



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES PACKAGE 1
HIGHWAY 401, 410, 403, AND QEW
CENTRAL REGION
ST. CATHARINES TO BRAMPTON, ONTARIO
Contract Number: DB 2018-2002**

GEOCRES No. 30M5-329

Report

to

Parsons

Date: September 21, 2018
File: 22436



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of Overhead Sign Supports (OSS) at various locations along Highway 401, 403, 410, and QEW. Thurber carried out this investigation as foundation consultant to Parsons Corporation (Parsons) for the Ministry of Transportation Ontario (MTO) Design Build Contract Number 2018-2002.

The purpose of this investigation was to explore the subsurface conditions near the proposed locations of the overhead and cantilevered sign supports and, based on this data, to provide borehole locations plans, records of boreholes, laboratory test results and a written description of the subsurface conditions.

The project consists of 23 sign locations, designated as Sites 1 through 23. Sites 1 through 20 required a geotechnical investigation and were completed in three stages designated as Package 1 to 3. This report covers the sites included in Package 1 (Sites 1, 5, 6, 7, 9, and 13).

2. SITE DESCRIPTION

The overhead and cantilevered signs are to be located on the QEW between McLeod Road in Niagara Falls, on Cawthra Road in Mississauga; on Highway 403 between Highway 6 in Hamilton and Guelph Line; on Highway 401 between First Line Nassagaweya and Renforth Drive; and on the Highway 410 north bound off ramp at Bovaird Drive.

The signs are to be located at sites numbered 1 to 23. Road side signs are proposed for Sites 21 to 23, and as such a geotechnical investigation was not conducted at those sites and is not included in this report.

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At Site 1, the project area is generally located within the physiographic region known as the Haldimand Clay Plains which generally consists of the area lying between the Niagara Escarpment and Lake Erie formerly inundated by Lake Warren. The surficial geology at Site 1 generally consists of coarse textured glaciolacustrine deposits of sand and gravel underlain by fine textured glaciolacustrine deposits of silt and clay. Based on published geologic maps, the underlying bedrock in the area is expected to comprise of sandstone, shale and dolostone of the Guelph Formation.

At Sites 2 to 9, 12, 13, and 18 to 19, the project areas are generally located within the physiographic region known as the Iroquois Plain which consists of low lying area adjacent to Lake Ontario formerly inundated by glacial Lake Iroquois. The surficial geology generally consists of fine to coarse textured glaciolacustrine deposits of sand and gravel to clay and silt with some areas of shallow bedrock. Based on published geologic maps, the underlying bedrock in the area is expected to consist of shale of the Queenston Formation, with the exception of Site 2 where the underlying bedrock is expected to consist of shale of the Georgian Bay Formation.

At Sites 10 and 11 the project areas are generally located within the physiographic region known as the South Slope. The South Slope is comprised predominantly of the Halton drift (till). The Halton Till is an interbedded complex of clayey silt till and sand. This deposit comprises a slightly hummocky till plain, into which the surface watercourses have eroded to 10 to 15 m deep gullies. Relatively recent fluvial sediments have been deposited in the gullies. Based on published geologic maps, the underlying bedrock in the area is expected to consist of shale of the Queenston Formation to shale of the Georgian Bay Formation.

At Sites 14 to 17 the project areas are generally located within the physiographic region known as the Niagara Escarpment in an area where the surficial geology consists of ice-contact stratified deposits of sand and gravel. Based on the published geologic maps, the underlying bedrock in the area is expected to consist of sandstone, shale and dolostone of the Armabel Formation.

3. INVESTIGATION PROCEDURES

The field investigation of this project was carried out in three stages known as Packages 1, 2 and 3. Package 1 consists of Sites 1, 5, 6, 7, 9, and 13 and was carried out between August 12 and August 19, 2018. Package 2 consists of Sites 2, 3, 4, 8, 10, 11, and 12 and was carried out between August 16 and September 14, 2018. Package 3 consists of Sites 14 to 20 and has not been completed to date. Boreholes were designated as 18-01 to 18-20, corresponding to their respective sites and were drilled near the locations of the proposed overhead signs. Boreholes were drilled to depths of between 7.4 m to 8.2 m. The approximate locations of the boreholes

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covered in the report are shown on the Borehole Location Plans in Appendix C.

Utility clearances at the borehole locations were obtained prior to the start of drilling. The ground surface elevations for the boreholes were surveyed by Tulloch Geomatics Inc. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

The field investigation was supervised on a full-time basis by a member of Thurber's technical staff who directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions were observed in the open boreholes throughout the drilling operations. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903, as amended. Completion details of the boreholes are summarized in Table 3.1 below.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
18-01	8.2 / 186.8	Borehole caved to 2.1 m then backfilled with bentonite holeplug and cuttings then asphalt to surface.
18-05	7.7 / 102.7	Borehole backfilled with holeplug and cuttings then asphalt to surface.
18-06	7.7 / 98.3	Borehole backfilled with holeplug and cuttings then asphalt to surface.
18-07	7.7 / 106.2	Borehole backfilled with holeplug and cuttings then asphalt to surface.
18-09	8.2 / 80.4	Borehole backfilled with holeplug and cuttings then asphalt to surface.
18-13	7.7 / 141.2	Borehole backfilled with holeplug and cuttings then asphalt to surface.

4. LABORATORY TESTING



The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

5.1 Package 1 (Sites 1, 5, 6, 7, 9, and 13)

In general, for Package 1, which consists of sites in the Hamilton, Niagara Falls, and St. Catharines area, the subsurface conditions encountered consisted of asphalt overlying sand and gravel to gravelly sand fill which is underlain by silty clay to clayey silt fill in some boreholes. The pavement structure and fills soils are generally underlain by native soils consisting of silty clay, silty sand to sandy silt, and till soils which are in turn underlain by shale bedrock. Descriptions of the individual strata are presented below.

5.1.1 Asphalt

All boreholes were drilled through the paved shoulder of Highway 403 or QEW and encountered approximately 150 mm of asphalt.

5.1.2 Sand and Gravel to Gravelly Sand Fill

Sand and gravel to gravelly sand fill, containing trace to some silt and clay was encountered beneath the asphalt in all boreholes. The sand and gravel to gravelly sand fill was approximately 0.5 m to 1.2 m thick and extended to depths of approximately 0.7 m to 1.4 m.

An SPT 'N' value recorded within the sand and gravel to gravelly sand fill was 34 blows per 0.3 m of penetration, indicating a dense condition. Moisture contents between 3 percent and 12 percent were measured in the fill.

The results of a grain size distribution analyses carried out on selected samples of the gravelly



sand to sand and gravel fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	26 to 36
Sand	44 to 52
Silt and Clay	12 to 30

5.1.3 Clayey Silt to Silty Clay Fill

Clayey silt to silty clay fill, containing some sand, and trace gravel, was encountered in Boreholes 18-06 and 18-09 at depths of approximately 0.7 m (Elevations 105.3 m and 87.9, respectively). The clayey silt to silty clay fill was approximately 0.8 m to 1.5 m thick and extended to depths of between 2.2 m and 1.5 m (Elevations 103.8 m and 87.1 m), respectively.

