



# FOUNDATION INVESTIGATION REPORT

PROPOSED REHABILITATION OF  
DUFFERIN STREET OVERPASS HWY 401  
EB & WB EXPRESS, TORONTO, ONTARIO

MINISTRY OF TRANSPORTATION, ONTARIO

Site Location: (Long. -79.457898°, Lat. 43.728059°)

CWP 2089-13-00 & 2088-16-00

GEOCRES NO. 30M11-300

WSP PROJECT NO.: 19M-01243-00

SEPTEMBER 18, 2020

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PART A: FOUNDATION INVESTIGATION REPORT  
PROPOSED REHABILITATION OF DUFFERIN STREET OVERPASS  
HWY 401 EB AND WB EXPRESS, TORONTO, ONTARIO

# 1 INTRODUCTION

This work was carried out as part of the Ministry of Transportation, Ontario (MTO) Central Region Highway 401 pavement rehabilitation and structural rehabilitation of various bridges programme under Assignment No: 2018-E-0057. WSP was retained by MTO to carry out detailed foundation investigation and design recommendations to support the Structural rehabilitation design of the Dufferin Street Overpass bridge carrying Highway 401 East bound (EB) and West bound (WB) express traffic. The overall rehabilitation work proposed at Dufferin Street Overpass include superstructure replacement, semi-integral abutment conversion and replacement of approach slabs.

The existing EB and WB structures are each two-span conventional bridges; each span is 15.0 m long. EB structure accommodates four lanes of traffic and WB structure accommodates five lanes of traffic. The bridges were originally constructed in 1966, and the structures were last rehabilitated in 2017.

This report addresses the foundation investigation carried out for the temporary roadway protection works for the proposed rehabilitation as the foundation scope under this assignment. These structures will be referred to as EB and WB structures in this report.

The purpose of the Geotechnical Investigation was to determine the sub-surface conditions and groundwater observations at the site by means of boreholes, field and laboratory tests. Based on the information obtained, the engineering characteristics of the subsurface soils were assessed, and site conditions described to develop geotechnical recommendations to address the foundation scope.

Part A of this report presents factual information concerning the subsurface conditions based on all of the subsurface information at hand and is followed by Part B wherein engineering discussion and foundation recommendations are made for the design and construction of the temporary protection works for the above proposed structure rehabilitation.

This report is based on the General Arrangement (GA) Drawings provided to WSP Structures on March 18, 2020.

## 2 BACKGROUND INFORMATION

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### 2.1 GEOLOGICAL SETTING

Site geology as per Ontario Geological Survey (OGS) Geology Map No: 2556 on the Quaternary Geology of Ontario, Southern Sheet (1:1,000,000 scale) indicates the surficial geology to be Halton till (Ontario-Erie lobe) comprising of predominantly silt to silty clay matrix. As per the Physiography of Southern Ontario map (Chapman and Putnam, 1984), the site is within the physiographic region known as the Peel Plain, and physiographic landforms consist of bevelled till plains.

According to OGS Geology Map No: 2544 on the Bedrock Geology of Ontario, Southern Sheet (1:1,000,000 scale), the bedrock in the general locality consists of shale, limestone, dolostone and siltstone of the Georgian Bay/Blue Mountain/Billings formation, belonging to Upper Ordovician Age.

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### 2.2 PREVIOUS GEOTECHNICAL INFORMATION

The following foundation reports pertain to the general area of the proposed structures rehabilitation.

- WP 233-61-2-1, GEOCRETS NO. 30M11-081: Foundation Investigation, Spadina Bridge #1 – Proposed Retaining Wall adjacent to ramp from Hwy 401 to Dufferin Street, dated July 9, 1963.
- GWP 2131-01-00, GEOCRETS NO. 30M11-247: Foundation Investigation and Design Report, Sign Support Structures, Hwy 401 Eastbound collector rehabilitation from Jane Street to Avenue Road, Toronto, ON, dated May 24, 1962.
- GWP 2131-01-00, GEOCRETS NO. 30M11-262: Foundation Investigation and Design Report, Hwy 401 W – Yorkdale Road Ramp over Dufferin Street (Site No. 37-284), Hwy 401 Eastbound collector rehabilitation from Jane Street to Avenue Road, , dated April 28, 2016.

According to the above reports, the soil stratigraphy generally comprised of fill material of varying thickness (an upper thin layer of granular material and a lower layer of clayey silt), underlain by stiff to hard, silty clay to clayey silt till deposit.

For further information, historic borehole logs from GEOCRETS NO. 30M011-081, namely 1A, 2B, 1C and 2A have been presented along side the current boreholes in **Drawings 1 & 2**. It is to be noted that the historic borehole locations are approximate and that the surface elevation of these boreholes have been assumed to be with respect to the same elevation datum to that of the current boreholes. Further, construction activities over the ensuing years may have masked the nature of surficial deposits identified in the historic borehole logs.

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### 2.3 SITE DESCRIPTION

The site of the proposed bridge rehabilitation is located at the Dufferin Overpass of Highway 401 EB/WB Express, North York, Ontario. The key plan of the site is shown on **Drawings 1 & 2**. Highway 401 EB & WB Express lanes are operationally, a four-lane and a five-lane roadway respectively with paved shoulders. Both Express lanes are bounded by the collector lanes laterally at each end. The highway runs approximately in an east-west direction over Dufferin Street. The posted regulatory speed limit is 100km/hr. There are industrial/commercial density of businesses located within the vicinity of the site. The existing bridges with abutment walls and pier are shown in Photos C1-2 and C1-3. A site reconnaissance visit was carried out on 1st November 2019.

There are minor transverse cracks on the highway (Photo C1-4). Also, there are no visible/observable signs of differential settlement between the approach slab and the approach embankment at each abutment. The embankment side slopes at the east and west approach embankments are well vegetated and green showing no sign of erosional activities.

# 3 FIELD AND LABORATORY INVESTIGATIONS

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## 3.1 FIELD INVESTIGATION

A reconnaissance visit was carried out in November 2019 prior to fieldwork. The reconnaissance observations about the nature of terrain and access constraints for conventional drilling gear were carefully considered in planning the field investigation program. Based on the site reconnaissance, underground utilities were cleared at the borehole locations by representatives of public and MTO. A conventional drilling approach was deployed, i.e. with the use of a truck mounted CME 55 drilling rig. All borehole investigations were carried out in compliance with the operational constraints, during night-time.

Eight (8) boreholes, namely BH 19-1 through BH 19-8 were drilled through the existing pavement, four boreholes each at the EB and WB cores, with two boreholes on each side of the bridge abutment (but diagonally placed either on the inner or the outer, shoulders ) along each core, with the borehole locations as shown on **Drawings 1 and 2**, following the text of the FIR. The boreholes were drilled on November 25 to December 6, 2019. The boreholes were advanced using solid stem augers (150 mm diameter).

The traffic set-up indicated a single lane closure with traffic cones and electronic signboards in accordance with TL-29 Right Lane Closure, MTO Book 7 (Photos C2-1 and C2-2 in **Appendix C**).

Existing express lanes on Dufferin Street overpass at Highway 401 can be seen in Photo C1-1. Night work at boreholes BH 19-3 and BH19-4 with associated traffic control setup is shown in Photos C2-1 and C2-2 in **Appendix C**.

The Fieldwork was carried out under full-time supervision of WSP technical staff who directed the exploration and sampling operation, logged borehole data in accordance with MTO Soils Classification System and took custody of soil samples retrieved for subsequent laboratory testing and identification. Soil samples were visually classified in the field and later re-evaluated by an engineer. The recovered soil samples were placed in labelled moisture-proof bags and returned to WSP's Galaxy laboratory for further assessment.

**Table 3-1** presents the exploratory borehole details of the WSP foundation investigation.

**Table 3 - 1 Summary of Exploratory Borehole Details\***

Structure	Borehole No.	Borehole Eastings, Northings (m) (MTM NAD 83, Zone 10)	Borehole Geospatial Coordinates: Latitude, (Longitude); (°)	Ground Elevation (m)	Explored Depth (m)	Drilling Methodology/Remarks
WB	BH 19 - 1	E308242.4, N4843131.3	43.728121°; (-79.457271)°	195.4	12.8	Solid Stem Auger/SPT Penetration Testing/Field Vane Shear/Shelby Tube Sampling
	BH 19 - 2	E308232.3, N4843128.4	43.728096°; (-79.457396°)	195.6		
	BH 19 - 3	E308161.4, N4843123.7	43.728054°; (-79.458279°)	195.6		
	BH 19 - 4	E308151.5, N4843121.1	43.728028°; (-79.458404°)	195.5		
EB	BH 19 - 5	E308157.2, N4843101.2	43.727856°; (-79.458333°)	195.6		
	BH 19 - 6	E308167.0, N4843104.1	43.727882°; (-79.458209°)	195.6		
	BH 19 - 7	E308226.7, N4843104.6	43.727881°; (-79.457476°)	195.6		
	BH 19 - 8	E308237.3, N4843107.0	43.727906°; (-79.457339°)	195.5		

Notes\*:

- 1) Locates done by CLI with participating companies such as Toronto Hydro One, Toronto Sewer, Toronto Water, Enbridge Gas, and Bell Canada.
- 2) The spacing and quantity of boreholes generally conform to RFP requirements;
- 3) Type of drilling rig used: Truck Mounted - CME 55 rig.
- 4) Co-ordinates: based on MTM NAD 83 Zone 10 coordinates; Terminology of directions, e.g., Reference to North is geographic;
- 5) Traffic control as per MTO Book 7 by Almon Equipment Ltd., Toronto, Ontario;
- 6) Names of Drilling Company: Pontil Drilling Services Inc., Mount Albert, Ontario



- 7) Drilling Supervision: by WSP staff from Toronto office;
- 8) Borehole Survey by WSP representative using Sokkia Archer Global Positioning System (GPS) unit (Model No. GRX2) with a horizontal accuracy of 0.05 m and vertical accuracy of 0.01 m, compliant with MTO requirements.

