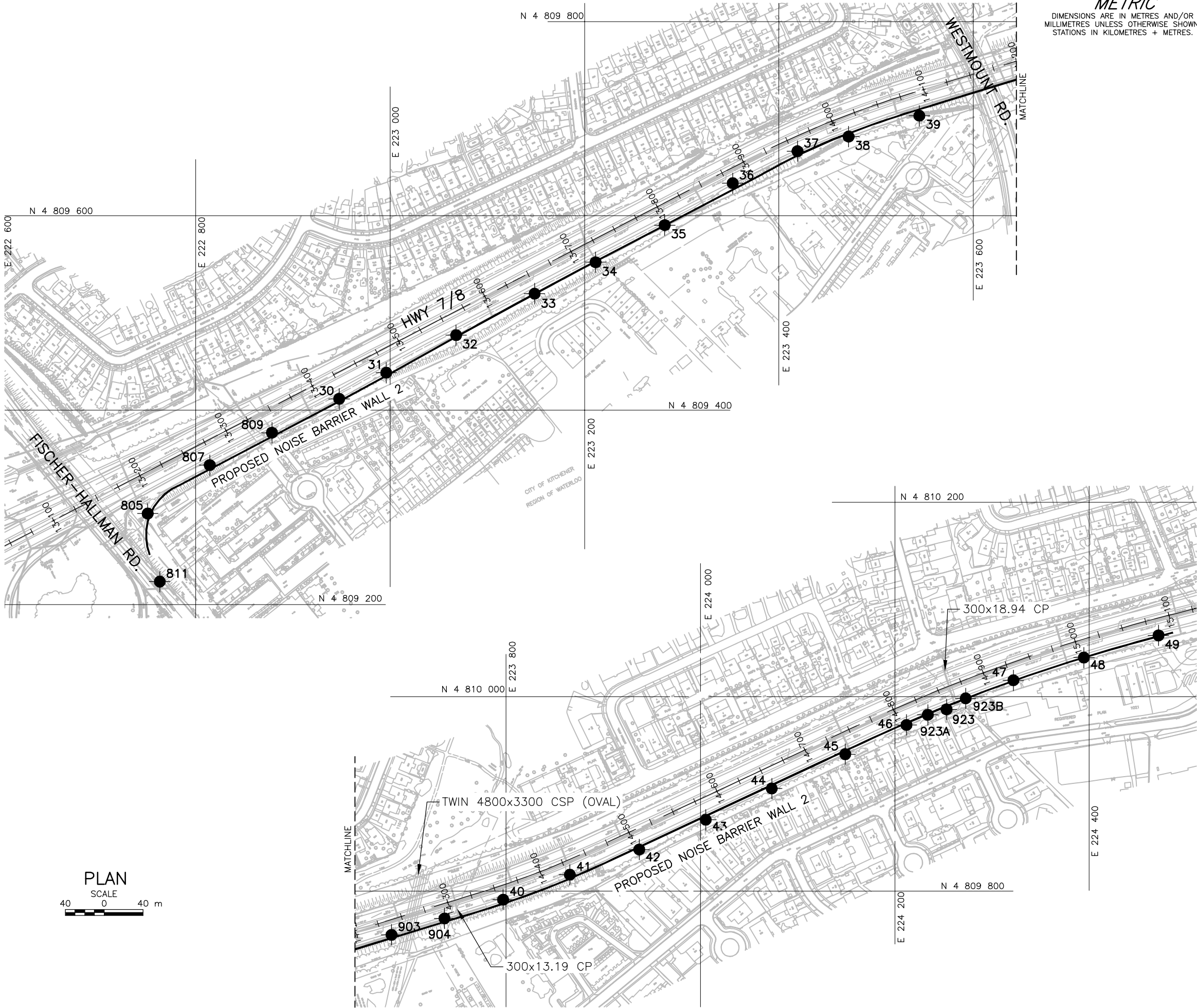
REFERENCE

BASE PLANS PROVIDED IN DIGITAL FORMAT
BY DILLON CONSULTING.

NOTE

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

PROJECT	PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00		
TITLE	NOISE BARRIER WALL LOCATION PLAN		
 Golder Associates LONDON, ONTARIO	PROJECT No.	08-1132-084-1	FILE No. 0811320841-F11E002
	SCALE	AS SHOWN	REV. 0
	CADD	WDF	Jan. 14/11
CHECK			
FIGURE 2			



PLAN
SCALE
0 40 m

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

CONT No.
WP No. 131-98-00



PROPOSED NOISE BARRIER WALL 2

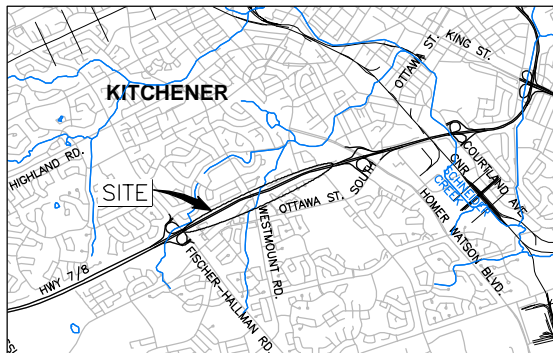
SHEET

WIDENING OF HIGHWAY 7/8

BOREHOLE LOCATIONS



Golder Associates Ltd.
LONDON, ONTARIO, CANADA



KEY PLAN

SCALE IN KILOMETRES
0 1 2

LEGEND

● Borehole — Current Investigation

No.	ELEVATION	CO-ORDINATES (MTM ZONE 10)	
		NORTHING	EASTING
30	343.77	4 809 413.0	222 947.0
31	343.93	4 809 440.5	222 996.0
32	343.67	4 809 479.0	223 068.5
33	343.01	4 809 519.5	223 145.5
34	342.34	4 809 551.5	223 208.0
35	341.13	4 809 590.5	223 282.5
36	341.49	4 809 633.7	223 352.4
37	340.20	4 809 666.6	223 419.0
38	338.67	4 809 681.6	223 471.7
39	338.32	4 809 703.0	223 544.5
40	337.12	4 809 791.3	223 797.1
41	336.52	4 809 816.9	223 865.7
42	335.35	4 809 842.9	223 937.0
43	333.76	4 809 873.5	224 005.5
44	333.04	4 809 905.6	224 073.4
45	332.08	4 809 941.0	224 149.0
46	331.04	4 809 971.0	224 212.0
47	330.62	4 810 017.0	224 322.0
48	329.81	4 810 040.3	224 394.5
49	329.18	4 810 063.2	224 471.3
805	344.73	4 809 296.0	222 748.0
807	342.58	4 809 343.0	222 813.0
809	343.20	4 809 375.5	222 877.0
811	350.34	4 809 223.6	222 763.0
903	337.86	4 809 755.1	223 682.3
904	337.34	4 809 772.0	223 736.8
923	330.39	4 809 987.1	224 253.2
923A	331.47	4 809 981.4	224 233.9
923B	331.11	4 809 998.3	224 272.9

