

FINAL REPORT**Subsurface Conditions Baseline Report***SOUTH INNISFIL CREEK DRAIN**HIGHWAY 400 TRENCHLESS INSTALLATIONS**RECONSTRUCTION OF HIGHWAY 400 / 89 INTERCHANGE**TOWN OF INNISFIL, ONTARIO**MTO ASSIGNMENT NO. 2015-E-0038, GWP 2438-13-00*

Submitted to:

Morrison Hershfield Limited.

1005 Skyview Drive, Suite 120

Burlington, Ontario L6P 5B1

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

GEOCRES No. 31D-786

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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 proposed trenchless installation of new culverts below Highway 400 in the Town of Innisfil, Ontario. Four new culverts are proposed to be located adjacent to the existing twin 4.6 m span corrugated steel pipe (CSP) arch culverts (Culvert Site No. 30-399/C) and existing 2.1 m diameter CSP culvert, as shown on the attached Figure 1.

The purpose of this report is to describe and summarize the subsurface conditions anticipated at the project site and to establish the baseline subsurface conditions for the Contract. It is intended to assist Contractors in bidding the work, assist the project Owner in reviewing the Contractors' submittals, and form the basis on which to judge whether the conditions encountered during construction are materially different from those anticipated at the time of bidding and to resolve any disputes and claims that may arise related to subsurface conditions.

This report consolidates and summarizes the results of geotechnical explorations and testing carried out at the site. This report is to be read together with the Contract Drawings and Specifications (Contract Documents) prepared by the project designers (MH) and MTO. Bidders shall refer to the Contract Documents for the order of precedence in the event of conflicting information.

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 trenchless installation site, prepared by Golder (GEOCRES No. 31D-776, dated August 4, 2021). 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 has been prepared for the installation of the four proposed culverts 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 subsurface baseline conditions identified in this report.

This SCBR is applicable only to the culvert installations that will cross beneath Highway 400 using trenchless methods at the site location and is not applicable to other elements of the Highway 400 / Highway 89 Interchange reconstruction.

2.0 SITE AND PROJECT DESCRIPTION

The proposed culvert installations are located on Highway 400, about 800 m north of the Highway 400/89 Interchange. Highway 400 is comprised of three northbound lanes and three southbound lanes at this location. Outside widening of the southbound lanes is being completed to accommodate a speed change lane as part of the Highway 400 / 89 interchange work. A golf course is located to the east of Highway 400 and agricultural lands are located to the west of Highway 400. Reive Boulevard, which runs parallel to Highway 400, is located directly east of Highway 400 and is owned and maintained by the Town of Innisfil. Highway 400 and Reive Boulevard are oriented in a north-northeast / south-southwest direction which, for the purpose of this report, is considered as a north / south orientation.

The culverts crossing Highway 400 at this location facilitate the drainage of the South Innisfil Creek, which flows southwest from Innisfil, crosses Highway 400 and then continues southwest before connecting with Bailey Creek in New Tecumseth. The creek at this location is referred to as the South Innisfil Creek Drain (SICD).

The proposed new culverts are required to accommodate modifications / lowering of the SICD and provide additional hydraulic capacity to convey the two-year storm event across Highway 400. There are three existing culverts that run below Highway 400 at the site (twin 4.6 m span CSP arch culverts and one 2.1 m diameter CSP culvert). The twin 4.6 m CSP arch culverts were modified, extended and a retaining wall was constructed to the west in late 2020 to accommodate widening of the Highway 400 southbound lanes as part of MTO's Highway 400/ 89 construction contract, as shown in Figure 1.

To the east, the SICD watercourse has been slightly realigned to pass under a new bridge on Reive Boulevard (constructed in late 2020 / early 2021 by the Town of Innisfil) and three culverts that previously allowed the SICD to flow beneath Reive Boulevard have been removed. It is understood that construction of the Reive Boulevard bridge and the SICD channel realignment/restoration below the bridge is complete.

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 / environmental conditions of the soil 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 Foundation Investigation Report (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 FIR. 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, Detail Design of South Innisfil Creek Drain Highway 400 Trenchless Installations, Reconstruction of Highway 400 / 89 Interchange, Town of Innisfil, Ontario, MTO Assignment No. 2015-E-0038, GWP 2438-13-00”, dated August 4, 2021, GEOCREs No. 31D-776.

Other sources have been used to supplement this information as follows:

- Golder Associates Ltd. “Preliminary Foundation Investigation and Design Report, Culverts, Structure Sites 30-399, 571, 572, 573 & 415, Highway 400 Widening from 1 km South of Highway 89 to Highway 11, G.W.P. 30-95-00, Agreement No. 3005-A-000074”, dated December 2001, GEOCREs No. 31D00-482.
- Peto MacCallum Ltd. “Geotechnical Investigation, Proposed Rehabilitation of Reive Boulevard, Town of Innisfil, Ontario”, Revised Report:1, PML Ref:19BF029, January 2020. Copies of Borehole No. 1 and 2, pages 4 and 5, and Drawing No. 1 provided by Town of Innisfil.
- Golder Associates Ltd. “Foundation Investigation and Design Report for Culvert Extensions (Structure Site Nos. 30-399/C and 30568/C), Reconstruction of Highway 400 / 89 Interchange, G.W.P. 2438-13-00”, dated August 2018, GEOCREs No. 31D-708.

3.2 Geological References

The geological publication referenced in this document and listed below is for general information purposes only.

- Chapman, L.J. and Putnam, D.F. *The Physiography of Southern Ontario*. 3rd Edition, Ontario Geological Survey, Special Volume 2, 1984. Ontario Ministry of Natural Resources.

3.3 Publications

The publications referenced in this document, as listed below, are for general information purposes only.

- ASCE (2007). *Geotechnical Baseline Reports for Construction: Suggested Guidelines*. The Technical Committee on Geotechnical Reports of the Underground Technology Research Council, R.J. Essex, chairman, ASCE, Reston, VA, 62 pp.
- Boone, S.J., Westland, J., Busbridge, J.R., and Garrod, B. (1998). “Prediction of Boulder Obstructions”, In *Tunnels and Metropolises, Proceedings of World Tunnel Congress 1998*, Sao Paulo, Brazil. A. Negro and A. Ferreira, Editors, Balkema, Rotterdam, pp. 817-822.
- Canadian Geotechnical Society (2006). *Canadian Foundation Engineering Manual*, 4th Edition. BiTech Publishers Ltd., Richmond, British Columbia.
- Heuer, R. E. (1974). “Important Ground Parameters in Soft Ground Tunneling”, in *Proceedings Specialty Conference on Subsurface Explorations for Underground Excavations and Heavy Construction*, ASCE, Reston, VA., pp. 152-167.
- Kulhawy, F.H. and P.W. Mayne. (1990). *Manual on Estimating Soil Properties for Foundation Design*. Report EPRI-EL6800. Palo Alto, CA, Electric Power Research Institute.
- Ministry of the Environment Ontario (2005). Water Well Information System, Version 2.01. Hydrogeology of Southern Ontario, Second Edition. http://www.ene.gov.on.ca/envision/techdocs/4800e_index.htm
- Poot, S., Boone, S.J., Westland, J., and Pennington, B. (2000). “Predicted Boulder Frequency Compared to Field Observations During Construction”, in *Proceedings of the 50th Canadian Geotechnical Conference*, Montreal, pp. 47-54.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The interpreted and simplified stratigraphic profiles shown on Figures 1 and 2 are the baseline stratigraphy for this project and are a simplification of the subsurface conditions encountered at and between the borehole locations. The strata shown on Sections A-A' and B-B' (Figure 1 and 2) represent the baseline stratigraphy at the south and north limits of the three proposed "south culvert crossings" and the strata shown on Section C-C' (Figure 2) represent the baseline stratigraphy at the proposed single "north culvert crossing".

Although interpreted strata boundaries are illustrated on Figures 1 and 2, it must be understood that the stratigraphic boundaries illustrated 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 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 subsurface conditions generally consist of cohesive and granular embankment fill underlain by a clayey silt layer (characterized as glacial till or lacustrine deposit with till-like grain size distributions) with saturated layers / interlayers of sandy silt to silty sand, silt, and sand, underlain by a deposit of clayey silt.

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 trenchless installations. Baseline values are provided consistent with 10th, 50th, and 90th 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 50th percentile value can be used for some design purposes, the range represented by the 10th to 90th 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 G, specific to this report and identified with colours on the baseline stratigraphic profiles, 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 11 following the text of this SCBR and in subsequent sections of this SCBR.

4.2.1 Pavement

Where boreholes were advanced through the existing pavement structures, an approximately 216 mm to 250 mm thick layer of asphalt was encountered at the road surface of Highway 400 in Boreholes CE-07, CE-08, CR-01, CR-02, CR-04, CR-08, and CR-09. While asphalt pavement materials were encountered within some of the boreholes, this SCBR does not provide baseline characterizations of pavement materials.

4.2.2 Non-Cohesive Fill (Class A)

A 1.2 m to 4.9 m thick layer of non-cohesive fill, comprised of silt to sand and gravel was encountered underlying the topsoil in Borehole CE-05; below the asphalt in Boreholes CE-07, CE 08, CR-01, CR-02, CR 04, CR-08 and CR 09; underlying the clayey silt fill in Boreholes CR-03 and CR-10; and at the surface in Borehole CR 07. The non-cohesive fill layer extended to depths ranging from 1.7 m to 4.9 m below ground surface (Elevation 227.1 m to 222.3 m). The silt to sand and gravel fill was observed to be interlayered with clayey silt fill in Boreholes CR-04 and CR-07. Trace organics / rootlets were observed within the cohesionless fill samples in Boreholes CR-03, CR-07, CR-09, and CR-10. In Borehole CR-07, wood pieces (up to 37.5 mm in maximum dimension due to limitations of the sampling equipment) were encountered within the fill material below a depth of 4.3 m (Elevation 224.6 m).

A baseline grain size distribution envelope of the Non-Cohesive Fill (Class A) is presented on Figure 3. Baseline classification and engineering parameters for the Non-Cohesive Fill (Class A) are provided in Table 1 below. The SPT "N"-values and water content percentages are based on field sampling and lab testing.

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

Parameter	10 th Percentile ¹ .	50 th Percentile ¹ .	90 th Percentile ¹ .
SPT "N"-Value ² .	3	21	46
Water Content, w_n (%)	3	10	46
Gravel (%) ³ .	3	14	32
Sand (%) ³ .	31	56	73
Fines (%) ⁴ .	13	29	57
D ₁₀ (mm)	0.002	0.02	0.05
D ₆₀ (mm)	0.09	0.3	2.0
Coefficient of Uniformity, C_u	6	30	60
Wet Unit Weight, kN/m ³	18	19	20
Effective Angle of Internal Friction, ϕ' (degrees)	28	31	35
Estimated Permeability, k (m/s)	5×10^{-8}	8×10^{-6}	3×10^{-5}

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer.
- 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 Cohesive Fill (Class B)

A 0.3 m to 3.9 m thick layer of cohesive fill, comprised of clayey silt to clayey silt-silt and sand was encountered underlying the topsoil in Boreholes C-1, C-2, CE-06, CR-03 and CR-10; underlying the non-cohesive fill in Boreholes CR-01 and CR-08; and interlayered within the non-cohesive fill in Boreholes CR-04 and CR-07. The cohesive fill layer extended to depths ranging from 1.0 m to 4.3 m below ground surface (Elevation 226.2 m to 224.1 m). Trace organics were encountered in Boreholes C-1, CR-7 and CR-8 and wood pieces (up to 37.5 mm in maximum dimension due to limitations of the sampling equipment) were observed in samples of the cohesive fill in Borehole CR-8.

A baseline grain size distribution envelope of Cohesive Fill (Class B) is presented on Figure 4. The baseline envelope for Atterberg Limits is presented on Figure 5, which indicates that these materials are of low to medium plasticity. Baseline classification and engineering parameters for Cohesive Fill (Class B) are provided in Table 2 below. The SPT "N"-values and water content percentages are based on field sampling and lab testing.

