



THURBER ENGINEERING LTD.

MEMORANDUM

To: Aaron E. Stuart
McIntosh Perry

Date: November 15, 2022

From: Rocío Palomeque Reyna, P.Eng.
Sydney Pang, P.Eng.
P. K. Chatterji, P.Eng.

File: 34469

**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN SUPPORT
HIGHWAY 404 AND SHEPPARD AVENUE INTERCHANGE
S-E/W RAMP
TORONTO, ONTARIO
G.W.P. 2434-15-00**

GEOCRES No. 30M14-545

PART 1: FACTUAL INFORMATION

Dear Mr. Stuart:

This technical memorandum presents the factual findings and engineering recommendations of a foundation investigation conducted for the detailed design of an overhead sign (OHS) support structure to be located on the S-E/W Ramp of the Highway 404 and Sheppard Avenue interchange in Toronto, Ontario.

The purpose of this investigation was to explore the subsurface conditions near the sign location, and based on the data obtained, to provide a borehole location plan, record of borehole, laboratory test results, and a written description of the subsurface conditions. Foundation recommendations and comments pertinent to the design and construction of this sign support are provided.

This technical memorandum with the interpretation and recommendations are intended for the use of the Ministry of Transportation and McIntosh Perry, and shall not be used or relied upon for any other purposes or by any other parties including the construction contractor. The contractor must make their own interpretation based on the Factual Information part of the report. Where comments are made on construction, they are provided only in order 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.

Thurber carried out this study as a sub-consultant to McIntosh Perry.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. SITE DESCRIPTION

The proposed overhead sign support structure will be located on the S-E/W Ramp (northeast quadrant) of the Highway 404 and Sheppard Avenue interchange in Toronto. The overall surface topography in the vicinity of the site is relatively flat and consists of mainly residential properties to the east and west of Highway 404.

The project is located within the border of the physiographic regions known as Peel Plain and South Slope. Peel Plain's topography is flat and gently undulating. The soil cover in the region typically comprises silty clay glacial tills with sand and silt layers. Shale bedrock of the Georgian Bay Formation is anticipated at an approximate depth of 50 m. The South Slope comprises smooth, faintly drumlinized clay till plain. The soil deposits in the project area are a result of glacial depositional systems that took place largely during the Wisconsin glacial period. This fluctuating glacial advance and retreat produced a complex distribution of heavily over-consolidated hard plastic glacial till layers, separated by interstadial stratified deposits of very stiff to hard glacio-lacustrine clays and very dense, non-plastic, silt and sand.

2. INVESTIGATION PROCEDURES

The borehole investigation and field testing program for this project were carried out on August 23, 2022, and consisted of drilling and sampling one borehole (numbered OHS 22-01) to 12.8 m depth (Elevation 166.1) near the proposed location of the OHS sign support.

The approximate location of the borehole (coordinates and elevation) is shown on the Borehole Location Plan in Appendix D. The Record of Borehole Sheets are provided in Appendix A. Thurber surveyed the borehole in the field, and obtained the borehole coordinates and ground surface elevations. Coordinates of boreholes are related to MTM NAD 83 Zone 10. The survey equipment used was a Trimble R10 GNSS system with a horizontal precision of 3 mm and a vertical precision of 3.5 mm.

Lane closure and traffic control were implemented for drilling the borehole. Prior to commencement of drilling, utility clearances were obtained for the borehole location. The borehole was advanced using a truck-mounted drill rig. Hollow stem augers were used to advance the borehole, and soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT) in general accordance with ASTM D1586. A Dynamic Cone Penetration Test (DCPT) was advanced to refusal from the base of the sampled borehole.



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

Groundwater conditions in the open borehole were observed throughout the drilling operations. A 50 mm diameter standpipe piezometer was installed and enclosed in filter sand in the borehole to permit groundwater level monitoring.

3. 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 analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance to MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing are summarized on the Record of Borehole sheets and on the accompanying figures in Appendices A and B, respectively.

4. DESCRIPTION OF SUBSURFACE CONDITIONS

An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

4.1 Topsoil

A 75 mm thick layer of topsoil was contacted surficially in the borehole.

The topsoil thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

4.2 Fill

Fill was contacted below the topsoil and consisted of a layer of brown silty sand containing trace to some clay and occasional rootlets overlying a layer of dark brown to grey clayey silt with sand containing occasional organics. The thickness of the fill was 2.4 m. The depth to the base of the fill was at 2.5 m (Elevation 176.4).

