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FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGHWAY 400 / BRADFORD BYPASS E-S INTERCHANGE RAMP BRIDGE
SITE NO. 30X-0869/B0
BRADFORD WEST GWILLIMBURY, ONTARIO
Assignment No. 2023-E-0068, GWP 2026-23-00
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PART A: FOUNDATION INVESTIGATION REPORT

1. INTRODUCTION

Thurber was retained by AECOM on behalf of the Ministry of Transportation Ontario (MTO) to carry out a detail foundation investigation services for the western portion of the new Bradford Bypass under Assignment No. 2023-E-0068. The proposed Bradford Bypass will be a four-lane rural divided freeway connecting Highway 400 to Highway 404 and can accommodate future widening of up to eight lanes.

The proposed work for this assignment involves the design of a 6.5 km stretch of Bradford Bypass from Highway 400 to west of Artesian Industrial Parkway and this report only addresses the investigation carried out for the proposed Bradford Bypass to Highway 400 E-S interchange ramp bridge in the Town of Bradford West Gwillimbury, Ontario.

The purpose of this investigation is to establish the subsurface conditions at the proposed bridge by borehole drilling, in situ testing, and laboratory testing on selected samples.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement for Use and Interpretation of Report.

2. SITE DESCRIPTION

The proposed E-S ramp bridge is located approximately 770 m south of 9th Line on Highway 400 in the Town of Bradford West Gwillimbury, Ontario.

The surrounding land generally consists of farmland and the vegetative cover comprised of tall grass, shrubs, and crop residue, and sporadic tree-covered areas. The topography in the surrounding area is flat with a gentle decrease in elevation from north to south.

Highway 400 is currently a six-lane highway oriented in a north to south direction, with three lanes in each NBL and SBL direction, separated by a concrete median. The site is void of overhead utilities, but a median sewer is located along the centreline of Highway 400, immediately adjacent to the concrete median.

Site photographs taken of the site are presented in Appendix A.

2.1 Site Geology

Based on published geological information, the Town of West Gwillimbury is located within three major physiographic regions of southern Ontario: the Simcoe Lowlands, the Schomberg Clay Plains, and the Peterborough Drumlin Field.

The Simcoe Lowlands form part of the larger Great Lakes–St. Lawrence Lowlands and are characterized by flat to gently undulating terrain. This region predominantly consists of clayey to silty glaciolacustrine deposits overlying till or glaciofluvial materials. The soils tend to have low

permeability, and the area is often associated with poor drainage, wetlands, and organic deposits in depressions.

The Schomberg Clay Plains extend across parts of southern Simcoe County, northern York Region, and adjacent areas. These clay plains are characterized by flat to gently undulating topography and are underlain predominantly by glaciolacustrine silts and clays, which were deposited in the post-glacial Lake Algonquin and Lake Iroquois basins. In the West Gwillimbury area, particularly west and southwest of Bradford, the Schomberg Clay Plain dominates the surface geology, forming thick, cohesive deposits with low permeability.

The Peterborough Drumlin Field covers approximately 900 km^2 on a Paleozoic limestone plain and is one of the largest drumlin fields in southern Ontario. This physiographic region is located between the Oak Ridges Moraine and the area of shallow overburden on the limestones of the Gull River Formation, extending from Hastings County in the east to Simcoe County in the west, and including the drumlins south of the moraine in Northumberland County. The surficial soils in the Peterborough Drumlin Field consist primarily of sand with gravel till or sand and gravel deposits. Deposits of silt, clay or peat may be found in the low-lying areas between drumlins.

The bedrock in this region is predominantly composed of limestone belonging to the Lindsay and Verulam Formations, which are part of the Upper Ordovician sequence. These formations are typically softer, more thinly bedded, and less massive than the older Gull River Formation, which lies stratigraphically below.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program completed for the proposed Bradford Bypass to Highway 400 E-S interchange ramp bridge was carried out between August 12 and October 23, 2024, and between June 9 and July 13, 2025, and consisted of eight boreholes and two seismic cone penetration tests (sCPTu) advanced at or near the proposed abutments, piers, and approach embankments. Dynamic cone penetration tests (DCPTs) were carried out through the bottom of selected boreholes.

Details of the borehole and sCPTu locations, ground surface elevations and termination depths are summarized in Table 3.1.

Table 3.1: Borehole and Cone Penetration Testing Details

Foundation Unit	Borehole / sCPTu	Coordinates MTM [1] NAD 83 Zone 10		Ground Surface Elevation (m)	Depth of Borehole / DCPT or sCPTu (m)
		Northing	Easting		
West Approach Embankment	HF-08 (sCPTu)	4,866,232.3	293,949.2	255.0	17.4
West Abutment	HWY400-36 [2]	4,886,250.7	293,937.3	255.8	60.0 / 60.5 [4]
Pier 1	HWY400-38 [2]	4,886,309.0	293,955.5	255.9	60.0 / 60.5 [4]

Foundation Unit	Borehole / sCPTu	Coordinates MTM [1] NAD 83 Zone 10		Ground Surface Elevation (m)	Depth of Borehole / DCPT or sCPTu (m)
		Northing	Easting		
	HWY400-BR03 [3]	4,886,318.0	293,941.8	256.5	138.4 / --
Pier 2	HWY400-39	4,886,309.0	293,955.5	258.2	60.0 / 62.1
Pier 3	HWY400-42 [2]	4,886,417.6	294,025.9	256.2	58.5 / 59.8 [4]
East Abutment	HWY400-44 [2]	4,886,449.6	294,039.3	256.9	58.5 / 60.5
East Approach Embankment	HWY400-30	4,886,494.6	294 035.9	257.9	58.5 / 61.2 [4]
	HWY400-BR02 [3]	4,886,489.6	294,041.2	258.0	141.7 / --
	HF-07 (sCPTu)	4,866,486.4	294,050.9	257.8	23.3

Notes:
1. Survey of as-drilled borehole and sCPTu locations was completed by AECOM or Thurber unless otherwise noted.
2. Monitoring well was installed at borehole location.
3. Two monitoring wells were installed at borehole location.
4. Borehole extended beyond refusal condition as defined by 3 m of 100-blow soils.

The locations of the boreholes and sCPTus are shown on the Borehole Location Plan drawing in Appendix B. The Record of Borehole sheets are provided in Appendix C.

It should be noted that the surveying of the as-drilled borehole and sCPTu locations was completed in accordance with MTO's requirements for the horizontal and vertical accuracy. The coordinates and elevations of the boreholes are presented on the Borehole Location Plan and Soil Strata drawings and Record of Borehole sheets.

A lane and shoulder closure and traffic control were implemented for drilling of Borehole HWY400-39. Prior to commencement of drilling, utility clearances were obtained for all borehole and sCPTu locations.

Boreholes were advanced using both a truck- and track-mounted drill rig. Boreholes HWY400-BR02 and HWY400-BR03 were advanced using sonic drilling technique using 115 mm diameter casing, while the other boreholes were advanced using tricone and mud rotary method using 108 mm ID hollow stem augers and 'NW' casings.

Continuous soil cores were obtained in Boreholes HWY400-BR02 and HWY400-BR03 while in other boreholes, soil samples were obtained at selected intervals of depth (in accordance with MTO's Guideline for Foundation Engineering Services (2022)) using a 50 mm outside diameter split-spoon sampler driven in accordance with ASTM D1586.

In Boreholes HWY400-BR02 and HWY400-BR03, bedrock cores were obtained using a 'HQ'-sized core barrel.

Two seismic Cone Penetration Tests (sCPTus) were carried out using an integrated electronic piezocone penetrometer and data acquisition system. Soil properties and a stratigraphic prolife based on Soil Behaviour Type (SBT) can be inferred from the test results. As part of the Cone Penetration Testing, shear wave velocity tests and pore pressure dissipation tests were also carried out. The results of the sCPTu as well as pore pressure dissipation tests are provided in Appendix D.

The subsurface investigation and testing were observed on a full-time basis by members of Thurber's technical staff who marked/staked the borehole and sCPTu locations in the field, directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil samples and bedrock cores for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations, and a monitoring well was installed at selected borehole locations to permit the monitoring of the groundwater level. Each monitoring well consists of 50 mm outside diameter Schedule 40 PVC pipe with 1.5 m or 3.0 m long slotted screens, enclosed in a column of filtered sand. The bottom of each well was sealed with a well cap. Well installation details, and groundwater level readings are shown on the Record of Borehole sheets and are summarized in Table 3.2.

Table 3.2: Monitoring Well Installation Details

Foundation Unit	Borehole	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
West Abutment	HWY400-36	60.0 / 195.8	4.6 / 215.2	Monitoring well was installed adjacent to Borehole HWY400-36. Monitoring well with 3.0 m slotted screen installed with sand filter from 1.5 m to 4.6 m, then backfilled with bentonite from 1.5 m to ground surface.
Pier 1	HWY400-38	60.0 / 195.9	7.6 / 248.3	Monitoring well was installed adjacent to Borehole HWY400-38. Monitoring well with 3.0 m slotted screen installed with sand filter from 4.0 m to 7.6 m, then backfilled with bentonite from 4.0 m to ground surface.
	HWY400-BR03	138.4 / 118.1	19.8 / 236.4	Shallow monitoring well was installed in Borehole HWY400-BR03. Monitoring well with 3.0 m slotted screen installed with sand filter from 16.0 m to 20.1 m, then backfilled with bentonite from 16.0 m to ground surface.
			155.8 / 140.4	Deep monitoring well was installed in Borehole HWY400-BR03. Monitoring well with 3.0 m slotted screen installed with sand filter from 112.3 m to 116.4 m, then backfilled with bentonite from 112.3 m to ground surface.
Pier 3	HWY400-42	58.5 / 197.7	6.1 / 250.1	Monitoring well was installed adjacent to Borehole HWY400-42. Monitoring well with 3.0 m slotted screen installed with sand filter from 2.4 m to 6.1 m, then backfilled with bentonite from 2.4 m to ground surface.
East Abutment	HWY400-44	58.5 / 198.4	3.0 / 253.9	Monitoring well was installed adjacent to Borehole HWY400-44. Monitoring well with 1.5 m slotted screen installed with sand filter from 0.9 m to 3.0 m, then backfilled with bentonite from 0.9 m to ground surface.
	HWY400-BR02	141.7 / 163.3	21.3 / 236.6	Shallow monitoring well was installed adjacent to Borehole HWY400-BR02. Monitoring well with 3.0 m slotted screen installed with sand filter from 17.7 m to 21.5 m, then backfilled with bentonite from 17.7 m to 0.3 m then concrete to ground surface.
			118.9 / 139.0	Deep monitoring well was installed in Borehole HWY400-BR02. Monitoring well with 3.0 m slotted screen installed with sand filter from 115.2 m to 119.0 m, then backfilled with bentonite from 115.2 m to 0.9 m then concrete to ground surface.

All boreholes without monitoring well installations were backfilled upon completion of drilling in accordance with O.Reg. 903 (as amended). Monitoring wells installed as part of the investigation

are left in place to permit groundwater level measurements prior to and during construction operations and is to be decommissioned by the Contractor in accordance with O.Reg. 903.

4. LABORATORY TESTING

The recovered soil samples were subjected to visual identification and natural moisture content determination. Approximately 25% of soil samples were subjected to grain size distribution analyses, and Atterberg Limits testing in accordance with MTO's requirements. In addition, uniaxial compression tests and point load tests were carried out on selected specimens from the bedrock cores to determine unconfined compressive strength and rock strength classification of the bedrock.

Geotechnical laboratory testing results of the investigation are summarized on the Record of Borehole sheets in Appendix C and are presented on the figures in Appendix E.

To assess the potential for sulphate attack on concrete foundations, as well as the potential for metal corrosion associated with the structure, samples of the native soils were subjected to analytical testing for corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 5.12 and are presented in Appendix F.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered subsurface stratigraphy from the investigation are presented on the Soil Strata drawing in Appendix B and on the Record of Borehole sheets in Appendix C.

A summary of the subsurface conditions encountered in the boreholes are presented in the following sections; however, the factual data presented in the Record of Boreholes sheets govern any interpretation of the site conditions.

The boundaries between soil deposits on the Record of Borehole sheets have been inferred from non-continuous sampling, observations during drilling operations, and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions at the site consist of a surficial layer of topsoil, or pavement structure underlain by loose to compact fill. Beneath the topsoil and fill is a deposit of stiff to very stiff clay over very loose to compact silty sand to sandy silt till containing pockets of stiff to hard sandy silty clay to clay with sand till and interlayers of hard sandy silty clay to silty clay with sand. The silty sand to sandy silt till deposit is in turn underlain by a thick deposit of very stiff to hard clay containing interlayers of silt and sandy clay. Beneath the clay deposit is an extensive deposit of hard silty clay with sand to clay till containing pockets of very dense silt with sand to silt till and interlayers of silty sand, overlying limestone bedrock of the Lindsay Formation.

More detailed descriptions of the individual stratum are presented below.

5.1 Topsoil

Topsoil between 100 mm and 250 mm thick was encountered at ground surface in Boreholes HWY400-30, HWY400-36, HWY400-38, HWY400-44, and HWY400-BR03.

The natural moisture contents measured on the topsoil ranged from 19 to 42 per cent.

The topsoil thickness may vary beyond the borehole locations, and the thickness of topsoil in these boreholes are not intended for the purpose of estimating quantities.

5.2 Asphalt

A layer of asphalt, approximately 255 mm thick, was encountered at ground surface in Borehole HWY400-39.

5.3 Silty Sand Fill

Fill consisting of silty sand with gravel to silty sand was encountered beneath the topsoil and asphalt in Boreholes HWY 400-38 and HWY400-29, respectively. The fill is about 1.0 m and 0.9 m thick and extends to depths 1.2 m (Elev. 254.7 m and 257.0 m) below ground surface in HWY 400-38 and HWY400-39, respectively.

The natural moisture contents measured on the fill ranged from 3 to 20 per cent.

SPT N-values recorded in the silty sand fill ranged from 16 blows to 48 blows per 0.3 m of penetration, indicating a compact to dense condition.

5.4 Sandy Clay to Clay Fill

Underlying the granular fill in Borehole HWY400-39 is cohesive fill consisting of sandy clay to about 2.9 m thick, which extends to a depth of 4.1 m below ground surface (Elev. 254.1 m).

The natural moisture contents measured on the fill ranged from 8 to 19 per cent.

SPT N-values recorded in the sandy clay to clay fill ranged from 10 blows to 29 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

The results of grain size analyses carried out on a sample of the sandy clay fill are presented in Figure 1 in Appendix E and are summarized in Table 5.1.

Table 5.1: Grain Size Distribution of Sandy Clay Fill

Particle Size	Percentage (%)
Gravel	2
Sand	46
Silt	41
Clay	11

5.5 Surficial Clay

A deposit of surficial clay between 2.0 m and 13.2 m thick was encountered beneath at ground surface or beneath the topsoil or fill in all boreholes. The base of the surficial clay is at depths between 2.2 m and 13.3 m below ground surface (Elev. 255.7 m to 242.5 m).

SPT N-values recorded in the surficial clay ranged from 4 blows to 29 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency.

The natural moisture contents measured on the surficial clay ranged from 8 to 41 per cent.

The results of grain size analyses carried out on samples of the surficial clay are presented in Figures 2A and 2B in Appendix E and are summarized in Table 5.2.

Table 5.2: Grain Size Distribution of Surficial Clay

Particle Size	Percentage (%)	
	Clay (CL)	Clay (CI)
Gravel	0 to 1	0
Sand	0 to 9	2 to 6
Silt	46 to 65	51 to 54
Clay	33 to 53	40 to 44

The result of Atterberg Limits tests carried on samples of the surficial clay is presented in Figures 3A and 3B of Appendix E and is summarized in Table 5.3. The results indicate that the material is a clay of low plasticity (CL) to intermediate plasticity (CI).

Table 5.3: Atterberg Limits of Surficial Clay

Parameter	Values	
	Clay (CL)	Clay (CI)
Liquid Limit	27 to 34	35 to 37
Plastic Limit	15 to 19	17 to 20
Plasticity Index	12 to 16	17 to 18

5.6 Upper Till

An upper till deposit, between 12.9 m and 33.5 m thick, was encountered beneath the surficial

clay deposit in all boreholes. The base of the upper till deposit extends to depths of 19.4 m to 39.9 m below ground surface (Elev. 237.8 m to 215.9 m). The deposit is predominantly silty sand to sandy silt till with layers of sandy silty clay to clay with sand till. It is noted that the sandy silty clay to clay with sand till deposit are typically encountered at the base of the till deposit but are also embedded within.

Although not encountered, cobbles and boulders are commonly present within glacially derived soils and should be expected within this deposit. It should also be noted that auger grinding was noted during the borehole advancement through this deposit, suggesting the presence of material with particle sizes equal to or larger than coarse gravel.

SPT N-values recorded in the silty sand to sandy silt portions of the till deposit ranged from 0 blows (weight of hammer) to 59 blows per 0.3 m of penetration, indicating a very loose to very dense condition. In the sandy silty clay to clay with sand portions of the deposit, the recorded SPT N-values ranged from 12 blows per 0.3 m of penetration to 100 per 0.1 m of penetration, suggesting a stiff to hard consistency.

The natural moisture contents measured on the silty sand to silty sand portions of the till deposit ranged from 4 to 18 per cent, while the natural moisture contents recorded sandy silty clay to clay with sand portions of the deposit ranged from 7 to 18 per cent.

The results of grain size analyses carried out on samples of the upper till deposit are presented in Figures 4A to 4C, and 5 in Appendix E, and is summarized in Table 5.4.

Table 5.4: Grain Size Distribution of the Upper Till Deposit

Particle Size	Percentage (%)		
	Silty Sand to Sandy Silt Till	Silty Sand to Silty Sand with Gravel Till	Sandy Silty Clay (CL-ML) to Clay with Sand (CL) Till
Gravel	0 to 9	19 to 22	0 to 14
Sand	32 to 53	44 to 58	26 to 47
Silt	28 to 51	18 to 28	30 to 45
Clay	8 to 17	3 to 9	12 to 31

The results of Atterberg Limits tests on upper till deposit are presented in Figures 6, 7A, and 7B and is summarized in Table 5.5. The results indicate that the sandy silty clay to clay with clay portions of the material is a silty clay of low plasticity (CL-ML) to a clay of low plasticity (CL).

Table 5.5: Atterberg Limits of the Upper Till Deposit

Parameter	Values		
	Silty Sand to Sandy Silt Till (1)	Sandy Silty Clay (CL-ML) to Silty Clay with Sand (CL-ML) Till	Sandy Clay (CL) to Clay with Sand (CL) Till
Liquid Limit	12 to 14	13 to 16	18 to 21
Plastic Limit	10 to 11	9 to 11	10 to 11
Plasticity Index	1 to 3	4 to 5	8 to 10

Note: 1. Twelve samples of the silty sand to sandy silt portions of the upper till were subjected to Atterberg Limits testing and eight were determined to be non-plastic.

5.7 Clay

A thick clay deposit containing occasional sandy clay and silty clay pockets and silt interlayers was encountered beneath the upper till deposit in all borehole locations. All boreholes were terminated in this deposit except at Boreholes HWY400-BR02 and HWY400-BR03. The clay deposit was between 20.1 m and 39.1 m thick in the boreholes and has base elevation of Elev. 199.4 m to 189.4 m prior to borehole termination. It is noted that the thickness of clay increases from west to east.

Details of the silty clay to sandy clay pockets and silty sand to silt interlayers are discussed in Section 5.7.1.

SPT N-values recorded in the clay deposit ranged from 18 blows per 0.3 m of penetration to 100 blows per 0.1 m of penetration, suggesting a very stiff to hard consistency.

The natural moisture contents measured on the clay deposit typically ranged from 4 to 44 per cent; however, natural moisture content of 52 per cent was measured in a sample in Boreholes HWY400-42 at a depth of about 53.6 m below ground surface (Elev. 213.9 m).

The results of grain size analyses carried out on samples of the clay deposit are presented in Figure 8A to 8D in Appendix E and is summarized in Table 5.6.

Table 5.6: Grain Size Distribution of Clay Deposit

Particle Size	Percentage (%)			
	Clay (CL)	Clay with Sand (CL)	Clay (CI)	Clay (CH)
Gravel	0	0	0 to 1	0 and 1
Sand	0 to 10	16	0 to 9	1 and 6
Silt	43 to 59	32	23 to 51	24 and 30
Clay	34 to 56	52	49 to 77	75 and 63

The results of Atterberg Limits tests carried on samples of the clay deposit are presented in Figures 9A to 9D of Appendix E and is summarized in Table 5.7. The results indicate that the

material ranges from a clay of low plasticity (CL) to high plasticity (CH).

Table 5.7: Atterberg Limits of Clay Deposit

Parameter	Values			
	Clay (CL)	Clay with Sand (CL)	Clay (CI)	Clay (CH)
Liquid Limit	20 to 33	29	35 to 48	53
Plastic Limit	11 to 19	14	15 to 24	22 and 24
Plasticity Index	7 to 19	15	17 to 25	31 and 29

5.7.1 Silty Clay to Sandy Clay Pockets and Silty Sand to Silt Interlayers

A 1.1 m thick sandy clay pocket and a 1.6 m thick silt interlayer was encountered at a depth of 43.4 m (Elev. 213.1 m) and 60.7 m (Elev. 195.7 m) below ground surface, respectively, in Borehole HWY400-BR03, while in Borehole HWY400-BR02, a 1.0 m thick silty clay pocket was encountered at a depth of 34.1 m (Elev. 223.8 m).

The results of grain size analyses carried out on samples of the sandy clay to silty clay pockets, and silty sand to silt interlayers are presented in Figures 10A and 10B in Appendix E and is summarized in Table 5.8.

Table 5.8: Grain Size Distribution of Sandy/Silty Clay Pockets and Silty Sand/Silt Interlayers

Particle Size	Percentage (%)			
	Sandy Clay (CL) Pocket	Silty Clay (CL-ML) Pocket	Silty Sand Interlayer	Silt Interlayer
Gravel	0	0	0	0
Sand	43	0	64	14
Silt	31	78	27	73
Clay	26	22	9	13

The moisture contents and results of the Atterberg Limits tests are summarized in Table 5.9. The results of Atterberg Limits tests carried on samples of the sandy clay and silty clay pockets and interlayers within the clay deposit are presented in Figures 11 of Appendix E.

Table 5.9: Atterberg Limits of Sandy Clay/Silty Clay Pockets and Silty Sand/Silt Interlayers

Parameter	Values			
	Sandy Clay (CL) Pocket	Silty Clay (CL-ML) Pocket	Silty Sand Interlayer	Silt Interlayer
Moisture Content	8	17	15	18 to 36
Liquid Limit	18	21	Non-Plastic	--
Plastic Limit	10	15		
Plasticity Index	8	6		

5.8 Lower Till

An extensive lower till deposit was encountered beneath the thick clay deposit in Boreholes HWY400-BR02 and HWY400-BR03 with thickness of about 58.0 m and 50.1 m, respectively. The base of the lower till deposit extends to depths of 117.2 m (Elev. 139.3 m) and 119.8 m (Elev. 138.1 m) below ground surface. The deposit is predominantly sandy clay to clay with layers of sandy silt to silt till, and occasional silty sand interlayers. Details of the silty sand interlayers are discussed in Section 5.8.1.

Although not encountered, cobbles and boulders are commonly present within glacially derived soils and should be expected within this deposit.

SPT N-values recorded in the sandy clay to clay portions of the till deposit ranged from 47 blows per 0.3 m of penetration to 100 blows with no penetration, suggesting a hard consistency. In the sandy silt to silt portions of the deposit, the recorded SPT N-values ranged from 100 blows per 0.28 m of penetration to 100 per 0.08 m of penetration, indicating a very dense condition.

The natural moisture contents measured on the sandy clay to clay portions of the till deposit ranged from 5 to 22 per cent, while the natural moisture contents recorded sandy silt to silt portions of the deposit ranged from 6 to 24 per cent.

The results of grain size analyses carried out on samples of the sandy clay to clay till and the silt with sand to silt till are presented in Figures 12A to 12C and 13A to 13B in Appendix E, respectively, and is summarized in Table 5.10.

Table 5.10: Grain Size Distribution of the Lower Till Deposit

Particle Size	Percentage (%)			
	Sandy Clay (CL) Till	Silty Clay (CL-ML) to Clay (CL) Till	Sandy Silt Till	Silt with Sand to Silt Till
Gravel	0 to 2	0 to 6	0	0
Sand	28 to 39	0 to 20	30 to 40	2 to 22
Silt	34 to 46	39 to 75	42 to 61	70 to 81
Clay	23 to 27	23 to 46	8 to 18	6 to 20

The results of Atterberg Limits tests on lower till deposit are presented in Figures 14A to 14C and 15 in Appendix E and is summarized in Table 5.11. The results indicate lower till is of the material is a silty clay of low plasticity (CL ML) to a clay of low plasticity (CL).

Table 5.11: Atterberg Limits of the Lower Till Deposit

Parameter	Values		
	Sandy Clay (CL) Till	Silty Clay (CL-ML) to Clay (CL) Till	Sandy Silt to Silt Till [1]
Liquid Limit	19 to 21	19 to 31	14 to 23
Plastic Limit	11 to 13	12 to 19	12 to 19
Plasticity Index	8	7 to 13	2 to 4

Note: 1. Five samples of the sandy silt to silt portions of the lower till were subjected to Atterberg Limits testing and one was determined to be non-plastic.

5.8.1 Silty Sand Interlayers

The interlayers of silty sand were encountered at various depths within the lower till deposit in Boreholes HWY400-BR02, and HWY400-BR03. The thickness of the interlayers ranged from 0.6 m to 1.9 m.

A SPT N-value of 170 blows per 0.3 m of penetration was recorded in a silty sand interlayer, indicating a very dense condition.

The natural moisture contents measured on the silty sand interlayers till ranged from 6 to 19 per cent.

The results of grain size analysis carried out on a sample of the silty sand interlayers is presented in Figure 16 in Appendix E and is summarized in Table 5.12.

Table 5.12: Grain Size Distribution of Silty Sand Interlayers

Particle Size	Percentage (%)
Gravel	0
Sand	74
Silt	19
Clay	7

5.9 Dynamic Cone Penetration Tests

Dynamic Cone Penetration Tests (DCPTs) were carried out through the base of selected boreholes and the results of which are summarized in Table 5.13.

Table 5.13: Summary of Dynamic Cone Penetration Testing

Borehole / DCPT	Start Depth / Elevation (m)	Refusal Depth / Elevation (m)
HWY400-30	58.2 / 199.7	60.9 / 197.0
HWY400-36	60.0 / 195.8	60.5 / 195.3
HWY400-38	60.0 / 195.9	60.5 / 195.4
HWY400-39	60.0 / 198.2	62.1 / 196.1
HWY400-42	58.5 / 197.7	59.8 / 196.4
HWY400-44	58.5 / 198.4	60.5 / 196.4

5.10 Bedrock

Bedrock was encountered at depths of 119.8 m (Elev. 138.1 m) and 117.2 m (Elev. 138.4 m) below ground surface in Boreholes HWY400-BR02 and HWY400-BR03, respectively. The bedrock encountered is limestone of the Lindsay Formation and the recovered cores are described as highly weathered to fresh, thinly bedded, grey to dark grey, and strong with shale interbeds and clay seams. It is noted that the upper 1.2 m to 1.4 m of the bedrock is highly and moderately weathered, and transitions to a slightly weathered to fresh bedrock below. Photographs of the bedrock cores are presented in Appendix C. The rock core quality measurements are summarized in Table 5.14 and on the record of borehole sheets in Appendix C.

Table 5.14: Rock Core Quality of Limestone Bedrock

Parameter	Range	Average
Total Core Recovery (TCR), %	69 to 100	97
Solid Core Recovery (SCR), %	50 to 100	93
Rock Quality Designation (RQD), %	50 to 100	92
Fracture Index (FI), discontinuities per 0.3 m	0 to >10	1

In accordance Table 4.26 of Canadian Foundation Engineering Manual, 5th Edition (CFEM, 2023)[1], the quality of the rock mass is ranges from fair to excellent based on RQD but is generally of excellent quality.

Unconfined Compression (UC) tests and Point Load Tests (PLTs) were carried out on selected cores of the limestone bedrock, the results of which are presented in Appendix C and summarized in Table 5.15.

[1] Canadian Foundation Engineering Manual, 5th Edition (2023). Canadian Geotechnical Society, Surrey.

Table 5.15: Strength of Limestone Bedrock

Parameter	Number of Tests	Range (MPa)	Average (MPa)
Uniaxial Compressive Strength	14	49.5 to 100.0	76.1
Point Load Strength Index, I_{s50} – Axial	40	2.35 to 5.98	3.70
Point Load Strength Index, I_{s50} – Diametral	53	1.39 to 4.77	3.01

Based on the result of the rock strength testing, the intact rock strength of the limestone classified as Medium Strong (R3) to Very Strong (R5) but is generally classified as Strong (R4).

5.11 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and measured upon completion of drilling. Monitoring wells were installed in selected boreholes to permit monitoring of groundwater levels.

Water levels measured in the monitoring wells and inferred from sCPTu are presented in Table 5.16.

Table 5.16: Groundwater Level Measurements

Location	Borehole	Date	Groundwater Level		Comments
			Depth (m)	Elevation (m)	
West Abutment / Approach Embankment	HF-08 (sCPTu)	March 3, 2025	1.4	253.6	Inferred from pore water pressure dissipation tests
	HWY400-36	November 5, 2024	3.8	252.0	Groundwater readings from monitoring well
		November 13, 2024	4.0	251.8	
		April 4, 2025	0.3	255.5	
		May 29, 2025	0.4	255.4	
		August 7, 2025	1.9	253.9	
		September 8, 2025	2.5	253.3	
		November 25, 2025	3.1	252.7	
Pier 1	HWY400-38	November 5, 2024	1.1	254.8	Groundwater readings from monitoring well
		November 13, 2024	1.3	254.6	
		December 11, 2024	0.7	255.2	
		April 4, 2025	-0.5 (1)	256.4	
		May 29, 2025	-0.7 (1)	256.6	
		September 8, 2025	0.5	255.4	
		November 25, 2025	1.3	254.6	

Location	Borehole	Date	Groundwater Level		Comments
			Depth (m)	Elevation (m)	
Pier 1	HWY400-BR03 (shallow)	July 15, 2025	1.1	255.4	Groundwater readings from monitoring well
		September 10. 2025	2.2	254.3	
		November 25, 2025	0.1	256.4	
	HWY400-BR03 (deep)	July 15, 2025	12.3	244.2	Groundwater readings from monitoring well
		September 10. 2025	24.8	231.7	
		November 25, 2025	24.9	231.6	
Pier 3	HWY400-42	November 12, 2024	1.0	255.2	Groundwater readings from monitoring well
		November 8, 2024	1.0	255.2	
		April 9, 2025	0.4	255.8	
		May 30, 2025	0.4	255.8	
		September 9, 2025	2.5	253.7	
		November 26, 2025	1.2	255.0	
East Abutment / Approach Embankment	HWY400-44	November 1, 2024	1.4	255.5	Groundwater readings from monitoring well
		November 7, 2024	1.4	255.5	
		April 4, 2025	0.7	256.2	
		May 30, 2025	0.8	256.1	
		September 9, 2025	Dry	--	
		November 26, 2025	Dry	--	
	HWY400-BR02A (shallow)	July 4, 2025	1.4	255.6	Groundwater readings from monitoring well
		July 15, 2025	1.6	256.4	
		September 10, 2025	2.1	255.9	
		November 26, 2025	1.2	256.8	
	HWY400-BR02 (deep)	July 3, 2025	25.5	232.4	Groundwater readings from monitoring well
		July 5, 2025	25.7	232.2	
		September 10, 2025	26.1	231.8	
		November 26, 2025	26.2	231.7	
	HF-07 (sCPTu)	March 25, 2025	0.2	257.6	Inferred from pore water pressure dissipation tests

Note: 1. Artesian pressure. Measured groundwater level is above the ground surface.

The groundwater levels measured in the monitoring wells are short term readings and seasonal fluctuations are to be expected. In addition, groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.12 Analytical Laboratory Testing

Selected soil samples were submitted for analytical testing of corrosivity parameters including sulphate content, the results of which are summarized in Table 5.17. The laboratory certificates of analysis are presented in Appendix F.

Table 5.17: Analytical Corrosivity Test Results

Sample ID / Description	Sample Depth / Elevation (m)	pH	Soil Redox Potential (mV)	Sulphide (Na_2CO_3) %	Resistivity (ohm-cm)	Electrical Conductivity mS/cm	Sulphate (µg/g)	Chloride (µg/g)
HWY400-30 SS1 / Surficial Clay (CL)	0.4 / 257.5	8.30	290	0.01	5,560	180	11	17
HWY400-36 SS1 / Surficial Clay (CL)	0.4 / 255.4	8.07	287	0.01	4,440	225	16	19
HWY400-38 SS6 / Surficial Clay (CL)	4.9 / 251.0	8.37	207	0.05	2,600	385	370	1.6
HWY400-38 SS1A / Surficial Clay (CL)	0.4 / 256.5	7.82	299	0.02	2,210	452	24	11

5.13 Seismic Cone Penetration Testing

The results of shear wave velocity, v_s, from the seismic cone penetration testing are presented in Appendix D and summarized in Table 5.18 below.

Table 5.18: Summary of Seismic Cone Penetration Testing

Test Location	Depth (m)	Elevation (m)	Shear Wave Velocity, v_s (m/s)	Average Shear Wave Velocity, v_s (m/s)
HF-07 (sCPTu)	2.0 to 23.0	255.8 to 234.8	344 to 687	518
HF-08 (sCPTu)	2.9 to 16.7	252.1 to 238.3	244 to 553	418

5.14 Pore Water Pressure Dissipation Testing

The results of pore water pressure dissipation testing carried out as part of the seismic cone penetration testing are presented in Appendix D and summarized in Table 5.19 below.

Table 5.19: Summary of Pore Water Pressure Dissipation Testing

Test Location	Depth / Elevation (m)	Stratigraphic Unit	Horizontal Coefficient of Consolidation, c_h (cm^2/min)
HF-07 (sCPTu)	6.0 / 251.8	Silty Sand to Sandy Silt Upper Till	18.7
	7.0 / 250.8		18.6
	16.0 / 241.8		7.2
HF-08 (sCPTu)	5.1 / 249.9	Surficial Clay (CL)	0.8
	10.0 / 245.0	Silty Sand Till to Sandy Silt Upper Till	15.4
	12.9 / 242.1		1.8

6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling.

The seismic cone penetration tests (SCPTu) were carried out using a TC23 CPT track-mounted rig by ConeTec Investigation Ltd. of Brampton, Ontario, who supplied and operated the CPT equipment. In addition, ConeTec supplied and operated a LS600 track-mounted sonic rig to advance Boreholes HWY400-BR02 to HWY400-BR03 using sonic drilling technique.

All other boreholes were advanced using a CME 55 track-mounted drill rig supplied and operated by 3D Drilling Inc. of Uxbridge, Ontario.

Uniaxial compressive testing and corrosivity testing were carried out by Geomechnica Inc. of Oakville, Ontario and SGS Canada Inc. of Lakefield, Ontario, respectively.

Corrosivity tests were carried out by SGS Canada Inc. of Lakefield, Ontario, a CALA accredited analytical laboratory.

The on-site foundation investigation was supervised by Messr. Abdul Basit, P.Eng., Kamil Feszak, and Nathan Curriston of Thurber. The coordination and management of the field program was carried out by Messrs. Rod de Castro, P.Eng. and Joshua Alexander, P.Eng. of Thurber.

7. CLOSURE

Interpretation of the field data and preparation of the report was carried out by Mr. Felipe Kozminski, P.Eng., a Geotechnical Engineer, and Ms. Rocio Reyna, P.Eng., a Senior Geotechnical Engineer. This report was reviewed by Messrs. Christopher Ng, P.Eng., a Senior Geotechnical Engineer, and Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART B: FOUNDATION DESIGN REPORT

8. GENERAL

This report provides an interpretation of the subsurface information obtained from the foundation investigations and provides foundation recommendations for the design of the proposed Bradford Bypass to Highway 400 E-S interchange ramp bridge in the Town of Bradford West Gwillimbury, Ontario.

The discussions and recommendations presented in this report are intended for the use of the Ministry of Transportation, Ontario and their designers AECOM, but should not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The contractor undertaking the work must make their own interpretation based on the information presented in the factual sections of the report (Part A of this report). Where comments are made on construction, they are provided to highlight those aspects which could affect the design of the project. The contractor must make their own interpretation of the data provided as it may affect equipment selection, proposed construction methods, scheduling, and the like.

Based on 100% Design Addendum 1 General Arrangement (GA) drawings dated December 2025, the proposed E-S ramp bridge will be a 14.4 m wide, 206 m long four-span bridge with semi-integral abutments, supported on deep foundations. The lengths from the westernmost to easternmost spans are 48 m, 64 m, 57 m, and 37 m, respectively.

The proposed approach embankments will be up to about 10 m and 10.8 m high at the west and east abutment, respectively, corresponding to finished grade at about Elev. 265.3 m and 267.8 m at the west and east abutments. It is understood that the proposed bridge is designated as Major-Route bridges as defined in the Canadian Highway Bridge Design Code (CHBDC). The 100% Design Addendum 1 GA drawings are included in Appendix G.

9. CONSEQUENCE AND SITE UNDERSTANDING CLASSIFICATION

It is assumed that the proposed bridge has a “typical consequence level” associated with exceeding limits states design in accordance with Clause 6.5 and Table 6.1 of the 2019 *Canadian Highway Bridge Design Code (2019 CHBDC)* and as such, a consequence factor, Ψ, of 1.0 is used for the foundation design.

In addition, based on the level of foundation investigation completed, the site understanding is considered to be a “typical degree of site and prediction model understanding”. Accordingly, the appropriate ultimate and serviceability geotechnical resistance factors, ϕ_{gu} and ϕ_{gs}, from Tables 6.2 and 6.3 of *the CHBDC (2019)* have been used for foundation design.

10. SEISMIC CONSIDERATIONS

10.1 Seismic Site Classification and Performance Category

In accordance with Clause 4.4.3.2 of the *CHBDC (2019)*, the section of the seismic site classification is based on the soil deposits within the upper 30 m of the stratigraphy. In general, the stratigraphy at this site consists of a surficial layer of firm to very stiff clay, underlain by an upper till deposit consisting of very loose to very dense silty sand to sandy silt till, which in turn is underlain by a deposit of very stiff to hard clay. Beneath the clay deposit is a lower till deposit consisting of hard clay with sand to clay overlying limestone bedrock. Based on the shear wave velocity test results from in the CPT within the silty sand till deposit and the inferred shear strength of the underlying clay and lower till deposits from SPT N-values, the site classification for the seismic site response is C (i.e., Site Class C) in accordance with Table 4.1, Clause 4.4.3.2 of *the CHBDC (2019)*.

The site-specific peak ground acceleration, PGA, for a 2,475-year return period earthquake at this site is 0.102 g as per the 2020 National Building Code of Canada (NBCC) (refer to Appendix H).

In accordance with Table 4.10 of the CHBDC, given a site-specific spectral response acceleration $S_a(0.2)$ of 0.221 and $S_a(1.0)$ of 0.0876, the Seismic Performance Category of the bridges are either 1 or 2 subject to the fundamental period of the bridge, T.

10.2 Liquefaction

Liquefaction is a phenomenon whereby seismically induced shaking generates shear stresses within the soil under undrained conditions. These stresses tend to densify the soil which may lead to potentially large surface deformations, and under undrained conditions generate excess pore water pressures that can lead to sudden temporary losses in strength. Where existing static shear stresses are present, the loss of strength can lead to significant lateral movements (analogous to slope failure) often referred to as “lateral spreading” or under certain conditions even catastrophic failure of slopes often referred to as “flow slides”. Lateral spreading and flow slide often accompany liquefaction along rivers and other shorelines.

Based on the relative density of the native soils and the low site-specific PGA, the soils at this site are considered to have a low potential for liquefaction during a seismic event.

11. BRIDGE FOUNDATIONS

This section presents discussions on the proposed foundation alternatives for the proposed Bradford Bypass to Highway 400 E-S interchange ramp bridge.

Based on discussions with AECOM’s Structural Team, Table 11.1 summarizes the load demand at each foundation element.

Table 11.1: Load Demand at Each Foundation Element

Foundation Element	Load Demand (kN)
West Abutment	15,000
Pier 1	25,300
Pier 2	25,600
Pier 3	21,000
East Abutment	13,000

In general, the foundation soil stratigraphy at the location of the bridge consists of a layer of firm to very stiff surficial clay underlain by an upper till deposit consisting of very loose to very dense silty sand to sandy silt upper till, which in turn is underlain by a deposit of very stiff to hard clay. Beneath the clay deposit is a lower till deposit consisting of hard clay with sand to clay till overlying limestone bedrock. The groundwater level measured in monitoring wells installed as part of the investigation ranged from 4.8 m below ground surface to 0.7 m above ground surface.

Based on the subsurface conditions at this site, consideration was given to supporting the bridge abutments and piers on the following foundation types:

- Piles driven into the very stiff to hard clay or the 100-blow lower till.
- Continuous Flight Auger (CFA) piles installed into compact upper till.
- Drilled shafts (caissons) installed into 100-blow lower till.
- Drilled shafts (caissons) socketed into limestone bedrock.
- Barrettes socketed into limestone bedrock.

Recommendations for design of the feasible foundation options are provided in the following sections. A comparison of advantages, disadvantages and risks of the different foundation alternatives is presented in Appendix I.

11.1 Spread Footings

Given the variable consistency of the surficial clay and level of compactness of the upper silty sand to sandy silt till deposit, both the ultimate and serviceability geotechnical resistance is expected to be low. Higher ultimate geotechnical resistances may be achieved through the use of a compacted granular pad (i.e., partial sub-excavation and replacement of the surficial clay); however, due to the thickness of the firm to very stiff surficial clay, the serviceability geotechnical resistances would remain low.

Combined with the high structural load demands, spread footings will not be feasible for the support of the proposed bridge without extensive sub-excavation and replacement of the surficial clay with granular material. As such, it is not recommended and will not be discussed further herein.

11.2 Driven Piles

Driven piles are technically feasible foundation alternative for the support of the proposed bridge; however, they are not considered an economical alternative at the piers as a result of the high load demands and the resulting substantial number of long piles required to meet those demands. Conversely, driven piles at the abutments are the preferred foundation alternative due to the relatively lower load demands compared to those at the piers, making them relatively more economically viable. The subsurface condition at the site is conducive to driving piles into the very stiff to hard clay deposit or into the underlying 100-blow lower till deposit; however, given that the lower till is over 65 m below existing ground surface, the length of piles would be significant as the ultimate geotechnical resistances of the piles will be derived primarily from shaft friction.

To confirm the geotechnical resistances of the piles, high strain dynamic testing should be carried out on selected piles.

11.3 Continuous Flight Auger (CFA) Piles

CFA piles, also known as Auger Cast-In-Place (ACIP) piles, are a type of non-displacement pile constructed by advancing a hollow-stem continuous flight auger to the design tip elevation (providing support for the sidewalls during excavation), then pumping concrete through the hollow stem auger as it is being retracted, followed by lowering the reinforcement cage into the freshly placed concrete. Subject to the depth of the CFA piles and structural design, the reinforcement cage may or may not extend to the full depth of the augered hole with the reinforcement limited to the upper 10 m to 15 m of each pile.

Due to its method of installation, temporary liners and slurry will not be required to prevent the collapse of the shaft excavation and to maintain basal stability and as such, CFA pile installation provides a higher rate of installation when compared to the installation of drilled shafts (caissons) of similar size and depth. In addition, installation of CFA piles produces low vibration and noise emissions compared to noise and vibration associated with driving piles, which can be advantageous for certain site conditions.

Considerations could be given for abutments to be supported on CFA piles; however, precise control of the rate of auger advancement and the grout placement during construction would be critical to reduce the potential for over-excavation/soil mining and soil collapse of the very loose to loose silty sand to sandy silt upper till. If CFA piles are adopted, pile load testing on pre-production and production pile should be carried out to verify that the design geotechnical resistances have been achieved.

Although the use of CFA piles for the support of proposed bridge is technically feasible, it is not recommended due to the risk of over-excavation/soil mining of the very loose to loose portions of the upper till as well as the anticipated number of piles required to meet the load demands,

especially at the proposed piers. Therefore, CFA piles will not be discussed further herein.

11.4 Drilled Shafts (Caissons)

Drilled shafts founded within the 100-blow lower clay till or socketed into bedrock is technically feasible and could be considered for the support of the proposed bridge.

If adopted, the installation of drilled shafts will require the use of temporary casing as well as polymer drilling slurry to prevent the walls of the shaft excavation from collapse as well as to maintain base stability, respectively, during construction. For drilled shafts founded within the 100-blow lower clay till deposit, bentonite slurry must not be used for the installation as it will reduce the shaft friction, which in turn will reduce the ultimate geotechnical resistance of the drilled shafts.

Due to the 100-blow consistency of the lower till deposit as well as the medium strong to very strong limestone bedrock, the installation process is expected to be slow.

Upon completion of installation, the base of the drilled shafts would require inspection for cleanliness, which can be accomplished by means of a Shaft Inspection Device (SID) such as a video camera, or a Shaft Quantitative Inspection Device (SQUID). Should the inspection reveal that loosened material is present at the base of the drilled shaft, the base would need to be cleaned and reinspected.

In addition, verification testing would be required for drilled shafts founded within the 100-blow lower clay till to confirm the geotechnical resistances of the drilled shafts meet the required load demands.

For the disadvantages presented above, the use of drilled shafts for the support of the proposed bridge is not recommended and will not be discussed further herein.

11.5 Barrettes

Barrettes are rectangular cast-in-place reinforced concrete elements that functions similarly to drilled shafts and are typically used when there is a need for high-capacity foundations. Excavations for barrettes are carried out with a hydromill under bentonite or polymer slurry support. Once the excavations have reached the design depths, pre-fabricated reinforcement cages are to be lowered into slurry within the excavations; concrete would then be placed in the excavation by tremie method, displacing the slurry, which would be cleaned and reused for subsequent installations.

Due to their shape, barrettes provide higher geotechnical resistances as compared to drilled shafts of equivalent diameter. Given barrettes can penetrate bedrock and be installed to depths over 100 m, barrettes socketed into the limestone bedrock is recommended for the support of the piers due to high load demands. Barrettes could also be considered for the support at the abutments; however, due to the comparatively lower load demands and cost of installation,

barrettes are not recommended for the support of the abutments.

12. DRIVEN PILES

Based on the 100% Design Addendum 1 General Arrangement (GA) drawings, it is understood the abutments are designed as semi-integral abutments.

As discussed in Section 11.2, driven piles are recommended as the preferred foundation alternative for supporting the proposed at the abutments only, and not at the piers due to the high load demands. As such, the following sections only provides foundation recommendations for driven piles at the proposed abutments.

All pile installation should be carried out in accordance with OPSS.PROV 903 (as amended). In addition, all piles should be equipped with Titus standard pile points, or equivalent.

In addition, a preload period has been recommended at the approach embankments to reduce post-construction settlement foundation soils (refer to Section 17.3 for details) and as such, it is recommended that pile be installed following the completion of the preload period.

Details regarding the foundation preloading, supply and installation of monitoring equipment and monitoring program are included in the report by Thurber titled "*Foundation Investigation and Design Report for High Fills and Deep Cuts Highway 400 / Bradford Bypass Freeway to Freeway Interchange, including Highway 400 Main Alignment, 9th Line Main Alignment, N-E Ramp, E-N Ramp, S-E Ramp and E-S Ramp, GEOCRES No. 31D04-022, dated March 2026.*"

12.1 Tip Elevations and Geotechnical Resistances

The tip elevations, founding strata, and geotechnical resistances presented in Table 12.1 may be used for design purposes. It should be noted that the geotechnical resistances provided assumed that the center-to-center spacing is at least three times the diameter of the pile. Furthermore, Section 18 provides details of recommendations on performing high-strain dynamic testing of production piles to verify that the design geotechnical resistances have been achieved.

Table 12.1: Factored Geotechnical Resistances for Driven Piles

Abutment	Elevation of Underside of Abutment [1]	Approx. Length of Pile / Pile Tip Elevation (m)	Founding Stratum	Factored Ultimate Geotechnical Resistance (kN)	Factored Serviceability Geotechnical Resistance [2] (kN)
West Abutment	254.5	50.0 / 204.8	Very Stiff to Hard Clay (CL) to Clay (CI)	1,450 (HP 310x110) 1,250 [3] (HSS 355.6x12.7)	950 (HP 310x110) 825 (HSS 355.6x12.7)
		66.8 / 188.0	100-blow Lower Clay (CL) Till	2,200 (HP 310x110) 2,050 [3] (HSS 355.6x12.7)	1,450 (HP 310x110) 1,350 (HSS 355.6x12.7)
East Abutment	258.5	50.0 / 208.8	Very Stiff to Hard Clay (CL) to Clay (CI)	1,400 (HP 310x110) 1,300 [3] (HSS 355.6x12.7)	925 (HP 310x110) 850 (HSS 355.6x12.7)
		63.8 / 195.0	100-blow Lower Clay (CL) Till	1,800 (HP 310x110) 1,650 [3] (HSS 355.6x12.7)	1,200 (HP 310x110) 1,100 (HSS 355.6x12.7)

Notes: 1. As shown on the 100% Design Addendum 1 GA drawings.
2. The Factored Serviceability Geotechnical Resistances presented are for 25 mm of settlement.
3. The Factored Ultimate Geotechnical Resistances for HSS section(s) are for open ended piles.

12.2 Downdrag

Due to the recommended preloading at the proposed abutments and approach embankments (refer to Section 17.3), long-term post-construction settlement is anticipated to be less than 25 mm and as such, downdrag loads acting on the driven piles are expected to be negligible.

13. BARRETTES

As discussed in Section 11.5, barrettes socketed into bedrock are recommended for supporting the proposed piers to meet the high load demands. Barrettes could also be considered for supporting the proposed abutments; however, due to the comparatively lower load demands, barrettes are not recommended at the abutment. As such, the following section only provides foundation recommendations for barrettes socketed in bedrock at the proposed piers only.

A Non-Standard Special Provision (NSSP) has been included in Appendix J for the inclusion into the Contract Documents to address the requirements for the construction of guide walls, the continuity of excavation operations, the use of slurry for the installation, the tolerances of the installation, the cleaning and inspection of the barrettes, and placement of concrete by tremie methods.

13.1 Tip Elevations and Geotechnical Resistances

The tip elevations, founding strata, and geotechnical resistances presented in Table 13.1 may be used for design purposes for 2.8 m by 1.5 m barrettes. It is understood that a single barrette would be used to support each pier.

Table 13.1: Factored Geotechnical Resistances for 2.8 m by 1.5 m Barrettes Socketed into Bedrock

Foundation Element	Assumed Elevation of Underside of Pier (1)	Elev. of Top of Sound Bedrock / Elevation of Base of Socket (m)	Founding Stratum	Factored Ultimate Geotechnical Resistance (kN)	Factored Serviceability Geotechnical Resistance (kN)
Pier 1	253.1	137.9 / 134.9	3 m deep socket into Slightly Weathered to Fresh Limestone Bedrock	30,000 (2)	Not Applicable (3)
Pier 2	255.9	136.9 (4) / 133.9	3 m deep socket into Slightly Weathered to Fresh Limestone Bedrock	30,000 (2)	Not Applicable (3)
Pier 3	253.5	136.9 (4) / 133.9	3 m deep socket into Slightly Weathered to Fresh Limestone Bedrock	30,000 (2)	Not Applicable (3)

Notes:
1. As shown on the 100% Design Addendum 1 GA drawings.
2. The weight of the barrette of about 10,000 kN has already been subtracted from the Factored Ultimate Geotechnical Resistance.
3. The Factored Serviceability Geotechnical Resistances for 25 mm of settlement will be greater than the Factored Ultimate Geotechnical Resistance and as such, the Serviceability Limits State condition does not apply.
4. Elevation of top of sound bedrock is estimated based on the nearest borehole that was advanced into the limestone bedrock.

14. RESISTANCE TO LATERAL LOADS

14.1 Driven Piles and Barrettes

The design of piles and barrettes subjected to lateral loads should take into account such factors as the relative rigidity of the piles to the surrounding soil, the fixity condition at the head of the piles (i.e., at the pile cap level), the structural capacity of the piles to withstand bending moments, the soil resistance that can be mobilized, the tolerable lateral deflections at the head of the piles or barrettes, as well as group effects. For longer, more flexible elements, the maximum yield moment of the pile may be reached prior to mobilization of the lateral geotechnical resistance.

Pressure-lateral displacement relationships (also known as P-y curves) have been developed for the assessment of resistance to lateral loads for HP 310x110, HSS 355.6x12.7 piles and 1.5 m by 2.8 m barrettes and are presented in Appendix K. The P-y curves were generated using the

commercially available program RSPile (Version 3.032), developed by Rocscience Inc.

Both the structural and geotechnical resistances of the piles/barrettes should be evaluated to establish the governing case at Ultimate Limit States (ULS). At Serviceability Limit States (SLS), the horizontal reaction of the piles will be controlled by deflections, and the horizontal resistance of the piles should be calculated based on P-y curves provided.

Group action for lateral loading should also be evaluated by reducing the coefficient of horizontal subgrade reaction either in the direction of loading or perpendicular to the direction of loading by relevant group pile efficiency factors as outlined in Clause C6.11.3.4 of the *Commentary to the CHBDC (2019)*.

15. LATERAL EARTH PRESSURES

15.1 Static Lateral Earth Pressures

The lateral earth pressures acting on the abutment walls will depend on the type and method of placement of the backfill materials, the nature of the soils behind the backfill, the magnitude of surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the walls.

Backfill placed behind the abutments should consist of free-draining, non-frost susceptible granular materials such as OPSS.PROV 1010 Granular A or B Type II and placed in accordance with OPSS.PROV 902, as amended by Special Provision 109S61. The granular backfill should be placed to the extents as shown on OPSD 3101.150. Compaction equipment to be used adjacent to the walls should be restricted in accordance with OPSS.PROV 501 as amended by Special Provision 105S22.

Earth pressures acting on the structures may be assumed to impose a triangular distribution governed by the characteristics of the abutment backfill. For a fully drained condition, the pressures should be calculated in accordance with *the CHBDC (2019)* but generally are given by the expression:

$$p_h = K(\gamma h + q)$$

Where: p_h = horizontal pressure on the wall at depth h (kPa)
K = coefficient of lateral earth pressure (see Table 15.1 below)
γ = unit weight of retained soil (see Table 15.1 below)
h = depth below top of fill where pressure is calculated (m)
q = value of any surcharge (kPa)

Earth pressure coefficients for backfill to the abutment walls are dependent on the material used as backfill with typical values presented in Table 15.1.

Table 15.1: Static Coefficient of Lateral Earth Pressures

Static Earth Pressure	Granular A [1] ϕ = 39°, γ = 22.9 kN/m³		Granular B Type II ϕ = 35°, γ = 22.8 kN/m³		Granular B Type I ϕ = 32°, γ = 21.2 kN/m³	
	Horizontal Backfill	2H:1V Sloping Backfill	Horizontal Backfill	2H:1V Sloping Backfill	Horizontal Backfill	2H:1V Sloping Backfill
Active, K_a [2] (Unrestrained Wall)	0.23	0.31	0.27	0.39	0.31	0.47
At-rest K_o (Restrained Wall)	0.37	0.54	0.43	0.62	0.47	0.68
Passive, K_p [2]	4.40	15.15	3.69	10.82	3.26	8.61

Notes: 1. Friction angle and unit weight of Granular A are based on the results from technical memorandum titled "Innovation Study – Memo, Determination of Strength Parameters of Granular Materials, Bradford Bypass West Contractor, CMGC 2023-E-0068", dated December 12, 2025.
2. The values of K_a and K_p correspond to full mobilization of active and passive earth pressures and require certain relative movements between the wall and adjacent soil to produce these conditions. Figures C6.27 and Table C6.12 of the Commentary to the CHBDC (2019) indicate relative movement required to fully mobilize the active and passive earth pressures.

In accordance with Clause 6.12.3 of *the CHBDC (2019*), a compaction surcharge should be added to the lateral force caused by compaction.

If lateral movement is not permissible and/or the wall is restrained, the at-rest/non-yielding coefficient of lateral earth pressures, K_o, should be used. If the wall allows for lateral movement, the active/yielding earth pressures, K_a, should be used.

A geotechnical resistance factor, ϕ_{gu}, of 0.5 should be applied in static design to the passive coefficient of lateral earth pressure, K_p, in accordance with Table 6.2 of *the CHBDC (2019)* for static analysis and typical understanding (consequence factor, $\Psi = 1.0$). The soils within the depth of frost penetration should be ignored from the passive lateral resistance; however, the equivalent surcharge loading from the weight of the soils above the depth of frost penetration should be incorporated in the soils below.

The design of the abutment walls must incorporate measures such as a subdrain and weep holes to permit drainage of the backfill and eliminate hydrostatic pressures acting on the back of the walls.

15.2 Seismic Lateral Earth Pressures

In accordance with Clause 6.14.7 of *the CHBDC (2019)*, structures should be designed using active, K_{AE}, and passive, K_{PE}, earth pressure coefficients that incorporate the effects of earthquake loading. The coefficients of horizontal earth pressure for seismic loading presented in Table 15.2 may be used:

Table 15.2: Seismic Coefficient of Lateral Earth Pressures

Seismic Earth Pressure [1,2]	Granular A [3] ϕ = 39°, γ = 22.9 kN/m³		Granular B Type II ϕ = 35°, γ = 22.8 kN/m³		Granular B Type I ϕ = 32°, γ = 21.2 kN/m³	
	Horizontal Backfill	2H:1V Sloping Backfill	Horizontal Backfill	2H:1V Sloping Backfill	Horizontal Backfill	2H:1V Sloping Backfill
Active (K_{AE})	0.26	0.50	0.31	0.55	0.35	0.59
Passive (K_{PE})	4.24	2.68	3.55	2.41	3.12	2.24

Notes: 1. After Mononobe and Okabe (1924).
2. The site-specific PGA is 0.102.
3. Friction angle and unit weight of Granular A are based on the results from technical memorandum titled " Innovation Study – Memo, Determination of Strength Parameters of Granular Materials, Bradford Bypass West Contractor, CMGC 2023-E-0068", dated December 12, 2025.

For force-based designs, a seismic geotechnical resistance factor, $\phi_{gu\ (seismic)}$, should be applied to the calculated the seismic earth pressure. In accordance with Table 6.3 of *the CHBDC (2019)*, seismic geotechnical resistance factors, $\phi_{gu(static)}$, is equal to the static geotechnical resistance factor plus 0.2 but must not be greater than 1.0 (i.e., $\phi_{gu(seismic)} = \phi_{gu\ (static)} + 0.2 \leq 1$). For seismic design, the consequence factor, Ψ, is equal to 1.0 as per Section 6.14.4 of *the CHBDC (2019)*.

16. FROST PROTECTION

A minimum 1.5 m of soil cover for frost protection of all foundation elements is required as per OPSD 3090.101, as measured vertically and perpendicular from the face of the abutment slope to the edge of the underside of the pile caps.

If adequate soil cover cannot be provided for foundation elements, rigid Styrofoam insulation could be installed to compensate for the lack of soil cover and provide protection from frost penetration. The insulation must be placed above the high groundwater level.

17. APPROACH EMBANKMENTS

17.1 Engineering Parameters

The design groundwater level is assumed to be at about Elev. 273 m and 258 m for the assessment of slope stability and settlement of the west and east approach embankments, respectively.

The foundation engineering parameters used in the settlement analyses are presented in Table 17.1 while the foundation engineering parameters for the soil types used in the stability analyses are presented on the stability figures in Appendix L.

Table 17.1: Engineering Parameters for Settlement Analyses

Engineering Parameter	Stratigraphic Unit				
	New Embankment Fill	Clay with Sand (CL) to Clay (CL)	Silty Sand to Sandy Silt Till	Sandy Silty Clay (CL-ML) to Sandy Clay (CL) Till	Silty Clay (CL-ML) to Clay (CL)
Unit Weight, γ (kN/m^3)	21	20	21	19	19
Elastic Modulus, E_s (kPa)	50,000	--	15,000	--	--
Coefficient of Compressibility, m_v (m^2/kN)	--	--	--	3.3×10^{-6} (Upper) 1.0×10^{-5} (Lower)	2.0×10^{-5}
Compression Index, c_c	--	0.13 – 0.1	0.1 – 0.08	--	0.08 – 0.12
Recompression Index, c_r	--	0.013 – 0.01	0.01 – 0.008	--	0.008 – 0.012
Pre-consolidation Stress, σ_p' (kPa)	--	500 – 1000	500 – 600	--	400 – 1250
Coefficient of Consolidation, c_v (m^2/yr)	--	15	40 - 100	--	30 – 40

17.2 Global Stability

Limit equilibrium global slope stability analyses were carried out for the proposed abutment walls and slopes at the proposed approach embankments using the commercially available program Slide2 (Version 9.031), developed by Rocscience Inc., employing the Morgenstern-Price method of analysis. The Factors of Safety of numerous potential failure surfaces were computed to establish the minimum Factor of Safety. The Factor of Safety is defined as the ratio of the forces tending to resist failure to the driving forces tending to cause failure. The Factor of Safety is equal to the inverse of the product of the consequence factor, Ψ, and the geotechnical resistance factor, ϕ_{gu}, (i.e., $FoS = 1/(\Psi \cdot \phi_{gu})$). Accordingly, minimum Factors of Safety of 1.3, 1.5, and 1.1 have been used for the design of the proposed approach embankments and associated walls for the temporary (short-term), permanent (long-term), and seismic condition, respectively.

Stability analyses were carried out on critical sections of the approach embankments corresponding to the greatest new embankment height and/or where loose/soft soils are present at shallow depths.

The stability analyses assume that all topsoil/organic matter, loose/soft soils, and other deleterious materials at the base of the embankment/excavation are removed and replaced with OPSS.PROV 1010 Granular A or B Type II prior to the construction of the new embankments.

Based on the GA drawings, the heights of approach embankments will be up to about 10 m and 10.8 m at the west and east abutments, respectively. Given that the height of the approach embankments exceeds 8 m, mid-slope benches would be required. For earth and granular fill embankments, a mid-slope bench should be incorporated into every 8 m of uninterrupted embankment slope. As such, it is recommended that two 2 m wide mid-slope benches be incorporated side slope profile of the approach embankments.

The results of the stability analyses are presented in Appendix L and are summarized in Table 17.2.

Table 17.2: Results of Stability Analyses

Approach Embankment	Slope Gradient (1)	Condition	Minimum Factor of Safety	Figure
Front Slope – West Approach	2H:1V	Temporary	1.9	L1
		Permanent	1.5	L2
		Seismic	1.7	L3
Side Slopes – West Approach (STA 11+957)	2H:1V	Temporary	1.5 (East) 1.4 (West)	L4
		Permanent	1.5 (East) 1.5 (West)	L5
		Seismic	1.3 (East) 1.2 (West)	L6
Front Slope – East Approach	2H:1V	Temporary	1.8	L7
		Permanent	1.5	L8
		Seismic	1.5	L9
Side Slopes – East Approach (STA 11+720)	2H:1V to 4H:1V (transitioning to high fill area)	Temporary	2.7 (North) 1.5 (South)	L10
		Permanent	2.7 (North) 1.5 (South)	L11
		Seismic	2.2 (North) 1.3 (South)	L12

Notes: 1. Side slopes were based on cross-sections provided by AECOM on June 15, 2025.
2. The site-specific PGA is 0.102.

The factor of safety from the stability analyses are greater than the minimum factor of safety for design and therefore slope instability mitigation measures are not required.

17.3 Settlement

Settlement analyses using the commercially available program Settle3 (Version 5.024), developed by Rocscience Inc. were carried out to estimate the magnitude of settlement associated with the filling at the proposed approach embankments and transition from nearby high fill areas.

The settlement performance criteria for design of approach embankments are outlined in MTO's Embankment Settlement Criteria for Design, dated July 2, 2010. In general, embankments

approaching structural elements such as bridge abutments are to be designed such that total settlements and rate of differential settlement do not exceed 25 mm, over a 20-year period following completion of construction. The sources of settlement at this site are considered to include short-term (immediate) settlement of the loose to very dense silty sand to sandy silt till and both short-term and long-term (consolidation) settlement of the very stiff to hard silty clay to clay deposit.

The results of settlement analyses at the west and east approach embankments of the E-S Ramp are included in the report by Thurber titled "*Foundation Investigation and Design Report for High Fills and Deep Cuts Highway 400 / Bradford Bypass Freeway to Freeway Interchange, including Highway 400 Main Alignment, 9th Line Main Alignment, N-E Ramp, E-N Ramp, S-E Ramp and E-S Ramp, GEOCRES No. 31D04-022, dated March 2026*" and are summarized in Table 17.3.

Table 17.3: Estimated Settlement at Approach Embankments

Approach Embankment	New Embankment Fill Thickness (m)	Estimated Foundation Settlement (mm)	Estimated Embankment Compression (mm)	Estimated Post-Construction Total Settlement (mm)
West Approach	Up to 10.0	Up to 275	Up to 45	Up to 65
East Approach	Up to 10.8	Up to 290	Up to 55	Up to 50

Given the estimated settlement exceeds the required post-construction settlement, recommendations for preload periods at the approach embankments are summarized in Table 17.4.

Table 17.4: Estimated Preload Period

Approach Embankment	Estimated Preload Period
West Approach	3 months
East Approach	3 months

The actual preload period is subject to the results of settlement monitoring data, which may vary from the estimated preload period presented in Table 17.4. It is important that the preload period must be completed, and the settlement monitoring data has been assessed to meet post-construction settlement criteria prior to the construction of spread footings or pile driving.

18. VERIFICATION TESTING FOR DRIVEN PILES

If driven piles are selected to support the abutments, it is recommended that the ultimate geotechnical resistances of the production piles be verified upon the completion of pile installation using high-strain dynamic testing on a minimum of two piles at each abutment or 10 per cent of

all production piles, whichever is greater.

Excess pore pressures are expected to develop in the soils surrounding the piles as a result of pile driving and as such, the design ultimate geotechnical resistance may not be reached immediately following installation. Therefore, to assess the ultimate geotechnical resistances of the production piles, it is recommended that high-strain dynamic testing be carried out at the end of initial driving (EOID) and 14 days following initial driving (at the beginning of restrike (BOR)). A Non-Standard Special Provision (NSSP) to amend OPSS.PROV 903 is included in Appendix J.

19. TEMPORARY OPEN-CUT EXCAVATIONS

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA) of Ontario and OPSS.PROV 902, as amended by Special Provision 109S61.

The existing loose to compact and stiff to very stiff embankment fill, the firm to very stiff surficial clay, and the very loose to compact upper till deposit are classified as Type 3 soils when they are above the groundwater table, and Type 4 soils when they are below the groundwater table. In accordance with O.Reg. 213, temporary cut slopes for Type 3 and Type 4 soils should have a minimum gradient of 1H:1V, and 3H:1V, respectively.

Excavations should be inspected regularly for evidence of instability if they have been left open for extended periods of time and following periods of heavy rain or thawing. If required, remedial actions must be taken to ensure the stability of the excavation and the safety of workers.

20. TEMPORARY PROTECTION SYSTEMS

Where required, temporary protection systems shall be designed and constructed for Performance Level 2 in accordance with OPSS.PROV 539 as amended by Special Provision 105S09. All protection systems shall be designed by a licensed Professional Engineer in Ontario with experience in design of shoring systems with consideration for adjacent traffic loads and placement of new engineered embankment fill.

The engineering parameters in Table 20.1 may be used for design of the temporary protection systems with horizontal backfill:

Table 20.1: Engineering Parameters for the Design of Temporary Protection Systems

Stratigraphic Unit	Unit Weight of Material, γ' (kN/m^3)	Angle of Internal Friction, φ (kN/m^3)	Coefficient of Static Lateral Earth Pressure (1)	
			Active, K_a	Passive, K_p (2)
New Granular Fill	22.8	35	0.27	3.69
Existing Loose to Compact Silty Sand with Gravel Fill	21	34	0.28	3.54
Firm to Very Stiff Surficial Clay with Sand (CL)	19	30	0.33	3.00
Loose to Very Dense Silty Sand to Sandy Silt Upper Till	20	32	0.31	3.25
Stiff to Hard Sandy Silty Clay (CL-ML) to Sandy Clay (CL) Upper Till	20	31	0.32	3.12
Very Stiff to Hard Clay (CL) to Clay (CI)	20	32	0.31	3.25

Notes: 1. The lateral earth pressure coefficients presented above are based on static loading conditions and level backfill/ground surface behind the protection system. Where there is sloping ground behind the protection system, the coefficient of lateral earth pressure must be adjusted to account for the slope.
2. The total passive resistance below the base of excavation, if required, may be calculated based on the values of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.27 of the Canadian Highway Bridge Design Code *(2019 CHBDC)*.

In accordance with OPSS.PROV 539, should the temporary protection systems be left in place after completion of construction, the top of the system shall be removed to at least 1.2 m below the finished grade or ground level.

21. SUBGRADE PREPARATION AND EMBANKMENT CONSTRUCTION

21.1 Subgrade Preparation

All topsoil/organic matter, soft/loose soils, and other deleterious materials should be removed from the area of the proposed abutments, approach embankments. The exposed subgrade should be proof-rolled and be inspected by qualified geotechnical engineer. Any softened/loosened or poorly performing areas of the subgrade should be sub-excavated and replaced with compacted engineered fill as directed by a qualified geotechnical engineer but must be approved by the Contract Administrator.

21.2 Backfill Behind Abutment Walls

Granular backfill behind the abutments should meet the specifications of OPSS.PROV 1010 Granular A or Granular B Type II, constructed in accordance with OPSS.PROV 902, as amended by Special Provision 109S61, and OPSD 3101.150. Compaction equipment to be used adjacent to abutments/retaining structures must be restricted in accordance with OPSS.PROV 501 as amended by Special Provision 105S22.

21.3 Site Grading

Granular fill for the grade raise should meet the specifications of OPSS.PROV 1010 OPSS.PROV 1010 Granular A or Granular B Type II, while granular fill for the embankment widening should meet the specifications of OPSS.PROV 1010 Select Subgrade Material (SSM) or better.

Site grading should be carried out in accordance with OPSS.PROV 206, as amended by Special Provision 102S05.

21.4 Erosion Protection

To reduce erosion of the embankment side slopes and earth cut slopes due to surface water runoff, placement of topsoil and seeding should be carried as soon as practicable after construction of the embankments. In the short term, if placement of cover material cannot be carried out soon after the placement of embankment fill or completion of earth cuts, erosion control blankets should be installed to minimize erosion of the slopes. The implementation of erosion protection should be in accordance with OPSS.PROV 802 and OPSS.PROV 804.

22. CONTROL OF GROUNDWATER AND SURFACE WATER

Groundwater is expected to be encountered during construction and dewatering measures will be required for construction in dry conditions. Dewatering operations should be carried out and managed in accordance with OPSS.PROV 517, as amended by Special Provision 517F01.

The design of the dewatering system is the responsibility of the Contractor, and the Contract Documents must alert them to this responsibility. Seasonal fluctuations of the groundwater level are to be expected.

Surface water from runoff and precipitation events should be directed away from any excavations and low-lying areas during construction.

23. CORROSION ASSESSMENT

Analytical testing was carried out to determine the pH, water soluble sulphate, sulphide, chloride concentration, resistivity, and electrical conductivity of a selected soil sample. The analytical test

results for the soil sample are presented in Appendix F and summarized in Section 5.12. In accordance with California Department of Transportation's (Caltrans) Corrosion Guideline version 3.2, dated May 2021, a site is considered corrosive if chloride concentration is 500 ppm or greater, sulphate concentration is 1,500 ppm or greater, and/or pH is 5.5 or less. Given the results of the analytical testing does not meet these conditions, the site is not considered to be corrosive. However, the corrosive effects of road de-icing salts/brine should also be considered for the design of corrosion protection of structural elements.

