



REPORT

FOUNDATION INVESTIGATION AND DESIGN REPORT

Pole-Mounted Variable Message Sign Supports

Highway 3

County of Essex

GWP 3008-22-00

Submitted to:

Ministry of Transportation - West Region

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PART A

**FOUNDATION INVESTIGATION REPORT
POLE-MOUNTED VARIABLE MESSAGE SIGN SUPPORTS
HIGHWAY 3
COUNTY OF ESSEX
GWP 3008-22-00**

1 INTRODUCTION

WSP Canada Inc. (WSP) has been retained by the Ministry of Transportation, Ontario (MTO) to provide Total Project Management (TPM) for the detail design of Intelligent Transportation Systems (ITS) for GWP 3008-22. The assignment includes the replacement of a number of signs on Highways 401, 402, and 3. This report addresses the signs on Highway 3, as shown on Drawings 1 and 2. Signs on Highways 401 and 402 are addressed under separate cover(s).

This report addresses the geotechnical aspects of the following signs:

Table 1: List of Highway 3 Signs

Sign No. (MTO Structure No.)	Site No.	Approximate Sign Location
003W0019AVPV	3182	Westbound 0.4 km east of Manning Road
401W0010VEA	3183	Westbound 1.4 km west of Walker Road

It is understood that each of the new signs will be a ground-mounted, Pole-Mounted Variable Message Sign (VMS), designed in accordance with the MTO's Sign Support Manual (2019)

2 SITE DESCRIPTION

2.1 General

Each of the subject signs are located on the westbound/north side of Highway 3 within Essex County, Ontario. Highway 3 in this area is a four-lane highway. The Site 3182 is located within the grassed area north of the paved shoulder and the Site 3183 is located within the grassed area north of the gravel shoulder. Both the signs are located behind existing guardrails. These areas are generally level, with slight slopes down to the adjacent ditches.

2.2 Site Geology

The Site is located in the physiographic region of Southwestern Ontario known as the St. Clair Clay Plains. Within this region, Essex County and the southwestern part of Kent County are normally discussed as a sub-region known as the Essex Clay Plain. The clay plain was deposited during the retreat of ice sheets (late Pleistocene Era) when a series of glacial lakes inundated the area. In general, the ice sheets deposited materials with a glacial-till-like gradation in the Essex County area. Depending on the locations of the glacial ice sheets and depths of water in the ice-contact glacial lakes, the materials may have been directly deposited at the contact between the ice sheet and the bedrock or, as the lake levels rose, and the ice sheets retreated and floated, the soil and rock debris within and at the base of the ice were deposited through the lake water (glaciolacustrine depositional environment). The Essex Clay Plain exhibits grain size distributions consistent with that of a cohesive glacial till but these deposits do not have increased densities and high strengths typically associated with tills deposited under a grounded ice sheet. It is most likely that in the Windsor area, the soils were deposited at the underside, or in front of floating ice through a shallow water depth as a broadly graded mud and, therefore, carried little or no weight of the overlying ice.

The quaternary geological mapping indicates a major soil stratum, consisting primarily of silty clay and clayey silt exhibiting a “till-like” structure by a random distribution of coarser particles within the primarily fine-grained silt and clay matrix (also called a ‘diamict’). Predominantly, the near-surface clayey soils are generally firm to hard and contain weathering structures consisting of fractures and desiccation cracks. Underlying this ‘crust’, the soil becomes grey-brown and soft to firm to stiff in consistency, indicating a historical groundwater level.

More typically, layered glaciolacustrine silty clay, silty sand, silt, or sand overly the extensive stratum of ‘till-like’ silty clay, or clayey silt. This interlayering of sands and silts indicates the glacial lake and glacial ice depositional environment. Typically, a relatively thin stratum of very dense, or hard, basal glacial till containing limestone clasts (sand and gravel) exists below the extensive silty clay / clayey silt deposit. This stratum overlies the bedrock and is generally referred to as the Catfish Creek Till.

The bedrock underlying the overburden soils at the Site consists of relatively horizontally oriented sedimentary rock of the Palaeozoic era. This sedimentary rock formed in shallow marine environments within what is now geologically referred to as the Michigan Basin, a regional bowl-shaped depression permeating through Southern Ontario. The indicated geological mapping suggests bedrock surface occurring at a depth of about 25 to 40 metres below the ground surface. The bedrock consists of the limestones of the Devonian Dundee Formation of the Hamilton Group Formations, and the underlying limestone of the Devonian Lucas Formation of the Detroit River Group of Formations.

Groundwater regime in the region is influenced by the presence of a pressurized brackish and H₂S and/or natural gas loaded deep, and pressurised aquifer located within the thin basal till layer and bedrock fractures covered by the more impervious silty clay deposit. The hydrostatic head within the basal till varies from slightly artesian to within typically 1 to 3 m below the ground surface.

3 INVESTIGATION PROCEDURES

The field work for the current investigation was carried out on September 3, 2025, during which time 2 boreholes were drilled at the locations shown on the Key Plan – Bore Hole Locations, Drawings 1 and 2.

The table below summarizes the locations, geodetic ground surface elevations, and depths of the boreholes.

Table 2: List of Highway 402 Signs and Boreholes

Sign No. (MTO Structure No.)	Site No.	Borehole No.	Borehole Locations				Geodetic Ground Surface Elevation (m)	Borehole Depth (m)
			MTM NAD83, Zone17		Latitude (deg)	Longitude (deg)		
			Northing (m)	Easting (m)				
003W0019AVPV	3182	BH-301	4672866	274040	42.19473	-82.872439	191.33	8.2
401W0010VEA	3183	BH-302	4677014	265196	42.23168	-82.979807	187.74	8.2

The geotechnical investigation was carried out using a track-mounted drill supplied and operated by a specialist drilling contractor, Direct Environmental Drilling. In the boreholes, samples of the overburden were obtained at generally 0.75 metre intervals of depth using 50 millimetre outside diameter split spoon sampling equipment in accordance with the standard penetration test (SPT) procedures of ASTM D1586. The recorded SPT N values are noted on the Record of Borehole sheets. According to ASTM D1586, the SPT resistance, or N value, is defined as the number of blows required by a 63.5 kilogram hammer dropped from a height of 760 millimetres to

drive a split-spoon sampler a distance of 300 millimetres, after an initial 150 millimetres of penetration. In cases where it was not possible to achieve a full 450 millimetres of drive, a penetration resistance representing the number of blows to drive the sampler is recorded on the Record of Borehole. The penetration resistance obtained in the first 150 millimetres is normally neglected unless the sampler could only be driven 150 millimetres or less, in which case SPT testing was terminated after 100 blows. The results of the SPT testing as presented on the Record of Borehole sheets and in Section 4 are unmodified (not standardized for hammer efficiency, borehole diameter, rod length, etc.).

The samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 40 millimetres. Therefore, particles that may exist within the soils that are larger than this dimension have not been sampled or represented in the grain size distributions. Larger particle sizes including cobbles and boulders are known to be present in the fill materials and native soils as discussed in the text of this report.

The boreholes were terminated at 8.2 metres (m) below the existing ground surface. Groundwater conditions in the boreholes were observed throughout the drilling operations. The boreholes were backfilled in general accordance with current MTO procedures and Ontario Regulation 903 (as amended).

The field work was monitored on a full-time basis by experienced WSP staff members who also located the boreholes in the field, monitored the drilling, sampling, and in situ testing operations, and logged the boreholes. The samples were identified in the field, placed in labelled containers, and transported to our Windsor laboratory for further examination and testing. Index and classification tests, consisting of water content determinations, grain size distribution analyses, and Atterberg limits tests were carried out on selected samples. The results of the geotechnical testing are shown on the Record of Borehole sheets and in Appendix B.

Additionally, one (1) sample from each of the boreholes was submitted to Bureau Veritas Lab in Mississauga, Ontario for analytical testing. The samples were analysed for conductivity, resistivity, redox potential, pH, sulfides, sulfate, and chloride ion content. The analytical test results are provided in Appendix C.

The locations of the boreholes are shown on the Record of Borehole sheets and on Drawings 1 and 2, attached.

4 SUBSURFACE CONDITIONS

4.1 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of the in-situ testing and the laboratory testing carried out on selected samples, are provided on the attached Record of Borehole sheets following the text of this report in Appendix A. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous samples and observations of drilling resistance and, therefore, may represent transitions between soil and rock types rather than exact planes of geological change. Further, the subsurface conditions will vary between and beyond the borehole locations.

The boreholes drilled at the site generally encountered surficial topsoil, over fill materials, over native clayey silt. Detailed descriptions of the subsurface conditions encountered in the boreholes are provided on the Record of Borehole sheets and are summarized in the following sections.

4.1.1 Fill Materials

Surficial organic clayey silt fill was encountered in borehole BH-301 underlain by native silty clay to clayey silt. Surficial silty sand and gravel fill was present in borehole BH-302 underlain by native silty clay to clayey silt. The thickness of the fill materials is summarized in the following table.

Table 3: Summary of Fill Thicknesses

Sign No. (MTO Structure No.)	Site No.	Borehole No.	Maximum Depth to Native Soils [Elevation] (m)	Material Thickness and Description (mm)	
003W0019AVPV	3182	BH-301	0.7 [190.6]	70	Fill – Sandy organic clayey silt
401W0010VEA	3183	BH-302	0.8 [186.9]	80	Fill – Silty sand and gravel

Samples of the organic clayey silt fill from borehole BH-301 had moisture contents ranging from 14% to 19%. A single measured N value from a SPT carried out in the organic clayey silt fill in BH-301 was 7 blows per 0.3 metres penetration indicating a firm consistency.

Samples of the silty sand and gravel fill from boreholes BH-302 had moisture contents of 6%. A single measured N value from a SPT carried out in the silty sand and gravel fill in borehole BH-302 was 21 blows per 0.3 metres penetration indicating a compact condition.

4.1.2 Silty Clay to Clayey Silt

An extensive cohesive stratum of silty clay to clayey silt was encountered beneath the fill in each of the boreholes. Regionally this stratum is generally divided into three general zones, the ‘weathered’ zone, the ‘crust’, and the ‘grey’ zone.

The weathered zone was observed in boreholes BH-301 and BH-302 beneath the fill materials to depths of 2.2 m. Soils in the weathered zone are subjected to freeze-thaw cycles, and changes in moisture content caused by seasonal weather variations. This zone is characterized by fissures, with a mottled brown and grey appearance. Measured N values from SPTs carried out in the weathered silty clay ranged from 6 blows to 10 blows per 0.3 m of penetration, indicating a firm to stiff consistency. Samples of the weathered/mottled silty clay had moisture contents typically ranging from 19% to 22%.

The crust was encountered underlying the weathered zone in boreholes BH-301 and BH-302. The crust was characterized by a brown colouration and oxidized fissures. This layer extended to depths of about 3.7 m in both the boreholes. Measured N values in the crust ranged from 26 blows to 32 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The moisture contents of samples of the crust/brown clayey silt typically ranged from 9% to 16%.