SPT 'N' values within the clayey silt to silty clay fill ranged from 9 to 10 blows per 0.3 m of penetration, indicating a stiff consistency. Moisture contents between 16 percent and 22 percent were measured in the fill.

5.1.4 Silty Sand

Silty sand, containing trace gravel, was encountered in Borehole 18-01 at a depth of approximately 0.7 m (Elevation 194.3 m). The silty sand was approximately 2.3 m thick and extended to a depth of 3.0 m (Elevation 192.0 m).

SPT 'N' values within the silty sand ranged from 19 to 53 blows per 0.3 m penetration indicating a compact to very dense condition. Measured moisture contents ranged between 18 and 28 percent.

5.1.5 Silty Clay to Clayey Silt

Silty clay to clayey silt, with trace to some sand and trace gravel, was encountered in Boreholes 18-01, 18-07, 18-09, and 18-13 at depths of between 0.7 m to 3.0 m (Elevations 87.1 m to 192.0 m). Where fully penetrated the silty clay to clayey silt was approximately 2.7 m to 3.7 m thick and extended to depths of between 4.1 m to 4.4 m (Elevations 109.7 m to 144.5 m). Boreholes 18-01 and 18-09 were terminated in the silty clay to clayey silt at a depth of 8.2 m (Elevations 186.8 m and 80.4 m, respectively).



SPT 'N' values within the silty clay to clayey silt ranged from 8 to 29 blows per 0.3 m penetration indicating a stiff to very stiff consistency. Moisture contents between 13 to 28 percent were measured in the clayey silt to silty clay.

The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the clayey silt to silty clay are presented on the Record of Borehole sheets included in Appendix A and on Figures B2 and B4 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 3
Sand	0 to 18
Silt	36 to 71
Clay	13 to 52

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	15 to 17
Liquid Limit	22 to 32
Plasticity Index	8 to 15

The results of the Atterberg Limits testing indicate these cohesive soils to be of low plasticity with group symbol CL.

5.1.6 Silty Clay to Clayey Silt Till

Silty clay to clayey silt till, with sand to some sand, and trace gravel was encountered in Boreholes 18-05 and 18-06 at depths of 0.7 m and 2.2 m (Elevation 109.7 m and 103.8 m), respectively. The clayey silt to silty clay till was approximately 2.6 m to 3.4 m thick and extended down to depths of 4.1 m and 4.8 m (Elevations 106.3 m and 101.2 m) in Boreholes 18-05 and 18-06 respectively.

SPT 'N' values within the silty clay to clayey silt till typically ranged from 8 to 35 blows for 0.3 m penetration indicating a stiff to hard consistency. Measured moisture contents in the silty clay to clayey silt till ranged from 13 to 19 percent.

The results of grain size distribution analyses and Atterberg Limits carried out on selected



samples of the silty clay to clayey silt till are presented on the Record of Borehole sheets included in Appendix A and on Figures B3 and B4 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	1
Sand	25
Silt	39
Clay	35

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	15 to 20
Liquid Limit	28 to 35
Plasticity Index	13 to 15

The results of the Atterberg Limits testing indicate these cohesive soils to be of low to medium plasticity with group symbol CL to CI.

5.1.7 Sandy Silt Till

Sandy silt till, containing trace to some gravel, trace clay, and trace shale fragments, was encountered in Boreholes 18-05, 18-07, and 18-13 at depths of between 4.1 m and 4.4 m (Elevations 106.3 m and 144.5 m). The sandy silt till was approximately 1.4 m to 3.1 m thick and extended to depths of approximately 5.5 m to 7.2 m (Elevations 103.2 m to 141.7 m).

SPT 'N' values in the sandy silt till ranged from 51 blows for 300 mm penetration to 100 blows for 25 mm penetration, indicating a very dense condition. Measured moisture contents in the sandy silt till ranged from 8 to 13 percent.

5.1.8 Bedrock

Highly weathered reddish brown shale bedrock of the Queenston formation was encountered in Boreholes 18-05, 18-06, and 18-07 at depths of between 4.8 m to 7.2 m (Elevations 101.2 m to 108.4 m). Weathered grey shale bedrock was also encountered in Borehole 18-03 at a depth of 7.2 m (Elevation 141.7 m).



SPT 'N' values in the shale bedrock ranged from 112 blows for 175 mm penetration to 100 blows for 75 mm penetration. Measured moisture contents in the shale bedrock ranged from 8 to 13 percent.

5.2 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling. Most of the boreholes were dry upon completion. The groundwater levels measured in the open boreholes are summarized below.

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
18-01	August 14, 2018	Dry	-	Borehole caved to 2.1 m
18-05	August 13, 2018	Dry	-	Open Borehole
18-06	August 12, 2018	Dry	-	Open Borehole
18-07	August 13, 2018	Dry	-	Open Borehole
18-09	August 19, 2018	Dry	-	Open borehole
18-13	August 14, 2018	6.9	142.0	Open borehole

The groundwater levels above are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. MISCELLANEOUS

Thurber obtained subsurface utility clearances at the borehole locations prior to drilling. The northing and easting coordinates and ground surface elevations were surveyed by Tulloch Geomatics Inc. and provided to Thurber.

Drill Tech Drilling Ltd. Of Newmarket, Ontario, and Tri-Phase Drilling of Mississauga, Ontario, supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. The field investigation was supervised on a full-time basis by Ms. Judy Mei, and Mr. Kevin Kweon, of Thurber. Overall supervision of the field program was provided by Mr. Cory Zanatta, P.Eng. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng., and Dr. Sydney Pang, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 400, 401, 427, AND 404
CENTRAL REGION
BOWMANVILLE TO TORONTO, ONTARIO
Contract Number: 2017-2029**

GEOGRES No. 30M5-329

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This section of the report presents foundation recommendations for the design of the proposed Overhead and Cantilevered Sign (OH & CS) supports.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of Parsons Corporation (Parsons) and shall not be used or relied upon for any other purposes or by any other parties. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Parsons and its subcontractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The project includes a total of twenty (20) overhead and cantilevered signs. The signs were number Sites 1 to 20. The field investigation was split into three stages, denoted as Package 1 through 3. This report addresses the signs in Package 1 (Sites 1, 5, 6, 7, 9, and 13).

Information on the proposed locations of the signs was provided to Thurber by Parsons. Based on the proposed design layout, one borehole was drilled near the location of each proposed sign location. The Record of Borehole sheets for these boreholes are presented in Appendix A.

8. FOUNDATION DESIGN PARAMETERS

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 1).

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Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) “Guidelines for the Design of High Mast Pole Foundations”, Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 2).
- Canadian Highway Bridge Design Code and Commentary (2014). CAN/CSA-S6-00 and S6.1-00 (Reference 3).

It is understood that a typical cantilevered sign support foundation consists of a single conventional augered caisson (drilled shaft), and a typical overhead or tri-chord sign support foundation consists of two conventional augered caissons, one at either end of the sign. Table 1 following the text of this report presents the recommended foundation design parameters for the design of such caissons. For the overhead signs with two supports, both caissons should be designed using the same set of foundation parameters as recommended in Table 1.