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. In accordance with Table 3 of Concrete Materials and Methods of Concrete Construction (CSA A23.1:24), water soluble sulphate concentrations of less than 0.1% (i.e., 1000 µg/g) in soil samples indicate a low degree of exposure to sulphate attack is expected. The selection for the class of concrete should include consideration of the effects of road de-icing salt/brine.

24. CONSTRUCTION CONCERNS

A qualified geotechnical engineer (Foundation Engineering Specialist) should be retained to observe activities during construction and advise the Contract Administrator on issues related to the installation of piles, barrettes and temporary protection systems, as well as the construction of the approach embankments.

Potential construction concerns include, but are not necessarily limited to:

- Due to the depth of the barrettes, there are inherent risks the geometry and verticality of the barrettes may not meet the specified tolerances, which may result in difficulties with lowering the reinforcement cage into the trench. Therefore, a robust slurry design and skilled operators are required for maintaining the trench stability and the advancement of the hydromill.
- Inspection and cleaning of the base of the rock socket will be challenging, if not practical, with traditional inspection devices such as a SQUID due to uneven base of the socket created by the cutter head of the hydromill and the depth of the trench. As a result, base cleanliness may be inferred from sand content in slurry after fluid exchange.
- Subject to the depth of the guide walls, the types of soils conditions encountered, and the space restrictions of the site (such as the Highway 400 median), temporary shoring may be required during the construction of guide walls.
- Should there be a desire to assess the ultimate geotechnical resistance of a pre-production barrette, the static load test may require multiple O-cells Osterberg cells) due to the high load demands and the weight of the barrette.
- There are inherent risks that the rate of settlement of the foundation soils at the approach embankments may be slower than estimated, requiring a longer preload period prior to

the construction of spread footings or pile driving at the abutments. As such, it is recommended that flexibility be incorporated in the construction schedule to accommodate for delays associated with slower than anticipated settlements.

- Cobbles and boulders may be encountered within the native sandy silty clay and silty sand till deposits, which may affect temporary open-cut excavations, pile driving, and installation of temporary protection systems, drilled shafts and barrettes. As such, considerations of such obstructions must be made in the selection of appropriate equipment and procedures for the work. An example of a Notice to Contractor (NTC) to alert the Contractor is included in Appendix J.
- Groundwater levels measured at the site ranged 4.8 m below existing ground surface to 0.7 m above ground surface and as such, it is anticipated that excavations for the abutments and piers will extend below the groundwater table. A robust dewatering system will be required for all excavations, particularly at Pier 1 where artesian pressures were observed in monitoring wells in April and May 2025.

25. CLOSURE

Preparation of the design report and engineering analysis was carried out by Ms. Alysha Kobylinski, P.Eng., a Geotechnical Engineer, and Mr. Christopher Ng, P.Eng., a Senior Geotechnical Engineer. This report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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ASTM International:

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

Canadian Standards Association (CSA):

CSA A23.1:24 Concrete Materials and Methods of Concrete Construction

CSA S6:19 Canadian Highway Bridge Design Code

Commercial Software:

RSPile (Version 3.031) by Rocscience Inc.

Slide2 (Version 9.031) by Rocscience Inc.

Settle3 (Version 5.024) by Rocscience Inc.

Ontario Occupational Health and Safety Act:

Ontario Regulation 213 Construction Projects (as amended)

Ontario Provincial Standard Specifications (OPSS):

OPSS.PROV 206	Construction Specification for Grading
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 517	Construction Specification for Dewatering and Temporary Flow Passage Systems
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSS.PROV 802	Construction Specification for Topsoil
OPSS.PROV 804	Construction Specification for Temporary Erosion Control
OPSS.PROV 902	Construction Specification for Excavating and Backfilling – Structures
OPSS.PROV 903	Construction Specification for Deep Foundations
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

Ontario Provincial Standard Drawings (OPSD):

OPSD 208.010	Benching of Earth Slopes
OPSD 3090.101	Foundations, Frost Penetration Depths for Southern Ontario
OPSD 3101.150	Walls, Retaining, Backfill, Minimum Granular Requirement

Ontario Regulations:

R.R.O. 1990, Regulation 903 Wells, under Ontario Water Resources Act, R.S.O. 1990, c. O.40

THURBER

STATEMENT FOR USE AND INTERPRETATION OF REPORT

1. STANDARD OF CARE

This Report has been prepared in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances at the same time and in the same or similar locality and in compliance with all applicable laws.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment, including this Statement For Use and Interpretation of Report, 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, AS DESCRIBED ABOVE. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE OF THE 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 for the development, design objectives, and/or purposes described to Thurber by the Client. **NO OTHER PARTY MAY USE OR RELY ON THE REPORT OR ANY PORTION THEREOF FOR OTHER THAN THE CLIENT'S BENEFIT IN CONNECTION WITH THE PURPOSES DESCRIBED IN THE REPORT**. Any use which a third party makes of the Report is the sole responsibility of such third party and is always subject to this Statement for Use and Interpretation of Report. Thurber accepts no liability or responsibility for damages suffered by any third party resulting from use of the Report for purposes outside the reasonable contemplation of Thurber at the time it was prepared or in any manner unintended by Thurber.

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 is inherently judgement-based. 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 parties making use of such documents or records with or without our express written consent need to 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 parties. Some conditions are subject to change over time and those making use of the Report need to be aware of this possibility and understand that the Report only presents the interpreted conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client must 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 based on conditions in evidence at the time of site inspections and based on 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 resulting from misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other parties 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 is recommended to 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 need to 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 to confirm and document that the site conditions do not materially differ from those 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. 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 other parties 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, unless such decisions expressly form part of the stated purpose of the Report as described in Paragraph 3.

APPENDIX A

Site Photographs



Photograph #1 – Approx. 45 m east of Borehole HWY400-BR02 looking northwest towards Highway 400. (September 2024)



Photograph #2 – Approx. 80 m north of Borehole HWY400-38 looking north. (September 2025)



Photograph #3 – Approx. 140 m north of Borehole HWY400-38 looking south-southeast towards Highway 400. (August 2025)



Photograph #4 – At Borehole HWY400-BR03 looking south. Monitoring wells installation at HWY400-BR03 in blue protection casings. (August 2025)



Photograph #5 – At Borehole HWY400-BR03 looking southeast towards Borehole 400-38. (August 2025)



Photograph #6 – At Borehole HWY400-38 looking west. (August 2025)

THURBER

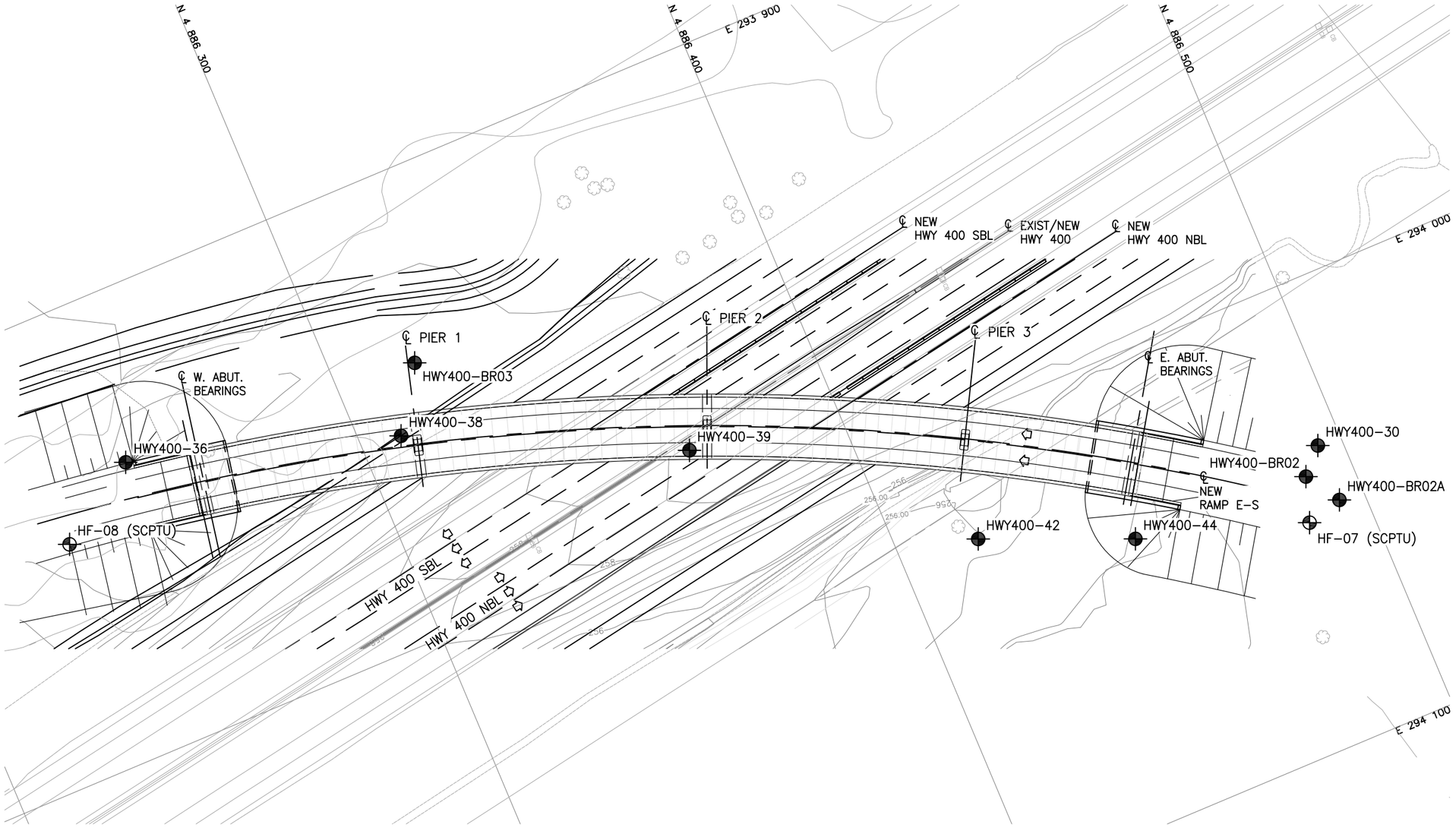
APPENDIX B

Borehole Locations Plans and Soil Strata Drawings

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



PLAN

20 0 20 40m

SCALE 1:1000

CONT No 2026-2005
GWP No 2026-23-00

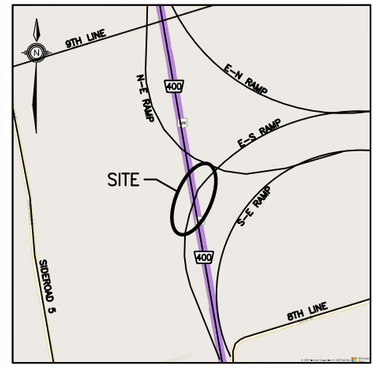
HWY 400 / BRADFORD BYPASS E-S INTERCHANGE RAMP

BOREHOLE LOCATION PLAN

SHEET 1111A

AECOM

THURBER



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 Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HF-07 (SCPTU)	257.8	4 886 486.4	294 050.9
HF-08 (SCPTU)	255.0	4 886 232.3	293 949.2
HWY400-30	257.9	4 886 494.6	294 035.9
HWY400-36	255.8	4 886 250.7	293 937.3
HWY400-38	255.9	4 886 309.0	293 955.5
HWY400-39	258.2	4 886 366.4	293 983.1
HWY400-42	256.2	4 886 417.6	294 025.9
HWY400-44	256.9	4 886 449.6	294 039.3
HWY400-BR02	257.9	4 886 489.6	294 041.2
HWY400-BR02A	258.0	4 886 494.4	294 048.8
HWY400-BR03	256.5	4 886 318.0	293 941.8

-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. 31D04-025

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
Feb. 23, 2026
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J.P.K. LEE
100086735
Feb. 23, 2026
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION
FEB 20/26	CN	UPDATE GA DRAWING

DESIGN CN	CHK JPL	CODE	LOAD	DATE	FEB 2026
DRAWN AN	CHK CN	SITE 30X-0869/B0	STRUCT	DWG	1

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PLOTDATE: 2/23/2026 10:56 AM

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No 2026-2005
GWP No 2026-23-00

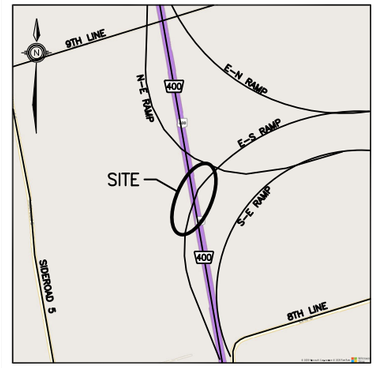
HWY 400 / BRADFORD BYPASS E-S INTERCHANGE RAMP

SHEET 1112A

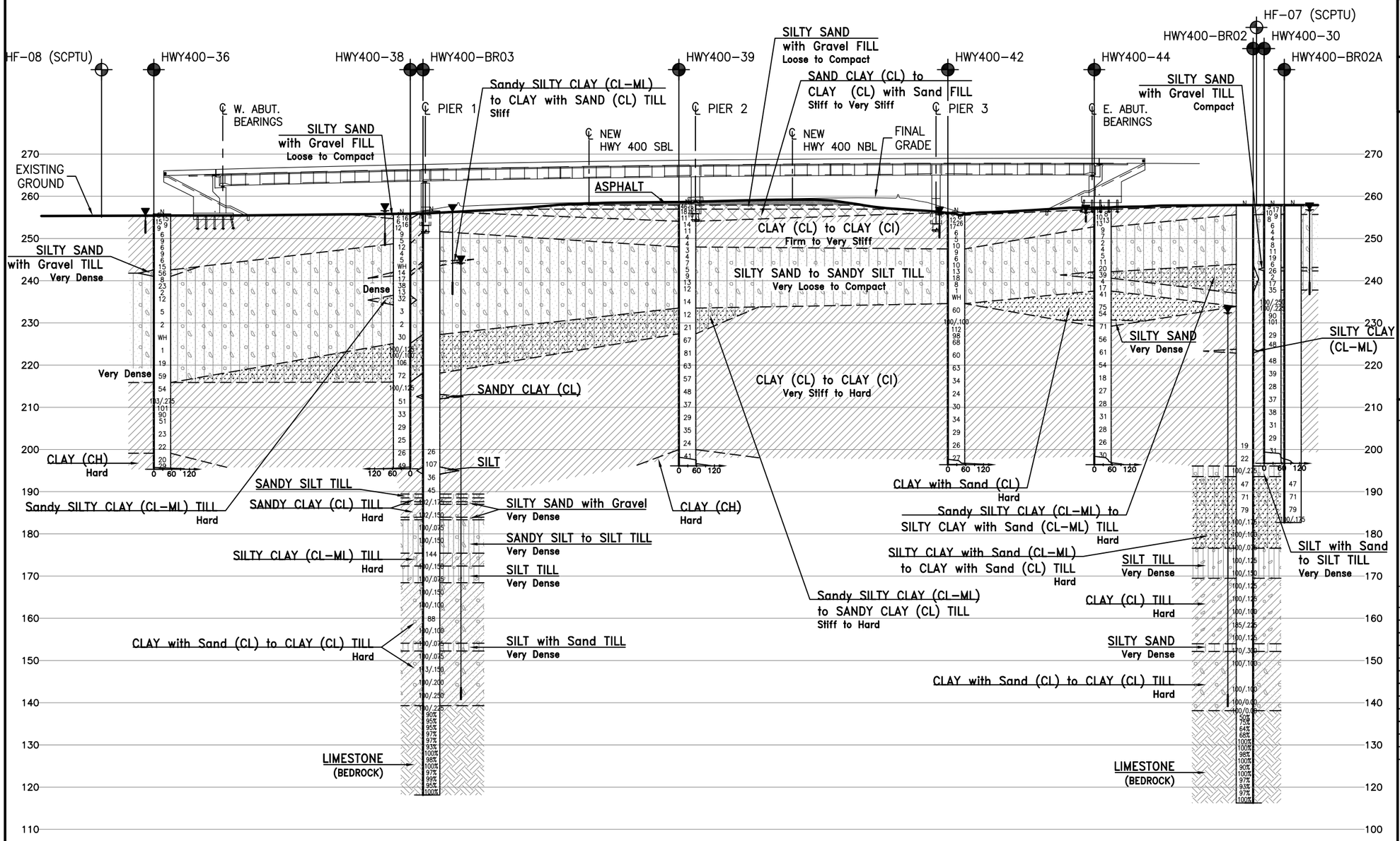
SOIL STRATA

AECOM

THURBER



KEYPLAN



PROFILE ALONG ℄ PROPOSED E-S INTERCHANGE RAMP

20 0 20 40m

SCALE 1:1000

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 Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
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NO	ELEVATION	NORTHING	EASTING
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REVISIONS		
DATE	BY	DESCRIPTION
FEB 20/26	CN	UPDATE GA DRAWING

DESIGN CN	CHK JPL	CODE	LOAD	DATE	FEB 2026
DRAWN AN	CHK CN	SITE 30X-0869/B0	STRUCT	DWG	2

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APPENDIX C

Record of Borehole Sheets and Rock Core Photographs

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORD OF BOREHOLES

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS:

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in size from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	greater than 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	less than 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. Where insufficient penetration was achieved, the number of blows are reported over the sampler penetration in metres (e.g. 50/0.15).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60-degree apex cone connected to “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

WATER LEVELS:



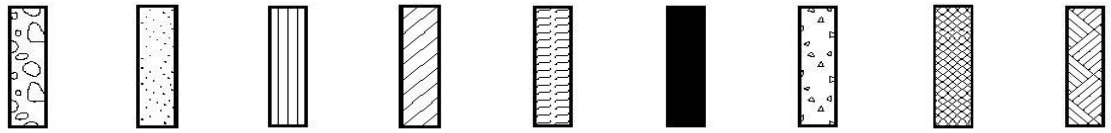
Water level upon completion of drilling

Water level in monitoring well / piezometer

Monitoring well / piezometer screen

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STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders Cobbles Gravels | Sands | Silts | Clays | Organics | Asphalt | Concrete | Fill | Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Clay	Less than 0.002 mm
Silt	0.002 mm – 0.075 mm
Sand	0.075 mm – 4.75 mm
Gravel	4.75 mm – 75 mm
Cobbles	75 mm – 300 mm
Boulders	Greater than 300 mm

TERMS DESCRIBING CONSISTENCY (FINE GRAINED SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	Less than 12
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split-spoon samples
TW	Thin-wall (Shelby) tube sample
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING DENSITY (COARSE GRAINED SOILS ONLY)

Descriptive Term	SPT 'N' Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

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MODIFIED UNIFIED SOIL CLASSIFICATION

Major Division		Group Symbol	Typical Description
COARSE GRAINED SOIL	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	SILT AND CLAY SOILS LL < 35	ML	Inorganic silts, 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.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS 35 ≤ LL < 50	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS LL ≥ 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		PT	Peat and other organic soils.

Note – LL = Liquid Limit

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EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh, W1 (FR)	No visible signs of weathering.
Slightly Weathered, W2 (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered, W3 (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered, W4 (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered, W5 (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.
Residual Soil, W6 (RS)	Rock is completely changed into a soil, where the rock texture and structures have been completely destroyed.

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length.
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

Bedding	Bedding Thickness
Thinly laminated	Less than 6 mm
Laminated	6 mm – 20 mm
Very thinly bedded	20 mm – 60 mm
Thinly bedded	60 mm – 0.2 m
Medium bedded	0.2 m – 0.6 m
Thickly bedded	0.6 m – 2 m
Very thickly bedded	Greater than 2 m

STRENGTH CLASSIFICATION

Rock Strength	Uniaxial Compressive Strength (MPa)
Extremely Weak, R0	0.25 – 1
Very Weak, R1	1 – 5
Weak, R2	5 – 25
Medium Strong, R3	25 – 50
Strong, R4	50 – 100
Very Strong, R5	100 – 250
Extremely Strong, R6	Greater than 250

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 1 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
257.9	GROUND SURFACE										
0.0	**TOPSOIL:** (150mm)										
0.2	**CLAY** (CL) Stiff to Very Stiff Brown Moist		1	SS	9						
			2	SS	17		257				0 3 63 34
			3	SS	10		256				
255.7											
2.2	Silty **SAND** Loose Brown to Grey Wet (TILL)		4	SS	9		255				Mud rotary and tricone used from 3.0m to 61.1m.
			5	SS	8						2 52 36 10 Non-plastic
			6	SS	6		254				
			7	SS	4		253				
			8	SS	4		252				3 48 39 10 Non-plastic
			9	SS	8		251				
							250				
							249				
							248				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 10/22/25

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **SAND** Loose to Compact Brown to Grey Wet (TILL)										
			10	SS	11		247		○		
							246				
			11	SS	19				○		
							245				
			12	SS	6		244		○		9 49 31 11 Non-plastic
243.1											
14.8	Silty **SAND** with Gravel Compact Grey Wet (TILL)						243		○		
242.3			13	SS	26				○		21 58 18 3
15.6	Silty **SAND** Loose to Compact Brown to Grey Wet (TILL)						242				
			14	SS	2		241		○		6 50 33 11 Non-plastic
							240				
			15	SS	17				○		
							239				
							238		○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Continued From Previous Page							20 40 60 80 100	20 40 60		
20.1	**CLAY** (CL) Very Stiff to Hard Grey Moist		16	SS	35		237				
			17	SS	100/ 0.250		235				0 9 57 34
			18	SS	100/ 0.225		233				
			19	SS	90		232				
			20	SS	101		230				0 1 59 40
							229				
							228				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 10/22/25

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RECORD OF BOREHOLE No HWY400-30 4 OF 7 METRIC

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DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Very Stiff to Hard Grey Wet										
			21	SS	29		227				
							226				
							225				
			22	SS	48		224				0 0 37 63
							223				
							222				
			23	SS	48		221				
							220				
							219				
			24	SS	39		218				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
	CLAY (CL) Very Stiff to Hard Grey Wet						217 216 215 214 213 212 211 210 209 208				
			25	SS	28						
			26	SS	37						
			27	SS	38						

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Very Stiff to Hard Grey Wet						207 206 205 204 203 202 201 200 199 198				
			28	SS	31				○		
			29	SS	29				○		
			30	SS	31				○		
199.4 58.5	End of sampling and start of DCPT										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-30 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.6 E 294 035.9 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.09.27 - 2024.10.01 LATITUDE 44.118367 LONGITUDE -79.634486 CHECKED BY JA

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 (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
196.7							197				
61.2	END OF DCPT AT 61.2m UPON REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CEMENT/GROUT MIXTURE TO GROUND SURFACE.										~~Drilling mud~~ added to borehole during drilling, therefore water level was not established upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 1 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
255.8	GROUND SURFACE										
0.0	**TOPSOIL:** (100mm)										
0.1	**CLAY** (CL), occasional rootlets Firm to Very Stiff Brown to Grey Moist to Wet		1	SS	5						
			2	SS	15		255				
			3	SS	15		254				0 2 54 44
			4	SS	9		253				
			5	SS	9						Mud rotary and tricone used from 3.0m to 60.0m.
							252				
			6	SS	6		251				0 0 47 53
			7	SS	9		250				
							249				
			8	SS	6		248				
							247				
			9	SS	9		246				0 9 46 45

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	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 (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Firm to Very Stiff Brown to Grey Moist to Wet										
			10	SS	6		245		○		
							244				
			11	SS	15				○		
242.5							243				
13.3	Silty **SAND** with Gravel Very Dense Grey Wet (TILL)						242				
			12	SS	56				○		22 48 25 5
241.0											
14.8	Silty **SAND** to Sandy **SILT** Very Loose to Compact Grey Wet (TILL)						241				
			13	SS	8				○		2 49 39 10
							240				
			14	SS	23		239		○		
							238				
			15	SS	2				○		
							237				
							236				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** to Sandy **SILT** Very Loose to Compact Grey Wet (TILL)		16	SS	12		235	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	○		
			17	SS	5		233		○		
			18	SS	2		230		○		2 48 39 11
	No recovery		19	SS	WH		226				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 4 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** to Sandy **SILT** Very Loose to Compact Grey Wet (TILL)						225				
							224				
			20	SS	1				o		
							223				
							222				
							221				
			21	SS	19				o		2 43 43 12 Non-plastic
							220				
							219				
							218				
	Auger grinding at a depth of 38.1m		22	SS	59				o		
							217				
215.9							216				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
39.9	**CLAY** (CL) to **CLAY** (CI) Hard Grey Wet						215				
			23	SS	54		214		○		
	Auger grinding at a depth of 43.9m		24	SS	103/ 0.275		213				
							212		○		
	No recovery		25	SS	101		211				
							210				
	Auger grinding at a depth of 47.8m		26	SS	90		209		○		
							208				
			27	SS	51		207		○		
							206				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) to **CLAY** (CI) Very Stiff Grey Wet						205				
							204				
			28	SS	23				○		
							203				
							202				
							201				
			29	SS	22				○		
							200				
199.1											
56.7	**CLAY** (CH) Very Stiff Grey Wet						199				
							198				
			30	SS	20				○——		0 1 24 75
							197				
			31	SS	29						
							196				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-36 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 250.7 E 293 937.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/Mud Rotary/Dynamic Cone Penetration Test COMPILED BY JW

DATUM Geodetic DATE 2024.09.25 - 2024.10.01 LATITUDE 44.116170 LONGITUDE -79.635714 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
195.8	Continued From Previous Page							20 40 60 80 100	20 40 60		
60.0 / 195.3	End of sampling and start of DCPT										
60.5	END OF DCPT AT 60.5m UPON REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CEMENT/GROUT MIXTURE TO GROUND SURFACE. A MONITORING WELL WAS INSTALLED ADJACENT TO BOREHOLE HWY400-36. Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										Drilling mud added to borehole during drilling, therefore water level was not established upon completion of drilling.

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2024.11.05	3.8	252.0
2024.11.13	4.0	251.8
2025.04.03	0.3	255.5
2025.05.29	0.4	255.4
2025.08.07	1.9	253.9
2025.09.08	2.5	253.3
2025.11.25	3.1	252.7

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 1 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
255.9	GROUND SURFACE										
0.0	**TOPSOIL:** (210mm)										
0.2	Silty **SAND** with Gravel Very Loose to Compact Brown Moist (FILL)		1	SS	2						
			2	SS	16		255				
254.7											
1.2	**CLAY** (CL) Firm to Very Stiff Brown to Grey Moist to Wet		3	SS	6		254				
			4	SS	16						0 0 55 45
			5	SS	12		253				Mud rotary and tricone used from 3.0m to 60.5m.
							252				
			6	SS	9		251				
							250				
			7	SS	5						
248.7							249				
7.2	Silty **SAND** Very Loose to Compact Grey Wet (TILL)		8	SS	12		248				
							247				
			9	SS	4						7 48 37 8
							246				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Very Loose to Loose Grey Wet (TILL)						245				
			10	SS	5						
							244				
			11	SS	WH				○		
							243				
242.0											
13.9	**CLAY** with Sand (CL) Stiff Grey Wet (TILL)		12	SS	14		242		○ ⊢e		1 20 48 31
241.1											
14.8	Silty **SAND** with Gravel to Silty **SAND** Compact to Dense Grey Wet (TILL)						241				
			13	SS	17				○		
							240				
			14	SS	38		239		○		19 44 28 9
							238				
	No recovery		15	SS	13						
236.5							237				
19.4	Sandy **SILTY CLAY** (CL-ML) Hard Grey (TILL)										
							236				

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+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Sandy **SILTY CLAY** (CL-ML) Hard Grey Wet (TILL)		16	SS	32				⊣		14 26 45 15
234.3							235				
21.6	Silty **SAND** Very Loose to Compact Grey Wet (TILL)						234				
			17	SS	3		233		⊣		3 49 40 8
							232				
							231				
			18	SS	2		230		○		
							229				
							228				
							227				
			19	SS	30				○		
							226				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 4 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
225.1	Silty **SAND** Very Loose to Dense Grey Wet (TILL)										
30.8	Sandy **CLAY** (CL) Hard Grey Wet (TILL)						225				
	Auger grinding at a depth of 31.4m		20	SS	100/ 0.125		224		○		
							223				
			21	SS	100/ 0.100				○		
	Auger grinding at a depth of 34.4m						222				
			22	SS	106		221		○		
	Auger grinding at a depth of 36.6m						220				
							219				
	Auger grinding at a depth of 37.5m						218				
			23	SS	72				⊢●⊣		0 30 42 28
	Auger grinding and spoon bouncing at a depth of 38.6m						217				
216.0							216				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
39.9	**CLAY** (CI) Very Stiff to Hard Grey Wet Auger grinding at a depth of 40.2m						215				
			24	SS	100/ 0.125				○		
	Auger grinding at a depth of 41.4m						214				
	Auger grinding at a depth of 42.1m						213				
	Auger grinding at a depth 42.9m						212				
			25	SS	51				○		
							211				
							210				
							209				
			26	SS	33				⊢○⊣		0 1 41 58
							208				
							207				
							206				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No HWY400-38 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE			GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Very Stiff to Hard Grey Wet		27	SS	29		205				
							204				
							203				
			28	SS	25		202				
							201				
							200				
			29	SS	26		199				
							198				
							197				
			30	SS	49		196				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \quad 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No HWY400-38 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 309.0 E 293 955.5 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.09 LATITUDE 44.116695 LONGITUDE -79.635488 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
195.9	Continued From Previous Page										
60.0 / 195.4	End of sampling and start of DCPT										
60.5	END OF DCPT AT 60.5m UPON REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CEMENT/GROUT MIXTURE TO GROUND SURFACE. A MONITORING WELL WAS INSTALLED NEXT TO BOREHOLE HWY400-38. Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										Drilling mud added to borehole during drilling, therefore water level was not established upon completion of drilling.

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2024.11.05	1.1	254.8
2024.11.13	1.3	254.6
2024.12.11	0.7	255.2
2025.04.03	-0.5	256.4
2025.05.29	-0.7	256.6
2025.09.08	0.5	255.4
2025.11.25	1.3	254.6

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No HWY400-39 1 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
258.2	GROUND SURFACE							20 40 60 80 100	20 40 60		
0.0 / 257.9	**ASPHALT:** (285mm)						258				
0.3 / 257.0	Silty **SAND** with Gravel Compact to Dense Moist (FILL)		1	SS	46				○		
			2	SS	18		257		○		
1.2 / 255.2	Sandy **CLAY** (CL), containing organics Stiff to Very Stiff Brown to Black Moist (FILL)		3	SS	18				○		2 46 41 11
			4	SS	10		256		○		
3.0 / 254.1	**CLAY** (CL) with Sand Stiff Brown Moist (FILL)		5	SS	11		255		○		Mud rotary and tricone used from 3.0m to 62.1m.
4.1	**CLAY** (CL) Firm to Stiff Brown to Grey Wet		6	SS	14		254		○ ○		
			7	SS	11		253				
			8	SS	4		252		○		1 6 60 33
			9	SS	4		251				
							250				
							249		○		

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-39 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
248.0 / 10.2	**CLAY** (CL) Firm Brown to Grey Wet						248				
	Sandy **SILT** Very Loose to Compact Grey Wet (TILL)		10	SS	3		247		○		
			11	SS	4		246		○		
			12	SS	7		245		○		
			13	SS	5		244		○		1 49 41 9
			14	SS	9		243		○		
			15	SS	13		242		○		
							241				
							240				
							239				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \overset{20}{\oplus} 5$ $\overset{}{10}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
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RECORD OF BOREHOLE No HWY400-39 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Sandy **SILT** Compact Grey Wet (TILL)		16	SS	12		238		○		
							237				
							236				
			17	SS	14		235		○		
233.5							234				
24.7	Sandy **SILTY CLAY** (CL-ML) Stiff to Very Stiff Grey Wet (TILL)						233				
			18	SS	12		232		⊕		1 45 42 12
							231				
							230				
			19	SS	21		229		○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No HWY400-39 4 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

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) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
227.4	Sandy **SILTY CLAY** (CL-ML) Stiff to Very Stiff Grey Wet (TILL)						228				
30.8	**CLAY** (CL) to **CLAY** (CI) Hard Grey Wet						227				
			20	SS	67		226		○		
							225				
							224				
			21	SS	81		223		○		
							222				
							221				
			22	SS	63		220		⊢○⊣		0 7 55 38
							219				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No HWY400-39 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) to **CLAY** (CI) Hard Grey Wet						218				
			23	SS	57		217		○		
							216				
							215				
			24	SS	48		214		○		
							213				
							212				
			25	SS	37		211		⊢●		0 0 51 49
							210				
							209				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-39 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 20 40 60		GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) to **CLAY** (CI) Very Stiff to Hard Grey Wet						208				
			26	SS	29				○		
							207				
							206				
							205				
			27	SS	35				○—|		0 0 51 49
							204				
							203				
							202				
			28	SS	24				○		
							201				
200.0											
58.2	**CLAY** (CH) Hard Grey Wet						200				
							199				
			29	SS	41				|—●		1 6 30 63

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No HWY400-39 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 366.4 E 293 983.1 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.08.12 - 2024.08.20 LATITUDE 44.117212 LONGITUDE -79.635143 CHECKED BY JA

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) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
198.2	Continued From Previous Page										
60.0	End of sampling and start of DCPT						198				
							197				
196.1											
62.1	END OF DCPT AT 62.1m UPON REFUSAL. BOREHOLE ELEVATION AND COORDINATES ARE APPROXIMATE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m SAND FROM 0.6m TO 0.3m,THEN CONCRETE TO GROUND SURFACE.										Drilling mud added to borehole during drilling, therefore water level was not established upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 1 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
256.2	GROUND SURFACE										
0.0	**TOPSOIL,** occasional rootlets Loose Dark Brown Moist		1	SS	6		256				
255.5											
0.7	**CLAY** (CL) Firm to Very Stiff Brown Moist		2	SS	6		255				
			3	SS	12						0 6 54 40
			4	SS	26		254				
			5	SS	17		253				Mud rotary and tricone used from 3.0m to 60.0m.
			6	SS	6		252				
			7	SS	5		251				0 3 56 41
			8	SS	10		250				
247.5							249				
8.7	Silty **SAND** Loose Grey Moist (TILL)		9	SS	9		248				
							247				

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+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No HWY400-42 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **SAND** Loose to Compact Grey Wet (TILL)						246				
			10	SS	6		245		○		
							244				
			11	SS	10				○		
242.9							243				
13.3	Sandy **SILT** Compact Grey Wet (TILL)										
			12	SS	13		242		○		3 39 41 17
241.4											
14.8	Silty **SAND** Very Loose to Compact Grey Wet (TILL)						241		○		
			13	SS	18						
							240				
			14	SS	8		239		○		
			15	SS	1		238		○		
							237				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page											
	Silty **SAND** Very Loose to Compact Grey Wet (TILL)		16	SS	WH		236 235			○		
234.6 21.6	**CLAY** (Cl) Very Stiff to Hard Grey Moist to Wet		17	SS	60		234 233			○		1 9 39 51
			18	SS	100/ 0.100		232 231 230			○		
			19	SS	112		229 228			○ ○		
			20	SS	98		227			○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 4 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

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 (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Very Stiff to Hard Grey Wet						226				
			21	SS	68				○		
							225				
							224				
							223				
			22	SS	60				⊢○⊣		0 0 45 55
							222				
							221				
							220				
			23	SS	63				○		
							219				
							218				
							217				
			24	SS	34				○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\overset{20}{15\oplus 5}$ $\underset{10}{}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Very Stiff to Hard Grey Wet						216 215 214				
			25	SS	24		213		○		
							212 211				
			26	SS	30		210		⊢○⊣		0 0 36 64
							209 208				
			27	SS	34		207		○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Very Stiff Grey Wet						206				
							205				
			28	SS	29		204		○		
							203				
							202				
			29	SS	26		201		⊖		0 0 46 54
							200				
							199				
			30	SS	27		198		○		
197.7											
58.5	End of sampling and start of DCPT						197				
196.4								197			
59.8	END OF DCPT AT 60.0m UPON										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-42 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 417.6 E 294 025.9 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.22 - 2024.10.23 LATITUDE 44.117673 LONGITUDE -79.634610 CHECKED BY RR/JA

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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	REFUSAL. BOREHOLE BACKFILLED WITH CEMENT BENTONITE GROUT MIXTURE TO GROUND SURFACE. A MONITORING WELL WAS INSTALLED ADJACENT TO BOREHOLE HWY400-42. Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2024.11.01 1.0 255.2 2024.11.08 1.0 255.2 2025.04.09 0.4 255.8 2025.05.30 0.4 255.8 2025.09.09 2.5 253.7 2025.11.26 1.2 255.0										Drilling mud added to borehole during drilling, therefore water level was not established upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 1 OF 7 METRIC

W.P. | LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 | ORIGINATED BY AB

DIST Central HWY 400 | BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary | COMPILED BY JW

DATUM Geodetic | DATE 2024.10.02 - 2024.10.04 | LATITUDE 44.117961 | LONGITUDE -79.634443 | CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
256.9	GROUND SURFACE									
0.0	**TOPSOIL:** (250mm)		1	SS	10					
0.2	**CLAY** (CL) Stiff Brown to Grey Moist		2	SS	8		256			0 2 59 39
			3	SS	10		255			
			4	SS	13		254			
			5	SS	13					Mud rotary and tricone used from 3.0m to 60.5m. 0 6 51 43
252.8							253			
4.1	Silty **SAND** Very Loose to Compact Grey Wet (TILL)		6	SS	9		252			
			7	SS	7		251			
			8	SS	2		250			
			9	SS	4		249			8 53 31 8 Non-plastic
							248			
							247			

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 2 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

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 (20 40 60 80 100)	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Very Loose to Compact Grey Wet (TILL)										
			10	SS	5		246		○		
							245				
			11	SS	11				○		
							244				
			12	SS	20		243		○		
242.1											
14.8	**SILTY CLAY** with Sand (CL-ML) Hard Grey Wet (TILL)		13	SS	39		242		⊢●		0 28 54 18
240.6							241				
16.3	Silty **SAND** Loose to Compact Grey Wet (TILL)		14	SS	4		240		○		
							239				
			15	SS	17				○		
237.5							238				
19.4	**CLAY** with Sand (CL) Hard Brown Wet						237				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 3 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY with Sand (CL) Hard Grey Wet		16	SS	41		236		○		0 16 32 52
			17	SS	75		235				
			18	SS	54		234				
230.7							233				
26.2	Silty **SAND** Very Dense Grey Moist						232				
229.2			19	SS	71		231				0 64 27 9 Non-plastic
27.7	**CLAY** (CL) Hard Grey Moist						230				
							229				
							228				
							227				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 4 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Hard Grey Wet										
			20	SS	56		226				
							225				
							224				
			21	SS	61		223				0 1 43 56
							222				
							221				
			22	SS	54		220				
							219				
							218				
			23	SS	18		217				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 5 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Very Stiff to Hard Grey Wet						216 215				
			24	SS	27		214				0 1 39 60
							213 212				
			25	SS	28		211 210				
							209 208				
			26	SS	31		207				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 6 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Very Stiff to Hard Grey Wet						206 205 204 203 202 201 200 199 198 197				
			27	SS	28				○		
			28	SS	26				○		
			29	SS	30						
198.4											
58.5	End of sampling and start of DCPT										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-44 7 OF 7 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 449.6 E 294 039.3 ORIGINATED BY AB

DIST Central HWY 400 BOREHOLE TYPE Hollow Stem Auger/ Mud Rotary COMPILED BY JW

DATUM Geodetic DATE 2024.10.02 - 2024.10.04 LATITUDE 44.117961 LONGITUDE -79.634443 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%) (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
196.4	Continued From Previous Page										
60.5	END OF DCPT AT 60.5m UPON REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CEMENT/GROUT MIXTURE TO GROUND SURFACE. A MONITORING WELL WAS INSTALLED ADJACENT TO BOREHOLE HWY400-44(MW). Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										Drilling mud added to borehole during drilling, therefore water level was not established upon completion of drilling.

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2024.11.01	1.4	255.5
2024.11.07	1.4	255.5
2025.04.09	0.7	256.2
2025.05.30	0.8	256.1
2025.09.09	DRY	-
2025.11.26	DRY	-

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)

WATER CONTENT (%): 20 40 60

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 1 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
257.9	GROUND SURFACE										
0.0	**CLAY** (CI), containing topsoil Brown Moist		1	RUN			257				0 5 51 44 **RUN #1** REC=98%
255.6							256				
2.3	Silty **SAND** Brown to Grey Moist (TILL)		2	RUN			255				**RUN #2** REC=100% 4 49 30 17 Non-Plastic
							254				
							253				
			3	RUN			252				**RUN #3** REC=17%
							251				
							250				
							249				
			4	RUN			248				**RUN #4** REC=0%

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+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 2 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Brown to Grey Moist (TILL)						247				
							246				
			5	RUN							**RUN #5** REC=15%
							245				
243.9											
14.0	Sandy Silty **CLAY** (CL-ML) Grey Moist (TILL)						244		○		
							243				
			6	RUN					e		**RUN #6** REC=46% 3 47 30 20
							242				
							241		○		
							240				
			7	RUN							**RUN #7** REC=0%
							239				
							238		○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 3 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Sandy Silty **CLAY** (CL-ML) Grey Moist (TILL)										
237.0	Possible cobble between depths of 20.7m and 20.9m						237				6 43 33 18
20.9	Sandy **SILT** Grey Moist (TILL)		8	RUN							**RUN #8** REC=35%
							236				
							235				
233.9											0 32 51 17
24.0	**CLAY** (CI) Grey Moist						234				Non-Plastic
			9	RUN							**RUN #9** REC=100%
							233				
							232				
							231				
			10	RUN							**RUN #10** REC=100%
							230				0 2 42 56
							229				
							228				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 4 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Grey Moist		11	RUN			227				**RUN #11** REC=100% 0 0 30 70
							226				
			12	RUN			225				0 0 42 58
223.8							224				**RUN #12** REC=100%
34.1	Silty **CLAY** (CL-ML) Grey Moist										0 0 78 22
222.8							223				
35.1	**CLAY** (CL) to **CLAY** (CI) Very Stiff Grey Moist						222				
			13	RUN			221				**RUN #13** REC=100%
							220				
							219				
			14	RUN			218				**RUN #14** REC=100%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 5 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) to **CLAY** (CI) Very Stiff Grey Moist						217 216 215 214 213 212 211 210 209 208				0 0 55 45
			15	RUN							**RUN #15** REC=100%
			16	RUN							0 0 43 57 **RUN #16** REC=100%
			17	RUN							**RUN #17** REC=100%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 6 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	CLAY (CL) to **CLAY** (CI) Very Stiff Grey Moist						207				
			18	RUN			206				RUN #18 REC=100%
							205				
							204				0 0 38 62
			19	RUN			203				RUN #19 REC=96%
							202				
			1	SS	19		201				0 0 35 65
							200				
			20	RUN			199				RUN #20 REC=100%
							198				

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+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 7 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) to **CLAY** (CI) Very Stiff Grey Moist		2	SS	22						
			21	RUN			197				
196.1							196				**RUN #21** REC=92%
61.8	**SILT** with Sand to **SILT** Very Dense Grey Wet (TILL)		3	SS	100/ 0.275		195				0 13 81 6 0 16 71 13
193.6							194				
64.3	Silty **CLAY** with Sand (CL-ML) to **CLAY** with Sand (CL) Hard Grey Moist (TILL)		22	RUN			193				**RUN #22** REC=100%
			3A*	SS	47		192				0 0 54 46
			23	RUN			191				**RUN #23** REC=83%
							190				
			3B*	SS	71		189				
							188				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 8 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY** with Sand (CL-ML) to **CLAY** with Sand (CL) Hard Grey Moist (TILL)		24	RUN			187				**RUN #24** REC=100% 2 18 39 41
	Cobble at a depth of 71.9m		3C*	SS	79		186				6 20 42 32
	Cobble at a depth of 72.0m		25	RUN			185				**RUN #25** REC=61%
			3D*	SS	100/ 0.175		184				
			26	RUN			183				**RUN #26** REC=90% 2 15 59 24
			4	SS	100/ 0.100		182				0 2 75 23
			27	RUN			181				**RUN #27** REC=100%
							180				
							179				
							178				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 9 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **CLAY** with Sand (CL-ML) to **CLAY** with Sand (CL) Hard Grey Moist (TILL)						177				
176.6			5	SS	100/ 0.075						0 15 45 40
81.3	**SILT** Very Dense Grey Moist (TILL)						176				
			28	RUN			175				**RUN #28** REC=100% 0 2 78 20
							174				
			6	SS	100/ 0.125						0 6 75 19
							173				
			29	RUN			172				**RUN #29** REC=100%
							171				
			7	SS	100/ 0.150						0 7 79 14 Non-Plastic
169.5							170				
88.4	**CLAY** with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)										
			30	RUN			169				**RUN #30** REC=100%
							168				0 9 66 25

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$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 10 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	CLAY with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		8	SS	100/ 0.125		167				
			31	RUN			166				RUN #31 REC=100%
			9	SS	100/ 0.125		165				
			32	RUN			164				RUN #32 REC=100% 4 20 44 32
			10	SS	100/ 0.100		163				
			33	RUN			162				RUN #33 REC=100% 0 10 55 35
			11	SS	185/ 0.225		161				
							160				
							159				
							158				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 11 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		34	RUN			157				RUN #34 REC=100%
							156				
			12	SS	100/ 0.125						0 4 57 39
154.0							155				
103.9	Silty **SAND** Very Dense Grey Wet		35	RUN			154				RUN #35 REC=100%
							153				0 74 19 7
152.1			13	SS	170/ 0.300						
105.8	**CLAY** (CL) Hard Grey Moist (TILL)		36	RUN			152				
							151				RUN #36 REC=100%
							150				0 8 64 28
			14	SS	100/ 0.100						
							149				
							148				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 12 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	CLAY (CL) Hard Grey Moist (TILL)		37	RUN			147				RUN #37 REC=66%
							146				
			38	RUN			145				RUN #38 REC=100%
							144				
			15	SS	100/ 0.100		143				
			39	RUN			142				RUN #39 REC=100%
							141				
			16	SS	100/ 0.0		140				
			40	RUN			139				RUN #40 REC=100%
138.1 119.8							138				

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+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 13 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
136.9	**LIMESTONE,** highly to moderately weathered, thinly bedded, with embedded sandy clay till seams: (LINDSAY FORMATION)		17	SS	100/ 0.0		137	○		FI	
121.0	**LIMESTONE,** slightly weathered to fresh, thinly bedded, grey, strong, SHALE interbeds and clay seams: (LINDSAY FORMATION)		1	RUN				○		1	**RUN #1** TCR=69% SCR=50% RQD=50%
	Horizontal fractures at depths of 122.3m, 122.5m, 122.6m and 122.8m		2	RUN			136			1 2 0 1	**RUN #2** TCR=91% SCR=66% RQD=75% UCS=57.7MPa
	Broken core from depths of 122.9m to 123.3m						135			3 9 6 1	
	Horizontal fractures at a depths of 123.7m, 124.2m, 124.4m and 124.5m		3	RUN			134			0 1 2	**RUN #3** TCR=82% SCR=79% RQD=64% UCS=98.5MPa
	Broken core from depths of 124.9m to 125.2m						133			>10 9	
	Horizontal fractures at a depths of 125.7m and 126.2m		4	RUN			132			0 1 0	**RUN #4** TCR=92% SCR=55% RQD=68% UCS=72.1MPa
	Fresh									1	
	Horizontal fractures at a depths of 126.8m and 127.0m		5	RUN			131			0 2 0 0	**RUN #5** TCR=100% SCR=100% RQD=100% UCS=95.1MPa
	Horizontal fractures at a depth of 128.5m		6	RUN			130			0 0 0 1	**RUN #6** TCR=100% SCR=100% RQD=100%
	Horizontal fracture at a depth of 129.8m						129			0 0 0 0	
	Continued Next Page						128				

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No HWY400-BR02 14 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	LIMESTONE, slightly weathered to fresh, thinly bedded, grey, strong, SHALE interbeds and clay seams: (LINDSAY FORMATION)		7	RUN						1 0 0	**RUN #7** TCR=100% SCR=100% RQD=98% UCS=82.0MPa
127											
	Horizontal fractures at a depth of 131.5m		8	RUN						0 1 0	**RUN #8** TCR=100% SCR=100% RQD=100%
126											
125			9	RUN						0 0 0	**RUN #9** TCR=98% SCR=95% RQD=90% UCS=74.4MPa
124											
123			10	RUN						1 0 0	**RUN #10** TCR=100% SCR=100% RQD=100%
122	Horizontal fractures at a depth of 134.8m		11	RUN						0 0 0	**RUN #11** TCR=100% SCR=100% RQD=97% UCS=92.8MPa
121											
	Horizontal fractures at a depth of 136.7m		12	RUN						1 0 0	**RUN #12** TCR=100% SCR=100% RQD=93%
120											
119			13	RUN						0 1 0	**RUN #13** TCR=100% SCR=100% RQD=97%
118										0	

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02 15 OF 15 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp / S-E Ramp: N 4 886 489.6 E 294 041.2 ORIGINATED BY AB/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2025.06.09 - 2025.06.21 LATITUDE 44.118322 LONGITUDE -79.634420 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	LIMESTONE, slightly weathered to fresh, thinly bedded, grey, strong, SHALE interbeds and clay seams: (LINDSAY FORMATION)		14	RUN			117			0 0 0 0 0	**RUN #14** TCR=100% SCR=100% RQD=100%
116.2											
141.7	END OF BOREHOLE AT 141.7m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2025.07.03	25.5	232.4
2025.07.15	25.7	232.2
2025.09.10	26.1	231.8
2025.11.26	26.2	231.7

Note:

* Split spoon from Borehole HWY400-BR02A transposed onto borehole log.

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 1 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

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 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
258.0	GROUND SURFACE										
0.0	Borehole advanced using sonic drilling methods to 75.3m. Refer to Borehole HWY400-BR02 for soil stratigraphy.					▼	257 256 255 254 253 252 251 250 249				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 2 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						247 246 245 244 243 242 241 240 239				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 3 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						237 236 235 234 233 232 231 230 229				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 4 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						227 226 225 224 223 222 221 220 219				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 5 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page						217 216 215 214 213 212 211 210 209				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 6 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						207 206 205 204 203 202 201 200 199				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 7 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

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 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						197				
							196				
							195				
							194				
							193				
			1	SS	47		192				
							191				
							190				
			2	SS	71		189				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR02A 8 OF 8 METRIC

W.P. _____ LOCATION Highway 400 N-E Ramp: N 4 886 494.4 E 294 048.8 ORIGINATED BY KF

DIST Central HWY 400 BOREHOLE TYPE Sonic COMPILED BY AN

DATUM Geodetic DATE 2025.06.26 - 2025.06.26 LATITUDE 44.118365 LONGITUDE -79.634325 CHECKED BY RR/JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						187				
							186				
			3	SS	79						
							185				
							184				
182.7			4	SS	100/ 0.175		183				
75.3	END OF BOREHOLE AT 75.3m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2025.07.04	1.4	256.6
2025.07.15	1.6	256.4
2025.09.10	2.1	255.9
2025.11.26	1.2	256.8

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 1 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
256.5	GROUND SURFACE										
0.0	**TOPSOIL**: (150mm)										
0.1	**CLAY** (CL) Brown to Grey Moist to Wet		1	RUN			256				**RUN #1** REC=76% 0 1 65 34
							255				
			2	RUN			254				**RUN #2** REC=100%
							253				
							252				
251.6											
4.9	Silty **SAND** Grey Moist (TILL)		3	RUN			251				**RUN #3** REC=73%
							250				
							249				
			4	RUN			248				4 49 32 15
							247				**RUN #4** REC=92%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 2 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Grey Moist (TILL)						246		○		
							245		○		
244.6											
11.9	Sandy Silty **CLAY** (CL-ML) Grey Moist (TILL)		5	RUN			244		⊕		**RUN #5** REC=100% 5 45 31 19
243.5											
13.0	Sandy **SILT** Grey Moist (TILL)						243		○		
							242		○		
			6	RUN			241		⊕		**RUN #6** REC=95% 3 47 34 16
240.3											
16.2	Silty **SAND** Grey Moist (TILL)						240		○		
							239		○		
			7	RUN			238		⊕		**RUN #7** REC=75% 7 49 31 13
							237				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 3 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Grey Moist (TILL)		8	RUN			236		○		
							235		○		**RUN #8** REC=100%
							234		+		6 52 28 14
			9	RUN			233				
							232				**RUN #9** REC=0%
							231				
							230				
			10	RUN			229				**RUN #10** REC=0%
227.2							228				
29.3	Sandy **CLAY** (CL) Grey Moist (TILL)						227				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 4 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Sandy **CLAY** (CL) Grey Moist (TILL)		11	RUN			226				**RUN #11** REC=0%
							225				
							224		○		
			12	RUN			223				**RUN #12** REC=45%
221.8							222		○		
34.7	Sandy **CLAY** (CL) Grey Moist (TILL)						221		⊢●		3 44 30 23
			13	RUN			220		○		**RUN #13** REC=100%
218.1							219		○		
38.4	**CLAY** (CL) Grey Moist						218		○		
			14	RUN			217		○		**RUN #14** REC=100%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 5 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CL) Grey Moist						216				0 10 48 42
							215				
							214				
			15	RUN							RUN #15 REC=100%
213.1							213				
43.4	Sandy **CLAY** (CL) Grey Moist										0 43 31 26
212.0							212				
44.5	**CLAY** (CI) Grey Moist										
			16	RUN			211				RUN #16 REC=100%
							210				0 0 42 58
							209				
							208				
			17	RUN							RUN #17 REC=100%
							207				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 6 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY (CI) Grey Moist						206				0 0 23 77
			18	RUN			205				**RUN #18** REC=100%
							204				
							203				0 0 30 70
			19	RUN			202				**RUN #19** REC=100%
							201				
							200				0 0 26 74
	Very Stiff		1	SS	26		199				
			20	RUN			198				**RUN #20** REC=88%
							197				0 0 41 59
	Continued Next Page										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 7 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
195.8	**CLAY** (CI) Hard Grey Moist		2	SS	107		196				
60.7 194.2	**SILT** Grey Moist		21	RUN			195				**RUN #21** REC=100% 0 14 73 13
62.3	**CLAY** (CL) Hard Grey Moist		3	SS	36		194				
189.4			22	RUN			193				**RUN #22** REC=100% 0 0 57 43
67.1 188.5	Sandy **SILT** Grey Moist (TILL)		4	SS	45		192				
68.0 187.6	Sandy **CLAY** (CL) Grey Moist (TILL)		23	RUN			191				**RUN #23** REC=100% 0 31 61 8
68.9 187.0	Silty **SAND** with Gravel Very Dense Grey Moist		5	SS	102/ 0.175		190				2 38 35 25
69.5	Sandy **CLAY** (CL) Hard Grey						189				33 53 14 (SI+CL)
							188				
							187				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 8 OF 15 METRIC

W.P. | LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 | ORIGINATED BY AK/KF/NC

DIST Central HWY 400 | BOREHOLE TYPE Sonic, HQ Coring | COMPILED BY AN/JW

DATUM Geodetic | DATE 2025.07.05 - 2025.07.13 | LATITUDE 44.116776 | LONGITUDE -79.635659 | CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Sandy **CLAY** (CL) Hard Grey Moist (TILL)		24	RUN			186				**RUN #24** REC=100%
							185				0 39 34 27
			6	SS	102/ 0.150						
184.0							184				
72.5	Silty **SAND** with Gravel Grey Moist										**RUN #25** REC=100%
183.3							183				
73.2	Sandy **SILT** Very Dense Grey Moist (TILL)		25	RUN			182				
			7	SS	100/ 0.075		181				**RUN #26** REC=100%
			26	RUN			180				0 40 42 18
178.5							179				
78.0	**SILT** Very Dense Grey Moist (TILL)		8	SS	100/ 0.150		178				**RUN #27** REC=100%
			27	RUN			177				0 2 80 18

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 9 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
175.4	**SILT** Very Dense Grey Moist (TILL)						176				
81.1	Silty **CLAY** (CL-ML) Hard Grey Moist (TILL)		9	SS	144		175				
172.4			28	RUN			174				RUN #28 REC=100% 0 11 62 27
84.1	**SILT** Very Dense Grey Moist (TILL)		10	SS	100/ 0.150		173				
			29	RUN			172				RUN #29 REC=100% 0 22 70 8
			11	SS	100/ 0.075		171				
168.4							170				
88.1	**CLAY** with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		30	RUN			169				
							168				0 10 61 29 RUN #30 REC=100%
							167				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 10 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	CLAY with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		12	SS	100/ 0.150		166				
			31	RUN			165				RUN #31 REC=100%
							164				1 17 49 33
			13	SS	100/ 0.100		163				
			32	RUN			162				RUN #32 REC=100%
							161				
			14	SS	88		160				0 3 60 37
			33	RUN			159				RUN #33 REC=100%
							158				
			15	SS	100/ 0.100		157				2 15 52 31

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-48856.GPJ 1-19-26

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 11 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
154.1	**CLAY** with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		34	RUN			156 155				**RUN #34** REC=100%
152.3	**SILT** with Sand Very Dense Grey Moist (TILL)		16	SS	100/ 0.075		154 153				0 30 57 13 **RUN #35** REC=100%
104.2	**CLAY** with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		17	SS	100/ 0.075		152 151				**RUN #36** REC=100% 1 10 61 28
			36	RUN			150 149				
			18	SS	113/ 0.150		148				
			37	RUN			147				**RUN #37** REC=100%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 12 OF 15 METRIC

W.P. | LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 | ORIGINATED BY AK/KF/NC

DIST Central HWY 400 | BOREHOLE TYPE Sonic, HQ Coring | COMPILED BY AN/JW

DATUM Geodetic | DATE 2025.07.05 - 2025.07.13 | LATITUDE 44.116776 | LONGITUDE -79.635659 | CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	CLAY with Sand (CL) to **CLAY** (CL) Hard Grey Moist (TILL)		38	RUN			146				**RUN #38** REC=100%
							145				
			19	SS	100/ 0.200						0 31 46 23
			39	RUN			144				**RUN #39** REC=100%
			40	RUN			143				**RUN #40** REC=100% 0 2 67 31
			20	SS	100/ 0.250		142				
			41	RUN			141				**RUN #41** REC=100%
139.3			42	RUN			140				**RUN #42** REC=100%
117.2	**LIMESTONE,** moderately to slightly weathered, thinly bedded with embedded sandy silty clay till seams: (LINDSAY FORMATION)		21	SS	100/ 0.225		139				
137.9							138			FI	
118.6	**LIMESTONE,** slightly weathered to fresh, thinly bedded, grey, medium strong to strong, SHALE interbeds and clay seams: (LINDSAY FORMATION) Sub-vertical fractures from depths of 118.6m to 118.6m, 119.8m to 119.8m and 119.7m to 119.9m		1	RUN			137			2 1 0 2 3	**RUN #1** TCR=100% SCR=88% RQD=90% UCS=49.5MPa

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 13 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	LIMESTONE, slightly weathered to fresh, thinly bedded, grey, medium strong to strong, SHALE interbeds and clay seams: (LINDSAY FORMATION)		2	RUN			136			2 1 1 1	**RUN #2** TCR=97% SCR=95% RQD=95%
	Horizontal fractures at depths of 118.7m, 119.1m, 119.5m, 119.6m and 119.9m										
	Horizontal fractures at depths of 120.2m, 120.5m, 120.9m and 121.1m						135			0 0 0	
	Horizontal fractures at depths of 122.4m, 122.8m and 122.9m		3	RUN			134			1 0 2	**RUN #3** TCR=98% SCR=95% RQD=95% UCS=70.2MPa
	Horizontal fractures at depths of 123.9m, 124.0m and 124.3m		4	RUN			133			0 2 1	**RUN #4** TCR=97% SCR=97% RQD=97%
	Horizontal fractures at depths of 125.3m, 125.7m, 125.9m, 126.0m and 126.1m Vertical fracture (25mm) at depth of 125.6m		5	RUN			132 131			0 0 0 1 3 2	**RUN #5** TCR=98% SCR=97% RQD=97% UCS=77.2MPa
	Horizontal fractures at depths of 126.6m, 126.8m and 127.3m		6	RUN			130			0 1 1	**RUN #6** TCR=95% SCR=93% RQD=93%
	Horizontal fractures at depths of 128.2m, 128.3m, 128.5m and 129.2m		7	RUN			129 128			0 2 1 0 0 1	**RUN #7** TCR=100% SCR=100% RQD=100% UCS=100.0MPa
							127			0	**RUN #8** TCR=98% SCR=98% RQD=98%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 14 OF 15 METRIC

W.P. | LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 | ORIGINATED BY AK/KF/NC

DIST Central | HWY 400 | BOREHOLE TYPE Sonic, HQ Coring | COMPILED BY AN/JW

DATUM Geodetic | DATE 2025.07.05 - 2025.07.13 | LATITUDE 44.116776 | LONGITUDE -79.635659 | CHECKED BY RR/JA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	LIMESTONE, slightly weathered to fresh, thinly bedded, grey, medium strong to strong, SHALE interbeds and clay seams: (LINDSAY FORMATION)		8	RUN			126			1 1 1	
	Horizontal fractures at depths of 129.8m, 130.2m and 130.7m Horizontal fractures at depths of 130.9m, 131.4m, 131.6m and 131.7m		9	RUN			125			1 0 2 1 1	**RUN #9** TCR=100% SCR=100% RQD=100% UCS=56.9MPa
	Horizontal fractures at depths of 132.8m and 133.6m		10	RUN			124 123			0 1 0 0	**RUN #10** TCR=97% SCR=97% RQD=97%
	Horizontal fracture at depth of 134.7m		11	RUN			122			0 1 0 0	**RUN #11** TCR=100% SCR=99% RQD=99% UCS=65.9MPa
	Horizontal fractures at depths of 135.8m and 136.8m		12	RUN			121 120			0 1 0 0	**RUN #12** TCR=95% SCR=95% RQD=95%
	Horizontal fractures at depths of 137.0m, 138.0m and 138.4m		13	RUN			119			1 1 0 1 0 1	**RUN #13** TCR=100% SCR=100% RQD=100% UCS=73.4MPa
118.1											
138.4	END OF BOREHOLE AT 138.4m. Well installation consists of two 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. **SHALLOW WELL:** WATER LEVEL READINGS DATE / DEPTH(m) / ELEV.(m) 2025.07.15 / 1.1 / 255.4 2025.09.10 / 2.2 / 254.3 2025.11.25 / 0.1 / 256.4										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HWY400-BR03 15 OF 15 METRIC

W.P. _____ LOCATION Highway 400 E-S Ramp: N 4 886 318.0 E 293 941.8 ORIGINATED BY AK/KF/NC

DIST Central HWY 400 BOREHOLE TYPE Sonic, HQ Coring COMPILED BY AN/JW

DATUM Geodetic DATE 2025.07.05 - 2025.07.13 LATITUDE 44.116776 LONGITUDE -79.635659 CHECKED BY RR/JA

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 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	DEEP WELL: WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2025.07.15 12.3 244.2 2025.09.10 24.8 231.7 2025.11.25 24.9 231.6										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR02

TOP **BOTTOM**

Run 1 – Elev. 136.9 m to 136.2 m



Run 2 – Elev. 136.2 m to 134.5 m



Run 3 – Elev. 134.5 m to 133.1 m



Run 4 – Elev. 133.1 m to 131.5 m



Run 5 – Elev. 131.5 m to 130.0 m



THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR02

TOP **BOTTOM**

Run 6 – Elev. 130.0 m to 128.5 m



Run 7 – Elev. 128.5 m to 127.0 m



Run 8 – Elev. 127.0 m to 125.5 m



Run 9 – Elev. 125.5 m to 123.9 m



Run 10 – Elev. 123.9 m to 122.4 m



THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR02

TOP **BOTTOM**

Run 11 – Elev. 122.4 m to 120.9 m



Run 12 – Elev. 120.9 m to 119.4 m



Run 13 – Elev. 119.4 m to 117.8 m



Run 14 – Elev. 117.8 m to 116.2 m



THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR03

TOP **BOTTOM**

Run 1 – Elev. 137.9 m to 136.4 m



Run 2 – Elev. 136.4 m to 134.9 m



Run 3 – Elev. 134.9 m to 133.4 m



Run 4 – Elev. 133.4 m to 131.8 m



Run 5 – Elev. 131.8 m to 130.3 m



THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR03

TOP **BOTTOM**

Run 6 – Elev. 130.3 m to 128.8 m



Run 7 – Elev. 128.8 m to 127.3 m



Run 8 – Elev. 127.3 m to 125.7 m



Run 9 – Elev. 125.7 m to 124.2 m



Run 10 – Elev. 124.2 m to 122.7 m



THURBER

ROCK CORE PHOTOGRAPHS – Borehole HWY400-BR03

TOP **BOTTOM**

Run 11 – Elev. 122.7 m to 121.2 m



Run 12 – Elev. 121.2 m to 119.6 m



Run 13 – Elev. 119.6 m to 118.1 m



THURBER

APPENDIX D

Seismic Cone Penetration Tests (SCPTu)

Seismic Cone Penetration Test
HF-07

CONETEC

Job No:	25-05-29237
Client:	Thurber Engineering Ltd.
Project:	Bradford Bypass
Start Date:	2025-03-25
End Date:	2025-03-31

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm^2)	Assumed Phreatic Surface[1] (m)	Final Depth (m)	Northing[2] (m)	Easting[2] (m)	Refer to Notation Number
SCPT25-HF01	25-05-29237_SP01	2025-03-25	948:T1000F10U35	15	2.1	20.600	4885865	609489	
SCPT25-HF07	25-05-29237_SP07	2025-03-25	948:T1000F10U35	15	0.2	23.300	4885920	609280	
SCPT25-HF08	25-05-29237_SP08	2025-03-31	765:T1500F15U35	15	1.4	17.425	4885664	609176	3
SCPT25-HF19	25-05-29237_SP19	2025-03-26	948:T1000F10U35	15	0.1	14.675	4886597	609121	
SCPT25-HF21	25-05-29237_SP21	2025-03-26	948:T1000F10U35	15	0.4	9.900	4886702	609081	
SCPT25-HWY400-01	25-05-29237_SPHWY400-01	2025-03-27	948:T1000F10U35	15	1.3	12.725	4886562	608981	
SCPT25-HWY400-14	25-05-29237_SPHWY400-14	2025-03-28	948:T1000F10U35	15	2.8	19.250	4886521	609045	
SCPT25-HWY400-16	25-05-29237_SPHWY400-16	2025-03-27	948:T1000F10U35	15	2.4	18.050	4886530	609093	
SCPT25-HWY400-21	25-05-29237_SPHWY400-21	2025-03-26	948:T1000F10U35	15	1.1	22.575	4886558	609141	
SCPT25-HWY400-34	25-05-29237_SPHWY400-34	2025-03-28	948:T1000F10U35	15		2.850	4886072	609084	4, 5
SCPT25-HWY400-34B	25-05-29237_SPHWY400-34B	2025-03-28	765:T1500F15U35	15		2.925	4886079	609081	4, 5

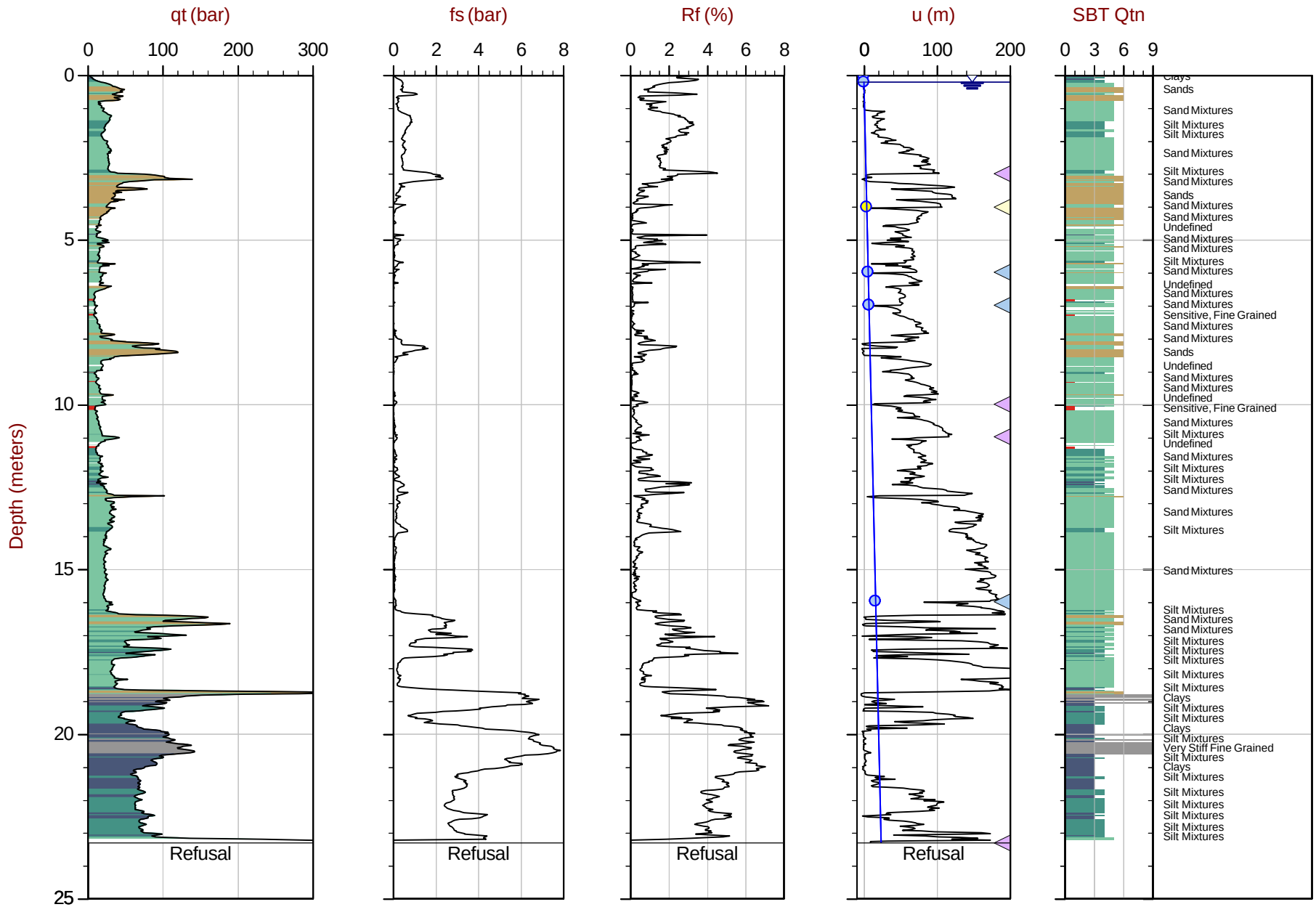
1. The assumed phreatic surface was based on pore pressure dissipation tests, unless otherwise noted. Hydrostatic conditions were assumed for the calculated parameters.
2. Coordinates were collected with a consumer grade GPS device in datum WGS84/UTM Zone 17 North .
3. The assumed phreatic surface was based on the dynamic pore pressure response.
4. No clear phreatic surface detected due to shallow refusal.
5. No seismic data reported due to shallow refusal.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Max Depth: 23.300 m / 76.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885920m E: 609280m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