The grey zone was encountered in each of the boreholes. The grey zone is generally characterized by higher moisture contents and little to no apparent soil structure or fissures. The grey zone was encountered in each of the boreholes. Each of these boreholes were terminated in the grey clayey silt. Measured N values in the grey clayey silt ranged from 6 blows to 19 blows per 0.3 m of penetration indicating firm to very stiff consistency. A single field vane testing was carried out in grey clayey silt and yielded undrained shear strength of greater than 72 kilopascals (kPa). The moisture contents of samples of the grey clayey silt ranged from 14% to 19%.

The results of laboratory testing carried out on samples of the clayey silt are summarized below, included on the borehole log sheets, and attached in Appendix C.

Table 4: Summary of Laboratory Test Results on Silty Clay to Clayey Silt

Borehole/ Sample No.	Sample Depth [Elevation] (m)	Grain Size Distribution (%) ¹				Atterberg Limits		
		GR	SA	SI	CL	Liquid Limit (WL)	Plastic Limit (PL)	Plasticity Index
BH-301/2	190.2	0.6	26.6	32.7	40.1	39	17	22
BH-301/5	188.0	2.9	43.8	33.7	19.6	25	13	12
BH-301/7	186.4	0.9	17.0	46.1	36.0	27	14	13
BH-302/3	185.9	7.0	23.6	32.1	37.3	38	15	23
BH-302/5	184.4	0.9	29.5	38	31.6	30	13	17
BH-302/6	183.6	0.5	28.1	36.9	34.5	27	13	14

1. GR: Gravel, SA: Sand, SI: Silt, CL: Clay sized particles

4.2 Groundwater Conditions

Groundwater conditions were observed during and on completion of drilling and sampling of the current boreholes. Each of the boreholes were dry during and immediately following drilling. Due to the low permeability of the clayey soil at the site, however, insufficient time had passed to allow stabilization of groundwater levels in the open boreholes, as such these conditions are not considered to be representative of the long-term, stabilized groundwater conditions.

Typically, the grey colour of the soils is indicative of a permanent saturated condition, and therefore, fluctuation of the long-term groundwater should be anticipated near this depth range. However, during and after local precipitation events, groundwater that is 'perched' above the long-term levels may accumulate in the fissured weathered clays or any fills above the relatively more impervious grey clayey silt. In addition, significant amounts of groundwater may be present within the layers/pockets of granular soils known to occur randomly within the overburden soils and within any fill materials around existing utilities that may be present. The depth of the brown to grey transition encountered in each borehole is summarized in the following table.

Table 5: Depths of Transition from Brown to Grey Clayey Silt

Sign No. (MTO Structure No.)	Site No.	Borehole No.	Depth of Colour Change from Brown to Grey [Elevation] (m)
003W0019AVPV	3182	BH-301	3.7 [187.6]
401W0010VEA	3183	BH-302	3.7 [184.0]

Perched groundwater may rise to the ground surface following precipitation and snowmelt. In the absence of an active, engineered drainage system, the design should assume possible temporary groundwater levels rising to the ground surface.

4.3 Analytical Test Results

As indicated above, one (1) sample was selected from each the boreholes and submitted to Bureau Veritas Lab in Mississauga, Ontario for analytical testing. The test results are included in Appendix C and summarized in the following table.

Table 6: Results of Analytical Test Results

Borehole/ Sample No.	pH	Redox Potential (mV)	Sulphide (mg/kg)	Chloride (mg/kg)	Sulfate (mg/kg)	Conductivity (uS/cm)	Resistivity ohm.cm
BH-301/5	7.76	170	0.57	68	44	287	3500
BH-302/2	7.59	160	<0.50	1100	83	2080	480

5 CLOSURE

This investigation was carried out using equipment supplied and operated by Direct Environmental Drilling, an Ontario Ministry of Environment licensed well contractor. The field operations were supervised by Mr. Harshkumar Kevadia.

The laboratory testing was carried out at WSP's Windsor laboratory under the direction of Mr. Jack Maringh and Mr. Peter Giuliani, P.Eng. The laboratory is an accredited participant in the MTO Soil and Aggregate Proficiency Program and is certified by the Canadian Council of Independent Laboratories (CCIL) for testing Types C and D aggregates.

This report was prepared by Mr. Harshkumar Kevadia, P.Eng. and reviewed by Mr. Nazmur Rhaman, M.A.Sc., PE, P.Eng., MTO Principal Foundations Contact and Quality Control Auditor for this assignment.

WSP Canada Inc.



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PART B
FOUNDATION DESIGN REPORT
POLE-MOUNTED VARIABLE MESSAGE SIGN SUPPORTS
HIGHWAY 3
COUNTY OF ESSEX
GWP 3008-22-00

6 ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides recommendations on the foundation aspects for design of the proposed variable message sign supports. The recommendations are based on our interpretation of the information obtained from the boreholes advanced near the proposed sign locations. This Foundation Design Report, with its interpretation and recommendations, is intended for use of the design engineers. Where comments are made on construction they are provided only to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods, and scheduling.

The following soil properties and long-term groundwater levels, based on the results of the borehole investigation, may be used for design of the sign support foundations.

Table 7: Summary of Soil Properties and Groundwater Levels

Site No.	Borehole Reference	Soil	Depth [Elevation] (m)	Undrained Shear Strength (kPa)	Angle of Internal Friction (deg)	Unit Weight (kN/m ³)	Long-term Groundwater Level [Elevation] (m)
3182	BH-301	Sandy organic clayey silt FILL	0 to 0.7 [191.3 to 190.6]	-	20 to 25	15.0	3.7* [187.6]
		Silty clay, stiff	0.7 to 2.2 [190.6 to 189.1]	55	26 to 28	20.5	
		Clayey silt, very stiff to hard	2.2 to 3.7 [189.1 to 187.6]	100-200	28 to 31	21.0	
		Clayey silt, very stiff to stiff	3.7 to 8.2 [187.6 to 183.1]	75	28 to 30	20.5	
3183	BH-302	Silty sand and gravel FILL, compact	0 to 0.8 [187.7 to 186.9]	-	30 to 32	22	3.7* [185.6]
		Silty clay, stiff to firm	0.8 to 2.2 [186.9 to 185.5]	50	26 to 28	20.5	
		Clayey silt, very stiff	2.2 to 3.7 [185.5 to 184.0]	150	28 to 30	20.5	
		Clayey silt, very stiff to stiff	3.7 to 8.2 [184.0 to 179.5]	70-100	28 to 30	20.5	

* Depth of transition from brown to grey clayey silt

6.2 Variable Message Sign Foundations

It is understood that each of the new signs will be a ground-mounted, Pole-Mounted Variable Message Sign (VMS), designed in accordance with the MTO's *Sign Support Manual* (2019), which includes a "standard" drilled shaft (caisson) foundation provided that minimum geotechnical parameters are available. The following minimum geotechnical design parameters are provided in Section 8.5.4 of the *Sign Support Manual*:

- Case 1 Sand: Non-cohesive soil with an effective friction angle of 28 degrees surrounding the upper two-thirds of the caisson below the frost depth, and an effective friction angle of 30 degrees surrounding the lower one-third of the caisson below the design frost depth.

- Case 2 Soft Clay: Cohesive soil with an undrained shear strength of 25 kilopascals (kPa) surrounding the upper two thirds of the caisson below the frost depth and an undrained shear strength of 50 kPa surrounding the lower third of the caisson below the frost depth.

Where soils meet the above minimum parameters, the “standard” foundation design consisting of a 1.2 m diameter caisson with a length of 6.0 m below the frost depth can be used.

6.2.1 Standard Foundation Design

The soil conditions at each sign site meet or exceed the minimum parameters specified in Case 2. Therefore, the standard design sign foundation detailed in Standard Drawing SS118-3 of the *Sign Support Manual* is applicable provided the board sizes and eccentricities are within the specification for pole-mounted variable message signs per *Sign Support Manual* Section 8.

It is noted that if the signs will be at risk of chloride exposure from the environment consideration should be given to the use of Class C-1 concrete which specifies a higher concrete compressive strength than the standard foundation design.

The frost depth to be used in the sign support foundation is 1.2 m, based on the frost penetration isopleths for Southern Ontario per Ontario Provincial Standard Drawing (OPSD) 3090.101 (Foundation Frost Penetration Depths).

6.3 Construction Considerations

VMS foundations should be constructed in accordance with the OPSS.PROV 915 (Construction Specification for Sign Support Structures) and OPSS.PROV 903 (Construction Specification for Deep Foundations).

While not explicitly encountered in the boreholes near the proposed VMS locations, cobbles and boulders should be expected in the soils in this project area and the contractor should be prepared to address their presence, if required.

During placement of concrete a positive head of concrete must be maintained at all times to prevent the breaking of the concrete continuity by the ingress of soil or water. The concrete should be placed by tremie methods to prevent segregation, allow air to escape, and reduce the potential for entrapped air in the concrete.

Groundwater inflow into excavations in the clayey soils is expected to be low; however, significant ‘perched’ groundwater may be present within the surficial fills. This would especially be true during and after local precipitation events. The Contractor should be prepared to address groundwater inflow with the use of pumps, temporary liners, and/or other appropriate means at the Contractor’s discretion. Care should be taken to prevent disturbance or softening of the supporting soils at the base of the excavation. A proper inspection should be carried out during construction of the caissons to check that the conditions encountered are consistent with the information obtained from the boreholes, to confirm the base elevation of the caissons, and to confirm cleanliness after inspection. Loosened material present at the base of the caissons must be removed.

The final grade surrounding the VMS support should be shaped to promote drainage of surface water away from the sign foundation.

A notice to contractor is provided in Appendix D.

6.4 Corrosion Potential and Concrete Exposure Class

Testing of corrosion potential parameters was carried out on selected soil samples from each borehole. The results of the testing have been provided in Section 4.3, above.

The test results indicate that concrete in contact with the tested soil samples would have a negligible degree of exposure to sulphate attack based on CSA-A23; therefore, sulphate resistant concrete is not considered necessary for this site.

ANSI/AWWA C105/A21.5-05, Appendix A, Table A.1 is often used to assess the risk of corrosion of buried metallic elements, including concrete reinforcing steel. The tested soil sample for boreholes BH-301 is not considered corrosive to buried metallic elements in accordance with ANSI/AWWA C105/A21.5-05, Appendix A, Table A.1. However, the sample from borehole BH-302 was found to have relatively low resistivity values and therefore may be corrosive to buried metallic elements in accordance with ANSI/AWWA C105/A21.5-05, Appendix A, Table A.1.

In general, CSA-A23.1 exposure class F-1 concrete should be used for the sign support foundations; however, class C-1 should be considered where there is a risk of environmental chloride exposure or where corrosive soil conditions have been identified as discussed above. In accordance with the MTO Structural Design Manual, Premium Reinforcing shall be used in locations vulnerable to salt induced corrosion. While sign supports are not specifically referenced, the recommendations for lighting poles provided in Table 12.2.1 of the Design Manual, as amended by MTO memo SCB-SO-2024-02, are considered applicable to sign supports. These recommendations include the use of stainless steel reinforcement or Glass Fibre Reinforced Polymer (GFRP). Considering the long-term potential for reduction of cover, these recommendations should also be applied to the sites where soil-related corrosion is likely, Site 3183 as indicated above. It is noted that the standard foundation design assumes the use of steel reinforcement and the use of GFRP would necessitate a non-standard foundation design.