Table 2: Baseline Geotechnical Parameters for Cohesive Fill (Class B)

Parameter	10 th Percentile ¹	50 th Percentile ¹	90 th Percentile ¹
SPT "N"-Value ²	7	16	25
Water Content, w_n (%)	15	18	26
Gravel (%) ³	1	1	5
Sand (%) ³	20	25	38
Fines (%) ⁴	62	72	81
D_{10} (mm)	0.0006	0.002	0.006
D_{60} (mm)	0.04	0.06	0.07
Wet Unit Weight, kN/m^3	17	19	20
Effective Angle of Internal Friction, ϕ' (degrees)	25	28	32
Plastic Limit, PL (%)	11	15	26
Liquid Limit, LL (%)	17	23	32
Plasticity Index, PI	5	6	8

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer.
- 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 Organic Deposits (Class C)

An approximately 0.3 m to 1.0 m thick layer of topsoil was encountered at ground surface in Boreholes C-1, C-2, CE-05, CE-06, CR-03, CR-05, CR-06, and CR-10. Organic soils (comprised of organic silt to sandy organic silt), 0.2 m to 2.0 m in thickness, were encountered below the fill in Boreholes C-1 and CR-03 and below the topsoil in Borehole CR-05. The deposit was described as fibrous peat in the previous investigation (Borehole C-1). The deposit was encountered at depths ranging from 1.0 m to 3.7 m below ground surface (approximately Elevation 224.2 m to 222.3 m) and extended to depths ranging from 3.0 m to 3.9 m below ground surface (approximately Elevation 223.1 m to 222.1 m).

Table 3: Baseline Geotechnical Parameters for Organic Soils (Class C)

Parameter	10 th Percentile ¹	50 th Percentile ¹	90 th Percentile ¹
SPT "N"-Value ²	2	4	39
Water Content, w_n (%)	40	60	110
Organic Content (%)	3	9	15
Wet Unit Weight, kN/m^3	12	15	18
Effective Angle of Internal Friction, ϕ' (degrees)	24	27	32

1) Baseline blow counts are based on SPT "N"-values measured for 0.3 m of penetration; for this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer.

2) Total weight of particles as compared to the total sample weight.

Materials designated as topsoil in this report were classified solely based on visual and textural evidence. Testing of organic content or for other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

4.2.5 Cohesive Till / Till-Like Deposits (Class D)

A 1.0 m to 8.0 m thick deposit of clayey silt to sandy clayey silt-silt till was encountered below the fill layers in Boreholes C-2, CE-05 to CE-08, CR-02, and CR-04; below the organic deposit in Boreholes CR-03; and interlayered within the sandy silt to silty sand deposit (described in Section 4.2.6) in Boreholes CR-06 to CR-09. Boreholes CE-05 to CE-08 (from the 2018 investigation) interpreted this upper clayey silt layer as a lacustrine deposit with till-like grain size distribution characteristics. Given the similar characteristics, the clayey silt deposit is interpreted as a till (or till-like) in Boreholes CE-05 to CE-08 in the stratigraphic section on Figure 2 based on the till designation of the same deposit in adjacent boreholes completed during the current investigation. The clayey silt contained cobble fragments in samples collected from Borehole CR-02 and given that the soils are glacially derived, cobbles and boulders should be expected within the deposit. The cohesive deposit was encountered at depths ranging from 1.5 m to 5.2 m (Elevation 226.5 m to 222.1 m) and extended to depths ranging from 4.9 m to 11.7 m (Elevations 221.6 to 217.0 m). A layer of non-cohesive silt till (0.8 m thick) was encountered above the clayey silt-silt till in Borehole CR-02 at a depth of 2.2 m (Elevation 226.4 m) and extended to a depth of 3.0 m (Elevation 225.6 m).

The baseline grain size distribution envelope for the Cohesive Till / Till-Like Deposits (Class D) is presented on Figure 6. The baseline envelope for Atterberg Limits is presented on Figure 7, which indicates that these materials are of low plasticity. Baseline values for other geotechnical engineering parameters for the Cohesive Till / Till-Like Deposits are provided in Table 4 below. Above the groundwater level, the Cohesive Till / Till-Like Deposits will be fissured and have a blocky structure when exposed. The presence of cobbles and boulders in the till / till-like

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 4: Baseline Geotechnical Parameters for Cohesive Till/Till-Like Deposits (Class D)

Parameter	10 th Percentile ¹	50 th Percentile ¹	90 th Percentile ¹
SPT "N"-Value ²	12	31	66
Water Content, w_n (%)	12	14	22
Gravel (%) ³	1	2	5
Sand (%) ³	11	13	25
Fines (%) ⁴	70	85	86
D ₁₀ (mm)	0.0002	0.0006	0.002
D ₆₀ (mm)	0.004	0.005	0.05
Coefficient of Uniformity, C_u	5	8	20
Wet Unit Weight, kN/m ³	19	21	23
Effective Angle of Internal Friction, ϕ' (degrees)	32	33	34
Plastic Limit, PL (%)	13	14	15
Liquid Limit, LL (%)	26	29	31
Plasticity Index, PI	12	14	16
Shear Strength, S_u (kPa)	100	175	250

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer
- 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.

4.2.6 Sandy Silt to Silty Sand Deposits and Silt Layers (Class E)

A 0.3 m to 8.8 m thick deposit of sandy silt to silty sand was encountered below the topsoil in Borehole CR-06; below the fills in Boreholes CR-01, CR 07, CR-08, CR-09 and CR-10; below the organic soils in Borehole CR 05; and below the cohesive glacial till in Boreholes CE-6, CE-8, CR-02, CR-03 and CR-04. The deposit was encountered at depths ranging from 0.7 m to 8.7 m below ground surface (Elevation 226.0 m to 218.8 m) and extended to depths ranging from about 7.2 m to 13.3 m below ground surface (Elevations 220 to 215.6 m). The sandy silt to silty sand deposit was observed to be interlayered with the clayey silt till in Boreholes CE-8, CR-06, CR-07, CR-08 and CR-09 and within the lower clayey silt layer in CR-05. Interlayers of silt (ranging from 0.4 m to 4.6 m thick) were encountered within the sandy silt to silty sand deposit in Boreholes CR-05 and CR-10, and between the upper and lower clayey silt deposits in Borehole CE-06. The silt layers were encountered at depths ranging from 4.5 m to 6.2 m below ground surface (Elevation 221.3 m to 218.9 m). The sandy silt to silty sand layer contained variable amounts of organics near the interface with the fill layer in Boreholes CR-1, CR-7, CR-8 and CR-9. Sand seams / interlayers were encountered within the silty sand to sandy silt deposit and are discussed in the next section.

The baseline grain size distribution envelope for the Sandy Silt to Silty Sand Deposits (Class E) is presented on Figure 8. The baseline envelope for Atterberg Limits is presented on Figure 9, which indicates that these materials are non-plastic to slightly plastic. Baseline values for other geotechnical engineering parameters for the Sandy Silt to Silty Sand Deposits are provided in Table 5 below

Table 5: Baseline Geotechnical Parameters for Sandy Silt to Silty Sand Deposits (Class E)

Parameter	10 th Percentile ¹	50 th Percentile ¹	90 th Percentile ¹
SPT "N"-Value ²	4	16	32
Water Content, w_n (%)	19	21	40
Gravel (%) ³	2	5	8
Sand (%) ³	29	52	78
Fines (%) ⁴	21	45	71
D ₁₀ (mm)	0.003	0.01	0.04
D ₆₀ (mm)	0.03	0.09	0.2
Coefficient of Uniformity, C_u	3	8	20
Wet Unit Weight, kN/m ³	19	21	22
Effective Angle of Internal Friction, ϕ' (degrees)	28	30	35
Estimated Permeability, k (m/s)	1.4×10^{-7}	1.4×10^{-6}	1.7×10^{-5}
Plastic Limit, PL (%) ⁵	15	16	17
Liquid Limit, LL (%) ⁵	17	18	19
Plasticity Index, PI ⁵	1	2	3

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer
- 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.
- 5) The deposit is considered non-plastic. Atterberg Limits testing for silt interlayers only.

4.2.7 Sand Deposits (Class F)

Sand seams / interlayers (ranging from less than 0.1 m to 3.9 m thick) were encountered in Boreholes C-1, CE-05, CE-07, CE-08, CR-01, CR-03, CR-09 and CR-10. The sand seams / interlayers were encountered within the sandy silt to silty sand deposit in Boreholes CR-01, CR-03, CR-09 and CR-10; below the organic deposit in Borehole C-1; and within the clayey silt deposits in Boreholes CE-05, CE-07 and CE-08. Sand seams were encountered in the silty sand layer below the fill in Boreholes CR-09 and CR-10. The top of the sand layers at the other boreholes were encountered at depths ranging from 3.4 m to 12.7 m (Elevation 223.1 m to 216.0 m) and extended to depths ranging from 7.2 m to 13.3 m below ground surface (Elevations 221.3 m to 215.4 m). Borehole CE-07 was terminated within the sand interlayer at a depth of 8.2 m (Elevation 220.6 m) after penetrating for a thickness of 1.0 m.

The baseline grain size distribution envelope for the Sand Deposits (Class F) is presented on Figure 10. Baseline values for other geotechnical engineering parameters for the Sand Deposits are provided in Table 6 below.

Table 6: Baseline Geotechnical Parameters for Sand Deposits (Class F)

Parameter	10 th Percentile ^{1.}	50 th Percentile ^{1.}	90 th Percentile ^{1.}
SPT "N"-Value ^{2.}	4	23	63
Water Content, w_n (%)	17	20	23
Gravel (%) ^{3.}	0	2	5
Sand (%) ^{3.}	85	88	89
Fines (%) ^{4.}	11	12	16
D ₁₀ (mm)	0.06	0.07	0.08
D ₆₀ (mm)	0.16	0.18	0.20
Coefficient of Uniformity, C_u	2	3	4
Wet Unit Weight, kN/m ³	19	21	22
Effective Angle of Internal Friction, ϕ' (degrees)	28	31	37
Estimated Permeability, k (m/s)	1×10^{-6}	5×10^{-5}	1×10^{-4}

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 0 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer
- 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.

4.2.8 Clayey Silt to Clayey Silt-Silt Deposits (Class G)

A lower deposit of clayey silt to clayey silt-silt was encountered below the sandy silt to silty sand deposit in Boreholes CE-08 and CR-01 to CR-10; and below the sand and silt interlayers in Boreholes C-1, CE-05 and CE-06. The deposit was previously designated as a till in Borehole C-1 from the previous investigation but has been reclassified as a lacustrine deposition (i.e., not a glacial till) based on additional information (well-sorted grain size distribution characteristics of samples at similar elevations) from adjacent boreholes from the current investigation. The top of the clayey silt to clayey silt-silt layer was generally encountered at depths ranging from 7.2 m to 13.3 m below ground surface (Elevation 220.0 m to 215.6 m), with the exception of Borehole CR-5 which contained clayey sand, sand and silt interlayers (0.1 m to 1.3 m thick) from a depth of about 3 m to 7.2 m below ground surface (classified in Section 4.2.6 as Class E deposits) before transitioning into a more homogenous lower clayey silt deposit at depth.

All boreholes which encountered the clayey silt to clayey silt-silt deposit were terminated within the deposit at depths ranging from 9.6 m to 17.4 m (Elevations 216.9 m to 211.1 m) after penetrating the deposit for thicknesses between 1.0 m and 8.7 m.

The baseline grain size distribution envelope for the Clayey Silt to Clayey Silt-Silt Deposits (Class G) is presented on Figure 11. The baseline envelope for Atterberg Limits is presented on Figure 12, which indicates that these materials are of low plasticity. Baseline values for other geotechnical engineering parameters for the Clayey Silt to Clayey Silt-Silt Deposits are provided in Table 7 below.

