



January 28, 2015

## FOUNDATION INVESTIGATION REPORT

**HIGHWAY 60 CULVERT REPLACEMENTS  
RESURFACING FROM 0.2 KM WEST OF HIGHWAY 127 EASTERLY 19.2 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5198-10-00**

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REPORT





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# **PART A**

**FOUNDATION INVESTIGATION REPORT**

**HIGHWAY 60 CULVERT REPLACEMENTS**

**RESURFACING FROM 0.2 KM WEST OF HIGHWAY 127 EASTERLY 19.2 KM**

**MINISTRY OF TRANSPORTATION, ONTARIO**

**GWP 5198-10-00**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by LEA Consulting Limited (LEA) on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the replacement of thirteen centreline culverts as part of the resurfacing of Highway 60 from Highway 127 easterly for 19 km, in Airy Township and Murchison Township, east of Whitney, Ontario. The general locations of the culverts are shown on the Key Plan on Figure 1.

The Terms of Reference and Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2013. Golder's proposal for foundation engineering services associated with the culvert replacements is contained in Section 6.8 of LEA's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project dated May 10, 2013.

This report addresses the investigation carried out for the thirteen centreline culverts only. Reports detailing the foundation investigations for other culvert replacements for this project are submitted separately.

The purpose of this investigation is to establish the subsurface conditions at the locations of the proposed culverts by methods of borehole drilling, in situ testing and laboratory testing on selected soil samples.

## **2.0 SITE DESCRIPTION**

The culverts are located along the existing Highway 60 alignment in Airy Township and Murchison Township and the locations and culvert details (size, length, type, etc.) are summarized in Table 1. The approximate locations of the culverts are shown on Drawing 1.

In general, the topography of the culvert sites consists of bedrock outcrops separated by creeks and swamps containing areas of standing water and various types of vegetation and organic soils, including dense tree cover in non-swamp areas. Select photographs of the topography and vegetation conditions at the culvert sites are presented in Appendices A to M.

## **3.0 INVESTIGATION PROCEDURES**

The fieldwork for the investigation at the culvert sites was carried out:

- between July 27 and October 3, 2013;
- between February 9 and 12, 2014;
- between May 5 and June 2, 2014;
- between September 10 and 12, 2014; and
- between November 11 and December 5, 2014.

A total of seventy-nine (79) boreholes, forty-four (44) Dynamic Cone Penetration Tests (DCPTs) and three (3) probe holes were advanced at the culvert sites. A summary of the boreholes advanced at each culvert site is



presented in Table 1 and the locations of the boreholes and culvert sites are shown on Drawings A1 to Q1 in Appendices A to Q respectively.

The field investigation in July and August 2013 was carried out using a track mounted CME 55 operated by Landcore Drilling Inc. of Chelmsford, Ontario. The remaining field investigation in September and October 2013 and between February and December 2014 was carried out using a truck/track mounted CME-55, skid mounted CME-45 or portable equipment supplied and operated by George Downing Estate Drilling Ltd. of Grenville-Sur-La-Rouge, Quebec.

The boreholes were advanced through the overburden using 108 mm inside diameter hollow stem augers, or NW casing with wash boring techniques. Where coring was required, a NQ size core barrel was used. In general, soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter split-spoon sampler operated by an automatic hammer on the track-mounted drill rig, performed in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Boreholes advanced by portable equipment generally employed a full weight hammer lifted manually and dropped from the SPT height. At some borehole locations where portable equipment was used, as noted on the applicable Record of Borehole sheets, half weight hammers were used and the SPT 'N'-values were corrected, as appropriate. All open boreholes were backfilled upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The boreholes were advanced to depths ranging from 0 m (bedrock exposed) to 14.8 m below existing ground surface or water surface, generally to refusal or 3 m into competent material or penetrating into competent material up to two times the foundation base beneath the foundation elevation. Competent material is defined as material that will provide resistance to settlement or instability of the embankment.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets in Appendices A to Q. Groundwater elevations as encountered in the boreholes may not be representative of static groundwater levels since the groundwater levels in the boreholes may not have stabilized on completion of drilling. Furthermore, groundwater elevations will vary depending on seasonal fluctuations, precipitation and local soil permeability.

Creek water samples were obtained on September 14, 2013, or November 27, 2014, at each culvert location, except at Culverts 2A, 3, 4, 21 and 28 to 30, which were dry at the time of the field investigation between November and December 2014. The samples were collected using appropriate sampling protocols and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of parameters. The results of the analytical testing are summarized in Table 2, following the text of this report.

The fieldwork was observed by members of our engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil samples. The soil and bedrock samples were identified in the field, placed in appropriate containers, labelled and transported to our Sudbury Geotechnical Laboratory where the samples and core underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO Laboratory Standards and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distributions) was carried out on selected soil samples.



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The as-drilled borehole locations were measured in reference to the existing culverts, or relative to marked stations placed on the pavement surface by LEA's surveyors, and the locations were subsequently converted into MTM NAD 83 coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to temporary benchmarks consisting of either the marked stations on the pavement surface, or horizontal control points installed by LEA's surveyors, or inferred from the survey provided by LEA. The elevations of the temporary benchmarks were obtained from the survey provided by LEA. The borehole locations given on the Record of Borehole sheets and shown on Drawings A1 to Q1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations and ground surface elevations are as follows:

Culvert Location (Township)	Borehole	MTM NAD 83 Coordinates (m)		Ground/Water Surface Elevation (m)	Borehole/DCPT Depth (m) (Includes Water Column)
		Northing	Easting		
Culvert 2A STA 23+188 (Airy)	C2A-1	5 040 189.0	406 638.3	465.3	6.1
	C2A-2	5 040 181.7	406 648.9	466.9	10.7
	C2A-3	5 040 167.8	406 649.8	463.4	5.3
Culvert 3 STA 23+313 (Airy)	C3-1	5 040 255.2	406 748.8	463.8	6.4
	C3-2	5 040 235.5	406 764.1	471.9	13.1
	C3-3	5 040 227.5	406 761.0	471.6	14.8
	C3-4	5 040 202.1	406 766.7	462.8	3.4/3.3
	C3-5	5 040 169.2	406 665.6	463.4	5.0
	C3-6	5 040 192.9	406 716.4	466.0	1.0
	C3-7	5 040 233.9	406 822.2	467.9	1.0
	P1/P1A	5 040 215.8	406 673.1	463.1	1.4
	P2/P2A/P2B	5 040 227.4	406 695.3	463.6	0.3 to 0.5
	P3	5 040 239.3	406 717.5	463.3	1.5
Culvert 4 STA 23+698 (Airy)	C4-1	5 040 394.8	407 113.2	479.6	3.2/2.5
	C4-2	5040 378.7	407 121.5	483.8	6.6/1.2
	C4-3	5 040 365.3	407 121.1	479.7	2.4/2.3
	C4-4	5 040 380.7	407 112.6	483.8	7.3/
Culvert 7 STA 25+121 (Airy)	C7-1	5 040 941.4	408 421.0	451.1	3.7/2.9
	C7-2	5 040 934.6	408 432.0	453.5	6.2/6.2
	C7-3	5 040 916.3	408 431.0	450.2	3.7/2.3
	C7-4	5 040 926.4	408 427.9	453.9	7.2
Culvert 15 STA 28+446 (Airy)	C15-1	5 040 206.9	411 561.8	424.0	8.2/8.2
	C15-2	5 040 192.1	411 550.2	427.9	10.1/1.1
	C15-3	5 040 174.1	411 541.2	425.1	3.3/3.3
	C15-4	5 040 186.1	411 554.5	427.5	7.1*
Culvert 17 STA 29+350 (Airy)	C17-1	5 040 076.7	412 451.5	399.1	5/4.6
	C17-2	5 040 055.7	412 446.1	404.3	12.6/12.6
	C17-3	5 040 041.7	412 443.7	400.3	5.0/4.6
	C17-4	5 040 051.9	412 395.8	400.3	5.0
	C17-5	5 040 033.3	412 490.2	403.0	4.3
	C17-6	5 040 061.6	412 344.2	402.2	4.6



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Culvert Location (Township)	Borehole	MTM NAD 83 Coordinates (m)		Ground/Water Surface Elevation (m)	Borehole/DCPT Depth (m) (Includes Water Column)
		Northing	Easting		
Culvert 18 STA 29+825 (Airy)	C18-1	5 039 914.1	412 895.7	393.3	5.0/4.4
	C18-2	5 039 892.6	412 903.8	396.5	13.8/10.5
	C18-3	5 039 884.0	412 887.8	393.5	5.0/4.6
	C18-4	5 039 894.7	412 897.5	396.8	10.6
Culvert 19 STA 30+277 (Airy)	C19-1	5 039 741.1	413 320.0	370.6	4.4/4.4
	C19-2	5 039 725.5	413 310.6	374.4	10.5/9.7
	C19-3	5 039 714.5	413 299.3	371.1	4.3/3.9
	C19-4	5 039 731.7	413 305.3	374.8	7.1
Culvert 21 STA 31+406 (Airy)	C21-1	5 039 281.1	414 351.5	363.5	4.9/3.5
	C21-2	5 039 270.6	414 338.4	367.2	10.4/2.3
	C21-3	5 039 255.8	414 334.9	362.8	5.3/2.3
	C21-4	5 039 270.7	414 347.4	367.0	10.4/0.6
Culvert 23 STA 32+256 (Airy)	C23-1	5 038 856.0	415 078.1	357.9	6.7
	C23-2	5 038 872.6	415 089.3	362.1	11.3
	C23-3	5 038 881.4	415 102.2	357.8	5.5
Culvert 26 STA 33+156 (Airy)	C26-1	5 038 613.8	415 920.1	383.6	4.6/4.1
	C26-2	5 038 595.1	415 925.5	389.6	9.0
	C26-3	5 038 577.1	415 929.3	383.4	4.2/2.6
	C26-7	5 038 607.1	415 869.9	383.6	3.0/3.0
	C26-8	5 038 598.9	415 821.3	384.5	1.0/1.0
	C26-9	5 038 617.8	415 967.8	388.2	1.8/1.0
Culvert 27 STA 10+294 (Murchison)	C27-1	5 038 730.0	416 340.2	390.4	3.0/1.2
	C27-2	5 038 707.4	416 345.8	395.7	7.7/7.1
	C27-3	5 038 698.3	416 350.5	393.3	5.6/5.5
	C27-4	5 038 710.6	416 339.0	395.8	9.1
Culvert 28 STA 10+674 (Murchison)	C28-1	5 038 796.3	416 715.0	386.3	4.4
	C28-2	5 038 817.2	416 710.7	390.3	9.5
	C28-3	5 038 829.1	416 701.2	385.8	4.4
Culvert 29 STA 11+410 (Murchison)	C29-1	5 039 004.1	417 417.9	357.1	4.3
	C29-2	5 039 019.5	417 417.8	359.9	10.5
	C29-3	5 039 033.3	417 413.5	356.1	4.0
Culvert 30 STA 11+817 (Murchison)	C30-1	5 039 070.4	417 819.7	393.3	3.7
	C30-2	5 039 085.9	417 818.4	396.4	9.4*
	C30-3	5 039 102.6	417 819.1	391.5	4.4
Culvert 33 STA 12+628 (Murchison)	C33-1	5 039 340.1	418 573.8	441.0	4.3/1.7
	C33-2	5 039 326.4	418 579.9	446.3	12.4/2.7
	C33-3	5 039 324.0	418 586.0	446.5	12.4
	C33-4	5 039 309.2	418 587.2	442.9	6.3/2.5
	C33-5	5 039 357.8	418 622.2	446.4	2.5
	C33-6	5 039 296.9	418 483.8	436.2	4.9
	C33-7	5 039 311.4	418 518.3	440.7	0**



Culvert Location (Township)	Borehole	MTM NAD 83 Coordinates (m)		Ground/Water Surface Elevation (m)	Borehole/DCPT Depth (m) (Includes Water Column)
		Northing	Easting		
Culvert 35 STA 13+530 (Murchison)	C35-1	5 039 886.8	419 244.8	456.4	2.4/2.4
	C35-2	5 039 884.5	419 261.4	459.6	7.3/5.9
	C35-3	5 039 874.5	419 271.1	456.0	2.2/2.2
	C35-4	5 039 876.1	419 252.6	459.6	5.6
Culvert 37 STA 13+943 (Murchison)	C37-1	5 040 255.0	419 426.8	454.0	3.5/3.4
	C37-2	5 040 249.3	419 445.3	458.2	11.7/8.6
	C37-3	5 040 238.7	419 455.8	453.7	5.0/4.7
	C37-4	5 040 163.9	419 417.1	455.6	5.0
	C37-5	5 040 193.4	419 436.2	453.6	3.9/3.0
	C37-6	5 040 285.0	419 479.1	455.7	1.1/1.0

Notes: \*Includes 1.9 m (BH C15-4) and 3.1 m (BH C21-2 and BH C29-2) of bedrock core  
 \*\*Bedrock Outcrop

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

Based on NOEGTS<sup>1</sup> mapping, the topography along the Highway 60 alignment in the culvert areas is characterized by bedrock outcrops separated by organic deposits, glaciofluvial deposits and shield deposits. The soils along the sections of the Highway 60 alignment consist of surficial layers of peat in low lying areas and silt till to sand till.

Published literature indicates that the bedrock in the area typically consists of magmatic rocks and gneisses within the Central Gneiss Belt, a subdivision of the Grenville Structural Province (OGS, 1991)<sup>2</sup>.

### 4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are presented on the Record of Borehole sheets and the laboratory test sheets in Appendices A to Q. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and in situ testing. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations.

The inferred subsurface stratigraphy as encountered in the boreholes advanced for the culverts are shown in profile on Drawings A1 to Q1. The orientation (i.e., north, south, east, west) stated in the text of the report is

<sup>1</sup> Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping.

<sup>2</sup> Ontario Geological Survey, 1991. Geology of Ontario, Special Volume 4, Part 1. Eds P.C. Thurston, H.R. Williams, R.H. Sutcliffe and G.M. Stott, Ministry of Northern Development and Mines, Ontario.



typically referenced to project north. For the purposes of this report, the Highway 60 alignment is in an east-west orientation and therefore may differ from those shown on the drawings which represent magnetic north.

In general, the stratigraphy encountered at the various areas investigated is similar. However the overburden (soil materials) thickness is variable from 1 m to about 14.8 m. The stratigraphy generally consists of:

- surficial layers of topsoil/organic soils/peat or embankment fill; and
- cohesionless deposits of silts and/or sands, as well as gravel, cobbles and boulders in some areas.

Detailed descriptions of the subsurface conditions at each investigated culvert crossing are provided in the following sections of this report. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit or stratum.

Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

### **4.3 Culvert 2A – STA 23+188 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 23+188 in Airy Township are shown on Drawing A1 in Appendix A. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP culvert is approximately 28 m long. A total of three (3) boreholes (Boreholes C2A-1 to C2A-3), one DCPT adjacent to one of the boreholes were advanced at the culvert site and three (3) probeholes (P1 to P3) were advanced at approximately 25 m intervals between Culvert 2A and 3 along the north side of the roadway.

#### ***Embankment Fill***

In Borehole C2A-2, 150 mm layer of asphalt was encountered from ground surface at Elevation 466.9 m. From ground surface in Borehole C2A-1 (Elevation 465.3 m) and underlying the asphalt in Borehole C2A-2 a 1.8 m to 6.0 m thick layer of fill comprised of silty sand to sand and gravel was penetrated.

The SPT 'N'-values measured within the fill deposit range from 7 blows to 79 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

A grain size distribution of a sample of the gravelly sand fill deposit is shown on Figure A1 in Appendix A.

The natural water content measured on a sample of the fill is about 8 per cent.

#### ***Peat***

Below the fill in Boreholes C2A-1 and C2A-2 at depths of 1.8 m and 6.2 m, respectively (Elevations 463.5 and 460.7 m) and from ground surface in Borehole C2A-3 (Elevation 463.4 m), a 0.4 m to 3.7 m thick layer of fibrous peat was encountered.

The SPT 'N'-values within the peat range from 0 blows (weight of hammer) to 4 blows per 0.3 m of penetration, suggesting a very soft to soft consistency.



The natural water content measured on two samples of the peat is 296 per cent and 722 per cent.

### **Clayey Silt**

Underlying the peat in Borehole C2A-2, a 0.8 m thick layer of clayey silt was encountered at depth of 7.0 m below ground surface corresponding to Elevation 459.9 m.

### **Gravelly Sand to Sandy Silt**

Underlying the peat in Boreholes C2A-1 and C2A-3 and the clayey silt deposit in Borehole C2A-2, the boreholes encountered a deposit of sandy silt to gravelly sand from 2.2 m to 7.8 m below ground surface, corresponding to Elevation 463.1 m to 459.1 m.

The SPT 'N'-values within the sandy silt to gravelly sand deposit range from 0 blows (weight of rods) to 16 blows per 0.3 m of penetration indicating a very loose to compact relative density.

The grain size distribution of three samples of this deposit are shown on shown on Figure A2 in Appendix A.

The natural water content measured on samples of this deposit range from about 16 per cent to 20 per cent.

### **Refusal**

In Boreholes C2A-2 to C2A-3 refusal to further spilt spoon or casing advancement was encountered at depths of 10.7 m and 5.3 m below ground surface, corresponding to Elevations 456.2 m and 458.1 m, respectively.

In Probeholes P1 and P2 and immediately adjacent probing's, refusal was encountered at depths between 0.3 m a 1.4 m below ground surface; Probehole P3 was terminated at 1.5 m without reaching refusal.

### **Groundwater Conditions**

The water levels observed in Boreholes C2A-2 and C2A-3 on completion of drilling were measured at depths of 5.9 m and 0.4 m below ground surface, corresponding to Elevation 461.0 m and 463.3 m, respectively. In Borehole C2A-1, a water level was not obtained due to heaving sand within the augers.

## **4.4 Culvert 3 – STA 23+313 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 23+313 in Airy Township are shown on Drawing A1 in Appendix A. The height of the embankment at this location is about 9 m and the existing 750 mm diameter CSP is approximately 48 m long. A total of seven (7) boreholes (Boreholes C3-1 to C3-7) and one (1) DCPT were advanced at the culvert site.



### ***Embankment Fill***

Borehole C3-2 and C3-3 encountered a 75 mm to 80 mm thick layer of asphalt at Elevation 471.9 m and 471.6 m, respectively, underlain by layers of sand and gravel fill and blast rock. The overall thickness of the fill was measured to be 8.7 m and 9.0 m, with the blast rock zone about 6.6 m and 6.9 m thick. The surface of the blast rock was encountered at 2.1 m depth below the roadway surface, corresponding to Elevation 469.8 m and 469.5 m. NW and NQ coring techniques were used to advance the boreholes through the blast rock.

The SPT 'N'-values measured within the sand and gravel fill range between 9 blows and 45 blows per 0.3 m of penetration, indicating a loose to dense relative density.

### ***Peat/Topsoil***

In Borehole C3-1 and C3-3 to C3-7, between 0.1 m and 2.1 m of peat or topsoil was encountered from ground surface between Elevation 467.9 m and 462.8 m and in Borehole C3-3, a 0.1 m thick layer of peat was encountered underlying the embankment fill at a depth of 8.7 m (Elevation 462.9 m) below the roadway surface.

The SPT 'N'-values measured within the peat/topsoil range from 0 blows (weight of hammer) to 11 blows per 0.3 m of penetration, suggesting a very soft to stiff consistency.

The natural water content measured samples of the peat ranges from about 38 per cent to 443 per cent.

### ***Silt and Sand to Silty Sand***

Underlying the embankment fill or the peat/topsoil in all boreholes, a deposit of silt and sand to silty sand was encountered with the surface of this deposit ranging from Elevation 467.3 m to 461.3 m. Borehole C3-5 was terminated after penetrating 2.9 m into this deposit and the bottom of the deposit in the remaining boreholes was inferred from spoon and/or casing refusal, with a deposit thickness between 0.4 m to 6.3 m.

The SPT 'N'-values measured within the silt and sand to silty sand deposit ranges from 7 blows to 102 blows per 0.3 m of penetration, indicating a loose to very dense relative density, however the majority of the 'N'-values indicated compact to dense relative densities.

The grain size distributions of samples of the silt and sand to silty sand deposit are shown on Figure A2 in Appendix A.

The natural water content measured on samples of the deposit ranges from about 10 per cent to 13 per cent.

### ***Refusal***

In all Boreholes except C3-5, refusal to further spilt spoon and/or casing advancement was encountered at depths ranging from 1.0 m to 14.8 m below ground surface, between Elevation 466.9 m and 456.8 m.



### ***Groundwater Conditions***

Borehole C3-6 was dry upon completion of drilling and the water levels observed in the remaining boreholes upon completion of drilling were measured between Elevation 467.2 m and 462.8 m, ranging from ground surface to 7.6 m below ground surface.

## **4.5 Culvert 4 – STA 23+698 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 23+698 in Airy Township are shown on Drawing B1 in Appendix B. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP is approximately 24 m long. A total of four (4) boreholes (Boreholes C4-1 to C4-4) and three (3) DCPTs were advanced at the culvert site.

### ***Embankment Fill***

Boreholes C4-2 and C4-4 encountered a 75 mm thick layer of asphalt at Elevation 483.8 m underlain by embankment fill. Below the asphalt in Borehole C4-2 a layer of fill about 3.2 m thick consisting of gravelly sand was encountered; a boulder was inferred at a depth of 1.2 m due to DCPT rods sliding. In Borehole C4-4, the embankment fill consists of a 0.5 m thick layer of sand and gravel underlain by 2.4 m of blast rock. NW and NQ coring techniques were used to advance Borehole C4-4 through the blast rock portions of the embankment fill.

The SPT 'N'-values measured within the fill range between 15 blows and 47 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The grain size distribution of one sample of the gravelly sand fill is shown on Figure B1 in Appendix B.

The natural water content measured on a sample of the fill is about 11 per cent.

### ***Topsoil/Peat***

In Boreholes C4-1 and C4-3, a 0.1 m and 0.5 m thick layer of topsoil/peat was encountered from ground surface, corresponding to Elevation 479.6 m and 479.7 m, respectively.

The SPT 'N'-value obtained from one sample of the peat is 5 blows per 0.3 m of penetration, suggesting a firm consistency.

### ***Gravelly Silty Sand to Silt and Sand***

Underlying the embankment fill or topsoil/peat, a deposit consisting of gravelly silty sand, silty sand, sand and silt or sand, along with cobbles and boulders, were encountered in each of the boreholes. The surface of the deposit was encountered between Elevation 480.8 m and 479.3 m and its thickness ranges from 1.9 m to 3.6 m. Cobbles and boulders ranging from 100 mm to 475 mm were encountered within the deposit in Boreholes C4-2 and C4-4, requiring NW casing and NQ coring techniques to advance the boreholes within this deposit.



The SPT 'N'-values measured within this deposit range between 6 blows and 37 blows per 0.3 m of penetration, indicating a loose to dense relative density, however the majority of the N-values are in the compact range of relative density.

The grain size distribution of six samples of this deposit is shown on Figure B2 in Appendix B.

The natural water content measured on samples of the deposit ranged from about 11 per cent to 18 per cent.

### ***Refusal/Boulder or Probable Bedrock***

In Boreholes C4-1 to C4-3, refusal to further spilt spoon and/or auger advancement, or resistance to further casing advancement, was encountered at depths ranging from 2.4 m to 6.6 m below ground surface, between Elevation 477.4 m and 476.4 m. In Borehole C4-4 at 6.6 m depth (Elevation 477.2 m), a gneiss boulder was penetrated by coring for 0.7 m before terminating the borehole, inferred to be on bedrock.

### ***Groundwater Conditions***

The water levels observed in the boreholes upon completion of drilling were measured between 0.0 m and 3.7 m below ground surface, ranging between Elevation 480.5 m and 478.1 m.

## **4.6 Culvert 7 – STA 25+121 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 25+121 in Airy Township are shown on Drawing C1 in Appendix C. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP is approximately 27 m long. A total of four (4) boreholes (Boreholes C7-1 and C7-4) and three (3) DCPTs were advanced at the culvert site.

### ***Embankment Fill***

Boreholes C7-2 and C7-4 encountered a 150 mm and 75 mm thick layer of asphalt at Elevation 453.9 m and 453.5 m, respectively. Below the asphalt, these boreholes encountered a 2.8 m and 3.3 m thick layer of embankment fill consisting of sand and gravel to silty sand. In Borehole C7-2, a 225 mm cobble was recovered from a depth of 2.5 m below the roadway surface.

The SPT 'N'-values measured within the fill range from 11 blows to 51 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The grain size distribution of a sample of the fill is shown on Figure C1 in Appendix C.

The natural water content measured on a sample of the fill is about 4 per cent.

### ***Topsoil/Peat***

Borehole C7-1 encountered a 0.1 m thick layer of topsoil at ground surface (Elevation 451.1 m), while Boreholes C7-2, C7-2 and C7-4 encountered a 0.6 m thick layer of fibrous peat at ground surface (Elevation 450.2 m) and



a 1.0 m and 0.4 m thick layer of peat below the embankment fill at depths of 3.0 m and 3.4 m depth (Elevation 450.5 m), respectively.

Two SPT 'N'-values measured within the peat are 5 blows and 10 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

The natural water content measured on one sample of this deposit is 29 per cent.

### ***Gravel/Cobbles***

Borehole C7-4 encountered an approximately 0.5 m thick layer of gravel/cobbles at a depth of 3.8 m below ground surface (Elevation 450.1 m).

### ***Silt and Sand to Gravelly Sand***

Underlying the topsoil/peat in Boreholes C7-1 to C7-3 and below the gravel/cobbles in Borehole C7-4, a 2.1 m to 3.6 m thick deposit of silt and sand to silty sand to gravelly sand was encountered with the surface of the deposit between Elevation 451.0 m and 449.6 m. Cobbles and boulders were inferred within the deposit in Boreholes C7-1 and C7-3 based on the following:

- Borehole C7-1 encountered auger resistance throughout the full deposit and DCPT refusal adjacent to the borehole at a depth of 3.2 m below ground surface; and
- Borehole C7-3 encountered auger refusal at a depth of 2.1 m, auger grinding between 0.6 m and 3.7 m depth and DCPT refusal adjacent to the borehole at a depth of 2.3 m below ground surface.

The SPT 'N'-values measured within this deposit range from 13 blows to 64 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of six samples of this deposit is shown on Figure C2 in Appendix C.

The natural water content measured on samples of this deposit range from about 11 per cent to 14 per cent.

### ***Refusal/Boulder***

Boreholes C7-1, C7-2 and C7-4 encountered spilt spoon or auger refusal at depths ranging from 3.7 m to 7.2 m below ground surface, between Elevation 447.4 m and 446.7 m.

### ***Groundwater Conditions***

The water levels observed upon completion of drilling were measured at depths ranging from 1.6 m to 4.7 m below ground surface, between Elevation 450.1 m and 448.4 m.



## 4.7 Culvert 15 – STA 28+446 (Airy Township)

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 28+446 in Airy Township are shown on Drawing D1 in Appendix D. The height of the embankment at this location is about 4 m and the existing 1200 mm diameter CSP is approximately 34 m long. A total of four (4) boreholes (Boreholes C15-1 to C15-4) and three (3) DCPTs were advanced at the culvert site.

### *Embankment Fill*

Borehole C15-1 encountered a 0.1 m thick layer of peat fill at ground surface (Elevation 424.0 m) underlain by a 1.3 m layer of sand fill.

Boreholes C15-2 and C15-4 encountered a 125 mm and 150 mm thick layer of asphalt at Elevation 427.9 m and 427.4 m, respectively, underlain by a layer of fill comprised of sand and gravel to silty sand about 4.4 m and 3.9 m thick, respectively. In Borehole C15-2, a boulder 450 mm in diameter was encountered within the fill at a depth of 2.8 m below roadway surface and DCPT refusal was encountered adjacent to Borehole C15-2 at a depth of 1.1 m. In Borehole C15-4, cobbles and boulders were inferred present within the fill due to augers grinding at a depth ranging from 0.9 m to 1.2 m, 1.7 m to 2.0 m and 2.7 m and 3.8 m.

The SPT 'N'-values measured within the fill range from 2 blows to 68 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distribution of three samples of the fill is shown on Figure D1 in Appendix D.

The natural water content measured on samples of the fill range from about 2 per cent to 18 per cent.

### *Peat*

Below the fill in Borehole C15-1 at a depth of 1.4 m (Elevation 422.6 m) and at ground surface in Borehole C15-3 (Elevation 425.1 m), a 1.6 m thick layer of peat mixed with sand and a 0.9 m layer of sandy peat, respectively, was encountered.

The SPT 'N'-values within the peat range from 3 blows to 12 blows per 0.3 m of penetration, suggesting a soft to stiff consistency.

The natural water content measured on two samples of the peat is 30 per cent and 42 per cent.

### *Silty Sand to Sand*

Boreholes C15-1 and C15-2 encountered a silty sand to sand deposit underlying the fill or peat, at Elevation 423.3 m and 421.0 m, respectively, and the deposit is 1.0 m thick in Borehole C15-2 and was explored for 5.2 m in Borehole C15-1 without reaching refusal. Heaving of sand (0.6 m to 2.1 m) was noted in Borehole C7-1 between the depths of 6.1 m and 7.6 m (Elevation 417.9 m to 416.4 m).

The SPT 'N'-values measured within the deposit range between 3 blows to 34 blows per 0.3 m of penetration, indicating a very loose to dense relative density.



The grain size distribution of three samples of the deposit is shown on Figure D2 in Appendix D.

The natural water content measured on samples deposit range from about 11 per cent to 22 per cent.

### ***Gravelly Sand to Sand and Gravel***

In Boreholes C15-2, C15-3 and C15-4, a deposit of gravelly sand to sand and gravel was encountered underlying the silty sand, peat or embankment fill. The surface of this deposit was encountered ranging from Elevation 424.2 m to 422.2 m and the thickness of the deposit ranges from 1.2 m to 4.5 m.

The SPT 'N'-values measured within the deposit range between 17 blows and 69 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of two samples of the deposit is shown on Figure D3 in Appendix D.

The natural water content measured on samples of the deposit range from about 13 per cent to 18 per cent.

### ***Bedrock/Refusal***

In Borehole C15-4, a 1.9 m thickness of bedrock was cored from a depth of 5.2 m (Elevation 422.3 m). The retrieved bedrock core is described as fine to coarse grained grey gneiss and the Total Core Recovery (TCR) is 100 per cent. The Rock Quality Designation (RQD) measured on the core samples is 98 per cent and 100 per cent, indicating a rock mass of excellent quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)<sup>3</sup>.

In Boreholes C15-2 and C15-3, refusal to further spilt spoon and/or casing advancement was encountered at depths of 10.1 m and 2.3 m below roadway/ground surface, at Elevation 417.8 m and 422.8 m, respectively. Refusal to a DCPT was encountered adjacent to Borehole C15-3 at a depth of 3.3 m below ground surface (Elevation 421.8 m).

### ***Groundwater Conditions***

The water levels in the open boreholes upon completion of drilling were measured at depths ranging from ground surface to 3.6 m below ground surface, ranging between Elevation 425.1 m and 422.2 m.

## **4.8 Culvert 17 – STA 29+350 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 29+350 in Airy Township are shown on Drawing E1 in Appendix E. The height of the embankment at this location is about 5 m and the existing 900 mm diameter CSP is approximately 34 m long. A total of six (6) boreholes (Boreholes C17-1 to C17-6) and three (3) DCPTs were advanced at the culvert site.

<sup>3</sup> Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual, 4th Edition. The Canadian Geotechnical Society c/o BiTech Publisher Ltd, British Columbia.



### ***Embankment Fill***

Borehole C17-2 encountered a 125 mm thick layer of asphalt at Elevation 404.3 m and 4.6 m deposit of sand to gravelly sand fill. Borehole C17-6 encountered 0.1 m of topsoil fill at ground surface (Elevation 402.2 m) underlain by a 0.5 m thick layer of sand fill.

The SPT 'N'-values measured within the fill range between 4 blows and 56 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

### ***Peat/Topsoil***

Boreholes C17-1, C17-3, C17-4 and C17-5 encountered a 0.1 m to 1.4 m thick deposit of peat or topsoil from ground surface between Elevation 400.3 m and 399.1 m, and Boreholes C17-2 and C17-6 encountered a 0.4 m and 1.1 m thick layer of peat below the embankment fill at Elevation 399.6 m and 401.6 m.

The SPT 'N'-values measured within the peat deposit range from 0 (weight of hammer) blows to 4 blows per 0.3 m of penetration, suggesting a very soft to soft consistency.

The natural water content measured on samples of the peat portion of the deposit ranges from about 52 per cent to 299 per cent.

### ***Silt to Sand***

Underlying the embankment fill and/or topsoil/peat deposit in each of the boreholes, a deposit consisting of silt to sandy silt to silt and sand to silty sand or sand was encountered. The surface of the deposit was encountered between Elevation 402.9 m and 397.7 m and the boreholes were terminated within this deposit after penetrating between 3.6 m and 5.4 m, and potentially up to 7.5 m as inferred from the DCPT driven adjacent to Borehole C17-2. In Borehole C17-6, the deposit was 2.9 m thick with the bottom of the deposit defined by spoon and casing refusal.

The SPT 'N'-values measured within this deposit range between 12 blows and 62 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of seven samples of the silt to sand deposit is shown on Figure E1 in Appendix E.

The natural water content measured on samples of the deposit ranges from about 12 per cent to 19 per cent.

### ***Refusal***

Refusal to further spilt spoon and casing advancement was encountered in Borehole C17-6 at depth of 4.6 m below ground surface, corresponding to Elevation 397.6 m.



### **Groundwater Conditions**

The water levels observed upon completion of drilling were measured at depths ranging from ground surface to 4.0 m below ground surface, between Elevation 402.3 m to 399.1 m.

## **4.9 Culvert 18 – STA 29+825 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 29+825 in Airy Township are shown on Drawing F1 in Appendix F. The height of the embankment at this location is about 4 m and the existing 900 mm granular CSP is approximately 25 m long. A total of four (4) boreholes (Boreholes C18-1 to C18-4) and three (3) DCPTs were advanced at the culvert site.

### **Embankment Fill**

Boreholes C18-2 and C18-4 encountered an 85 mm thick layer of asphalt at Elevation 396.5 m and 396.8 m, respectively. Underlying the asphalt, the boreholes penetrated a deposit of fill comprised of an upper layer of sand and gravel underlain by a layer of silty sand or gravelly silty sand, for an overall fill thickness of 3.7 m and 4.2 m; a 475 mm boulder was cored through in Borehole C18-2 at a depth of 3.3 m.

Borehole C18-1 penetrated 0.1 m thick layer of topsoil fill was encountered from ground surface (Elevation 393.3 m) underlain by a 0.5 m layer of sandy gravel fill.

The SPT 'N'-values measured within the fill range from 1 blow to 57 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distribution of four samples of the fill is shown on Figure F1 in Appendix F.

The natural water content measured on samples of the fill is 2 per cent and 13 per cent.

### **Silt and Sand to Gravelly Sand**

Underlying the fill or topsoil, Boreholes C18-1 to C18-4 encountered a granular deposit comprised of silt and sand to silty sand to sand and/or gravelly sand with the surface of the deposit between Elevations 393.4 m and 392.5 m. In Borehole C18-1 and C18-3, the deposit was not penetrated after exploring for 4.4 m and 4.9 m; and in Boreholes C18-2 and C18-4, the deposit is 10.0 m and 5.9 m thick, respectively. Boreholes C18-2 and C18-4 encountered a 325 mm and 475 mm boulder within the deposit and DCPT refusal was encountered adjacent to Borehole C18-2 likely on a boulder at a depth of 9.9 m. NW casing and NQ coring techniques were used to advance the boreholes through these coarse materials.

The SPT 'N'-values measured within the granular deposit range between 10 blows and 104 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of nine samples of the deposit is shown on Figure F2 in Appendix F.

The natural water content measured on samples deposit ranges from about 10 per cent to 15 per cent.



### ***Refusal/Boulder***

Borehole C18-2 encountered spoon refusal to split spoon advancement at a depth of 13.8 m below ground surface (Elevation 382.7 m). Borehole C18-4 was terminated at a depth of 10.2 m (Elevation 386.6 m) after penetrating a 0.4 m gneiss boulder.

### ***Groundwater Conditions***

The water levels measured in the open boreholes upon completion of drilling range from ground surface to 3.7 m below ground surface corresponding to between Elevation 393.5 m and 392.8 m.

## **4.10 Culvert 19 – STA 30+277 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 30+277 in Airy Township are shown on Drawing G1 in Appendix G. The height of the embankment at this location is about 4 m and the existing 900 mm diameter CSP is approximately 32 m long. A total of four (4) boreholes (Boreholes C19-1 and C19-4) and three (3) DCPTs were advanced at the culvert site.

### ***Embankment Fill***

Boreholes C19-2 and C19-4 encountered 85 mm of asphalt at Elevation 374.4 m and 374.8 m, respectively, underlain by a 5.2 m and 4.5 m deposit of fill comprised of sand and gravel and silty sand. The overall thickness of the deposit is about 5.2 m and 4.5 m in the respective boreholes.

The SPT 'N'-values measured within the fill deposit range from 1 blow to 75 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distribution of two samples of the fill is shown on Figure G1 in Appendix G.

The natural water content measured on samples of the fill is about 7 per cent and 15 per cent.

### ***Peat***

Borehole C19-4 encountered a 0.4 m thick deposit of amorphous sandy peat below the fill layer at a depth of 4.6 m below ground surface (Elevation 470.2 m).

The natural water content on the sample of the sandy peat is about 32 per cent.

### ***Silt to Silty Sand***

A deposit of silt to silty sand was encountered from ground surface (Elevation 370.8 m) in Borehole C19-1, underlying the embankment fill at a depth of 5.3 m (Elevation 369.1 m) in Borehole C19-2 and below the peat in Borehole C19-4 and the thickness of the deposit ranges from 1.7 m to 5.2 m.



The SPT 'N'-values measured within the silt to silty sand deposit range between 3 blows to 57 blows per 0.3 m of penetration, indicating a very loose to very dense relative density, with the majority of the 'N'-values being in the loose to compact range of relative density.

The grain size distribution of four samples of the silty sand to silt deposit is shown on Figure G2 in Appendix G.

The natural water content measured on samples of this deposit ranges from about 15 per cent to 27 per cent. One Atterberg limits test indicates a non-plastic result on a sample of the silt deposit.

### ***Sand and Gravel***

A deposit of sand and gravel was encountered underlying the silt deposit in Borehole C19-1 at Elevation 367.5 m and from ground surface in Borehole C19-3 at Elevation 371.1 m. Boreholes C19-1 was terminated within this deposit, penetrating into the deposit for 1.3 m and the deposit is 4.3 m thick in Borehole C19-3 as defined by refusal to split spoon advancement. Cobbles and/or boulders are inferred in Borehole C19-1 from augers grinding between the depths of 3.1 m and 3.8 m; and 50 mm to 150 mm sized cobbles were encountered in Boreholes C19-3. NW casing and NQ coring techniques were required to advance Borehole C19-3.

The SPT 'N'-values measured within the sand and gravel deposit range from 10 blows to 91 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of two samples of the sand and gravel deposit is shown on Figure G3 in Appendix G.

The natural water content measured on a sample of this deposit is 13 per cent.

### ***Refusal/Boulder***

In Boreholes C19-2 and C19-3, refusal to casing or split further spoon advancement was encountered at depths of 10.5 m and 4.3 m below ground surface, at Elevation 363.9 m and 366.8 m, respectively. Borehole C19-4 was terminated at a depth of 7.1 m below ground surface (Elevation 367.7 m) after penetrating a 0.4 m boulder below the silt deposit.

### ***Groundwater Conditions***

The water levels observed in the open boreholes upon completion of drilling were measured at ground surface to 4.0 m below ground surface, ranging between Elevations 371.8 m and 369.6 m.

## **4.11 Culvert 21 – STA 31+406 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 31+406 in Airy Township are shown on Drawing H1 in Appendix H. The height of the embankment at this location is about 4 m and at the time of the subsurface investigation the CSP culvert was 750 mm diameter and approximately 34 m long; the culvert was replaced in the fall of 2013 after the foundation



investigation. A total of four (4) boreholes (Boreholes C21-1 and C21-4) and four (4) DCPTs were advanced at the culvert site prior to replacement.

### ***Embankment Fill***

Boreholes C21-2 and C21-4 penetrated an 85 mm and 75 mm thick layer of asphalt at Elevation 367.2 m and 367.0 m, respectively, underlain by a 4.5 m and 3.8 m thick deposit of gravelly sand fill. In Borehole C21-2, a 100 mm cobble was encountered at a depth of 4.5 m, and in Borehole C21-4 the augers were noted to be grinding between 0.8 m and 2.3 m, and between 3.0 m and 3.5 m, inferred on cobbles within the fill. In the DCPT advanced adjacent to Boreholes C21-2 and C21-4, refusal occurred at a shallow depth within the fill, likely as due to the presence of a cobble or boulder.

The SPT 'N'-values measured within the fill range from 5 blows (weight of hammer) to 38 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The grain size distribution of a sample of the fill is shown on Figure H1 in Appendix H.

The natural water content measured on a sample of the fill is about 14 per cent.

### ***Peat/Topsoil***

A 0.1 m layer of topsoil was encountered at ground surface in Boreholes C21-1 and C21-3, at Elevations 363.5 m and 362.8 m, respectively. A 0.1 m thick layer of sandy peat was encountered underlying the fill in Borehole C21-2 at a depth of 4.6 m (Elevation 362.6 m) and a 0.5 m thick layer of peat was encountered under the fill in Borehole C21-4 at a depth of 3.9 m (Elevation 363.1 m).

### ***Silt to Gravelly Silty Sand***

Underlying the fill or organic deposits, Boreholes C21-1 to C21-4 encountered a granular deposit comprised of various strata of silt, silt and sand, silty sand, sand, gravelly silt, or gravelly silty sand. The surface of the granular deposit was encountered between Elevations 363.4 m and 362.5 m, and the thickness of the overall deposit ranges between 2.1 m and 6 m. A 200 mm cobble was encountered in Borehole C21-2 at a depth of 8.2 m and auger grinding was noted in Borehole C21-4 at depths of 6.9 m and 8.5 m, likely as a result of cobbles within the depth.

The SPT 'N'-values measured within this deposit range from 1 blow to 62 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distribution of five samples of this deposit is shown on Figure H2 in Appendix H.

The natural water content measured on samples of this deposit is between 10 per cent and 23 per cent.



### ***Sand and Gravel***

A 2.6 m thick deposit of sand and gravel was encountered in Borehole C21-1 at a depth of 2.3 m (Elevation 361.2 m). Auger grinding, likely as a result of cobbles within the deposit, was noted between the depths of 2.3 m and 4.6 m.

The SPT 'N'-values measured within this deposit range from 22 blows to 47 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of one sample of this deposit is shown on Figure H3 in Appendix H.

The natural water content measured on a sample of this deposit is 10 per cent.

### ***Bedrock/Refusal***

In Borehole C21-3, the surface of the bedrock encountered at a depth of 2.2 m (Elevation 360.6 m) and was cored for a length of 3.1 m with. The retrieved bedrock core is described as fine to coarse grained grey gneiss, as presented in the Record of Drillhole sheets in Appendix H. The TCR is 100 per cent. The Rock Quality Designation (RQD) measured on the core samples is between 83 per cent and 100 per cent, indicating a rock mass of good to excellent quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006).

In Borehole C21-1, spoon refusal to split spoon advancement was encountered at a depth of 4.9 m below ground surface (Elevation 358.6 m) and refusal to DCPT advancement adjacent to the borehole occurred at a depth of 3.5 m, likely on a boulder. In Borehole C21-2, a 0.5 m diameter boulder was encountered at a depth of 9.9 m (Elevation 357.3 m) and cored through before terminating the borehole. In Borehole C21-4, auger refusal was encountered at a depth of 10.4 m (Elevation 356.6 m).

### ***Groundwater Conditions***

The water levels measured in the open boreholes upon completion of drilling are between 0.8 m and 4.0 m below ground surface, ranging between Elevation 363.5 m and 361.9 m.

## **4.12 Culvert 26 – STA 33+156 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 33+156 in Airy Township are shown on Drawing I1 in Appendix I. The height of the embankment at this location is about 7 m and the existing 900 mm diameter CSP is approximately 40 m long. A total of six (6) boreholes (Boreholes C26-1 to C26-3 and C26-7 to C26-9) and five (5) DCPTs were advanced at the culvert site.



### ***Ice/Water***

Boreholes C26-1, C26-3 and C26-7 encountered between about 0.3 m and 0.5 m of ice/water, between Elevation 383.4 m and 383.6 m at the time of drilling.

### ***Embankment Fill***

Borehole C26-2, drilled through the roadway embankment, encountered a 90 mm thick layer of asphalt at Elevation 389.6 m, underlain by 1.1 m thick layer of sand and gravel fill, a 3.4 m deposit of blast rock fill and a lower 1.5 m thick layer of sand and gravel fill. NW and NQ coring techniques were used to advance the boreholes through the blast rock portion of the borehole.

SPT 'N'-values measured within the granular portion of the fill are between 24 blows and 52 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of one sample of the sand and gravel fill is shown on Figure I1 in Appendix I.

The natural water content measured on a sample of the fill is about 6 per cent.

### ***Peat/Organics***

In Boreholes C26-1 and C26-7 a 0.3 m and 0.4 m thick deposit of fibrous peat was encountered below the ice/water at Elevation 383.3 m. In Borehole C26-9, a 0.3 m thick layer of peat was encountered at ground surface at Elevation 388.2 m.

### ***Silt to Silty Sand***

Underlying the peat in Borehole C26-1 at Elevation 383.0 m and ground surface at Elevation 384.5 m in Borehole C26-8, the borehole penetrated a 0.6 m layer of sand underlain by a 1.6 m thick layer of silt and by a 1.0 m thick layer of silty sand, respectively.

The SPT 'N'-values measured within this deposit range between 10 blows and 48 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The grain size distribution of one sample of the silt portion of the deposit is shown on Figure I2 in Appendix I.

The natural water content measured on a sample of the silt is 18 per cent.

### ***Sand to Sand and Gravel***

In Boreholes C26-1 to C26-3, C26-7 and C26-9, a deposit of sand to gravelly silty sand to gravelly sand and/or sand and gravel was encountered at depths between 0.3 m and 6.1 m below ground surface, between Elevation 387.9 m and 380.8 m, and the thickness of the deposit ranges from 1.6 m to 3.7 m to the depths drilled.



The SPT 'N'-values measured within this deposit range from 5 blows to 62 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The grain size distribution of five samples of this deposit is shown on Figure I3 in Appendix I.

The natural water content measured on samples of the deposit ranges from about 11 per cent to 30 per cent.

### ***Refusal***

Refusal to further spilt spoon and/or casing advancement was encountered in Boreholes C26-1 to C26-3, C26-7 and C26-8 at depths ranging from 1.0 m to 9.0 m below ground surface, between Elevation 386.4 m and 379.0 m.

### ***Groundwater Conditions***

Boreholes C26-1, C26-3 and C26-7 indicate water levels at the ice surface in February 2014, between Elevation 383.6 m and 383.4 m. The water levels observed in Boreholes C26-2 and C26-9 upon completion of drilling were measured at 5.5 m and 1.4 m below roadway/ground surface, respectively, corresponding to Elevation 384.1 m and 386.8 m. Borehole C26-8 was noted to be dry upon completion of drilling.

## **4.13 Culvert 27 – STA 10+294 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+294 in Murchison Township are shown on Drawing J1 in Appendix J. The height of the embankment at this location is about 5 m and the existing 750 mm diameter CSP is approximately 30 m long. A total of four (4) boreholes (Boreholes C27-1 and C27-4) and three (3) DCPTs were advanced at the culvert site.

### ***Embankment Fill***

Boreholes C27-2 and C27-4 encountered a 95 mm and 90 mm thick layer of asphalt at Elevation 395.7 m and 395.8 m, respectively, underlain by a 3.9 m and 3.7 m thick deposit of fill comprised of an upper layer of sand and gravel and a lower layer of silty sand. Coring in Borehole C27-2 recovered portions of 75 mm and 275 mm size cobbles. Borehole C27-3 encountered a 0.1 m thick layer of sand fill at ground surface at Elevation 383.3 m.

The SPT 'N'-values measured within the fill range from 0 blows (weight of hammer) to 42 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The grain size distribution of a sample of the silty sand portion of the fill is shown on Figure J1 in Appendix J.

The natural water content measured on two samples of the fill is about 10 per cent and 14 per cent.



### ***Peat/Topsoil***

At ground surface in Borehole C27-1 and underlying the fill in Boreholes C27-3 and C27-4, the boreholes penetrated a deposit of peat or sandy topsoil with surface between Elevation 393.2 m and 390.4 m and thickness of the deposit ranging from 0.5 m to 0.8 m.

The SPT 'N'-values measured within the peat are 1 blow per 0.3 m of penetration, suggesting a very soft consistency. One 'N'-value measured within the sandy topsoil is 5 blows per 0.3 m of penetration, indicating a loose relative density.

The natural water content measured on two samples of the peat is 28 per cent and 42 per cent.

### ***Sandy Silt to Silt and Sand***

Underlying the peat/topsoil in Boreholes C27-1, C27-3 and C27-4 and underlying the fill in Borehole C27-2, a deposit of sandy silt or silt and sand was encountered. The surface of this deposit was encountered from Elevation 392.7 m to 389.8 m and the thickness of the deposit ranges from 0.8 m to 4.0 m. Adjacent to Borehole C27-1, the DCPT rods were noted to be sliding at a depth of 1.2 m, likely as a result of a cobble or boulder in the deposit, and the DCPT was terminated. In Borehole C27-2, a 175 mm cobble and a 300 mm boulder were recovered.

The SPT 'N'-values measured within the sandy silt to silt and sand deposit range from 13 blows to 118 blows per 0.3 m of penetration, suggesting a compact to very dense relative density.

The grain size distribution of three samples of the silt and sand deposit is shown on Figure J2 in Appendix J.

The natural water content measured on a sample of the silt and sand is about 10 per cent and 13 per cent.

### ***Sand to Sand and Gravel***

Underlying the sandy silt in Borehole C27-3, a 4.2 m thick deposit of sand to sand and gravel was encountered at a depth of 1.4 m below ground surface (Elevation 391.9 m). A 75 mm cobble was encountered at 4.0 m depth.

The SPT 'N'-values measured within the sand to sand and gravel deposit range from 19 blows to 45 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The grain size distribution of two samples of the sand to sand and gravel deposit is shown on Figure J3 in Appendix J.

The natural water content measured on two samples of this deposit is about 10 per cent.

### ***Refusal/Boulder or Probable Bedrock***

In Boreholes C27-1 and C27-3, refusal to further spilt spoon and/or resistance to further casing advancement was encountered at 3.0 m and 5.6 m depths below ground surface, at Elevation 387.4 m and 387.7 m,



respectively. Boreholes C27-2 and C27-4 recovered a 0.6 m and 0.5 m boulder or broken portions of probable bedrock at depths of 7.1 m and 8.6 m below ground surface, at Elevation 388.0 m and 386.7 m, respectively.

### **Groundwater Conditions**

The depth of the water levels was measured upon completion of drilling at 0.2 m to 3.5 m below ground surface, between Elevation 392.9 m and 390.2 m.

## **4.14 Culvert 33 – STA 12+628 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 12+628 in Murchison Township are shown on Drawing K1 in Appendix K. The height of the embankment at this location is about 5 m and the existing 750 mm diameter CSP is approximately 35 m long. A total of seven (7) boreholes (Boreholes C33-1 to C33-7) and three (3) DCPT were advanced at the culvert site.

### **Water**

In Borehole C33-1, 0.2 m of water was encountered at the borehole location.

### **Embankment Fill**

Boreholes C33-2 and C33-3 encountered a 75 mm thick layer of asphalt at Elevation 446.3 m and 446.5 m. Below the asphalt, Borehole C33-2 penetrated embankment fill consisting of a 5.7 m thick deposit of gravelly silty sand. Below the asphalt, Borehole C33-3 penetrated sand and gravel fill (0.9 m thick) underlain by blast rock fill (2.8 m thick) and silt and sand fill (0.8 m thick). NW and NQ coring techniques were used to advance the borehole C33-3 through the blast rock portions of the embankment fill. Refusal to DCPT advancement was encountered at a depth of 2.7 m adjacent to Borehole C33-2 likely as a result of a cobble or boulder within the fill.