An SPT 'N' value measured in the silty sand fill was 20 blows per 0.3 m of penetration indicating a compact state. Moisture content measured in the cohesionless fill was 16 percent. SPT 'N' values measured in the clayey silt fill were 10 and 12 indicating a stiff consistency. Moisture contents measured in the clayey silt fill were 12 and 13 percent.

Grain size analysis was conducted on a sample of the cohesive fill. The tested cohesive soil sample contains 4 percent gravel, 44 percent sand, 36 percent silt and 16 percent clay size



particles. Atterberg Limits test done on one sample of the clayey silt fill indicates a liquid limit of 27 percent, a plastic limit of 17 percent and a plasticity index of 10 percent. The clayey silt fill has a low plasticity with a group symbol of CL. The grain size distribution curve and Atterberg Limits results are presented on Figures B1 and B3 in Appendix B.

4.5 Clayey Silt Till to Silty Clay Till

Native grey clayey silt till to silty clay till with sand containing trace gravel was encountered below the fill at 2.5 m depth.

Sampling of the borehole was terminated at 11.3 m depth (Elevation 167.6) within the silty clay till. A Dynamic Cone Penetration Test (DCPT) was advanced from 11.3 m depth to refusal, which was encountered at 12.8 m depth (Elevation 166.1).

Measured SPT 'N' values in the clayey silt till/clayey silt till ranged from 15 to 31 blows per 0.3 m of penetration indicate a very stiff to hard consistency. An SPT 'N' value of 10 blows per 0.3 m of penetration was measured in the clayey silt till at 3.3 m depth, indicating a stiff consistency.

Grain size analysis was conducted on three samples of the clayey silt till/clayey silt till. The tested samples contain 1 to 2 percent gravel, 32 to 40 percent sand, 44 to 48 percent silt and 14 to 22 percent clay size particles. Atterberg Limits tests on the clayey silt till/silty clay till indicate liquid limits of 16 to 29 percent, plastic limits of 11 to 19 percent and plasticity indices of 5 to 9 percent. The soil has a low to slight plasticity with group symbols of CL to CL-ML. The grain size distribution curves and Atterberg Limits results are presented on Figures B2 and B4 in Appendix B.

Glacial tills inherently contain cobbles and boulders.

4.6 Groundwater Conditions

Groundwater level was not observed in the borehole during or upon completion of drilling.

Water levels measured in the two installed piezometers and open boreholes are presented in Table 4.1 below.



Table 4.1- Groundwater Level Measurements

Borehole	Date	Groundwater Level		Comments
		Depth (m)	Elev. (m)	
OHS 22-01	August 23, 2022	Dry	-	Open borehole
	September 20, 2022	8.5	170.4	Piezometer
	October 27, 2022	10.4	168.6	Piezometer

This is a short term observation and groundwater level may be higher during construction.

Piezometer was decommissioned on October 27, 2022, in general conformance with O.Reg. 903.

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

5. FOUNDATION RECOMMENDATIONS

This section of the report presents interpretation of the geotechnical data from the factual information section and provides foundation recommendations for the design of the proposed overhead sign (OHS) support structure.

5.1 Foundation Design Parameters

Design of the sign support foundation should be carried out in accordance with the following documents:

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 1).
- 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 (2019), CAN/CSA-S6-19 and S6.1-19 (Reference 3).

It is understood that a typical sign support consists of a conventional augered caisson (drilled shaft). This cantilever OHS is supported on a single caisson. Table 1 following the text of this report presents the recommended parameters for foundation design of such a caisson.

It is recommended that MTO's standard designs in Reference 1 be used as a basis for the sign support foundations. The foundation design parameters in Table 1 should be used in conjunction with References 2 and 3 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 any topsoil and organics, if present, 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 at 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 cohesive soils (clayey silt to silty clay fill and native 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 caisson 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 two (2) times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

5.2 Caisson Installation

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

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix D.

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, where encountered. The cohesive deposits may contain water-bearing cohesionless sand and silt interlayers that can slough from the sidewalls. Temporary liners should be available for use to advance the caisson hole where required. The caisson hole should be pumped dry before concreting. Tremie concreting techniques may be required if the hole cannot be made dry.



5.3 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, soil sloughing and water seepage from caisson sidewalls. Recommendations on how to address these issues have been outlined in the previous section.

5.4 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.