These test results and comments are provided as high-level guidance for the design team. If more in-depth recommendations are required, the above results and conclusions/inferences should be reviewed by a corrosion specialist to assess the risk to buried metallic elements including concrete reinforcing steel.

7 CLOSURE

This report was prepared by Mr. Harshkumar Kevadia, P.Eng. and reviewed by Mr. Nazmur Rhaman, M.A.Sc., PE, P.Eng., MTO Principal Foundations Contact and Quality Control Auditor for this assignment.

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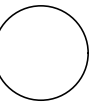
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Attachments

METRIC

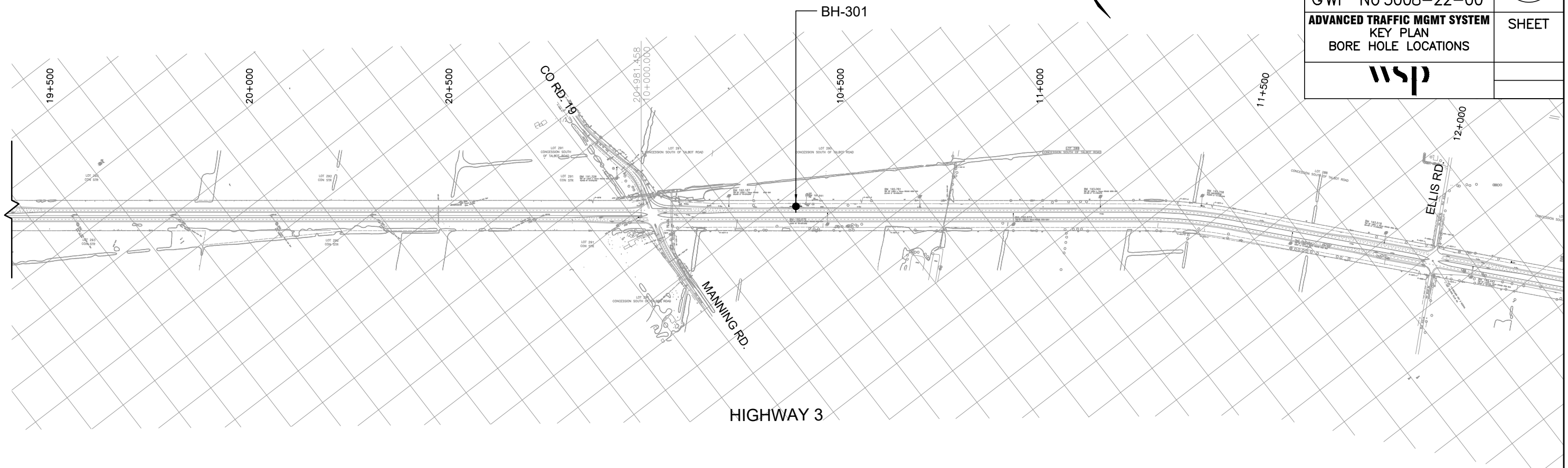
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GWP No 3008-22-00
ADVANCED TRAFFIC MGMT SYSTEM
KEY PLAN
BORE HOLE LOCATIONS



SHEET

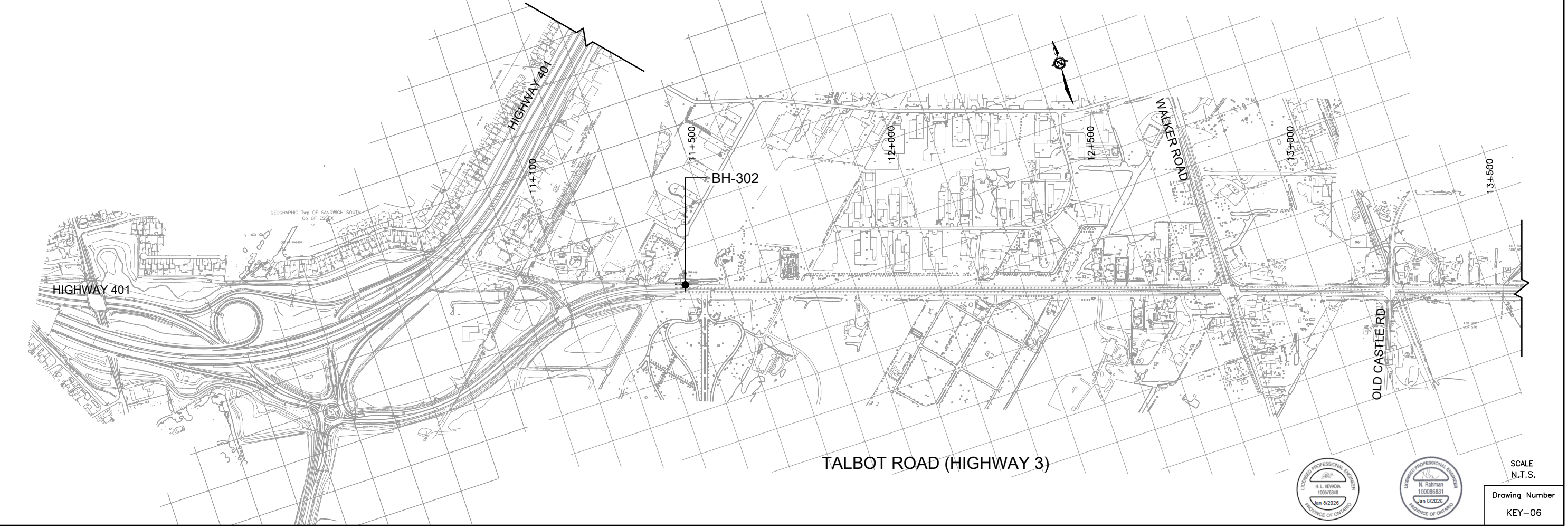


MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707
BB-05

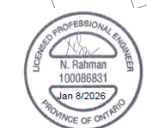


HIGHWAY 3

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DATE PLOTTED: 11/13/2025 2:41:20 PM BY: GARALDEN



TALBOT ROAD (HIGHWAY 3)



SCALE
N.T.S.

Drawing Number
KEY-06

APPENDIX A

Record of Boreholes

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

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse	19 to 75	0.75 to 3
	Fine	4.75 to 19	(4) to 0.75
SAND	Coarse	2.00 to 4.75	(10) to (4)
	Medium	0.425 to 2.00	(40) to (10)
	Fine	0.075 to 0.425	(200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

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

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

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve friction (f_s) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d :

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

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

SAMPLES

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

SOIL TESTS

w	water content
PL, w_p	plastic limit
LL, w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_r	relative density (specific gravity, G_s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
Y	unit weight

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

COARSE-GRAINED SOILS

Compactness¹

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

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

FINE-GRAINED SOILS

Consistency

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

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

Field Moisture Condition

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

LIST OF SYMBOLS
MINISTRY OF TRANSPORTATION, ONTARIO

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

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

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_P or PL	plastic limit
I_P or PI	plasticity index = $(w_L - w_P)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_c	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

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

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

Notes: 1
2

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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

AXJ Axial Joint	KV Karstic Void
BD Bedding	K Slickensided
BC Broken Core	LC Lost Core
CC Continuous Core	MB Mechanical Break
CL Closed	PL Planar
CO Contact	PO Polished
CU Curved	RO Rough
CT Coated	SA Slightly Altered
FLT Fault	SH Shear
FOL Foliation	SM Smooth
FR Fracture	SR Slightly Rough
GO Gouge	SY Stylolite
IN Infilled	UN Undulating
IR Irregular	VN Vein
JN Joint	VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250

APPENDIX B

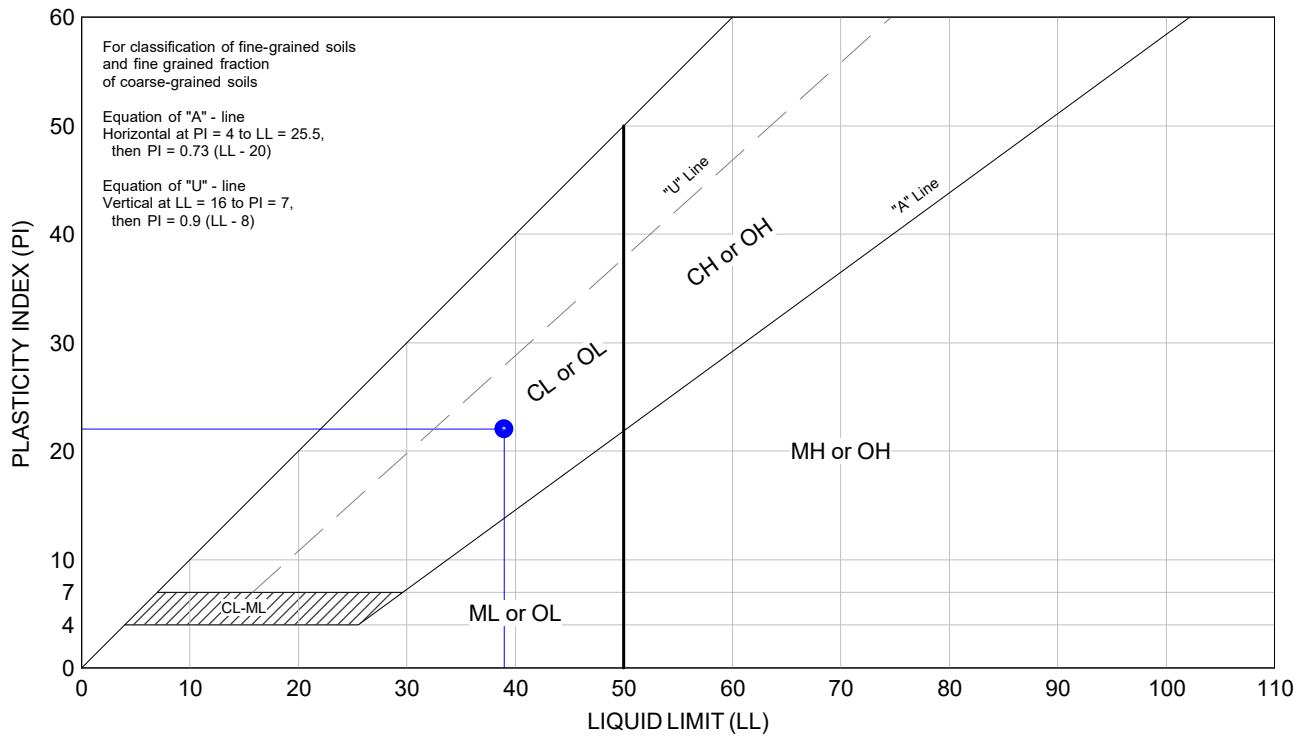
Geotechnical Laboratory Test Data



**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052715	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site sampled	Client:	MTO
Sample Number:	BH301 - 2	Report Number:	LON00097-25
Soil Description:		WSP Lab Number:	WIN25-01583
Soil Classification:		Date Received:	09/02/2025
Sampled By:	H. Kevadia	Date of Test:	09/26/2025
Date Sampled:	09/02/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
			39	17	22	