Samples were retrieved at regular intervals with a 50 mm Outer Diameter (O.D.), split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler 300 mm depth into the undisturbed soil (SPT 'N'-values) gives an indication of the compactness condition or consistency of the sampled soil material based on the cohesionless or the cohesive nature of the material, respectively. At select borehole locations, for low blow count fine-grained material, field vane shear tests (MTO Vane 'N') were performed as per ASTM D 2573. The SPT 'N' values are indicated on the Record of Borehole Sheets (Refer to **Appendix A**).

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## 3.2 LABORATORY INVESTIGATIONS

Visual examination and classification were undertaken on the soil samples returned to WSP laboratory. A routine laboratory testing program consisting of natural water content tests, grain size analysis, hydrometer testing and Atterberg Limit testing was carried out on selected representative soil samples in compliance with the MTO requirements. The results of the laboratory tests are summarized on the appropriate Record of Borehole Sheets in **Appendix A** and compiled test results are given in **Appendix B**.

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## 3.3 GROUNDWATER INVESTIGATION

Groundwater conditions in the boreholes were observed during and on completion of drilling in the open boreholes. Two (2) 50 mm monitoring wells were installed in BH 19-4 (WB) and BH 19-8 (EB) upon completion of drilling to enable long-term groundwater level monitoring and water levels to be read subsequently. The rest of the boreholes were grouted (decommissioned) using a cement/bentonite mixture and surface patched with asphalt as per MTO procedures. As part of the construction, the two installed monitoring wells need to be decommissioned by others, in accordance with Ontario Regulation 903 (amended to Ontario Regulation 372/07).

**Table 3-2** provides information about the monitoring wells installed for this investigation.

**Table 3 - 2 Monitoring Well Installation Details**

BH No./Structure	Ground Surface Elevation (m)	Borehole Bottom		Well Screen Interval Depth, m		Well Screen Interval Elevation, m		Remarks
		Depth (m)	Elevation (m)	From	To	From	To	
BH 19-4 / WB	195.5	12.8	182.7	6.1	9.1	189.4	186.4	WB Structure, Behind West Abutment
BH 19-8 / EB	195.5	12.8	182.7	4.6	7.6	190.9	187.9	EB Structure, Behind East Abutment

# 4 SUBSURFACE CONDITIONS

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## 4.1 GENERAL

The subsurface conditions encountered at the structure locations are described in the following sections.

**Drawings 1 & 2** show key plans with longitudinal profiles for EB and WB structures (projected along the centrelines of the Hwy 401 cores at the proposed structure rehabilitation). The inferred stratigraphic profiles at the structure locations are based on the borehole data. The soil descriptions are based on visual and tactile observations and complemented by the results of field and laboratory soil test results.

For purposes of soil description, the MTO Soil classification manual was generally followed. The strata boundaries shown on the subsurface profiles must not be interpreted as exact planes of geological change but rather as inferred transitions from one soil type to another since they are based on non-continuous sampling information at discrete borehole locations. It should be noted that the subsurface conditions and the pavement fill thicknesses encountered might vary in between and beyond the borehole locations. All pavement fill thicknesses reported should not be relied upon for quantity estimation as they may vary between/beyond the borehole locations. Unless otherwise stated, all SPT 'N' values quoted are for 300 mm of penetration.

An overview of subsurface conditions is described below. All depths quoted are below the existing ground surface.

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## 4.2 OVERVIEW

The intercepted pavement structure was asphalt generally over cohesionless soil as the support layer to asphalt. However, at BH 19-3 a concrete pavement was intercepted, this location likely to be backfill from a previous test pit. The thickness of the pavement structure ranged from 0.4 m to 2.3 m with the road grade elevation varying from 195.4 m to 195.6 m.

Following the pavement structure, the embankment fill encountered comprised of clayey silt material of low plasticity with thickness ranging from 2.5 m to 7.2 m, with a greater fill thickness on the WB. It was found to be typically of a stiff consistency and of low plasticity. This material based on grain size and plasticity information was found to be of low frost susceptibility and medium erodibility.

The native stratigraphy underlying the fill layer predominantly consisted of glacial till comprising predominantly of stiff to hard clayey silt. The intercepted clayey silt and silty clay deposit thickness ranged from 5.2 m to 8.4 m. This material based on grain size and plasticity information was found to be of moderate frost susceptibility and medium erodibility. Drilling was terminated within this native deposit at a depth of 12.8 m.

Stable groundwater depth readings ranging from 6.0 to 7.4 m were observed in the installed monitoring wells.

The intercepted native geology closely resembles the geology reported in the literature (See Section 2.1).

Fuller details of the above overview are given below.

## 4.3 SUBSURFACE CONDITIONS

### 4.3.1 PAVEMENT STRUCTURE

A pavement structure consisting of asphalt/concrete over predominantly cohesionless pavement fill was intercepted in the boreholes. The thickness of asphalt intercepted in the boreholes ranged from 203 mm to 380 mm while the cored concrete was only contacted in BH 19-3 and was 610 mm thick. The pavement fill was typically cohesionless and about 0.5 m thick. While in BH 19-7 the cohesionless layer was 2.0 m thick. The concrete was underlain by a 0.9 m thick sandy clay. Four (4) grain size distribution tests and one (1) Atterberg Limits test was performed on the pavement fill material and the tests indicated the following grain size distribution and index values as shown in **Table 4-1**.

**Table 4 - 1 Grain Size Distribution and Atterberg Limits Summary - Pavement Fill**

Structure	Samples Tested	Size Fraction (%)				Atterberg Limits			Remarks
		Gravel	Sand	Silt	Clay	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	
WB	BH 19-3/SS2	3	40	39	18	22	13	9	Shown in Figure B-1 and B-2, <b>Appendix B</b> Summarized on the relevant Record of Borehole Sheets
EB	BH 19-5/SS1	25	56	17	2	-	-	-	
	BH 19-6/SS2	3	82	11	4	-	-	-	
	BH 19-7/SS3	6	78	12	4	-	-	-	

Based on the above grain size distribution, the material can be classified as primarily cohesionless, with major size fraction to be sand.

### 4.3.2 EMBANKMENT FILL

At WB structure, the approach embankment fill comprising clayey silt was intercepted in all the boreholes (BH 19-1 to BH 19-4), with layer thickness ranging from 5.3 m to 7.2 m.

At EB structure, the approach embankment fill comprising clayey silt was intercepted in the all boreholes (BH 19-5 to BH 19-8), with layer thickness ranging from 2.5 m to 5.1 m. The fill material also consisted of traces of wood in BH 19-6. And intercepted sand seams in BH 19-8.

Fifteen (15) grain size distribution and twelve (12) Atterberg limits tests were performed on the above fill material and the tests indicated the following grain size distribution and index values as shown in **Table 4-2**.

**Table 4 - 2 Grain Size Distribution and Atterberg Limits Summary - Embankment Fill**

Structure	Samples Tested	Size Fraction (%)				Atterberg Limits			Remarks
		Gravel	Sand	Silt	Clay	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	
WB	BH 19-1/SS2	1	28	48	23	27	15	12	Shown in Figure B-3 and B-4, <b>Appendix B</b> Summarized on the relevant Record of Borehole Sheets
	BH 19-1/SS7	1	27	50	22	26	15	11	
	BH 19-2/SS4	1	27	48	24	27	15	12	
	BH 19-2/SS6	2	26	48	24	29	16	13	
	BH 19-3/SS6	2	25	48	25	32	16	16	
	BH 19-4/SS3	3	28	47	22	26	14	12	
EB	BH 19-5/SS5	1	25	48	26	30	16	14	For primarily cohesive fill, sand fraction ranged from 24-40%. LL values ranged from 22-32 and PI values ranged from 9-16, resulting in low plasticity.
	BH 19-6/SS4	1	24	50	25	30	16	14	
	BH 19-7/SS7	2	24	46	28	31	16	15	
	BH 19-8/SS2	3	32	46	19	24	13	11	
	BH 19-8/SS4	2	32	44	22	27	13	14	

Based on the visual, tactile, grain size and Atterberg limits testing information, the fill material can be described as primarily clayey silt of low plasticity. Based on the shape of the grain size distribution curves it can be describes as a fill of glacial till origin. Accordingly, based on the MTO Frost Susceptibility Chart and the MTO Erosion and Sediment Control guidelines (MTO Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects), the fill material can be ranked as “Moderate” frost susceptibility and “Medium Erodibility” on the erodibility classification, respectively.

For the WB structure, measured moisture contents of the spoon samples ranged from 12% to 31% indicative of a moist to wet condition.

SPT ‘N’ values recorded in the range 4 to 20. Field Shear Vane results recorded an average undrained shear strength of about 72 kPa (based on three measurements). Collectively, these indicate the fill to be of firm to very stiff consistency.

For the EB structure, measured moisture contents of the spoon samples ranged from 11% to 24%, with the moisture content within upper 1.5 m around the 11% and below that the moisture was around 20%. This is indicative of a moist to wet condition. SPT ‘N’ values recorded in the range 6 to 19 indicate the fill to be firm to very stiff, but typically firm to stiff.

No cobbles, boulders or other obstructions were intercepted in this fill layer. However, their presence cannot be discounted.

### 4.3.3 COHESIVE TILL (CLAYEY SILT)

The dominant native soil deposit underlying the fill material intercepted in all the boreholes at both WB and EB structures, was a cohesive till comprising predominantly of clayey silt with a silty clay deposit overlying clayey silt in BH 19-3. All boreholes terminated within this deposit. The intercepted thickness of the deposit ranged from 5.2 m (BH 19-1) to 8.4 m (BH 19-6) with an average of 7.0 m. The intercepted top elevation of the deposit varied from 191.2 m (BH 19-6) to 187.8 m (BH 19-1).

Sixteen (16) grain size distribution and sixteen (16) Atterberg limits tests were performed on the above till deposit and the tests indicated the following grain size distribution and index values as shown in **Table 4-3**.

