Foundation Investigation and Design Report

Temporary Cofferdams at Five Culvert Locations, Highway 7A Resurfacing and Structure Rehabilitations at Various Locations, Port Perry, Ontario, G.W.P. 2436-15-00

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PART A

FOUNDATION INVESTIGATION REPORT
TEMPORARY COFFERDAMS AT FIVE CULVERT LOCATIONS
HIGHWAY 7A RESURFACING AND STRUCTURE REHABILITATIONS AT VARIOUS LOCATIONS
PORT PERRY, ONTARIO
G.W.P. 2436-15-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Parsons on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the proposed temporary cofferdams for the rehabilitation of various culvert structures along Highway 7 and Highway 7/12. The culverts included in this investigation are identified below:

- Beaver River Culvert (22-189/C)
- North of Scugog Line 8 Culvert (22-409/C)
- North of Reach Street Culvert (22-407/C)
- North of Highway 7A Culvert (22-82/C)
- Brook Street Culvert (22-406/C)

This report addresses the foundation investigation carried out to support the temporary cofferdam systems needed for the rehabilitation of the existing culverts at the sites identified above. This report was developed based on information from the current investigation.

The Terms of Reference and Scope of Work for the foundation engineering services are outlined in MTO's Request for Proposal, dated May 2016, which forms part of the Consultant Agreement (No. 2017-E-0012) for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated December 18, 2017.

2.0 SITE DESCRIPTION

2.1 Beaver River Culvert (22-189/C)

The Beaver River Culvert (22-189/C) crosses beneath Highway 7 approximately 2.3 km east of the intersection of Highway 7 / 12 (see Drawing 1). The existing culvert consists of a concrete closed double-box structure with a total span of about 12 m (twin 6 m span box units) oriented in a north-south direction and allows Beaver River to flow under Highway 7. Highway 7 consists of an asphalt road surface with one lane of traffic in the eastbound and westbound direction. Residential and undeveloped lands surround the culvert to the north and south and several ponds are present in the area. Photographs taken during site visits (in March and September 2018) at the north and south end of the culvert are provided below.

Photograph 1: North end of culvert looking southeast

Photograph 2: South end of culvert looking east

Observations made during the site visits and investigation indicate that the embankment adjacent to the culvert is sloped at approximately 2 horizontal to 1 vertical (2H:1V), with flared wing walls / headwalls located at both the inlet and outlet location. Minimal embankment erosion was observed and there were no obvious signs of instability or distress. It was observed that portions of the double box culvert have experienced some concrete degradation as patches of concrete have dislodged from the culvert walls and obvert.

2.2 North of Scugog Line 8 Culvert (22-409/C)

The North of Scugog Line 8 Culvert (22-409/C) is located approximately 800 m north of Scugog Line 8 on Highway 7/12 (see Drawing 2). The existing culvert consists of an open footing concrete box culvert (3 m span) which is oriented in an east-west direction and allows the watercourse to flow freely under Highway 7/12. Highway 7/12 consists of one lane in both the northbound and southbound direction. Undeveloped lands surround the culvert with a rural residence approximately 100 m southeast of the culvert location. Photographs taken during site visits (in March and September 2018) at the west and east end of the culvert are provided below.

Photograph 3: West end of culvert looking northeast

Photograph 4: East end of culvert looking southeast

Observations made during the site visits and investigation indicate that there is an approximately 1 m high embankment at the culvert location with approximately 2H:1V side-slopes. Minimal embankment erosion was observed and there were no obvious signs of instability. No significant concrete degradation of the existing culvert was observed during the site visits and the culvert appears to be performing satisfactorily.

2.3 North of Reach Street Culvert (22-407/C)

The North of Reach Street Culvert (22-407/C) is located approximately 350 m north of Reach Road on Highway 7/12 (see Drawing 3). The culvert consists of a concrete closed box culvert (3 m span) which is oriented in an east-west direction and allows the watercourse to flow freely under Highway 7/12. Highway 7/12 consists of one lane in both the northbound and southbound direction. Residential and undeveloped lands surround the culvert to the east and west. Photographs taken during site visits (in March and September 2018) at the west and east end of the culvert are provided below.

Photograph 5: East end of culvert looking west

Photograph 6: West end of culvert looking north

Observations made during the site visits and investigation indicate that the existing embankment near the culvert is several metres high with an approximately 2H:1V vegetated side-slope. Minimal embankment erosion was observed and there were no obvious signs of instability. There were no signs of concrete degradation or distress to the existing concrete culvert during the site visits and the culvert appears to be performing satisfactorily.

2.4 North of Highway 7A Culvert (22-82/C)

The North of Highway 7A Culvert (22-82/C) is located approximately 400 m north of Highway 7A along Highway 7/12 (see Drawing 4). The culvert consists of an open footing concrete box culvert (3.1 m span) which is oriented in an east-west direction and carries the watercourse below Highway 7/12. Highway 7/12 consists of one lane in both the northbound and southbound direction. There is an auto repair shop east of the culvert and residential and farm lands are present to the west. Photographs taken during site visits (in March and September 2018) at the west and east end of the culvert are provided below.

Photograph 7: East end of culvert looking northwest

Photograph 8: West end of culvert looking south

Observations made during the site visits and investigation indicate that there the embankment is several metres high near the culvert with approximately 2H:1V side-slopes, except directly adjacent to the east end of the culvert where gabion baskets were present. Embankment erosion was observed at the east end of the culvert, mainly near the toe of the embankment and within the ditch, however there were no obvious signs of instability. Erosion from surface water near the invert at the west end was also observed (see Photograph 8), however, the end of the culvert is located a significant distance from the toe of the embankment at this location and no instability was observed. The existing culvert was observed be performing satisfactorily.

2.5 Brook Street Culvert (22-406/C)

The Brook Street Culvert (22-406/C) is located at the intersection of Highway 7/12 and Brook Street (see Drawing 5). The culvert consists of a concrete closed box culvert (3.1 m span) which is oriented in a north-south direction and allows the watercourse / ditch to flow freely under Brook Street. Brook Street consists of one lane in both the northeast and southwest direction. An auto repair shop is located to the north of the culvert. To the south there exists residential and undeveloped properties. Photographs taken during site visits (in March and September 2018) at the north and south ends of the culvert are provided below.

Photograph 9: North end of culvert looking south

Photograph 10: South end of culvert looking north

Observations made during the site visits and investigation indicate that the embankment at the culvert is less than 1 m high with an approximately 3H:1V to 4H:1V side-slope. Embankment erosion or instability was not observed and the existing concrete culvert showed minor concrete degradation / spalling. Embankment fill materials appear to have accumulated within the ditch and appear to be restricting the full capacity of the culvert, although the culvert appears to be performing satisfactorily.

3.0 INVESTIGATION PROCEDURES

The field work for the current investigation was carried out between September 11 and October 24, 2018 during which time ten boreholes (designated as Boreholes 17-1 to 17-10) were advanced at the culvert sites. Two boreholes were advanced at each culvert site, one borehole located at each the inlet and outlet side of the culvert. The borehole locations are shown relative to each culvert location on Drawings 1 to 5.

All boreholes were advanced using a portable tripod drill rig supplied and operated by OGS Inc. of Almonte, Ontario. The portable tripod drill rig typically utilized wash boring methods to advance BW casing through the overburden to depths ranging from 5 m to 11.3 m below ground surface. Soil samples were obtained using continuous sampling operations and at intervals ranging from 0.75 m to 1.5 m depth using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586)[1]. At selected locations, Standard Dynamic Cone Penetration Tests were carried out below the drilled borehole depth.

Field vane shear test were conducted at selected locations for determination of undrained shear strengths (in general accordance with ASTM D2573)[2] using Standard 'B' size vanes to fit inside the casing used for portable drilling.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations. All boreholes were backfilled with bentonite to ground surface, in accordance with Ontario Regulation 903 (Wells, as amended).

The field work was monitored on a full-time basis by a member of Golder's technical staff who located the boreholes in the field, directed the sampling and in situ testing operations, logged the boreholes and examined the soil samples. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further visual review and geotechnical laboratory testing on selected samples, consisting of natural moisture content, Atterberg limits, grain size distribution and organic content conducted in accordance with MTO and / or ASTM Standards as applicable.

The borehole locations were surveyed in the field by Golder personnel using a Global Positioning System (GPS) unit (i.e. Trimble Geo 7X). The Trimble Geo 7X achieved a horizontal accuracy of 1 cm to 1.2 cm and a vertical accuracy of 1.4 cm to 2 cm while in use at the sites. The locations given in the Record of Borehole sheets and shown on Drawings 1 to 5 are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The culvert structure site, borehole locations (including geographic Latitude / Longitude coordinates), the ground surface elevations and borehole drilled depths are summarized below.

[1] ASTM D 1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

[2] ASTM D 2573 – Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils.

Culvert Structure Site	Borehole No.	MTM NAD 83 (Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
		Northing (m) (Latitude)	Easting (m) (Longitude)		
Beaver River Culvert (Site No. 22-189/C)	17-1	4,906,149.4 (44.294453)	341,067.3 (-79.045529)	259.2	11.3
	17-2	4,906,133.1 (44.294305)	341,106.6 (-79.045038)	259.9	9.8
North of Scugog Line 8 Culvert (Site No. 22-409/C)	17-3	4,887,023.1 (44.122130)	344,590.7 (-79.002827)	253.6	9.8
	17-4	4,887,030.1 (44.122192)	344,614.6 (-79.002528)	253.7	10.7 (includes 4 m of DCPT testing)
North of Reach Street Culvert (Site No. 22-407/C)	17-5	4,885,230.8 (44.105964)	345,230.1 (-78.994976)	252.8	13.4 (includes 3.3 m of DCPT testing)
	17-6	4,885,254.9 (44.106179)	345,249.4 (-78.994734)	252.9	10.4
North of Highway 7A Culvert (Site No. 22-82/C)	17-7	4,882,516.5 (44.081485)	346,105.3 (-78.984257)	271.4	5.0
	17-8	4,882,523.9 (44.081550)	346,133.0 (-78.983911)	272.0	5.6
Brook Street Culvert (Site No. 22-406/C)	17-9	4,882,420.0 (44.080613)	346,165.6 (-78.983511)	272.1	5.6
	17-10	4,882,392.3 (44.080363)	346,179.9 (-78.983335)	271.4	7.7

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area straddles the boundary between two physiographic regions of Southern Ontario; the Schomberg Clay Plains and the Peterborough Drumlin Field, as delineated in The Physiography of Southern Ontario (Chapman and Putnam, 1984).

The Schomberg Clay Plain physiographic region includes a number of topographic basins along the northern slopes of the Oak Ridges Moraine that contain deep deposits of stratified clay and silt. The region includes areas near Schomberg, Newmarket, and Lake Scugog. The soils of the Schomberg clay plains are characterized by well-drained Schomberg silty clay loam, imperfectly drained Smithfield silty clay loam and poorly drained Simcoe silty clay and silt loams. The Lake Scugog area is also characterized by sand plains and drumlinized till plains which have resulted in a flat topography with rolling hills.

The Peterborough Drumlin Field physiographic region consists of a rolling till plain that lies between the Oak Ridges Moraine and the Gull River Formation. This region contains approximately 3,000 drumlins composed of highly calcareous till underlying silt and fine sand. The Peterborough Drumlin Field is also characterized by eskers and deposits of clay that lay between the drumlins in areas flooded by old glacial lakes. In general, highly fossiliferous limestone bedrock underlies this physiographic region as part of the Lindsay and Verulam Formations.

4.2 General Overview of Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes of the current investigation, and the results of the in situ and laboratory tests are provided on the Record of Borehole Sheets in Appendix A. The results of the in-situ field tests (i.e., SPT "N"-values) as presented on the borehole records and in Section 4 are uncorrected. The results of the geotechnical laboratory testing on soil samples are presented on the Laboratory test figures in Appendix B.

The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected, however, the factual data presented on the borehole records governs any interpretation of the site conditions.

4.2.1 Beaver River Culvert (22-189/C)

Two boreholes (17-1 and 17-2) were advanced at the Beaver River Culvert location. In general, the subsurface conditions at the Beaver River culvert consist of fill and/or peat underlain by silty sand, further underlain by a clayey silt to silty clay deposit. A deposit of silt and sand was encountered below the clayey silt.

4.2.1.1 Sand and Gravel Fill:

An approximately 1.4 m thick layer of sand and gravel fill was encountered at ground surface in Borehole 17-2. The Standard Penetration Test (SPT) "N"-value measured in the layer was 6 blows per 0.3 m of penetration, indicating a loose level of compactness.

4.2.1.2 Sandy Silt Fill:

An approximately 0.5 m thick layer of surficial sandy silt was encountered at ground surface in Borehole 17-1.

4.2.1.3 Peat:

An approximately 2.9 m thick deposit of peat was encountered underlying the surficial sandy silt at Elevation 258.7 m in Borehole 17-1. The peat contained some sand and gravel throughout the full thickness of this layer. The SPT "N"-values measured within the peat layer range between 2 blows and 8 blows per 0.3 m of penetration suggesting a very loose to loose level of compactness.

The natural water content measured on a selected sample of the peat was 27 per cent. One organic content test was carried out on a selected sample of the peat and measured organic content of 3.1 per cent. The low natural water content and organic content measured on the peat sample can be attributed to the significant portion of sand and gravel that was present within the peat layer and specifically the sample submitted for laboratory analysis.

4.2.1.4 Gravelly Silty Sand to Silty Sand and Gravel:

An approximately 2.9 m thick deposit of gravelly silty sand to silty sand and gravel was encountered underlying the fill at Elevation 258.5 m in Borehole 17-2. The SPT “N”-values measured within the deposit range between 8 blows and 21 blows per 0.3 m of penetration, indicating a loose to compact level of compactness.

One grain size distribution test was carried out on a sample of the gravelly silty sand to silty sand and gravel and the results are shown on Figure B1 in Appendix B.

The natural water content measured on two selected samples of the gravelly silty sand to sand and gravel were 14 per cent and 20 per cent.

4.2.1.5 Silty Sand:

An approximately 1.1 m thick deposit of silty sand, containing some peat, was encountered underlying the peat layer at Elevation 255.8 m in Borehole 17-1. The SPT “N”-values measured within the deposit range between 3 blows and 32 blows per 0.3 m of penetration, indicating a very loose to dense level of compactness.

One grain size distribution test was carried out on a sample of the silty sand and the results are shown on Figure B4 in Appendix B. The natural water content measured on a selected sample of the silty sand was 23 per cent.

4.2.1.6 Sandy Silty Clay:

An approximately 1.3 m thick deposit of sandy silty clay was encountered underlying the gravelly silty sand to silty sand and gravel at Elevation 255.6 m in Borehole 17-2. The SPT “N”-values measured within the deposit range between 11 blows and 26 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

One Atterberg limits test carried out on the sandy silty clay measured a liquid limit of 39 per cent, a plastic limit of 18 per cent, and a plasticity index of 21 per cent. These results, which are plotted on a plasticity chart on Figure B6 in Appendix B, indicate the fine-grained portion of the sandy silty clay has a intermediate plasticity. The natural water content measured on two selected samples of the sandy silty clay were 19 per cent and 24 per cent.