We trust the above assessment and recommendations address McIntosh Perry's requirements. Should you have any questions, please do not hesitate to contact our office.

Yours truly,
THURBER ENGINEERING LTD.

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Attachments:

Statement of Limitations and Conditions.

Appendix A	Record of Borehole Sheets
Appendix B	Geotechnical Laboratory Test Results
Appendix C	Borehole Location Drawing
Appendix D	List of Specifications and Suggested Wording for NSSP

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.

TABLE 1
GEOTECHNICAL DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAY 404 AND SHEPPARD AVENUE INTERCHANGE
S-E/W RAMP

Sign Number	Reference Borehole	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
				q_u (kPa)	ϕ' (deg.)	n_h (kN/m ³)	K_p	γ (kN/m ³)	γ' (kN/m ³)	Ground water Depth (m)
N/A	OHS22-01	Sand (Fill)	0.1 – 0.7	-	30	3,000	3.0	20	-	8.5
		Clayey Silt (Fill)	0.7 – 2.5	90	-	-	-	19	-	(below
		Clayey Silt/Silty Clay (Till)	2.5 – 11.3	120	-	-	-	20	-	existing grade)
This Location	New Fill (see Note 3)	Variable height above ground surface	-	-	30	3,000	3.0	20	-	Below base of new fill

LEGEND

q_u	=	Unconfined Compressive Strength (= 2 x C_u , undrained shear strength) (kPa)
ϕ'	=	Angle of Internal Friction (degrees)
n_h	=	Coefficient Related to Soil Density (MN/m ³ or x 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 only for cohesionless soils below the groundwater table

- Notes: 1. This table must be read in conjunction with the text of this memo.
2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance adjacent to the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
3. If new fill was placed, this caisson may be partially embedded within the new fill.



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

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


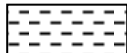



 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>			
Fresh (FR)	No visible signs of weathering.				
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE		
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE		
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE		
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL		
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)		
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa) (psi)	Field Estimation of Hardness*	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m		Very Strong	100-250	15,000 to 36,000
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No OHS 22-01

1 OF 2

METRIC

W.P. 2434-15-00 LOCATION Hwy 404 & Sheppard Ave. N 4 848 525.3 E 317 854.9 ORIGINATED BY NR
DIST HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AA
DATUM Geodetic DATE 2022.08.23 - 2022.08.23 LATITUDE 43.776574 LONGITUDE -79.337825 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
178.9	GROUND SURFACE							20	40	60	80	100		W _P	W	W _L		GR SA SI CL
0.0 0.1	TOPSOIL: (75mm)							20	40	60	80	100						
178.2	Silty SAND , trace to some clay, trace gravel, occasional rootlets Compact		1	SS	20									○				
0.7	Brown Moist (FILL)		2	SS	12		178							○				
	Clayey SILT , with sand, trace gravel, occasional organics Stiff Brown to Dark Brown Moist (FILL)		3	SS	10		177							○	├─┤			4 44 36 16
176.4	Occasional decayed wood pieces Grey																	
2.5	Clayey SILT , with sand, trace gravel Stiff Grey Moist (TILL)		4	SS	11		176							○				
			5	SS	10									├─┤				1 40 45 14
							175											
	Occasional silt seams Very Stiff		6	SS	21		174							○				
							173											
			7	SS	15									├─┤				1 36 48 15
							172											
171.8 7.2	Hard		8	SS	31		171							○				
170.2 8.7							170							○				
168.9			9	SS	23		169											

Continued Next Page

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

RECORD OF BOREHOLE No OHS 22-01

2 OF 2

METRIC

W.P. 2434-15-00 LOCATION Hwy 404 & Sheppard Ave. N 4 848 525.3 E 317 854.9 ORIGINATED BY NR
 DIST HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AA
 DATUM Geodetic DATE 2022.08.23 - 2022.08.23 LATITUDE 43.776574 LONGITUDE -79.337825 CHECKED BY RPR

