Subsurface Conditions Baseline Report

Sanitary Sewer Installation at Station 17+460, QEW Widening from West of Mississauga Road to West of Hurontario Street, Mississauga
Ministry of Transportation, Ontario, GWP 2002-13-00

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to prepare this Subsurface Conditions Baseline Report (SCBR) for the sanitary sewer installation crossing the Queen Elizabeth Way (QEW) at about Station 17+460, associated with the widening of the QEW from west of Mississauga Road to west of Hurontario Street in the City of Mississauga, Ontario. This report consolidates and summarizes the results of geotechnical explorations and testing carried out at the crossing. This report is to be read together with the Contract Drawings and Specifications (Contract Documents) prepared by the project designers (MH) and the MTO. Bidders shall refer to the Contract Documents for the order of precedence in the event of conflicting information.

The purpose of this report is to describe and summarize the subsurface conditions anticipated at the crossing site and to establish the baseline subsurface conditions for the Contract. It forms the basis on which to judge whether the conditions encountered during construction are materially different from those anticipated at the time of bidding.

This report provides figures that summarize data and presents baseline subsurface conditions and geotechnical engineering parameters. For individual test results, the bidder is to refer to the Foundation Investigation Report (FIR) for this sanitary sewer installation, prepared by Golder (GEOCRES No. 30M12-451, dated July 30, 2019). Where alignments and stations are shown on the figures or referenced in the text, they are based on the General Arrangement drawings provided by MH. The stations referred to in this SCBR are approximate and the Contractor is expected to refer to the Contract Documents for the exact station, coordinates and details of existing and proposed features, structures and buried utilities.

This SCBR is intended to:

- provide a subsurface conditions baseline for bidding the work;
- assist the project Owner in reviewing the Contractor's submittals; and
- establish a subsurface conditions baseline that will be used to resolve disputes and claims related to subsurface conditions.

This SCBR has been prepared for a Design-Bid-Build construction contract for the installation of the primary liner and the sanitary sewer at the above-noted site and does not provide discussions on the anticipated ground behaviour in relation to specific construction means and methods because the Contractor is responsible for and will select the construction means and methods. This report does describe anticipated natural soil behaviour in the absence of any support or modification provided by the Contractor's means and methods. Therefore, the content of this report departs from typical practice, and this SCBR is not to be considered the equivalent of a Geotechnical Baseline Report, as defined in ASCE (2007).

The provision of baseline conditions in the Contract is not a warranty that the baseline conditions will be encountered; rather, the baseline conditions represent a contractual basis for the Owner and the Contractor to use when interpreting the differing site conditions clause in the General Conditions and Special Conditions of the Contract. The Contractor is to rely on this report for bidding and construction planning purposes related to anticipated ground and groundwater conditions and the Contractor is to plan construction and select equipment to fully address the expected baseline conditions identified in this report.

This SCBR is applicable only to the sanitary sewer installation section that will cross beneath the QEW using tunnelling methods and is not applicable to other elements of the QEW Widening from west of Mississauga Road to west of Hurontario Street or other sections of the sanitary sewer.

2.0 SITE AND PROJECT DESCRIPTION

The proposed sanitary sewer installation at Station 17+460 is located approximately 600 m east of the Credit River and extends from Premium Way to the south side of the QEW, in the City of Mississauga, Ontario (see Drawing 1). The QEW and Premium Way are oriented in a southwest-northeast direction which, for the purpose of this report, is referred to as west-east orientation.

The QEW consists of three eastbound lanes (Toronto bound) and three westbound lanes (Hamilton bound), while Premium Way consist of one lane in each direction. Residential areas are located along the north side of the Premium Way and between the south side of the QEW and Pinetree Way. The existing ground surface along the alignment of the relocated sanitary sewer varies from about Elevation 93.5 m at the north end, about Elevation 95.0 m on the pavement surface of the QEW (eastbound lanes) and about Elevation 90.0 m at the south end.

3.0 SOURCES OF INFORMATION

The documents listed in this section have been used in developing the SCBR, but these are not to be considered part of the SCBR and publications are referenced herein for information purposes only.

Where precise determination of deposit boundaries or geotechnical engineering parameters are necessary for the safety and stability of the works, or for other construction concerns, or in instances where specialized geotechnical engineering properties of soils or bedrock are required but are not presented in the SCBR, these boundaries and parameters are to be identified and determined by supplementary investigations and testing by the Contractor prior to construction. This SCBR provides baseline conditions only for the physical subsurface conditions and does not provide baseline conditions for the chemistry of the soil, bedrock or groundwater.

3.1 Subsurface Data

Subsurface data gathered from multiple sources have been used in development of this report. The principal source of data is the FIR, referenced below. The subsurface materials as characterized in the FIR were defined at specific sample locations within the boreholes, and the Contractor is expected to review the specific subsurface data available in the Foundation Investigation Report. However, the interpretation of geotechnical engineering properties and parameters for the deposits and the stratigraphy as interpreted between samples provided in this SCBR are the baselines for this project. In the event of conflict between the FIR and the SCBR, the SCBR shall be given precedence for the purpose of tendering and evaluating claims related to ground conditions.

- Golder Associates Ltd. "Foundation Investigation Report, Sanitary Sewer Installation at Station 17+460, QEW Widening from West of Mississauga Road to West of Hurontario Street, Mississauga, Ministry of Transportation, Ontario, GWP 2002-13-00", dated July 30, 2019, GEOCRES No. 30M12-451.

3.2 Geological References

The geological publications referenced in this document and listed below are for general information purposes only.

- Brennand, T. A. "Urban Geology of Toronto and Surrounding Area" in *Urban Geology of Canadian Cities*. GAC Special Paper 42, pp. 323-352. Karrow, P.F., and White O.L., Editors, Geological Association of Canada Special Paper 42, Geological Association of Canada, Newfoundland, 1998.
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3.3 Publications

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4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The interpreted and simplified stratigraphic profile shown on Drawing 2 is the baseline stratigraphy for this project and is a simplification of the subsurface conditions encountered at and between the borehole locations.

Although interpreted strata boundaries are illustrated on Drawing 2, it must be understood that the stratigraphic boundaries illustrated on Drawing 2 are inferred from non-continuous sampling, observations of drilling progress and results of Standard Penetration Tests, and, therefore represent transitions between soil types rather than exact planes of geological change; actual contacts between deposits will typically be gradational as a result of natural geologic processes. Further, the boundaries shown on Drawing 2 are illustrated for the indicated section line and are based on projection of the subsurface data onto this line. Variations in the deposit boundaries and the boundaries of major intra-deposit zones from those illustrated must be anticipated both along and perpendicular to the profile line. Therefore, selection of construction equipment and procedures must be made to accommodate variations in the deposit boundaries as described in this SCBR. Where precise determination of deposit boundaries is necessary for the safety and stability of the works, or for other construction concerns, they are to be verified by supplementary investigations and testing by the Contractor prior to construction.

In summary, the stratigraphy encountered at the various borehole locations typically consists of surficial layers of asphalt / concrete pavement underlain by fill, underlain by a sandy silt to silt and sand deposit, underlain by a till deposit interlayered with sandy silt to sand deposits..