4.2.1.7 Clayey Silt:

An approximately 5.9 m and 4.1 m thick deposit of clayey silt was encountered underlying the sandy silty clay and silty sand deposits at Elevations 254.7 m and 254.3 m in Boreholes 17-1 and 17-2, respectively. Borehole 17-2 terminated within this deposit, penetrating it for a thickness of 4.1 m. The SPT “N”-values measured within the deposit range between 4 blows and 32 blows per 0.3 m of penetration.

Field vanes measured shear strengths ranging between 43 kPa and greater then 144 kPa, confirming that the deposit has a firm to very stiff consistency.

Two grain size distribution tests were carried out on samples of the clayey silt and the results are shown on Figure B5 in Appendix B. Two Atterberg limits test carried out on the clayey silt deposit measured liquid limits of 22 and 33 per cent, plastic limits of 15 and 16 per cent, and plasticity indices of 8 and 17 per cent. These results, which are plotted on a plasticity chart on Figure B6 in Appendix B, and indicate the clayey silt has low plasticity. The natural water content measured on selected samples of the clayey were between 22 per cent and 26 per cent.

4.2.1.8 Silt and Sand:

A deposit of silt and sand was encountered underlying the clayey silt deposit at Elevation 248.8 m in Borehole 17-1. Borehole 17-1 terminated within this deposit, penetrating it for a thickness of 1.2 m. The SPT "N"-value measured in the deposit is 60 blows per 0.3 m of penetration indicating a very dense level of compactness.

One grain size distribution test was carried out on a selected sample of the silt and sand and the results are shown on Figure B3 in Appendix B.

4.2.2 North of Scugog Line 8 Culvert (22-409/C)

Two boreholes (17-3 and 17-4) were advanced at the Scugog Line 8 Culvert location. In general, the subsurface conditions at this culvert consist of organic silty sand or peat underlain by sand, further underlain by a clayey silt deposit.

4.2.2.1 Sandy Peat to Organic Silty Sand:

An approximately 2.3 m to 3.4 m thick layer of sandy peat or organic silty sand was encountered at ground surface in Boreholes 17-3 and 17-4. The SPT "N"-values range between 1 blow and 10 blows per 0.3 m of penetration, indicating a very loose to compact level of compactness, but typically very loose.

One grain size distribution test was carried out on a sample of the sandy peat and the results are shown on Figure B4 in Appendix B. The natural water content measured on selected samples of the organic sandy peat to organic silty sand generally range from 132 per cent to 345 per cent. Two organic content tests were carried out on selected samples of the organic deposit and measured organic contents of 17 per cent and 45 per cent.

4.2.2.2 Sand:

An approximately 4.2 m to 4.4 m sand deposit was encountered underlying the organic layer at Elevations 250.2 m and 251.4 m in Boreholes 17-3 and 17-4, respectively. Borehole 17-4 was terminated within the deposit due to refusal of the casing. The SPT "N"-values in the deposit range between 14 blows and 48 blows per 0.3 m of penetration, indicating a compact to dense level of compactness.

Three grain size distribution tests were carried out on selected samples of the sand and the results are shown on Figure B4 in Appendix B. The natural water content measured on selected samples of the sand generally range from 18 per cent to 28 per cent.

4.2.2.3 Clayey Silt:

An approximately 2.6 m thick deposit of clayey silt was encountered underlying the sand at Elevation 246.4 m in Borehole 17-3. Two SPT "N"-values measured in the deposit are 11 blows per 0.3 m of penetration, suggesting a stiff consistency. Borehole 17-3 was terminated in this deposit.

One grain size distribution test was carried out on a sample of the clayey silt and the results are shown on Figure B5 in Appendix B. One Atterberg limits test carried out on the clayey silt measured a liquid limit of 26 per cent, a plastic limit of 15 per cent, and a plasticity index of 11 per cent. These results, which are plotted on a plasticity chart on Figure B6 in Appendix B, indicate the clayey silt has low plasticity. The natural water content measured on a selected sample of the clayey silt was 21 per cent.

A Dynamic Cone Penetration Test (DCPT) was conducted between Elevations 247.0 m and 243.0 m in Borehole 17-4. The measured values ranged between 14 blows and 70 blows per 0.3 m of penetration and generally increased with depth.

4.2.3 North of Reach Road Culvert (22-407/C)

Two boreholes (Boreholes 17-5 and 17-6) were advanced at the North of Reach Road Culvert location. In general, the subsurface conditions at this culvert consist of fill underlain by a deposit of clayey silt to silty clay.

4.2.3.1 Topsoil and Peat:

An approximately 25 mm layer of topsoil and peat was encountered at ground surface in Boreholes 17-5 and 17-6. The SPT "N"-values measured within the deposit are between 2 blows and 3 blows per 0.3 m of penetration, indicating a very loose level of compactness.

4.2.3.2 Silty Sand to Sand Fill:

An approximately 3.6 m to 3.0 m thick layer of silty sand to sand fill was encountered underlying the topsoil and peat at Elevations 252.6 m and 252.7 m in Boreholes 17-5 and 17-6, respectively. The silty sand to sand fill layer was observed to be interlayered with sandy silty peat fill and clayey silt fill in Borehole 17-5. The SPT "N"-values measured within the fill layer range between 1 blow and 23 blows per 0.3 m of penetration, indicating a very loose to compact level of compactness.

Three grain size distribution tests were carried out on samples of the silty sand to sand fill and the results are shown on Figure B7 in Appendix B. The natural water content measured on selected samples of the silty sand to sand fill generally ranged between 10 per cent and 18 per cent.

4.2.3.3 Silty Sandy Peat Fill:

An approximately 0.3 m thick layer of silty sandy peat fill was encountered within the silty sand to sand fill at Elevation 251.6 m in Borehole 17-5. The SPT "N"-value measured within the peat layer was 3 blows per 0.3 m of penetration, indicating a very loose level of compactness.

The natural water content measured on the sample of silty sandy peat fill was 93 per cent. One organic content test was carried out on the silty sand peat fill and measured an organic content of 13 per cent.

4.2.3.4 Clayey Silt Fill:

An approximately 1.3 m thick layer of clayey silt fill was encountered within the silty sand to sand fill at Elevation 251.3 m in Borehole 17-5. The SPT "N"-values measured within the layer range between 3 blows and 4 blows per 0.3 m of penetration, suggesting a soft to firm consistency. A field shear vane measured a shear strength of about 80 kPa suggesting the fill deposit is stiff.

4.2.3.5 Clayey Silt to Silty Clay:

A deposit of clayey silt to silty clay was encountered underlying the fill at Elevations 249.0 m and 249.7 m in Boreholes 17-5 and 17-6, respectively. Boreholes 17-5 and 17-6 were terminated within the clayey silt to silty clay deposit at Elevations 242.7 m and 242.5 m, respectively. The SPT "N"-values measured within the deposit range between 5 blows and 36 blows per 0.3 m of penetration, suggesting a firm to hard consistency. Field shear vanes measured shear strengths ranging from about 32 kPa to 60 kPa confirming the deposit is firm to stiff.

Four grain size distribution tests were carried out on selected samples of the clayey silt to silty clay and the results are shown on Figure B5 in Appendix B. Four Atterberg limits test carried out on the clayey silt to silty clay measured liquid limits of 25 to 39 per cent, plastic limits of 14 to 18 per cent, and plasticity indices of 11 to 20 per cent. These results, which are plotted on a plasticity chart on Figure B6 in Appendix B, indicate the clayey silt to silty clay has

low to intermediate plasticity. The natural water content measured on selected samples of the clayey silt to silty were between 19 and 31 per cent.

A Dynamic Cone Penetration Test (DCPT) was conducted between Elevations 242.7 m and 239.4 m in Borehole 17-5. The measured values ranged between 2 blows and8 blows per 0.3 m of penetration and generally increased with depth.

4.2.4 North of Highway 7A Culvert (22-82/C)

Two boreholes (Boreholes 17-7 and 17-8) were advanced at the North of Highway 7A Culvert location. In general, the subsurface conditions at this culvert consist of topsoil and/or fill underlain by a deposit of silt and sand to sandy gravel.

4.2.4.1 Topsoil:

An approximately 0.2 m to 0.4 m thick deposit of topsoil was encountered at ground surface in Boreholes 17-7 and 17-8. The SPT “N”-values measured within the organic layer range between 4 blows and 10 blows per 0.3 m of penetration, indicating a very loose to loose level of compactness.

The natural water content measured on a selected sample of the topsoil was 30 per cent.

4.2.4.2 Sandy Clayey Silt Fill

An approximately 1.2 m thick layer of sandy clayey silt fill was encountered below the topsoil in Borehole 17-7 at Elevation 271.2 m. The SPT “N”-values measured within the sandy clayey silty fill range between 4 blows and 66 blows per 0.3 m of penetration, suggesting a firm to hard consistency.

The natural water content measured on a selected sample of the sandy clayey silty fill was 34 per cent.

4.2.4.3 Silt and Sand to Sandy Gravel:

An approximately 3.6 m to 5.2 m thick deposit of silt and sand to sandy gravel was encountered underlying the cohesive fill in Borehole 17-7 and underlying the topsoil in Borehole 17-8 at Elevations 270.0 m and 271.6 m, respectively. Boreholes 17-7 and 17-8 were terminated within the deposit at Elevation 266.4 m. The SPT “N”-values measured within the deposit range between 66 blows per 0.3 m of penetration and 100 blows for 0.08 m of penetration, indicating a very dense level of compactness.

Five grain size distribution tests were carried out on samples of the silt and sand to sandy gravel and the results are shown on Figure B1 in Appendix B. Four Atterberg limits tests carried out on the silt and sand to sandy gravel measured a liquid limit ranging from 12 to 15 per cent, a plastic limit ranging from 11 to 13 per cent, and plasticity indices ranging from 1 to 2 per cent. These results, which are plotted on a plasticity chart on Figure B2 in Appendix B, indicate the fine-grained portion of the silt and sand to sandy gravel has slight plasticity. The natural water content measured on selected samples of the silt and sand to sandy gravel range from 4 per cent to 17 per cent.

4.2.5 Brook Street Culvert (22-406/C)

Two boreholes (Boreholes 17-9 and 17-10) were advanced at the Brook Street Culvert location. In general, the subsurface conditions at this culvert consist of topsoil or organic silty sand underlain by interlayered deposits of clayey silt, silt and sand, sand and sand and gravel.

4.2.5.1 Topsoil and Organic Silty Sand:

An approximately 0.4 m to 1.2 m thick layer of topsoil and organic silty sand was encountered at ground surface in Boreholes 17-9 and 17-10. The SPT “N’-values measured within the organic layer range between 1 blow and 3 blows per 0.3 m of penetration, indicating a very loose level of compactness.

One organic content test was carried out on a selected sample of the organic deposit and measured organic content of about 5 per cent. The natural water content measured on a selected samples of the topsoil and organic silty sand range from 14 per cent to 28 per cent.

4.2.5.2 Sandy Clayey Silt to Silt:

A 1.2 m to 1.8 m thick deposit of sandy clayey silt to silt was encountered underlying the topsoil and organic silty sand at Elevations 270.9 m and 271.0 m in Boreholes 17-9 and 17-10, respectively. The SPT “N”-values measured within the clayey silt to silt deposit range from 11 blows per 0.3 m to 100 blows for 0.13 m of penetration, suggesting a stiff to hard consistency.

One grain size distribution test was carried out on a sample of the clayey silt and the result is shown on Figure B5 in Appendix B. Two Atterberg limits tests carried out on the clayey silt to sandy clayey silt to silt measured a liquid limit ranging from 18 to 23 per cent, a plastic limit ranging from 13 to 18 per cent, and plasticity indices of 5 per cent. These results, which are plotted on a plasticity chart on Figure B6 in Appendix B, indicate the clayey silt has low plasticity. The natural water content measured on selected samples of the clayey silt to sandy clayey silt to silt generally range from 6 per cent to 22 per cent.

4.2.5.3 Sand to Silt and Sand:

An approximately 1.3 m deposit of sand to silt and sand was encountered below the clayey silt at Elevations 269.7 m and 268.4 m in Boreholes 17-9 and 17-10, respectively. The SPT “N”-values measured within the layer range between 17 blows per 0.3 m and 100 blows for 0.2 m of penetration, indicating a compact to very dense level of compactness.

Two grain size distribution tests were carried out on samples of the sand to silt and sand and the results are shown on Figure B4 in Appendix B. One Atterberg limits test was carried out on the sand to silty sand till measured a liquid limit ranging from of 13 per cent, a plastic limit of 11 per cent, and plasticity index of 2 per cent. These results, which are plotted on a plasticity chart on Figure B2 in Appendix B, indicate the fines portion of the sand to silty sand has slight plasticity. The natural water content measured on selected samples of the sand to silty sand till generally range from 7 per cent to 13 per cent.

4.2.5.4 Sand and Gravel:

An approximately 0.3 m to 3.4 m deposit of sand and gravel, some silt to silty was encountered below the sand to silt and sand deposit at Elevations 268.4 m and 267.1 m in Boreholes 17-9 and 17-10, respectively. Borehole 17-10 was terminated in the sand and gravel deposit. The SPT “N”-values measured within the layer range between 85 blows per 0.3 m and 100 blows for 0.08 m of penetration, indicating a very dense level of compactness.

One grain size distribution test was carried out on a sample of the sand and gravel to silty sand and gravel and the results are shown on Figure B1 in Appendix B. The natural water content measured on selected samples of the sand and gravel to silty sand and gravel generally range from 3 per cent to 6 per cent.

4.2.5.5 Clayey Silt with Sand:

A deposit of clayey silt with sand was encountered in Borehole 17-9 at Elevation 268.1 m and was terminated in the deposit at Elevation 266.5 m. The SPT "N"-values measured within the deposit range between 100 blows per 0.1 m and 100 blows for 0.13 m of penetration, suggesting a hard consistency.

The natural water content measured on a selected sample of the clayey silt with sand was 3 per cent.

4.2.6 Groundwater Conditions

The groundwater levels in the open boreholes were measured upon completion of drilling operations. The groundwater level recorded in the open boreholes are shown on the borehole records in Appendix A and are summarized below. It should be noted that in all boreholes, since drilling mud had to be used, the measured groundwater level is only an estimation, and further, was generally consistent with the water level in the creek.

