FOUNDATION INVESTIGATION AND DESIGN REPORT

Highway 66, Station 17+903, Township of Gauthier Culvert Replacement
Ministry of Transportation, Ontario
GWP 5210-14-00

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PART A

FOUNDATION INVESTIGATION REPORT
HIGHWAY 66, STA 17+903, TOWNSHIP OF GAUTHIER
CULVERT REPLACEMENT
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5210-14-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services related to the replacement of the gabion basket walls at each end of the culvert on Highway 66 at Station 17+903, in the Township of Gauthier, approximately 6.3 km east of the Highway 66 and Highway 672 intersection. The Key Plan of the general location of this section of Highway 66 and the location of the investigated area are shown on Drawing 1.

The purpose of this investigation is to establish the subsurface conditions at the culvert site for the gabion basket wall replacement by borehole drilling with laboratory testing carried out on selected soil samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated February 2018, and the subsequent clarifications/addenda, which forms part of the Consultant's Assignment Number 5017-E-0039 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 November 2018.

Investigation of the Pavement Distress Area between about Station 17+886 and 17+928, Gauthier Township is provided in Golder Pavement Design Report under Golder Project 1896349.

2.0 SITE DESCRIPTION

It should be noted that the orientation (i.e., north, south, east, west) stated in the text of the report is typically referenced to project north and therefore may differ from magnetic north shown on Drawing 1. For the purpose of this report, Highway 66 is oriented in a west-east direction with the culvert positioned on a skew to the highway generally in a north-south orientation. At the culvert location, the creek flows in a north to south direction.

The existing culvert consists of a 1.9 m wide by 1.2 m high, 40 m long Corrugated Steel Pipe Arch (CSPA), with gabion basket wall around the pipe at the inlet and outlet. The culvert inlet (north end) and outlet (south end) inverts are at approximately Elevations 274.3 m and 273.5 m, respectively. The highway grade at the culvert location is at approximately Elevation 278.5 m and the highway embankment is about 4.2 m and 5.0 m high relative to the culvert invert at the inlet and outlet, respectively. In general, the topography in the vicinity of the culvert is relatively flat, grassy terrain with shrubs and trees. The ground surface conditions at select locations of the culvert area are shown on Photographs 1 to 4.

At the time of the subsurface exploration field work, the embankment side slopes appeared to be grass covered with some local vegetation growing adjacent to the toe of the embankment slopes and exhibit some localized shallow erosion gullies. The gabion basket wall at the toe of the embankment side slope at each end of the culvert shows signs of slight tilting laterally relative to each basket and slight slumping. The highway pavement shows sign of some distress in the form of longitudinal and transverse cracks and appears to be an older section compared to that to the east of the culvert. The embankment appeared to be stable with no signs of slope instability or roadway settlement.

3.0 INVESTIGATION PROCEDURES

Field work for this subsurface exploration was carried out between May 24 to 26, 2019, during which time five boreholes (Boreholes C258-1 to C258-5) were advanced at the approximate locations shown on Drawing 1. Boreholes C258-1 to C258-3 were advanced from the highway grade through the roadway embankment and Boreholes C258-4 and C258-5 were advanced near the north and south toes of the highway embankment slopes adjacent to the culvert inlet and outlet, respectively. The boreholes were advanced using a track mounted CME-55LC drilling rig supplied and operated by George Downing Estate Drilling of Grenville-Sur-La-Rouge, Quebec. Traffic control, where required, was performed in accordance with MTO's Ontario Traffic Control Manual Book 7 – Temporary Conditions.

The boreholes were advanced using NW Casing with wash boring techniques. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using 50 mm outer diameter split-spoon samplers driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586). In-situ vane shear tests were carried out in cohesive soils for determination of undrained shear strengths in accordance with Standard Test Method for Field Vane Shear Test in Saturated Fine Grained Soils (ASTM 2573), using an MTO standard "N"-size vane. The water level inside the NW casing was observed upon completion of drilling operations, but it is noted that water was added into the casing during borehole advancement. The boreholes were backfilled upon completion in accordance with Ontario Regulation 903 (wells) as amended. The boreholes drilled through Highway 66 are capped at the roadway surface using cold patch asphalt.

Field work was supervised on a full-time basis by a member of Golder's technical staff who: located the boreholes in the field; arranged for the clearance of underground services; supervised the drilling and sampling 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 geotechnical laboratory in Sudbury for further examination and laboratory testing. Index and classification testing consisting of water content determinations, grain size distributions, Atterberg limits, and organic content was carried out on selected soil samples. The geotechnical laboratory testing was completed according to ASTM and MTO LS standards, as applicable. In addition, one soil sample was submitted to Bureau Veritas Laboratories (formerly Maxxam) in Sudbury, Ontario, an accredited analytical laboratory, for testing of a suite of corrosivity indicator parameters.

The as-drilled borehole locations were measured relative to highway chainages/station marked on the pavement by a member of our technical staff and converted into northing/easting coordinates on the plan drawing. The ground surface elevation at each borehole location was surveyed by Golder relative to the highway and culvert centreline, with the elevation of the centreline provided by AECOM. The MTM NAD 83-CSRS CBN v6-2010.0 (Zone 12) northing and easting coordinates, geographical coordinates, ground surface elevations referenced to Geodetic datum, and borehole depths at each borehole location are presented on the borehole records in Appendix A and summarized below.

Borehole Number	MTM NAD 83 Northing (m) (Latitude)	MTM NAD 83 Easting (m) (Longitude)	Ground Surface Elevation (m)	Borehole Depth (m)
C258-1	5330483.6 (48.106971)	394108.7 (-79.800632)	278.4	21.0
C258-2	5330481.9 (48.106957)	394092.5 (-79.800851)	278.6	16.5
C258-3	5330478.7 (48.106924)	394123.5 (-79.800435)	278.3	16.5
C258-4	5330496.2 (48.107085)	394099.2 (-79.800757)	276.2	10.4
C258-5	5330462.5 (48.106778)	394122.4 (-79.800453)	274.4	10.4

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS)[1] mapping, the culvert site is located within a glaciolacustrine plain, with the subsoils consisting primarily of clay.

Based on geological mapping (MNDM)[2], the site is underlain by mafic to intermediate metavolcanics rocks.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the summary results of in situ and laboratory testing are given on the Record of Borehole sheets contained in Appendix A. The plotted results of geotechnical laboratory testing are contained in Appendix B. The results of the in-situ field tests (i.e., SPT 'N'-values and in-situ vane shear strengths) as presented on the Record of Borehole sheets and discussed in Section 4.2 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profiles shown on Drawing 1 are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The results of the analytical laboratory testing (by Bureau Veritas Laboratories) are summarized in Section 4.4 and the detailed laboratory testing report is included in Appendix B.

The subsurface conditions will vary between and beyond the borehole locations, however, the factual data presented on the Record of Borehole sheets governs any interpretation of the site conditions. A summary description of the soil deposits and groundwater conditions encountered in the boreholes is provided below. It should be noted that the interpreted stratigraphy shown on Drawing 1 is a simplification of the subsurface conditions.

4.2.1 Asphalt / Fill

An approximately 140 mm to 100 mm thick layer of asphalt pavement was encountered at ground surface in Boreholes C258-1 and C258-2 at Elevations 278.4 m and 278.6 m, respectively. A 3.6 m to 5.5 m thick layer of embankment fill, consisting of an upper 0.2 m to 2.1 m thick layer of gravelly sand to gravel to sand, underlain by a 3.4 m to 3.7 m thick layer of sand fill, was encountered below the asphalt in Boreholes C258-1 and C258-2, and from ground surface in Borehole C258-3 at Elevation 278.3 m.

From ground surface in Boreholes C258-4 and C258-5, an approximately 0.4 m and 0.2 m thick layer of organic silty sand fill was encountered at Elevations 276.2 m and 274.4 m, respectively. Below the organic silty sand, an approximately 0.6 m to 1.0 m thick layer of silty sand to sand fill was encountered.

The SPT "N"-values measured within the gravelly sand fill and sand fill ranges from 1 blow to 22 blows per 0.3 m of penetration, indicating a very loose to compact compactness condition.

[1] Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41PNE.

[2] Ontario Ministry of Northern Development and Mines. Bedrock Geology of Ontario, East-Central Sheet. Map 2543.

Grain size distribution testing was carried out on one sample of the sand fill and the result is presented on Figure B-1 in Appendix B. The natural moisture content measured on one sample of the sand fill is 8 per cent.

4.2.2 Organic Silt to Organic Silty Sand / Peat

An approximately 0.6 m to 0.8 m thick layer of organic silt to organic silty sand was encountered below the fill in Boreholes C258-2, C258-3, and C258-5 between Elevations 274.9 m and 273.6 m. A 0.8 m thick deposit of peat was encountered below the fill in Borehole C258-4 at Elevation 274.8 m.

The SPT "N"-values measured within the organic deposit range from 2 blows to 7 blows per 0.3 m of penetration indicating a very loose to loose compactness condition.

The natural moisture content and the organic content measured on one sample of the organic silty sand is about 50 per cent and about 7 per cent, respectively.

4.2.3 Sand

An approximately 2.2 m to 3.4 m thick layer of sand, trace to some gravel, trace silt was encountered below the fill in Borehole C258-1 and below the organic deposit in Boreholes C258-2 to C258-5 between Elevations 274.1 m and 272.8 m.

The SPT "N"-values measured within the sand deposit ranges from 0 blows (weight of hammer) to 13 blows per 0.3 m of penetration, indicating a very loose to compact compactness condition.

Grain size distribution testing was carried out on two samples of the sand and the results are presented on Figure B-2 in Appendix B. The natural moisture content measured on two samples of the sand deposit are about 18 per cent and 39 per cent.

4.2.4 Silt

An approximately 1.5 m to 4.8 m thick layer of silt, some clay, trace to some sand was encountered below the sand deposit in Boreholes C258-1, C258-4, and C258-5 and interlayered within the silty clay to clay deposit (discussed below) in Boreholes C258-2 and C258-3 between Elevations 270.6 m and 267.0 m. Borehole C258-4 was terminated within the silt deposit, penetrating into it for a depth of 4.8 m.

The SPT "N"-values measured within the silt deposit range from 2 blows to 8 blows per 0.3 m of penetration, indicating a very loose to loose compactness condition.

Grain size distribution testing was carried out on five samples of the silt deposit and the results are presented on Figure B-3 in Appendix B. Atterberg limit tests were carried out on three samples of the silt deposit and two samples measured liquid limits of about 19 per cent, plastic limits of about 15 per cent and 17 per cent and plasticity indices of about 2 per cent and 4 per cent; and one sample is non-plastic. The results of the Atterberg limit test are presented in Figure B-4 and indicate the deposit is comprised of silt to silt of slight plasticity. The natural moisture content measured on five samples of the deposit are about 18 per cent and 31 per cent.