**Table 4 - 3 Grain Size Distribution and Atterberg Limits Summary - Clayey Silt (Till)**

Structure	Sample Tested	Size Fraction (%)				Atterberg Limits			Remarks
		Gravel	Sand	Silt	Clay	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	
WB	BH 19-1/SS11	2	20	51	27	29	15	14	Shown in Figure B-5 and B-6, <b>Appendix B</b> , Summarized on the relevant Record of Borehole Sheets
	BH 19-1/SS13	2	30	49	19	21	12	9	
	BH 19-2/SS10	1	23	54	22	29	15	14	
	BH 19-2/SS12	2	24	51	23	25	13	12	
	BH 19-3/SS11	1	9	43	47	39	19	20	
	BH 19-3/SS13	1	28	51	20	23	12	11	
	BH 19-4/SS10	1	24	52	23	29	16	13	
	BH 19-4/SS13	1	27	52	20	23	12	11	
EB	BH 19-5/SS10	2	26	49	23	24	13	10	For cohesive till, LL values ranged from 21-39 and PI values ranged from 9-20, resulting in low to intermediate plasticity
	BH19-5/SS12	3	28	45	24	28	15	13	
	BH 19-6/SS9	1	21	53	25	30	17	13	
	BH 19-6/SS11	3	23	51	23	27	14	13	
	BH 19-7/SS11	2	21	50	27	30	15	15	
	BH 19-7/SS13	3	24	50	23	24	12	12	
	BH 19-8/SS10	3	22	52	23	28	15	13	
	BH 19-8/SS12	2	23	51	24	25	13	12	

Based on the visual, tactile, grain size and Atterberg limits testing information, the deposit can be described as predominantly a glacial clayey silt deposit of low plasticity with a localized silty clay deposit of intermediate plasticity deposit intercepted overlying the clayey silt at borehole BH19-3.

Measured moisture contents ranged from 10% to 27% with an average of 15%, indicative of a moist condition.

SPT 'N' blow counts ranged from 7 to 44 (based on 43 measurements), indicating firm to hard consistency. Two Field Shear Vane Tests measured and average undrained shear strength of about 86 kPa. Collectively, the native till deposit can be described typically as stiff to hard.

No cobbles or boulders were intercepted in this glacial deposit. However, their presence cannot be discounted.

## 4.4 GROUNDWATER LEVEL OBSERVATIONS

Monitoring wells were installed in Boreholes BH 19-4 & BH 19-8 for long-term groundwater monitoring. The screen for the well was installed spanning the clayey silt/silty clay fill/till. It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events. Findings are summarized in **Table 4-4**.

**Table 4 - 4 Summary of Groundwater Level Observations**

Structure	BH No.	Existing Ground Elevation (m)	Date of Measurement	Groundwater Level- Depth (m)	Groundwater Level - Elevation (m)	Notes
WB	BH 19-1	195.4	November 28, 2019 (upon completion)	Not Encountered	Not Encountered	No Cave-in and dry borehole upon completion
	BH 19-2	195.6	November 27, 2019 (upon completion)	Not Encountered	Not Encountered	No Cave-in and dry borehole upon completion
	BH 19-3	195.6	November 25, 2019 (upon completion)	7.0	188.6	Wet spoon below 7.6 m, No Cave-in and wet borehole upon completion
	BH 19-4 (MW)	195.5	November 26, 2019 (upon completion)	7.9	187.6	Borehole cave-in at 11.6 m below GL and wet borehole upon completion
			December 5, 2019	12.5	183.0	
			March 19, 2020	6.0	189.5	
	BH 19-5	195.6	December 6, 2019 (upon completion)	Not Encountered	Not Encountered	No Cave-in and dry borehole upon completion
EB	BH 19-6	195.6	December 5, 2019 (upon completion)	12.5	183.1	No Cave-in and wet borehole upon completion
	BH 19-7	195.6	December 3, 2019 (upon completion)	Not Encountered	Not Encountered	No Cave-in and dry borehole upon completion
	BH 19-8 (MW)	195.5	December 2, 2019 (upon completion)	Not Encountered	Not Encountered	No Cave-in and dry borehole upon completion
			March 25, 2020	7.4	188.1	

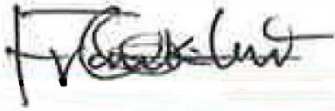
All groundwater levels observed in the exploratory holes are subject to seasonal fluctuations and variations due to precipitation events.

# SIGNATURES



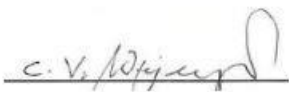
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Anuj Choudhari, M.S.C.E., P.E.  
Geotechnical EIT



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Franklin Oliha, MSc., P.Eng., PMP  
Geotechnical Engineer



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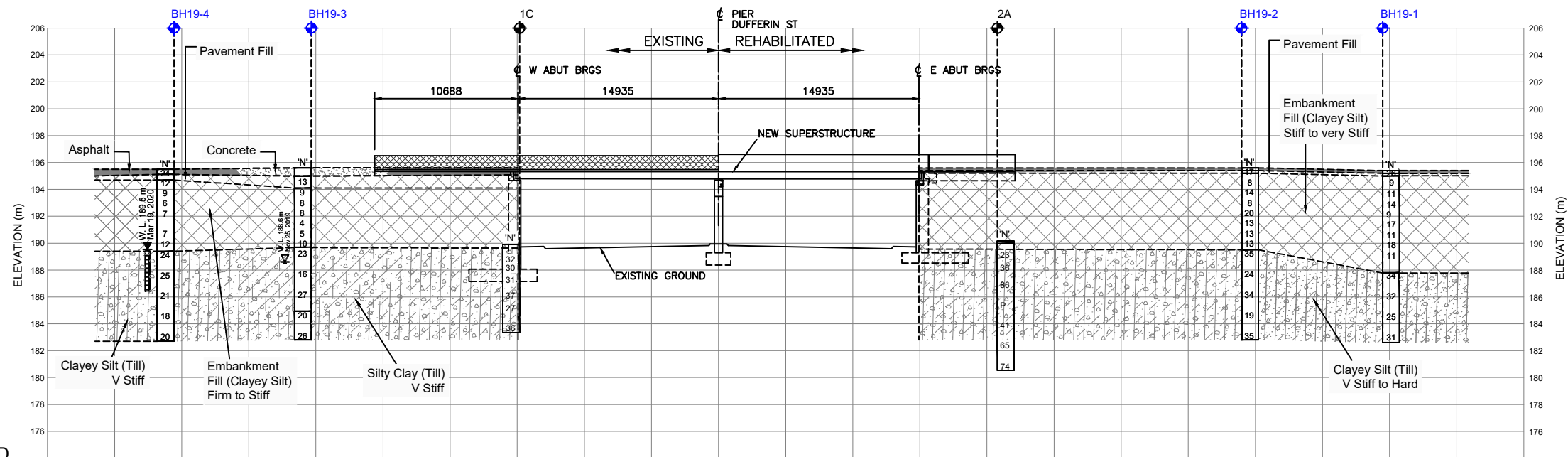
Vasantha Wijeyakulasuriya, M.Eng., P.Eng.  
MTO Designate (Foundations).










# DRAWINGS

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 Asphalt
  Fill
  Concrete

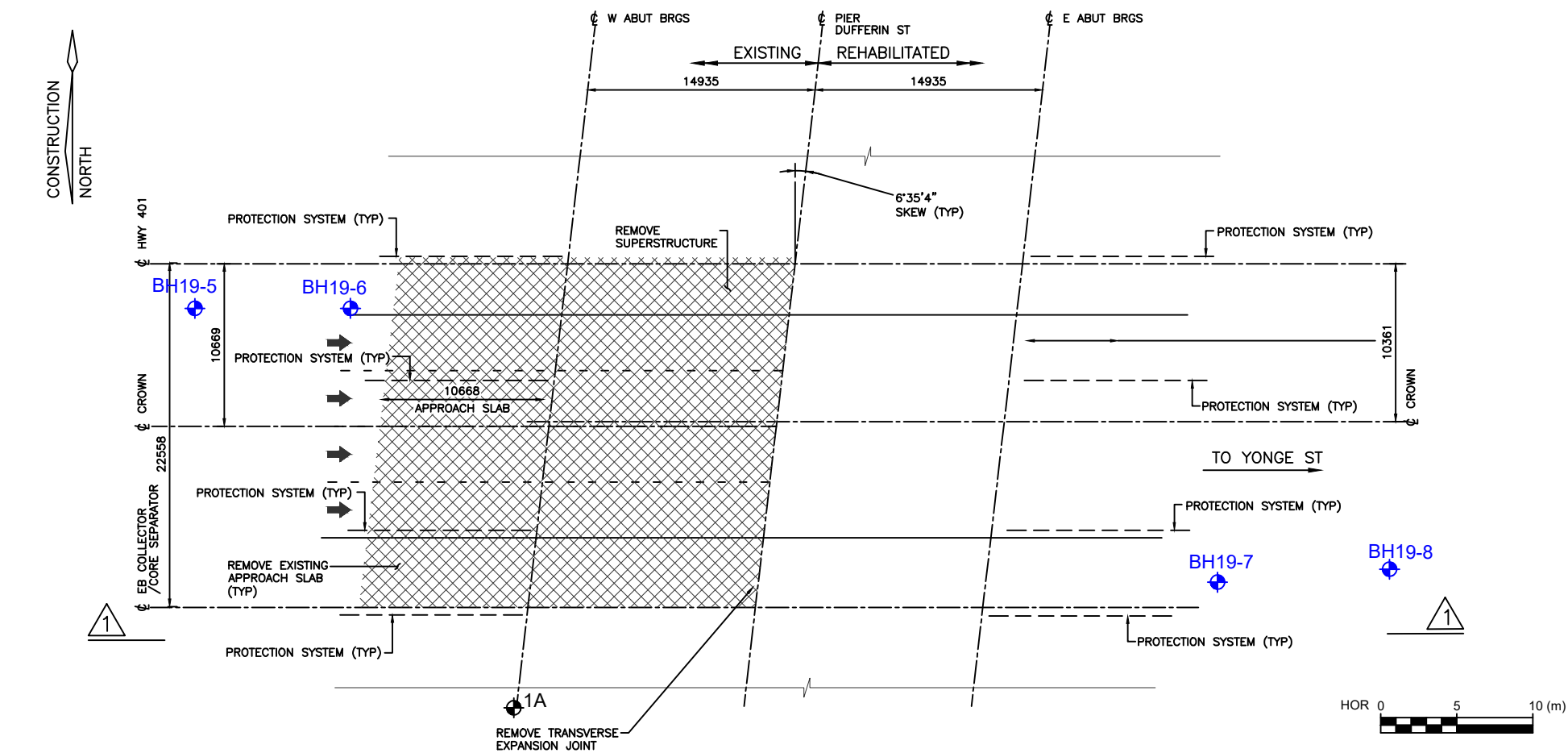
 Silty Clay (Till)
  Clayey Silt (Till)