Borehole No.	Ground Surface Elevation (m)	Depth to Water Level (m)	Groundwater Elevation (m)	Date	Comments
17-1	259.2	0	259.2	September 12, 2018	Open Borehole
17-2	259.9	0	259.9	September 12, 2018	Open Borehole
17-3	253.6	0.2	253.4	October 19, 2018	Open Borehole
17-4	253.7	0.2	253.5	October 17, 2018	Open Borehole
17-5	252.8	0.2	252.6	October 22, 2018	Open Borehole
17-6	252.9	0.2	252.7	October 24, 2018	Open Borehole
17-7	271.4	0.9	270.5	October 9, 2018	Encountered during drilling operations
17-8	272.0	1.7	270.3	October 10, 2018	Encountered during drilling operations
17-9	272.1	1.5	270.6	October 11 & 12, 2018	Encountered during drilling operations
17-10	271.4	0.2	271.2	October 10, 2018	Encountered during drilling operations

The groundwater level observations at this site will be subject to seasonal fluctuations and precipitation events; the water levels should be expected to be higher during the spring season or during and following periods of heavy precipitation.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Carter Comish, E.I.T and Nikol Kochmanova, P.Eng., and reviewed by Ms. Sarah Poot, P.Eng., an Associate of Golder. Mr. Kevin J. Bentley, P.Eng., an Associate and MTO Foundations Designated Contact of Golder, conducted an independent quality control review of this report.

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PART B

FOUNDATION DESIGN REPORT
TEMPORARY COFFERDAMS AT FIVE CULVERT LOCATIONS
HIGHWAY 7A RESURFACING AND STRUCTURE REHABILITATIONS AT VARIOUS LOCATIONS
PORT PERRY, ONTARIO
G.W.P. 2436-15-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundation engineering parameters / values and general design considerations for the proposed temporary cofferdams / protection systems required for rehabilitation of the existing culverts listed below.

- Beaver River Culvert (22-189/C)
- North of Scugog Line 8 Culvert (22-409/C)
- North of Reach Street Culvert (22-407/C)
- North of Highway 7A Culvert (22-82/C)
- Brook Street Culvert (22-406/C)

This foundation investigation and design report with the interpretations and recommendations are intended for the use of the Ministry of Transportation and shall not be used or relied upon for any other purpose or by any other parties including the construction or design-build contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of this report. Where comments are made on construction, they are provided only in order to highlight those aspects that could affect the design of the project, and for which special provisions may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Temporary Cofferdams

Temporary cofferdams are anticipated to be required near the inlets and outlets of the five culverts identified in the previous section to allow for control of surface water through the culverts and allow for rehabilitation of the structures in dry conditions. It is noted that cofferdams may need to be supplemented with dewatering activities in order to achieve dry conditions, depending on the location of the structural repairs, and more details regarding dewatering considerations is provided in a later section of this report.

Conceptual temporary cofferdam options will depend on the subsurface conditions, height / depth of water to be retained, staging area, structural rehabilitation work areas and methodology, and assessment of risk for the timing of work and design life of the cofferdam structure. The detail design of the cofferdams will need to be performed by the proprietary designer.

For conceptual design, if the depth of water and unrestrained height of the required cofferdam in the watercourse near the culvert inlet and outlet is low, consideration may be given to the use of the following types of temporary cofferdams:

- Small inflatable bladder cofferdams;
- Water dams consisting of industrial grade, impermeable, composite fabrics formed into flexible tubes containing one or more chambers; or
- Multiple rows / levels of large sand bags (‘super-bags’ or ‘bulk-bags’) lined with an impermeable barrier (poly-material).

If the depth of water and unrestrained height of required cofferdam is high (as anticipated at the Beaver River Culvert, Site No. 22-189/C), alternative cofferdam options must be considered such as more specialized water dams, interlocking steel sheet piles, or similar type of cantilevered cut-off system and/or temporary protection system.

The temporary cofferdams may be designed using the following foundation soil parameters in collaboration with the anticipated soil profile using the most relevant borehole(s) at the specific location of the proposed cofferdam. The submerged unit weight should be used where applicable for detailed design. The design groundwater level for the various sites is considered to be approximately equal to the design water level in the watercourse at the time of construction. Based on the groundwater levels measured at the time of the investigation, the following groundwater levels can be used for preliminary design:

- Beaver River Culvert (22-819/C) – Elevation 259.9 m
- North of Scugog Line 8 Culvert (22-409/C) – Elevation 253.7 m
- North of Reach Street Culvert (22-407/C) – Elevation 252.9 m
- North of Highway 7A Culvert (22-82/C) – Elevation 272 m
- Brook Street Culvert (22-406/C) – Elevation 272.1 m

Culvert Site	Soil Type	Bulk Unit Weight, γ (kN/m^3)	Cohesion Intercept (c') (kPa)	Internal Angle of Friction, ϕ' (°)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients [1]		
						Kp (Passive)[2]	Ko (AtRest)	Ka (Active)
Beaver River Culvert (Site No. 22-819/C) Boreholes 17-1 and 17-2	Organic Silt to Peat	14	1	27	-	2.77	0.53	0.36
	Non-Cohesive Fill (Loose)	18	0	28	-	2.77	0.53	0.36
	Silty Sand to Gravelly Silty Sand (Very Loose to Dense)	19	0	30	-	3.00	0.50	0.33
	Clayey Silt to Silty Clay (Firm)	19	0	30	40	3.00	0.50	0.33
	Clayey Silt to Silty Clay (Stiff to Very Stiff)	20	0	32	100	3.25	0.47	0.31
	Sand and Silt (Very Dense)	20	0	35	-	3.65	0.43	0.27

Culvert Site	Soil Type	Bulk Unit Weight, γ (kN/m^3)	Cohesion Intercept (c') (kPa)	Internal Angle of Friction, ϕ' (°)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients [1]		
						Kp (Passive)[2]	Ko (AtRest)	Ka (Active)
North of Scugog Line 8 Culvert (Site No. 22-409/C) Boreholes 17-3 and 17-4	Organic Silt to Peat	14	1	27	-	2.77	0.53	0.36
	Sand (Compact to Dense)	19	0	32	-	3.25	0.47	0.31
	Clayey Silt (Stiff)	20	0	32	50	3.25	0.47	0.31
North of Reach St. Culvert (22-407/C) Boreholes 17-5 and 17-6	Topsoil / Peat	14	1	27	-	2.77	0.53	0.36
	Non-Cohesive Silty Sand to Sand Fill (Very Loose to Loose)	18	0	28	-	2.77	0.53	0.36
	Non-Cohesive Sand Fill (Compact)	18	0	32	-	3.25	0.47	0.31
	Clayey Silt Fill (Soft to Stiff)	18	0	30	50	3.00	0.50	0.33
	Clayey Silt to Silty Clay (Very Stiff to Hard)	20	0	32	150	3.25	0.47	0.31
	Clayey Silt to Silty Clay (Firm)	19	0	30	40	3.00	0.50	0.33
North of Hwy 7A Culvert (Site No. 22-82/C) Boreholes 17-7 and 17-8	Topsoil / Peat	14	1	27	-	2.77	0.53	0.36
	Sandy Clayey Silt Fill (Firm)	18	0	30	35	3.00	0.50	0.33
	Silt and Sand (Dense to Very Dense)	20	0	35	-	3.65	0.43	0.27
	Gravelly Silty Sand to Sand	20	0	35	-	3.65	0.43	0.27

Culvert Site	Soil Type	Bulk Unit Weight, γ (kN/m^3)	Cohesion Intercept (c') (kPa)	Internal Angle of Friction, ϕ' (°)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients [1]		
						Kp (Passive)[2]	Ko (AtRest)	Ka (Active)
	and Silt (Very Dense)							
Brook St. Culvert (Site No. 22-406/C) Boreholes 17-9 and 17-10	Organic Silty Sand to Peat / Topsoil	14	1	27	-	2.77	0.53	0.36
	Silt (Compact)	19	0	32	-	3.25	0.47	0.31
	Sandy Clayey Silt (Hard)	20	0	32	200	3.25	0.47	0.31
	Silty Sand to Sand (Compact to Very Dense)	20	0	34	-	3.54	0.44	0.28
	Silty Sand and Gravel to Sand and Gravel (Compact to Dense)	20	0	35	-	3.65	0.43	0.27
	Clayey Silt with Sand (Hard)	20	0	35	200	3.65	0.43	0.27

Notes:
1. The lateral earth pressure coefficients presented above are based on a horizontal surface adjacent to the dredge line / cofferdam. If sloped surfaces are expected, the coefficients should be corrected accordingly.
2. The total passive resistance below the base of the dredge line / cofferdam / ground surface may be calculated based on the values of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.16 of the Canadian Highway Bridge Design Code (CHBDC, 2014) to account for the fact that a large strain would be required for mobilization of the full passive resistance.
3. For cohesive deposits, an assessment for both the drained (ϕ') and undrained (s_u) cases should be made to establish the more conservative earth pressure condition for design.

It should be noted that the pressure distributions resulting from using the above parameters are for limit equilibrium analysis using ultimate force / resistance conditions. A more detailed design is required to estimate displacements of the cofferdam systems within an acceptable range depending on tolerable limits of the chosen system. Settlements due to loading from the cofferdam systems (e.g. sand bags) founded on the peat / fill soils within the watercourse must be considered and any mitigation measures, if required, must be designed by the Contractor and may include staged construction / preloading, geogrid reinforcement, and/or soil stabilization.

Based on the 90% design drawings, it is anticipated that more elaborate cofferdam / water cut-off systems will be required at Beaver River Culvert (Site No. 22-819/C). The design and construction of sheet piles or similar cantilevered cut-off wall for temporary cofferdams must be in accordance with OPSS.PROV 539 (Temporary Protection Systems) and meet a Performance Level 3 within the watercourse and shoreline and Performance Level 2 if located within the highway embankment. The installation of sheetpiles / cut-off walls may be impeded by the presence of wood debris along the watercourse, cobbles inferred to be present within the gravelly silty sand to silty sand and gravel deposit encountered during drilling operations, and possibly construction debris within the fill / near the watercourse from the original construction. Predrilling and/or removal of obstructions should be anticipated if cofferdam construction will rely on penetration of sheetpiles / cut-off system into the gravelly silty sand to sand and gravel deposit and/or fill soils. Given the presence of these obstructions, consideration should be given to protecting the tips of the sheet piles and/or the use of heavier sheet pile sections, assuming a sheet pile system is selected.

Based on the site conditions, from a foundations perspective, the following temporary protection systems are the preferred options at the culvert sites:

- Beaver River Culvert (22-819/C) – Sheet Piles
- North of Scugog Line 8 Culvert (22-409/C) – Sheet Piles
- North of Reach Street Culvert (22-407/C) – Sheet Piles
- North of Highway 7A Culvert (22-82/C) – Water Dam
- Brook Street Culvert (22-406/C) – Water Dam

Consideration could be given to either partial or full removal of the cofferdam system upon completion of construction or each stage of construction (as required). Where possible, full removal of the cofferdam system should be considered to mitigate potential impediments to future rehabilitation/reconstruction work at the culvert site. If a portion of the temporary cofferdam / protection system is left in place, it should be cut-off not less than 1.5 m below the underside of the streambed or ground surface. An NSSP is included in Appendix C which addresses the removal or cut-off of the cofferdam / temporary protection system in the Contract Documents.

6.3 Frost Penetration

As per Ontario Provincial Standard Drawing (OPSD) 3090.101 (Foundation Frost Penetration Depths for Southern Ontario), the frost penetration depth in the area is interpreted to be 1.5 m.

6.4 Control of Groundwater and Surface Water

Groundwater control may be required to control flow of groundwater in addition to the temporary cofferdam structures that will generally control surface water. The method and extent of groundwater control required will depend on the type and extent of the temporary cofferdam system and/or cut-off walls selected by the Contractor, as applicable, and ultimately the extent and staging of the rehabilitation works to be undertaken below the groundwater / watercourse level.

The contractor is responsible for the design and installation of all groundwater control measures giving due consideration to the type of cofferdam system, temporary shoring / cut-off system selected as well as the requirements for maintaining the stability/integrity of the foundation subgrade during construction operations and/or requirement for rehabilitation methodologies to be performed in-the-dry.

Surface water should be directed away from the excavation / work area(s) to prevent excess ponding of water that could result in disturbance and loosening/softening of the foundation subgrade and/or excessive moisture that could compromise staging areas supporting equipment and materials required for rehabilitation methods of construction. Depending on environmental restrictions and working within the watercourse (i.e. river or stream), a turbidity curtain (OPSD 219.260) may be required.

Dewatering operations must be in accordance with OPSS.PROV 517 (*Construction Specification for Dewatering*) and MTO's Special Provision 517F01 (*Temporary Flow Passage System*) recommending that a design engineer be required; SP517F01 as obtained from Parsons has been included in Appendix C. Depending on the design of the cofferdam and dewatering systems, if construction water pumping rates are anticipated to exceed 50 m^3/day, an Environmental Activity Section Registry (EASR) or Permit to Take Water (PTTW) will be required as per the recently introduced changes to the Environmental Protection Act by the Ontario Ministry of Environment and Climate Change (MOECC) / Ministry of Environment, Conservation and Parks (MECP).

6.5 Obstructions

The fill soils and peat contain variable amounts of organics that indicate the soils may contain larger wood fragments and tree branches / logs, especially in Boreholes 17-1 and 17-2 (Site No. 22-189/C), 17-3 (Site No. 22-409/C) and 17-5 (Site No. 22-407/C). Cobble and gravel zones / pockets were encountered within the fill and native cohesionless soils in Boreholes 17-2 (Site No. 22-189/C), 17-7 and 17-8 (Site No. 22-82/C) and 17-9 and 17-10 (Site No. 22-406/C). The type and depth of potential obstructions, as inferred from the drilling operations, are described in the Foundation Investigation Report (Part A of this report). It is recommended that a Notice to Contractor be included in the Contract Documents to alert the Contractor of the possible presence of obstructions within the fill and native soils; an example Notice to Contractor is provided in Appendix C.

7.0 CLOSURE

This Foundation Design Report was prepared by Mr. Carter Comish, E.I.T. and reviewed by Ms. Nikol Kochmanová, P.Eng. Mr. Kevin J. Bentley, P.Eng., an Associate and MTO Foundations Designated Contact of Golder, conducted an independent technical and quality control review of this report.

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REFERENCES

Canadian Standards Association, 2014. Canadian Highway Bridge Design Code (CHBDC) and Commentary on CAN/CSA-S6-14. CSA Group.