Within this SCBR, the stratigraphy is defined and described based on the likely geologic origin, grain size distribution, plasticity characteristics and relative elevation. This approach is used to avoid geologic unit classifications based on geologic age or stage of glacial advance. In some instances, geologic nomenclature, although correct in defining the geologic origin and age of a particular layer does not necessarily convey indications of material type or potential engineering behaviour. Precedence in this SCBR has therefore been given to naming the different soil layers based on relative elevation, grain size distribution and plasticity characteristics.

4.2 Baseline Engineering Characteristics of Soil

This section of the SCBR provides baseline geotechnical engineering parameters to be used for design of temporary works and for selection of equipment and construction methods. The baseline geotechnical engineering parameters presented are those considered relevant for the proposed installation of a reinforced concrete pipe primary liner for a sanitary sewer. Baseline values are provided consistent with 10^{th}, 50^{th}, and 90^{th} percentiles, as a means for quantitatively describing the statistical distribution of the parameter values and their natural variability. In some cases, the percentiles are based directly on statistical evaluation of available data and, in other cases, these values are supplemented by judgement based on local and regional experience with these soil types. While the 50^{th} percentile value can be used for some design purposes, the range represented by the 10^{th} to 90^{th} percentiles must also be considered as variability in physical properties is intrinsic to the nature of earth materials and is to be taken into account for estimating quantities, selection of equipment, and selection of construction means and methods.

Engineering Classes A to C, specific to this report and identified with colours on the baseline stratigraphic profile, group soil types in relation to anticipated natural behaviour during construction if exposed and in the absence of support or other modification provided through the Contractor's means and methods. The Engineering Classes used in this report are described in Table A following the text of this SCBR and in subsequent sections of this SCBR.

4.2.1 Asphalt / Concrete Pavement

Where boreholes were advanced through the existing pavement structures, an approximately 150 mm, 100 mm and 150 mm thick layer of asphalt pavement was encountered at ground surface in Boreholes C5-1, C5-2 and NRW3-5, respectively. A 510 mm thick layer of concrete was encountered underlying the asphalt pavement in Borehole C5-2. While asphalt pavement materials were encountered within some of the boreholes, this SCBR does not provide baseline characterizations of thicknesses, extents or locations of pavement materials.

4.2.2 Fill (Class A)

Approximately 1.0 m to 4.3 m thick layer of fill comprised of silt and sand to silty sand to sand, trace to some gravel, was encountered underlying the asphalt / concrete pavement within the limits of the roadways. The fill is considered to be associated with the local road structure, QEW construction and nearby utility trenches.

A baseline grain size distribution envelope of Fill (Class A) is presented on Figure 1. Baseline classification and engineering parameters for Fill (Class A) are provided in Table 1 below. SPT "N"-values and water content percentages are based on field sampling and lab testing.

Table 1: Baseline Geotechnical Parameters for Fill (Class A)

Parameter	10th Percentile[1]	50th Percentile[1]	90th Percentile[1]
SPT "N"-Value[2]	2	8	23
Water Content, w_n (%)	4	15	28
Gravel (%) [3]	1	7	19
Sand (%) [3]	49	63	78
Fines (%) [4]	22	33	50
D_{10} (mm)	0.005	0.042	0.050
D_{60} (mm)	0.088	0.1	0.438
Coefficient of Uniformity, Cu	2	3	34
Wet Unit Weight, kN/m^3	18	21	22
Effective Angle of Internal Friction, φ' (degrees)	30	33	35
Estimated Permeability, k (m/s)	2.0×10^{-5}	2.0×10^{-3}	3×10^{-3}

1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100 per cent, percentile values do not necessarily add to 100 per cent because these statistics represent ranges of separate measurement parameters.
2) Baseline blow counts are based on SPT "N"-values measured for 0.3 m of penetration; for tests that did not penetrate a full 0.3 m, the blow count values were increased in proportion to the fraction of a standard 0.3 m penetration actually achieved, to a maximum equivalent SPT "N"-value of 150 blows per 0.3 m. Where a value of 150 blows per 0.3 m penetration is indicated within this report, this must also be interpreted that these values represent effective refusal to penetration of SPT equipment.
3) Total weight of particles as compared to the total sample weight.
4) "Fines" content refers to the total weight of particles passing the 0.075 mm sieve opening size as compared to the total sample weight.

4.2.3 Granular Deposits (Class B)

A 0.4 m to 3.4 m thick granular deposit comprised of sandy silt to silt and sand was encountered was encountered at ground surface outside of the limits of the roadways and underlying the fill within the limits of the roadways at depths of between about 0.0 m and 4.9 m below ground surface.

A baseline grain size distribution envelope of the Granular Deposits (Class B) is presented on Figure 2. Baseline classification and engineering parameters for the Granular Deposits Soils (Class B) are provided in Table 2 below, based on the site-specific data as well as experience with similar native deposits in the project vicinity.

The presence of cobbles and boulders in the granular deposits has been inferred based on local knowledge of this geologic layer. Baseline characterization of cobbles and boulders is provided in a later section of this SCBR.

Table 2: Baseline Geotechnical Parameters for Native Granular Deposits (Class B)

Parameter	10^{th} Percentile[1.]	50^{th} Percentile[1.]	90^{th} Percentile[1.]
SPT "N"-Value[2.]	7	25	43
Submerged Water Content, w_n (%)	14	20	27
Gravel (%) [3.]	0	0	5
Sand (%) [3.]	21	35	59
Fines (%) [4.]	39	65	78
D_{10} (mm)	0.007	0.023	0.036
D_{60} (mm)	0.065	0.084	0.100
Coefficient of Uniformity, Cu	2	4	13
Wet Unit Weight, kN/m^3	18	20	21
Effective Angle of Internal Friction, φ' (degrees)	30	34	38
Estimated Permeability, k (m/s)	$4.9x10^{-5}$	$5.0\ x10^{-4}$	$1.0\ x10^{-3}$

1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100 per cent, percentile values do not necessarily add to 100 per cent because these statistics represent ranges of separate measurement parameters.
2) Baseline blow counts are based on SPT "N"-values measured for 0.3 m of penetration.
3) Total weight of particles as compared to the total sample weight.
4) "Fines" content refers to the total weight of particles passing the 0.075 mm sieve opening size as compared to the total sample weight.

4.2.4 Glacial Till (Class C)

A 5.3 m to greater than 8.5 m thick till deposit was encountered underlying the granular deposit (Class B). The till deposit consists of clayey silt with sand to sandy clayey silt to clayey silt and gravelly silt and sand to silty gravelly sand.

The baseline grain size distribution envelope for the Glacial Till (Class C) deposit is presented on Figure 3. The baseline envelope for Atterberg Limits is presented on Figure 4, which indicates that these materials are have low plasticity to medium plasticity. Above the groundwater level, the Glacial Till will be fissured and have a blocky structure when exposed. Baseline values for other geotechnical engineering parameters for the Glacial Till are provided in Table 3 below. Baseline SPT "N"-values provided within Table 3 are for samples where a full 457 mm of penetration could be accomplished and appropriate hammer blows summed for the last 300 mm of penetration. The baseline SPT "N"- values provided in Table 3 below are, therefore, considered representative of the soil matrix. For baseline purposes, it is expected that within the Glacial Till Deposits approximately 45 per cent of all SPT "N"- values will not achieve full penetration and exhibit more than 100 hammer blows for less than 0.3 m of penetration, considered representative of driving the sampler on very dense soil, gravel, cobbles and/or boulders.