NOTES

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

REFERENCE

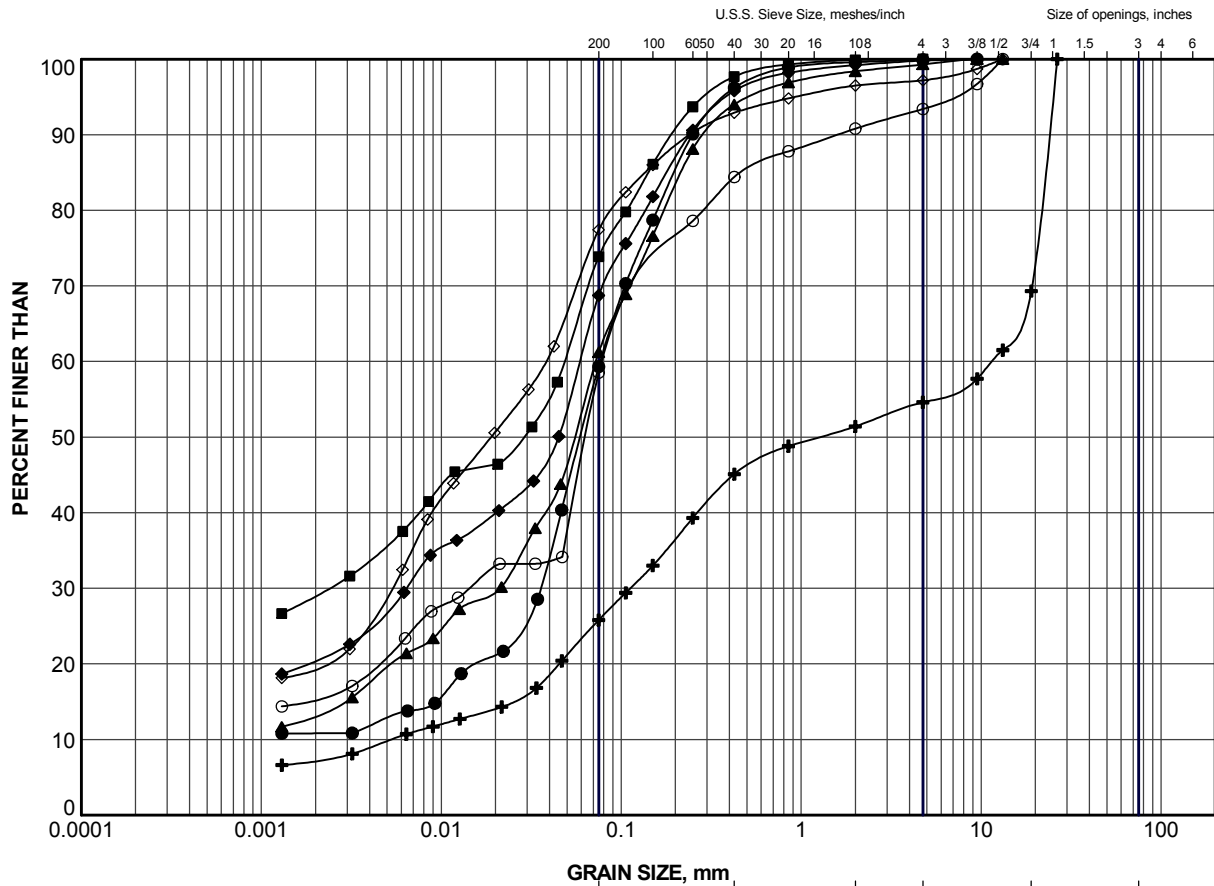
Base plans provided in digital format by Dillon Consulting.

NO.	DATE	BY	REVISION
Geocres No.	40P7-61		
HWY.	7/8	PROJECT NO.	08-1132-084-1
SUBM'D.	ML	CHKD.	DATE: Jan. 14/11
DRAWN:	WDF/LMK	CHKD.	APPD.
DWG.	1		