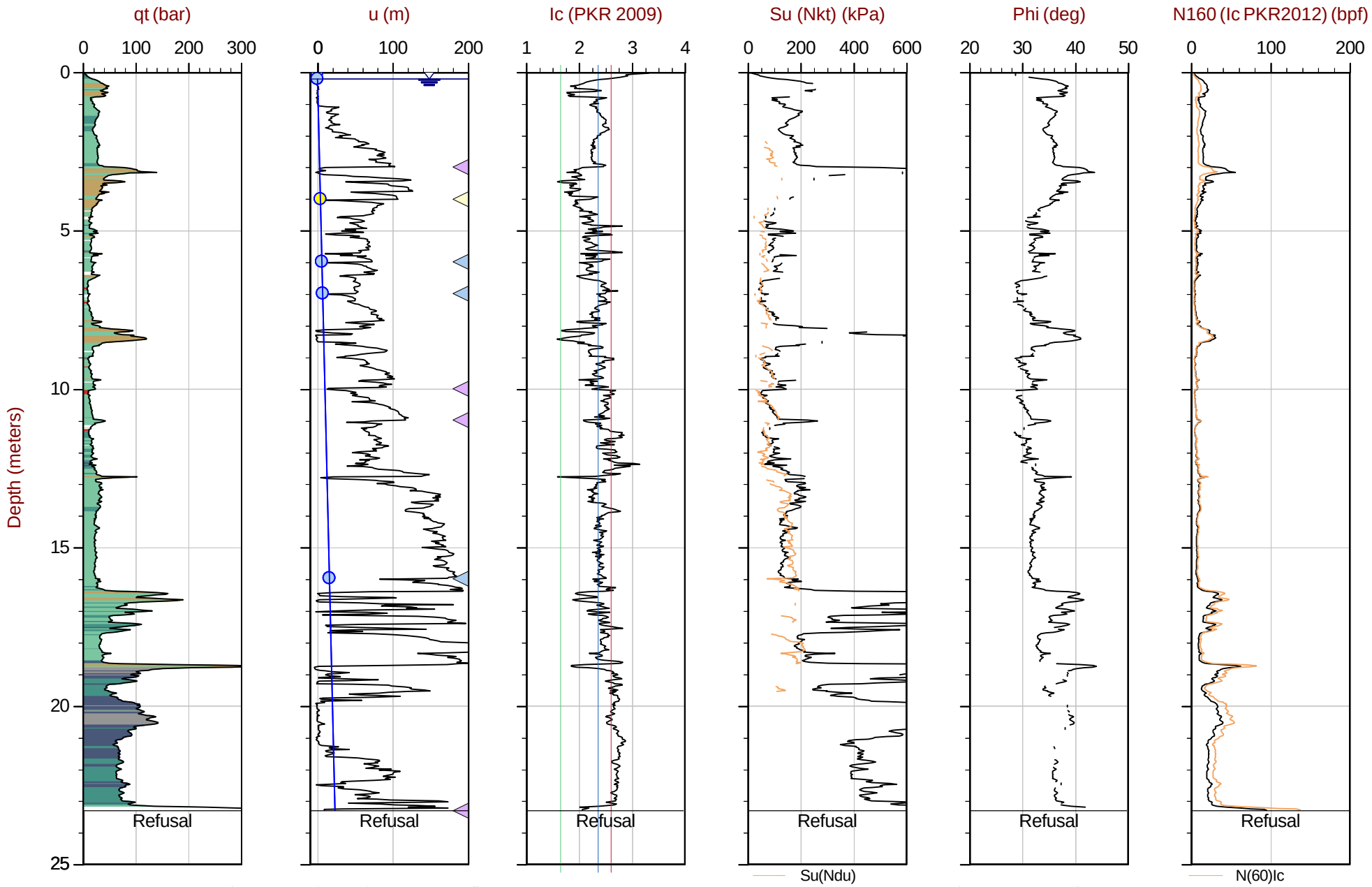
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Max Depth: 23.300 m / 76.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP07.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885920m E: 609280m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

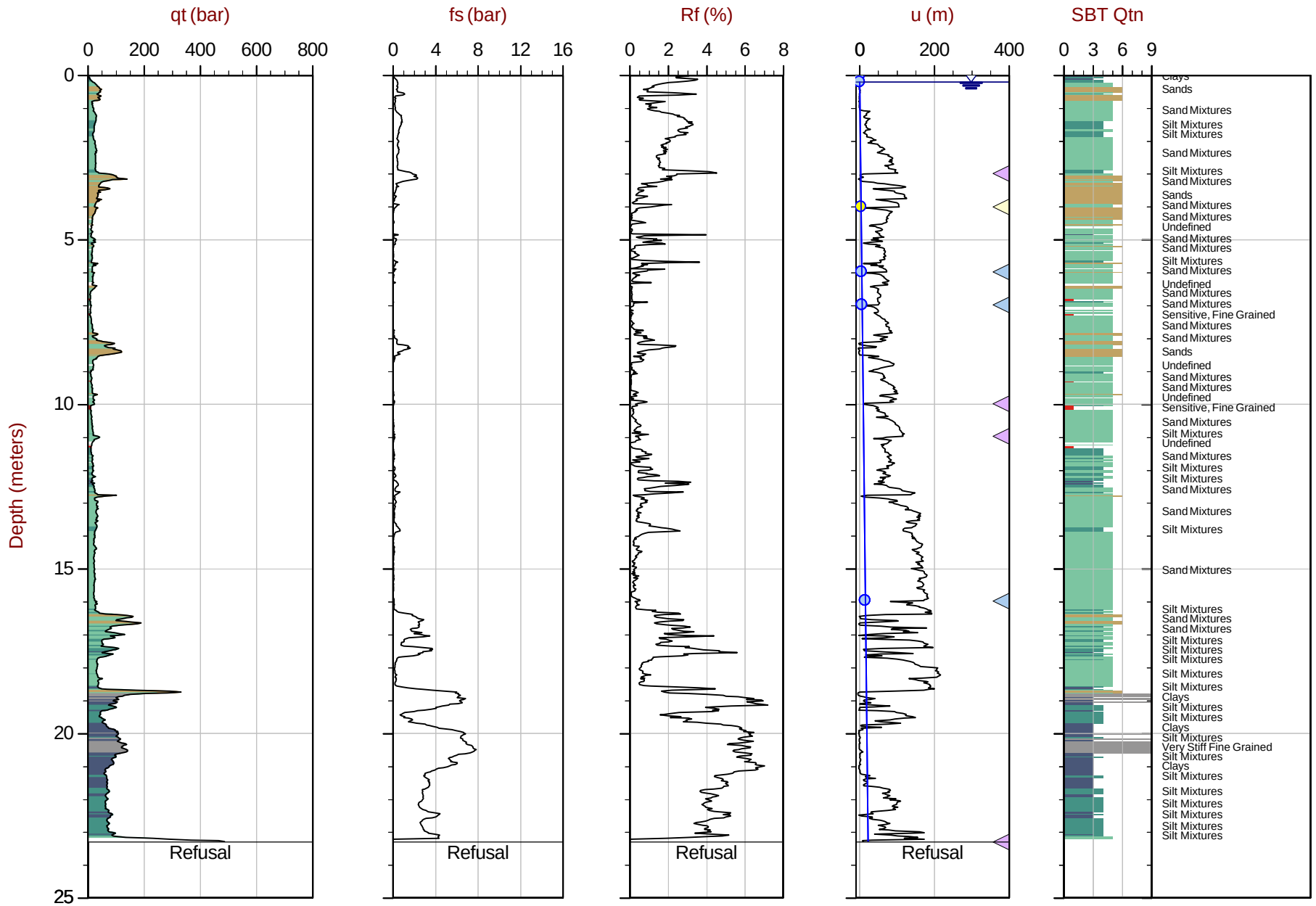
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Max Depth: 23.300 m / 76.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885920m E: 609280m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

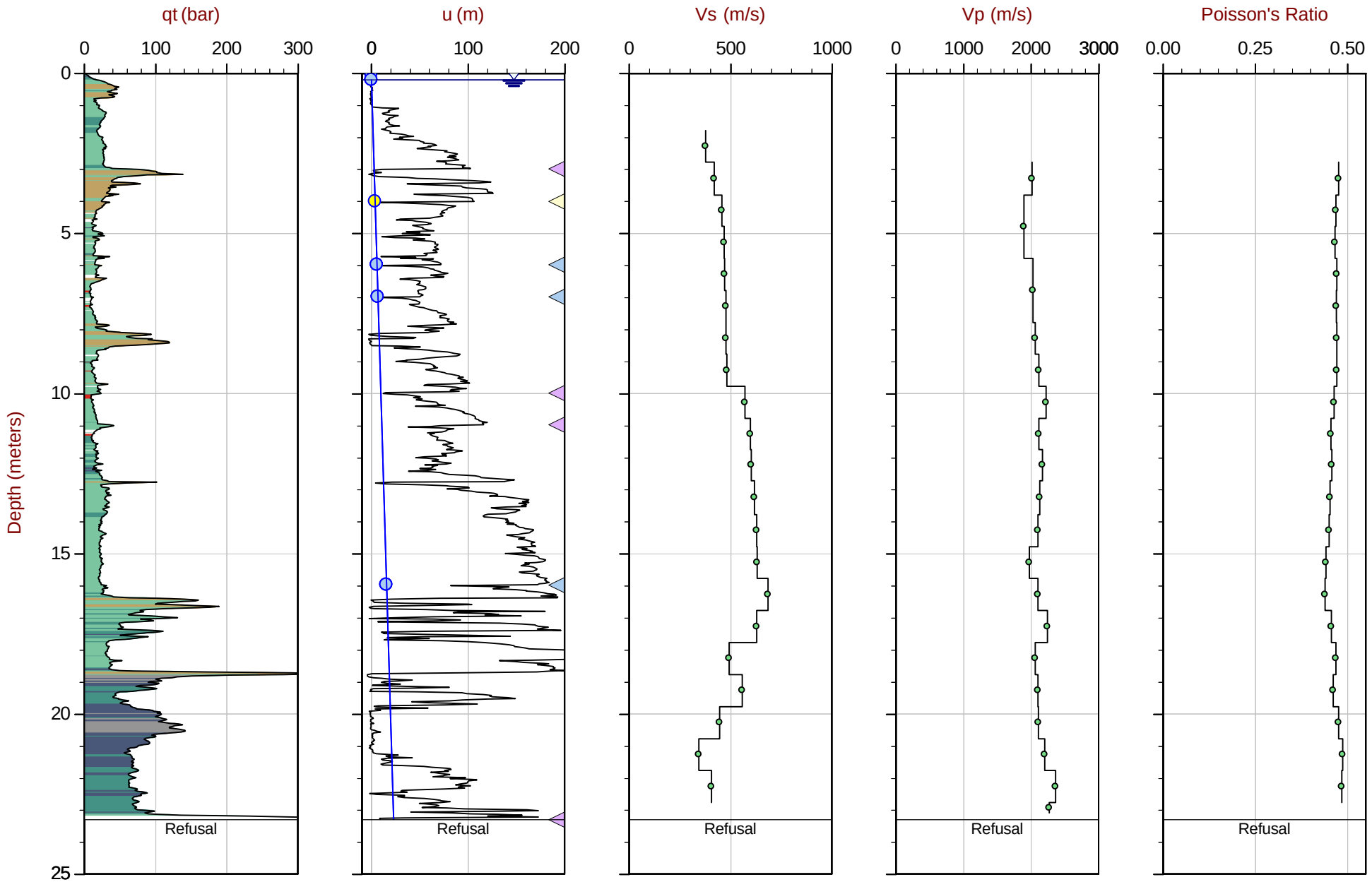
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Max Depth: 23.300 m / 76.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885920m E: 609280m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

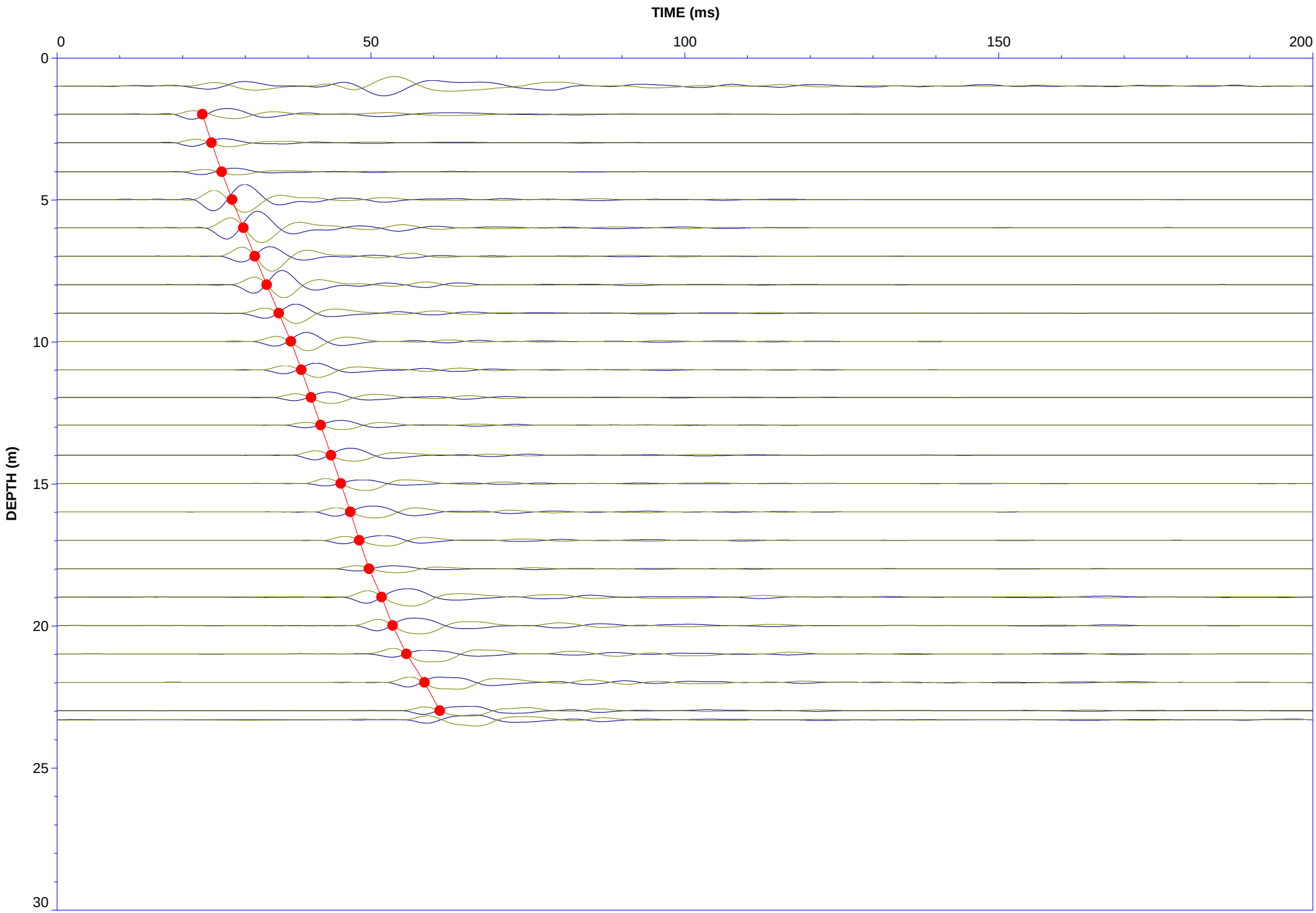
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF07
Date:	2025-03-25
Seismic Source:	Beam
Source Offset (m):	3.50
Source Depth (m):	0.00
Sensor Type:	Geophone
Sensor Offset (m):	0.20

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (m)	Sensor Depth (m)	Ray Path (m)	Ray Path Difference (m)	Travel Time Interval (ms)	Interval Velocity (m/s)
1.98	1.78	3.93			
2.98	2.78	4.47	0.54	1.43	379
4.00	3.80	5.17	0.70	1.65	421
4.98	4.78	5.92	0.76	1.65	459
5.98	5.78	6.76	0.83	1.77	470
6.98	6.78	7.63	0.87	1.85	471
7.98	7.78	8.53	0.90	1.88	478
8.98	8.78	9.45	0.92	1.92	479
9.98	9.78	10.39	0.94	1.93	484
10.98	10.78	11.33	0.95	1.65	573
11.95	11.75	12.26	0.93	1.54	600
12.92	12.72	13.19	0.93	1.54	605
13.98	13.78	14.22	1.03	1.65	620
14.98	14.78	15.19	0.97	1.54	630
15.98	15.78	16.16	0.97	1.54	632
16.98	16.78	17.14	0.98	1.42	687
17.98	17.78	18.12	0.98	1.55	631
18.98	18.78	19.10	0.98	1.98	495
19.98	19.78	20.09	0.98	1.76	558
20.98	20.78	21.07	0.99	2.21	447
21.98	21.78	22.06	0.99	2.86	344
22.98	22.78	23.05	0.99	2.43	408

Job No: 25-05-29237 Client: Thurber Engineering Project: Bradford Bypass Sounding: SCPT25-HF07 Filter: 0-200Hz Date: 2025-03-25
Analysis: S Wave - Geo X

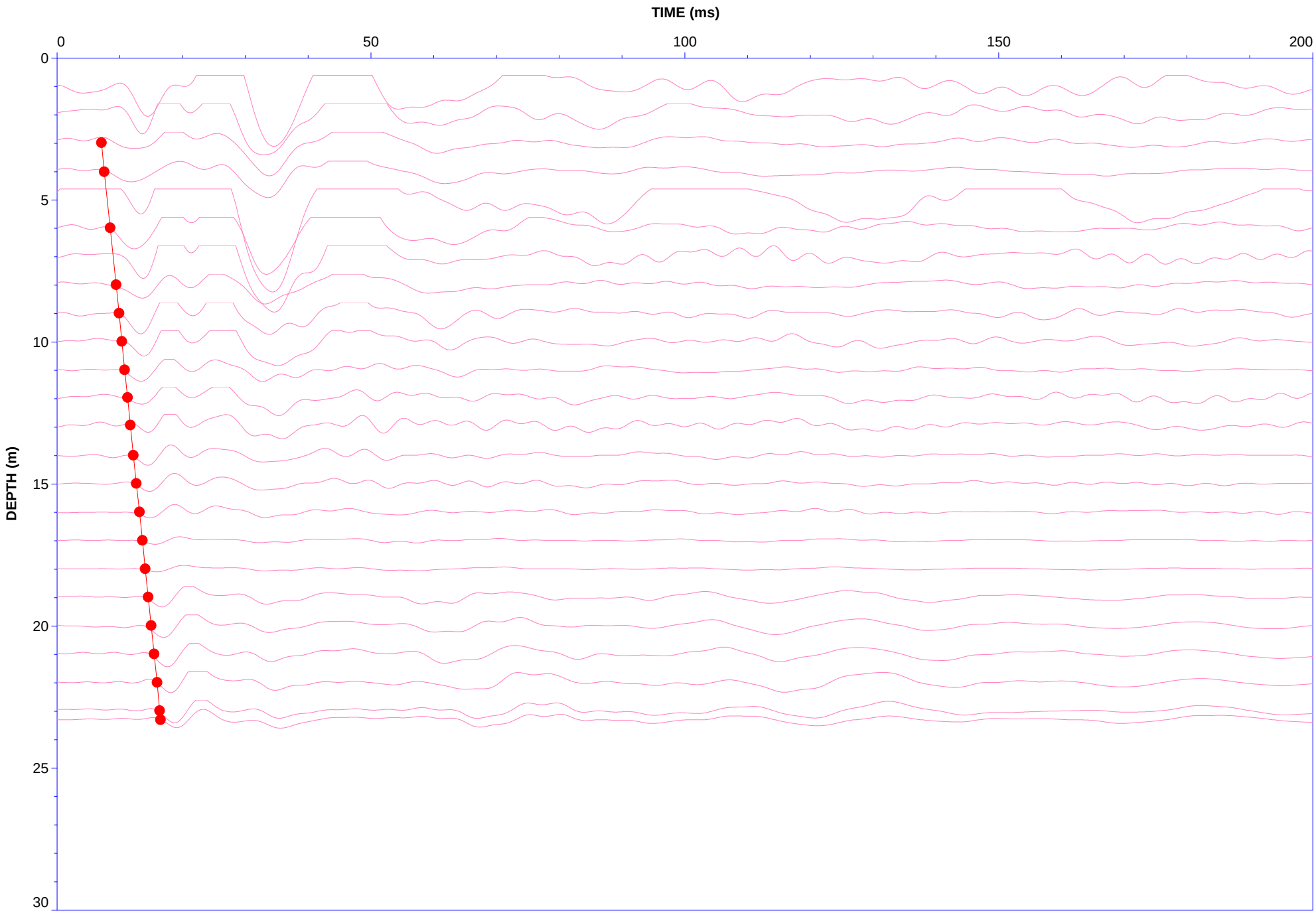


Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF07
Date:	2025-03-25
Seismic Source:	Plate
Source Offset (m):	2.00
Source Depth (m):	0.00
Sensor Type:	Geophone
Sensor Offset (m):	0.20

SCPTu COMPRESSION WAVE VELOCITY TEST RESULTS - Vp

Tip Depth (m)	Sensor Depth (m)	Ray Path (m)	Ray Path Difference (m)	Travel Time Interval (ms)	Interval Velocity (m/s)
2.98	2.78	3.42			
4.00	3.80	4.29	0.87	0.43	2019
5.98	5.78	6.12	1.82	0.96	1896
7.98	7.78	8.03	1.92	0.94	2033
8.98	8.78	9.01	0.97	0.47	2063
9.98	9.78	9.98	0.98	0.46	2118
10.98	10.78	10.96	0.98	0.44	2225
11.95	11.75	11.92	0.96	0.45	2116
12.92	12.72	12.88	0.96	0.44	2170
13.98	13.78	13.92	1.05	0.49	2132
14.98	14.78	14.92	0.99	0.47	2104
15.98	15.78	15.91	0.99	0.50	1976
16.98	16.78	16.90	0.99	0.47	2105
17.98	17.78	17.89	0.99	0.44	2250
18.98	18.78	18.89	0.99	0.48	2067
19.98	19.78	19.88	1.00	0.47	2109
20.98	20.78	20.88	1.00	0.47	2112
21.98	21.78	21.87	1.00	0.45	2206
22.98	22.78	22.87	1.00	0.42	2365
23.30	23.10	23.19	0.32	0.14	2273

Job No: 25-05-29237 Client: Thurber Engineering Project: Bradford Bypass Sounding: SCPT25-HF07 Filter: BP 0-200Hz Date: 2025-03-25
Analysis: P Wave - Geo Z



Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF07
Date:	2025-03-25

SCPTu POISSON'S RATIO RESULTS

Depth From (m)	Depth To (m)	Vs Interval Velocity (m/s)	Vp Interval Velocity (m/s)	Poisson's Ratio
2.78	3.80	421	2019	0.48
3.80	4.78	459	1896	0.47
4.78	5.78	470	1896	0.47
5.78	6.78	471	2033	0.47
6.78	7.78	478	2033	0.47
7.78	8.78	479	2063	0.47
8.78	9.78	484	2118	0.47
9.78	10.78	573	2225	0.47
10.78	11.75	600	2116	0.46
11.75	12.72	605	2170	0.46
12.72	13.78	620	2132	0.45
13.78	14.78	630	2104	0.45
14.78	15.78	632	1976	0.44
15.78	16.78	687	2105	0.44
16.78	17.78	631	2250	0.46
17.78	18.78	495	2067	0.47
18.78	19.78	558	2109	0.46
19.78	20.78	447	2112	0.48
20.78	21.78	344	2206	0.49
21.78	22.78	408	2365	0.49

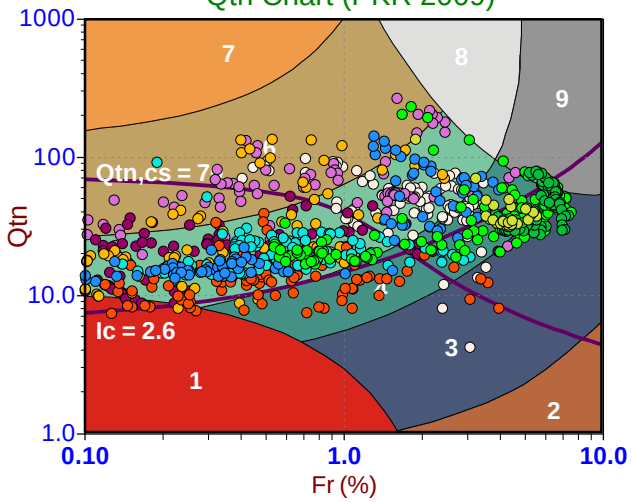
CONETEC

Thurber Engineering

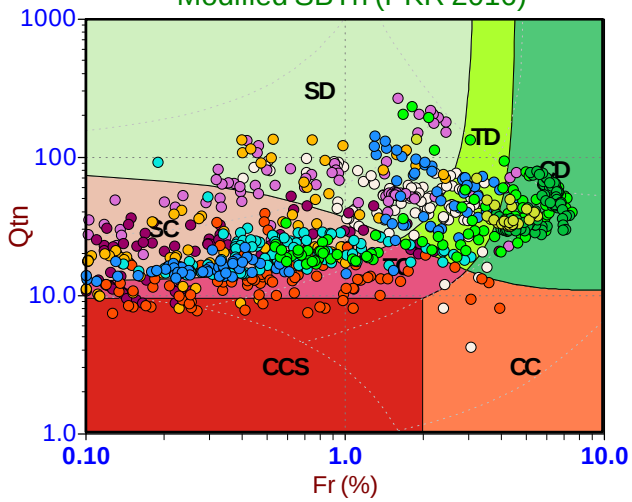
Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²

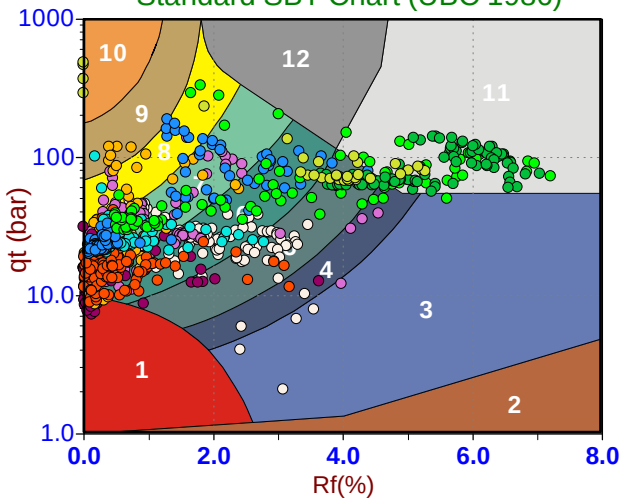
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m
- >20.0 to 22.5 m
- >22.5 to 25.0 m
- >25.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Job No:	25-05-29237
Client:	Thurber Engineering Ltd.
Project:	Bradford Bypass
Start Date:	2025-03-25
End Date:	2025-03-31

CPTu PORE PRESSURE DISSIPATION SUMMARY

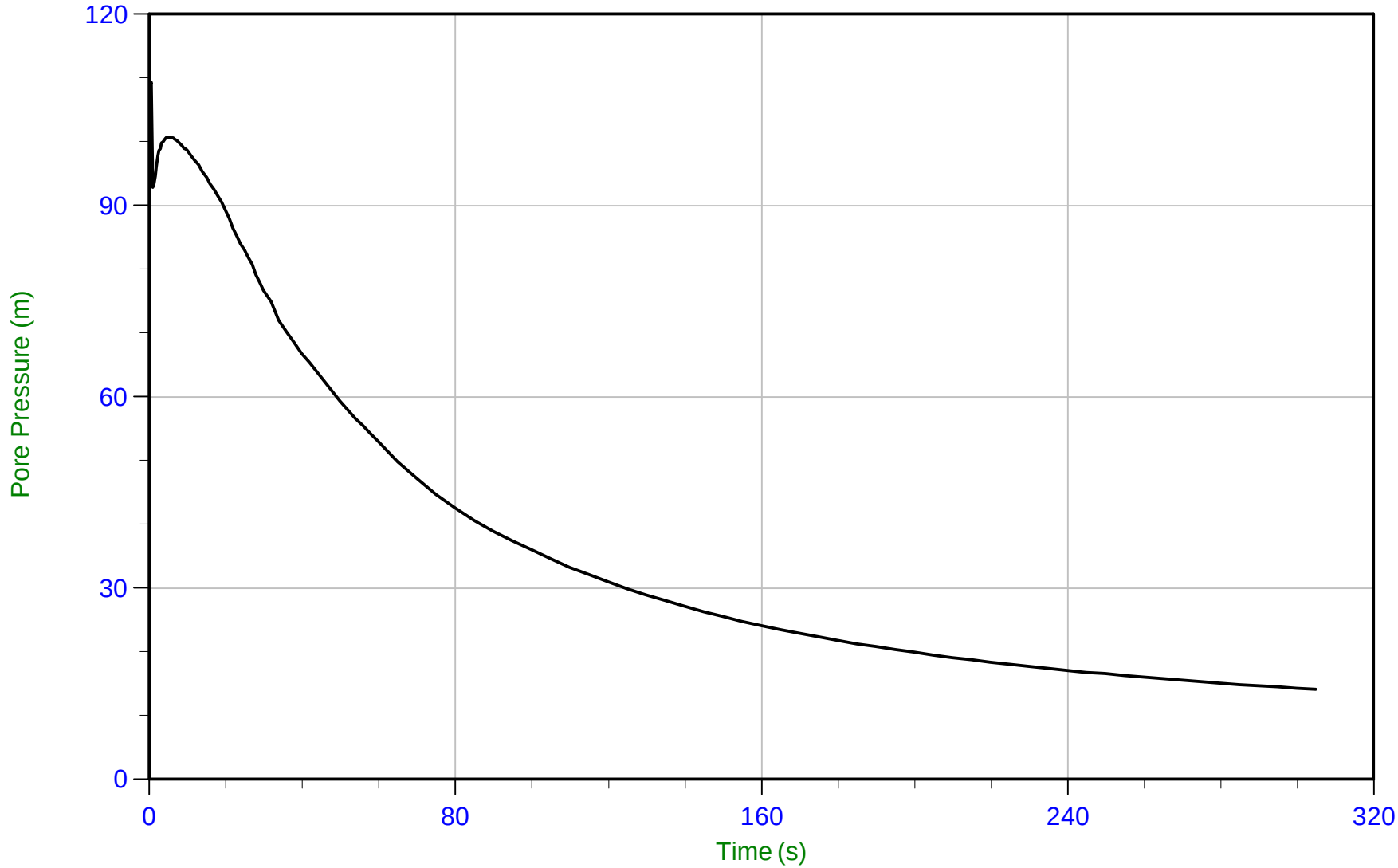
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (m)	Observed Equilibrium Pore Pressure U_{eq} (m)	Estimated Equilibrium Pore Pressure U_{eq} (m)	Assumed Phreatic Surface (m)	t_{50} $(s)_1$	Assumed Rigidity Index (I_r)	c_h $(cm^2/min)_2$	Refer to Notation Number
SCPT25-HF01	25-05-29237_SP01	15	315	4.950							
SCPT25-HF01	25-05-29237_SP01	15	225	20.600	18.5		2.1				
SCPT25-HF07	25-05-29237_SP07	15	305	2.975							
SCPT25-HF07	25-05-29237_SP07	15	1020	4.000	3.8		0.2				
SCPT25-HF07	25-05-29237_SP07	15	300	5.975		5.8	0.2	37.5	100	18.7	3
SCPT25-HF07	25-05-29237_SP07	15	305	6.975		6.8	0.2	37.8	100	18.6	3
SCPT25-HF07	25-05-29237_SP07	15	340	9.975							
SCPT25-HF07	25-05-29237_SP07	15	210	10.975							
SCPT25-HF07	25-05-29237_SP07	15	320	15.975		15.8	0.2	97.8	100	7.2	3
SCPT25-HF07	25-05-29237_SP07	15	220	23.300							
SCPT25-HF08	25-05-29237_SP08	15	220	4.900							
SCPT25-HF08	25-05-29237_SP08	15	3150	5.100		3.7	1.4	891.7	100	0.8	3
SCPT25-HF08	25-05-29237_SP08	15	270	7.900							
SCPT25-HF08	25-05-29237_SP08	15	380	8.900							
SCPT25-HF08	25-05-29237_SP08	15	1060	10.025		8.6	1.4	45.6	100	15.4	3
SCPT25-HF08	25-05-29237_SP08	15	1000	12.900		11.5	1.4	395.7	100	1.8	3
SCPT25-HF08	25-05-29237_SP08	15	630	17.425							
SCPT25-HF19	25-05-29237_SP19	15	385	0.850							
SCPT25-HF19	25-05-29237_SP19	15	300	2.850	2.8		0.1				
SCPT25-HF19	25-05-29237_SP19	15	250	3.850							
SCPT25-HF19	25-05-29237_SP19	15	300	6.825							
SCPT25-HF19	25-05-29237_SP19	15	400	11.850	13.4		-1.6				
SCPT25-HF19	25-05-29237_SP19	15	300	12.850	14.3		-1.5				
SCPT25-HF19	25-05-29237_SP19	15	180	13.850	15.0		-1.2				

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 2.975 m / 9.760 ft
Duration: 305.0 s

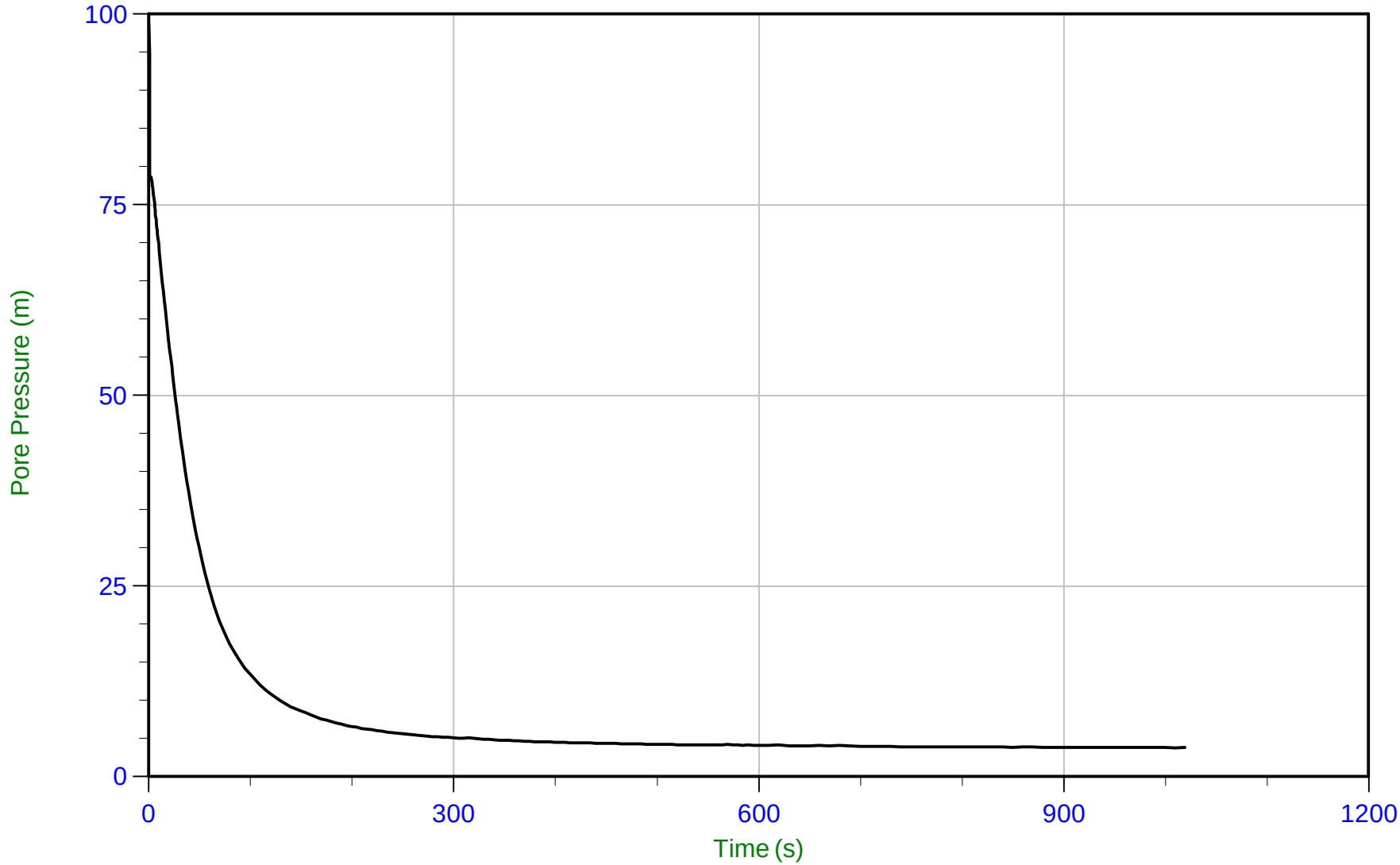
u Min: 14.1 m
u Max: 109.3 m
u Final: 14.1 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 4.000 m / 13.123 ft
Duration: 1020.0 s

u Min: 3.8 m
u Max: 102.7 m
u Final: 3.8 m

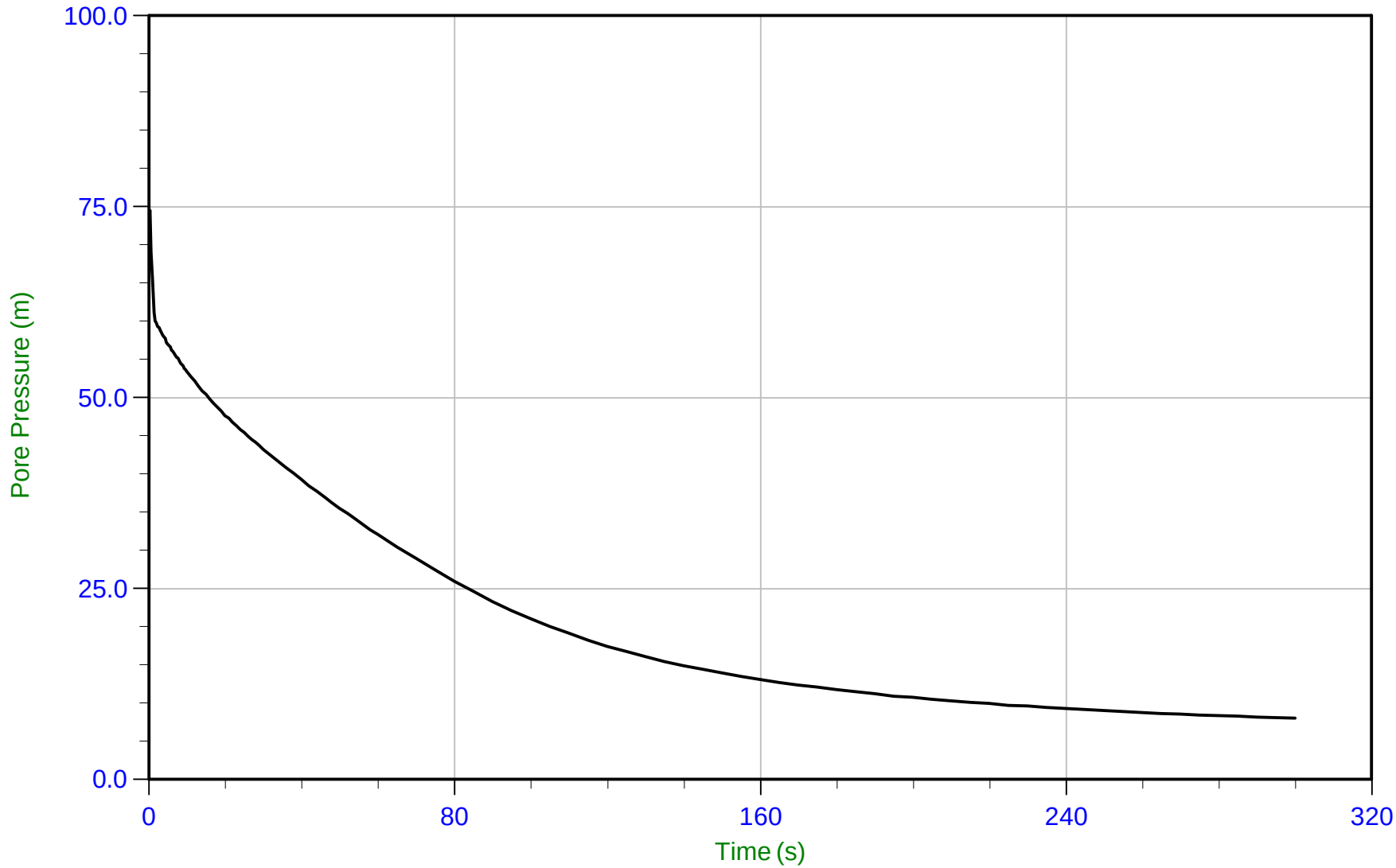
WT: 0.2 m / 0.7 ft
Ueq: 3.8 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 5.975 m / 19.603 ft
Duration: 300.0 s

u Min: 8.0 m
u Max: 74.5 m
u Final: 8.0 m

WT: 0.2 m / 0.7 ft
Ueq: 5.8 m
U(50): 40.13 m

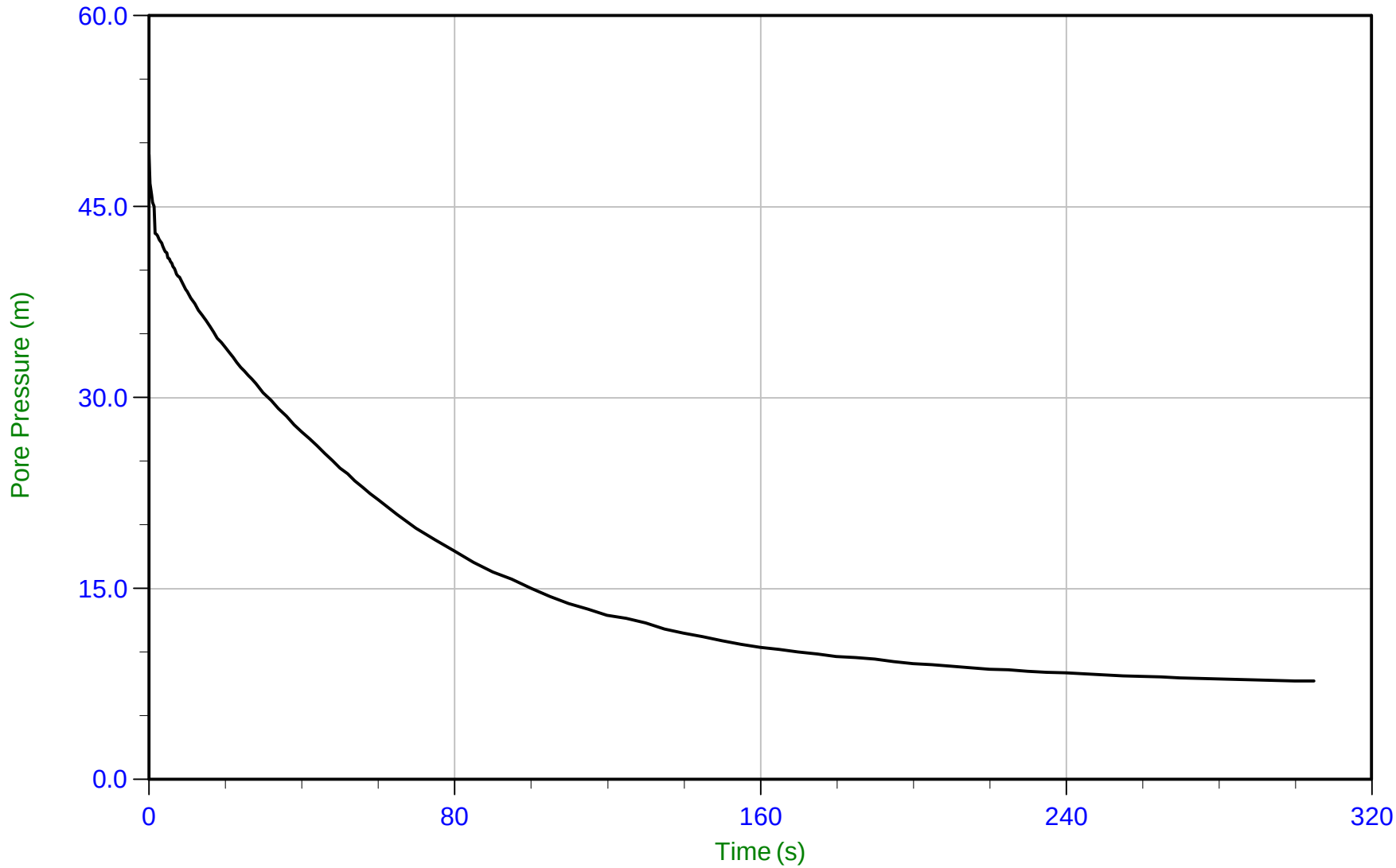
T(50): 37.5 s
Ir: 100
Ch: 18.7 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 6.975 m / 22.884 ft
Duration: 305.0 s

u Min: 7.7 m
u Max: 49.1 m
u Final: 7.7 m

WT: 0.2 m / 0.7 ft
Ueq: 6.8 m
U(50): 27.93 m

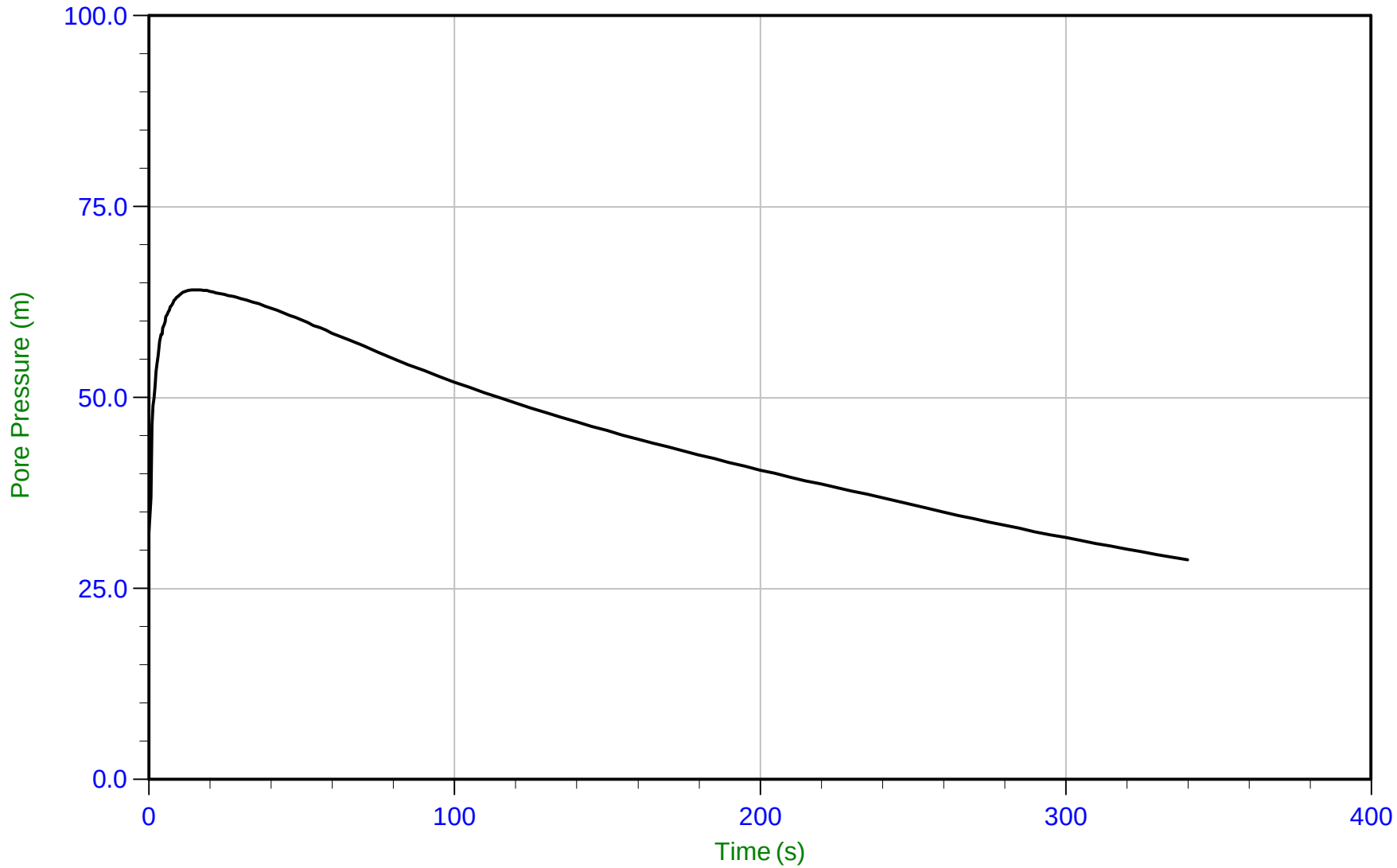
T(50): 37.8 s
Ir: 100
Ch: 18.6 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 9.975 m / 32.726 ft
Duration: 340.0 s

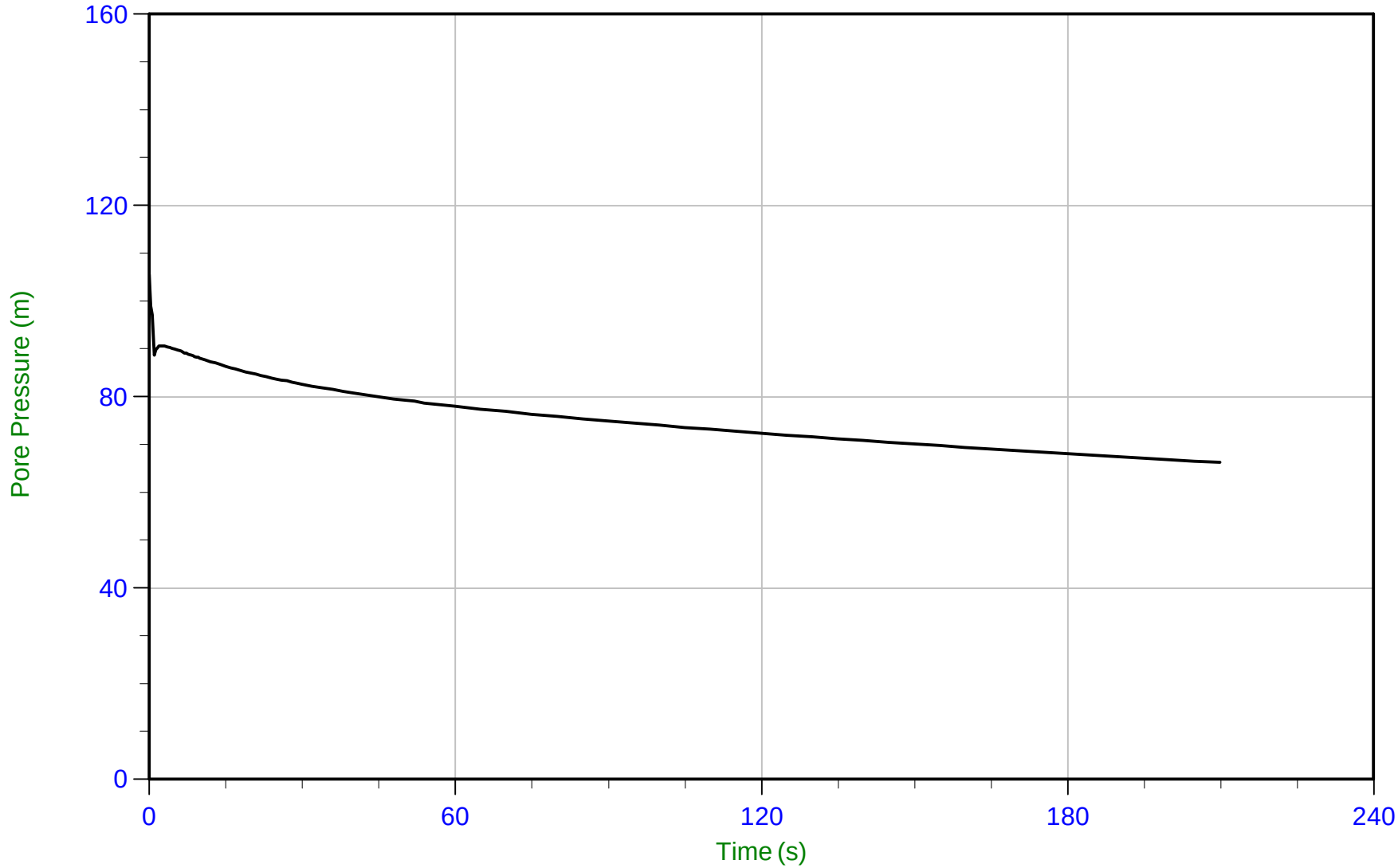
u Min: 28.7 m
u Max: 64.1 m
u Final: 28.7 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 10.975 m / 36.007 ft
Duration: 210.0 s

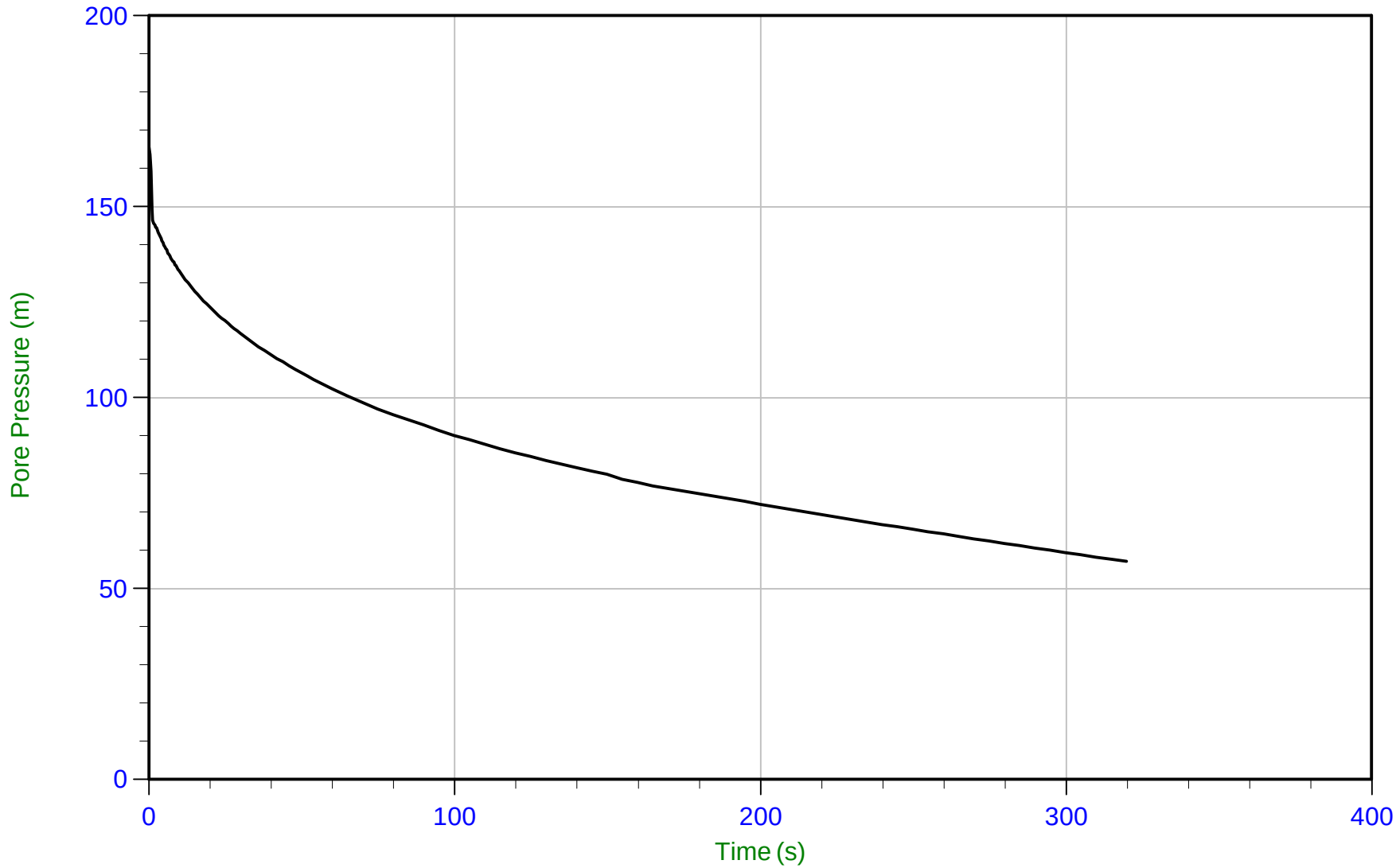
u Min: 66.2 m
u Max: 105.6 m
u Final: 66.2 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 15.975 m / 52.411 ft
Duration: 320.0 s

u Min: 57.1 m
u Max: 165.5 m
u Final: 57.1 m

WT: 0.2 m / 0.7 ft
Ueq: 15.8 m
U(50): 90.65 m

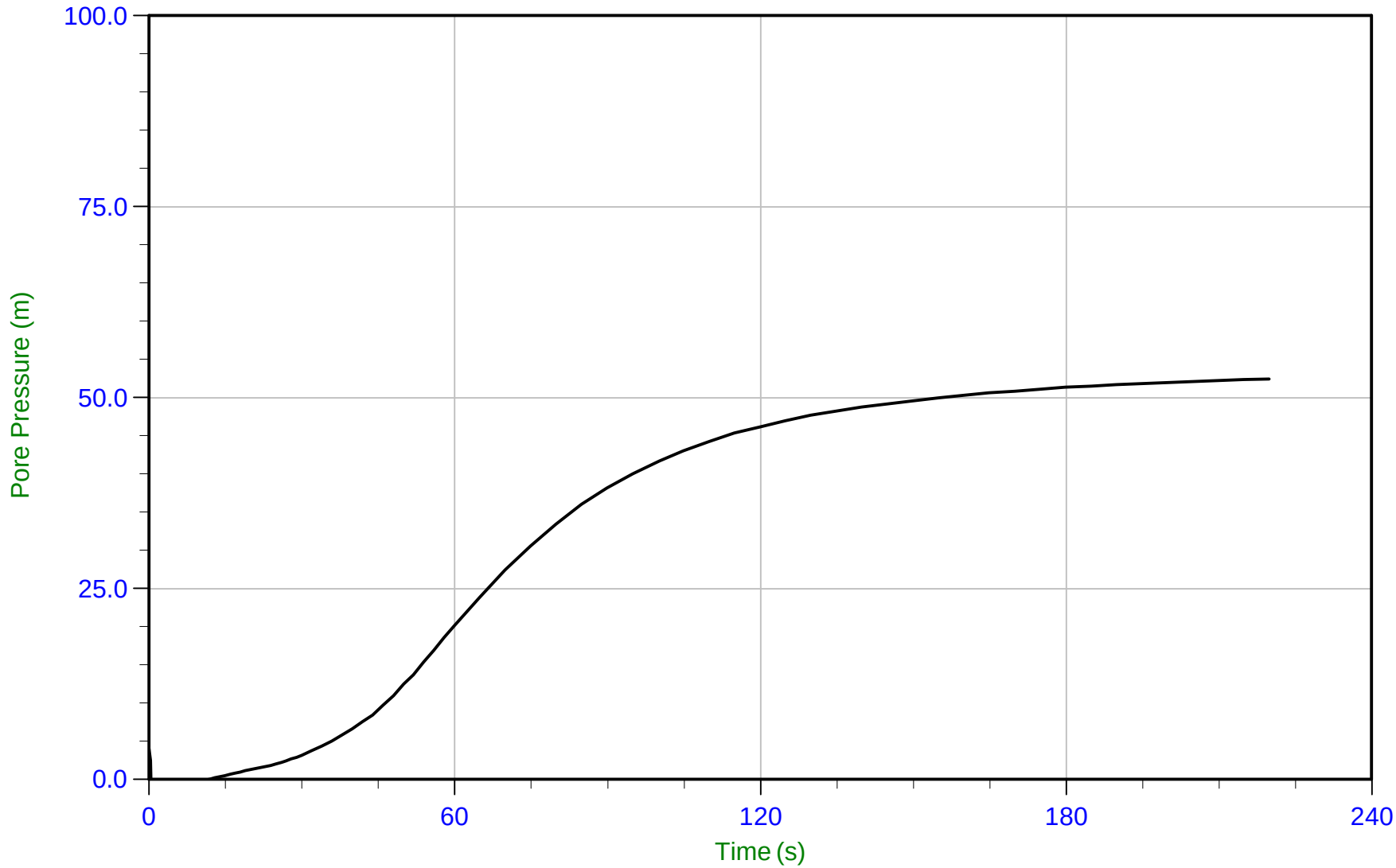
T(50): 97.8 s
Ir: 100
Ch: 7.2 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-25 11:33
Site: Bradford Bypass

Sounding: SCPT25-HF07
Cone: 948:T1000F10U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP07.PPF2
Depth: 23.300 m / 76.443 ft
Duration: 220.0 s

u Min: -8.7 m
u Max: 52.4 m
u Final: 52.4 m

Seismic Cone Penetration Test
HF-08

CONETEC

Job No:	25-05-29237
Client:	Thurber Engineering Ltd.
Project:	Bradford Bypass
Start Date:	2025-03-25
End Date:	2025-03-31

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm^2)	Assumed Phreatic Surface[1] (m)	Final Depth (m)	Northing[2] (m)	Easting[2] (m)	Refer to Notation Number
SCPT25-HF01	25-05-29237_SP01	2025-03-25	948:T1000F10U35	15	2.1	20.600	4885865	609489	
SCPT25-HF07	25-05-29237_SP07	2025-03-25	948:T1000F10U35	15	0.2	23.300	4885920	609280	
SCPT25-HF08	25-05-29237_SP08	2025-03-31	765:T1500F15U35	15	1.4	17.425	4885664	609176	3
SCPT25-HF19	25-05-29237_SP19	2025-03-26	948:T1000F10U35	15	0.1	14.675	4886597	609121	
SCPT25-HF21	25-05-29237_SP21	2025-03-26	948:T1000F10U35	15	0.4	9.900	4886702	609081	
SCPT25-HWY400-01	25-05-29237_SPHWY400-01	2025-03-27	948:T1000F10U35	15	1.3	12.725	4886562	608981	
SCPT25-HWY400-14	25-05-29237_SPHWY400-14	2025-03-28	948:T1000F10U35	15	2.8	19.250	4886521	609045	
SCPT25-HWY400-16	25-05-29237_SPHWY400-16	2025-03-27	948:T1000F10U35	15	2.4	18.050	4886530	609093	
SCPT25-HWY400-21	25-05-29237_SPHWY400-21	2025-03-26	948:T1000F10U35	15	1.1	22.575	4886558	609141	
SCPT25-HWY400-34	25-05-29237_SPHWY400-34	2025-03-28	948:T1000F10U35	15		2.850	4886072	609084	4, 5
SCPT25-HWY400-34B	25-05-29237_SPHWY400-34B	2025-03-28	765:T1500F15U35	15		2.925	4886079	609081	4, 5

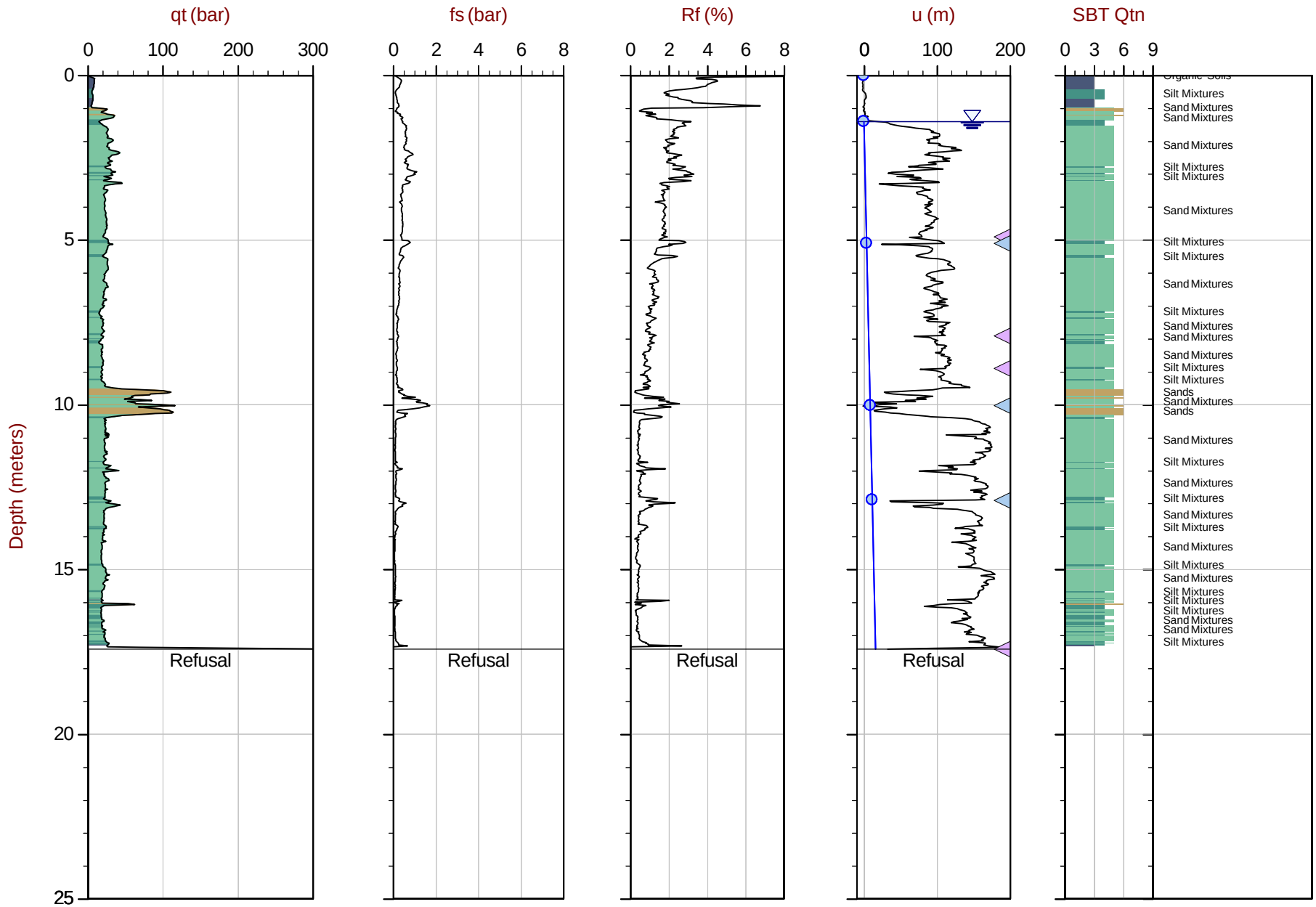
1. The assumed phreatic surface was based on pore pressure dissipation tests, unless otherwise noted. Hydrostatic conditions were assumed for the calculated parameters.
2. Coordinates were collected with a consumer grade GPS device in datum WGS84/UTM Zone 17 North .
3. The assumed phreatic surface was based on the dynamic pore pressure response.
4. No clear phreatic surface detected due to shallow refusal.
5. No seismic data reported due to shallow refusal.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885664m E: 609176m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

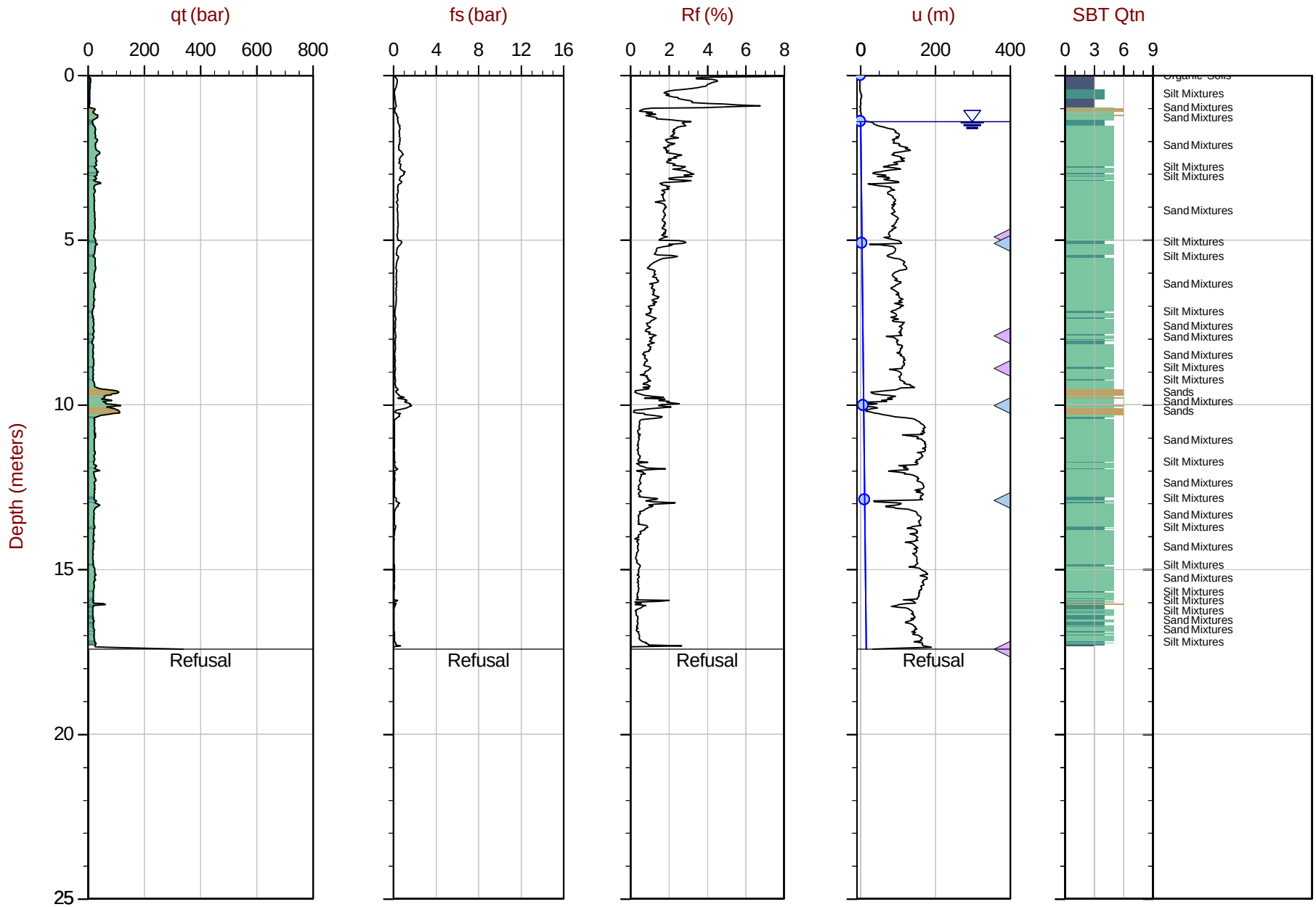
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885664m E: 609176m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

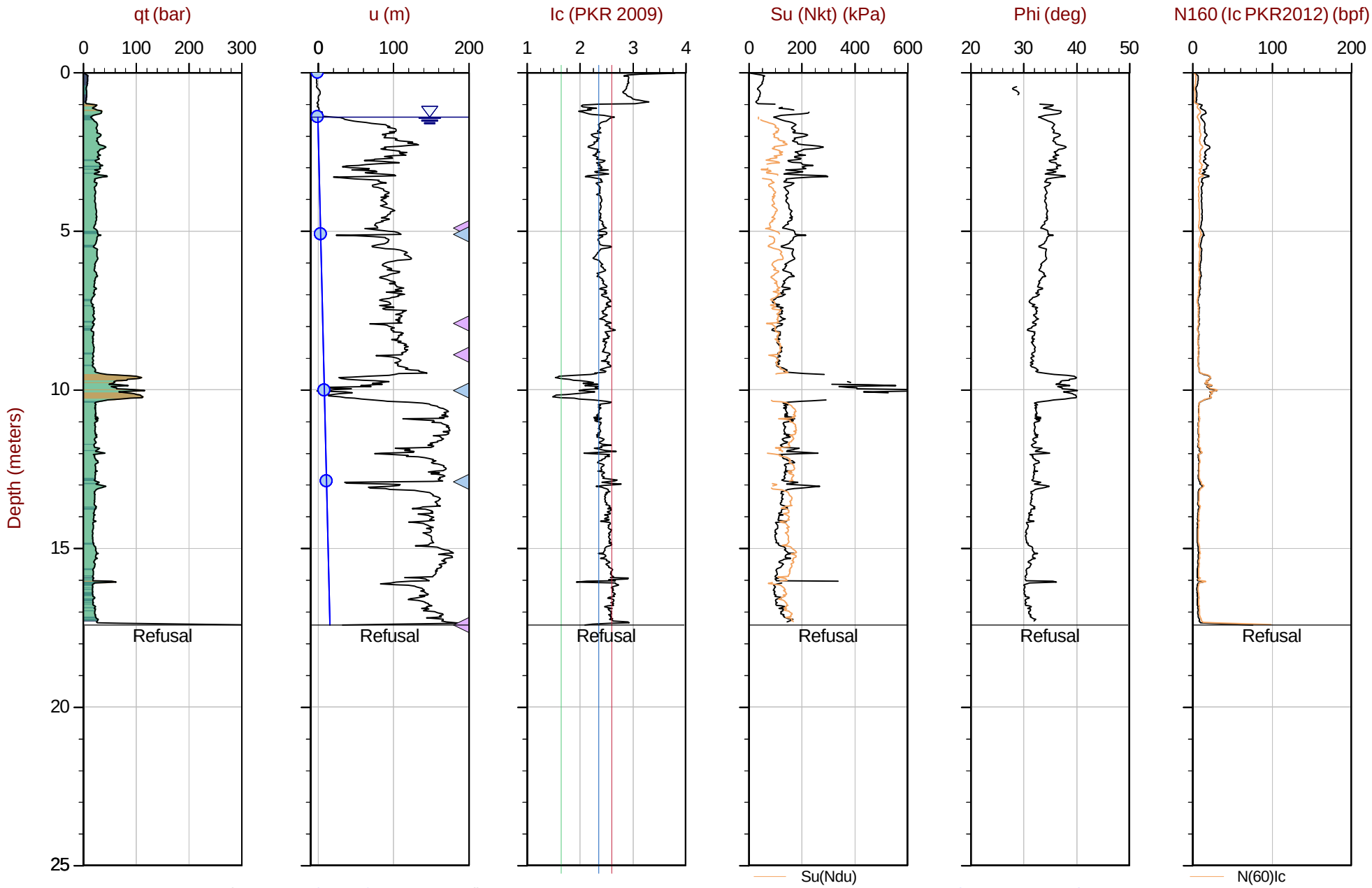
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP08.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 9.0