In Borehole C33-4 a 0.1 m thick layer of topsoil fill was encountered from ground surface at Elevation 442.9 m underlain by 0.6 m of silty sand fill.

The SPT 'N'-values measured within the granular fill range between 0 blows (weight of hammer) and 43 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The grain size distribution of three samples of the granular fill is shown on Figure K1 in Appendix K.

The natural water content measured on samples of the fill ranges from about 9 per cent to 25 per cent.

### **Peat/Topsoil**

A 0.3 m and 0.6 m deposit of peat was encountered below the water in Borehole C33-1 (Elevation 440.8 m), underlying the fill in Borehole C33-4 (Elevation 442.2 m) and from ground surface in Borehole C33-6



(Elevation 436.2 m). In Borehole C33-5, a 0.1 m thick layer of topsoil was encountered from ground surface at Elevation 446.4 m.

The SPT 'N'-values measured within the peat deposit are 1 blow to 6 blows per 0.3 m of penetration, suggesting a very soft to firm consistency.

The natural moisture content of one sample of the peat deposit is about 33 per cent.

### ***Gravel, Cobbles and Boulders***

In Borehole C33-2, a 0.6 m thick layer of gravel and cobbles was encountered at a depth of 5.8 m below ground surface (Elevation 440.5 m). In Borehole C33-3, a 0.6 m boulder was encountered at Elevation 441.9 m and core through using NW casing and NQ coring techniques.

### ***Sand and Gravel***

A sand and gravel deposit was encountered underlying the peat in Boreholes C33-1 and C33-4 at depths of 0.3 m and 1.4 m below ground surface, at Elevation 440.5 m and 441.5 m, respectively, and underlying the topsoil in Boreholes C33-5 at Elevation 446.3 m. Adjacent to Boreholes C33-1 and C33-4, refusal to DCPT advancement was noted at depths of 1.7 m and 2.5 m, likely as a result of cobbles or a boulder within this deposit.

The SPT 'N'-values measured within the sand and gravel portion of the deposit range from 19 blows to 79 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of two samples of the sand and gravel deposit is shown on Figure K2 in Appendix K.

The natural moisture content of two samples of the sand and gravel deposit is about 10 per cent and 12 per cent.

### ***Silt and Sand to Silty Sand***

Boreholes C33-1 to C33-6 encountered a deposit of silt and sand or silty sand between Elevation 445.6 m and 435.8 m, and the thickness of the deposit ranges between 1.9 m and 7.4 m. A 125 mm cobble was encountered in Borehole C33-3 at 6.3 m depth and cobbles were inferred from augers grinding in Borehole C33-4 between the depths of 3.1 m and 6.3 m.

The SPT 'N'-values measured within the silt and sand to silty sand deposit range from 13 blows to 102 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distribution of seven samples of the silt and sand to silty sand deposit is shown on Figure K3 in Appendix K.

The natural moisture content measured on samples of the silt and sand to silty sand deposit ranges from 10 per cent to 16 per cent.



### ***Refusal/Bedrock***

Bedrock is exposed at Borehole C33-7 at Elevation 440.7 m. The remaining boreholes encountered refusal to split spoon, auger and/or casing advancement at depths ranging from 2.5 m to 12.4 m below ground surface, between Elevation 443.9 m and 431.3 m.

### ***Groundwater Conditions***

Borehole C33-1 was advanced from the water surface at Elevation 441.0 m. The depths to the water levels upon completion of drilling in Boreholes C33-2 to C33-6 was measured at between ground surface and 4.3 m below ground surface, between Elevations 446.4 m and 441.5 m.

## **4.15 Culvert 35 – STA 13+530 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+530 in Murchison Township are shown on Drawing L1 in Appendix L. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP is approximately 34 m long. A total of four (4) boreholes (Boreholes C35-1 and C35-4) and three (3) DCPTs were advanced at the culvert site.

### ***Embankment Fill***

Boreholes C35-2 and C35-4 encountered a 90 mm thick layer of asphalt at Elevation 459.6 m underlain by a 2.9 m and 1.9 m thick layer of sand to silty sand fill. Cobbles ranging in size from 75 mm to 225 mm were encountered within the sand to silty sand fill. Borehole C35-4 encountered a lower layer of asphalt (less than 0.1 m thick) at a depth of 2.0 m below ground surface (Elevation 457.6 m) in turn underlain by a 0.9 m thick layer of gravelly sand fill.

The SPT 'N'-values measured within the fill range from 6 blows to 64 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The grain size distribution of a sample of the fill is shown on Figure L1 in Appendix L.

The natural water content measured on a sample of the fill is about 11 per cent.

### ***Peat/Topsoil***

From ground surface in Borehole C35-1, a 0.4 m thick layer of sandy topsoil was encountered at Elevation 456.4 m. Underlying the fill in Boreholes C35-2 and C35-4, an approximately 0.6 m to 0.7 m layer of peat was encountered at Elevation 456.6 m.

The SPT 'N'-values measured within the peat/topsoil deposit range from 1 blow to 14 blows per 0.3 m of penetration, suggesting a firm to stiff consistency.

The natural water content measured on a sample of the peat is about 59 per cent.



### ***Sandy Silt to Gravelly Silty Sand***

Underlying the peat/topsoil in Boreholes C35-1 and C35-4 a deposit of sandy silt to silt and sand or gravelly silty sand was encountered at Elevation 356.0 m and from ground surface in Borehole C35-3 and the thickness of the deposit ranges from 1.7 m to 2.2 m.

The SPT 'N'-values measured within this deposit range from 0 blows (weight of hammer) to 83 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The grain size distribution of three samples of the silt and sand to gravelly silty sand deposit is shown on Figure L2 in Appendix L.

The natural water content measured on two samples of the gravelly silty sand is about 12 per cent and 15 per cent and that of one sample of the silt and sand is about 19 per cent.

### ***Sand and Gravel***

Underlying the peat in Borehole C35-2, a 2.2 m thick deposit of sand and gravel was encountered at Elevation 455.9 m.

Two SPT 'N'-values measured within the sand and gravel deposit are 6 blows and 21 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The grain size distribution of a sample of the sand and gravel deposit is shown on Figure L3 in Appendix L.

The natural water content measured on a sample of the sand and gravel deposit is about 11 per cent.

### ***Refusal/Boulder or Probable Bedrock***

In Boreholes C35-1 and C35-3, refusal to further spilt spoon and/or casing advancement was encountered at depths of 2.4 m and 2.2 m below ground surface at Elevation 454.0 m and 453.8 m, respectively. Boreholes C35-2 and C35-4 penetrated a 1.4 m and 0.3 m thick boulder, or broken fragments of probable bedrock, at depths of 5.9 m and 5.3 m below ground surface, at Elevations 453.7 m and 454.3 m, respectively.

### ***Groundwater Conditions***

The water levels measured in the open boreholes upon completion of drilling to range from ground surface to 3.5 m below ground surface, between Elevations 456.4 m and 456.0 m.

## **4.16 Culvert 37 – STA 13+943 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 13+943 in Murchison Township are shown on Drawing M1 in Appendix M. The height of the embankment at this location is about 4 m and the existing 900 mm diameter CSP is approximately 32 m long. A total of six (6) boreholes (Boreholes C37-1 to C37-6) and five (5) DCPTs were advanced at the culvert site.



### ***Embankment Fill***

Borehole C37-2 encountered a 90 mm thick layer of asphalt at Elevation 458.2 m underlain by a 3.9 m thick deposit of gravelly sand to silty sand fill, and a 125 mm diameter cobble at a depth of 3.5 m. Borehole C37-5 encountered a 0.1 m thick layer of topsoil fill at ground surface at Elevation 453.6 m, underlain by a 1.3 m thick deposit of silty sand to sandy silt fill.

The SPT 'N'-values measured within the fill deposit range from 3 blows to 35 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The grain size distribution of a sample of the gravelly sand fill is shown on Figure M1 in Appendix M.

The natural water content measured on a sample of the fill is about 5 per cent.

### ***Peat/Topsoil***

From ground surface in Boreholes C37-1, C37-3, C37-4 and C37-6 and underlying the fill in Borehole C37-2, the boreholes encountered a 0.1 m and 0.4 m thick layer of peat or topsoil, with the surface at between Elevations 455.7 m and 453.6 m.

One SPT 'N'-values measured within the surficial peat in Borehole C37-1 is 2 blows per 0.3 m of penetration, suggesting a soft consistency, and one value measured in the peat below the fill in Borehole C37-2 is 28 blows per 0.3 m of penetration, suggesting a very stiff consistency.

The natural water content measured on the sample of peat in Borehole C37-2 is about 18 per cent.

### ***Sandy Silt to Silt and Sand***

Underlying the peat/topsoil in Boreholes C37-2, C37-3 and C37-6, a 0.5 m to 4.3 m thick layer of sandy silt to silt and sand was encountered between Elevation 455.6 m to 453.6 m.

The SPT 'N'-values measured within the sandy silt to silt and sand range from 4 blows to 53 blows per 0.3 m of penetration, suggesting a loose to very dense relative density.

The grain size distribution of two samples of the silt and sand portion of the deposit is shown on Figure M2 in Appendix M.

The natural water content measured on samples of the sandy silt to silty sand is about 17 per cent.

### ***Gravelly Silty Sand to Sand and Gravel***

Boreholes C37-1 to C37-3 and C37-5 and C37-6 encountered a deposit of gravelly silty sand to silty sand and gravel between Elevation 455.3 m to 449.5 m and the thickness ranges from 0.5 m to 4.4 m.

The SPT 'N'-values measured within the gravelly silty sand to silty sand and gravel deposit range from 18 blows to 104 blows per 0.3 m of penetration, suggesting a compact to very dense relative density.



The grain size distribution of five samples of the gravelly silty sand to silty sand and gravel deposit is shown on Figure M3 in Appendix M.

The natural water content measured on samples of the gravelly silty sand to sand and gravel is about 7 per cent to 16 per cent.

### ***Refusal***

In Boreholes C37-1, C37-2, C37-5 and C37-6, refusal to split spoon and/or casing advancement was encountered at depths ranging from 1.1 m to 11.7 m below ground surface, corresponding to between Elevation 454.6 m and 446.5 m. DCPTs carried out adjacent to Boreholes C37-1 to C37-3 and C37-6 encountered refusal at depths ranging from 1.0 m and 8.6 m below ground surface.

### ***Groundwater Conditions***

The water levels upon completion of drilling were measured ranging at depths from ground surface to 4.6 m below ground surface between Elevation 455.7 m and 452.6 m.

## **4.17 Culvert 23 – STA 32+256 (Airy Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 32+256 in Airy Township are shown on Drawing N1 in Appendix N. The height of the embankment at this location is about 4 m and the existing 900 mm diameter CSP is approximately 32 m long. A total of three (3) boreholes (Boreholes C23-1 to C23-3) and one (1) DCPT were advanced at the culvert site.

### ***Embankment Fill***

Borehole C23-2 encountered a 100 mm thick layer of asphalt at Elevation 362.1 m underlain by a 5.0 m thick deposit of sand to sand and gravel fill, a 0.1 m thick layer of asphalt within the fill deposit and a 2.9 m thick layer of sand fill at Elevation 360.0 m.

The SPT 'N'-values measured within the fill deposit range from 4 blows to 59 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The grain size distribution of a sample of the sand fill is shown on Figure N1 in Appendix N.

The natural water content measured on a sample of the fill is about 6 per cent.

### ***Peat***

A deposit of peat to silty sandy peat was encountered from ground surface in Boreholes C23-1 and C23-3 at Elevations 357.9 m and 357.8 m, and underlying the embankment fill a depth of 5.0 m below ground surface in Borehole C23-2 corresponding to Elevation 357.1 m. The overall thickness of the peat deposit ranges from



0.9 m to 1.8 m including a 0.6 m thick layer of brown sandy silt, trace organics was encountered within the peat in Borehole C23-3 at a depth of 0.3 m corresponding to Elevation 357.8 m.

The SPT 'N'-values measured within the peat deposit range from 2 blows to 5 blows per 0.3 m of penetration, suggesting a soft to firm consistency.

The natural water content measured on two samples of the peat deposit are about 69 per cent and 108 per cent.

### ***Sand***

Underlying the peat deposit in each of the boreholes, a 3.7 m to 5.4 m thick deposit of sand was encountered but not fully penetrated in two of the boreholes, at depths ranging from 1.5 m to 5.9 m below ground surface and from Elevation 356.4 m and 365.0 m. In Borehole C23-3, a cobble was encountered at a depth of 3.6 m within the sand deposit.

The SPT 'N'-values measured within the sand deposit range from 5 blows to 84 blows per 0.3 m of penetration indicating a loose to very dense relative density.

The grain size distributions of four samples of the sand deposit is shown on Figure N2 in Appendix N.

The natural water content measured on four samples of the sand deposit range from 19 per cent to 35 per cent

### ***Refusal***

In Borehole C23-3, refusal to casing advancement was encountered at a depth of 5.5 m below ground surface, corresponding to Elevation 352.3 m. A DCPT driven adjacent to Borehole C23-3 encountered refusal at a depth of 5.3 below ground surface.

### ***Groundwater Conditions***

The water levels in the open boreholes upon completion of drilling were measured at depths ranging from 0.4 m to 4.6 m below ground surface, between Elevation 357.5 m and 357.4 m.

## **4.18 Culvert 28 – STA 10+674 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 10+674 in Murchison Township are shown on Drawing O1 in Appendix O. The height of the embankment at this location is about 4 m and the existing 900 mm diameter CSP is approximately 32 m long. A total of three (3) boreholes (Boreholes C28-1 to C28-3) were advanced at the culvert site.

### ***Embankment Fill***

Borehole C28-2 encountered a 100 mm thick layer of asphalt at Elevation 390.3 m underlain by a 3.8 m thick fill deposit comprised of sand to sand and gravel.



The SPT 'N'-values measured within the fill deposit range from 7 blows to 78 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The natural water content measured on a sample of the fill is about 3 per cent.

### ***Peat***

A 0.2 m to 1.0 m thick deposit of peat to silty peat was encountered from ground surface in Boreholes C28-1 and C28-3 and underlying the embankment fill in Borehole C28-2 at a depth of 3.8 m below the ground surface, between Elevations 386.5 m and 3.85.8 m.

Two SPT 'N'-values measured within the peat deposit are 2 blows to 3 blows per 0.3 m of penetration, suggesting a soft consistency.

### ***Silt and Sand to Sand and Gravel***

A deposit of silt and sand to silty gravelly sand to sandy gravel to sand and gravel was encountered underlying the peat deposit in all boreholes. The deposit was encountered at depths ranging from 0.2 m to 4.8 m below ground surface, ranging from Elevation 385.8 m to 385.5 m. Cobbles were noted in the deposit in Borehole C28-2 and the upper 0.6 m of the deposit in Borehole C28-3.

The SPT 'N'-values measured within the silt and sand to sand and gravel deposit range from 15 blows to 73 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distributions of five samples of this deposit is shown on Figure O1 in Appendix O.

The natural water content measured on samples of this deposit range from about 9 per cent to 12 per cent.

### ***Groundwater Conditions***

The water levels in the open boreholes upon completion of drilling were measured at depths ranging from ground surface to 5.3 m below ground surface, between Elevation 386.3 m and 385.0 m.

## **4.19 Culvert 29 – STA 11+410 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 11+410 in Murchison Township are shown on Drawing P1 in Appendix P. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP is approximately 25 m long. A total of three (3) boreholes (Boreholes C29-1 to C29-3) were advanced at the culvert site.

### ***Embankment Fill***

Borehole C29-2 encountered a 100 mm thick layer of asphalt at Elevation 359.9 m underlain by a 4.5 m thick deposit of gravelly sand fill. Two cobbles of 100 mm to 225 mm were encountered within the deposit at 2.0 m



and 0.8 m depth, respectively, requiring NW casing and NQ coring techniques to advance the boreholes within this deposit.

The SPT 'N'-values measured within the fill deposit range from 22 blows to 101 blows per 0.3 m of penetration, and 60 blows for 0.15 m of penetration inferred to be on a cobble, indicating a compact to very dense relative density.

The grain size distributions of one sample of the deposit is shown on Figure P1 in Appendix P.

The natural water content measured on a sample of the fill is about 5 per cent.

### ***Peat***

A 0.3 m and 0.8 m thick deposit of silty peat was encountered from ground surface in Boreholes C29-1 and C29-3, corresponding to Elevation 357.1 m and 356.1 m, respectively.

The SPT 'N'-values measured within the peat deposit are 6 blows and 7 blows per 0.3 m of penetration, suggesting a firm consistency.

The natural water content measured on a sample of the silty peat is about 48 per cent.

### ***Silt and Sand to Silty Sand and Gravel***

A deposit of silt and sand to sand to silty sand and gravel was encountered beneath the peat deposit in Boreholes C29-1 and C29-3 and underlying the embankment fill in Borehole C29-2. The deposit was encountered ranging from 0.3 m to 4.6 m below the ground surface, ranging from Elevation 356.8 m to 355.3 m.

The SPT 'N'-values measured within the deposit range from 14 blows to 81 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distributions of four samples of this deposit are shown on Figure P2 in Appendix P.

The natural water content measured on samples of this deposit range from about 9 per cent to 12 per cent.

### ***Bedrock***

In Borehole C29-2, the surface of the bedrock was encountered at a depth of 7.4 m below ground surface (Elevation 352.5 m) and was cored for a length of 3.1 m. The retrieved bedrock core is described as fresh, coarse grained grey gneiss, as presented in the Record of Drillhole sheets in Appendix O. The Total Core Recovery is 100 per cent. The Rock Quality Designation (RQD) measured on the core samples is 100 per cent, indicating a rock mass of excellent quality as per Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006).



### **Groundwater Conditions**

The water levels in the open boreholes upon completion of drilling were measured at depths ranging from 0.2 m to 4.7 m below ground surface, between Elevation 356.9 m and 355.2 m.

## **4.20 Culvert 30 – STA 11+817 (Murchison Township)**

The plan and profile along the culvert centreline showing the borehole locations and interpreted stratigraphy at approximately STA 11+817 in Murchison Township are shown on Drawing Q1 in Appendix Q. The height of the embankment at this location is about 4 m and the existing 750 mm diameter CSP is approximately 29 m long. A total of three (3) boreholes (Boreholes C30-1 to C30-3) were advanced at the culvert site.

### **Embankment Fill**

Borehole C30-2 encountered an 80 mm thick layer of asphalt at Elevation 396.4 m underlain by a 3.3 m thick deposit of sand to sand and gravel fill. In Borehole C30-1 a 1.5 m thick layer of fill comprised of 0.2 m of silty peat and 1.3 m of sandy silt was encountered at ground surface at Elevation 393.3 m.

The SPT 'N'-values measured within the sand to sand and gravel fill deposit, including those measured at the contact between the silty peat/sandy silt fill and sand fill/silt and sand deposit, range from 7 blows to 50 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The grain size distribution of a sample of the sand fill is shown on Figure Q1 in Appendix Q.

The natural water content measured on a sample of the fill is about 5 per cent.

### **Peat**

A 1.0 m thick deposit of fibrous peat was encountered from ground surface in Borehole C30-3, corresponding to Elevation 391.5 m.

A SPT 'N'-value measured within the peat deposit is 0 blows (weight of hammer) per 0.3 m of penetration, suggesting a very soft consistency.

### **Silt and Sand to Silty Gravelly Sand**

A deposit of silt and sand to silty gravelly sand was encountered underlying the embankment fill in Boreholes C30-1 and C30-2 and underlying the peat in C30-3. The deposit was encountered at depths ranging from 1.0 m to 3.4 m below the ground surface, ranging from Elevation 393.0 m to 390.5 m.

The SPT 'N'-values measured within the non-cohesive deposit range from 12 blows to 93 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The grain size distributions of six samples of this deposit is shown on Figure Q1 in Appendix Q.

The natural water content measured on samples of this deposit range from about 9 per cent to 25 per cent.



### ***Refusal***

In Borehole C30-2, refusal to split spoon advancement was encountered at a depth of 9.4 m below ground surface, corresponding to Elevation 387.0 m.

### ***Groundwater Conditions***

The water levels in the open boreholes upon completion of drilling were measured at depths ranging from 0.5 m to 6.6 m below ground surface, between Elevations 392.5 m and 389.8 m.

## **5.0 CLOSURE**

The drilling program was supervised by Messrs. Shane Albert, Gabriel Mathieu, Cody Walter, Adam Core, and Ed Savard and this report was prepared by Mr. Adam Core, E.I.T. The technical aspects were reviewed by Mr. André Bom, P.Eng., and Mr. Jorge M. A. Costa, P.Eng., Principal and Golder's Designated MTO Contact for this project, carried out a quality control review of the report.



## Report Signature Page

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AC/AB/JMAC/kp

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15jan28 fnl hwy 60 fir.docx



**FOUNDATION REPORT - HIGHWAY 60 CULVERT REPLACEMENTS**  
**GWP 5198-10-00**

**Table 1: Summary of Culvert Details**

Culvert Location Highway 60 (Township)	Approximate Existing Embankment Height (m)	Existing Culvert			Approximate Existing Inlet/Outlet Invert Elevation (m)	Boreholes	Reference Appendix
		Type	Size (mm)	Length (m)			
Culvert 2A STA 23+188	4	CSP	750	28		3 Boreholes (C2A-1 to C2A-3) 3 Probe holes (P1 to P3) and 1 DCPT	A
Culvert 3 STA 23+313 (Airy)	9	CSP	750	48	463.3/462.3	7 Boreholes (C3-1 to C3-7) and 1 DCPT	A
Culvert 4 STA 23+698 (Airy)	4	CSP	750	24	480.0/479.6	4 Boreholes (C4-1 to C4-4) and 3 DCPTs	B
Culvert 7 STA 25+121 (Airy)	4	CSP	750	27	449.9/449.3	4 Boreholes (C7-1 to C7-4) and 3 DCPTs	C
Culvert 15 STA 28+446 (Airy)	4	CSP	1200	34	424.1/422.3	4 Boreholes (C15-1 to C15-4) and 3 DCPTs	D
Culvert 17 STA 29+350 (Airy)	5	CSP	900	34	399.3/399.2	6 Boreholes (C17-1 to C17-6) and 3 DCPTs	E
Culvert 18 STA 29+825 (Airy)	4	CSP	900	25	392.9/392.4	4 Boreholes (C18-1 to C18-4) and 3 DCPTs	F
Culvert 19 STA 30+277 (Airy)	4	CSP	900	32	369.8/369.3	4 Boreholes (C19-1 to C19-4) and 3 DCPTs	G
Culvert 21 STA 31+406 (Airy)	4	CSP	750	34	363.0/362.7	4 Boreholes (C21-1 to C21-4) and 4 DCPT	H



**FOUNDATION REPORT - HIGHWAY 60 CULVERT REPLACEMENTS**  
**GWP 5198-10-00**

**Table 1: Summary of Culvert Details**

Culvert Location Highway 60 (Township)	Approximate Existing Embankment Height (m)	Existing Culvert			Approximate Existing Inlet/Outlet Invert Elevation (m)	Boreholes	Reference Appendix
		Type	Size (mm)	Length (m)			
Culvert 26 STA 33+156 (Airy)	7	CSP	900	40	382.6/382.2	6 Boreholes (C26-1 to C26-3 and C26-7 to C26-9) and 5 DCPTs	I
Culvert 27 STA 10+294 (Murchison)	5	CSP	750	30	392.0/390.1	4 Boreholes (C27-1 to C27-4) and 3 DCPTs	J
Culvert 33 STA 12+628 (Murchison)	5	CSP	750	35	441.4/440.3	7 Boreholes (C33-1 to C33-7) and 3 DCPTs	K
Culvert 35 STA 13+530 (Murchison)	4	CSP	750	34	455.5/455.3	4 Boreholes (C35-1 to C35-4) and 3 DCPTs	L
Culvert 37 STA 13+943 (Murchison)	4	CSP	750	32	453.4/453.0	6 Boreholes (C37-1 to C37-6) and 5 DCPTs	M
Culvert 23 STA 32+256 (Airy)	4	CSP	900	32	356.8/356.6	3 Boreholes (C23-1 to C23-3) and 1 DCPT	N
Culvert 28 STA 10+674 (Murchison)	4	CSP	900	32	385.4/386.9	3 Boreholes (C28-1 to C28-3)	O
Culvert 29 STA 11+410 (Murchison)	4	CSP	750	25	392.3/391.7	3 Boreholes (C29-1 to C29-3)	P
Culvert 30 STA 11+817 (Murchison)	4	CSP	750	29	393.1/390.9	3 Boreholes (C30-1 to C30-3)	Q

Prepared by: AC  
Reviewed by: AB



**FOUNDATION REPORT - HIGHWAY 60 CULVERT REPLACEMENTS**  
**GWP 5198-10-00**

**Table 2: Summary of Analytical Testing of Surface Water**

Culvert Location Highway 60 (Township)	Parameter (Units, Detection Limit)				
	Chloride (mg/L, 0.2)	Sulphate (mg/L, 1)	Conductivity (µS/cm, 1)	Resistivity (Mohm-cm)	pH
Culvert 2A STA 23+188 (Airy)	-	-	-	-	-
Culvert 3 STA 23+313 (Airy)	-	-	-	-	-
Culvert 4 STA 23+698 (Airy)	-	-	-	-	-
Culvert 7 STA 25+121 (Airy)	230	19	970	1,000	7.37
Culvert 15 STA 28+446 (Airy)	80	12	360	2,800	7.19
Culvert 17 STA 29+350 (Airy)	110	ND	440	2,300	6.83
Culvert 18 STA 29+825 (Airy)	1,200	ND	4,000	250	7.09
Culvert 19 STA 30+277 (Airy)	140	ND	520	1,900	6.93
Culvert 21 STA 31+406 (Airy)	-	-	-	-	-
Culvert 23 STA 32+256 (Airy)	8	ND	55	18,000	5.99
Culvert 26 STA 33+156 (Airy)	110	2	410	2,500	6.71
Culvert 27 STA 10+294 (Murchison)	ND	ND	44	23,000	6.62
Culvert 28 STA 10+674 (Murchison)	-	-	-	-	-
Culvert 29 STA 11+410 (Murchison)	-	-	-	-	-
Culvert 30 STA 11+817 (Murchison)	-	-	-	-	-
Culvert 33 STA 12+628 (Murchison)	210	9	840	1,200	7.07
Culvert 35 STA 13+530 (Murchison)	13	10	140	7,100	6.76
Culvert 37 STA 13+943 (Murchison)	6	ND	93	11,000	6.65

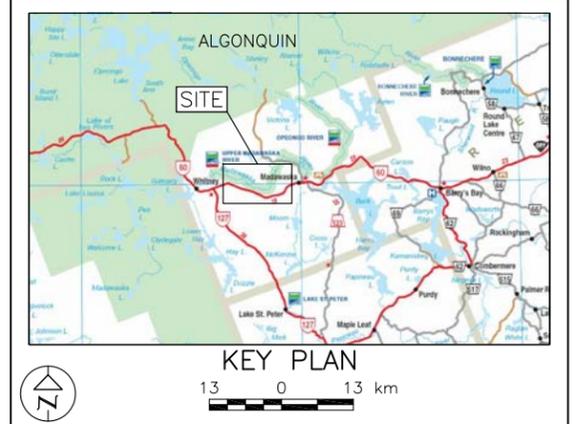
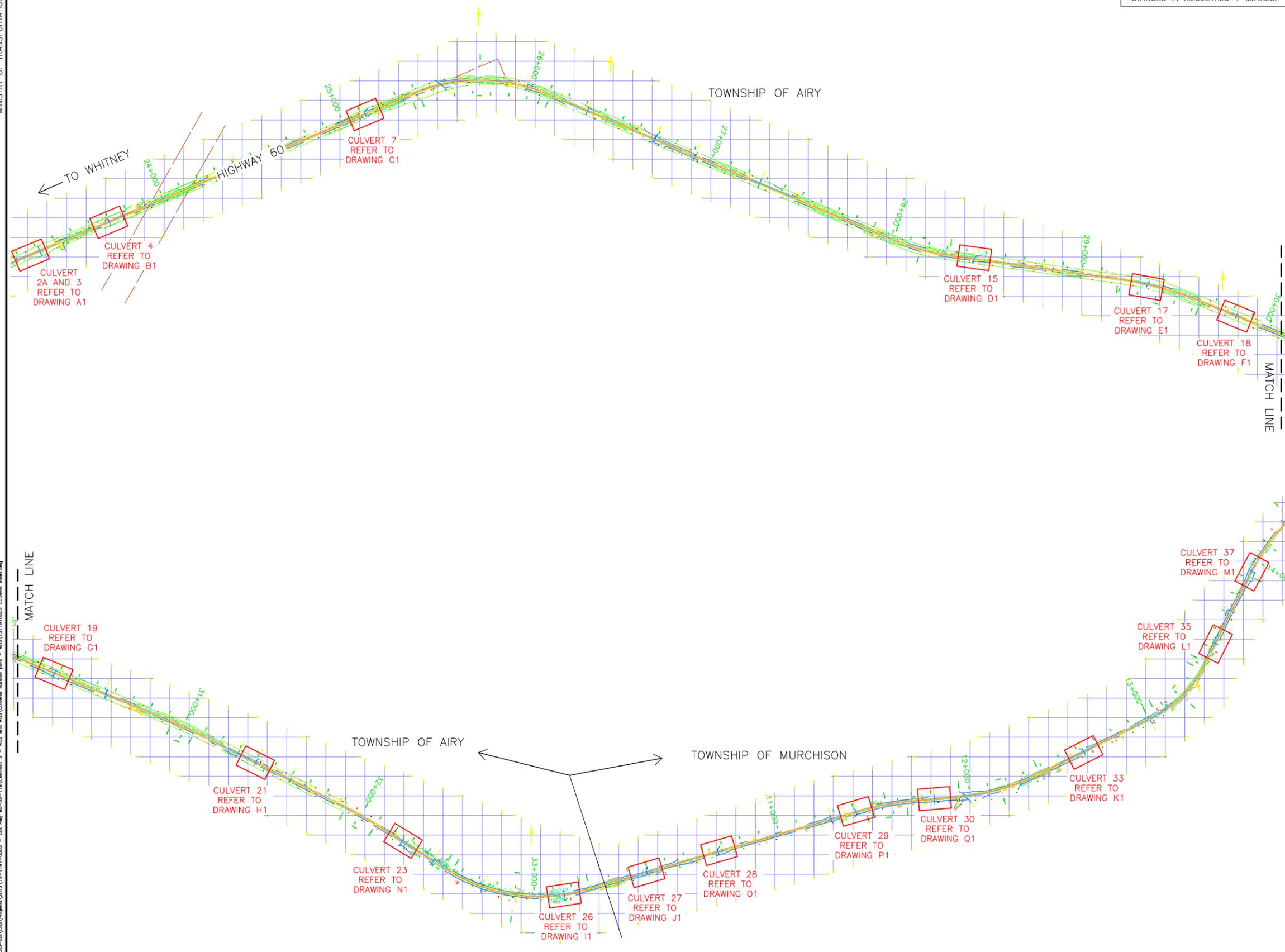
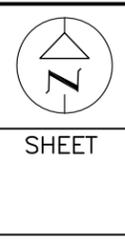
- Notes:
1. Samples obtained September 14, 2013.
  2. Analytical testing carried out by Maxam.
  3. Culverts 3, 4 and 21 were dry at time of sampling event on September 14, 2013.
  4. Culverts 2A, 28, 29, and 30 were dry at time of sampling on November 11, 2014.
  5. ND – Not Detected

Prepared by: AC  
 Reviewed by: AB

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

CONT No.  
**GWP No. 5198-10-00**

HIGHWAY 60  
 CULVERT INDEX PLAN



**NOTES**

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

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00 TEMP.dwg, received FEB 13, 2014.

**PLAN**



P:\IT\PROJECTS\2013\13-1191-0003 - LEA Hwy 60-35-118\Contract 3 - R02 and R03\Culverts outside park - R03\131910003\Culverts index.dwg  
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 DATE: 13-11-2014 10:00:00 AM  
 USER: jmac

NO.	DATE	BY	REVISION

Geocres No.

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE:
		DWG. 1



## LIST OF SYMBOLS

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

<b>I.</b>	<b>GENERAL</b>	<b>(a)</b>	<b>Index Properties (continued)</b>
$\pi$	3.1416	w	water content
$\ln x$ ,	natural logarithm of x	$w_l$ or LL	liquid limit
$\log_{10}$	x or log x, logarithm of x to base 10	$w_p$ or PL	plastic limit
g	acceleration due to gravity	$I_p$ or PI	plasticity index = $(w_l - w_p)$
t	time	$w_s$	shrinkage limit
FoS	factor of safety	$I_L$	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>II.</b>	<b>STRESS AND STRAIN</b>	<b>(b)</b>	<b>Hydraulic Properties</b>
$\gamma$	shear strain	h	hydraulic head or potential
$\Delta$	change in, e.g. in stress: $\Delta \sigma$	q	rate of flow
$\varepsilon$	linear strain	v	velocity of flow
$\varepsilon_v$	volumetric strain	i	hydraulic gradient
$\eta$	coefficient of viscosity	k	hydraulic conductivity (coefficient of permeability)
$\nu$	Poisson's ratio	j	seepage force per unit volume
$\sigma$	total stress	<b>(c)</b>	<b>Consolidation (one-dimensional)</b>
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )	$C_c$	compression index (normally consolidated range)
$\sigma'_{vo}$	initial effective overburden stress	$C_r$	recompression index (over-consolidated range)
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)	$C_s$	swelling index
$\sigma_{oct}$	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$	$C_\alpha$	secondary compression index
$\tau$	shear stress	$m_v$	coefficient of volume change
u	porewater pressure	$C_v$	coefficient of consolidation (vertical direction)
E	modulus of deformation	$C_h$	coefficient of consolidation (horizontal direction)
G	shear modulus of deformation	$T_v$	time factor (vertical direction)
K	bulk modulus of compressibility	U	degree of consolidation
		$\sigma'_p$	pre-consolidation stress
		OCR	over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$
<b>III.</b>	<b>SOIL PROPERTIES</b>	<b>(d)</b>	<b>Shear Strength</b>
<b>(a)</b>	<b>Index Properties</b>	$\tau_p, \tau_r$	peak and residual shear strength
$\rho(\gamma)$	bulk density (bulk unit weight)*	$\phi'$	effective angle of internal friction
$\rho_d(\gamma_d)$	dry density (dry unit weight)	$\delta$	angle of interface friction
$\rho_w(\gamma_w)$	density (unit weight) of water	$\mu$	coefficient of friction = $\tan \delta$
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	$c'$	effective cohesion
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )	$C_u, S_u$	undrained shear strength ( $\phi = 0$ analysis)
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )	p	mean total stress $(\sigma_1 + \sigma_3)/2$
e	void ratio	$p'$	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
n	porosity	q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
S	degree of saturation	$q_u$	compressive strength $(\sigma_1 - \sigma_3)$
		$S_t$	sensitivity

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

**Notes:** 1  
2

$\tau = c' + \sigma' \tan \phi'$   
shear strength = (compressive strength)/2



## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

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

#### Dynamic Cone Penetration Resistance; $N_d$ :

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm<sup>2</sup> 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.

### V. MINOR SOIL CONSTITUENTS

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

### III. SOIL DESCRIPTION

#### (a) Non-Cohesive (Cohesionless) Soils

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

#### (b) Cohesive Soils Consistency

	<u>kPa</u>	<u>C<sub>u</sub>, S<sub>u</sub></u>	<u>psf</u>
Very soft	0 to 12		0 to 250
Soft	12 to 25		250 to 500
Firm	25 to 50		500 to 1,000
Stiff	50 to 100		1,000 to 2,000
Very stiff	100 to 200		2,000 to 4,000
Hard	over 200		over 4,000

### IV. SOIL TESTS

w	water content
w <sub>p</sub>	plastic limit
w <sub>l</sub>	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
D <sub>R</sub>	relative density (specific gravity, G <sub>s</sub> )
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 <sub>4</sub>	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.



## WEATHERINGS STATE

**Fresh:** no visible sign of weathering

**Faintly weathered:** weathering limited to the surface of major discontinuities.

**Slightly weathered:** penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

**Moderately weathered:** weathering extends throughout the rock mass but the rock material is not friable.

**Highly weathered:** weathering extends throughout rock mass and the rock material is partly friable.

**Completely weathered:** rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

## BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

## JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

## GRAIN SIZE

<u>Term</u>	<u>Size*</u>
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: \* Grains greater than 60 microns diameter are visible to the naked eye.

## CORE CONDITION

### Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

### Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

### Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

## DISCONTINUITY DATA

### Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

### Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

### Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

### Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	



# APPENDIX A

Culvert 2A STA 23+188 and 3 – STA 23+313 (Airy Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 2A - STA 23+188 AND  
CULVERT 3 - STA 23+313  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA

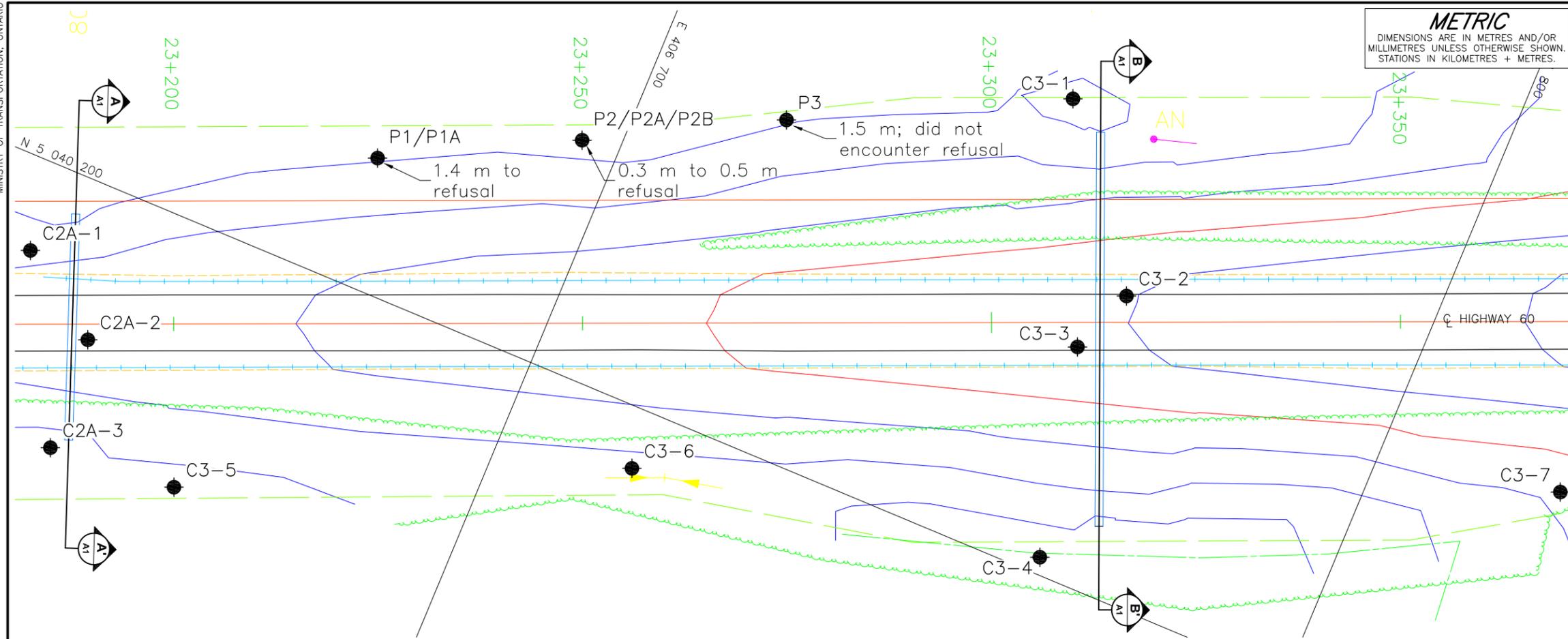


KEY PLAN  
13 0 13 km



LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ≡ WL upon completion of drilling



PLAN  
SCALE  
6 0 6 12 m

BOREHOLE CO-ORDINATES

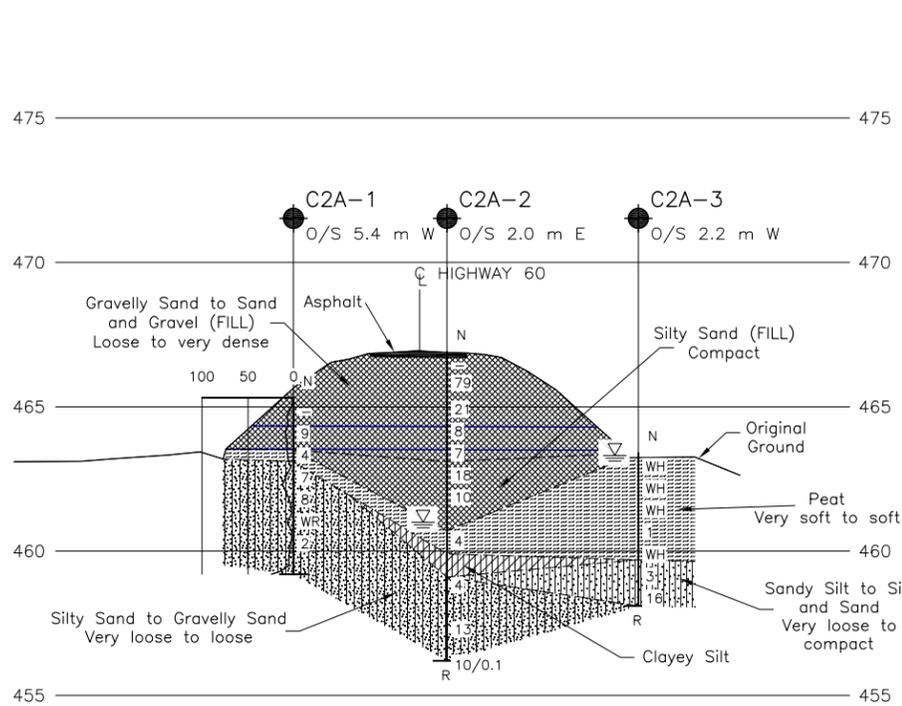
No.	ELEVATION	NORTHING	EASTING
C2A-1	465.3	5040189.0	406638.3
C2A-2	466.9	5040181.7	406648.9
C2A-3	463.4	5040167.8	406649.8
C3-1	463.8	5040255.2	406748.8
C3-2	471.9	5040235.5	406764.1
C3-3	471.6	5040227.5	406761.0
C3-4	462.8	5040202.1	406766.6
C3-5	463.4	5040169.2	406665.6
C3-6	466.0	5040192.9	406716.4
C3-7	467.9	5040233.9	406822.2
P1/P1A	463.1	5040215.8	406673.1
P2/P2A/P2B	463.6	5040227.4	406695.3
P3	463.3	5040239.3	406717.5

NOTES

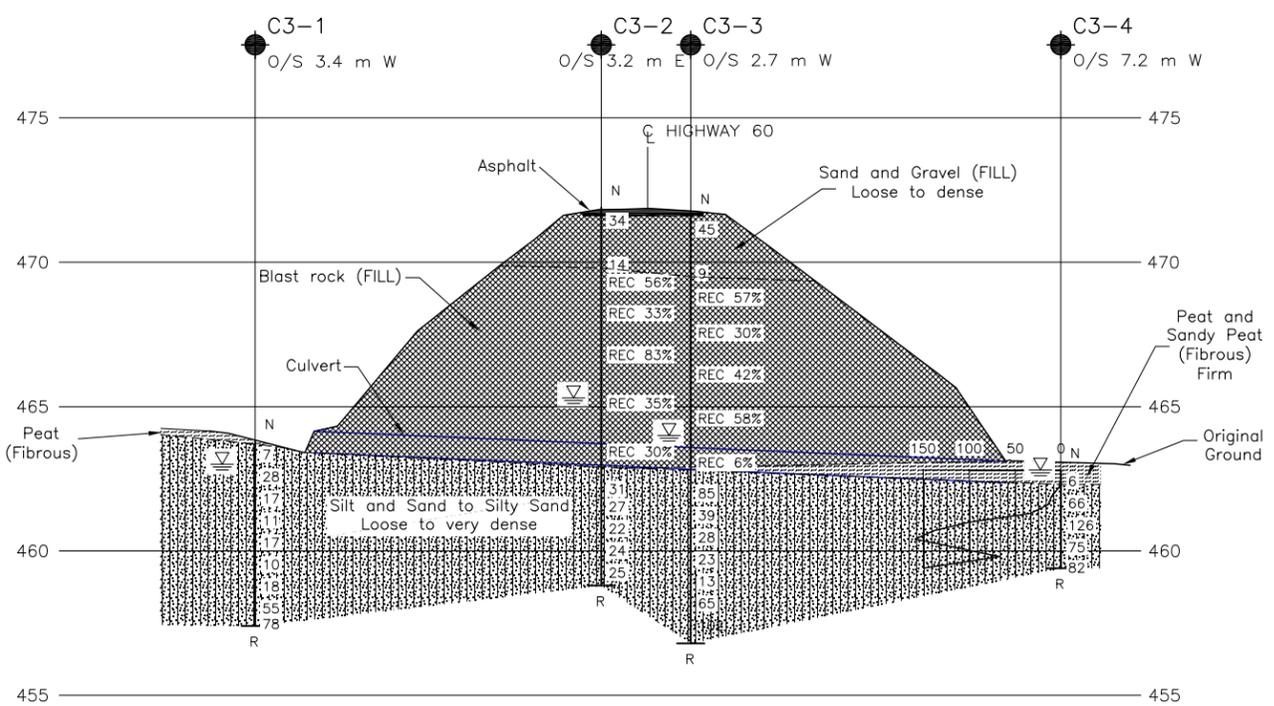
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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



PROFILE  
A-A'  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m



PROFILE  
B-B'  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m



REFERENCE  
Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.

NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY: 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. A1



**PHOTOGRAPHS**

**Photograph 1: Culvert 2A at STA 23+240  
Looking East from Culvert on South Side of Embankment (September 2014)**



**Photograph 2: Culvert 2A at STA 23+240  
Looking West from Culvert on North Site of Embankment from Toe of Slope (September 2014)**





PHOTOGRAPHS

**Photograph 3: Culvert 3 at STA 23+313  
Looking West from Culvert on South Side of Embankment (September 2013)**



**Photograph 4: Culvert 3 at STA 23+313  
Looking East from Culvert on North Side of Embankment (September 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C2A-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040189.0; E 406638.3</u>	ORIGINATED BY <u>MT</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 19, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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		GR SA SI CL
465.3 0.0	GROUND SURFACE Sand and gravel (FILL) Loose Brown Moist		1	AS	-										
			2	SS	9										
463.5	PEAT (Fibrous) Soft Black Wet		3	SS	4										
463.1 2.2	Silty SAND to Gravelly SAND, trace clay Very loose to loose Grey Wet		4	SS	7										
			5	SS	8										25 57 14 4
			6	SS	WR										
			7	SS	2										
459.2 6.1	END OF BOREHOLE  Notes: 1. Stopped borehole due to heaving sand in augers. Water level not obtained. 2. Advanced DCPT 0.6 m east of borehole.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C2A-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040181.7; E 406648.9</u>	ORIGINATED BY <u>MT</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 18, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
466.9	GROUND SURFACE															
0.0	ASPHALT (150 mm)															
0.2	Gravelly sand to sand and gravel (FILL) Loose to very dense Brown to grey Moist to wet		1	AS	-											
			2	SS	79											
			3	SS	21											
			4	SS	8						○				20	65 (15)
			5	SS	7											
463.1	Silty sand, trace to some gravel (FILL) Compact Grey Wet		6	SS	18											
			7	SS	10											
460.7	PEAT (Fibrous) Soft Black Wet		8	SS	4								○			
459.9	CLAYEY SILT, trace organics Grey Wet															
459.1	SILT and SAND, trace to some gravel, trace clay Loose to compact Grey Wet		9	SS	4											
			10	SS	13						○				10	52 33 5
456.2	END OF BOREHOLE SPLIT-SPOON AND AUGER REFUSAL (HAMMER BOUNCING)		11	SS	10/0.4											
10.7	Notes: 1. Water level at a depth of 5.9 m below ground surface (Elev. 461.0 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C2A-3** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5040167.8; E 406649.8 ORIGINATED BY MT  
 DIST                      HWY 60 BOREHOLE TYPE Portable Equipment COMPILED BY AC  
 DATUM GEODETIC DATE September 17-18, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
463.4	GROUND SURFACE																		
0.0	PEAT (Fibrous) Very soft Black Wet		1	SS	WH														
			2	SS	WH														
			3	SS	WH														
			4	SS	1														
			5	SS	WH														
459.7																			
3.7	Sandy SILT, trace clay Very loose to compact Grey Wet		6	SS	3														
			7	SS	16														
458.1																			
5.3	END OF BOREHOLE REFUSAL TO FURTHER CASING ADVANCEMENT (HAMMER BOUNCING)  Notes:  1. Water level at a depth of 0.1 m below ground surface (Elev. 463.3 m) upon completion of drilling.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040255.2; E 406748.8</u>	ORIGINATED BY <u>GM</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>July 28, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)								
						20	40	60	80	100						GR	SA	SI	CL						
463.8	GROUND SURFACE																								
0.0	PEAT (Fibrous)		1	SS	7	▽																			
0.1	Silty SAND, trace to some gravel, trace clay Loose to very dense Brown Moist to wet		2	SS	28																				
			3	SS	17																	12	55	28	5
			4	SS	11																				
			5	SS	17																				
			6	SS	10																				
			7	SS	18																				
			8	SS	55																				
			9	SS	78																				
457.4	END OF BOREHOLE SPLIT-SPOON REFUSAL (HAMMER BOUNCING)																								
6.4	Notes:  1. Water level at a depth of 0.8 m below ground surface (Elev. 463.0 m) upon completion of drilling.																								

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040235.5; E 406764.1</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 10 and 11, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
											○ UNCONFINED	+ FIELD VANE				
											● QUICK TRIAXIAL	× REMOULDED				
											WATER CONTENT (%)					
											20	40	60			
471.9	GROUND SURFACE															
0.0	ASPHALT (80 mm)															
0.1	Sand and gravel, trace silt (FILL) Compact to dense Brown Moist		1	SS	34											
	A 100 mm diameter cobble was encountered at 1.2 m depth.															
469.8			2	SS	14											
2.1	Blast rock (FILL)		-	RC	REC 56%											
			-	RC	REC 33%											
			-	RC	REC 83%											
			-	RC	REC 35%											
			-	RC	REC 30%											
462.9																
9.0	SILT and SAND to Silty SAND, trace to some gravel, trace clay Compact to dense Grey Wet		3	SS	31							○				8 55 31 6
			4	SS	27											
			5	SS	22											
			6	SS	24							○				10 60 25 5
			7	SS	25											
458.8																
13.1	END OF BOREHOLE RESISTANCE TO FURTHER CASING ADVANCEMENT															
	Note: 1. Water level at a depth of 6.6 m below ground surface (Elev. 465.3 m) inside casing upon completion of drilling (water level falling slowly).															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-3</b>	1 OF 2 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040227.5; E 406761.0</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 9 and 10, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60						80	100	20
471.6	GROUND SURFACE																	
0.0	ASPHALT (75 mm)		1	SS	45													
0.1	Sand and gravel, trace silt (FILL) Loose to dense Brown Moist																	
469.5			2	SS	9													
2.1	Blast rock (FILL)																	
			-	RC	REC 57%													
			-	RC	REC 30%													
			-	RC	REC 42%													
			-	RC	REC 58%													
			-	RC	REC 6%													
462.9	PEAT (Fibrous), some sand, trace gravel Brown Wet																	
8.8	Silty SAND, trace to some gravel, trace clay Compact to very dense Grey Wet		4	SS	85													
			5	SS	39													11 58 26 5
			6	SS	28													
			7	SS	23													
			8	SS	13													
			9	SS	65													11 60 23 6
			10	SS	102													
456.8																		
14.8																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

Continued Next Page

 +<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-3</b>	2 OF 2 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040227.5; E 406761.0</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 9 and 10, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	END OF BOREHOLE RESISTANCE TO FURTHER CASING ADVANCEMENT  Note:  1. Water level at a depth of 7.6 m below ground surface (Elev. 464.0 m) inside casing upon completion of drilling (water level falling slowly).															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040202.1; E 406766.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 21 and 22, 2014</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40					
462.8	GROUND SURFACE													
0.0	Sandy PEAT (Fibrous)		1	SS	6									
462.3	Firm Black Wet													
0.5	SILT and SAND, trace to some gravel, trace clay Very dense Grey Wet		2	SS	66									
			3	SS	126									5 59 31 5
			4	SS	75									
459.4	END OF BOREHOLE SPOON REFUSAL AND RESISTANCE TO FURTHER CASING ADVANCEMENT		5	SS	82									
3.4	Notes: 1. Water level at ground surface (Elev. 462.8 m) upon completion of drilling. 2. Advanced DCPT 0.8 m south of borehole. Refusal at a depth of 3.3 m.													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-5</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040169.2; E 406665.6</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 21, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
463.4	GROUND SURFACE															
0.0	PEAT (Fibrous), some sand Very soft Black Wet		1	SS	1											
			2	SS	WH											
462.0																
1.4	Sandy PEAT (Amorphous) Stiff Black Wet		3	SS	11											
461.3																
2.1	Silty SAND, trace clay Compact to very dense Grey Wet		4	SS	21											
			5	SS	30											
459																
458.4			6	SS	58											
5.0	END OF BOREHOLE															
	Note: 1. Water level at ground surface (Elev. 463.4 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-6</b>	1 OF 1	<b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040192.9 ;E 406716.4</u>	ORIGINATED BY <u>EHS</u>	
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>	
DATUM <u>GEODETIC</u>	DATE <u>May 21, 2014</u>	CHECKED BY <u>AB</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
466.0	GROUND SURFACE																	
0.0	Sandy TOPSOIL		1	SS	2													
465.6	Loose Black Moist																	
0.4																		
465.0	Silty SAND, trace to some gravel		2	SS	23/0.2													
1.0	Compact Grey Moist																	
	END OF BOREHOLE SPOON REFUSAL AND RESISTANCE TO FURTHER CASING ADVANCEMENT																	
	Note: 1. Borehole dry upon completion of drilling.																	