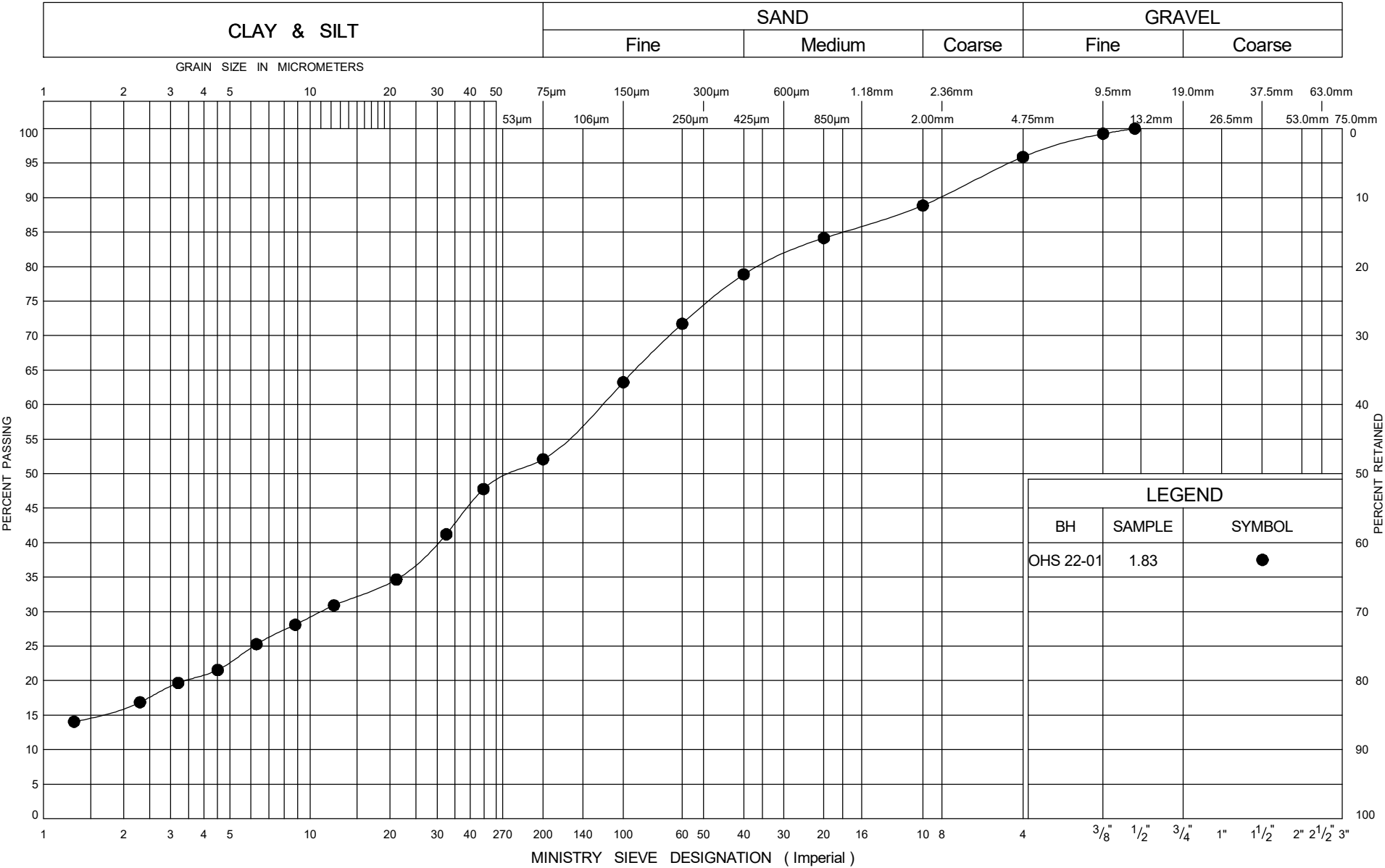
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
10.0	Silty CLAY , with sand, trace gravel Very Stiff Grey Moist (TILL)													
167.6	END OF SAMPLING AT 11.3m		10	SS	19									2 32 44 22
11.3	DCPT BEGINS AT 11.3m													
166.1														
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE DRY UPON COMPLETION OF DRILLING. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2022.09.20 8.5 170.4 2022.10.27 10.4 168.6													