Chapman, L.J. and Putnam, D. F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

ASTM International

ASTM D1586Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils

ASTM D2573 Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils

Ontario Provincial Standard Specifications (OPSS) and Drawings (OPSD)

OPSS.PROV 517	Construction Specification for Dewatering
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSD 219.260	Turbidity Curtain
OPSD 3090.101	Foundation Frost Penetration Depths for Southern Ontario

Special Provision (SP)

SP517F01	Temporary Flow Passage System

Ontario Water Resources Act

Ontario Regulation 903/90 Wells: O. Reg. 468/10 Amendment to Ontario Regulation 903

Ontario Occupational Health and Safety Act

Ontario Regulation 213 (Construction Projects)

MINISTRY OF TRANSPORTATION, ONTARIO

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

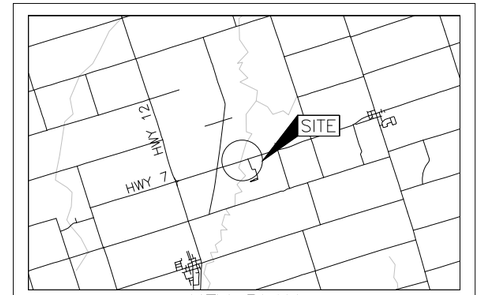
CONT No.
GWP No. 2436-15-00

TEMPORARY COFFERDAMS
HWY 7 – BEAVER RIVER CULVERT

BOREHOLE LOCATIONS PLAN

SHEET

GOLDER



KEY PLAN
SCALE
2 0 2 4 km

PLAN
SCALE
10 0 10 20 m

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
17-1	259.2	4906149.4	341067.3
17-2	259.9	4906133.1	341106.6

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.

REFERENCE
Base plans provided in digital format by Parsons, drawing file nos. ACAD-35-7.dwg and Highway7-Baseplan.dwg, received February 27, 2018.

LICENSED PROFESSIONAL ENGINEER
N. KOCHMAN
100117863
Mar. 01, 2019
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 01, 2019
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-721

HWY. 7		PROJECT NO. 1782177	DIST. .
SUBM'D. CC	CHKD. NK	DATE: 03/01/2019	SITE: 22-189/C
DRAWN: DD	CHKD. NK	APPD. KJB	DWG. 1

PLOT DATE: March 1, 2019
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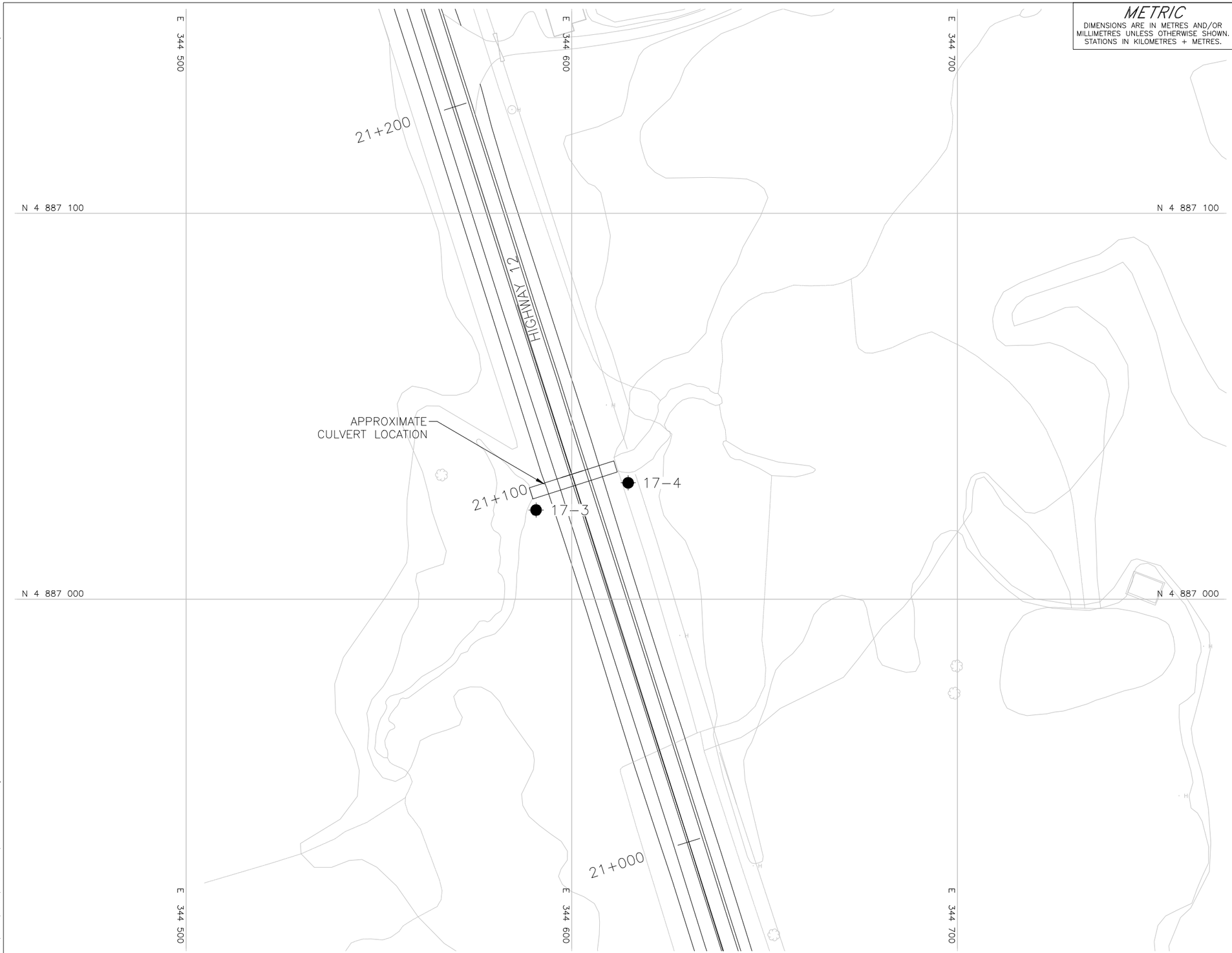
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN
SCALE
10 0 10 20 m

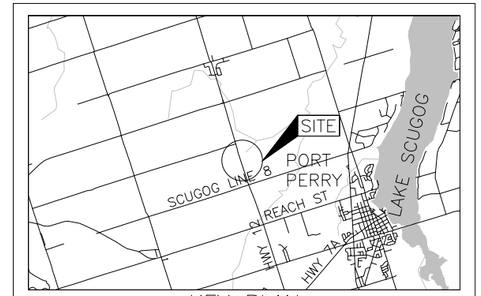
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2436-15-00

TEMPORARY COFFERDAMS
HWY 7/12 – NORTH OF SCUGOG LINE 8 CULVERT
BOREHOLE LOCATIONS PLAN

SHEET

GOLDER



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
17-3	253.6	4887023.1	344590.7
17-4	253.7	4887030.1	344614.6

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.

REFERENCE

Base plans provided in digital format by Parsons, drawing file nos. ACAD-34-12.dwg and Highway12-Baseplan.dwg, received February 27, 2018.

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-721

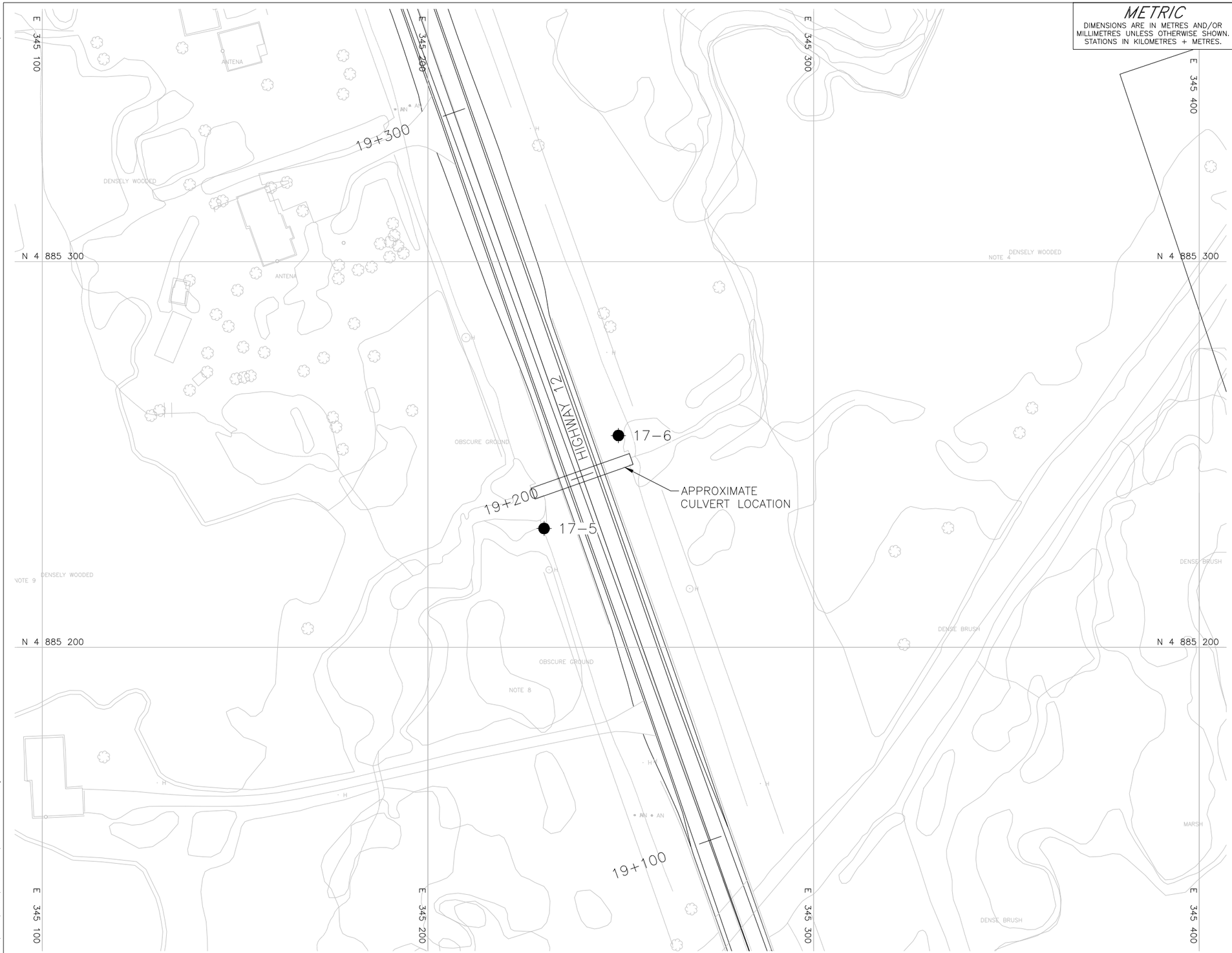
HWY. 7/12		PROJECT NO. 1782177	DIST. .
SUBM'D. CC	CHKD. NK	DATE: 03/01/2019	SITE: 22-409/C
DRAWN: DD/SW	CHKD. NK	APPD. KJB	DWG. 2

LICENSED PROFESSIONAL ENGINEER
N. KOCHMAN
100117863
Mar. 01, 2019
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 01, 2019
PROVINCE OF ONTARIO

PLOT DATE: March 1, 2019
FILENAME: S:\Clients\MTO\Hwy_7\99_PROJ\1782177\40_PROD\0008_TPS_Various\1782177-0008-BC-0002.dwg

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN
SCALE
10 0 10 20 m

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

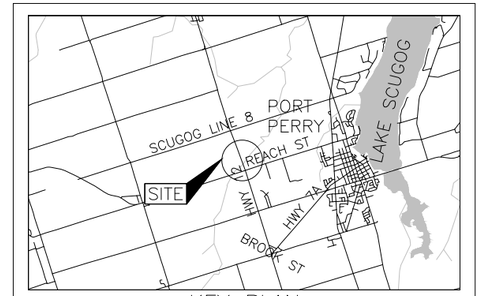
CONT No.
GWP No. 2436-15-00

SHEET

TEMPORARY COFFERDAMS
HWY 7/12 – NORTH OF REACH STREET CULVERT

BOREHOLE LOCATIONS PLAN

GOLDER



KEY PLAN
SCALE
2 0 2 4 km

LEGEND
● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
17-5	252.8	4885230.8	345230.1
17-6	252.9	4885254.9	345249.4

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

REFERENCE
Base plans provided in digital format by Parsons, drawing file nos. ACAD-34-12.dwg and Highway12-Baseplan.dwg, received February 27, 2018.

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100117863
Mar. 01, 2019
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 01, 2019
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-721

HWY. 7/12	PROJECT NO. 1782177		DIST. .
SUBM'D. CC	CHKD. NK	DATE: 03/01/2019	SITE: 22-407/C
DRAWN: DD/SW	CHKD. NK	APPD. KJB	DWG. 3

PLOT DATE: March 1, 2019
FILENAME: S:\Clients\MTO\Hwy_7\99_PROJ\1782177\40_PROD\0008_TPS_Various\1782177-0008-BD-0003.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

PLAN
SCALE
10 0 10 20 m

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

CONT No.
GWP No. 2436–15–00

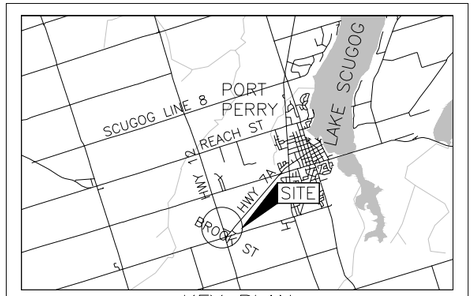
N

SHEET

TEMPORARY COFFERDAMS
HWY 7/12 – NORTH OF HIGHWAY 7A CULVERT

BOREHOLE LOCATIONS PLAN

GOLDER



KEY PLAN
SCALE
2 0 2 4 km

LEGEND
● Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
17–7	271.4	4882516.5	346105.3
17–8	272.0	4882523.9	346133.0

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.

REFERENCE
Base plans provided in digital format by Parsons, drawing file nos. ACAD–34–12.dwg and Highway12–Baseplan.dwg, received February 27, 2018.

LICENSED PROFESSIONAL ENGINEER
N. KOCHMAN
100117863
Mar. 01, 2019
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 01, 2019
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D–721

HWY. 7/12		PROJECT NO. 1782177	DIST. .
SUBM'D. CC	CHKD. NK	DATE: 03/01/2019	SITE: 22–82/C
DRAWN: DD/SW	CHKD. NK	APPD. KJB	DWG. 4

PLOT DATE: March 1, 2019
FILENAME: S:\Clients\MTO\Hwy_7\99_PRO\1782177\05_PROD\0008_TPS_Horizon\1782177–0008–BS–0004.dwg

MINISTRY OF TRANSPORTATION, ONTARIO

PLAN
SCALE
10 0 10 20 m

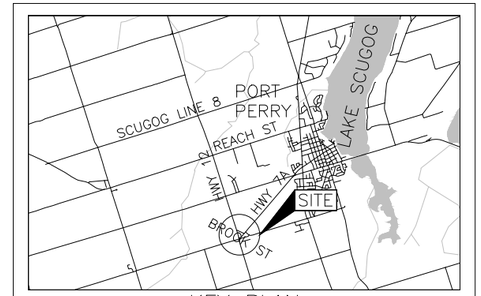
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2436-15-00

SHEET

TEMPORARY COFFERDAMS
HWY 7/12 – BROOK STREET CULVERT
BOREHOLE LOCATIONS PLAN

GOLDER



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

Borehole – Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
17-9	272.1	4882420.0	346165.6
17-10	271.4	4882392.3	346179.9

NOTES

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

REFERENCE

Base plans provided in digital format by Parsons, drawing file nos. ACAD-34-12.dwg and Highway12-Baseplan.dwg, received February 27, 2018.