Table 7: Baseline Geotechnical Parameters for Clayey Silt to Clayey Silt-Silt Deposits (Class G)

Parameter	10 th Percentile ^{1.}	50 th Percentile ^{1.}	90 th Percentile ^{1.}
SPT "N"-Value ^{2.}	14	28	41
Water Content, w_n (%)	17	21	23
Gravel (%) ^{3.}	1	2	5
Sand (%) ^{3.}	1	3	10
Fines (%) ^{4.}	90	95	99
D ₁₀ (mm)	0.0002	0.0003	0.002
D ₆₀ (mm)	0.004	0.007	0.02
Wet Unit Weight, kN/m ³	19	21	22
Effective Angle of Internal Friction, ϕ' (degrees)	26	28	32
Plastic Limit, PL (%)	14	16	18
Liquid Limit, LL (%)	19	26	31
Plasticity Index, PI	5	9	14
Shear Strength, S_u (kPa)	75	150	250

- 1) While for any given sample, percentages of gradation categories (e.g., gravel, sand, fines) will add to 100%, percentile values do not necessarily add to 100% 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 this soil class, 1 out of 100 SPT values are greater than 100 blows per 0.3 m penetration, and 0 out of 100 SPT values are 0 blows, or weight of hammer
- 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.

4.3 Groundwater Conditions

Where borehole drilling techniques allowed, the groundwater level was observed in the open boreholes upon completion of drilling operations; these levels may not represent longer-term stabilized groundwater conditions. Standpipe piezometers were installed in Boreholes CR-04, CR-05, CR-07, CR-09, C-1 and CE-05 to permit monitoring of the groundwater level at these locations, as summarized below.

Table 8: Recorded Groundwater Levels in Standpipe Piezometers

Borehole / Piezometer Designation	Depth to Groundwater Level (m)	Groundwater Elevation (m)	Date of Measurement	Comments
CR-04	5.4 3.3	222.2 224.3	28-Jan-2021 10-Feb-2021	Open borehole Piezometer
CR-05	1.5 1.3	223.6 223.8	18-Jan-2021 10-Feb-2021	Open borehole Piezometer
CR-07	4.7 4.0	224.2 224.9	22-Jan-2021 10-Feb-2021	Open borehole Piezometer
CR-09	5.0 3.5	223.4 224.9	26-Jan-2021 10-Feb-2021	Open borehole Piezometer
CE-05	1.4 2.5	225.8 224.7	27-Feb-2018 5-Mar-2018	Open borehole Piezometer
C-1	4.6 1.6	221.9 224.9	26-Oct-2000 19-Mar-2001	Open borehole Piezometer

The groundwater levels will be influenced by the water level in the open channel of the South Innisfil Creek Drain that was measured to be at Elevation 224.4 m and 223.9 m (June 2017) near the inlet and outlet of the proposed crossings.

While a baseline groundwater level is provided on Figures 1 and 2, the groundwater (piezometric) level should 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 highway and embankment fill is also expected to be inhibited by and therefore perched within the Fill and Granular Deposits overlying the Cohesive or Glacial Till (or Till-Like) deposits.

4.4 Cobbles, Boulders and Other Obstructions

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. Although boulders and cobbles were not cored in the boreholes advanced at the site, inferred cobble / boulder fragments were encountered in samples collected from Borehole CR-2, with higher SPT “N”-values close to 100 blows per 0.3 m of penetration measured within the proposed tunnel path. Based on local knowledge of the glacially derived deposits in the area and general embankment construction practice near watercourses, it is inferred that the lower portion of the embankment fills (i.e. near fill / native soil interface) and glacial till / till-like soils contain cobbles and/or boulders at this site.

Based on past experience with similar geological settings, the combined total volume of individual boulders, known as the Boulder Volume Ratio (BVR), within glacially derived soils typically ranges between 0.15 per cent and 0.3 per cent 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 9 below.

Table 9: Baseline Boulder Parameters

Parameter	Cohesive Fill (Class B)	Cohesive Till / Till-Like Deposits (Class D)
Boulder Volume Ratio (BVR)	0.10%	0.15%
Boulder Number Ratio (BNR)	10	10
Boulder Maximum Size (m ³)	0.5	0.5

For example, using the BVR and BNR baselines provided above for an excavated volume of 100 m³ of Cohesive Till / Till-Like Deposit (Class D) by drilling or other excavation equipment, a cumulative 0.15 m³ of boulder rock manifested in approximately 1.5 (say 2) 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 to be routine requirements of construction and not to be accounted for separately. For baseline purposes, as part of the boulder volumes given in Table 9 above, one boulder with a diameter between 0.8 m and 1.0 m should be expected to be encountered along each tunnel alignment.

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 Highway 400 fill placement and original location of the watercourse 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 or topsoil / organic materials there will be debris consisting of broken concrete, reinforcing bars, logs, stumps and brush from previous clearing and grubbing operations or from the original alignment of the watercourse, including cobbles and boulders. Wood pieces and organics / peat were encountered (within the tunnel horizon) in Boreholes C-1, CR-3, CR-5, CR-7, and CR-8. The Contractor must select a construction method that is capable of removing / penetrating these types of obstructions in the fill or organic deposit and at the transition between native, organic and fill materials.

5.0 EXISTING STRUCTURES AND UTILITIES

Existing structures and utilities present along the project alignment (i.e. single north crossing and the three south crossings) must be accurately located and protected from construction operations.

Existing settlement / movement-sensitive structures include the following:

- The recently constructed culvert headwall as part of the existing CSP arch extension on the west side (about 5 m from nearest south crossing centreline).
- Highway 400 median storm sewer (500 mm diameter pipe) that crosses the north crossing alignment with about 1.8 m of soil cover between the top of proposed tunnel and bottom of sewer. Also, the associated storm sewer appurtenances (e.g. catchbasins) and lateral storm sewer that are located in close proximity to the south side of both the north and south trenchless crossings.

- Reive Boulevard Bridge including both the north and south abutment walls and associated cantilevered wingwalls. According to the Reive Boulevard Bridge IFC drawings (dated July 14, 2020), the abutment walls are supported on shallow foundations founded at Elevation 222.3 m on the native soil deposits.
- Existing two CSP arch culverts (near proposed south crossings) and single CSP culvert (near proposed north crossing) below Highway 400.
- Highway 400 pavement structure and shoulders.

The Contractor is responsible for protecting existing and any 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 measure, control, and document the amount of displacement at these sites.

For baseline purposes, it is to be expected that utilities will be bedded in and backfilled with Class A Non-Cohesive Fill Deposits. These materials will conduct water and where these are within surrounding lower permeability soils and/or below the baseline piezometric levels they will be saturated.

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 trenchless culvert alignments, and their anticipated behaviour if exposed and unsupported (see Table 11 following the text of this report). The interpreted baseline stratigraphy and the baseline piezometric level along or adjacent to the alignments of the trenchless crossings are shown on Figures 1 and 2.

The anticipated ground behaviour presented in this report is described using the Ground Behaviour Classification System provided below in Table 10. 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 tunnelling 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, tunnelling systems, etc.); the intent of using the Engineering Classes is to describe the behaviour of the material if exposed during excavation and tunnelling without provision of support or ground modifications.

Table 10: Ground Behaviour Classification

Classification and Descriptive Terms	Sub-Classification	Behaviour
Firm		Excavation face(s) can be cut without initial support
Ravel, Ravelling	Slow ravelling	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 ravelling ground, the process starts within a few minutes; otherwise the ground is slow ravelling.
	Fast ravelling	

Classification and Descriptive Terms	Sub-Classification	Behaviour
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 non-cohesive strata, 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 Class A to G soils are described in Section 4.2. It is noted that while the fines content is conventionally useful for assisting with interpretation of soil behaviour, the glacially derived soils of Southern Ontario and variability of fill / organic soils can commonly include a significant “fines” content (e.g. Class B, C and D soils) and yet also run, ravel or flow (depending on water content and presence of non-cohesive seams / interlayers) contrary to conventional interpretations of likely behaviour.

Excavation through the Sandy Silt to Silty Sand Deposits (Class E) and Sand Deposits (Class F) will be below the baseline groundwater level and will flow upon initial exposure. 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 Cohesive Fill (Class B), Cohesive Till / Till-Like Deposits (Class D) and Clayey Silt to Clayey Silt-Silt Deposits (Class G).

Therefore, the baseline behaviour descriptions and classifications provided in this report have been developed specifically for this project and are described in Table 11 following the text of this report.

7.0 CLOSURE

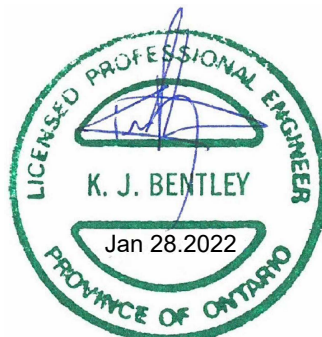
This Subsurface Conditions Baseline Report was prepared by Golder Associates Ltd., with input and consultation by the project designer (Morrison Hershfield Limited) on behalf of the Ministry of Transportation, Ontario for the proposed South Innisfil Creek Drain trenchless crossings below Highway 400 in the Township of Innisfil, Ontario. It is intended for use by bidders of MTO Contract No. 2018-2024.

Signature Page

Golder Associates Ltd.



Carter Comish, P.Eng.
Geotechnical Engineer



Kevin Bentley, P.Eng.
*Geotechnical Engineer, MTO Foundations Designated Contact and
RAQS-Approved Tunnelling Specialist*

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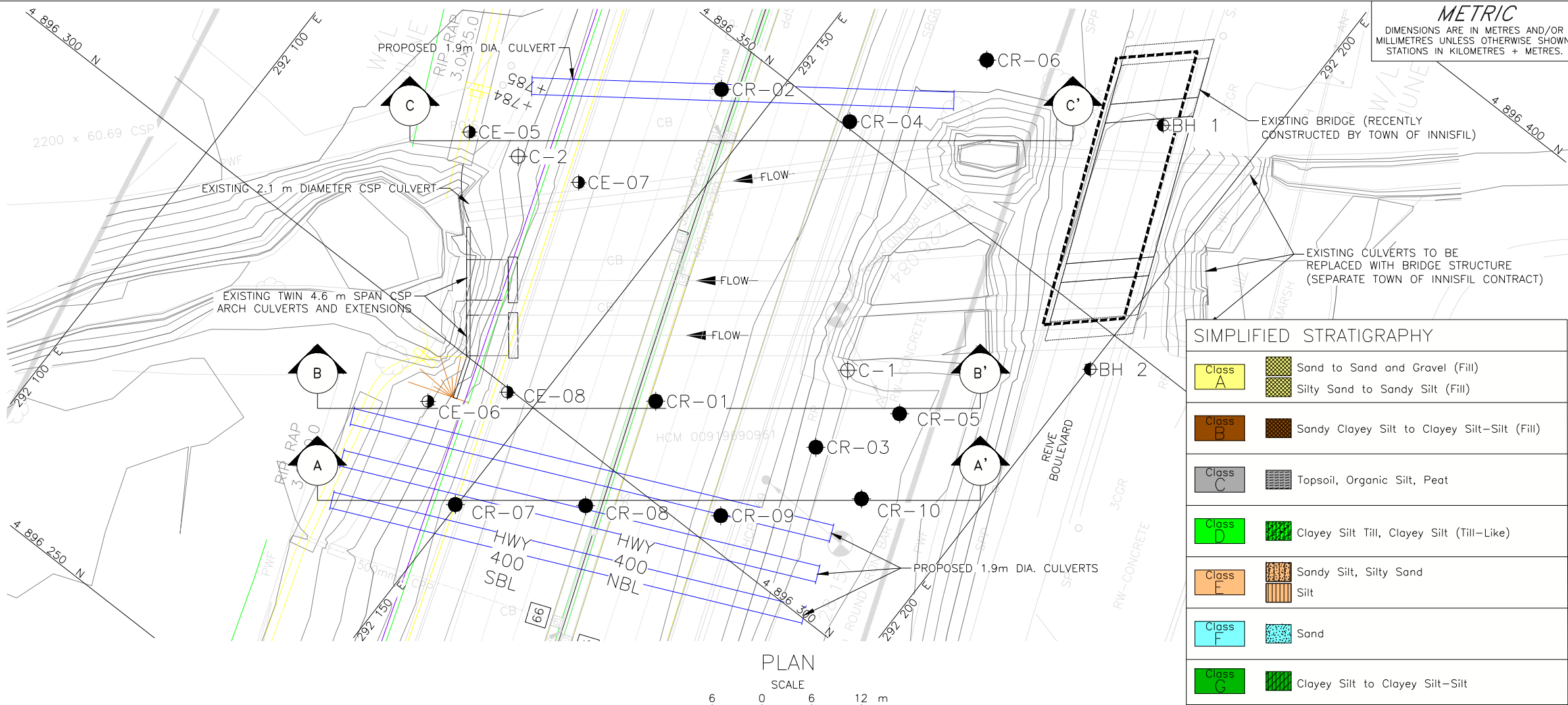
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Table 11: Description of Engineering Soil Classes