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C3-7</b>	1 OF 1	<b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040233.9 ;E 406822.2</u>	ORIGINATED BY <u>EHS</u>	
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>	
DATUM <u>GEODETIC</u>	DATE <u>May 27, 2014</u>	CHECKED BY <u>AB</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
467.9	GROUND SURFACE																	
0.0	Silty TOPSOIL		1	SS	5													
467.3	Loose Brown Moist																	
466.9	SILT and SAND, trace gravel, trace organics		2	SS	18/0.2													
1.0	Compact Brown Wet																	
	END OF BOREHOLE SPOON REFUSAL (Rods sliding)																	
	Note: 1. Water level at a depth of 0.7 m below ground surface (Elev. 467.2 m) upon completion of drilling. 2. Split spoon sample obtained by driving with a half weight hammer. SPT 'N' value has been adjusted to the inferred values that would be obtained using a standard weight hammer. 3. Exposed bedrock noted about 4 m south of borehole and also about 3 m east of borehole.																	

SUD-MTO 002 13-1191-0003.GPJ GAL=MISS.GDT 15/07/14 DATA INPUT:



PROJECT 13-1191-0003 **RECORD OF PROBEHOLE No P1/P1A** 1 OF 1 **METRIC**  
 G.W.P. 5141-11-01 LOCATION N 5040215.8; E 406673.1 ORIGINATED BY EHS  
 DIST          HWY 60 BOREHOLE TYPE Portable Equipment COMPILED BY AC  
 DATUM GEODETIC DATE December 5, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
463.1	GROUND SURFACE															
0.0						463										
461.7						462										
1.4	END OF PROBEHOLE REFUSAL TO FURTHER PENETRATION (HAMMER AND RODS BOUNCING)  Note:  1. Moved 0.6 m north advanced additional probehole; refusal at 1.4 m depth.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 29/01/15 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF PROBEHOLE No P2/P2A/P2B</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5141-11-01</u>	LOCATION <u>N 5040227.4; E 406695.3</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>December 5, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
463.6	GROUND SURFACE																
0.0																	
463.1																	
0.5	END OF PROBEHOLE REFUSAL TO FURTHER PENETRATION (HAMMER AND RODS BOUNCING)  Notes:  1. Moved 1.3 m north advanced additional probehole; refusal at 0.3 m depth.  2. Moved 1.6 m north advanced additional probehole; refusal at 0.3 m depth.																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 29/01/15 DATA INPUT:

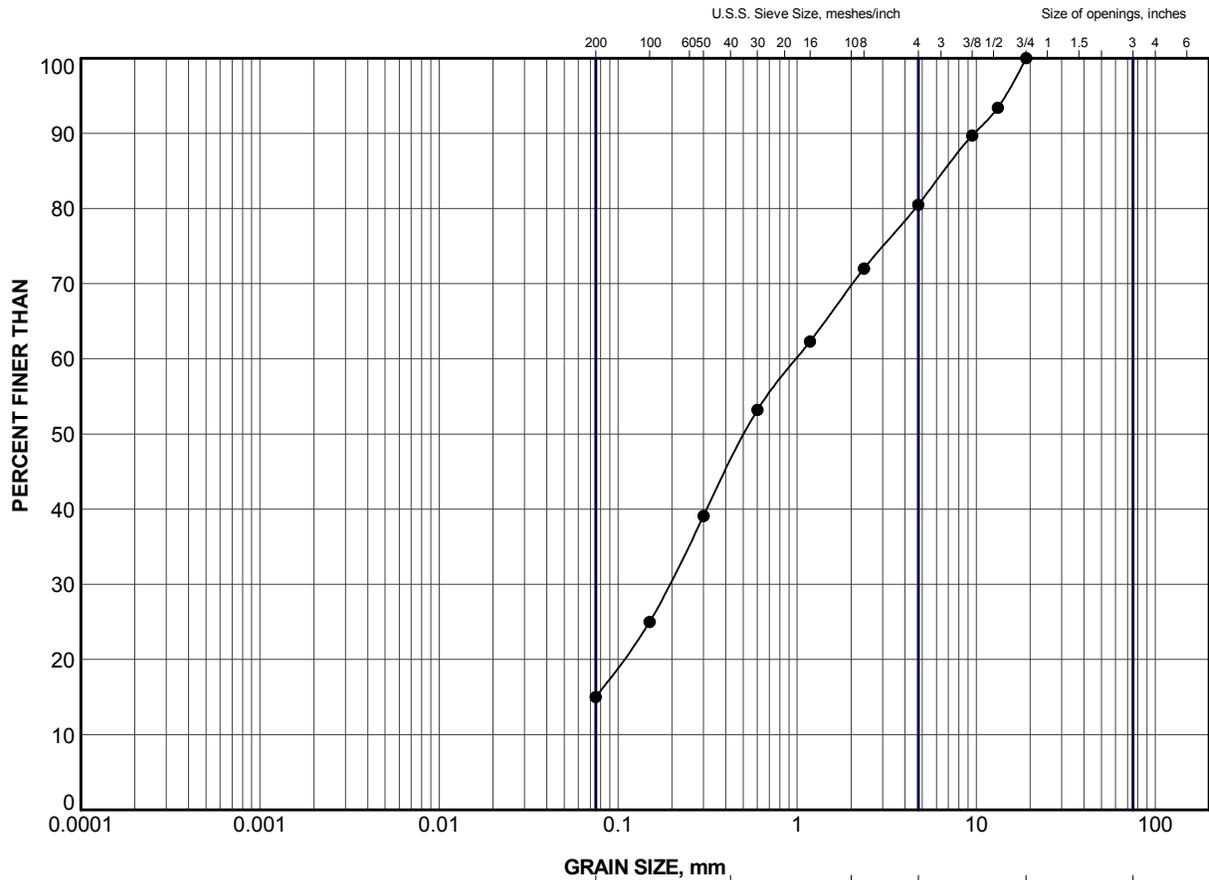


PROJECT 13-1191-0003 **RECORD OF PROBEHOLE No P3** 1 OF 1 **METRIC**  
 G.W.P. 5141-11-01 LOCATION N 5040239.3; E 406717.5 ORIGINATED BY EHS  
 DIST          HWY 60 BOREHOLE TYPE Portable Equipment COMPILED BY AC  
 DATUM GEODETIC DATE December 5, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100	20					
463.3 0.0	GROUND SURFACE						463										
461.8 1.5	END OF PROBEHOLE						462										

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 29/01/15 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



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

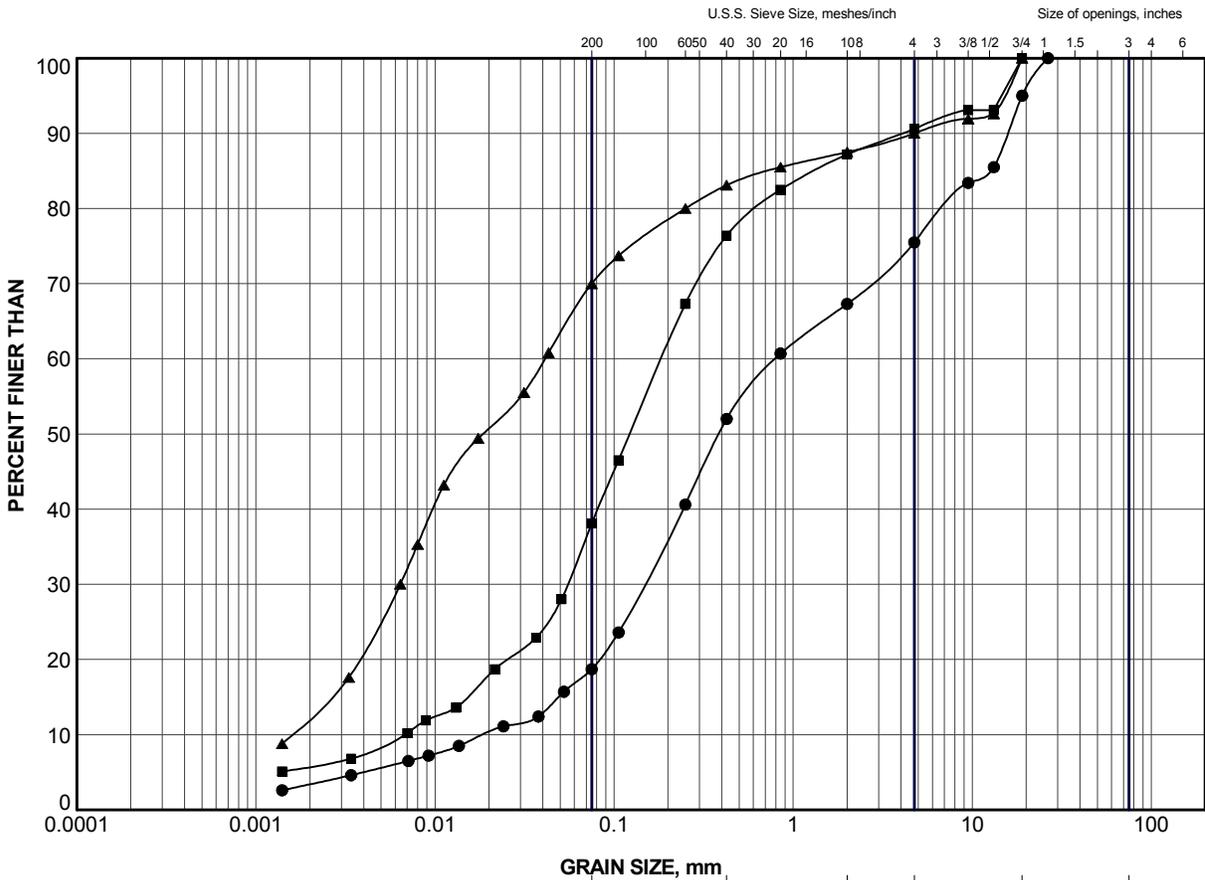
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2A-2	4	464.3

PROJECT					HIGHWAY 60 CULVERT 2A				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Dec 2014			SCALE	N/A	REV.		
CHECK	AB	Dec 2014			<b>FIGURE A1</b>				
APPR		Dec 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

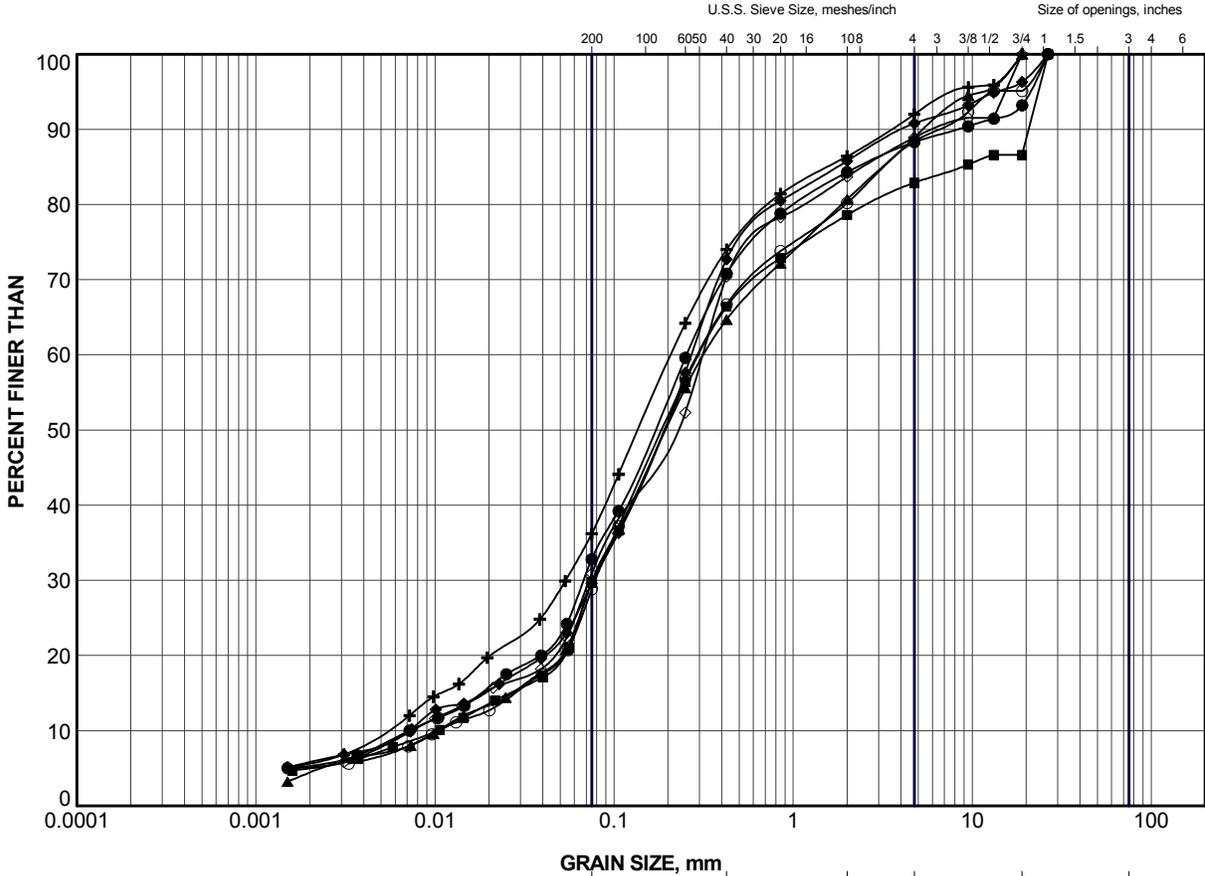
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C2A-1	5	462.0
■	C2A-2	10	457.5
▲	C2A-3	7	458.5

PROJECT					HIGHWAY 60 CULVERT 2A				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SANDY SILT to GRAVELLY SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Dec 2014			SCALE	N/A		REV.	
CHECK	AB	Dec 2014			APPR		<b>FIGURE A2</b>		
APPR		Dec 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C3-1	3	462.0
■	C3-1	5	460.5
▲	C3-1	8	458.2
+	C3-2	3	462.3
◆	C3-2	6	460.2
◇	C3-3	5	461.4
○	C3-3	9	458.3

PROJECT					HIGHWAY 60 CULVERT 3				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILTY SAND to SILT and SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Nov 2014			SCALE	N/A	REV.		
CHECK	AB	Nov 2014			APPR		<b>FIGURE A3</b>		
APPR		Nov 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# **APPENDIX B**

**Culvert 4 – STA 23+698 (Airy Township)**

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 4 - STA 23+698  
BOREHOLE LOCATIONS AND SOIL STRATA

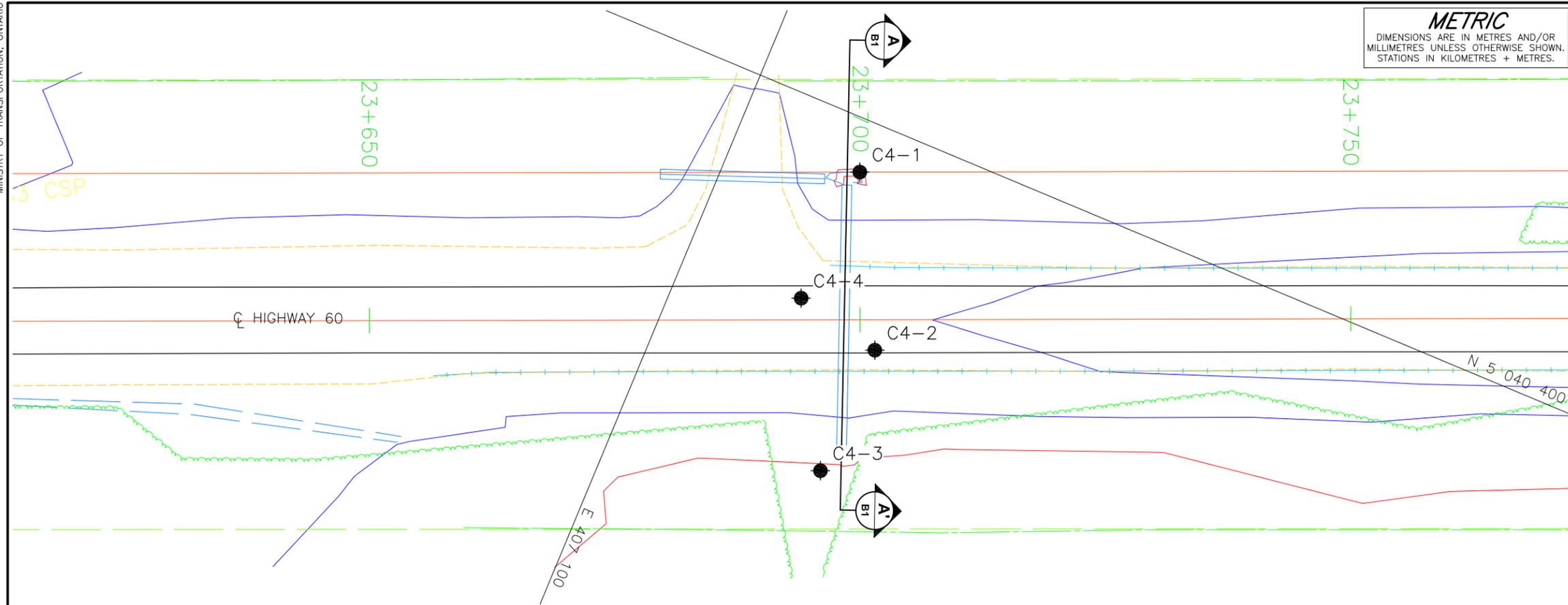
SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km



PLAN



LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C4-1	479.6	5040394.8	407113.2
C4-2	483.8	5040378.7	407121.5
C4-3	479.7	5040365.3	407121.1
C4-4	483.8	5040380.7	407112.6

NOTES

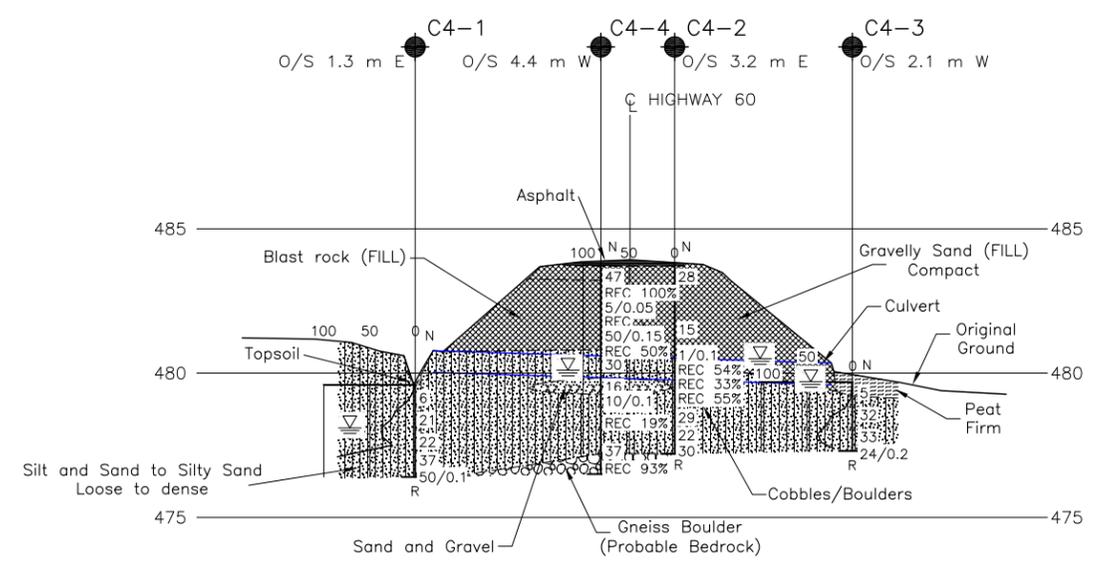
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



PROFILE  
A-A'  
B1  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. B1



PHOTOGRAPHS

**Photograph 1: Culvert 4 at STA 23+698  
Looking East at North Embankment and Culvert (September 2013)**



**Photograph 2: Culvert 4 at STA 23+698  
Looking East from South Shoulder at Culvert location (September 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C4-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040394.8; E 407113.2</u>	ORIGINATED BY <u>GM</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>July 28, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
479.6	GROUND SURFACE																		
0.0	TOPSOIL																		
	Silty SAND to SILT and SAND, trace gravel, trace to some clay Loose to dense Brown Moist to wet		1	SS	6														
			2	SS	21														
			3	SS	22						o					5	55	34	6
			4	SS	37														
476.4	END OF BOREHOLE SPOON AND AUGER REFUSAL		5	SS	5/0.1						o					1	50	43	6
3.2	Note: 1. Water level at a depth of 1.5 m below ground surface (Elev. 478.1 m) upon completion of drilling. 2. Advanced DCPT 5 m west of borehole, refusal at 2.5 m depth.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C4-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040378.7; E 407121.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 11, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100					
483.8	GROUND SURFACE														
0.0	ASPHALT (75 mm)		1	SS	28										
	Gravelly sand, trace to some silt (FILL)														
	Compact Brown Moist														
	Boulder at 1.2 m in DCPT.														
			2	SS	15										26 68 (6)
480.5			3	SS	1/0.1										
3.3	SILT and SAND to SAND, trace to some gravel, trace clay														
	Compact Brown Wet		4	RC	REC 33%										
	Cobbles and boulders were encountered as follows:														
	<u>Depth (m)</u> <u>Thickness (mm)</u>														
	3.3            475														
	4.1            100														
	4.3            300														
	4.7            100														
			5	SS	29										
			6	SS	22										9 53 34 4
477.2			7	SS	30										
6.6	END OF BOREHOLE RESISTANCE TO FURTHER CASING ADVANCEMENT														
	Note:														
	1. Water level at a depth of 3.3 m below ground surface (Elev. 480.5 m) upon completion of drilling.														
	2. Advanced DCPT 2 m east of borehole, after predrilling to 0.3 m, rods sliding at 1.2 m depth.														

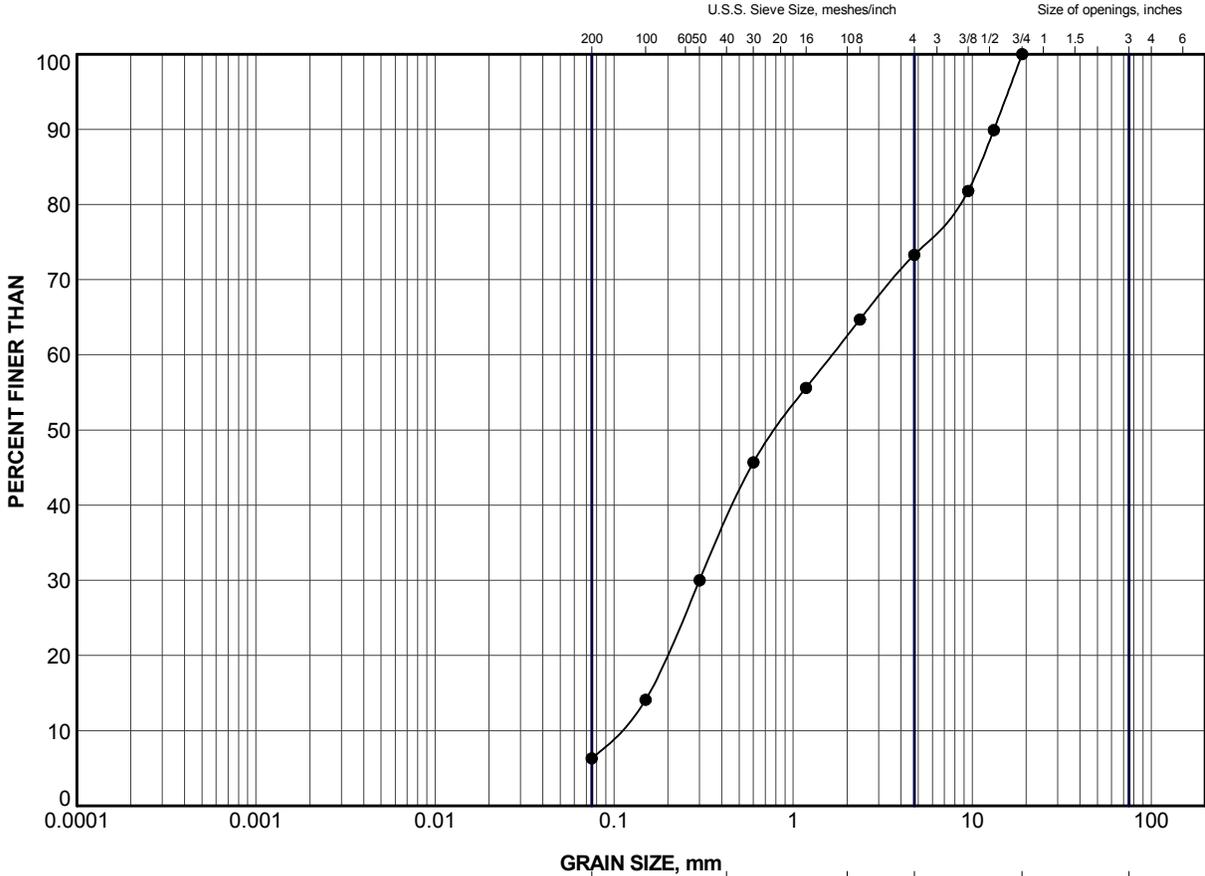
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C4-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040365.3; E 407121.1</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 5, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40
479.7	GROUND SURFACE																		
0.0	PEAT (Fibrous), trace sand, trace gravel		1	SS	5														
479.2	Firm Black Wet																		
0.5	Gravelly Silty SAND, trace clay		2	SS	32														
	Dense Brown Wet		3	SS	33														
477.3	END OF BOREHOLE SPOON REFUSAL AND RESISTANCE TO FURTHER CASING ADVANCEMENT		4	SS	24/0.2														
2.4	Notes: 1. Water level at ground surface (Elev. 479.7 m) upon completion of drilling. 2. Advanced DCPT 1.0 m east of Borehole C4-3. Refusal at a depth of 2.3 m.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:





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

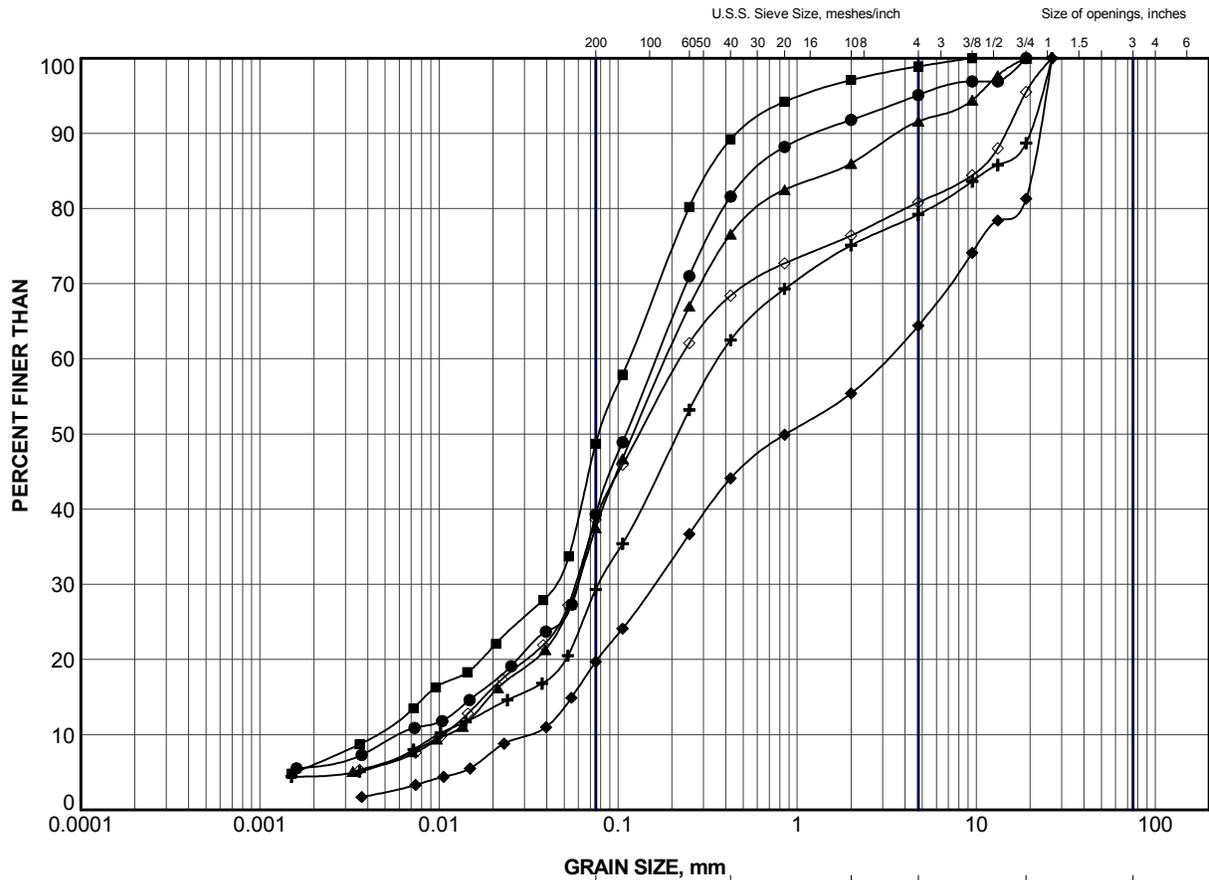
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C4-2	2	481.7

PROJECT					HIGHWAY 60 CULVERT 4				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A	REV.		
CHECK	AB	Jul 2014			<b>FIGURE B1</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C4-1	3	477.8
■	C4-1	5	476.5
▲	C4-2	6	478.0
+	C4-3	3	477.9
◆	C4-4	4	479.7
◇	C4-4	6	477.5

PROJECT					HIGHWAY 60 CULVERT 4				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to GRAVELLY SILTY SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE B2</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# **APPENDIX C**

**Culvert 7 – STA 25+121 (Airy Township)**

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 7 - STA 25+121  
 BOREHOLE LOCATIONS AND SOIL STRATA

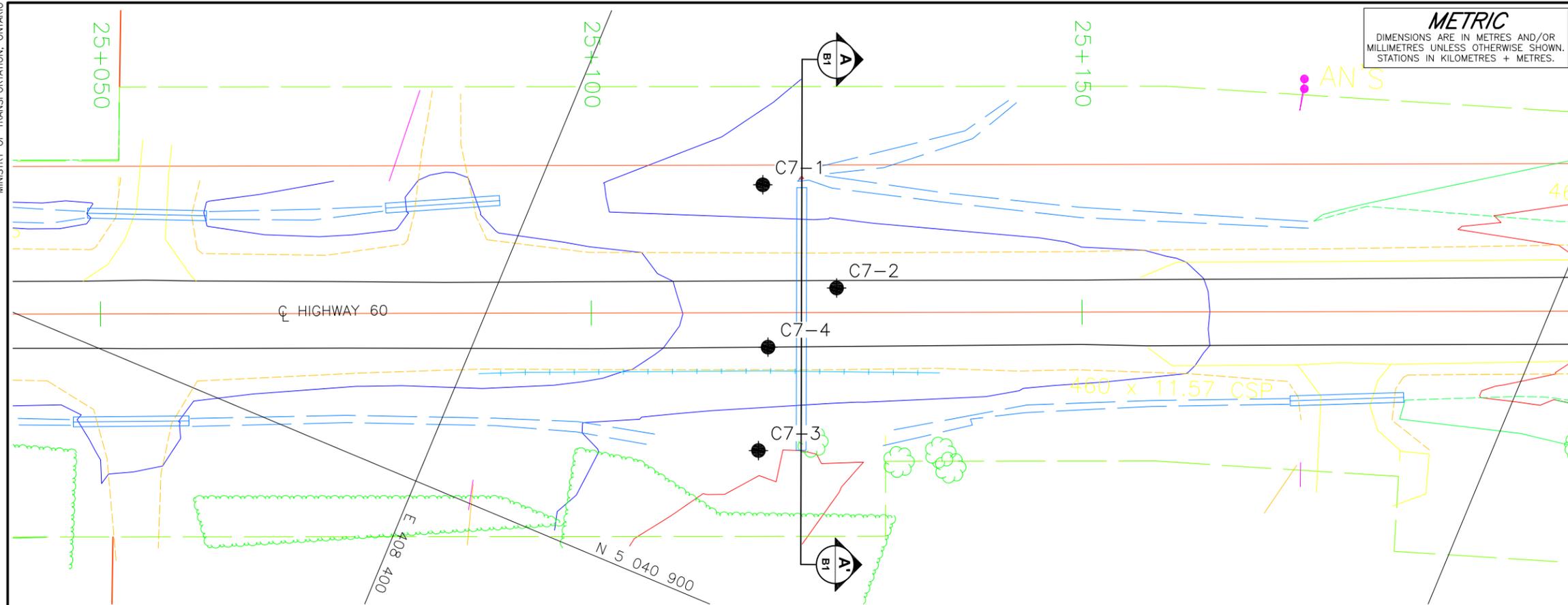
SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 13 0 13 km



PLAN

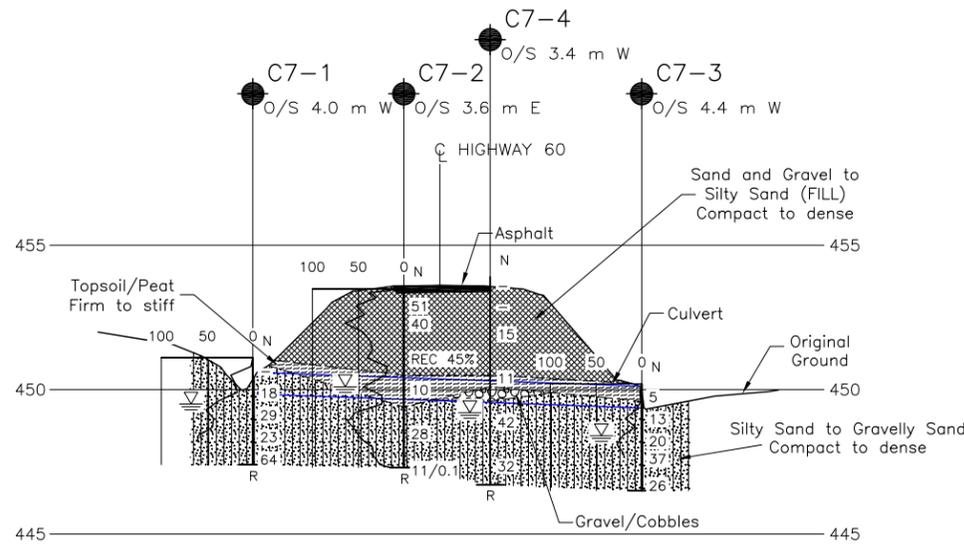
SCALE  
 5 0 5 10 m

**LEGEND**

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ∇ WL upon completion of drilling

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C7-1	451.1	5040941.4	408421.0
C7-2	453.5	5040934.6	408432.0
C7-3	450.2	5040916.3	408431.0
C7-4	453.9	5040926.4	408427.9



**PROFILE**  
 A-A'  
 C1  
 HIGHWAY 60  
 HORIZONTAL SCALE  
 5 0 5 10 m  
 VERTICAL SCALE  
 2.5 0 2.5 5 m

**NOTES**

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

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00 TEMP.dwg, received FEB 13, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. C1



**PHOTOGRAPHS**

**Photograph 1: Culvert 7 at STA 25+121  
Looking West along South shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert 7 at STA 25+121  
Looking East along North Shoulder at Culvert Location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C7-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040941.4; E 408421.0</u>	ORIGINATED BY <u>GM</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>August 9, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
451.1	GROUND SURFACE																	
0.0	TOPSOIL																	
0.1	Silty SAND, trace to some gravel, trace clay Compact to dense Grey Moist to wet		1	AS	-													
			2	SS	18													6 59 30 5
	Cobbles and/or boulders inferred from auger resistance between ground surface to bottom of borehole and DCPT refusal at 3.2 m depth.		3	SS	29													
			4	SS	23													
			5	SS	64													5 62 28 5
447.4	END OF BOREHOLE AUGER REFUSAL																	
3.7	Notes:  1. Water level at a depth of 1.6 m below ground surface (Elev. 449.5 m) upon completion of drilling.  2. Advanced DCPT 1 m east of borehole, refusal at 2.9 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C7-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040934.6; E 408432.0</u>	ORIGINATED BY <u>GM</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>August 8, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
453.5	GROUND SURFACE																	
0.0	ASPHALT (150 mm)																	
0.2	Sand and gravel, trace to some silt, trace clay (FILL) Dense Brown Moist  A 225 mm diameter cobble was encountered at 2.5 m depth.		1	SS	51									40	48	11	1	
			2	SS	40													
			3	RC	REC 45%													
450.5	PEAT (Amorphous), some sand, some gravel Stiff Black to brown Moist		4	SS	10													
449.4	Silty SAND, some gravel, trace clay Compact Brown to grey Wet		5	SS	28									19	53	23	5	
			6	SS	11/0.1													
447.3	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)  Notes: 1. Water level at a depth of 3.4 m below ground surface (Elev. 450.1 m) upon completion of drilling. 2. Advanced DCPT 1.5 m east of borehole, refusal at 6.2 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

**RECORD OF BOREHOLE No C7-3** 1 OF 1 **METRIC**

PROJECT 13-1191-0003 G.W.P. 5198-10-00 LOCATION N 5040916.3; E 408431.0 ORIGINATED BY GM

DIST                      HWY 60 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY AC

DATUM GEODETIC DATE August 9, 2013 CHECKED BY AB

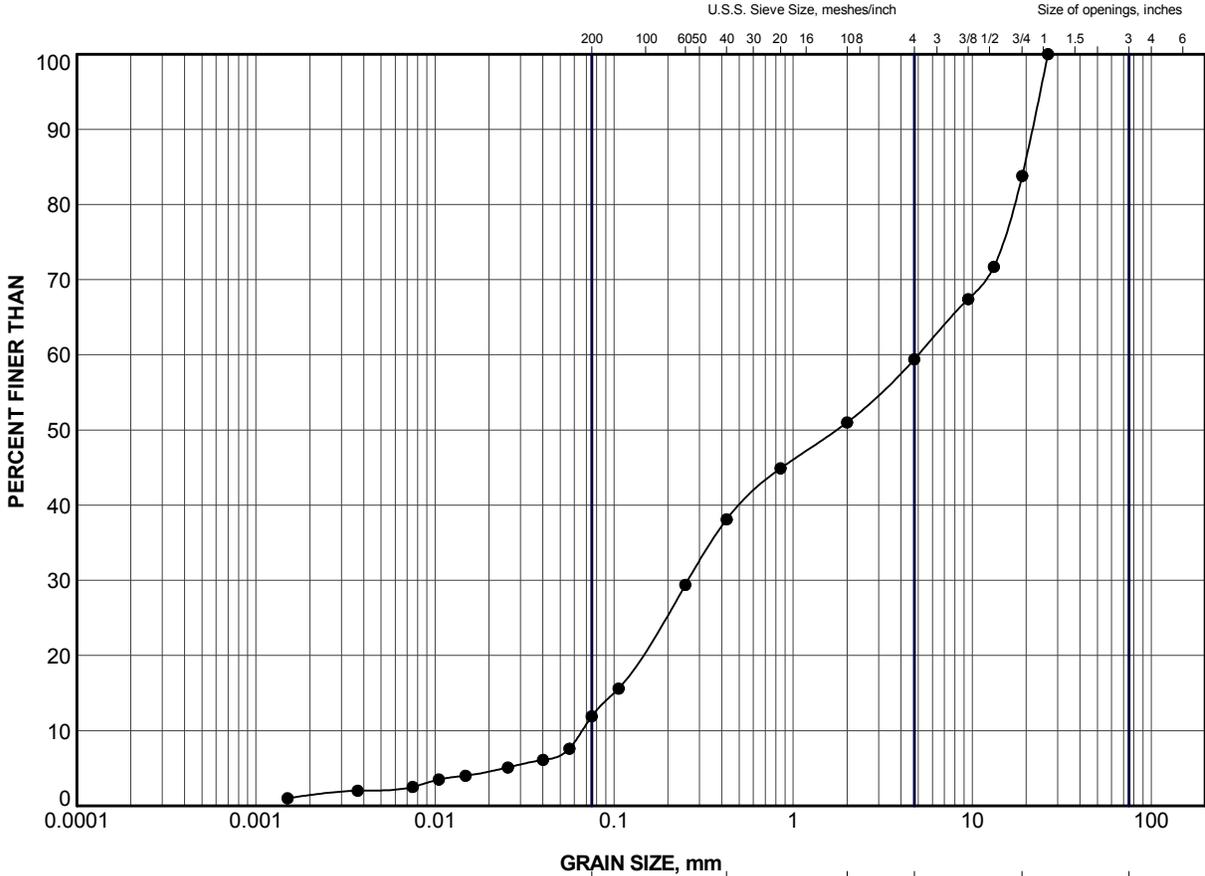
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60						80	100	20	40
450.2	GROUND SURFACE																		
0.0	PEAT (Fibrous), some sand Firm Black Moist		1	SS	5														
449.6	Gravelly SAND to SILT and SAND, trace to some clay Compact to dense Grey Wet		2	SS	13														
0.6	Auger refusal at 2.1 m depth, moved 1 m west, advanced augers to 2.1 m depth to continue sampling.		3	SS	20														24 58 15 3
	Cobbles inferred from auger grinding between 0.6 m and 3.7 m depth.		4	SS	37														
			5	SS	26														10 48 34 8
446.5	END OF BOREHOLE																		
3.7	Notes:  1. Water level at a depth of 1.8 m below ground surface (Elev. 448.4 m) upon completion of drilling.  2. Advanced DCPT 1 m east of borehole, rods sliding/bending at 2.3 m depth.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C7-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040926.4; E 408427.9</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>June 2, 2014</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
453.9	GROUND SURFACE																		
0.0	ASPHALT (75 mm)		1	AS	-														
	Sand and gravel to silty sand (FILL) Compact Brown Moist to wet		2	AS	-		453												
	Augers grinding at 1.5 m depth.		3	SS	15		452												
							451												
450.5	Sandy PEAT, trace gravel		4	SS	11														
450.1	Brown Wet						450												
3.8	GRAVEL/COBBLES																		
449.6	Augers grinding from 3.8 m to 4.3 m depth.																		
4.3	Silty SAND to SILT and SAND, trace to some gravel Dense Wet		5	SS	42		449									5	62	27	6
							448												
			6	SS	32		447												
446.7	END OF BOREHOLE AUGER REFUSAL																		
7.2	Note:  1. Water level at a depth of 4.7 m below ground surface (Elev. 449.2 m) upon completion of drilling.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:



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

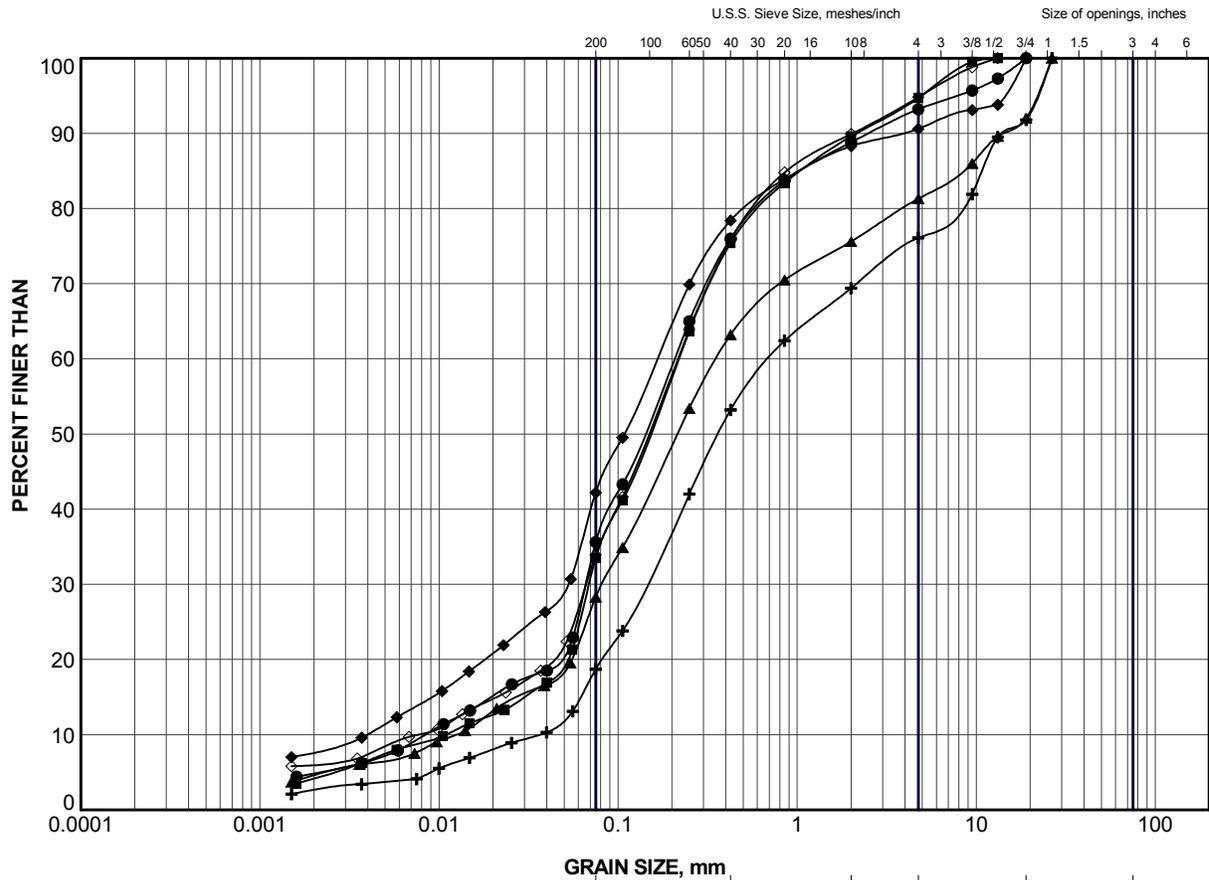
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-2	1	453.1

PROJECT					HIGHWAY 60 CULVERT 7				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A	REV.		
CHECK	AB	Jul 2014			<b>FIGURE C1</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-1	2	450.0
■	C7-1	4	448.5
▲	C7-2	5	448.6
+	C7-3	3	448.4
◆	C7-3	5	446.9
◇	C7-4	5	449.0

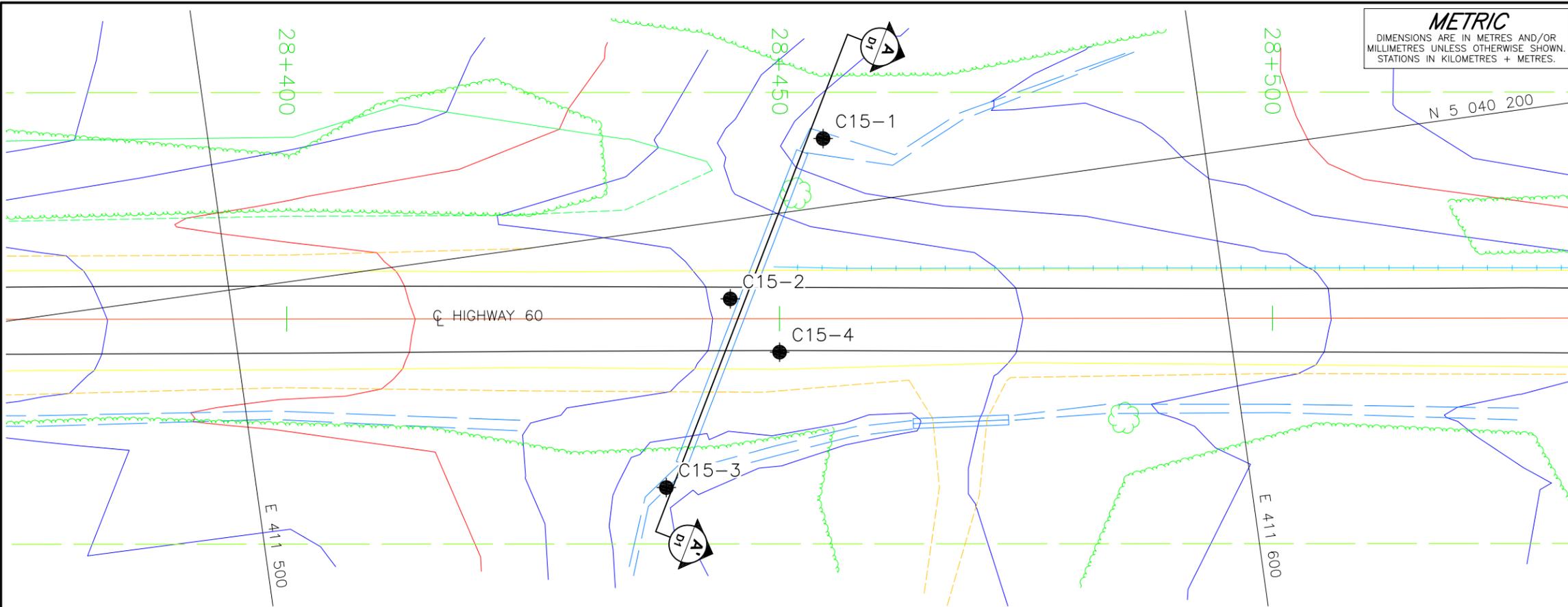
PROJECT					HIGHWAY 60 CULVERT 7					
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to GRAVELLY SAND					
DRAWN		TB	Jul 2014		PROJECT No.		13-1191-0003	FILE No.		13-1191-0003.GPJ
CHECK		AB	Jul 2014		SCALE		N/A	REV.		
APPR		JMAC	Jul 2014		<b>FIGURE C2</b>					



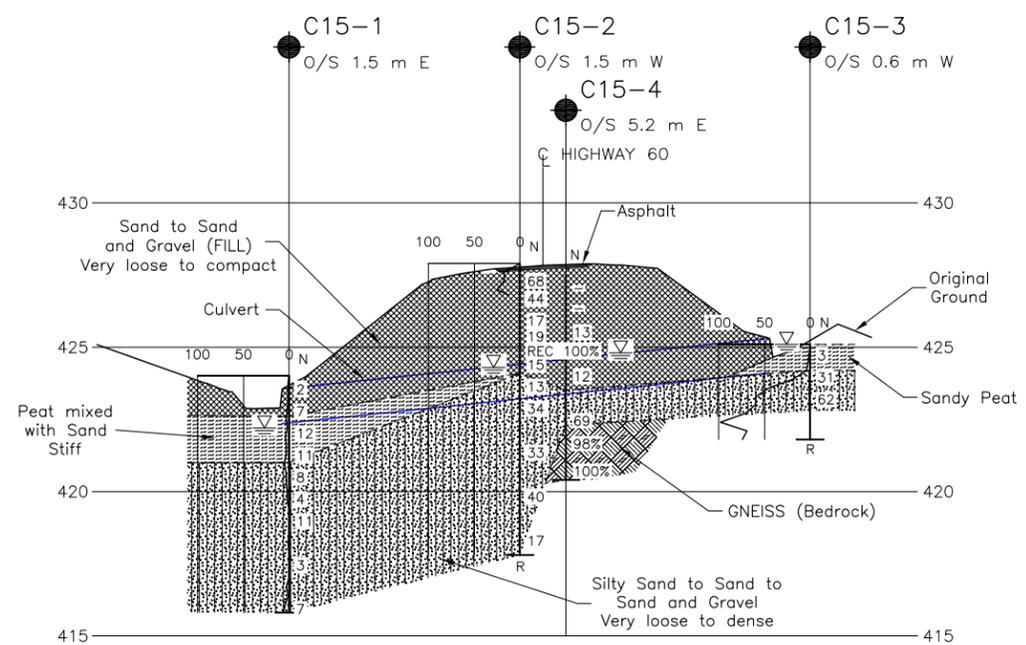
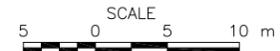


# **APPENDIX D**

## **Culvert 15 – STA 28+446 (Airy Township)**



PLAN



PROFILE  
 HIGHWAY 60  
 HORIZONTAL SCALE  
 VERTICAL SCALE

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

CONT No.  
 GWP No. 5198-10-00



HIGHWAY 60  
 Culvert 15 - STA 28+446  
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 15 0 15 km

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- 100% Rock Quality Designation (RQD)
- R Refusal
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C15-1	424.0	5040206.9	411561.8
C15-2	427.9	5040192.1	411550.2
C15-3	425.1	5040174.1	411541.2
C15-4	427.5	5040186.1	411554.5

NOTES

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

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

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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE: DWG. D1



## PHOTOGRAPHS

**Photograph 1: Culvert 15 at STA 28+446  
Looking East along South Shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert 15 at STA 28+446  
Looking West along South Shoulder at Culvert location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C15-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040206.9; E 411561.8</u>	ORIGINATED BY <u>GM</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>August 6 and 7, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)			
						20	40	60	80	100	20	40	60		GR	SA	SI	CL		
424.0	GROUND SURFACE																			
0.0	Peat (Fibrous) (FILL)		1	SS	2															
	Sand, trace to some silt, some organics (FILL) Very loose to loose Brown Wet		2	SS	7															
422.6	PEAT with sand																			
1.4	Stiff Brown Wet		3	SS	12															
			4	SS	11															
421.0	SAND, trace to some silt, trace gravel, trace clay Very loose to compact Brown Wet																			
3.0			5	SS	8															
			6	SS	4															
			7	SS	11															
			8	SS	3															
	From 0.6 m to 2.1 m of heave encountered in augers between 6.1 m and 7.6 m depth.																			
415.8	END OF BOREHOLE																			
8.2	Note: 1. Water level at a depth of 1.8 m below ground surface (Elev. 422.2 m) inside casing. 2. Advanced DCPT 1 m west of borehole.																			