LICENSED PROFESSIONAL ENGINEER
N. KOCHMAN
100117863
Mar. 01, 2019
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
K. J. BENTLEY
Mar. 01, 2019
PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31D-721

HWY. 7/12		PROJECT NO. 1782177	DIST. .
SUBM'D. CC	CHKD. NK	DATE: 03/01/2019	SITE: 22-406/C
DRAWN: DD/SW	CHKD. NK	APPD. KJB	DWG. 5

PLOT DATE: March 1, 2019
FILENAME: S:\Clients\MTO\Hwy_7\9b_PROJ\1782177\4D_PROD\0006_TPS_Vankoh\1782177-0006-BD-0005.dwg

APPENDIX A

Borehole Records

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

2 shear strength = (compressive strength)/2

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, 60º cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

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

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

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

(b) Cohesive Soils

Consistency

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

IV. SOIL TESTS

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

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

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

GOLDER

RECORD OF BOREHOLE No 17-1

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00 LOCATION N 4906149.4; E 341067.3 MTM NAD 83 ZONE 10 (LAT. 44.294453; LONG. -79.045529) ORIGINATED BY LK

DIST Central HWY 7A BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig COMPILED BY CC

DATUM Geodetic DATE September 11 and 12, 2018 CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.2	GROUND SURFACE						259				
0.0 / 258.7	Sandy silt, contains organics (FILL) Dark brown to grey Moist										
0.5	PEAT, some gravel, some sand, trace to some clay Very loose to loose Grey Wet		1	SS	2		258				
			2	SS	8				○	O.C. = 3.1%	
			3	SS	3		257				
255.8			4A 4B	SS	3		256				
3.4	Silty SAND, some peat, trace to some gravel, trace to some clay Very loose to dense Grey Wet		5	SS	32		255		○		8 56 30 6
254.7											
4.5	CLAYEY SILT, trace to some sand, trace gravel Firm to very stiff Grey Moist to wet below 7.6m		6	SS	18		254				
			7	SS	12		253		○		2 10 37 51
			8	SS	18		252				
			9	SS	4		251		○		
248.8							250	+ 1.2			
10.4	SILT and SAND, trace clay Very dense Grey Wet		10	SS	60		249		>143.6 kPa		
247.9									○		0 40 57 3
11.3	END OF BOREHOLE						248				

Note:

1. Water level measured at ground surface upon completion of drilling.

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

GOLDER

RECORD OF BOREHOLE No 17-2

SHEET 1 OF 1 **METRIC**

PROJECT 1782177(4000)
G.W.P. 2436-15-00
DIST Central HWY 7A
DATUM Geodetic

LOCATION N 4906133.1; E 341106.6 MTM NAD 83 ZONE 10 (LAT. 44.294305; LONG. -79.045038)
BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig
DATE September 13, 2018

ORIGINATED BY LK
COMPILED BY CC
CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.9	GROUND SURFACE										
0.0	Sand and gravel, some rootlets (FILL) Loose Brown/Grey Moist		1	SS	6		259				
258.5											
1.4	Gravelly Silty SAND to Silty SAND and GRAVEL, trace clay Loose to compact Light grey to dark grey Wet - Augers grinding on inferred cobbles at 1.4 m		2	SS	8		258				
			3	SS	17						30 42 25 3
			4	SS	21		257				
255.6			5A 5B	SS	11		256				
4.3	Sandy SILTY CLAY Stiff to very stiff Light grey Wet		6A 6B	SS	26		255				
254.3											
5.6	CLAYEY SILT, trace gravel, trace sand, contains some silt interbeds Stiff to hard Grey Moist to wet		7	SS	32		254				
			8	SS	12		253				1 1 72 26
							252		>143.6 kPa		
250.2			9	SS	11		251				
9.8	END OF BOREHOLE Notes: 1. Water level measured at ground surface on completion of drilling.										

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

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GOLDER

RECORD OF BOREHOLE No 17-3

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4887023.1; E 344590.7 MTM NAD 83 ZONE 10 (LAT. 44.122130; LONG. -79.002827)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 18 and 19, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
253.6	GROUND SURFACE										
0.0	Sandy PEAT, some silt, trace gravel, trace clay, contains wood fragments, rootlets and topsoil Very loose Black Wet - 0.3 m sand layer encountered at a depth of 0.6 m.		1	SS	1	▽	253				
			2	SS	1						
			3	SS	3		252		290.4	OC=45.4%	3 69 26 2
			4	SS	2				243.9		
			5	SS	2		251		209.7		
250.2			6A 6B	SS	15						
3.4	SAND, trace to some silt, trace clay, trace gravel Compact to dense Grey Wet		7	SS	20		250				1 91 6 2
			8	SS	31		249				
							248				
			9	SS	14		247				
246.4											
7.2	CLAYEY SILT, some sand, trace gravel Stiff Grey Moist to wet		10	SS	11		246				3 14 45 38
							245				
243.9			11	SS	11		244				
9.8	END OF BOREHOLE Notes: 1. Borehole caved to 4.7 m upon removal of casing. 2. Water level not measured in borehole due to use of drilling mud. 3. Approximate water level in borehole at a depth of 0.2 m (Elev. 253.4 m) upon completion of drilling.										

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

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

GOLDER

RECORD OF BOREHOLE No 17-4

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4887030.1; E 344614.6 MTM NAD 83 ZONE 10 (LAT. 44.122192; LONG. -79.002528)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 17, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
253.7	GROUND SURFACE										
0.0	Organic Silty SAND Very loose to loose Black Wet		1	SS	1	▽	253				
			2	SS	2						
			3	SS	2		252				
251.4			4A 4B	SS	10						
2.3	SAND, some silt to SAND and SILT, trace clay Compact to dense Grey Wet - Clayey silt pockets at a depth of 4.5 m to 4.9 m		5	SS	44		251				
			6	SS	37						0 87 11 2
			7	SS	47		250				
			8	SS	48		249				0 58 38 4
							248				
247.0			9	SS	28						
6.7	END OF BOREHOLE START OF DCPT						247				
							246				
							245				
243.0							244				
10.7	END OF DCPT										

Notes:

1. Borehole caved to 3.4 m upon removal of casing.
2. Water level not measured in borehole due to use of drilling mud.
3. Approximate water level in borehole at a depth of 0.2 m (Elev. 253.5 m) upon completion of drilling.
4. A Dynamic Cone Penetration Test (DCPT) was conducted from 6.1 m to 10.7 m following casing refusal.

131.5 ○ OC=16.6%

345.2 ○

○ WATER CONTENT

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

○ $^{3\%}$ STRAIN AT FAILURE

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GOLDER

RECORD OF BOREHOLE No 17-5

SHEET 1 OF 2

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4885230.8; E 345230.1 MTM NAD 83 ZONE 10 (LAT. 44.105964; LONG. -78.994976)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 22, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
252.8	GROUND SURFACE						
0.0	TOPSOIL and PEAT (243 mm)		1A	SS	2	▽	
0.2	Silty sand, some gravel, trace clay (FILL) Loose Grey Wet		1B				
251.6			2	SS	1		19 52 24 5
251.3	Sandy silty peat (FILL) Very loose Black Wet		3A	SS	3		
1.5	Clayey silt, trace sand, trace gravel (FILL) Firm to stiff Grey Wet		3B				
249.7			4A	SS	4		
3.1	Sand, trace silt (FILL) Compact Grey Wet		4B				
249.0			5	SS	18		
3.8	- Gravel at 3.6 m depth		6A	SS	17		
	CLAYEY SILT Firm to very stiff Grey Moist		6B				
			7	SS	17		0 0 63 37
			8	SS	7		
			9	TO	PM		
			10	SS	5		0 0 60 40
242.7							
10.1	END OF BOREHOLE START OF DCPT						
239.4							
13.4	END OF DCPT						

ELEVATION SCALE: 252, 251, 250, 249, 248, 247, 246, 245, 244, 243

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

2.3

2.8

2.2

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

WATER CONTENT (%): 10 20 30

93 OC=12.6%

UNIT WEIGHT γ kN/m³

GTA-MTO 001 S:\CLIENTS\MTO\HWY_7\02_DATA\GINT\HWY_7.GPJ GAL-GTA.GDT 19-2-15

Continued Next Page

+3, ×3: Numbers refer to Sensitivity

○3% STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 17-5

SHEET 2 OF 2 **METRIC**

PROJECT 1782177(4000)
G.W.P. 2436-15-00
LOCATION N 4885230.8; E 345230.1 MTM NAD 83 ZONE 10 (LAT. 44.105964; LONG. -78.994976)
ORIGINATED BY LK
DIST Central HWY 7A
BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig
COMPILED BY CC
DATUM Geodetic
DATE October 22, 2018
CHECKED BY NK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---										
	Notes: 1. Water level not measured in borehole due to use of drilling mud. 2. Approximate water level in borehole at a depth of 0.2 m (Elev. 252.6 m) upon completion of drilling. 3. A Dynamic Cone Penetration Test (DCPT) was conducted from 10.1 m to 13.4 m following casing refusal.										

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

GOLDER

RECORD OF BOREHOLE No 17-6

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4885254.9; E 345249.4 MTM NAD 83 ZONE 10 (LAT. 44.106179; LONG. -78.994734)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 23 and 24, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
252.9	GROUND SURFACE								
0.0	TOPSOIL and PEAT (243 mm)		1A	SS	3	▽			
0.2	Silty sand, some gravel, trace to some clay (FILL) Very loose to compact Brown Wet		1B				252		
			2	SS	23				17 51 23 9
251.7									
1.2	Sand, some silt, trace to some gravel, trace to some clay (FILL) Loose to compact Grey Wet		3	SS	15				9 71 15 5
			4	SS	7		251		
			5	SS	3				
249.7							250		
3.2	CLAYEY SILT to SILTY CLAY, trace to some sand, trace gravel Firm to hard Grey Moist to wet below 7.6 m		6A 6B	SS	9				2 13 55 30
			7	SS	36		249		
			8	SS	16				
							248		
							247		
			9	TO	PM				0 1 39 60
							246		
			10	SS	9		245		
							244		
			11	SS	5				
			12	SS	5		243		
242.5									
10.4	END OF BOREHOLE								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

WATER CONTENT (%): 10 20 30

3.0

2.0

1.3

1.2

Notes:

1. Water level not measured in borehole due to use of drilling mud.

2. Approximate water level in borehole at a depth of 0.2 m (Elev. 252.7 m) upon completion of drilling.

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

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

GTA-MTO 001 S:\CLIENTS\MTO\HWY_7\02_DATA\GINT\HWY_7.GPJ GAL-GTA.GDT 19-2-15

GOLDER

RECORD OF BOREHOLE No 17-7

SHEET 1 OF 1 **METRIC**

PROJECT 1782177(4000)
G.W.P. 2436-15-00
DIST Central HWY 7A
DATUM Geodetic

LOCATION N 4882516.5; E 346105.3 MTM NAD 83 ZONE 10 (LAT. 44.081485; LONG. -78.984257)
BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig
DATE October 9, 2018

ORIGINATED BY LK
COMPILED BY CC
CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.4	GROUND SURFACE										
0.0	TOPSOIL (243 mm)										
0.2	Sandy clayey silt, trace to some gravel (FILL) Soft to hard Grey/brown Moist		1A 1B	SS	4		271		○ at 30		
			2A 2B	SS	7	▽			○ at 30		
270.0	- Organics, rootlets from 0.2 m to 1.0 m		3A 3B	SS	66		270		○ at 10; H at 20		19 40 33 8
1.4	SILT and SAND, some gravel to Sandy GRAVEL, trace to some clay Very dense Brown Moist		4	SS	135						
			5	SS	40/0.05		269		○ at 10		63 20 14 3
			6	SS	85/0.15						
			7	SS	110/0.05		268		○ at 10; H at 20		
			8	SS	100/0.13		267		○ at 10		
266.4			9	SS	100/0.08						
5.0	END OF BOREHOLE										

Notes:

1. Water level not measured in borehole due to use of drilling mud.

2. Approximate water level in borehole at a depth of 0.9 m (Elev. 270.5 m) during drilling operations.

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

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

GOLDER

RECORD OF BOREHOLE No 17-8

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4882523.9; E 346133.0 MTM NAD 83 ZONE 10 (LAT. 44.081550; LONG. -78.983911)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 10, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.0	GROUND SURFACE										
0.0	TOPSOIL (427 mm)		1A	SS	10						
271.6			1B								
0.4	SILT and SAND to Silty SAND, trace gravel to gravelly, trace to some clay Compact to very dense Grey/brown Moist to wet below 4.0 m		2	SS	41		271				
			3	SS	76	▽			○ H		10 43 39 8
			4	SS	133/0.18		270				
			5	SS	100/0.15				○		
			6	SS	100/0.13		269				
			7	SS	100/0.13				○ H		
			8	SS	60/0.05		268		○		28 36 30 6
			9	SS	100/0.13		267				
266.4			10	SS	100/0.13				○		7 44 44 5
5.6	END OF BOREHOLE										

Notes:

1. Water level not measured in borehole due to use of drilling mud.

2. Approximate water level in borehole at a depth of 1.7 m (Elev. 270.3 m) during drilling operations.

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

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

GOLDER

RECORD OF BOREHOLE No 17-9

SHEET 1 OF 1 **METRIC**

PROJECT 1782177(4000)

G.W.P. 2436-15-00 LOCATION N 4882420.0; E 346165.6 MTM NAD 83 ZONE 10 (LAT. 44.080613; LONG. -78.983511) ORIGINATED BY LK

DIST Central HWY 7A BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig COMPILED BY CC

DATUM Geodetic DATE October 11 and 12, 2018 CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.1	GROUND SURFACE						272				
0.0	TOPSOIL and Organic Silty SAND		1	SS	1				○	OC=5.5%	
270.9			2A 2B 2C	SS	3		271		○	OC=4.6%	
1.2	Sandy CLAYEY SILT, trace gravel Hard Brown/grey Moist to wet		3	SS	59	▽			○—⊢		8 27 50 15
269.7			4	SS	81		270		○		
2.4	SILT and SAND, trace to some gravel, trace to some clay Very dense Grey Moist		5	SS	120				○ H		7 46 38 9
268.4			6	SS	100/0.08		269				
268.1	SAND and GRAVEL, trace silt Very dense		7	SS	100/0.15				○		
4.0	Grey/brown Wet		8	SS	100/0.13		268		○		
	CLAYEY SILT with SAND, some gravel Hard Grey Moist										
266.5			9	SS	100/0.10		267				
5.6	END OF BOREHOLE										