Engineering Soil Class and Colour Code	Soil Type(s) Description	Description of Engineering Class	Major Deposit Designation	Behaviour of Engineering Class
A	Sand to Sand and Gravel (Fill) Sandy Silt to Silty Sand (Fill)	<ul style="list-style-type: none">Near-surface non-cohesive materials placed by man-made processes related to highway embankment construction.Fill can include natural and man-made materials and debris such as concrete, pavements, glass, ashes, wood, topsoil or other organics.	Non-Cohesive Fill (Class A)	<ul style="list-style-type: none">Above groundwater levels, these materials are cohesive running.Below groundwater levels, these materials will flow immediately upon 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 Clayey Silt to Clayey Silt-Silt (Fill) Silt (Fill)	<ul style="list-style-type: none">Near-surface cohesive materials placed by man-made processes related to highway embankment construction ranging from clayey silt to sandy clayey silt, containing varying fractions of sand and gravel.Cohesive embankment fill is generally located below or within the non-cohesive embankment fill.Cobbles / boulders or wood / stumps are expected in lower portion near native soil interface.	Cohesive Fill (Class B)	<ul style="list-style-type: none">Above groundwater levels, these materials are firm to slow ravellingBelow groundwater levels, these materials are firm to fast ravelling.Material behaviour in exposed areas will be sensitive to variation in water content and construction traffic.Sand and gravel components of material (and cobbles/boulders) are abrasive.
C	Topsoil Organic Silt/Peat	<ul style="list-style-type: none">Near-surface materials containing organics, possibly random and broad in compositionWood debris / branches from watercourse fluvial deposits can be anticipated.	Organic Deposits (Class C)	<ul style="list-style-type: none">Behaviour of Class C materials will be unpredictable and will vary from flowing to ravelling to firm.Rapid support required to control the behaviour of these materials.
D	Clayey Silt to Sandy Clayey Silt-Silt (Till) Clayey Silt (Till-Like) Clayey Silt	<ul style="list-style-type: none">Broadly-graded, low plasticity soils ranging from clayey silt to sandy clayey silt-silt, containing trace gravel.Above groundwater levels, the till is anticipated to be fissured from various weathering processes, and have a “blocky” structure when exposed.The material varies in permeability and may be influenced by silt and sand seams / interlayersCobbles and boulders are expected within these soils.	Cohesive Till / Till-Like Deposits (Class D)	<ul style="list-style-type: none">Above groundwater levels, these materials are firm to slow ravellingBelow groundwater levels, these materials are firm to fast ravelling.Material behaviour in exposed areas will be sensitive to variation in water content and construction traffic.Sand and gravel components of material (and cobbles/boulders) are abrasive.
E	Sandy Silt to Silty Sand Silt	<ul style="list-style-type: none">Well-graded sands and siltsFines content up to about 70%, content of clay-size fraction less than 10%.Generally non-plastic with regions containing plastic fines.	Sandy Silt to Silty Sand Deposits (Class E)	<ul style="list-style-type: none">Above groundwater levels, these materials are cohesive running.Below groundwater levels, these materials will be flowing to fast ravelling upon 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.Material behaviour in exposed areas will be sensitive to variation in water content and construction traffic.
F	Sand	<ul style="list-style-type: none">Uniform and poorly graded sands (up to about 90% sand).Fines content up to about 12%Soil deposit is non-plastic.	Sand Deposits (Class F)	<ul style="list-style-type: none">Above groundwater levels, these materials are running.Below groundwater levels, these materials will be flowing upon exposure.Rapid support of these materials and groundwater control are required to control the behaviour of these materials.The material is abrasive.
G	Clayey Silt to Clayey Silt-Silt	<ul style="list-style-type: none">Low plasticity soils ranging from clayey silt to clayey silt-silt, containing trace gravel and trace sand.Contains seams/interlayers of sand and siltThe plasticity index of this soil class is less than 14%.	Clayey Silt to Clayey Silt-Silt Deposits (Class G)	<ul style="list-style-type: none">Above groundwater levels, these materials are firm to slow ravellingBelow groundwater levels, these materials are firm to fast ravelling.Material behaviour in exposed areas will be sensitive to variation in water content and construction traffic.Silt and sand interlayers are cohesive running to flowing above and below groundwater level.


1. Colour shade may vary from those illustrated on the interpreted profiles due to variation in plotting/printer settings.


FIGURES

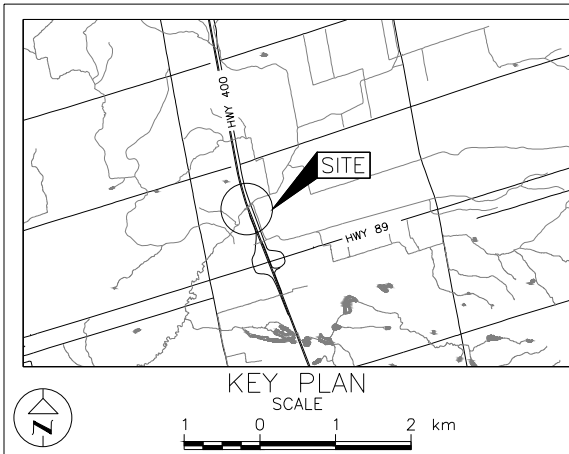


CONT No. 2018-2024
GWP No. 2438-13-00


HIGHWAY 400/89 INTERCHANGE
SOUTH INNISFIL CREEK DRAIN
BOREHOLE LOCATIONS AND INTERPRETED
BASELINE STRATIGRAPHIC PROFILE

**GOLDER**
MEMBER OF WSP


SHEET




LEGEND




- Borehole - Current Investigation
- Borehole - Advanced by Peto MacCallum in 2019
- Borehole - Advanced in 2018
- Borehole - Previous (GEOCRES No. 31D00-482)




- Seal
- Piezometer




- N Standard Penetration Test Value



- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)



- WL in piezometer, measured on FEBRUARY 10, 2021

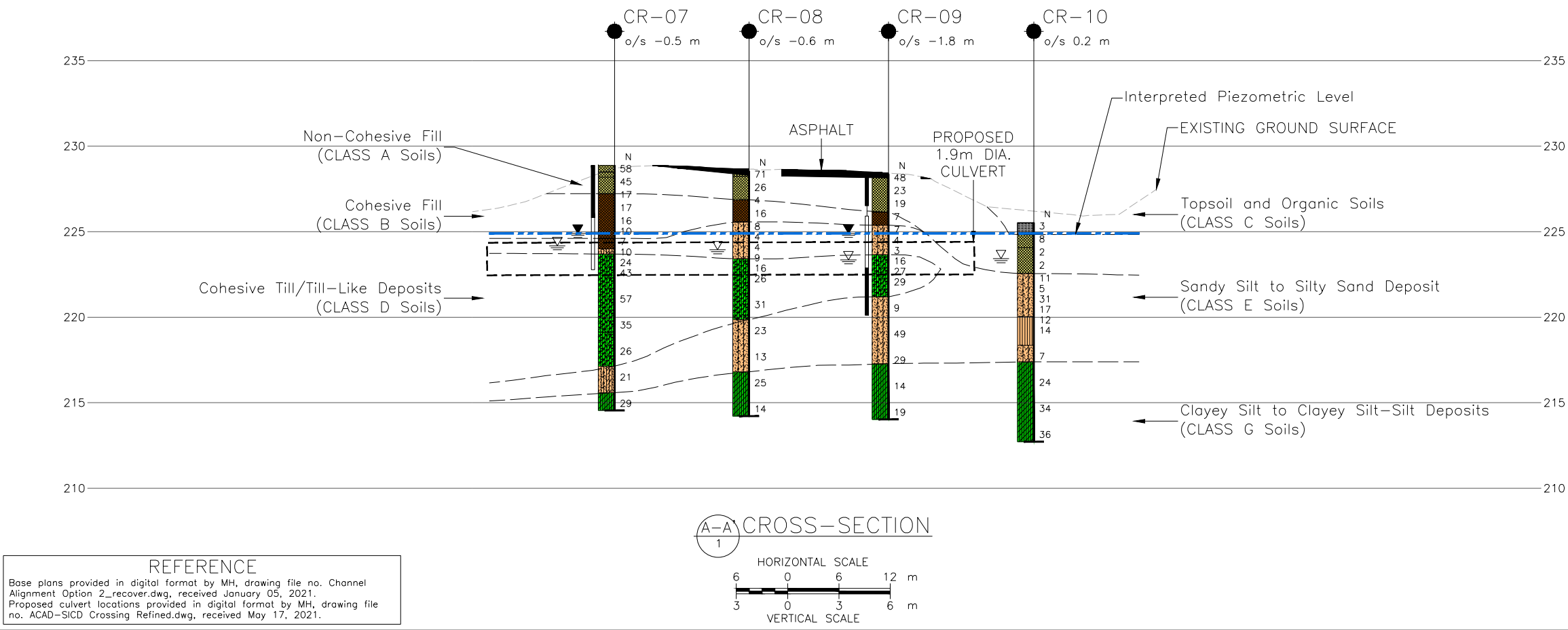


- WL upon completion of drilling

Site Coordinates Lat/Long: 44.206826/-79.658281

- NOTES
- This figure is to be read in conjunction with the accompanying Subsurface Conditions Baseline Report.
 - The characteristics and variability anticipated within the major soil deposits are described in the text of the accompanying Subsurface Conditions Baseline Report. Significant layers, interlayers and lenses within the major deposits are illustrated from interpretation of the borehole records. The boundaries illustrated are intended to highlight the variability within the deposits, which exhibit gradual transitions from one soil type to another. In addition, lenses and interlayers not detected by subsurface investigation will be present between boreholes.
 - This interpreted stratigraphic figure is a simplification of subsurface conditions. Detailed descriptions of the conditions encountered at borehole locations are found on the borehole records contained in the Foundation Investigation Report listed in the accompanying Subsurface Condition Baseline Report.
 - Borehole widths are not to scale.
 - Proposed structure outlines are shown for general illustration purposes only and do not necessarily indicate extents of foundations or other work. Extents of planned work are defined on the contract drawings and specifications.
 - All locations are approximate.

NO.	DATE	BY	REVISION
1	12/01/2021	TR/DD	1
Geocres No. 1668512			
HWY. 400/89	PROJECT NO. 1668512	DIST. .	
SUBM'D. CC	CHKD. CC	DATE: 12/01/2021	SITE: .
DRAWN: TR/DD	CHKD. KJB	APPD. .	FIG. 1



REFERENCE

Base plans provided in digital format by MH, drawing file no. Channel Alignment Option 2_recover.dwg, received January 05, 2021.

Proposed culvert locations provided in digital format by MH, drawing file no. ACAD-SICD Crossing Refined.dwg, received May 17, 2021.