Appendix B

Geotechnical Laboratory Test Results

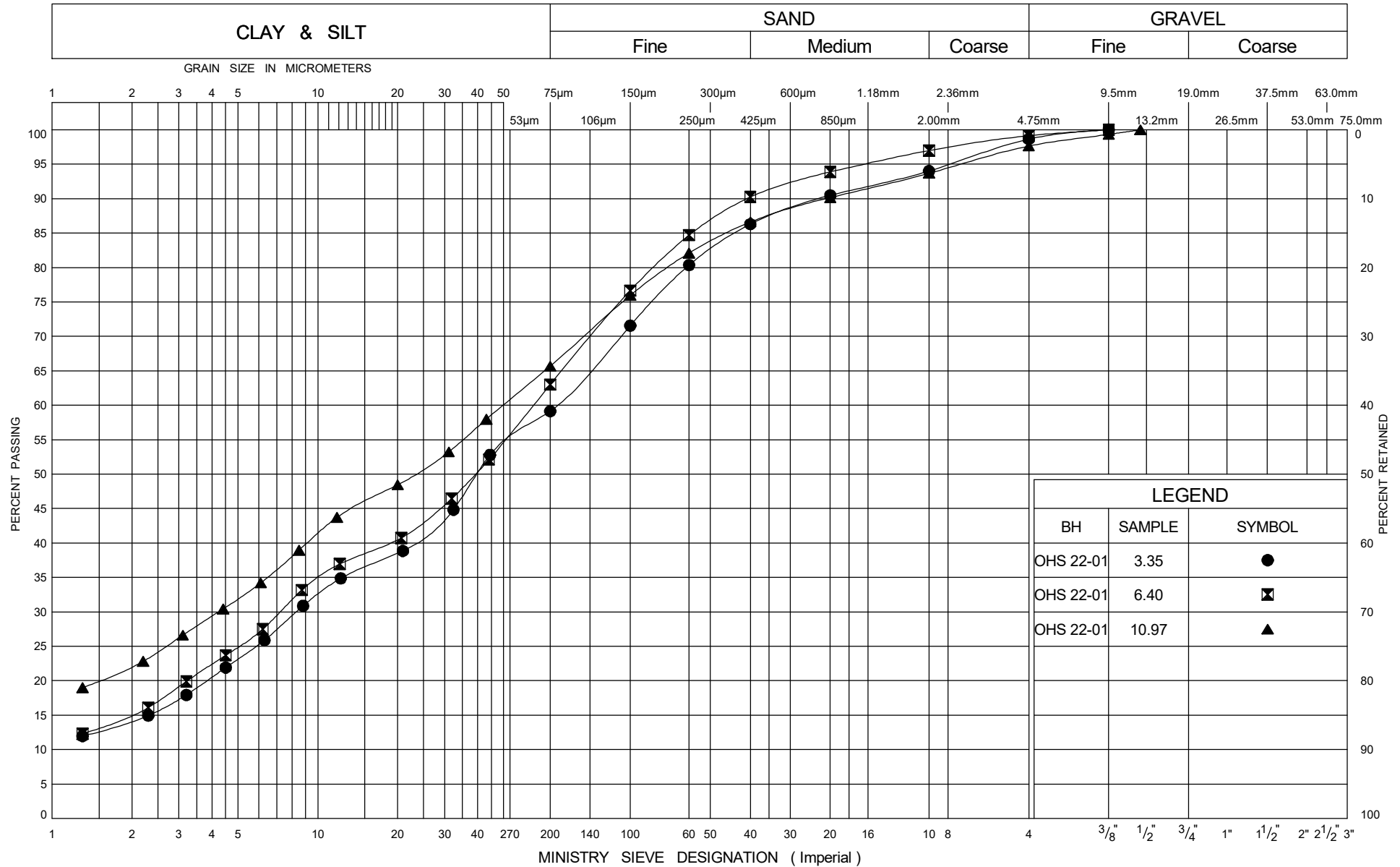
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
Clayey Silt Fill

FIG No B1
W.P. 2434-15-00
Hwy 404 & Sheppard Ave.