MTO’s standard designs for the various sign types and other relevant foundation design recommendations in Reference 1 may be used as a basis for the sign support designs. The foundation design parameters in Table 1 should be used in conjunction with Reference 2 to confirm that the standard designs are adequate.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.2 m below final grade should be neglected in the foundation design. It is recommended that all topsoil and organics be neglected in determining lateral resistance.

Where downward sloping fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. For foundation design of the caissons, it should be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately four (4) times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the pile, and full passive resistance at the level where the slope face is at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength, q_u , ($q_u = 2 \times C_u$, undrained shear strength) is provided for a cohesive soil (clayey silt to silty clay fill, silty clay till or clayey silt till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When



designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight, γ' , should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

An equivalent caisson width equal to 2 times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

9. CAISSON INSTALLATION

Caisson installation should generally be carried out in accordance with OPSS.PROV 903.

Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers and weathered shale bedrock, where encountered.

The short-term groundwater levels were measured in Borehole 18-13 to be about 7 m depths below existing ground surface. The stabilized groundwater levels are anticipated to be at the depths shown in Table 1.

Variable types of subsurface materials may be encountered at the locations of the foundations. For construction purposes, it should be assumed that:

- The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
- Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. Obstructions including rubble, cobbles and boulders may also be present within the fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment should be able to dislodge, handle, remove or otherwise penetrated these obstructions
- Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. At locations where water bearing sands and silts are present, a balancing water head may be required inside the liner to minimize the potential of basal heave and disturbance. Any accumulated water



may have to be pumped out from the hole prior to placing concrete. Should it prove to be impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

10. CONSTRUCTION CONCERNS

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils and weathered shale bedrock, soil sloughing and water seepage from caisson sidewalls, and basal instability. Recommendations on how to address these issues have been outlined in the previous sections.

11. CONSTRUCTION INSPECTION AND TESTING

Caisson construction should be monitored by qualified geotechnical personnel (as per OPSS.PROV 903) to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

12. CLOSURE

Engineering assessment and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng. The report was reviewed by Mr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



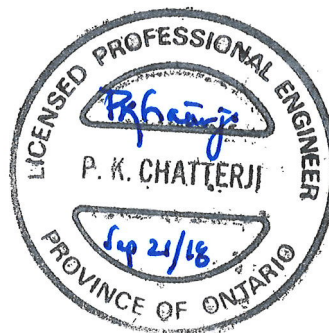
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**FOUNDATION DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAYS 401, 410, 403, QEW**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						
				q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Groundwater Depth (m) below ground surface
1	BH 18-01	Silty Sand	0.7 to 3.0	-	32	20	-	5	3.2	4
		Silty Clay	3.0 to 8.2	100	-	19	-	-	-	
5	BH 18-05	Silty Clay (Till)	0.7 to 4.1	100	-	19	-	-	-	1
		Sandy Silt (Till)	4.1 to 7.2	-	34	21	11	7	3.7	
		Weathered Shale	7.2 to 7.7	200	-	22	-	-	-	
6	BH 18-06	Clayey Silt (Fill)	0.7 to 2.2	100	-	19	-	-	-	4
		Clayey Silt (Till)	2.2 to 4.8	150	-	20	-	-	-	
		Weathered Shale	4.8 to 7.7	200	-	22	-	-	-	
7	BH 18-07	Gravelly Sand (Fill)	0.2 to 1.4	-	30	19	-	3	3.0	2
		Silty Clay	1.4 to 4.1	100	-	19	-	-	-	
		Sandy Silt (Till)	4.1 to 5.5	-	34	21	11	7	3.7	
		Weathered Shale	5.5 to 7.7	200	-	22	-	-	-	

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected.

**FOUNDATION DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAYS 401, 410, 403, QEW**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						
				q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Groundwater Depth (m) below ground surface
9	BH 18-09	Silty Clay (Fill)	0.7 to 1.5	100	-	19	-	-	-	2
		Silty Clay	1.5 to 8.2	150	-	19	-	-	-	
13	BH 18-13	Silty Clay	0.7 to 4.4	160	-	19	-	-	-	4
		Sandy Silt (Till)	4.4 to 7.2	-	34	21	11	7	3.7	
		Weathered Shale	7.2 to 7.7	200	-	22	-	-	-	

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected.

LEGEND

q_u	=	Unconfined Compressive Strength ($=2 \times C_u$, undrained shear strength) (kPa)
ϕ'	=	Angle of Internal Friction (degrees)
n_h	=	Coefficient of Horizontal Subgrade Reaction (MN/m ³) or $\times 10^3$ kN/m ³)
K_p	=	Coefficient of Passive Earth Pressure
γ	=	Soil Unit Weight (kN/m ³)
γ'	=	Submerged Soil Unit Weight (kN/m ³) - to be used for cohesionless soils below the groundwater table

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 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	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS W _L < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W _L < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W _L < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W _L > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No BH 18-01

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 772 340.4 E 335 801.0 ORIGINATED BY KK
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.14 - 2018.08.14 LATITUDE 43.090261 LONGITUDE -79.119215 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
195.0	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
0.0	ASPHALT (150mm)							20 40 60 80 100						
0.2	SAND and GRAVEL (FILL)		1	GS										
194.3														
0.7	Silty SAND, trace gravel Very Dense to Compact Brown Moist		1	SS	53		194							
			2	SS	23		193							
			3	SS	19									
192.0							192							
3.0	Silty CLAY to Clayey SILT, trace to some sand, trace gravel Stiff to Very Stiff Brown Moist		4	SS	8									0 9 48 43
							191							
			5	SS	16		190							
							189							
			6	SS	21									
							188							
			7	SS	15		187							0 16 71 13
186.8														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 2.1m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 18-05

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 796 051.2 E 274 691.7 ORIGINATED BY KK
 DIST HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.13 - 2018.08.13 LATITUDE 43.303739 LONGITUDE -79.871112 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _P W W _L WATER CONTENT (%)						
110.4	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT (150mm)							20	40	60	80	100						
0.2	Gravelly SAND, some silt and clay (FILL)		1	GS			110										27	50 23 (SI+CL)
109.7	Silty CLAY, with sand, trace gravel Stiff Grey Moist (TILL)		1	SS	10													
							109											
				2	SS	8												
				3	SS	11												
			4	SS	10													
106.3	Sandy SILT, trace clay, trace gravel Very Dense Grey Moist (TILL)																	
4.1			5	SS	51													
				6	SS	100/												
						0.100												
103.2	SHALE highly weathered, red																	
7.2			7	SS	100/													
102.7	END OF BOREHOLE AT 7.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.				0.075													
7.7																		