LEGEND

- Borehole – Current Investigation
- Borehole – Advanced in 2018
- Borehole – Previous (GEOCRES No. 31D00–482)
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- WL in piezometer, measured on MARCH 19, 2001, FEBRUARY 5, 2018 and FEB 10, 2021
- WL upon completion of drilling

Site Coordinates Lat/Long: 44.206826/–79.658281

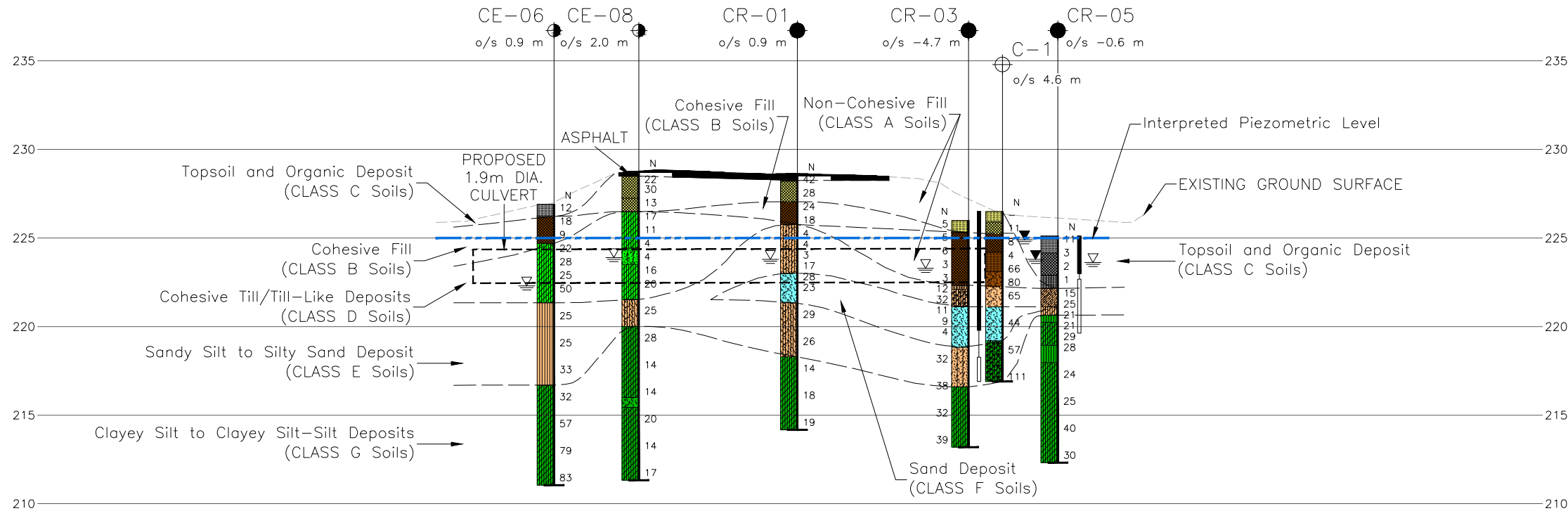
SIMPLIFIED STRATIGRAPHY

Class A	Sand to Sand and Gravel (Fill)
	Silty Sand to Sandy Silt (Fill)
Class B	Sandy Clayey Silt to Clayey Silt–Silt (Fill)
Class C	Topsoil, Organic Silt, Peat
Class D	Clayey Silt Till, Clayey Silt (Till–Like)
Class E	Sandy Silt, Silty Sand
	Silt
Class F	Sand
Class G	Clayey Silt to Clayey Silt–Silt

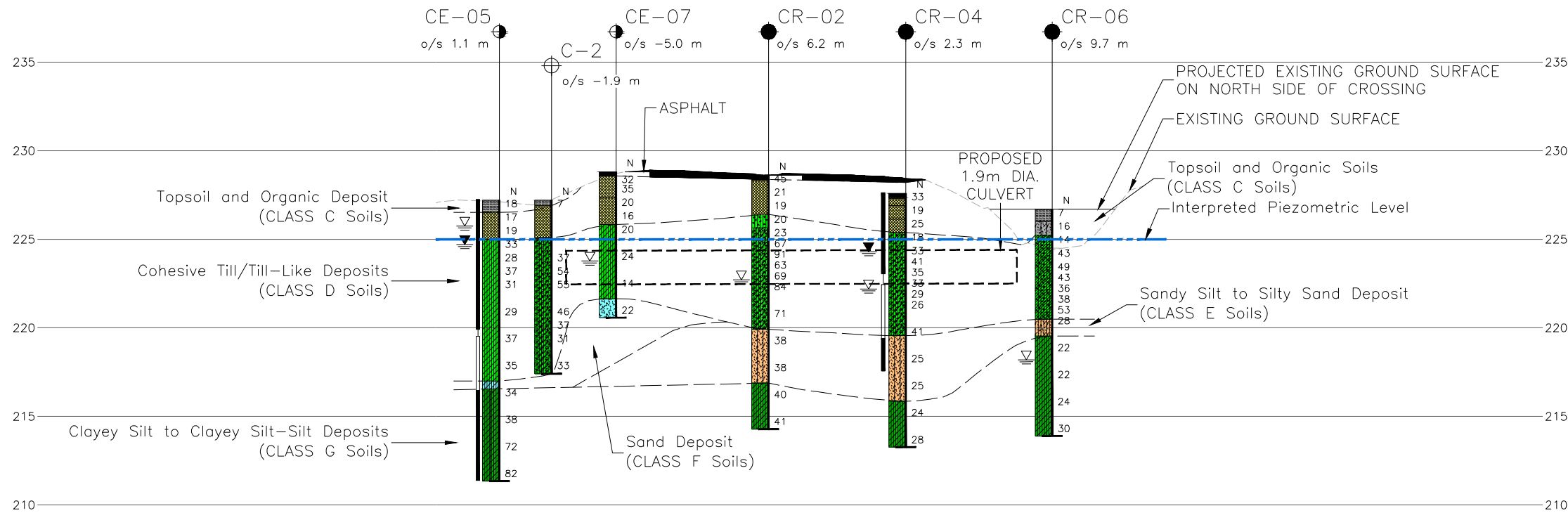
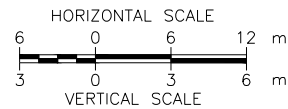
NOTES

- This figure is to be read in conjunction with the accompanying Subsurface Conditions Baseline Report.
- The characteristics and variability anticipated within the major soil deposits are described in the text of the accompanying Subsurface Conditions Baseline Report. Significant layers, interlayers and lenses within the major deposits are illustrated from interpretation of the borehole records. The boundaries illustrated are intended to highlight the variability within the deposits, which exhibit gradual transitions from one soil type to another. In addition, lenses and interlayers not detected by subsurface investigation will be present between boreholes.
- This interpreted stratigraphic figure is a simplification of subsurface conditions. Detailed descriptions of the conditions encountered at borehole locations are found on the borehole records contained in the Foundation Investigation Report listed in the accompanying Subsurface Condition Baseline Report.
- Borehole widths are not to scale.
- Proposed structure outlines are shown for general illustration purposes only and do not necessarily indicate extents of foundations or other work. Extents of planned work are defined on the contract drawings and specifications.
- All locations are approximate.

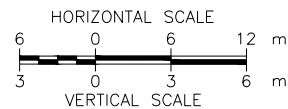
NO.	DATE	BY	REVISION
Geocres No.,			
HWY. 400/89	PROJECT NO. 1668512		DIST. .
SUBM'D. CC	CHKD. CC	DATE: 12/01/2021	SITE: .
DRAWN: TR/DD	CHKD. KJB	APPD. .	FIG. 2