The presence of cobbles and boulders in the Glacial Till has been inferred based on observations during drilling and local knowledge of this geologic layer. Baseline characterization of cobbles and boulders is provided in a later section of this SCBR.

Table 3: Baseline Geotechnical Parameters for Glacial Till (Class C)

Parameter	10th Percentile[1.]	50th Percentile[1.]	90th Percentile[1.]
SPT "N"-Value[2.]	4	19	77
Water Content, w_n (%)	8	12	19
Gravel (%) [3.]	3	10	22
Sand (%) [3.]	19	30	54
Fines (%) [4.]	29	61	76
Plastic Limit, PL (%)	14	15	18
Liquid Limit, LL (%)	18	23	29
Plasticity Index, PI	3	8	12
D_{10} (mm)	<0.001	<0.001	0.09
D_{60} (mm)	0.0086	1.02	0.076
Coefficient of Uniformity, Cu	1	85	1800
Wet Unit Weight, kN/m^3	18	20	22
Effective Angle of Internal Friction, φ' (degrees)	30	36	40
Estimated Permeability, k (m/s)	$1x10^{-8}$	$3x10^{-7}$	$8x10^{-3}$

1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100 per cent, percentile values do not necessarily add to 100 per cent because these statistics represent ranges of separate measurement parameters.
2) Baseline blow counts are based on SPT "N"-values measured for 0.3 m of penetration.
3) Total weight of particles as compared to the total sample weight.
4) "Fines" content refers to the total weight of particles passing the 0.075 mm sieve opening size as compared to the total sample weight.

4.2.5 Groundwater Conditions

Water levels were observed in the open boreholes upon completion of drilling operations and were dry upon completion in Borehole C5-2, to between 1.5 m and 7.9 m below ground surface (between Elevations 92.2 m and 91.5 m) in Boreholes C5-1and NRW3-5. However, the water level observed in the open boreholes during and/or upon completion of drilling does not necessarily represent the longer-term, stabilized groundwater level at the site. Borehole C5-3 was advanced with wash boring methods and the groundwater level was at ground surface upon completion of drilling; however, this water level is not reflective of in-situ conditions. Standpipe piezometers were installed in Boreholes C5-1 and C5-3 and measured groundwater levels in the standpipe piezometers are summarized in Table 4:

Table 4: Recorded Groundwater Levels in Standpipe Piezometers

Borehole No.	Depth to Water Level (m)	Groundwater Elevation (m)	Date of Measurement
C5-1	3.5	90.2	February 19, 2019
	2.2	91.5	March 19, 2019
C5-3	2.7	87.1	March 13, 2019

A baseline groundwater level is provided on Drawing 2. For baseline purposes, groundwater levels are to be expected to fluctuate seasonally in response to changes in precipitation and snow melt to as much as 1 m above or below the baseline groundwater level. Any water infiltrating through the roadway and embankment fill is also expected to be inhibited by and therefore perched within the Fill and Granular Deposits overlying the Glacial Till deposit.

4.3 Cobbles, Boulders and Other Obstructions

With the exception of processed (crushed and screened) sand and gravel road base, the materials through which construction will be performed are glacially derived and therefore will contain cobbles and boulders. Cobbles are defined as rock fragments that cannot pass through a screen with 75 mm square openings, but that are less than 300 mm in maximum dimension. Boulders are defined as rock fragments with their maximum dimension equal to or greater than 300 mm. Boulders and cobbles were not sampled or cored in the boreholes advanced at the site; however, instances of auger/casing grinding and coring of boulders were recorded during drilling in some boreholes and it is inferred that the native granular soils and glacial till soils contain cobbles and/or boulders at this site.

Based on past experience within the Greater Toronto Area, the combined total volume of individual boulders, known as the Boulder Volume Ratio (BVR), within glacial derived soils typically ranges between 0.15 percent and 0.3 percent of the excavated volume. Typically, the size distribution of boulders is such that between 5 and 10 boulders of varying sizes are found for every cumulative cubic metre of boulder rock. The number of boulders per cubic metre of cumulative boulder volume encountered is the Boulder Number Ratio (BNR). For baseline purposes, the BVR, BNR and Boulder Maximum Size values are provided in Table 5 below.

Table 5: Baseline Boulder Parameters

Parameter	Granular Deposits (Class B)	Glacial Till (Class C)
Boulder Volume Ratio (BVR)	0.1%	1.0%
Boulder Number Ratio (BNR)	10	10
Boulder Maximum Size (m^3)	0.4	1.0

For example, using the BVR and BNR provided above for an excavated volume of 100 cubic metres (m^3) of Glacial Till (Class C) (by drilling or other excavation equipment), a cumulative 1.0 m^3 of boulder rock manifested in approximately 10 boulders will be anticipated. For baseline purposes, where calculations result in a fractional number of boulders, the number is to be rounded up to the nearest integer. The Contractor is to consider penetration, breaking, or removal of cobbles routine requirements of construction and not to be accounted for separately. For baseline purposes, as part of the boulder volumes given in Table 5 above, one boulder with a diameter between 0.8 m and 1.0 m should be expected to be encountered along the tunnel alignment. The Contractor is to also anticipate "nests" or groups of boulders closely spaced within the glacial till deposits.

For baseline purposes, the cobbles and boulders will be composed of gneissic and dioritic rocks of the Canadian Shield. The uniaxial compressive strength of the rock forming cobbles and boulders will range from about 120 MPa to 200 MPa (10th and 90th percentiles) with a 50th percentile value of about 180 MPa.

The date of construction of the original QEW, Stavebank Road and Premium Way fill placement is unknown; as well, typical construction practices with regards to clearing and grubbing of the site prior to fill placement at the time of construction are unknown. No records of construction of the highway or local roadways (site records/journals, photographs, as-constructed drawings, etc.) were available at the time of writing this SCBR. For baseline purposes it is to be expected that where construction penetrates fill materials there will be debris consisting of broken concrete, reinforcing bars, logs, stumps and brush from previous clearing and grubbing operations and cobbles and boulders buried in the fill. The contractor must select a construction method that is capable of removing these types of obstructions in fill materials and at the transition between native and fill materials.

5.0 EXISTING UTILITIES

Utilities present along the project alignment, including but not limited to lighting, communications cables, storm sewers, and natural gas pipelines, must be accurately located and either protected or relocated. Depending upon the location, utilities relocated to avoid the trenchless construction could be affected by the settlement trough created by excavations required for trenchless construction. The Contractor is responsible for protecting existing and newly relocated utilities from settlement and horizontal displacement. Protection of utilities, support of excavations, instrumentation and monitoring have been specified elsewhere in the Contract Documents to control, measure and document the amount of displacement at these sites.