4.2.5 Silty Clay to Clay

A deposit of silty clay to clay was encountered at the following borehole locations:

- Borehole C258-1: at 7.9 m thick deposit of clay with silt laminations below the silt deposit, at Elevation 265.3 m
- Borehole C258-2: an upper 4.4 m thick layer of silty clay below the sand deposit, at Elevation 271.4 m; and a lower 3.4 m thick layer of clay with silt laminations below the silt deposit, at Elevation 265.5 m
- Boreholes C258-3: an upper 2.9 m thick layer of silty clay below the sand deposit, at Elevation 271.1 m; and a lower 3.2 m thick layer of clay with silt laminations below the silt deposit, at Elevation 265.0 m
- Borehole C258-5: a 1.7 m thick layer of silty clay below the silt deposit, at Elevation 265.7 m

The deposit was not penetrated in Boreholes C258-1 to C258-3 and C258-5.

The SPT "N"-values measured within the silty clay to clay deposit range from 0 blows (weight of hammer) to 10 blows per 0.3 m of penetration. In-situ field vane tests carried out within the deposit measured undrained shear strengths ranging from about 48 kPa to 58 kPa, with one test measured greater than 100 kPa, and sensitivity ranging from about 2 to 3. The field vane test results suggest that the deposit generally has a firm to stiff consistency.

Atterberg limit tests were carried out on seven samples of the cohesive deposit and measured liquid limits ranging between about 39 per cent and 58 per cent, plastic limits ranging between about 18 per cent and 25 per cent and plasticity indices ranging between about 21 per cent and 36 per cent. The results of the Atterberg limit test are presented in Figure B-5 and indicate the deposit are comprised of silty clay of medium plasticity to clay of high plasticity. Grain size distribution testing was carried out on two samples of the silty clay deposit and the result is presented on Figure B-6 in Appendix B. The natural moisture content measured on seven samples of the deposit are ranging between about 35 per cent and 57 per cent.

4.3 Groundwater Conditions

The unstabilized groundwater levels relative to ground surface measured inside the casing or augers upon completion of drilling are summarized below. Groundwater water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Unstabilized Groundwater Level (m)	Approximate Groundwater Elevation (m)
C258-1	1.9	276.5
C258-2	2.8	275.8
C258-3	3.1	275.2
C258-4	0.3	275.9
C258-5	0.1	274.3

4.4 Analytical Laboratory Testing Results

Analytical testing was carried out on a sample of the sand deposit recovered from Borehole C227-1 (Sample #7). The soil sample was submitted to Bureau Veritas Laboratories of Mississauga, Ontario for corrosivity testing. The analytical laboratory test results are summarized below, and the detailed analytical laboratory test report is included in Appendix B.

Borehole No.	Borehole Sample No.	Depth (m)	Parameters					
			Resistivity (ohm-cm)	Electrical Conductivity (μmho/cm)	Soluble Sulphate (SO4) Content (μg/g)	Chloride (Cl) Content (μg/g)	Sulphide (μg/g)	pH
C258-1	7	6.1 – 6.7	5,400	185	<20[1]	40	<0.50[2]	7.7

Note:
1. The sulphate concentration is below the reportable detection limit of 20 μg/g.
2. The sulphide was below the reportable detection limit of 0.50 μg/g.

5.0 CLOSURE

The field drilling program was carried out under the supervision of Mr. Mathew Riopelle under the overall direction of Mr. André Bom, P. Eng., an Associate of Golder. This Foundation Investigation Report was prepared by Mr. Tibor Berecz, a geotechnical EIT with Golder and Mr. André Bom provided a technical review of the report. Mr. Jorge Costa, P. Eng., an MTO Foundations Designated Contact and Senior Consultant for Golder, conducted an independent quality control review of this report.

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PART B

FOUNDATION DESIGN REPORT
HIGHWAY 66, STA 17+903, TOWNSHIP OF GAUTHIER
CULVERT REPLACEMENT
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5210-14-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides foundation design recommendations for the replacement of the culvert crossing Highway 66 at about Station 17+903, Township of Gauthier, Ontario. These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current subsurface exploration. The discussion and recommendations presented are intended to provide the designer with sufficient information to assess feasible foundation alternatives and culvert types and to design the proposed replacement culvert. The foundation investigation report, discussion and recommendations are intended for the use of the Ministry of Transportation, Ontario (MTO) 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 the report. Where comments are made on construction, they are provided 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 the aspects of construction must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

6.1 Proposed Culvert Alignment and Installation Options

The existing culvert consists of a 1.9 m wide by 1.2 m high, 40 m long Corrugated Steel Pipe Arch (CSPA). Based on the drawings provided by AECOM via email on August 14, 2019, and our site observations during the foundation exploration work, the existing culvert crosses the existing Highway 66 embankment on a skew. An existing three-step gabion basket wall is located on both sides and over the culvert immediately behind each end as shown on Drawing 1 and Photographs 3 and 4. The wall extends approximately 2 m beyond the sides of the culvert; the second higher row of gabion basket is approximately equal in length to the width of the culvert, and is located behind/over the first lower wall section. The third (highest) row is comprised of one-basket wide section constructed partially over the second-row gabion basket. We understand that AECOM has recommended to MTO to replace the gabion walls as the existing gabions baskets show signs of slight slumping, rotation and distortion. The existing embankment north and south slopes at the culvert location are inclined at about 1.5 Horizontal to 1 Vertical (1.5.H:1V) above and immediately adjacent to the existing gabion basket wall and flattens to and inclination of about 2H:1V about 5 m to 10 m away from the existing culvert/gabion wall ends. The existing embankment is about 4.2 m and 5.0 m high relative to the culvert invert at the inlet and outlet, respectively. The invert at the inlet and outlet of the existing culvert is about Elevations 274.3 m and 273.5 m, respectively.

We understand from AECOM (email correspondence dated November 24, 2019) that culvert replacement is not required and the gabion basket wall system, including the sections of wall on both sides of the culvert providing lateral support around the pipe at the inlet and outlet, are to be replaced. It is anticipated that a temporary protection system will be required on the embankment side slopes to allow for the wall replacement.

6.2 Consequence and Site Understanding Classification

In accordance with Section 6.5 of the *Canadian Highway Bridge Design Code* (CHBDC, 2014) and its *Commentary*, the culvert crosses Highway 66 at Station 17+903, the highway and foundation system are expected to carry medium traffic volumes and their performance will have potential impacts on other transportation corridors; hence, the culvert foundation system is classified as having a “typical consequence level” associated with exceeding limits states design. In addition, given the typical project-specific foundation investigation carried out at this site (as presented in Part A of the report), in comparison to the degree of site understanding in Section 6.5 of *CHBDC* (2014), the level of confidence for design is considered to be a "typical degree of site and prediction model understanding." Accordingly, the appropriate corresponding ultimate limit state (ULS) and serviceability limit state (SLS) consequence factor, Ψ, and geotechnical resistance factors, ϕ_{gu} and ϕ_{gs}, from Tables 6.1 and 6.2 of the *CHBDC* have been used for design, as applicable.

6.3 Gabion Walls

At the culvert location, we understand that the existing gabion basket wall at each end of the culvert is to be replaced by a new gabion basket wall. The new gabion basket walls should be constructed in accordance with OPSS.PROV 512 (Installation of Gabions). The gradation requirements of the gabion stone [G-3 or G-10 as per OPSS.PROV 1004 (Aggregates - Miscellaneous)] should be specified by the gabion basket wall design engineer in consultation with the hydraulics engineer, if required. The lower course of gabion baskets should be founded below the existing ground surface, following removal of any unsuitable surficial materials, such as the existing fill and the organic silty sand / peat in Boreholes C258-4 and C258-5, to Elevations 274.0 m and 273.0 m, respectively. The minimum toe embedment for internal stability of the gabion basket wall and scour protection of the founding course of baskets should be considered by the gabion wall designer and hydraulics design engineer.

The sub-excavated areas should be backfilled with a minimum of 300 mm thick bedding layer comprised of OPSS.PROV 1010 (Aggregates) Granular 'B' Type II material placed below the baskets. The Granular 'B' Type II should extend at least 0.5 m beyond the outside edge of the baskets.

Due to the proximity of the gabion basket wall to the creek, it is anticipated that the excavation for installation of the bottom course of the gabion wall and granular pad will extend below the groundwater level. In order to complete the sub-excavation for removal of the organic silt, peat, and organic silty sand and allow for placement of the granular bedding/levelling pad and gabion baskets, the excavation and backfilling operations should be carried out simultaneously in accordance with the requirements in OPSS.PROV 209 (Embankments over Swamps and Compressible Soils). It is also expected that construction dewatering of the excavations will be required to allow for placement of bedding layers/the levelling pad and gabion baskets.

It is recommended that a Class II non-woven geotextile meeting the requirements of OPSS.PROV 1860 (Geotextiles) and having a Filtration Opening Size (FOS) between 105 µm and 210 µm, be placed fully against the back of the gabion basket wall as a separator between the highway embankment backfill or native subgrade soil and the gabion stone, to reduce the potential for migration of the retained soil into the gabion stone.

For an assumed 1.5 m or 2 m wide gabion basket (i.e., base width) constructed on a compacted granular bedding/levelling pad overlying the very loose to compact sand deposit, a factored geotechnical resistance at ULS of 150 kPa and a geotechnical reaction at SLS (for 25 mm of settlement) of 100 kPa may be used for design. It is estimated that the total settlement will be less than 25 mm.

Resistance to lateral forces/sliding resistance between the cobble-size stone fill of the gabion basket wall and the subgrade should be calculated in accordance with Section 6.7.5 of the CHBDC. The coefficient of friction, tan φ', between the compacted bedding/levelling pad and the gabion wall may be taken as 0.60.

Static global stability analyses of the gabion wall constructed at the toe of the highway embankment were carried out employing the Morgensen-Price method of analysis. A target minimum Factor of Safety (FoS) of 1.3 is adopted for the gabion basket wall/embankment reconstruction under static conditions as per the CHBC (2014) for a "typical consequence level" considering that the system is not adjacent to a major structure. The results of the analysis for the north slope gabion basket wall model indicate that a minimum factor of safety of 1.3 is achieved for the gabion basket retaining wall assumed to be installed in three steps of approximately 1 m width/height, as shown on Figure 1, which would also apply for the south slope gabion basket wall. The backfill within the excavation behind/above the gabion wall should be comprised of granular material such as OPSS.PROV 1010 Granular ‘A’ or ‘B’ Type I or Type II, and the embankment side slopes reconstructed at an inclination to be no steeper than 2H:1V.

6.4 Construction Considerations

6.4.1 Open Cut Excavations

Open-cut excavations at the toes of the roadway embankment for gabion basket wall construction are anticipated to encounter granular embankment fill and organic silt/peat and organic silty sand deposits and will extend below the groundwater level. Where space permits for an open cut excavation into these materials, the excavation must be carried out in accordance with the guidelines outlined in the Occupation Health and Safety Act (OHSA) for Construction Activities. Above the water table, the existing fill materials are classified as Type 3 soil, according to OHSA and temporary excavations (i.e., those which are open for a relatively short time period) should be made with side slopes no steeper than 1 horizontal to 1 vertical (1H:1V). Below the water table, the existing fill materials and underlying native soils are classified as Type 4 soil, according to OHSA and temporary excavations (i.e., those which are open for a relatively short time period) into this soil type should be made with side slopes no steeper than 3 horizontal to 1 vertical (3H:1V).