APPENDIX A


Laboratory Test Data

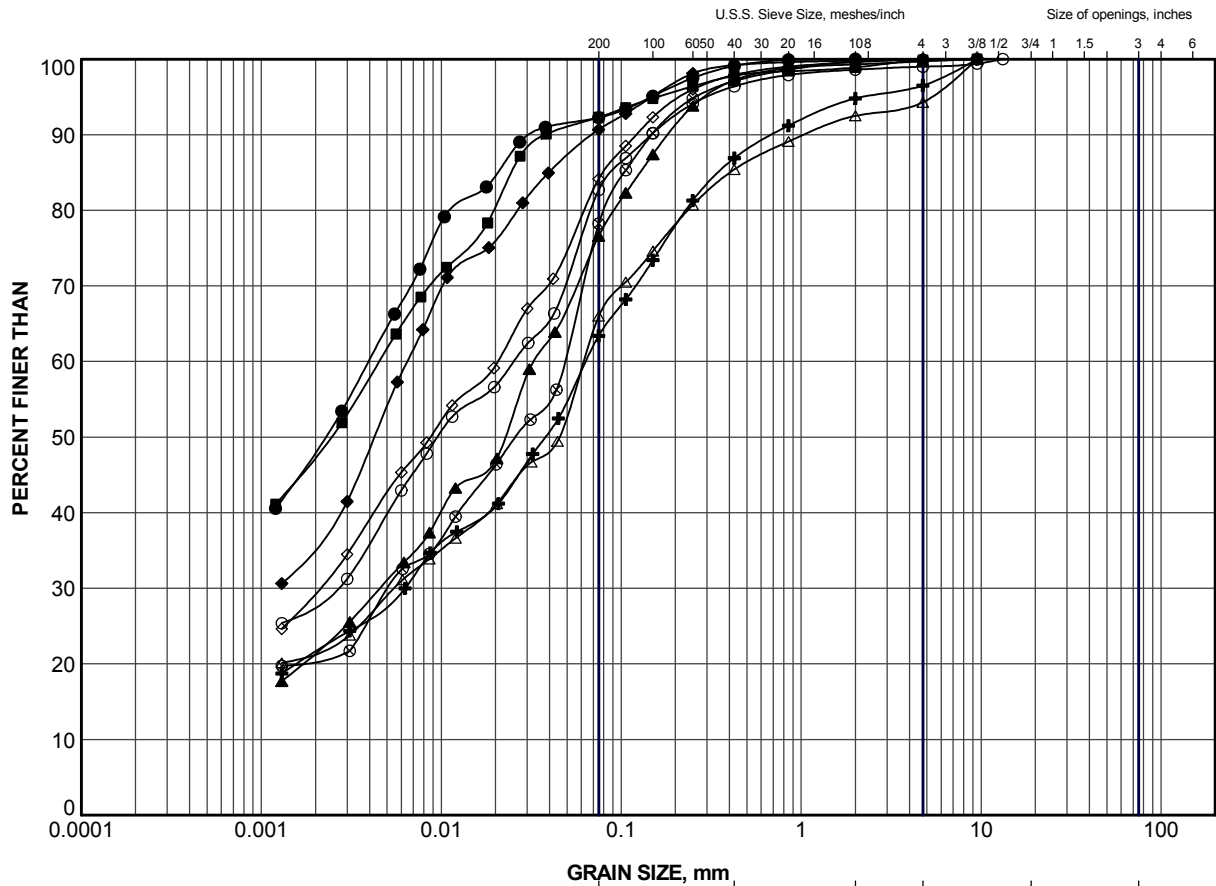


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	37	2	338.5
■	40	2	335.4
▲	49	2	327.4
+	811	5	346.3
◆	903	8	331.5
◇	904	4	334.1
○	923	3	327.9


PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				GRAIN SIZE DISTRIBUTION FILL, GRANULAR			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A1	
DRAWN		LMK		SCALE		N/A	
CHECK				REV.			
 Golder Associates LONDON, ONTARIO				Jan. 14/11		FIGURE A-1	

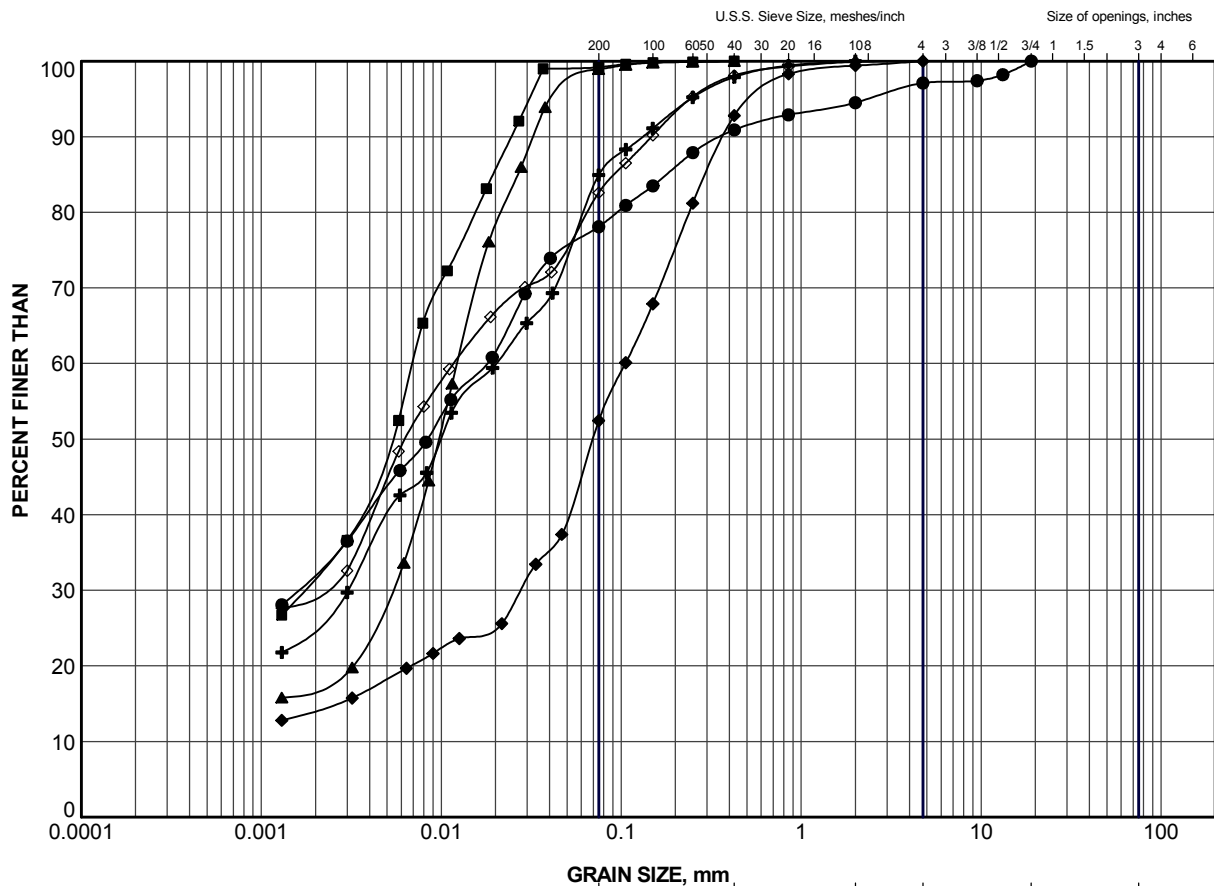


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	31	2	342.2
■	34	2	340.6
▲	36	2	339.7
+	40	1	336.1
◆	40	5	333.1
◇	41	3	334.0
○	42	3	332.8
△	903	2	336.1
⊗	904	7	331.8


PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				GRAIN SIZE DISTRIBUTION FILL, COHESIVE			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A2	
DRAWN		LMK		SCALE		N/A	
CHECK				REV.			
		Jan. 14/11					
 Golder Associates LONDON, ONTARIO				FIGURE A-2			

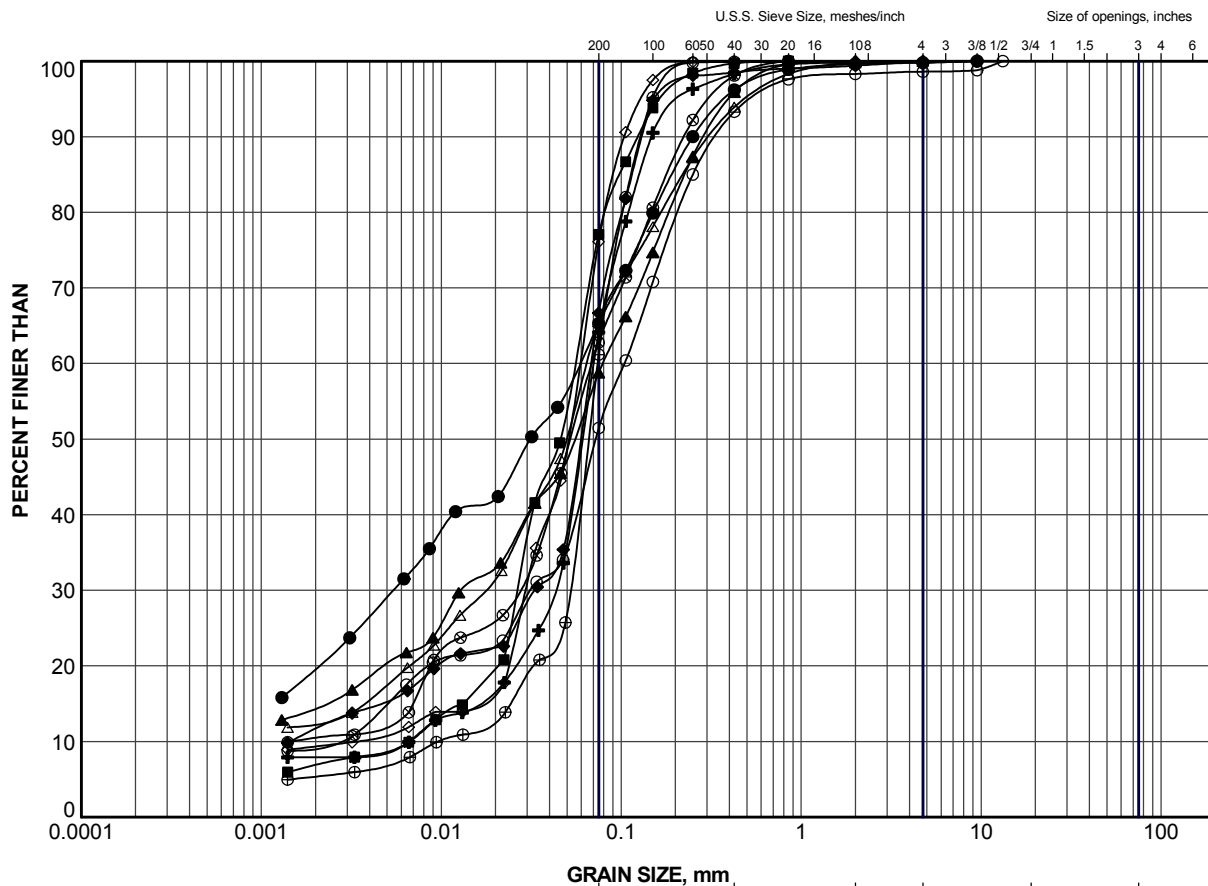


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	39	2	336.6
■	44	2	331.3
▲	44	3	329.8
+	805	3	342.2
◆	805	7	339.2
◇	809	2	341.5

PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				GRAIN SIZE DISTRIBUTION CLAYEY SILT			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A3	
DRAWN		LMK		SCALE		N/A	
CHECK				REV.			
 Golder Associates LONDON, ONTARIO				FIGURE A-3			



CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	30	2	342.0
■	32	3	341.2
▲	33	2	341.3
+	34	3	339.8
◆	35	2	339.4
◇	37	5	336.2
○	38	5	334.6
△	46	2	329.3
⊗	46	7	325.5
⊕	48	2	328.1

PROJECT

PROPOSED NOISE BARRIER WALL 2
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