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

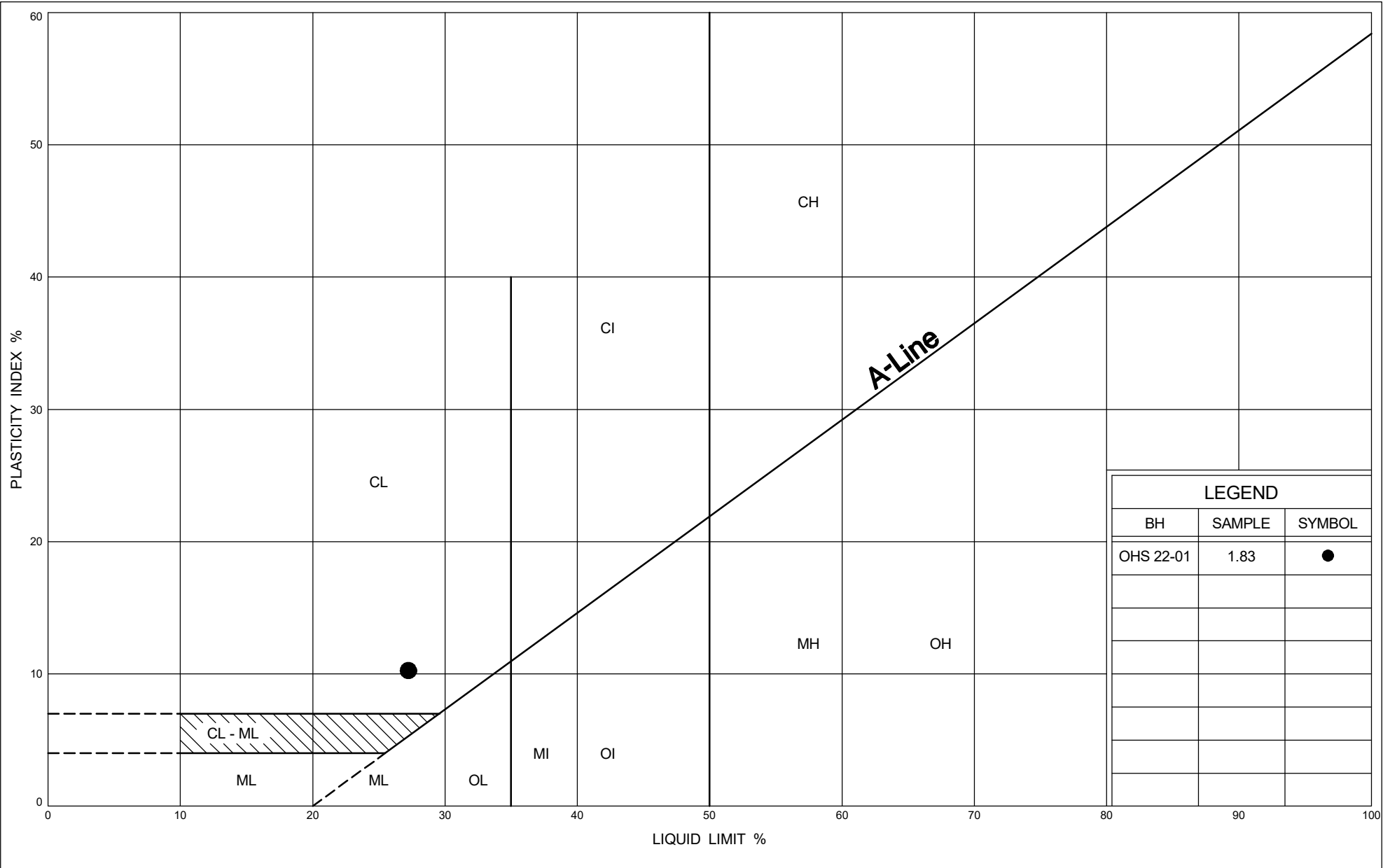
GRAIN SIZE DISTRIBUTION