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

**RECORD OF BOREHOLE No C15-2** 1 OF 1 **METRIC**

PROJECT 13-1191-0003 G.W.P. 5198-10-00 LOCATION N 5040192.1; E 411550.2 ORIGINATED BY GM

DIST                      HWY 60 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE August 7 and 8, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60
427.9	GROUND SURFACE																			
0.0	ASPHALT (150 mm)																			
0.2	Gravelly sand to sand and gravel, trace to some silt (FILL) Compact to very dense Brown Moist to wet  Cobbles encountered from 2.6 m to 3.0 m depth.  Boulder (450 mm) at 2.8 m depth.		1	SS	68															
			2	SS	44															44 46 (10)
			3	SS	17															
			4a	SS	19															
			4b	RC	REC 100%															
			5	SS	15															
423.3	Silty SAND, some gravel, trace clay Dense Brown Wet		7	SS	34													19 49 30 2		
422.3			8	SS	33															
417.8	SAND and GRAVEL, trace to some silt, trace clay Compact to dense Brown Wet  From 0.15 m to 0.22 m of heave encountered inside casing between 5.6 m and 9.1 m depth.		9	SS	40													35 57 6 2		
			10	SS	17															
417.8			10.1	END OF BOREHOLE RESISTANCE TO FURTHER CASING ADVANCEMENT																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C15-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040174.1; E 411541.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 13, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
425.1	GROUND SURFACE														
0.0	Sandy PEAT (Amorphous) Soft Black Wet		1	SS	3	▽	425								
424.2	Gravelly SAND, some silt Dense to very dense Brown Wet		2	SS	31		424								
0.9			3	SS	62		423								20 62 (18)
422.8	END OF BOREHOLE SPOON AND CASING REFUSAL					422									
2.3	END OF DCPT DCPT REFUSAL														
421.8	Notes:  1. Water level at ground surface (Elev. 425.1 m) upon completion of drilling.  2. Advanced DCPT 2.7 m south of Borehole. Refusal at a depth of 3.3 m.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MASS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C15-4</b>	1 OF 2 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040186.1; E 411554.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>June 2, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
427.5	GROUND SURFACE															
0.0	ASPHALT (125 mm)		1	AS	-											
	Sand and gravel to sand, some silt (FILL) Compact Brown Moist to wet		2	AS	-											20 64 (16)
	Augers grinding from 0.9 m to 1.2 m, 1.7 m to 2.0m, 2.7 m and 3.8 m depths.		3	SS	13											
			4	SS	12											11 72 14 3
423.5																
4.0	SAND and GRAVEL		5	SS	69											
	Very dense Brown to grey Wet															
422.3																
5.2	GNEISS BEDROCK		1	RC	REC 100%											RQD = 98%
	Bedrock cored from 5.2 m depth to 7.1 m depth.  For coring details see Record of Drillhole C15-4.		2	RC	REC 100%											RQD = 100%
420.4																
7.1	END OF BOREHOLE															
	Note:  1. Water level at a depth of 2.7 m below ground surface (Elev. 424.8 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT: 13-1191-0003

# RECORD OF DRILLHOLE: C15-4

SHEET 2 OF 2

LOCATION: N 5040186.1 ;E 411554.5

DRILLING DATE: June 2, 2014

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: George Downing Estate Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRALLIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES WATER LEVELS INSTRUMENTATION		
							TOTAL CORE %	SOLID CORE %			B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jun				k, cm/s	q
							FLUSH														
		REFER TO PREVIOUS PAGE		422.3																	
	NW CME 55 Truck Mount NO Coring	GNEISS Very fine to coarse grained Grey		5.2	1	GREY 100%															
					2	GREY 100%															
		END OF DRILLHOLE		420.4																	
				7.1																	
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

SUD-RCK 13-1191-0003.GPJ GAL-MISS.GDT 150714 DATA INPUT:

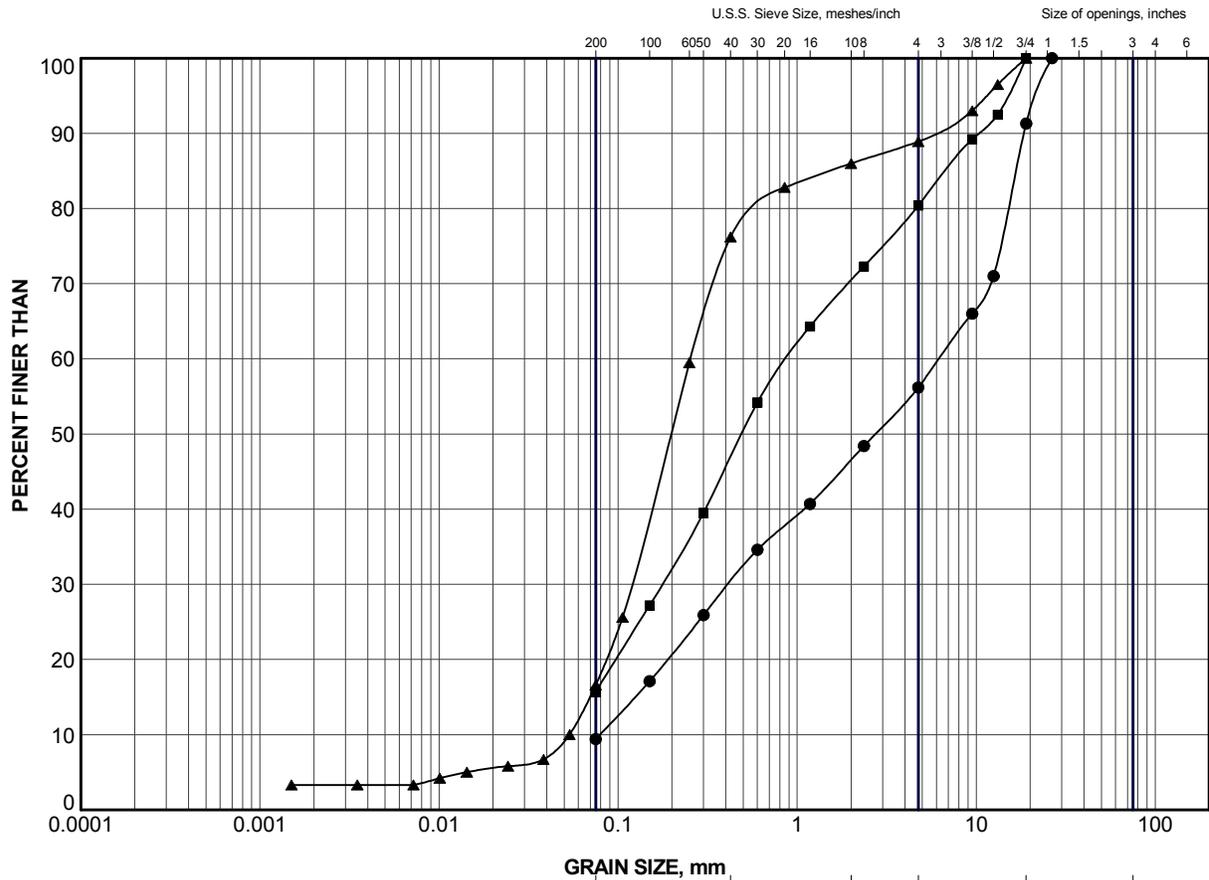
DEPTH SCALE

1 : 50



LOGGED: EHS

CHECKED: AB



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

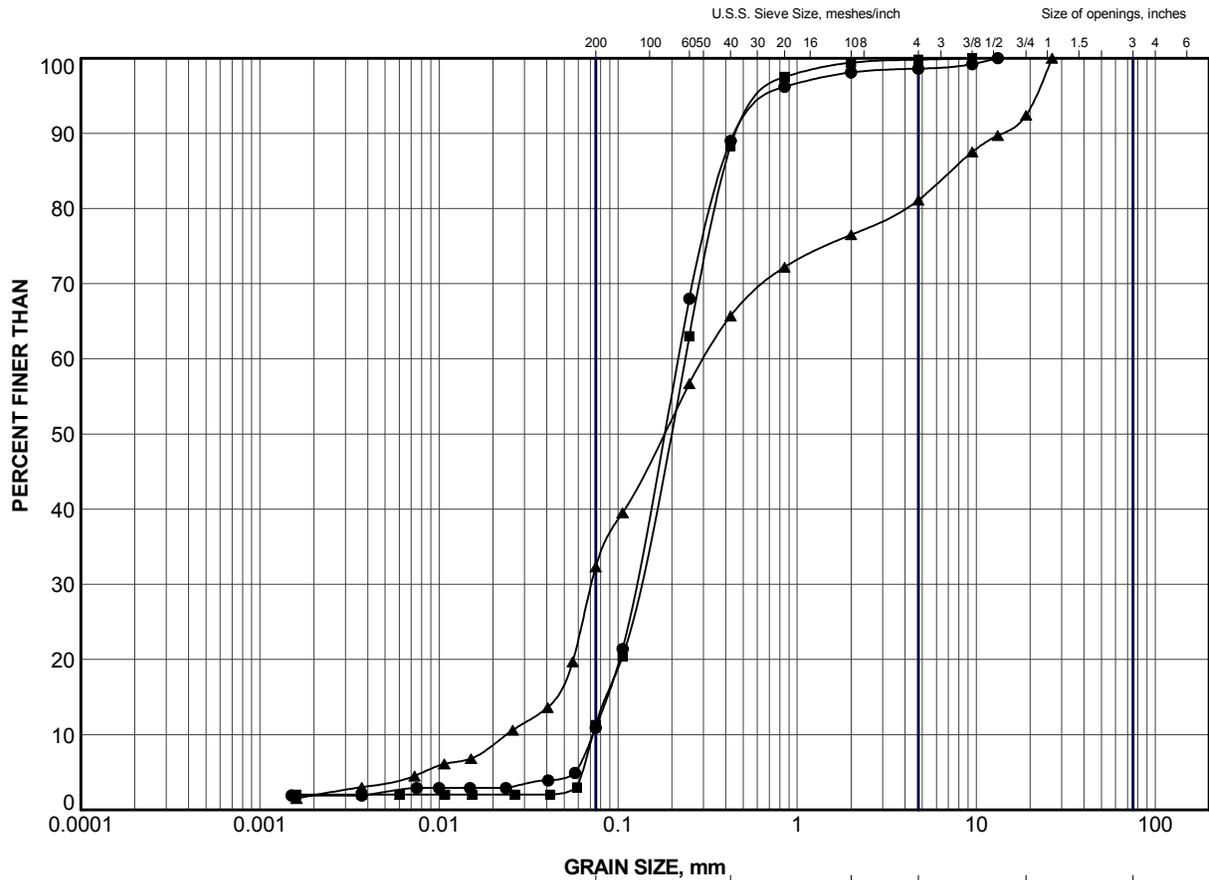
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C15-2	2	426.8
■	C15-4	2	426.5
▲	C15-4	4	424.2

PROJECT					HIGHWAY 60 CULVERT 15				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND to SAND and GRAVEL (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE D1</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

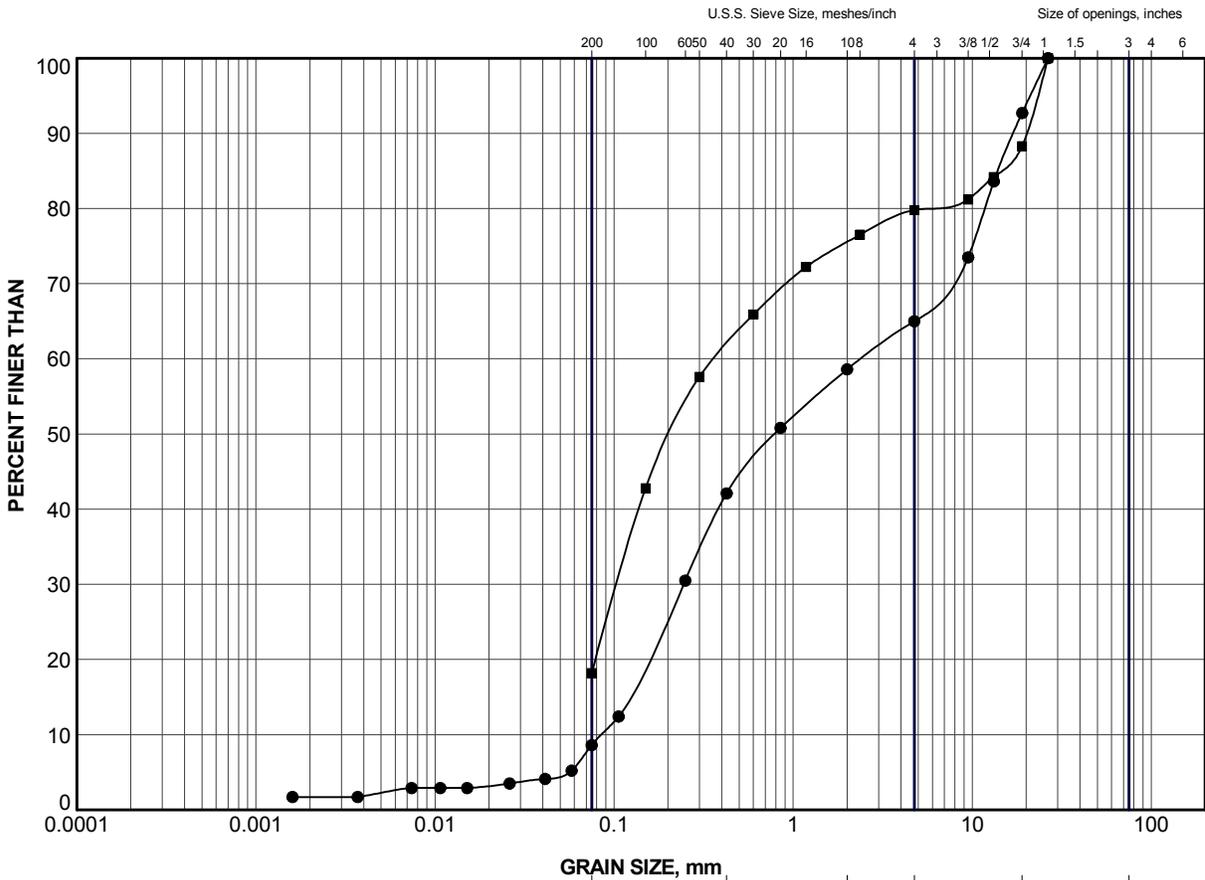
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C15-1	5	420.7
■	C15-1	8	417.6
▲	C15-2	7	423.0

PROJECT					HIGHWAY 60 CULVERT 15				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILTY SAND to SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE D2</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C15-2	9	420.0
■	C15-3	3	423.3

PROJECT					HIGHWAY 60 CULVERT 15				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SAND to SAND and GRAVEL				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A	REV.		
CHECK	AB	Jul 2014			<b>FIGURE D3</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# **APPENDIX E**

## **Culvert 17 – STA 29+350 (Airy Township)**

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 17 - STA 29+350  
 BOREHOLE LOCATIONS AND SOIL STRATA

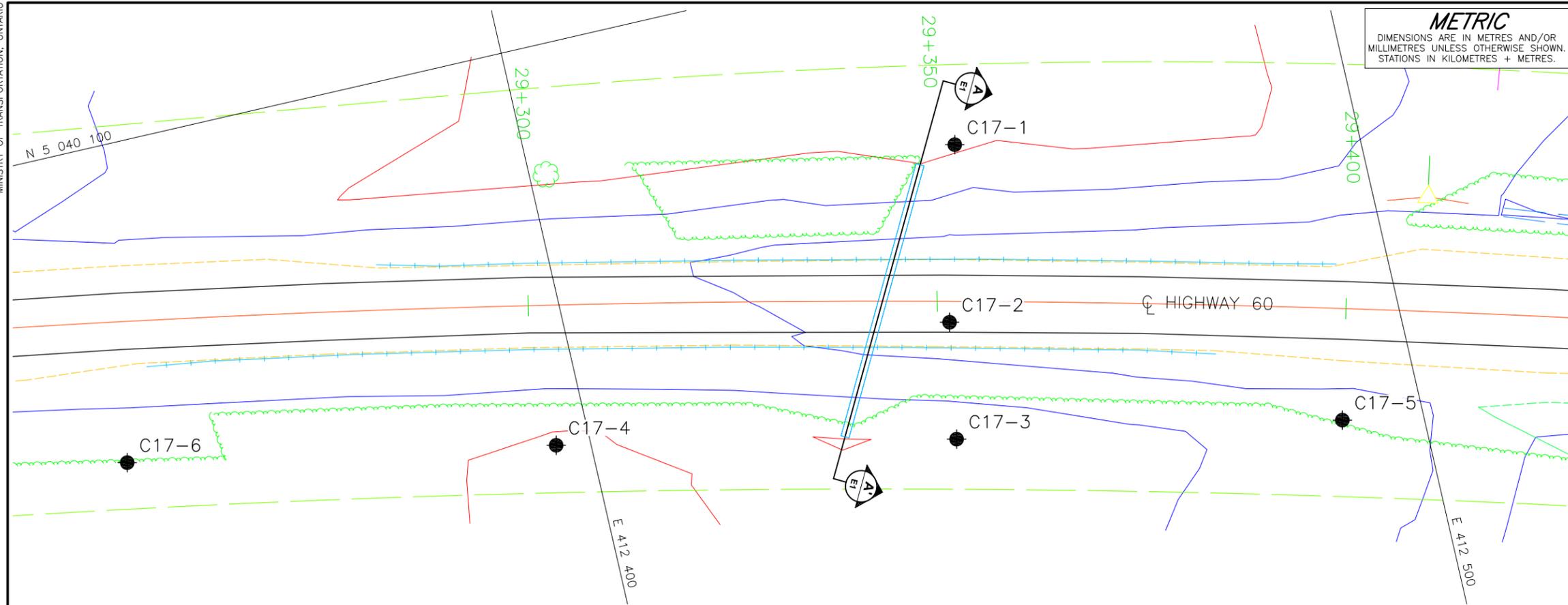
SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 13 0 13 km



PLAN

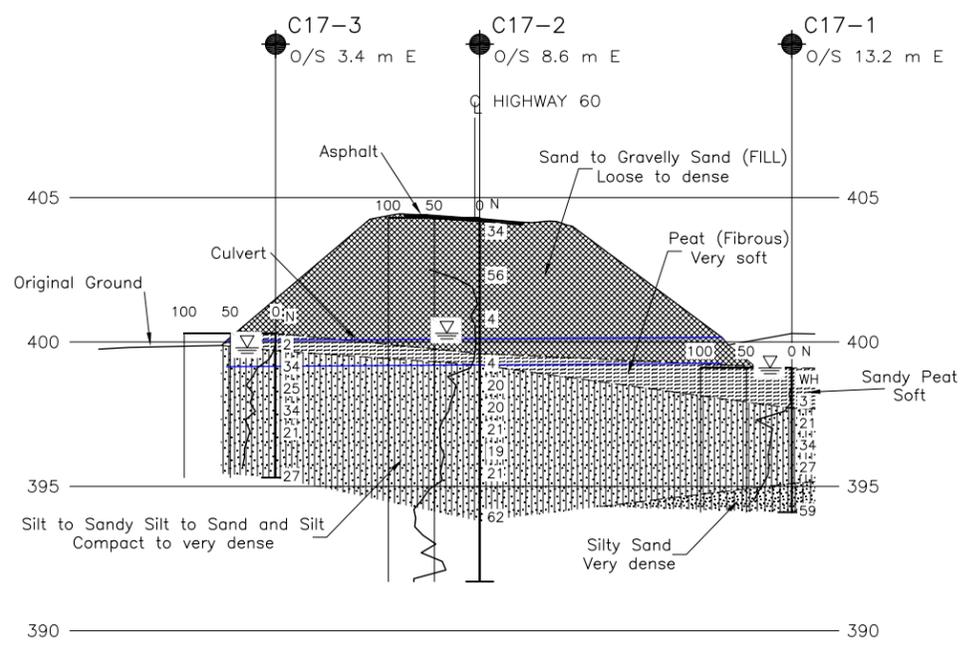


**LEGEND**

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

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C17-1	399.1	5040076.7	412451.5
C17-2	404.3	5040055.7	412446.1
C17-3	400.3	5040041.7	412443.7
C17-4	400.3	5040051.9	412395.8
C17-5	403.0	5040033.3	412490.2
C17-6	402.2	5040061.6	412344.2



**PROFILE**  
 A-A'  
 E1  
 HIGHWAY 60  
 HORIZONTAL SCALE  
 5 0 5 10 m  
 VERTICAL SCALE  
 2.5 0 2.5 5 m

**NOTES**

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

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**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. E1



PHOTOGRAPHS

**Photograph 1: Culvert 17 at STA 29+350  
Looking West along South Shoulder at Culvert Location (September 2013)**



**Photograph 2: Culvert 17 at STA 29+350  
Looking East along North Shoulder at Culvert Location (September 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C17-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040076.7; E 412451.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 13, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
399.1	GROUND SURFACE																	
0.0	PEAT (Fibrous), some sand Very soft Black Wet		1	SS	WH													
398.5																		
0.6	Sandy PEAT (Amorphous) Soft Black Wet		2	SS	3													
397.7																		
1.4	SILT to Sandy SILT, trace to some clay Compact to dense Brown to grey Wet		3	SS	21													
			4	SS	34													
		5	SS	27														
395.1																		
4.0	Silty SAND, some gravel Very dense Grey Wet																	
394.1																		
5.0	END OF BOREHOLE																	
Notes:																		
1. Water level at ground surface (Elev. 399.1 m) upon completion of drilling.																		
2. Advanced DCPT 0.5 m north of borehole to 4.6 m depth.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C17-2** 1 OF 1 **METRIC**

G.W.P. 5198-10-00 LOCATION N 5040055.7; E 412446.1 ORIGINATED BY EHS

DIST \_\_\_\_\_ HWY 60 BOREHOLE TYPE NW Casing and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE September 13, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
404.3	GROUND SURFACE						20 40 60 80 100						
0.0	ASPHALT (125 mm)	[Cross-hatched]	1	SS	34								
0.1	Sand to gravelly sand, trace to some silt (FILL) Loose to dense Brown Moist	[Cross-hatched]	2	SS	56								
			3	SS	4								
399.6	PEAT (Fibrous)	[Wavy lines]	4	SS	4								
399.2	Soft Black Wet	[Wavy lines]											
5.1	Sandy SILT to SILT and SAND, trace clay Compact to very dense Brown to grey Wet	[Dotted]	5	SS	20								
			6	SS	20							0 20 75 5	
			7	SS	21								
			8	SS	19								
			9	SS	21							13 50 (37)	
			10	SS	62								
393.8	END OF BOREHOLE												
10.5													
391.7	END OF DCPT												
12.6	Note: 1. Water level at a depth of 4.0 m below ground surface (Elev. 400.3 m) upon completion of drilling. 2. Advanced DCPT 1.5 m east of borehole. Preaugered to 1.5 m before start of DCPT.												

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C17-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040041.7; E 412443.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 11, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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		GR SA SI CL
400.3	GROUND SURFACE														
0.0	Sandy PEAT (Fibrous) Soft Black Wet		1	SS	2										
399.7															
0.6	SILT, some sand, trace to some clay Compact to dense Brown Wet		2	SS	34						○				0 18 74 8
			3	SS	25										
			4	SS	34										
			5	SS	21						○				
			6	SS	27										
395.3	END OF BOREHOLE														
5.0	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 399.8 m) upon completion of drilling. 2. Advanced DCPT 0.5 m west of borehole to 4.6 m depth.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C17-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040051.9; E 412395.8</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 12, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
400.3	GROUND SURFACE						20	40	60	80	100					
0.0	PEAT (Fibrous) Soft Black Wet	1	SS	2		400										
399.7	0.6															
398.9	PEAT (Amorphous) Soft Black Wet	2	SS	1		399										
1.4	SILT to SILT and SAND, trace to some gravel, trace to some clay Compact Brown to grey Wet	3	SS	15		398										
		4	SS	24		397										13 45 36 6
396.3		5	SS	24		396										
4.0	Silty SAND Dense Brown Wet	6	SS	44												
395.3	5.0															
	END OF BOREHOLE															
	Note: 1. Water level at ground surface (Elev. 400.3 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C17-5</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040033.3; E 412490.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 12, 2014</u>	CHECKED BY <u>AB</u>

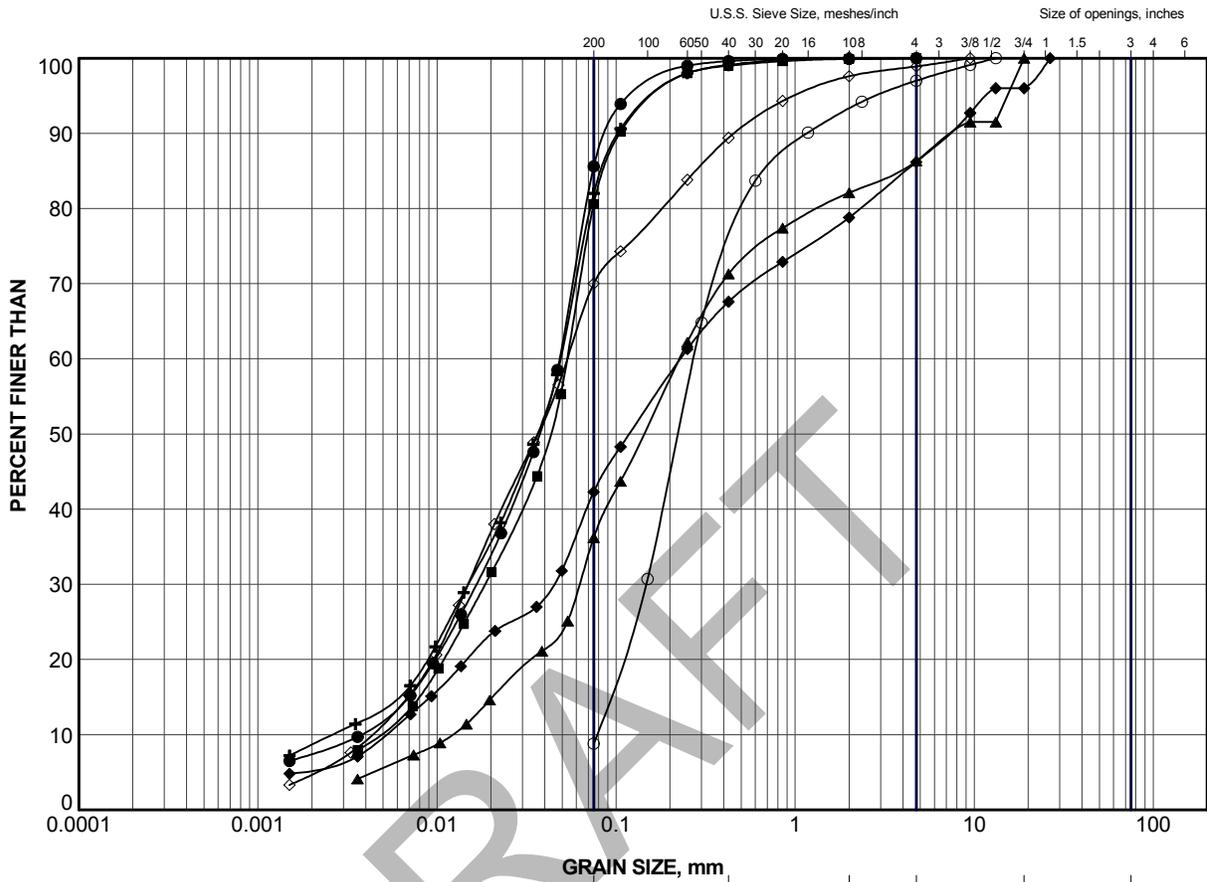
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
403.0	GROUND SURFACE						20	40	60	80	100					
0.0	TOPSOIL		1	SS	2											
0.1	Sandy SILT to Silty SAND, trace to some gravel, trace clay Compact to very dense Brown to grey Wet		2	SS	49	▽						○			1 29 65 5	
	A sandy gravel layer was encountered at 1.5 m depth in Sample 3.		3	SS	58											
			4	SS	49											
			5	SS	28											
398.7			6	SS	20											
4.3	END OF BOREHOLE															
	Note: 1. Water level at a depth of 0.7 m below ground surface (Elev. 402.3 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:

PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C17-6** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5040061.6; E 412344.2 ORIGINATED BY EHS  
 DIST                      HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE May 12, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
402.2	GROUND SURFACE																	
0.0	Topsoil (FILL)		1	SS	5													
401.6	Sand, some gravel (FILL)																	
0.6	Loose Brown Wet		2	SS	4													
	PEAT (Amorphous) Soft Black Wet																	
400.5	SAND, trace to some silt, trace to some gravel		3	SS	22													
1.7	Compact to dense Brown Wet		4	SS	47													
			5	SS	12													
397.6	END OF BOREHOLE SPOON REFUSAL AND RESISTANCE TO FURTHER CASING ADVANCEMENT		6	SS	30/01													
4.6	Note: 1. Water level at a depth of 0.5 m below ground surface (Elev. 401.7 m) upon completion of drilling.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 15/07/14 DATA INPUT:



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C17-1	4	396.6
■	C17-2	6	397.9
▲	C17-2	9	395.6
+	C17-3	2	399.3
◆	C17-4	4	397.8
◇	C17-5	2	402.0
○	C17-6	5	398.9

PROJECT					HIGHWAY 60 CULVERT 17				
TITLE					GRAIN SIZE DISTRIBUTION SILT to SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE E1</b>				
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX F

Culvert 18 – STA 29+825 (Airy Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 18 - STA 29+825  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km

LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C18-1	393.3	5039914.1	412895.7
C18-2	396.5	5039892.6	412903.8
C18-3	393.5	5039884.0	412887.8
C18-4	396.8	5039894.7	412897.5

NOTES

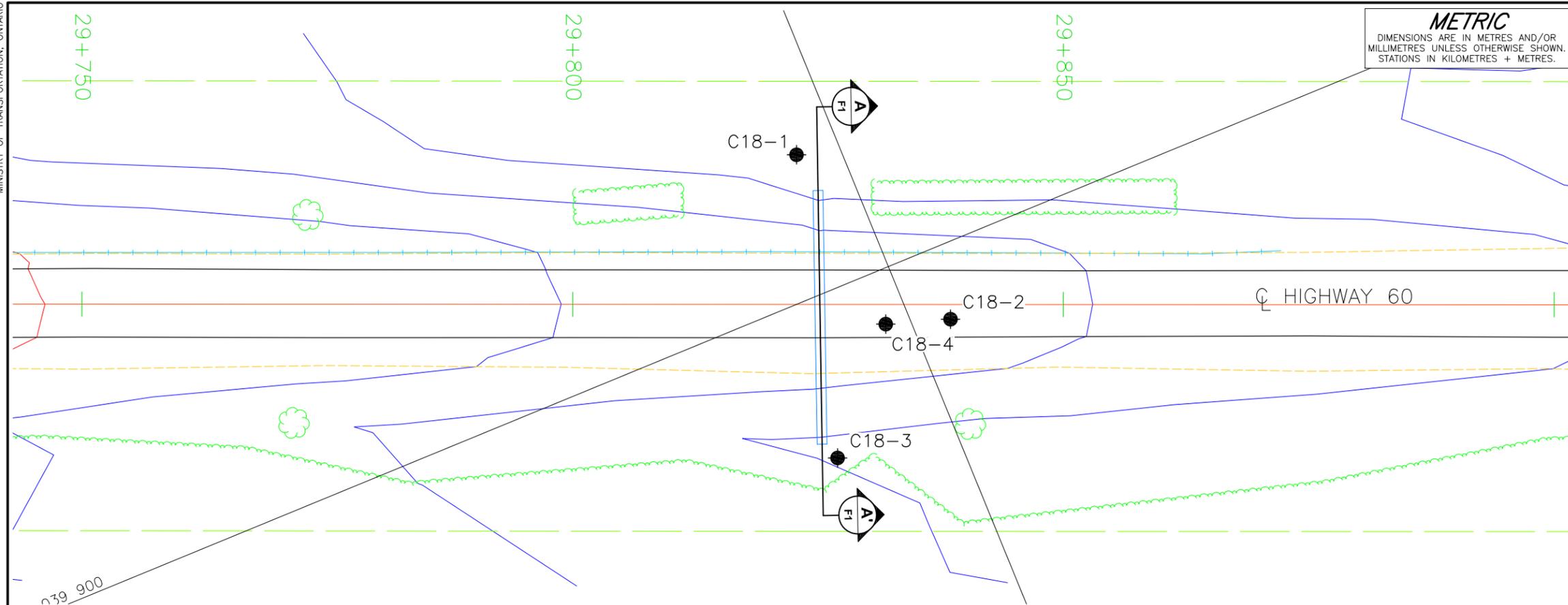
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

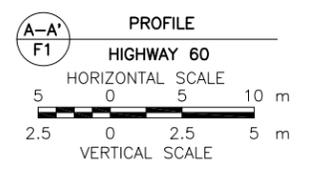
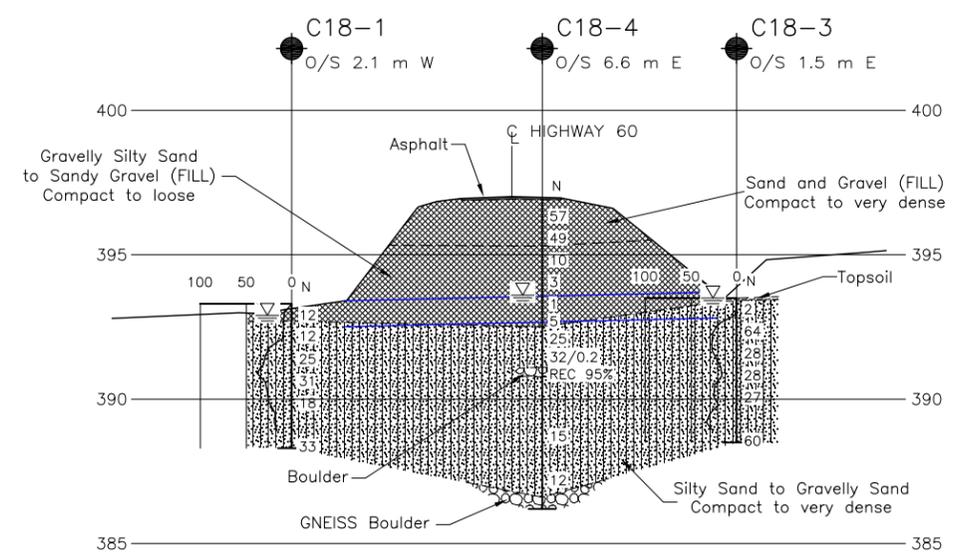
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



PLAN



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. F1



PHOTOGRAPHS

**Photograph 1: Culvert 18 at STA 29+825  
Looking West along North Shoulder at Culvert Location (September 2013)**



**Photograph 2: Culvert 18 at STA 29+825  
Looking East along North Shoulder at Culvert Location (September 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C18-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039914.1; E 412895.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 14, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40
393.3	GROUND SURFACE																		
0.0	Sandy topsoil (FILL)		1	SS	12														
0.1	Sandy gravel (FILL)																		
392.7	Compact Brown Wet																		
0.6	Gravelly SAND, trace clay, some silt																		
	Compact to dense Grey Wet																		
				2	SS	12													26 52 20 2
			3	SS	25														
			4	SS	31														
			5	SS	18													29 56 13 2	
			6	SS	33														
388.3	END OF BOREHOLE																		
5.0	Note: 1. Water level at a depth of 0.4 m below ground surface (Elev. 392.9 m) upon completion of drilling. 2. Advanced DCPT 0.3 m south of Borehole to 4.4 m depth.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C18-2** 1 OF 2 **METRIC**

G.W.P. 5198-10-00 LOCATION N 5039892.6; E 412903.8 ORIGINATED BY EHS

DIST \_\_\_\_\_ HWY 60 BOREHOLE TYPE NW Casing and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE September 18 and 19, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20
396.5	GROUND SURFACE																
0.0 0.1	ASPHALT (85 mm) Sand and gravel, trace to some silt (FILL) Dense to very dense Moist	1	SS	53													
		2	SS	47													42 46 (12)
395.0 1.5	Silty sand, trace gravel (FILL) Loose to compact Brown Wet	3	SS	23													
		4	SS	4													
	Boulders were encountered as follows:  Depth (m) Thickness (mm) 3.3 475	-	RC	REC 100%													
392.7 3.8	SILT and SAND to Silty SAND, trace to some gravel, trace clay Compact to very dense Brown to Grey Wet	5	SS	5													
		6	SS	21													
		7	SS	38													19 49 (32)
		8	SS	18													
		9	SS	21													
		10	SS	10													
	No recovery in split-spoon at 10.7 m depth.		SS	-													
		11	SS	104													3 45 (52)
382.7 13.8		12	SS	50/0.1													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C18-2** 2 OF 2 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5039892.6; E 412903.8 ORIGINATED BY EHS  
 DIST          HWY 60 BOREHOLE TYPE NW Casing and NQ Coring COMPILED BY AC  
 DATUM GEODETIC DATE September 18 and 19, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
	END OF BOREHOLE SPOON REFUSAL  Note: 1. Water level at a depth of 3.7 m below ground surface (Elev. 392.8 m) upon completion of drilling. 2. Advanced DCPT 1 m east of borehole, refusal at 10.5 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C18-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039884.0; E 412887.8</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 14, 2014</u>	CHECKED BY <u>AB</u>

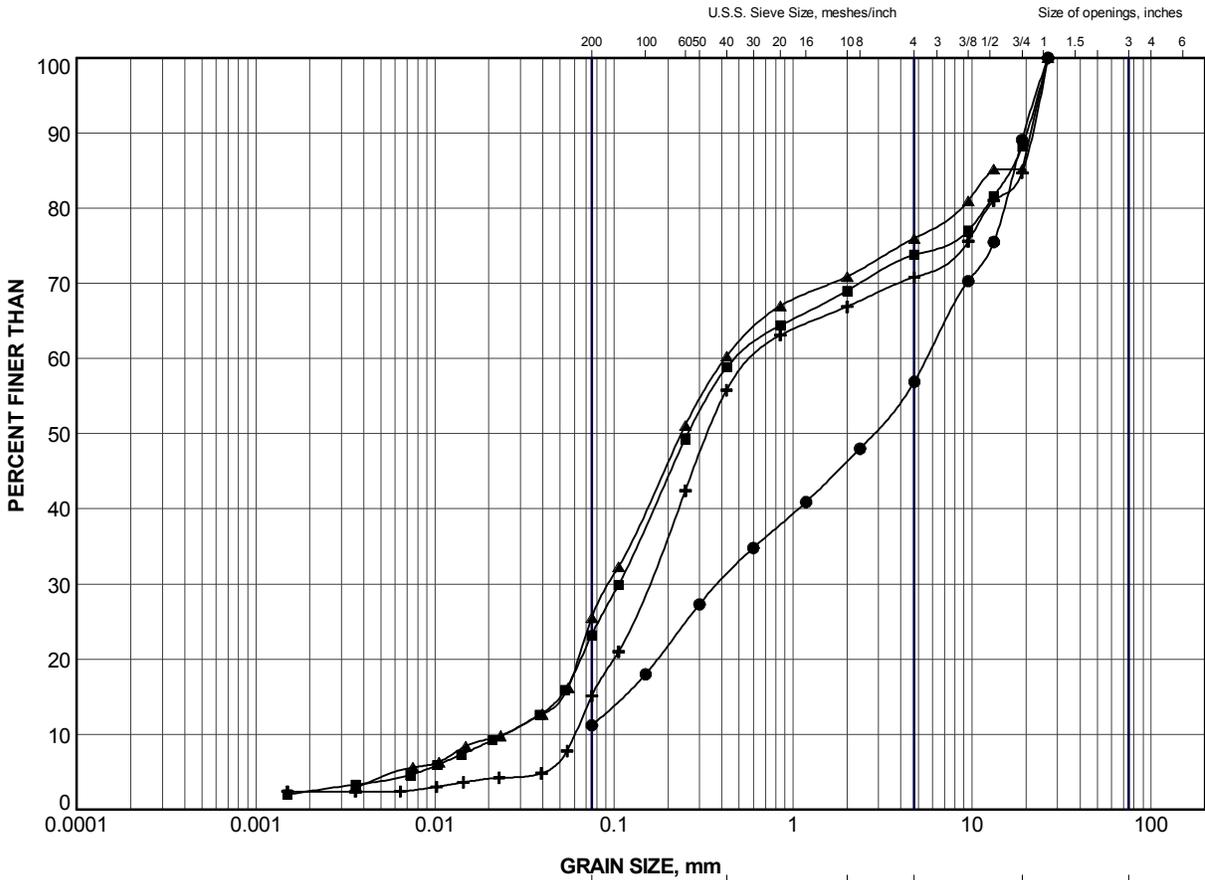
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
393.5	GROUND SURFACE																
0.0	TOPSOIL																
0.1	Silty SAND to SAND, trace to some gravel Compact to very dense Brown to grey Wet	1	SS	2													
		2	SS	64													
		3	SS	28						○				9	65	(26)	
		4	SS	28													
		5	SS	27						○				13	72	(15)	
		6	SS	60						○				9	73	(18)	
388.5	END OF BOREHOLE																
5.0	Notes: 1. Water level at ground surface (Elev. 393.5 m) upon completion of drilling. 2. Advanced DCPT 0.5 m east of borehole to 4.6 m depth.																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C18-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039894.7; E 412897.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 19, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
396.8	GROUND SURFACE																		
0.0	ASPHALT (85 mm)		1	SS	57														
	Sand and gravel, trace to some silt (FILL) Dense to very dense Brown Moist		2	SS	49						o								26 51 20 3
395.3																			
1.5	Gravelly silty sand (FILL) Very loose to compact Brown Wet		3	SS	10														
			4	SS	3						o								24 50 (26)
			5	SS	1						o								29 56 13 2
			6	SS	5						o								
392.5																			
4.3	SILT and SAND to SAND, trace to some gravel, trace clay Compact to very dense		7	SS	25						o								8 39 (53)
			8	SS	32/0.2														
	A 325 mm boulder was encountered at 5.7 m depth.		-	RC	REC 95%														
			9	SS	15						o								18 62 (20)
			10	SS	12														
386.6	GNEISS BOULDER																		
386.2	END OF BOREHOLE																		
10.6	Note: 1. Water level at a depth of 3.6 m below ground surface (Elev. 393.2m) upon completion of drilling.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:



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

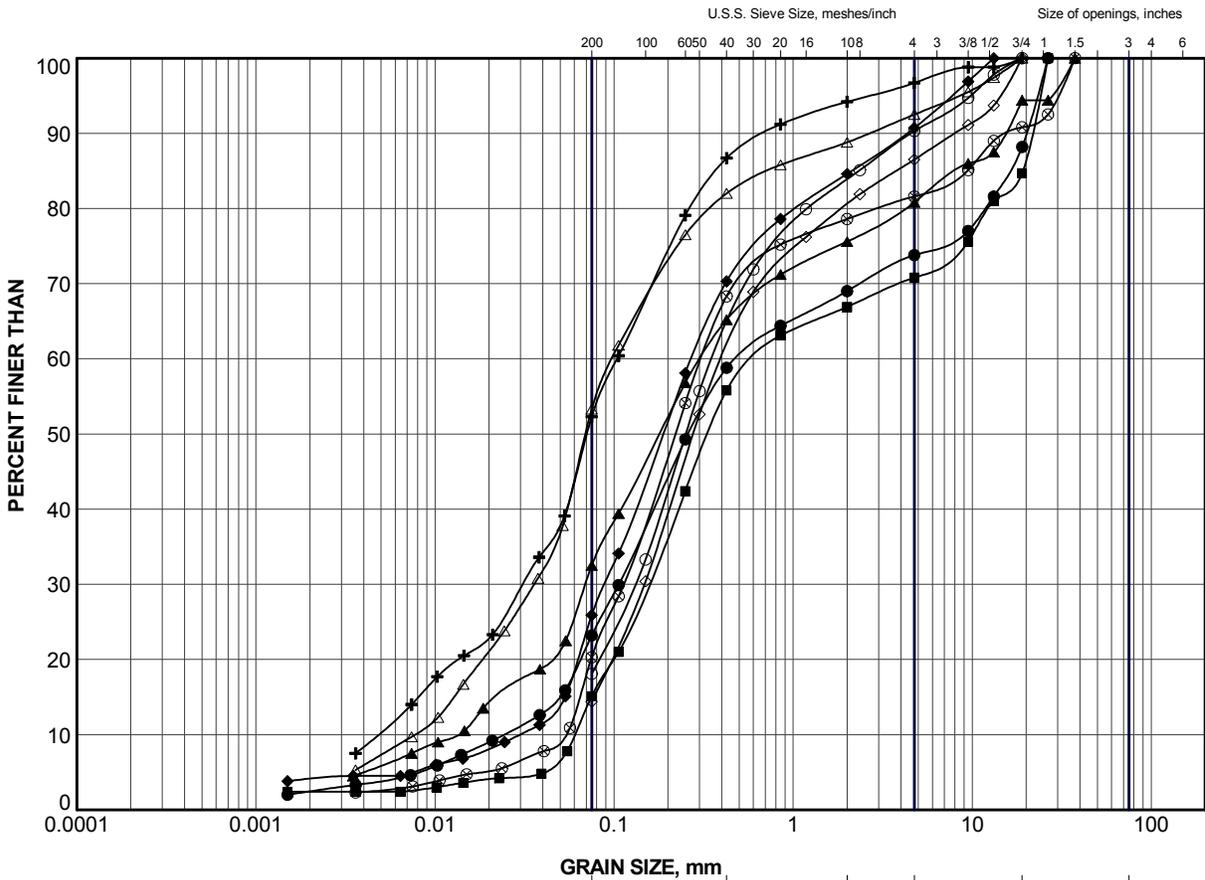
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C18-2	2	395.4
■	C18-4	2	395.7
▲	C18-4	4	394.2
+	C18-4	5	393.5

PROJECT					HIGHWAY 60 CULVERT 18				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SILTY SAND to SAND and GRAVEL (FILL)				
PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ			
DRAWN	TB	Jul 2014		SCALE	N/A	REV.			
CHECK	AB	Jul 2014		<b>FIGURE F1</b>					
APPR	JMAC	Jul 2014							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C18-1	2	392.3
■	C18-1	5	389.9
▲	C18-2	7	391.6
+	C18-2	11	384.0
◆	C18-3	3	391.7
◇	C18-3	5	390.2
○	C18-3	6	388.7
△	C18-4	7	391.9
⊗	C18-4	9	388.9

PROJECT					HIGHWAY 60 CULVERT 18					
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to GRAVELLY SAND					
DRAWN		TB	Jul 2014		PROJECT No.		13-1191-0003	FILE No.		13-1191-0003.GPJ
CHECK		AB	Jul 2014		SCALE		N/A	REV.		
APPR		JMAC	Jul 2014		<b>FIGURE F2</b>					



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# **APPENDIX G**

## **Culvert 19 – STA 30+277 (Airy Township)**

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 19 - STA 30+277  
 BOREHOLE LOCATIONS AND SOIL STRATA