Depending upon the construction procedures adopted by the contractor, groundwater seepage conditions, and weather conditions at the time of construction, some local flattening of the slopes of open cut excavations may be required, especially in looser/softer zones or where localized seepage is encountered. Further, layering of soils and the effectiveness of the contractor’s dewatering systems could affect the OHSA classification and, therefore, the classification of soils for OHSA purposes must be made at the time the excavation is open and can be directly observed during construction.

6.4.2 Groundwater / Surface Water Control

The groundwater level is expected to be below the ground surface level adjacent to the culvert and the excavation for the gabion basket wall replacement should be expected to extend below the groundwater level. The groundwater should be lowered to at least 1 m below the base of the excavation to maintain basal stability and allow for construction in dry conditions. Groundwater may be controlled by providing an active dewatering system consisting of an adequate number of sumps and pumps installed and operated in advance/during the excavation, or in combination with temporary support systems such as a sheet piling wall and/or cofferdams (as required).

The contractor is responsible for the assessment of dewatering requirements, which depends on their chosen method of open cut excavation for replacement, as well as on the method and procedure for construction/operation/maintenance and decommissioning. The design of dewatering, unwatering, and temporary flow passage system is the responsibility of the contractor. The contractor is also responsible for confirming that the radius of groundwater drawdown does not impact the existing embankment and any surrounding features.

Surface water should be directed away from open excavation areas to prevent ponding of water that could result in disturbance and weakening of the subgrade and/or affect construction or lining operations, as applicable.

Depending on the water flow through the watercourse at the time of construction and staging/diversion requirements/limitations, temporary cofferdams may also be required.

Groundwater and surface water control will be required for excavation and construction of the gabion basket wall replacement. Dewatering operations should be carried out in accordance with OPSS.PROV 517 (*Dewatering*), as amended by SP 517F01 (*Dewatering System/Temporary Flow Passage System*) recommending that a design engineer be required, to carry out the design of the system. The return period flow estimates in Table A of SP 517F01 (included in Appendix C) shall be filled in by the hydraulic design engineer. The Designer Engineer fill in for Note 1 in Table A shall indicate “Yes”. Given the apparent lack of infrastructure present in the vicinity of the culvert, a preconstruction survey is not considered to be required at this site and the fill in for Note 2 should be N/A.

It should be noted that construction water takings in excess of 50 m^3/day are regulated by the Ministry of the Environment, Construction and Parks (MECP). Takings of groundwater/stormwater for construction dewatering purposes with a combined total less than 400 m^3/day, qualify for self-registration on the MECP’s Environmental Activity and Sector Registry (EASR). Registry on the EASR replaces the need to obtain a PTTW for water taking less than 400 m^3/day and a Section 53 approval for discharge to the environment; however, a “Water Taking Plan” and a “Discharge Plan” are required by the MECP if water is taken in accordance with an EASR. If construction water taking will be required at this site, the construction water taking permit and registration under the AESR should be prepared by the Contractor adequality in advance of site excavation work, so as not to unduly affect the construction schedule.

The existing subdrains (see Photograph 4) should be protected / reinstated as part of the gabion basket wall replacement.

6.4.3 Temporary Protection Systems

If open cut excavation is not feasible for gabion wall replacement at either end of the culvert, a temporary protection system will be required. The temporary excavation protection and support systems shall be designed and constructed in accordance with OPSS.PROV 539 (*Temporary Protection Systems*) as amended by SP 105S09. The lateral movement of the protection systems shall meet Performance Level 2 as specified in OPSS.PROV 539, provided that any utilities, if present, can tolerate this magnitude of deformation.

It is anticipated that a driven interlocking steel sheet pile system is suitable at this site. Alternatively, the contractor may use a soldier pile and lagging system; however, the site would need to be adequately dewatered prior to installation of the lagging boards as the cohesionless fills will not have adequate stand-up time to permit installation of the lagging boards.

The sheet piles (or soldier piles) will need to extend to a sufficient depth to provide the necessary passive resistance for the retained soil height, plus any surcharge loads behind the protection system. Lateral support to the sheet pile wall or soldier pile wall could be provided in the form of struts, rakers, or temporary anchors, if and as required.

Vibratory equipment for the installation of temporary protection systems may be used at this site provided that it does not impact nearby buried infrastructure or structures, if present. The installation of temporary protection systems by vibratory equipment should be monitored to ensure the vibration levels produced by such construction activity are within tolerable limits and in consultation with the infrastructure/utility and property owners within the zone of influence of the site.

While the selection and design of the temporary protection system will be the responsibility of the contractor, the following information is provided to MTO and its designers to aid in the assessment of feasible alternatives.

Stratigraphic Unit	Bulk Unit Weight, γ (kN/m³)	Angle of Internal Friction, φ (degrees)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients[1/2]		
				Passive, K_p[3]	Active, K_a	At-rest, K_o
Embankment Fill – Very loose to compact silty sand to sand, gravelly sand, sand and gravel	20	32	-	3.25	0.31	0.47
Very loose to loose organic silt/organic silty sand	16	28	-	2.77	0.36	0.53
Very loose peat	12	27	1	2.64	0.38	0.55
Very loose to loose silt	18	28	-	2.77	0.36	0.53
Firm to stiff silty clay/clay	18	28	40	2.77	0.36	0.53

Notes:

1. The design groundwater level may be assumed to be Elevations 276.0 and 274.5 m near the inlet and outlet respectively, based on the ground water levels in the boreholes.
2. The lateral earth pressure coefficients presented above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are expected, the coefficients should be corrected accordingly.
3. The total passive resistance below the base of the excavation (i.e., adjacent to the temporary protection system) 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 CHBDC (2014) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

It is recommended that the ground surface extending back/upwards from the top of the temporary protection system to the existing Highway 66 surface be graded to an inclination no steeper than 2 horizontal to 1 vertical (2H:1V). This should be shown on the Contract staging drawings.

The loading from construction equipment as well as any material stockpiles within a distance defined by a 1 horizontal to 1 vertical line drawn from the bottom of the excavation to the existing ground surface should be included as a surcharge in the design of the temporary protection system.

Consideration could be given to either partial or full removal of the temporary protection system upon completion of construction or each stage of construction (as required). Vibration and noise controls during installation and extraction of any temporary systems should meet the same tolerable limits used for installation.

6.4.4 Embankment Reconstruction

Engineered fill for reconstruction of the embankment behind the new gabion wall should consist of OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type I or Type II material. The new embankment fill should be placed and compacted in accordance with OPSS.PROV 501 (*Compacting*) as amended by SP 105S22 and OPSS.PROV 206 (*Grading*). Embankment side slopes should be constructed no steeper than 2H:1V in granular fill.

7.0 CLOSURE

This Foundation Design report was prepared by Mr. Tibor Berecz, a geotechnical EIT with Golder, and the technical aspects were reviewed by Mr. André Bom, P. Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge Costa, P. Eng., an MTO Foundations Designated Contact and Senior Consultant with Golder, conducted an independent and quality control review of the report.

Signature Page

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TB/AB/JMAC/ca

https://golderassociates.sharepoint.com/sites/1809001/deliverables/foundations/2. reporting/r15 - gau 258 (hf)/3. final/1896349-r15 r-rev0 aecom culvert gau 258 hwy 66 27feb_2020.docx

REFERENCES

Canadian Standards Associations (CSA) Group 2014. Canadian Highway Bridge Design Code and Commentary S6-14.

Canadian Standards Association (CSA), 2014. CSA A23.1-09 Concrete Materials and Methods of Construction (R2014).

Cashman, P.M. and Preene M. (2001) Groundwater Lowering in Construction, A Practical Guide. Spoon Press Publisher.

Heuer, R.E. (1974) Important Parameters in Soft Ground Tunneling. Proceedings of Specialty Conference on Subsurface Exploration for Underground Excavation and Heavy Construction. ASCE, New York.

Ministry of Transportation, Ontario, MTO Gravity Pipe Design Guidelines, April 2014.

Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41PNE.

Ontario Ministry of Northern Development and Mines. Bedrock Geology of Ontario, East-Central Sheet. Map 2543.

Ontario Regulation 903 (Wells).

Occupational Health and Safety Act and Regulation for Construction Projects (as amended).

ASTM International:

ASTM D1586 Standard 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) – Provincial Oriented

OPSS.PROV 206	Construction Specification for Grading
OPSS.PROV 209	Construction Specification for Embankments Over Swamps and Compressible Soils
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 512	Construction Specification for Installation of Gabions
OPSS.PROV 517	Construction Specification for Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
OPSS.PROV 1004	Material Specification for Aggregates – Miscellaneous
OPSS.PROV 1860	Material Specification for Geotextiles

Special Provisions

SP 105S22	Amendment to OPSS 501
SP 105S09	Amendment to OPSS 539

MINISTRY OF TRANSPORTATION, ONTARIO

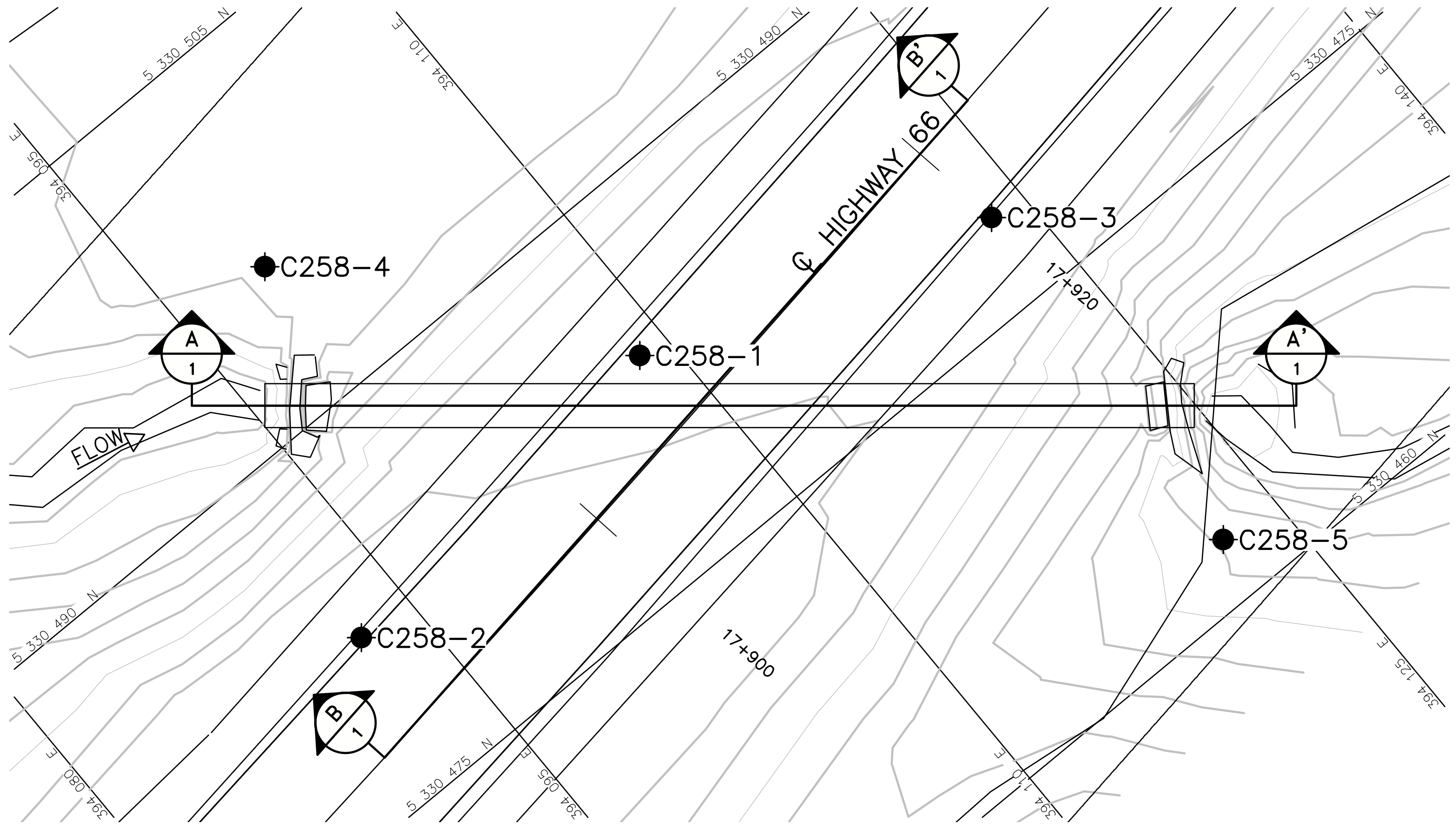
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 5210-14-00