PROFILE 1-1  
PROFILE OF HWY 401 WB CORE

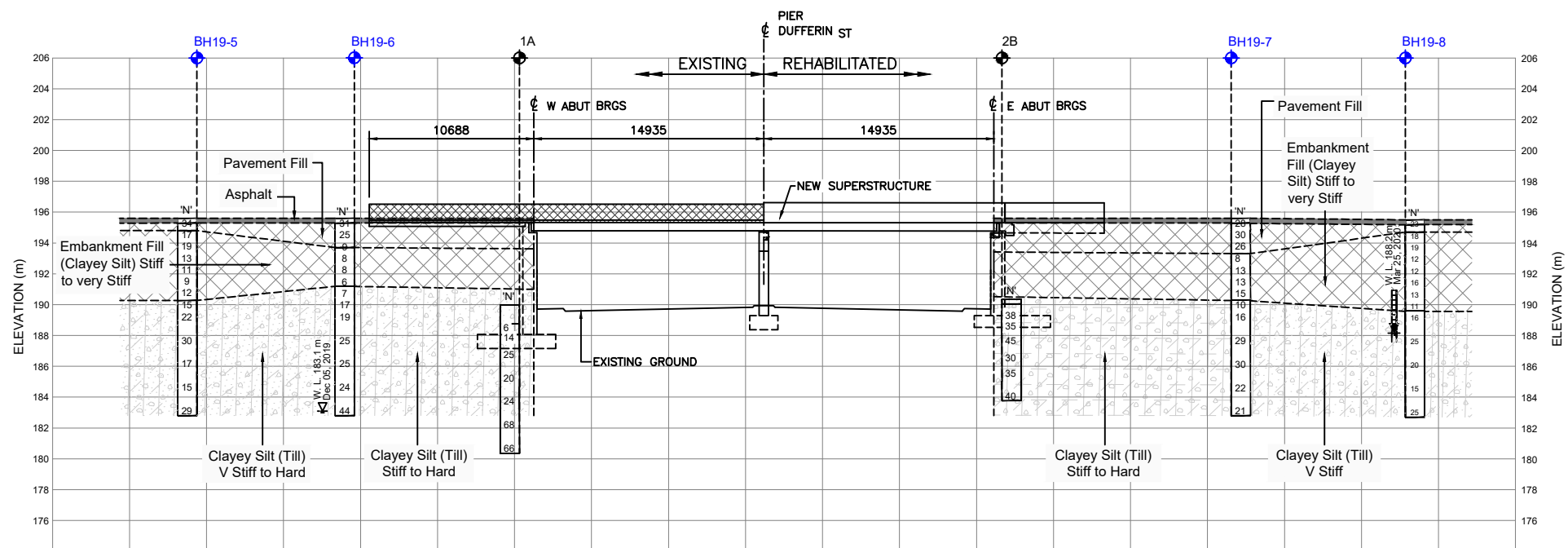
BH No.	APPROX. ELEV. (m)	MTM NAD83 ZONE 10 CO-ORDINATES	
		NORTHING (m)	EASTING (m)
BH19-1	195.4	4843131.3	308242.4
BH19-2	195.6	4843128.4	308232.3
BH19-3	195.6	4843123.7	308161.4
BH19-4	195.5	4843121.1	308151.5

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

REVISIONS	Sept 17, 2020	WSL	Final Submission to MTO		
	April 29, 2020	WSL	Submission for MTO review		
	April 13, 2020	ZMO	Submission for MTO review		
	DATE	BY	DESCRIPTION		
WSP No : 19M-01243-00			GEOCREs No : 30M11-300		
HWY No 401				DIST	
SUBM'D		CHECKED FO	DATE Sept 17/ 2020		SITE
DRAWN ZMO		CHECKED FO	APPROVED VW	DWG	1



## PLAN



PROFILE 1-1

# PROFILE OF HWY 401 EB CORE

## LEGEND



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



GWP No. 2088-16-00

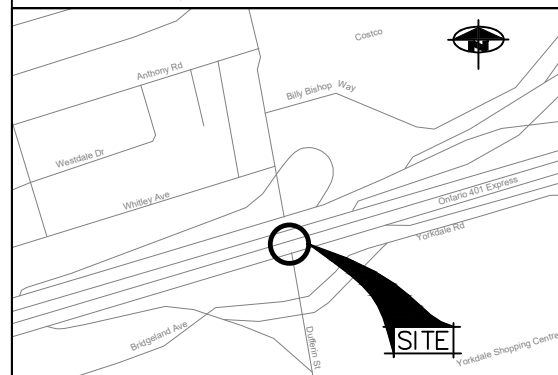
CONT No. 2018-E-0057

HIGHWAY 401 EB CORE  
DUFFERIN STREET OVERPASS EB  
BRIDGE REHABILITATION  
BOREHOLE LOCATIONS & SOIL STRATA

SHEET  
1 OF 1



2 International Blvd, Suite 201  
Toronto, Ontario  
M9W 1A2



KEY PLAN



## SOIL STRATA SYMBOLS



Borehole  Borehole by Others

N

Blows/0.3m (Std Pen Test, 475 J/blow)



WL upon completion of drilling



WL in Piezometer



Piezometer

BH No.	APPROX. ELEV. (m)	MTM NAD83 ZONE 10 CO-ORDINATES	
		NORTHING (m)	EASTING (m)
BH19-5	195.6	4843101.2	308157.2
BH19-6	195.6	4843104.1	308167.0
BH19-7	195.6	4843104.6	308226.7
BH19-8	195.5	4843107.0	308237.3

HWY 401 EB CORE COORDINATES:  
LAT: 43.727897° LONG: -79.457858°

— NOTES —

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

REVISIONS	Sept 17,2020	WSL	Final Submission to MTO
	April 29,2020	WSL	Submission for MTO review
	April 13,2020	ZMO	Submission for MTO review
	DATE	BY	DESCRIPTION

WSP No : 19M-01243-00

GEOCRES No : 30M11-300

HWY No 401			DIST
SUBM'D	CHECKED FO	DATE Sept 17/ 2020	SITE
DRAWN ZMO	CHECKED FO	APPROVED VW	DWG 2

# APPENDIX

**A**

RECORD OF BOREHOLE SHEETS





## Explanation of Terms Used in the Record of Borehole

### Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### 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) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under “weight of hammer”

#### Dynamic Cone Penetration Resistance, $N_d$ :

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).

### Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm (*)

(\*) Canadian Foundation Engineering Manual (4<sup>th</sup> Edition)

### Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion (*)
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

(\*) Canadian Foundation Engineering Manual (4<sup>th</sup> Edition)

### Soil Description

#### a) Cohesive Soils (\*)

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(\*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT “N” value
5. Pocket penetrometer

#### b) Cohesionless Soils

Density Index (Relative Density)	SPT “N” Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

### Soil Tests

w	Water content
w <sub>p</sub>	Plastic limit
w <sub>l</sub>	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D <sub>R</sub>	Relative density (specific gravity, G <sub>s</sub> )
DS	Direct shear test
ENV	Environmental/ chemical analysis
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
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

METRIC 1 OF 2

[illegible][illegible]

19M-01243-00

+3, ×3: Numbers refer to Sensitivity      ○ **8**=3% Strain at Failure

Measurement    

WSP-SOIL-ROCK-MAY-29-2017 AC.GLB



RECORD OF BOREHOLE No 19-1

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308242.4, N 4843131.3 ORIGINATED BY BS  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Nov-28-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (G <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	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 (%)							
						20 40 60 80 100					10 20 30							
Continued	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff to hard (continued)																	
11			12	SS	25													
12																		
182.6			13	SS	31													
12.8	END OF BOREHOLE																	
	Notes: 1) No Cave-in upon borehole completion 2) No water at the bottom of borehole upon completion																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

19M-01243-00

# RECORD OF BOREHOLE No 19-2

METRIC 1 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308232.3, N 4843128.4 ORIGINATED BY BS  
 DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
 DATUM Geodetic DATE Nov-27-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							
195.6	Ground Surface															GR SA SI CL	
0.0 195.4	ASPHALT 203 mm																
0.2 195.2	PAVEMENT FILL: sand and gravel, brown, moist, compact		1	SS1A	17												
0.4	EMBANKMENT FILL: clayey silt, trace gravel, sandy, brown to greyish brown, moist to wet, stiff to very stiff			SS1B													
1			2	SS	8												
2			3	SS	14												
3			4	SS	8											1 27 48 24	
4			5	SS	20												
5			6	SS	13											2 26 48 24	
6			7	SS	13												
6.1 189.5	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff to hard		9	SS	35												
7			10	SS	24											1 23 54 22	
8			11	SS	34												
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Continued Next Page

## GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00



RECORD OF BOREHOLE No 19-2

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308232.3, N 4843128.4 ORIGINATED BY BS  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Nov-27-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	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 (%)							
						20 40 60 80 100					10 20 30							
Continued	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff to hard (continued)		12	SS	19		185											
11																		
12							184											
182.8			13	SS	35		183											
12.8	END OF BOREHOLE																	
Notes: 1) No Cave-in upon borehole completion 2) No water at the bottom of borehole upon completion																		