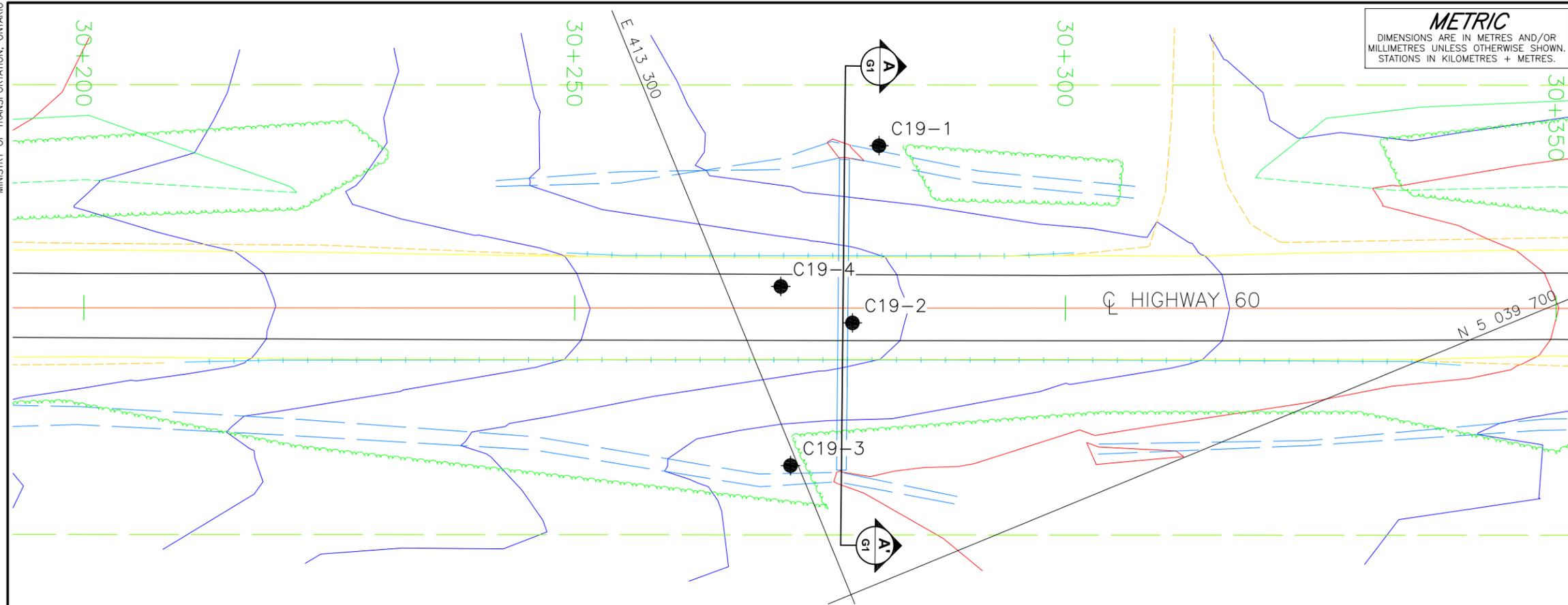
SHEET



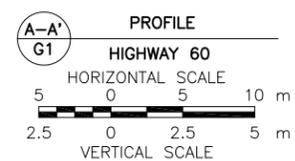
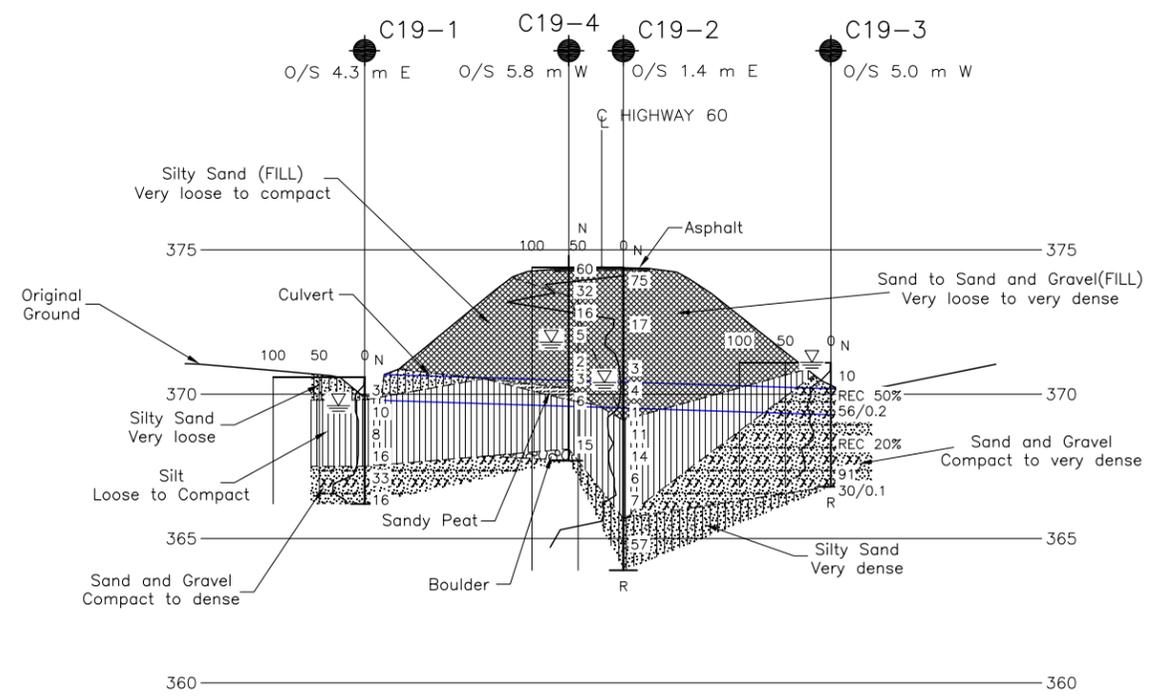
**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



**KEY PLAN**  
 13 0 13 km



**PLAN**



**LEGEND**

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ≡ WL upon completion of drilling

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C19-1	370.6	5039741.1	413320.0
C19-2	374.4	5039725.5	413310.6
C19-3	371.1	5039714.5	413299.3
C19-4	374.8	5039731.7	413305.3

**NOTES**

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

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE: DWG. G1



**PHOTOGRAPHS**

**Photograph 1: Culvert 19 at STA 30+277  
Looking East along South Shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert 19 at STN 30+277  
Looking West along South Shoulder at Culvert Location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C19-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039741.1; E 413320.0</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 15, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40
370.6	GROUND SURFACE													
0.0	Silty SAND, trace organics Very Loose Brown Moist		1	SS	3									
369.8			2	SS	10									
0.8	SILT, trace to some sand, trace clay Loose to compact Brown to grey Wet		3	SS	8								0 5 (95)	
			4	SS	16									
367.5			5	SS	33									
3.1	SAND and GRAVEL, trace silt, trace clay Compact to dense Brown to grey Wet		6	SS	16								35 58 (7)	
366.2	Cobbles and/or boulders inferred from augers grinding between 3.1 m and 3.8 m depth.													
4.4	END OF BOREHOLE													
	Note: 1. Water level at a depth of 1.0 m below ground surface (Elev. 369.6 m) upon completion of drilling. 2. Advanced DCPT 2 m east of borehole.													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C19-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039725.5; E 413310.6</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 23, 2013</u>	CHECKED BY <u>AB</u>

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60					
374.4	GROUND SURFACE														
0.0	ASPHALT (85 mm)														
0.1	Sand to Sand and gravel, trace to some silt (FILL) Very loose to very dense Brown Moist to wet		1	SS	75		374								
			2	SS	17		373							31	63 (6)
	100 mm cobble at 2.7 m depth.		3	SS	3		372								
			4	SS	4		371								
			5	SS	1		370								
369.1							369							NP	0 8 (92)
5.3	SILT, trace to some sand, trace clay Loose to compact Grey Wet		6	SS	11		368								
			7	SS	14		367								
			8	SS	6		366								
			9	SS	7		365								
365.7							364								
8.7	Silty SAND, trace gravel, trace clay Very Dense Grey Wet		10	SS	57									3	68 (29)
363.9															
10.5	END OF BOREHOLE RESISTANCE TO FURTHER CASING PENETRATION														
	Note: 1. Water level at a depth of 4.0 m below ground surface (Elev. 370.4 m) upon completion of drilling. 2. Advanced DCPT 1.2 m east of borehole, refusal at 9.7 m depth.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C19-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039714.5; E 413299.3</u>	ORIGINATED BY <u>AC</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 24, 2013</u>	CHECKED BY <u>AB</u>

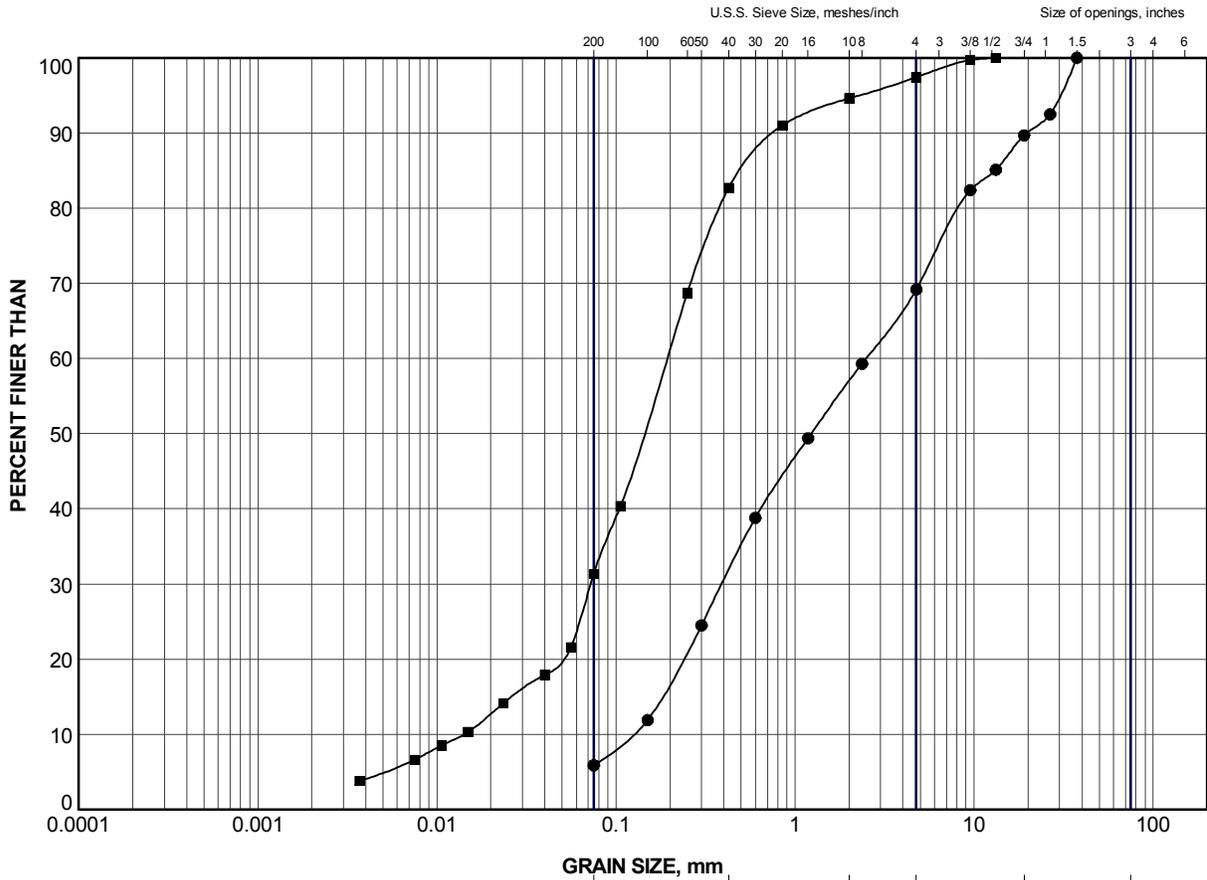
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
371.1	GROUND SURFACE																
0.0	SAND and GRAVEL, trace to some silt Compact to very dense Brown Wet  Cobbles were encountered as follows:  Depth (m)    Thickness (mm) 0.8            50 0.9            150 2.4            100 3.0            100																
		1	SS	10													
		2	RC	REC 50%													
		3	SS	56/0.2													
		4	RC	REC 20%													
		5	SS	91													
366.8	END OF BOREHOLE SPLIT-SPOON REFUSAL																
4.3	Note:  1. Water level at ground surface (Elev. 371.1 m) upon completion of drilling.  2. Advanced DCPT 0.5 m west of borehole, refusal at 3.9 m depth.																
		6	SS	30/0.4													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C19-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039731.7; E 413305.3</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 24, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
374.8	GROUND SURFACE																	
0.0	ASPHALT (85 mm)		1	SS	60													
	Sand and gravel, trace to some silt (FILL) Very loose to very dense Brown Moist		2	SS	32													
373.4																		
1.4	Silty sand, trace gravel, trace clay (FILL) Very loose to compact Brown Moist to wet		3	SS	16													2 67 (31)
			4	SS	5													
			5	SS	2													
			6	SS	3													
370.2																		
	Sandy PEAT (Amorphous) Black Wet		7A	SS	6													
369.8			7B															
5.0	SILT, some sand, trace to some clay Compact Brown Wet																	0 14 (86)
			8	SS	15													
368.1																		
	BOULDER																	
367.7																		
7.1	END OF BOREHOLE																	
	Note: 1. Water level at a depth of 3.0 m below ground surface (Elev. 371.8 m) upon completion of drilling.																	

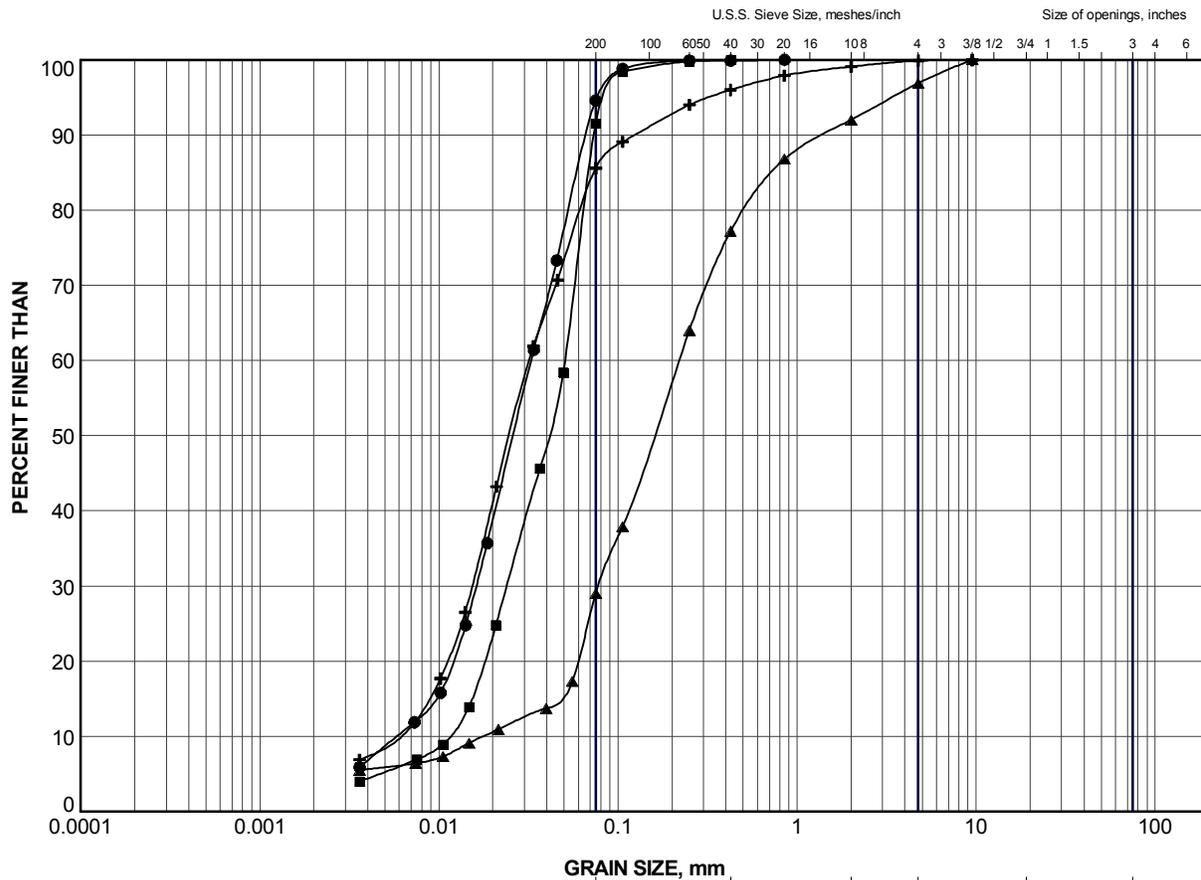
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:



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

<b>LEGEND</b>			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C19-2	2	372.6
■	C19-4	3	373.0

PROJECT	HIGHWAY 60 CULVERT 19				
TITLE	<b>GRAIN SIZE DISTRIBUTION</b> SILTY SAND to SAND and GRAVEL (FILL)				
 <b>Golder Associates</b> SUDBURY, ONTARIO	PROJECT No.	13-1191-0003	FILE No.	13-1191-0003.GPJ	
	DRAWN	TB	Jul 2014	SCALE	N/A
	CHECK	AB	Jul 2014	REV.	
APPR	JMAC	Jul 2014	<b>FIGURE G1</b>		



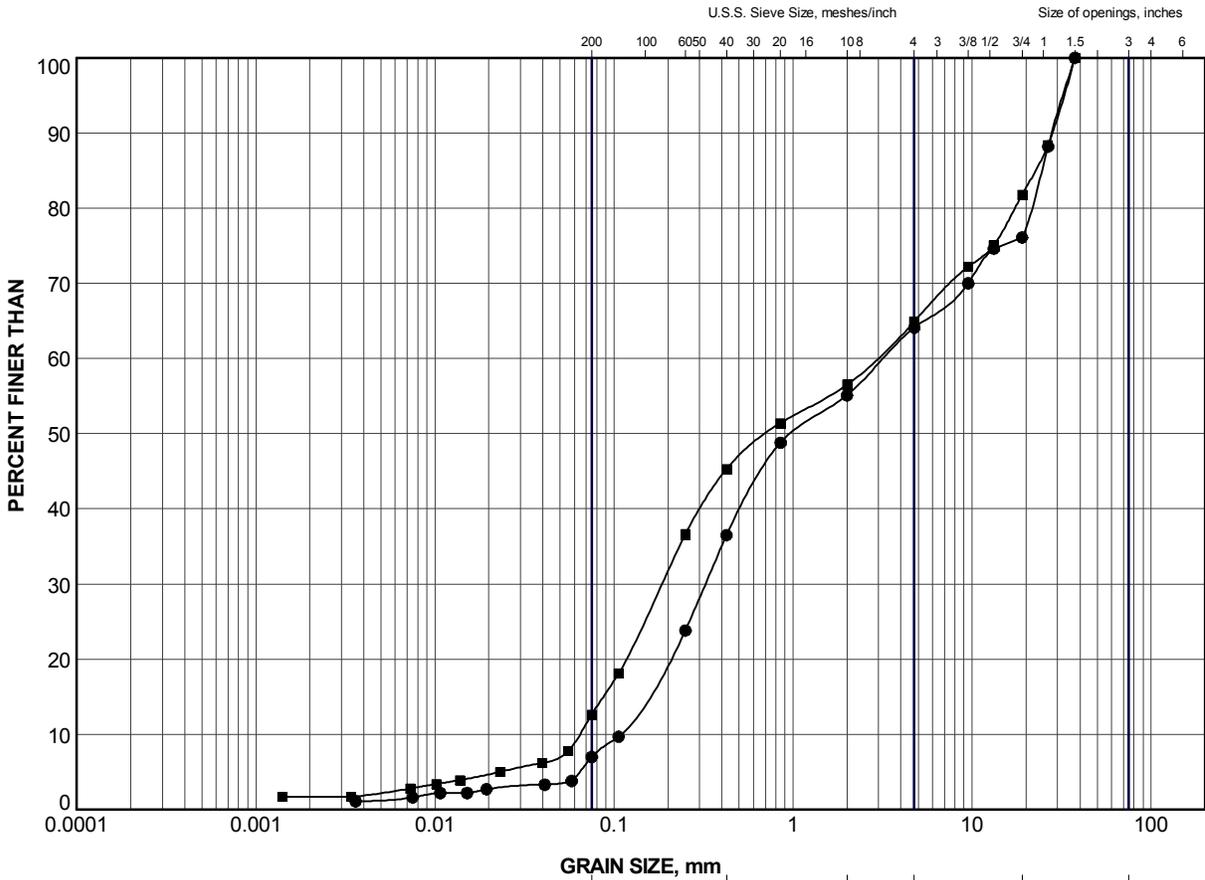
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C19-1	3	368.8
■	C19-2	6	368.8
▲	C19-2	10	365.0
+	C19-4	7b	369.8

PROJECT					HIGHWAY 60 CULVERT 19				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT to SILTY SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE G2</b>				
APPR	JMAC	Jul 2014							





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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C19-1	6	366.5
■	C19-3	3	369.6

PROJECT					HIGHWAY 60 CULVERT 19				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE G3</b>				
APPR	JMAC	Jul 2014							





# APPENDIX H

Culvert 21 – STA 31+406 (Airy Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 21 - STA 31+406  
BOREHOLE LOCATIONS AND SOIL STRATA

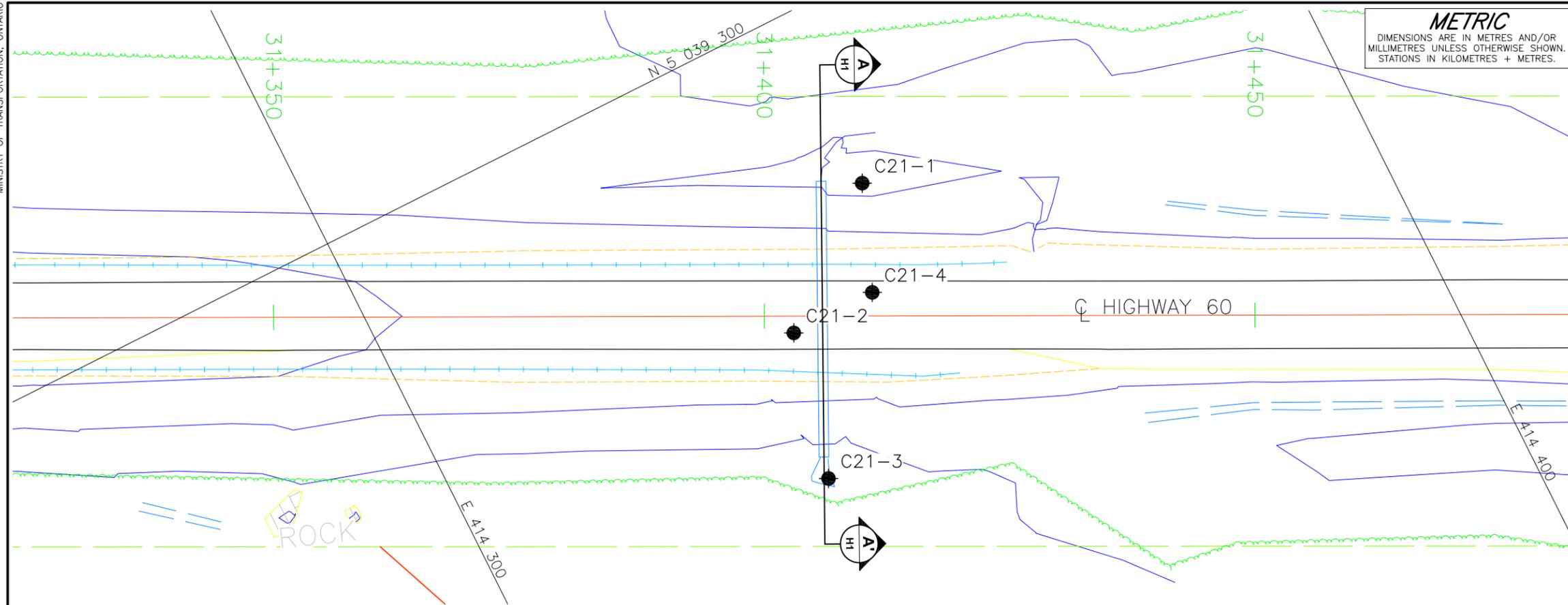
SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



**KEY PLAN**  
13 0 13 km



**PLAN**

SCALE  
5 0 5 10 m

**LEGEND**

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- 100% Rock Quality Designation (RQD)
- R Refusal
- ≡ WL upon completion of drilling

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C21-1	363.5	5039281.1	414351.5
C21-2	367.2	5039270.6	414338.4
C21-3	362.8	5039255.8	414334.9
C21-4	367.0	5039270.7	414347.4

**NOTES**

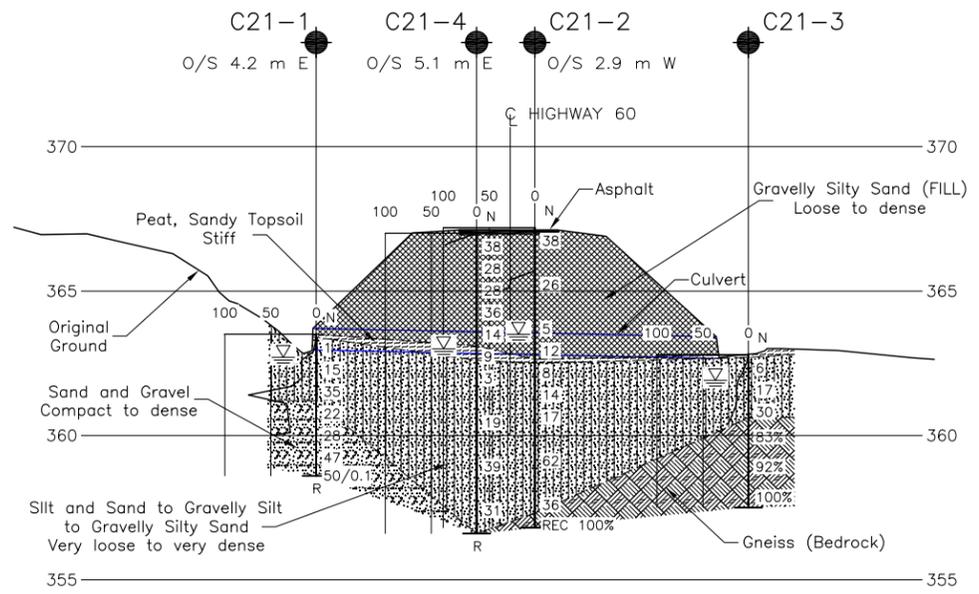
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**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



**PROFILE**  
A-A'  
G1  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE: DWG. H1



## PHOTOGRAPHS

**Photograph 1: Culvert 21 at STA 31+406  
Looking East along North Shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert 21 at STA 31+406  
Looking West along South Shoulder at Culvert Location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C21-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039281.1; E 414351.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 15, 2013</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			20	40	60						80
363.5	GROUND SURFACE															
0.0	TOPSOIL															
0.1	Silty SAND Very loose to compact Brown Wet		1	SS	1		363									
362.0			2	SS	15		362									
1.5	Gravelly SILT Dense Brown Wet		3	SS	35		362							21	9	(70)
361.2			4	SS	22		361									
2.3	SAND and GRAVEL Compact to dense Brown Wet		5	SS	28		360									
	Augers grinding from 2.3 m to 4.6 m depth.		6	SS	47		360									
			7	SS	50/0.1		359							34	56	(10)
358.6	END OF BOREHOLE SPOON REFUSAL															
4.9	Note: 1. Water level at a depth of 0.8 m below ground surface (Elev. 362.7 m) upon completion of drilling. 2. Advanced DCPT 1 m east of borehole, refusal at 3.5 m depth.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C21-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039270.6; E 414338.4</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 17, 2013</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			20	40	60						80
367.2	GROUND SURFACE															
0.0	ASPHALT (85 mm)		1	SS	38		367									
	Gravelly silty sand, trace clay (FILL) Loose to dense Brown Moist to wet		2	SS	26		366									
			3	SS	5		365									
			4	SS	12		364							21	54	(25)
362.6	A 100 mm cobble was encountered at 4.5 m depth.						363									
	Sandy PEAT		5	SS	8		362									
4.7	SILT and SAND, trace clay Loose to compact Brown Wet		6	SS	14		361							0	34	(66)
			7	SS	17		360									
360.3	Gravelly Silty SAND Dense to very dense Brown to grey Wet		8	SS	62		359									
	A 200 mm cobble was encountered at 8.2 m depth.		9	SS	36		358									
357.3							357									
9.9	BOULDER OR PROBABLE BEDROCK		-	RC	REC 100%											
356.8	END OF BOREHOLE															
10.4	Note: 1. Water level at a depth of 3.7 m below ground surface (Elev. 363.5 m) upon completion of drilling. 2. Advanced DCPT 1 m west of borehole. Pre-drilled to 1.5 m, stopped at 2.3 m depth due to sliding of rods.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C21-3</b>	1 OF 1	<b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039255.8; E 414334.9</u>	ORIGINATED BY <u>EHS</u>	
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring</u>	COMPILED BY <u>AC</u>	
DATUM <u>GEODETIC</u>	DATE <u>September 15 and 16, 2013</u>	CHECKED BY <u>AB</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
362.8	GROUND SURFACE																
0.0	TOPSOIL																
362.2	Silty SAND Loose Brown Wet		1	SS	6												
0.6	SILT, trace to some sand Compact Brown Wet		2	SS	17												0 16 (84)
			3	SS	30												
360.6	GNEISS BEDROCK																
2.2	Bedrock cored from 2.2 m depth to 5.3 m depth.  For coring details see Record of Drillhole C21-3.		1	RC	REC 100%												RQD = 83%
			2	RC	REC 100%												RQD = 92%
			3	RC	REC 100%												RQD = 100%
357.5	END OF BOREHOLE																
5.3	Note: 1. Water level at a depth of 0.9 m below ground surface (Elev. 361.9 m) upon completion of drilling. 2. Advanced DCPT 1.5 m west of borehole. Refusal at 2.3 m depth.																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

PROJECT: 13-1191-0003

# RECORD OF DRILLHOLE: C21-3

SHEET 1 OF 1

LOCATION: N 5039255.8 ;E 414334.9

DRILLING DATE: September 15 and 16, 2013

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA				HYDRALLIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES WATER LEVELS INSTRUMENTATION		
								TOTAL CORE %	SOLID CORE %			B Angle	DIP w/CL AXIS	Type and Surface Description	Jr	Ja	Jn				k, cm/s	σ
								80 90 95 98 99	80 90 95 98 99			0 10 20 30 40 50 60 70 80 90	0 10 20 30 40 50 60 70 80 90									
		GROUND SURFACE		360.6																		
	NW	GNEISS Fine to coarse grained Fresh Grey		2.2	1	GREY	100%															
	CME 55 NQ Coring				2	GREY	100%															
					3	GREY	100%															
		END OF DRILLHOLE		357.5	5.3																	

SUD-RCK 13-1191-0003.GPJ GAL-MISS.GDT 160714 DATA INPUT:

DEPTH SCALE

1 : 50



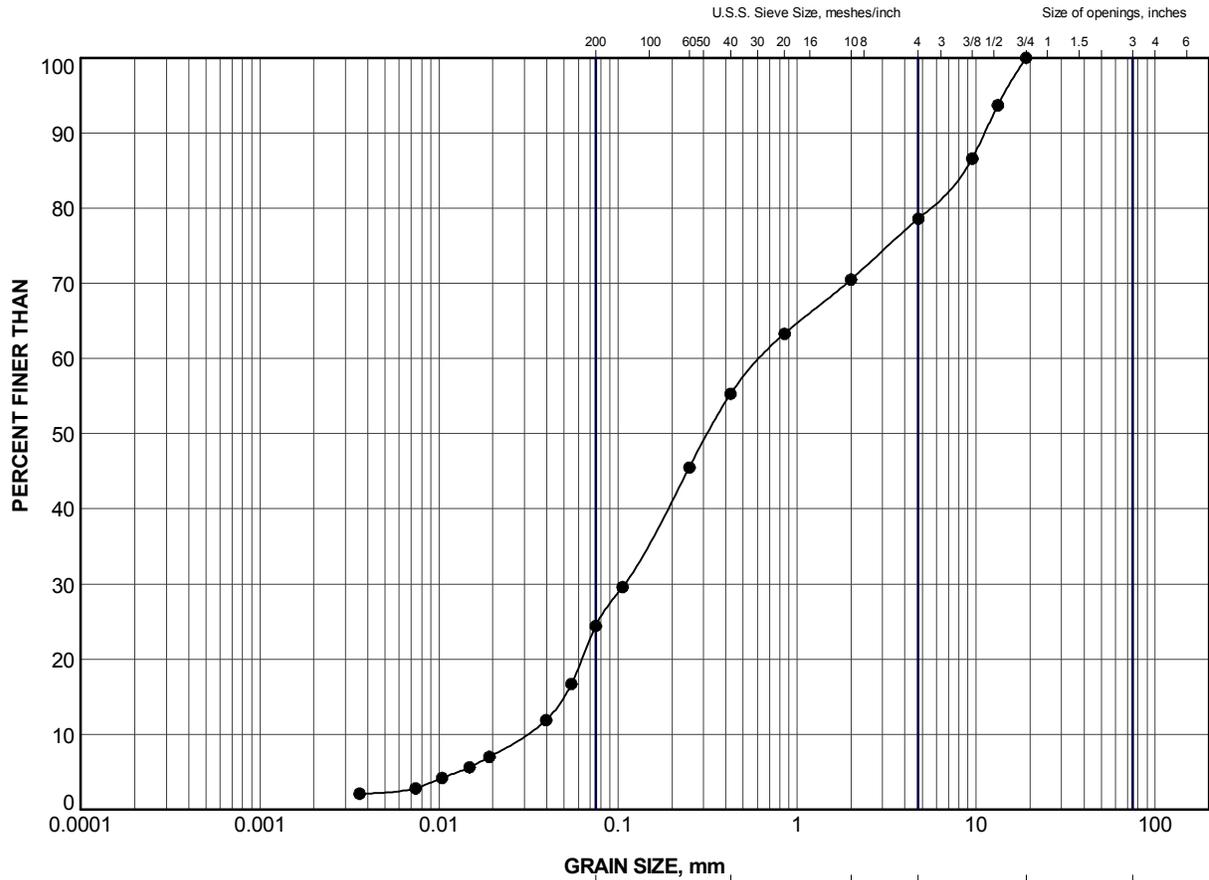
LOGGED: EHS

CHECKED: AB

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C21-4** **1 OF 1 METRIC**  
**G.W.P.** 5198-10-00 **LOCATION** N 5039270.7; E 414347.4 **ORIGINATED BY** EHS  
**DIST** \_\_\_\_\_ **HWY** 60 **BOREHOLE TYPE** 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing, Wash Boring **COMPILED BY** AC  
**DATUM** GEODETIC **DATE** September 17, 2013 **CHECKED BY** AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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	GR	SA	SI	CL	
367.0	GROUND SURFACE																	
0.0	ASPHALT (75 mm)																	
	Gravelly sand, some silt (FILL) Compact to dense Brown Moist		1	SS	38													
			2	SS	28													
	Augers grinding from 0.8 m to 2.3 m and 3.0 to 3.5 m depth.		3	SS	28													
			4	SS	36													
			5	SS	14													
363.1	PEAT (Fibrous) Stiff Black Wet		6	SS	9													
362.6	SAND, some silt, trace organics Very loose Brown Wet		7	SS	3													
361.4	SILT, some sand Compact Brown Wet		8	SS	19													
360.0	Silty SAND Dense Brown Wet		9	SS	39													
356.6	END OF BOREHOLE AUGER REFUSAL		10	SS	31													
10.4	Note: 1. Water level at a depth of 4.0 m below ground surface (Elev. 363.0 m) upon completion of drilling. 2. Advanced DPT 1.5 m east of borehole. Stopped at 0.6 m depth, rods sliding.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:



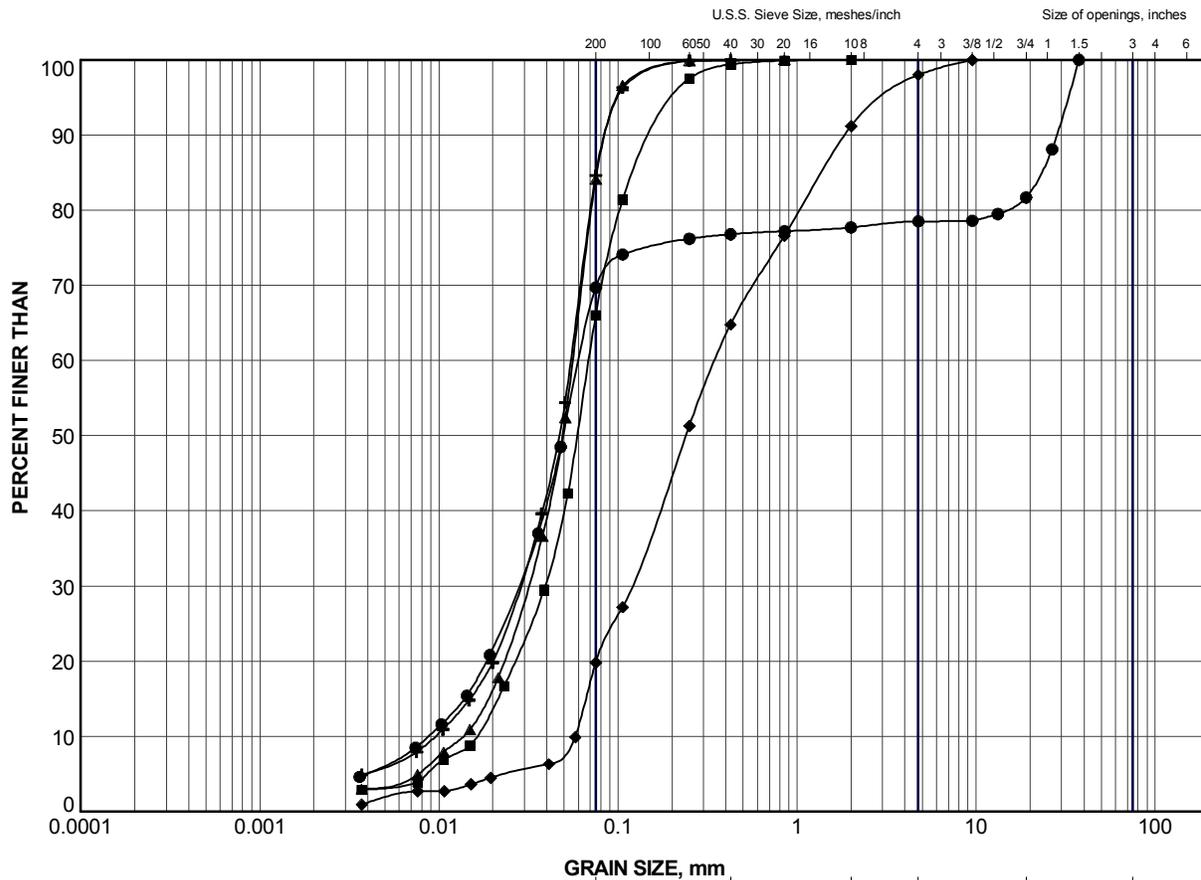
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C21-2	3	363.9

PROJECT					HIGHWAY 60 CULVERT 21				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SILTY SAND (FILL)				
PROJECT No.			13-1191-0003		FILE No.			13-1191-0003.GPJ	
DRAWN	TB	Jul 2014		SCALE	N/A		REV.		
CHECK	AB	Jul 2014		<b>FIGURE H1</b>					
APPR	JMAC	Jul 2014							





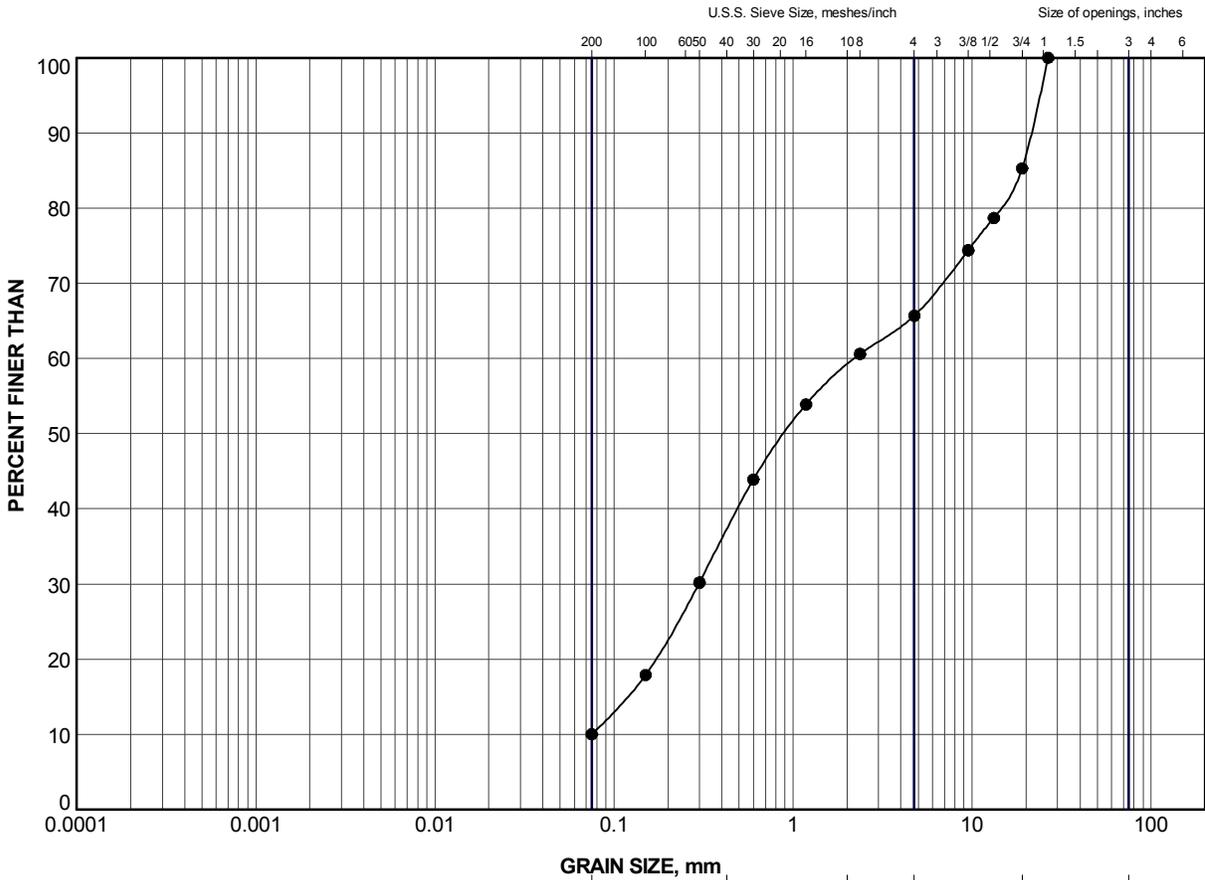
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C21-1	3	361.7
■	C21-2	6	361.6
▲	C21-3	2	361.7
+	C21-4	8	360.6
◆	C21-4	10	357.6

PROJECT					HIGHWAY 60 CULVERT 21				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT to SILTY SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE H2</b>				
APPR	JMAC	Jul 2014							





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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C21-1	6	359.4

PROJECT					HIGHWAY 60 CULVERT 21					
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL					
 Golder Associates SUDBURY, ONTARIO		PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ		
		DRAWN	TB	Jul 2014		SCALE	N/A		REV.	
		CHECK	AB	Jul 2014		<b>FIGURE H3</b>				
APPR	JMAC	Jul 2014								

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX I

## Culvert 26 – STA 33+156 (Airy Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
Culvert 26 - STA 33+156  
BOREHOLE LOCATIONS AND SOIL STRATA

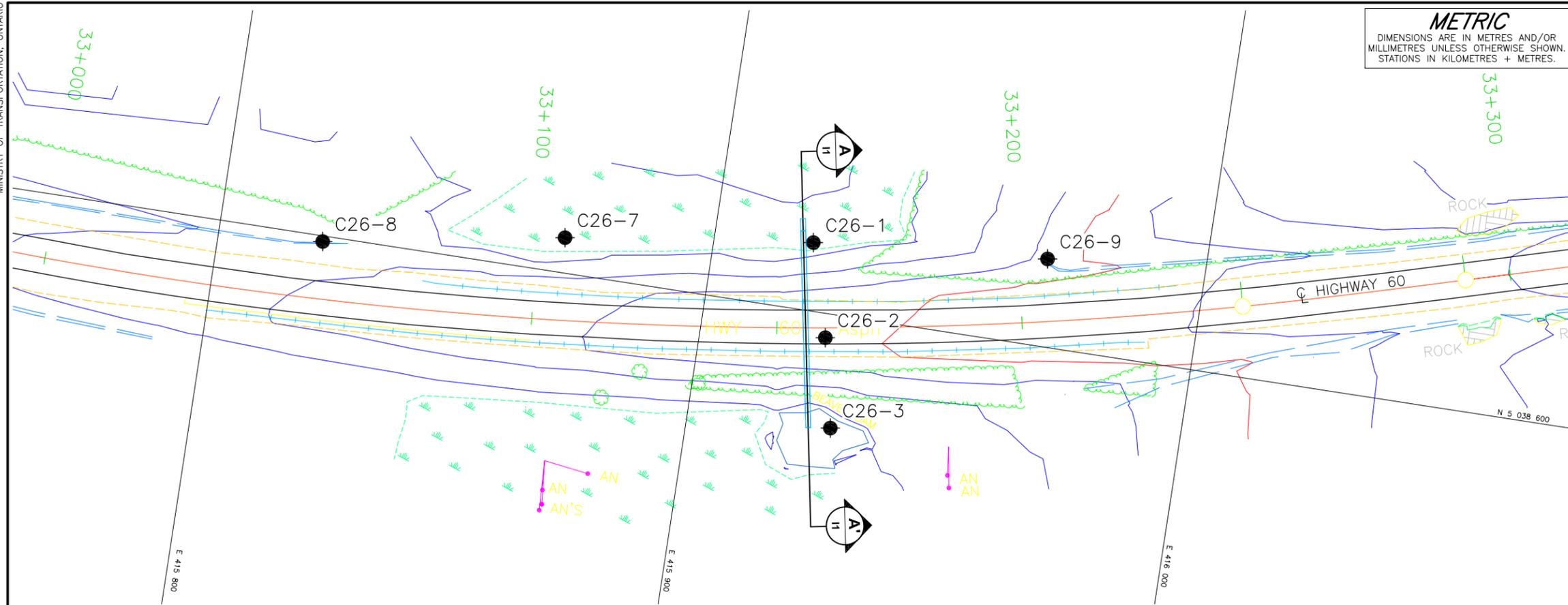
SHEET



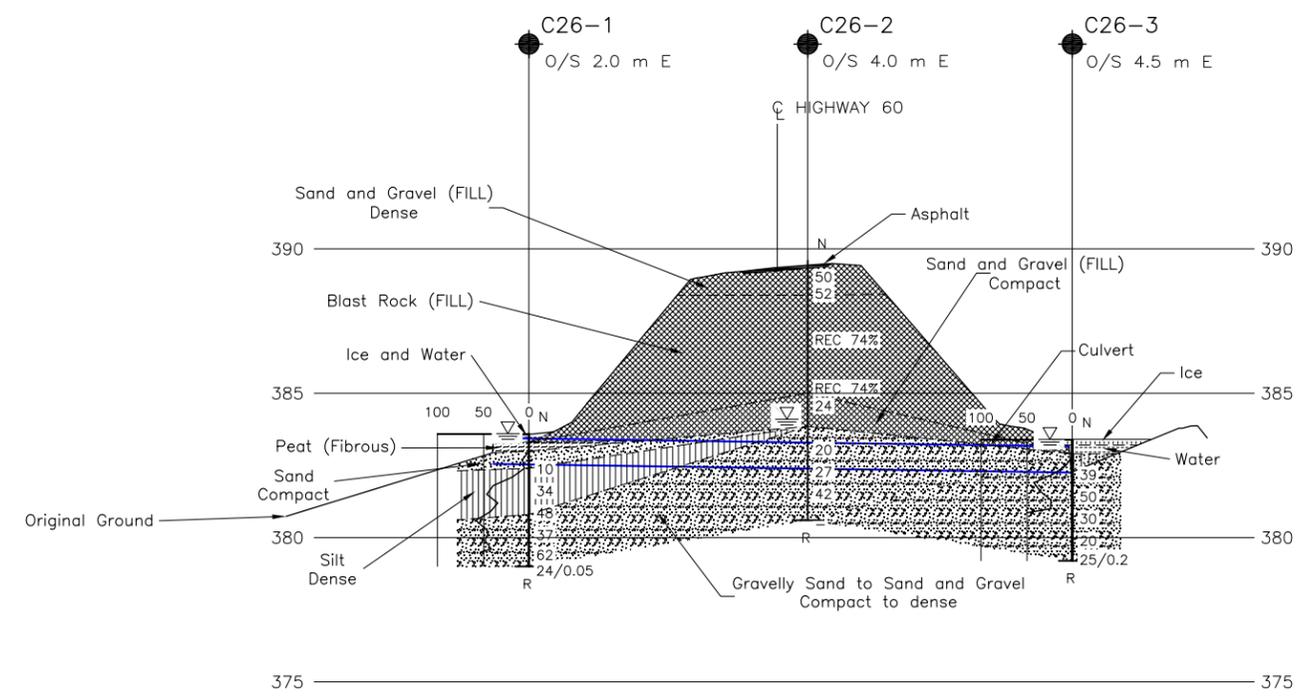
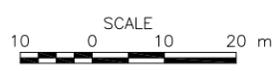
**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km



PLAN



PROFILE  
A-A'  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
2.5 0 2.5 5 m  
VERTICAL SCALE

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C26-1	383.6	5038613.8	415920.1
C26-2	389.6	5038595.1	415925.5
C26-3	383.4	5038577.1	415929.3
C26-7	383.6	5038607.1	415869.9
C26-8	384.5	5038598.9	415821.3
C26-9	388.2	5038617.8	415967.8

NOTES

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

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

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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE:
		DWG. 11



**PHOTOGRAPHS**

**Photograph 1: Culvert 26 at STA 33+156  
Looking East along North Shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert 26 at STA 33+156  
Looking West along South Shoulder from Culvert Location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C26-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038613.8; E 415920.1</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>February 8, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
383.6 0.0	ICE SURFACE ICE																	
383.0 0.6	WATER PEAT (Fibrous) Black Wet																	
382.4 1.2	SAND, some silt Compact Brown Wet		1	SS	10													
	SILT, trace to some sand, trace to some clay Dense Brown Wet		2	SS	34													0 9 83 8
380.8 2.8	Gravelly SAND, some silt, trace clay Compact to very dense Brown Wet		3	SS	48													
			4	SS	37													21 57 20 2
			5	SS	62													
379.0 4.6	END OF BOREHOLE SPLIT-SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT (HAMMER BOUNCING)		6	SS	24/0.05													
	Note: 1. Advanced DCPT 1 m west of borehole and refusal at 4.1 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C26-2** **1 OF 1 METRIC**  
**G.W.P.** 5198-10-00 **LOCATION** N 5038595.1; E 415925.5 **ORIGINATED BY** GM  
**DIST** HWY 60 **BOREHOLE TYPE** NW Casing and NQ Coring **COMPILED BY** AC  
**DATUM** GEODETIC **DATE** July 30 and 31, 2013 **CHECKED BY** AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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		GR SA SI CL	
389.6	GROUND SURFACE															
0.0	ASPHALT (90 mm)															
0.1	Sand and gravel, trace to some silt (FILL)		1	SS	50										40 49 (11)	
388.4	Dense Brown Moist		2	SS	52											
1.2	Blast rock (FILL)															
			3A	RC	REC 74%											
			3B	RC	REC 74%											
385.0	Sand and gravel (FILL)															
4.6	Compact Brown Wet		4	SS	24											
383.5	Gravelly SAND to SAND and GRAVEL, some silt, trace clay		5	SS	20										36 44 19 1	
	Compact to dense Brown to grey Wet		6	SS	27											
			7	SS	42										27 54 17 2	
380.6	END OF BOREHOLE SPLIT-SPOON AND RESISTANCE TO FURTHER CASING ADVANCEMENT															
9.0	Notes: 1. Water level at a depth of 5.5 m below ground surface (Elev. 384.1 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C26-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038577.1; E 415929.3</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>February 9 and 10, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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	20 40 60	20 40 60	20 40 60	20 40 60	20 40 60	kN/m <sup>3</sup>	GR SA SI CL	
383.4	ICE SURFACE														
0.0	ICE														
382.9	WATER														
0.5	Gravelly SAND to SAND and GRAVEL Compact to dense Brown Wet		1	SS	39										
			2	SS	50										
			3	SS	30										
			4	SS	20										
			5	SS	25/0.2										
379.2	END OF BOREHOLE SPLIT-SPOON AND CASING REFUSAL (HAMMER BOUNCING)														
4.2	Notes:  1. Advanced DCPT 1 m east of borehole, refusal at 2.6 m depth.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C26-7</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038607.1; E 415869.9</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>February 10 and 11, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
							○ UNCONFINED    + FIELD VANE					WATER CONTENT (%)					
							● QUICK TRIAXIAL    × REMOULDED										
							20   40   60   80   100					20   40   60					
383.6	ICE SURFACE																
0.0 383.3	ICE																
382.9	PEAT (Fibrous) Black Wet					383											
0.7	Gravelly Silty SAND Loose to very dense Brown Wet		1	SS	5	382							○				
	Organics encountered in Sample 1.		2	SS	38	381											
381.0			3	SS	99	380.6											
380.6	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)					3.0											
	END OF DCPT																
	Notes:  1. Advanced DCPT 1 m north of borehole and stopped at 3.0 m depth..																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C26-8** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5038598.9; E 415821.3 ORIGINATED BY EHS  
 DIST          HWY 60 BOREHOLE TYPE Portable Equipment, NW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE February 11, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
384.5	GROUND SURFACE											
0.0	Silty SAND, some gravel Compact to very dense Brown Frozen to 0.3 m, then moist		1	SS	28	384						
383.5			2	SS	66/0.1							
1.0	END OF BOREHOLE SPLIT-SPOON REFUSAL  Notes: 1. Borehole dry upon completion of drilling. 2. Advanced DCPT 1 m northwest of borehole, refusal at 1 m depth.											