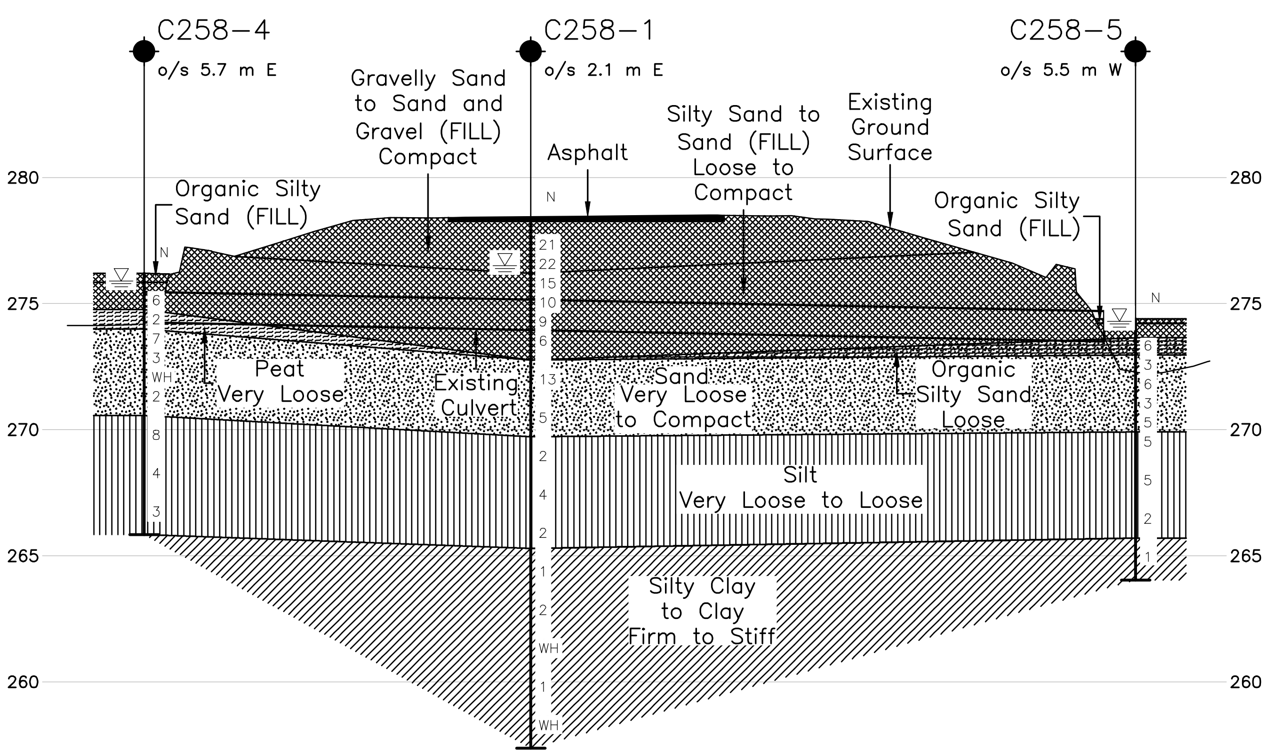
SHEET

HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT
BOREHOLE LOCATIONS AND SOIL STRATA

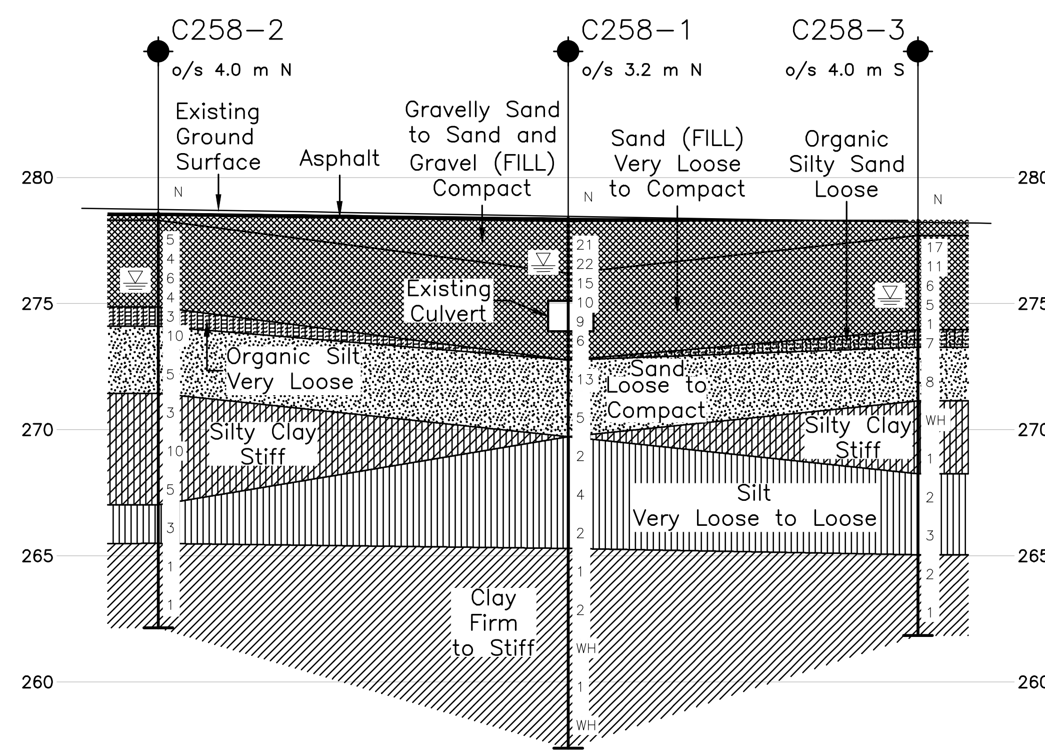
GOLDER



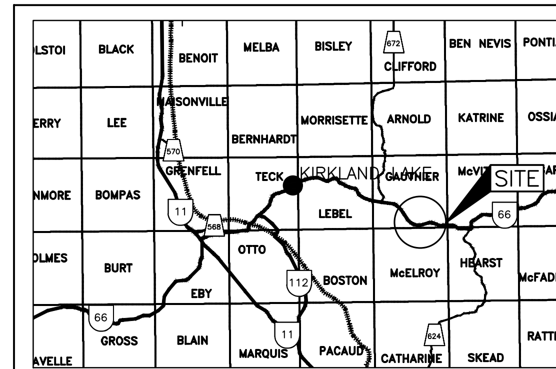
PLAN
SCALE
3 0 3 6 m



(A-A' / 1) CULVERT CENTERLINE PROFILE
HORIZONTAL SCALE 3 0 3 6 m
3 0 3 6 m VERTICAL SCALE



(B-B' / 1) HIGHWAY CENTERLINE PROFILE
HORIZONTAL SCALE 3 0 3 6 m
3 0 3 6 m VERTICAL SCALE



KEY PLAN
SCALE
10 0 10 20 km

LEGEND

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

BOREHOLE CO-ORDINATES (NAD 83 MTM ZONE 12)

No.	ELEVATION	NORTHING	EASTING
C258-1	278.4	5330483.6	394108.7
C258-2	278.6	5330481.9	394092.5
C258-3	278.3	5330478.7	394123.5
C258-4	276.2	5330496.2	394099.2
C258-5	274.4	5330462.5	394122.4

NOTES

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

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

REFERENCE

Base plans provided in digital format by CALLON DIETZ LTD., drawing file no. gwp52101400b.dwg, received AUGUST 14, 2019.

NO.	DATE	BY	REVISION

Geocres No. 32D-29

HWY. 66	PROJECT NO. 1896349		DIST.
SUBM'D.	CHKD. TB	DATE: 2/18/2020	SITE:
DRAWN: TR	CHKD. AB	APPD. JMAC	DWG. 1

PLOT DATE: February 18, 2020
FILENAME: S:\Clients\MTO\Hwy65&66\99_PROJ\1896349_AECOM_Hwy65-66-566\40_PROD\0015_R15_GAU258\1896349-0015-BG-0001.dwg

Photograph 1: Road Surface at Culvert Location, Facing East (April 2019)