B-B CROSS-SECTION
1

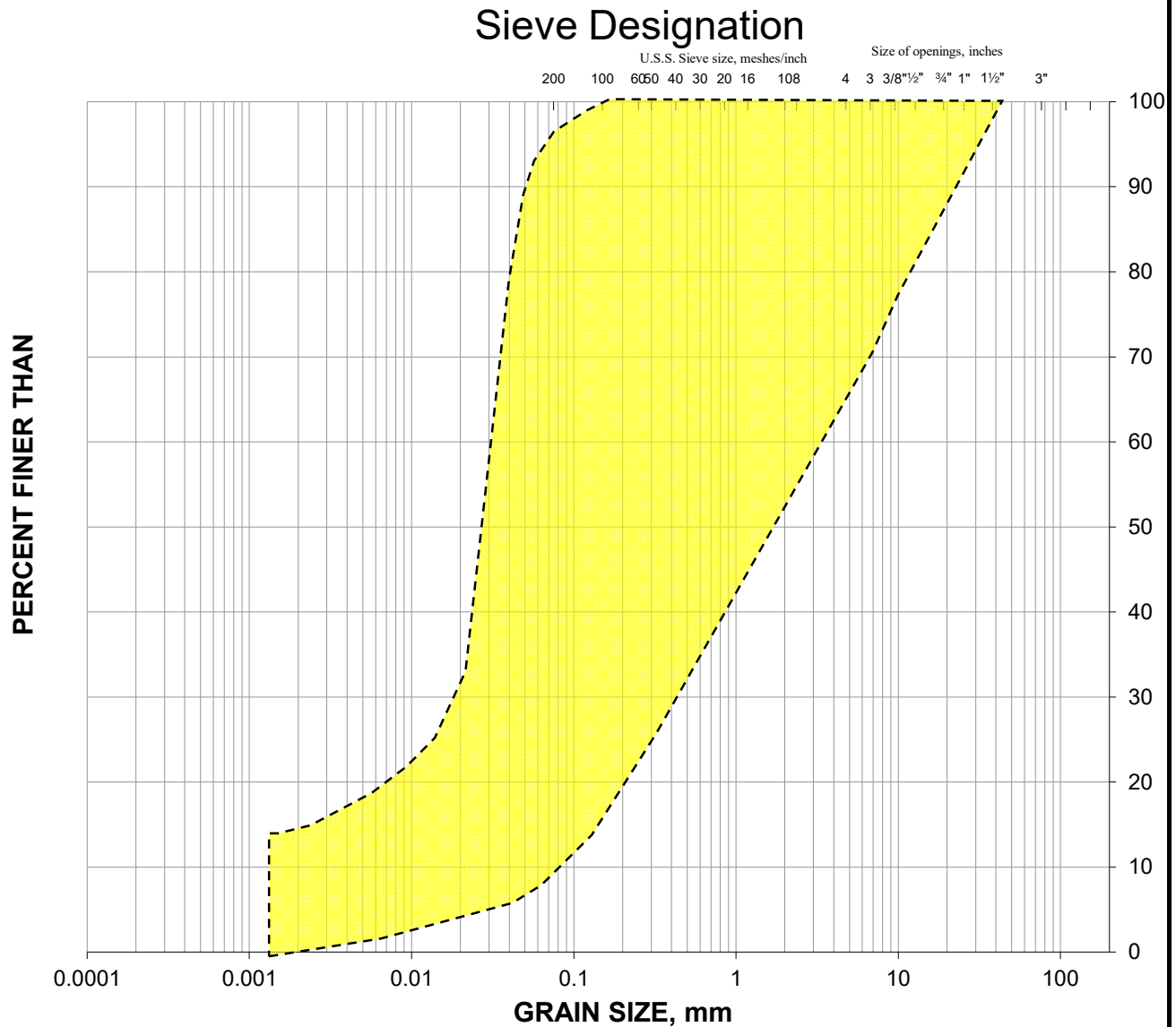


C-C CROSS-SECTION
1



**Baseline Grain Size Distribution
Granular Fill
(Class A)**

FIGURE 3



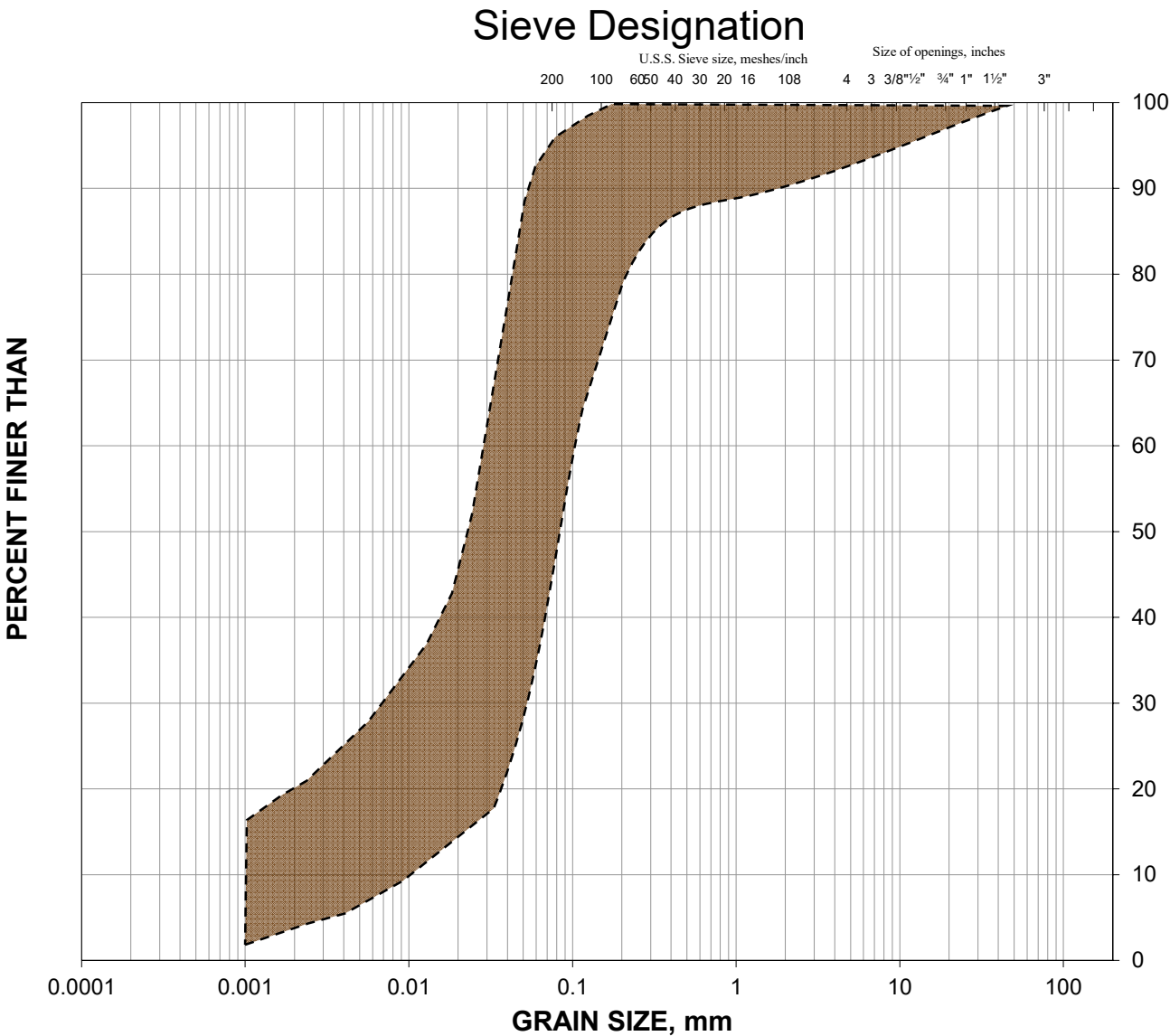
Date: Sep-21
Project: 1668512

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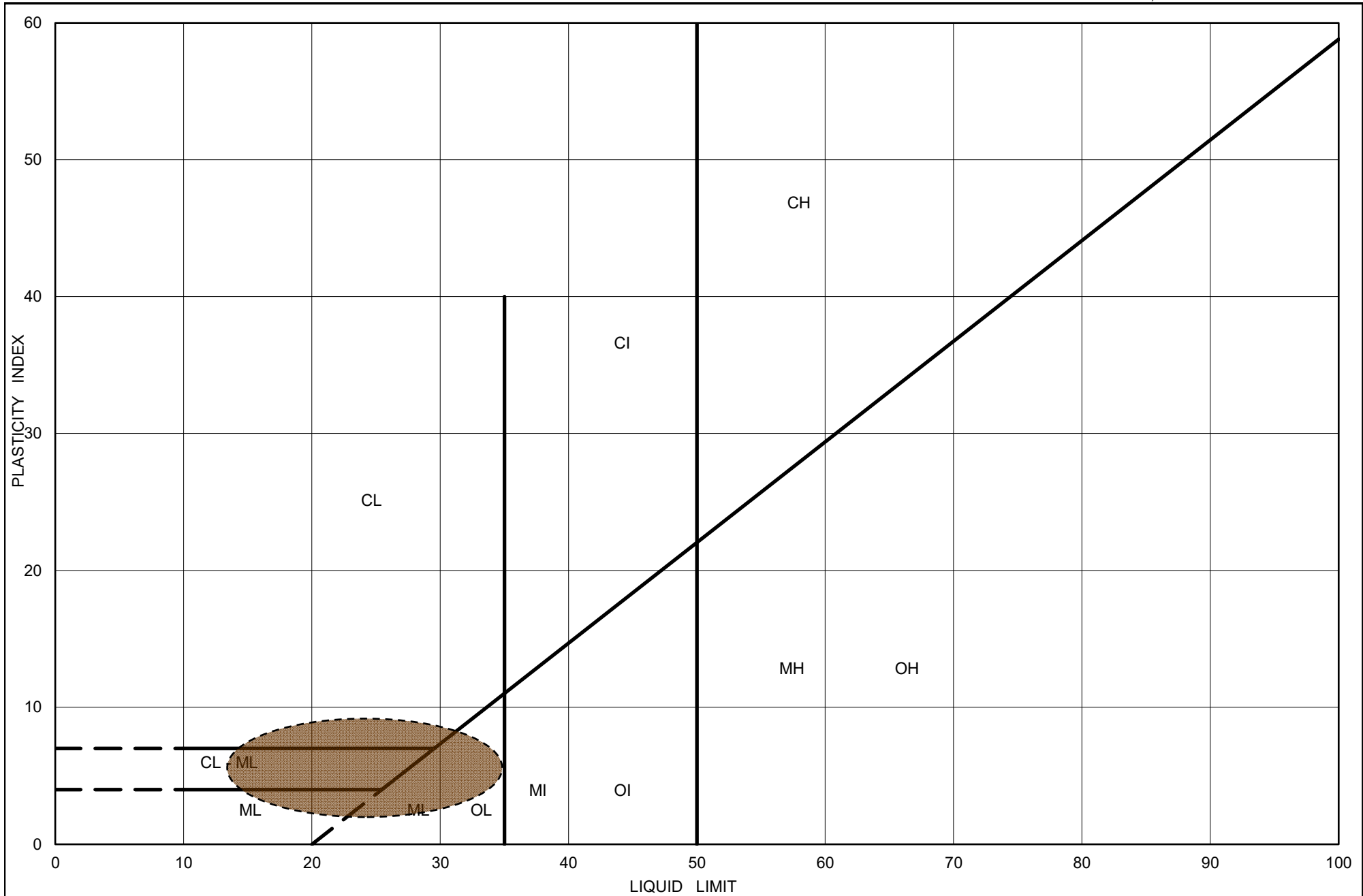
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**Baseline Grain Size Distribution
Cohesive Fill
(Class B)**

FIGURE 4



SILT AND CLAY SIZES	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND SIZE	GRAVEL	



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Baseline Atterberg Limits

Cohesive Fill (Class B)

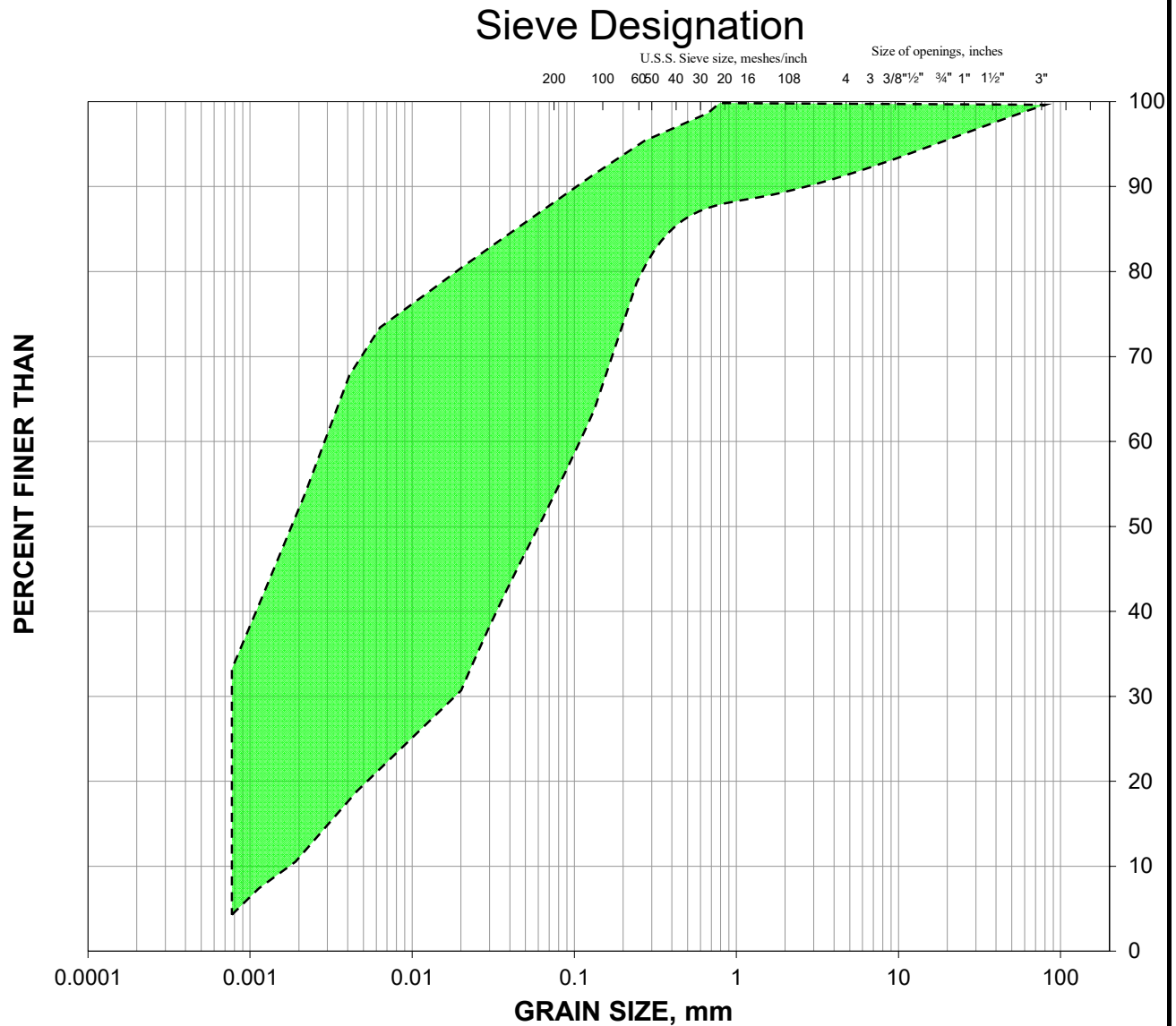
Figure No. 5

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**Baseline Grain Size Distribution
Cohesive Till / Till-Like Deposits
(Class D)**