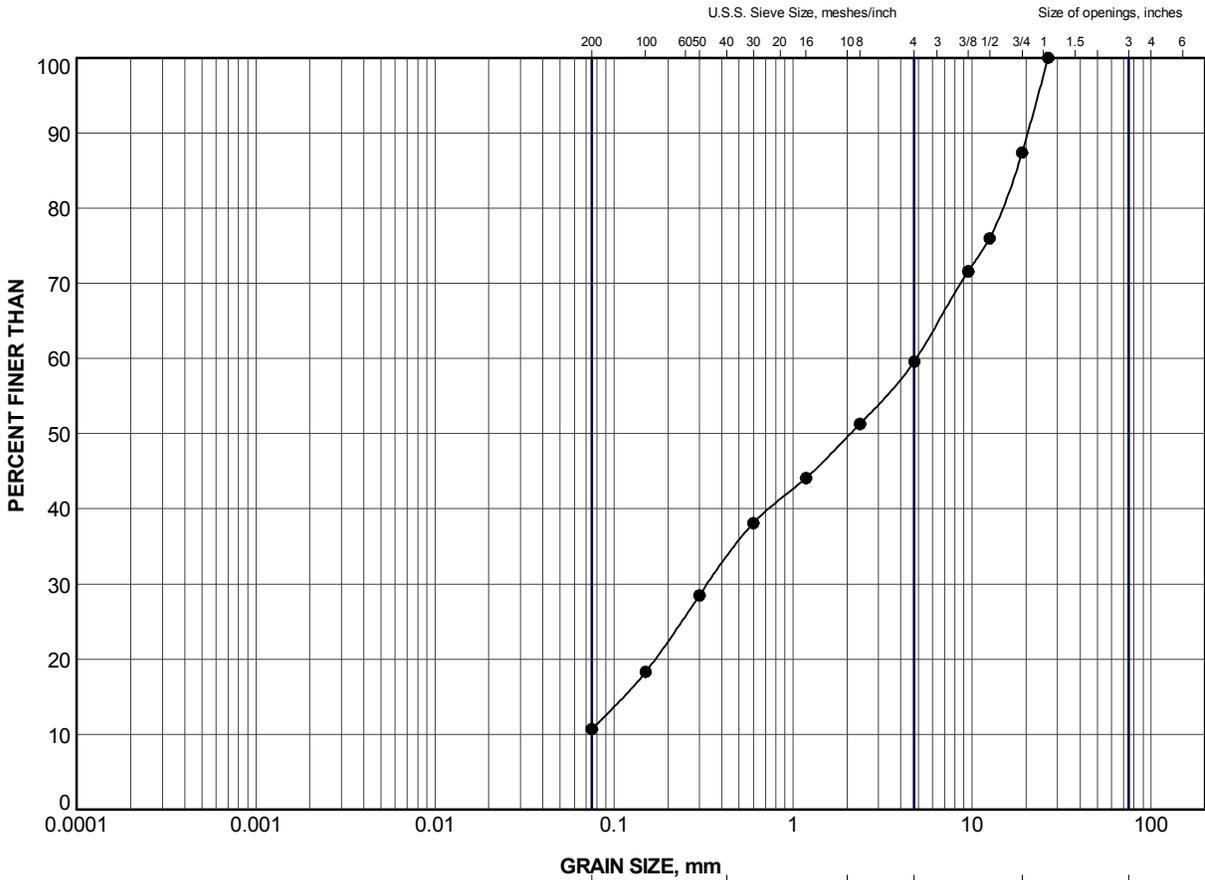
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C26-9</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038617.8; E 415967.8</u>	ORIGINATED BY <u>EHS</u>
DIST <u>          </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>February 12, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
388.2	GROUND SURFACE																	
0.0 387.9 0.3	PEAT Black Wet		1	SS	1													
	SAND, some silt, some gravel Compact to very dense Brown Moist		2	SS	15													13 69 (18)
386.4			3	SS	37	▽												
1.8	END OF BOREHOLE																	
Notes: 1. Attempted borehole three different locations in the immediate vicinity of this borehole and refusal at 0.3 m. 2. Water level at a depth of 1.4 m below ground surface (Elev. 386.8 m) upon completion of drilling. 3. Advanced DCPT 1 m west of borehole, refusal at 1.0 m depth. 4. Split Spoon samples obtained by driving with a 1/2 weight hammer. SPT 'N' values have been adjusted to the inferred values that would be obtained using a standard weight hammer.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:



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

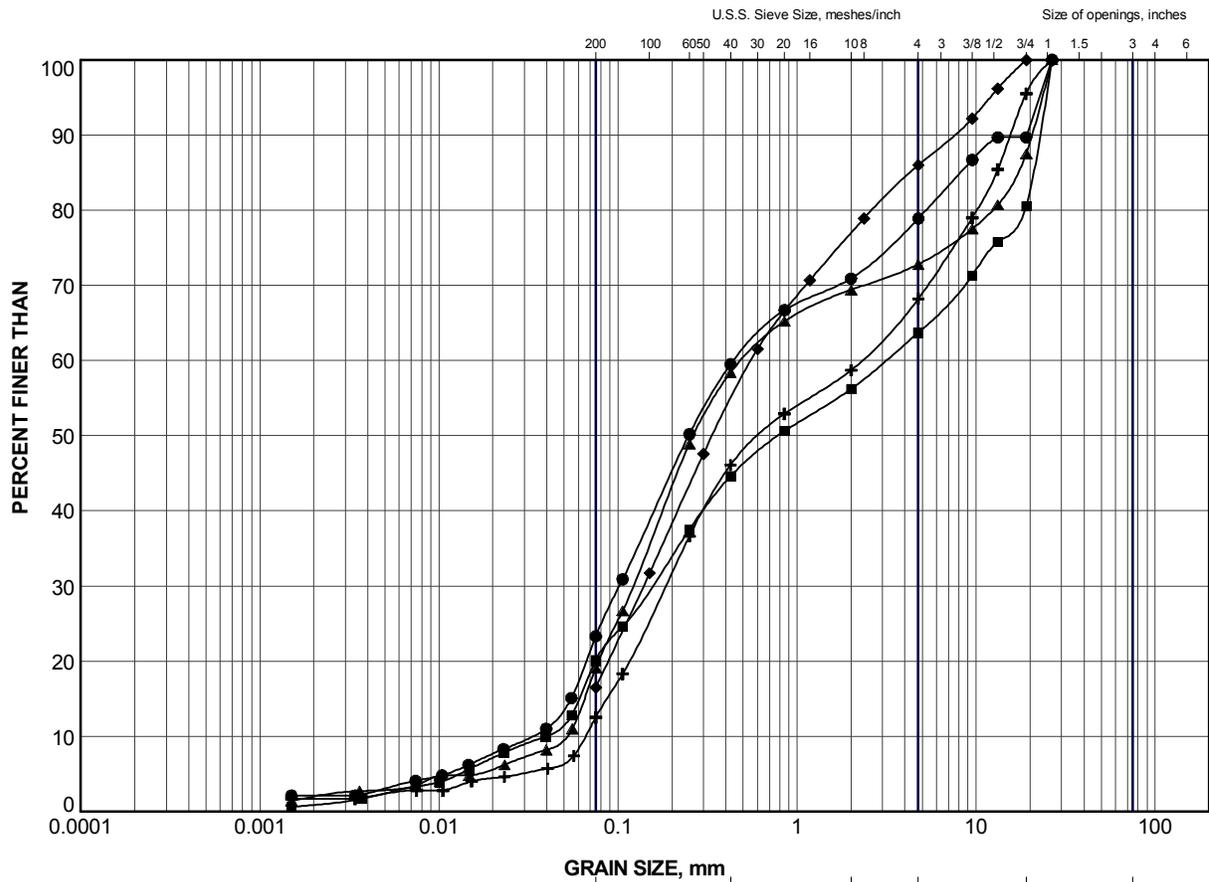
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C26-2	2	388.6

PROJECT					HIGHWAY 60 CULVERT 26				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE 11</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									

SUD-MTO GSD (NEW) GLDR\_LDN.GDT





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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C26-1	4	380.3
■	C26-2	5	383.2
▲	C26-2	7	381.7
+	C26-3	4	380.1
◆	C26-9	2	387.3

PROJECT					HIGHWAY 60 CULVERT 26				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND to SAND and GRAVEL				
PROJECT No. 13-1191-0003			FILE No. 13-1191-0003.GPJ		DRAWN TB Jul 2014			SCALE N/A REV.	
CHECK AB Jul 2014			APPR JMAC Jul 2014		<b>FIGURE 13</b>				
<b>Golder Associates</b> SUDBURY, ONTARIO									

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX J

Culvert 27 – STA 10+294 (Murchison Township)

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

CONT No.  
 GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 27 - STA 10+294  
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



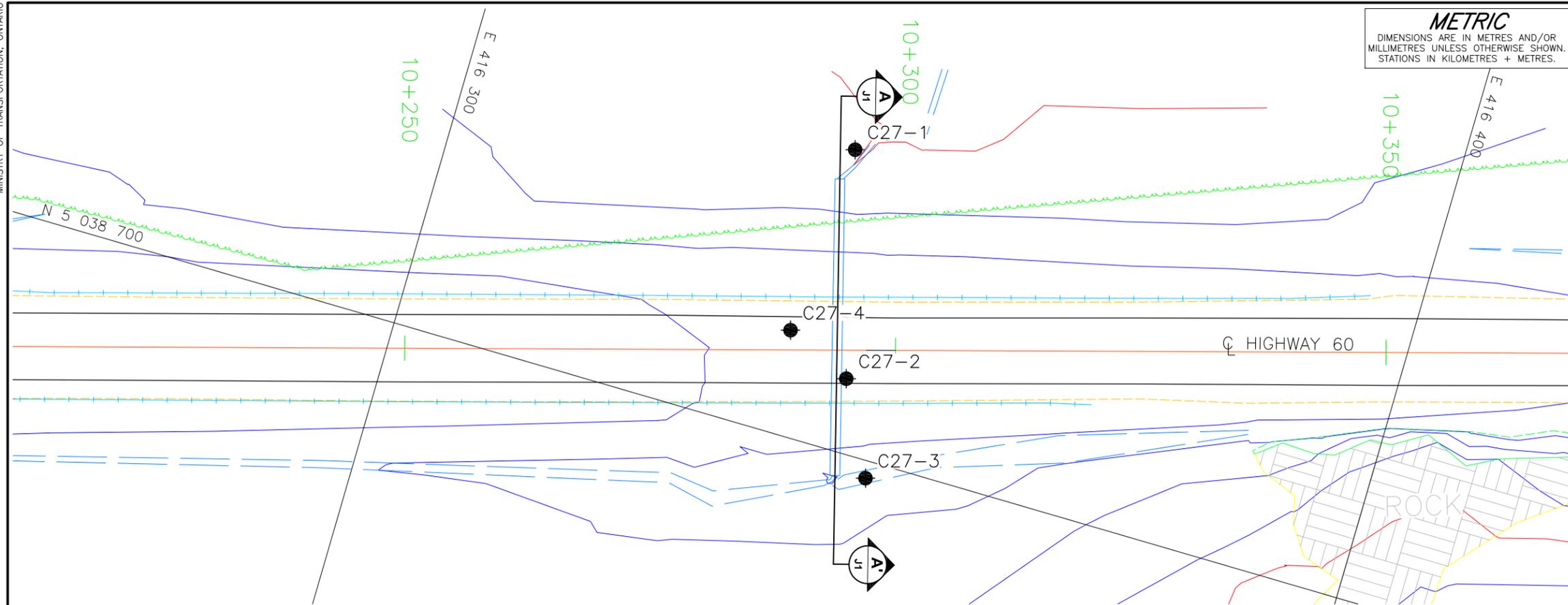
**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



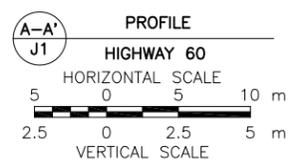
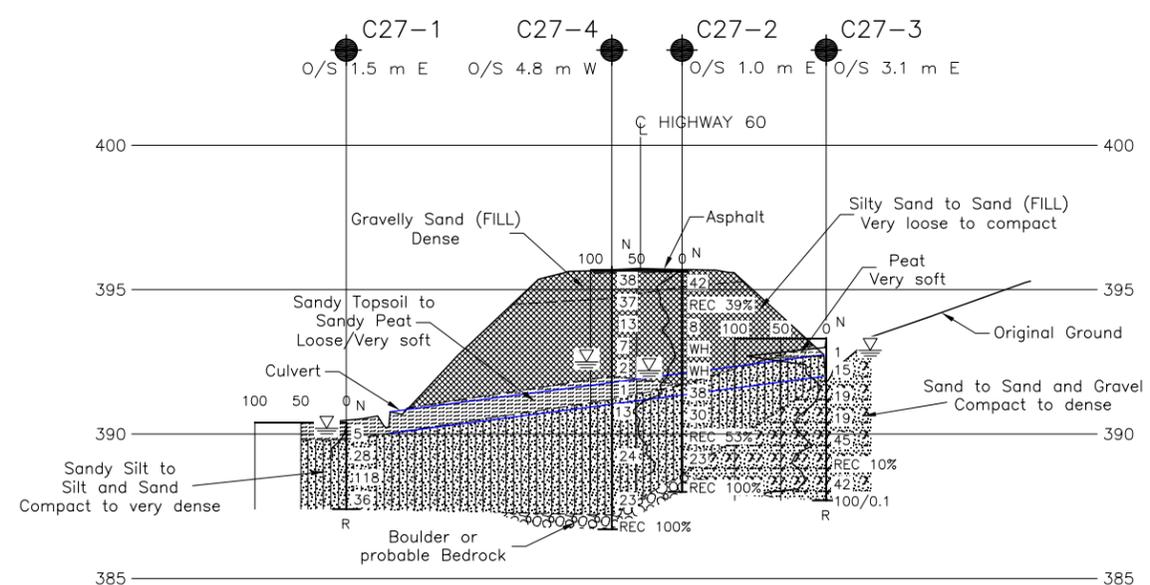
**KEY PLAN**  
 13 0 13 km

**LEGEND**

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ≡ WL upon completion of drilling



**PLAN**



**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C27-1	390.4	5038730.0	416340.2
C27-2	395.7	5038707.4	416345.8
C27-3	393.3	5038698.3	416350.5
C27-4	395.8	5038710.6	416339.0

**NOTES**

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

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. J1



PHOTOGRAPHS

**Photograph 1: Culvert 27 at STA 10+294  
Looking West along South Shoulder at Culvert Location (September 2013)**



**Photograph 2: Culvert 27 at STA 10+294  
Looking East along North Shoulder at Culvert Location (July 2013)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C27-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038730.0; E 416340.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 22, 2014</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
390.4	GROUND SURFACE																
0.0	Sandy TOPSOIL Loose Brown Moist to wet		1	SS	5	∇	390										
389.8																	
0.6	SILT and SAND, trace to some gravel, trace clay Compact to very dense Brown Wet		2	SS	28		389										7 48 42 3
			3	SS	118												
			4	SS	36		388										
387.4	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT																
3.0	Note:  1. Water level at a depth of 0.2 m below ground surface (Elev. 390.2 m) upon completion of drilling.  2. Advanced DCPT 0.5 m east of Borehole . DCPT stopped at a depth of 1.2 m, rods sliding.																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C27-2** **1 OF 1 METRIC**

G.W.P. 5198-10-00 LOCATION N 5038707.4; E 416345.8 ORIGINATED BY EHS

DIST HWY 60 BOREHOLE TYPE NW Casing and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE September 24 and 25, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40
395.7	GROUND SURFACE													
0.0	ASPHALT (95 mm)													
0.1	Gravelly sand (FILL)		1	SS	42									
395.1	Dense Brown Moist													
0.6	Silty sand, some gravel (FILL) Very loose to loose Brown Moist		-	RC	REC 39%									
	Cobbles encountered as follows:		2	SS	8									
	Depth (m) Thickness (mm)													
	1.0 75													
	1.2 275		3	SS	WH									
			4	SS	WH									
391.7	SILT and SAND, trace to some gravel, trace clay		5	SS	38									
4.0	Cobbles and boulders were encountered as follows:		6	SS	30									
	Depth (m) Thickness (mm)													
	5.5 175													
	5.8 300		-	RC	REC 53%								10 48 (42)	
			7	SS	23									
388.6	BOULDER OR PROBABLE BEDROCK													
7.1			-	RC	REC 100%									
388.0	END OF BOREHOLE													
7.7	Note: 1. Water level at a depth of 3.5 m below ground surface (Elev. 392.2 m) upon completion of drilling. 2. Advanced DCPT 1 m east of borehole, refusal at 7.1 m depth.													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:

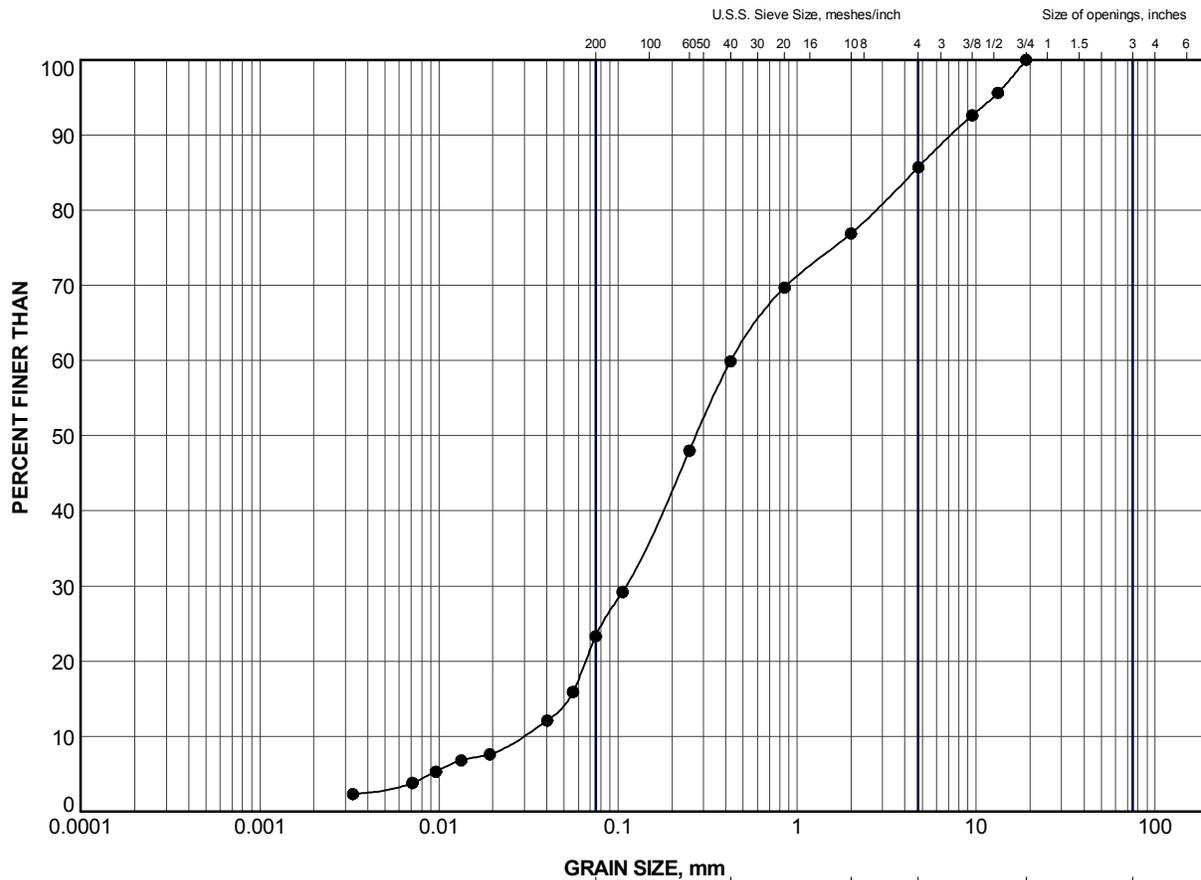
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C27-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038698.3; E 416350.5</u>	ORIGINATED BY <u>AC</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 25, 2013</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40					
393.3	GROUND SURFACE													
0.0	Sand (FILL) Brown Moist		1	SS	1	▽	393							
392.7	PEAT (Fibrous) Very soft Black Wet		2	SS	15									
391.9	Sandy SILT, trace to some sand Compact Brown Wet		3	SS	19									45 41 12 2
1.4	SAND to SAND and GRAVEL, some silt Compact to dense Brown Wet		4	SS	19									
			5	SS	45									
	A 75 mm cobble was encountered at 4.0 m depth.		6	RC	REC 10%									
			7	SS	42									16 67 15 2
387.7	END OF BOREHOLE SPLIT-SPOON REFUSAL (HAMMER BOUNCING)		8	SS	100/0.1		388							
5.6	Notes: 1. Water level at a depth of 0.4 m below ground surface (Elev. 392.9 m) upon completion of drilling. 2. Advanced DCPT 1 m south of borehole, refusal at 5.5 m depth.													

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 16/07/14 DATA INPUT:



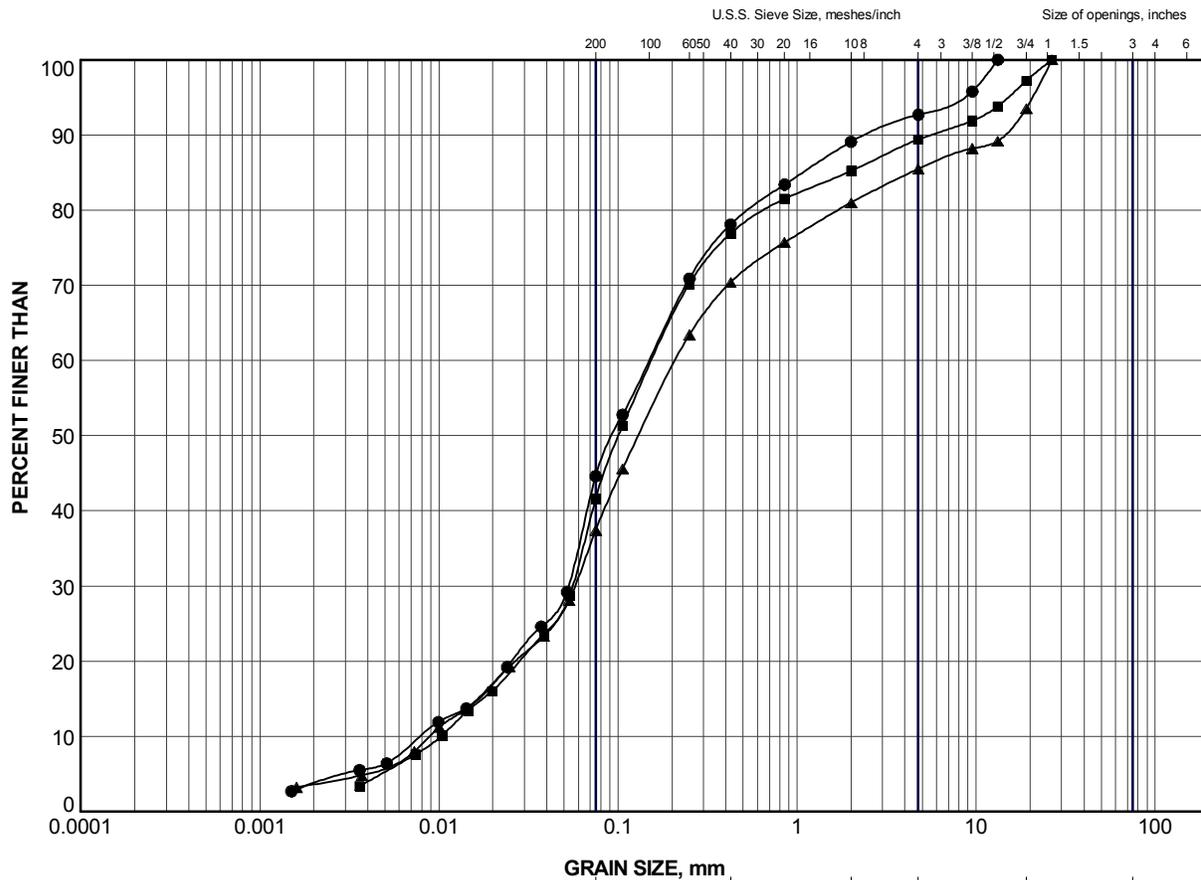


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C27-4	3	394.0

PROJECT					HIGHWAY 60 CULVERT 27						
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILTY SAND (FILL)						
 <b>Golder Associates</b> SUDBURY, ONTARIO		PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ			
		DRAWN	TB	Jul 2014		SCALE	N/A		REV.		
		CHECK	AB	Jul 2014		APPR	JMAC	Jul 2014		<b>FIGURE J1</b>	

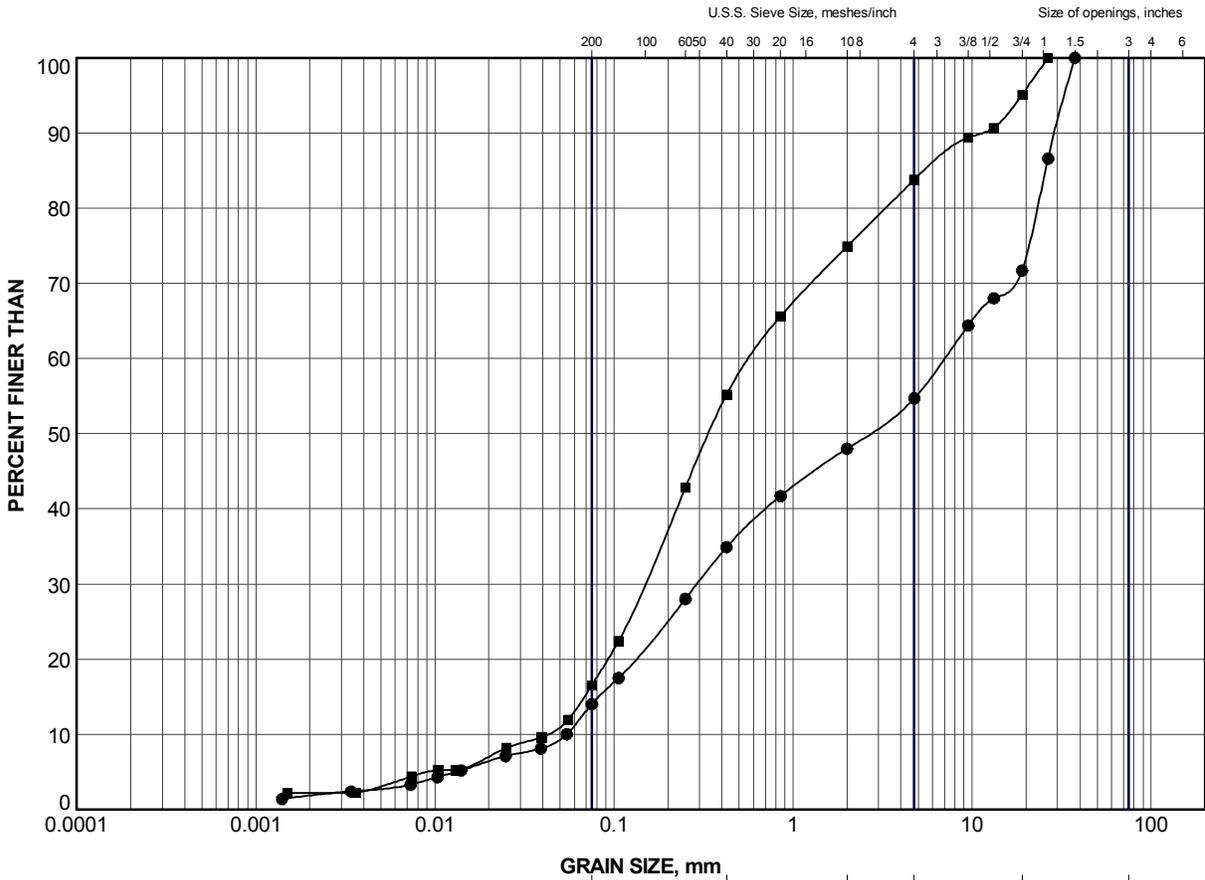


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C27-1	3	388.6
■	C27-2	6	390.8
▲	C27-4	8	389.4

PROJECT					HIGHWAY 60 CULVERT 27				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE J2</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C27-3	3	391.5
■	C27-3	7	388.4

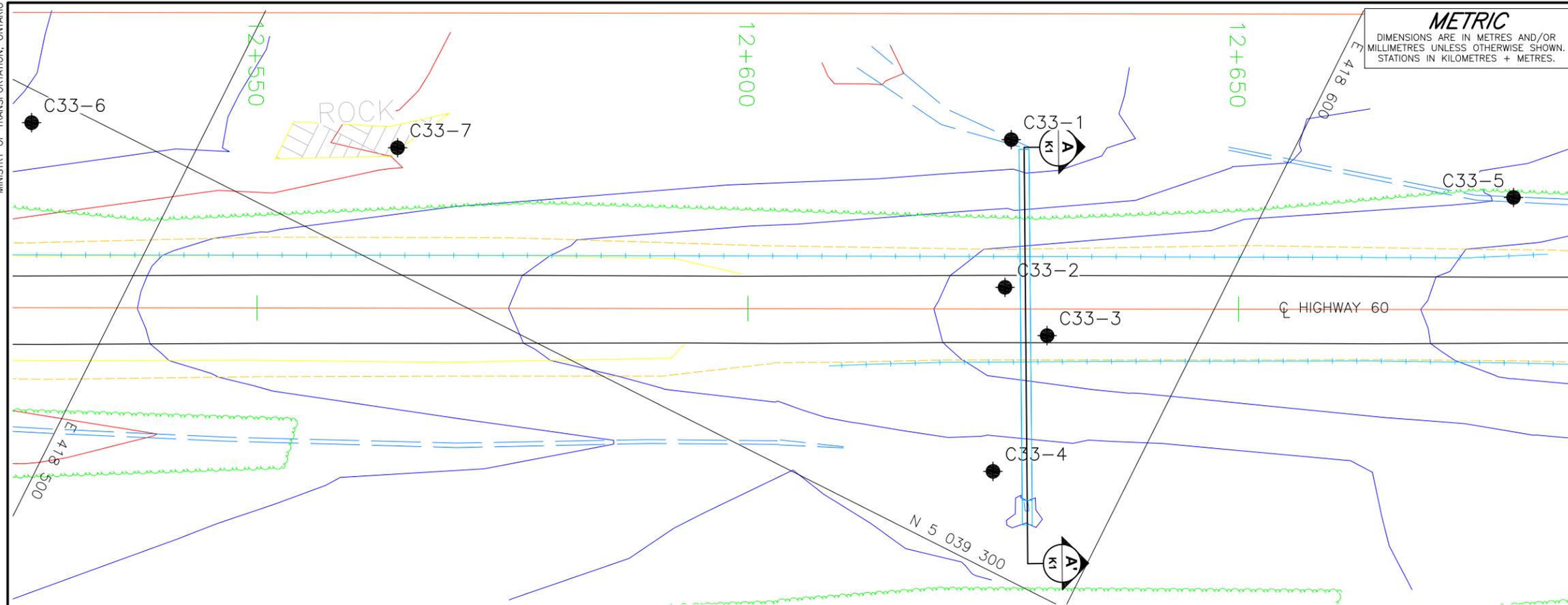
PROJECT					HIGHWAY 60 CULVERT 27				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND to SAND and GRAVEL				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE J3</b>				
APPR	JMAC	Jul 2014							



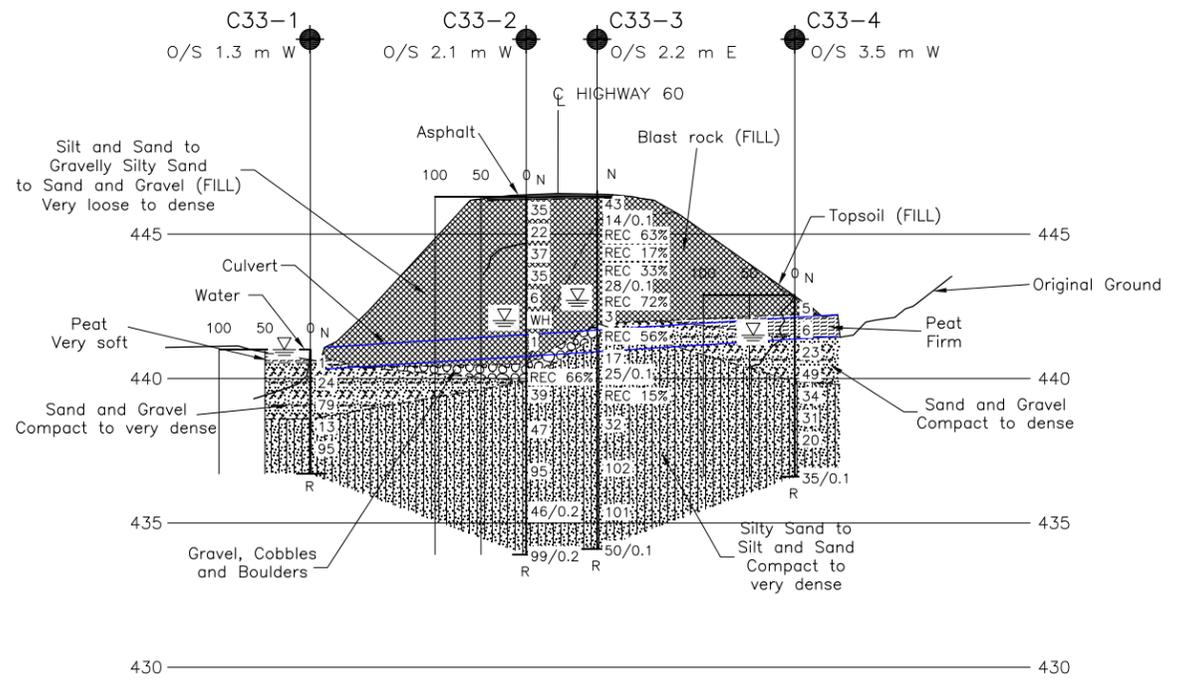


# APPENDIX K

Culvert 33 – STA 12+628 (Murchison Township)



PLAN



A-A'  
 K1  
 PROFILE  
 HIGHWAY 60  
 HORIZONTAL SCALE  
 0 5 10 m  
 VERTICAL SCALE  
 0 2.5 5 m

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

CONT No.  
 GWP No. 5198-10-00



HIGHWAY 60  
 Culvert 33 - STA 12+628  
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 0 13 km

LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ∇ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C33-1	441.0	5039340.1	418573.8
C33-2	446.3	5039326.4	418579.9
C33-3	446.5	5039324.0	418586.0
C33-4	442.9	5039309.2	418587.2
C33-5	446.4	5039357.8	418622.2
C33-6	436.2	5039296.9	418483.8
C33-7	440.7	5039311.4	418518.3

NOTES

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

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

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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE: DWG. K1



## PHOTOGRAPHS

**Photograph 1: Culvert 33 at STA 12+628  
Looking East along South Shoulder at Culvert Location (September 2013)**



**Photograph 2: Culvert 33 at STA 12+628  
Looking West along North Shoulder at Culvert Location (July 2013)**



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C33-1** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5039340.1; E 418573.8 ORIGINATED BY EHS  
 DIST                      HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE May 10, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
441.0	WATER SURFACE														
0.0	WATER														
440.5	PEAT (Fibrous), some sand Very soft Black Wet		1	SS	1										
0.5	SAND and GRAVEL, trace to some silt Compact to very dense Brown Wet		2	SS	24										
			3	SS	79										
438.6	Silty SAND Compact to very dense Brown Wet		4	SS	13										
2.4			5	SS	95										
436.7	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT														
4.3	Notes: 1. Advanced DCPT 0.3 m west and 0.5 m south of borehole, refusal at 1.7 m depth.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C33-2** **1 OF 1 METRIC**  
**G.W.P.** 5198-10-00 **LOCATION** N 5039326.4; E 418579.9 **ORIGINATED BY** EHS  
**DIST** HWY 60 **BOREHOLE TYPE** NW Casing and NQ Coring **COMPILED BY** AC  
**DATUM** GEODETIC **DATE** September 30 and Oct. 1, 2013 **CHECKED BY** AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
446.3	GROUND SURFACE																	
0.0	ASPHALT (75 mm)		1	SS	35													
	Gravelly silty sand (FILL) Very loose to dense Brown Moist to wet		2	SS	22													
			3	SS	37													23 55 (22)
			4	SS	35													
			5	SS	6													
			6	SS	WH													28 50 (22)
			7	SS	1													
440.5	GRAVEL and COBBLES		-	RC	REC 66%													
439.9																		
6.4	SILT and SAND, some gravel, trace clay Dense to very dense Grey Wet		8	SS	39													11 44 (45)
			9	SS	47													
			10	SS	95													18 40 (42)
			11	SS	46/0.2													
433.9	END OF BOREHOLE SPOON REFUSAL		12	SS	99/0.2													
12.4	Note: 1. Water level at a depth of 3.3 m below ground surface (Elev. 443.0 m) inside casing upon completion of drilling. 2. Advanced DCPT 1.7 m west of borehole, predrilled to 1.5 m and refusal (rods sliding) at 2.7 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C33-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039324.0; E 418586.0</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>September 26, 2013</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)		
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
446.5	GROUND SURFACE																	
0.0	ASPHALT (75 mm)		1	SS	43													
	Sand and gravel (FILL)		2	SS	14/0.1													
445.5	Dense Brown Moist																	
1.0	Blast rock (FILL)		-	RC	REC 63%													
			-	RC	REC 17%													
			-	RC	REC 33%													
			3	SS	28/0.1													
			-	RC	REC 72%													
442.7	Silt and sand, trace to some gravel, trace clay (FILL)		4	SS	3													8 50 39 3
3.8	Loose Brown Wet																	
441.9	BOULDER		-	RC	REC 56%													
441.5	SILT and SAND, trace clay, trace gravel		5	SS	17													
5.0	Compact to very dense Grey Wet		6	SS	25/0.1													
	A 125 mm cobble encountered at 6.3 m depth.		-	RC	REC 15%													
			7	SS	32													2 49 44 5
			8	SS	102													
			9	SS	101													
			10	SS	50/0.1													
434.1	END OF BOREHOLE SPOON REFUSAL																	
12.4	Note: 1. Water level at a depth of 3.8 m below ground surface (Elev. 442.7 m) inside casing.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

**RECORD OF BOREHOLE No C33-4** 1 OF 1 **METRIC**

PROJECT 13-1191-0003 G.W.P. 5198-10-00 LOCATION N 5039309.2; E 418587.2 ORIGINATED BY EHS

DIST                      HWY 60 BOREHOLE TYPE 108 mm I.D. Continuous Flight Hollow Stem Augers COMPILED BY AC

DATUM GEODETIC DATE September 27, 2013 CHECKED BY AB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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		GR SA SI CL	
442.9	GROUND SURFACE															
0.0	Topsoil (FILL)		1	SS	5											
0.7	Silty sand (FILL) Loose Brown Moist		2	SS	6											
442.2	PEAT (Amorphous), some gravel Firm Black Moist															
441.5																
1.4	SAND and GRAVEL, trace to some silt, trace clay Compact to dense Brown Wet		3	SS	23											
			4	SS	49										58 33 8 1	
439.9																
3.0	SILT and SAND, trace to some gravel, trace clay Compact to dense Grey Wet		5	SS	34											
			6	SS	31											
	Cobbles inferred from augers grinding between 3.1 m and 6.3 m depth.		7	SS	20										8 44 (48)	
436.6	END OF BOREHOLE SPOON AND AUGER REFUSAL		8	SS	35/0.1											
6.3	Note: 1. Water level at a depth of 1.4 m below ground surface (Elev. 441.5 m) in borehole. 2. Advanced DCPT 1 m west of borehole and refusal (rods sliding) at 2.5 m depth.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C33-5</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039357.8; E 418622.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 11, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
446.4	GROUND SURFACE															
0.0	TOPSOIL															
0.1	SAND and GRAVEL, trace to some silt	0.0 - 0.1	1	SS	19											
445.6	Compact Brown Wet															
0.8	Silty SAND, trace to some gravel	0.1 - 0.8	2	SS	33							○			4 68 (28)	
	Compact to dense Brown Wet															
443.9	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT															
2.5	Note: 1. Water level at ground surface (Elev. 446.4 m).															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C33-6** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5039296.9; E 418483.8 ORIGINATED BY EHS  
 DIST                      HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE May 10, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60	GR	SA
436.2	GROUND SURFACE																					
0.0	PEAT (Fibrous)		1	SS	1	▽																
435.8	Black Moist																					
0.4	Silty SAND, trace to some gravel, trace clay		2	SS	26																	
	Compact to very dense		3	SS	54							○						20	59	(21)		
	Brown to grey		4	SS	61																	
	Wet		5	SS	69							○								8	60	29
431.3	END OF BOREHOLE SPOON REFUSAL	6	SS	81																		
4.9	Notes: 1. Water level at a depth of 0.3 m below ground surface (Elev. 435.9m) upon completion of drilling.																					

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

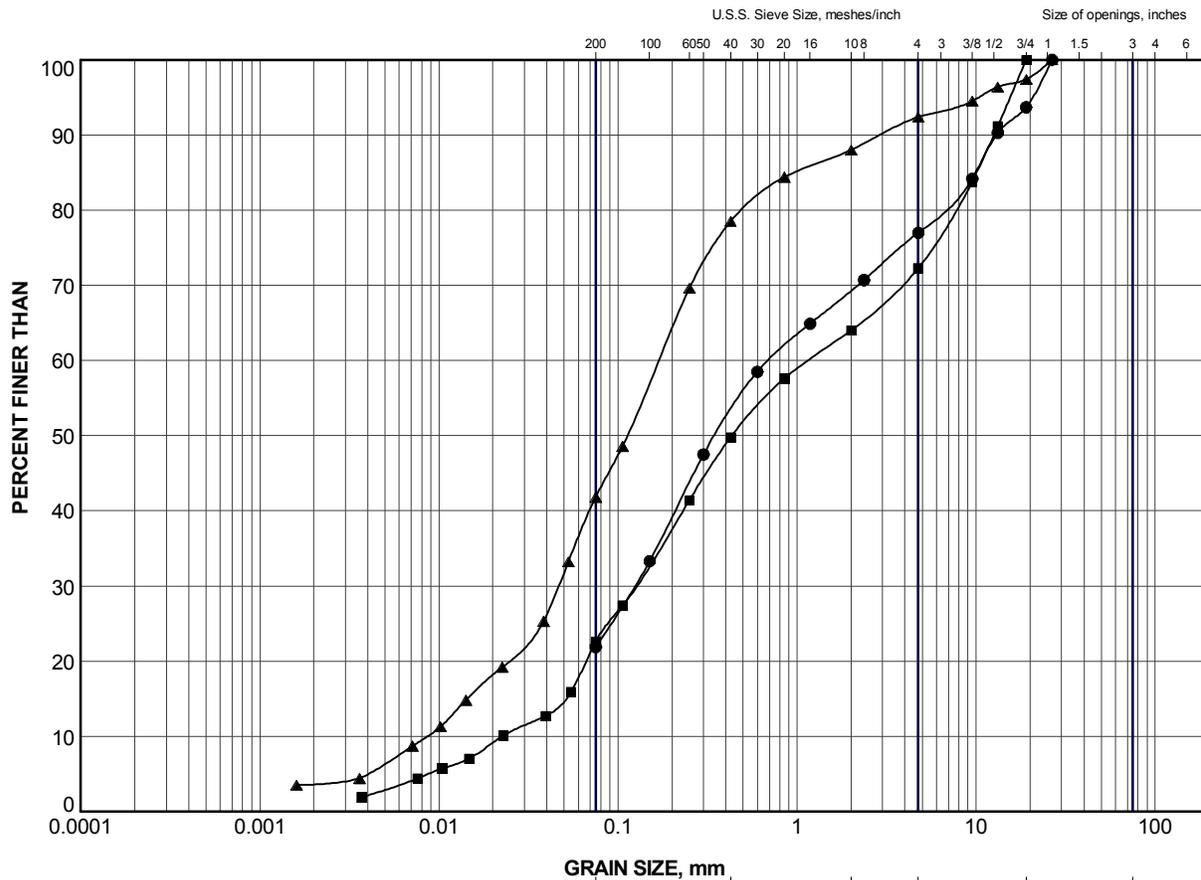


PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C33-7** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5039311.4; E 418518.3 ORIGINATED BY EHS  
 DIST          HWY 60 BOREHOLE TYPE          COMPILED BY AC  
 DATUM GEODETIC DATE May 10, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
440.7 0.0	GROUND SURFACE EXPOSED BEDROCK																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 17/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

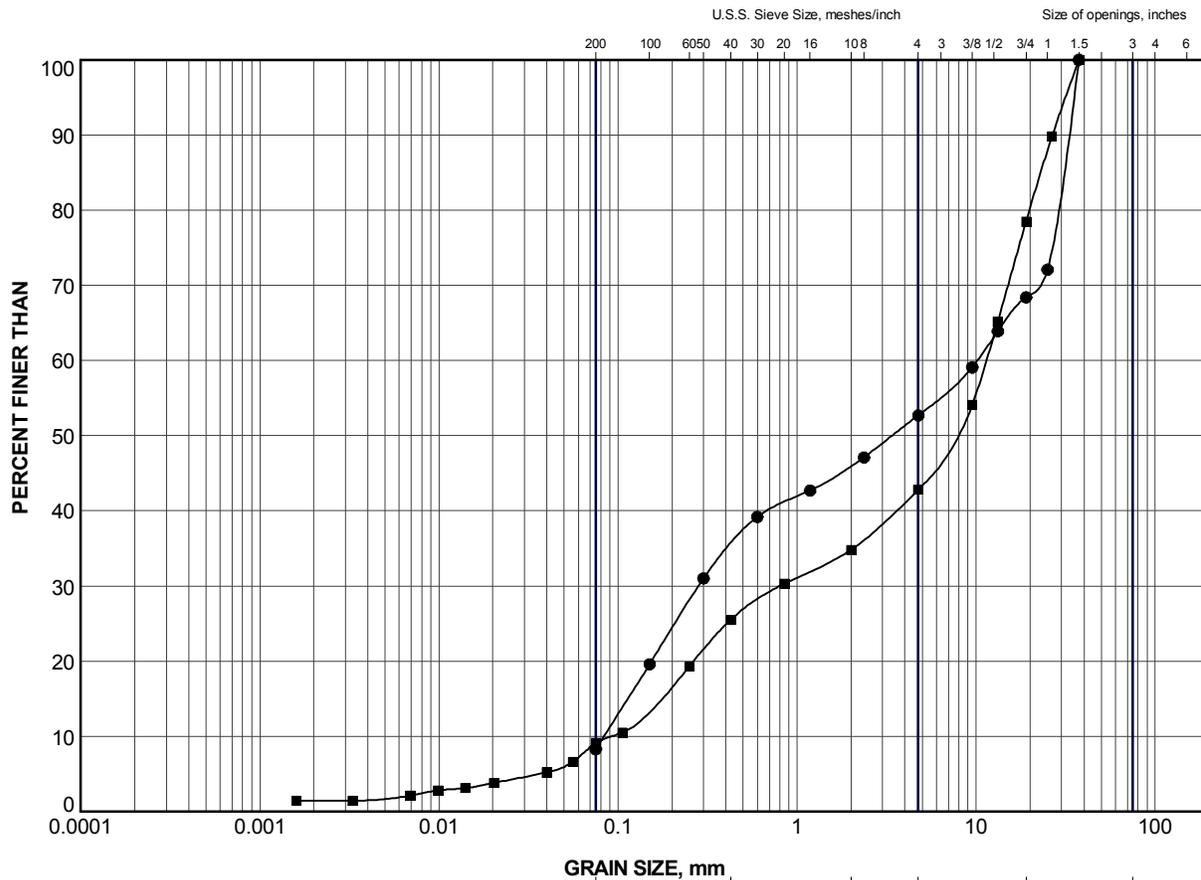


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C33-2	3	444.5
■	C33-2	6	442.2
▲	C33-3	4	442.5

PROJECT					HIGHWAY 60 CULVERT 33				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to GRAVELLY SILTY SAND (FILL)				
PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ			
DRAWN	TB	Jul 2014		SCALE	N/A		REV.		
CHECK	AB	Jul 2014		<b>FIGURE K1</b>					
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									



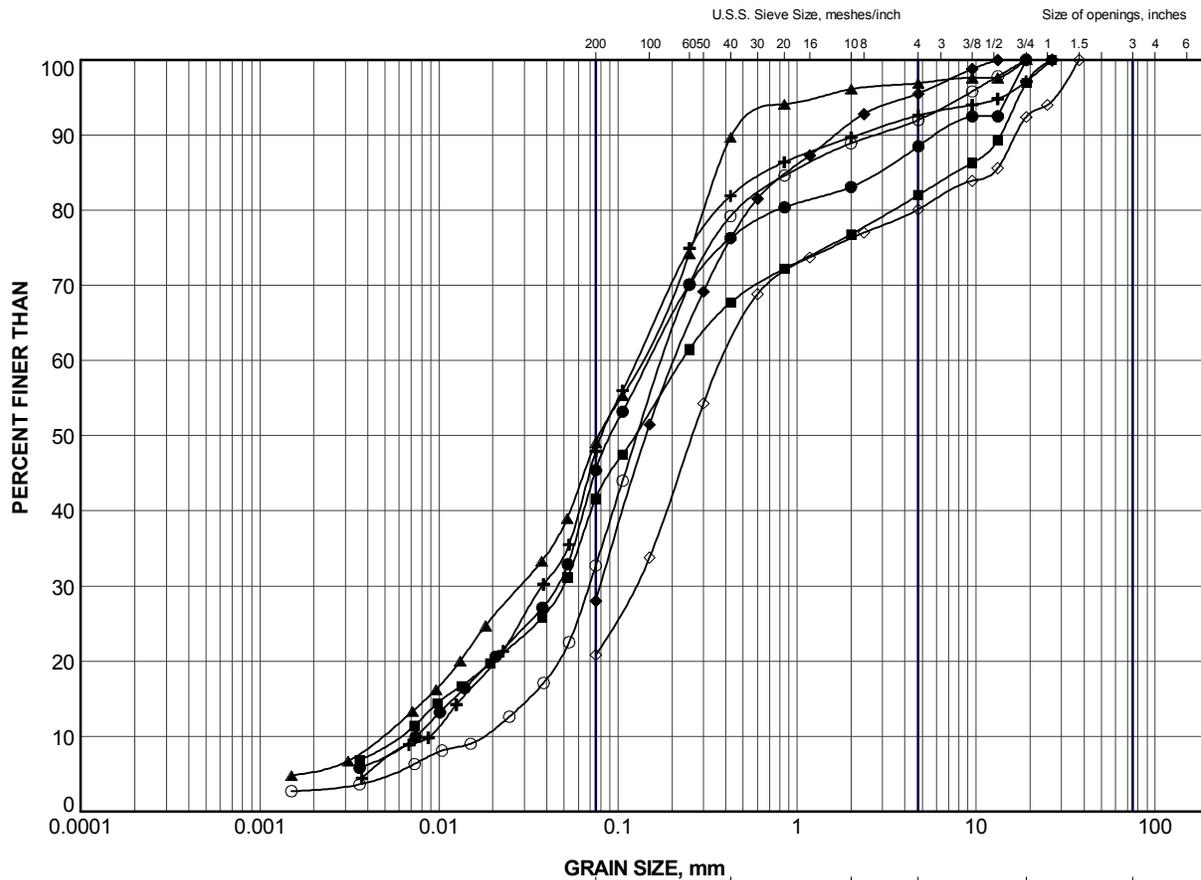
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C33-1	3	439.2
■	C33-4	4	440.3

PROJECT					HIGHWAY 60 CULVERT 33				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE K2</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C33-2	8	439.6
■	C33-2	10	436.9
▲	C33-3	7	438.6
+	C33-4	7	438.1
◆	C33-5	2	445.4
◇	C33-6	3	434.4
○	C33-6	5	432.9

PROJECT <b>HIGHWAY 60 CULVERT 33</b>					
TITLE <b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to SILTY SAND					
PROJECT No.		13-1191-0003		FILE No.	13-1191-0003.GPJ
DRAWN	TB	Jul 2014	SCALE	N/A	REV.
CHECK	AB	Jul 2014	<b>FIGURE K3</b>		
APPR	JMAC	Jul 2014			
		<b>Golder Associates</b> SUDBURY, ONTARIO			

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX L

Culvert 35 – STA 13+350 (Murchison Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 35 - STA 13+530  
BOREHOLE LOCATIONS AND SOIL STRATA

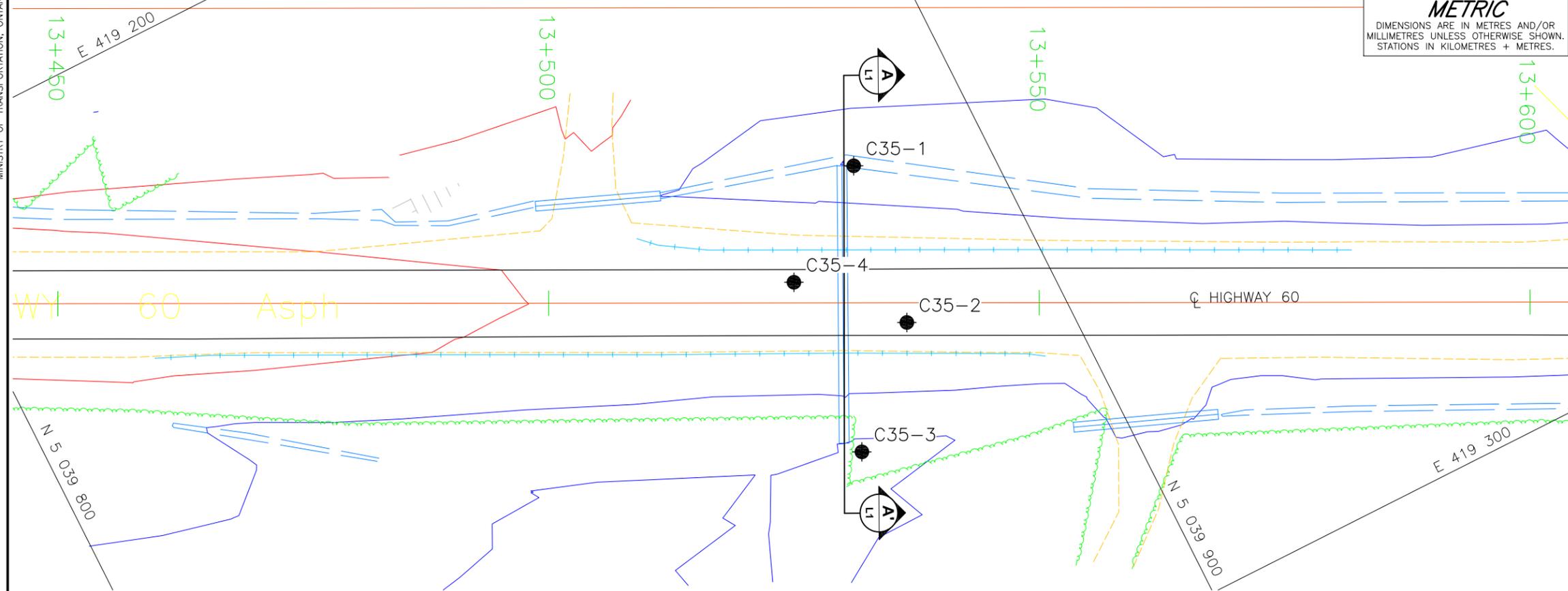
SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km



PLAN



**LEGEND**

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- REC Recovery (%)
- R Refusal
- ∇ WL upon completion of drilling

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C35-1	456.4	5039886.8	419244.8
C35-2	459.6	5039884.5	419261.4
C35-3	456.0	5039874.5	419271.1
C35-4	459.6	5039876.1	419252.6

**NOTES**

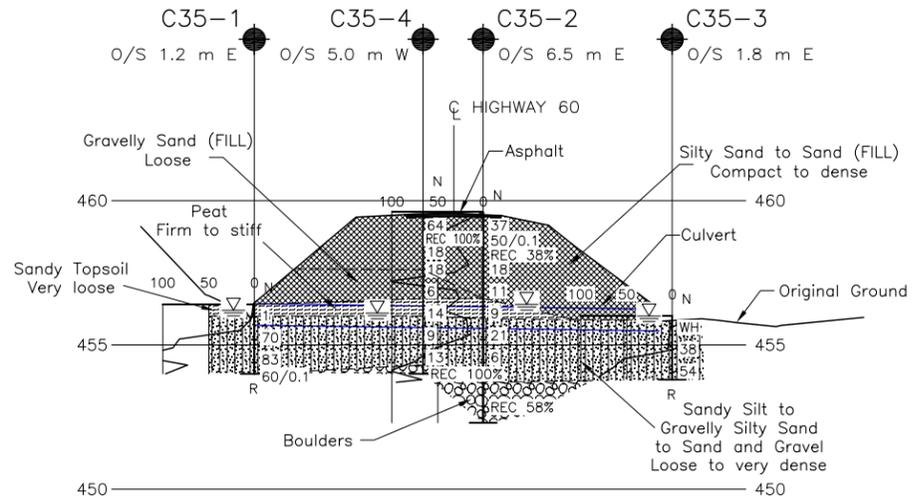
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



**PROFILE**  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
2.5 0 2.5 5 m  
VERTICAL SCALE



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. L1



PHOTOGRAPHS

**Photograph 1: Culvert 35 at STA 13+530  
Looking West along South Shoulder at Culvert Location (September 2013)**



**Photograph 2: Culvert 35 at STA 13+530  
Looking East along North Shoulder at Culvert Location (September 2013)**





PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C35-1** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5039886.8; E 419244.8 ORIGINATED BY EHS  
 DIST                      HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE May 6, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
456.4	GROUND SURFACE																	
0.0	Sandy TOPSOIL		1	SS	1													
456.0	Very loose Brown																	
0.4	Gravelly Silty SAND, trace clay, oxidized		2	SS	70													
	Very dense Brown Brown Wet		3	SS	83													
454.0	END OF BOREHOLE SPOON REFUSAL		4	SS	160/0 T													
2.4	Notes: 1. Water level at a depth of 0.2 m below ground surface (Elev. 456.2 m) upon completion of drilling. 2. DCPT 1 m east of borehole and refusal at 2.4 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C35-2** **1 OF 1 METRIC**

G.W.P. 5198-10-00 LOCATION N 5039884.5; E 419261.4 ORIGINATED BY EHS

DIST HWY 60 BOREHOLE TYPE NW Casing and NQ Coring COMPILED BY AC

DATUM GEODETIC DATE October 2, 2013 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
459.6	GROUND SURFACE																	
0.0	ASPHALT (90 mm)		1	SS	37													
	Silty sand to sand, some gravel (FILL) Compact to dense Brown Moist		2	SS	50/0.1													
	A 225 mm cobble encountered at 0.8 m depth.		-	RC	REC 38%													
			3	SS	18													
			4	SS	11													
456.6	PEAT (Amorphous) Firm Black Wet		5	SS	9													
455.9	SAND and GRAVEL, trace to some silt Loose to compact Brown Wet		6	SS	21													
			7	SS	6													
453.7	BOULDERS		-	RC	REC 58%													
452.3	END OF BOREHOLE																	
7.3	Note: 1. Water level at a depth of 3.2 m below ground surface (Elev. 456.4 m) inside casing. 2. Advanced DCPT 1 m east of borehole, refusal at 5.9 m depth.																	