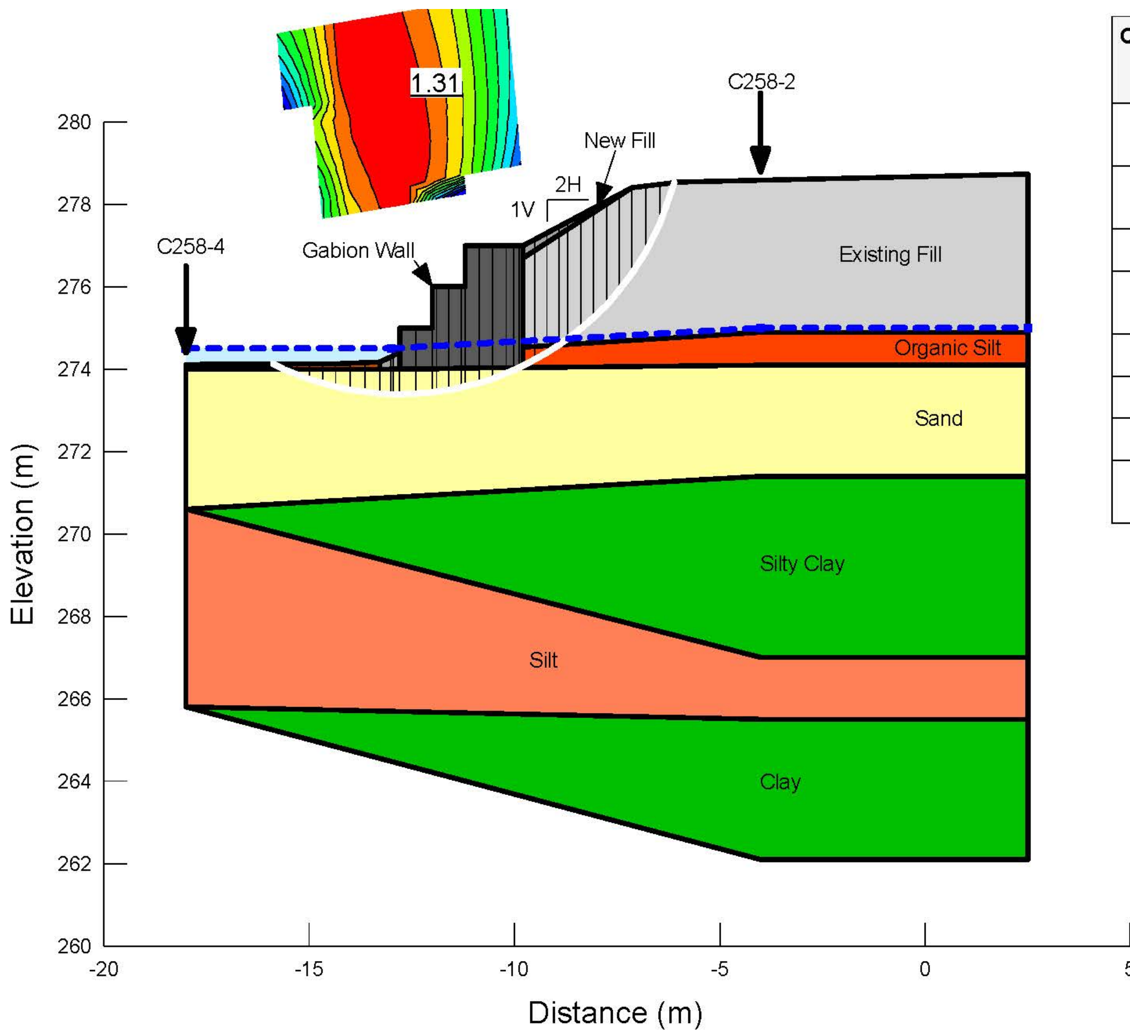
Photograph 2: Embankment North Slope at Culvert Inlet, Facing East (April 2019)

Photograph 3: Embankment South Slope at Culvert Outlet, Facing South (April 2019)

Photograph 4: Culvert Outlet, South Side of Embankment (April 2019)

Figure 1

Global Stability Analysis – Long-term Condition
Highway 66, Sta. 17+903, Township of Gauthier Culvert



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Existing Fill	20	0	32
	Gabion Wall	21	10	35
	New Fill	21	0	35
	Organic Silt	16	0	28
	Peat	12	1	27
	Sand	20	0	32
	Silt	18	0	28
	Silty Clay to Clay	18	50	0

Date: December 2019
Project No: 1896349-R15

Analysis By: TB **Reviewed By:** AB

GOLDER

APPENDIX A

Record of Boreholes

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS
MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS[1,2]

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (*i.e.,* SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (*i.e.,* some sand)
≤ 10	trace (*i.e.,* trace fines)

1. Only applicable to components not described by Primary Group Name.
2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)
An 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 (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

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

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

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , 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, Gs)
DS	direct shear test
GS	specific gravity
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 (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness[1]

Term	SPT 'N' (blows/0.3m)[2]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	➢ 50

3. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
4. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

LIST OF SYMBOLS
MINISTRY OF TRANSPORTATION, ONTARIO

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
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
U	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

* 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 = ($w_l - w_p$)
NP	non-plastic
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

GOLDER

Foundation Design

RECORD OF BOREHOLE No C258-1

 METRIC

PROJECT 1896349

G.W.P. 5210-14-00

LOCATION N 5330483.6; E 394108.7 NAD83 MTM ZONE 12 (LAT. 48.106971; LONG. -79.800632)

ORIGINATED BY MR

DIST ___ HWY 66

BOREHOLE TYPE NW Casing, Wash Boring

COMPILED BY TR

DATUM GEODETIC

DATE May 24, 2019

CHECKED BY AB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	GR	SA	SI	CL
278.4	GROUND SURFACE													
0.0	ASPHALT (140 mm)						278							
0.1	Gravelly sand to sand and gravel (FILL) Compact Brown Moist to wet		1	SS	21		277							
			2	SS	22	∇			○		30	65	(5)	
276.2 2.2	Sand, trace to some gravel (FILL) Loose to compact Brown to grey Wet		3	SS	15		276							
			4	SS	10		275							
			5	SS	9		274							
			6	SS	6		273							
272.8 5.6	SAND, some gravel, trace silt Loose to compact Grey Wet		7	SS	13		272, 271							
			8	SS	5		270		○		17	80	(3)	
269.7 8.7	SILT, trace sand, with clayey silt laminations Very loose to loose Grey Wet		9	SS	2		269							
							268	+ >100 kPa						
			10	SS	4		267		H○		0	2	82	16
								+ >100 kPa						

Dynamic cone penetration resistance plot scale: 20, 40, 60, 80, 100. Shear strength legend: ○ UNCONFINED; + FIELD VANE; ● QUICK TRIAXIAL; × REMOULDED. Water content: PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; scale 20, 40, 60. REMARKS & GRAIN SIZE DISTRIBUTION (%).

Continued Next Page

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

SUD-MTO 001 S:\CLIENTS\MTO\HWY65&66\02_DATA\GINT\1896349.GPJ GAL-MISS.GDT 11-27-19 TR

GOLDER

RECORD OF BOREHOLE No C258-1

 METRIC

PROJECT 1896349
G.W.P. 5210-14-00
LOCATION N 5330483.6; E 394108.7 NAD83 MTM ZONE 12 (LAT. 48.106971; LONG. -79.800632)
ORIGINATED BY MR
DIST ____ HWY 66
BOREHOLE TYPE NW Casing, Wash Boring
COMPILED BY TR
DATUM GEODETIC
DATE May 24, 2019
CHECKED BY AB

--- CONTINUED FROM PREVIOUS PAGE ---

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	FIELD VANE (Sensitivity)	WATER CONTENT	REMARKS GR SA SI CL
	SILT, trace sand, with clayey silt laminations Very loose to loose Grey Wet	11	SS	2	266			
265.3 13.1	CLAY, with silt laminations Firm to stiff Grey Wet				265	2		
		12	SS	1	264		plotted	0 0 35 65
						2		
		13	SS	2	263			
					262	3		
		14	SS	WH	261		plotted	
						3		
		15	SS	1	260			
					259	3		
		16	SS	WH	258			
257.4 21.0	END OF BOREHOLE					2		

NOTE:

1. Water level inside casing at a depth of 1.9 m below ground surface (Elev. 276.5 m) upon completion of drilling.

Legend: 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 (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

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

RECORD OF BOREHOLE No C258-2

 METRIC

PROJECT 1896349
G.W.P. 5210-14-00
LOCATION N 5330481.9; E 394092.5 NAD83 MTM ZONE 12 (LAT. 48.106957; LONG. -79.800851)
ORIGINATED BY MR
DIST ____ HWY 66
BOREHOLE TYPE NW Casing, Wash Boring
COMPILED BY TR
DATUM GEODETIC
DATE May 26, 2019
CHECKED BY AB

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
278.6	GROUND SURFACE						
0.0	ASPHALT (100 mm)						
	Sand and gravel (FILL)						
0.3	Sand, trace gravel (FILL) Very loose to loose Brown Moist to wet	1	SS	5			
		2	SS	4			
		3	SS	6	∇ (approx. el. 275.9)		
	- Trace asphalt in Sample 4	4	SS	4			
274.9 / 3.7	Organic SILT, trace gravel, trace sand, trace wood Very loose Dark brown Wet	5	SS	3			
274.1 / 4.5	SAND, trace gravel, trace silt Loose to compact Grey Wet	6	SS	10			
		7	SS	5		○	2 96 (2)
271.4 / 7.2	SILTY CLAY Very stiff Grey Wet	8	SS	3		wP–w–wL	0 3 60 37
	(Field vane: + >100 kPa at approx. el. 269.7)						
		9	SS	10			
		10	SS	5			
267.0 / 11.6	SILT, trace sand, trace clay						

Continued Next Page

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

SUD-MTO 001 S:\CLIENTS\MTO\HWY65&66\02_DATA\GINT\1896349.GPJ GAL-MISS.GDT 11-27-19 TR

GOLDER

RECORD OF BOREHOLE No C258-2

 METRIC

PROJECT 1896349
G.W.P. 5210-14-00
LOCATION N 5330481.9; E 394092.5 NAD83 MTM ZONE 12 (LAT. 48.106957; LONG. -79.800851)
ORIGINATED BY MR
DIST HWY 66
BOREHOLE TYPE NW Casing, Wash Boring
COMPILED BY TR
DATUM GEODETIC
DATE May 26, 2019
CHECKED BY AB

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (FIELD VANE, sensitivity)	WATER CONTENT
	--- CONTINUED FROM PREVIOUS PAGE ---						
	SILT, trace sand, trace clay Very loose Grey Wet	11	SS	3	266		
265.5 13.1	CLAY, with silt laminations Stiff Grey Wet					+ (2)	
		12	SS	1	265		plotted (Wp, w, WL)
					264	+ (3)	
		13	SS	1	263		
262.1 16.5	END OF BOREHOLE					+ (3)	

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | 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 (%) 20 40 60 | UNIT WEIGHT γ kN/m[3] | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

NOTE:

1. Water level inside casing at a depth of 2.8 m below ground surface (Elev. 275.8 m) upon completion of drilling.

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

GOLDER

RECORD OF BOREHOLE No C258-3

 METRIC

PROJECT 1896349

G.W.P. 5210-14-00

LOCATION N 5330478.7; E 394123.5 NAD83 MTM ZONE 12 (LAT. 48.106924; LONG. -79.800435)

ORIGINATED BY MR

DIST ____ HWY 66

BOREHOLE TYPE NW Casing, Wash Boring

COMPILED BY TR

DATUM GEODETIC

DATE May 26, 2019

CHECKED BY AB

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	SHEAR STRENGTH / WATER CONTENT (plot)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
278.3	GROUND SURFACE							
0.0	Sand and gravel (FILL)							
277.7 / 0.6	Sand, trace to some gravel (FILL) Very loose to compact Brown Moist to wet	1	SS	17				
	- Trace asphalt in Sample 2	2	SS	11				
		3	SS	6				
		4	SS	5	▽ (approx. El. 275.2)			
		5	SS	1				
274.0 / 4.3	Organic SILTY SAND, trace gravel Loose Dark brown Wet	6 A/B	SS	7		w ≈ 50%	OC=7.2%	
273.3 / 5.0	SAND, trace to some gravel Loose Grey Wet	7	SS	8				
271.1 / 7.2	SILTY CLAY Stiff Grey Wet	8	SS	WH		w_P ≈ 20%, w_L ≈ 41%, w ≈ 43%		
						Field vane ≈ 57 kPa, sensitivity 2 (El. ≈ 269.6)		
		9	SS	1				
268.2 / 10.1	SILT, some clay, trace sand Very loose Grey Wet	10	SS	2		w ≈ 26%	NP	0 5 79 16
						Field vane >100 kPa		

Continued Next Page

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

GOLDER

RECORD OF BOREHOLE No C258-3

 METRIC

PROJECT 1896349			
G.W.P. 5210-14-00	LOCATION N 5330478.7; E 394123.5 NAD83 MTM ZONE 12 (LAT. 48.106924; LONG. -79.800435)		ORIGINATED BY MR
DIST	HWY 66	BOREHOLE TYPE NW Casing, Wash Boring	COMPILED BY TR
DATUM GEODETIC		DATE May 26, 2019	CHECKED BY AB

Column headings: SOIL PROFILE (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, + FIELD VANE, ● QUICK TRIAXIAL, × REMOULDED; 20 40 60 80 100) | PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (20 40 60) | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) (GR SA SI CL)

--- CONTINUED FROM PREVIOUS PAGE ---

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES
	SILT, some clay, trace sand Very loose Grey Wet	11	SS	3
265.0 / 13.3	CLAY, with silt laminations Stiff Grey Wet	12	SS	2
		13	SS	1
261.8 / 16.5	END OF BOREHOLE NOTE: 1. Water level inside casing at a depth of 3.1 m below ground surface (Elev. 275.2 m) upon completion of drilling.			