Notes:

1. Water level not measured in borehole due to use of drilling mud.

2. Approximate water level in borehole at a depth of 1.5 m (Elev. 270.6 m) during drilling operations.

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

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GOLDER

RECORD OF BOREHOLE No 17-10

SHEET 1 OF 1

METRIC

PROJECT 1782177(4000)

G.W.P. 2436-15-00

LOCATION N 4882392.3; E 346179.9 MTM NAD 83 ZONE 10 (LAT. 44.080363; LONG. -78.983335)

ORIGINATED BY LK

DIST Central HWY 7A

BOREHOLE TYPE 75 mm O.D. BW Casing, Portable Tripod Rig

COMPILED BY CC

DATUM Geodetic

DATE October 10, 2018

CHECKED BY NK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.4	GROUND SURFACE										
0.0 / 271.0	TOPSOIL (390 mm)		1A, 1B	SS	1	▽	271				
0.4 / 270.2	SILT, some clay to CLAYEY SILT, trace sand, trace gravel Stiff Mottled light grey Wet		2	SS	11				⊢○⊣		2 4 86 8
1.2	Sandy CLAYEY SILT, some gravel Hard Light grey and brown Moist		3A, 3B	SS	146		270		○		
			4	SS	100/0.13						
268.4			5	SS	130		269		○		
3.0	SAND, some silt, some gravel, trace clay Compact to very dense Brown Moist		6	SS	104		268		○		15 67 16 2
267.1			7	SS	17						
4.3	Silty SAND and GRAVEL, trace clay, contains trace cobbles Very dense Brown Moist		8	SS	85		267		○		37 35 25 3
	- 100 mm cobble cored at a depth of 6.1 m		9	SS	100/0.10		266				
			10	SS	100/0.08		265				
263.7			11	SS	100/0.08		264				
7.7	END OF BOREHOLE										

Notes:

1. Water level not measured in borehole due to use of drilling mud.

2. Approximate water level in borehole at a depth of 0.2 m (Elev. 271.2 m) during drilling operations.

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

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

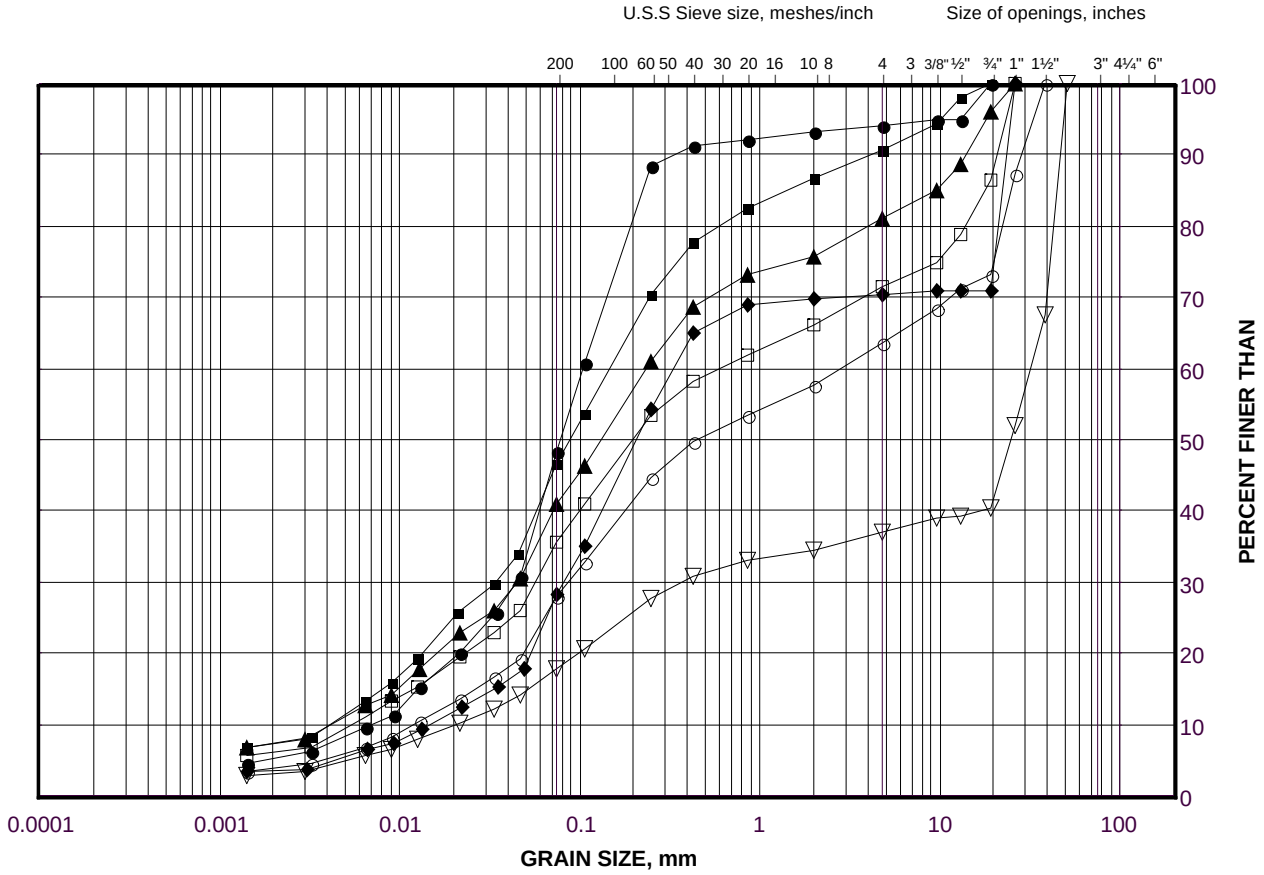
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy Gravel to Silt and Sand

FIGURE B1



LEGEND

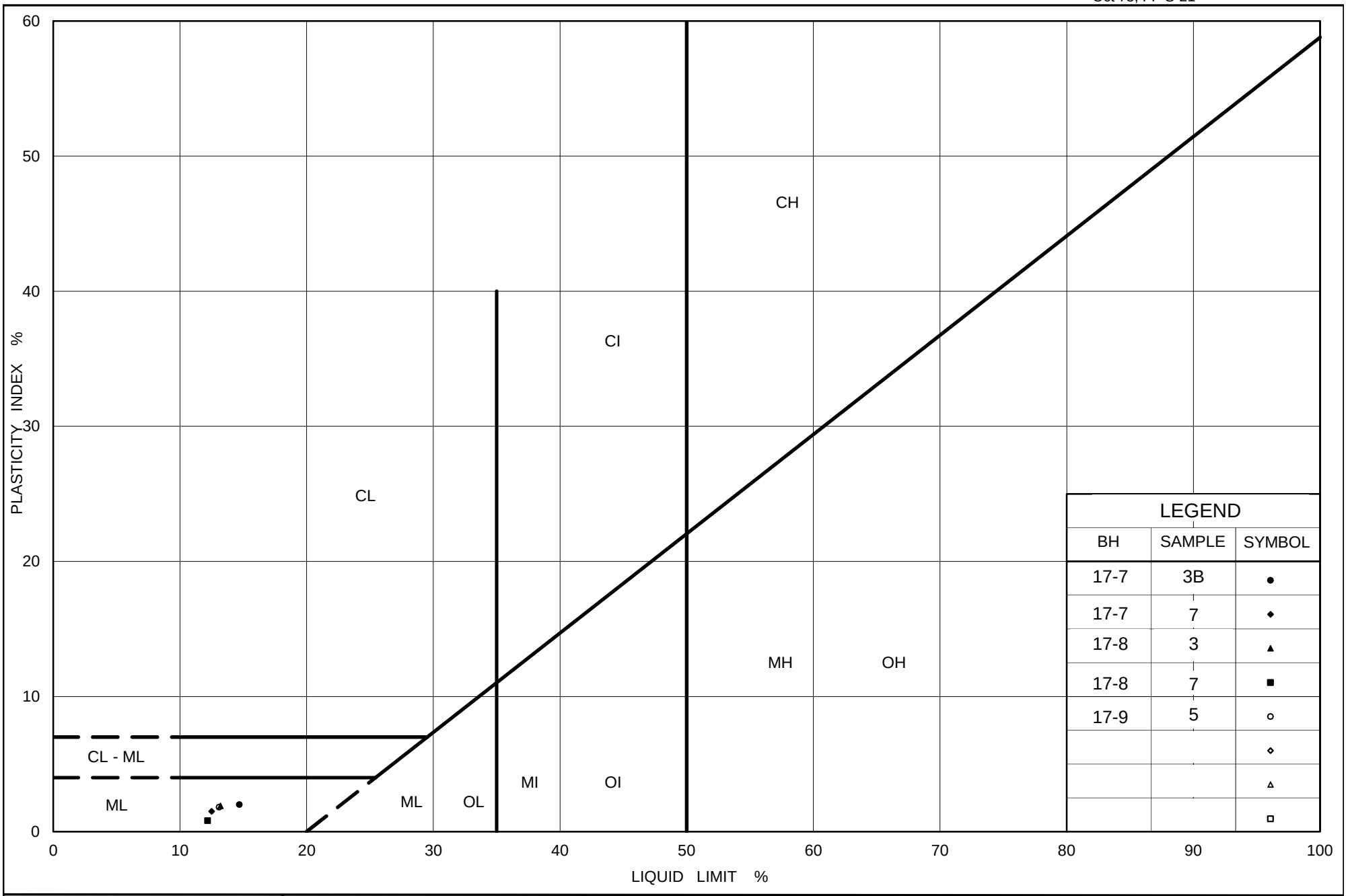
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-8	10	266.6
■	17-8	3	270.5
◆	17-2	3	257.3
▲	17-7	3B	269.8
▽	17-7	5	268.9
❍	17-10	8	266.8
□	17-8	8	267.7