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-3

METRIC 1 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308161.4, N 4843123.7 ORIGINATED BY BS  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D.) COMPILED BY FO  
DATUM Geodetic DATE Nov-25-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100						
195.6 0.0	Ground Surface														
	CONCRETE 610 mm		1	AS											
195.0 0.6	PAVEMENT FILL: sandy silty clay, trace gravel, trace organics, brown, moist, stiff		2	SS	13		195								3 40 39 18
194.1 1.5	EMBANKMENT FILL: clayey silt, trace gravel, sandy, brown, moist, firm to stiff		3	SS	9		194						150		
			4	SS	8		193						125		
			5	SS	8		192						150		
			6	SS	4		191						50		2 25 48 25
			7	SS	5		190						50		
			8	SS	10		189						150		
189.7 5.9	SILTY CLAY (TILL): trace gravel, trace sand, trace oxidization, brownish grey, moist, very stiff		9	SS	23		188						225		
			10	SS	16		187						200		Wet Spoon
			11	SS	27		186						>225		1 9 43 47

W. L. 188.6 m  
Nov 25, 2019

Wet Spoon

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to  
Sensitivity

○ = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-3

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308161.4, N 4843123.7 ORIGINATED BY BS  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Nov-25-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (G <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	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 (%)										
						20	40	60	80	100	20	40	60	80	100	10	20	30			
Continued																					
184.9	<b>SILTY CLAY (TILL):</b> trace gravel, trace sand, trace oxidization, brownish grey, moist, very stiff ( <i>continued</i> )																				
10.7	<b>CLAYEY SILT (TILL):</b> trace gravel, sandy, trace oxidization, brownish grey to grey, moist, very stiff		12	SS	20																
182.8			13	SS	26																
12.8	<b>END OF BOREHOLE</b>  Notes: 1) No Cave-in upon borehole completion 2) Water level was at 7.0 m upon completion																				

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, × 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

**METRIC** 1 OF 2

[illegible]

	1st	2nd	3rd	4th
Measurement				

+3, ×3: Numbers refer to Sensitivity      ○ **8**=3% Strain at Failure

19M-01243-00

# RECORD OF BOREHOLE No 19-4

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308151.5, N 4843121.1 ORIGINATED BY BS  
 DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
 DATUM Geodetic DATE Nov-26-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (G <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						
	Continued														
	<b>CLAYEY SILT (TILL):</b> trace gravel, sandy, trace oxidization, brown to greyish brown, moist, very stiff (continued)														
11			12	SS	18										
12															
182.7			13	SS	20										
12.8	<b>END OF BOREHOLE</b>														
	Notes: 1) Cave-in at 11.6 m upon borehole completion 2) Water level at 7.9 m depth upon completion 3) Water level in monitoring wells measured as follows:  <b>Water Level:</b> Date W.L. Depth (m) Elevation (m) December 5, 2019 12.5 183.0 March 19, 2020 6.0 189.5														

## GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-5

METRIC 1 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308157.2, N 4843101.2 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D.) COMPILED BY FO  
DATUM Geodetic DATE Dec-06-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			
195.6 0.0	Ground Surface ASPHALT 310 mm														
195.3 0.3	PAVEMENT FILL: gravelly sand, some silt, trace clay, brown, moist, dense		1	SS	34		195								25 56 17 2
194.8 0.8	EMBANKMENT FILL: clayey silt, trace gravel, sandy, trace sand seams, brown to grey, moist, stiff to very stiff		2	SS	17										
			3	SS	19		194								
			4	SS	13		193								
			5	SS	11		192								1 25 48 26
			6	SS	9		191								
			7	SS	12		190								
190.3 5.3	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff to hard		8	SS	15		189								
			9	SS	22		188								
			10	SS	30		187								2 26 49 23
			11	SS	17		186								

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-5

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308157.2, N 4843101.2 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Dec-06-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (G <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	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 (%)										
						20	40	60	80	100	20	40	60	80	100	10	20	30			
Continued	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff to hard (continued)																				
11			12	SS	15																
12																					
182.8			13	SS	29																
12.8	END OF BOREHOLE																				
	Notes: 1) No Cave-in upon borehole completion 2) No water at the bottom of borehole upon completion																				

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, × 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-6

METRIC 1 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308167, N 4843104.1 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D.) COMPILED BY FO  
DATUM Geodetic DATE Dec-05-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100						
195.6 0.0	Ground Surface														
195.3 0.3	ASPHALT 310 mm		1	SS	31		195								
194.8 0.8	PAVEMENT FILL: sand and gravel, brown, moist, dense		2	SS	25		194								3 82 11 4
193.7 1.9	EMBANKMENT FILL: sand, some silt, trace gravel, trace clay, brown, moist, loose to compact		3	SS3A	9		193								
				SS3B											
			4	SS	8		192								
			5	SS	8		191								
			6	SS	6		190								
191.2 4.4	CLAYEY SILT (TILL): trace gravel, sandy, trace oxidization, grey, moist, firm to hard		7	SS	7		189								
			8	SS	17		188								
			9	SS	19		187								
			10	SS	25		186								
			11	SS	25										

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00



RECORD OF BOREHOLE No 19-6

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308167, N 4843104.1 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Dec-05-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	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 (%)							
						20 40 60 80 100					10 20 30							
Continued	CLAYEY SILT (TILL): trace gravel, sandy, trace oxidization, grey, moist, firm to hard (continued)																	
11			12	SS	24													
12																		
182.8			13	SS	44													
12.8	END OF BOREHOLE																	
	Notes: 1) No Cave-in upon borehole completion 2) Water level at 12.5 m depth upon completion																	

+ 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

19M-01243-00

GROUNDWATER ELEVATIONS  
Measurement 1st 2nd 3rd 4th

RECORD OF BOREHOLE No 19-7

METRIC 1 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308226.7, N 4843104.6 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D.) COMPILED BY FO  
DATUM Geodetic DATE Dec-03-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100						
195.6 0.0	Ground Surface														
195.3 0.3	ASPHALT 310 mm		1	SS	28		195								
194.8 0.8	PAVEMENT FILL: sand and gravel, trace silt, trace clay, brown, moist, dense		2	SS	30		194								
	sand, some silt, trace gravel, brown, moist, compact to dense		3	SS	26		193								6 78 12 4
193.3 2.3	EMBANKMENT FILL: clayey silt, trace gravel, sandy, brown to greyish brown, moist, stiff to hard		4	SS	8		192								
			5	SS	13		191								
			6	SS	13		190								
			7	SS	15		189								
190.3 5.3	CLAYEY SILT (TILL): trace gravel, sandy, trace oxidization, grey, moist, stiff to hard		8	SS	10		188								
			9	SS	16		187								
			10	SS	29		186								
			11	SS	30										2 24 46 28
															2 21 50 27

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

RECORD OF BOREHOLE No 19-7

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308226.7, N 4843104.6 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Dec-03-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued																	
11	CLAYEY SILT (TILL): trace gravel, sandy, trace oxidization, grey, moist, stiff to hard (continued)		12	SS	22													
12																		
182.8			13	SS	21													
12.8	END OF BOREHOLE																	
	Notes: 1) No Cave-in upon borehole completion 2) No water at the bottom of borehole upon completion																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

19M-01243-00

**METRIC** 1 OF 2

[illegible]

19M-01243-00

	1st	2nd	3rd	4th
Measurement				

RECORD OF BOREHOLE No 19-8

METRIC 2 OF 2

W.P. 2089-13-00 & 2088-16-00 LOCATION MTM NAD 1983 (Zone 10), E 308237.3, N 4843107 ORIGINATED BY FO  
DIST HWY 401 BOREHOLE TYPE CME55 Truck Mount/Solid Stem Auger (150 mm O.D) COMPILED BY FO  
DATUM Geodetic DATE Dec-02-2019 CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (G <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
	Continued													
	CLAYEY SILT (TILL): trace gravel, sandy, grey, moist, very stiff (continued)													
11			12	SS	15							175		2 23 51 24
12														
182.7			13	SS	25							>225		
12.8	END OF BOREHOLE Notes: 1) No Cave-in upon borehole completion 2) No water at the bottom of borehole upon completion 3) Water level in monitoring wells measured as follows:  Water Level: Date W.L. Depth (m) Elevation March 25, 2020 7.4 188.1													