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 18-06

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 796 656.0 E 275 347.5 ORIGINATED BY KK
DIST HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2018.08.12 - 2018.08.12 LATITUDE 43.309209 LONGITUDE -79.863061 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)					
106.0	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT (150mm)							20	40	60	80	100							
0.2	SAND and GRAVEL, some silt and clay (FILL)		1	GS															36 52 12 (SI+CL)
105.3																			
0.7	ClayeySILT, some sand, trace gravel, weathered shale fragments Stiff Red Moist (FILL)		1	SS	10		105												
			2	SS	9		104												
103.8																			
2.2	ClayeySILT, some sand, trace gravel, weathered shale fragments Very Stiff to Hard Red Moist (TILL)		3	SS	17		103												
			4	SS	35		102												
101.2			5	SS	95/		101												
4.8	SHALE highly weathered, red				0.225														
			6	SS	100/		100												
					0.050														
							99												
98.2			7	SS	100/														
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.				0.100														

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 18-07

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 798 864.5 E 277 031.3 ORIGINATED BY KK
 DIST HWY 403 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.13 - 2018.08.13 LATITUDE 43.329153 LONGITUDE -79.842416 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
113.9	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT (150mm)							20	40	60	80	100							
0.2	Gravelly SAND, with silt and clay Dense Brown Moist (FILL)		1	GS			113							○					26 44 30 (SI+CL)
			1	SS	34									○					
112.4																			
1.4	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Grey Moist		2	SS	8		112							○					
			3	SS	8		111							○					0 0 48 52
			4	SS	16		110							○					
109.7							109							○					
4.1	Sandy SILT, trace gravel Very Dense Brown Moist (TILL)		5	SS	101/ 0.200														
108.3																			
5.5	SHALE, highly weathered, red		6	SS	112/ 0.175		107							○					
106.1			7	SS	100/ 0.100									○					
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.																		

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 18-09

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 781 953.5 E 322 401.3 ORIGINATED BY KK
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.19 - 2018.08.19 LATITUDE 43.177229 LONGITUDE -79.283497 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L
88.6	GROUND SURFACE																
0.0	ASPHALT (150mm)																
0.2	SAND and GRAVEL (FILL)		1	GS													
87.9																	
0.7	Silty CLAY, some sand, trace gravel Stiff Brown Moist (FILL)		1	SS	9												
87.1																	
1.5	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist		2	SS	11												
	Grey below 2.2m		3	SS	15												
			4	SS	13												

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BH 18-13

1 OF 1

METRIC

W.P. Contract 2018-2002 LOCATION MTM Zone 10, NAD 83 CSRS (2010): N 4 778 535.9 E 333 856.5 ORIGINATED BY KK
 DIST HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.14 - 2018.08.14 LATITUDE 43.146110 LONGITUDE -79.142775 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
148.9	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20406080100</div>					
0.0	ASPHALT (150mm)							<div>204060</div> <div>W_P W W_L</div> <div>WATER CONTENT (%)</div>					
0.2	SAND and GRAVEL (FILL)		1	GS									
148.2													
0.7	Silty CLAY, some sand Stiff to Very Stiff Brown Moist		1	SS	13		148						0 13 36 51
			2	SS	20		147						
			3	SS	29		146						
			4	SS	29		145						0 16 49 35
144.5													
4.4	Sandy SILT, some gravel, some shale fragments Very Dense Grey Moist (TILL)		5	SS	100/ 0.050		144						
			6	SS	100/ 0.025		143						
141.7							142						
7.2	SHALE highly weathered, grey												
141.2			7	SS	100/ 0.075								
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN TO 7.7m AND WATER LEVEL AT 6.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN COLD PATCH ASPHALT TO SURFACE.												

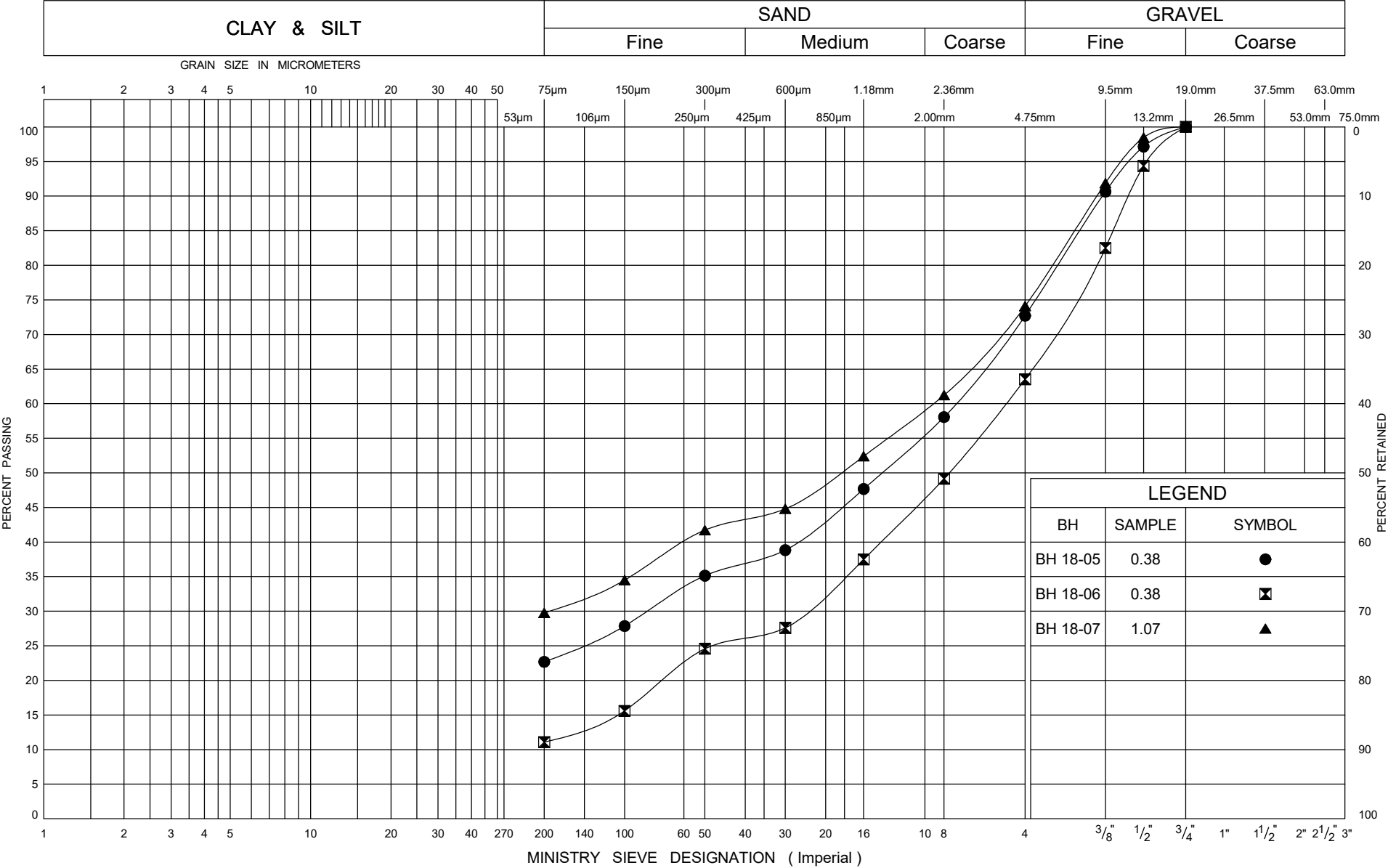
+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE



Appendix B

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM

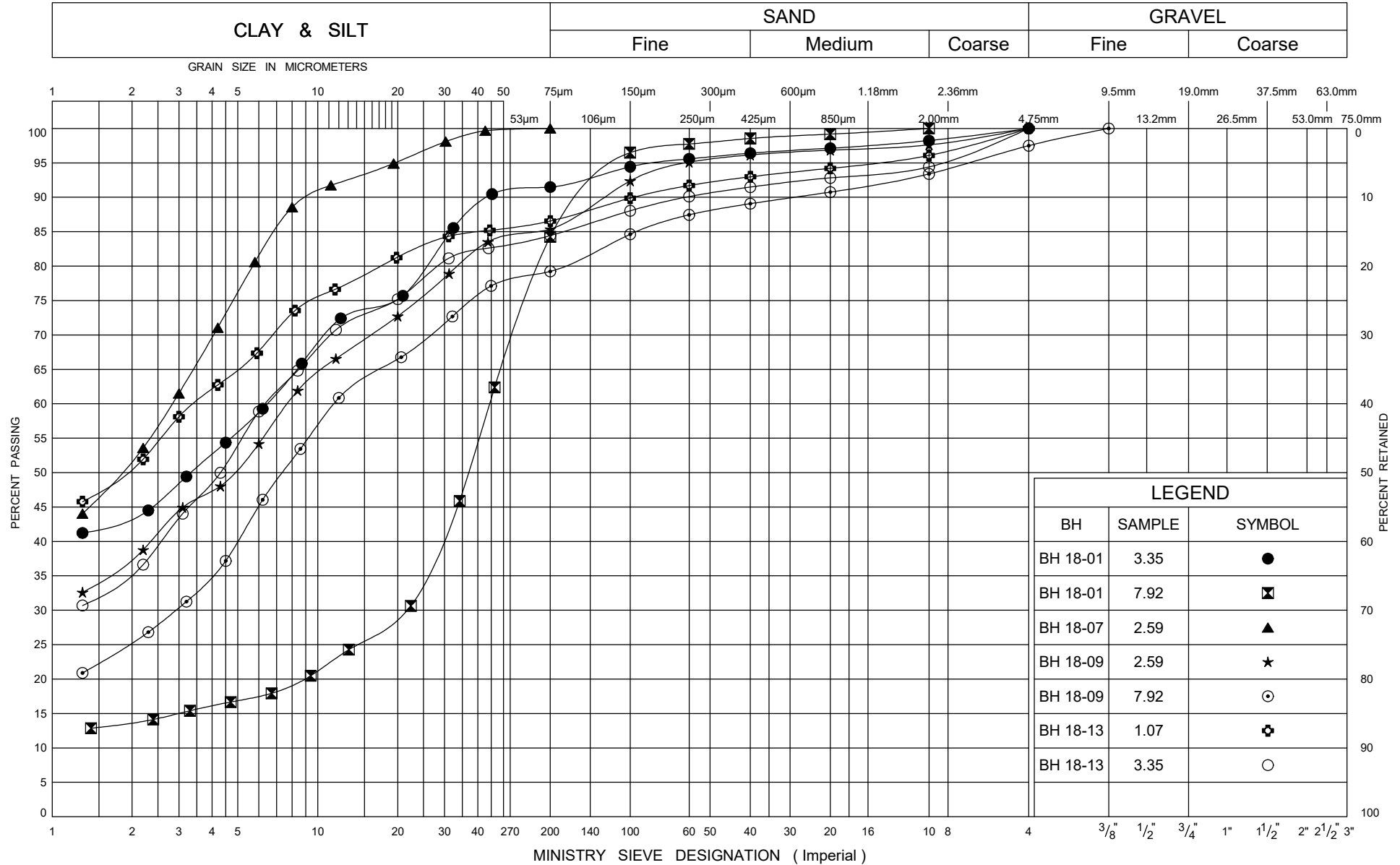


GRAIN SIZE DISTRIBUTION
Sand and Gravel to Gravelly Sand Fill

FIG No B1
W P Contract 2018-2002



UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

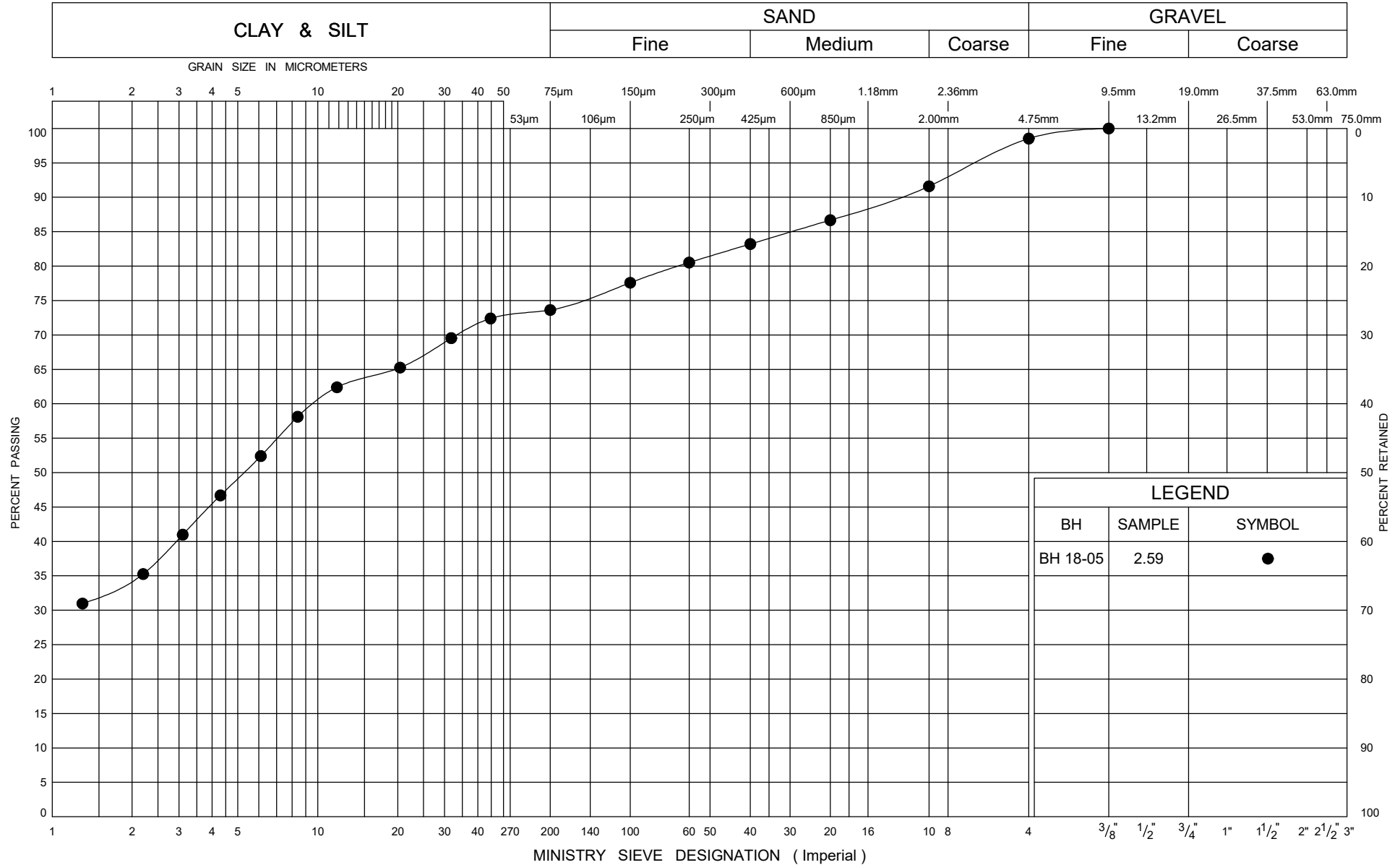
GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt

FIG No B2

W P Contract 2018-2002

UNIFIED SOIL CLASSIFICATION SYSTEM



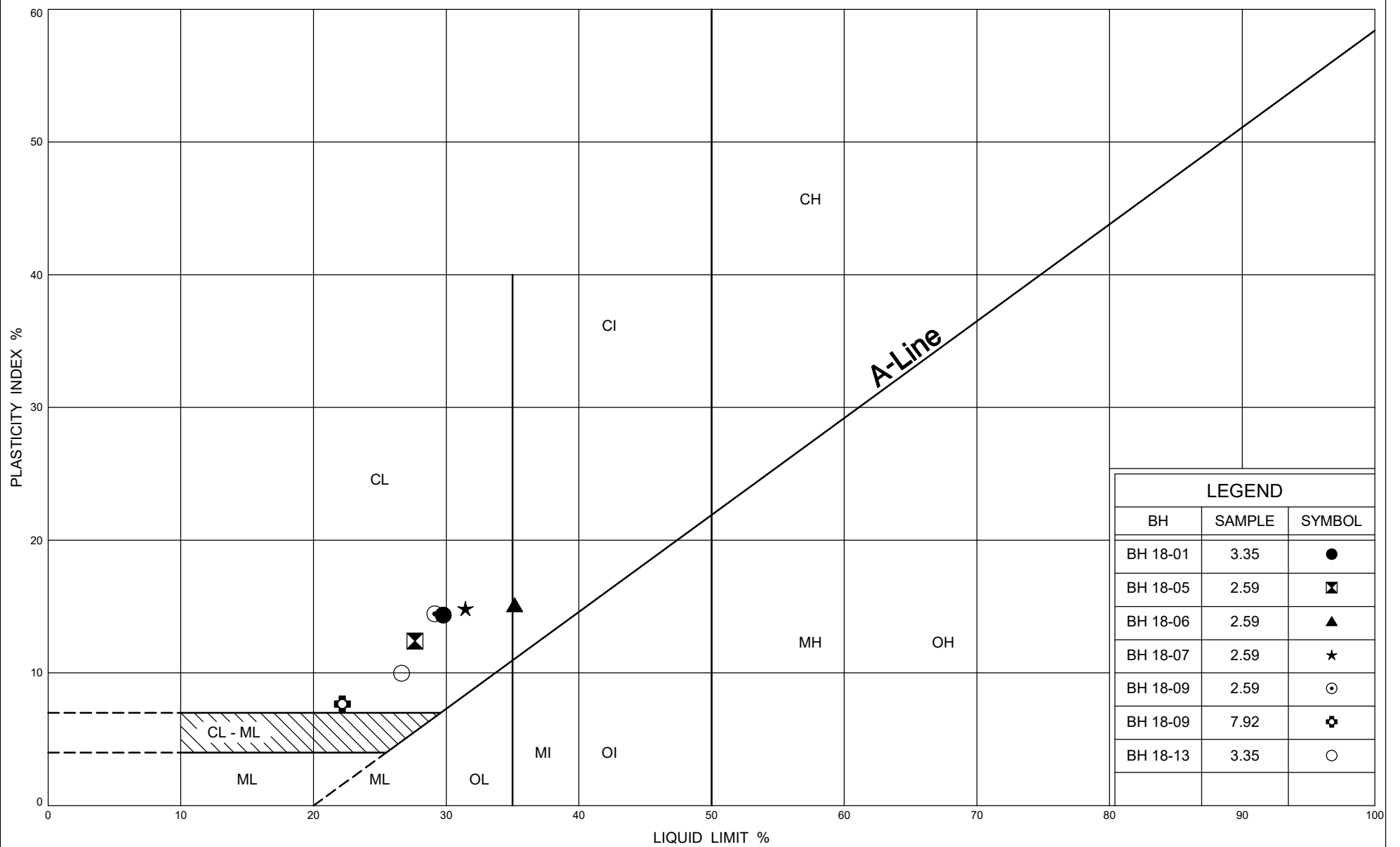
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Silty Clay to Clayey Silt Till

FIG No B3

W P Contract 2018-2002










Appendix C

Borehole Locations and Soil Strata Drawing



KEYPLAN

LEGEND

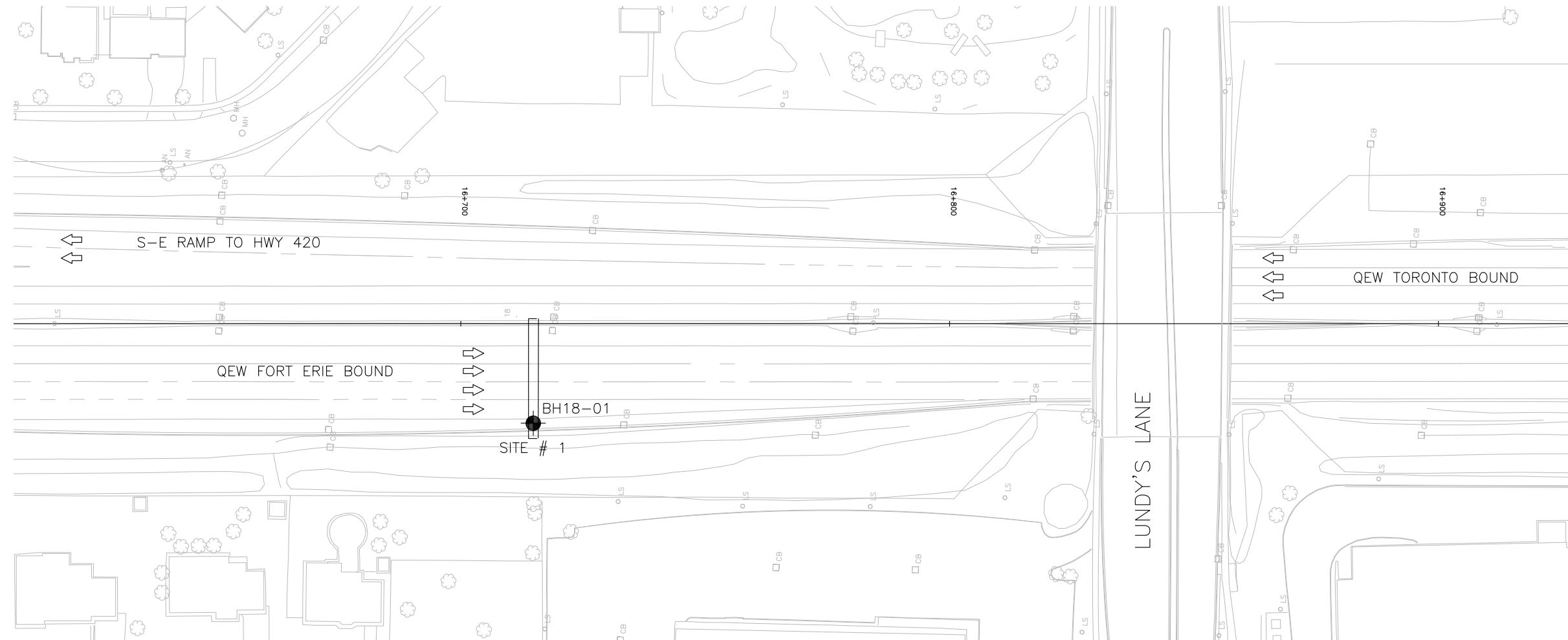
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M5-329