Project Number: 1782177

Checked By: KJB

Golder Associates

Date: 15-Feb-19



Ministry of Transportation

Ontario

PLASTICITY CHART

Gravelly Sand to Silt and Sand

Figure No. B2

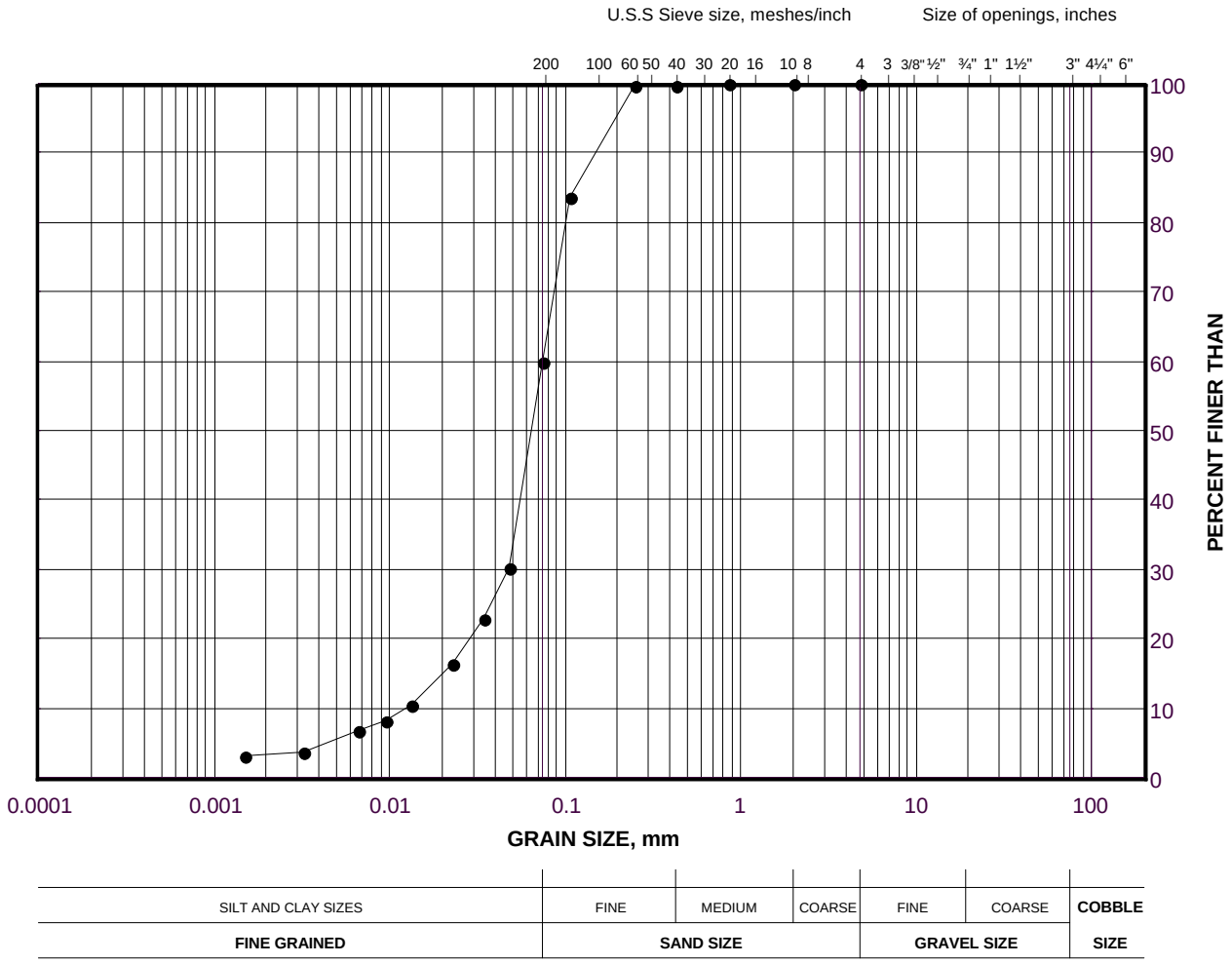
Project No. 1782177

Checked By: KJB

GRAIN SIZE DISTRIBUTION

Silt and Sand

FIGURE B3



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-1	10	249.3

Project Number: 1782177

Checked By: KJB

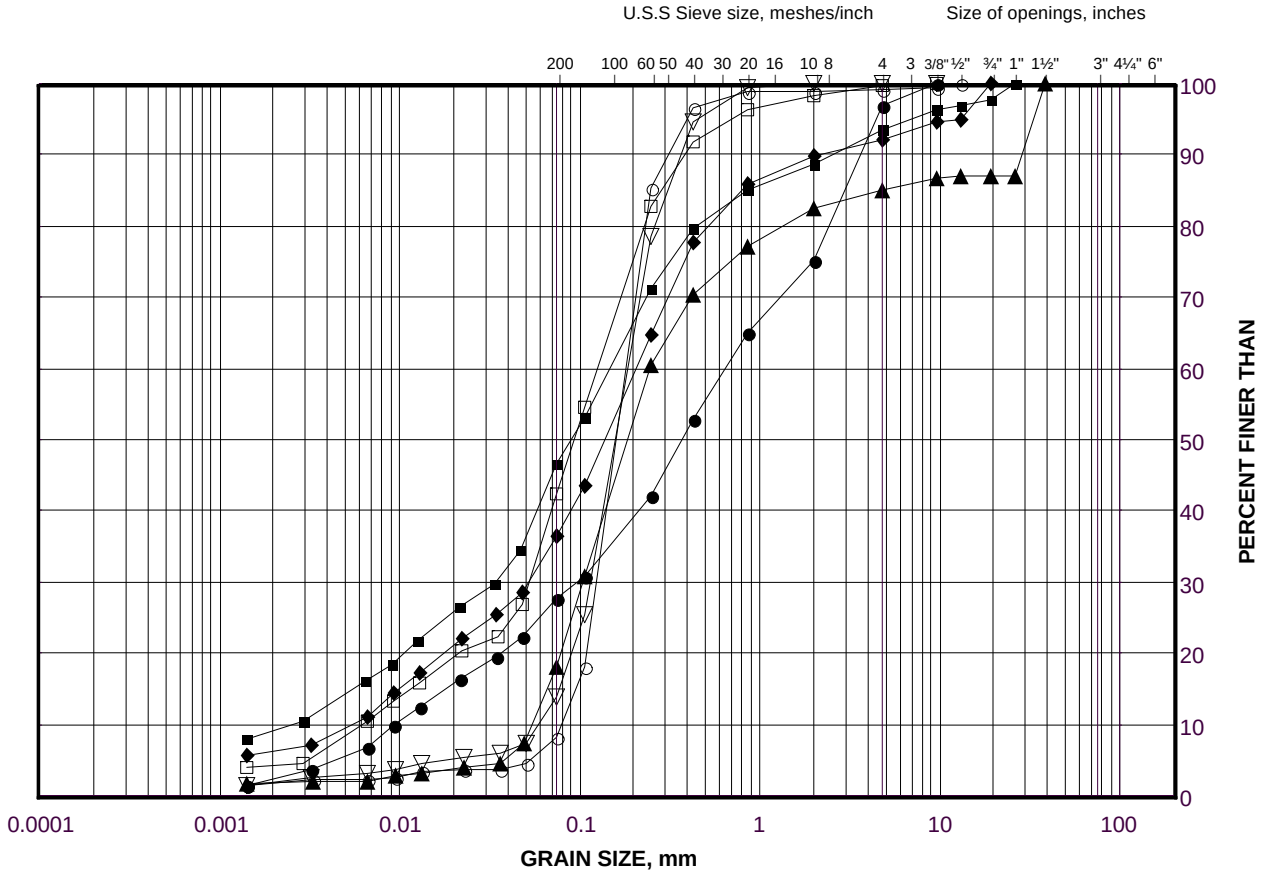
Golder Associates

Date: 15-Feb-19

GRAIN SIZE DISTRIBUTION

Sand, Sandy Peat, Silt and Sand

FIGURE B4



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-3	3+4	252.0
■	17-9	5	269.4
◆	17-1	5	255.1
▲	17-10	6	268.0
▽	17-4	6	250.3
❍	17-3	7	249.6
□	17-4	8	249.1

Project Number: 1782177

Checked By: KJB

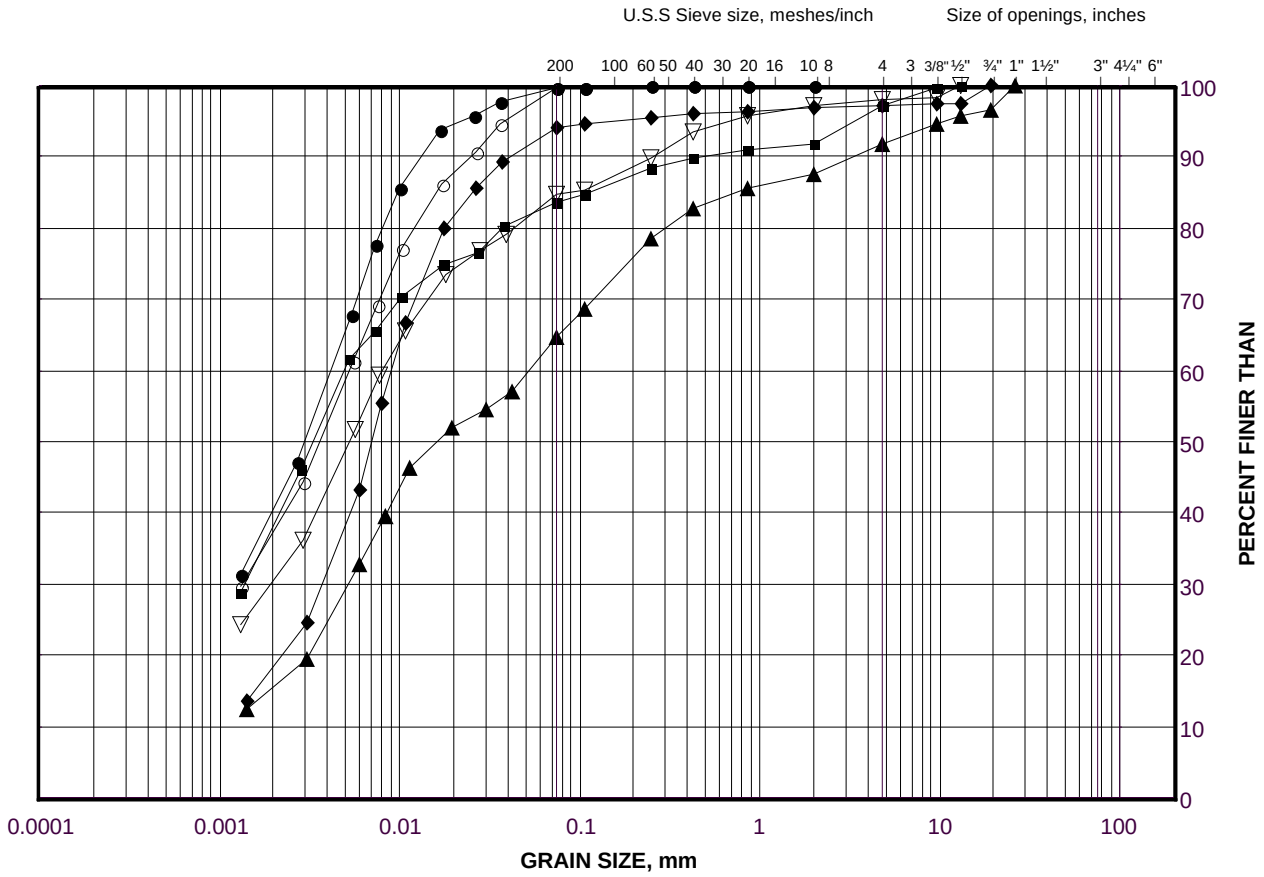
Golder Associates

Date: 15-Feb-19

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE B5A



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-5	10	243.4
■	17-3	10	245.6
◆	17-10	2	270.5
▲	17-9	3	270.6
▽	17-6	6B	249.4
❍	17-5	7	248.3

Project Number: 1782177

Checked By: KJB

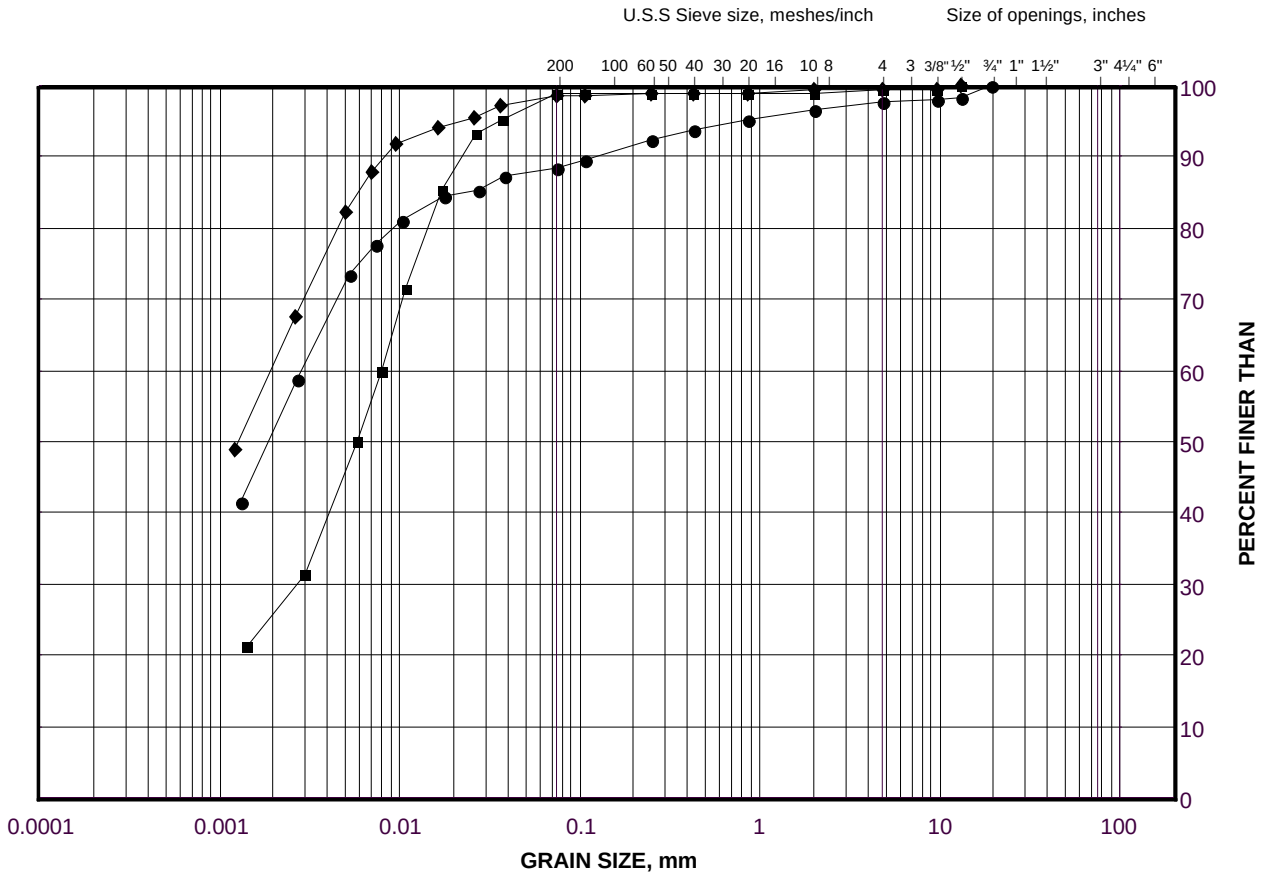
Golder Associates

Date: 15-Feb-19

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE B5B



LEGEND

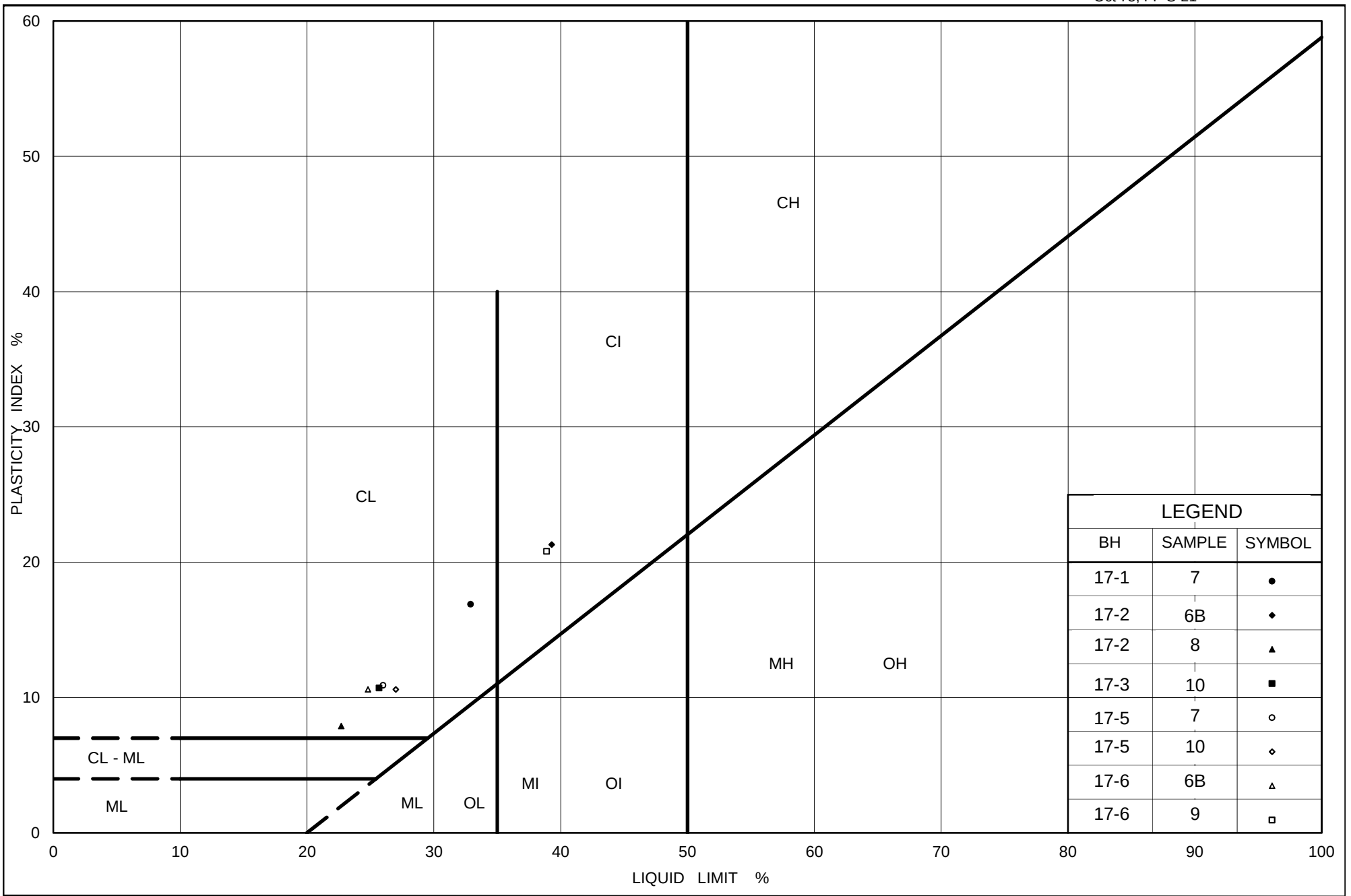
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-1	7	252.9
■	17-2	8	252.0
◆	17-6	9	246.5