6.0 CLASSIFICATION OF ANTICIPATED GROUND BEHAVIOUR

This section of the SCBR describes the Engineering Classes of the various soil types as identified along the proposed sanitary sewer alignment, and their anticipated behaviour if exposed and unsupported. The interpreted baseline stratigraphy and the baseline piezometric level along the sanitary sewer alignment are shown on Drawing 2.

The anticipated ground behaviour presented in this report is described using the Ground Behaviour Classification System provided below in Table 6. The Tunnelman's Ground Classification System (Heuer, 1974), as derived from the original system by Terzaghi (1950), has been used as a basis to describe the anticipated behaviour of the ground. No account is taken in the given classifications of the supporting pressure provided to the face by tunneling equipment and fluids or to the response of the ground to support or modifications that are selected and implemented by the Contractor (e.g., dewatering, shoring, tunneling systems, etc.); the intent of using the Engineering Classes is to describe the behaviour of the material if exposed during excavation and tunneling without provision of support or ground modifications.

Table 6: Ground Behaviour Classification

Classification and Descriptive Terms	Sub-Classification	Behaviour
Firm		Excavation face(s) can be cut without initial support
Ravel, Raveling	Slow raveling Fast raveling	Chunks or flakes of material begin to drop out of the excavation face(s) sometime after the ground has been exposed, due to loosening, overstress, fissures, and “brittle” fracture (ground separates or breaks along distinct surfaces, as opposed to squeezing ground). In fast raveling ground, the process starts within a few minutes; otherwise the ground is slow raveling.
Squeeze, Squeezing		Ground squeezes or extrudes plastically from excavation face(s) without visible fracturing or loss of continuity, without perceptible increase in water content, and exhibits ductile plastic yield and flow.
Run, Running	Cohesive-running	Apparent cohesion in moist sand, silt, or mixtures of these, or weak cementation in any non-cohesive soil, allows the material to stand for a brief period of raveling, before it breaks down and degrades to running or flowing behaviour.
	Running	Dry non-cohesive materials without cohesion are unstable at a slope greater than their angle of repose (approximately 30 to 35 degrees). When exposed at steeper slopes, the soils run like granulated sugar or dune sand until the slope flattens to the angle of repose. Soil exhibiting such behaviour is running.
Flow, Flowing		A mixture of soil and water flows from excavation face(s) like a viscous fluid. The material can flow for great distances, completely filling excavations or tunnels in some cases.

In granular soils, face stability is commonly assessed using groundwater conditions, soil gradation, variability in gradation and in situ density. The “fines content” (combined silt and clay-size fraction of soil) for the Classes A and B soils is described in Section 4.2. While the fines content is conventionally useful for assisting with interpretation of soil behaviour, in the Greater Toronto Area granular soils can commonly include a significant “fines” content and yet also run, ravel or flow (depending on water content) contrary to conventional interpretations of likely behaviour because the “fines” can consist primarily of relatively uniformly graded silt. Therefore, the baseline behaviour descriptions and classifications provided in this report have been developed specifically for this project.

The Fill and Class B Granular Deposit will flow upon exposure where these are below the baseline piezometric groundwater level and exhibit ravelling to fast ravelling behaviour above the groundwater level. Excavation through the Glacial Till (Class C) will also encounter water-bearing granular layers that will flow upon initial exposure where these are below the baseline groundwater level. Excavation difficulties such as lumping, balling and sticking to equipment are to be expected where zones/lenses with higher silt and clay contents are encountered within the Glacial Till (Class C).

7.0 CLOSURE

This Subsurface Conditions Baseline Report was prepared by Golder Associates Ltd., with input and consultation by the project designer, Morrison Hershfield Limited., on behalf of the Ministry of Transportation, Ontario for the proposed realignment of the sanitary sewer located under the QEW at about Station 17+460, in Mississauga, Ontario. It is intended for use by bidders of MTO Contract 2019-2016.

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TABLE A: Description of Engineering Soil Classes

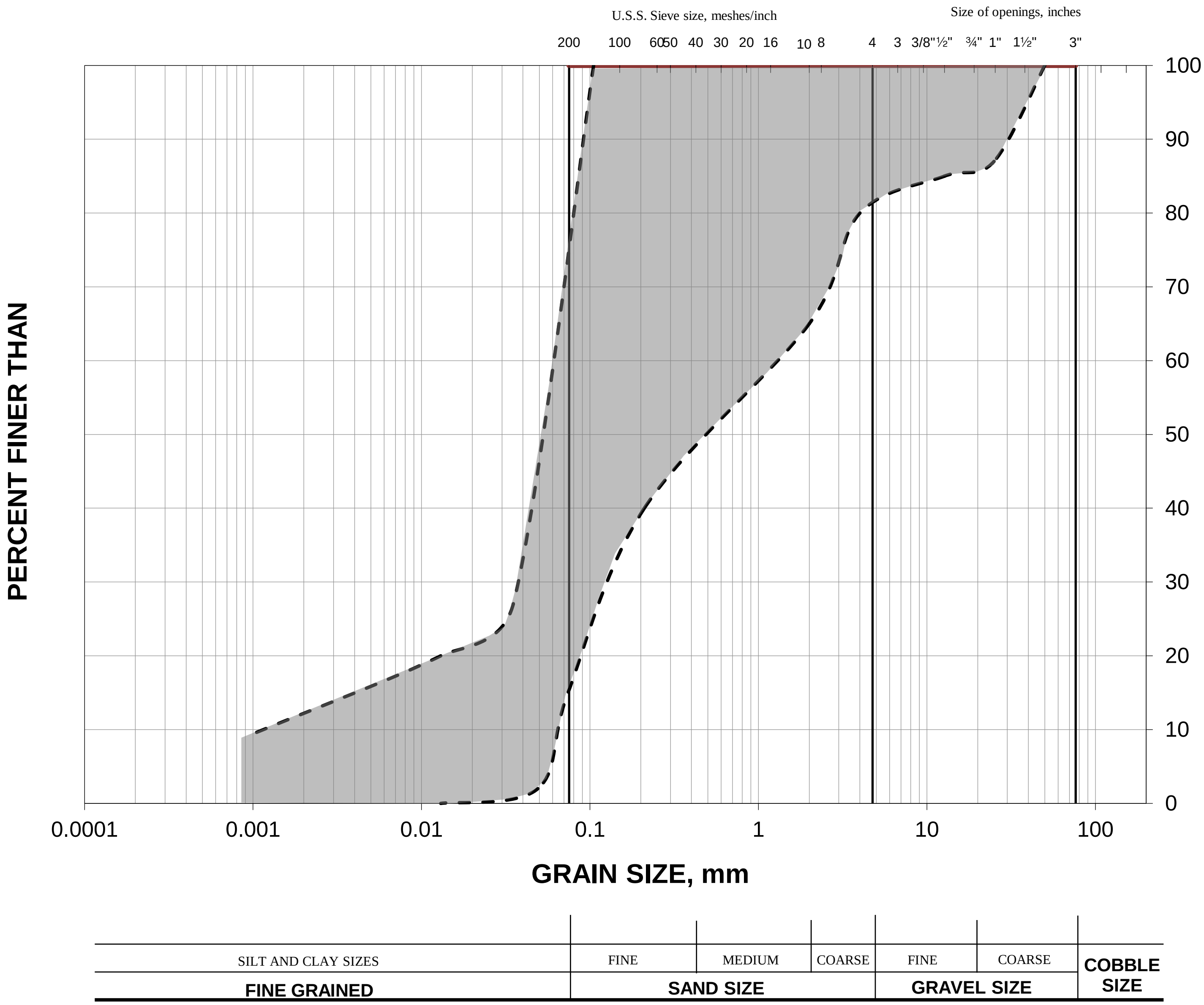
Engineering Soil Class	Colour Code	Soil Type Description	Description of Engineering Class	Major Deposits	Behaviour of Engineering Classes
A		■ Sandy Silt Fill ■ Silt and Sand Fill ■ Silty Sand Fill ■ Sand Fill ■ Construction and demolition debris	■ Near-surface materials placed by man-made processes, with random and broad compositions ■ Fill can include natural and man-made materials related to highway/roadway embankment construction, containing varying fractions of gravel silt, sand and clay, along with organic material and other debris.	■ Fill	■ Above groundwater levels, slow raveling. ■ Below groundwater levels, fast raveling to flowing. ■ Groundwater flows from and within coarser layers will decrease following exposure. ■ Rapid support of these materials and groundwater control are required to control the behaviour of these materials. ■ Sand and gravel components of material are abrasive.
B		■ Sandy Silt ■ Silt and Sand ■ Silty Sand ■ Silt ■ Sand ■ Sand and Gravel	■ Uniformly and poorly graded to well graded silt, silt and sand, sand, and sand and gravel containing trace to some clay. ■ Fines content between about 8%, and 98% content of clay-size fraction equal to or less than about 18%. ■ Non-plastic. ■ Cobbles and boulders are expected within these soil types.	■ Granular Deposit	■ Above groundwater levels, running. ■ Below groundwater levels, cohesive-running to flowing. ■ Rapid support of these materials and groundwater control are required to control the behaviour of these materials. ■ Sand and gravel components of material are abrasive.