Elevation scale: 266, 265, 264, 263, 262

Field vane (+) shear strength approx. 57 kPa at Elev. approx. 264.9, 263.4 and 261.8, sensitivity 2 each.

Water content at Sample 12: W_P approx. 22 %, W approx. 45 %, W_L approx. 56 %.

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

GOLDER

Foundation Design

RECORD OF BOREHOLE No C258-4

 METRIC

PROJECT 1896349

G.W.P. 5210-14-00

LOCATION N 5330496.2; E 394099.2 NAD83 MTM ZONE 12 (LAT. 48.107085; LONG. -79.800757)

ORIGINATED BY MR

DIST HWY 66

BOREHOLE TYPE NW Casing, Wash Boring

COMPILED BY TR

DATUM GEODETIC

DATE May 25, 2019

CHECKED BY AB

ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	WATER CONTENT (%)	GR	SA	SI	CL
276.2	GROUND SURFACE									
0.0	Organic silty sand (FILL) Dark brown Moist to wet				▽ (approx. Elev. 275.9)					
275.8 / 0.4	Silty sand, trace gravel, trace organics (FILL) Loose Grey Wet	1	SS	6						
274.8 / 1.4	PEAT, trace gravel, trace wood Very loose Dark brown Wet	2	SS	2						
274.0 / 2.2	SAND, trace gravel, trace silt Very loose to loose Grey Wet	3	SS	7						
		4	SS	3						
		5	SS	WH						
		6	SS	2						
270.6 / 5.6	SILT, some sand, some clay Very loose to loose Grey Wet	7	SS	8		plotted	0	3	81	16
		8	SS	4		plotted, with W_P–W_L range	0	16	70	14
		9	SS	3						
265.8 / 10.4	END OF BOREHOLE									

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, "N" VALUES); GROUND WATER CONDITIONS; ELEVATION SCALE (276 to 266); 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 (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) (GR SA SI CL)

NOTE:

1. Water level inside casing at a depth of 0.3 m below ground surface (Elev. 275.9 m) upon completion of drilling.

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

GOLDER

RECORD OF BOREHOLE No C258-5

 METRIC

PROJECT 1896349
G.W.P. 5210-14-00
LOCATION N 5330462.5; E 394122.4 NAD83 MTM ZONE 12 (LAT. 48.106778; LONG. -79.800453)
ORIGINATED BY MR
DIST HWY 66
BOREHOLE TYPE NW Casing, Wash Boring
COMPILED BY TR
DATUM GEODETIC
DATE May 25, 2019
CHECKED BY AB

ELEV / DEPTH	DESCRIPTION
274.4	GROUND SURFACE
0.0	Organic silty sand (FILL), Dark brown, Moist to wet
0.2	Sand, trace gravel, trace organics (FILL), Dark brown, Wet
273.6 / 0.8	Organic SILTY SAND, Loose, Dark brown, Wet
273.0 / 1.4	SAND, trace gravel, Very loose to loose, Brown, Wet
269.9 / 4.5	SILT, some sand, some clay, Very loose to loose, Brown, Wet
265.7 / 8.7	SILTY CLAY, Firm, Grey, Wet
264.0 / 10.4	END OF BOREHOLE

SAMPLE NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	6	
2	SS	3	
3	SS	6	
4	SS	3	
5	SS	5	
6	SS	5	
7	SS	5	0 20 63 17
8	SS	2	
9	SS	1	

GROUND WATER CONDITIONS: water level symbol near 274.3 m

ELEVATION SCALE: 274, 273, 272, 271, 270, 269, 268, 267, 266, 265

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED; 20 40 60 80 100
Field vane value near 264.0 m: 3

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT W_L
WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

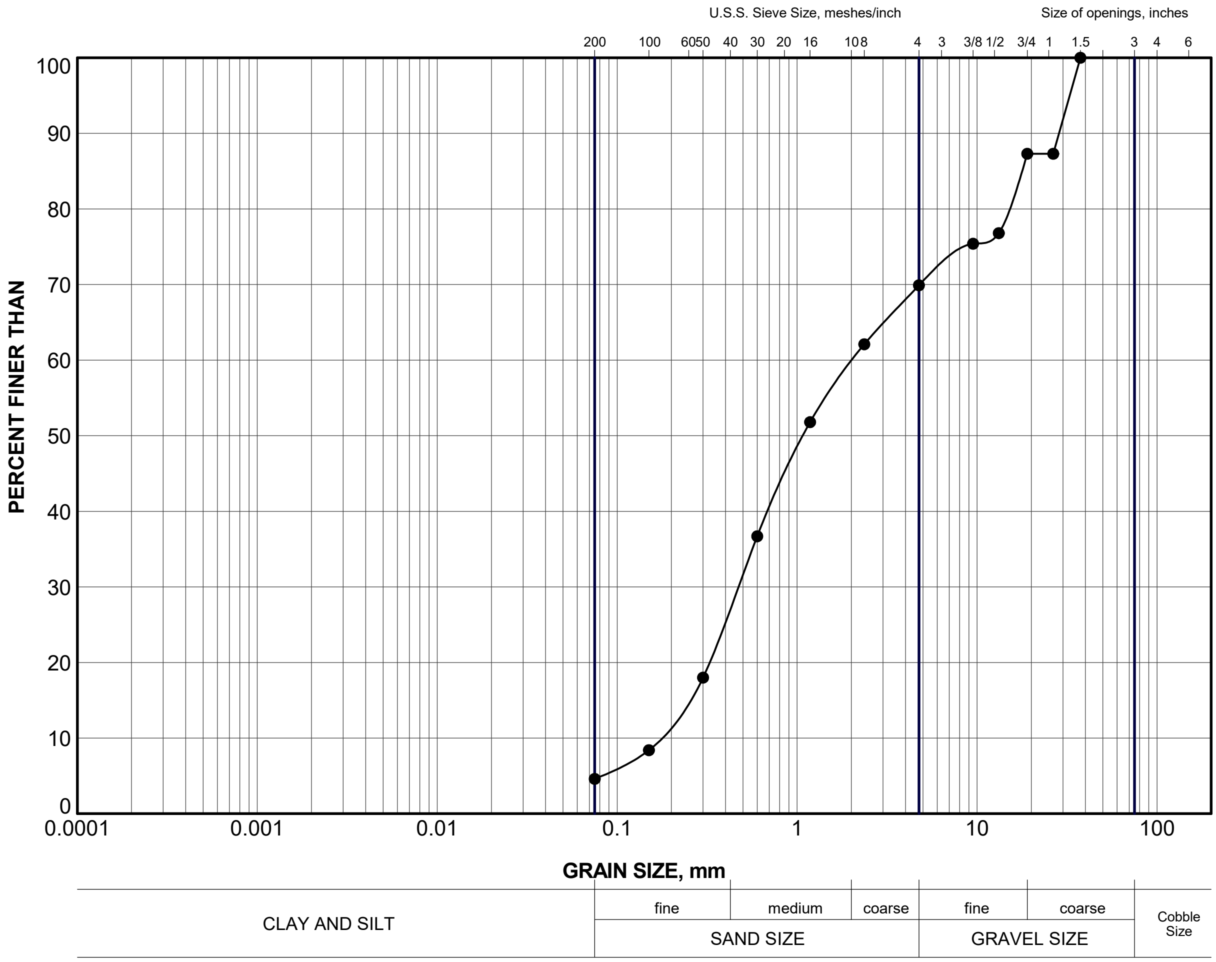
NOTE:

1. Water level inside casing at a depth of 0.1 m below ground surface (Elev. 274.3 m) upon completion of drilling.

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

APPENDIX B

Laboratory Test Results



LEGEND

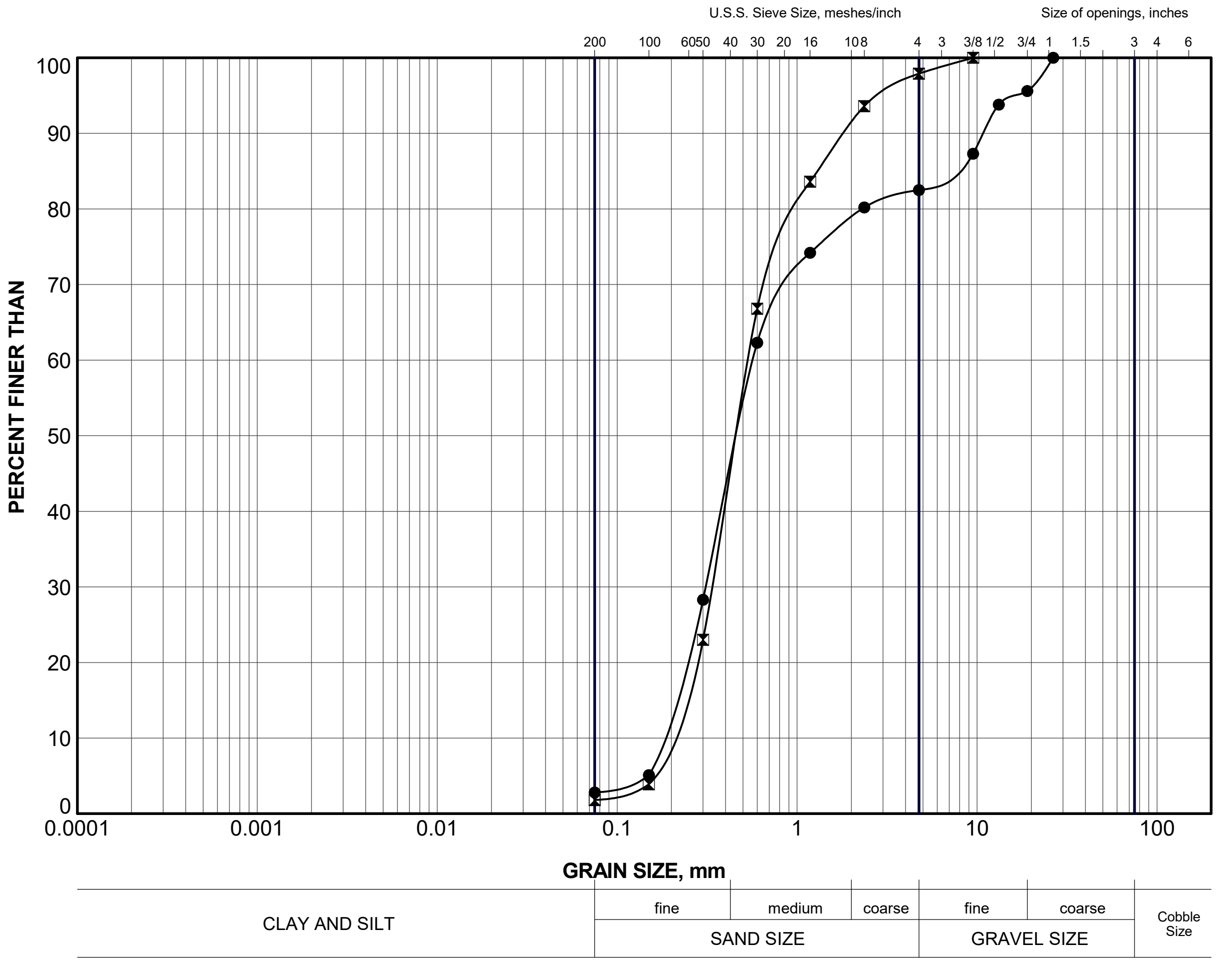
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C258-1	2	276.6