NP = Non-Plastic
 ND = Not Determined

Test Preparation
Lab Testing Comments/ Deviations:
General Comments:

Reviewed By: Dave Dillabough	Title: Laboratory Supervisor	
Signature: <i>Dall</i>		

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



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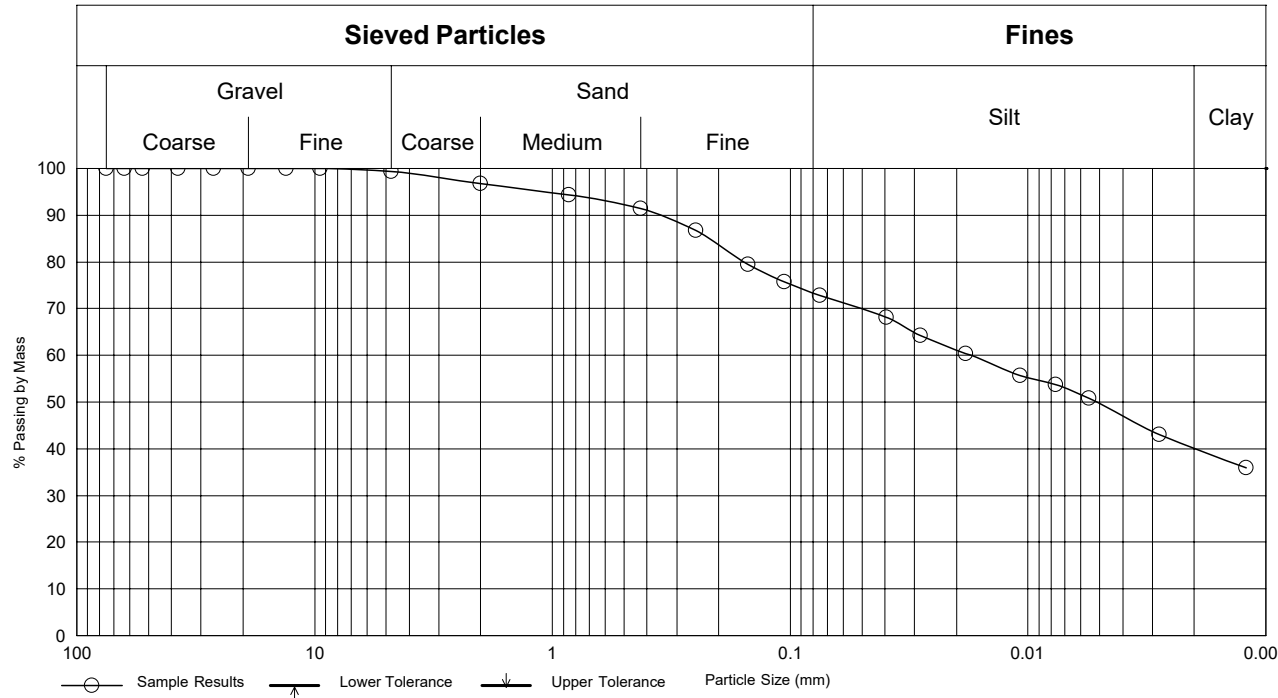
11/12/2025

Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #:	052715	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Client:	MTO
Sample Location:	Site sampled	Project Name:	Hwy 3, 401, 402
Sample Number:	BH301 - 2	Report Number:	LON00097-25
Soil Description:		WSP Lab Number:	WIN25-01583
Soil Classification:		Date Received:	09/02/2025
Specification:		Date of Test:	09/24/2025
Sampled By:	H. Kevadia	Tested By:	Marinigh, Jack
Date Sampled:	09/02/2025		

Grain Size Distribution	Gravel	Sand	Silt / Clay
	0.6	26.6	72.8


Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0394	68.1
		0.0283	64.3
		0.0182	60.4
		0.0108	55.7
		0.0077	53.7
		0.0056	50.8
75.0		0.0028	43.1
63.0		0.0012	36.0
53.0			
37.5			
26.5			
19.0			
13.2			
9.5	100.0		
4.75	99.4	0.005mm	49.6
2.00	96.8	0.002mm	40.1
0.850	91.4	D60	0.017
0.425	86.7	D30	NA
0.250	79.5	D10	NA
0.106	75.7	Cu	NA
0.075	72.8	Cc	NA



Notes: _____ Disclaimer: _____
 Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*





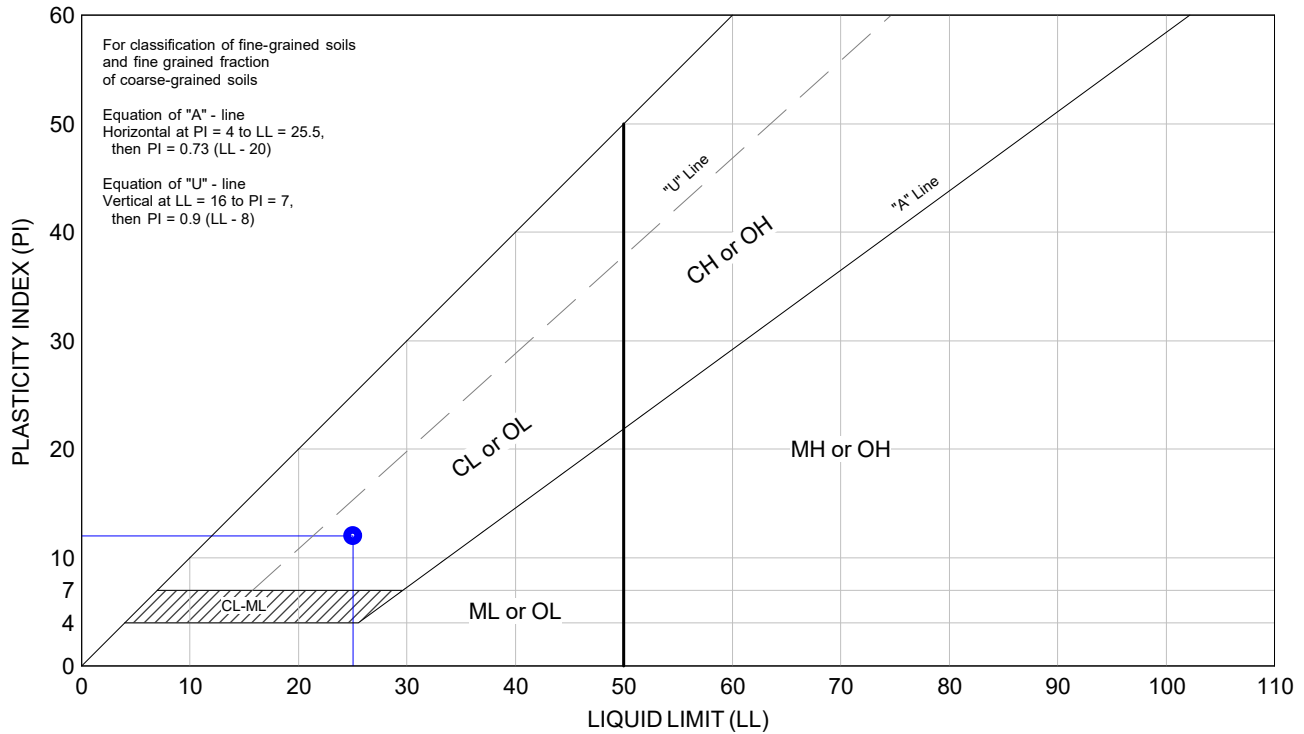
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11/12/2025

**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052718	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site Sampled	Client:	MTO
Sample Number:	BH301 - 5	Report Number:	LON00098-25
Soil Description:		WSP Lab Number:	WIN25-01584
Soil Classification:		Date Received:	09/02/2025
Sampled By:	H. Kevadia	Date of Test:	09/29/2025
Date Sampled:	09/02/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
			25	13	12	

NP = Non-Plastic
 ND = Not Determined

Test Preparation

Lab Testing Comments/ Deviations:

General Comments:

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *D.Dill*

CERTIFIED BY

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



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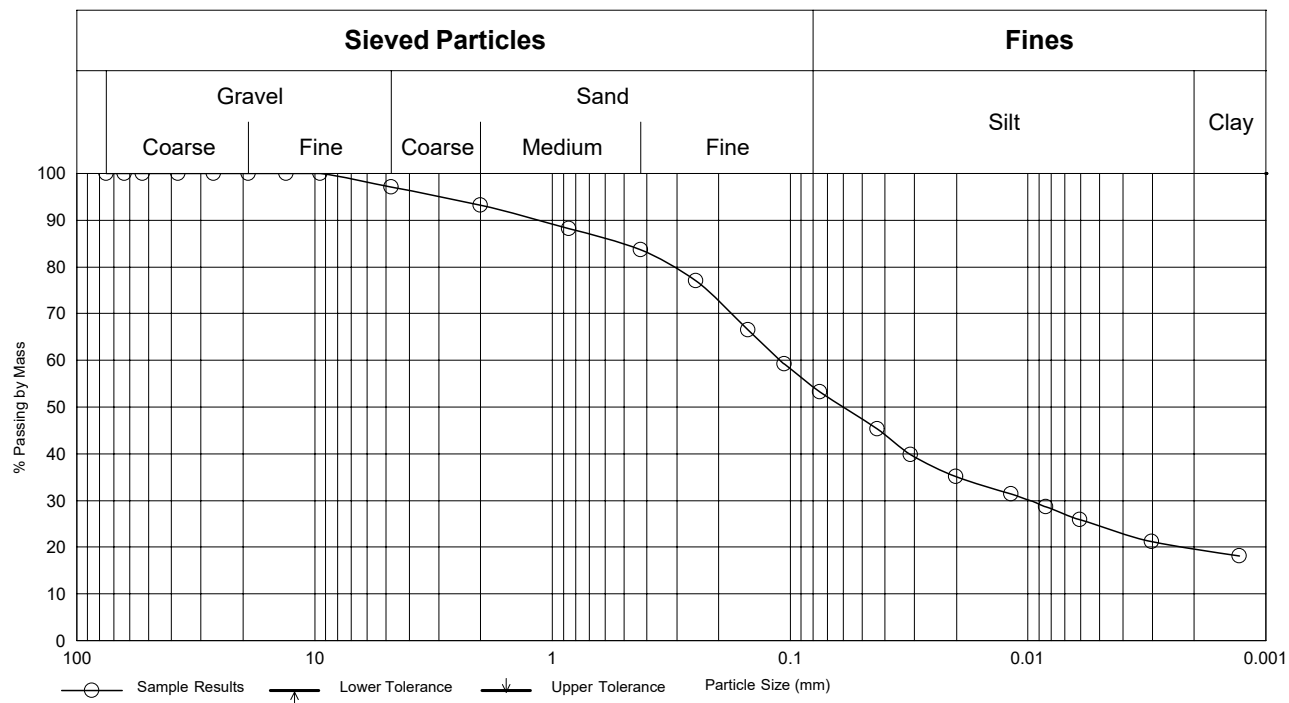
11/12/2025

Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #:	052718	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Client:	MTO
Sample Location:	Site sampled	Project Name:	Hwy 3, 401, 402
Sample Number:	BH301 - 5	Report Number:	LON00098-25
Soil Description:		WSP Lab Number:	WIN25-01584
Soil Classification:		Date Received:	09/02/2025
Specification:		Date of Test:	09/24/2025
Sampled By:	H. Kevadia	Tested By:	Marinigh, Jack
Date Sampled:	09/02/2025		

Grain Size Distribution	Gravel	Sand	Silt / Clay
	2.9	43.8	53.3

Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0431	45.3
		0.0312	39.7
		0.0201	35.2
		0.0117	31.5
		0.0084	28.7
		0.0061	25.8
75.0		0.0030	21.2
63.0		0.0013	18.1
53.0			
37.5			
26.5			
19.0			
13.2			
9.5	100.0		
4.75	97.1	0.005mm	24.5
2.00	93.2	0.002mm	19.6
0.850	83.7	D60	0.111
0.425	76.9	D30	0.010
0.250	66.5	D10	NA
0.106	59.2	Cu	NA
0.075	53.3	Cc	NA




Notes: _____ Disclaimer: _____

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*

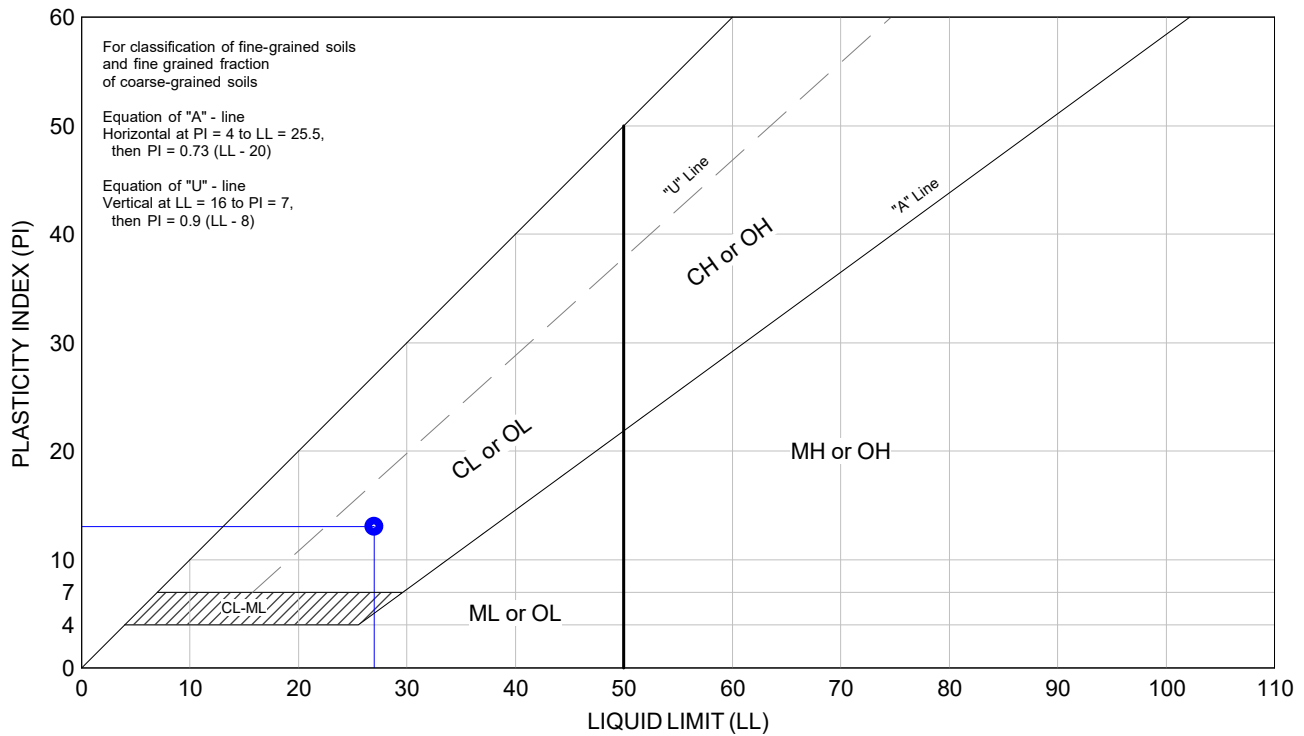




**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052721	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site sampled	Client:	MTO
Sample Number:	BH301 - 7	Report Number:	LON00099-25
Soil Description:		WSP Lab Number:	WIN25-01585
Soil Classification:		Date Received:	09/02/2025
Sampled By:	H. Kevadia	Date of Test:	09/29/2025
Date Sampled:	09/02/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
			27	14	13	

NP = Non-Plastic
 ND = Not Determined

Test Preparation

Lab Testing Comments/ Deviations:

General Comments:

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*

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Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



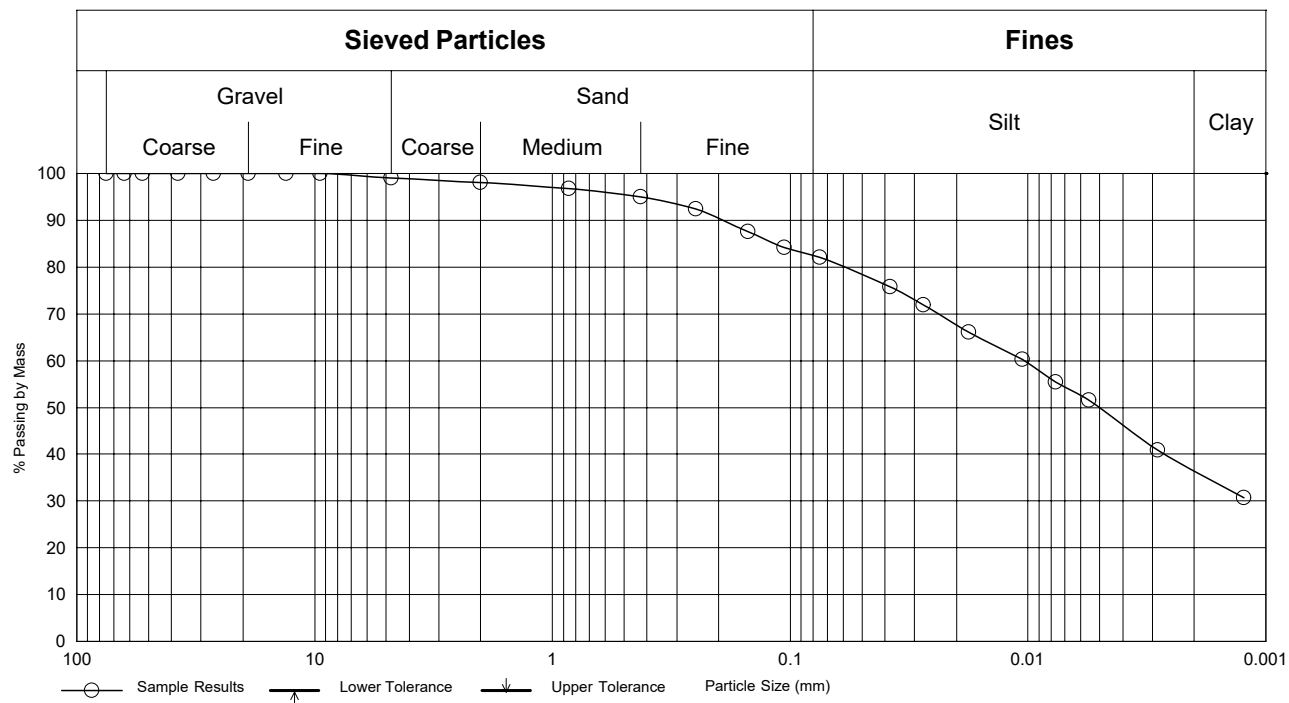
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11/12/2025

Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #:	052721	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Client:	MTO
Sample Location:	Site sampled	Project Name:	Hwy 3, 401, 402
Sample Number:	BH301 - 7	Report Number:	LON00099-25
Soil Description:		WSP Lab Number:	WIN25-01585
Soil Classification:		Date Received:	09/02/2025
Specification:		Date of Test:	09/24/2025
Sampled By:	H. Kevadia	Tested By:	Marinigh, Jack
Date Sampled:	09/02/2025		

Grain Size Distribution	Gravel	Sand	Silt / Clay
	0.9	17.0	82.1



Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0380	75.8
		0.0275	72.0
		0.0178	66.1
		0.0106	60.3
		0.0076	55.5
		0.0056	51.5
75.0		0.0028	40.8
63.0		0.0012	30.7
53.0			
37.5			
26.5			
19.0			
13.2			
9.5	100.0		
4.75	99.1	0.005mm	49.9
2.00	98.0	0.002mm	36.0
0.850	95.0	D60	0.010
0.425	92.3	D30	NA
0.250	87.6	D10	NA
0.106	84.1	Cu	NA
0.075	82.1	Cc	NA