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885664m E: 609176m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

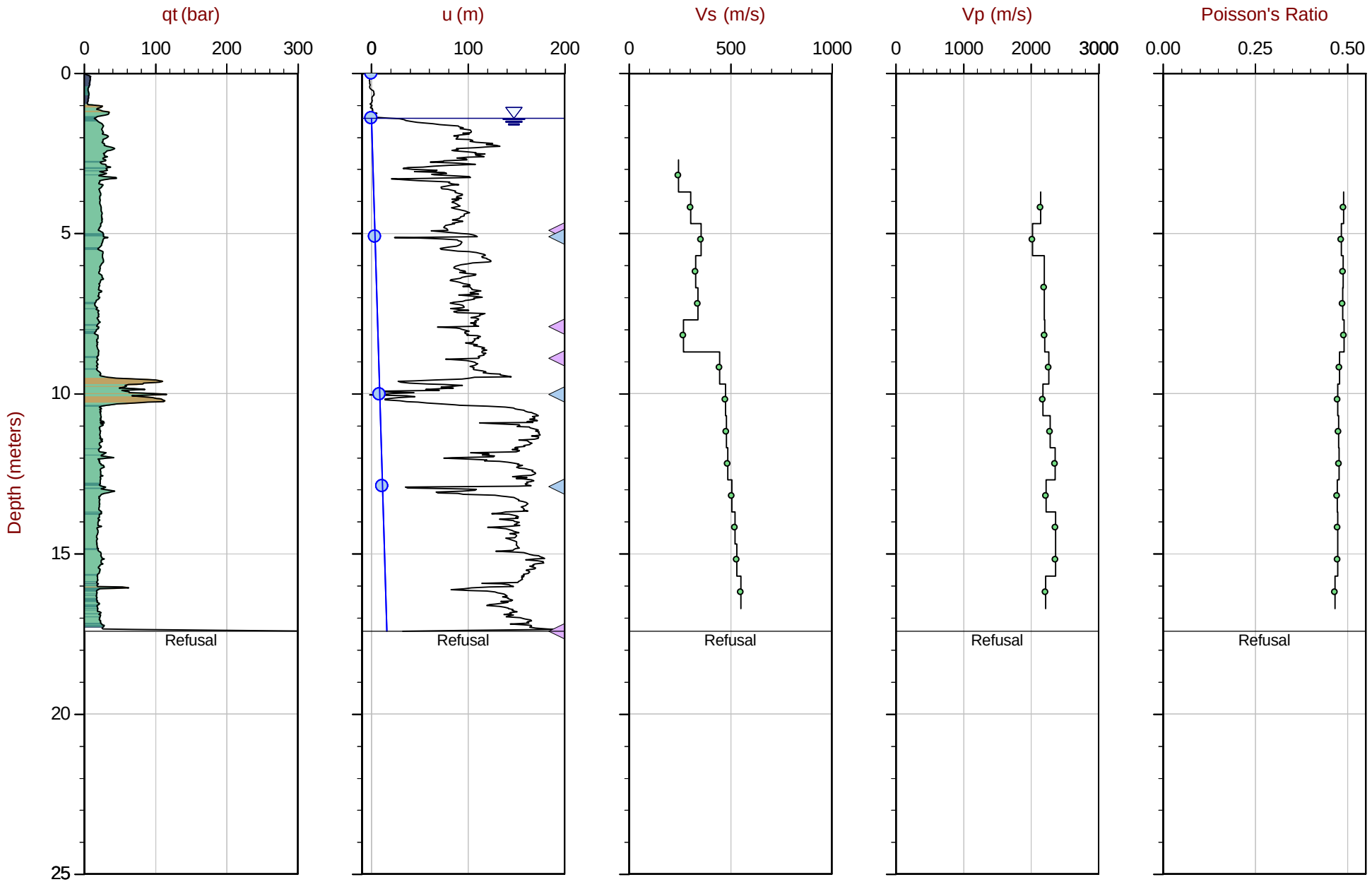
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Max Depth: 17.425 m / 57.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 25-05-29237_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 17N N: 4885664m E: 609176m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Dissipation, Ueq assumed, Hydrostatic Line

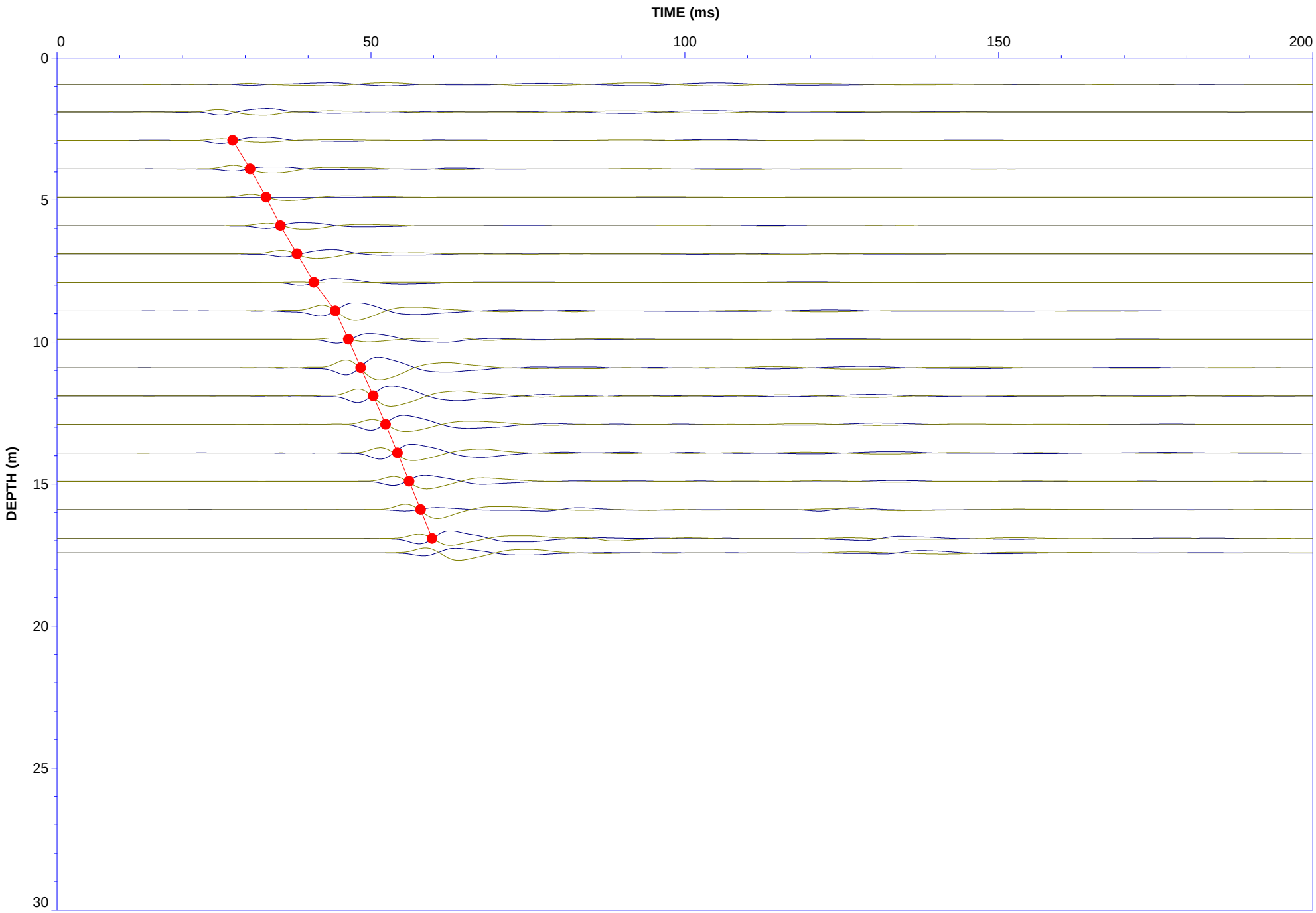
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF08
Date:	2025-03-31
Seismic Source:	Beam
Source Offset (m):	3.50
Source Depth (m):	0.00
Sensor Type:	Geophone
Sensor Offset (m):	0.20

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (m)	Sensor Depth (m)	Ray Path (m)	Ray Path Difference (m)	Travel Time Interval (ms)	Interval Velocity (m/s)
2.90	2.70	4.42			
3.90	3.70	5.09	0.67	2.76	244
4.90	4.70	5.86	0.77	2.53	304
5.90	5.70	6.69	0.83	2.33	357
6.90	6.70	7.56	0.87	2.64	329
7.90	7.70	8.46	0.90	2.65	340
8.90	8.70	9.38	0.92	3.43	268
9.90	9.70	10.31	0.93	2.08	449
10.90	10.70	11.26	0.95	1.98	477
11.90	11.70	12.21	0.95	1.98	481
12.90	12.70	13.17	0.96	1.97	487
13.90	13.70	14.14	0.97	1.91	508
14.90	14.70	15.11	0.97	1.85	524
15.90	15.70	16.09	0.97	1.83	532
16.92	16.72	17.08	1.00	1.80	553

Job No: 25-05-29237 Client: Thurber Engineering Project: Bradford Bypass Sounding: SCPT25-HF08 Filter: 0-200Hz Date: 2025-03-31
Analysis: S Wave - Geo X

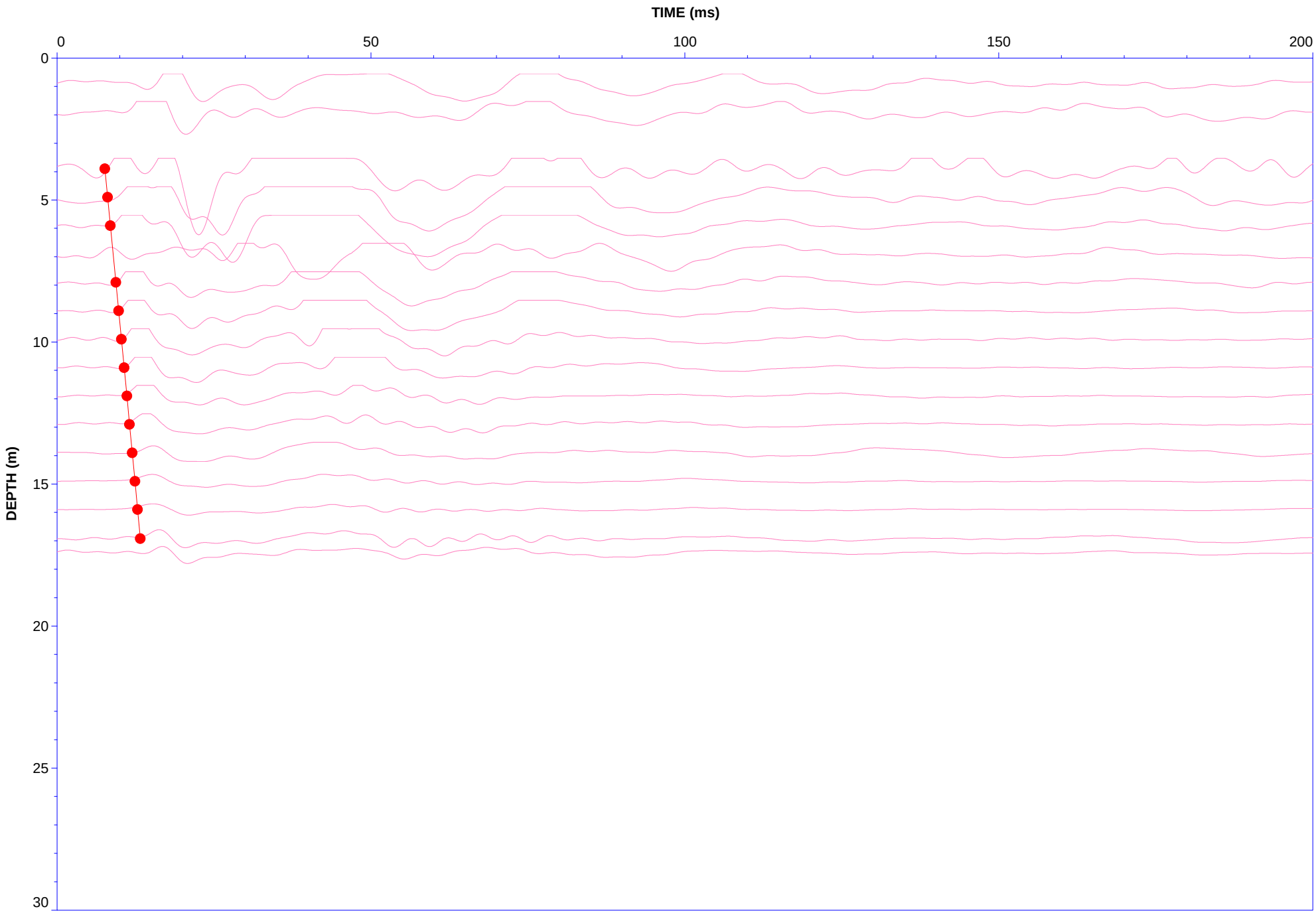


Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF08
Date:	2025-03-31
Seismic Source:	Plate
Source Offset (m):	2.00
Source Depth (m):	0.00
Sensor Type:	Geophone
Sensor Offset (m):	0.20

SCPTu COMPRESSION WAVE VELOCITY TEST RESULTS - Vp

Tip Depth (m)	Sensor Depth (m)	Ray Path (m)	Ray Path Difference (m)	Travel Time Interval (ms)	Interval Velocity (m/s)
3.90	3.70	4.21			
4.90	4.70	5.11	0.90	0.42	2145
5.90	5.70	6.04	0.93	0.46	2023
7.90	7.70	7.96	1.92	0.87	2198
8.90	8.70	8.93	0.97	0.44	2204
9.90	9.70	9.90	0.98	0.43	2269
10.90	10.70	10.89	0.98	0.45	2180
11.90	11.70	11.87	0.99	0.43	2287
12.90	12.70	12.86	0.99	0.42	2359
13.90	13.70	13.85	0.99	0.44	2225
14.90	14.70	14.84	0.99	0.42	2367
15.90	15.70	15.83	0.99	0.42	2370
16.92	16.72	16.84	1.01	0.46	2218

Job No: 25-05-29237 Client: Thurber Engineering Project: Bradford Bypass Sounding: SCPT25-HF08 Filter: BP 0-200Hz Date: 2025-03-31
Analysis: P Wave - Geo Z



Job No:	25-05-29237
Client:	Thurber Engineering
Project:	Bradford Bypass
Sounding ID:	SCPT25-HF08
Date:	2025-03-31

SCPTu POISSON'S RATIO RESULTS

Depth From (m)	Depth To (m)	Vs Interval Velocity (m/s)	Vp Interval Velocity (m/s)	Poisson's Ratio
3.70	4.70	304	2145	0.49
4.70	5.70	357	2023	0.48
5.70	6.70	329	2198	0.49
6.70	7.70	340	2198	0.49
7.70	8.70	268	2204	0.49
8.70	9.70	449	2269	0.48
9.70	10.70	477	2180	0.48
10.70	11.70	481	2287	0.48
11.70	12.70	487	2359	0.48
12.70	13.70	508	2225	0.47
13.70	14.70	524	2367	0.47
14.70	15.70	532	2370	0.47
15.70	16.72	553	2218	0.47

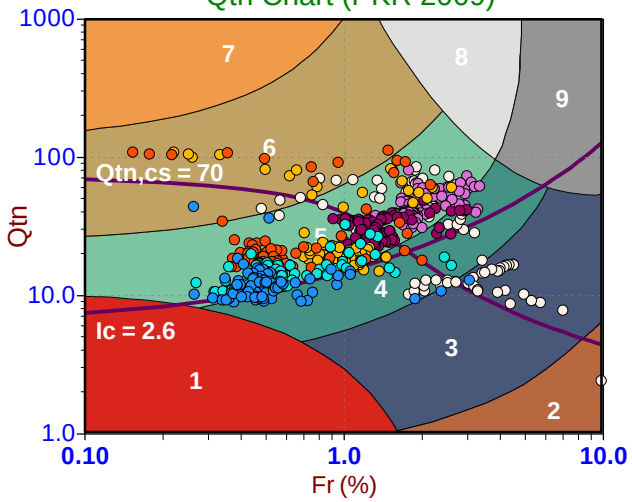
CONETEC

Thurber Engineering

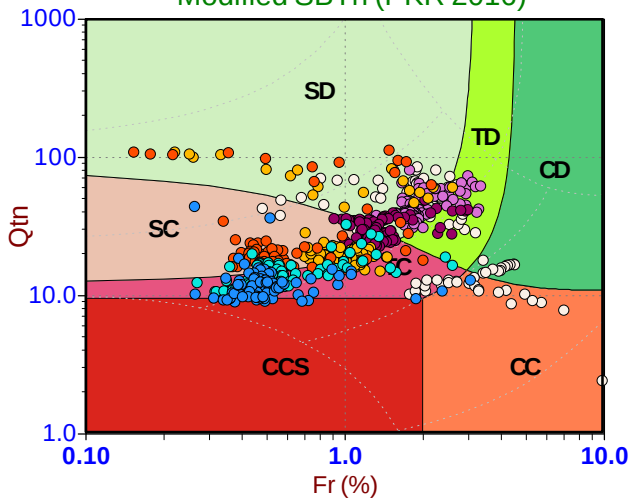
Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²

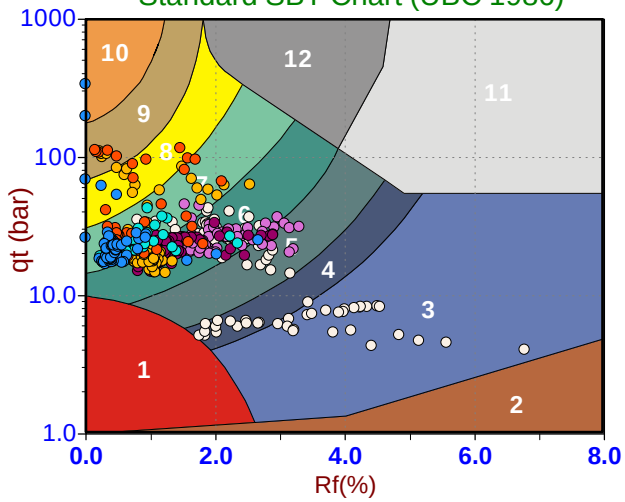
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges

- >0.0 to 2.5 m
- >2.5 to 5.0 m
- >5.0 to 7.5 m
- >7.5 to 10.0 m
- >10.0 to 12.5 m
- >12.5 to 15.0 m
- >15.0 to 17.5 m
- >17.5 to 20.0 m
- >20.0 to 22.5 m
- >22.5 to 25.0 m
- >25.0 m

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Job No:	25-05-29237
Client:	Thurber Engineering Ltd.
Project:	Bradford Bypass
Start Date:	2025-03-25
End Date:	2025-03-31

CPTu PORE PRESSURE DISSIPATION SUMMARY

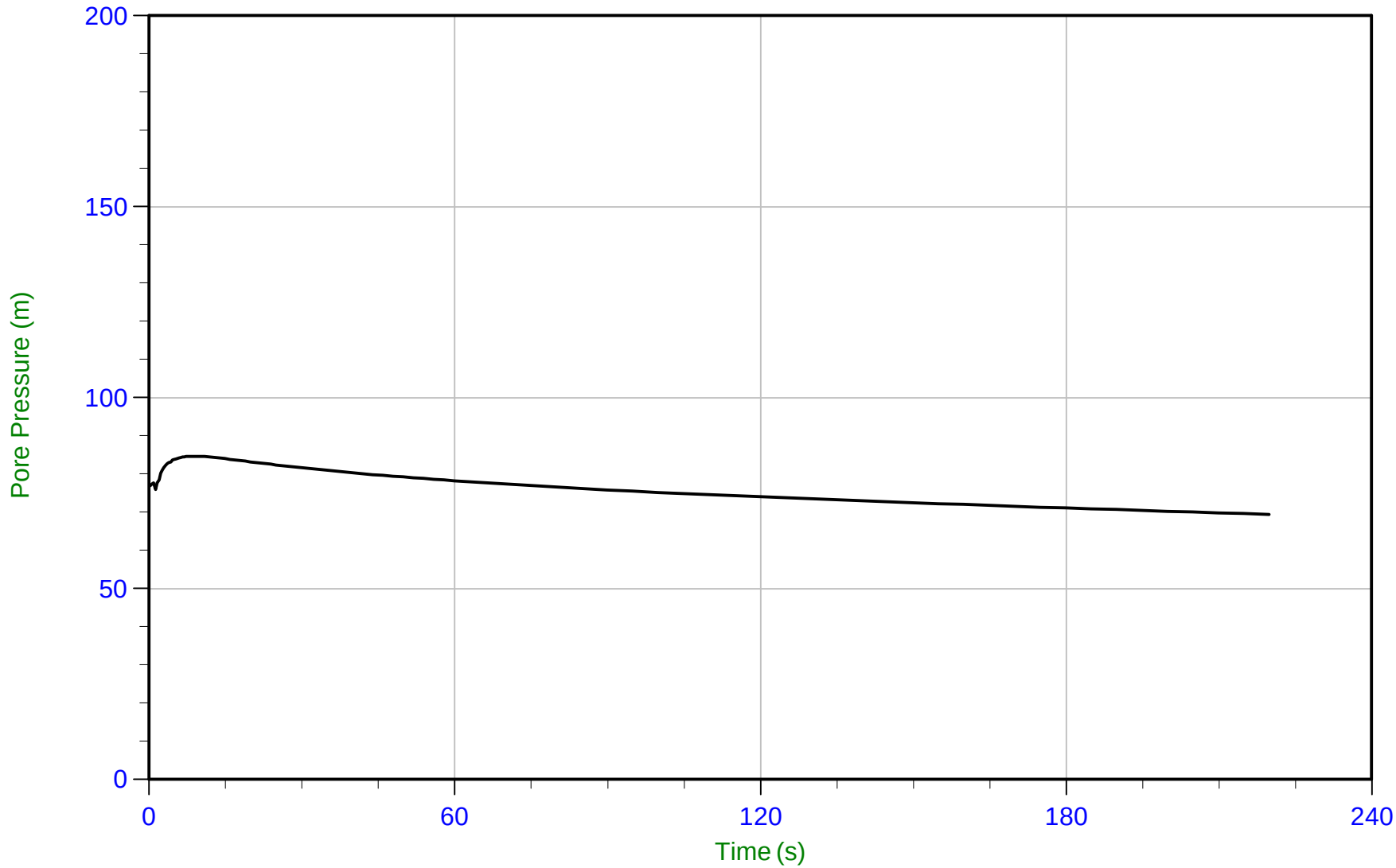
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (m)	Observed Equilibrium Pore Pressure U_{eq} (m)	Estimated Equilibrium Pore Pressure U_{eq} (m)	Assumed Phreatic Surface (m)	t_{50} $(s)_1$	Assumed Rigidity Index (I_r)	c_h $(cm^2/min)_2$	Refer to Notation Number
SCPT25-HF01	25-05-29237_SP01	15	315	4.950							
SCPT25-HF01	25-05-29237_SP01	15	225	20.600	18.5		2.1				
SCPT25-HF07	25-05-29237_SP07	15	305	2.975							
SCPT25-HF07	25-05-29237_SP07	15	1020	4.000	3.8		0.2				
SCPT25-HF07	25-05-29237_SP07	15	300	5.975		5.8	0.2	37.5	100	18.7	3
SCPT25-HF07	25-05-29237_SP07	15	305	6.975		6.8	0.2	37.8	100	18.6	3
SCPT25-HF07	25-05-29237_SP07	15	340	9.975							
SCPT25-HF07	25-05-29237_SP07	15	210	10.975							
SCPT25-HF07	25-05-29237_SP07	15	320	15.975		15.8	0.2	97.8	100	7.2	3
SCPT25-HF07	25-05-29237_SP07	15	220	23.300							
SCPT25-HF08	25-05-29237_SP08	15	220	4.900							
SCPT25-HF08	25-05-29237_SP08	15	3150	5.100		3.7	1.4	891.7	100	0.8	3
SCPT25-HF08	25-05-29237_SP08	15	270	7.900							
SCPT25-HF08	25-05-29237_SP08	15	380	8.900							
SCPT25-HF08	25-05-29237_SP08	15	1060	10.025		8.6	1.4	45.6	100	15.4	3
SCPT25-HF08	25-05-29237_SP08	15	1000	12.900		11.5	1.4	395.7	100	1.8	3
SCPT25-HF08	25-05-29237_SP08	15	630	17.425							
SCPT25-HF19	25-05-29237_SP19	15	385	0.850							
SCPT25-HF19	25-05-29237_SP19	15	300	2.850	2.8		0.1				
SCPT25-HF19	25-05-29237_SP19	15	250	3.850							
SCPT25-HF19	25-05-29237_SP19	15	300	6.825							
SCPT25-HF19	25-05-29237_SP19	15	400	11.850	13.4		-1.6				
SCPT25-HF19	25-05-29237_SP19	15	300	12.850	14.3		-1.5				
SCPT25-HF19	25-05-29237_SP19	15	180	13.850	15.0		-1.2				

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 4.900 m / 16.076 ft
Duration: 220.0 s

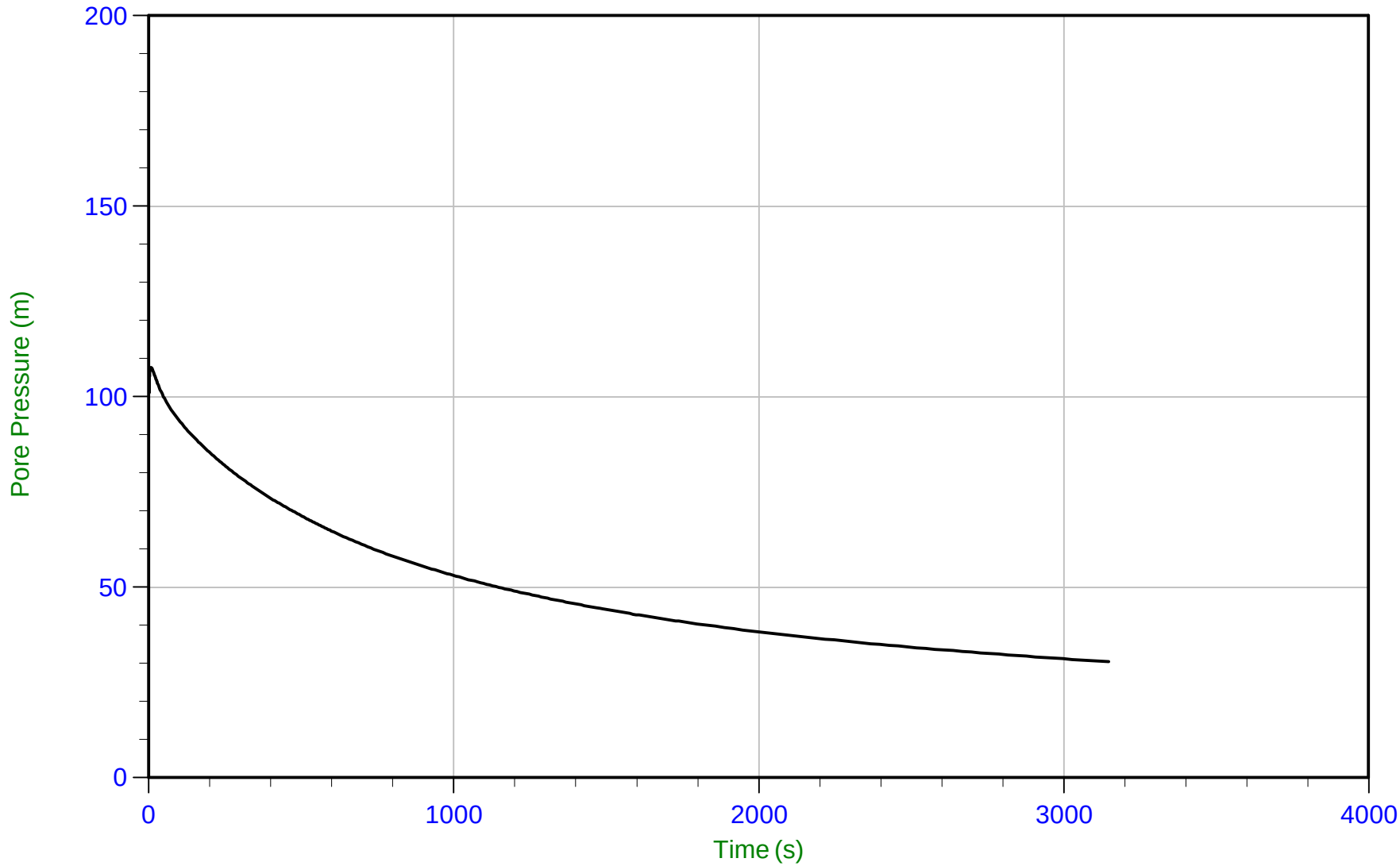
u Min: 69.5 m
u Max: 84.6 m
u Final: 69.5 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 5.100 m / 16.732 ft
Duration: 3150.0 s

u Min: 30.5 m
u Max: 107.7 m
u Final: 30.5 m

WT: 1.4 m / 4.6 ft
Ueq: 3.7 m
U(50): 55.71 m

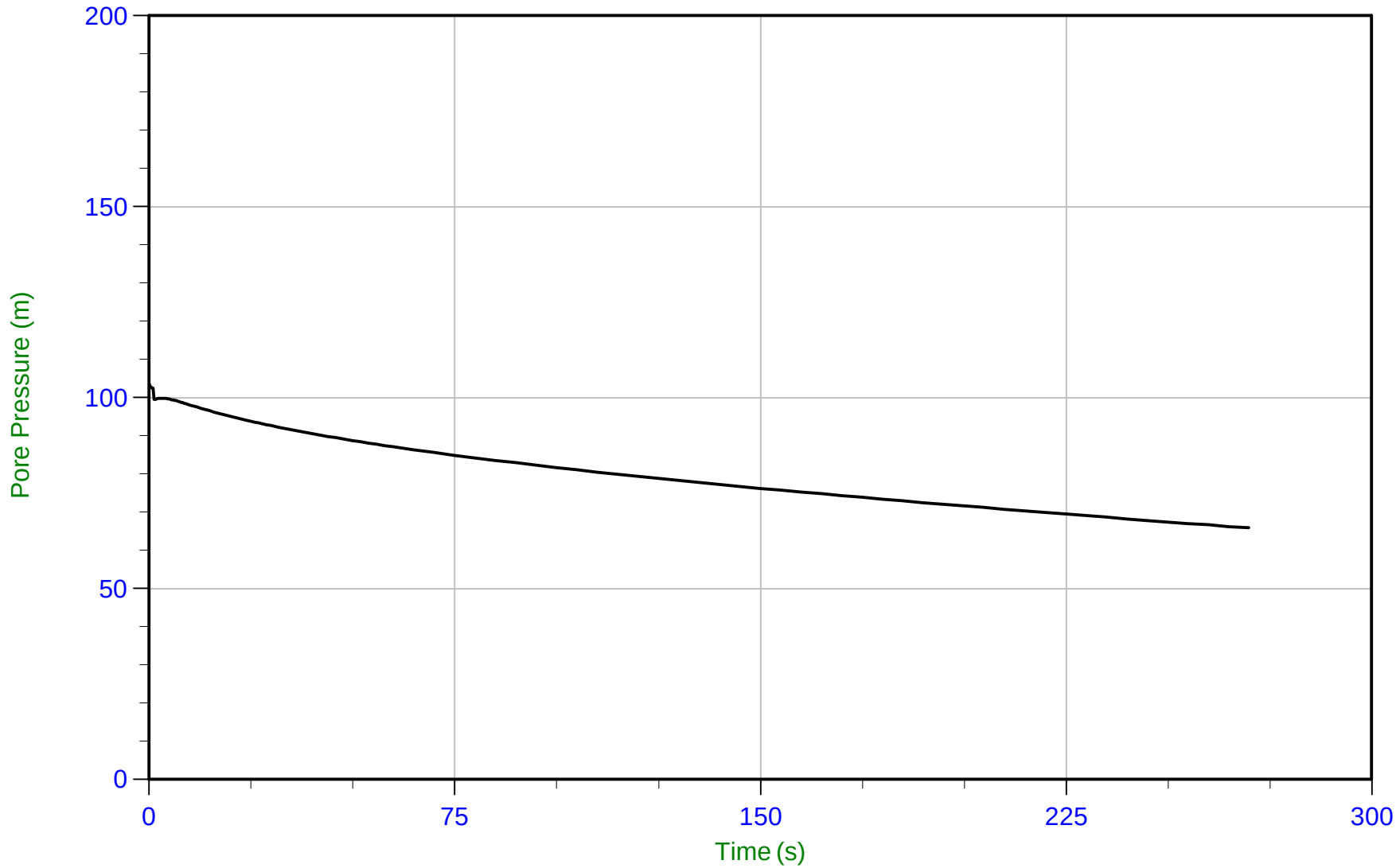
T(50): 891.7 s
Ir: 100
Ch: 0.8 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 7.900 m / 25.918 ft
Duration: 270.0 s

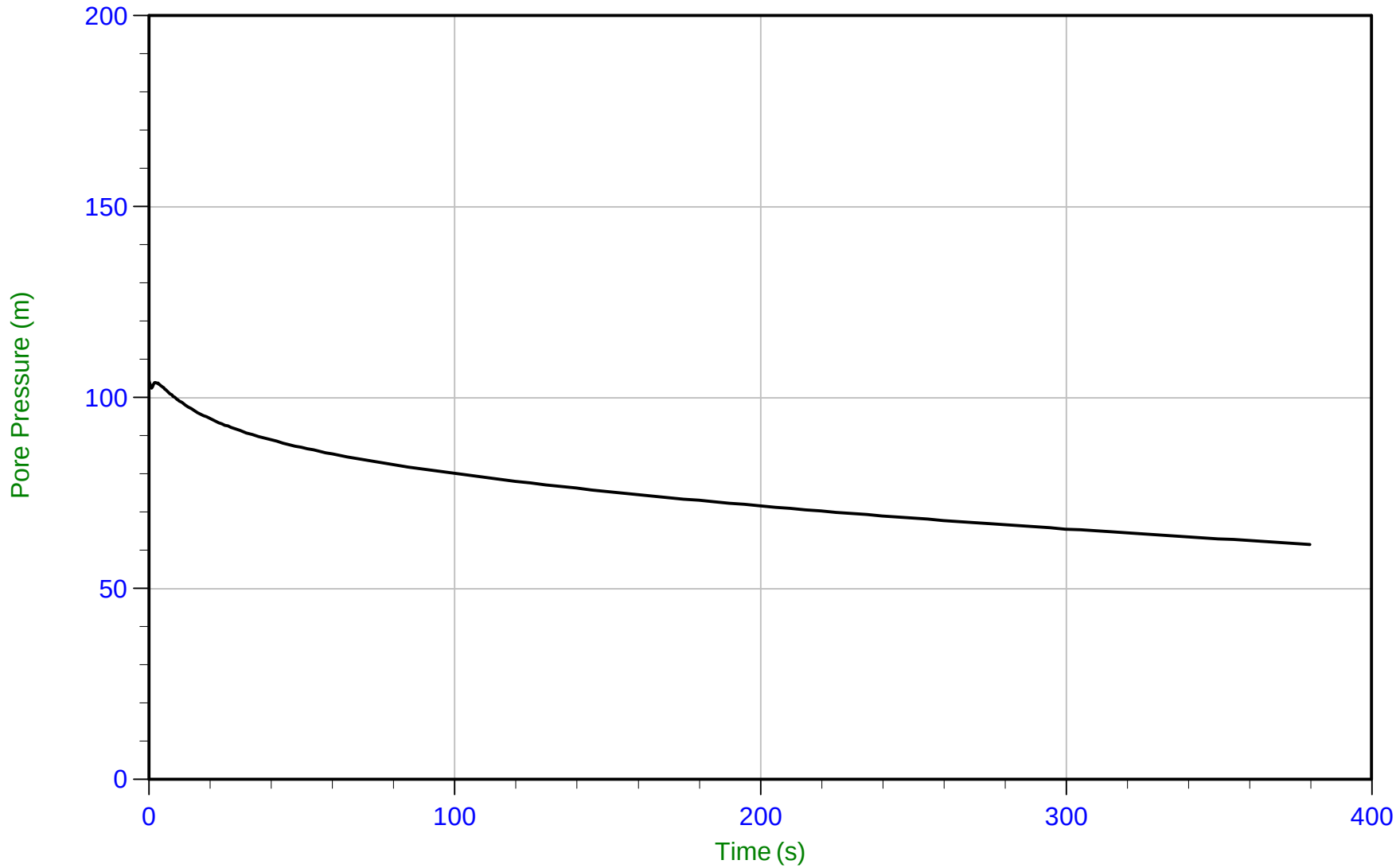
u Min: 65.9 m
u Max: 103.8 m
u Final: 65.9 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 8.900 m / 29.199 ft
Duration: 380.0 s

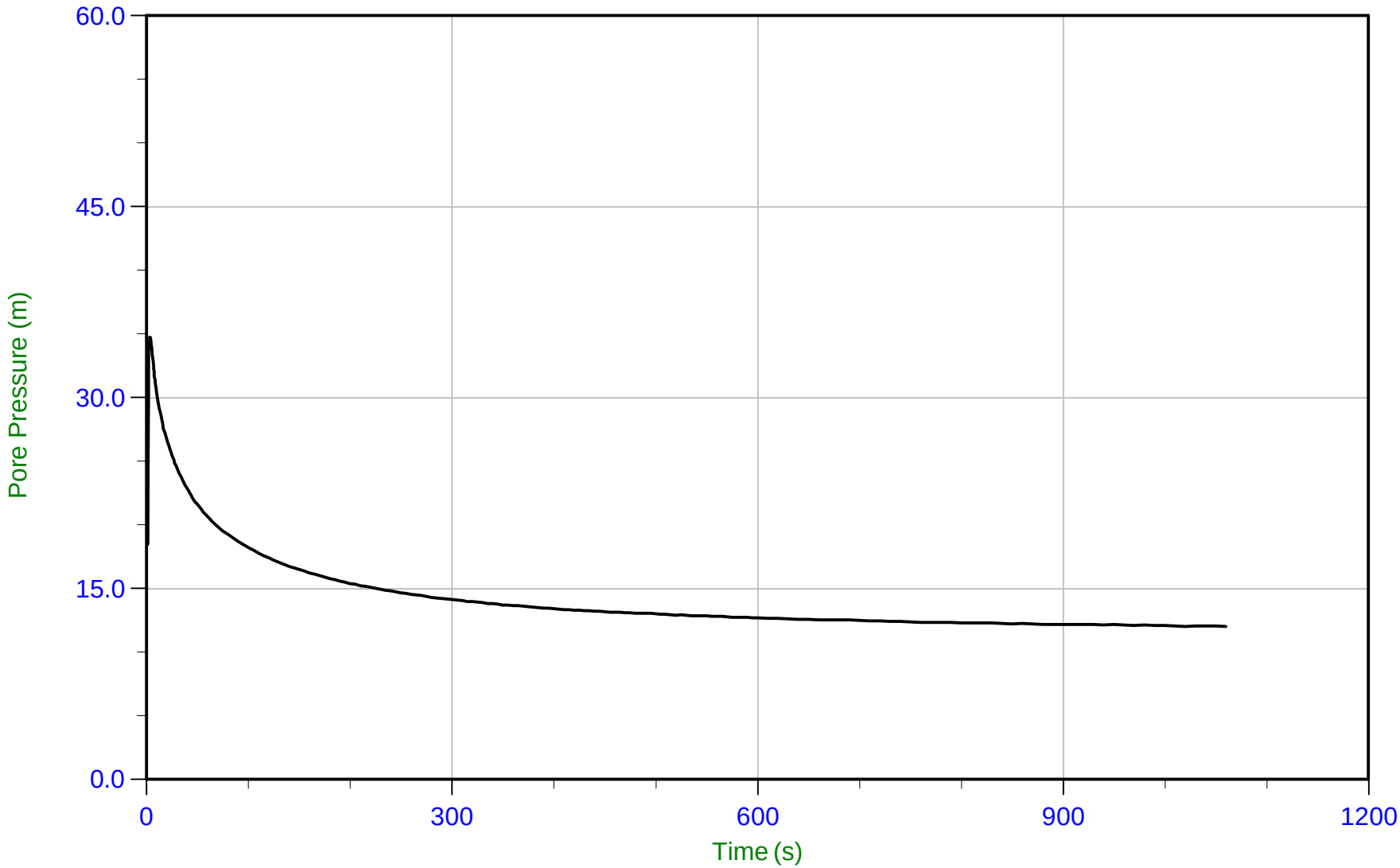
u Min: 61.6 m
u Max: 104.5 m
u Final: 61.6 m

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 10.025 m / 32.890 ft
Duration: 1060.0 s

u Min: 12.0 m
u Max: 34.8 m
u Final: 12.0 m

WT: 1.4 m / 4.6 ft
Ueq: 8.6 m
U(50): 21.69 m

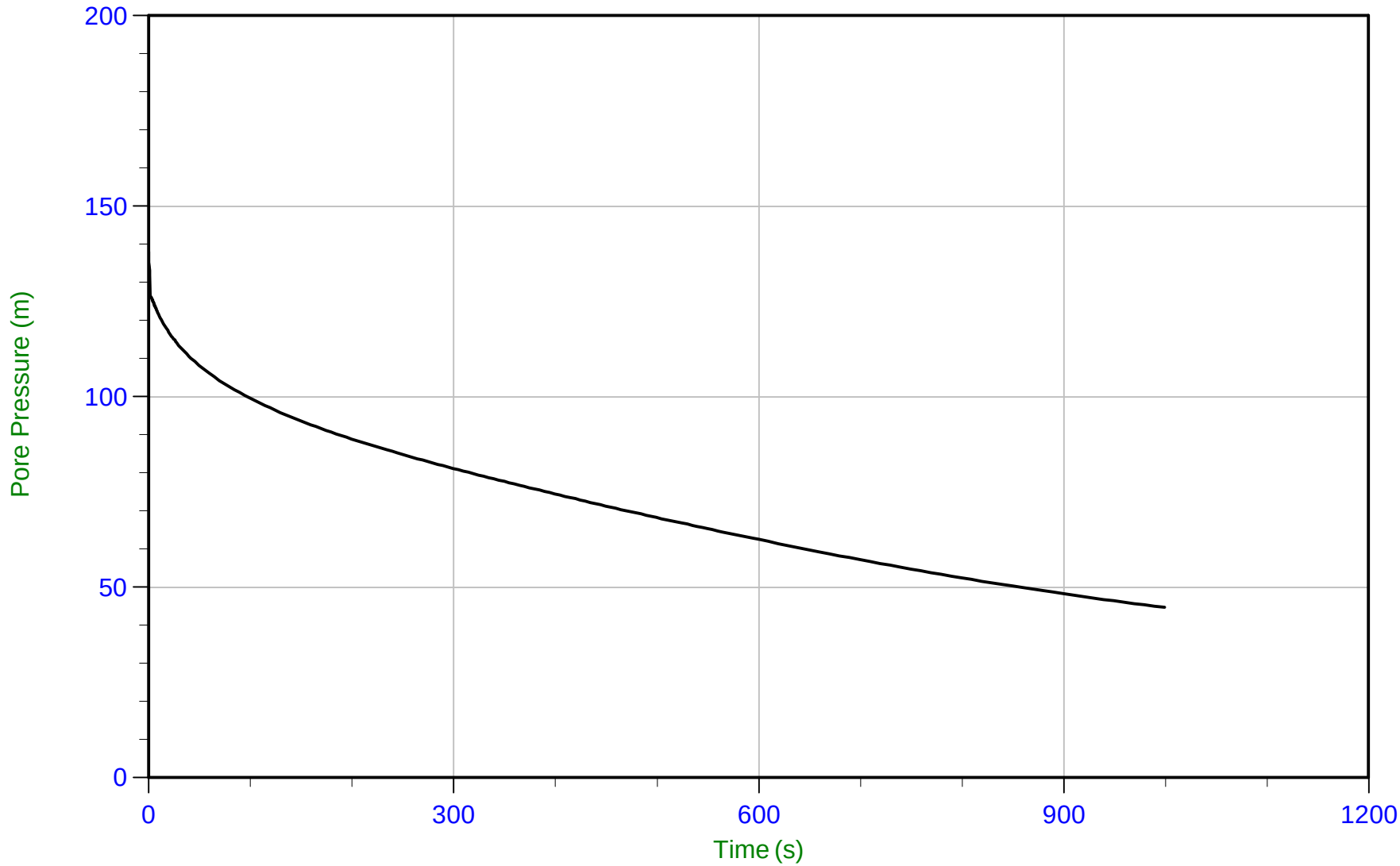
T(50): 45.6 s
Ir: 100
Ch: 15.4 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 25-05-29237_SP08.PPF2
Depth: 12.900 m / 42.322 ft
Duration: 1000.0 s

u Min: 44.7 m
u Max: 138.1 m
u Final: 44.7 m

WT: 1.4 m / 4.6 ft
Ueq: 11.5 m
U(50): 74.78 m

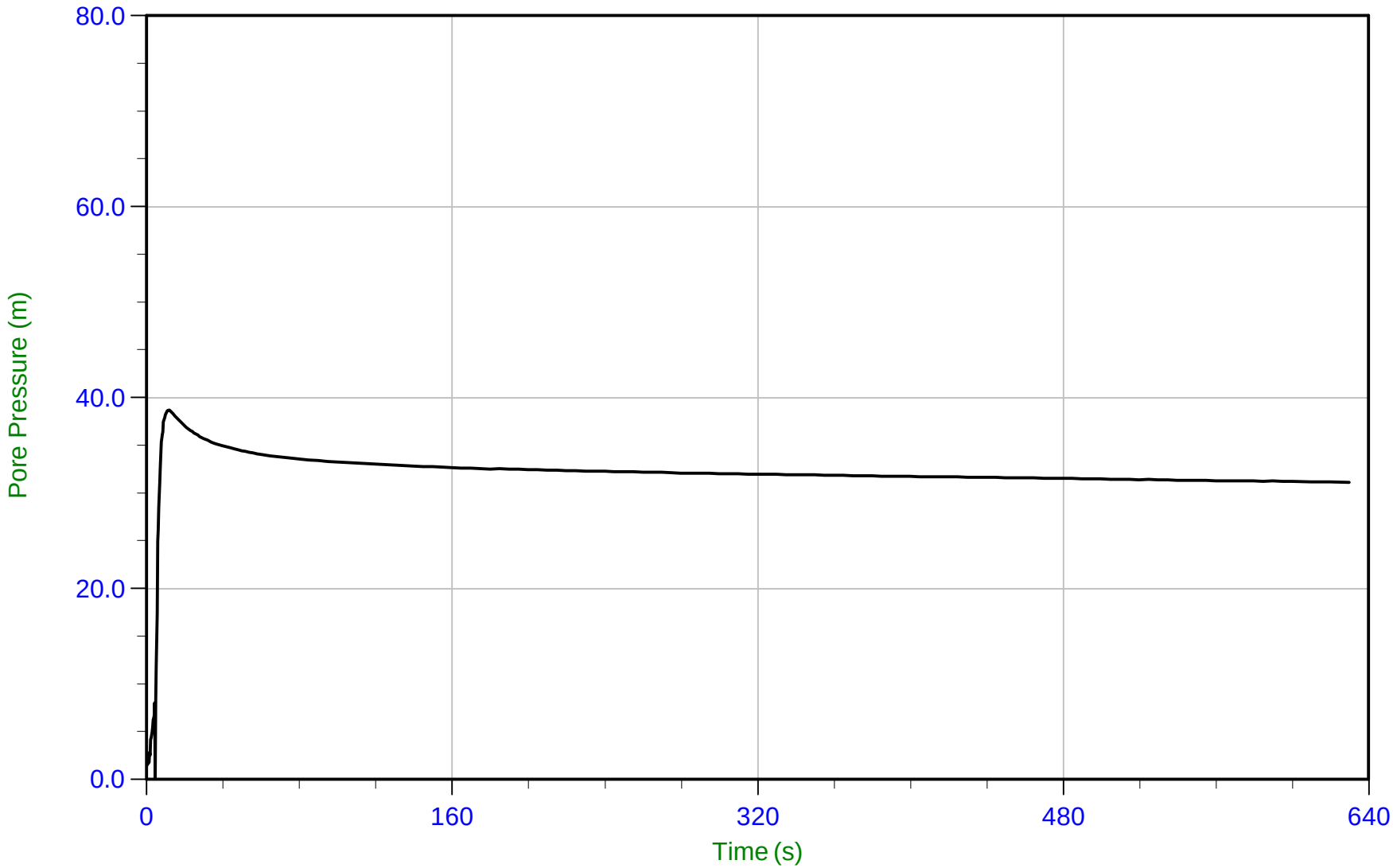
T(50): 395.7 s
Ir: 100
Ch: 1.8 cm²/min

CONETEC

Thurber Engineering

Job No: 25-05-29237
Date: 2025-03-31 09:29
Site: Bradford Bypass

Sounding: SCPT25-HF08
Cone: 765:T1500F15U35 Area=15 cm²



Trace Summary:

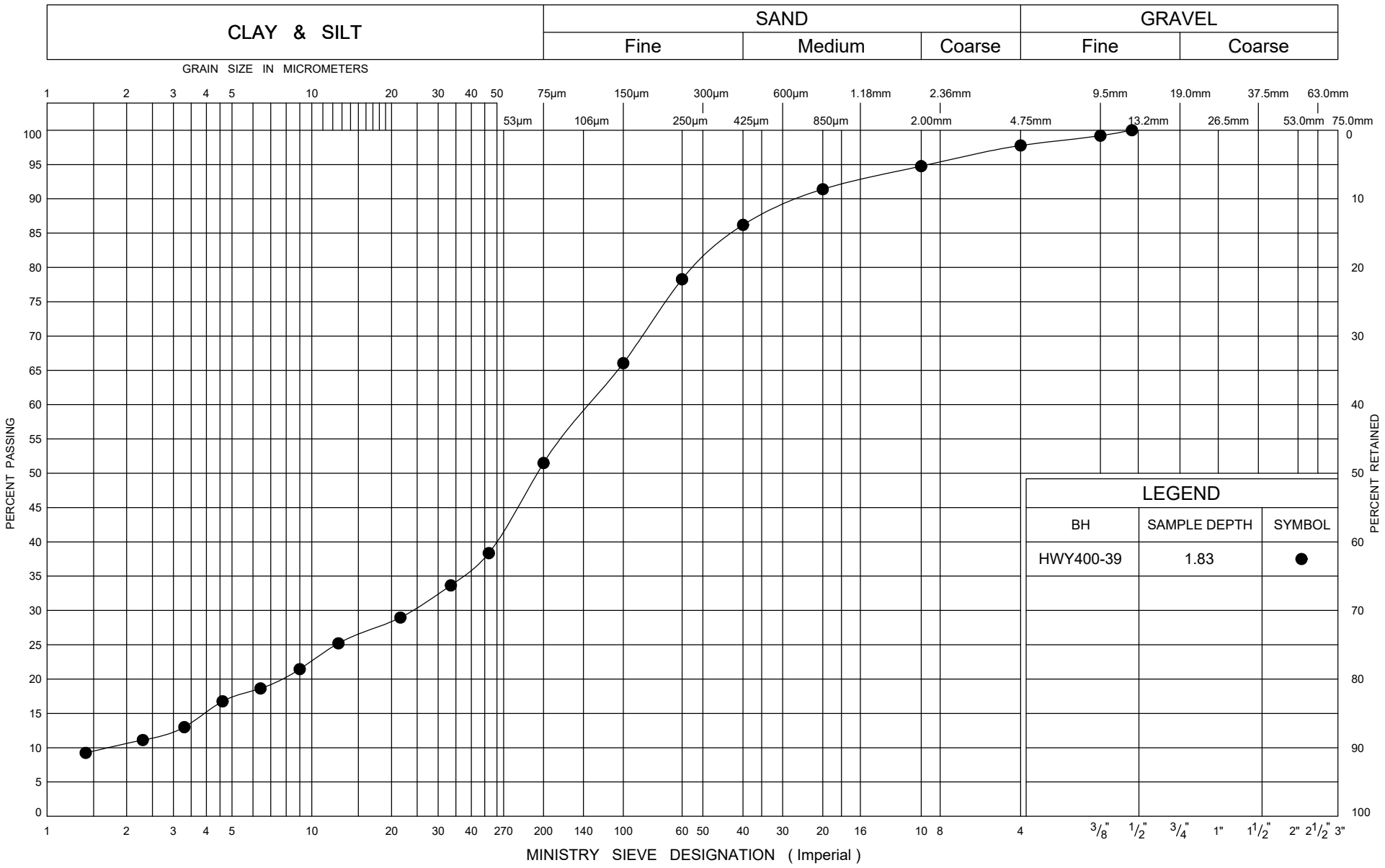
Filename: 25-05-29237_SP08.PPF2
Depth: 17.425 m / 57.168 ft
Duration: 630.0 s

u Min: -0.2 m
u Max: 38.7 m
u Final: 31.1 m

THURBER

APPENDIX E

Geotechnical Laboratory Test Results



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GRAIN SIZE DISTRIBUTION

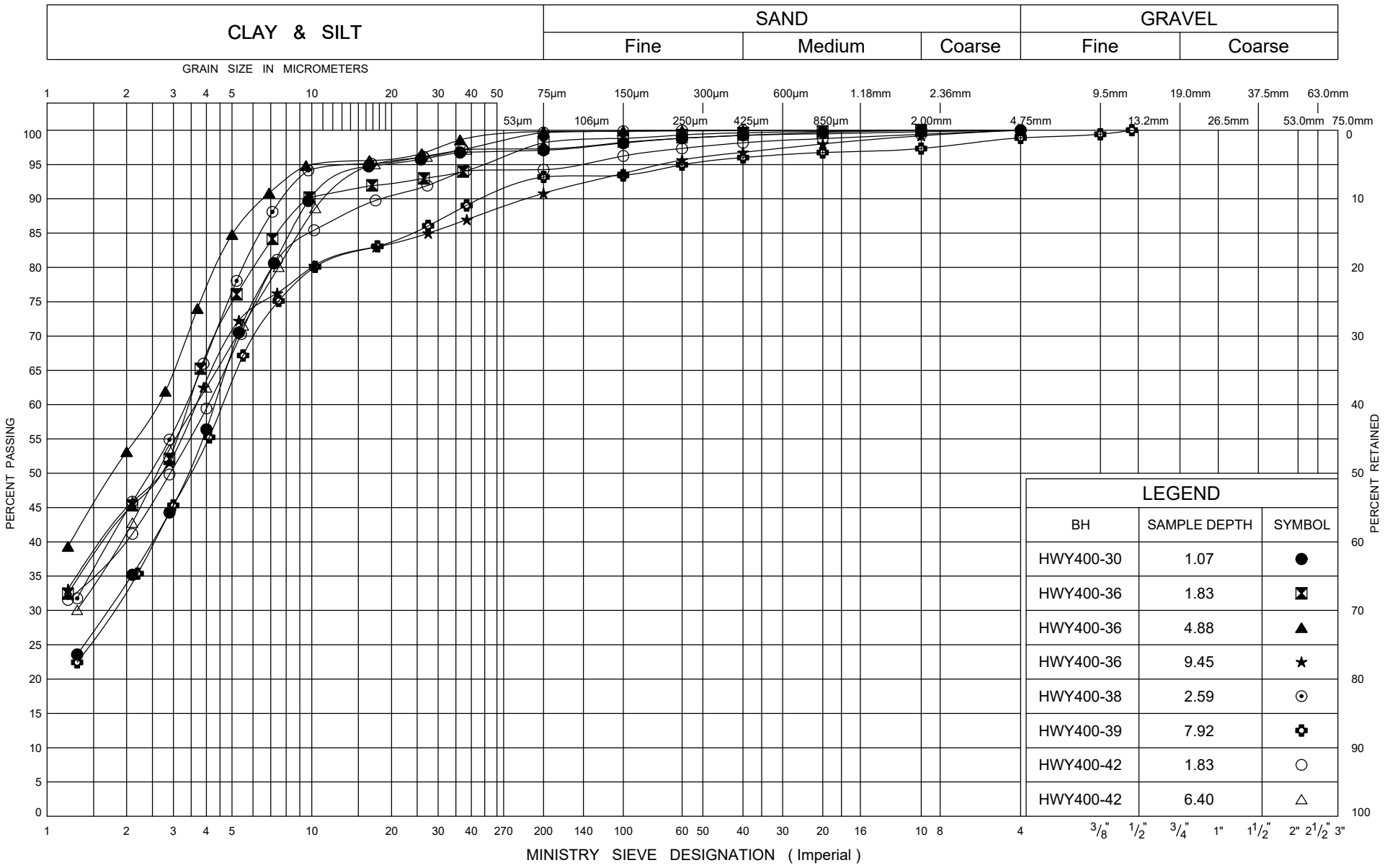
Sandy CLAY (CL) FILL

FIG No 1

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
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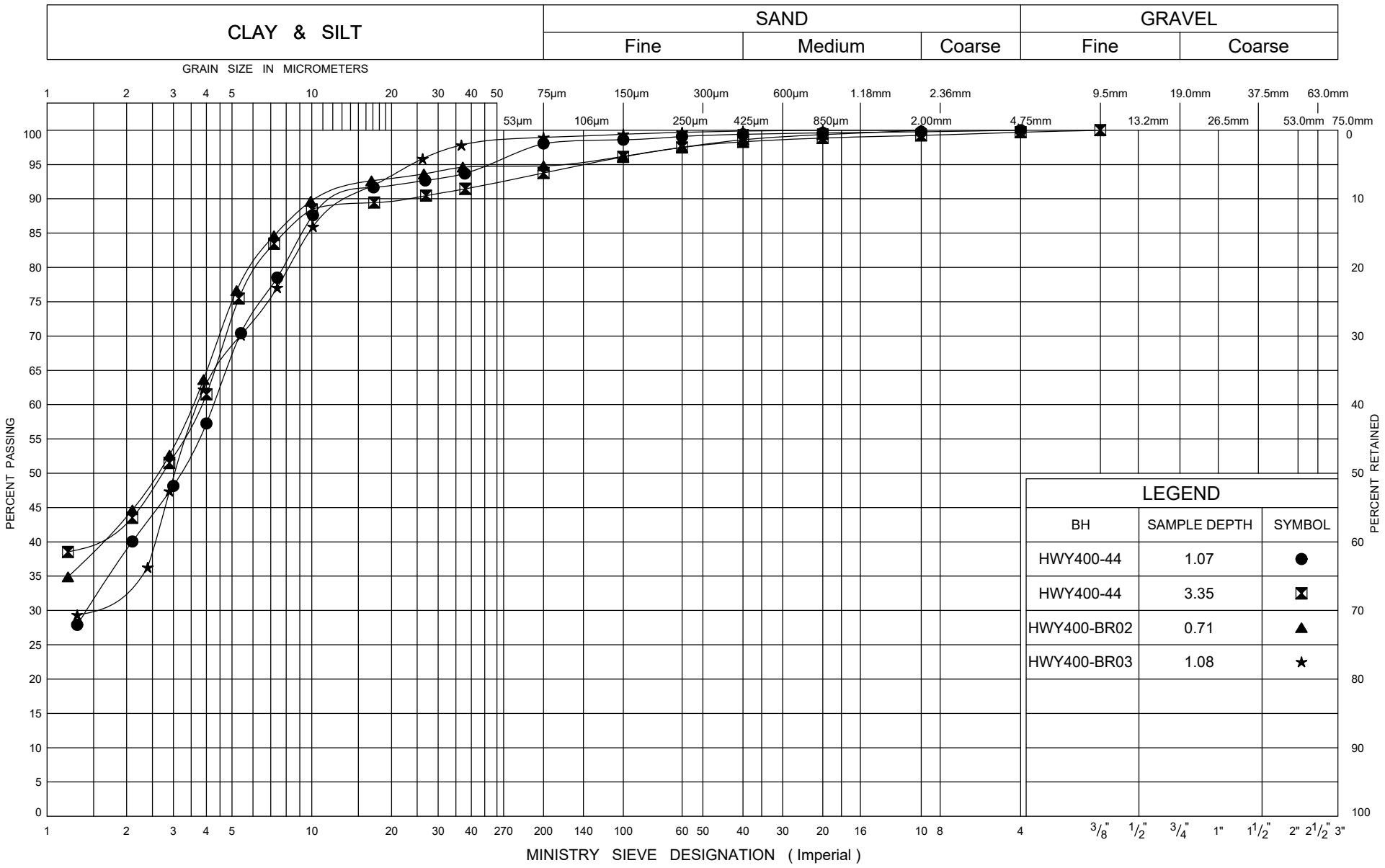
GRAIN SIZE DISTRIBUTION

Surficial CLAY (CL) to CLAY (CI)

FIG No 2A

W.P.

Highway 400 E-S Ramp



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Surficial CLAY (CL) to CLAY (CI)

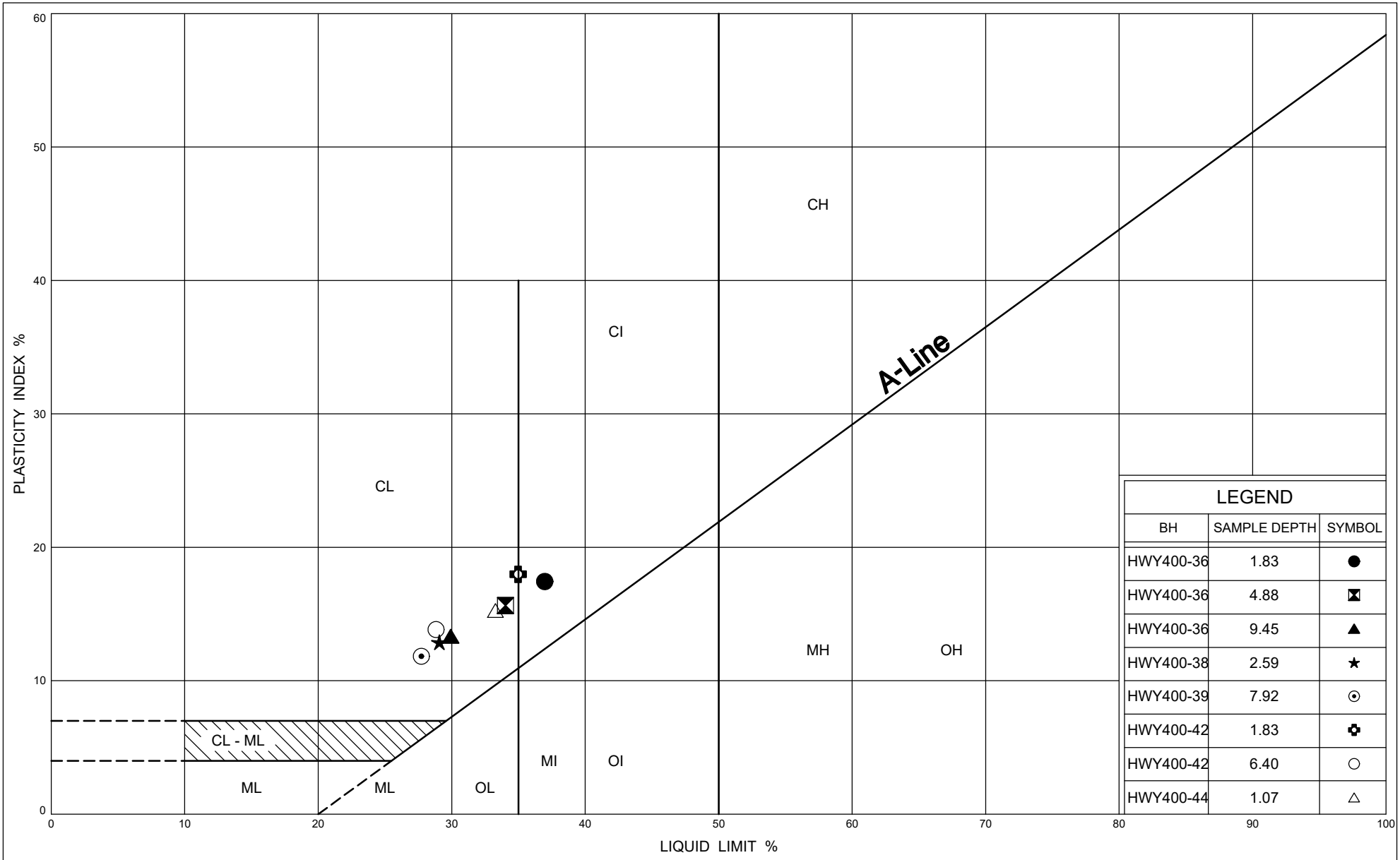
FIG No 2B

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-36	1.83	●
HWY400-36	4.88	⊠
HWY400-36	9.45	▲
HWY400-38	2.59	★
HWY400-39	7.92	⊙
HWY400-42	1.83	✿
HWY400-42	6.40	○
HWY400-44	1.07	△

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Ontario

PLASTICITY CHART

Surficial CLAY (CL) to CLAY(CI)

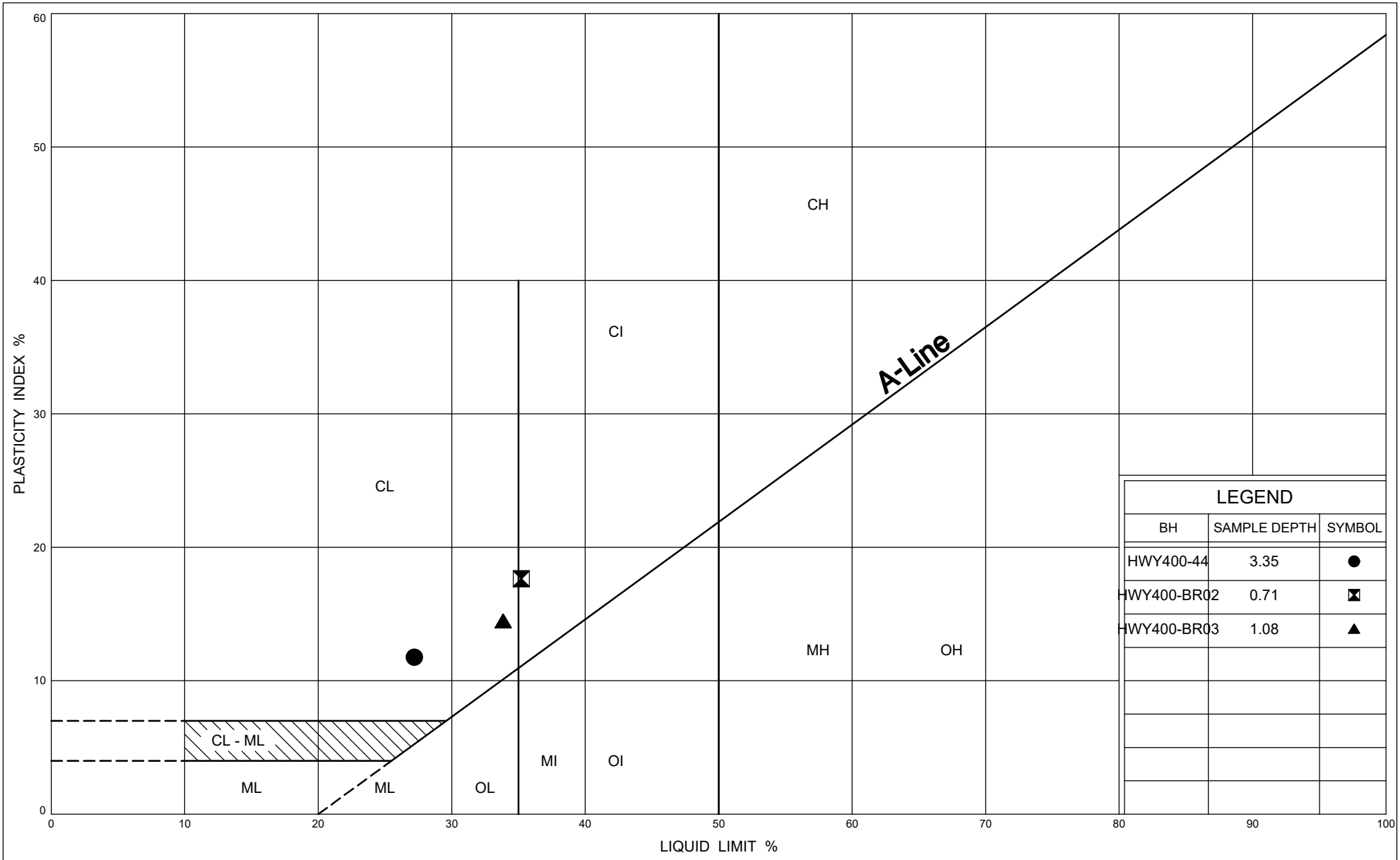
FIG No 3A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

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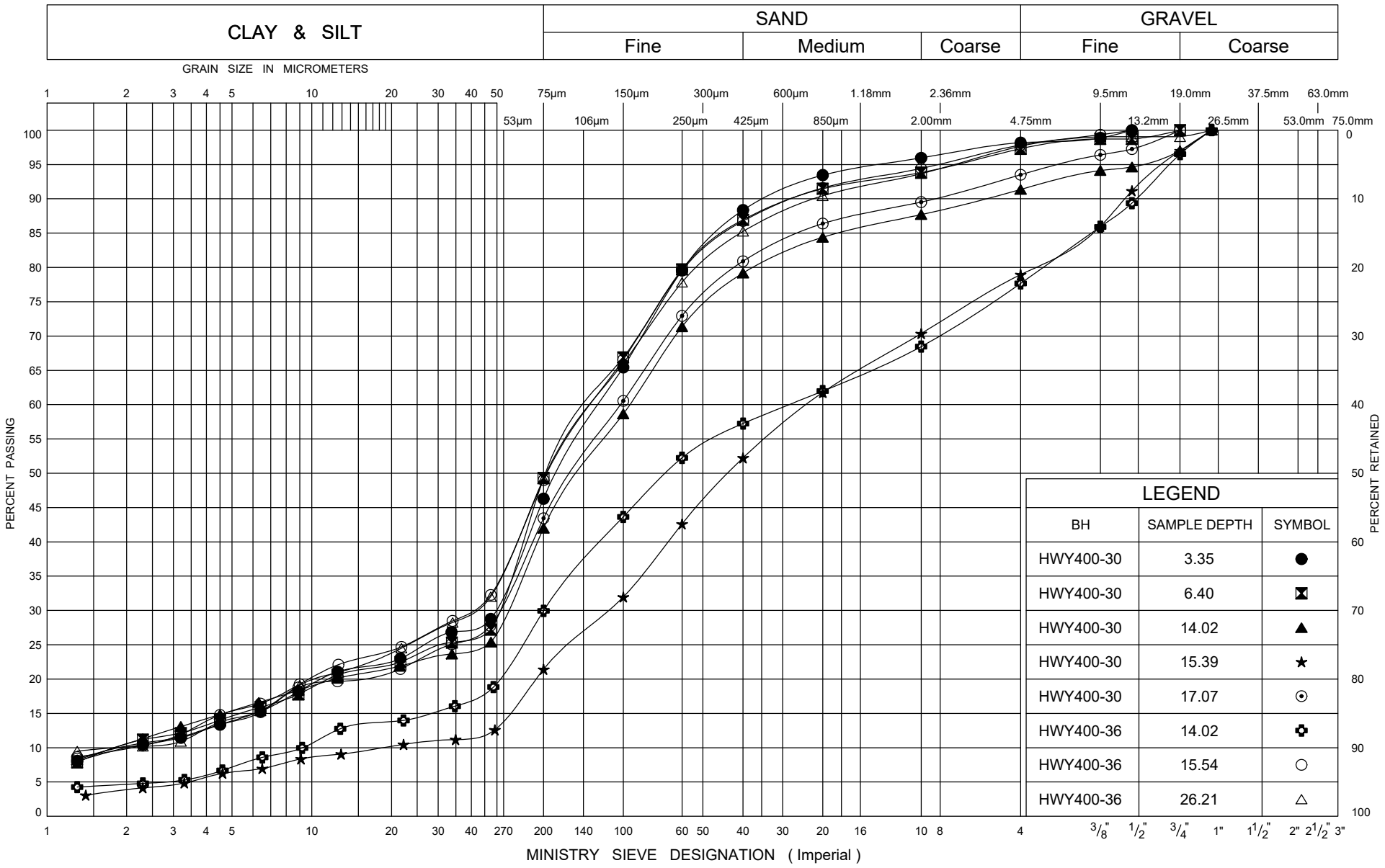
PLASTICITY CHART

Surficial CLAY (CL) to CLAY(CI)

FIG No 3B

W.P.