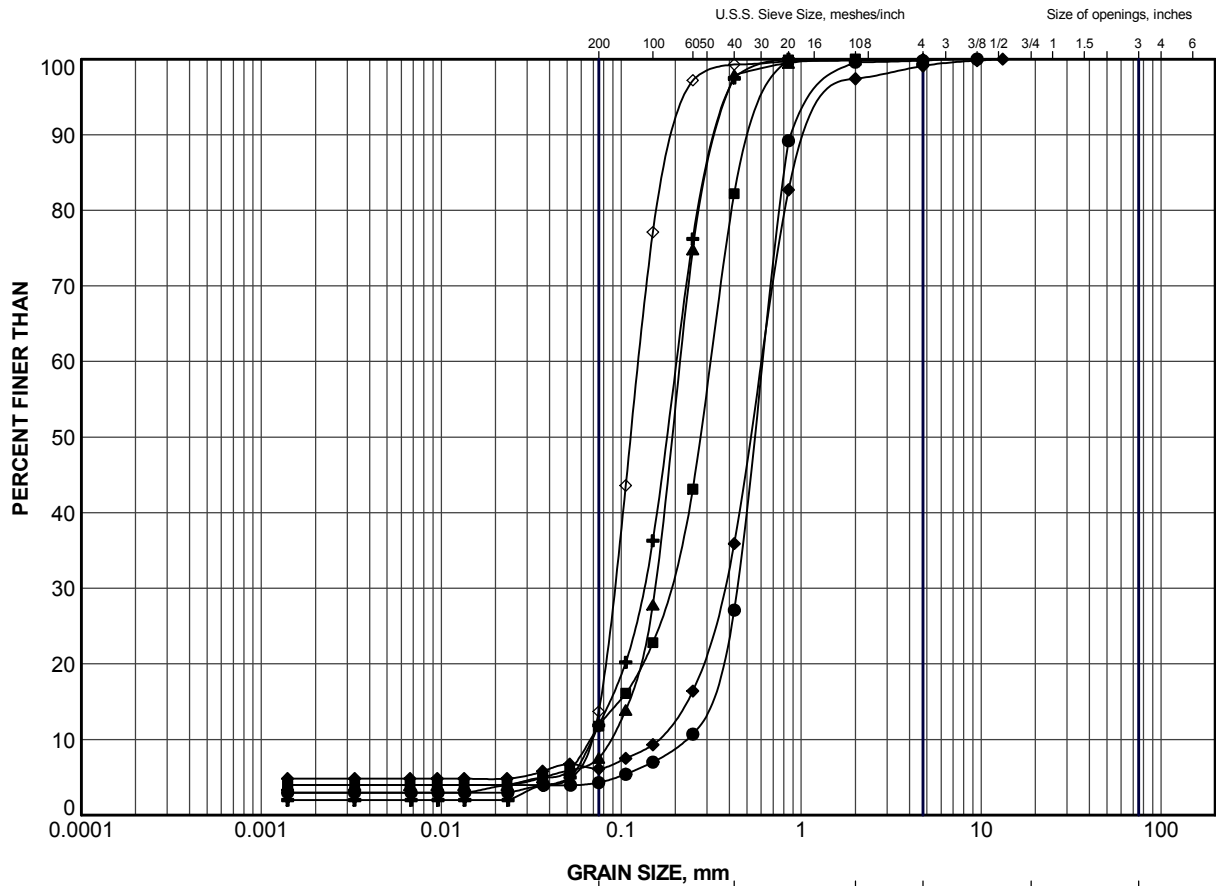
TITLE

GRAIN SIZE DISTRIBUTION
SANDY SILT



PROJECT No.	08-1132-084-1	FILE No.	0811320841-F11E0A4
DRAWN	LMK	Jan. 14/11	SCALE N/A REV.
CHECK			


FIGURE A-4

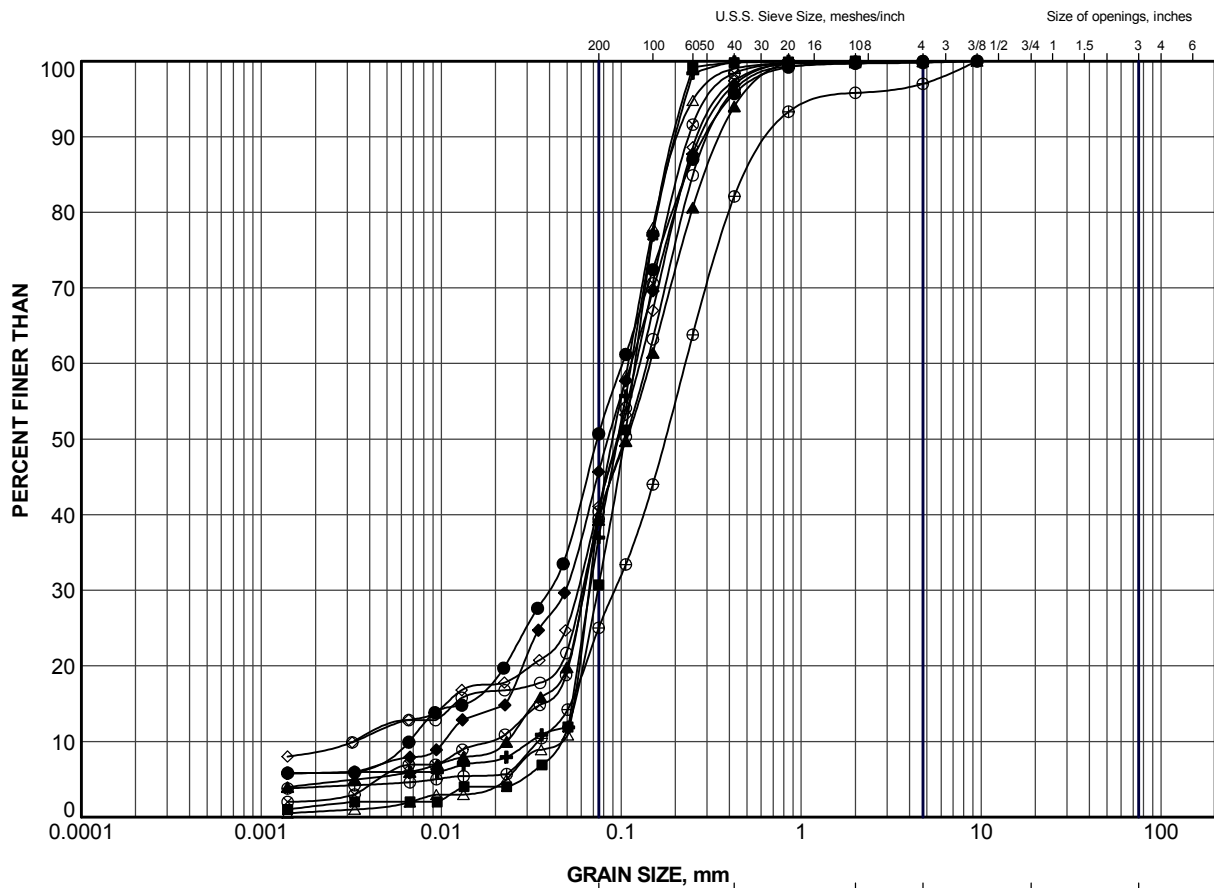


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	34	4	339.1
■	39	4	335.0
▲	43	3	331.2
+	45	3	329.6
◆	49	5	325.1
◇	807	5	338.5

PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				GRAIN SIZE DISTRIBUTION SAND			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A5	
DRAWN		LMK		SCALE		N/A	
CHECK				REV.			
 Golder Associates LONDON, ONTARIO				Jan. 14/11 FIGURE A-5			



CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	30	5	339.7
■	43	5	329.7
▲	47	3	328.1
+	48	4	326.5
◆	805	10	336.9
◇	807	2	340.8
○	807	8	336.3
△	809	6	338.4
⊗	809	9	336.1
⊕	923	8	323.3

PROJECT

PROPOSED NOISE BARRIER WALL 2
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

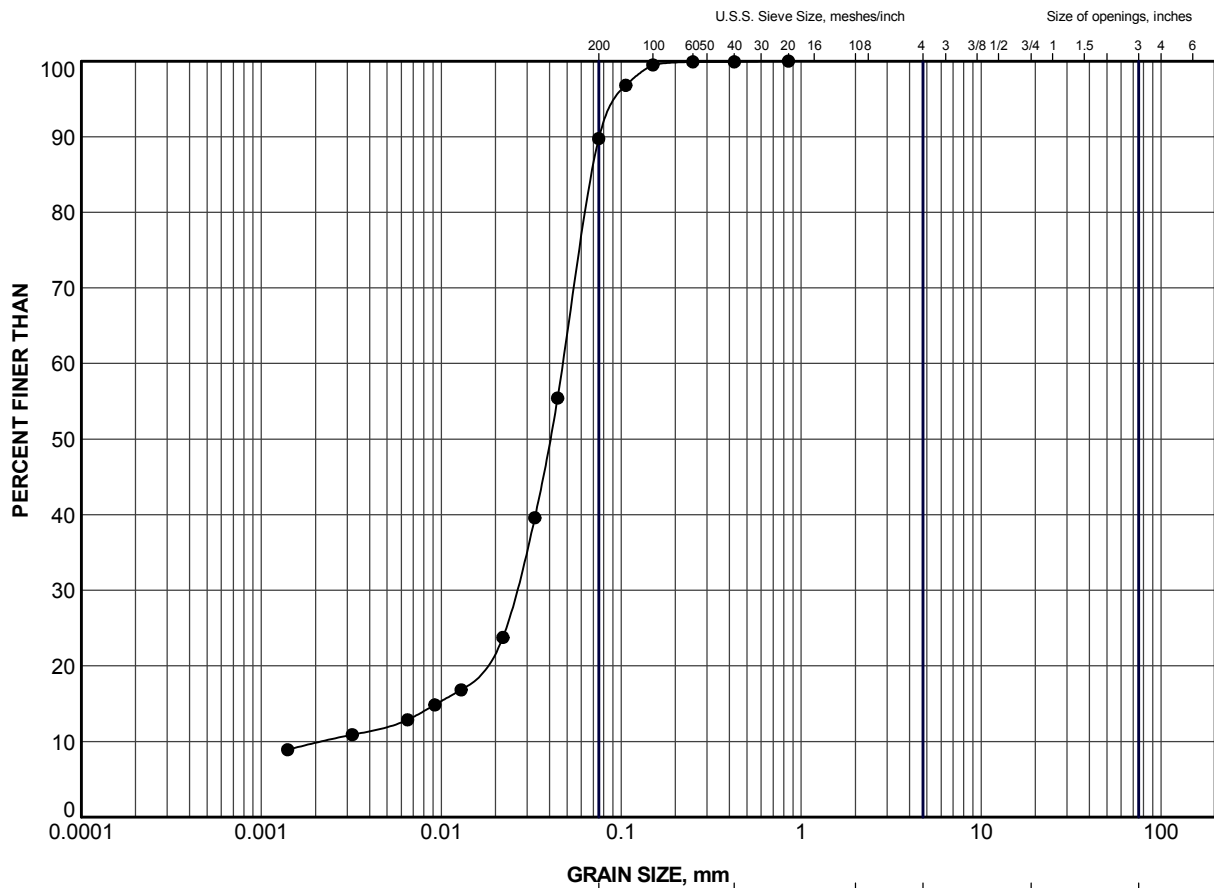
TITLE

GRAIN SIZE DISTRIBUTION
SILTY SAND




Golder Associates
LONDON, ONTARIO

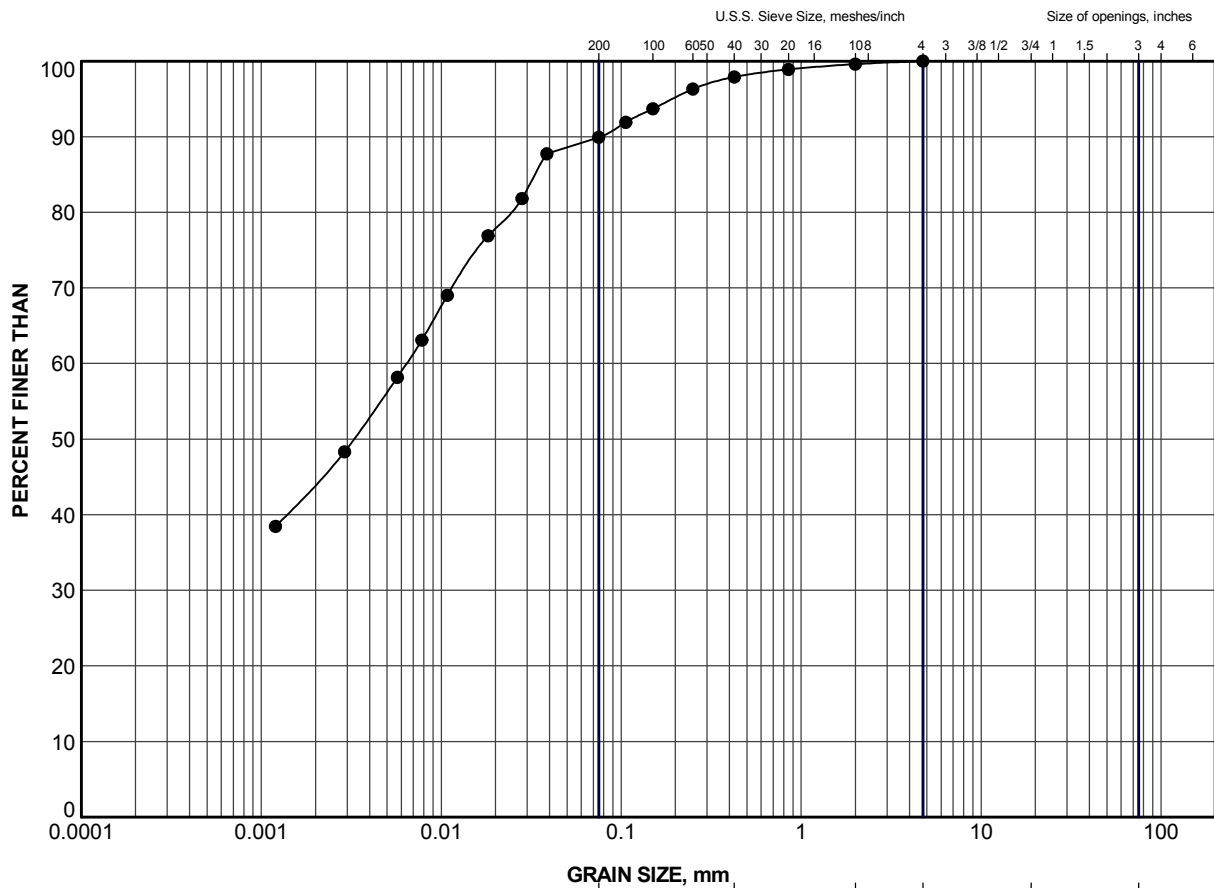
PROJECT No.	08-1132-084-1	FILE No.	0811320841-F11E0A6
DRAWN	LMK	Jan. 14/11	SCALE N/A REV.
CHECK			FIGURE A-6



CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	33	4	339.7

PROJECT		PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE		GRAIN SIZE DISTRIBUTION SILT			
 Golder Associates LONDON, ONTARIO	PROJECT No. 08-1132-084-1		FILE No. 0811320841-F11E0A8		
	DRAWN	LMK	Jan. 14/11	SCALE	N/A
	CHECK			FIGURE A-8	