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

+ 3, × 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

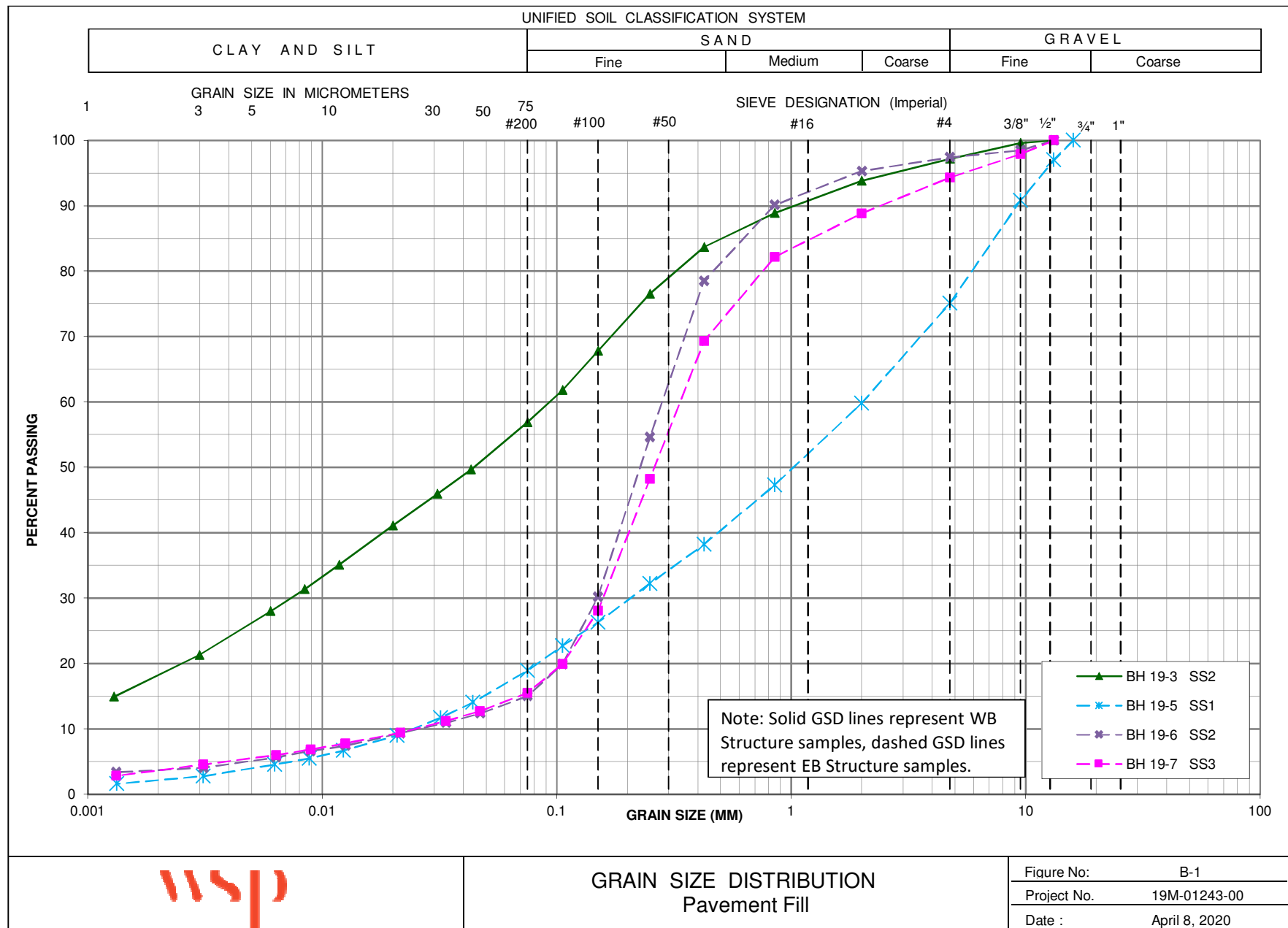
19M-01243-00

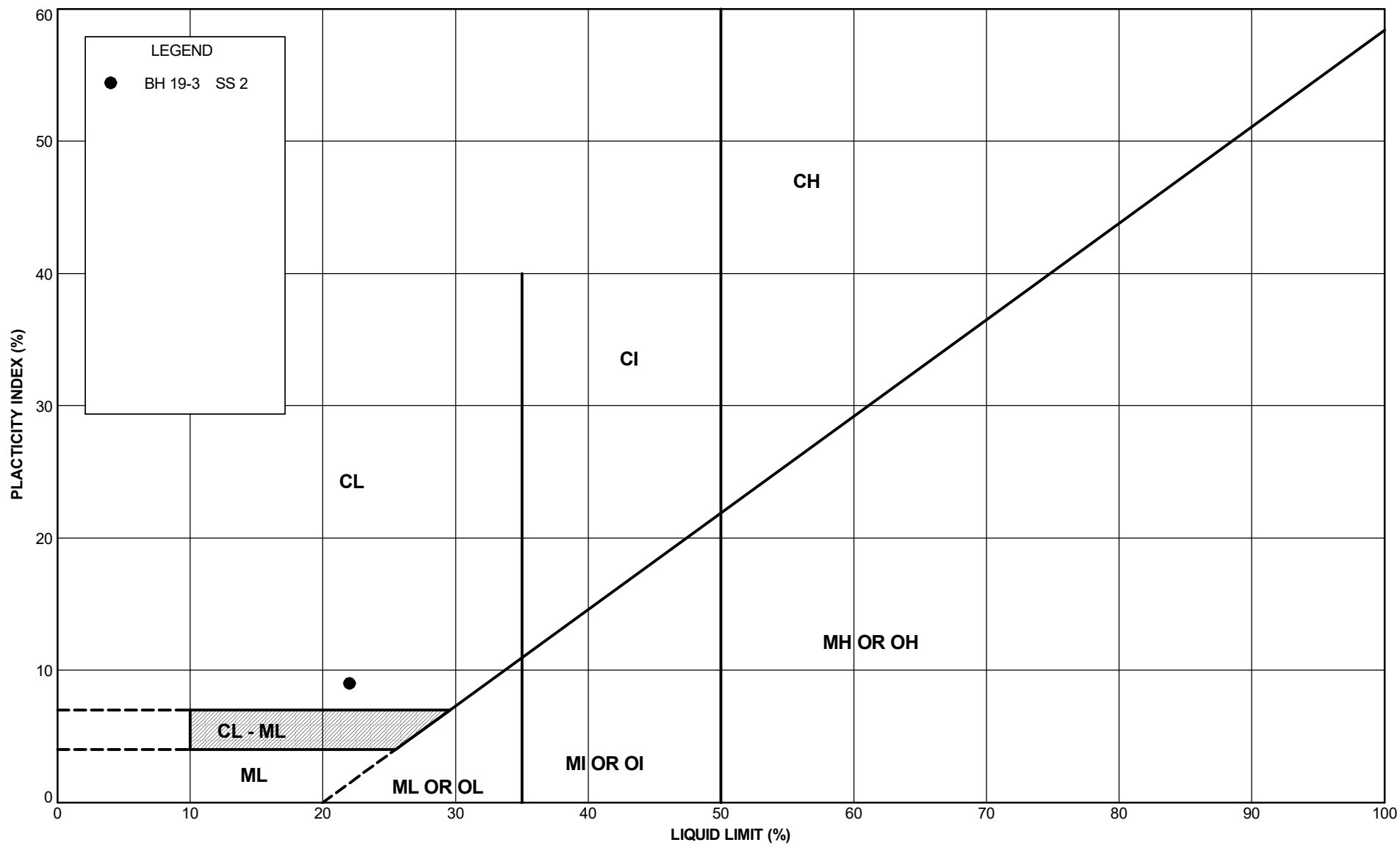
# APPENDIX

## B

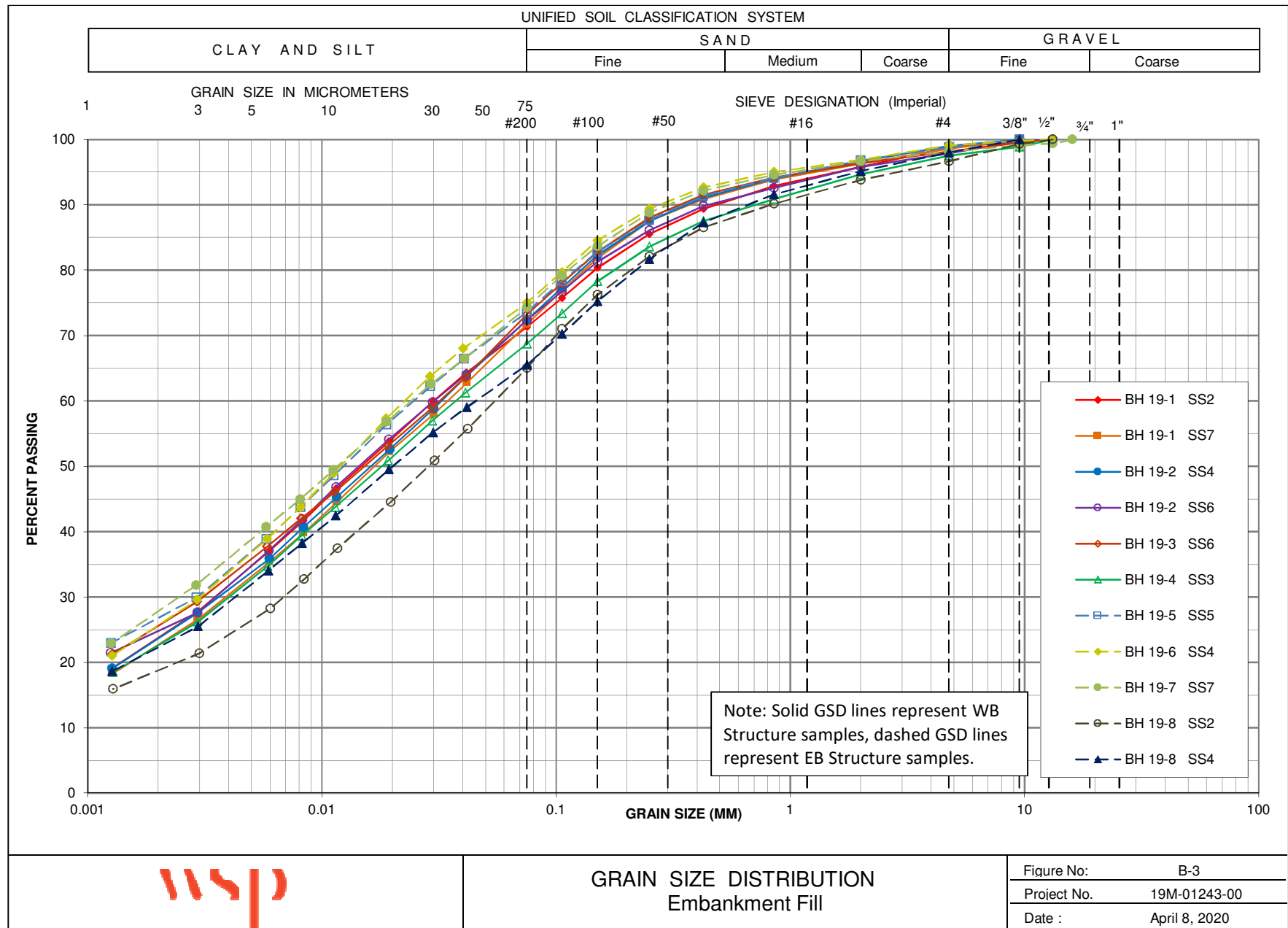