Highway 400 E-S Ramp



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
Ontario

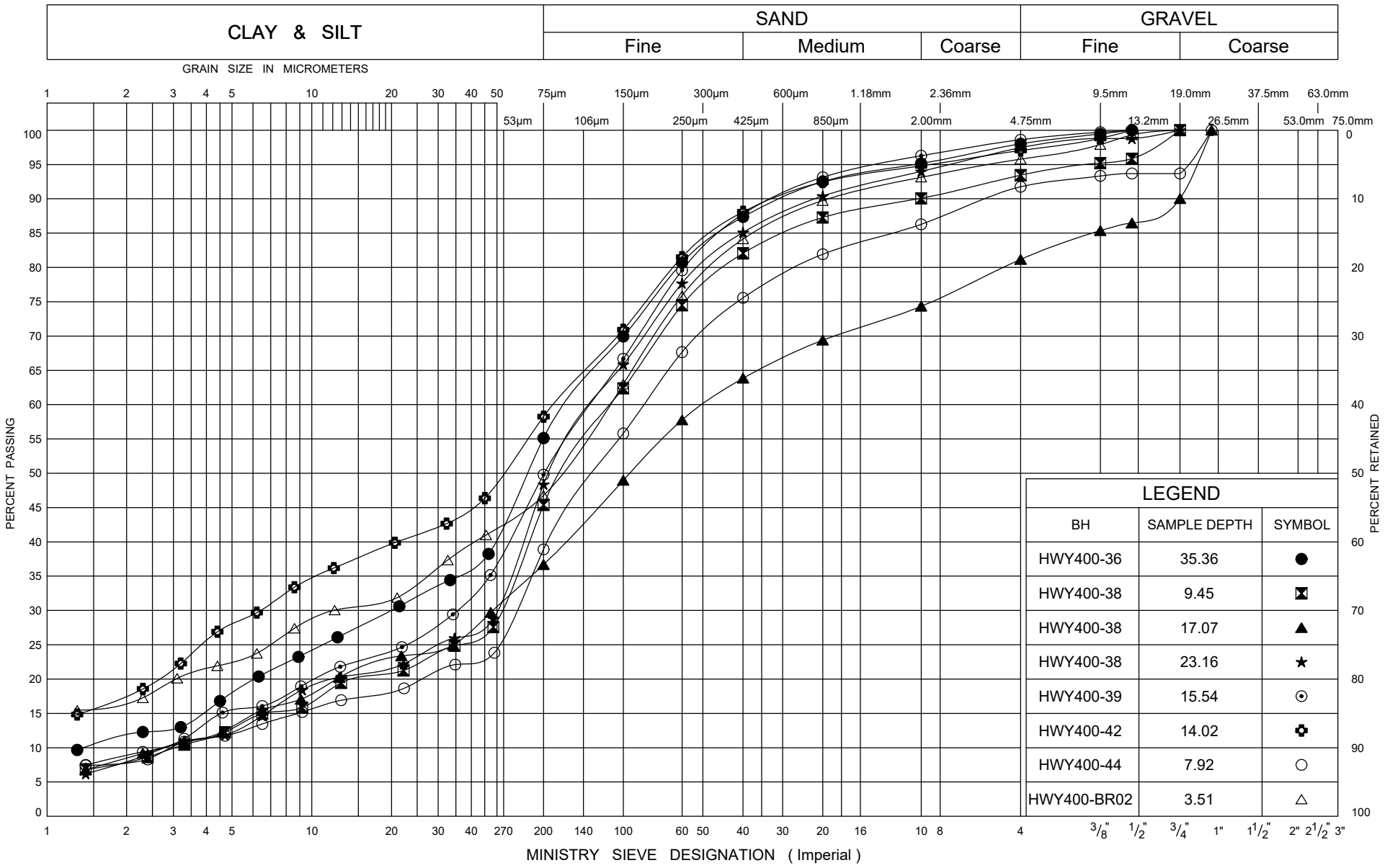
GRAIN SIZE DISTRIBUTION

Silty SAND with Gravel to Sandy SILT TILL

FIG No 4A

W.P.

Highway 400 E-S Ramp



Ministry of Transportation
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GRAIN SIZE DISTRIBUTION

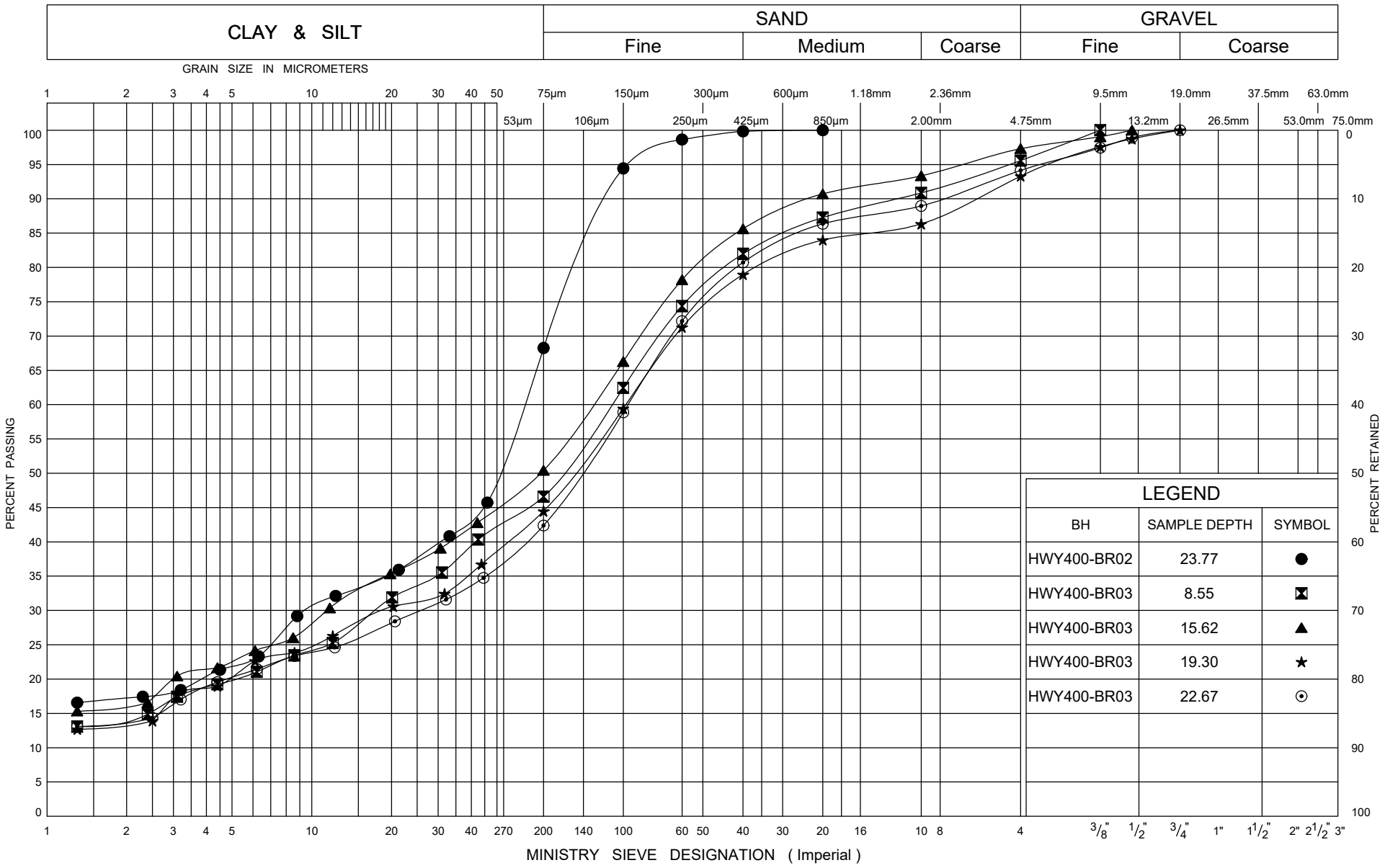
Silty SAND with Gravel to Sandy SILT TILL

FIG No 4B

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25

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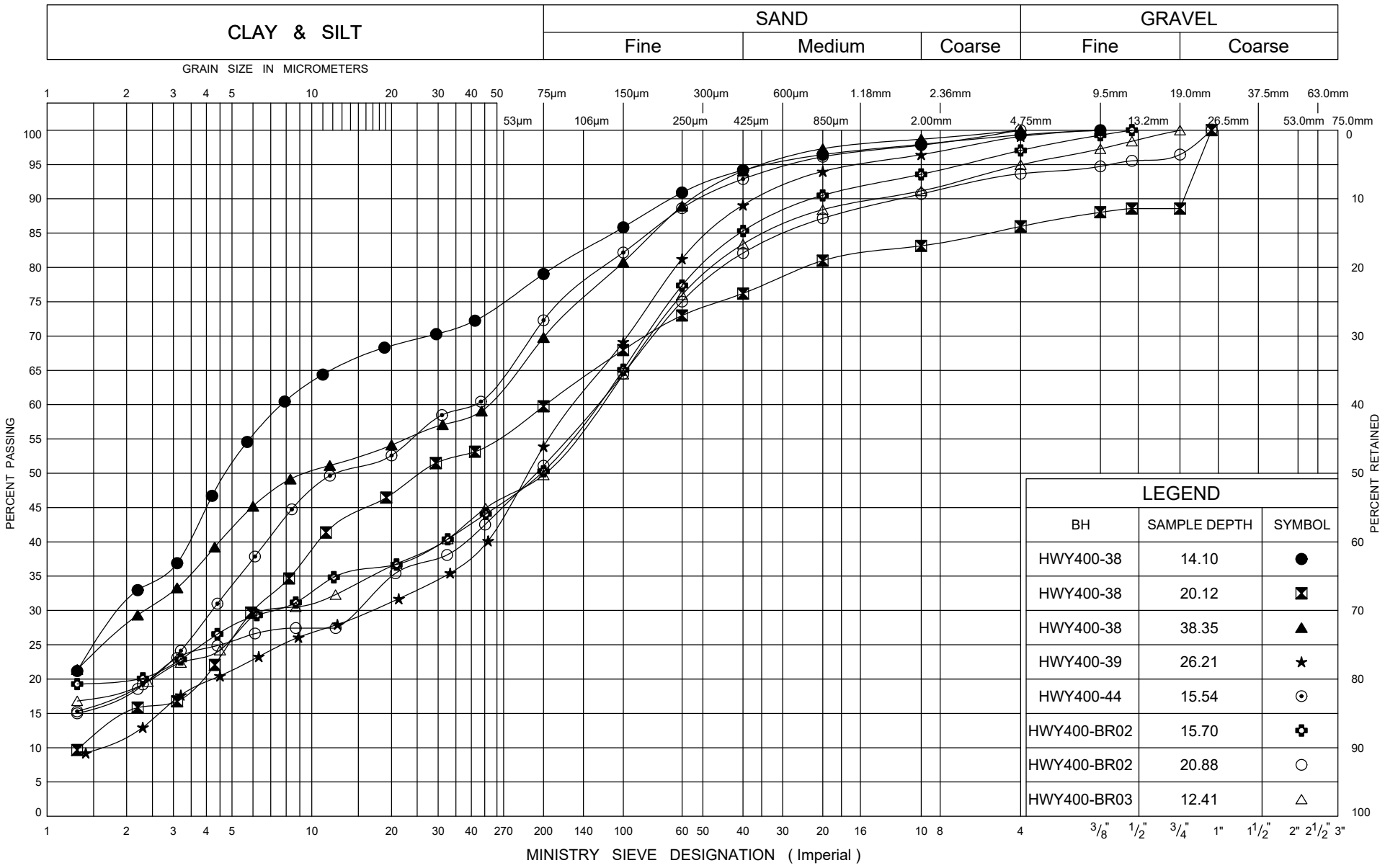
GRAIN SIZE DISTRIBUTION

Silty SAND with Gravel to Sandy SILT TILL

FIG No 4C

W.P.

Highway 400 E-S Ramp



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

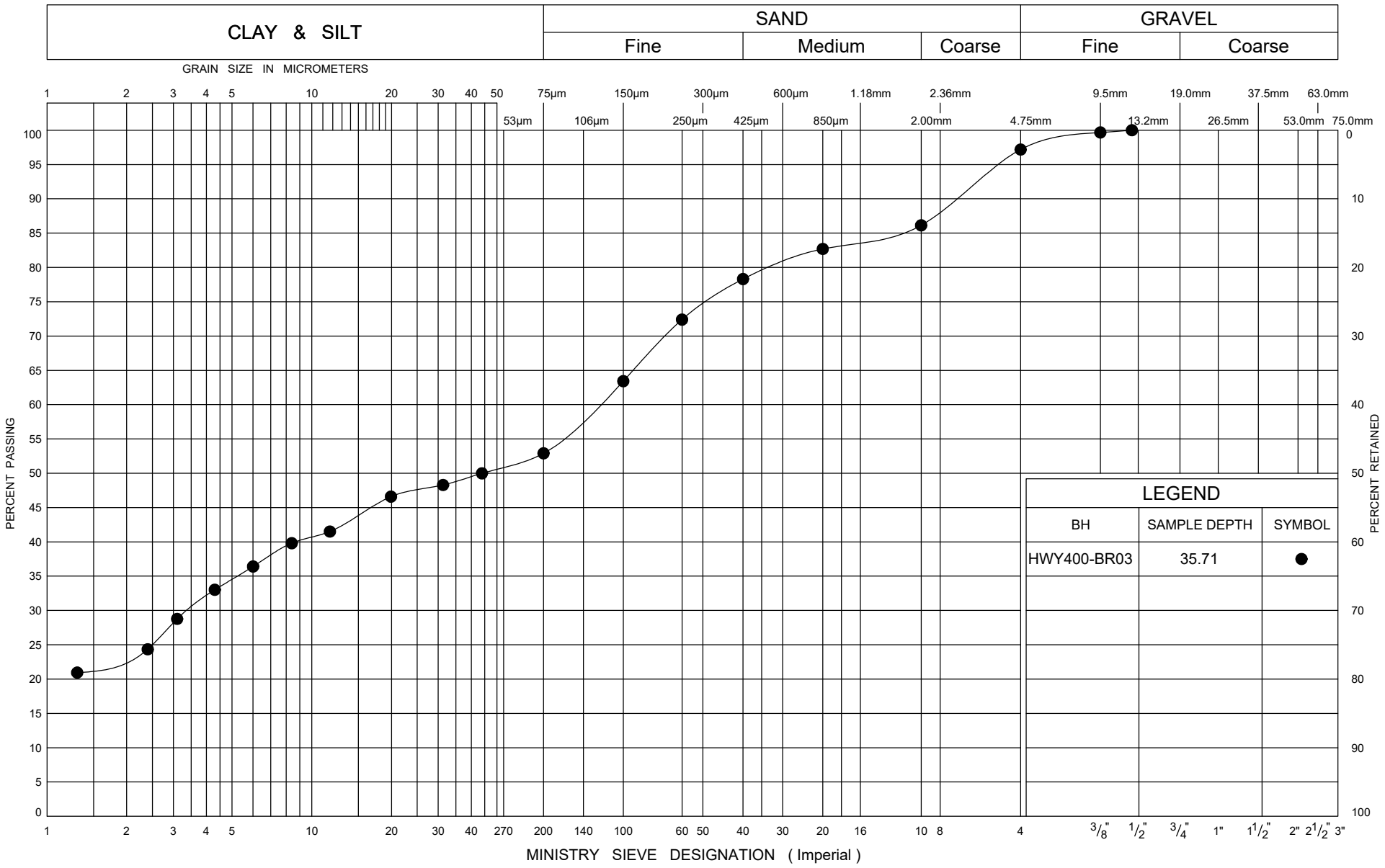
Sandy SILTY CLAY (CL-ML) to CLAY with Sand (CL) TILL

FIG No 5A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25



Ministry of Transportation
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GRAIN SIZE DISTRIBUTION

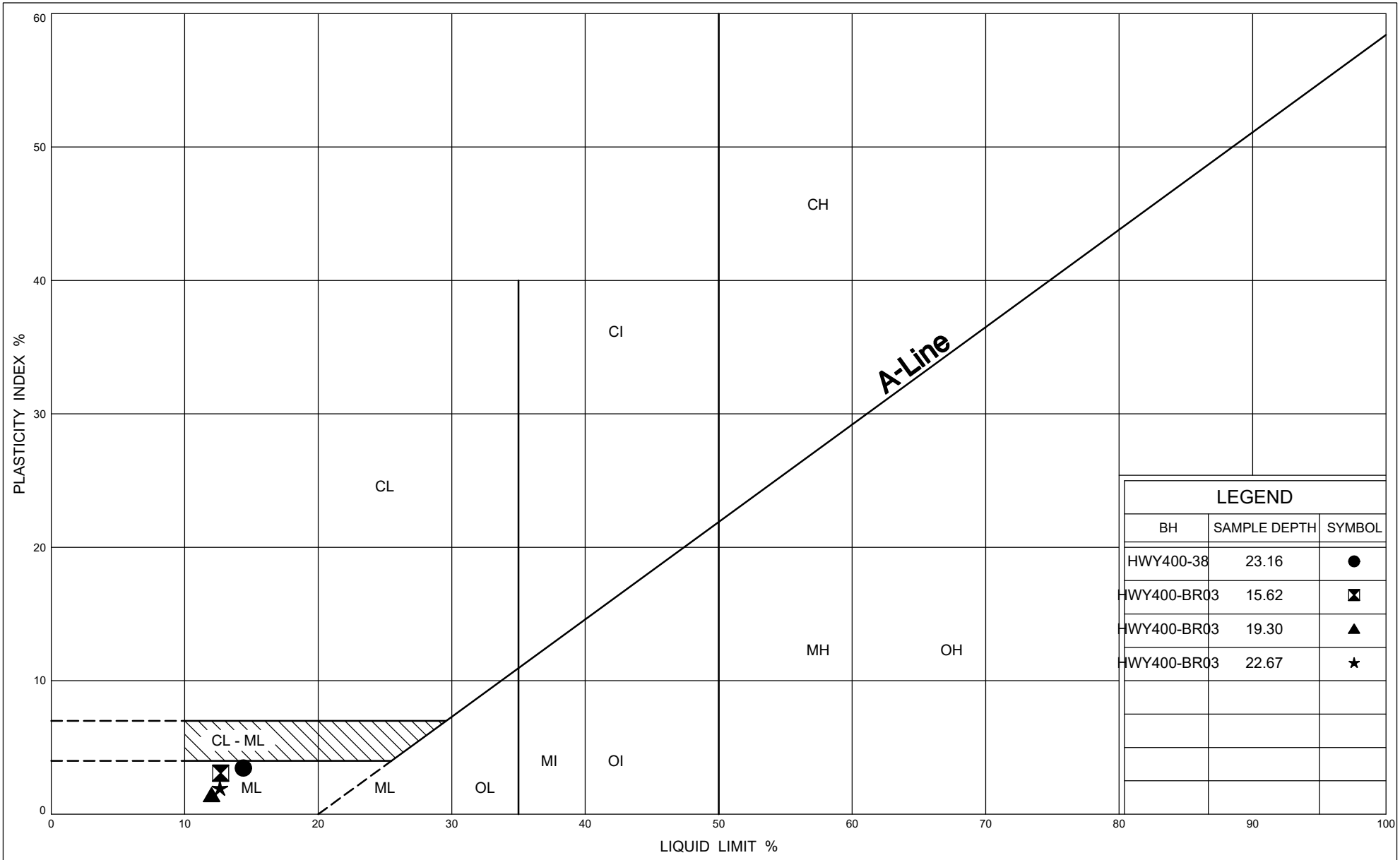
Sandy SILTY CLAY (CL-ML) to CLAY with Sand (CL) TILL

FIG No 5B

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25

Ministry of Transportation
Ontario

PLASTICITY CHART

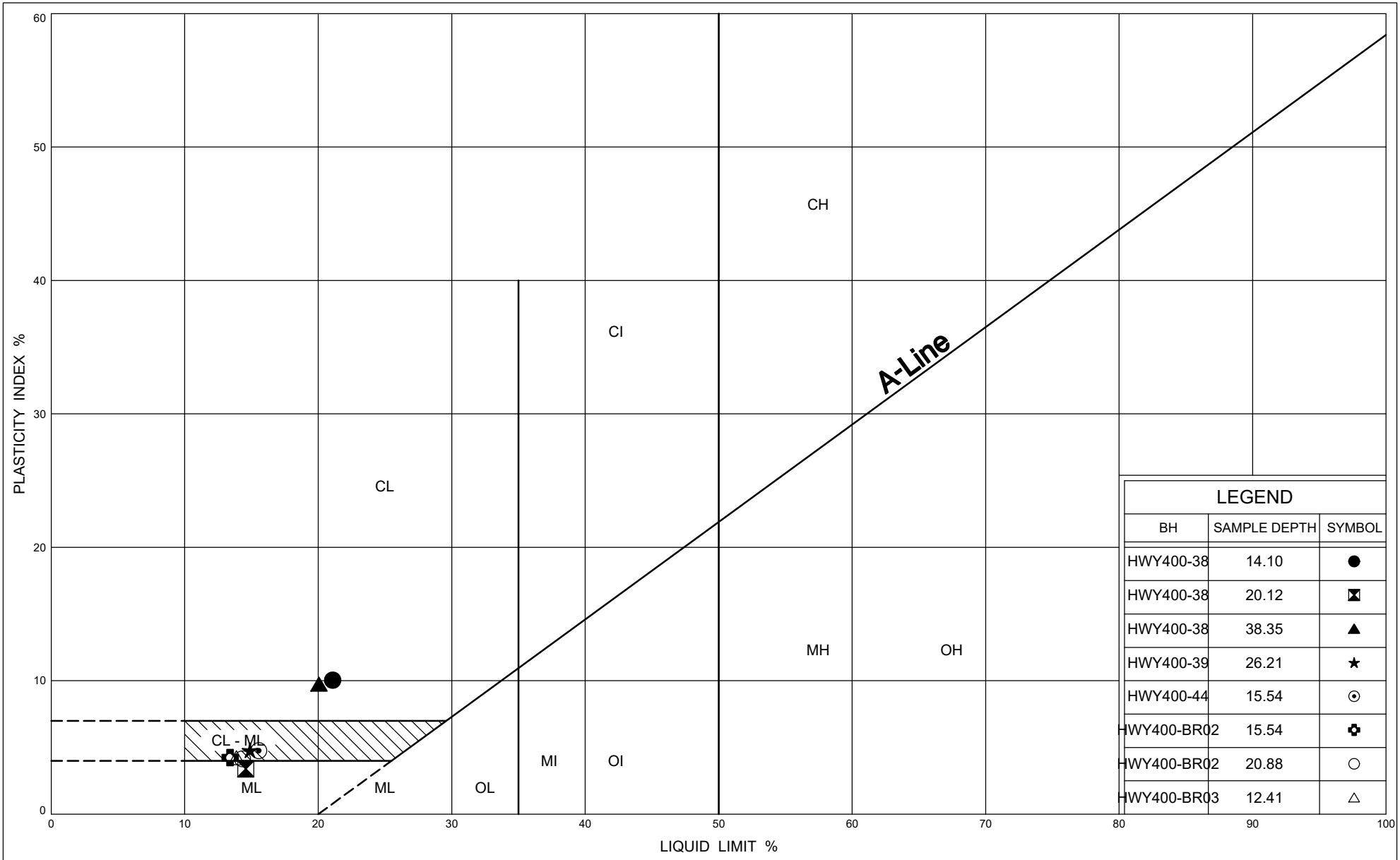
Silty SAND with Gravel to Sandy SILT TILL

FIG No 6

W.P.

Highway 400 E-S Ramp

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-38	14.10	●
HWY400-38	20.12	⊠
HWY400-38	38.35	▲
HWY400-39	26.21	★
HWY400-44	15.54	⊙
HWY400-BR02	15.54	✿
HWY400-BR02	20.88	○
HWY400-BR03	12.41	△

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PLASTICITY CHART

Sandy SILTY CLAY (CL-ML) to CLAY with Sand (CL) TILL

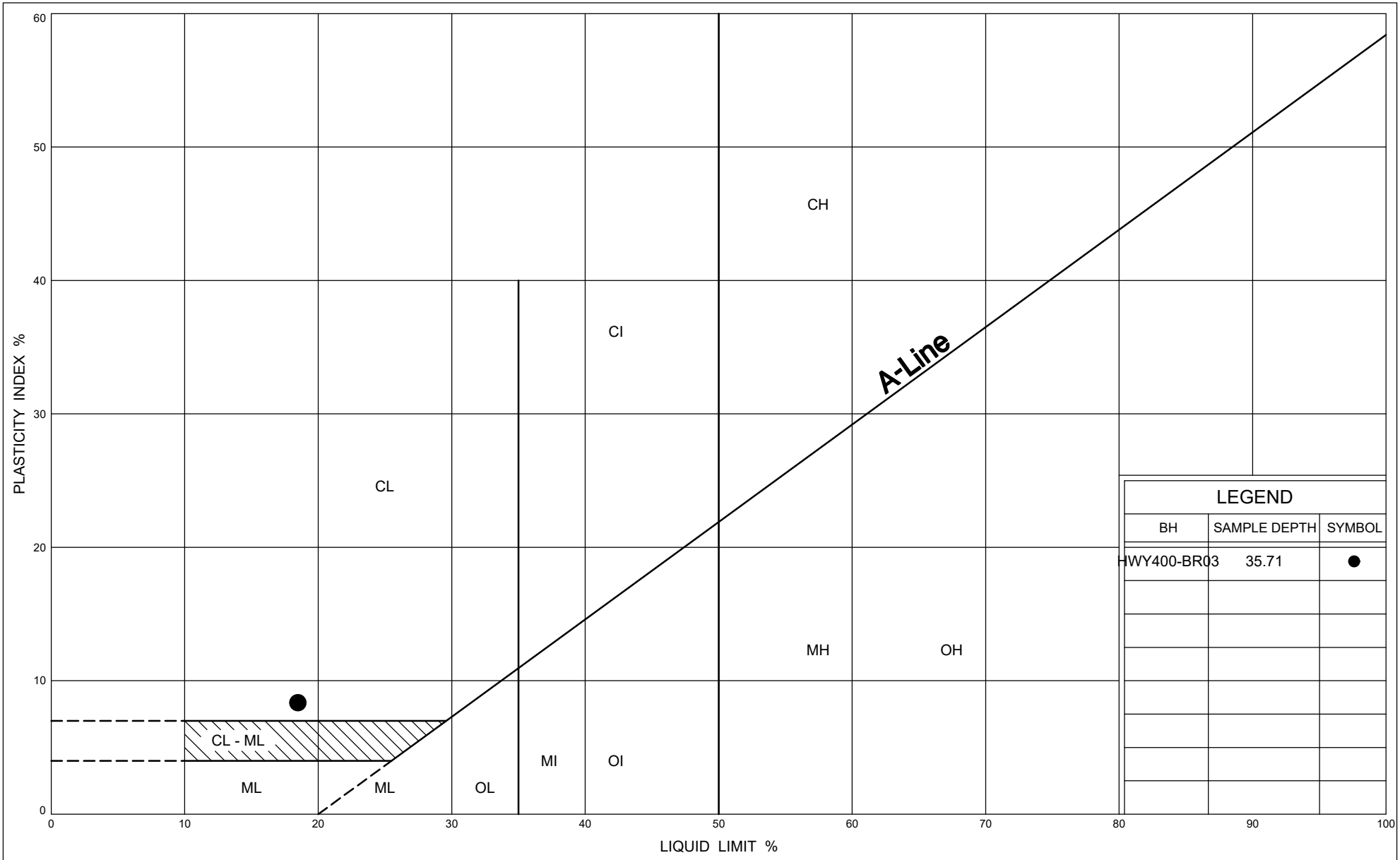
FIG No 7A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/31/25

Ministry of Transportation
Ontario

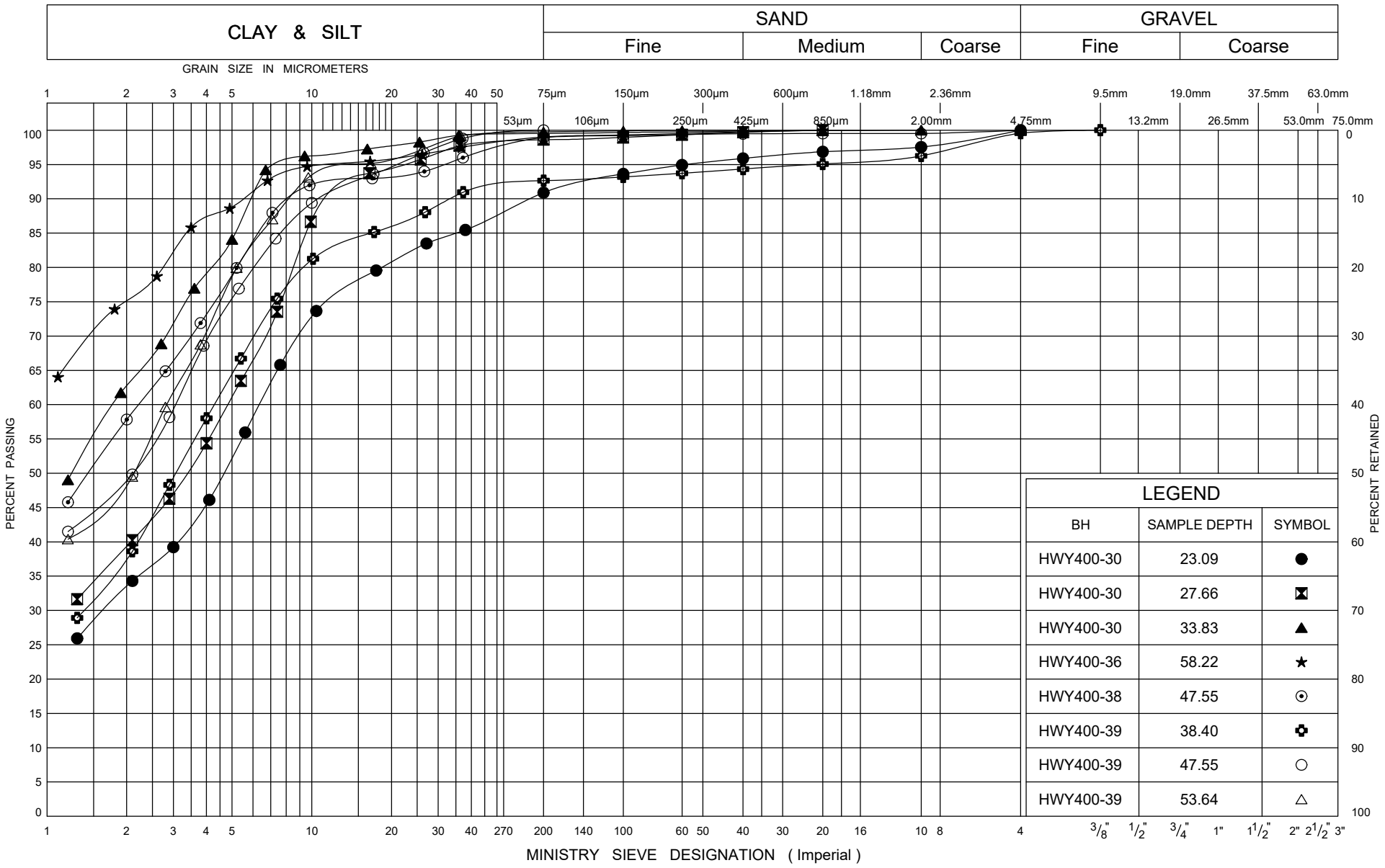
PLASTICITY CHART

Sandy SILTY CLAY (CL-ML) to CLAY with Sand (CL) TILL

FIG No 7B

W.P.

Highway 400 E-S Ramp



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Ontario

GRAIN SIZE DISTRIBUTION

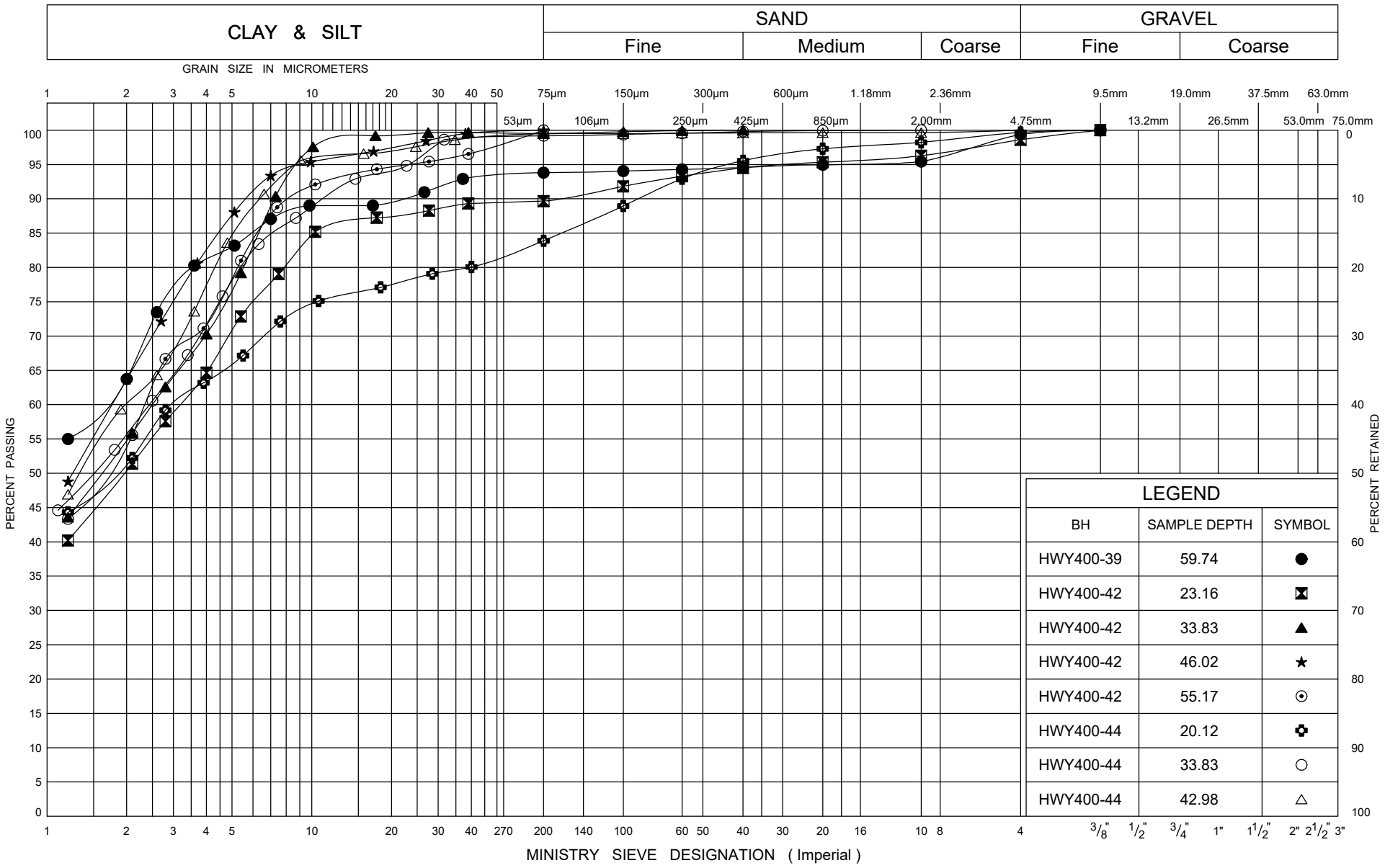
CLAY with Sand (CL) to CLAY (CH)

FIG No 8A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
Ontario

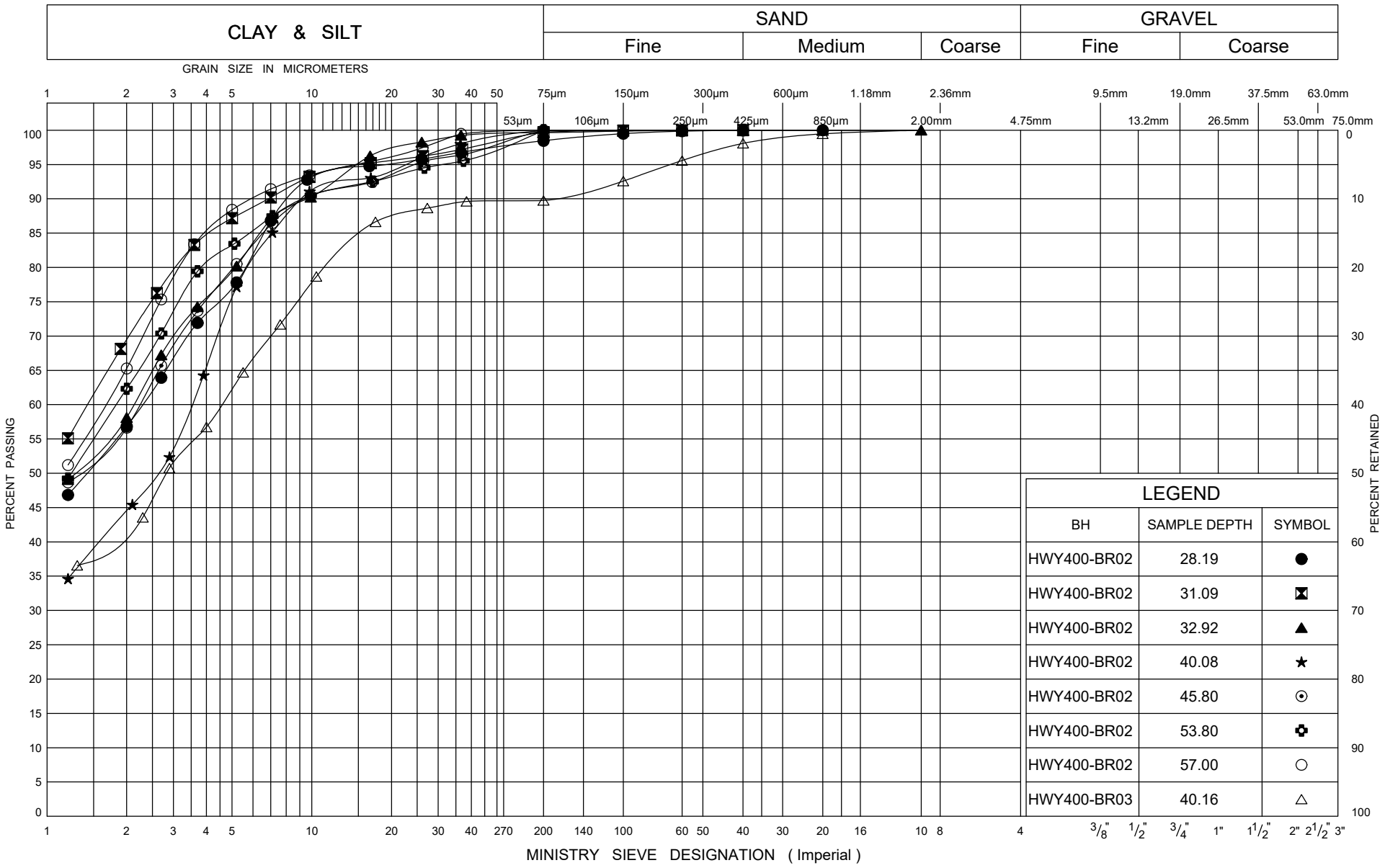
GRAIN SIZE DISTRIBUTION

CLAY with Sand (CL) to CLAY (CH)

FIG No 8B

W.P.

Highway 400 E-S Ramp



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

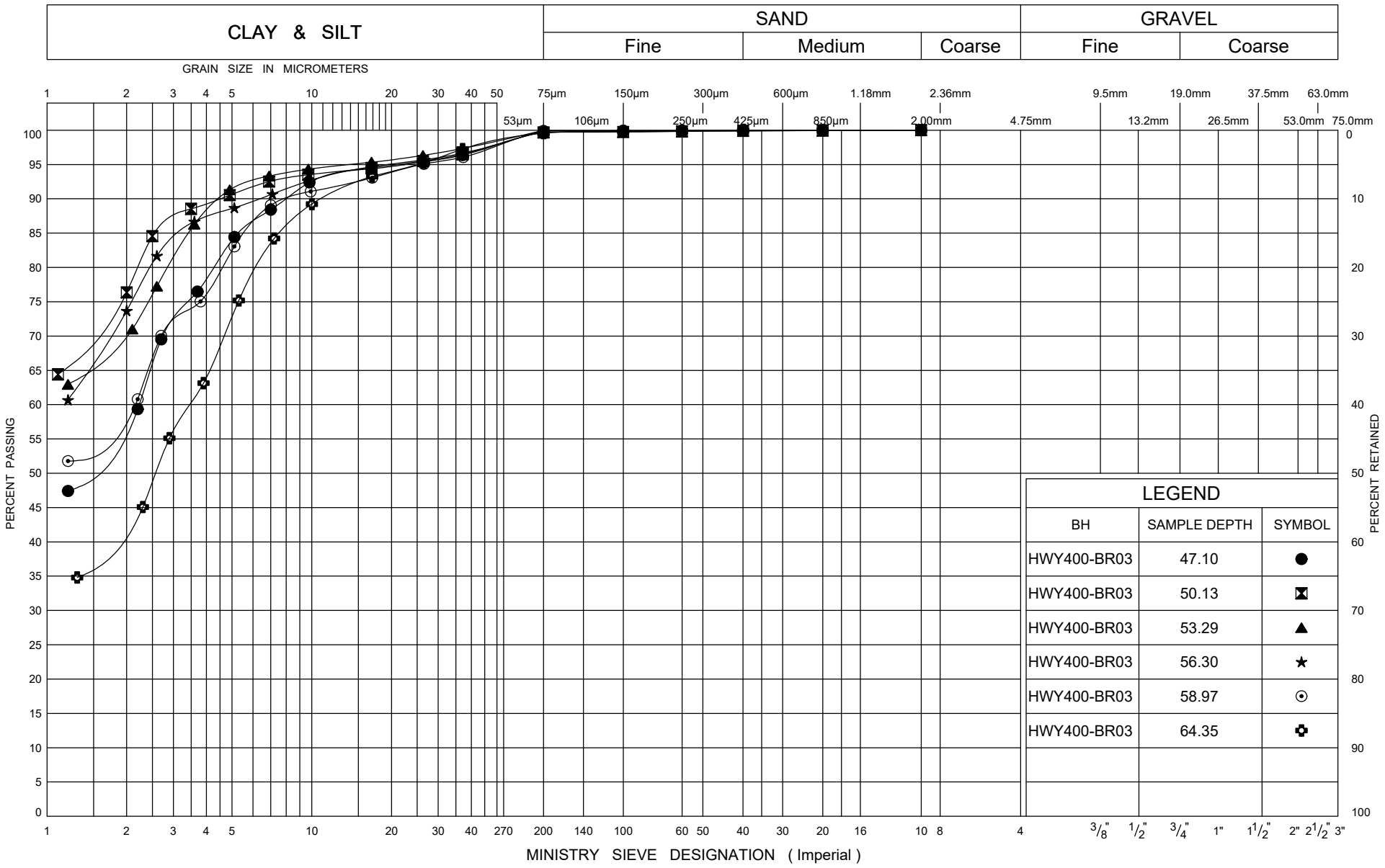
CLAY with Sand (CL) to CLAY (CH)

FIG No 8C

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/22/25



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

CLAY with Sand (CL) to CLAY (CH)

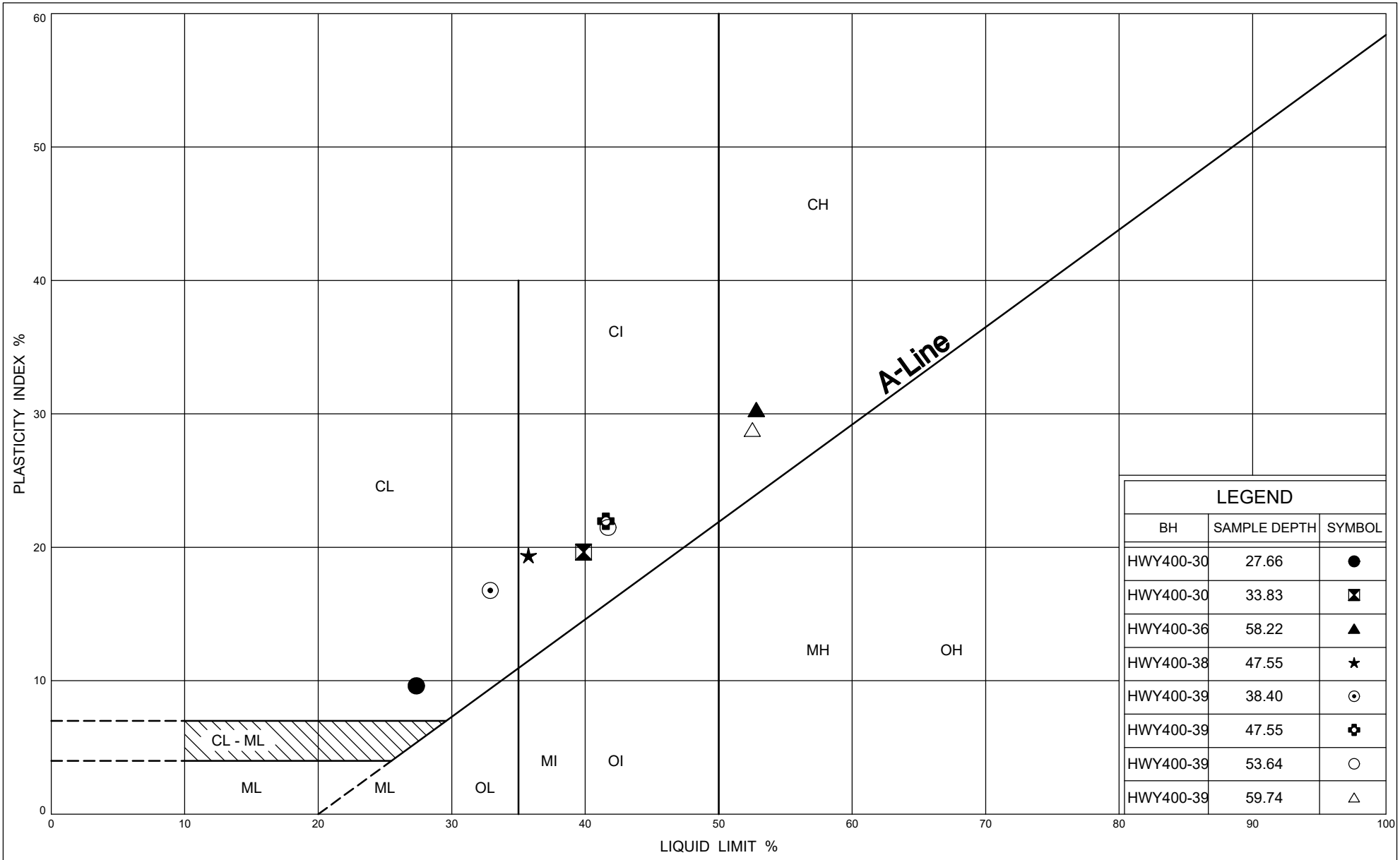
FIG No 8D

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/22/25

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-30	27.66	●
HWY400-30	33.83	⊠
HWY400-36	58.22	▲
HWY400-38	47.55	★
HWY400-39	38.40	⊙
HWY400-39	47.55	✿
HWY400-39	53.64	○
HWY400-39	59.74	△

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PLASTICITY CHART

CLAY with Sand (CL) to CLAY (CH)

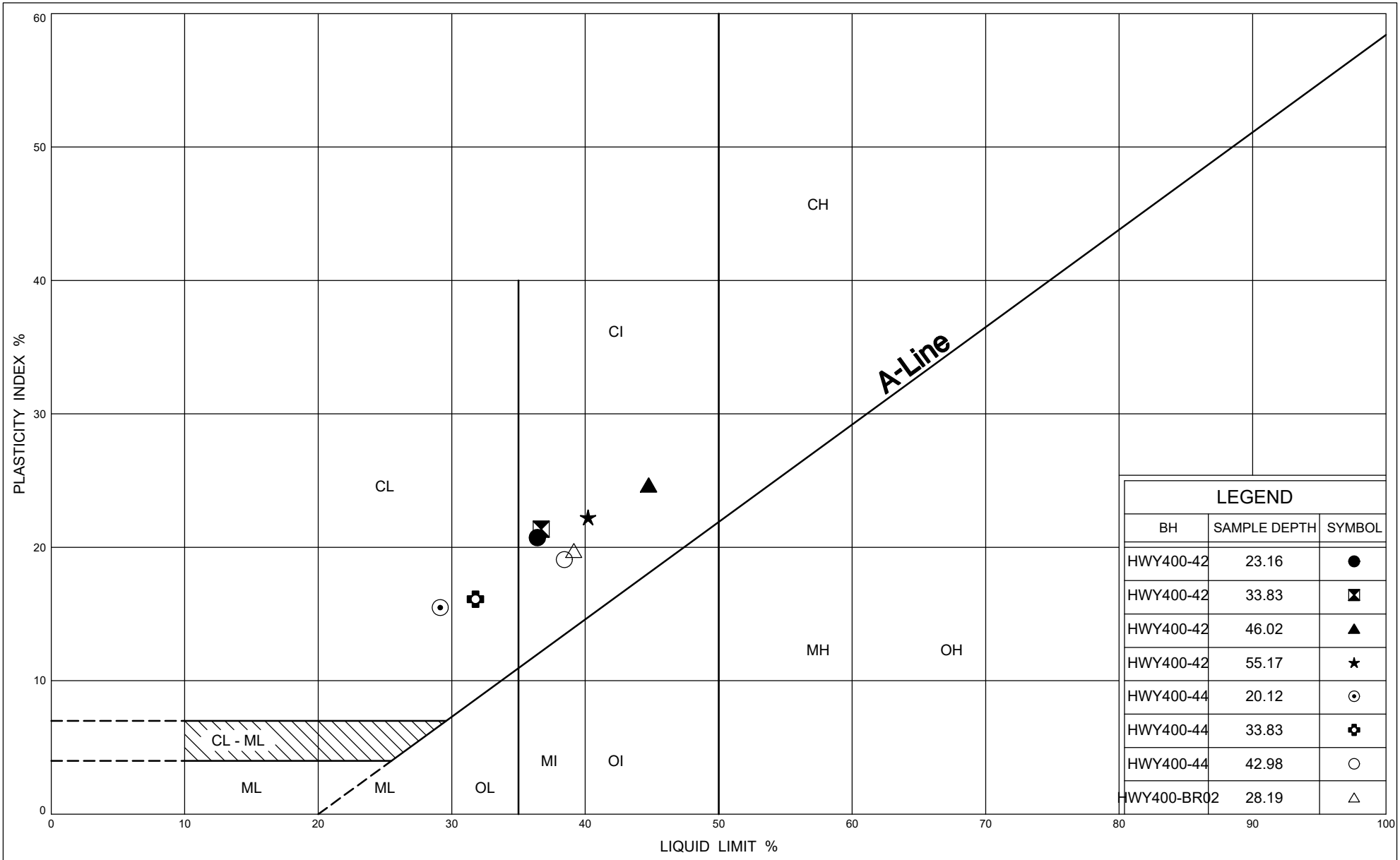
FIG No 9A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-42	23.16	●
HWY400-42	33.83	⊠
HWY400-42	46.02	▲
HWY400-42	55.17	★
HWY400-44	20.12	⊙
HWY400-44	33.83	✿
HWY400-44	42.98	○
HWY400-BR02	28.19	△

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
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PLASTICITY CHART

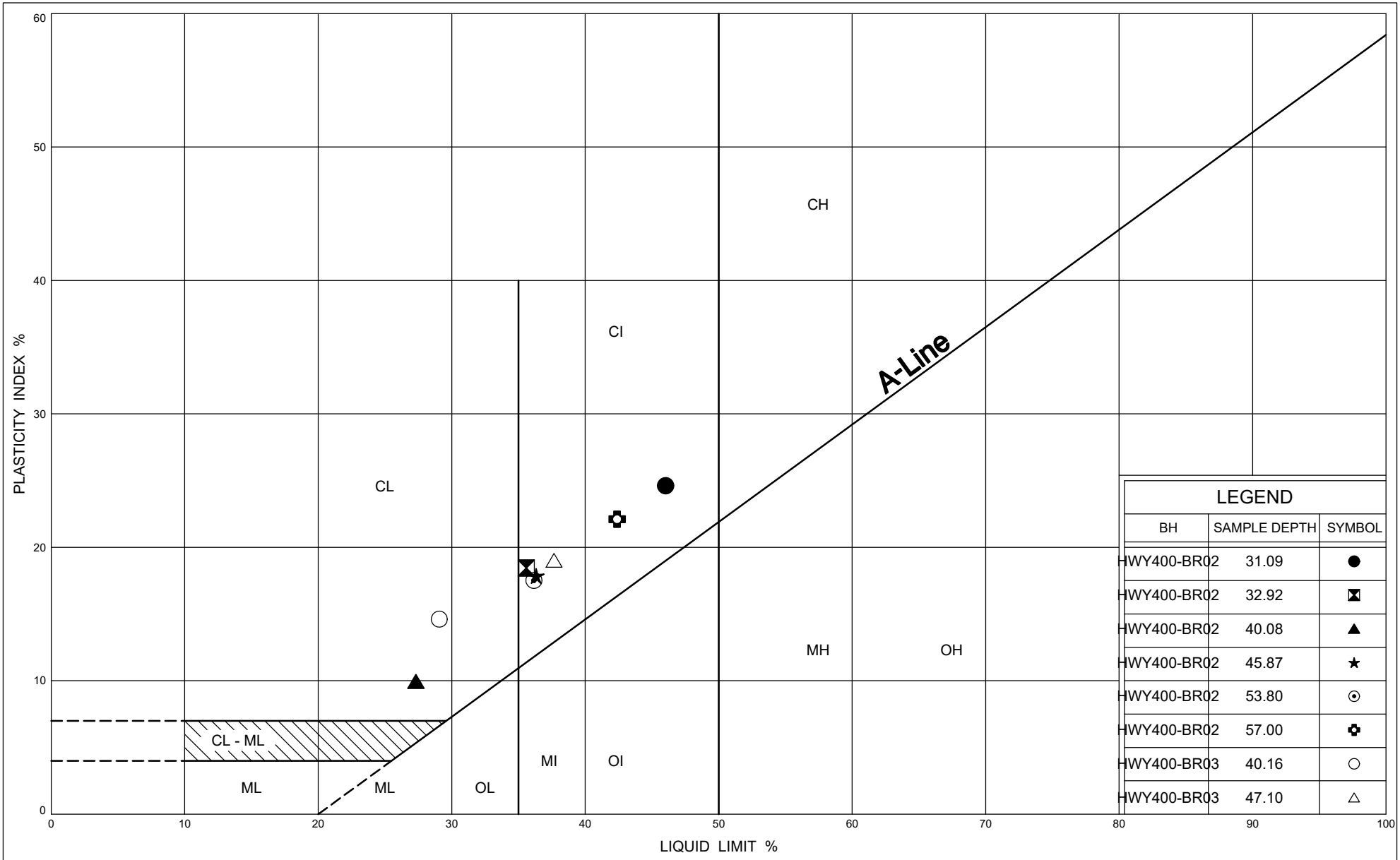
CLAY with Sand (CL) to CLAY (CH)

FIG No 9B

W.P.

Highway 400 E-S Ramp

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-BR02	31.09	●
HWY400-BR02	32.92	⊠
HWY400-BR02	40.08	▲
HWY400-BR02	45.87	★
HWY400-BR02	53.80	⊙
HWY400-BR02	57.00	✿
HWY400-BR03	40.16	○
HWY400-BR03	47.10	△

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/22/25

Ministry of Transportation
Ontario

PLASTICITY CHART

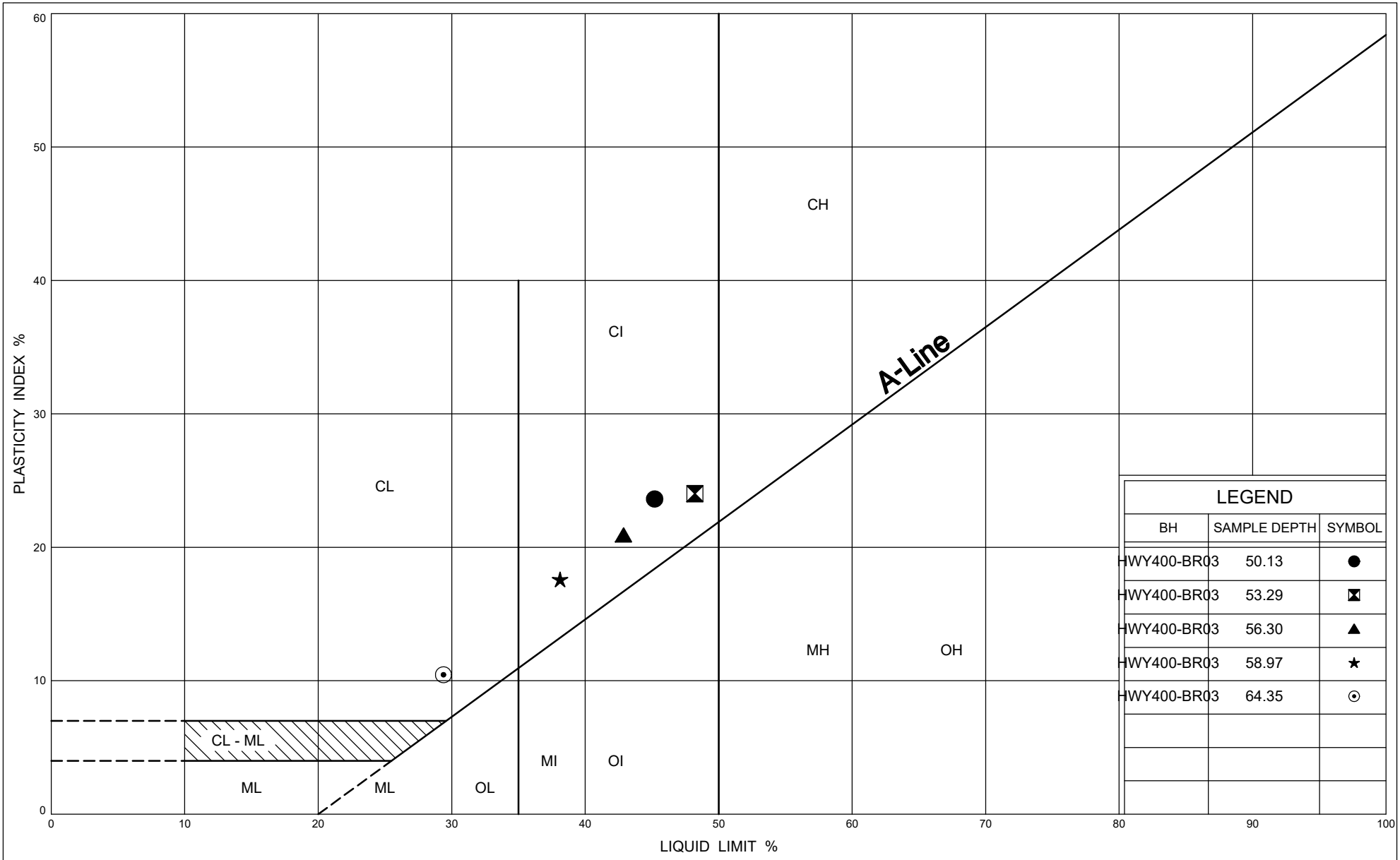
CLAY with Sand (CL) to CLAY (CH)

FIG No 9C

W.P.

Highway 400 E-S Ramp

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/22/25

Ministry of Transportation
Ontario

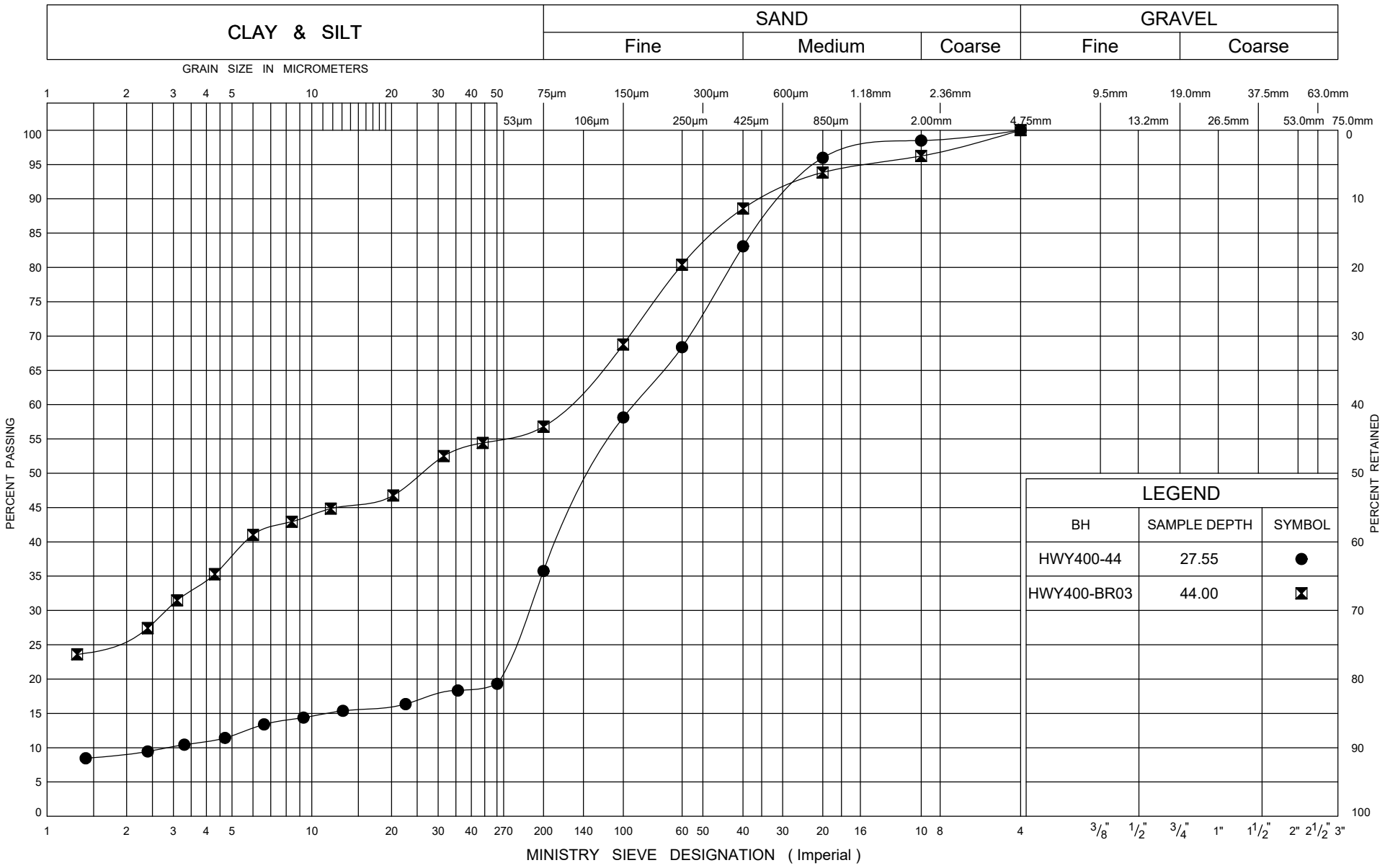
PLASTICITY CHART

CLAY with Sand (CL) to CLAY (CH)

FIG No 9D

W.P.

Highway 400 E-S Ramp



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GRAIN SIZE DISTRIBUTION

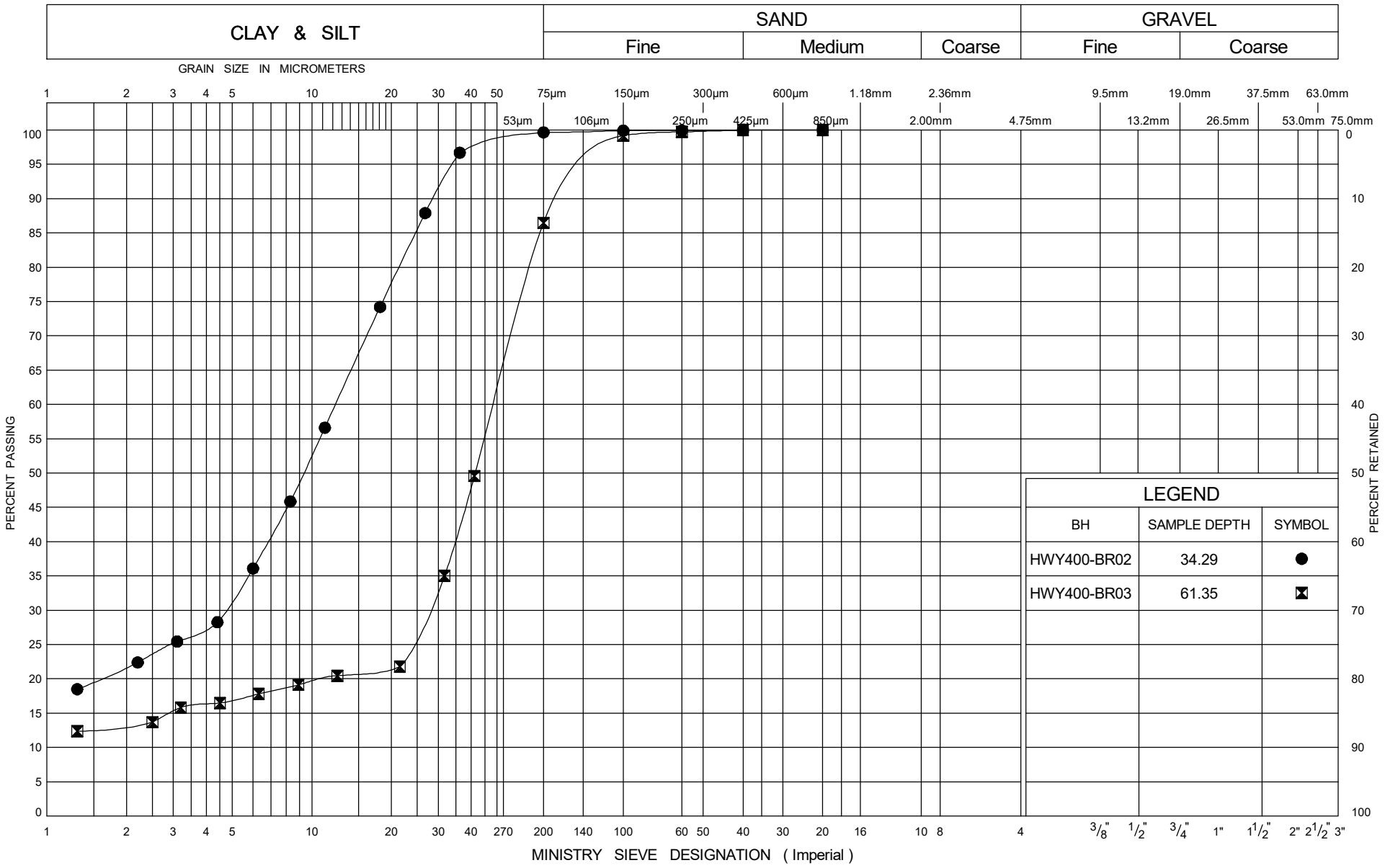
Silty SAND and Sandy CLAY (CL) Interlayers

FIG No 10A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25



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GRAIN SIZE DISTRIBUTION

SILT to Silty CLAY (CL-ML) Interlayers

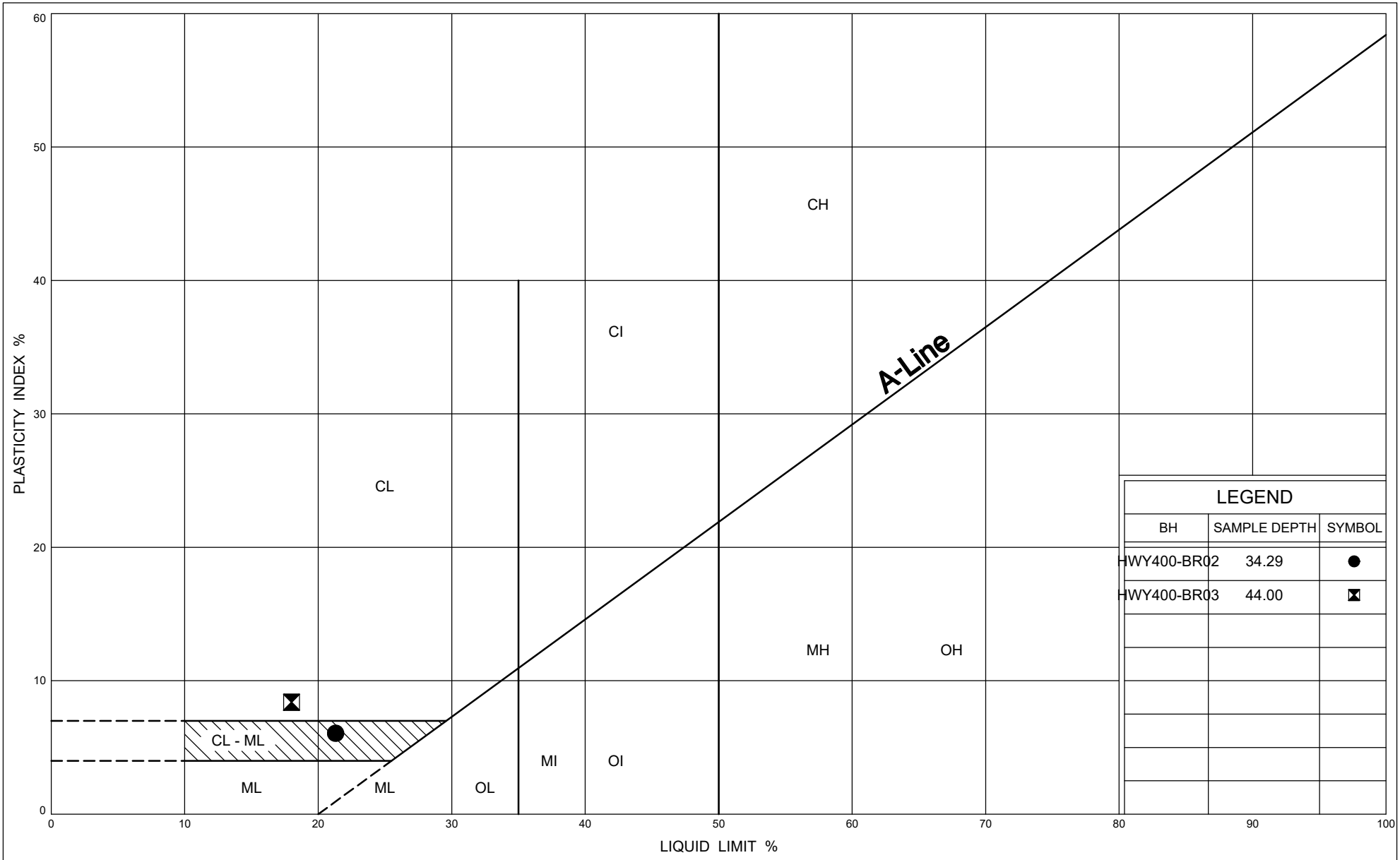
FIG No 10B

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 11/6/25

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ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/22/25

Ministry of Transportation
Ontario

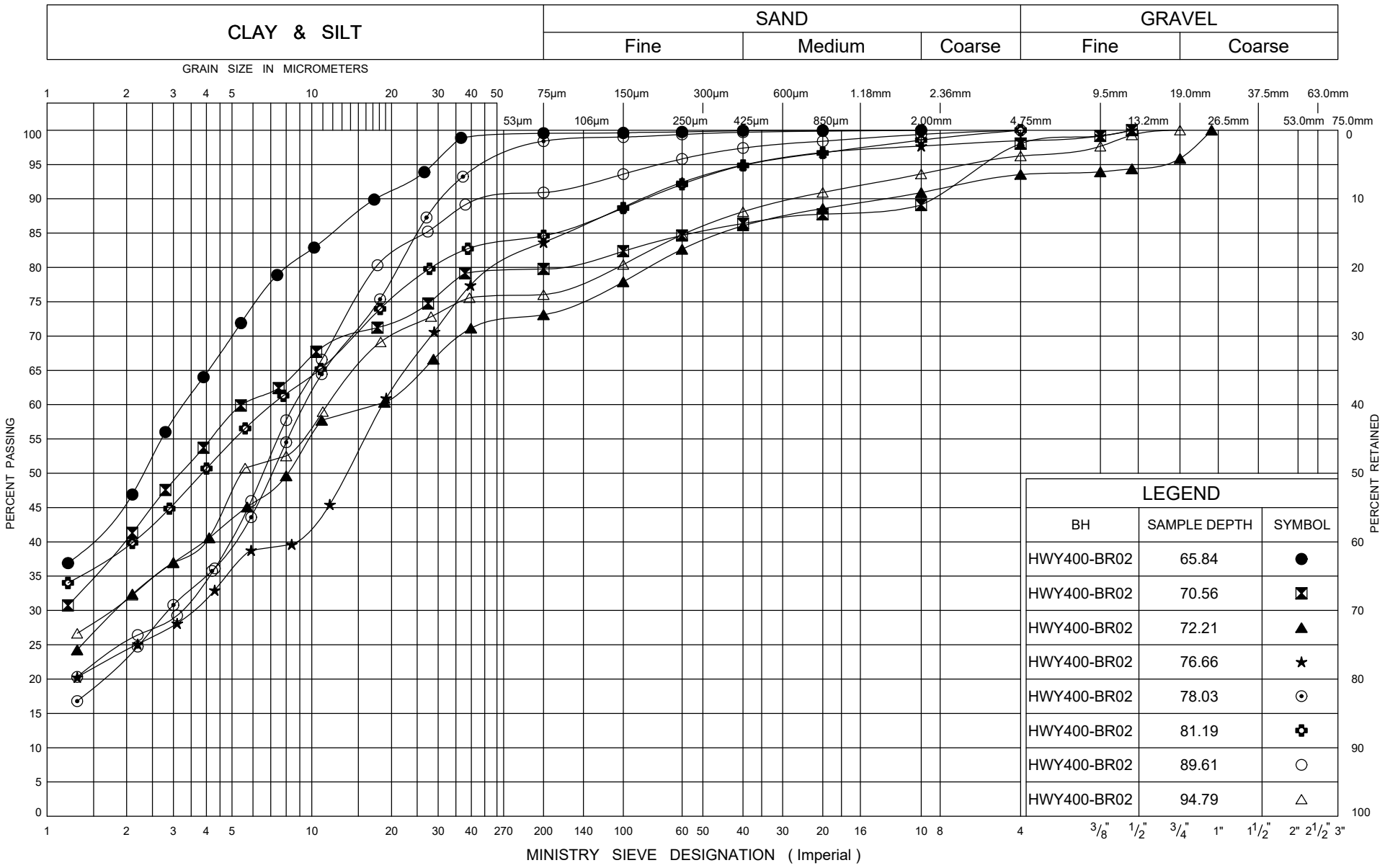
PLASTICITY CHART

Sandy CLAY (CL) and Silty CLAY (CL-ML) Interlayers

FIG No 11

W.P.