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

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



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C35-3** 1 OF 1 **METRIC**

G.W.P. 5198-10-00 LOCATION N 5039874.5; E 419271.1 ORIGINATED BY EHS

DIST          HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC

DATUM GEODETIC DATE May 7, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
456.0	GROUND SURFACE																	
0.0	Sandy SILT, trace organics Very loose Brown Wet		1	SS	WH													
455.4																		
0.6	Gravelly Silty SAND, trace clay Dense to very dense Brown Wet		2	SS	38													24 51 22 3
			3	SS	54													
453.8	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT																	
2.2	Note:  1. Water level at ground surface (Elev. 456.0 m) upon completion of drilling.  2. Advanced DCPT 1.8 m west and 4.4 m south of borehole, refusal at 2.2 m depth.																	

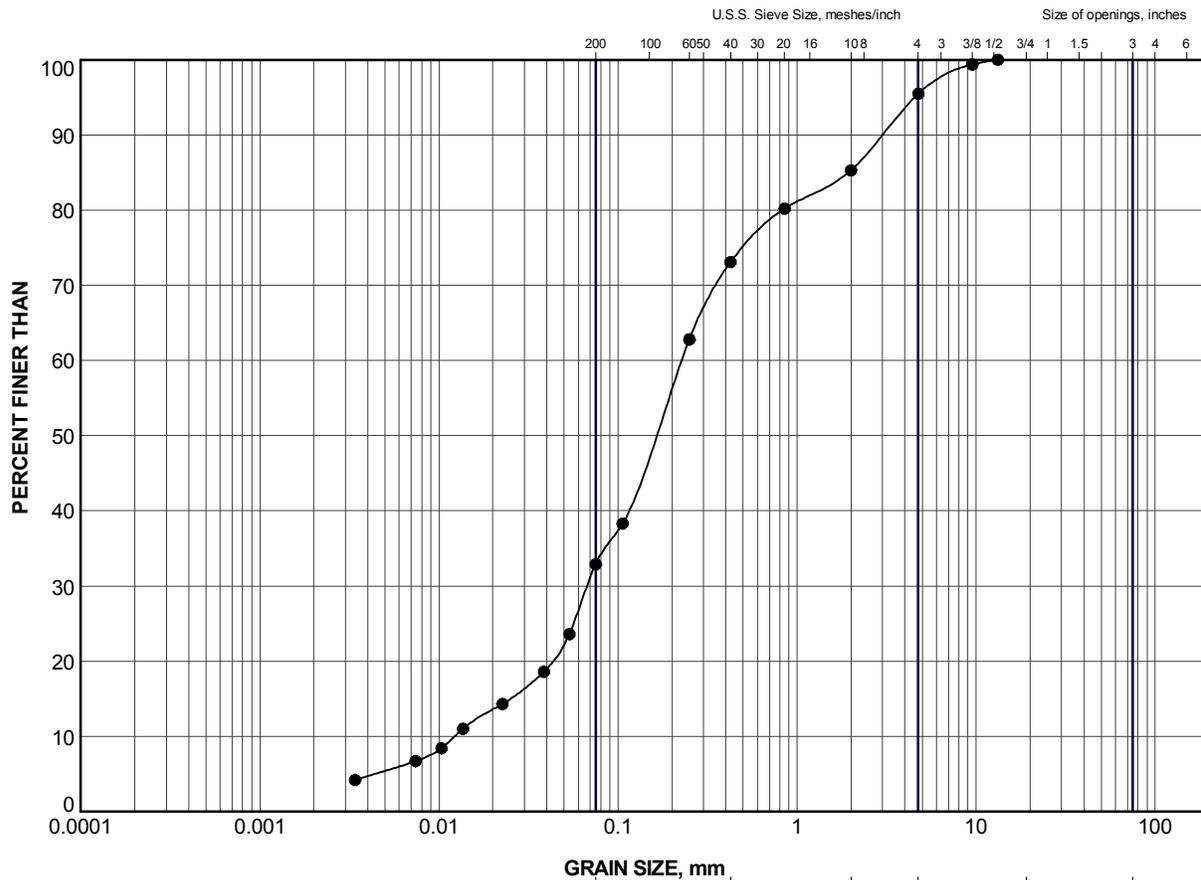
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C35-4</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039876.1; E 419252.6</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>October 2, 2013</u>	CHECKED BY <u>AB</u>

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
459.6	GROUND SURFACE																
0.0	ASPHALT (90 mm)		1	SS	64												
	Silty sand to sand, some gravel (FILL) Compact to dense Brown Wet		-	RC	REC 100%		459										
	Three cobbles 75 mm to 100 mm sizes at 1.0 m depth.		2	SS	18												3 64 (33)
457.6	ASPHALT		3	SS	18		458										
2.1	Gravelly sand (FILL) Loose Brown Wet		4	SS	6		457										
456.6	PEAT (Amorphous), some gravel Stiff Brown Wet		5	SS	14		456										
3.0	SILT and SAND, trace to some gravel Loose to compact Brown Wet		6	SS	9		455										12 46 (42)
456.0			7	SS	13		454										
454.3	BOULDER OR PROBABLE BEDROCK		-	RC	REC 100%		454										
454.0	END OF BOREHOLE																
5.6	Note: 1. Water level at a depth of 3.5 m below ground surface (Elev. 456.1 m) inside casing.																

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:



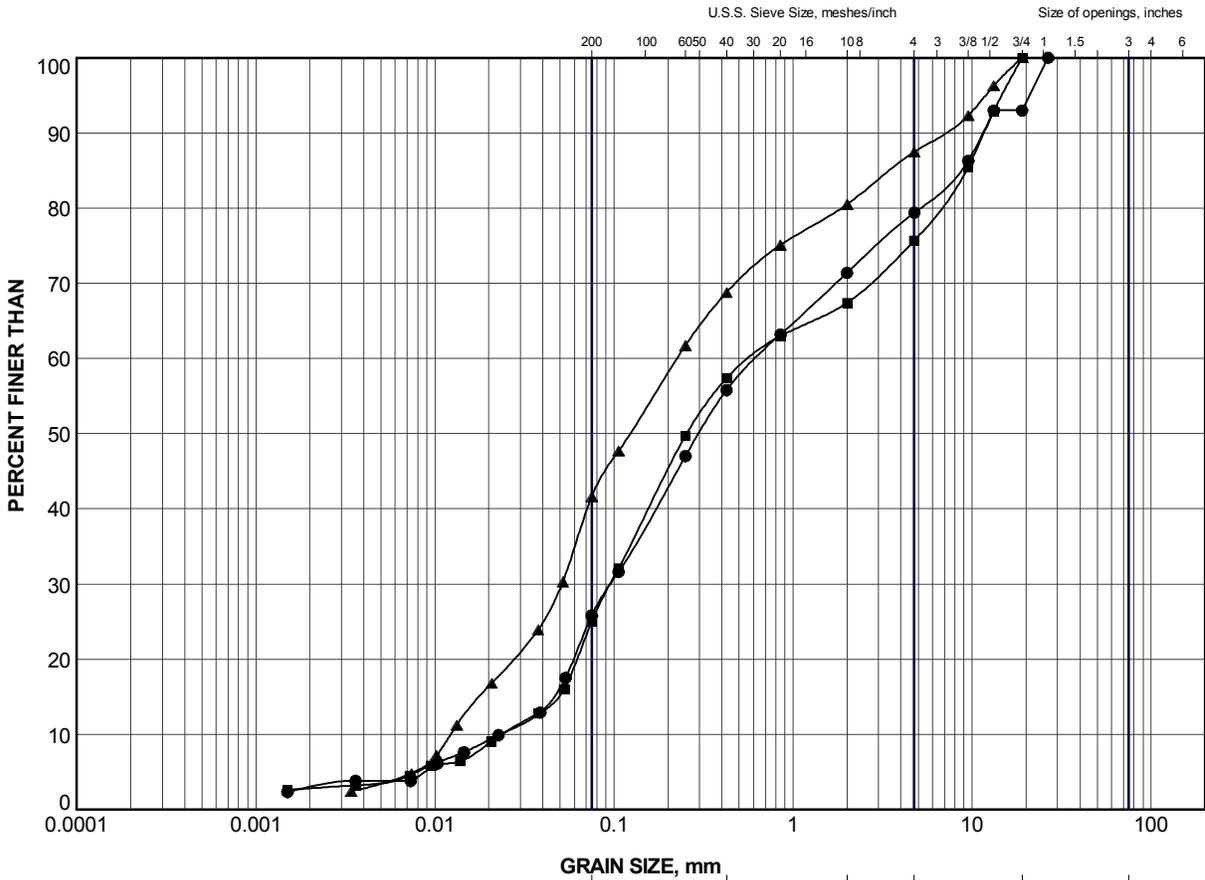
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C35-4	2	458.4

PROJECT					HIGHWAY 60 CULVERT 35				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILTY SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE L1</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									

SUD-MTO GSD (NEW) GLDR\_LDN.GDT

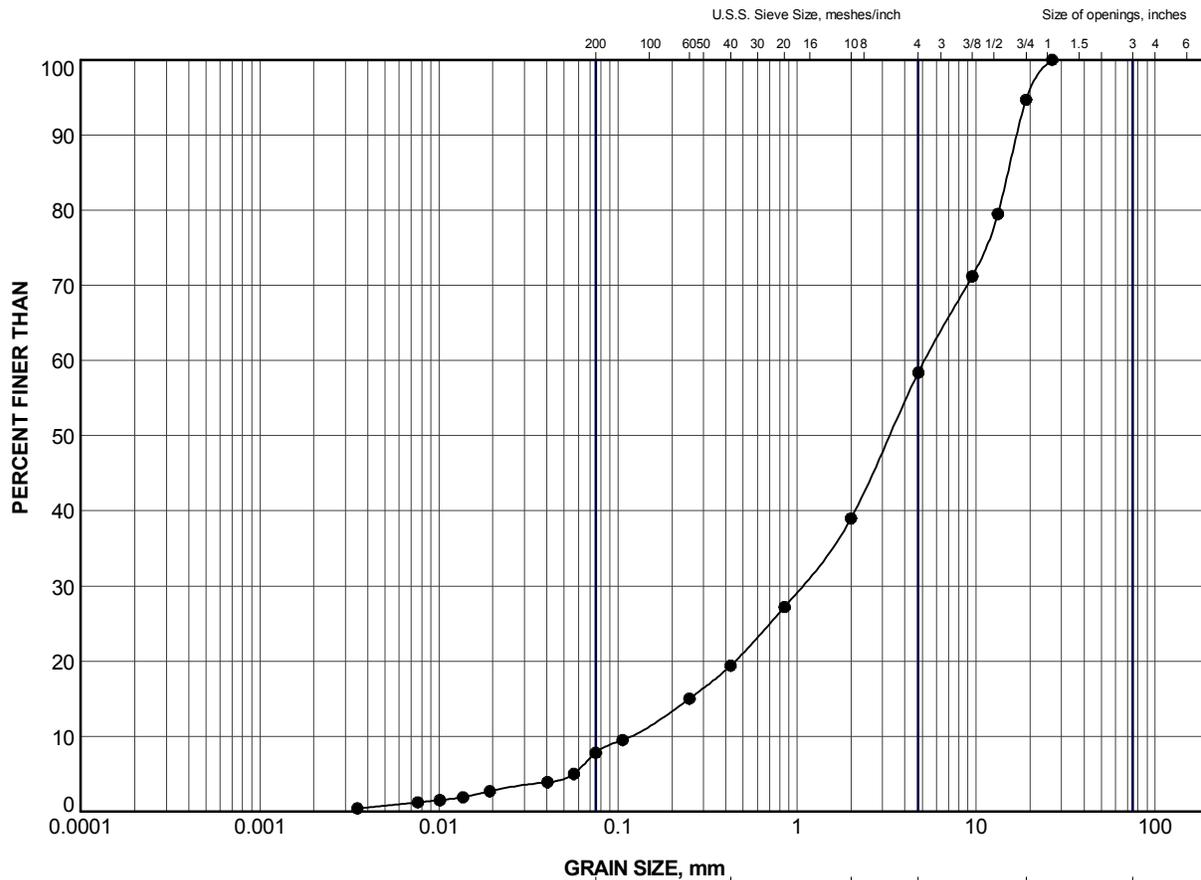


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C35-1	3	454.6
■	C35-3	2	455.0
▲	C35-4	6	455.5

PROJECT					HIGHWAY 60 CULVERT 35				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SILTY SAND to SILT and SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE L2</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C35-2	7	454.7

PROJECT					HIGHWAY 60 CULVERT 35				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE L3</b>				
APPR	JMAC	Jul 2014							





# APPENDIX M

Culvert 37 – STA 13+943 (Murchison Township)

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

CONT No.  
 GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 37 - STA 13+943  
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 13 0 13 km



LEGEND

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

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C37-1	454.0	5040255.0	419426.8
C37-2	458.2	5040249.3	419445.3
C37-3	453.7	5040238.7	419455.8
C37-4	455.6	5040163.9	419417.1
C37-5	453.6	5040193.4	419436.2
C37-6	455.7	5040285.0	419479.1

NOTES

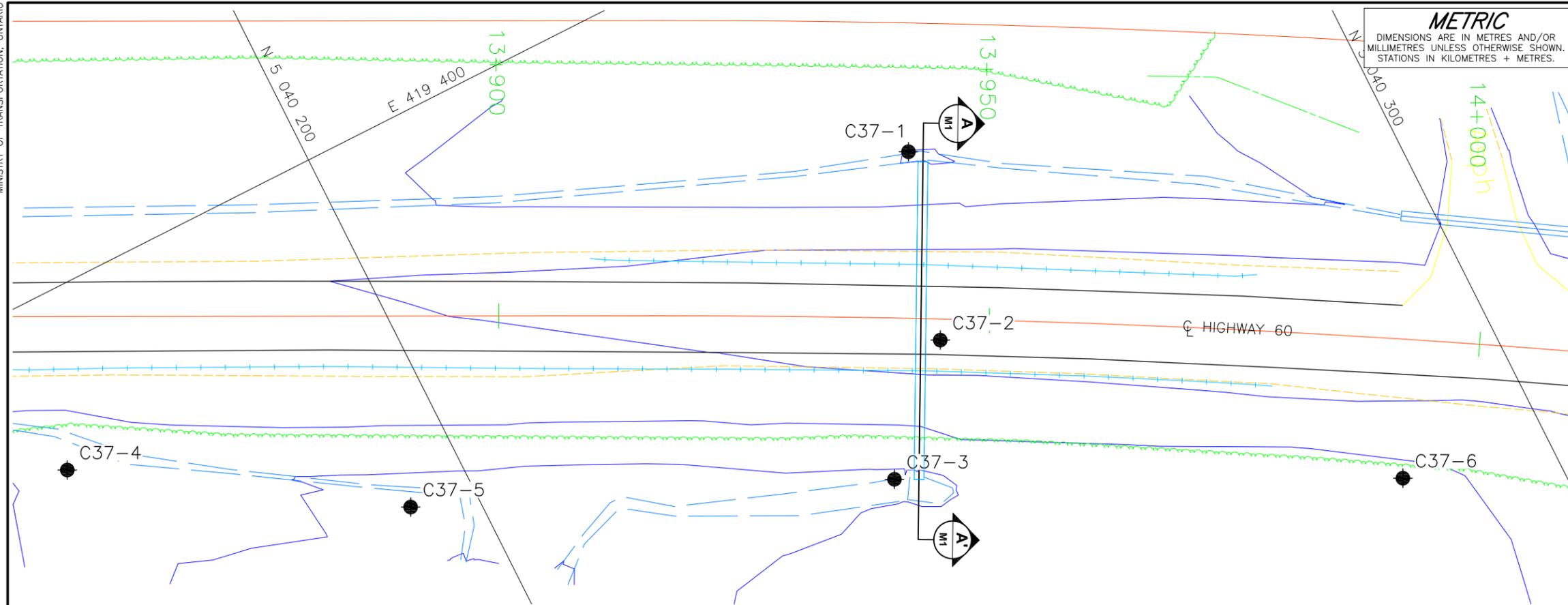
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

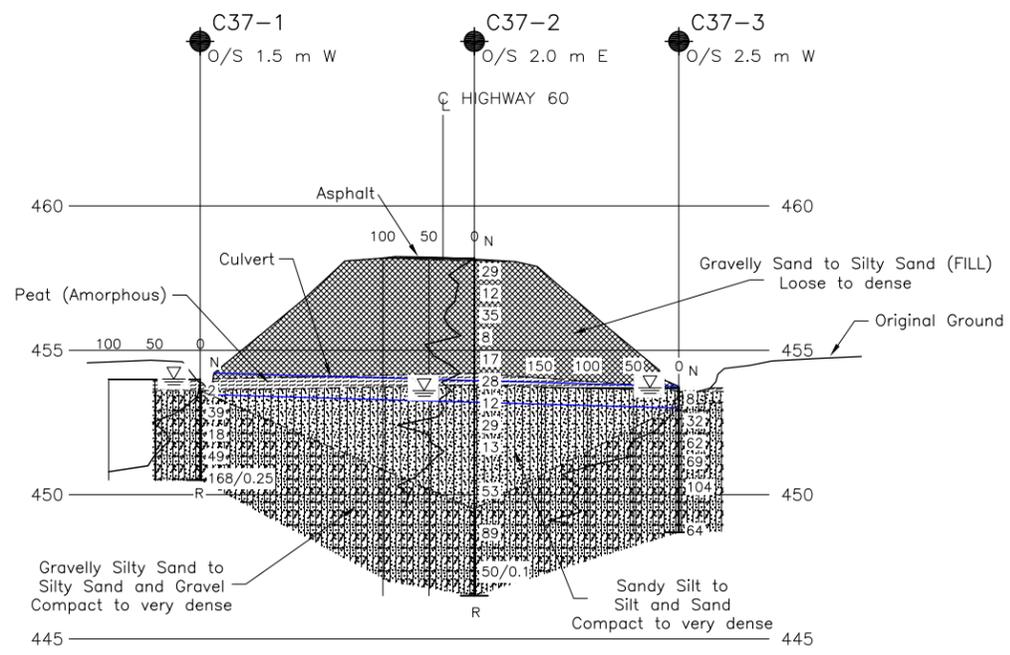
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

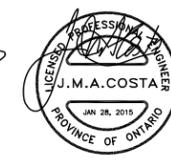
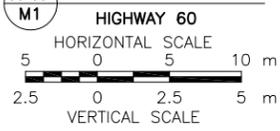
Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



PLAN



PROFILE



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. M1



**PHOTOGRAPHS**

**Photograph 1: Culvert C37 at STA 13+943  
Looking West along North Shoulder at Culvert Location (July 2013)**



**Photograph 2: Culvert C37 at STA 13+943  
Looking East along South Shoulder at Culvert Location (July 2013)**

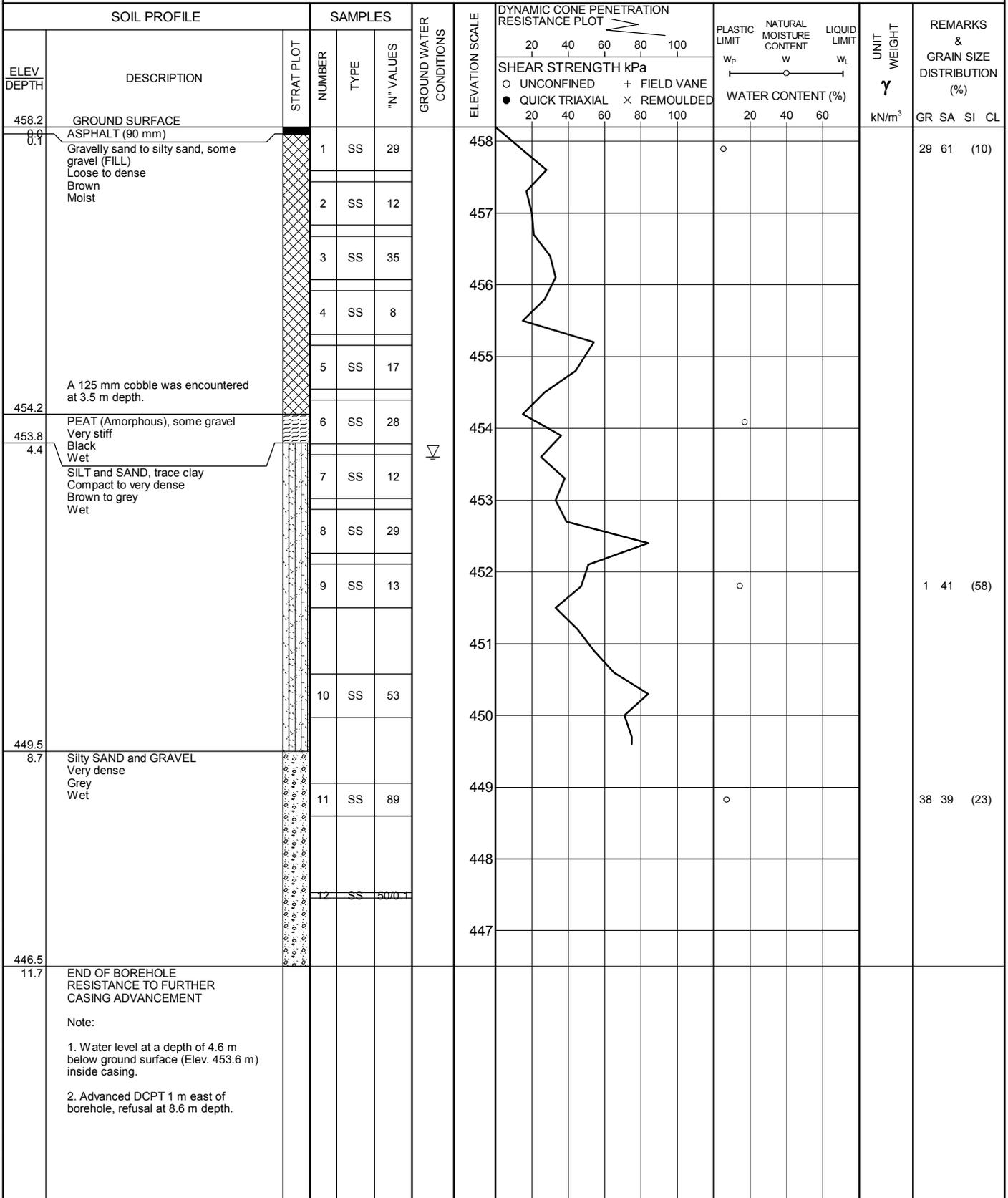


PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C37-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040255.0; E 419426.8</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 7, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
454.0	GROUND SURFACE														
0.0	PEAT (Fibrous)		1	SS	2										
453.6	Soft														
0.4	Brown														
	Wet														
	Gravelly Silty SAND, trace clay														
	Compact to very dense		2	SS	39	453									
	Brown to grey		3	SS	18	452				○				22 46 28 4	
	Wet		4	SS	49	451									
450.5	END OF BOREHOLE		5	SS	168/0.25	451									
3.5	SPOON REFUSAL														
	Note: 1. Water level at ground surface (Elev. 454.0 m) upon completion of drilling. 2. Advanced DCPT 1.0 m west of borehole. Refusal at a depth of 3.4 m.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

PROJECT <u>13-1191-0003</u>		<b>RECORD OF BOREHOLE No C37-2</b>		1 OF 1 <b>METRIC</b>	
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040249.3; E 419445.3</u>	ORIGINATED BY <u>EHS</u>			
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>NW Casing and NQ Coring</u>	COMPILED BY <u>AC</u>			
DATUM <u>GEODETIC</u>	DATE <u>October 2 and 3, 2013</u>	CHECKED BY <u>AB</u>			



SUD-MTO 001 13-1191-0003.GPJ GAL-MASS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C37-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040238.7; E 419455.8</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 8, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
453.7	GROUND SURFACE												
0.0	TOPSOIL												
0.1	Sandy SILT, trace rootlets	1	SS	8									
453.1	Loose Brown Wet												
0.6	Gravelly SAND to Gravelly Silty SAND, trace clay Dense to very dense Brown to grey Wet	2	SS	32									24 56 18 2
		3	SS	62									
		4	SS	69									
		5	SS	104									
		6	SS	64									22 46 27 5
448.7	END OF BOREHOLE												
5.0	Note: 1. Water level inside casing at ground surface (Elev. 453.7 m) upon completion of drilling. 2. Advanced DCPT 1 m east of borehole, refusal at 4.7 m depth.												

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C37-4** 1 OF 1 **METRIC**  
 G.W.P. 5198-10-00 LOCATION N 5040163.9; E 419417.1 ORIGINATED BY EHS  
 DIST HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC  
 DATUM GEODETIC DATE May 9, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60
455.6	GROUND SURFACE																			
0.0	TOPSOIL																			
455.3			1	SS	12	▽														
0.3	SILT and SAND to SILTY SAND, trace gravel, trace clay Dense to very dense Brown Wet  Gravel seams encountered in Samples 1 and 3.		2	SS	47															
			3	SS	68						○						12	52	33	3
			4	SS	32															
			5	SS	43						○									
			6	SS	56															
450.6	END OF BOREHOLE																			
5.0	Note: 1. Water level inside casing at a depth of 0.4 m below ground surface (Elev. 455.2 m) upon completion of drilling.																			

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C37-5</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5040193.4; E 419436.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment, BW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>May 8 and 9, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa				W <sub>p</sub>	W		
						20 40 60 80 100	20 40 60 80 100	20 40 60							
453.6	GROUND SURFACE														
0.0	Topsoil (FILL)	[Cross-hatch pattern]	1	SS	3										
	Silty sand to sandy silt (FILL)	[Cross-hatch pattern]	2	SS	3	453									
	Very loose														
	Brown														
	Moist to wet														
452.2	1.4					452									
	Gravelly SAND, some silt	[Dotted pattern]	3	SS	42										
	Dense to very dense														
	Brown														
	Wet														
			4	SS	41	451				o				27 55 (18)	
			5	SS	54	450									
449.7	3.9														
	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT														
	Note:														
	1. Water level inside casing at a depth of 1.0 m below ground surface (Elev. 452.6 m) upon completion of drilling.														
	2. Advanced DCPT 1 m east of borehole and stopped at 3.0 m depth.														

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:



PROJECT 13-1191-0003 **RECORD OF BOREHOLE No C37-6** 1 OF 1 **METRIC**

G.W.P. 5198-10-00 LOCATION N 5040285.0; E 419479.1 ORIGINATED BY EHS

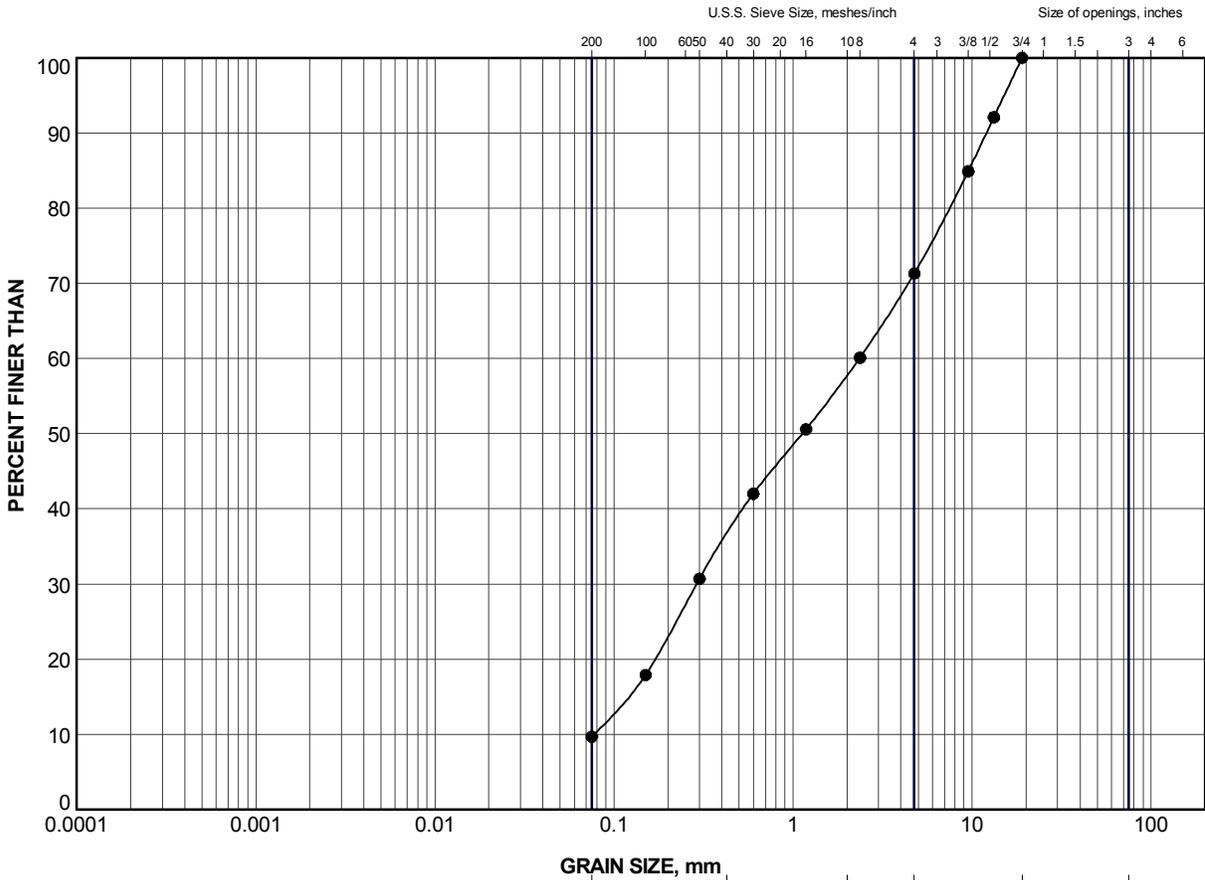
DIST          HWY 60 BOREHOLE TYPE Portable Equipment, BW Casing and Wash Boring COMPILED BY AC

DATUM GEODETIC DATE May 9, 2014 CHECKED BY AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
455.7	GROUND SURFACE																	
0.0	TOPSOIL																	
0.1	Sandy SILT, trace gravel		1	SS	4													
455.1	Loose Brown Wet																	
0.6																		
454.6	Gravelly Silty SAND Very dense Brown Wet		2	SS	113													
1.1	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT																	
<p>Note:</p> <p>1. Water level at ground surface (Elev. 455.7 m) upon completion of drilling.</p> <p>2. Advanced DCPT 1 m north of borehole, refusal at 1.0 m depth.</p>																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 18/07/14 DATA INPUT:

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

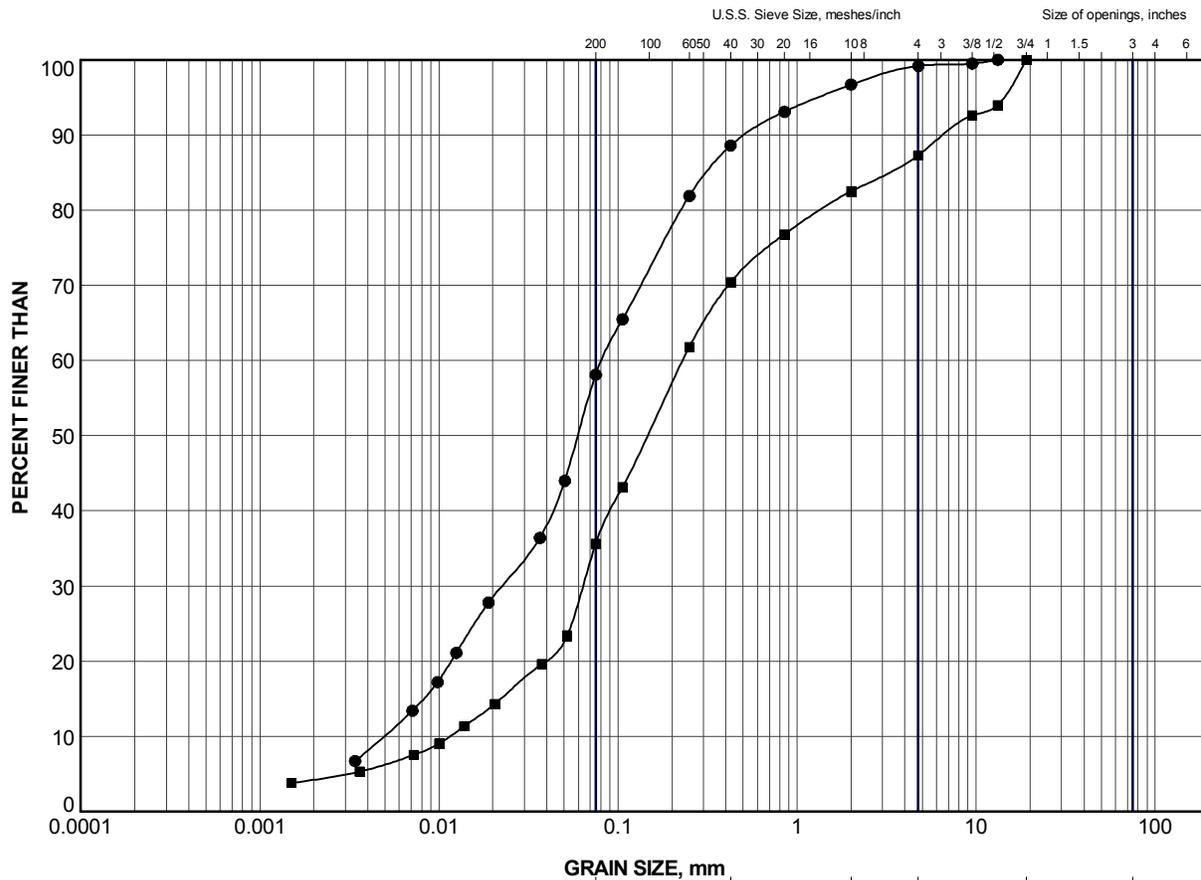


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C37-2	1	457.9

PROJECT					HIGHWAY 60 CULVERT 37				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE M1</b>				
APPR	JMAC	Jul 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									



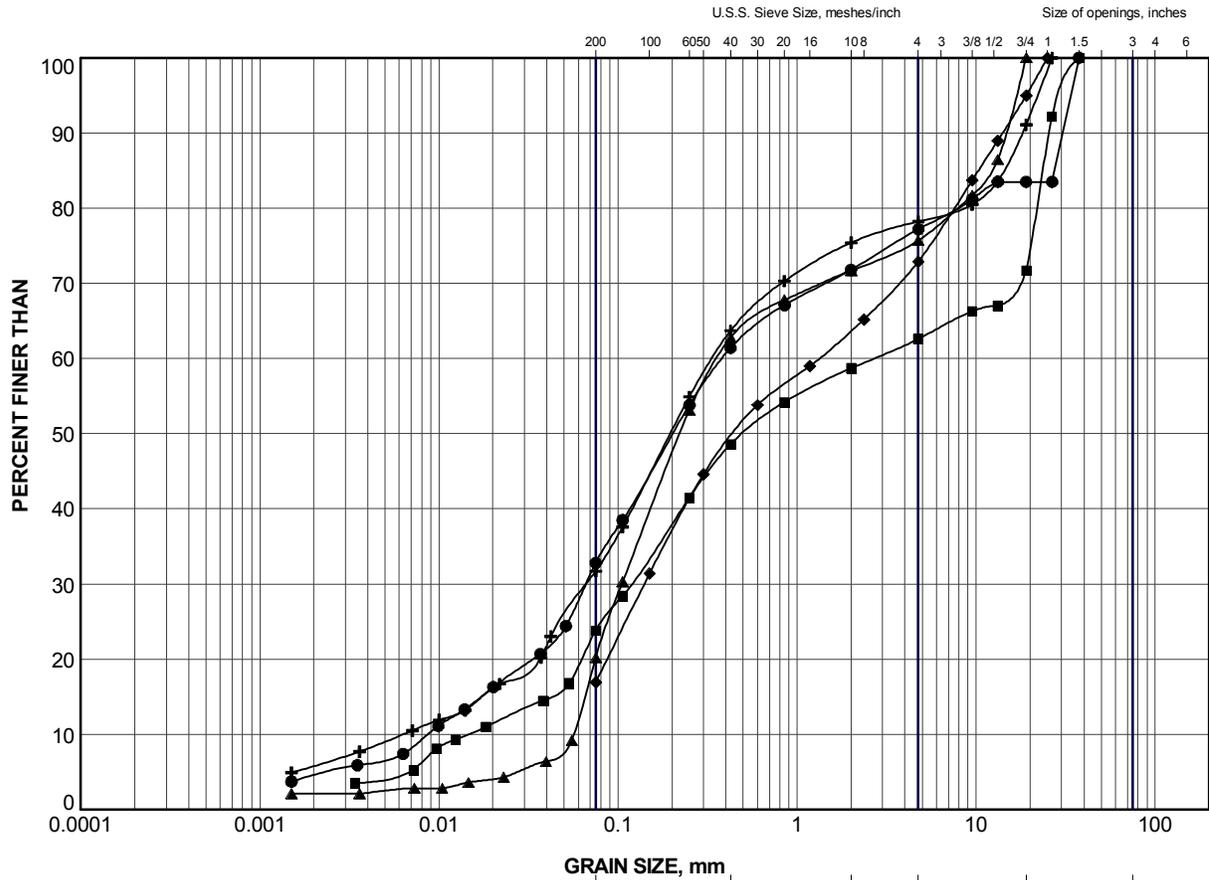
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C37-2	9	451.8
■	C37-4	3	453.8

PROJECT					HIGHWAY 60 CULVERT 37				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jul 2014			SCALE	N/A		REV.	
CHECK	AB	Jul 2014			<b>FIGURE M2</b>				
APPR	JMAC	Jul 2014							





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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C37-1	3	452.2
■	C37-2	11	448.8
▲	C37-3	2	452.7
+	C37-3	6	448.9
◆	C37-5	4	451.1

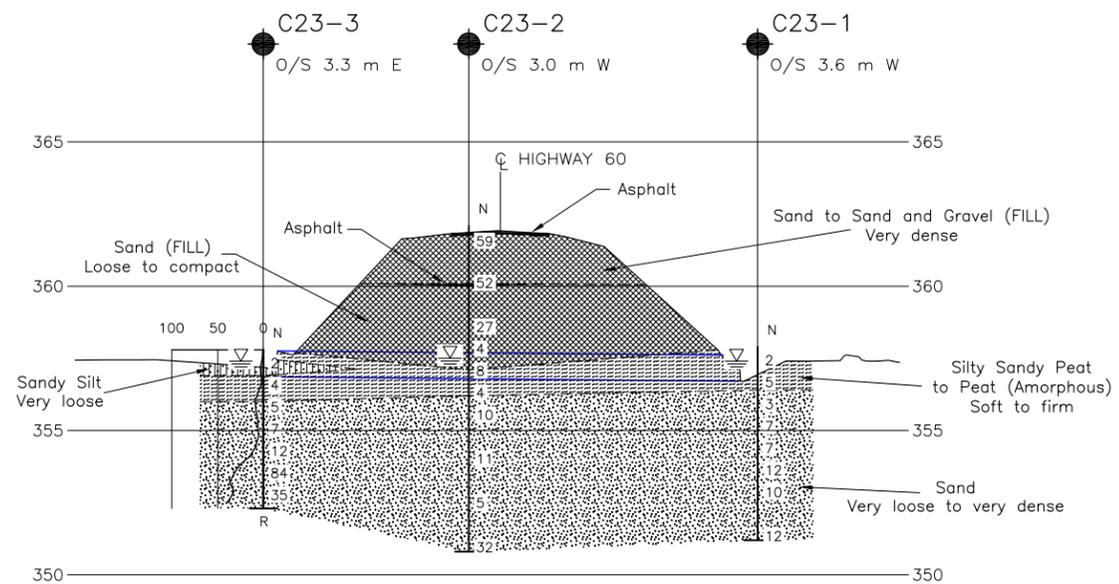
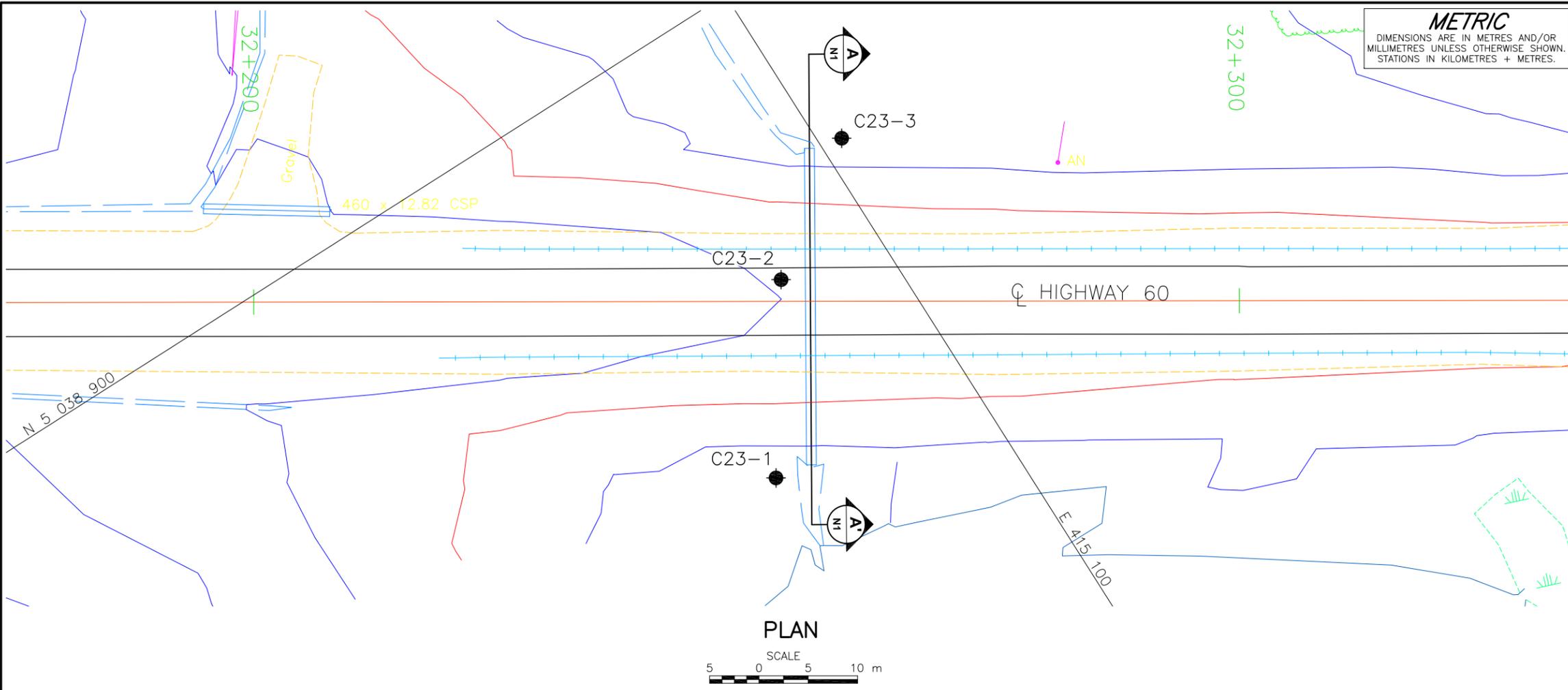
PROJECT					HIGHWAY 60 CULVERT 37				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SILTY SAND to SILTY SAND and GRAVEL				
PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ			
DRAWN	TB	Jul 2014		SCALE	N/A	REV.			
CHECK	AB	Jul 2014		<b>FIGURE M3</b>					
APPR	JMAC	Jul 2014							





# **APPENDIX N**

## **Culvert 23 – STA 32+256 (Airy Township)**



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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 23 - STA 32+256  
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



**LEGEND**

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

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C23-1	357.9	5038856.0	415078.1
C23-2	362.1	5038872.6	415089.3
C23-3	357.8	5038881.4	415102.2

**NOTES**

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

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. N1



## PHOTOGRAPHS

**Photograph 1: Culvert 23 at STA 32+256  
Looking East (November 2014)**



**Photograph 2: Culvert 23 at STA 32+256  
Looking West (November 2014)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C23-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038856.0; E 415078.1</u>	ORIGINATED BY <u>EHS</u>
DIST <u>HWY 60</u>	BOREHOLE TYPE <u>Portable equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>December 4, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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						
357.9 0.0	GROUND SURFACE																
	Silty Sandy PEAT Soft to firm Brown Moist to wet	[Pattern]	1	SS	2	i▽											
			2	SS	5		357										
356.4 1.5	SAND, trace to some silt, trace organics in upper 0.5 m Very loose to compact Brown Wet	[Pattern]	3	SS	3		356				○				0	83 (17)	
			4	SS	7		355										
			5	SS	7		354				○				0	89 (11)	
			6	SS	12		353										
			7	SS	10		352										
351.2 6.7	END OF BOREHOLE		8	SS	12												
	Notes:  1. Water level at a depth of 0.5 m below ground surface (Elev. 357.4 m) upon completion of drilling.																