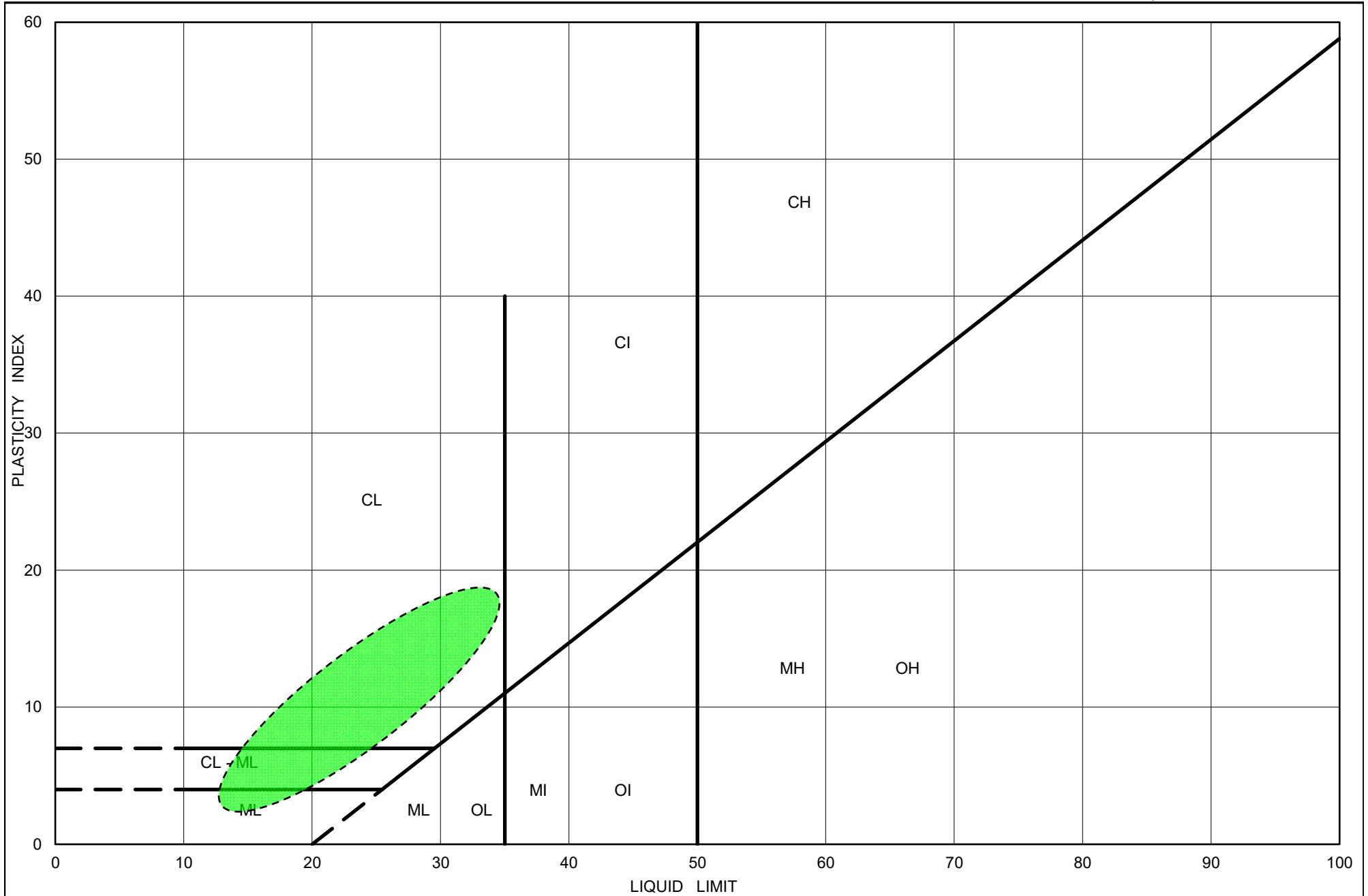
FIGURE 6



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Baseline Atterberg Limits

Cohesive Till / Till-Like Deposits (Class D)

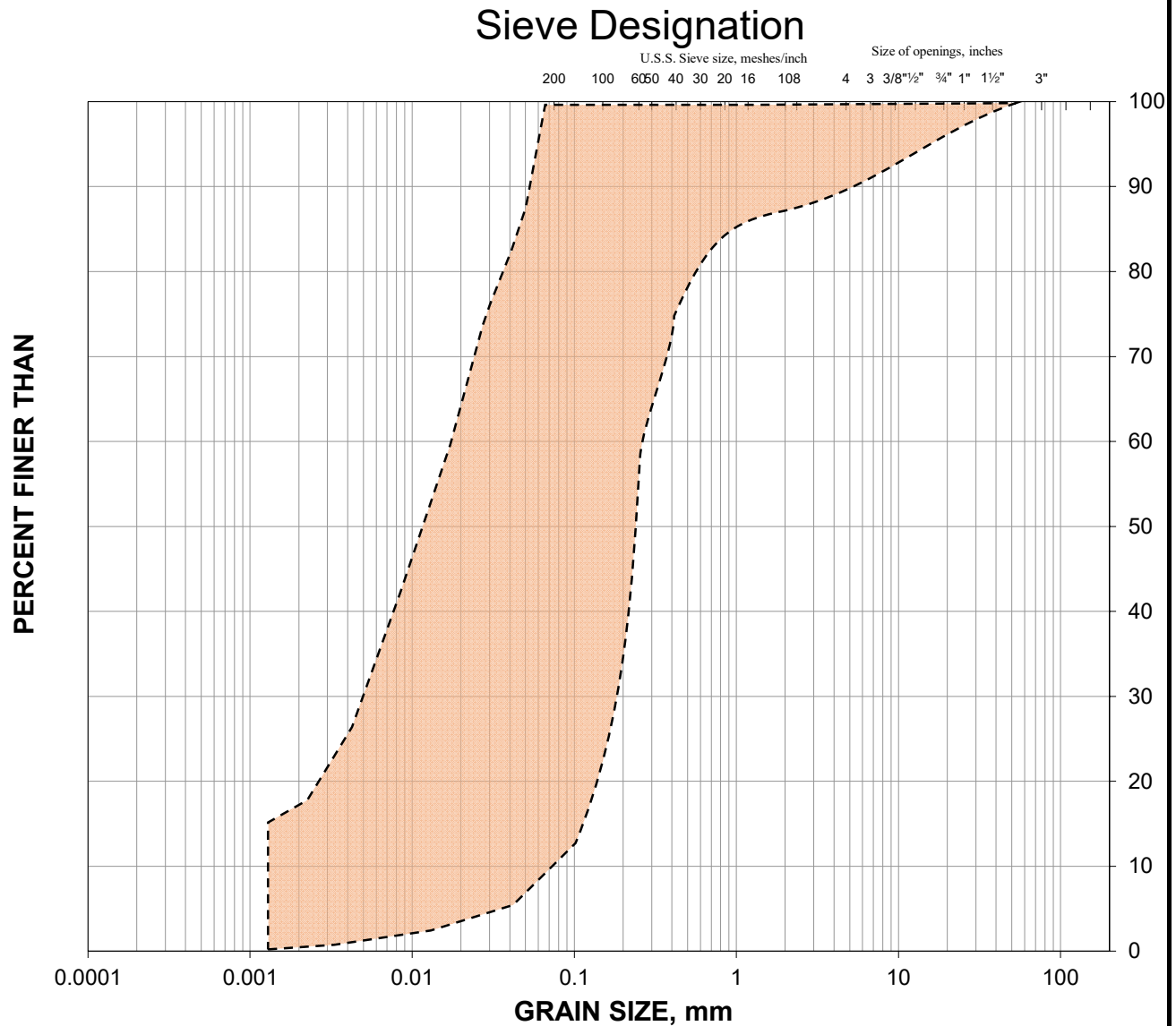
Figure No. 7

Project No. 1668512

Checked By: KJB

**Baseline Grain Size Distribution
Sandy Silt to Silty Sand Deposits
(Class E)**

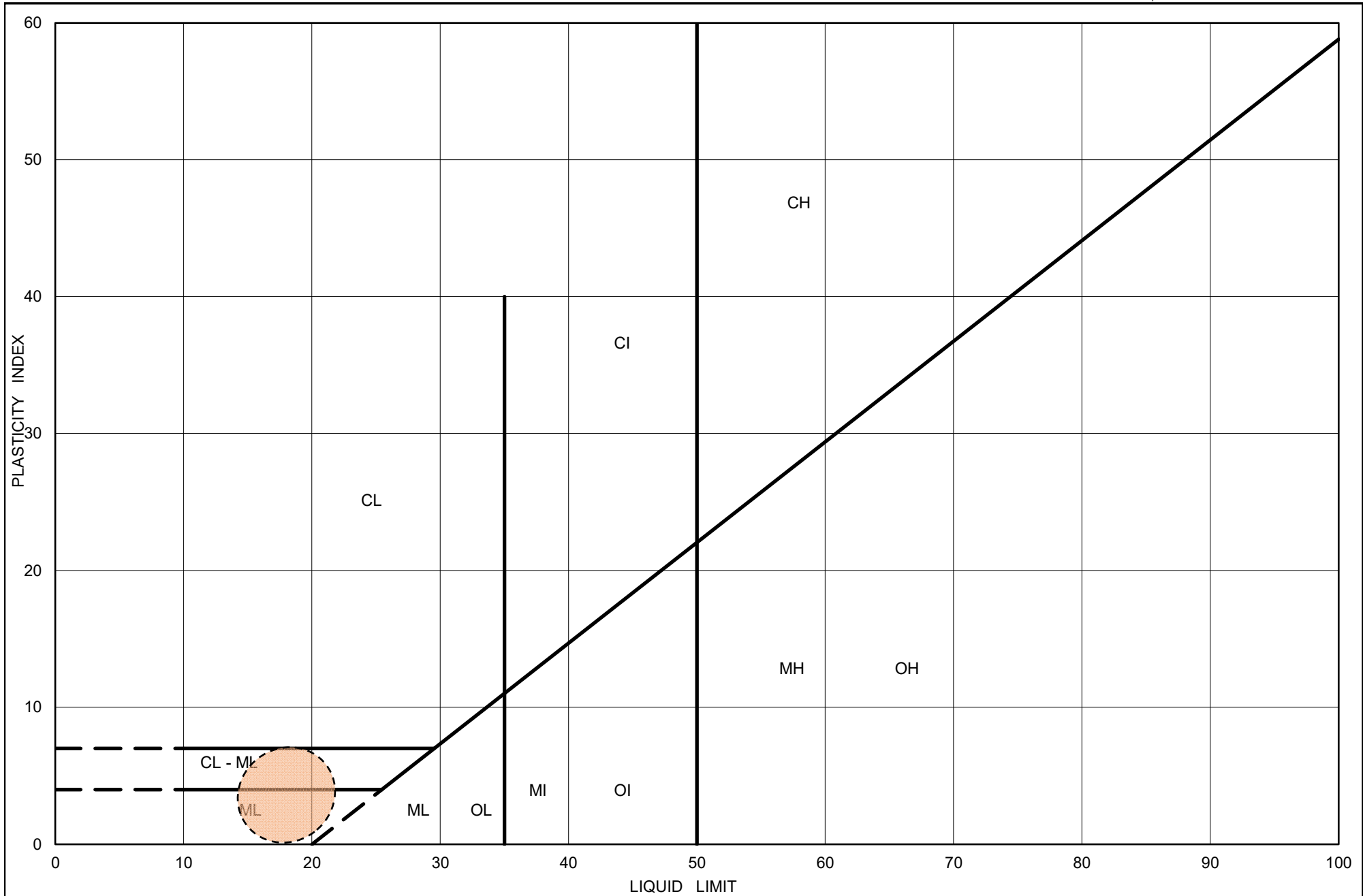
FIGURE 8



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Baseline Atterberg Limits

Sandy Silt to Silty Sand Deposits (Class E)