Highway 400 E-S Ramp



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
Ontario

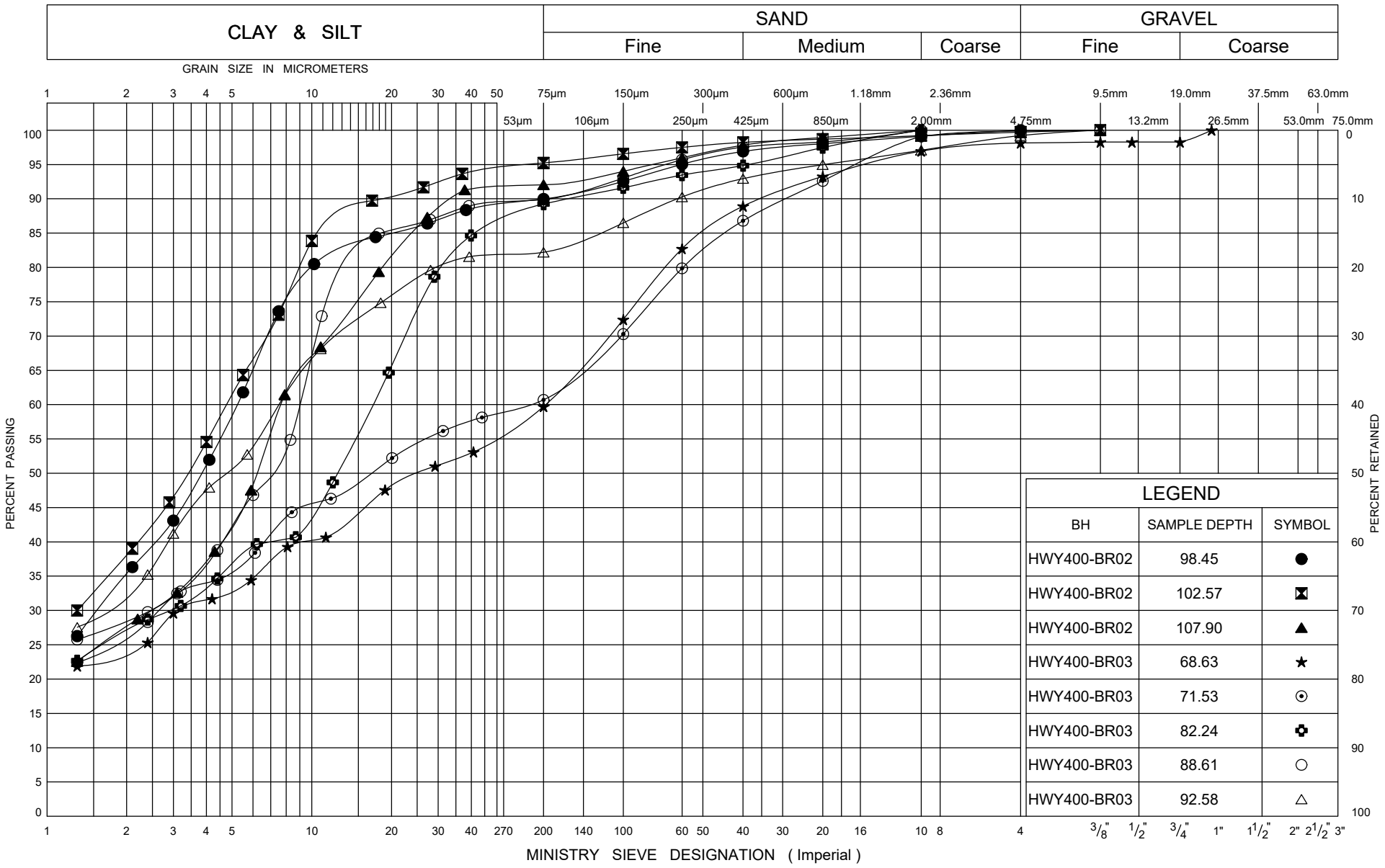
GRAIN SIZE DISTRIBUTION

Sandy CLAY (CL) to CLAY (CL) TILL

FIG No 12A

W.P.

Highway 400 E-S Ramp



ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

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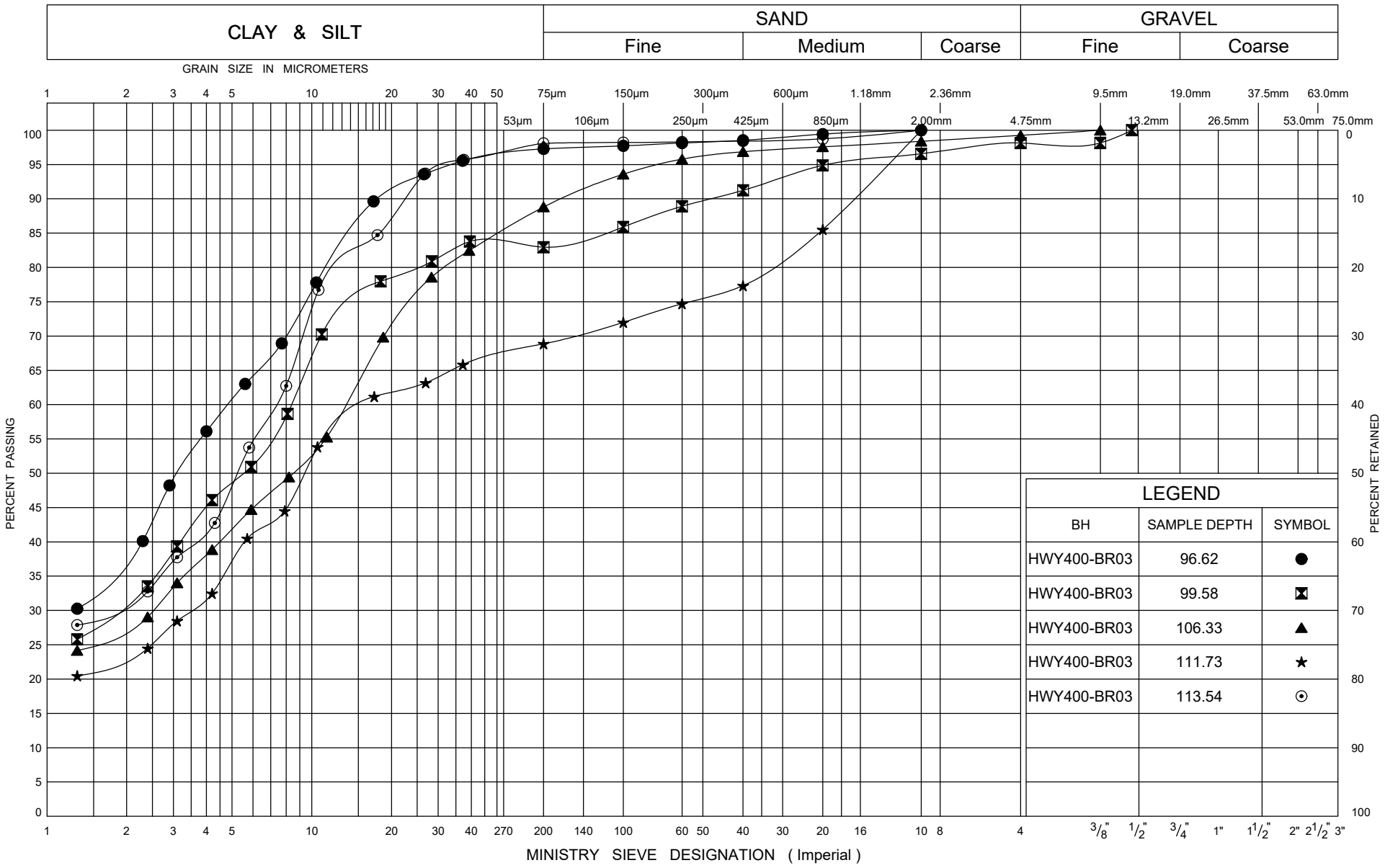
GRAIN SIZE DISTRIBUTION

Sandy CLAY (CL) to CLAY (CL) TILL

FIG No 12B

W.P.

Highway 400 E-S Ramp



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GRAIN SIZE DISTRIBUTION

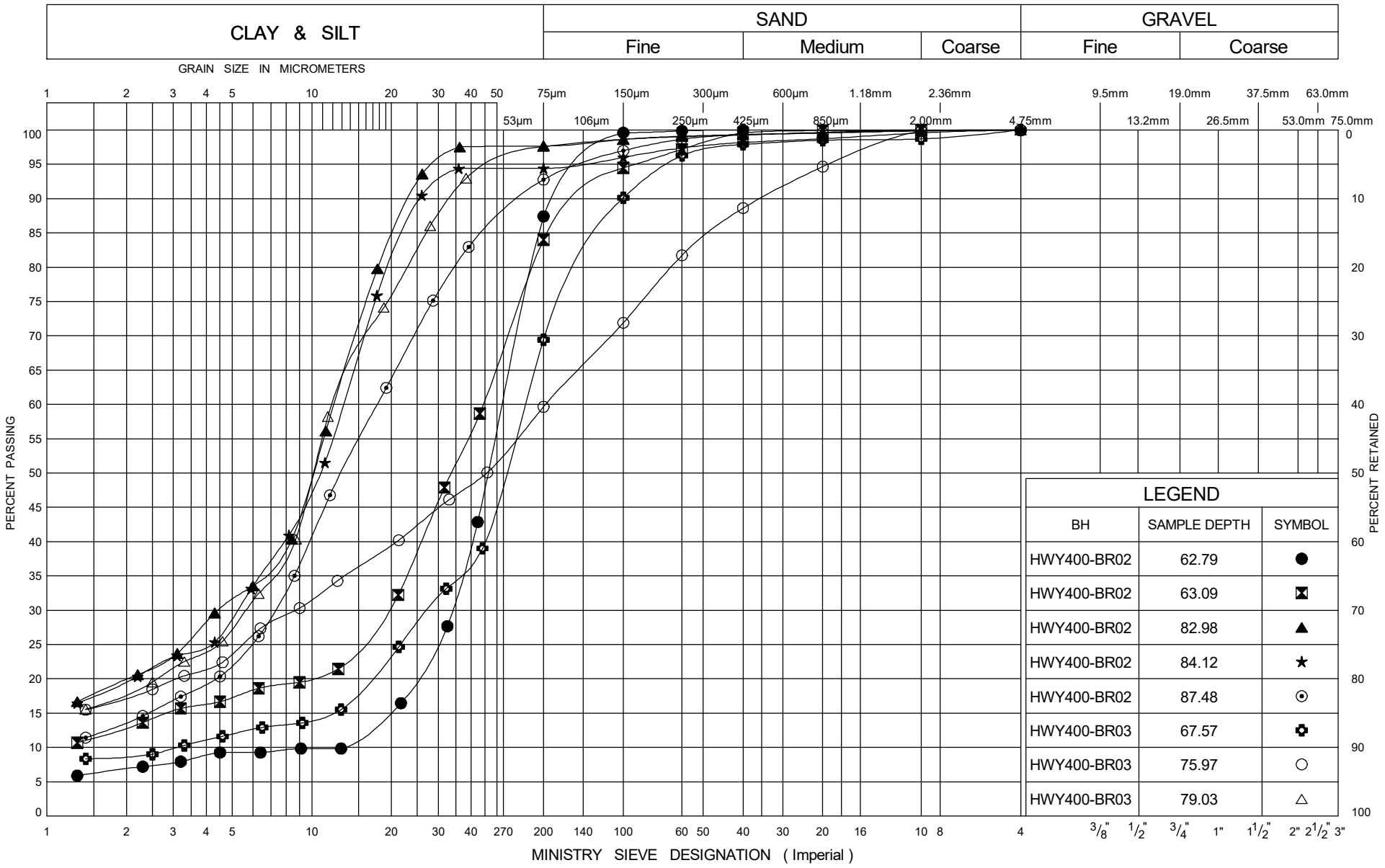
Sandy CLAY (CL) to CLAY (CL) TILL

FIG No 12C

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

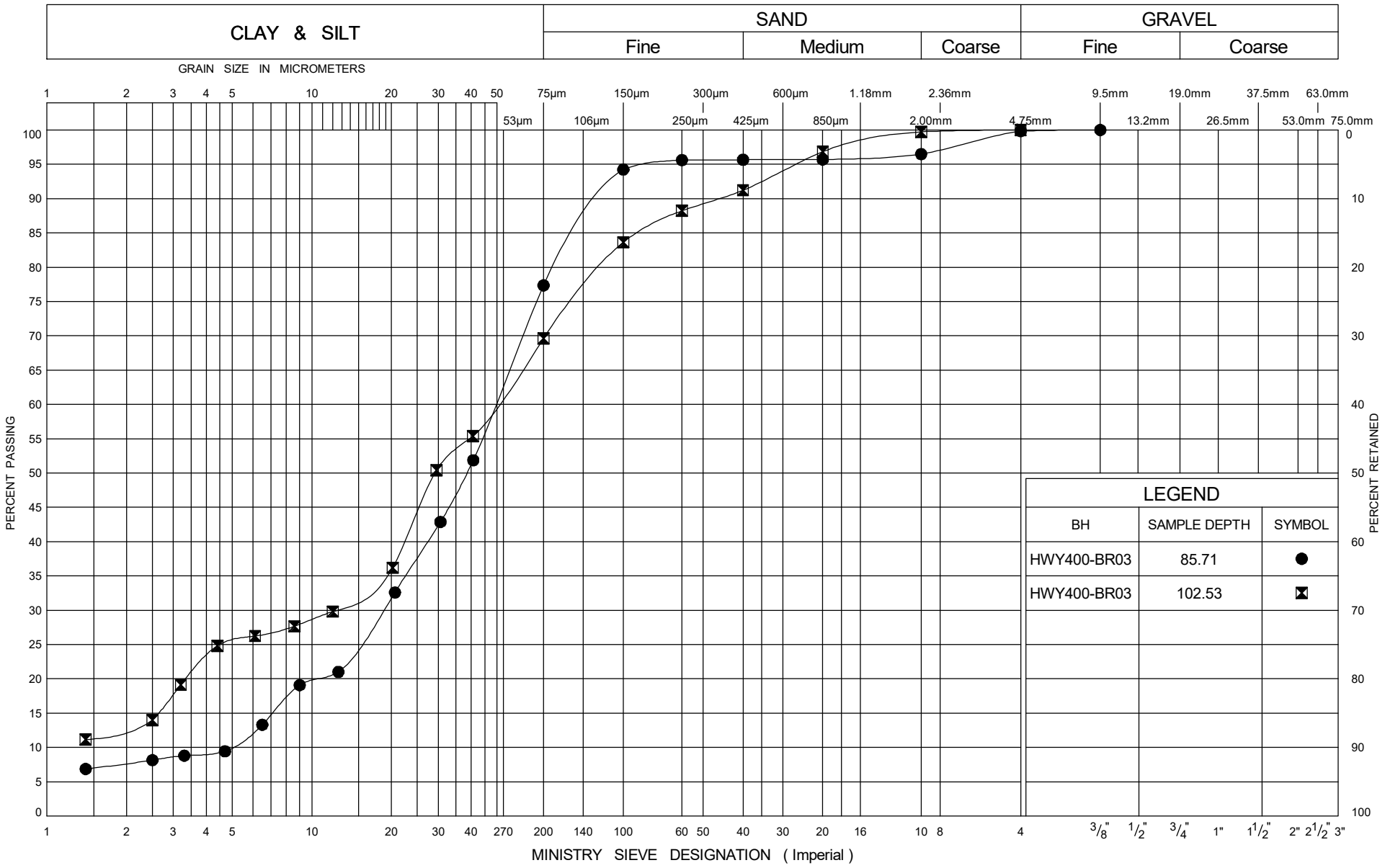
Sandy SILT to SILT TILL

FIG No 13A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 11/6/25



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Sandy SILT to SILT TILL

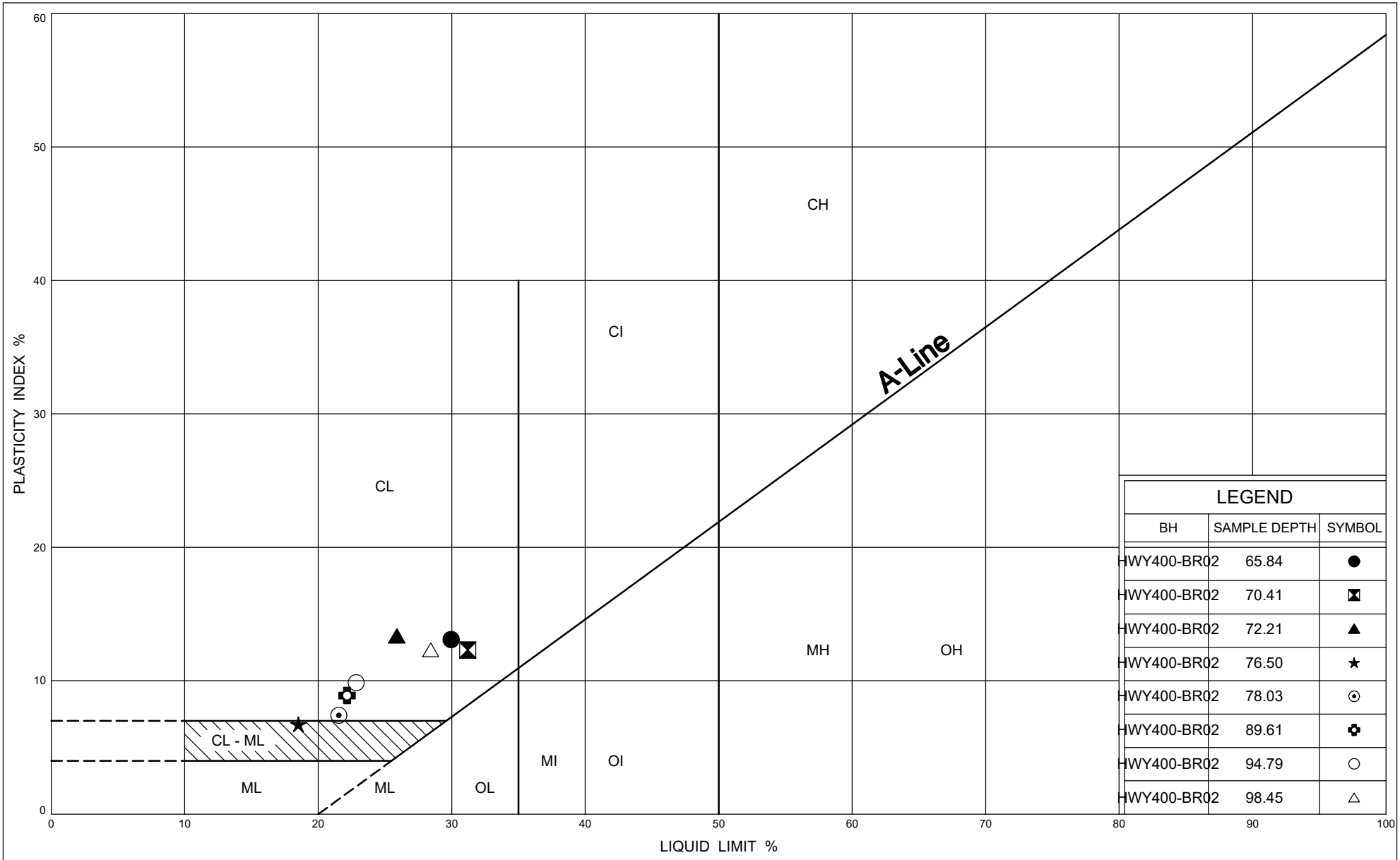
FIG No 13B

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 11/6/25

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HWY400-BR02	65.84	●
HWY400-BR02	70.41	⊠
HWY400-BR02	72.21	▲
HWY400-BR02	76.50	★
HWY400-BR02	78.03	⊙
HWY400-BR02	89.61	✿
HWY400-BR02	94.79	○
HWY400-BR02	98.45	△

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PLASTICITY CHART

Sandy CLAY (CL) to CLAY (CL) TILL

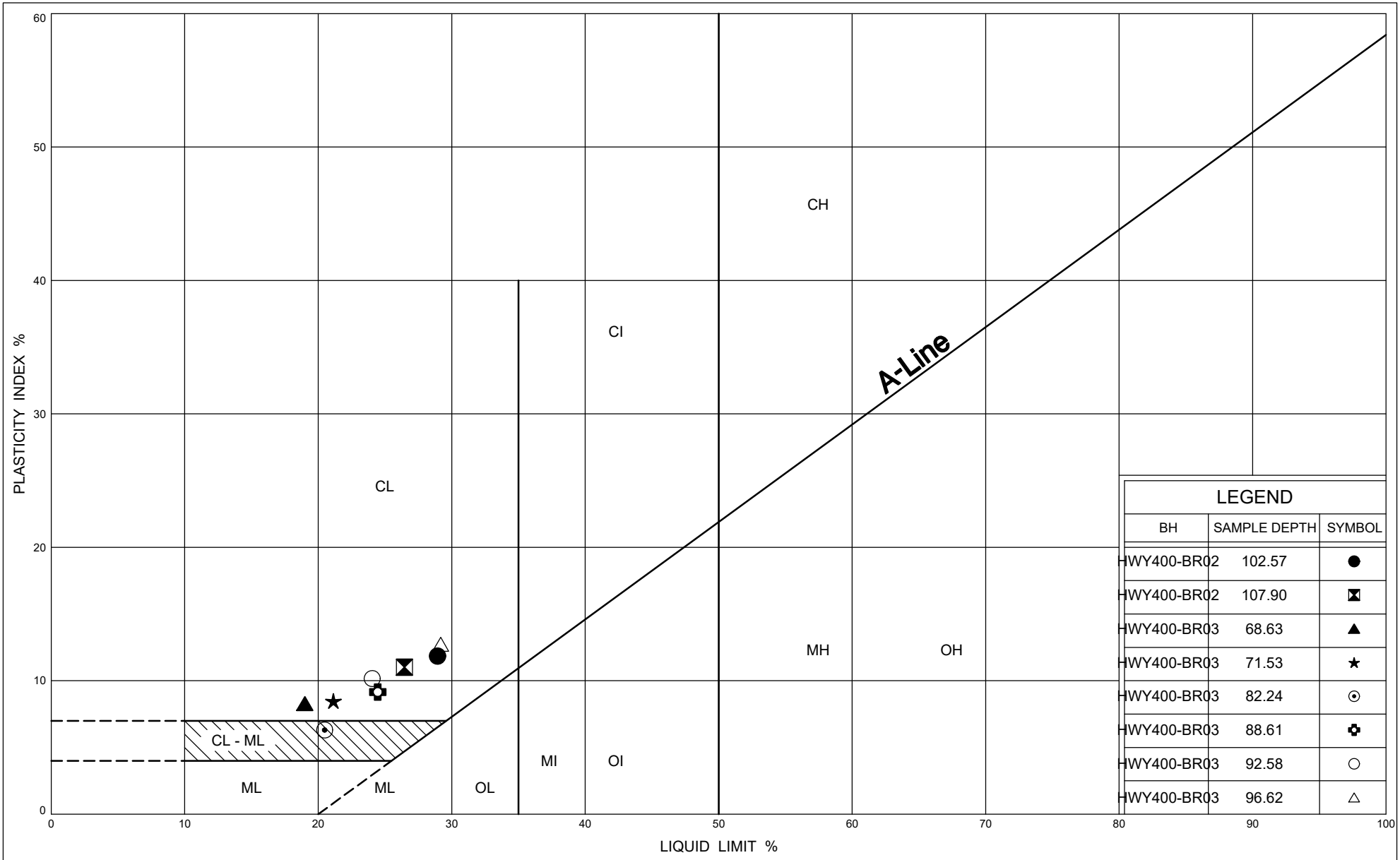
FIG No 14A

W.P.

Highway 400 E-S Ramp

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
Ontario

PLASTICITY CHART

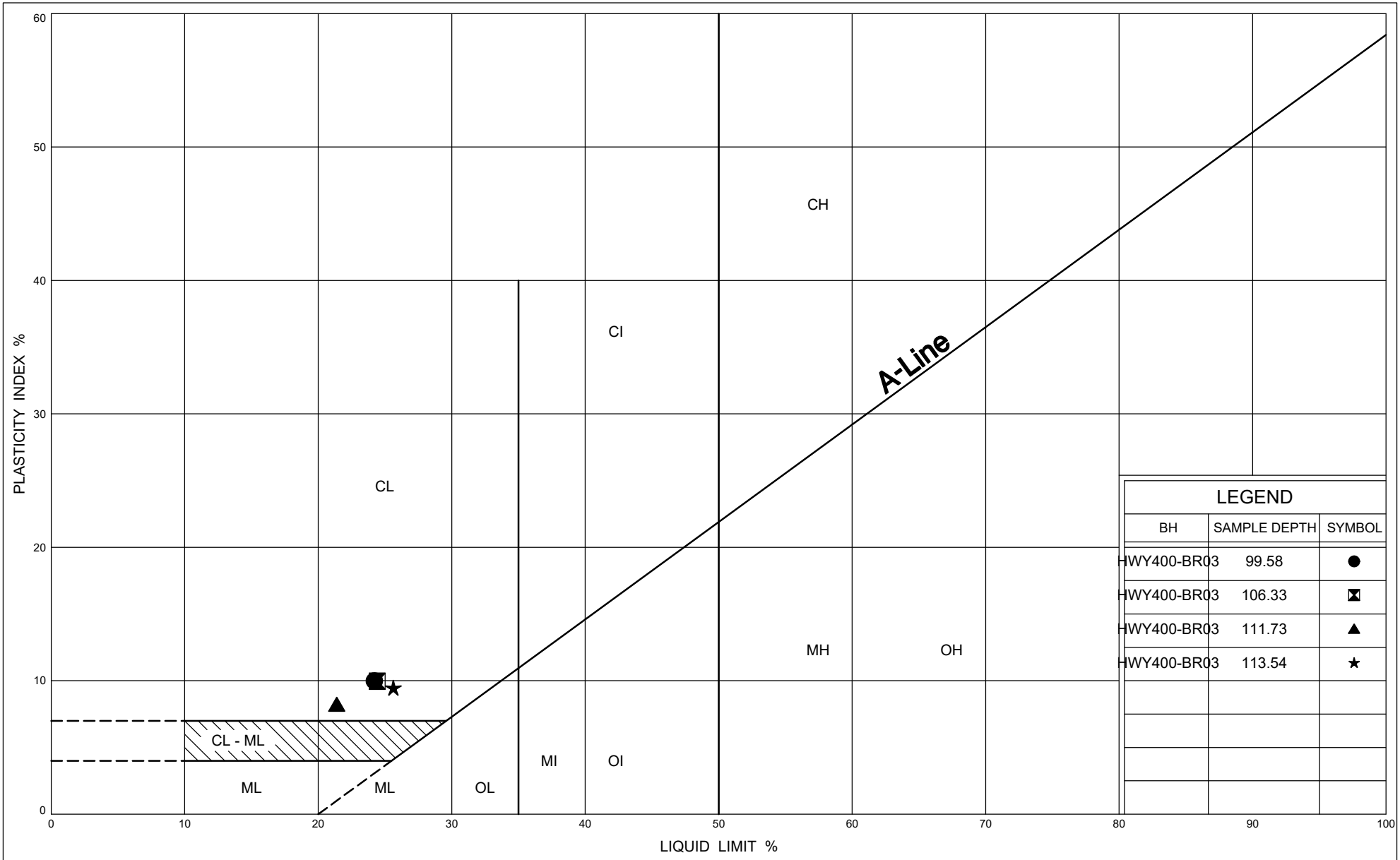
Sandy CLAY (CL) to CLAY (CL) TILL

FIG No 14B

W.P.

Highway 400 E-S Ramp

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Ministry of Transportation
Ontario

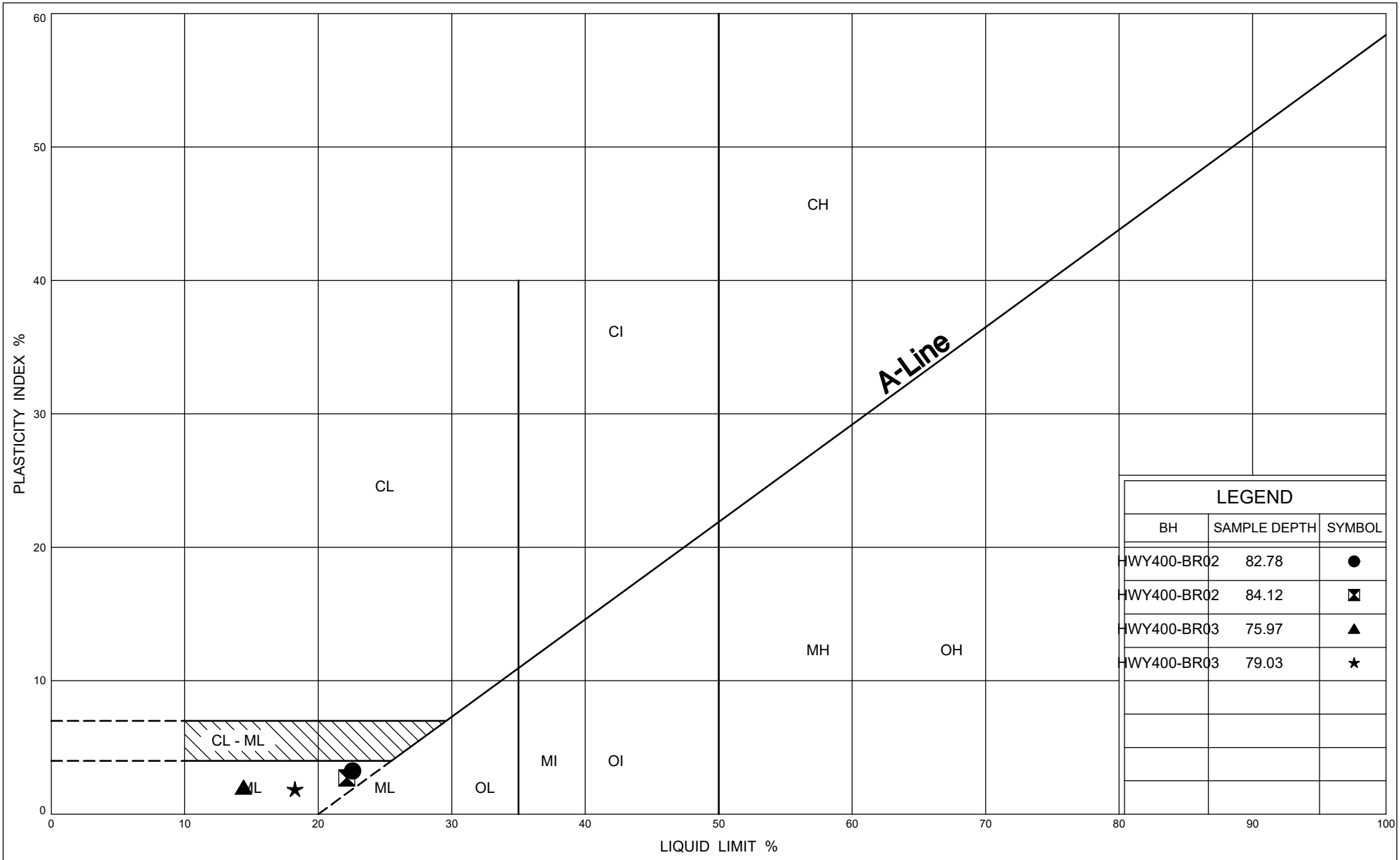
PLASTICITY CHART

Sandy CLAY (CL) to CLAY (CL) TILL

FIG No 14C

W.P.

Highway 400 E-S Ramp



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PLASTICITY CHART

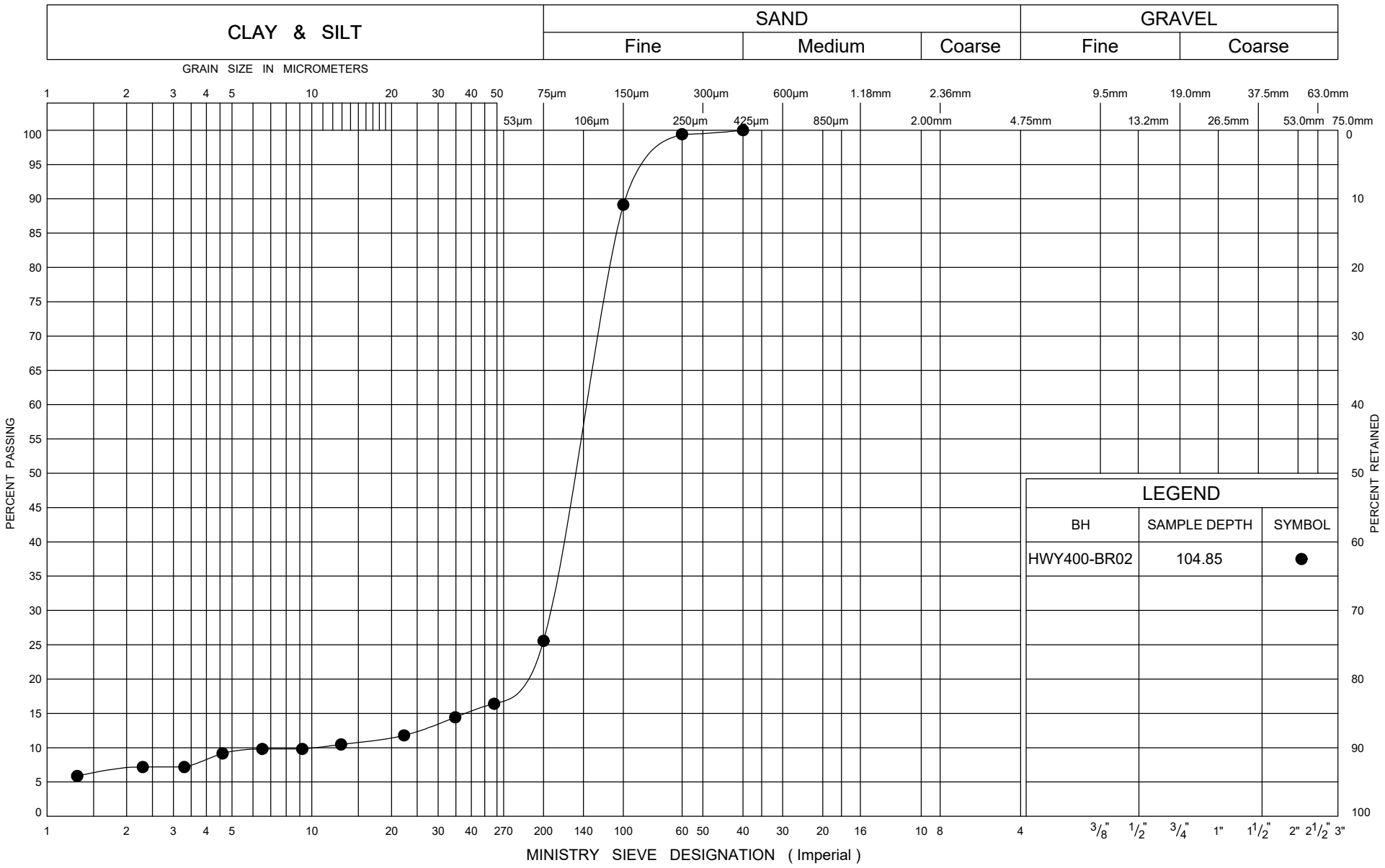
Sandy SILT to SILT TILL

FIG No 15

W.P.

Highway 400 E-S Ramp

ONTARIO MOT PLASTICITY CHART 2 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25



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GRAIN SIZE DISTRIBUTION

Silty SAND Interlayer

FIG No 16

W.P.

Highway 400 E-S Ramp

ONTARIO MOT GRAIN SIZE 3 MTO-48856.GPJ ONTARIO MOT.GDT 10/7/25

Geomechanica Inc.
#14-1240 Speers Rd.
Oakville ON
L6L 2X4 Canada

July 10, 2025

Rocio Reyna
Thurber Engineering Ltd.
202 – 1908 Ironoak Way
Oakville, Ontario
Canada, L6H 0N1

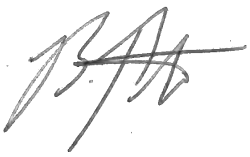
Re: UCS Testing
(Thurber Engineering Ltd. Project No. 44856)

Dear Rocio Reyna:

On June 30, 2025 a series of core samples (HQ-sized) were received by Geomechanica Inc. via drop-off by Thurber personnel. These samples were identified as being from Thurber Engineering Ltd. Project No. 44856. From these samples, 7 Uniaxial Compressive Strength (UCS) tests were completed.

Details regarding the steps of specimen preparation and testing along with the test results are presented in the accompanying laboratory report and summary spreadsheet.

Sincerely,



Bryan Tatone, PhD, PEng

Geomechanica Inc.
Tel: +1-647-478-9767
lab@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

Rocio Reyna
Thurber Engineering Ltd.
202 – 1908 Ironoak Way
Oakville, Ontario
Canada, L6H 0N1

Prepared by:

Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng
Geomechanica Inc.
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Oakville ON
L6L 2X4 Canada
Tel: +1-647-478-9767
lab@geomechanica.com

July 10, 2025
Project number: 44856

Abstract

This document summarizes the results of rock laboratory testing of 7 Uniaxial Compressive Strength (UCS) tests. Results including Uniaxial Compressive Strength (UCS) along with photographs of samples before and after testing are presented.

In this document:

1 Uniaxial Compressive Strength Tests 1
Appendices 3

Disclaimer: This report was prepared by Geomechanica Inc. for Thurber Engineering Ltd. . The material herein reflects Geomechanica Inc.'s best judgment given the information available at the time of preparation. Any use which a third party makes of this report, any reliance on or decision to be made based on it, are the responsibility of such third parties. Geomechanica Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing. The testing was performed in Geomechanica Inc.'s rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.05 mm/min (Figure 1). The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture and potential damage during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding the specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimen to rupture while continuously recording axial force to determine the peak strength (UCS).



Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, and the minimum length:diameter criteria were met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C.

1.2 Results

The results of UCS testing are summarized in Table 1. Additional specimen and test details are provided on the summary spreadsheet that accompanies this report.

Table 1: Summary of UCS test results.

Sample	Depth (m)	Bulk density ρ (g/cm^3)	UCS (MPa)	Lithology	Failure description
BR02, Run 2	122.10 - 122.33	2.662	57.7	Limestone	1
BR02, Run 3	123.93 - 124.16	2.668	98.5	Limestone	2
BR02, Run 4	125.32 - 125.58	2.649	72.1	Limestone	2
BR02, Run 5	127.41 - 127.86	2.686	95.1	Limestone	3
BR02, Run 7	129.39 - 129.59	2.689	82.0	Limestone	1
BR02, Run 9	132.89 - 133.40	2.681	74.4	Limestone	1
BR02, Run 11	135.94 - 136.35	2.678	92.8	Limestone	2

[1] Inclined shear fracture and axial splitting failure
[2] Partial hourglass failure
[3] Hourglass failure

1.3 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.

Appendices

Specimen sheets

- BR02, Run 2
- BR02, Run 3
- BR02, Run 4
- BR02, Run 5
- BR02, Run 7
- BR02, Run 9
- BR02, Run 11

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 2	**Depth**	122.10 - 122.33

Specimen parameters	
Diameter (mm) [a]	61.08
Length (mm) [a]	120.92
Bulk density ρ (g/cm^3)	2.662
UCS (MPa)	57.7
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min. Failure in less than 3 min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 3	**Depth**	123.93 - 124.16

Specimen parameters	
Diameter (mm) [a]	60.96
Length (mm) [a]	128.53
Bulk density ρ (g/cm^3)	2.668
UCS (MPa)	98.5
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Partial hourglass failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 4	**Depth**	125.32 - 125.58

Specimen parameters	
Diameter (mm) [a]	60.90
Length (mm) [a]	128.69
Bulk density ρ (g/cm^3)	2.649
UCS (MPa)	72.1
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Partial hourglass failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 5	**Depth**	127.41 - 127.86

Specimen parameters	
Diameter (mm) [a]	60.89
Length (mm) [a]	129.01
Bulk density ρ (g/cm^3)	2.686
UCS (MPa)	95.1
Lithology	Limestone
Failure description [b]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Hourglass failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 7	**Depth**	129.39 - 129.59

Specimen parameters	
Diameter (mm) [a]	60.85
Length (mm) [a]	126.92
Bulk density ρ (g/cm^3)	2.689
UCS (MPa)	82.0
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 9	**Depth**	132.89 - 133.40

Specimen parameters	
Diameter (mm) [a]	60.95
Length (mm) [a]	128.16
Bulk density ρ (g/cm^3)	2.681
UCS (MPa)	74.4
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR02, Run 11	**Depth**	135.94 - 136.35

Specimen parameters	
Diameter (mm) [a]	60.84
Length (mm) [a]	128.59
Bulk density ρ (g/cm^3)	2.678
UCS (MPa)	92.8
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Partial hourglass failure;

Prior to testing



After testing



Remarks: Displacement rate 0.05 mm/min.

Performed by	AA	**Date**	2025-07-07

Geomechanica Inc.
#14-1240 Speers Rd.
Oakville ON
L6L 2X4 Canada

July 25, 2025

Rocio Reyna
Thurber Engineering Ltd.
202 – 1908 Ironoak Way
Oakville, Ontario
Canada, L6H 0N1

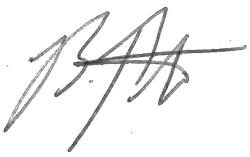
Re: UCS Testing
(Thurber Engineering Ltd. Project No. 44856)

Dear Rocio Reyna:

On July 18, 2025 a series of 7 core samples (HQ-sized) were received by Geomechanica Inc. via drop-off by Thurber personnel. These samples were identified as being from Thurber Engineering Ltd. Project No. 44856. From these samples, 7 Uniaxial Compressive Strength (UCS) tests were completed.

Details regarding the steps of specimen preparation and testing along with the test results are presented in the accompanying laboratory report and summary spreadsheet.

Sincerely,



Bryan Tatone, PhD, PEng

Geomechanica Inc.
Tel: +1-647-478-9767
lab@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

Rocio Reyna
Thurber Engineering Ltd.
202 – 1908 Ironoak Way
Oakville, Ontario
Canada, L6H 0N1

Prepared by:

Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng
Geomechanica Inc.
#14-1240 Speers Rd.
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L6L 2X4 Canada
Tel: +1-647-478-9767
lab@geomechanica.com

July 25, 2025
Project number: 44856

Abstract

This document summarizes the results of rock laboratory testing of 7 Uniaxial Compressive Strength (UCS) tests. The UCS values along with photographs of specimens before and after testing are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests 1
Appendices 3

Disclaimer: This report was prepared by Geomechanica Inc. for Thurber Engineering Ltd. . The material herein reflects Geomechanica Inc.'s best judgment given the information available at the time of preparation. Any use which a third party makes of this report, any reliance on or decision to be made based on it, are the responsibility of such third parties. Geomechanica Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing. The testing was performed in Geomechanica Inc.'s rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.05 mm/min (Figure 1). The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture and potential damage during subsequent specimen preparation.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding the specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimen to rupture while continuously recording axial force to determine the peak strength (UCS).



Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, and the minimum length:diameter criteria were met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C.

1.2 Results

The results of UCS testing are summarized in Table 1. Additional specimen and test details are provided on the summary spreadsheet that accompanies this report.

Table 1: Summary of UCS test results.

Sample	Depth (m)	Bulk density ρ (g/cm^3)	UCS (MPa)	Lithology	Failure description
BR03, Run 1	118.67 - 118.92	2.692	49.5	Limestone	1
BR03, Run 3	122.35 - 122.61	2.693	70.2	Limestone	2
BR03, Run 5	125.07 - 125.27	2.679	77.2	Limestone	1
BR03, Run 7	128.47 - 128.70	2.681	100.0	Limestone	1
BR03, Run 9	131.06 - 131.32	2.655	56.9	Limestone	2
BR03, Run 11	134.42 - 134.42	2.680	65.9	Limestone	2
BR03, Run 13	137.26 - 137.52	2.703	73.4	Limestone	2

[1] Inclined shear fracture and axial splitting failure
[2] Inclined shear failure

1.3 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.

Appendices

Specimen sheets

- BR03, Run 1
- BR03, Run 3
- BR03, Run 5
- BR03, Run 7
- BR03, Run 9
- BR03, Run 11
- BR03, Run 13

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 1	**Depth**	118.67 - 118.92

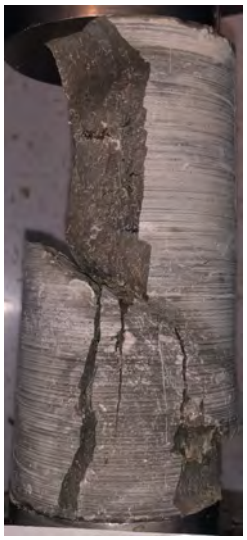
Specimen parameters	
Diameter (mm) [a]	60.70
Length (mm) [a]	123.56
Bulk density ρ (g/cm^3)	2.692
UCS (MPa)	49.5
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min. Speciemen experienced pre-peak localized failure(s).

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 3	**Depth**	122.35 - 122.61

Specimen parameters	
Diameter (mm) [a]	60.90
Length (mm) [a]	122.99
Bulk density ρ (g/cm^3)	2.693
UCS (MPa)	70.2
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Inclined shear failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min.

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 5	**Depth**	125.07 - 125.27

Specimen parameters	
Diameter (mm) [a]	61.08
Length (mm) [a]	119.35
Bulk density ρ (g/cm^3)	2.679
UCS (MPa)	77.2
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min.

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 7	**Depth**	128.47 - 128.70

Specimen parameters	
Diameter (mm) [a]	60.86
Length (mm) [a]	123.41
Bulk density ρ (g/cm^3)	2.681
UCS (MPa)	100.0
Lithology	Limestone
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear fracture and axial splitting failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min.

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 9	**Depth**	131.06 - 131.32

Specimen parameters	
Diameter (mm) [a]	60.90
Length (mm) [a]	123.16
Bulk density ρ (g/cm^3)	2.655
UCS (MPa)	56.9
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Inclined shear failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min.

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 11	**Depth**	134.42 - 134.42

Specimen parameters	
Diameter (mm) [a]	60.96
Length (mm) [a]	122.84
Bulk density ρ (g/cm^3)	2.680
UCS (MPa)	65.9
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Inclined shear failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min. Speciemen experienced pre-peak localized failure(s).

Performed by	AB	**Date**	2025-07-21

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	44856
Sample	BR03, Run 13	**Depth**	137.26 - 137.52

Specimen parameters	
Diameter (mm) [a]	60.83
Length (mm) [a]	121.54
Bulk density ρ (g/cm^3)	2.703
UCS (MPa)	73.4
Lithology	Limestone
Failure description [b]	2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [2] Inclined shear failure;

Prior to testing



After testing



Remarks: Displacement rate: 0.15 mm/min.

Performed by	AB	**Date**	2025-07-21

THURBER

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	48856	**Date Drilled:**	20-Jun-25
Client:	AECOM	**Date Tested:**	30-Jun-25
Project Name:	BRADFORD BYPASS	**Tester:**	AK
Core Size:	HQ **BH No :** HWY400-BR02	**Reviewed by:**	GL

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	Correlated UCS (MPa)	Rock Type	Correlated Rock Strength (after Hoek & Brown, 1997)
1	1	121.8	A	16.0	60.8	64.9	3.54	77.8	Limestone	Strong
2	2	121.8	A	16.2	60.9	62.2	3.68	80.9	Limestone	Strong
3	3	123.8	A	14.3	60.7	62.2	3.26	71.6	Limestone	Strong
4	4	125.6	A	15.9	60.7	62.7	3.62	79.6	Limestone	Strong
5	5	126.4	A	13.2	60.9	69.7	2.76	60.7	Limestone	Strong
6	6	127.9	A	13.2	60.9	63.8	2.95	65.0	Limestone	Strong
7	7	129.6	A	14.2	60.9	64.1	3.16	69.6	Limestone	Strong
8	8	131.0	A	14.3	60.9	62.0	3.27	72.0	Limestone	Strong
9	9	132.4	A	10.6	60.9	64.3	2.35	51.8	Limestone	Strong
10	10	134.0	A	14.0	60.9	64.2	3.11	68.4	Limestone	Strong
11	11	135.5	A	15.1	60.8	63.3	3.40	74.8	Limestone	Strong
12	12	137.0	A	17.5	60.8	62.9	3.96	87.1	Limestone	Strong
13	13	138.5	A	15.6	60.7	62.3	3.55	78.1	Limestone	Strong
14	14	140.1	A	11.8	60.8	64.1	2.64	58.1	Limestone	Strong
15	1	121.3	D	10.3	60.8	145.3	2.88	63.3	Limestone	Strong
16	2	122.0	D	9.5	61.0	136.3	2.66	58.4	Limestone	Strong
17	2	122.8	D	10.0	60.8	145.9	2.80	61.7	Limestone	Strong
18	3	124.2	D	11.6	60.8	130.8	3.26	71.7	Limestone	Strong
19	3	123.8	D	11.7	60.7	139.3	3.27	72.0	Limestone	Strong
20	4	125.7	D	10.7	60.7	121.6	2.99	65.9	Limestone	Strong
21	4	126.0	D	10.6	60.7	123.1	2.97	65.2	Limestone	Strong
22	5	126.8	D	11.5	60.9	139.3	3.22	70.8	Limestone	Strong
23	5	127.1	D	10.8	61.0	135.0	3.01	66.3	Limestone	Strong
24	6	128.4	D	9.6	60.9	122.9	2.69	59.2	Limestone	Strong
25	6	128.7	D	11.6	60.9	123.3	3.23	71.1	Limestone	Strong
26	7	130.1	D	9.8	60.9	134.1	2.73	60.0	Limestone	Strong
27	7	130.6	D	8.4	60.9	135.2	2.35	51.7	Limestone	Strong
28	8	131.1	D	9.3	61.0	131.6	2.60	57.3	Limestone	Strong
29	8	132.0	D	11.9	60.9	131.8	3.31	72.9	Limestone	Strong
30	9	133.0	D	9.1	60.9	143.4	2.54	55.9	Limestone	Strong
31	9	133.6	D	9.1	60.9	150.6	2.55	56.1	Limestone	Strong
32	10	134.9	D	9.9	60.9	137.6	2.77	61.0	Limestone	Strong
33	10	135.3	D	9.4	60.9	142.7	2.62	57.6	Limestone	Strong
34	11	135.9	D	10.0	60.8	146.1	2.80	61.5	Limestone	Strong
35	11	136.3	D	11.0	60.8	136.8	3.07	67.5	Limestone	Strong
36	12	137.5	D	12.8	60.9	140.7	3.57	78.6	Limestone	Strong
37	12	138.0	D	10.2	60.8	140.9	2.84	62.5	Limestone	Strong
38	13	139.2	D	17.1	60.8	120.7	4.77	105.0	Limestone	Very Strong

THURBER

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	48856	**Date Drilled:**	20-Jun-25
Client:	AECOM	**Date Tested:**	30-Jun-25
Project Name:	BRADFORD BYPASS	**Tester:**	AK
Core Size:	HQ **BH No :** HWY400-BR02	**Reviewed by:**	GL

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	Correlated UCS (MPa)	Rock Type	Correlated Rock Strength (after Hoek & Brown, 1997)
39	13	139.5	D	12.7	60.8	153.2	3.57	78.4	Limestone	Strong
40	14	140.5	D	14.8	60.8	142.3	4.14	91.0	Limestone	Strong
41	14	140.9	D	11.3	60.8	145.5	3.15	69.3	Limestone	Strong

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
  Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have 0.7 x D on either side of test point.
* Correlation factor to obtain UCS values is 22.

Last Modified: August 15, 2025.

THURBER

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	48856	**Date Drilled:**	13-Jul-25
Client:	AECOM	**Date Tested:**	18-Jul-25
Project Name:	BRADFORD BYPASS	**Tester:**	GA
Core Size:	HQ **BH No :** HWY400-BR03	**Reviewed by:**	GL

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	Correlated UCS (MPa)	Rock Type	Correlated Rock Strength (after Hoek & Brown, 1997)
1	1	118.9	A	22.7	60.8	68.2	4.8	106.1	Limestone	Very Strong
2	1	119.6	A	16.2	60.8	70.3	3.3	73.7	Limestone	Strong
3	2	120.4	A	15.0	60.9	70.1	3.1	68.5	Limestone	Strong
4	2	121.2	A	16.0	60.9	61.1	3.7	81.4	Limestone	Strong
5	3	121.9	A	18.9	60.9	61.2	4.4	95.9	Limestone	Strong
6	3	122.9	A	16.1	60.9	60.1	3.8	83.1	Limestone	Strong
7	4	123.5	A	19.6	61.0	63.1	4.4	96.8	Limestone	Strong
8	4	124.0	A	18.1	61.0	66.1	3.9	86.4	Limestone	Strong
9	5	124.9	A	21.6	61.0	61.2	5.0	109.6	Limestone	Very Strong
10	5	125.7	A	15.6	61.0	64.0	3.5	76.3	Limestone	Strong
11	6	126.7	A	19.2	61.0	60.3	4.5	98.4	Limestone	Strong
12	6	127.5	A	15.5	61.0	56.5	3.8	83.4	Limestone	Strong
13	7	128.2	A	13.6	60.9	60.1	3.2	70.0	Limestone	Strong
14	7	128.8	A	16.1	61.0	63.0	3.6	79.8	Limestone	Strong
15	8	129.8	A	20.3	60.9	60.3	4.7	104.1	Limestone	Very Strong
16	8	130.4	A	14.1	61.0	60.2	3.3	72.3	Limestone	Strong
17	9	131.4	A	16.9	61.0	62.2	3.8	84.7	Limestone	Strong
18	9	132.2	A	19.9	61.0	56.8	4.9	106.8	Limestone	Very Strong
19	10	132.9	A	14.9	61.0	61.1	3.4	75.7	Limestone	Strong
20	10	133.5	A	14.9	60.9	64.4	3.3	72.4	Limestone	Strong
21	11	133.9	A	16.4	61.0	60.8	3.8	83.7	Limestone	Strong
22	11	135.1	A	20.1	60.9	69.6	4.2	92.4	Limestone	Strong
23	12	135.9	A	12.5	61.0	65.2	2.7	60.2	Limestone	Strong
24	12	136.4	A	19.2	61.0	61.3	4.4	97.3	Limestone	Strong
25	13	137.0	A	14.7	61.0	65.7	3.2	70.5	Limestone	Strong
26	13	137.8	A	24.2	60.9	56.0	6.0	131.6	Limestone	Very Strong
27	1	119.3	D	5.0	60.7	120.5	1.4	30.5	Limestone	Medium Strong
28	1	120.0	D	11.4	60.8	150.3	3.2	70.0	Limestone	Strong
29	2	120.8	D	10.5	60.8	98.4	2.9	64.8	Limestone	Strong
30	2	121.5	D	11.4	60.9	155.2	3.2	70.2	Limestone	Strong
31	3	121.7	D	9.1	60.9	170.3	2.6	56.1	Limestone	Strong
32	3	122.3	D	10.3	60.9	101.7	2.9	63.3	Limestone	Strong
33	4	123.2	D	14.3	61.0	140.5	4.0	87.6	Limestone	Strong
34	4	124.4	D	14.4	61.0	140.4	4.0	88.1	Limestone	Strong
35	5	125.4	D	14.7	61.0	150.3	4.1	89.8	Limestone	Strong
36	5	126.0	D	10.1	60.9	168.1	2.8	61.8	Limestone	Strong
37	6	126.4	D	10.4	61.0	138.2	2.9	63.6	Limestone	Strong
38	6	127.1	D	15.3	61.0	87.1	4.3	93.5	Limestone	Strong

THURBER

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	48856	**Date Drilled:**	13-Jul-25
Client:	AECOM	**Date Tested:**	18-Jul-25
Project Name:	BRADFORD BYPASS	**Tester:**	GA
Core Size:	HQ **BH No :** HWY400-BR03	**Reviewed by:**	GL

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	Correlated UCS (MPa)	Rock Type	Correlated Rock Strength (after Hoek & Brown, 1997)
39	7	127.8	D	10.4	60.9	150.2	2.9	63.8	Limestone	Strong
40	7	129.0	D	9.6	60.9	175.1	2.7	58.7	Limestone	Strong
41	8	129.4	D	9.7	60.9	131.8	2.7	59.5	Limestone	Strong
42	8	130.2	D	10.3	60.9	152.5	2.9	63.0	Limestone	Strong
43	9	131.0	D	6.6	61.0	162.4	1.8	40.6	Limestone	Medium Strong
44	9	131.9	D	9.6	61.0	158.9	2.7	58.7	Limestone	Strong
45	10	132.5	D	12.3	61.0	155.3	3.4	75.4	Limestone	Strong
46	10	133.2	D	9.7	60.9	115.1	2.7	59.4	Limestone	Strong
47	11	134.2	D	10.5	60.9	129.2	2.9	64.7	Limestone	Strong
48	11	134.7	D	12.1	60.9	149.6	3.4	74.2	Limestone	Strong
49	12	135.4	D	9.1	61.0	150.9	2.5	55.8	Limestone	Strong
50	12	136.7	D	10.4	61.0	130.2	2.9	63.7	Limestone	Strong
51	13	137.2	D	9.9	61.0	117.1	2.8	60.6	Limestone	Strong
52	13	137.7	D	10.0	61.0	133.3	2.8	61.3	Limestone	Strong

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
  Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have 0.7 x D on either side of test point.
* Correlation factor to obtain UCS values is 22.

Last Modified: August 15, 2025.

THURBER

APPENDIX F

Analytical Laboratory Test Results





FINAL REPORT

CA40041-JAN25 R1

48856, Bradford Bypass West Contract

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	1908 Ironoak Way, Suite 202 Oakville, ON L6H 0N1. Canada
Contact	Joshua Alexander
Telephone	613-606-7303
Facsimile	
Email	jalexander@thurber.ca
Project	48856, Bradford Bypass West Contract
Order Number	
Samples	Soil (8)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA40041-JAN25
Received	01/10/2025
Approved	01/16/2025
Report Number	CA40041-JAN25 R1
Date Reported	01/16/2025

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C
Cooling Agent Present: yes
Custody Seal Present: yes

Chain of Custody Number: 1

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc



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Legend..... 7

Annexes..... 8

FINAL REPORT

CA40041-JAN25 R1

Client: Thurber Engineering Ltd.
Project: 48856, Bradford Bypass West Contract
Project Manager: Joshua Alexander
Samplers: Abdul Basit

MATRIX: SOIL

Sample Number				5	6	7	8	9	10	11	12
Sample Name				HWY400-30 SS1	HWY400-26 SS5(A)	HWY400-36 SS1	HWY400-44 SS1(A)	HWY400-24 SS5	HWY400-32 SS1	HWY400-38 SS6	PEN-07 SS3
Sample Matrix				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date				27/09/2024	21/10/2024	25/09/2025	01/10/2024	16/10/2024	25/09/2024	02/10/2024	08/10/2024
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Corrosivity Index											
Corrosivity Index	none	1		1	4	1	6	4	4	6	4
pH	pH Units	0.05		8.30	8.96	8.07	7.82	8.71	7.97	8.37	8.56
Soil Redox Potential	mV	no		290	257	287	299	270	304	207	323
Sulphide (Na2CO3)	%	0.01		0.01	< 0.01	0.01	0.02	< 0.01	0.02	0.05	0.01
Resistivity (calculated)	ohms.cm	-9999		5560	7090	4440	2210	7810	4330	2600	9900
General Chemistry											
Conductivity	uS/cm	2		180	141	225	452	128	231	385	101
Metals and Inorganics											
Sulphate	µg/g	0.4		11	7.7	16	24	7.0	11	370	12
Other (ORP)											
Chloride	µg/g	0.4		17	12	19	11	20	12	1.6	11

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0225-JAN25	µg/g	0.4	<0.4	2	35	100	80	120	98	75	125
Sulphate	DIO0225-JAN25	µg/g	0.4	<0.4	1	35	99	80	120	99	75	125
Chloride	DIO0245-JAN25	µg/g	0.4	<0.4	9	35	104	80	120	108	75	125
Sulphate	DIO0245-JAN25	µg/g	0.4	<0.4	7	35	103	80	120	91	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0029-JAN25	%	0.01	< 0.01								

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0207-JAN25	uS/cm	2	< 2	0	20	101	90	110	NA		

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0207-JAN25	pH Units	0.05	NA	1		100			NA		

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.
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This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 1 Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Sean Gerow
Received Date: 01/10/25 (mm/dd/yy)
Received Time: 1445 (hr : min)
Received By (signature):
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☑ No ☐
Cooling Agent Present: Yes ☐ No ☑ Type: N/A
Temperature Upon Receipt (°C) 8°, 3 SG
LAB LIMS #: CA40041 Jan 25

REPORT INFORMATION	INVOICE INFORMATION
Company: Thurber Engineering Ltd.	☑ (same as Report Information)
Contact: Joshua Alexander	Company:
Address: 202 - 1908 Ironoak Way, Oakville, ON L6H 7G4	Contact:
Phone: 613-606-7303	Address:
Fax:	Phone:
Email: jalexander@thurber.ca	Email: accountingON@thurber.ca

Quotation #: P.O. #: 48856
Project #: 48856 Site Location/ID: Bradford Bypass West Contract

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ Res/Park ☐ Ind/Com ☐ Agri/Other Soil Texture: ☐ Coarse ☐ Medium/Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☑ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	HWY400-30 SS1	09/27/24	-	1	soil
2	HWY400-26 SS5(A)	10/21/24	-	1	soil
3	HWY400-36 SS1	09/25/24	-	1	soil
4	HWY400-44 SS1(A)	10/01/24	-	1	soil
5	HWY400-24 SS5	10/16/24	-	1	soil
6	HWY400-32 SS1	09/25/24	-	1	soil
7	HWY400-38 SS6	10/02/24	-	1	soil
8	PEN-07 SS4	10/08/24	-	1	soil
9					
10					
11					
12					

M & I				SVOC		PCB	PHC		VOC		Pest	Other (please specify)							TCLP	COMMENTS:
Field Filtered (Y/N)	Metals & Inorganics incl CrVI, CN, Hg pH, (B(HWS),EC,SAR–soil) (Cl, Na–water)	Full Metals Suite (CP metals plus B(HWS-soil only) Hg, CrVI	ICP Metals only Sb,As, Ba, Be, B, Co,Cr, Cu,Pb, Mo, Ni, Se, Ag, Tl, U, V, Zn	PAHs	SVOCs all incl PAHs, ABNs, CPs	PCBs Aroclor ☐ Total ☑	F1-F4 + BTEX	F1-F4 only no BTEX	VOCs all incl BTEX	BTEX only	Pesticides Organochlorine or specify other	Corrosivity Suite	1,4-dioxane	Dioxins and furans	PHC F1		Sewer Use: Specify pkg:	Water Characterization Pkg General ☐ Extended ☐	Specify TCLP tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ gnit.	
												✓								
												✓								
												✓								
												✓								
												✓								
												✓								
												✓								
												✓								

Observations/Comments/Special Instructions: Pickup from Thurber - Pickering

Sampled By (NAME): ABDUL BASIT Signature: AB Date: 1/10/24 (mm/dd/yy)
Relinquished by (NAME): CZARLENE PONTEJOS Signature: CP Date: 1/10/24 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision #: 1.3
Date of Issue: 13 Oct, 2019

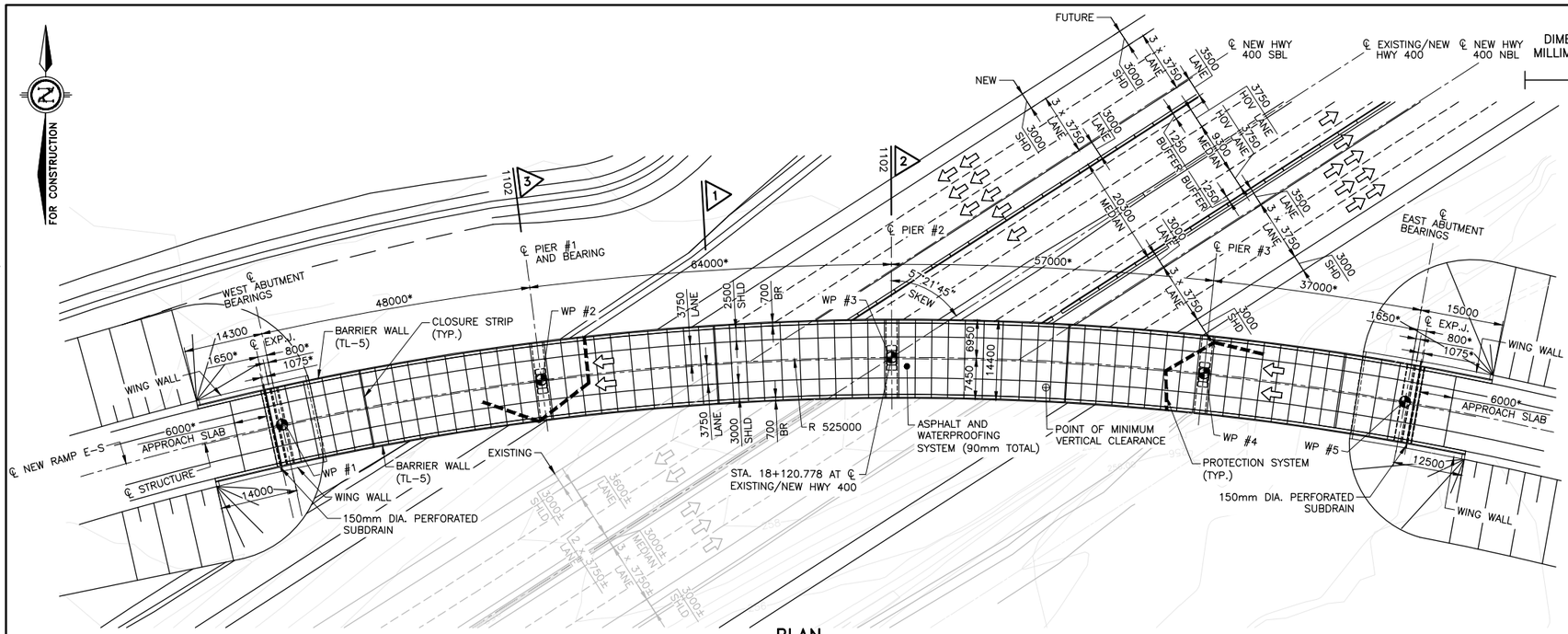
Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. {2} Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). {3} Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

THURBER

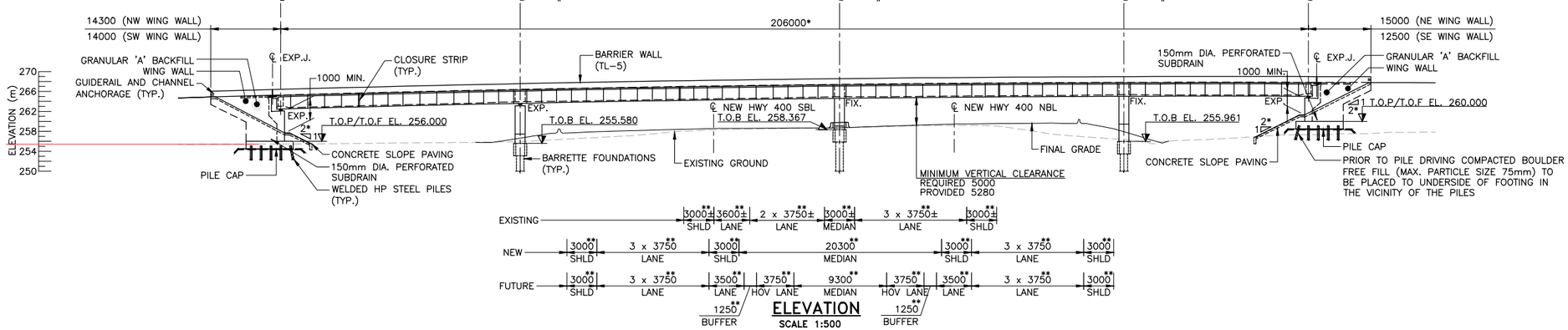
APPENDIX G

100% Design Addendum 1 General Arrangement (GA) Drawings

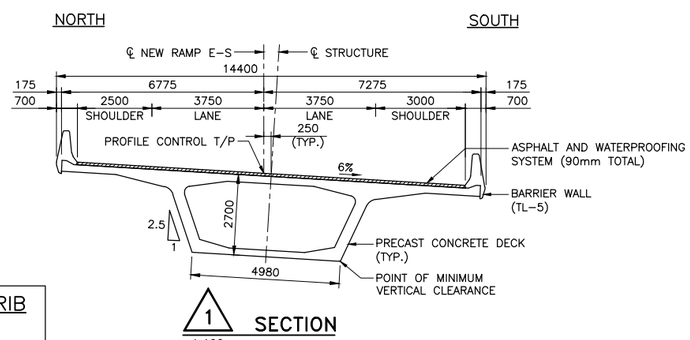
FOR CONSTRUCTION



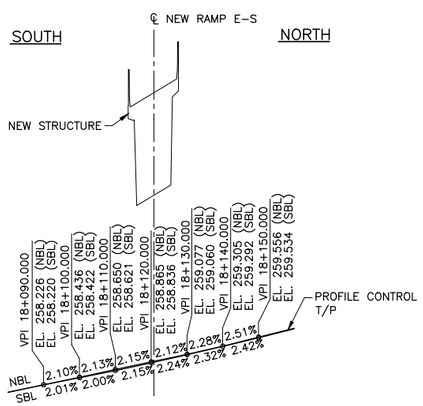
PLAN
SCALE 1:500



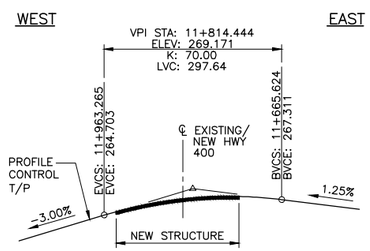
ELEVATION
SCALE 1:500



1 SECTION
1:100



PROFILE OF EXISTING/NEW HWY 400
N.T.S



PROFILE OF NEW RAMP E-S
N.T.S

B.M. TOP OF RIB
EL. 256.154
STA. 17 + 940.971
N. 4886192.004
E. 293993.538

WP #	STATION	T/P ELEVATION	NORTHING	EASTING
WP #1	11+943.089	265.279	4886264.948	293947.755
WP #2	11+895.089	266.416	4886311.696	293958.575
WP #3	11+831.089	267.420	4886372.120	293979.550
WP #4	11+774.089	267.812	4886423.437	294004.298
WP #5	11+737.089	267.834	4886455.186	294023.280

NOTES:

1. * DENOTES DIMENSIONS MEASURED ALONG ℄ NEW RAMP E-S.
2. ** DENOTES DIMENSIONS MEASURED PERPENDICULAR TO ℄ EXISTING/NEW HWY 400.
3. FOR SEGMENT LENGTHS REFER TO SEGMENT LAYOUT PLANS.
4. FOR GENERAL NOTES REFER TO DRAWING ST-1102.