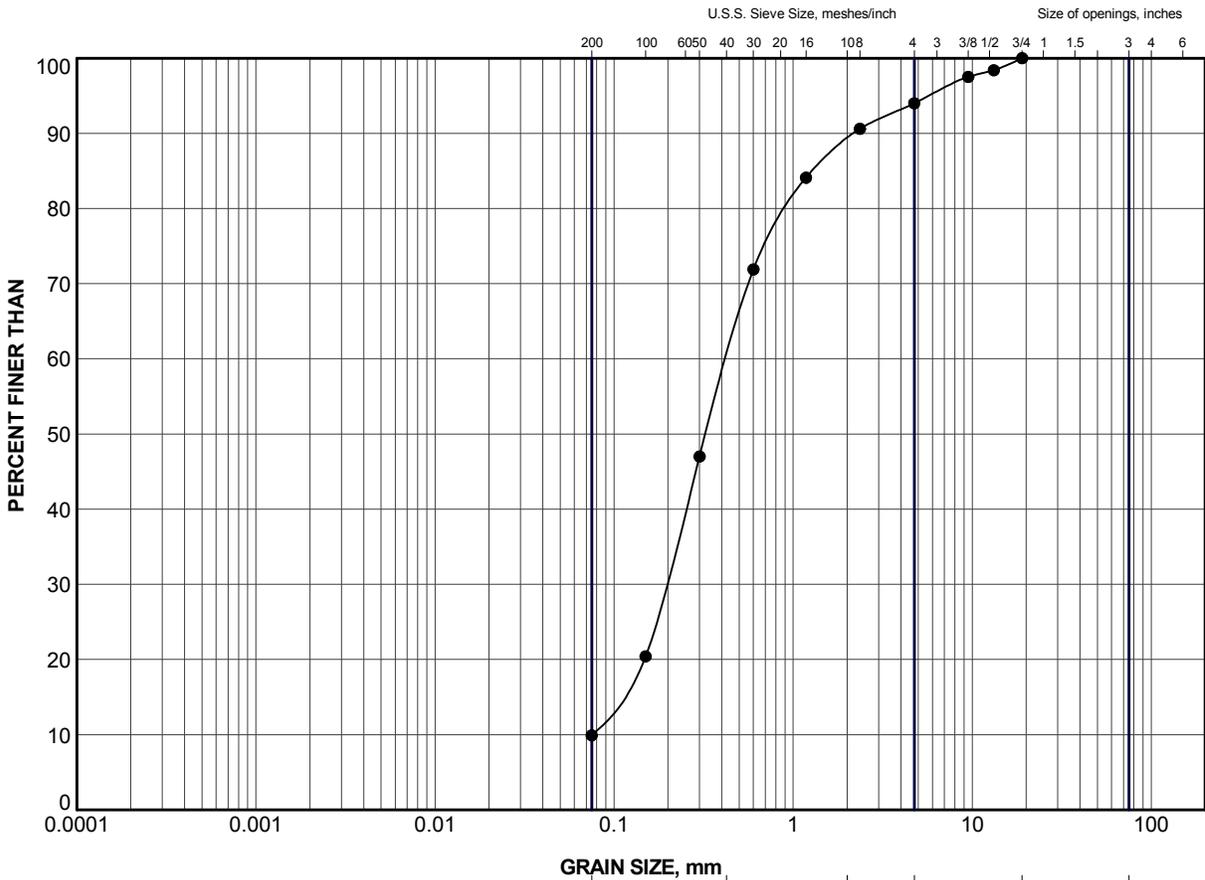
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C23-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038881.4; E 415102.2</u>	ORIGINATED BY <u>EHS</u>
DIST <u>                    </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>December 3, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)
							20	40	60	80	100	20	40	60	GR SA SI CL	
357.8	GROUND SURFACE															
0.0	Silty PEAT		1	SS	2											
357.5	Soft Black Wet															
0.3																
356.9	Sandy SILT, trace organics															
0.9	Very loose Brown Wet			2	SS		4									
356.0	Sandy PEAT															
1.8	Firm Black Wet			3a	SS		5									
	SAND, trace to some silt, trace gravel		3b													
	Loose to very dense Brown to grey Wet		4	SS	7											
			5	SS	12											
	Cobble at 3.6 m depth.		6	SS	84											
			7	SS	35											
352.3	END OF BOREHOLE REFUSAL TO FURTHER CASING ADVANCEMENT/PENETRATION															
5.5	Notes: 1. Water level at a depth of 0.4 m below ground surface (Elev. 357.4 m) upon completion of drilling. 2. DCPT was advanced 1.0 m west of borehole, DCPT refusal was encountered at 5.3 m depth.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:



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

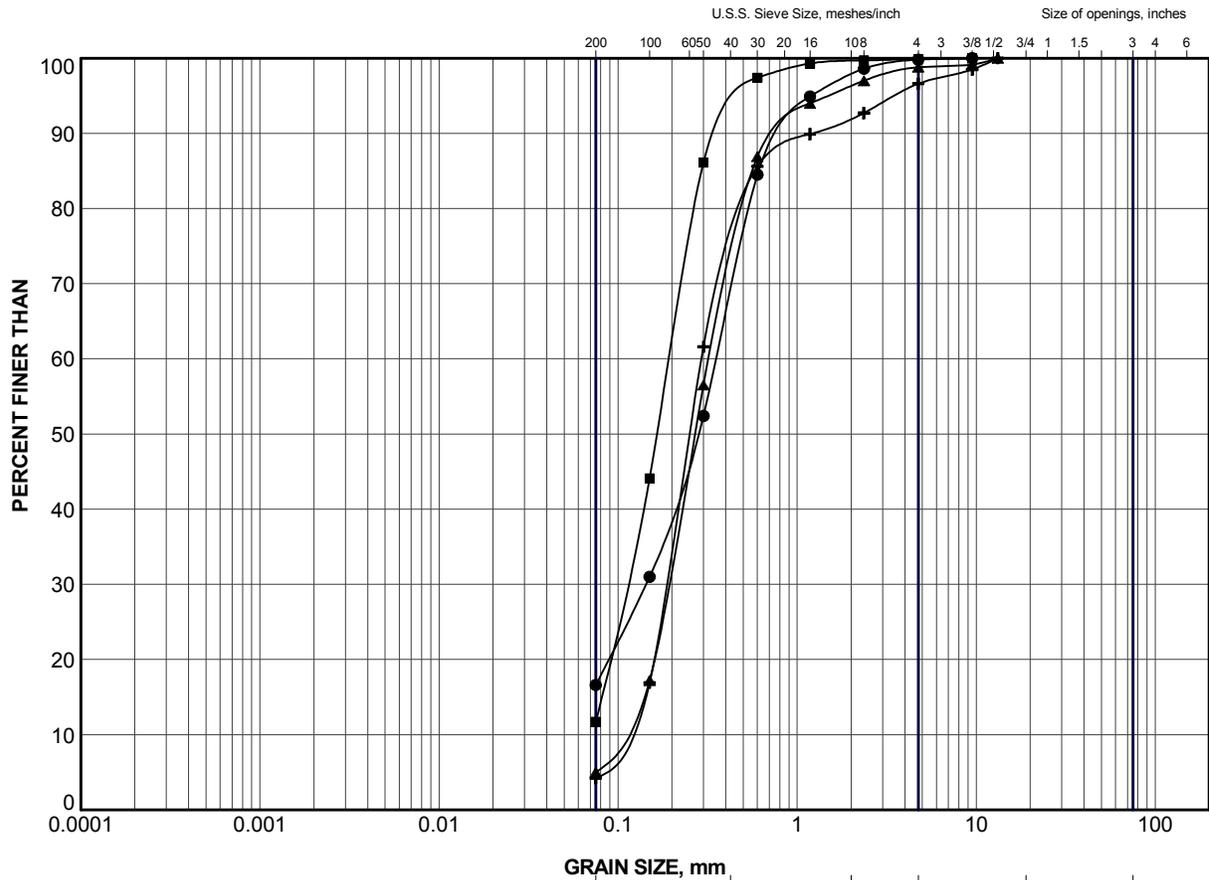
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C23-2	3	358.8

PROJECT					HIGHWAY 60 CULVERT C23				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jan 2015			SCALE	N/A	REV.		
CHECK	AB	Jan 2015			<b>FIGURE N1</b>				
APPR	JMAC	Jan 2015							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C23-1	3	356.1
■	C23-1	6	353.8
▲	C23-2	8	354.2
+	C23-3	5	354.5

PROJECT					HIGHWAY 60 CULVERT C23				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jan 2015			SCALE	N/A		REV.	
CHECK	AB	Jan 2015			<b>FIGURE N2</b>				
APPR	JMAC	Jan 2015							



SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX O

## Culvert 28 – STA 10+674 (Murchison Township)

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

CONT No.  
 GWP No. 5198-10-00



HIGHWAY 60  
 CULVERT 28 - STA 10+674  
 BOREHOLE LOCATIONS AND SOIL STRATA

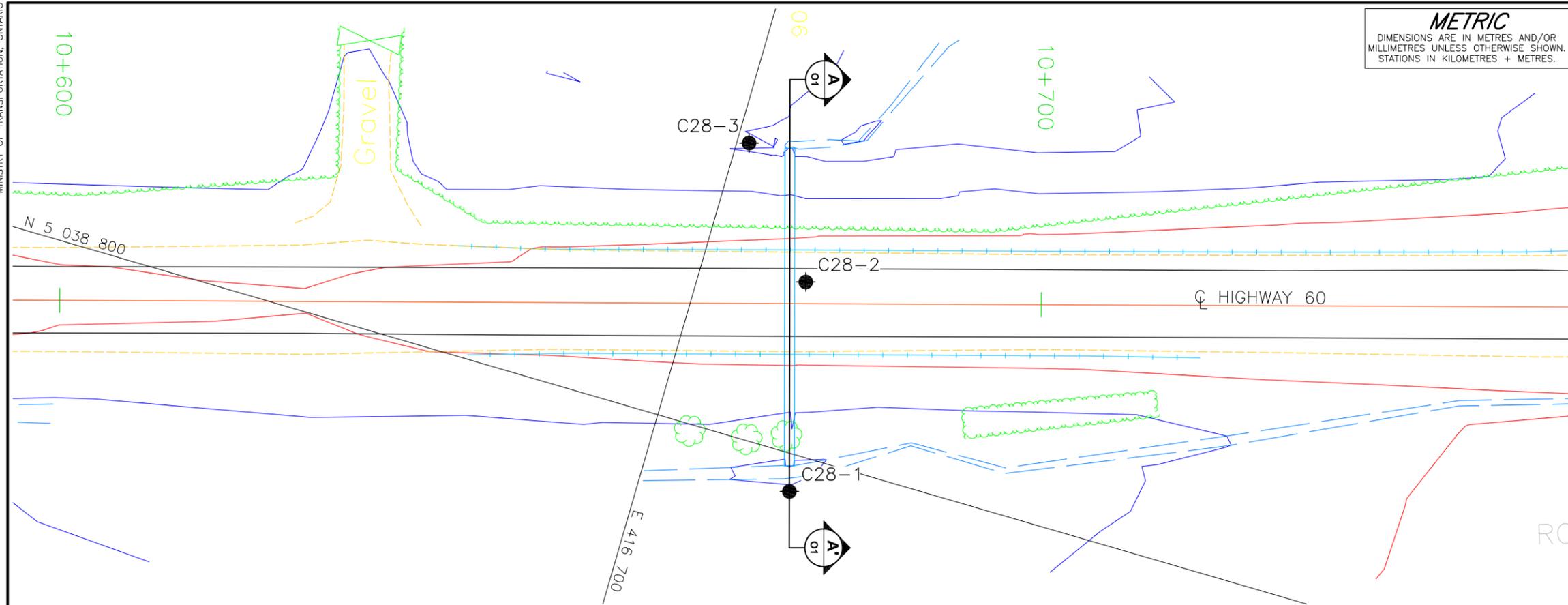
SHEET



**Golder Associates Ltd.**  
 SUDBURY, ONTARIO, CANADA



KEY PLAN  
 13 0 13 km



PLAN



**LEGEND**

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

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C28-1	386.3	5038796.3	416715.0
C28-2	390.3	5038817.2	416710.7
C28-3	385.8	5038829.1	416701.2

**NOTES**

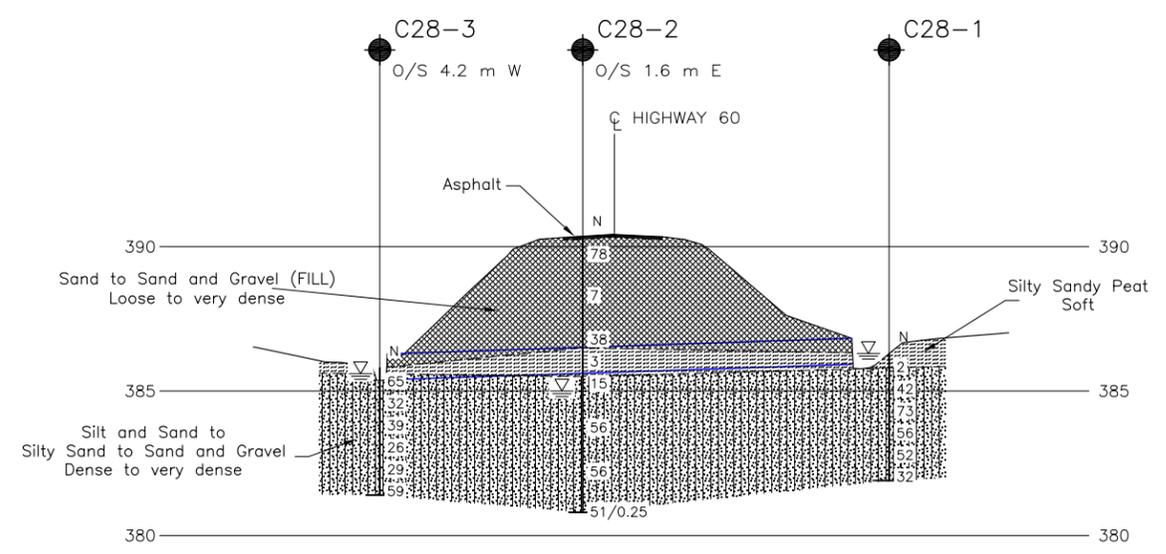
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



**PROFILE**  
 A-A'  
 01  
 HIGHWAY 60  
 HORIZONTAL SCALE  
 5 0 5 10 m  
 VERTICAL SCALE  
 2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE: DWG. 01



## PHOTOGRAPHS

**Photograph 1: Culvert 28 at STA 10+674  
Looking East (September 2014)**



**Photograph 2: Culvert 28 at STA 10+674  
Looking West (September 2014)**



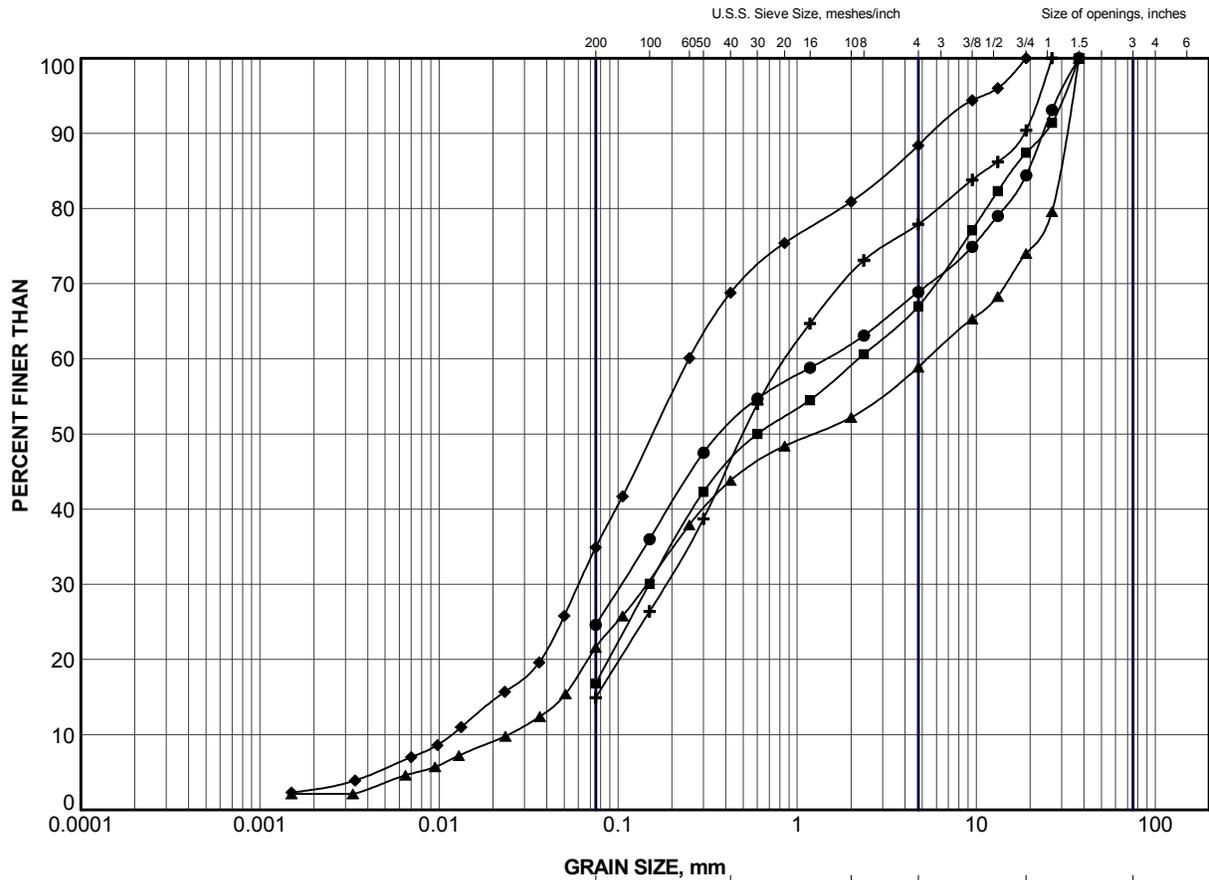


PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C28-2</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5038817.2; E 416710.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>108 mm I.D. Continuous Flight Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>November 13 and 14, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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		GR SA SI CL	
390.3	GROUND SURFACE															
0.0	ASPHALT (100 mm)		1	SS	78											
	Sand to sand and gravel, trace to some silt (FILL) Loose to very dense Brown Moist		2	SS	7											
			3	SS	38											
386.5	Silty Sandy PEAT (Amorphous), some gravel Soft Brown to black Wet		4	SS	3											
385.5	Silty SAND and GRAVEL, cobbles Very dense Brown Wet		5	SS	15											
			6	SS	56											41 37 20 2
			7	SS	56											
380.8	END OF BOREHOLE		8	SS	51/0.25											22 63 (15)
9.5	Notes: 1. Water level at a depth of 5.3 m below ground surface (Elev. 385.0 m) upon completion of drilling.															

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:





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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C28-1	2	385.2
■	C28-1	5	383.0
▲	C28-2	6	383.9
+	C28-2	8	381.0
◆	C28-3	3	384.0

PROJECT					HIGHWAY 60 CULVERT C28							
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to SAND and GRAVEL							
DRAWN		TB	Jan 2015		PROJECT No.		13-1191-0003		FILE No.		13-1191-0003.GPJ	
CHECK		AB	Jan 2015		SCALE		N/A		REV.			
APPR		JMAC	Jan 2015		<b>FIGURE O1</b>							
<b>Golder Associates</b> <small>SUDBURY, ONTARIO</small>												

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# **APPENDIX P**

## **Culvert 29 – STA 11+410 (Murchison Township)**

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 29 - STA 11+410  
BOREHOLE LOCATIONS AND SOIL STRATA

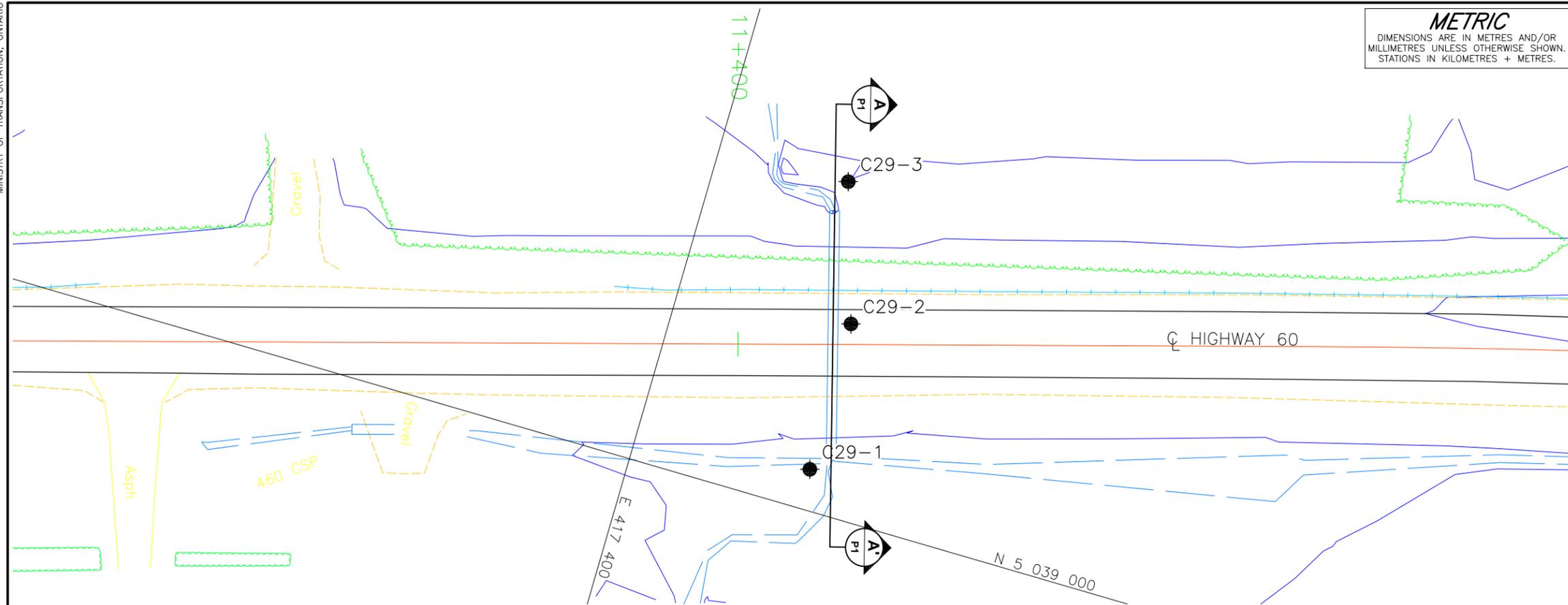
SHEET



**Golder Associates Ltd.**  
SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km



PLAN



LEGEND

- Borehole
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C29-1	357.1	5039004.1	417417.9
C29-2	359.9	5039019.5	417417.8
C29-3	356.1	5039033.3	417413.5

NOTES

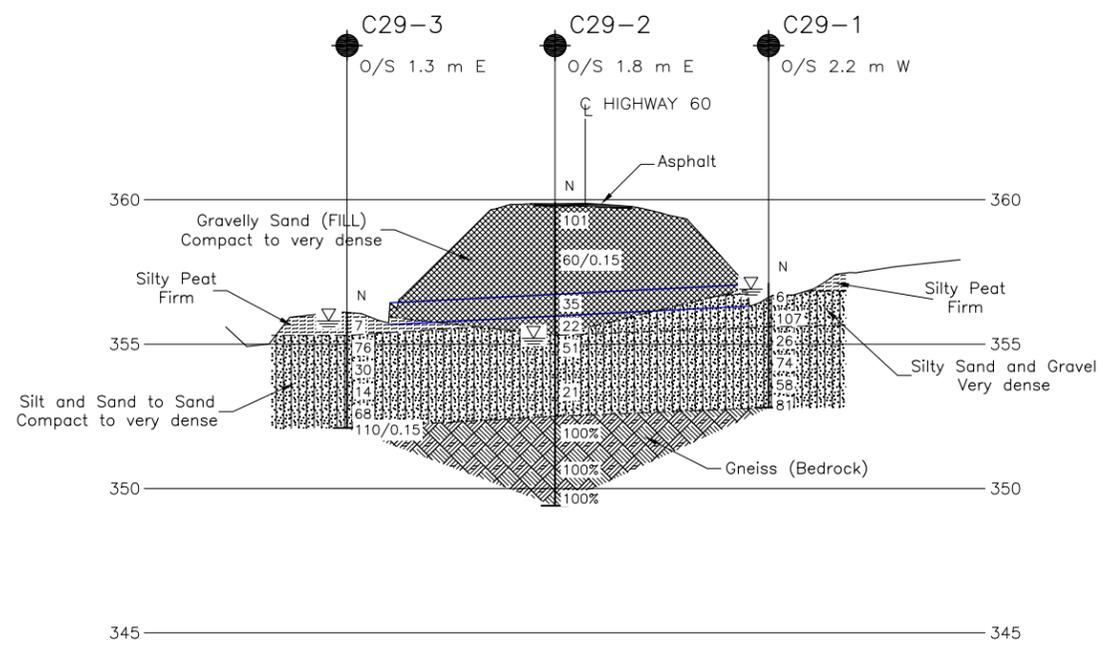
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

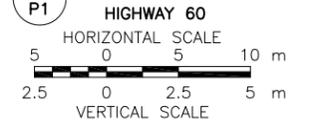
The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS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

REFERENCE

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



PROFILE  
A-A'  
P1  
HIGHWAY 60



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		SITE:
		DWG. P1



## PHOTOGRAPHS

**Photograph 1: Culvert 29 at STA 11+410  
Looking East (September 2014)**



**Photograph 2: Culvert 29 at STA 11+410  
Looking West (September 2014)**







PROJECT: 13-1191-0003

# RECORD OF DRILLHOLE: C29-2

SHEET 1 OF 1

LOCATION: N 5039019.5 ;E 417417.8

DRILLING DATE: November 12 and 13, 2014

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: George Downing Estate Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR	RECOVERY		R.Q.D. %	FRACT. INDEX METRES	DISCONTINUITY DATA			HYDRALLIC CONDUCTIVITY k, cm/s	Diametral Point Load Index (MPa)	RMC -Q AVG.	NOTES WATER LEVELS INSTRUMENTATION			
							FLUSH	TOTAL CORE %			SOLID CORE %	B Angle	DIP w.r.t. CORE AXIS					TYPE AND SURFACE DESCRIPTION		
																		Jr	Ja	Jun
		REFER TO PREVIOUS PAGE		352.5																
8	NW	GNEISS Fresh Coarse grained Grey		7.4	1	GREY 100														
9	NQ Coring				2	GREY 100														
10					3	GREY 100														
		END OF DRILLHOLE		349.4 10.5																

SUD-RCK 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:

DEPTH SCALE

1 : 50



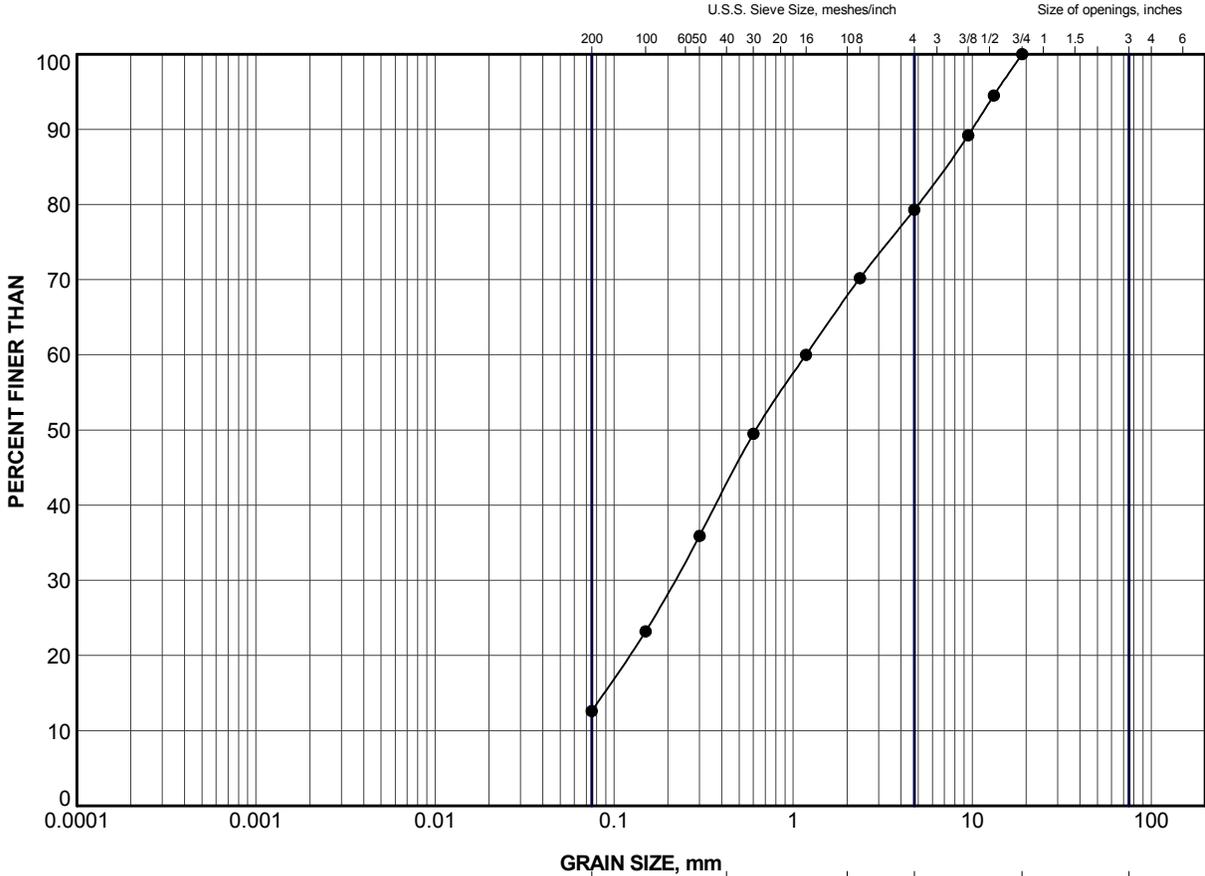
LOGGED: EHS

CHECKED: AB

PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C29-3</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039033.3; E 417413.5</u>	ORIGINATED BY <u>EHS</u>
DIST <u>        </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>November 18, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
356.1	GROUND SURFACE															
0.0	Silty PEAT Firm Black Wet		1	SS	7	▽										
355.3																
0.8	SILT and SAND, some gravel Compact to very dense Grey Wet		2	SS	76											
			3	SS	30											
			4	SS	14											
			5	SS	68											
352.1			6	SS	10/0.15											
4.0	END OF BOREHOLE  Notes:  1. Water level at a depth of 0.3 m below ground surface (Elev. 355.8 m) upon completion of drilling.															11 56 31 2

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:



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

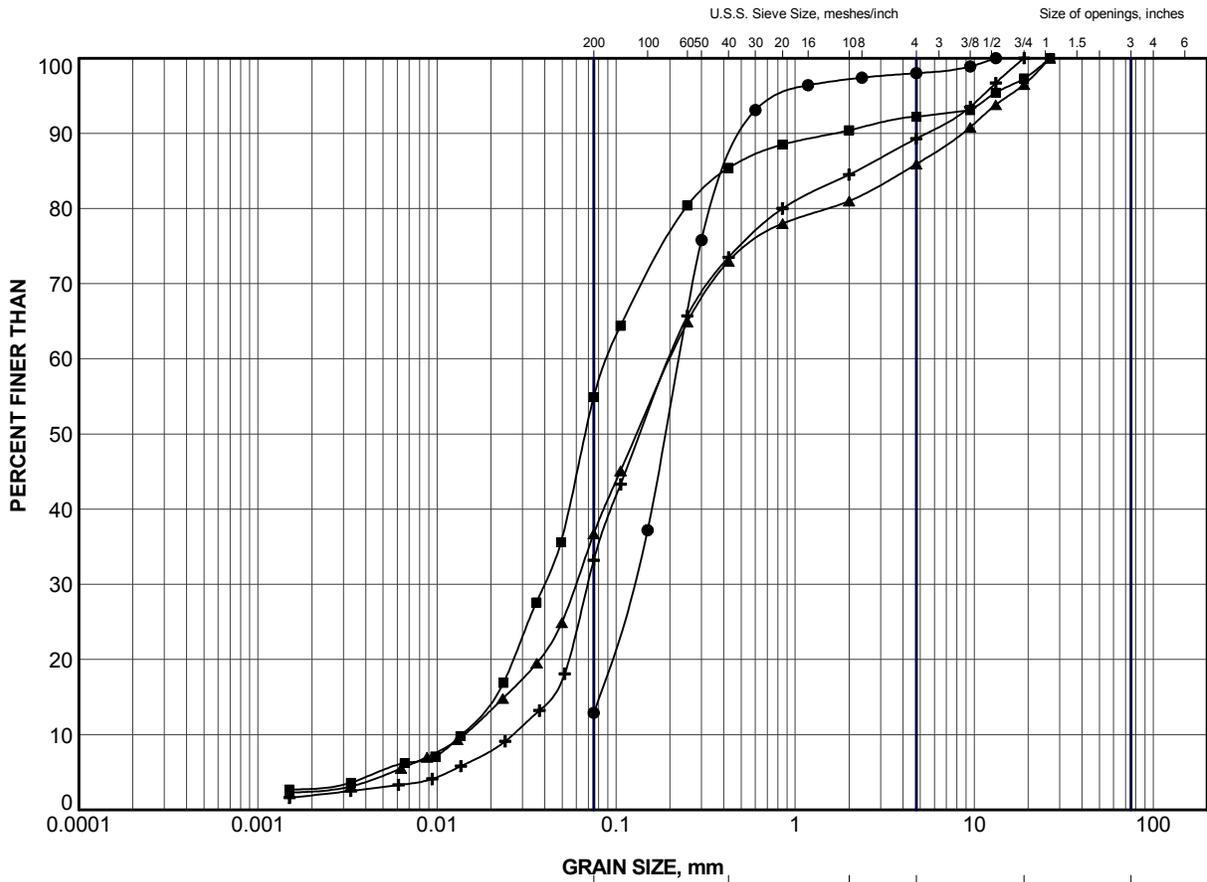
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C29-2	1	359.4

PROJECT					HIGHWAY 60 CULVERT C29				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> GRAVELLY SAND (FILL)				
PROJECT No.			13-1191-0003		FILE No.			13-1191-0003.GPJ	
DRAWN	TB	Jan 2015			SCALE	N/A		REV.	
CHECK	AB	Jan 2015			<b>FIGURE P1</b>				
APPR	JMAC	Jan 2015							



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

<b>LEGEND</b>			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C29-1	3	355.3
■	C29-1	5	353.8
▲	C29-2	5	355.0
+	C29-3	4	353.5

PROJECT					HIGHWAY 60 CULVERT C29				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to SAND				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jan 2015			SCALE	N/A		REV.	
CHECK	AB	Jan 2015			<b>FIGURE P2</b>				
APPR	JMAC	Jan 2015							





# APPENDIX Q

Culvert 30 – STA 11+817 (Murchison Township)

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

CONT No. GWP No. 5198-10-00



HIGHWAY 60  
CULVERT 30 - STA 11+817  
BOREHOLE LOCATIONS AND SOIL STRATA

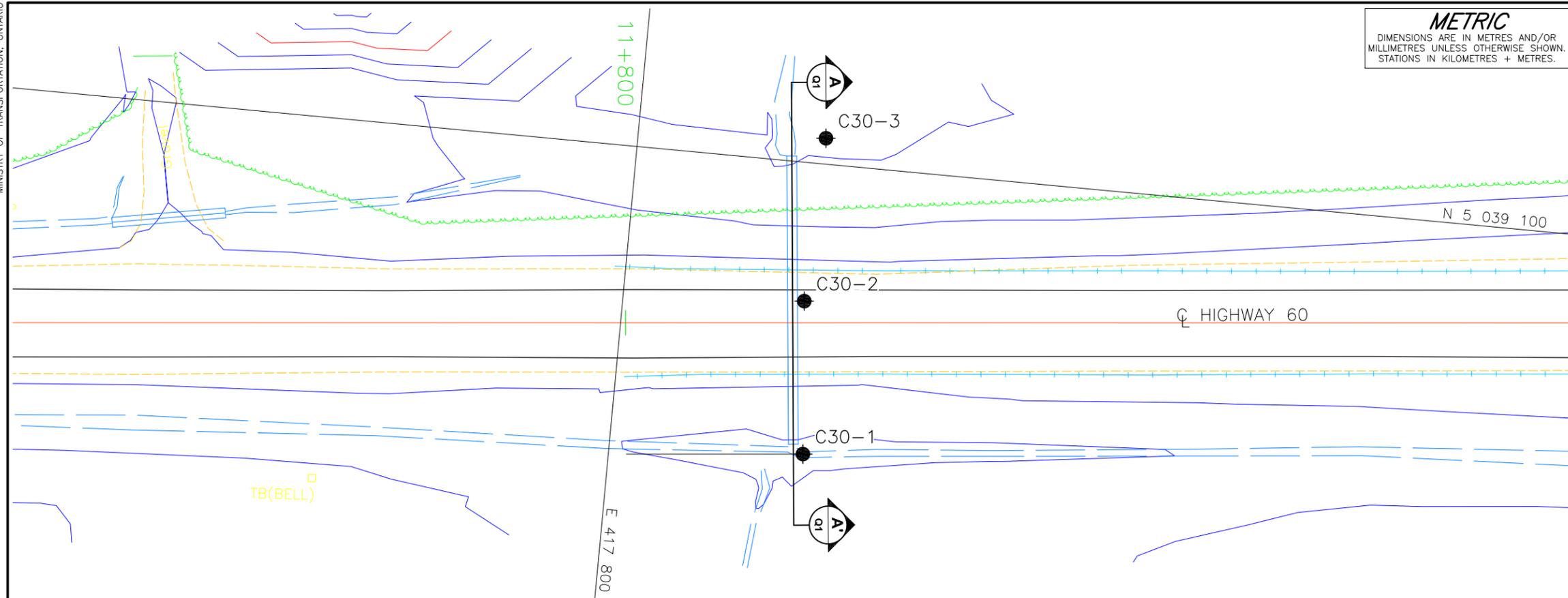
SHEET



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SUDBURY, ONTARIO, CANADA



KEY PLAN  
13 0 13 km



PLAN



**LEGEND**

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

**BOREHOLE CO-ORDINATES**

No.	ELEVATION	NORTHING	EASTING
C30-1	393.3	5039070.4	417819.7
C30-2	396.4	5039085.9	417818.4
C30-3	391.5	5039102.6	417819.1

**NOTES**

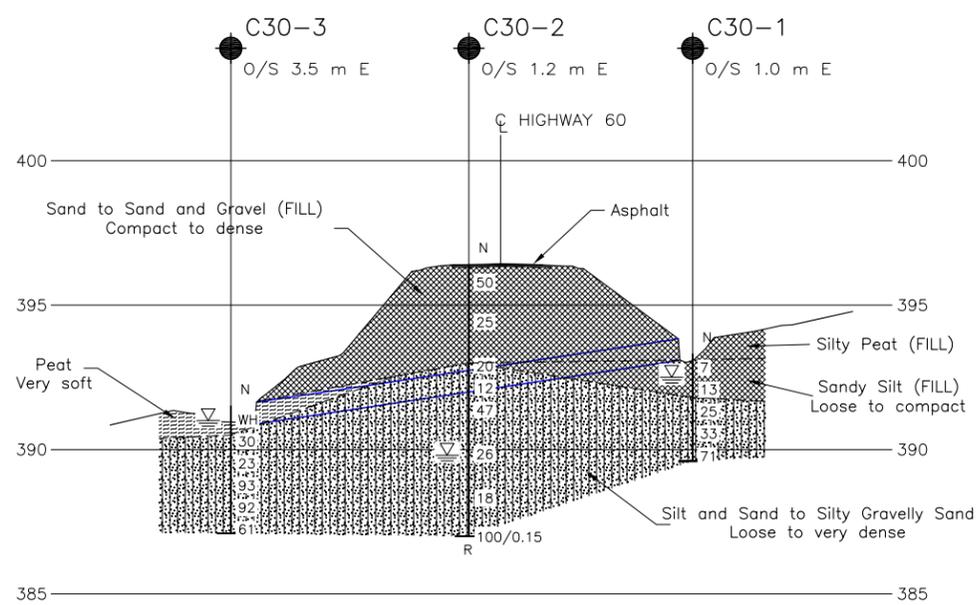
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

**REFERENCE**

Base plans provided in digital format by LEA, drawing file no. GWP 5198-10-00.dwg, received APR, 2014.



**PROFILE**  
A-A'  
Q1  
HIGHWAY 60  
HORIZONTAL SCALE  
5 0 5 10 m  
VERTICAL SCALE  
2.5 0 2.5 5 m



NO.	DATE	BY	REVISION

Geocres No. 31E-339

HWY. 60	PROJECT NO. 13-1191-0003	DIST.
SUBM'D. AC	CHKD.	DATE: JAN 2015
DRAWN: TB	CHKD. AB	APPD. JMAC
		DWG. Q1



## PHOTOGRAPHS

**Photograph 1: Culvert 30 at STA 11+817  
Looking East (September 2014)**



**Photograph 2: Culvert 30 at STA 11+817  
Looking West (September 2014)**



PROJECT <u>13-1191-0003</u>	<b>RECORD OF BOREHOLE No C30-1</b>	1 OF 1 <b>METRIC</b>
G.W.P. <u>5198-10-00</u>	LOCATION <u>N 5039070.4; E 417819.7</u>	ORIGINATED BY <u>EHS</u>
DIST <u>          </u> HWY <u>60</u>	BOREHOLE TYPE <u>Portable Equipment</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>November 19 and 20, 2014</u>	CHECKED BY <u>AB</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100						
393.3	GROUND SURFACE															
0.0	Silty peat (FILL) Black Wet	[Hatched]	1	SS	7											
0.2	Sandy silt, trace to some gravel, trace organics (FILL) Loose to compact Brown Wet	[Cross-hatched]	2	SS	13	▽										
391.8						392										
1.5	SILT and SAND to Silty Gravelly SAND, trace clay Compact to very dense Grey Wet	[Dotted]	3	SS	25						○				20 44 32 4	
			4	SS	33											
			5	SS	71						○				28 44 25 3	
389.6						390										
3.7	END OF BOREHOLE  Notes:  1. Water level at a depth of 0.8 m below ground surface (Elev. 392.5 m) upon completion of drilling.															

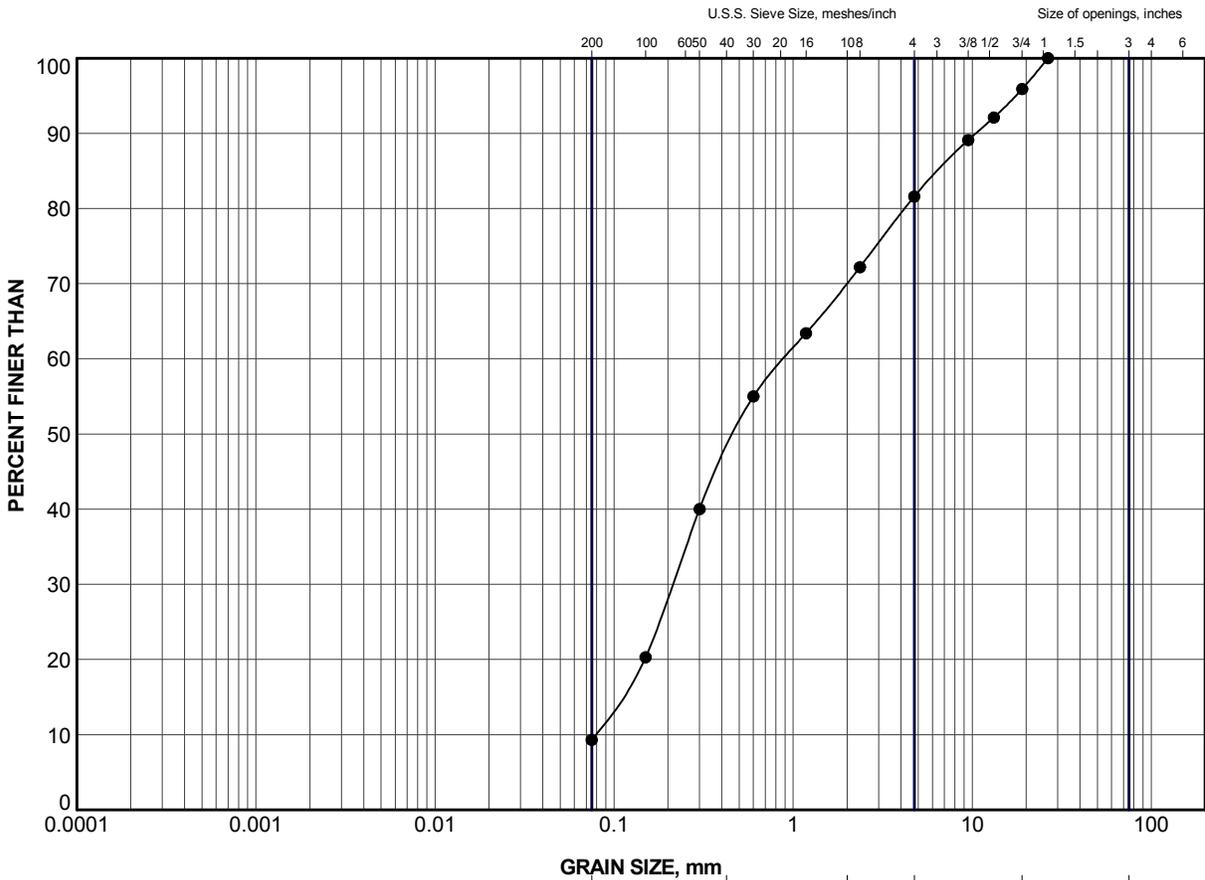
SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:

**PROJECT** 13-1191-0003 **RECORD OF BOREHOLE No C30-2** **1 OF 1 METRIC**  
**G.W.P.** 5198-10-00 **LOCATION** N 5039085.9; E 417818.4 **ORIGINATED BY** EHS  
**DIST** HWY 60 **BOREHOLE TYPE** 108 mm I.D. Continuous Flight Hollow Stem Augers **COMPILED BY** AC  
**DATUM** GEODETIC **DATE** November 11, 2014 **CHECKED BY** AB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
396.4	GROUND SURFACE																		
0.0	ASPHALT (80 mm)																		
0.1	Sand to sand and gravel, some silt (FILL) Compact to dense Brown Moist		1	SS	50														
			2	SS	25						○								19 72 (9)
393.0			3	SS	20														
3.4	SILT and SAND, trace gravel Compact to dense Brown to grey Moist to wet		4	SS	12						○								3 33 58 6
			5	SS	47														
			6	SS	26						○								7 46 44 3
			7	SS	18														
			8	SS	100/0.15														
387.0	END OF BOREHOLE SPOON REFUSAL																		
9.4	Notes: 1. Water level at a depth of 6.6 m below ground surface (Elev. 389.8 m) upon completion of drilling.																		

SUD-MTO 001 13-1191-0003.GPJ GAL-MISS.GDT 28/01/15 DATA INPUT:





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

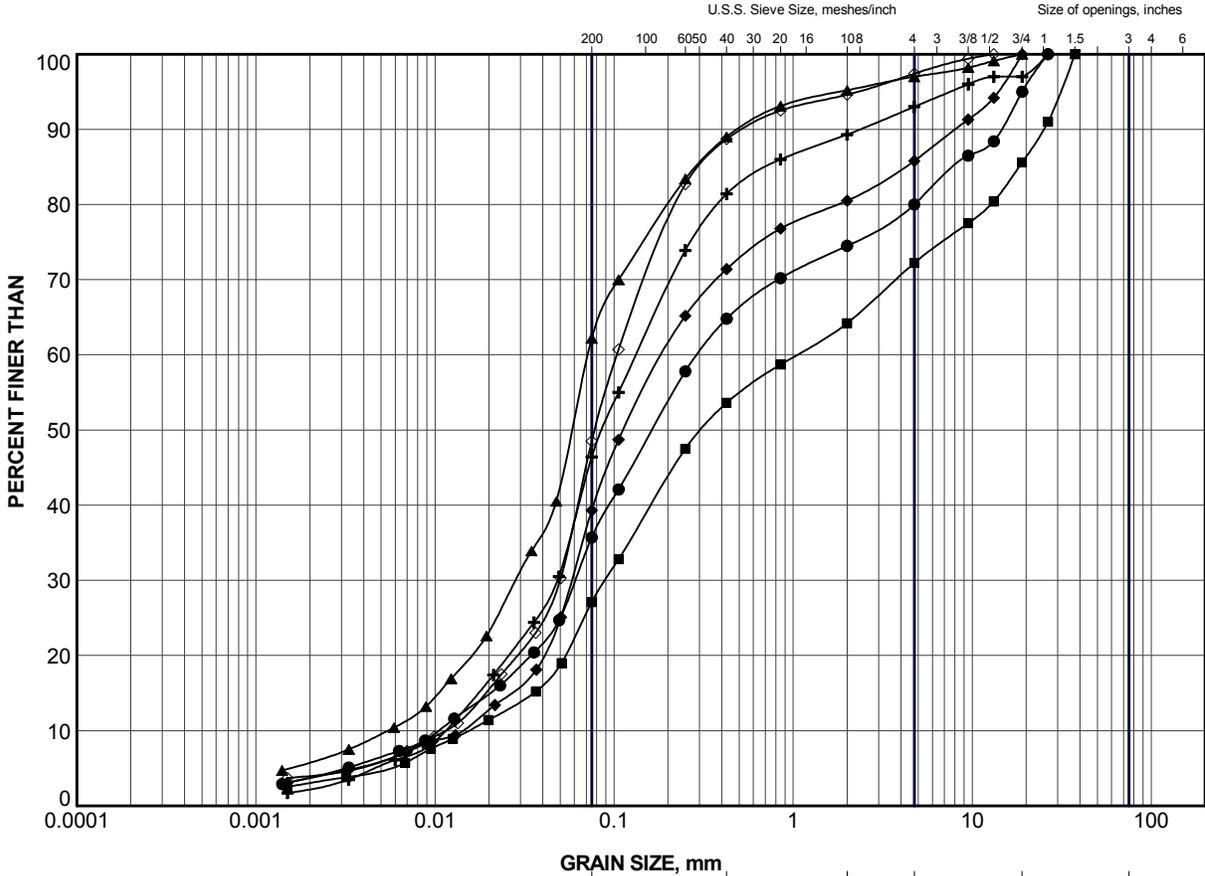
**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C30-2	2	394.6

PROJECT					HIGHWAY 60 CULVERT C30				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SAND (FILL)				
PROJECT No.		13-1191-0003			FILE No.		13-1191-0003.GPJ		
DRAWN	TB	Jan 2015			SCALE	N/A		REV.	
CHECK	AB	Jan 2015			<b>FIGURE Q1</b>				
APPR	JMAC	Jan 2015							



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

**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C30-1	3	391.5
■	C30-1	5	389.9
▲	C30-2	4	392.3
+	C30-2	6	390.0
◆	C30-3	2b	390.3
◇	C30-3	5	388.2

PROJECT					HIGHWAY 60 CULVERT C30				
TITLE					<b>GRAIN SIZE DISTRIBUTION</b> SILT and SAND to SILTY GRAVELLY SAND				
PROJECT No. 13-1191-0003			FILE No. 13-1191-0003.GPJ		DRAWN TB Jan 2015			SCALE N/A REV.	
CHECK AB Jan 2015			APPR JMAC Jan 2015		<b>FIGURE Q2</b>				

**Golder Associates**  
 SUDBURY, ONTARIO

SUD-MTO GSD (NEW) GLDR\_LDN.GDT

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. 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 who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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