PLAN

[illegible]

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No

HIGHWAY 403
SIGN SUPPORT
WEST OF LEMONVILLE ROAD
BOREHOLE LOCATIONS PLAN

	SHEET



KEYPLAN

LEGEND

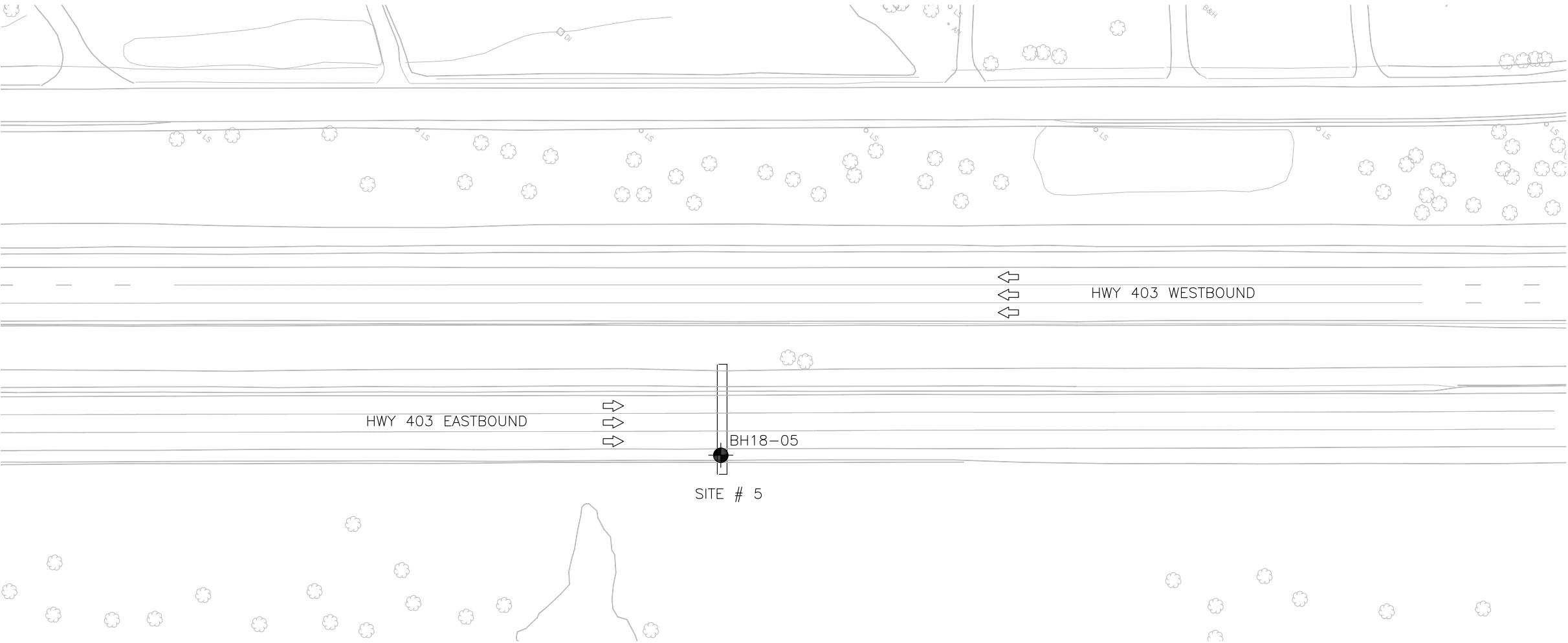
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH18-05	110.4	4 796 051.2	274 691.7

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M5-329



REVISIONS									
	DATE	BY							
DESIGN	CZ	CHK	PKC	CODE		LOAD		DATE	SEP 2018
DRAWN	MFA	CHK	CZ	SITE		STRUCT		DWG	1

CONT No
WP No



HIGHWAY 403
SIGN SUPPORT
WEST OF WATERDOWN ROAD
BOREHOLE LOCATIONS PLAN

SHEET |








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

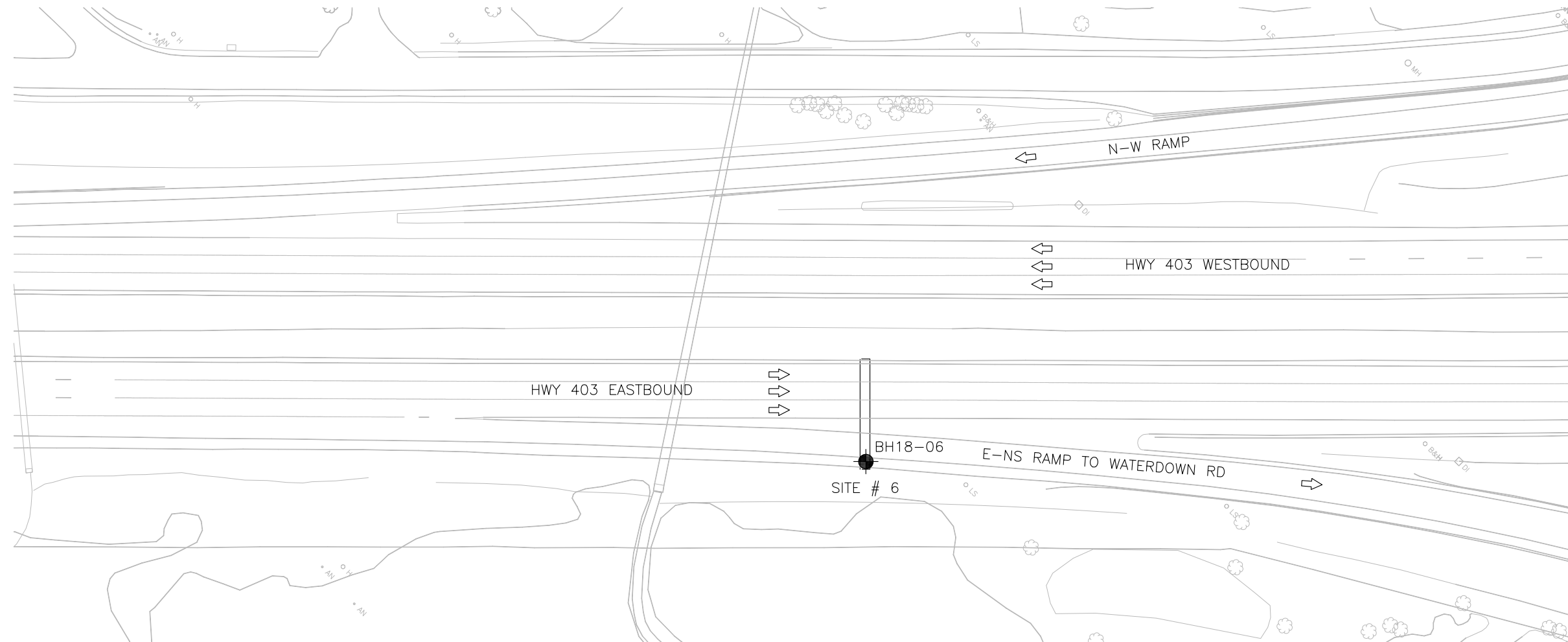
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