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	38	2	336.9

PROJECT

PROPOSED NOISE BARRIER WALL 2
WIDENING OF HIGHWAY 7/8
GWP 131-98-00

TITLE

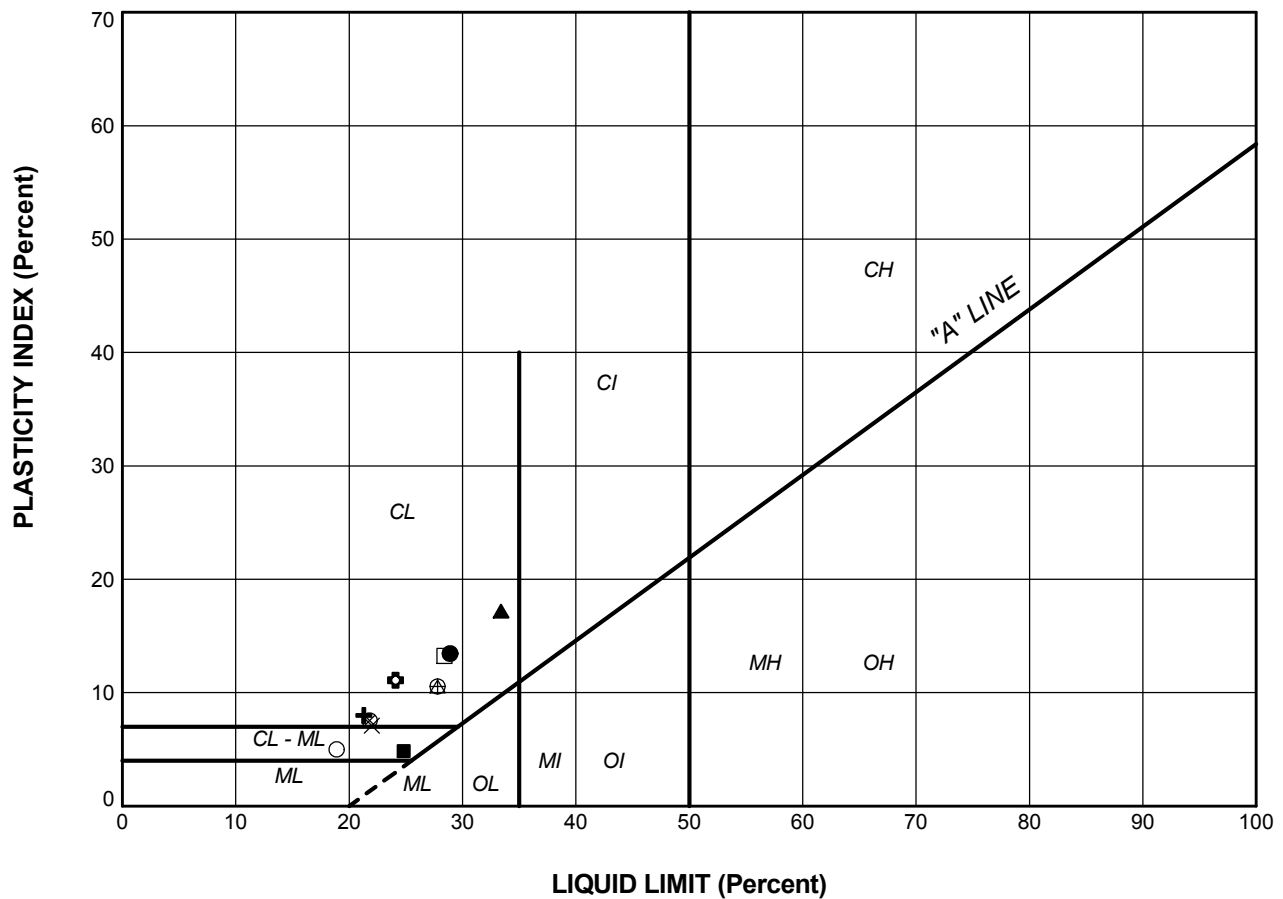
GRAIN SIZE DISTRIBUTION
SILTY CLAY TILL



Golder Associates
LONDON, ONTARIO

PROJECT No.	08-1132-084-1	FILE No.	0811320841-F11E0A9
DRAWN	LMK	Jan. 14/11	SCALE N/A REV.
CHECK			

FIGURE A-9

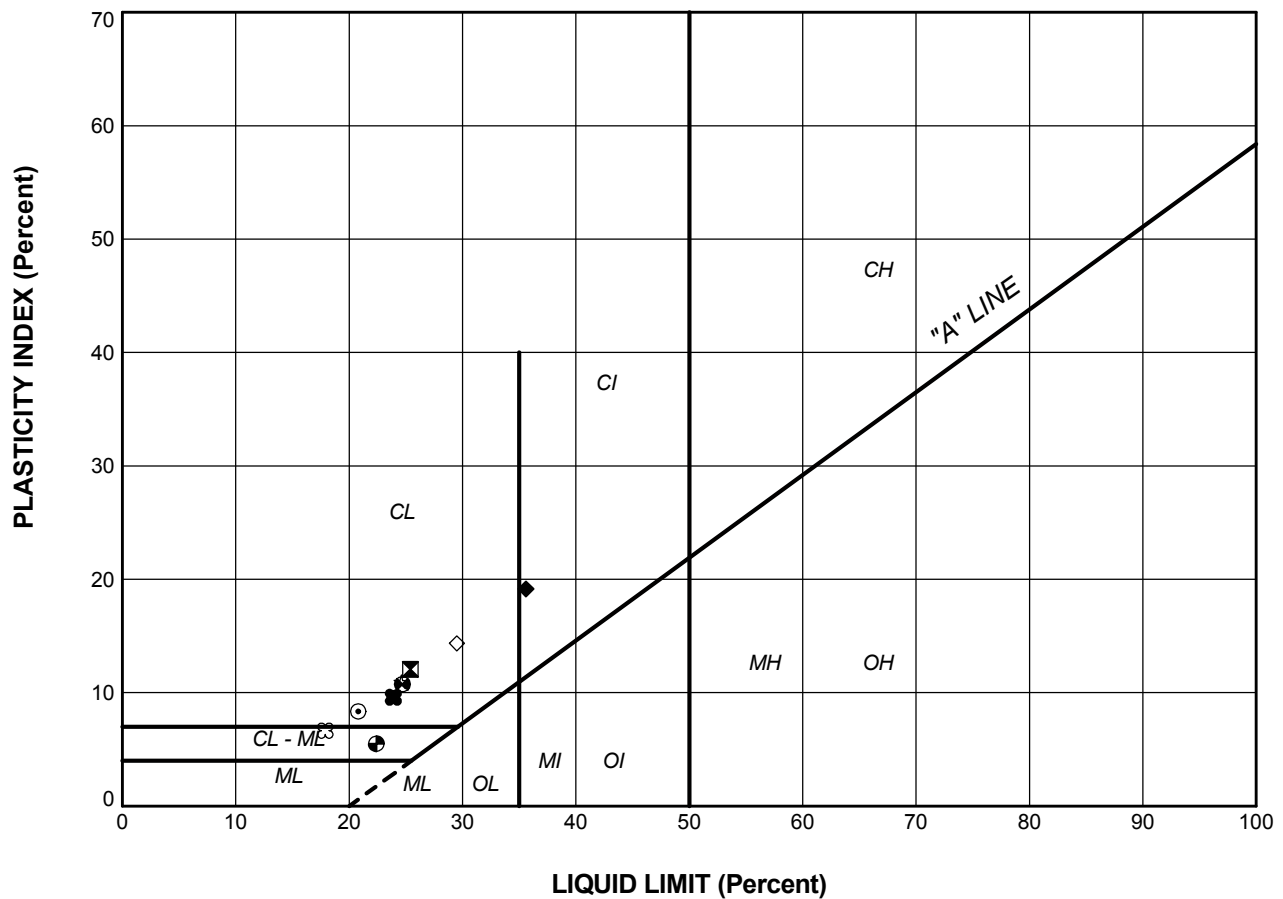


LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
FILL, COHESIVE					
●	31	2	28.9	15.5	13.5
■	34	1	24.8	20.0	4.9
▲	34	2	33.4	16.2	17.2
+	36	2	21.3	13.3	8.0
○	40	1	18.9	13.9	5.0
△	40	3	27.8	17.3	10.6
⊗	40	5	21.8	14.3	7.6
⊕	41	3	27.8	17.3	10.6
□	42	3	28.4	15.2	13.3
⊛	903	2	24.1	13.0	11.1
×	904	7	22.0	14.9	7.1

PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				PLASTICITY CHART			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A10	
DRAWN	LMK	Jan. 14/11		SCALE	N/A	REV.	
CHECK				FIGURE A-10			





LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
CLAYEY SILT					
◇	39	2	29.5	15.2	14.4
⊕	44	2	24.7	14.0	10.8
⊙	44	3	22.4	16.9	5.5
★	805	3	24.6	13.7	11.0
⊗	805	7	17.9	11.3	6.7
⊠	809	2	25.4	13.4	12.1
CLAYEY SILT TILL					
⊙	811	9	20.8	12.5	8.4
■	904	11	23.9	14.3	9.6
SILTY CLAY TILL					
◆	38	2	35.6	16.5	19.2

PROJECT				PROPOSED NOISE BARRIER WALL 2 WIDENING OF HIGHWAY 7/8 GWP 131-98-00			
TITLE				PLASTICITY CHART			
PROJECT No.		08-1132-084-1		FILE No.		0811320841-F11E0A11	
DRAWN	LMK	Jan. 14/11		SCALE	N/A	REV.	
CHECK				FIGURE A-11			



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

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

solutions@golder.com
www.golder.com

Golder Associates Ltd.
309 Exeter Road, Unit #1
London, Ontario, N6L 1C1
Canada
T: +1 (519) 652 0099