Clayey Silt Till to Silty Clay Till

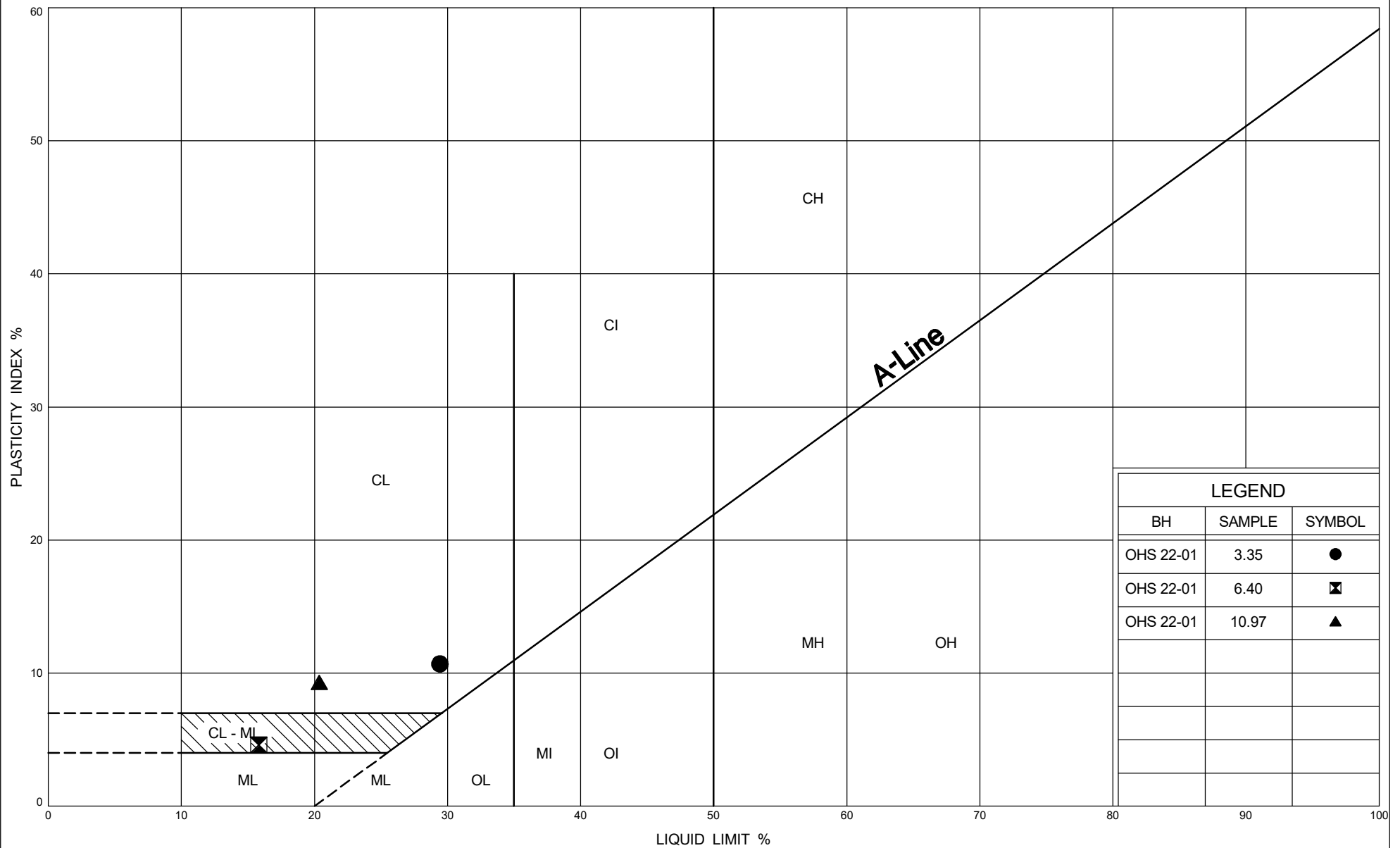
FIG No B2

W.P. 2434-15-00

Hwy 404 & Sheppard Ave.