PROJECT	HIGHWAY 66 STATION 17+903 TOWNSHIP OF GAUTHIER CULVERT
TITLE	**GRAIN SIZE DISTRIBUTION** Gravelly Sand (FILL)

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ
DRAWN	TR	Nov 2019	SCALE N/A	REV.
CHECK	AB	Nov 2019	**FIGURE B-1**	
APPR	JMAC	Nov 2019		

SUD-MTO GSD GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C258-1	8	270.5
⧗	C258-2	7	272.2

PROJECT

HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT

TITLE

GRAIN SIZE DISTRIBUTION

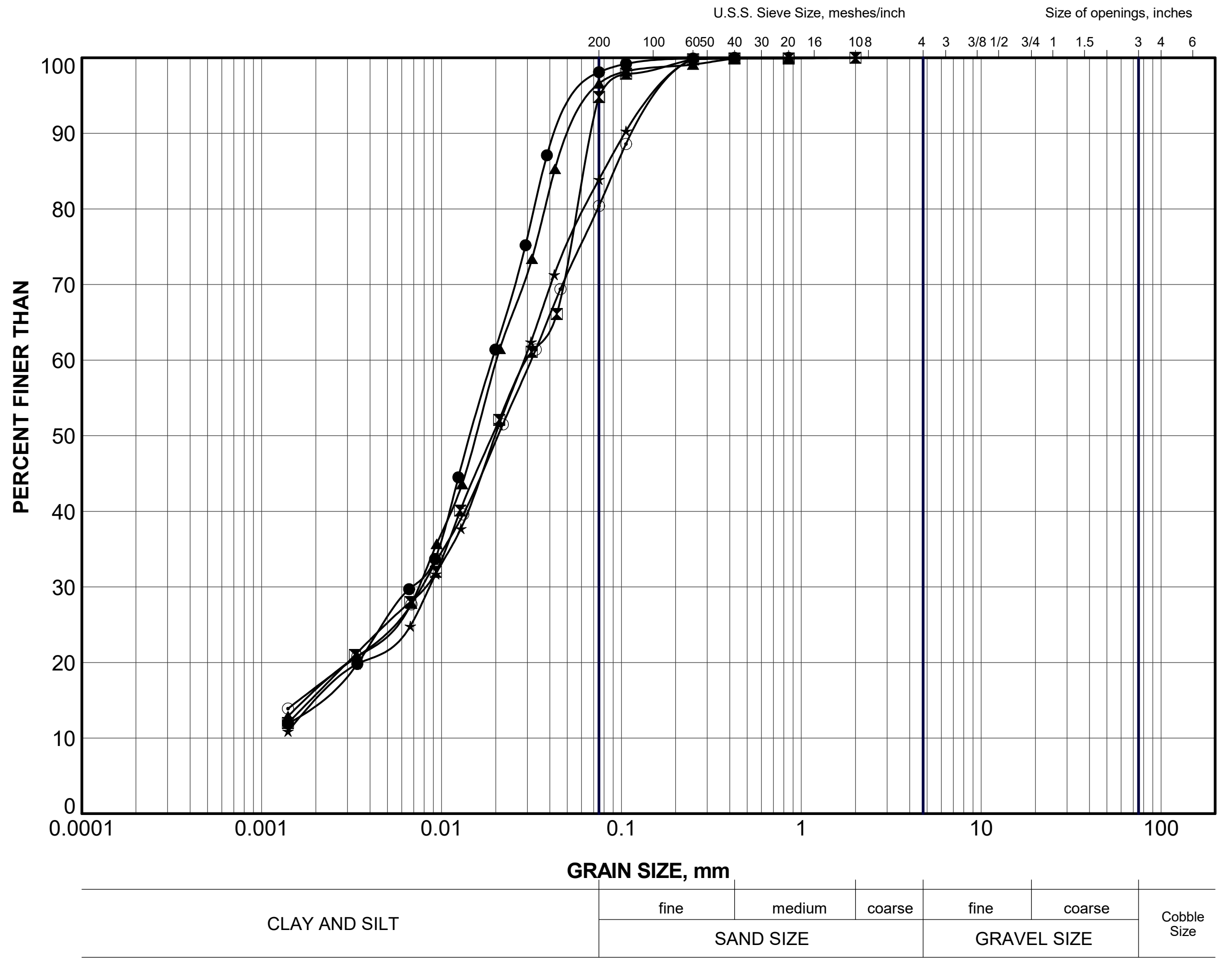
SAND

GOLDER

SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ
DRAWN	TR	Nov 2019	SCALE N/A	REV.
CHECK	AB	Nov 2019		
APPR	JMAC	Nov 2019	**FIGURE B-2**	

SUD-MTO GSD GLDR_LDN.GDT



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C258-1	10	267.4
⧗	C258-3	10	267.3
▲	C258-4	7	269.8
★	C258-4	8	268.3
⊙	C258-5	7	268.0

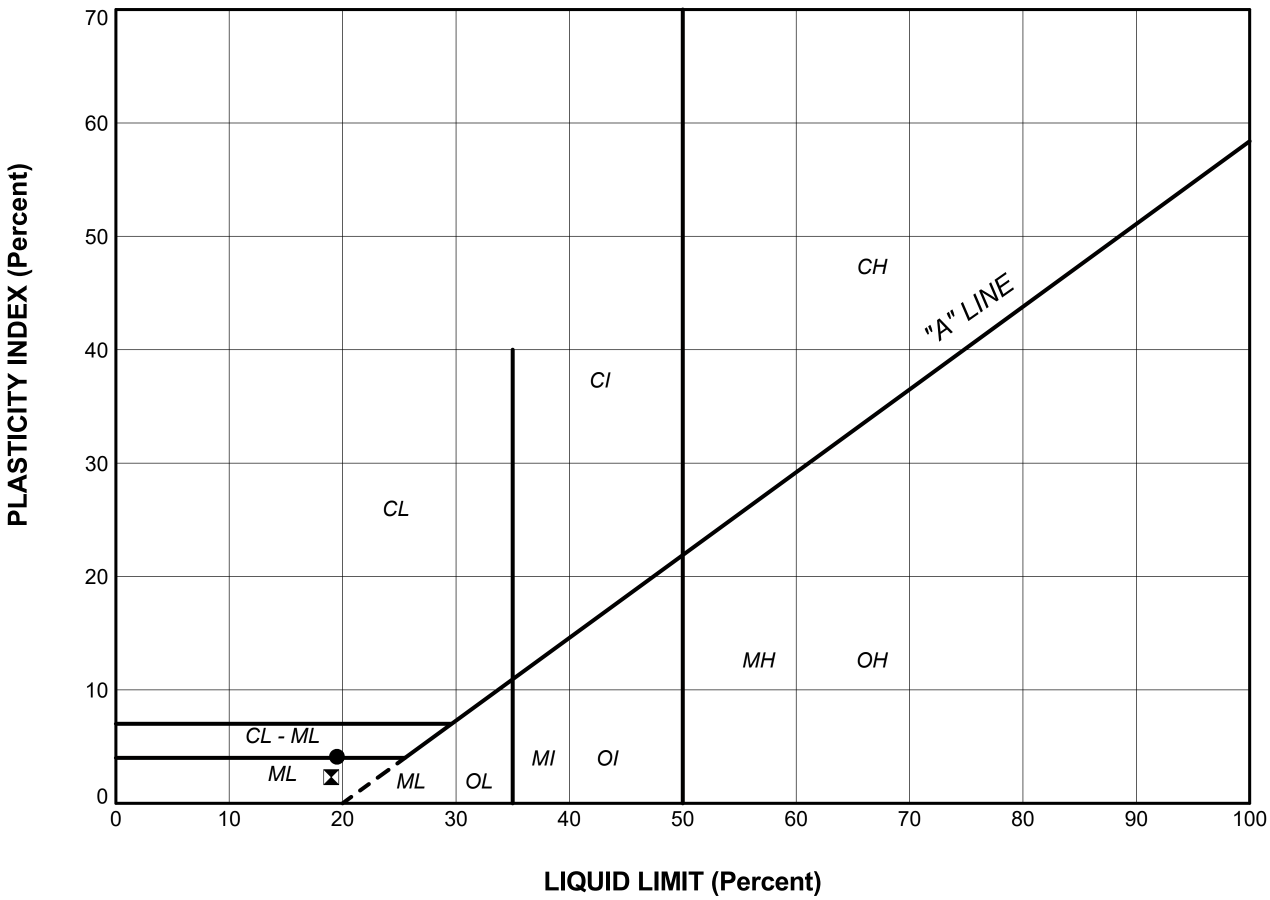
PROJECT
HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT

TITLE
GRAIN SIZE DISTRIBUTION
SILT

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ
DRAWN	TR	Nov 2019	SCALE N/A	REV.
CHECK	AB	Nov 2019		
APPR	JMAC	Nov 2019	**FIGURE B-3**	

SUD-MTO GSD GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C258-1	10	19.5	15.4	4.1
⧗	C258-4	8	19.0	16.7	2.3