TABLE A: Description of Engineering Soil Classes

Engineering Soil Class	Colour Code	Soil Type Description	Description of Engineering Class	Major Deposits	Behaviour of Engineering Classes
C		■ Clayey Silt to Clayey Silt with Sand Glacial Till	■ Well graded, low plasticity soils ranging from clayey silt to clayey silt with sand, containing trace to some gravel and rock fragments. ■ Above groundwater levels, the glacial till is anticipated to be fissured from various weathering processes and have a “blocky” structure when exposed. ■ The plasticity index of this soil class will range between about 4 per cent and 15 per cent. ■ The material varies in permeability and contains fissures ■ Cobbles and boulders are expected within these soils.	■ Glacial Till	■ Above groundwater levels, firm to slow raveling ■ Below groundwater levels, fast raveling. ■ Material behaviour in exposed areas will be sensitive to variation in water content and construction traffic. ■ Sand and gravel components are abrasive.

Figures

Baseline Grain Size Distribution **Sandy Silt to Silt and Sand (Fill)** **(Class A)**	**FIGURE 1**

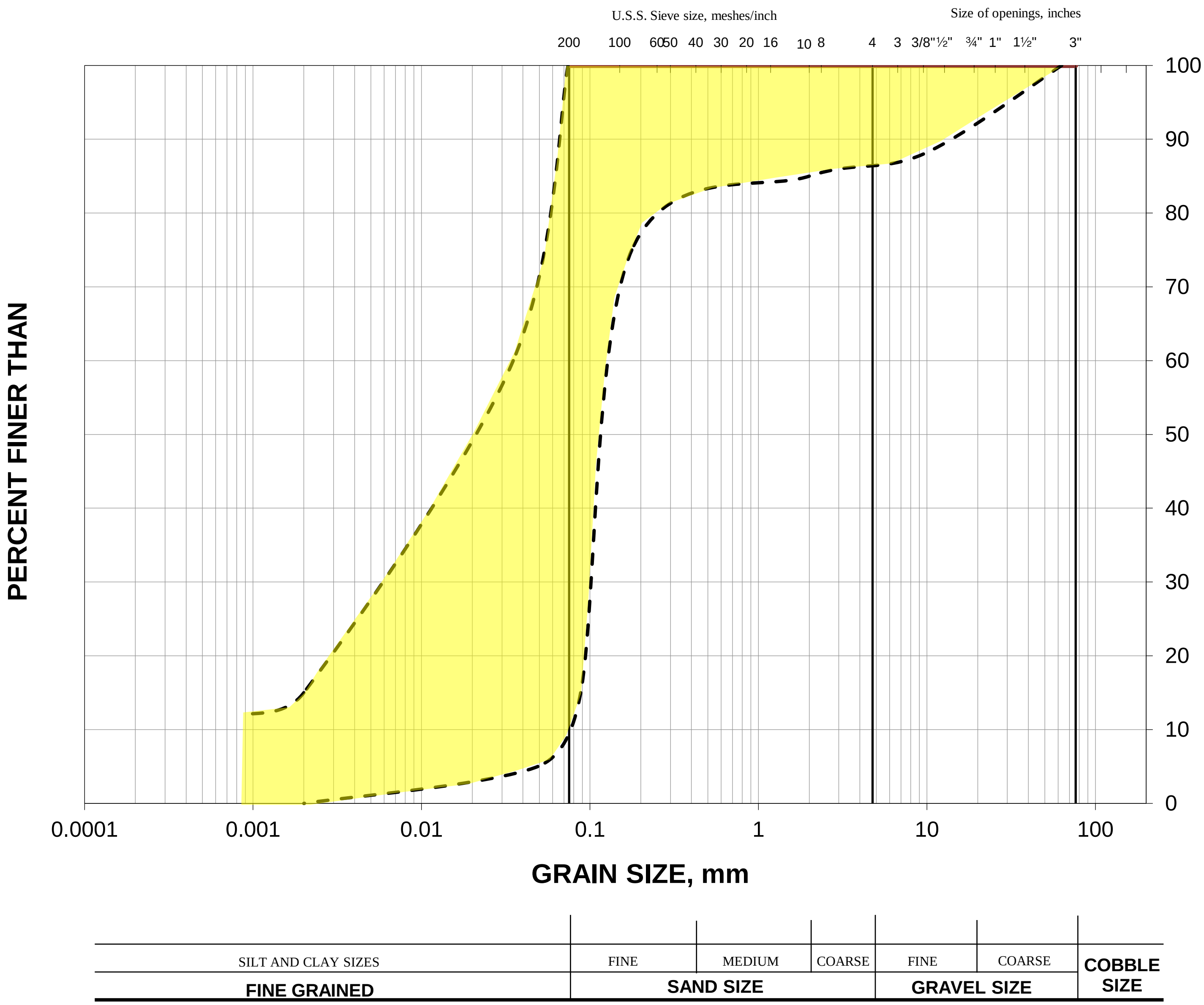


Date: April, 2019
Project: 1662333

Golder Associates

Drawn: MWK
Checked: SM

Baseline Grain Size Distribution Granular Deposits (Class B)	FIGURE 2



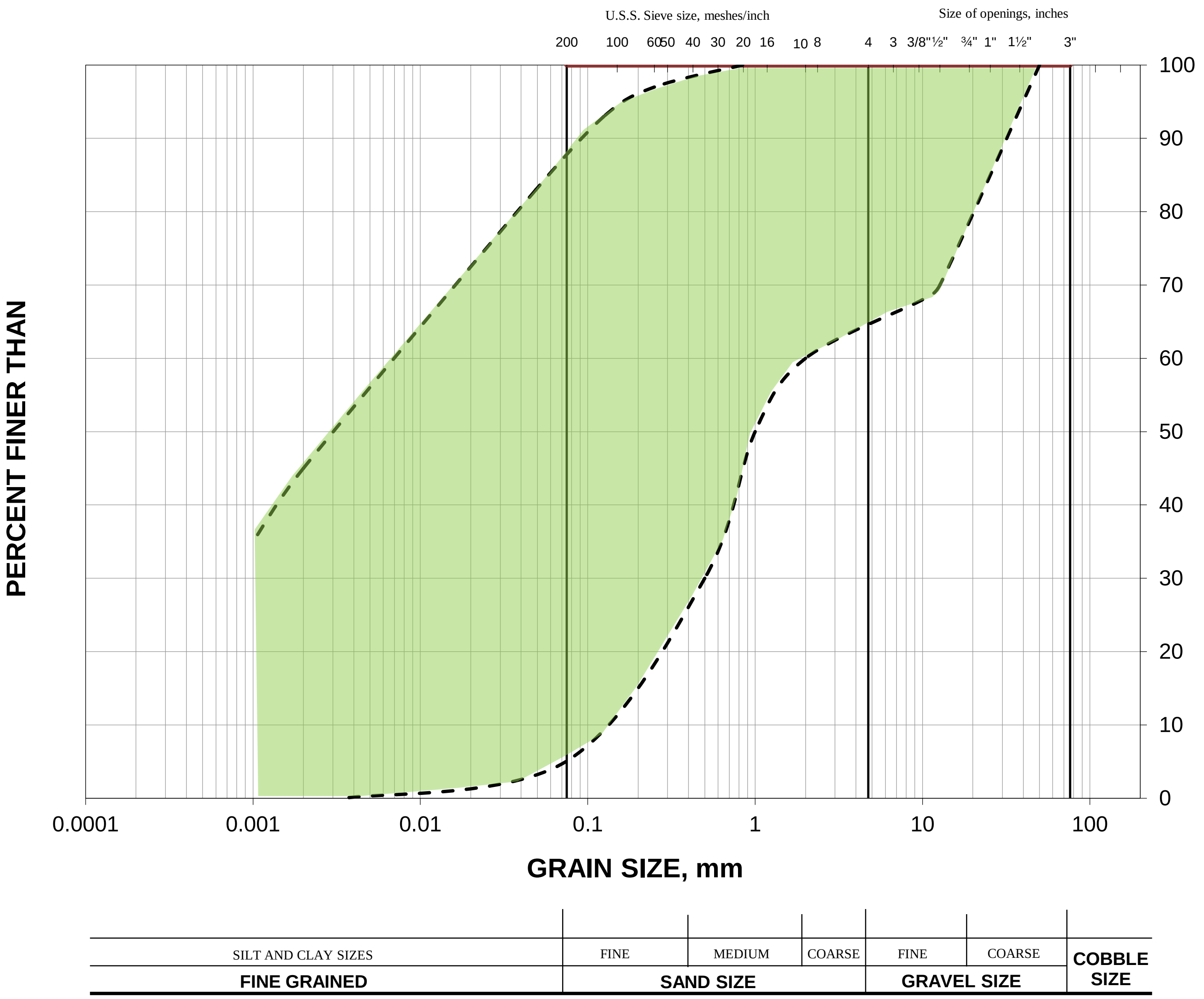
Date: April, 2019
Project: 1662333

Golder Associates

Drawn: MWK
Checked: SM

Baseline Grain Size Distribution
Glacial Till
(Class C)

FIGURE 3

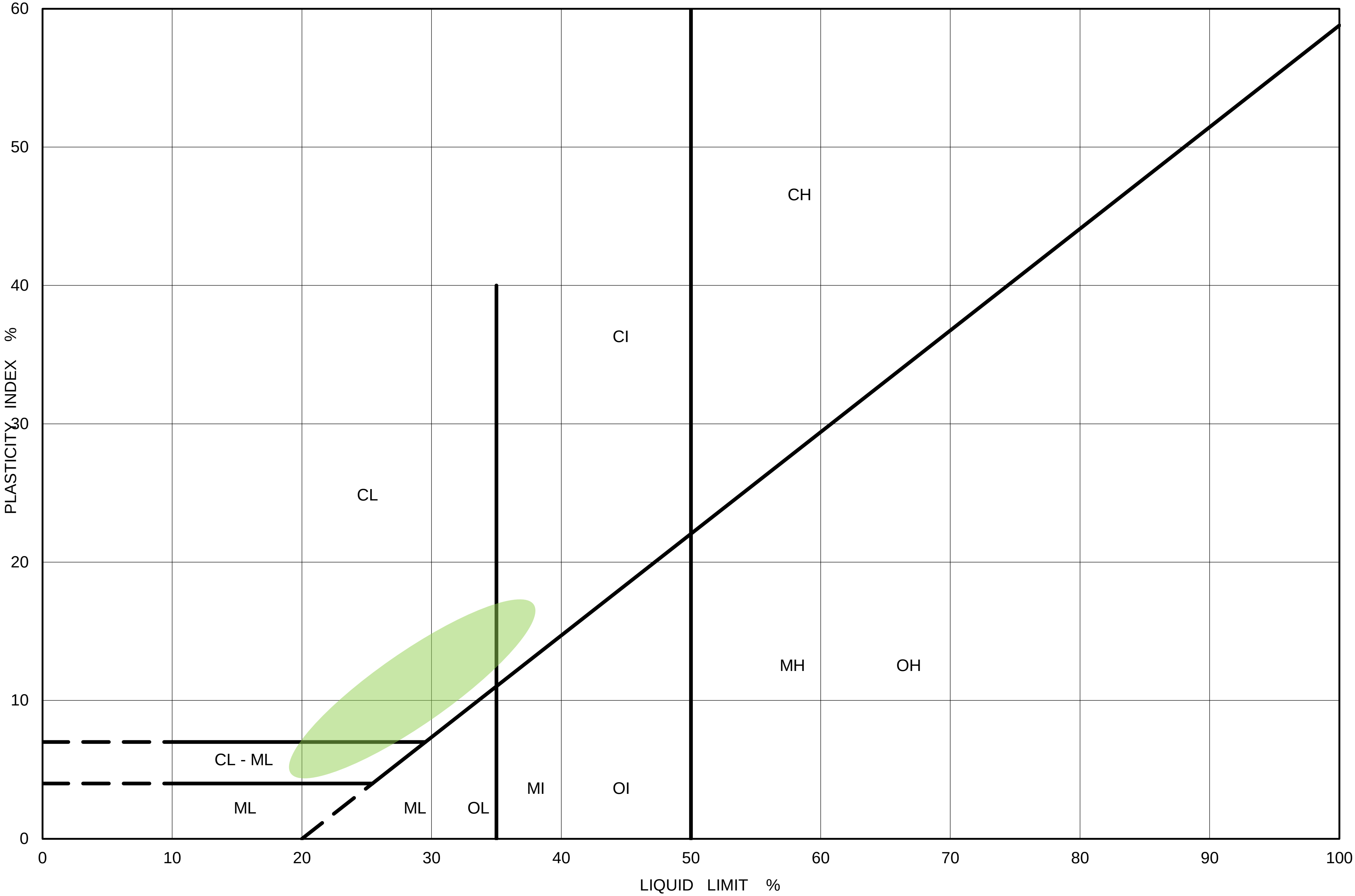


Date: April, 2019
Project: 1662333

Golder Associates

Drawn: AB
Checked: SM

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Glacial Till (Class C)