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

Ontario Ministry of Transportation

CONT 2026-2005
GWP 2026-23-00

BRADFORD BYPASS HWY 400 E-S RAMP

GENERAL ARRANGEMENT - 1

SHEET 1109A

AECOM

REVISIONS			
MAR 04,2026	VR	WELDED STEEL PILES REVISION	
DATE	BY	DESCRIPTION	

DESIGN	BS	CHK	LP	CODE	CSA S6-19	LOAD CL-625-ONT	DATE JAN, 2026
DRAWN	PK	CHK	KS	SITE 30X-0869/B0			DWG ST-1101

MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

FILE NAME: C:\Users\RV\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-1101_HWY400 RAMP E-S_BR06_GENERAL ARRANGEMENT - 1.dwg
MODIFIED: 2026-03-03 16:22

GENERAL NOTES:

1. SPECIFIED 28-DAY COMPRESSIVE STRENGTH OF CONCRETE:

PRECAST SEGMENT	40MPa
CAST-IN-PLACE CLOSURE POURS	35MPa
DIAPHRAGMS	35MPa
PIER COLUMNS	35MPa
ABUTMENTS	30Mpa
FOUNDATIONS & WING WALLS	30Mpa
REMAINDER OF STRUCTURE UNLESS OTHERWISE NOTED.	30Mpa

2. CLEAR COVER TO REINFORCING STEEL:

PILE CAP AND BARRETTE	100 ± 25 mm
PIERS, ABUTMENT WALLS	70 ± 10 mm
RETAINING WALLS AND WING WALLS	70 ± 10 mm
DECK TOP PRECAST	55 ± 10 mm
SOFFIT	40 ± 10 mm
INTERIOR SURFACE OF VOIDS	40 ± 10 mm
WEB EXTERIOR	50 ± 10 mm
REMAINDER OF STRUCTURE UNLESS OTHERWISE NOTED.	70 ± 20 mm

3. REINFORCING STEEL:

3.1 REINFORCING STEEL SHALL BE GRADE 500W.

3.2 UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.

3.3 BAR MARKS WITH THE PREFIX 'G' DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.

3.4 GLASS FIBRE REINFORCED POLYMER REINFORCING BARS SHALL BE GRADE III, AND THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

3.5 BAR MARKS WITH THE PREFIX 'S' DENOTE STAINLESS STEEL BARS.

3.6 STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 OR DUPLEX 2304 AND HAVE A MINIMUM YIELD STRENGTH OF 500Mpa, UNLESS OTHERWISE SPECIFIED.

3.7 BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS112-1 UNLESS INDICATED OTHERWISE.FOR GFRP BARS, HOOKS AND BENDS SHALL HAVE A MINIMUM BEND RADIUS-TO-BAR DIAMETER RATIO (r/d) OF 4.0.

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND REINFORCING STEEL TO SUIT THE ACTUAL HEIGHT OF THE BEARING SUPPLIED. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING FULL BEARING CONTACT TO GIRDER SOFFIT AND BEARING SEAT. ADDITIONAL COST DUE TO ANY CHANGES IN ELEVATIONS OF THE TOP OF BEARINGS BY THE CONTRACTOR SHALL BE AT THEIR OWN EXPENSE.

2. THE CONTRACTOR SHALL VERIFY ALL RELEVANT DIMENSIONS, ELEVATIONS AND DETAILS ON SITE AND REPORT ANY DISCREPANCIES TO THE CONTRACT ADMINISTRATOR PRIOR TO PROCEEDING WITH WORK.

3. CONSTRUCTION LOADS

   DEAD LOAD - NIL, SINCE GROUND MOUNTED CRANES WILL BE USED.
   LIVE LOAD - 500Pa ON ONE CANTILEVER AND 250Pa ON THE OTHER CANTILEVER.

4. ROADWAY PROTECTION SYSTEM SHALL BE DESIGNED FOR PERFORMANCE LEVEL 2.

APPLICABLE STANDARD DRAWINGS

OPSD 3101.150	WALLS ABUTMENT, BACKFILL MINIMUM GRANULAR REQUIREMENT
OPSD 3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD 3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS
OPSD 3390.100	DECK DRIP CHANNEL
OPSD 3419.100	BARRIERS AND RAILING STEEL GUIDE RAIL AND CHANNEL ANCHORAGE
OPSD 3941.200	FIGURES IN CONCRETE, SITE NUMBER AND DATE LAYOUT
OPSD 3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE
OPSD 3339.100	DECK, VOIDS ACCESS HATCH FOR CONCRETE BRIDGES ASSEMBLY
OPSD 3339.101	DECK, VOIDS ACCESS HATCH FOR CONCRETE BRIDGES INSTALLATION
OPSD 3000.160	FABRICATED EQUIVALENT STEEL H-PILES

LIST OF ABBREVIATIONS:

AH	DENOTES ACCESS HATCH
EL.	DENOTES ELEVATION
HOV	DENOTES HIGH OCCUPANCY VEHICLE
HWY	DENOTES HIGHWAY
MIN.	DENOTES MINIMUM
NBL	DENOTES NORTH BOUND LANE
N.T.S.	DENOTES NOT TO SCALE
SBL	DENOTES SOUTH BOUND LANE
SHLD	DENOTES SHOULDER
BR	DENOTES BARRIER
STA.	DENOTES STATION
T/P	DENOTES TOP OF PAVEMENT
TYP.	DENOTES TYPICAL
WP	DENOTES WORKING POINT
ST.P.	DENOTES STATION POINT
EXP.J.	DENOTES EXPANSION JOINT
C.J	DENOTES CONSTRUCTION JOINT
EXP	DENOTES FREE TO EXPAND
FIX	DENOTES FIXED
T.O.P	DENOTES TOP OF PILE CAP
T.O.F	DENOTES TOP OF FOOTING
T.O.B	DENOTES TOP OF BARRETTE
TL-5	DENOTES TEST LEVEL 5
TBC	DENOTES TO BE CONFIRMED

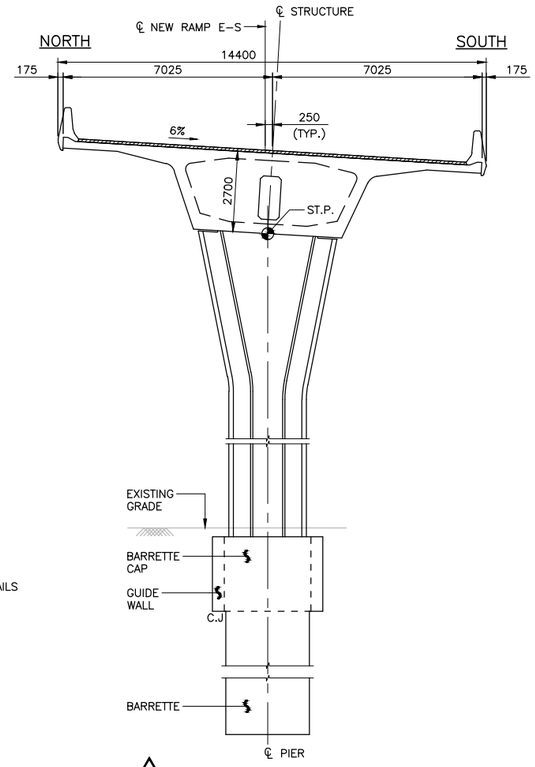
LIST OF DRAWINGS:

E-S RAMP:

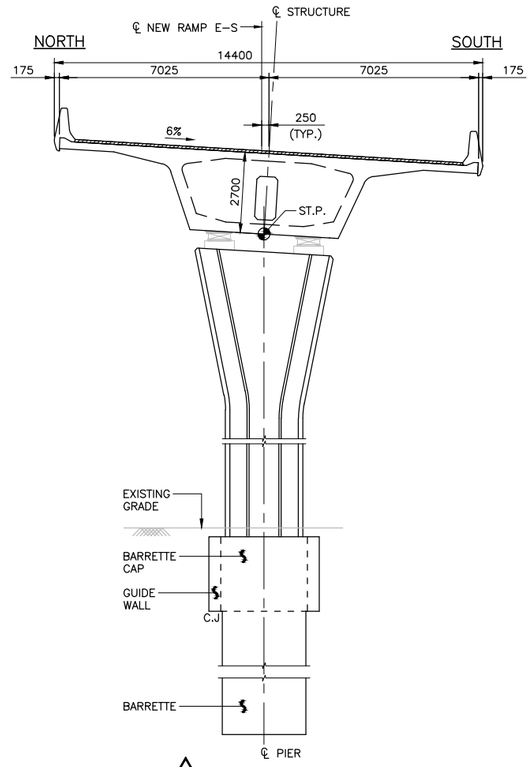
1. ST-1101_HWY400 RAMP E-S_BR06_GENERAL ARRANGEMENT - I
2. ST-1102_HWY400 RAMP E-S_BR06_GENERAL ARRANGEMENT - II
3. ST-1150_HWY400 RAMP E-S_BR06_BOREHOLES & SOIL STARTA - SHEET - 1
4. ST-1151_HWY400 RAMP E-S_BR06_BOREHOLES & SOIL STARTA - SHEET - 2
5. ST-1190_HWY400 RAMP E-S_BR06_CONSTRUCTION SEQUENCE - 1
6. ST-1191_HWY400 RAMP E-S_BR06_CONSTRUCTION SEQUENCE - 2
7. ST-1200_HWY400 RAMP E-S_BR06_FOUNDATION LAYOUT
8. ST-1221_HWY400 RAMP E-S_BR06_ABUTMENT GEOMETRY - 1
9. ST-1380_HWY400 RAMP E-S_BR06_BEARING SCHEDULE
10. ST-1400_HWY400 RAMP E-S_BR06_SEGMENT LAYOUT
11. ST-1401_HWY400 RAMP E-S_BR06_SEGMENT DESIGNATIONS
12. ST-1500_HWY400 RAMP E-S_BR06-TENDON LAYOUT - 1
13. ST-1501_HWY400 RAMP E-S_BR06_TENDON LAYOUT - 2
14. ST-1502_HWY400 RAMP E-S_BR06-TENDON LAYOUT - 3
15. ST-1520_HWY400 RAMP E-S_BR06_EXTERNAL FUTURE TENDONS

COMMON SHEETS:

1. ST-3201_HWY400 RAMP_PIER FOUNDATION GEOMETRY
2. ST-3211_HWY400 RAMP_PIER FOUNDATION REINFORCEMENT DETAILS
3. ST-3222_HWY400 RAMP_ABUTMENT GEOMETRY - 2
4. ST-3223_HWY400 RAMP_ABUTMENT GEOMETRY - 3
5. ST-3231_HWY400 RAMP_ABUTMENT REINFORCEMENT DETAILS - 1
6. ST-3232_HWY400 RAMP_ABUTMENT REINFORCEMENT DETAILS - 2
7. ST-3233_HWY400 RAMP_ABUTMENT REINFORCEMENT DETAILS - 3
8. ST-3301_HWY400 RAMP_EXPANSION PIER GEOMETRY
9. ST-3302_HWY400 RAMP_INTEGRAL PIER GEOMETRY
10. ST-3321_HWY400 RAMP_EXPANSION PIER REINFORCEMENT DETAILS
11. ST-3322_HWY400 RAMP_INTEGRAL PIER REINFORCEMENT DETAILS
12. ST-3390_HWY400 RAMP_MECHANICAL BEARING SCHEMATICS
13. ST-3405_HWY400 RAMP_BULKHEAD DETAILS
14. ST-3410_HWY400 RAMP_TYPICAL SEGMENT - GEOMETRY
15. ST-3420_HWY400 RAMP_VARIABLE DEPTH SEGMENT - GEOMETRY
16. ST-3430_HWY400 RAMP_EXPANSION PIER SEGMENT - GEOMETRY - 1
17. ST-3440_HWY400 RAMP_INTEGRAL PIER SEGMENT - GEOMETRY - 1
18. ST-3441_HWY400 RAMP_INTEGRAL PIER SEGMENT - GEOMETRY - 2
19. ST-3450_HWY400 RAMP_ABUTMENT SEGMENT GEOMETRY - 1
20. ST-3451_HWY400 RAMP_ABUTMENT SEGMENT GEOMETRY - 2
21. ST-3460-HWY400 RAMP_TYPICAL BLOCKS-GEOMETRY - 1
22. ST-3461_HWY400 RAMP_TYPICAL BLOCKS-GEOMETRY - 2
23. ST-3470_HWY400 RAMP_SEGMENTS WEIGHT
24. ST-3510_HWY400 RAMP_TRANSVERSE POST-TENSIONING AND VERTICAL PT BAR DETAILS
25. ST-3600_HWY400 RAMP_TYPICAL SEGMENT REINFORCEMENT - 1
26. ST-3620_HWY400 RAMP_VARIABLE DEPTH SEGMENT REINFORCEMENT
27. ST-3630_HWY400 RAMP_EXPANSION PIER SEGMENT REINFORCEMENT DETAILS - 1
28. ST-3631_HWY400 RAMP_EXPANSION PIER SEGMENT REINFORCEMENT DETAILS - 2
29. ST-3632_HWY400 RAMP_EXPANSION PIER SEGMENT REINFORCEMENT DETAILS - 3
30. ST-3640_HWY400 RAMP_INTEGRAL PIER SEGMENT REINFORCEMENT DETAILS - 1
31. ST-3641_HWY400 RAMP_INTEGRAL PIER SEGMENT REINFORCEMENT DETAILS - 2
32. ST-3642_HWY400 RAMP_INTEGRAL PIER SEGMENT REINFORCEMENT DETAILS - 3
33. ST-3643_HWY400 RAMP_INTEGRAL PIER SEGMENT REINFORCEMENT DETAILS - 4
34. ST-3650_HWY400 RAMP_ABUTMENT SEGMENT REINFORCEMENT DETAILS - 1
35. ST-3651_HWY400 RAMP_ABUTMENT SEGMENT REINFORCEMENT DETAILS - 2
36. ST-3652_HWY400 RAMP_ABUTMENT SEGMENT REINFORCEMENT DETAILS - 3
37. ST-3660_HWY400 RAMP_TYPICAL BLISTER AND DEVIATOR REINFORCEMENT DETAILS
38. ST-3670_HWY400 RAMP_CAST IN PLACE CLOSURE REINFORCEMENT DETAILS
39. ST-3800_HWY400 RAMP_EXPANSION JOINT DETAILS - 1
40. ST-3801_HWY400 RAMP_EXPANSION JOINT DETAILS - 2
41. ST-3802_HWY400 RAMP_EXPANSION JOINT DETAILS - 3
42. ST-3803_HWY400 RAMP_EXPANSION JOINT DETAILS - 4
43. ST-3804_HWY400 RAMP_EXPANSION JOINT DETAILS - 5
44. ST-3805_HWY400 RAMP_EXPANSION JOINT DETAILS - 6
45. ST-3820_HWY400 RAMP_BARRIER REINFORCEMENT DETAILS
46. ST-3900_HWY400 RAMP_6000mm APPROACH SLAB
47. ST-3910_HWY400 RAMP_CONCRETE SLOPE PAVING DETAILS
48. ST-3930_HWY400 RAMP_PILE DRIVING CONTROL
49. ST-3960_HWY400 RAMP_TEMPORARY PT BAR BLOCKS
50. ST-3970_HWY400 RAMP_ERECTION SCHEMATIC - PT BARS
51. ST-3980_HWY400 RAMP_MISCELLANEOUS DETAILS



2 SECTION AT P2 & P3
1101 1:100



3 SECTION AT P1
1101 1:100

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
DRAWING NOT TO BE SCALED
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Ontario Ministry of Transportation

CONT 2026-2005
GWP 2026-23-00

BRADFORD BYPASS HWY 400 E-S RAMP

GENERAL ARRANGEMENT - II

SHEET 1110A

AECOM

REVISIONS			
	MAR 04,2026	VR	NOTES AND LIST OF DRAWINGS UPDATED
	DATE	BY	DESCRIPTION

DESIGN	BS	CHK	LP	CODE CSA S6/19	LOAD CL-625-ONT	DATE JAN, 2026	
DRAWN	PK	CHK	KS	SITE 30X-0869/BO		DWG ST-1102	

MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

FILE NAME: C:\Users\PK\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-1102_HWY400 RAMP E-S_BR06_GENERAL PLAN & ELEVATION - SHEET 2.dwg
MODIFIED: 2026-03-03 11:44

METRIC
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Ontario Ministry of Transportation

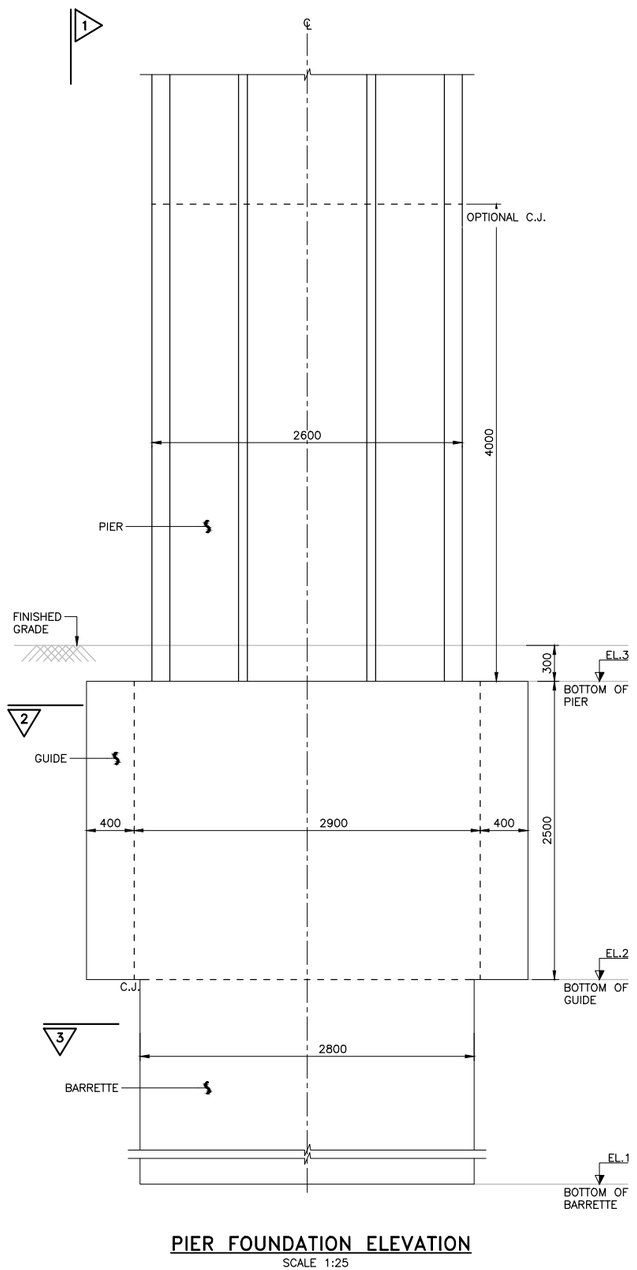
CONT 2026–2005
GWP 2026–23–00

BRADFORD BYPASS HWY 400 RAMP

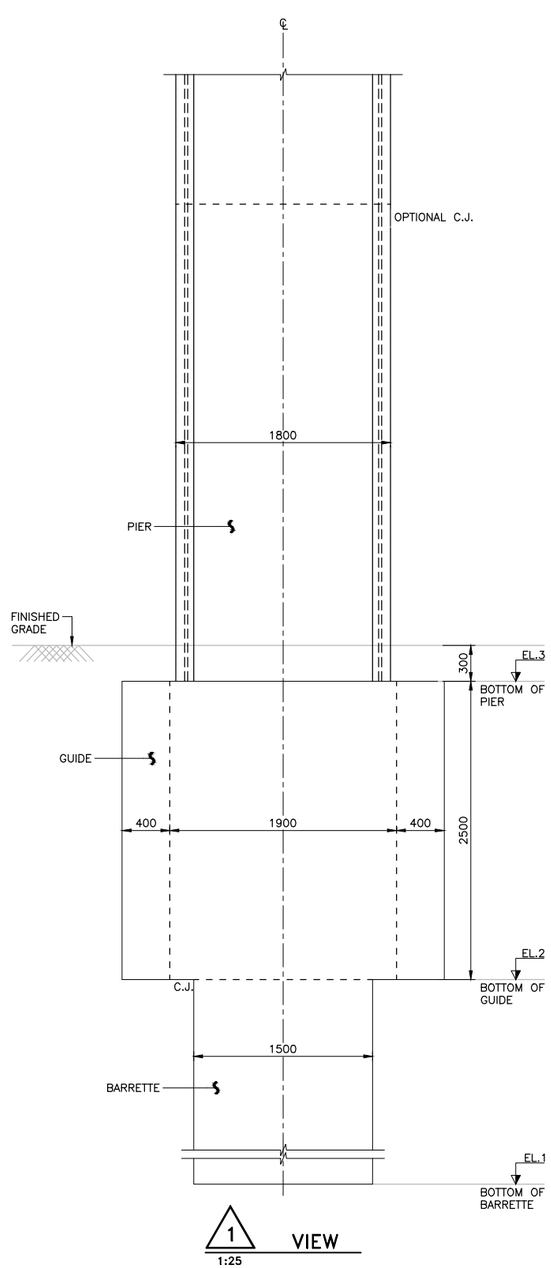
PIER FOUNDATION GEOMETRY

SHEET 1116A

AECOM

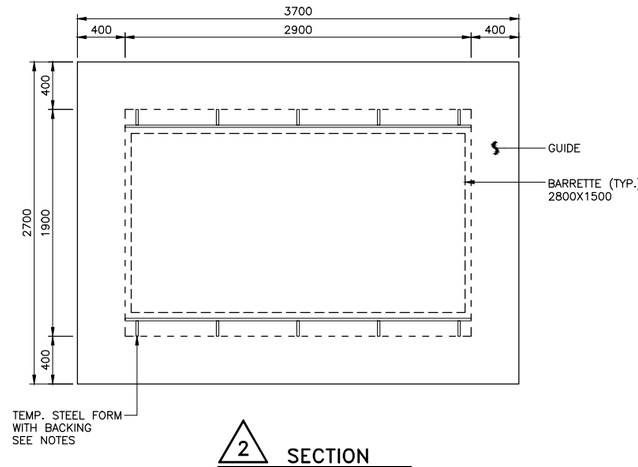


PIER FOUNDATION ELEVATION
SCALE 1:25

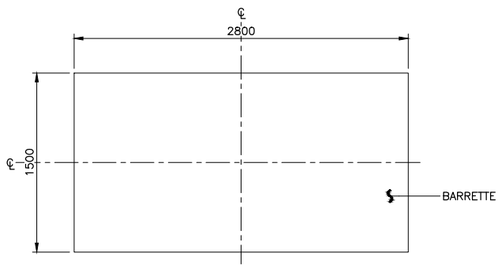


1 VIEW
1:25

* STEEL GUIDE PLATES ARE NOT SHOWN FOR CLARITY



2 SECTION
1:25 (BARRETTE GUIDE /CAP)



3 SECTION
1:25

NOTES:

1. FOR GENERAL NOTES REFER TO DRAWING ST–1102 AND ST–2102.
2. FOR REINFORCEMENT DETAILS REFER TO DRAWING ST–3211.
3. FOR PIER GEOMETRY DETAILS REFER TO DRAWING ST–3301 AND ST–3302.
4. FOR PIER REINFORCEMENT DETAILS REFER TO DRAWING ST–3321 AND ST–3322.
5. FACTORED ULTIMATE GEOTECHNICAL RESISTANCE FOR BARRETTES SOCKETED 3m INTO BEDROCK IS 30000kN.
6. BOTTOM OF BARRETTE IS TO BE SOCKETED A MINIMUM OF 3m INTO SLIGHTLY WEATHERED TO FRESH LIMESTONE BEDROCK.

SUGGESTED CONSTRUCTION SEQUENCE:

1. EXCAVATE AND INSTALL BARRETTE GUIDE FORMWORKS.
2. PLACE GUIDE CONCRETE.
3. INSTALL STEEL PLATES WITH BACKING.
4. CONSTRUCT BARRETTE UP TO BOTTOM OF GUIDE.
5. REMOVE STEEL PLATES WITH BACKING.
6. INSTALL PIER COLUMN REBAR CAGE.
7. PLACE CONCRETE AT BARRETTE CAP AND COLUMN UP TO THE CONSTRUCTION JOINT.

E–S RAMP			
PIER #	P1	P2	P3
EL.1	134.900	133.900	133.900
EL.2	253.080	255.867	253.461
EL.3	255.580	258.367	255.961

N–E RAMP				
PIER #	P1	P2	P3	P4
EL.1	136.200	136.200	133.900	133.900
EL.2	260.042	260.610	254.785	255.553
EL.3	262.542	263.110	257.285	258.053

REVISIONS			
MAR 04,2026	VR	CSL TUBE REMOVED AND LEVELS ARE REVISED	
DATE	BY	DESCRIPTION	

DESIGN	BS	CHK	LP	CODE CSA S6–19	LOAD CL–625–ONT	DATE JAN, 2026	
DRAWN	VKY	CHK	PK	SITE 30X–0869/B0		DWG	ST–3201

FILE NAME: C:\Users\RV\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-3201_HWY400 RAMP_PIER FOUNDATION GEOMETRY.dwg
MODIFIED: 2026-03-03 13:41
MINISTRY OF TRANSPORTATION, ONTARIO ANSI–D 2017–08

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DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
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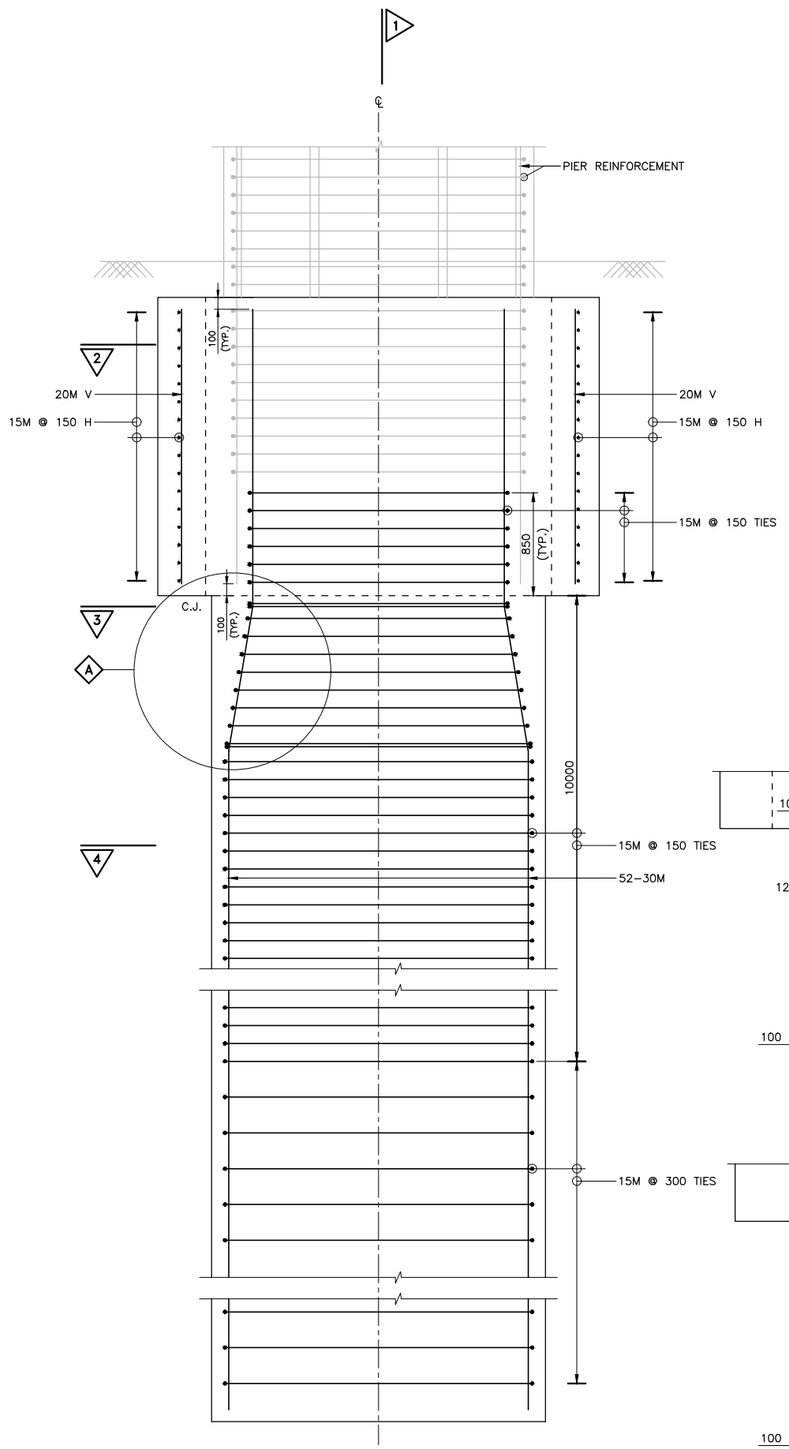
Ontario Ministry of Transportation

CONT 2026-2005
GWP 2026-23-00

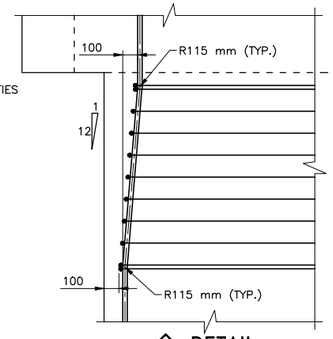
BRADFORD BYPASS HWY 400 RAMP
PIER FOUNDATION REINFORCEMENT DETAILS

SHEET 1117A

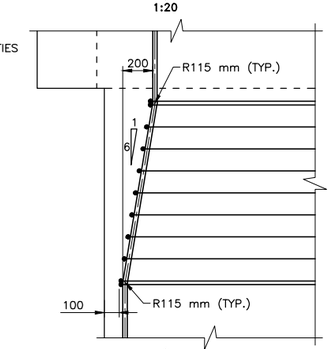
AECOM



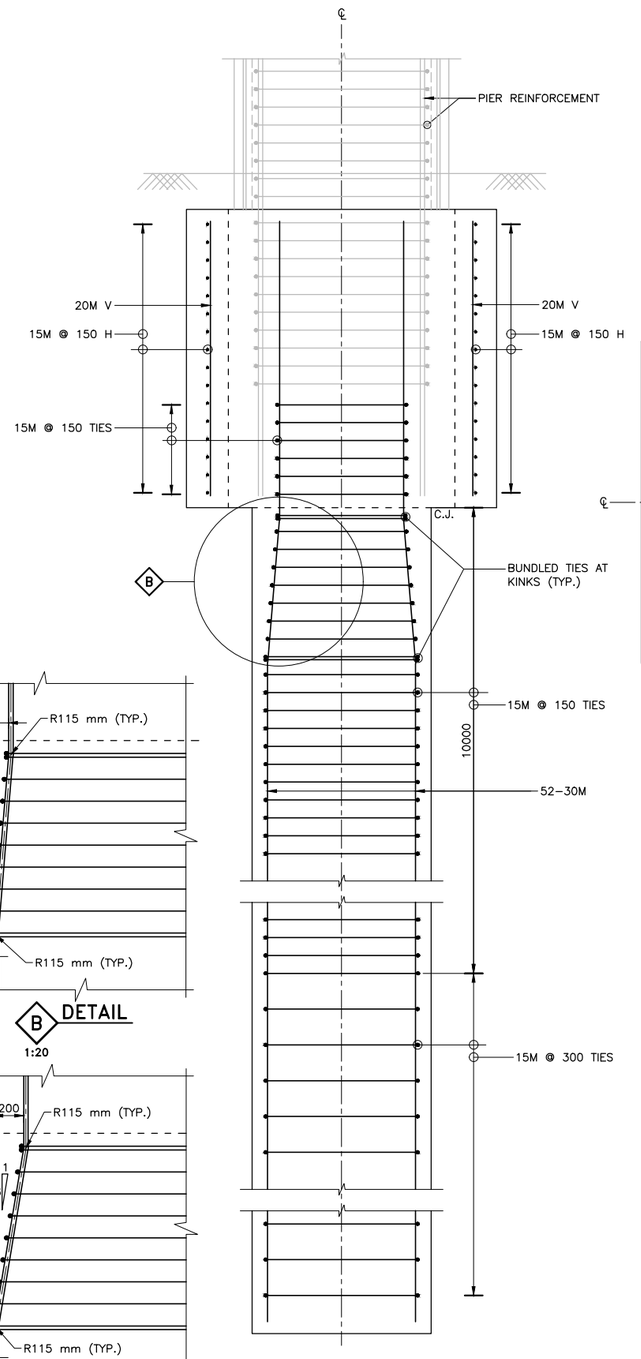
PIER FOUNDATION ELEVATION
SCALE 1:25



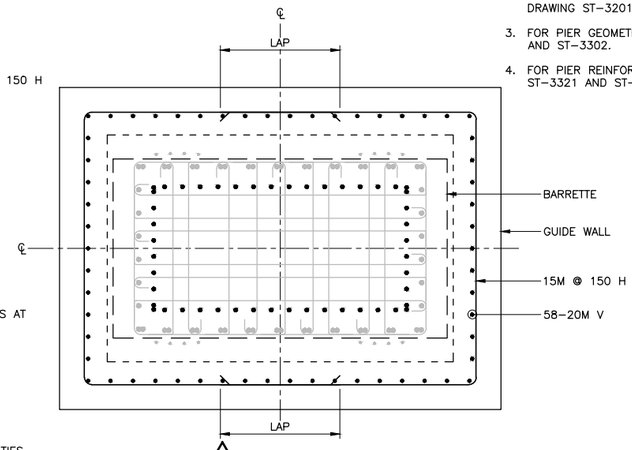
B DETAIL
1:20



A DETAIL
1:20

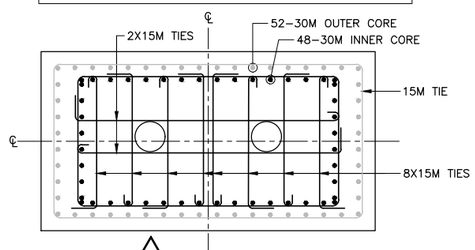


1 SECTION
1:25

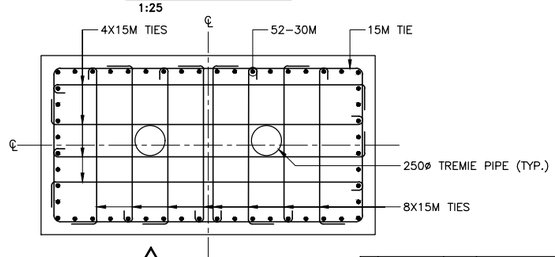


2 SECTION
1:25

GUIDE WALL AND BARRETTE REINFORCEMENT
PIER REINFORCEMENT



3 SECTION
1:25



4 SECTION
1:25

NOTES:

1. FOR GENERAL NOTES REFER TO DRAWING ST-1102 AND ST-2102.
2. FOR PIER FOUNDATION GEOMETRY DETAILS REFER TO DRAWING ST-3201.
3. FOR PIER GEOMETRY DETAILS REFER TO DRAWING ST-3301 AND ST-3302.
4. FOR PIER REINFORCEMENT DETAILS REFER TO DRAWING ST-3321 AND ST-3322.

REVISIONS			
DATE	BY	DESCRIPTION	
MAR 04,2026	VR	CSL TUBE REMOVED & NEW SECTION AND DETAIL INCLUDED	
DESIGN BS	CHK LP	CODE CSA S6-19	LOAD CL-625-ONT DATE JAN, 2026
DRAWN PK	CHK KS	SITE 30X-0869/B0	DWG ST-3211

FILE NAME: C:\Users\RV\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-3211_HWY400 RAMP_PIER FOUNDATION REINFORCEMENT DETAILS.dwg
MODIFIED: 2026-03-03 13:42
MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

FILE NAME: C:\Users\RV\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-1221_HWY400 RAMP E-S_BR06_ABUTMENT GEOMETRY-1.dwg
MODIFIED: 2026-03-03 19:25
MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
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Ontario Ministry of Transportation

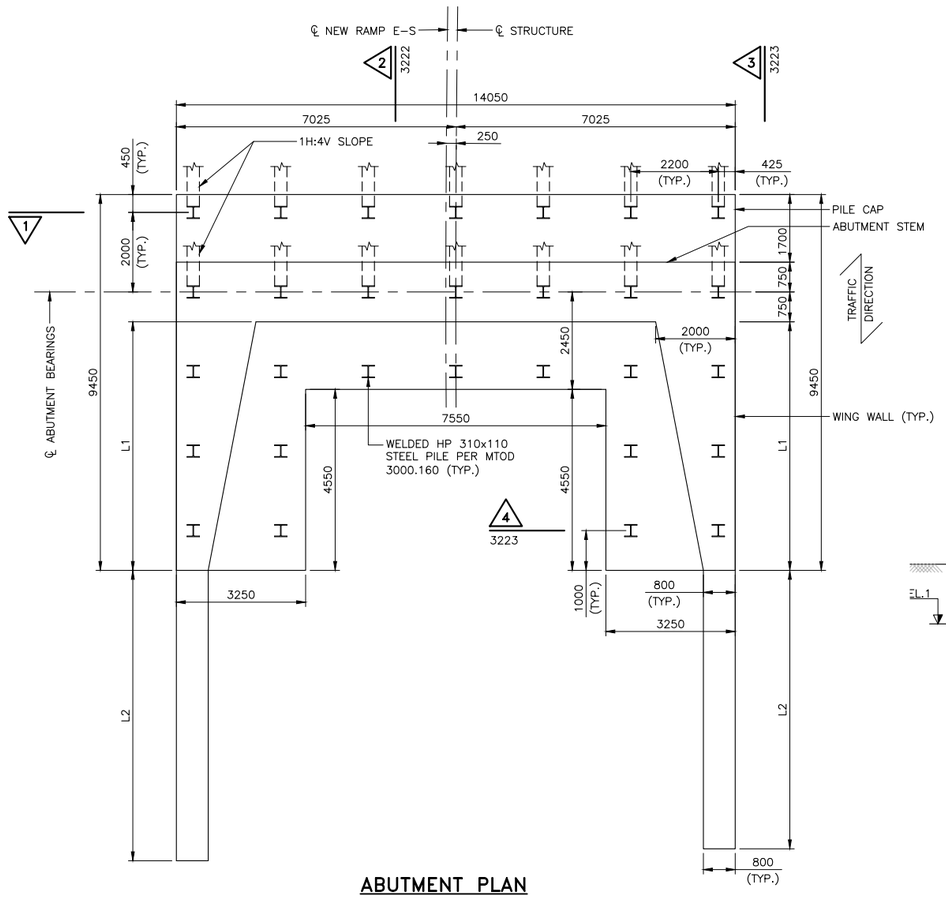
CONT 2026-2005
GWP 2026-23-00

BRADFORD BYPASS HWY 400 E-S RAMP

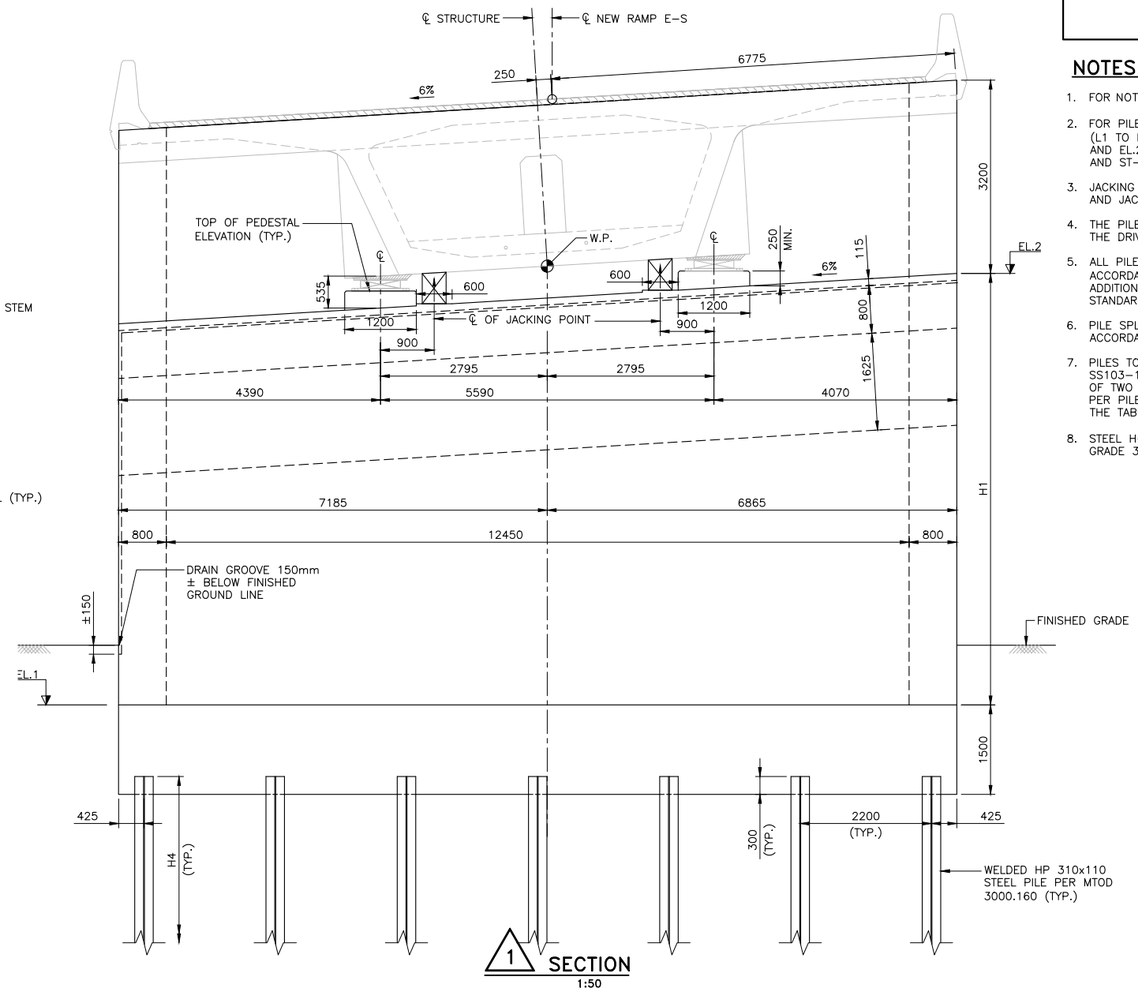
ABUTMENT GEOMETRY-1

SHEET 1118A

AECOM



ABUTMENT PLAN
SCALE 1:75



1 SECTION
1:50

NOTES:

1. FOR NOTES REFER TO DRAWING ST-3222.
2. FOR PILE DIMENSION (H4), WING WALL DIMENSIONS (L1 TO L3 AND H1 TO H3) AND ELEVATION LEVELS EL.1 AND EL.2, AND SECTIONS REFER TO DRAWING ST-3222 AND ST-3223.
3. JACKING SHALL FOLLOW BRO-062 BEARING REPLACEMENT AND JACKING GUIDELINES.
4. THE PILE DRIVING EQUIPMENT SHALL BE APPROPRIATE TO THE DRIVING CONDITIONS.
5. ALL PILE INSTALLATION SHALL BE CARRIED OUT IN ACCORDANCE WITH OPSS.PROV 903 (AS AMENDED). IN ADDITION, ALL PILES SHALL BE EQUIPPED WITH TITUS STANDARD PILE POINTS, OR EQUIVALENT.
6. PILE SPLICES SHALL BE AS PER OPSD 3000.150 AND IN ACCORDANCE WITH OPSS 903.
7. PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS103-11 USING ULTIMATE GEOTECHNICAL RESISTANCE OF TWO TIMES THAT SHOWN IN THE PILE LOAD TABLE PER PILE BUT NOT BELOW PILE TIP ELEVATION SHOWN IN THE TABLE WITHOUT APPROVAL OF THE ENGINEER.
8. STEEL H-PILES SHALL CONFORM TO CSA G40.20/G40.21 GRADE 350W.

TYPICAL JACKING & TEMPORARY SUPPORT LOAD TABLE*				
	WEST ABUTMENT		EAST ABUTMENT	
BEARING LOCATION**	A1-N	A1-S	A2-N	A2-S
JACKING PERMANENT LOAD AT SLS (kN)	2560	1930	2050	1580
JACKING LIVE LOAD AT SLS (kN)	2270	1560	2170	1410
TOTAL TEMP. SUPPORT LOAD AT ULS (kN)	7235	-750/5475*	-455/6255*	-1010/4715*

* FORCES LISTED ABOVE ARE UNFACTORED BEARING REACTIONS AND SHALL BE MULTIPLIED BY FACTOR OF SAFETY, AS PER CSA S6, TO DETERMINE THE JACK CAPACITY.

** FOR BEARING LOCATION REFER TO DWG ST-1380.

*** -ve (TENSION)

RAMP NAME	APPLICABLE ABUTMENTS
E-S RAMP	WEST ABUTMENT AND EAST ABUTMENT

REVISIONS			
DATE		BY	DESCRIPTION
MAR 04,2026		VKY	PILE DETAILS REVISED

DESIGN	BS	CHK	LP	CODE	CSA S6-19	LOAD CL-625-ONT	DATE JAN. 2026
DRAWN	PK	CHK	KS	SITE 30X-0869/BO		DWG	ST-1221

METRIC
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Ontario Ministry of Transportation

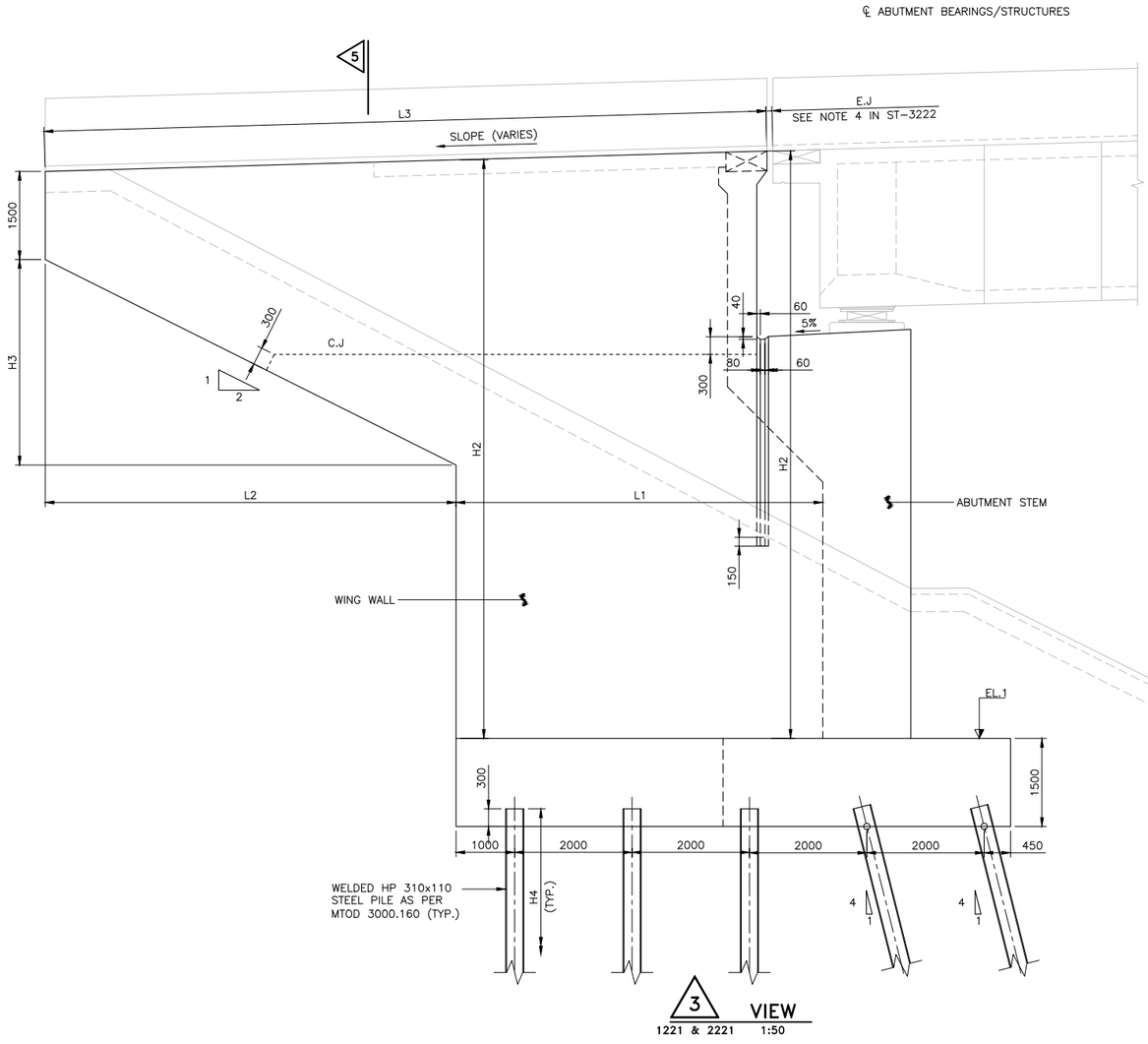
CONT 2026-2005
GWP 2026-23-00

BRADFORD BYPASS HWY 400 RAMP

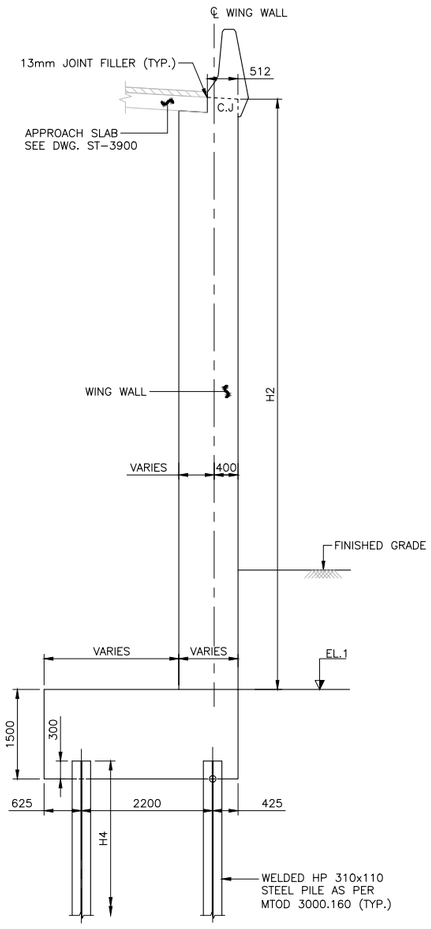
ABUTMENT GEOMETRY-3

SHEET 1120A

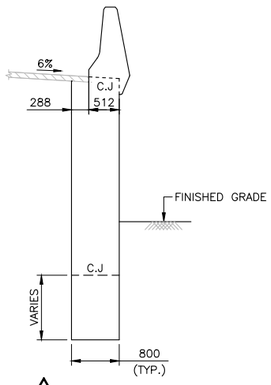
AECOM



3 VIEW
1221 & 2221 1:50



4 SECTION
1221 & 2221 1:50



5 SECTION
1:50

NOTES:

1. FOR NOTES REFER TO DRAWING ST-3222.
2. FOR PILE DIMENSION (H4), WING WALL DIMENSIONS (L1 TO L3 AND H1 TO H3) AND ELEVATION LEVELS EL.1 AND EL.2 REFER TO DRAWING ST-3222.

REVISIONS			
MAR 04,2026	PK	PILE DETAILS REVISED	
DATE	BY	DESCRIPTION	

DESIGN	BS	CHK	LP	CODE	CSA S6-19	LOAD	CL-625-ONT	DATE	JAN, 2026
DRAWN	PK	CHK	KS	SITE	30X-0869/B0			DWG	ST-3223

FILE NAME: C:\Users\RV\AECOM\Bradford Bypass Internal - Files\CAD WIP\CAD\100% Addendum\20260303\BR06\ST-3223_HWY400 RAMP_ABUTMENT GEOMETRY-3.dwg
MODIFIED: 2026-03-03 19:35

MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
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Ontario Ministry of Transportation

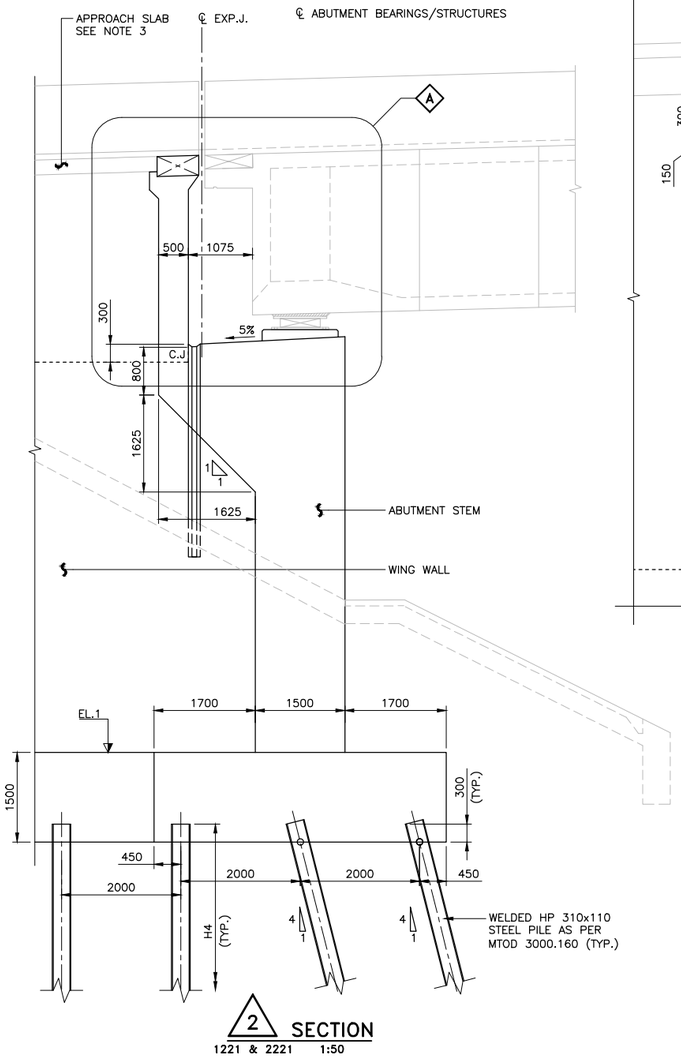
CONT 2026–2005
GWP 2026–23–00

BRADFORD BYPASS HWY 400 RAMP

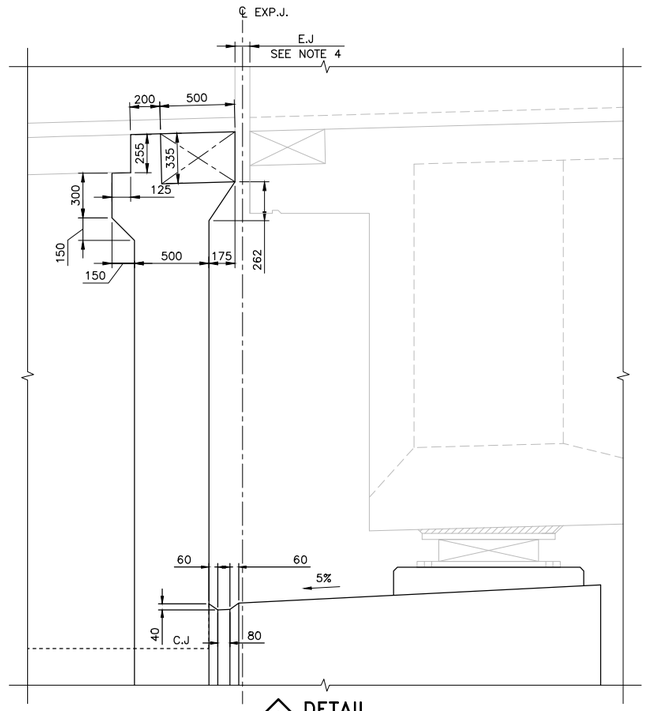
ABUTMENT GEOMETRY–2

SHEET 1119A

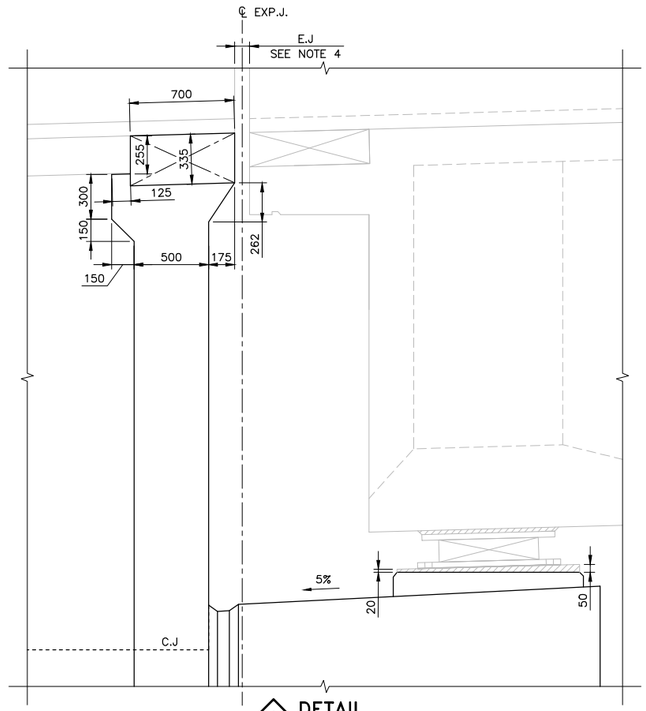
AECOM



2 SECTION
1221 & 2221 1:50



A DETAIL
1:20
(AT EAST ABUTMENT IN E–S RAMP & WEST ABUTMENT IN N–E RAMP)



A DETAIL
1:20
(AT WEST ABUTMENT IN E–S RAMP & EAST ABUTMENT IN N–E RAMP)

NOTES:

1. FOR ABUTMENT FOUNDATION LAYOUT PLANS OF E–S AND N–E RAMPS REFER TO DRAWING ST–1200 AND ST–2200 RESPECTIVELY.
2. FOR ABUTMENT GEOMETRY DETAILS REFER TO DRAWING ST–1221 AND ST–2221 RESPECTIVELY.
3. FOR APPROACH SLAB DETAILS REFER TO DRAWING ST–3900.
4. FOR EXPANSION JOINT DETAILS REFER TO DRAWING ST–3800 THRU 3805.
5. FOR CRASH BARRIER DETAILS REFER TO DRAWING ST–3905.
6. FOR SLOPE PROTECTION DETAILS REFER TO DRAWING ST–3910.
7. PILE SPACING IS MEASURED AT THE UNDERSIDE OF FOOTINGS.
8. PILE LENGTHS SHOWN ARE THE THEORETICAL LENGTHS BELOW CUT–OFF.

APPLICABLE STANDARD DRAWINGS:

OPSD 3000.100 FOUNDATION, PILES, STEEL H–PILE DRIVING SHOE

OPSD 3000.150 FOUNDATION, PILES, STEEL H–PILE SPLICE

RAMP E–S DIMENSIONS AND ELEVATION LEVELS

E–S RAMP								
LOCATION	L1 (mm)	L2 (mm)	L3 (mm)	H1 (mm)	H2 (mm)	H3 (mm)	EL.1 (m)	EL.2 (m)
E–S SOUTH WEST	6250	7000	12305	5515	VARIES (8560 TO 8710)	3500	256.000	261.514
E–S NORTH WEST	6250	7300	12605	6360	VARIES (9405 TO 9555)	3650	256.000	262.357
E–S SOUTH EAST	6250	5500	10800	4075	VARIES (7315 TO 7295)	2750	260.000	264.076
E–S NORTH EAST	6250	8000	13300	4920	VARIES (8135 TO 8155)	4000	260.000	264.919

RAMP N–E DIMENSIONS AND ELEVATION LEVELS

N–E RAMP								
LOCATION	L1 (mm)	L2 (mm)	L3 (mm)	H1 (mm)	H2 (mm)	H3 (mm)	EL.1 (m)	EL.2 (m)
N–E SOUTH WEST	6250	7000	12305	6045	VARIES (9290 TO 9315)	3500	269.965	276.007
N–E NORTH WEST	4250	5000	8305	5200	VARIES (8445 TO 8465)	2500	269.965	275.164
N–E SOUTH EAST	6250	5000	10305	4945	VARIES (7975 TO 8130)	2500	267.348	272.291
N–E NORTH EAST	4250	7000	10305	4100	VARIES (7190 TO 7290)	3500	267.348	271.448

PILE DATA				
	ES RAMP		NE RAMP	
WELDED H–PILE 310x110	EAST ABUTMENT	WEST ABUTMENT	EAST ABUTMENT	WEST ABUTMENT
NUMBER REQUIRED	29	29	27	27
ESTIMATED PILE TIP ELEVATION (m)	195.000	188.000	195.000	194.500
ESTIMATED PILE CUT–OFF ELEVATION (m)	258.800	254.800	266.148	268.765
ESTIMATED PILE LENGTH TOTAL H4(m) *	63.8	66.8	71.148	74.265

* THESE LENGTHS ARE ONLY APPLICABLE FOR VERTICAL PILES.

PILE LOAD TABLE			
RAMP NAME	LOCATION	ULS FACTORED AXIAL GEOTECHNICAL RESISTANCE (kN)	SLS FACTORED AXIAL GEOTECHNICAL RESISTANCE (kN)
ES RAMP	EAST ABUTMENT	1800	1200
	WEST ABUTMENT	2200	1450
NE RAMP	EAST ABUTMENT	1900	1250
	WEST ABUTMENT	2300	1500

REVISIONS			
MAR 10,2026	PK		PILE DETAILS REVISED
DATE	BY		DESCRIPTION

DESIGN	BS	CHK	LP	CODE	CSA S6–19	LOAD	CL–625–ONT	DATE	JAN, 2026
DRAWN	PK	CHK	KS	SITE	30X–0869/BO			DWG	ST–3222

FILE NAME: C:\Users\SakthivelB1\OneDrive - AECOM\Bradford Bypass Internal - CAD WIP\CAD\100% Addendum\20260303\BR06\ST-3222_HWY400 RAMP_ABUTMENT GEOMETRY-2.dwg
MODIFIED: 2026-03-03 22:27
MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-08

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APPENDIX H

Seismic Hazard Values (2020 National Building Code of Canada)

Government of Canada / Gouvernement du Canada

2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_C
Latitude (°)	44.117
Longitude (°)	-79.635

Please select one of the tabs below.

NBC 2020 | Additional Values | Plots | API | Background Information

The 5%-damped spectral acceleration (S_a(T,X), where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_C)$	$S_a(0.5, X_C)$	$S_a(1.0, X_C)$	$S_a(2.0, X_C)$	$S_a(5.0, X_C)$	$S_a(10.0, X_C)$	$PGA(X_C)$	$PGV(X_C)$
0.221	0.154	0.0876	0.0424	0.0114	0.00397	0.102	0.0994

The log-log interpolated 2%/50 year $S_a(4.0, X_C)$ value is : **0.0157**

▶ Tables for 5% and 10% in 50 year values

Download CSV

← Go back to the seismic hazard calculator form

Date modified: 2021-04-06

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APPENDIX I

Comparison of Foundation Alternatives

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Comparison of Foundation Alternatives
Highway 400 / Bradford Bypass E-S Ramp Interchange Structure

Spread Footing on Firm to Very Stiff Surficial Clay	Piles Driven into Very Stiff to Hard Clay or 100-blow Lower Clay Till	Continuous Flight Auger (CFA) Piles Installed into Compact Silty Sand to Sandy Silt Upper Till	Drilled Shafts (Caissons) Installed into 100-blow Lower Clay Till	Drilled Shafts (Caissons) Socketed into Limestone Bedrock	Barrettes Socketed into Limestone Bedrock
Advantages:					
• Ease of construction. • Does not require specialized construction method or equipment. • The most economical foundation alternative for the support of the abutments. • Generates very little noise and vibration during construction. • Does not require post-construction testing.	• Ease of construction. • Does not require specialized construction method or equipment. • Has the highest rate of installation as compared to the other types of deep foundations. • Driving of piles does not generate spoils. • Economical for large projects. • Allows for integral abutment design.	• Does not require the use of temporary casings or slurry during installation. • Has a higher rate of construction as compared to the installation of drilled shafts and barrettes. • Generates very little noise and vibration during construction.	• Provides higher geotechnical resistances to support the load demands of the structure compared to driven piles and CFA piles. • Provide higher resistance to lateral forces as compared to driven piles and CFA piles.	• Provides higher geotechnical resistances to support the load demands of the structure compared to Drilled Shafts installed into the 100-blow lower till. • Provide higher resistance to lateral forces as compared to driven piles and CFA piles. • Potentially a smaller number of drilled shafts will be required due to higher geotechnical resistance in bedrock as compared to drilled shafts into the 100-blow lower clay till. • Negligible post-construction settlement as compared to deep foundation not driven to or socketed into bedrock.	• A single large diameter drilled shaft can provide geotechnical resistances that meets or exceeds the load demands of the structure. • Can provide high resistance to lateral forces as compared to circular deep foundations. • Constructability review indicates barrettes into bedrock could be more technically feasible and cost effective than drilled shafts in bedrock over 100 m deep. • Negligible post-construction settlement as compared to deep foundation not driven to or socketed into bedrock.
Disadvantages:					
• Soil conditions at the abutments and piers will not provide adequate geotechnical resistances for the high structural load demands. • Dewatering will be required for construction of footings in dry conditions at the west abutment.	• Generates noise and vibration during pile driving. • Piles may refuse prematurely on very dense and/or hard layers. • Piles may be damaged during driven through very dense and/or hard layers. • Driving of long piles may be difficult due to the friction along the pile shaft. • Each pile provides a low geotechnical resistance as compared to the other types of deep foundation and as a result, numerous piles will be required to meet the load demands of the structure. Geotechnical	• Limited experience for bridge applications amongst contractors in Ontario. • Requires specialized equipment, and skilled operators. • Typically used for structures with moderate load demands and may not be suitable for structures with high load demands. • Requires the disposal of excavated spoils upon completion of installation. • Diameter of CFA piles are typically up to 1.2 m. Larger diameter CFA piles can be installed but at greater difficulty.	• The installation process is expected to be slow due to the need for advancing the drilled shaft into the 100-blow lower clay till. • Due to the depths of excavations, permanent casings will be required to prevent the walls of the shaft excavation from collapsing. • Polymer slurry will be required during the installation of the drilled shafts to maintain basal stability. Bentonite slurry cannot be used as it would reduce the shaft friction of the drilled shaft,	• Deeper installation of drill shafts to reach bedrock. • The installation process is expected to be slow due to the need for advancing the drilled shaft through the 100-blow lower clay till and to create the socket in the underlying bedrock. • Due to the depths of excavations, permanent casings will be required to prevent the walls of the shaft excavation from collapsing. • Bentonite/polymer slurry will be required during the installation of the drilled shafts to maintain basal stability.	• Limited experience to install barrettes of over 100 m amongst contractors. • Requires the design and construction of guide walls for the barrettes. Subject to the subsurface conditions and the groundwater level at the piers, the construction of guide walls may require temporary shoring. • Requires specialized equipment, bentonite/polymer slurry system, and skilled operators to maintain trench stability during construction. • Requires a large construction area for slurry plants, multiple

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Comparison of Foundation Alternatives Highway 400 / Bradford Bypass E-S Ramp Interchange Structure					
Spread Footing on Firm to Very Stiff Surficial Clay	**Piles Driven into Very Stiff to Hard Clay or 100-blow Lower Clay Till**	**Continuous Flight Auger (CFA) Piles Installed into Compact Silty Sand to Sandy Silt Upper Till**	**Drilled Shafts (Caissons) Installed into 100-blow Lower Clay Till**	**Drilled Shafts (Caissons) Socketed into Limestone Bedrock**	**Barrettes Socketed into Limestone Bedrock**
	resistance is further reduced resulting from friction fatigue phenomenon due to pile driving through the loose to compact silty sand till above the very stiff to hard clay. • Large settlement of the pile group should be expected due to the high load demand. • High Strain Dynamic Testing on selected piles will be required to confirm the design geotechnical resistances were achieved.	• Typically limited to installation depths of about 25 m. Special attachments are required to install to depth of up to about 35 m. • Soil mining is possible during installation due to presence of very loose silty sand to sandy silt till. • Numerous CFA piles will be required to meet the structural load demands. • Large settlement of the CFA pile group should be expected due to the high load demand. • Requires pre-production load testing on a test pile and verification testing on selected production piles to confirm the design geotechnical resistances were achieved. • Construction costs are expected to be high due to the number of CFA piles required.	<u>resulting in lower geotechnical resistances.</u> • A fluid column exchange of the slurry will be required upon completion of excavation for sand suppression. • Will require the disposal of excavated spoils and slurry during/upon completion of installation. • Complex logistics due to multiple segments of reinforcement cages to be lowered into the excavation, particularly at the pier at centreline of Highway 400. • Installation of thermal wires/ sensors for Thermal Integrity Profiling (TIP) will be required to assess the structural integrity of the drilled shafts. • Installation of access tubing for Crosshole Sonic Logging (CSL) will not be possible/practical due to multiple segments of reinforcement cage. • A load test will be required on a pre-production drilled shaft to confirm the geotechnical resistance meets the high load demands. • Has a high construction cost due to the need for multiple drilled shafts, casings, slurry, base inspection, instrumentation and verification testing. • Some post-construction settlement may occur as a result of the high load demands from the structure.	• A fluid column exchange of the slurry will be required upon completion of excavation for sand suppression. • Will require the disposal of excavated spoils and slurry during/upon completion of installation. • Complex logistics due to multiple segments of reinforcement cages to be lowered into the excavation, particularly at the pier at centreline of Highway 400. • Installation of thermal wires/ sensors for Thermal Integrity Profiling (TIP) will be required to assess the structural integrity of the drilled shafts. • Installation of access tubing for Crosshole Sonic Logging (CSL) will not be possible/practical due to multiple segments of reinforcement cage. • A load test may be required on a pre-production drilled shaft to confirm the geotechnical resistance meets the high load demands. • Has a high construction cost due to the need for casings, slurry, base inspection, instrumentation and verification testing.	segments of reinforcement cage, and trenching equipment. • A fluid column exchange of the slurry will be required upon completion of excavation for sand suppression. • Requires the disposal of excavated spoils during/upon completion of installation. • Complex logistics due to multiple segments of reinforcement cages to be lowered into the excavation, particularly at the pier at centreline of Highway 400. • Installation of thermal wires/ sensors for Thermal Integrity Profiling (TIP) will be required to assess the structural integrity of the barrettes. • Installation of access tubing for Crosshole Sonic Logging (CSL) will not be possible/practical due to multiple segments of reinforcement cage. • Has a high construction cost as compared to other types of deep foundations due to the disadvantages above. • Due to the shape of the cutter head, the bedrock socket will not have a flat bottom. • A load test may be required on a pre-production barrette to confirm the geotechnical resistance meets the high load demands.