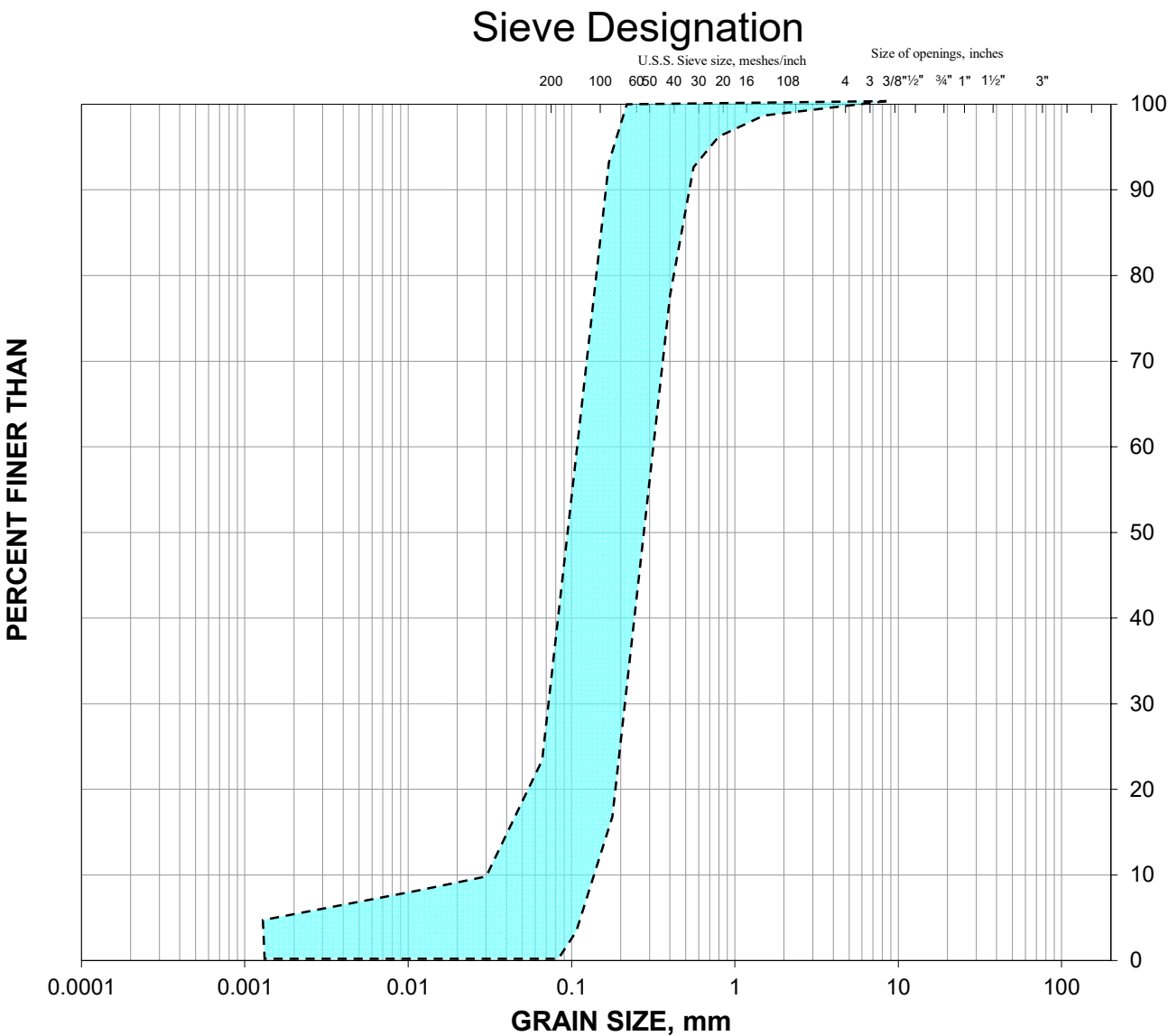
Figure No. 9

Project No. 1668512

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Baseline Grain Size Distribution
Sand Deposits
(Class F)

FIGURE 10



SILT AND CLAY SIZES	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND SIZE	GRAVEL	

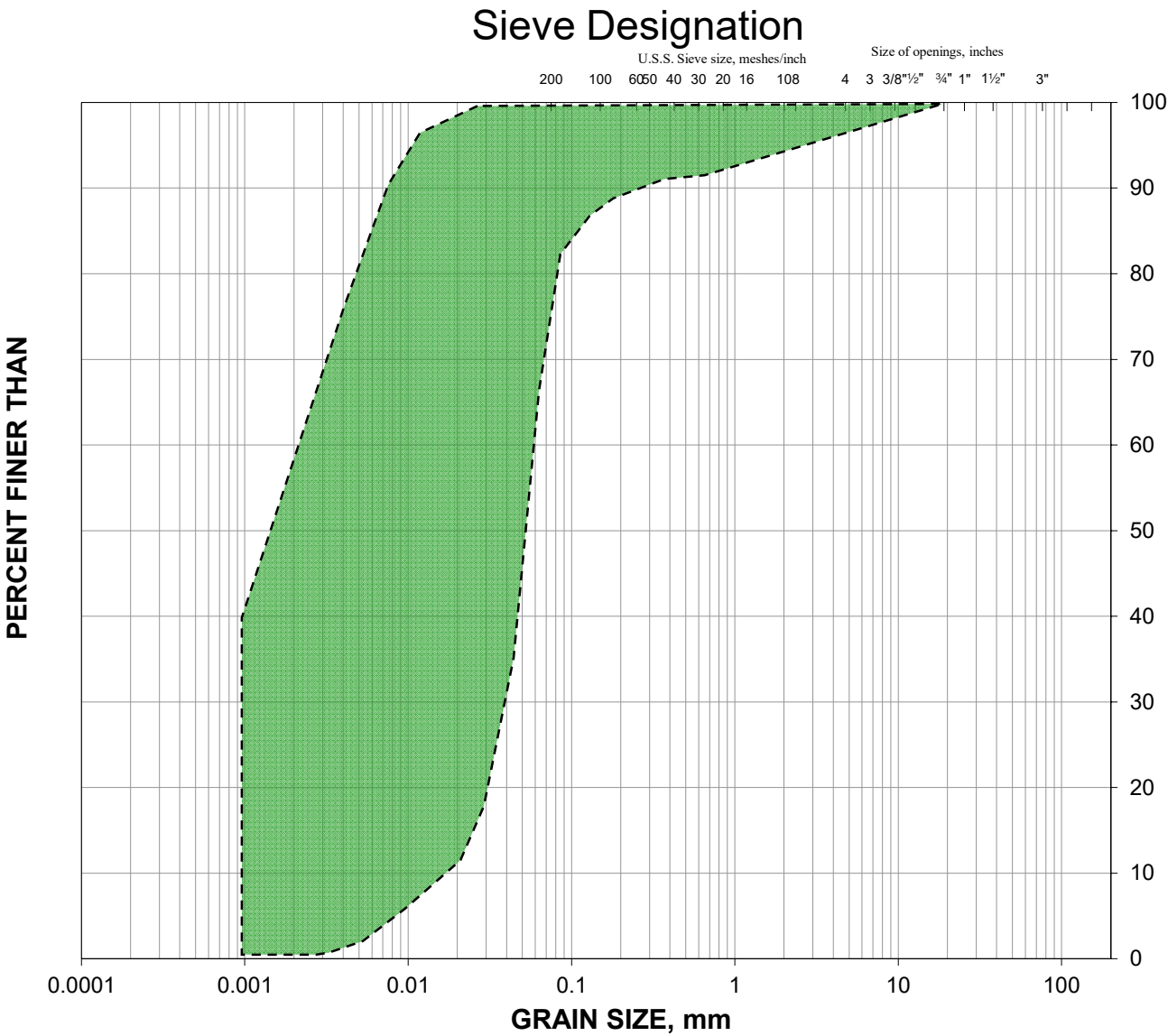
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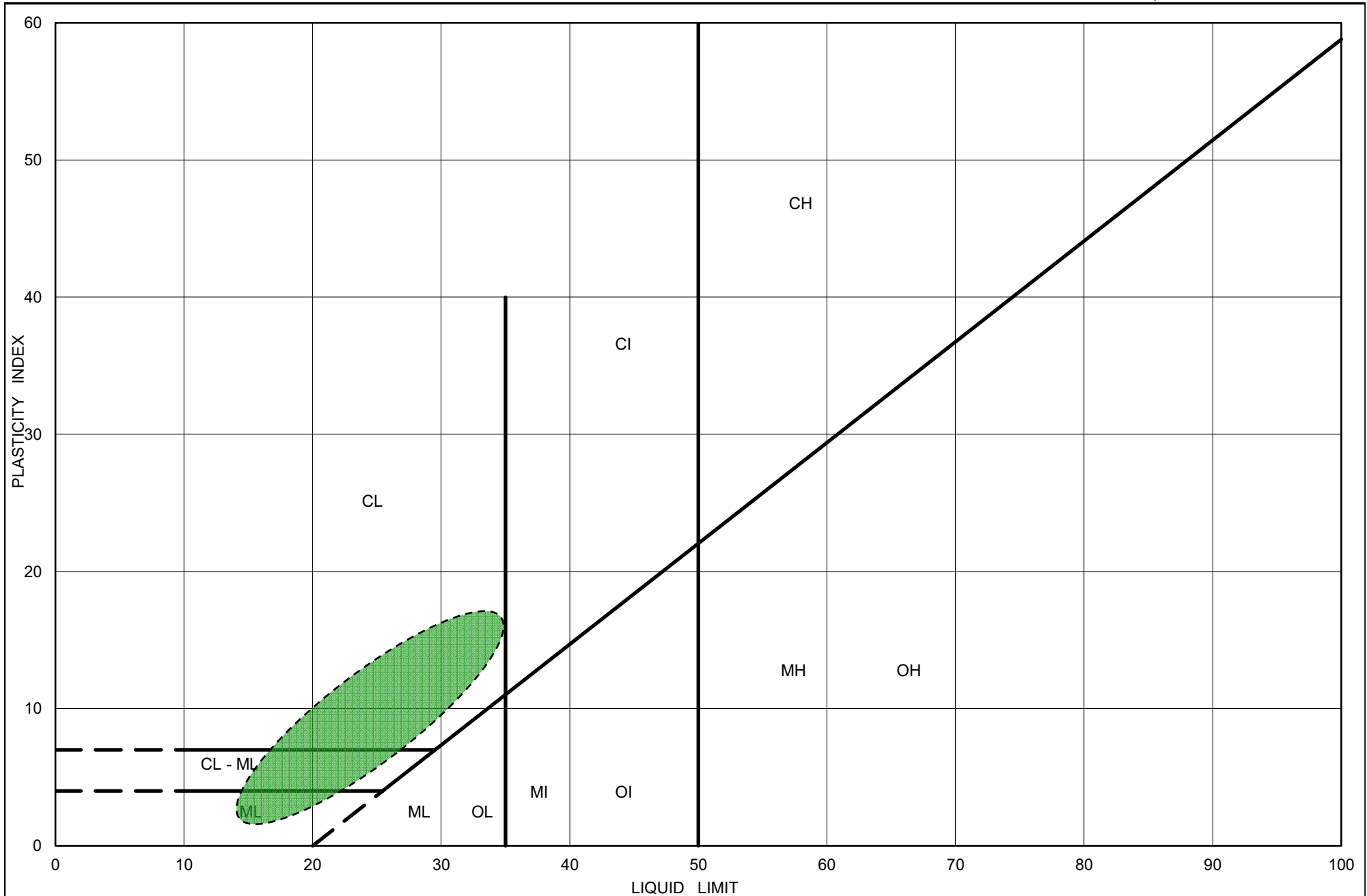
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**Baseline Grain Size Distribution
Clayey Silt to Clayey Silt-Silt Deposits
(Class G)**

FIGURE 11



SILT AND CLAY SIZES	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND SIZE	GRAVEL	



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Baseline Atterberg Limits

Clayey Silt to Clayey Silt-Silt Deposits (Class G)

Figure No. 12

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