### LABORATORY TEST RESULTS

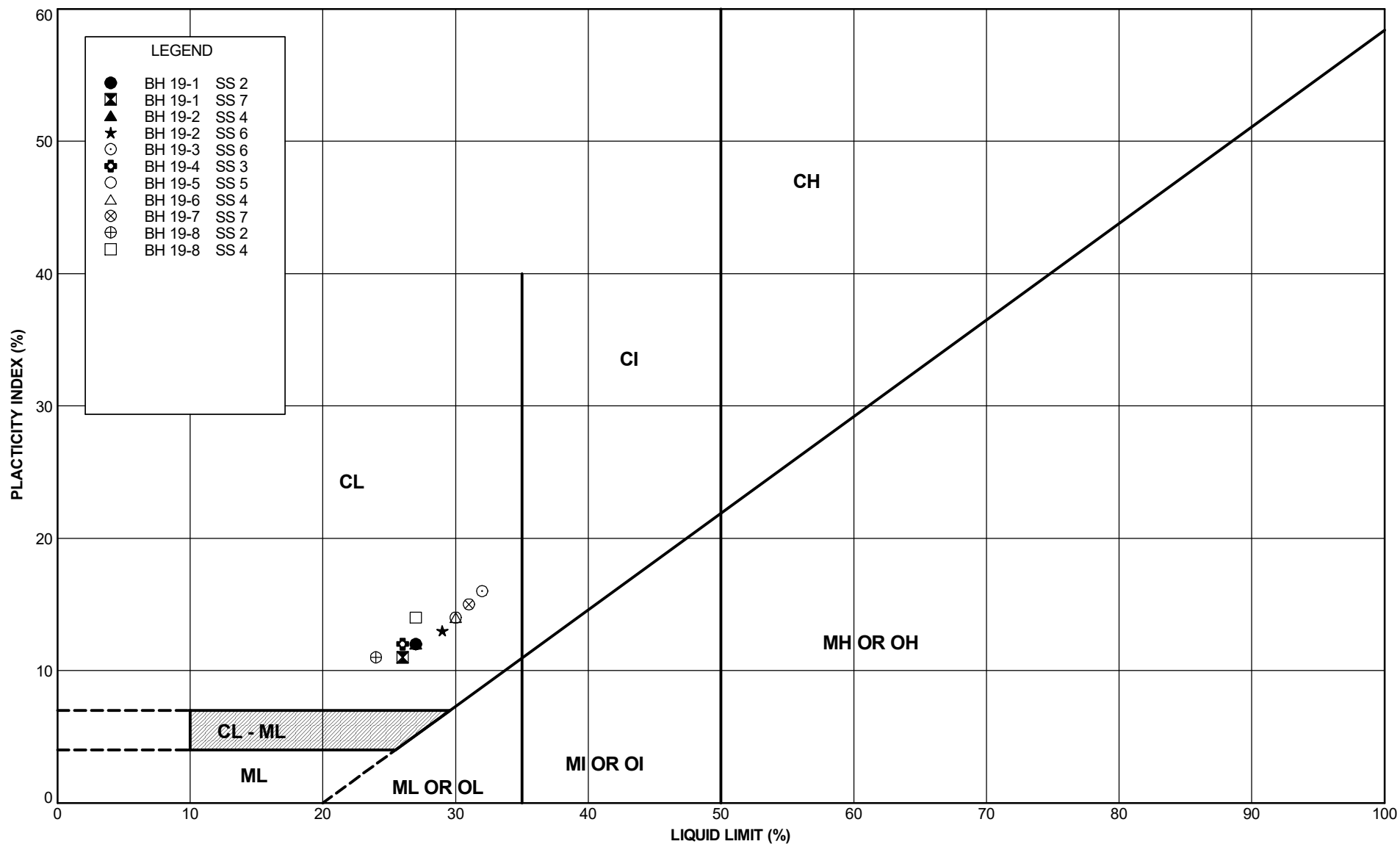


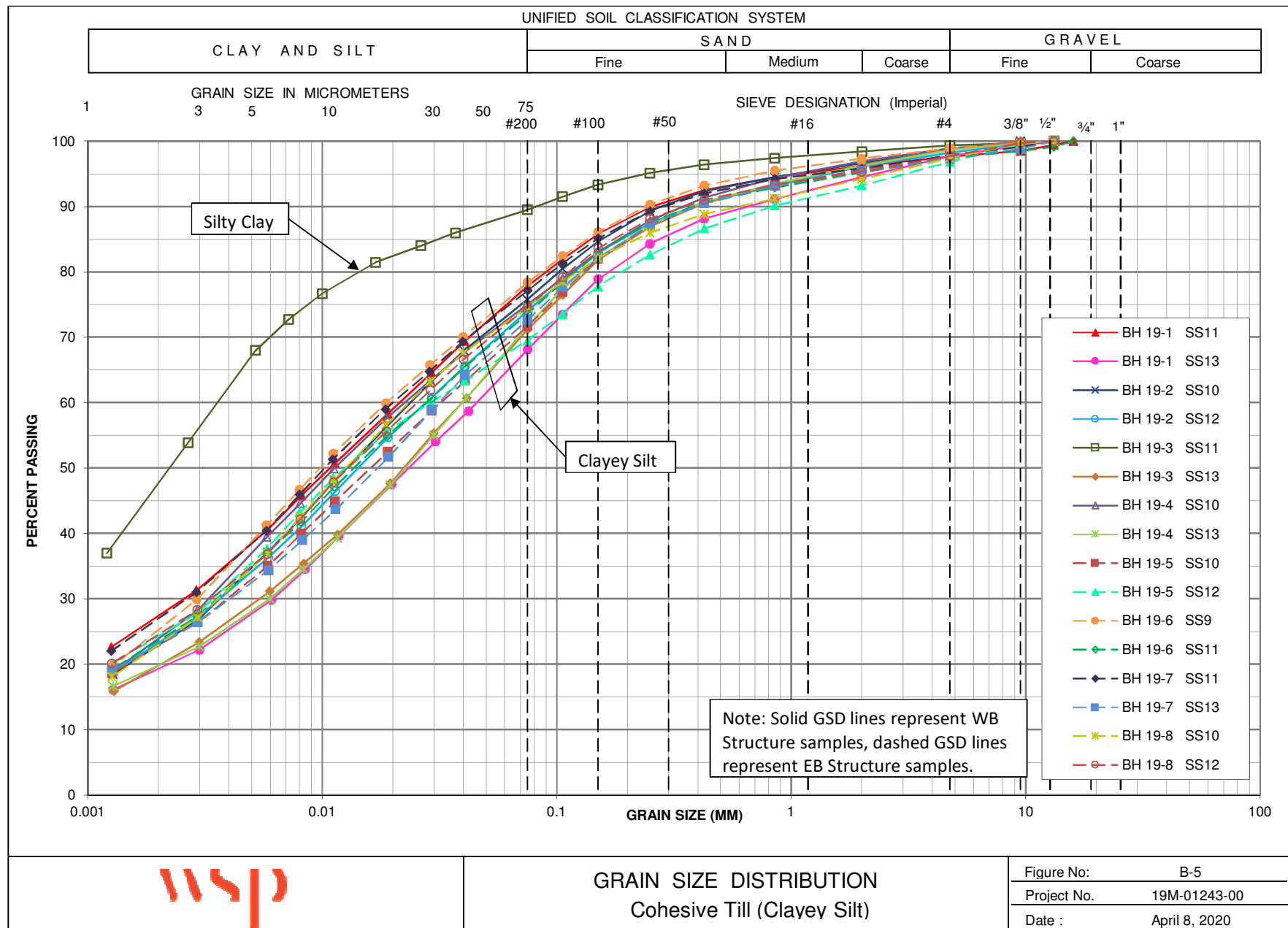






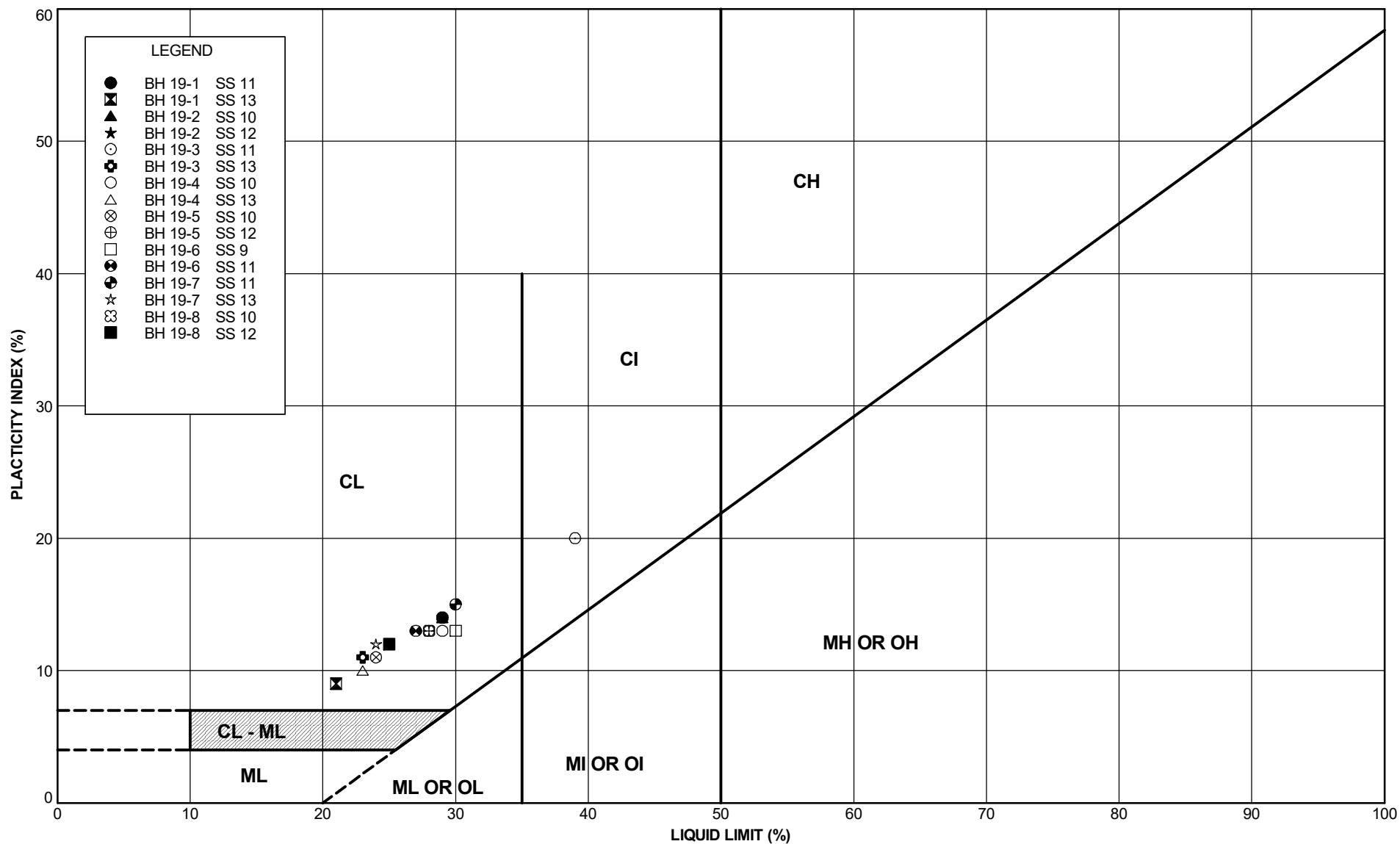






GRAIN SIZE DISTRIBUTION  
Cohesive Till (Clayey Silt)