PROJECT

HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT

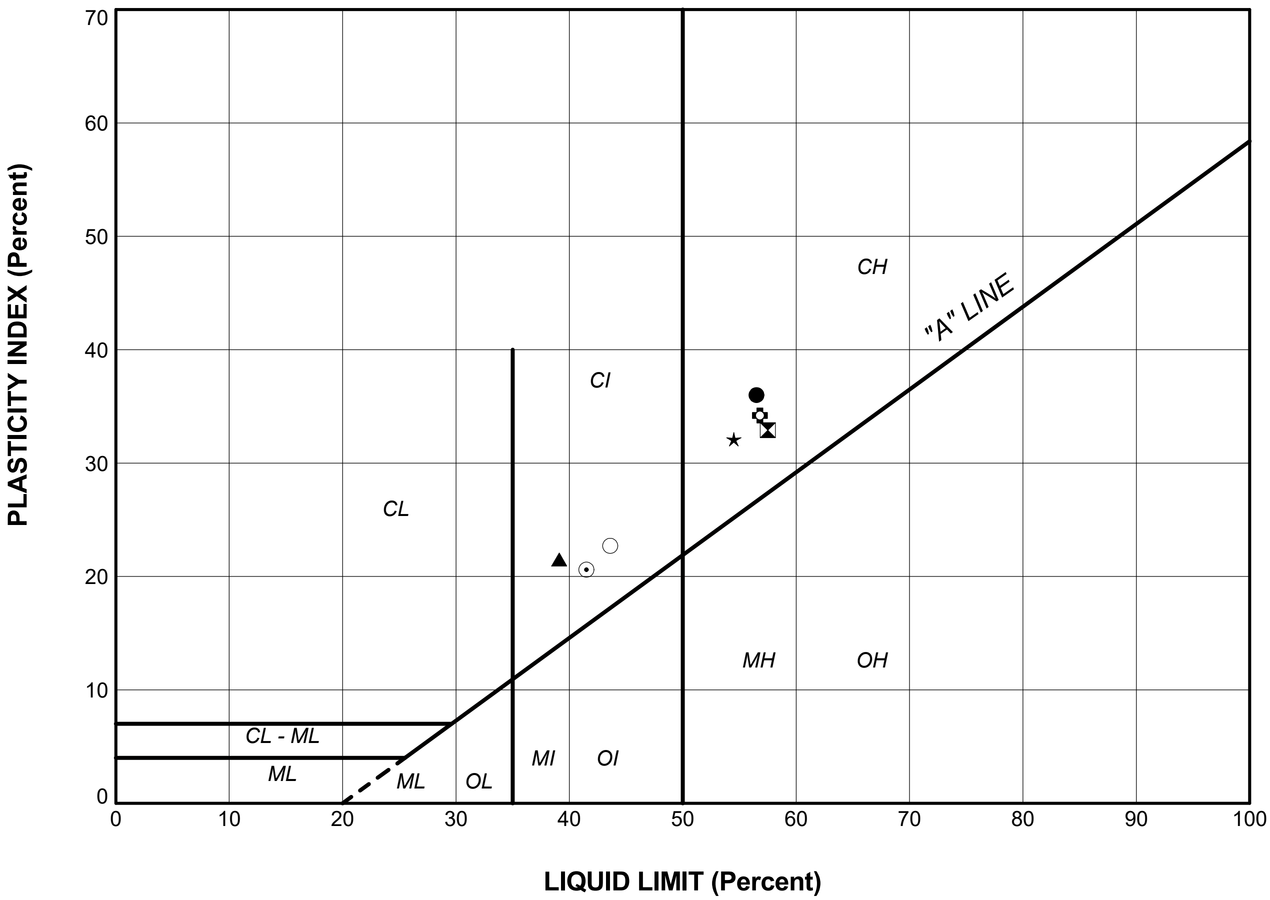
TITLE

PLASTICITY CHART
SILT

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ
DRAWN	TR	Nov 2019	SCALE N/A	REV.
CHECK	AB	Nov 2019	**FIGURE B-4**	
APPR	JMAC	Nov 2019		

SUD-MTO PL GLDR_LDN.GDT



SOIL TYPE
C = Clay
M = Silt
O = Organic

PLASTICITY
L = Low
I = Intermediate
H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C258-1	12	56.5	20.5	36.0
⧗	C258-1	14	57.5	24.6	32.9
▲	C258-2	8	39.1	17.6	21.5
★	C258-2	12	54.5	22.4	32.1
⊙	C258-3	8	41.5	20.9	20.6
✪	C258-3	12	56.8	22.6	34.2
○	C258-5	9	43.6	20.9	22.7

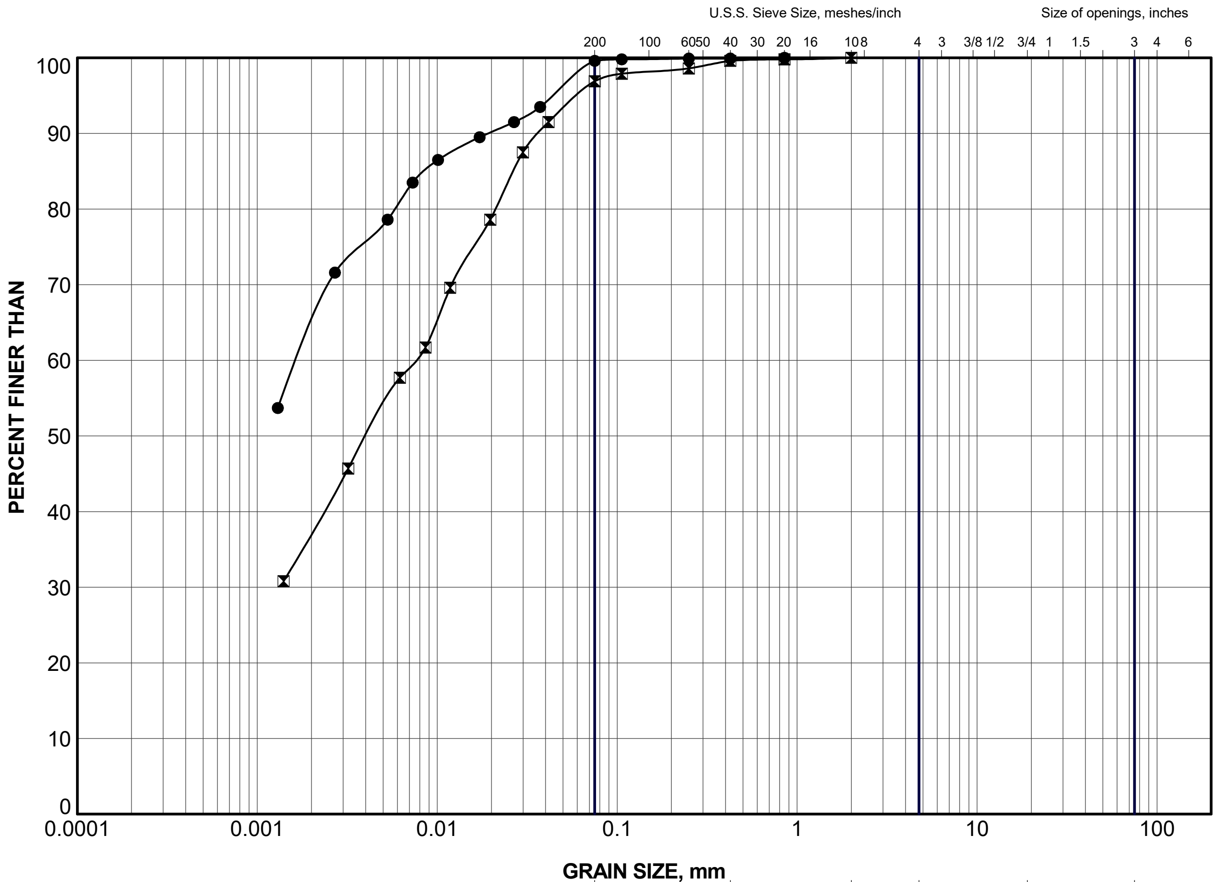
PROJECT
HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT

TITLE
PLASTICITY CHART
SILTY CLAY to CLAY

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ
DRAWN	TR	Nov 2019	SCALE N/A	REV.
CHECK	AB	Nov 2019	**FIGURE B-5**	
APPR	JMAC	Nov 2019		

SUD-MTO PL GLDR_LDN.GDT



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C258-1	12	264.4
⧗	C258-2	8	270.7

PROJECT
HIGHWAY 66
STATION 17+903
TOWNSHIP OF GAUTHIER CULVERT

TITLE
GRAIN SIZE DISTRIBUTION
SILTY CLAY to CLAY

GOLDER
SUDBURY, ONTARIO

PROJECT No.		1896349	FILE No.	1896349.GPJ	
DRAWN	TR	Nov 2019	SCALE	N/A	REV.
CHECK	AB	Nov 2019			
APPR	JMAC	Nov 2019	**FIGURE B-6**		

SUD-MTO GSD GLDR_LDN.GDT

BV Labs Job #: B9E6999
Report Date: 2019/06/10

Golder Associates Ltd
Client Project #: 1896349
Site Location: HWY 66
Sampler Initials: MR

RESULTS OF ANALYSES OF SOIL

BV Labs ID		JWF921			JWF921			JWF922		
Sampling Date		2019/05/21 09:10			2019/05/21 09:10			2019/05/24 12:10		
COC Number		127612			127612			127612		
	UNITS	**C212-1**	**RDL**	**QC Batch**	**C212-1 Lab-Dup**	**RDL**	**QC Batch**	**C258-1**	**RDL**	**QC Batch**
CONVENTIONALS										
Sulphide	ug/g	<0.50	0.50	6165835	<0.50	0.50	6165835	<0.50	0.50	6165835
Calculated Parameters										
Resistivity	ohm-cm	30000		6152340				5400		6152340
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	<20	20	6156490				40	20	6156490
Conductivity	umho/cm	33	2	6158961	32	2	6158961	185	2	6158961
Available (CaCl2) pH	pH	6.11		6156642				7.70		6156642
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	6156491	<20	20	6156491	<20	20	6156491
Physical Testing										
Moisture-Subcontracted	%	12	0.30	6165834				19	0.30	6165834

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

APPENDIX C

Non-Standard Special Provisions and Notice to Contractor

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.

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: 48.106900					Longitude: -79.800600
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	
Highway 66, Station 17+903, Township of Gauthier Culvert Replacement	***	****	****	****	****	Yes
Dewatering Systems						
Site Name / Station Reference	Preconstruction Survey Distance (Note 2) (m)					Design Engineer Requirements (Note 1)
Highway 66, Station 17+903, Township of Gauthier Culvert Replacement	N/A					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.

NOTES TO DESIGNER:

Designer Fill-in for Table A:

* Enter the latitude and longitude co-ordinates of the IDF Curve as obtained using the MTO IDF Curve Look up Tool. Create additional tables, as necessary, if more than one (1) IDF curve was used on the contract (i.e. on a very long contract there may be two IDF curves used to better represent rainfall events for two (2) different sections of the contract).

** Fill-in site name, work, and station reference as appropriate for the dewatering system and/or temporary flow passage system item locations.

*** For temporary flow passage system item locations, fill-in the minimum design storm return period for the site based on MTO Drainage Design Standard TW-1.

**** For temporary flow passage system item locations, fill-in the design flow rate estimates for the various return periods.

***** Insert "Yes" when recommended by the Foundation Engineer. Insert "No" otherwise.

****** Fill-in the required distance for preconstruction survey if recommended by the Foundation Engineer. Fill-in "N/A" if not recommended.

WARRANT: Always with these tender items.

GOLDER

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