Notes: _____ Disclaimer: _____

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*

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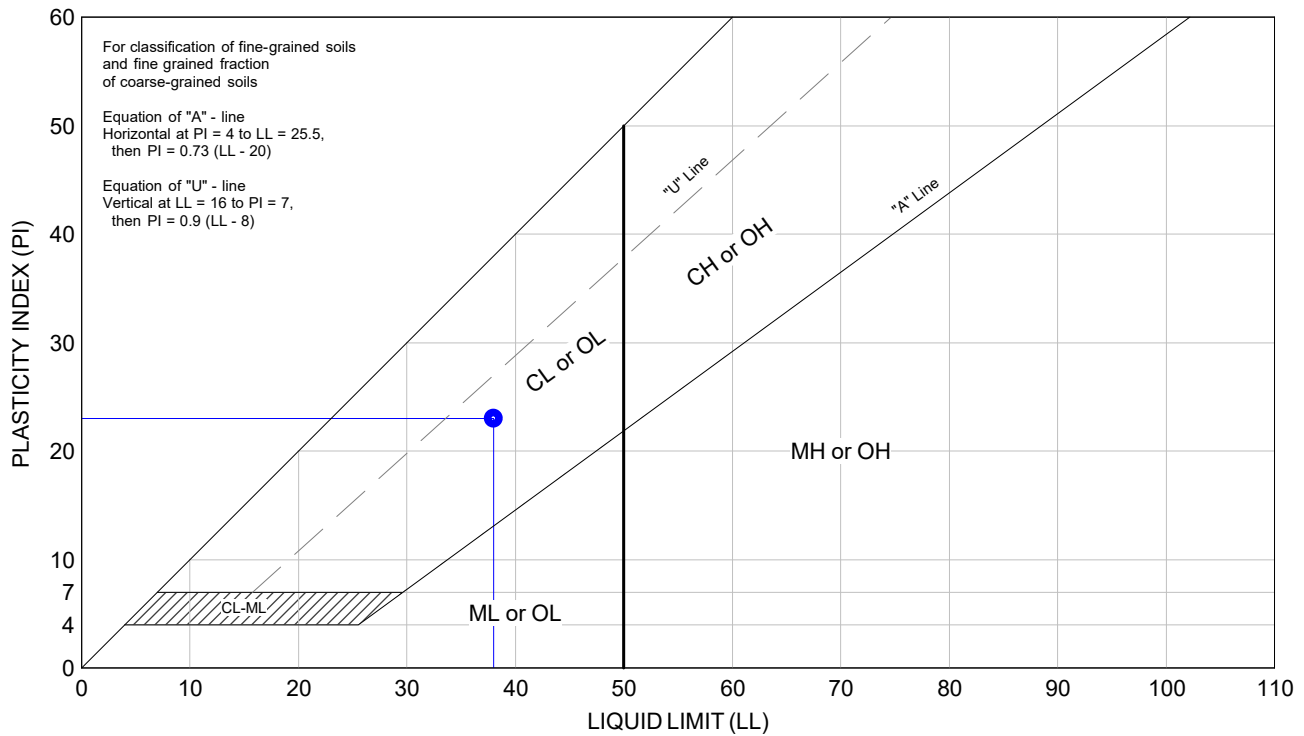
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11/12/2025

**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052724	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site Sampled	Client:	MTO
Sample Number:	BH302 - 3	Report Number:	LON00100-25
Soil Description:		WSP Lab Number:	WIN25-01586
Soil Classification:		Date Received:	09/03/2025
Sampled By:	H. Kevadia	Date of Test:	09/29/2025
Date Sampled:	09/03/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
			38	15	23	

NP = Non-Plastic
 ND = Not Determined

Test Preparation

Lab Testing Comments/ Deviations:

General Comments:

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *D.Dill*

CERTIFIED BY

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



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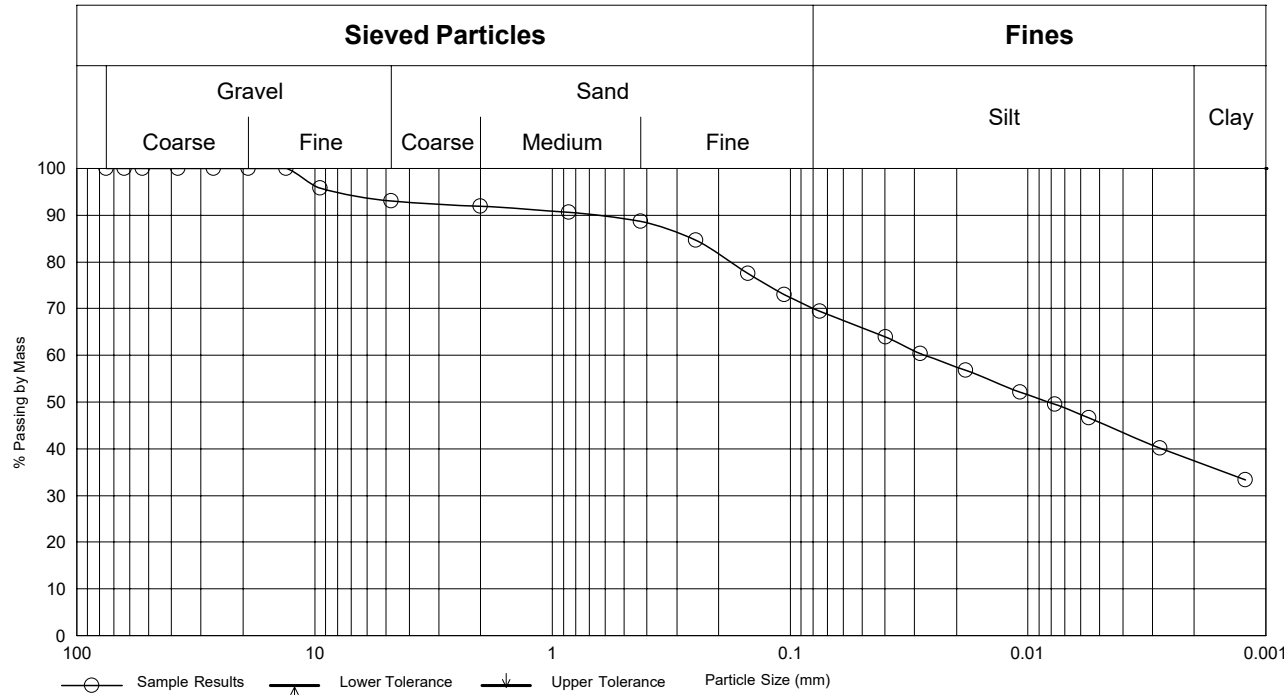
11/12/2025

Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #:	052724	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Client:	MTO
Sample Location:	Site sampled	Project Name:	Hwy 3, 401, 402
Sample Number:	BH302 - 3	Report Number:	LON00100-25
Soil Description:		WSP Lab Number:	WIN25-01586
Soil Classification:		Date Received:	09/03/2025
Specification:		Date of Test:	09/24/2025
Sampled By:	H. Kevadia	Tested By:	Marinigh, Jack
Date Sampled:	09/03/2025		

Grain Size Distribution	Gravel	Sand	Silt / Clay
	7.0	23.6	69.4


Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0396	64.0
		0.0284	60.4
		0.0183	56.7
		0.0108	52.2
		0.0077	49.4
		0.0055	46.5
75.0		0.0028	40.2
63.0		0.0012	33.3
53.0			
37.5			
26.5			
19.0			
13.2	100.0		
9.5	95.9		
4.75	93.0	0.005mm	45.6
2.00	92.0	0.002mm	37.3
0.850	88.7	D60	0.027
0.425	84.7	D30	NA
0.250	77.5	D10	NA
0.106	73.0	Cu	NA
0.075	69.4	Cc	NA



Notes: _____ Disclaimer: _____
 Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*





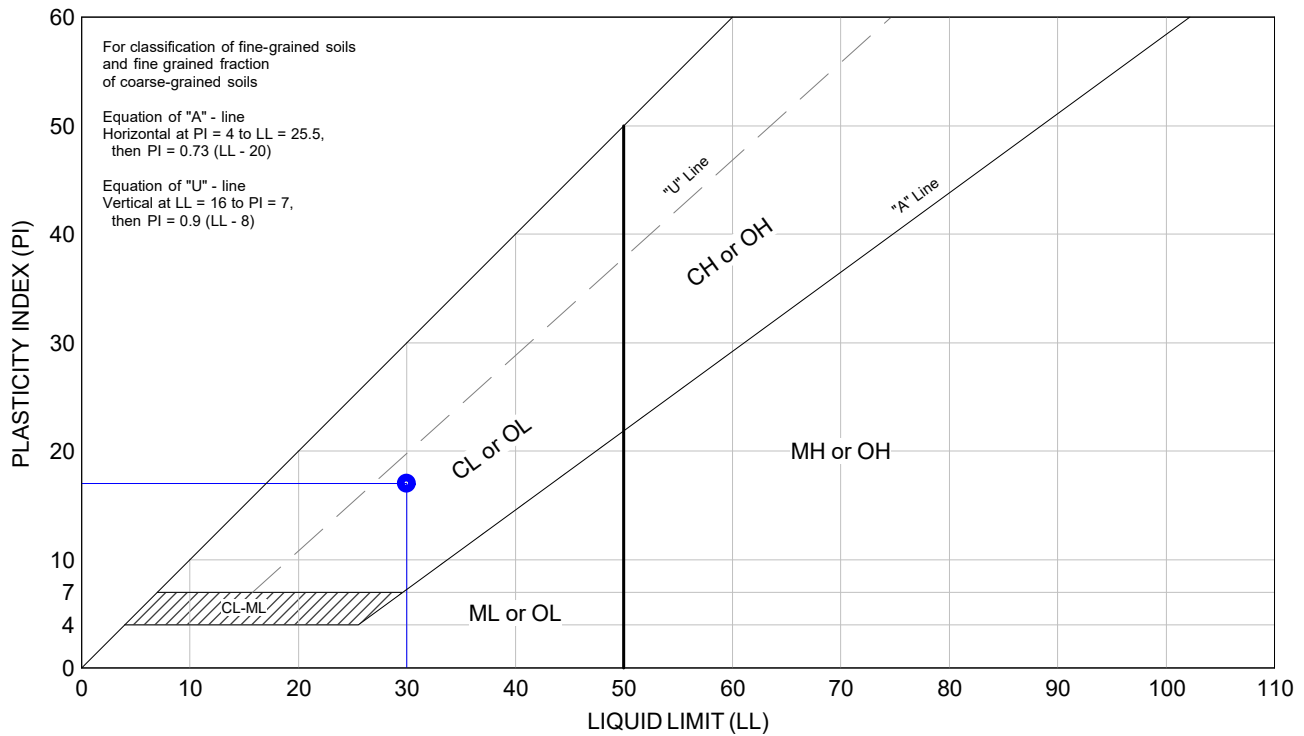
WSP Canada Inc.
 1825 Provincial Road Unit 1
 Windsor, N8W 5V7
 519-250-3733

12/19/2025

**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052728	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site Sampled	Client:	MTO
Sample Number:	BH302 - 5	Report Number:	LON00101-25
Soil Description:		WSP Lab Number:	WIN25-01587
Soil Classification:		Date Received:	09/03/2025
Sampled By:	H. Kevadia	Date of Test:	10/01/2025
Date Sampled:	09/03/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
	NA		30	13	17	

NP = Non-Plastic
 ND = Not Determined

Test Preparation
Lab Testing Comments/ Deviations: Silty Clay
General Comments:

Reviewed By: Dave Dillabough	Title: Laboratory Supervisor	
Signature: <i>Dill</i>		

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



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 Windsor, N8W 5V7
 519-250-3733