LEGEND		
BH	SAMPLE	SYMBOL
OHS 22-01	1.83	●





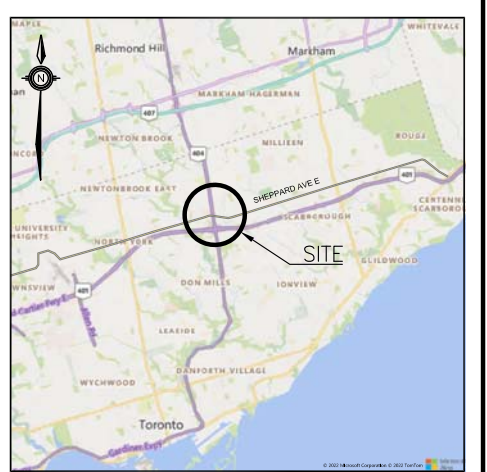
Appendix C

Borehole Location Drawing

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

CONT No
WP No 2434-15-00

HIGHWAY 404 S-E/W RAMP
SHEPPARD AVENUE EAST
OVERHEAD SIGN
BOREHOLE LOCATIONS



KEYPLAN

LEGEND

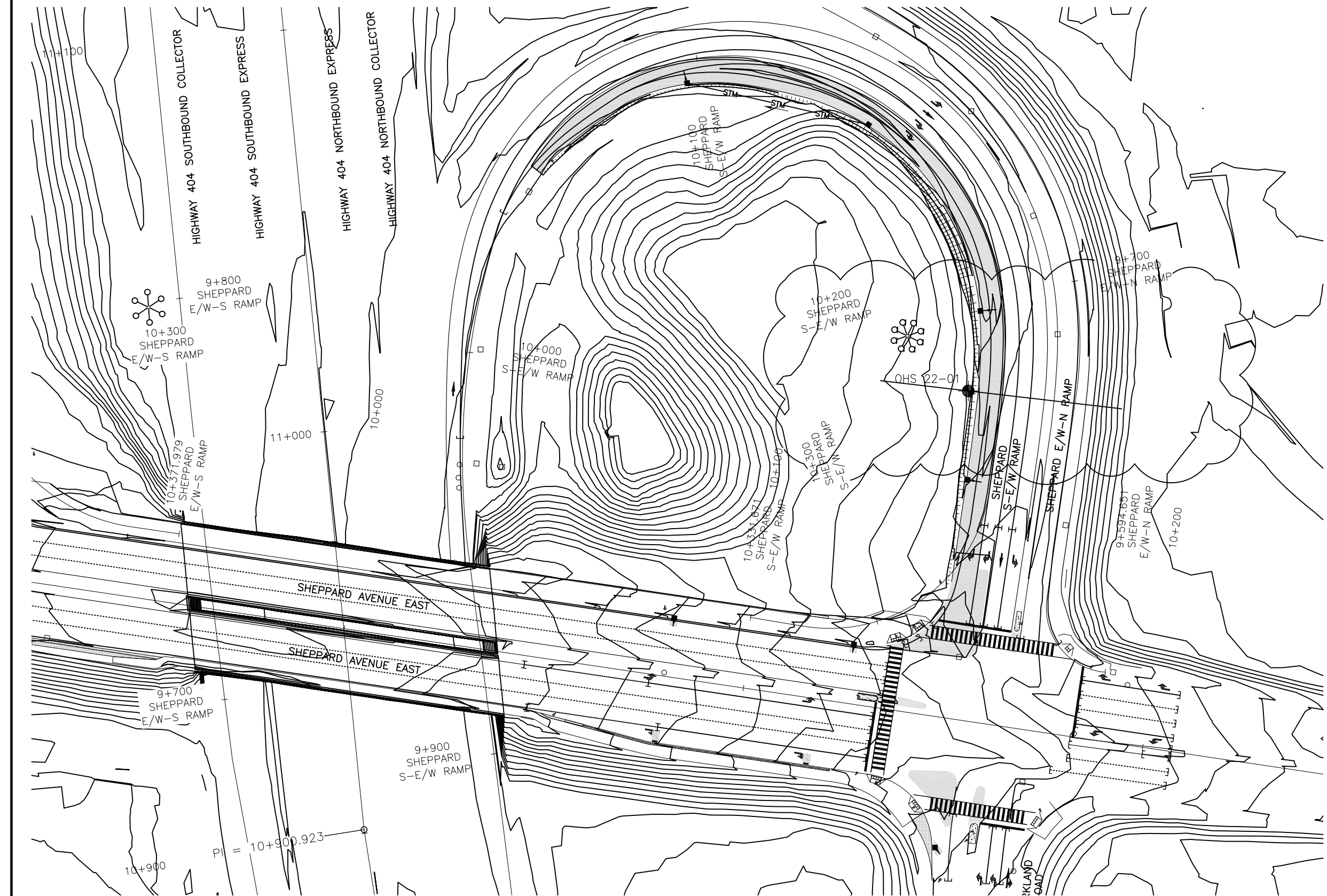
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
OHS 22-01	178.9	4 848 525.3	317 854.9

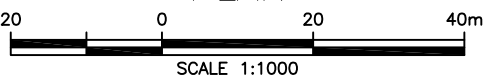
-NOTES-

- 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. 30M14-545



PLAN



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RPR	CHK	PKC	CODE	LOAD	DATE	NOV 2022
DRAWN	MFA	CHK	RPR	SITE	STRUCT	DWG	1



Appendix D

List of Specifications and Suggested Wording for NSSP

List of Special Provisions Referenced in this Report

- OPSS 903

Suggested Text for NSSP on:

“Augered Caisson Construction for OHS Support Foundations”

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the OHS foundations.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.
2. 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 must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard/very dense layers.
3. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill and existing soils with high percent of sands and silts. The cohesive deposits may contain water-bearing cohesionless sand and silt interlayers that can slough from the sidewalls. Temporary liners should be available for use to advance the caisson hole where required. The caisson hole should be pumped dry before concreting. Tremie concreting techniques may be required if the hole cannot be made dry.

The Contractor is responsible for constructing the OHS foundations without disturbing the material at the sides or bases of the foundations.