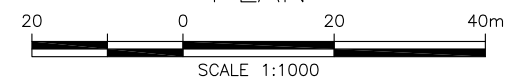
-NOTES-

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- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M5-329



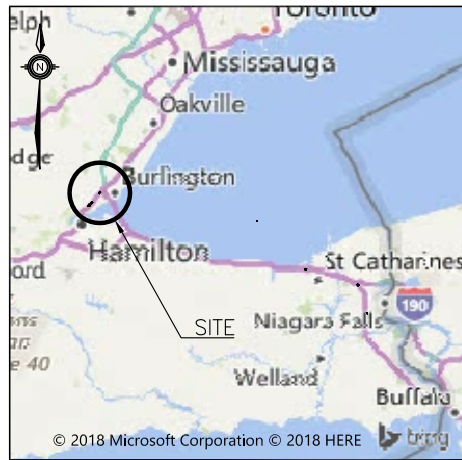
PLAN



REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	CZ	CHK	PKC			LOAD		DATE	SEP 2018
DRAWN	MFA	CHK	CZ		CODE	STRUCT	DWG	1	
					SITE				

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No	
WP No	
HIGHWAY 403 SIGN SUPPORT EAST OF KING ROAD BOREHOLE LOCATIONS PLAN	
	SHEET



KEYPLAN

LEGEND

- | | |
|------|---------------------------------------|
| | Borehole |
| | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
| | Water Level |
| | Head Artesian Water |
| | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
BH18-07	110.4	4 798 864.5	277 031.3

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GEOCRES No. 30M5-329



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CZ	CHK PKC	CODE
DRAWN	MFA	CHK CZ	SITE
			LOAD
			DATE
			SEP 2018
			STRUCT
			DWG 1

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No



Q.E.W.
SIGN SUPPORT
EAST OF HIGHWAY 406
BOREHOLE LOCATIONS PLAN

SHEET



KEYPLAN

LEGEND

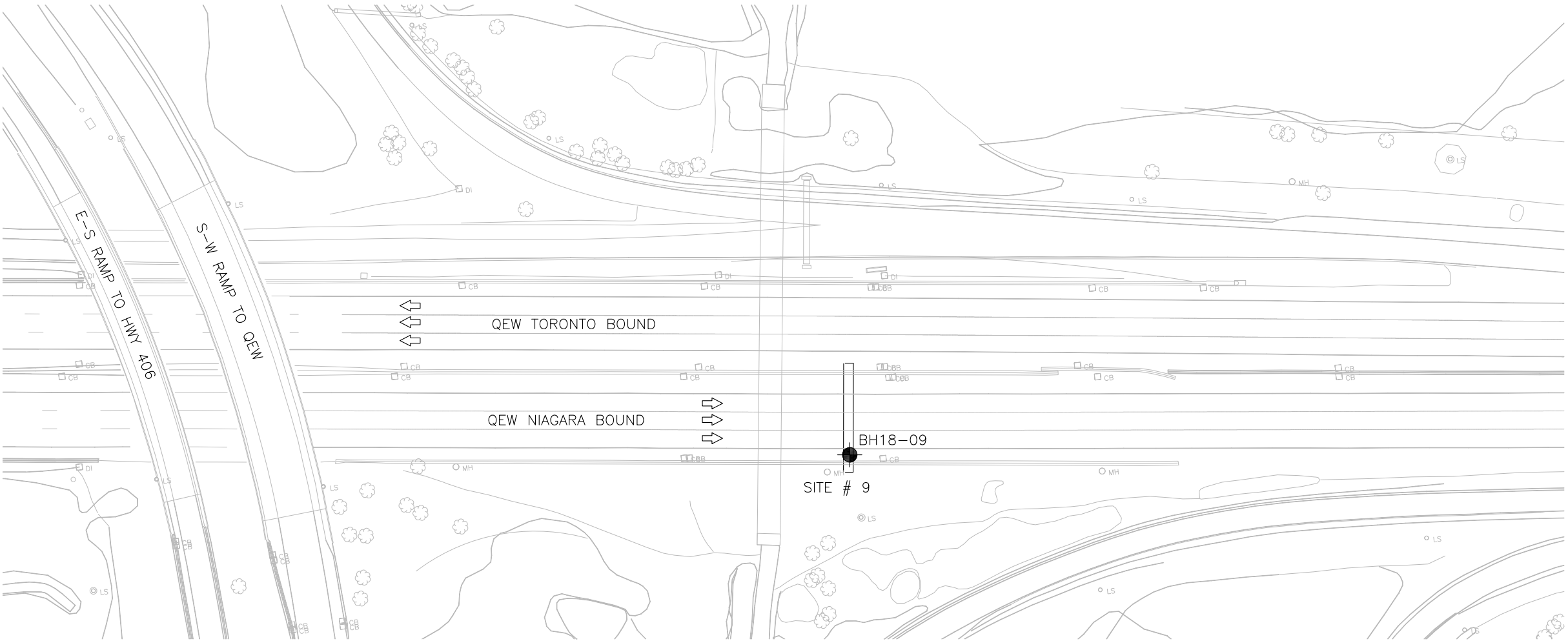
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH18-09	195.0	4 781 953.5	322 401.3

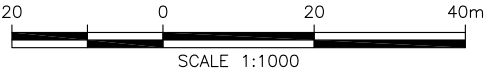
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GEOCRES No. 30M5-329



PLAN








REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CZ	CHK	PKC	CODE	LOAD	DATE	SEP 2018
DRAWN	MFA	CHK	CZ	SITE	STRUCT	DWG	1



L E G E N D

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
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[illegible]