12/19/2025

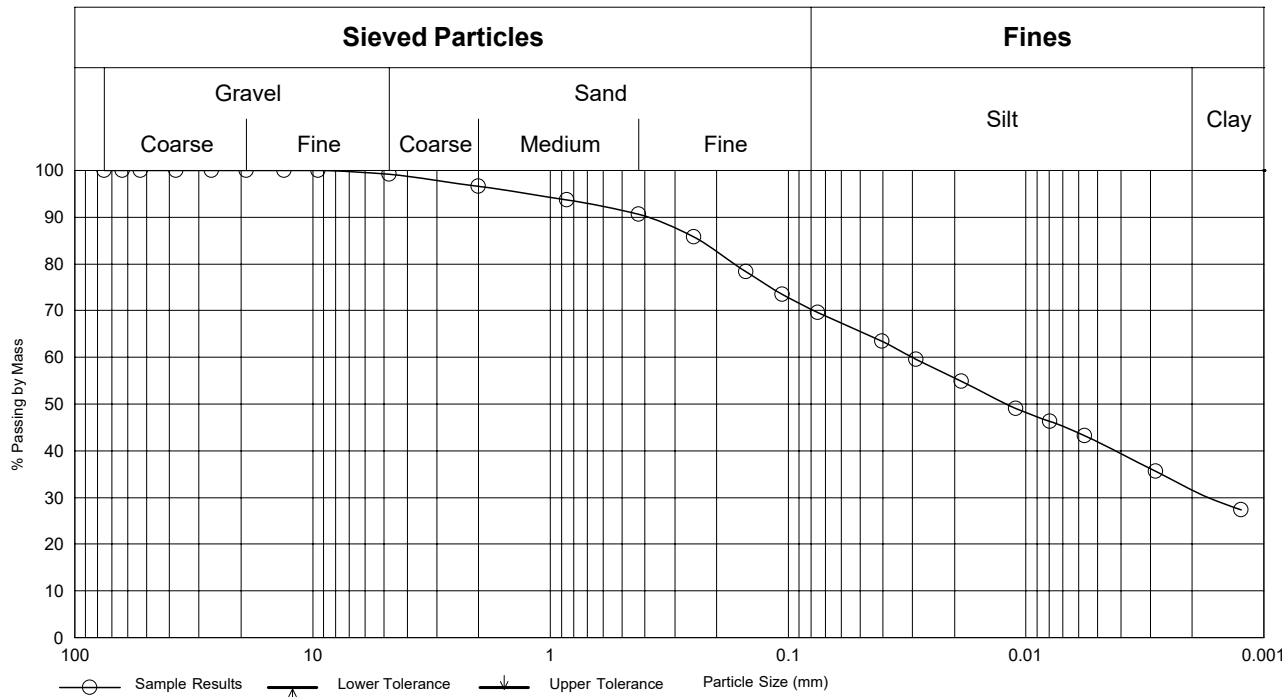
Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #: 052728
 Supplier:
 Source: On site
 Sample Location: Site sampled
 Sample Number: BH302 - 5
 Soil Description:
 Soil Classification:
 Specification:
 Sampled By:
 Date Sampled: 09/03/2025

Project Number: CA0051716.2286
 Contract Number:
 Client: MTO
 Project Name: Hwy 3, 401, 402
 Report Number: LON00101-25
 WSP Lab Number: WIN25-01587
 Date Received: 09/03/2025
 Date of Test: 09/24/2025
 Tested By: Maringh, Jack

Grain Size Distribution	Gravel	Sand	Silt / Clay
	0.9	29.5	69.6

Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0402	63.4
		0.0289	59.6
		0.0187	54.8
		0.0111	49.1
		0.0079	46.2
		0.0057	43.2
75.0		0.0029	35.5
63.0		0.0013	27.3
53.0			
37.5			
26.5			
19.0			
13.2			
9.5	100.0		
4.75	99.1	0.005mm	41.8
2.00	96.5	0.002mm	31.6
0.850	90.7	D60	0.030
0.425	85.8	D30	0.002
0.250	78.3	D10	NA
0.106	73.5	Cu	NA
0.075	69.6	Cc	NA



Notes:

Disclaimer:

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough | Title: Laboratory Supervisor

Signature: *Dall*

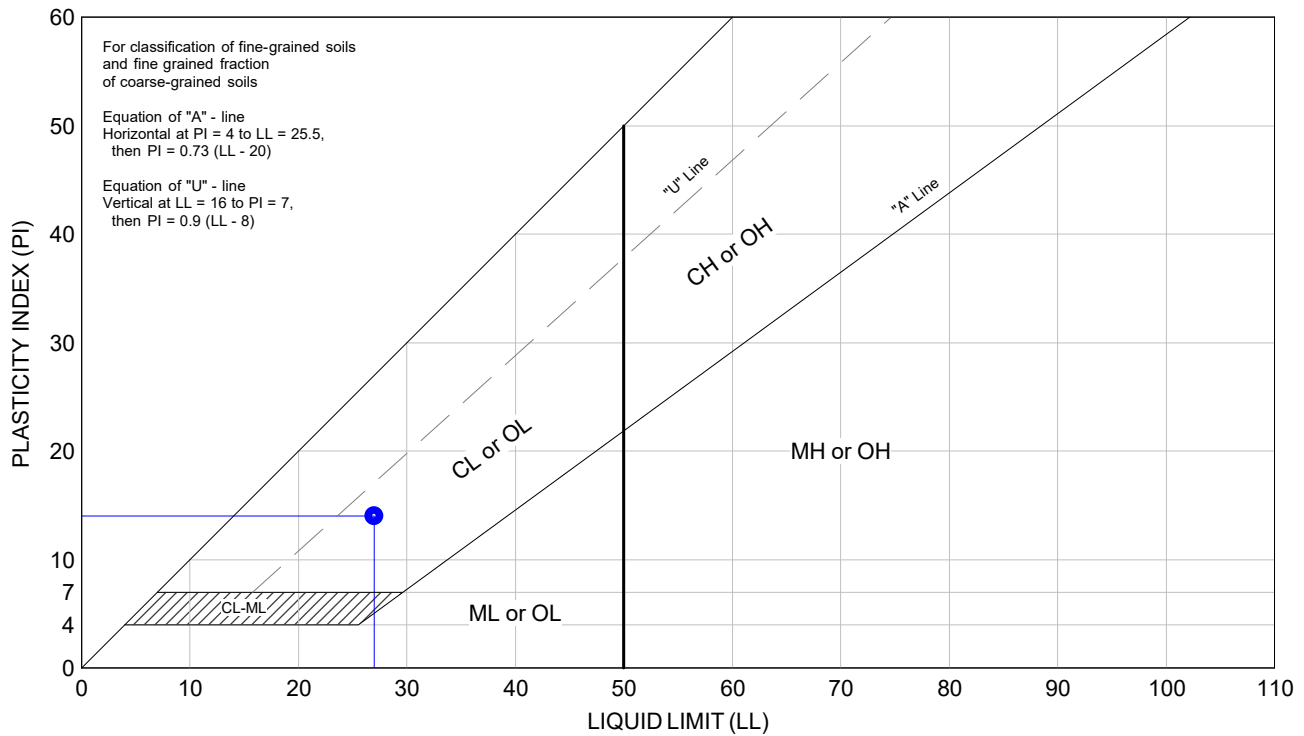




**Liquid Limit, Plastic Limit and
 Plasticity Index**

Testing Standard: MTO LS-703/704 (Rev. 36)

Testing Program #	052729	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Project Name:	Hwy 3, 401, 402
Sample Location:	Site sampled	Client:	MTO
Sample Number:	BH302 - 6	Report Number:	LON00102-25
Soil Description:		WSP Lab Number:	WIN25-01588
Soil Classification:		Date Received:	09/03/2025
Sampled By:	H. Kevadia	Date of Test:	10/01/2025
Date Sampled:	09/03/2025	Tested By:	Jack Marinigh



Sample Depth (m)	Percent Passing 425um Sieve	Natural Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
			27	13	14	

NP = Non-Plastic
 ND = Not Determined

Test Preparation

Lab Testing Comments/ Deviations:

General Comments:

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *D.Dill*

CERTIFIED BY

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.



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 Windsor, N8W 5V7
 519-250-3733

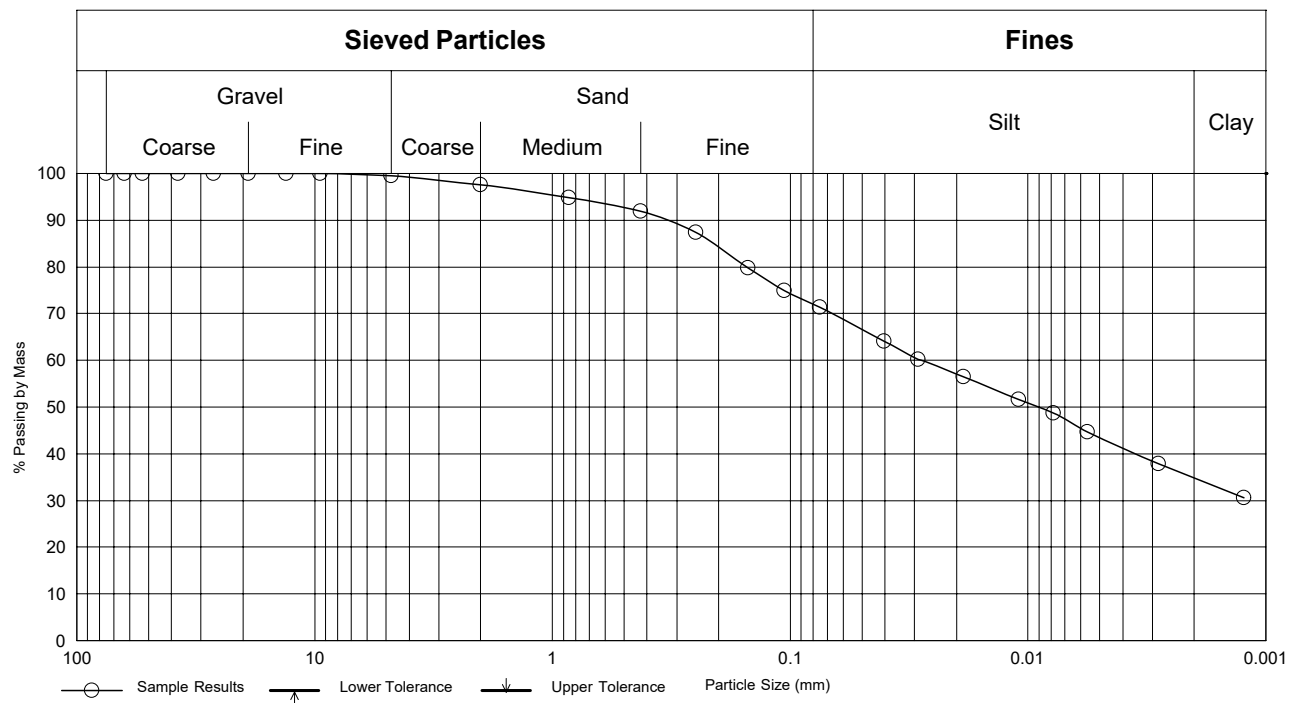
11/12/2025

Particle Size Distribution of Soils
 Testing Standard: MTO LS-702 (Rev. 37)

Testing Program #:	052729	Project Number:	CA0051716.2286
Supplier:		Contract Number:	
Source:	On site	Client:	MTO
Sample Location:	Site sampled	Project Name:	Hwy 3, 401, 402
Sample Number:	BH302 - 6	Report Number:	LON00102-25
Soil Description:		WSP Lab Number:	WIN25-01588
Soil Classification:		Date Received:	09/03/2025
Specification:		Date of Test:	09/24/2025
Sampled By:	H. Kevadia	Tested By:	Marinigh, Jack
Date Sampled:	09/03/2025		

Grain Size Distribution	Gravel	Sand	Silt / Clay
	0.5	28.1	71.4

Sieve		Hydrometer	Sedimentation
Sieve Size (mm)	% Passing	Particle Size mm	% Passing
		0.0402	64.1
		0.0289	60.3
		0.0186	56.4
		0.0110	51.6
		0.0078	48.7
		0.0056	44.6
75.0		0.0028	37.8
63.0		0.0012	30.5
53.0			
37.5			
26.5			
19.0			
13.2			
9.5	100.0		
4.75	99.5	0.005mm	43.3
2.00	97.6	0.002mm	34.5
0.850	92.0	D60	0.028
0.425	87.3	D30	NA
0.250	79.8	D10	NA
0.106	75.0	Cu	NA
0.075	71.4	Cc	NA



Notes: _____ Disclaimer: _____

Notice: The test data given herein pertain to the sample provided and may not be applicable to other samples or to material from earlier or subsequent production. Reporting of these results constitutes a testing service only. Engineering interpretation and advice may be provided upon written request.