Project Number: 1782177

Checked By: KJB

Golder Associates

Date: 15-Feb-19



Ministry of Transportation

Ontario

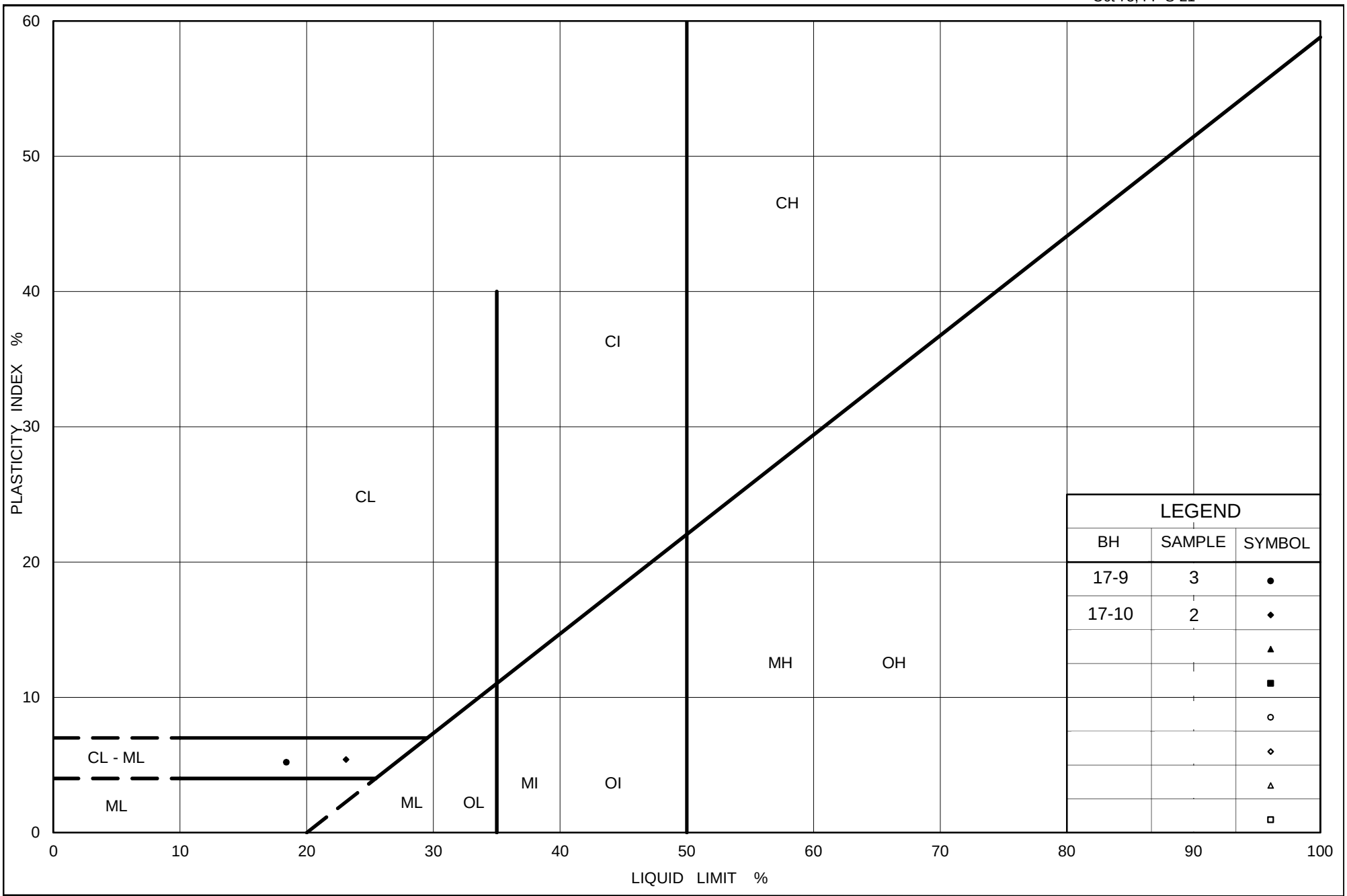
PLASTICITY CHART

Clayey Silt to Silty Clay

Figure No. B6A

Project No. 1782177

Checked By: KJB



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt to Silty Clay

Figure No. B6A

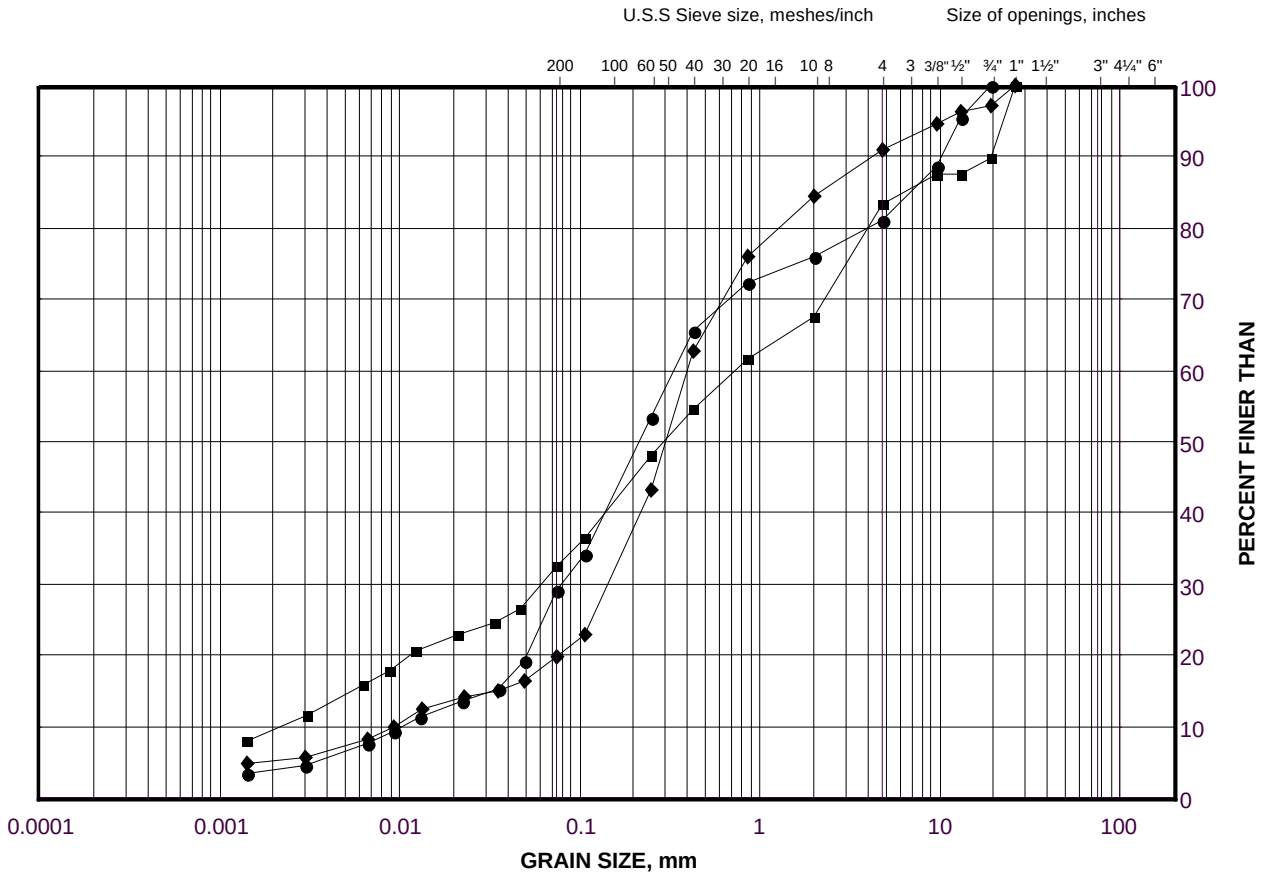
Project No. 1782177

Checked By: KJB

GRAIN SIZE DISTRIBUTION

Sand to Silty Sand (Fill)

FIGURE B7



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-5	2	251.9
■	17-6	2	252.0
◆	17-6	3	251.4

Project Number: 1782177

Checked By: KJB

Golder Associates

Date: 15-Feb-19

APPENDIX C

Non-Standard Special Provisions

PROTECTION SYSTEM – Item No.

Special Provision

Amendment to OPSS 539, November 2014

593.07.02 Removal of Protection Systems

Subsection 539.07.02 of OPSS 539 is deleted in its entirety and replaced with the following:

Protection systems shall be removed from the right-of-way unless it is specified in the Contract Documents that the protection system may be left in place.

Where piles are left in place, the top shall be removed to at least 1.5 m below the finished grade or ground level or at least 0.6 m below the streambed.

The method and sequence of removal shall be such that there shall be no damage to the new work, existing work, and facility being protected.

All disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

NOTES TO DESIGNER:

- When the protection system is to be left in place after construction, indicate in the Contract Drawings "To be Left in Place".

Warrant: Always with the above tender item.

DEWATERING SYSTEM - Item No.
TEMPORARY FLOW PASSAGE SYSTEM - Item No.

Special Provision No. 517F01 July 2017

Amendment to OPSS 517, November 2016

Design Storm Return Period and Preconstruction Survey Distance

517.01 SCOPE

Section 517.01 of OPSS 517 is deleted in its entirety and replaced with the following:

This specification covers the requirements for the design, operation, and removal of a dewatering or temporary flow passage system or both to control water during construction, and the control of the water prior to discharge to the natural environment and sewer systems.

As part of the work under this item, the Contractor shall:
- Carry out any additional field investigation the Contractor deems necessary in order to engineer the dewatering systems;
- Design and install dewatering systems to construct the Works in the dry;
- Modify dewatering systems to suit construction staging;
- Remove the dewatering systems in its entirety.

517.04 DESIGN AND SUBMISSION REQUIREMENTS

517.04.01 Design Requirements

Subsection 517.04.01 of OPSS 517 is amended by deleting the first paragraph in its entirety and replacing it with the following:

A dewatering or temporary flow passage system or both shall be designed to control water at the locations specified in the Contract Documents and at any other location where a system is necessary to complete the work. The design of the system shall be sufficient to permit the work at each location to be carried out as specified in the Contract Documents.

Subsection 517.04.01 of OPSS 517 is further amended by deleting the second last paragraph in its entirety and replacing it with the following:

Temporary flow passage systems shall be designed, as a minimum, for a 2 year design storm return period and groundwater discharge, except for the work specified in Table A. For the work specified in Table A, the temporary flow passage system shall be designed, as a minimum, for the design storm return period specified in Table A and groundwater discharge. A longer return period shall be used when determined appropriate for the work.

Intensity-Duration Factor (IDF) curve location, site specific minimum return period, return period flow estimates, and other information is provided in Table A. The IDF information can be accessed through the MTO IDF Curve Look up Tool on the Drainage and Hydrology page of MTO's website. The return period flow estimates do not include flow volumes from groundwater discharge. The Owner specifically excludes

these flow estimates from the warranty in the Reliance on Contract Documents subsection of OPSS 100, MTO General Conditions of Contract.

Table A

IDF Curve Location	Latitude: 44.104167			Longitude: -78.929167	
Temporary Flow Passage Systems					
Site Name / Station Reference	Minimum Return Period (Years)	Return Period Flow Estimates (m^3/s)			Design Engineer Requirements (Note 1)
		2 Year	5 Year	10 Year	25 Year	
Site 22-189/C (Beaver River Culvert) Geographic Township of Brock	2	6.58	13.81	18.43	24.01	N/A
Site 22-406/C (Brook St. Culvert) Geographic Township of Reach	2	3.12	6.12	7.92	10.01	N/A
Site 22-82/C (North of Hwy 7A Culvert) Geographic Township of Reach	2	3.12	6.12	7.92	10.01	N/A
Site 22-407/C (North of Reach St Culvert) Geographic Township of Reach	2	0.95	1.26	1.46	2.01	N/A
Site 22-409/C (North of Scugog Line 8 Culvert) Geographic Township of Reach	2	1.20	2.54	3.41	4.45	N/A
CV-0034-007A-0001 (Manchester Culvert) Geographic Township of Reach	2	2.94	5.83	7.57	9.60	N/A
CV-0034-007A-0004 & CV-0836-007A-0001 (Causeway culverts) Geographic Township of Reach & Scugog	2	3.46	7.41	9.96	13.05	N/A
CV-CL-04 Sta 15+256; Geographic Township of Cartwright	2	0.07	0.10	0.12	0.15	N/A
CV-0268-007A-0004 Sta 16+121; Geographic Township of Cartwright	2	0.98	1.89	2.45	3.11	N/A
Dewatering Systems						
Site Name / Station Reference	Preconstruction Survey Distance (Note 2) (m)					Design Engineer Requirements (Note 1)
Site 22-189/C (Beaver River Culvert) Geographic Township of Brock	100					Yes
CV-0034-007A-0004 (Single-barrel Causeway culvert) Geographic Township of Reach	200					Yes
CV-0836-007A-0001 (3-barrel Causeway culvert) Geographic Township of Scugog	200					Yes

Note:

1. "Yes" means the design Engineer and design-checking Engineer shall have a minimum of 5 years of experience in designing systems of similar nature and scope to the required work. "No" means a minimum experience level is not required for the design Engineer and design-checking Engineer.
2. "N/A" indicates a preconstruction survey is not required.

517.07 CONSTRUCTION

Section OPSS 517.07 of OPSS 517 is amended by the addition of the following:

All work must be carried out in the dry. The dewatering systems/ sheet piles/cofferdams shall be kept stable during the work.

Minimum dimensions for the inside face of the dewatering system shall be sufficient to suit new work.

The Contractor shall fully remove the dewatering system at the completion of the construction.
Section OPSS 902.07.04 is amended by the addition of the following:

The dewatering system shall be adequate for carrying out the works in the dry conditions.

The Contractor shall reference borehole records as shown elsewhere in the Contract Documents as a guide in determining dewatering requirements.

The work for dewatering shall be completed in accordance with the environmental and operational constraints specified elsewhere in the Contract Documents.

The work under this item shall include un-watering, for the purpose of maintaining base-flow or storm flow and/or carry out construction/rehabilitation work in dry conditions.

Basis of Payment
Payment at the contract price for the dewatering systems shall be full compensation for all labour, equipment and materials to carry out the work.

OBSTRUCTIONS

Notice to Contractor

The Contractor shall be alerted that the fill soils and peat soils at various culvert locations contain variable amounts of organics that indicate the presence of wood fragments and possibly tree branches / logs, especially in Boreholes 17-1 and 17-2 (Site No. 22-189/C), 17-3 (Site No. 22-409/C) and 17-5 (Site No. 22-407/C). Cobbles and gravel zones / pockets were encountered within the fill and native cohesionless soils in Boreholes 17-2 (Site No. 22-189/C), 17-7 and 17-8 (Site No. 22-82/C) and 17-9 and 17-10 (Site No. 22-406/C). The type and depth of potential obstructions, as inferred from the drilling operations, are described in the Foundation Investigation Report.

Consideration of the presence of these obstructions must be made in the selection of appropriate equipment and procedures for any excavations and installation of cofferdam systems and temporary protection / cutoff wall systems.

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