Figure No. 4

Project No. 1662333

Checked By: SM

Drawings

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

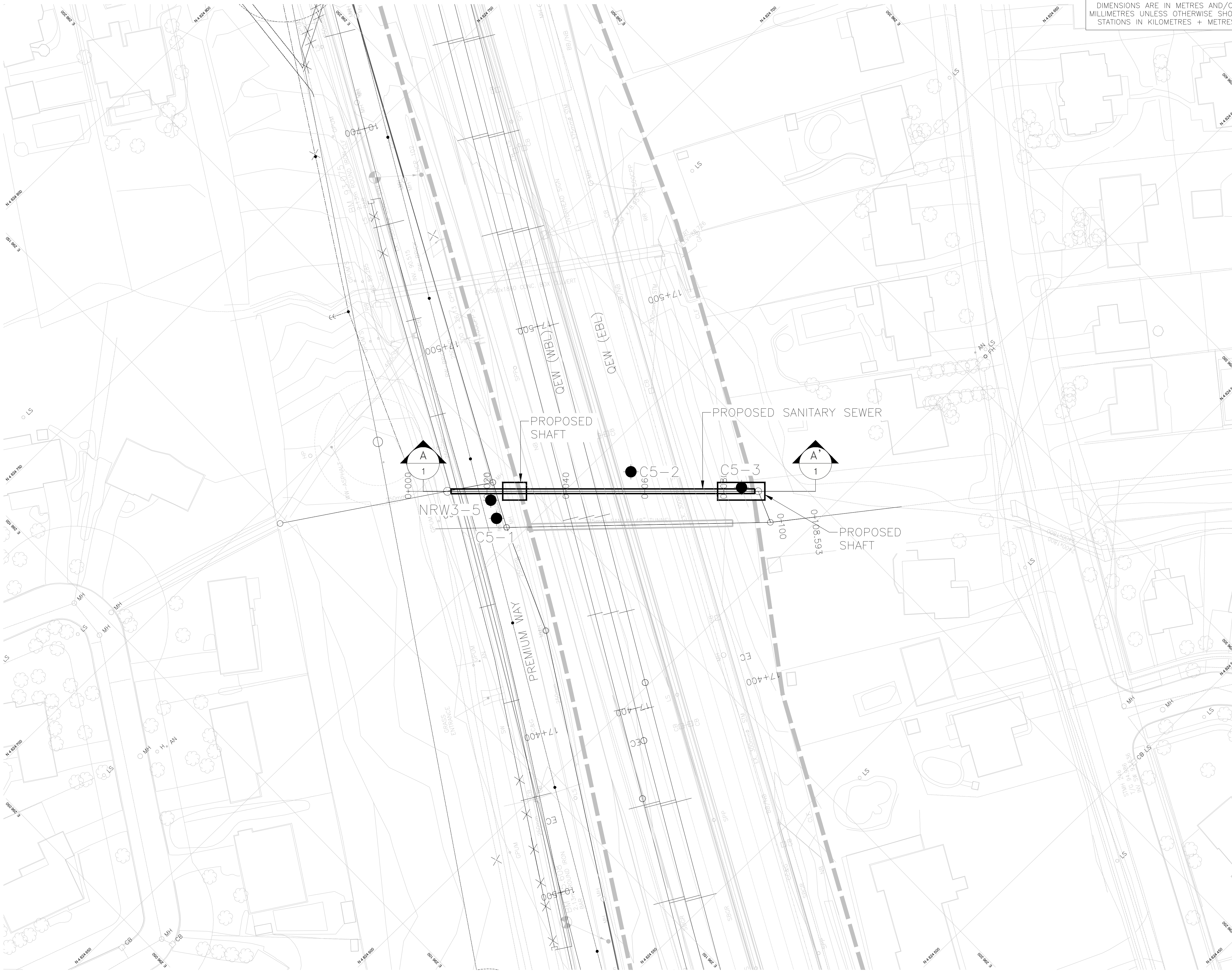
CONT No.
WP No. 2002-13-00

SHEET

QEW WIDENING – MISSISSAUGA RD TO HURONTARIO ST
SANITARY SEWER INSTALLATION STATION 17+460

BOREHOLE LOCATIONS

GOLDER



PLAN
SCALE
10 0 10 20 m

KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- ● Borehole – Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- R Split-Spoon Refusal
- WL in piezometer, March 19, 2019
- WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
C5-1	93.7	4824657.1	296188.7
C5-2	95.0	4824641.8	296221.4
C5-3	89.8	4824619.4	296238.7
NRW3-5	93.7	4824661.4	296190.9

LICENSED PROFESSIONAL ENGINEER M.W.KELLY July 30, 2019 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER S.J.BOONE 90559733 July 30, 2019 PROVINCE OF ONTARIO

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 MH, drawing file nos. X11609340Base.dwg, X-Final Merged Util.dwg, X-PROP-UTIL.dwg, Existing Property.dwg, 11609340 – QEW Prop Util-Dickson & Lynchmere – C3D 2017.dwg, 11609340 – QEW Prop Util-IndianGroveAve – C3D 2017.dwg, 11609340 – QEW Prop Util-Stavebank Rd – C3D 2017.dwg, 11609340 – QEW Prop Util-Knareswood Dr – C3D 2017.dwg, and x1160934_Align.dwg, received March 25, 2019.

NO.	DATE	BY	REVISION

Geocres No. 30M12-458

HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL
SUBM'D. AB/EJ	CHKD. MWK	DATE: 07/30/2019	SITE:
DRAWN: SW	CHKD. SMM	APPD. SJB	DWG. 1

PLOT DATE: July 30, 2019
FILENAME: S:\Clients\MTO\QEW-Credit_River\99_PROJ\1662333_MH_P&F\40_PROD\0027_SCBR_Crossing_5\1662333-0027-B0-0001.dwg