Reviewed By: Dave Dillabough Title: Laboratory Supervisor

Signature: *Dall*

CERTIFIED BY

APPENDIX C

Analytical Laboratory Test Data



Your Project #: CA0051716.2286, TASK 700
Your C.O.C. #: C#1057533-05-01

Attention: Harshkumar Kevadia

WSP Canada Inc.
55 King St
Suite 700
St. Catharines, ON
CANADA L2R3H5

Report Date: 2025/11/21
Report #: R8655775
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BUREAU VERITAS JOB #: C5B0983

Received: 2025/09/08, 13:33

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	2	2025/09/11	2025/09/12	CAM SOP-00463	MOE E3013 m
Conductivity	2	2025/09/11	2025/09/11	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	2	N/A	2025/09/14	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2025/09/16	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	2	2025/09/11	2025/09/11	CAM SOP-00413	EPA 9045 D m
Redox Potential (3)	2	2025/09/17	2025/09/18	CAM SOP-00421	SM 24 2580 B
Resistivity of Soil	2	2025/09/09	2025/09/12	CAM SOP-00414	SM 24 2510 m
Sulphate (20:1 Extract)	2	2025/09/11	2025/09/12	CAM SOP-00464	MOE E3013 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE, Calgary, AB, T2E 6P8

(2) Offsite analysis requires that subcontracted moisture be reported.

(3) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode. The test is therefore, not SCC accredited for this matrix.



Your Project #: CA0051716.2286, TASK 700
Your C.O.C. #: C#1057533-05-01

Attention: Harshkumar Kevadia

WSP Canada Inc.
55 King St
Suite 700
St. Catharines, ON
CANADA L2R3H5

Report Date: 2025/11/21
Report #: R8655775
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BUREAU VERITAS JOB #: C5B0983
Received: 2025/09/08, 13:33

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Keshani Vijh, Sr. Project Manager
Email: keshani.vijh@bureauveritas.com
Phone# (905) 817-5700

=====

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SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		AUWU16		AUWU17		
Sampling Date		2025/09/02 16:00		2025/09/02 09:00		
COC Number		C#1057533-05-01		C#1057533-05-01		
	UNITS	BH-301-5	RDL	BH-302-2	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	3500		480		A006393
CONVENTIONALS						
Redox Potential	mV	170	N/A	160	N/A	A011952
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	68	20	1100	40	A008007
Conductivity	umho/cm	287	2	2080	2	A008151
Available (CaCl2) pH	pH	7.76		7.59		A008293
Soluble (20:1) Sulphate (SO4)	ug/g	44	20	83	20	A008192
Sulphide	mg/kg	0.57 (1)	0.50	<0.50 (2)	0.50	A011827
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Extracted past method specified hold time Sample contained greater than 10% headspace at time of extraction. (2) Extracted past method specified hold time						



**BUREAU
VERITAS**

Bureau Veritas Job #: C5B0983
Report Date: 2025/11/21

WSP Canada Inc.
Client Project #: CA0051716.2286, TASK 700
Sampler Initials: HK

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		AUWU16	AUWU17		
Sampling Date		2025/09/02 16:00	2025/09/02 09:00		
COC Number		C#1057533-05-01	C#1057533-05-01		
	UNITS	BH-301-5	BH-302-2	RDL	QC Batch
Physical Testing					
Moisture-Subcontracted	%	22	17	0.30	A010007
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



**BUREAU
VERITAS**

Bureau Veritas Job #: C5B0983
Report Date: 2025/11/21

WSP Canada Inc.
Client Project #: CA0051716.2286, TASK 700
Sampler Initials: HK

GENERAL COMMENTS

Revised Report [2025/11/21]: Split report as per client request.

Results relate only to the items tested.



QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A008007	ADB	Matrix Spike	Soluble (20:1) Chloride (Cl-)	2025/09/12		NC	%	70 - 130
A008007	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2025/09/12		98	%	70 - 130
A008007	ADB	Method Blank	Soluble (20:1) Chloride (Cl-)	2025/09/12	<20		ug/g	
A008007	ADB	RPD	Soluble (20:1) Chloride (Cl-)	2025/09/12	4.8		%	35
A008151	GTK	Spiked Blank	Conductivity	2025/09/11		101	%	90 - 110
A008151	GTK	Method Blank	Conductivity	2025/09/11	<2		umho/cm	
A008151	GTK	RPD	Conductivity	2025/09/11	0		%	10
A008192	MJ1	Matrix Spike	Soluble (20:1) Sulphate (SO4)	2025/09/12		NC	%	70 - 130
A008192	MJ1	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2025/09/12		97	%	75 - 125
A008192	MJ1	Method Blank	Soluble (20:1) Sulphate (SO4)	2025/09/12	<20		ug/g	
A008192	MJ1	RPD	Soluble (20:1) Sulphate (SO4)	2025/09/12	5.8		%	35
A008293	SRT	Spiked Blank	Available (CaCl2) pH	2025/09/11		100	%	97 - 103
A008293	SRT	RPD [AUWU15-01]	Available (CaCl2) pH	2025/09/11	0.29		%	N/A
A010007	RJF	Method Blank	Moisture-Subcontracted	2025/09/14	<0.30		%	
A010007	RJF	RPD [AUWU15-01]	Moisture-Subcontracted	2025/09/14	1.0		%	20
A011827	CT6	Matrix Spike [AUWU14-01]	Sulphide	2025/09/16		98	%	75 - 125
A011827	CT6	Spiked Blank	Sulphide	2025/09/16		97	%	75 - 125
A011827	CT6	Method Blank	Sulphide	2025/09/16	<0.50		mg/kg	
A011827	CT6	RPD [AUWU14-01]	Sulphide	2025/09/16	7.3		%	30
A011952	GTK	Spiked Blank	Redox Potential	2025/09/18		100	%	80 - 120
A011952	GTK	RPD [AUWU15-01]	Redox Potential	2025/09/18	4.1		%	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)



BUREAU
VERITAS

Bureau Veritas Job #: C5B0983
Report Date: 2025/11/21

WSP Canada Inc.
Client Project #: CA0051716.2286, TASK 700
Sampler Initials: HK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere

Cristina Carriere, Senior Scientific Specialist

Veronica Falk

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Louise A Harding


Louise Harding, Scientific Specialist



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HARSHKUMAR.KEVADIA@WSP.COM
Page 1 of 1

Bureau Veritas
109 & 110, 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel: (519) 652-9444 Toll-free 800-563-6266 Fax: (519) 652-8189 www.bvna.com

MADE IN LONDON

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:										
Company Name: #29908 WSP Canada Inc.		Company Name: WSP CANADA INC		Quotation #: C50182		Bureau Veritas Job #:										
Attention: Accounts Payable		Attention: Quorine Alavata HARSHKUMAR KEVADIA		Project #: CA0051716.2286, Task 400 400		Bottle Order #:										
Address: 55 King St Suite 700 St. Catharines ON L2R3H5		Address: HARSHKUMAR.KEVADIA@WSP.COM		Project Name:		Barcode: 1057533										
Tel: Fax:		Tel: Fax:		Site #:		COC #:										
Email: capayablesinvoice@wsp.com		Email: quorine.alavata@wsp.com		Sampled By:		Barcode: C#1057533-05-01										
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY				ANALYSIS REQUESTED (PLEASE BE SPECIFIC)				Turnaround Time (TAT) Required:								
Regulation 153 (2011) <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Medium/Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> Table _____		Other Regulations <input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Municipality _____ <input type="checkbox"/> PWQO <input type="checkbox"/> Reg 406 Table _____ <input type="checkbox"/> Other _____		Special Instructions 		Field Filtered (please circle): Metals / Hg / Cr-VI O Reg 153 PNCs, BTEXMFI-F4 (Soil) Metals + Hydrides Conductivity Sodium Adsorption Ratio (SAR) pH CaCl2 EXTRACT O Reg 406 Excess Soil SPLP Metals O Reg 406 Excess Soil SPLP Prep Grossivity		Please provide advance notice for rush projects Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details. <input type="checkbox"/>								
Include Criteria on Certificate of Analysis (Y/N)? _____				Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Time Required: _____ Rush Confirmation Number: _____ (call tab for #)		<input type="checkbox"/>										
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered	Metals / Hg / Cr-VI	O Reg 153 PNCs	Metals + Hydrides	Conductivity	SAR	pH CaCl2 EXTRACT	O Reg 406 Excess Soil SPLP Metals	O Reg 406 Excess Soil SPLP Prep	Grossivity	# of Bottles	Comments
1 BH-102-5		Sept 2	10:00	S										X	1	
2 BH-103-3		Sept 2	14:00	S										X	1	
3 BH-301-5		Sept 2	16:00	S										X	1	
4 BH-302-2		Sept 3	9:00	S										X	1	
5																
6																
7																
8																
9																
10																


LON-2025-09-042

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only				
Harshkumar Kevadia		25/09/25	11:30	Saomya		2025/09/08	13:33		Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
										18/18	Present		
											Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

White: Bureau Veritas Yellow: Client
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APPENDIX D

Notice to Contractor

SIGN SUPPORT FOUNDATIONS – SUBSURFACE CONDITIONS

NOTICE TO CONTRACTOR

The contractor is alerted that the native soils contain cobbles and boulders. Appropriate equipment and procedures will be required to penetrate or remove such obstructions during sign foundation construction.

The contractor is also alerted that perched groundwater conditions may be likely. Appropriate equipment and procedure, such as use of casings and/or water/drilling fluid to maintain a positive head of pressure within the drill hole, will be required to minimize the ground loss and to control base disturbance/heave. Further, the placement of concrete by tremie method will be required.

Sign foundations will be constructed in accordance with the OPSS.PROV 915 (Construction Specification for Sign Support Structures) and OPSS.PROV 903 (Construction Specification for Deep Foundations). The contractor is to confirm cleanliness of the base of the foundation excavation. Loosened material present at the base of the foundations must be removed.