Figure No: B-5  
Project No. 19M-01243-00  
Date : April 8, 2020



# APPENDIX

C

SITE PHOTOGRAPHS



# **Project: Proposed Rehabilitation of Dufferin Street Overpass Hwy 401EB/WB Express**

**GWP: 2089-13-00 & 2088-16-00**

**Assignment No. 2018 – E – 0057**

## **SITE VISIT PHOTOGRAPHS**

**C1: Site Reconnaissance Photographs**

**C2: Field Investigation Photographs**



Photo C1-1 Looking towards West at Dufferin Street Overpass Highway 401 Express (November 2019)

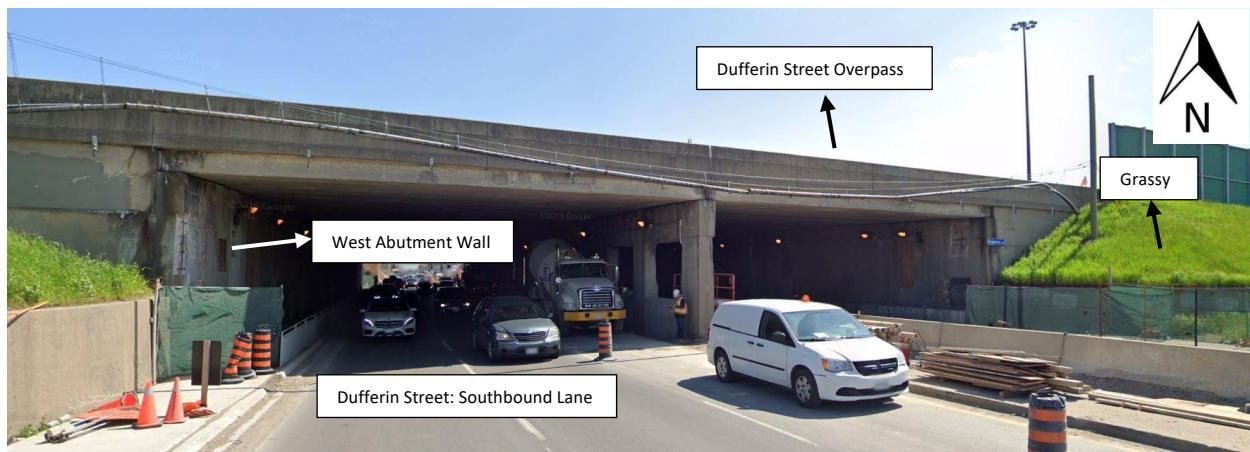


Photo C1-2 Looking towards North: Dufferin Street Overpass (November 2019)



Photo C1-3 Looking towards South: Dufferin Street Overpass (November 2019)



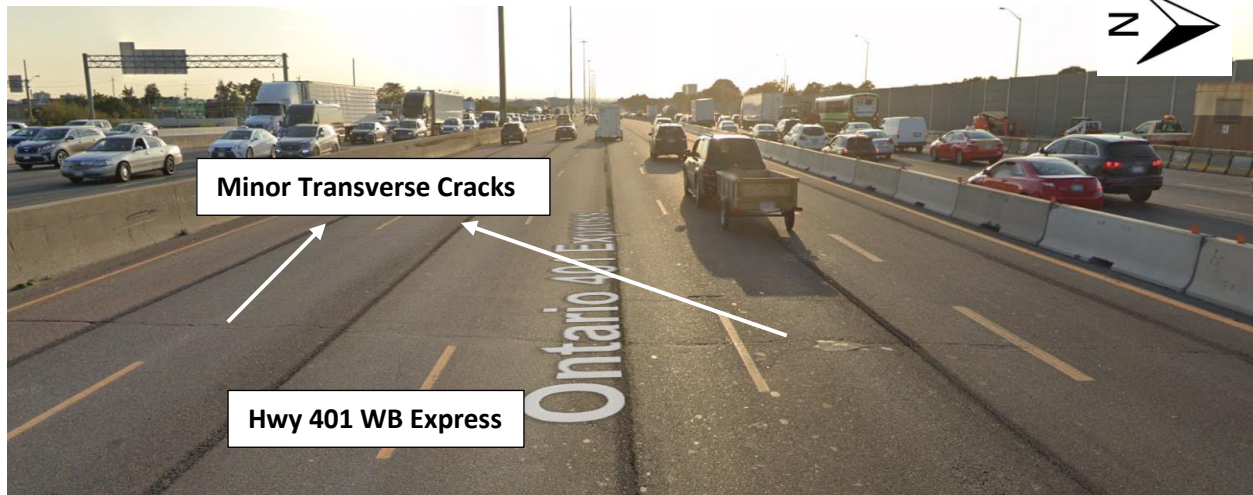


Photo C1-4 Looking towards West : Dufferin Street Overpass (November 2019)



Photo C2-1: Looking towards West at Dufferin street Overpass on Highway 401 WB Express. – Traffic Control Set-up (November 2019)



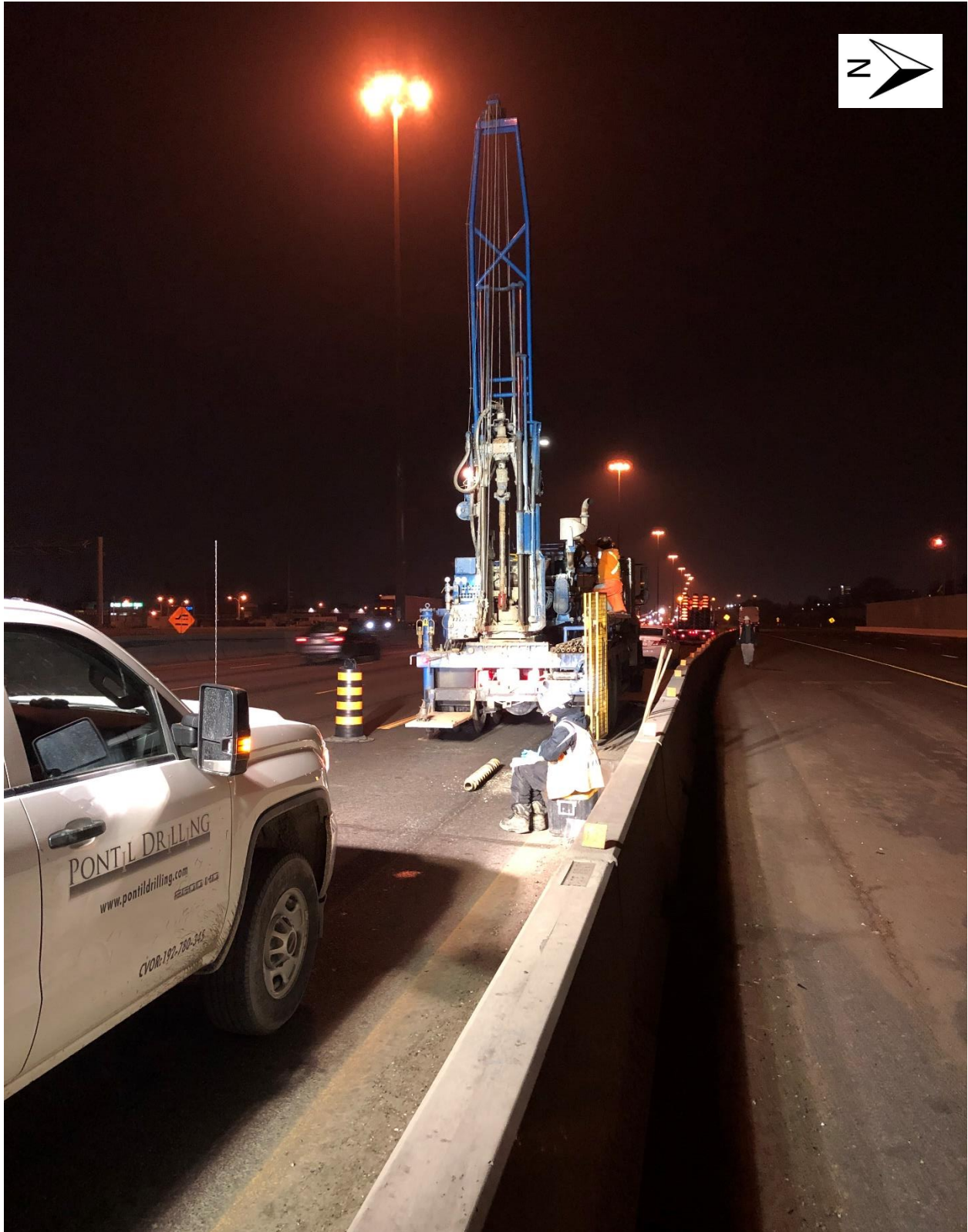


Photo C2-2: Looking towards West at Dufferin street Overpass on Highway 401 WB Express. – Traffic Control Set-up (November 2019)

Foundation Investigation Report  
Proposed Rehabilitation of Dufferin Street Overpass Hwy 401EB/WB Express, Toronto, Ontario.  
WSP Project No. 19M-01243-00