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

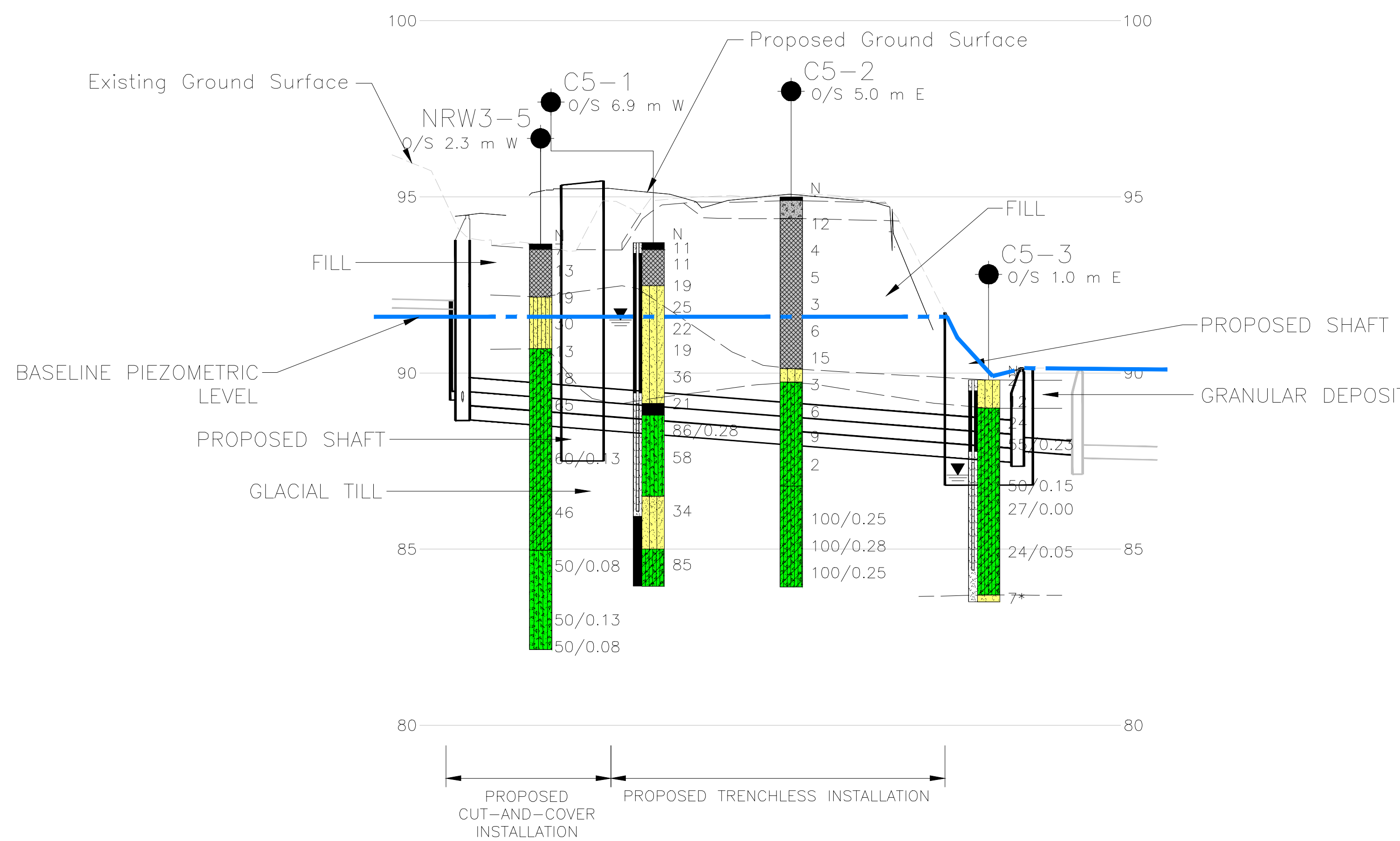
CONT No.
WP No. 2002–13–00

SHEET

QEW WIDENING – MISSISSAUGA RD TO HURONTARIO ST
SANITARY SEWER INSTALLATION STATION 17+460

BASELINE STRATIGRAPHIC PROFILE

GOLDER



PROFILE A–A' – SANITARY SEWER – STATION 17+460

KEY PLAN
SCALE
2 0 2 4 km

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- R — Split–Spoon Refusal
- WL in piezometer, March 13, 2019
- WL upon completion of drilling

BOREHOLE CO–ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
C5–1	93.7	4824657.1	296188.7
C5–2	95.0	4824641.8	296221.4
C5–3	89.8	4824619.4	296238.7
NRW3–5	93.7	4824661.4	296190.9

Class A	FILL	Fill Organics/Topsoil
Class B	GRANULAR DEPOSIT	Sandy Silt Silt and Sand
Class C	GLACIAL TILL	Gravelly Silt and Sand to Silty Gravelly Sand (TILL) /Clayey Silt with Sand to Clayey Silt (TILL)
		Baseline Major Soil Deposit or Bedrock Boundary
		Interpreted Piezometric Water Level

NOTES

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

This drawing is to be read in conjunction with the report titled "Subsurface Conditions Baseline Report, Sanitary Sewer Installation Station 17+460, QEW Widening From West of Mississauga Road to West of Hurontario Strret, Mississagua, Ontario, Ministry of Transportation Ontario, GWP 2002–13–00, Dated May X, 2019.

This interpreted stratigraphy is a simplification of the subsurface conditions. Detailed descriptions of the conditions encountered at the borehole locations are found on the records of boreholes in the Foundation Investigation Report referenced in this report.

Major soil deposit and rock formations are delineated by the boundary line identified above. The boundary established represents the baseline ground conditions; however, variation in the boundaries from those illustrated must be anticipated both parallel and perpendicular to the section line.

The characteristics and variability anticipated with the major soil deposits are described in the text of this report. Significant layers, interlayers, and lenses within the major deposits are illustrated where identified on the borehole logs. The boundaries so illustrated are intended to highlight the variability within the deposits that will exhibit gradual transitions from one soil type to another. In addition, lenses and interlayers not detected by the subsurface investigation will be present between boreholes.

Construction equipment and procedures must be selected to accommodate variation in the deposit boundaries as well as variations within the deposits as described in the report text. Where precise determination of deposit boundaries and deposit variability are critical for safety and stability they should be verified by investigation during design and construction.

The ground surface profile and plan and profile of proposed construction are approximate and shown for illustrative purposes only. Refer to Contract Drawings for dimensions and limits of the work.

Borehole width in profile is not to scale.

VERTICAL SCALE
10 0 10 20 m

HORIZONTAL SCALE
10 0 10 20 m

NOTES

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

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

REFERENCE

Base plans provided in digital format by MH, drawing file nos. X11609340Base.dwg, X–Final Merged Util.dwg, X–PROP–UTIL.dwg, Existing Property.dwg, 11609340 – QEW Prop Util–Dickson & Lynchmere – C3D 2017.dwg, 11609340 – QEW Prop Util–IndianGroveAve – C3D 2017.dwg, 11609340 – QEW Prop Util–Stavebank Rd – C3D 2017.dwg, 11609340 – QEW Prop Util–Knareswood Dr – C3D 2017.dwg, and x1160934_Align.dwg, received March 25, 2019.

LICENSED PROFESSIONAL ENGINEER M.W.KELLY July 30, 2019 PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER S.J.BOONE 90559733 July 30, 2019 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 30M12–458

HWY. QEW	PROJECT NO. 1662333	DIST. CENTRAL
SUBM'D. AB/EJ	CHKD. MWK	DATE: 07/30/2019	SITE:
DRAWN: SW	CHKD. SMM	APPD. SJB	DWG. 2

MINISTRY OF TRANSPORTATION, ONTARIO

PLOT DATE: July 31, 2019

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