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Comparison of Foundation Alternatives Highway 400 / Bradford Bypass E-S Ramp Interchange Structure					
Spread Footing on Firm to Very Stiff Surficial Clay	**Piles Driven into Very Stiff to Hard Clay or 100-blow Lower Clay Till**	**Continuous Flight Auger (CFA) Piles Installed into Compact Silty Sand to Sandy Silt Upper Till**	**Drilled Shafts (Caissons) Installed into 100-blow Lower Clay Till**	**Drilled Shafts (Caissons) Socketed into Limestone Bedrock**	**Barrettes Socketed into Limestone Bedrock**
			• Multiple drilled shafts may be required to meet the structural load demands at the piers.		
Risks:					
• Risk of loosening of the foundation soils if dewatering is not effective at the west abutment.	• Risk of damage when driving piles into/through 100-blow soils. • Risk of not achieving the design geotechnical resistance at End of Initial Driving into very stiff to hard clay. • Cobbles and boulders maybe present within the silty sand till deposit potentially resulting into piles being terminated above the design tip elevations.	• Proper management of slurry will be crucial to avoid inclusions and necking. • Soil mining may occur if the rate of auger advancement is not precisely controlled. • Soil collapse may occur if retraction of the auger and placement of concrete is not carefully controlled.	• The handling of bentonite/polymer slurry adds time and complexity. • Verticality of drilled shafts may not meet specified tolerances due to the depth of the excavation. • Handling of slurry adds time and complexity. • Proper management of slurry will be crucial to avoid inclusions. • Inspection and cleaning of the base of excavation will be challenging/not practical due to its depth. Socket cleanliness may be inferred from fines content in slurry after fluid exchange. • Concrete placement by tremie methods must be continuous and carefully controlled. • Damage to thermal wires/ sensors for Thermal Integrity Profiling (TIP) during the assembly of multiple segments of the reinforcement cages.	• Challenging to install large diameter drilled shaft to depth of over 100 m. • Verticality of drilled shafts may not meet specified tolerances due to the depth of the excavation. • Handling of slurry adds time and complexity. • Proper management of slurry will be crucial to avoid inclusions. • Inspection and cleaning of the base of the bedrock socket will be challenging/not practical due to its depth. Socket cleanliness may be inferred from sand content in slurry after fluid exchange. • Concrete placement by tremie methods must be continuous and carefully controlled. • Damage to thermal wires/ sensors for Thermal Integrity Profiling (TIP) during the assembly of multiple segments of the reinforcement cages.	• Challenging to install barrettes to depth of over 100 m. • Verticality and geometry of barrettes may not meet specified tolerances due to the depth of the excavation, which may result in difficulties with lowering of the reinforcement cages. • Handling of slurry adds time and complexity. • Proper management of slurry will be crucial to avoid inclusions and necking. • Inspection and cleaning of the base of the bedrock socket will be challenging/not practical due to its depth. Base cleanliness may be inferred from sand content in slurry after fluid exchange. • Concrete placement by tremie methods must be continuous and carefully controlled. • Damage to thermal wires/ sensors for Thermal Integrity Profiling (TIP) during the assembly of multiple segments of the reinforcement cages.

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Comparison of Foundation Alternatives Highway 400 / Bradford Bypass E-S Ramp Interchange Structure					
Spread Footing on Firm to Very Stiff Surficial Clay	Piles Driven into Very Stiff to Hard Clay or 100-blow Lower Clay Till	Continuous Flight Auger (CFA) Piles Installed into Compact Silty Sand to Sandy Silt Upper Till	Drilled Shafts (Caissons) Installed into 100-blow Lower Clay Till	Drilled Shafts (Caissons) Socketed into Limestone Bedrock	Barrettes Socketed into Limestone Bedrock
Conclusions and Recommendations:					
ABUTMENTS: Not feasible due to high load demands and therefore not recommended.	**ABUTMENTS:** Recommended and preferred foundation alternative at the abutments.	**ABUTMENTS:** Technically feasible but not recommended.	**ABUTMENTS:** Technically feasible but not recommended.	**ABUTMENTS:** Technically feasible but not recommended.	**ABUTMENTS:** Technically feasible but not recommended.
PIERS: Not feasible due to high load demands and therefore not recommended.	**PIERS:** Technically feasible but not recommended due to the number of piles required to meet the high load demands.	**PIERS:** Not feasible due to high load demands.	**PIERS:** Technically feasible but not recommended.	**PIERS:** Technically feasible but not recommended.	**PIERS:** Recommended and preferred foundation alternative for the piers.

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APPENDIX J

Non-Standard Special Provisions and Notice to Contractor

SUPPLY AND INSTALLATION OF BARRETTE PILES – Item No.
SUPPLY AND INSTALLATION OF THERMAL WIRES AND THERMAL ACQUISITION PORTS FOR THERMAL INTEGRITY PROFILING (TIP) TESTING – Item No.
TECHNIQUE SHAFT – Item No
BI-DIRECTIONAL STATIC LOAD TEST – Item No

Non-Standard Special Provision

1.0 SCOPE

This specification covers the requirements for the supply and installation of cast-in-place concrete barrette deep foundation units for the following structures:

- Bradford Bypass N-E Interchange Bridge over Highway 400 (30X-0868/B0), and,
- Bradford Bypass E-S Interchange Bridge over Highway 400 (30X-0869/B0).

2.0 REFERENCES

This specification refers to the following specifications, standards, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 903	Deep Foundations
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 1002	Aggregates - Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1302	Water
OPSS 1350	Concrete – Materials and Production
OPSS 1440	Steel Reinforcement for Concrete

CSA Standards

CSA A23.2-19C*	Slump Flow of Concrete
* [Part of A23.1-14/A23.2-19 - Test and Standard Practices for Concrete]	Concrete Materials and Methods of Concrete Construction/Methods of
CSA W186-21	Welding of Reinforcing Bars
G40.20-04/G40.21-04 (R2009)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
W47.1-03 (R2008)	Certification of Companies for Fusion Welding of Steel
W48-06	Filler Materials and Allied Materials for Shielded Metal Arc Welding
W59-03(R2008)	Welded Steel Construction (Metal Arc Welding)

W178.1-08	Certification of Welding Inspection Organizations
W178.2-08	Certification of Welding Inspectors

Canadian General Standards Board (CGSB)

48.9712-2006	Non-destructive Testing, Qualification and Certification of Personnel

ASTM International

D7949	Integrity Testing of Concrete Deep Foundations by Thermal Methods
D8169	Deep Foundations Under Bi-Directional Static Axial Compressive Load

American Petroleum Institute (API)

API 13A	Drilling Fluid Materials, 19th Edition, 10.00.08
API RP 13B-1	Field Testing Water Based Drilling Fluids, 5th Edition,

Steel Structures Painting Council (SSPC)

SP10/NACE No.2-Jan. 1, 2001 Near-White Blast Cleaning

International Organization for Standardization / International Electrotechnical Commission (ISO/IEC)

17025	General Requirements for the Competence of the Testing and Calibration Laboratories

European Federation of Foundation Contractors / Deep Foundation Institute

Guide to Support Fluids for Deep Foundations, First Edition, 2019

2.01 SUBSURFACE CONDITIONS

The subsurface conditions are described in the Foundation Investigation Reports for the two interchange ramp structures included in the contract.

1. In general, the excavation for the barrettes will extend through the upper very loose to compact silty sand to sandy silt to approximately 20 to 25 m (~El. 225 m to 230 m), underlain by very stiff to hard clay to about 60 to 70 m (~El 190 m to 200 m), which in turn is underlain by 100-blow silty clay to clay till containing silt and silty sand interlayers, and limestone fragments.
2. The bedrock encountered is limestone of the Lindsay Formation at depths between 120 and 128 m (~El. 138.0 m to 139.0 m), and is generally described as highly weathered to fresh, thinly bedded, grey to dark grey, with shale interbeds and clay seams. The bedrock consists of medium strong to very strong limestone.
3. Barrette piles will extend through extensive layers of water-bearing, cohesionless overburden soils (e.g. very loose to loose silty sand to sandy silt) below the groundwater level near or at ground surface. In the Spring 2025, artesian groundwater levels of up to 0.7 m above ground surface was recorded at a monitoring well installed in the borehole advanced near Pier 1 of the E-S Interchange ramp structure (Borehole HWY400-38).

4. In addition to the limestone fragments encountered in the till above the bedrock, very strong to extremely strong cobbles and boulders are commonly present within the glacially deposited soils. Nested cobbles and higher percentage of boulders are expected to be encountered within the 5 m to 10 m of overburden immediately overlying the bedrock. Nested cobbles and boulders can create a zone of high conductivity that can cause sudden slurry loss during excavation.

3.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bedrock means a natural solid bed of the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin that may or may not be weathered.

Boulder means particles of rock with size greater than 300 mm.

Barrette Piles is a rectangular cast-in-place deep foundation element formed by placing concrete in an excavated hole following the placement of steel reinforcement.

Cold Joint means the interface surface other than at a formed joint that occurs when plastic concrete is placed against concrete that has taken its initial set.

Cold Weather means those conditions when the ambient air temperature is at or below 5°C. It is also considered to exist when the ambient air temperature is at or is likely to fall below 5°C within 96 hours after completion of concrete placement. Temperature refers to shade temperature.

Deep Foundation Unit means a structural member, driven or otherwise, installed in the ground to transfer the loads from a structure to soil or rock and derives supporting resistance from the surrounding soil or rock or from the soil or rock strata below its tip or a combination of both.

Diaphragm Wall or slurry wall is a continuous underground concrete wall constructed in panels. Construction involves the excavation of trenches (or panels) supported by the use of slurry, lowering of steel reinforcement and placement of concrete by tremie method.

Guide Wall is a temporary reinforced concrete structure that functions as a template for constructing barrette piles, diaphragm walls, and secant pile walls.

Hydromill is a specialized piece of heavy construction equipment for creating deep, narrow trenches using rotating cutting wheels to excavate soil and roc Slurry is used in conjunction with the excavation operations to stabilize the excavation walls.

Obstruction means a material and/or objects that cannot be removed during normal excavation operations, which necessitate the use of other methods and/or equipment to remove. Such obstructions may be boulders, rock fragments, waterlogged timbers, or any material, natural or man-made which requires use of special tools or procedures not otherwise required for excavation of rock or earth materials.

Pile Cap means a footing or some other structural component used to transfer the load to the piles as well as maintaining them in position.

Pumped Concrete means a method of transporting concrete through hose or pipe by means of positive and continuous pressure.

Temperature Control System means a mechanical system used to apply cooling or heating to the concrete to ensure specified temperature ranges are maintained during the temperature monitoring period. Systems may include tubing, chillers, heaters, pumps, manifolds, flow meters, temperature monitoring equipment, insulation and equipment required to adjust and maintain concrete temperatures as specified in the Contract Documents.

Tremie Concrete means concrete placed by means of tremie pipe equipment, for depositing concrete under water or slurry, the discharge end of the pipe being kept submerged in the freshly deposited concrete so that the concrete-water or concrete-slurry interface is not disturbed.

Slurry means a drilling fluid, consisting of water or water mixed with one or more of various solids or polymers, used to maintain the stability of the side walls and bottom of an excavation.

Thermal Integrity Profiling (TIP) is a non-destructive testing method using the heat from curing concrete to assess the quality and shape of the deep foundations like barrettes piles. The method is used to detect defects such as necks and bulges by monitoring temperature changes of the concrete through thermal wires.

Tremie means a hopper with a vertical pipe used for placing concrete under water. The foot of the pipe is always submerged in concrete except during commencement of concreting and the upper level of the concrete in the pipe is always above water level.

Trench means an excavation made for the entire depth of the barrette pile from ground surface to its base.

Visual Stability Index (VSI) is a result of visual assessment of concrete circular spread during a slump flow test, which classifies segregation resistance of concrete (CSA A23.2-19C).

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.01 Design Requirements

4.01.01 Concrete

The Contractor is responsible for providing concrete with suitable characteristics for installation. The concrete shall be flowable, non-segregating concrete that does not exhibit rapid slump loss. The concrete mix shall satisfy the requirements specified herein.

4.01.02 Guide Wall

Guide walls shall ensure accurate horizontal positioning, vertical alignment, and safe excavation of barrette trenches. The Contractor shall design and construct guide walls to meet all barrette pile construction requirements. The Contractor shall meet these requirements for the guide walls:

- Provide stable support during trench excavation.
- Maintain trench alignment and prevent soil collapse.
- Provide a fixed and secure support point for suspending the reinforcement cage.

4.02 Submission Requirements

4.02.01 General

All submissions shall bear the seal and signature of both a Design Engineer and Design Checking Engineer. Both the Design Engineer and Design Checking Engineer shall be Professional Engineers in the Province of Ontario with a minimum of 5 years experienced in the field of barrette piles, diaphragm walls, and/or deep bored piles of depths greater than 50 m, and 10 years experience in deep foundations working with slurries. All submissions shall be submitted to the Contract Administrator as specified in the Contract Documents. In lieu of any specified timeline in the Contract Documents, all submissions shall be submitted 6 weeks prior to construction.

When welded field splices are used, welding procedures according to the Canadian Welding Bureau shall be submitted to the Contract Administrator.

4.02.02 Preconstruction Survey

A condition survey of property and structures that may be affected by the work shall be submitted to the Contract Administrator prior to commencing the work. The survey shall be conducted in accordance with the Contract Documents as specified and include the locations and conditions of adjacent properties; buildings; underground structures; above ground and underground utilities; and structures.

4.02.03 Concrete

The concrete mix shall be designed to provide adequate strength and durability for the intended use and to meet the requirements as specified in Section 5.02.

4.02.04 Installation

4.02.04.01 Pre-Construction

The barrette pile pre-construction submittal shall be comprised of the following components:

a) Construction experience.

b) Installation work plan.

c) Slurry technical assistance (if applicable).

d) Non-destructive QC testing personnel.

e) Technique shaft.

f) Bi-Directional Static Load Test (BDSLT).

4.02.04.01.01 Construction Experience

The Contractor's experience and qualifications in the construction of barrette piles, diaphragm walls, and/or deep bored piles shall include at least three projects with:

a) Ground conditions similar to those as specified in the Contract Documents.

b) Installation of barrette piles, diaphragm walls, and/or deep bored piles to depths greater than 50 m.

The on-site supervisors shall have a minimum 5 years of experience in supervising construction of barrette piles, diaphragm walls, and/or deep bored piles of depths greater than 50 m deep, and 10 years overall

experience in deep foundations working with slurries. Work experience shall be direct supervisory responsibility for the on-site construction operations.

The hydromill operators shall have a minimum of 5 years of experience in construction of diaphragm wall and/or barrette pile foundations.

A Request to Proceed with the work of barrette pre-construction shall be submitted to the Contract Administrator with:

c) A project reference list for the Contractor's experience and qualifications.

d) Individual's experience lists for the on-site supervisors and hydromill operators assigned to the work.

The project reference list shall contain a description of each listed project with the name and current phone number of the projects' owner(s) or the owner's Contractor(s).

The individual's experience lists shall be limited to a single page for each supervisor or operator and contain a description of the on-site experience in excavation operations using a hydromill, placement of assembled steel reinforcement cages and concrete in excavated shafts.

The Contract Administrator may suspend the barrette piles construction if the Contractor substitutes previously accepted personnel. The Contractor shall be fully liable for the additional costs resulting from the suspension of work, and no adjustments in contract time resulting from the suspension of work will be allowed.

The installation of barrette piles shall not proceed until a Notice of Proceed has been received from the Contract Administrator.

4.02.04.01.02 Installation Work Plan

The Contractor shall submit a barrette pile installation Work Plan to the Contract Administrator at least 6 weeks prior to the start of the installation of the technique shaft. In preparing the Work Plan, the Contractor shall reference the available subsurface information presented elsewhere in the Contract Documents. This Work Plan shall provide at least the following information:

a) Proposed overall construction operation schedule and sequence.

b) Details of guide walls to be used, including the top and bottom level, wall thickness, steel reinforcements, concrete type, supports used and their spacing.

c) Means of access and details of concrete delivery to site. Description, size, and capacities of proposed equipment, including but not limited to cranes, coring equipment for the removal of obstructions or hard rock, final cleaning equipment, and hydromill unit. The Work Plan shall describe why the equipment was selected and describe equipment suitability to the anticipated site conditions and work methods. The Work Plan shall include a project history of the hydromill equipment demonstrating the successful use of the equipment for the construction of barrette piles. The Work Plan shall also include details of excavation operations and cleanout methods.

d) Details of the method(s) to be used to ensure stability of the excavation (i.e., prevention of caving, and bottom heave using slurry, or other means), including pauses and stoppages, lowering of the steel reinforcement, and concrete placement. Trench stability methodologies, design calculations,

and numerical modelling outputs shall be submitted.

e) Mitigation measures shall be included in the Work Plan if evidence of trench instability is observed due to slurry failure.

f) A slurry mix design, including all additives and their specific purpose in the slurry mix, with a discussion of its suitability to the anticipated subsurface conditions, shall be submitted and include the procedures for mixing, using, and maintaining the slurry.

g) A detailed plan for quality control of the selected slurry, including tests to be performed, test methods to be used, and minimum and/or maximum property requirements which must be met to ensure the slurry functions as intended, considering the anticipated subsurface conditions and construction methods, in accordance with the slurry manufacturer's recommendations and this project special provision shall be included. As a minimum, the slurry quality control plan shall include the tests specified in Section 5.05 of this Special Provision.

h) Description for the monitoring and control of verticality and geometry.

i) Description of an emergency construction joint method.

j) Methods for dewatering of the site (as necessary).

k) Detailed method(s) for cleaning of base of barrettes due to debris accumulation. Excessive accumulation of sediment at the base of the barrettes can significantly reduce end-bearing capacity. Contractor shall include method(s) of cleaning the base ensuring proper cleaning to the rock socket in the Work Plan.

l) The proposed concrete mix to be used.

m) Details of concrete placement, including proposed operational procedures for pumping methods, and a sample uniform yield form to be used by the Contractor for plotting the approximate volume of concrete placed versus the depth of barrette for all concrete placement (except concrete placement in the dry).

n) Methods to prevent and handle delays in concrete batching and delivery to site.

o) Description and details of the containment, storage, and disposal plan for excavated material and slurry (if applicable).

p) A contingency plan for containment and clean-up of any spill or discharge of material which might contaminate public waters. The contingency plan shall address day-to-day operations and unplanned emergency situations.

q) Reinforcing steel shop drawings with details of reinforcement placement, including bracing, centering, and lifting methods, and the method to ensure the reinforcement cage position is maintained during construction, including use of bar boots and/or reinforcement cage base plates.

r) Contingency plan to remedy sinking of the reinforcement cage into concrete.

s) Crane pad design if used.

The reinforcing steel shop drawings and installation plan shall include, at a minimum:

a) Procedure and sequence of steel reinforcement cage assembly. Detailed welding procedures shall be included, signed and sealed by the Design Engineer and Design Checking Engineer and included in the Work Plan.

b) The tie pattern, tie types, and tie wire gages for all ties on permanent reinforcing and temporary bracing.

c) Number and location of primary handling steel reinforcing bars used during lifting operations.

d) Type and location of all steel reinforcing bar splices. No tack welding is allowed.

e) Details and orientation of all internal cross-bracing, including a description of connections to the reinforcement cage.

f) Description of how temporary bracing is to be removed.

g) Location of support points during transportation.

h) Cage weight and location of the center of gravity.

i) Number and location of pick points used for lifting for installation and for transport (if assembled off-site).

j) Crane charts and a description and/or catalog cuts for all spreaders, blocks, sheaves, and chockers used to equalize or control lifting loads.

k) The sequence and minimum inclination angle at which intermediate belly rigging lines (if used) are released.

l) Pick point loads at 0, 45, 60, and 90 degrees and at all intermediate stages of inclination where rigging lines are engaged or slackened.

m) Methods and temporary supports required for cage splicing.

n) For picks involving multiple cranes, the relative locations of the boom tips at various stages of lifting, along with corresponding net horizontal forces imposed on each crane.

o) A description of spacers and supports to be used for the reinforcement.

p) Location and dimensions of suitable placement of tremie pipes. This involves very deep tremie concrete placement using tremie pipes. Due to the depth and associated flow resistance, there will be significantly high internal pressures within the tremie system. As a result, the tremie system details shall be clearly identified and fully documented. This includes, at a minimum, tremie pipe sizes and wall thicknesses, overall dimensions, connection and joint details, allowable pressure capacity, and the proposed method of concrete placement. All related information shall be provided to demonstrate the suitability and safety of the tremie system for the intended depth and placement conditions. A minimum of two tremie pipes shall be used.

q) Location of non-destructive testing apparatuses (TIP wires, etc.).

The Contract Administrator will evaluate the installation Work Plan for conformance with the Drawings, Specifications, and project special provisions, within the review time specified. The Contract Administrator will schedule a Barrette piles installation Work Plan Submittal Meeting following review of the Contractor's initial submittal of the Work Plan and prior to Contract Administrator's formal response to the initial submittal.

4.02.04.01.03 Slurry Methodology

Contractor shall retain a Design Engineer and Design Checking Engineer with a minimum of 10 years experience to provide or arrange for technical assistance in the use of the slurry. The Contractor shall submit the following to the Contract Administrator:

a) The name and current phone number of the slurry manufacturer's technical representative assigned to the project, and the frequency of scheduled visits to the project site by the slurry manufacturer's representative.

b) The name(s) of the Contractor's personnel assigned to the project and trained by the slurry manufacturer in the proper use of the slurry. The submittal shall include a signed training letter from the slurry manufacturer for each trained Contractor's employee listed, including the date of the training.

The following shall be submitted:

a) The type, source, and physical and chemical properties of the bentonite (mineral) or polymer (synthetic) slurry.

b) The source of water.

c) Method of mixing slurry.

d) The water solids ratio and the mass and volumes of the constituent parts, including any chemical admixtures or physical treatment employed to produce slurry with the required physical properties.

e) Details of procedure to be used for monitoring the quality of the slurry.

f) A test report showing the properties of the slurry and certifying that the slurry meets the requirements of API RP 13B-1.

g) Method of disposal of the slurry.

The proposed final slurry methodology shall be submitted to the Contract Administrator with a Request to Proceed.

4.02.04.01.04 Cage Lift

The Contractor is responsible for providing proper lift procedure for rebar cage. Contractor shall submit a proposed procedure (engineered lift plan) to the Contract Administrator at least 6 weeks prior to the start of construction works.

4.02.04.01.05 Temperature Control Plans

Barrettes with geometry of 1.5 m x 2.8 m cross section over 100 m deep shall be considered as a mass concrete element. Temperature control plan shall be prepared according to OPSS 904 and submitted to the Contract Administrator. The plan shall include methods for monitoring and controlling concrete temperature and the temperature difference prior to, during, and after placement for concrete subject to cold weather. The temperature control plan shall include, as a minimum, the following:

a) Concrete element for which the plan applies.

b) Temperature monitoring system, including the locations and depths, number of thermocouples, and frequencies of recordings to be used in each placement.

c) Method of ensuring concrete temperature and temperature difference is maintained for the duration of the protection period.

d) Any alterations to work schedule, production, delivery schedule, and time of placement for temperature control purposes.

e) Any modification to mix design for temperature control purposes.

f) Any other specific measures to be taken.

g) Method of withdrawal of protection.

In addition, for concrete subject to cold weather the Temperature Control Plan shall also include the following:

a) Type of insulation, RSI value and number of layers, including test data verifying the RSI value. The submission for cold weather protective measures shall be accompanied by samples of insulation, if requested by the Contract Administrator.

b) Type and layout of heaters and type and extent of housing.

4.03 Pre-Construction Meeting

A preconstruction meeting shall be held at least 3 months prior to the Contractor beginning any barrette pile construction to discuss construction procedures, personnel, and equipment to be used, and other elements of the approved installation narrative. As a minimum the following shall represent the Contractor at the meeting:

a) Project Manager.

b) Project Engineer.

c) Project Superintendent.

d) On site supervisors, and all foremen in charge of excavation operations, the use of slurry as applicable, placing the reinforcement cage and placing the concrete.

e) If slurry is used, the slurry manufacturer's representative or approved Contractor's employees trained in the use of the slurry shall also attend.

4.04 Acceptance of Submissions

The Contract Administrator will review the Submissions for the purpose of verifying compliance to contract requirements, within 14 calendar days after the Pre-Construction Meeting and provide written comments if changes are necessary to meet Contract requirements. The Contractor shall submit to the Contract Administrator a final installation plan which meets all Contract requirements within 14 calendar days.

If revisions in the previously reviewed Work Plans are required to accommodate site conditions, or for other reasons, the Contractor shall submit the revised Work Plans to the Contract Administrator prior to implementation. The proposed final installation Work Plan shall be submitted to the Contract Administrator with a Request to Proceed. The Contractor shall not proceed with the installation Work Plan until a Notice to Proceed is given by the Contract Administrator.

The Contract Administrator's approval of the installation plan does not relieve the Contractor of full responsibility for the safe and successful completion of construction of the barrette pile foundations.

5.0 MATERIALS

5.01 Steel Reinforcement

Steel reinforcement shall be according to OPSS 1440 unless otherwise specified in the Contract specifications or drawings.

5.02 Concrete

5.02.01 General

Concrete shall be according to OPSS 1350, in its entirety, with the following exceptions and additions:

a) The requirements for slump and plastic air content do not apply. The plastic concrete and coarse aggregate size shall be according to the Table below titled 'Concrete for Tremie Placement Method (Wet Excavation).

b) The requirements for hardened concrete air void system do not apply.

c) Testing of compressive strength shall be according to OPSS 1350.

d) Testing of rapid chloride permeability shall be according to OPSS 1350, except that testing shall be done on cylinders instead of cores, and 1 cylinder for acceptance testing of rapid chloride permeability and 1 cylinder for referee testing of rapid chloride permeability shall be cast for each set of acceptance test cylinders for compressive strength. The sublot used for compressive strength testing shall be considered a lot, for the purposes of acceptance of rapid chloride permeability.

e) A trial batch shall be mixed and placed at an offsite location in the presence of the Contract Administrator, to demonstrate the ability of the Contractor to meet the requirements of this specification, prior to being given approval by the ministry to place concrete in the work.

Concrete for Tremie Placement Method (Wet Excavation)

Property	Test	Test Method	Specified Value	Frequency of Testing
28-day Compressive Strength	Compressive Strength	CSA A23.2-19C	As shown on the design drawings	Trial Batch, one set (3 cylinders) per 35 m^3 placed
Workability	Slump Flow	CSA A23.2-19C	400-550 (mm)	Trial Batch and Each Truck (1)
Stability	Visual Stability Index	CSA A23.2-19C	0	Trial Batch and Each Truck (1)
Workability Retention	Slump Flow	CSA A23.2-19C	≥350 (mm) at the end of concrete placement (2)	Trial Batch and Verification During Construction (3)
Stability	Column Segregation (4)	ASTM C1610	≤10 (%)	Trial Batch
Stability	Bleeding Test	ASTM C232	≤0.1 (ml/min)	Trial Batch
Washout Resistance (5)	Washout Test	USACE CRD-C 61	8% Cumulative Mass Loss	Trial Batch (If required)
Coarse Aggregate Size	Maximum 19 mm or not more than one fifth of the reinforcement clear spacing (6), whichever is smaller. The maximum aggregate size shall not be smaller than 13 mm.			

Notes:

(1) Trial batch and during construction in accordance with the specified concrete sampling frequency.

(2) Minimum slump flow at the end of concrete placement (including removal of temporary casing, if necessary). Slump flow loss is determined by performing initial slump flow test immediately after

obtaining the concrete sample, followed by one slump flow test every 15 to 30 minutes up to the predetermined time limit (estimated time to complete tremie concrete placement).

(3) Additional slump flow loss testing may be required when drilled shaft construction is performed during warm and cold seasons as the dosage of a hydration stabilizing admixture may require adjustment.

(4) Hardened Visual Stability Index (AASHTO R81) can be performed in addition to Column Segregation test, if directed by the Contract Administrator.

(5) Only applicable when anti-washout admixture is used. The admixture should be considered to enhance the washout resistance of tremie concrete when fresh concrete might be exposed to moving water and/or controlling tremie pipe embedment might be challenging. Additional testing requirements may apply due to thixotropic behavior of the concrete containing the admixture. The Contactor shall obtain the approval from the Contract Administrator prior to the use of anti-washout admixture.

(6) Minimum distance between parallel longitudinal and parallel transverse reinforcing bars.

5.02.02 Concrete Trial Batch

Prior to commencement of construction of the barrettes, the concrete mix design for the barrettes requires verification by testing of a trial batch, in the presence of the Owner, to assess the properties of the plastic and hardened concrete. The slump flow of the trial batch shall be within the highest half of the target slump flow range identified by the Contractor. The Owner shall be notified of the location and date of the trial, one week in advance.

The Contractor shall use the trial batch as a means of assessing plastic and hardened concrete properties, to verify the concrete's suitability for the work.

The following trial batch requirements shall be met:

a) The trial batch shall use the same batching sequence, mixing time, production methods and ready-mix plant to be used for the concrete in the work. A new trial batch is required if any changes to the mix design are made which require a new mix design submission.

b) All submitted test results shall be from the same trial batch.

c) Each trial batch shall consist of a load of concrete with a minimum volume of 3 m^3.

d) Sampling and testing shall be carried out after a period of time has elapsed that would simulate the anticipated time between batching and end of placing the concrete in the Contract work.

e) Trial batch testing of the plastic concrete shall be according to the table in Section 5.02.01 titled 'Concrete for Tremie Placement Method (Wet Excavation)'. and this specification with the addition of time of set testing according to ASMT C403 Time of Setting of Concrete by Penetration Resistance.

f) Trial batch testing of hardened concrete shall be according to this specification with the addition of linear shrinkage testing according to LS-435. Linear shrinkage testing is for information purposes.

g) Additional trial batches shall be carried out if the specified requirements are not met.

A report summarizing the trial batch results shall be submitted to the Contract Administrator.

5.03 Reinforcing Bar Spacers and Support Devices

Rebar spacers, centralizers, and other support devices shall be according to OPSS 905.

5.04 Thermal Wires and Thermal Acquisition Port for Thermal Integrity Profiling (TIP) Testing

The Contractor shall furnish thermal wires and Thermal Acquisition Ports (TAPs) for the Thermal Integrity Profiling (TIP) testing.

5.05 Slurry

Bentonite (mineral) slurry shall be according to API Spec 13A as well as the requirements in Section 5.05.02.

Polymer (synthetic) slurry shall be according to Guide to Support Fluids for Deep Foundations, First Edition published by EFFC/DFI Support Fluids Task Group.

The slurry shall consist of a stable colloidal suspension of pulverized solids or polymers thoroughly mixed with water.

Slurry will be defined as drilling fluid in the form of water, bentonite, polymer slurry used to maintain stability of the excavation. In addition, the term polymer slurry will be defined as the final mixed composite of all additives, including polymer slurry additives required to produce the acceptable drilling slurry.

A slurry manufacturer representative shall be at site on a full-time basis at least during the construction of the technique shaft and the first production barrette and can be on site as requested by the Contractor on subsequent applications. The use of slurry will be non-compensable and effect on time of performance due to the use of the slurry will be non-excusable.
The material used to make the slurry shall not be detrimental to the concrete or surrounding ground strata. Polymer slurries shall have appropriate viscosity and gel characteristics to transport excavated material to suitable screening systems or settling tanks. The percentage and specific gravity of the material used to make the slurry shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. The Contractor shall use appropriate means to clean the bottom of the excavations to achieve direct contact between concrete and undisturbed end bearing formation. The use of a clean-out bucket is not sufficient for final cleanout.

Prior to introduction into the excavation, the manufactured polymer slurry admixture shall be pre-mixed thoroughly with clean, fresh water and for adequate time in accordance with the slurry admixture manufacturer's recommendations allotted for hydration. Water used for mixing shall be potable. Slurry tanks of adequate capacity will be required for slurry mixing, circulation, storage, and treatment. Excavated slurry pits are not permitted in lieu of slurry tanks. Adequate equipment will be required as necessary to control slurry properties during the excavation operations in accordance with the values provided in tables in the following sections.

5.05.01 Polymer (Synthetic) Slurry

Polymer slurry shall be used as per manufacturers recommendations and shall conform to the following requirements:

Property	Test Procedure	Specified Value
Density	Mud Weight (Density) API RP 13B-1, Section 1	1040 kg/m^3 Maximum

Sand Content	Sand API RP 13B-1, Section 5	1.0% Maximum
Temperature (prior to concrete placement)	-	5.0°C Minimum
Viscosity	Marsh Funnel and Cup API RP 13B-1, Section 2.2	32 to 135 second/quart (1)
pH	Glass Electrode, pH Meter, or pH Paper	8 to 10

Note:

(1) Minimum viscosity shall be specified by the slurry manufacturer for the site geotechnical conditions.

5.05.02 Bentonite (Mineral) Slurry

Use of bentonite slurry is not permitted unless approved by the Contract Administrator. If approved for use, bentonite slurry shall conform to the following requirements:

Property	Test Procedure	Specified Value
Density	Mud Weight (Density) API RP 13B-1, Section 1	1010 to 1200 kg/m^3
Sand Content (prior to final cleaning and immediately prior to placing concrete)	Sand API RP 13B-1, Section 5	2.0% maximum
Temperature (prior to concrete placement)	-	5.0°C Minimum
Viscosity	Marsh Funnel and Cup API RP 13B-1, Section 2.2	26 to 50 second/quart (1)
pH	Glass Electrode, pH Meter, or pH Paper	8 to 11

Note:

(1) Minimum viscosity shall be specified by the slurry manufacturer for the site geotechnical conditions.

6.0 EQUIPMENT

6.01 Drilling and Excavation Equipment

Equipment used for construction of barrette piles shall be capable of providing sufficient torque and down-thrust for excavation operations and capable of excavating to the required dimensions of the barrette piles. Appropriate drilling and coring equipment must be available to remove and/or penetrate through obstructions and bedrock and to create the rock socket.

6.02 Concrete Placement Equipment

Tremie pipe to place concrete underwater shall be watertight and of sufficient length, weight, and diameter to discharge concrete to the base of the rock socket. The tremie must not contain aluminum parts that will have contact with the concrete. The inside diameter of the tremie pipe must not be less than 250 mm for an open system or 125 mm for a closed system. The inside and outside surfaces of the tremie pipe must be clean and smooth to permit flow of concrete and unimpeded withdrawal during concrete placement. The discharge end of the tremie must be constructed to permit the free radial flow of concrete. Wall thickness of the tremie must be adequate to prevent crimping or sharp bends that may restrict concrete placement.

A plug shall be placed at the top of the tremie or pump line to separate the concrete from the slurry until the concrete is flowing through the orifice. Plugs, if left in the concrete, must be of a material approved by

the Contract Administrator. Tremie pipe sections must have connections that will not loosen and separate and remain watertight if a portion of the tremie becomes stuck.

6.03 Temperature Monitoring and Recording System

The Contractor shall monitor, record, and submit records for the concrete and ambient air temperature for the barrettes. The selection of the concrete temperature monitoring and recording system equipment shall be carried out according to OPSS 904. The temperature monitoring and recording system shall provide unalterable records of temperature during the temperature monitoring period. Prior to use on the Contract, the temperature monitoring and recording system shall be confirmed by the Contract Administrator, in writing, to be acceptable.

Temperature sensors and associated instrumentation shall have a combined accuracy of ± 1.5°C and shall record temperatures at time intervals not exceeding 1 hour and shall digitally display the temperature.

Thermocouples for monitoring ambient air temperature shall be installed in the shade close to the surface of the concrete at a minimum frequency of one thermocouple per stage.

7.0 CONSTRUCTION

7.01 Transporting, Storing, and Handling Reinforcing Steel Reinforcement Cages

7.01.01 General

Steel reinforcement shall be transported, stored, and handled in such a manner that damage is prevented and the strength of the components is not affected by deterioration or deformation.

Components shall be lifted and placed using appropriate lifting equipment, temporary bracing, guys, or stiffening devices so that the components are at no time overloaded, unstable, or unsafe.

Material shall be supported to prevent unequal settlement when stacked.

7.02 Guide Wall

7.02.01 General

The Contractor shall construct guide walls in a manner that provide a stable wall without moving or settling during the excavation operations. The top of the guide wall shall be at equal elevation on all sides.

Temporary external supports shall be provided to guide wall to avoid movement until excavation operation begins.

The Contractor shall submit a Request to Proceed once Guide walls are constructed and barrette installation shall commence only when Notices to Proceed have been given by the Contract Administrator.

7.03 Excavation

7.03.01 General

The Contractor shall submit Requests to Proceed prior to construction and at the milestones specified. Construction of barrette piles shall commence only after Notices to Proceed have been given by the Contract Administrator.

Barrette piles shall be excavated to the required depth as shown on the Contract Drawings. Excavation operations shall conform to this section and the installation Work Plan.

The Contractor bears full responsibility for selection and execution of the method(s) of stabilizing and maintaining the excavation. Stabilization shall conform to the installation Work Plan.

7.03.02 Continuity of Excavation Operations

Once the excavation operation has commenced, the excavation shall be conducted in a continuous operation until the excavation reaches the target depth, except for pauses and stops as noted, using approved equipment capable of excavating through the type of material expected. Pauses during the excavation operation, except for tooling changes, slurry maintenance, and removal of obstructions, are not permitted.

Pauses, defined as momentary interruptions of the excavation operation, will only be permitted for tooling changes, slurry maintenance, and removal of obstructions. Excavation operation interruptions not conforming to this definition shall be considered stops. Stops shall not exceed 24 hours duration unless approved by the Contract Administrator.

During stops, the Contractor shall protect the base of the excavation from weathering and stabilize the excavation to prevent bottom heave, caving, head loss, and loss of ground.

If any signs of trench excavation instability due to slurry failure is observed, the Contractor shall inform the Contract Administrator and execute pre-planned measures. No further advancement of the barrette pile shall take place until all of the following conditions are satisfied:

a) The cause of instability has been identified by the Contractor.

b) The Contractor submits a corrective/preventative plan to the Contract Administrator.

c) Any corrective/preventative measures deemed necessary collectively by the Contractor and Contract Administrator have been implemented by the Contractor.

d) The Contract Administrator deems it safe to proceed with the advancement of the barrette pile.

The Contractor shall conform to the requirements of Section 903.07.03.02.04 of OPSS 903 regarding the maintenance of the slurry and the minimum level of drilling slurry throughout the stoppage of the excavation operation and shall recondition the slurry to the required slurry properties prior to recommencing excavation operations.

The duration from the time of base inspection to the start of concreting shall not exceed 96 hours or as it will be simulated in the technique shaft, whichever is shorter.

7.03.03 Cleaning of Bottom of Excavation and Inspection

7.03.03.01 Cleaning

The Contractor is responsible for cleaning the base of the excavation to comply with the requirements of the specification.

Immediately upon the completion of the bedrock socket, cleaning of the base of the excavation shall begin. Cleaning shall be carried out with sufficient slurry exchange. Sand content testing at the mid-point and at the base of the barrettes will determine the completeness of the cleaning.

The following criteria must be followed prior to concrete placement:

a) Sand content at the mid-point and base of barrettes shall be no more than 2% after sufficient slurry exchange.

The Contractor shall obtain the approval from the Contract Administrator prior to concrete placement.

7.03.04 Obstruction

When obstructions are encountered, the Contractor shall notify the Contract Administrator promptly. An obstruction is defined as a specific object encountered during the excavation operation which prevents or hinders the advance of the hydromill.

An obstruction will be classified as material and/or objects that cannot be efficiently removed during normal excavation operations, which necessitate the use of other methods and/or equipment to remove. Such obstructions may be boulders, rock fragments, waterlogged timbers, or any material, natural or man-made, which requires use of special tools or procedures.

For this Contract, the following are *not* classified as obstructions and, if present, must be removed by the Contractor with no additional compensation.

1. Material present which is:
    a. Required to be removed by the Contract, or,
    b. Known to the Contractor or readily visible upon site investigation and which can be removed by conventional surface excavation methods.
2. Boulders within the baseline defined below.
3. All native soils with particle size less than 300 mm.

When efforts to advance past the obstruction to the target elevation result in the rate of advance of the hydromill being significantly reduced relative to the rate of advance for the portion of the excavation in the geological unit that contains the obstruction, then the Contractor shall remove, break up, or push aside the obstruction.

All soil groups are anticipated to contain cobbles and boulders in various proportions. For baseline purposes and based on other infrastructure projects in similar glacial deposits, it could be assumed that the Boulder Volume Ratio (BVR), defined as the ratio of the cumulative volume of all boulders to the total excavated volume of ground, for all native soil layers is 0.4%. For the lower 10 m thick layers of overburden immediately above the bedrock, the baseline BVR is 1.6%. Boulders within the barrettes encountered during excavation will need to be excavated through. For baseline purposes, the maximum boulder volume for one event is 1.25 m^3.

Subsurface obstructions at barrette pile locations shall be removed, broken, or pushed aside by the Contractor. The Contractor shall employ special procedures or tools when the excavation cannot be

advanced using conventional equipment. Blasting will not be permitted. The contract requires the Contractor to manage underground obstructions encountered during barrette excavation as part of the work; however, the baseline conditions establish expected boulder volumes and Boulder Volume Ratios (BVR) that are deemed included in the contract price. The Contractor may be entitled to claim additional compensation or time only where the actual boulder volume or BVR exceeds the stated baseline values, or where unforeseen subsurface obstructions materially differ from those indicated in the Contract Documents and result in unexpected delays, provided that the Contractor follows the differing site condition procedures set out in the Contract Documents.

7.03.04.01 Slurry Technical Assistance

The slurry manufacturer's representative, shall:

a) Provide technical assistance for the use of the slurry,

b) Be at the site prior to introduction of the slurry into the first barrette pile requiring slurry, and,

c) Remain at the site during the construction of at least the first barrette pile to adjust the slurry mix to the specific site conditions.

After the manufacturer's representative is no longer present at the site, the Contractor's employee trained in the use of the slurry, as identified to the Contract Administrator shall be present at the site throughout the remainder of slurry operations to perform the duties specified in items a) through c) above.

7.03.04.02 Minimum Level of Slurry in the Excavation

When slurry is used in an excavation the following is required:

a) The height of the slurry shall be as required to provide and maintain a stable excavation to prevent bottom heave, caving or sloughing of all unstable zones.

b) During excavation operations, the slurry level shall be maintained above the groundwater level the greater of the following dimensions:

   i. Not less than 1.5 m for bentonite (mineral) slurries.

   ii. Not less than 1.5 m for polymer (synthetic) slurries.

c) The slurry level shall be maintained in the excavation throughout all stops and during concrete placement.

7.03.04.03 Slurry Sampling and Testing

Bentonite slurry and polymer slurry shall be mixed and thoroughly hydrated in slurry tanks, ponds, or storage areas. Mixing in the excavation is not permitted.

The Contractor shall draw sample sets from the slurry storage facility and test the samples for conformance with the specified viscosity and pH properties before beginning slurry placement in the excavation. A sample set shall be composed of samples taken at mid-height and within 600 mm of the base of the storage area. The Contractor shall keep a written record of all additives and concentrations of the additives in the polymer slurry. These records shall be submitted to the Contract Administrator once the slurry system has been established for the installation of the first barrette pile. The Contractor shall provide revised data to the Contract Administrator if changes are made to the type or concentration of additives during construction.

The date, time, names of the persons sampling and testing the slurry, and the results of the tests shall be recorded. A copy of the recorded slurry test results shall be submitted to the Contract Administrator at the completion of each excavation, and during construction when requested by the Contract Administrator. Sample sets of all slurry, composed of samples taken at mid-height and within 600 mm of the base of the excavation and the storage area, shall be taken and tested once every 4 hours minimum at the beginning and during excavation operations and prior to cleaning the base of the excavation to verify the control of the viscosity and pH properties of the slurry. Sample sets of all slurry shall be taken and tested at least once every 2 hours if the previous sample set did not have consistent viscosity and pH properties. All slurry shall be recirculated or agitated when tests show that the sample sets do not have consistent viscosity and pH properties. Cleaning of the base of the excavation shall not begin until tests show that the samples taken at mid-height and within 600 mm of the base of the excavation have consistent viscosity and pH properties. Sample sets of all slurry, as specified, shall be taken and tested to verify control of the viscosity, pH, density, and sand content properties after final cleaning of the base of the excavation just prior to placing concrete. Placement of the concrete shall not commence until tests show that the samples taken at mid-height and within 600 mm of the base of the excavation have consistent specified properties.

7.03.04.04 Maintenance of a Stable Excavation

The Contractor shall demonstrate to the satisfaction of the Contract Administrator that stable conditions are being maintained. If the Contract Administrator determines that stable conditions are not being maintained, the Contractor shall immediately take action to stabilize the excavation. The Contractor shall submit to the Contract Administrator a revised installation Work Plan that addresses the problem and prevents future instability. The Contractor shall not continue with the excavation operations until the damage that has already occurred is repaired in accordance with the specifications, and until receiving the Contract Administrator's review of the revised installation Work Plan.

7.03.04.05 Disposal of Slurry and Drill Cuttings

Disposal of the soil/rock cutting, slurry, and slurry contacted spoils shall be in accordance with all applicable regulatory requirements.

7.04 Assembly and Placement of Reinforcing Steel

7.04.01 Reinforcement Cage Assembly

The Contractor shall assemble the reinforcement cage and place as a unit in accordance with the installation plan. The reinforcement cage shall be placed immediately after the excavation is inspected and accepted, and just prior to concrete placement.

All reinforcing steel shall be supported such that the steel remains within the allowable tolerances specified herein during placement of concrete. Splices shall be located in accordance with and as shown on the Contract Drawings. Mechanical bar splices meeting the requirements specified in the Contract Documents shall be used. Mechanical bar splices in adjacent bars shall be staggered not less than 1067 mm (3.5 feet) apart. If welding of the reinforcing steel is proposed, Contractor shall submit a welding work plan that is signed and sealed by a CWB-certified welding engineer, which shall be reviewed and approved by a qualified structural engineer retained by the Contractor. The welding work plan shall be submitted to the Contract Administrator 6 weeks prior to construction for review. Welding of reinforcement shall be as per CSA W186-21. Welding shall be performed by a qualified welder working for a company certified by the Canadian Welding Bureau according to CSA W186-21.

Welding of the reinforcing steel is not permitted on any reinforcing steel that is which 10 m of the underside of the guide wall.

The reinforcement cage shall be rigidly braced to retain its configuration during handling and construction. The Contractor shall show bracing and any extra reinforcing steel required for fabrication of the cage on the shop drawings. The reinforcement cage shall be supported on a continuous surface to the extent possible. All rigging connections shall be located at primary handling bars, as identified in the reinforcing steel assembly and installation plan. Internal bracing is required at each support and lift point. When lifting the cage for placement in the excavation, the Contractor shall provide sufficient pick-up points to prevent bending of the cage that will cause deformation of the reinforcement bars and damage to inspection cables.

Damaged bars and inspection cables must be replaced at the Contractor's expense.

The reinforcement shall be carefully positioned and securely fastened to provide the minimum clearances listed below, and to ensure that displacement of the reinforcing steel bars will not occur during placement of the concrete.

7.04.02 Reinforcement Cage Centralizers and Template

Rolling centralizers for reinforcing steel shall be used to minimize disturbance of the sidewalls of the excavation. The reinforcing steel centralizers at each longitudinal space plane shall be placed in accordance with the following minimum criteria:

a) A plane of centralizers shall be provided within 0.5 m of bottom of the excavation.

b) A plane of centralizers shall be provided within 1.5 m of top of the excavation.

c) Planes of centralizers shall be provided at a maximum longitudinal spacing of either two and a half times the equivalent dimension of the barrette pile or 4.5 m, whichever is less.

d) Each plane of centralizers shall consist of either one centralizer per 0.3 m equivalent dimension of the barrette pile or four centralizers whichever is more.

The Contractor shall furnish and install additional centralizers as required to maintain the specified concrete cover throughout the depth of the excavation.

7.04.03 Reinforcement Cage Installation and Support

Reinforcement cage should be securely held in the position immediately before, during and after the concrete placement. The bottom supports of the reinforcement case shall be positioned such that the reinforcing steel is not permitted to come into contact with the soil or rock and to ensure that the bottom of the cage is maintained at the proper distance above the base as identified in the Contract Documents.

The Contractor shall laterally support the reinforcement cage at the top during placement of the concrete. The support system must be concentric to prevent racking and displacement of the cage. Internal cage stiffeners shall be placed and installed in a manner such that interference with the placement of concrete does not occur.

The reinforcement cage can be released only when the concrete achieved sufficient strength to support the weight of the cage.

The elevation of the top of the reinforcement cage shall be checked before and after the concrete is placed. The reinforcement cage shall be maintained within the specified tolerances, and the Contractor shall make corrections to those tolerances, as required, to the satisfaction of the Contract Administrator.

If the Contract Administrator determines that the condition of the excavation is unsuitable for concrete placement following the placement of the reinforcement cage, or if concrete placement does not commence immediately following the placement of the reinforcement cage, the Contractor shall remove the cage from the excavation as directed by the Contract Administrator so that the integrity of the excavation, including accumulation of loose material in the base of the excavation and the condition of the sidewalls, can be determined by inspection. If the reinforcement cage moves up or down from its original position by more than 75 mm, the Contractor shall submit a proposal to the Contract Administrator for approval to address the out of tolerance reinforcement installation.

7.05 Concrete Placement

7.05.01 General

Concrete should be placed as soon as possible but not to exceed 96 hours after completing cleaning of the base of the excavation, inspecting and finding it satisfactory, and immediately after placing reinforcement cage.

The full depth of the excavation shall not be open for more than 96 hours or as simulated in the technique shaft, whichever is shorter, prior to receiving concrete, including all the necessary time to clean the base, exchange the slurry, inspect the base, and place the cage.

The concrete shall be placed continuously at a rate to prevent cold joints within the barrette pile. An unplanned stoppage of work may require an emergency construction joint during the construction of the barrette pile. A detailed plan for an emergency construction joint shall be included in the installation Work Plan.

During concrete placement, the Contractor shall monitor, and minimize, the difference in the level of concrete inside and outside of the reinforcement cage.

Upward and downward movement of the reinforcement cage should be monitored during concrete placement.

7.05.02 Concrete Placement in Wet Excavation (Tremie Method)

Tremie pipes used for concrete placement shall comply with the following requirements:

a) Be watertight.

b) A minimum inside diameter of:

   i. Pressurized tremie pipe – 125 mm or 3 times of maximum coarse aggregate size, whichever is larger.

   ii. Gravity tremie pipe – 250 mm or eight times of maximum coarse aggregate size, whichever is larger.

c) Should be sufficiently robust (not flexible).

d) Should be made of steel (aluminum or PVC should not be used).

e) Should have clean inner and outer surface to minimize drag on the concrete flow.

The tremie pipe should be embedded into previously placed concrete at all times during the concrete placement. The tremie pipe embedment should be within the range of 2 m to 4 m.

The discharge end of the tremie pipe shall be sealed using a sacrificial plate prior to lowering the tremie pipe into the excavation. Alternatively, the Contractor may use a plug that is inserted from the top end of the tremie pipe and travels through the tremie to keep the concrete separated from the slurry in the excavation. The concrete should not come into contact with the slurry until the concrete flows out of the tremie pipe.

During the start of the placement operations, ensure that the discharge end of the tremie pipe is within 150 ± 50 mm of the bottom of the excavation until at least 3 m of concrete embedment has been established (tremie pipe should first be placed to rest on the base of the excavation and then raised approximately 150 mm).

Depths of top of the concrete, and discharge end of the tremie pipe should be continuously monitored during concrete placement. These depths should be plotted against concrete volume and compared to theoretical values computed prior to concrete placement. These graphs should later be provided to the Contract Administrator.

At the completion of the concrete placement, contaminated laitance concrete on the upper portion of the barrette should be expected and be removed later. Therefore, the Contractor is advised to over-pour by approximately 1 m above the target cut-off elevation.

If tremie concrete placement operation is interrupted, the Contract Administrator may require the Contractor to prove that the quality of the final product was not affected. The methodology of the investigation shall be specified by the Contract Administrator. All costs related to such investigation shall be responsibility of the Contractor.

For this Contract, all barrette piles shall be concreted using tremie method.

7.05.03 Control of Temperature and Temperature Differences

7.05.03.01 Temperature Monitoring Period

The temperature monitoring period shall be a minimum of 7 days. A longer temperature monitoring period may be necessary in order to meet the requirements of the Withdrawal of Protection Section 7.05.03.04. Recording of concrete temperatures shall begin at the start of concrete placement.

During the temperature monitoring period, the concrete temperature shall not fall below 10°C or exceed 70°C. The temperature difference between the internal temperature at the centre of the concrete component at a location where the concrete is expected to reach the highest temperature and the surface of the concrete component shall not exceed 20°C. Temperature difference is measured from the internal temperature and the corresponding surface temperature sensor(s) set according to Table 1.

Table 1: Minimum Number of Thermocouple Sets for Concrete Temperature Measurement

	Concrete Elements Requiring Temperature Monitoring	Number of Thermocouple Sets in Each Element	Number of Thermocouples in Each Set	Thermocouple Set Locations
Cold Weather Protection	Each concrete element.	Minimum of 3 per element or stages thereof.	2	At locations where the concrete is expected to reach the highest temperature and at the surface of concrete.
Large Concrete Components Where the Smallest Dimension is 1.0 m	Elements with smallest dimension of 1.0 m or more.	Minimum of 3 per element or stages thereof.	2	At locations where the concrete is expected to reach the highest temperature and at the surface of concrete.

7.05.03.02 Temperature Monitoring

The recording of concrete temperatures shall begin at the start of concrete placement, and the temperature shall be recorded automatically at intervals no greater than one hour until the end of the monitoring period.

The digital temperature indicators shall be left in place until the end of the monitoring period. The Contractor shall also physically monitor and verify concrete and ambient air temperature readings every six hours, or more frequently, for the first 3 calendar days and every 12 hours for the remainder of the monitoring period.

The Contractor shall take necessary action to maintain the temperature within the specified limits; the Contract Administrator shall be provided access to verify temperature readings. The Contract Administrator may elect to have additional temperature sensors installed in any selected component. The additional temperature sensors will be supplied by the Contract Administrator. The Contract Administrator-supplied temperature sensors shall be installed at locations designated by the Contract Administrator and access and assistance shall be provided. All temperature sensors and data collection devices shall be protected from damage throughout the construction activities and temperature monitoring period. The Contract Administrator-supplied temperature sensors are in addition to the minimum number of Contractor-supplied temperature sensors specified in Table 1.

7.05.03.03 Temperature Monitoring

The Contractor shall monitor, record, and submit records for the concrete and ambient air temperature. At the end of each day during the temperature monitoring period, the following documentation shall be submitted to the Contract Administrator:

a) A completed MTO Form PH-CC-117, Concrete Temperature Record.

b) Temperature records for all temperature sensors, and a graphical plot of temperature versus time for each sensor.

c) Temperature records showing the difference between the centre of the concrete component and the surface of the concrete component, and a graphical plot of the differential temperature versus time.

At the end of the temperature monitoring period, the following documentation shall be submitted to the Contract Administrator:

a) A completed MTO Form PH-CC-117, Concrete Temperature Record.

b) A complete temperature record for all temperature sensors, and a graphical plot of temperature versus time for each sensor.

c) A complete temperature record showing the difference between the centre of the concrete component and the surface of the concrete component, and a graphical plot of the differential temperature versus time.

d) The unmodified original output file generated by the data logger.

e) Any actions taken to maintain control of temperature.

f) Cylinder curing records for concrete test cylinders.

7.05.03.04 Withdrawal of Protection

For concrete subject to cold weather and for large concrete components where the smallest dimension is 1.5 m, the protection shall be gradually removed or reduced in such a manner that the maximum allowable drop of concrete temperature, as shown in Table 2, for each 24-hour period is not exceeded.

Table 2: Maximum Allowable Drop in Concrete Temperature

Thickness	> 2.0 m	1.0 – 1.99 m	< 1.0 m
Maximum Allowable Drop in Concrete Temperature per 24 hours	10°C	15°C	20°C

The protection shall not be totally removed, nor shall the concrete be fully exposed to the air until the average concrete temperature is within 10°C of the ambient air temperature outside of the protection.

7.05.04 Protection of Fresh and Immature Concrete

Construction operations (e.g., compaction operations) and equipment (e.g., vibratory hammers, pile drivers, machine mounted impact tools, roller compactors, and other large pieces of equipment) capable of producing excessive ground vibrations or ground loss should not be performed/used in the radius of 10 m or 3 equivalent diameters of the barrette pile, whichever is larger, from the freshly place concrete for first 48 hours or until concrete reaches a compressive strength of 14 MPa, whichever comes first.

7.06 Tolerances

During excavation, the Contractor shall perform plumbness, alignment and dimensional checks of the excavation at 1.5 m increments. Any deviation exceeding the allowable construction tolerances specified herein shall be corrected by the Contractor. Upon completion of the rock socket, the barrettes shall be profiled using a Shaft Area Profile Evaluator (i.e. Koden, or similar). The deviation from vertical shall not be more than 1H:200V.

Excavations constructed in such a manner that the barrette pile cannot be completed within the required tolerances will not be accepted.

When an excavation is completed with unacceptable tolerances, the Contractor shall propose, develop and, submit a plan to the Contract Administrator describing the procedure for the corrective work. The

Contractor shall submit a Request to Proceed and shall not continue with the work until a Notice to Proceed is given.

The following construction tolerances will apply unless stated otherwise in the Contract Documents:

a) Excavation shall be constructed such that the center of the top of the barrette pile is within 75 mm of plan position in the horizontal plane at the plan elevation for the top of the barrette pile.

b) The vertical alignment of the excavation shall not vary from the plan alignment by more 1 mm per 200 mm of depth. The overall plumbness, including the barrette pile and column, shall be within 75 mm of the vertical alignment of the barrette pile and column.

c) The concrete cover tolerance for the reinforcement cage shall be 13 mm. Ensure that the reinforcement cage is centered with the excavation within a tolerance of 25 mm.

d) After placing all the concrete, ensure that the top of the reinforcement cage is not more than 75 mm above or below the plan position.

7.07 Non-Destructive Post Construction Testing

Non-destructive QC concrete integrity testing of barrette piles will include Thermal Integrity Profiling in accordance with ASTM D7949.

The Contractor is responsible for the supply, assembly, and installation of the thermal wires, and carry out the testing.

For this Contract, Thermal Integrity Profiling shall be carried out on all barrette piles.

The reports shall be submitted to the Contract Administrator for review.

7.07.01 Thermal Integrity Profiling (TIP)

The Contractor shall coordinate with the Contract Administrator and install the necessary TIP instrumentation cables prior to concreting the excavation. At or prior to completion of concrete placement, the Contractor shall coordinate with the Contract Administrator to connect the necessary data acquisition equipment. Within 48 hours of concrete placement, the Contractor shall provide the Contract Administrator with records including but not limited to: excavation, cage, and concrete depths and elevations, field concrete volume logs with times and dates, and a record of the cable serial numbers installed with corresponding locations in the barrette pile.

The TIP testing is required for all of the barrette piles.

a) The Contractor shall supply and install the TIP under direction of the TIP supplier and in accordance with ASTM D7949.

b) Testing Requirements:

TIP testing results shall be presented in a written report prepared by the TIP consultant within 5 working days of completion of testing. The report shall present results of TIP tests by including:

1. Graphical displays of all temperature measurements versus depth.
2. The overall average temperature.

3. Indication of unusual temperatures, particularly significantly cooler local deviations of the average at any depth from the overall average and estimates of shaft radius at these depths.
4. Estimates of minimum, maximum, and mean rock socket diameter.
5. Variations in temperature between cables (at each depth) which in turn correspond to variations in cage alignment. The cage alignment or offset from center should be noted.

7.07.01.01 Use of Thermal Wires

The Contractor shall furnish and install thermal wire in all reinforcement cage receiving the thermal wire method of TIP testing.

The thermal wire and associated couplers shall be obtained from the source approved by the Contract Administrator. The Contractor shall securely attach the thermal wire to the interior of the reinforcement cage in conformance with the supplier's instructions. At least one pair of thermal wires shall be furnished for each cardinal directions (North, South, East and West) and ordinal directions (Northeast, Northwest, Southeast, and Southwest) of the reinforcement cage, for a minimum of 16 thermal wires. The thermal wires shall be placed inside the spiral or hoop reinforcement and tied to the vertical reinforcement with plastic zip ties at a maximum spacing of 600 mm. The use of steel tie wire is not permitted. The thermal wire shall be installed in straight alignment and taut, but with enough slack to not be damaged during reinforcement cage lifting. The wires shall be as near to parallel to the vertical axis of the reinforcement cage as possible. The thermal wire shall extend from the bottom to the top of the reinforcement cage, with 5 m of slack wire provided above the top of reinforcement cage. Care shall be taken to prevent damaging the thermal wires during installation of the reinforcement cage and concrete placement operations within the excavation.

After completing reinforcement cage fabrication and prior to installation of the cage into the excavation, the Contractor shall supply, install, and connect Thermal Acquisition Ports (TAPs) to the thermal wires. The TAPs shall record data for at least one hour after the cage is placed in the excavation to measure the slurry temperature and enable the steel and slurry temperatures to equilibrate prior to placing concrete in the excavation. The TAPs shall record and store data every 15 minutes. The TAPs shall record the data until the maximum average temperature in the shaft is achieved and for a minimum period of 7 days post concrete placement, whichever occurs later. Prior to beginning concrete placement, all TAPs shall be checked to ensure they are recording data and that the wires have not been damaged. If any TAP is not functioning due to a damaged wire, the Contractor shall repair or replace the wire. If any TAP fails or if a wire breaks after concrete placement has started, the Contractor shall not stop the concrete placement operation to repair the wire.

7.08 Non-Destructive Quality Control Test Results Submittals

TIP testing shall be carried out by the Contract Administrator. The Contract Administrator will review and evaluate the TIP results to determine if the barrette pile is acceptable. If the Contract Administrator determines additional evaluation is necessary, the Contract Administrator will specify the requirements. If repair is necessary, the Contractor is responsible for developing and submitting a repair plan to the Contract Administrator for approval as well as executing the approved plan.

7.09 Milestone Inspections

The Contract Administrator shall witness the following interim inspections of the work:

a) Construction of the guide wall.

b) Excavation for the barrette pile.

c) Base cleaning inspection/testing.

d) Installation of the steel reinforcement cage.

e) Placement of concrete.

A Request to Proceed shall be submitted to the Contract Administrator after each of the items above.

The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

7.10 Technique Shaft

The Contractor shall demonstrate the adequacy of its methods, techniques and equipment by successfully constructing a technique shaft (test barrette pile) in accordance with the barrette pile requirements in the Contract Documents. The technique shaft shall be positioned at the location on the west side of Highway 400 by Pier 1 of the Bradford Bypass E-S Ramp Interchange Bridge over Highway 400 (30X-0869/B0) but not less than a clear distance of 15 m from any other existing or planned structures or watercourses included in this contract, including other barrette/piled foundations and the re-alignment of Pennville Creek and its associated culvert (30X-0890/C0). The technique shaft shall be advanced to the minimum tip elevation (3 m into slightly weathered to fresh limestone bedrock) as required for the Pier 1 barrette pile.

7.11 Bi-Directional Static Load Test

7.11.01 General

The technique shaft shall be subjected to Bi-directional static load cell tests to be performed in accordance with the procedures specified in ASTM D8169/D8169M. The Contractor shall install load cells and load test instrumentation in accordance with the bi-directional load cell supplier recommendations, instructions, and procedure manual(s), and in accordance with the barrette pile installation plan approved by the Design Engineer and Design Checking Engineer. The Contractor shall be responsible for coordinating with the load cell supplier to determine and/or verify all required equipment, materials, quantities, procedures, calibration data, and all other applicable items necessary to complete the load testing as indicated in the Contract Documents. The Contractor shall furnish, install and monitor load test instrumentation as indicated in the Contract Documents.

The technique shaft shall be excavated using identical tools, slurry mix, and construction techniques as planned for the production shafts. The concrete mix of the technique shaft shall be the same as that planned to be used for the production shafts.

7.11.02 Description

This work shall consist of furnishing all materials, equipment, labor, and incidentals necessary for conducting a two-level Bi-directional Static Load Testing of the technique shaft. In addition, the load-deflection and soil-load transfer relationships shall also be determined. The Bi-Directional Static Load Test shall be performed as indicated in the Contract Documents.

The Bi-Directional Static Load Test cell equipment shall have sufficient capacity to fully mobilize the shaft and end bearing geotechnical resistances.

A multi-level O-cell load test is an advanced type of static load test used to evaluate the axial capacity and load-transfer behavior of deep foundations where the test uses one or more Osterberg Cells (O-cells). In a multi-level arrangement, two or more O-cells are positioned at different elevations to isolate resistance along various portions of the foundation. During testing, the lower O-cell shall be activated first to evaluate end bearing and the shaft resistance within the rock socket or lower soils. After completing this stage, the upper O-cell is activated to measure shaft resistance in the upper soil layers.

To mobilize the full shaft and end bearing resistance for the technique shaft, a two-level test with a 110 MN O-cell at the toe and another 110 MN O-cell at approximate elevation of 175 m is required to be installed in the technique shaft.

Load testing of the technique shaft shall not begin until the concrete has attained a compressive strength (f'c) as indicated in the Contract Documents and had a curing time of not less than 10 working days.

The Bi-Directional Static Load Testing shall be performed as indicated in the Contract Documents. The Contractor shall engage the services of an approved Bi-Directional Static Load Test supplier for instrumenting, performing, and reporting of the Bi-directional Static Load Test. The Bi-Directional Static Load Test supplier shall have a minimum of 10 years of experience in conducting tests of similar scope and complexity and have conducted at least five similar tests within the last 5 years.

The technique shaft used for the load test program will be instrumented by the Bi-Directional Static Load Test device supplier. The Contractor shall subcontract with the Bi-Directional Static Load Test manufacturer to supply the load test cells and other necessary equipment and instrumentation, perform the test, and analyze the results of the Bi-Directional Static Load Test.

The Contractor shall retain both a Design Engineer and a Design Checking Engineer for the Bi-Directional Static Load Test. The Design Engineer will develop the Contractor's barrettes testing plan for the Bi-Directional Static Load Test and the Design Checking Engineer shall independently review the plan developed by the Design Engineer. The testing plan shall be submitted to the Contract Administrator at least 21 working days prior to the start of testing for MTO's review. The testing plan shall be signed and sealed by both the Design Engineer and the Design Checking Engineer. Both the Design Engineer and the Design Checking Engineer shall be Professional Engineers in the Province of Ontario with a minimum of 5 years experience in load testing of barrettes and have completed at least three similar projects in the past 5 years.

The Contractor shall submit electronic copies of shop drawings, erection plans, test calculations and details associated with the axial Bi-Directional Static Load Testing. The Contractor shall submit a Request to Proceed and shall not conduct the Bi-Directional Static Load Testing until a Notice to Proceed is provided.

The submittal shall include details with respect to the reinforcement cage fabrication, instrumentation plans, reference beams and movement measuring systems. All details, drawings, calculations, and procedures shall be submitted a minimum of 6 weeks to beginning the axial Bi-Directional Static Load Test.

The Contractor, in cooperation with the selected Bi-Directional Static Load Test supplier, shall supply and supervise the mobilization, assembly, and operation of the Bi-Directional Static Load Test equipment. The Bi-Directional Static Load Test supplier shall provide and install the required instrumentation for the technique shaft, acquire the test data during testing, and reduce the data into a report. This report shall be presented to the Contract Administrator.

7.11.03 Materials and Equipment

The Contractor shall supply all materials required to install the two-level BDSLT devices and conduct the axial load test and remove the load test apparatus as required. The Contractor shall furnish the BDSLT assembly as required for the technique shaft. The BDSLT assembly to be provided shall have a capacity that fully mobilizes the test load and shall be equipped with all necessary hydraulic lines, fittings, pressure source, pressure gauge and telltale devices.

Additional materials required include, but are not limited to, the following:

1. Fresh, clean, potable water from an approved source to be used as hydraulic fluid to pressurize the bi-directional static load test devices.
2. Materials sufficient to construct and shade a stable reference beam system for monitoring movements of the technique shaft during testing. The system shall be supported at a minimum distance of three shaft diameters from the center of the technique shaft to minimize disturbance of the reference system.

   A tripod shall be provided to support an automated digital survey level used to monitor movement of the reference system during testing. Alternatively, two survey levels located in excess of three shaft diameters may be used to monitor the top of technique shaft displacement in lieu of the beam. In this case, two tripods and weather protection (Quik Shade or equivalent) shall be provided.
3. Stable electric power source, as required for lights, welding, instruments, etc.
4. Materials such as angle or channel iron, steel bearing plates and/or other devices needed to attach the Bi-Directional Static Load Test assembly to rebar cage or carrying frame, as required.

The Contractor shall supply equipment required to install the BDSLT devices, conduct the load tests, and remove the load test apparatus as required. Equipment required includes but is not limited to:

1. Welding equipment and certified welding personnel, as required, to assemble the test equipment under the supervision of the Bi-directional Static Load Test supplier and to attach hydraulic fittings and telltales to the Bi-Directional Static Load Test devices, and prepare the work area.
2. Equipment and labor to construct the reinforcing steel cage and/or placement frame required for the technique shaft, including steel bearing plates as required.
3. Equipment and operators for handling the Bi-Directional Static Load Test device and instrumentation and placement frame or reinforcing steel cage during the installation of the Bi-Directional Static Load Test device and during the conduct of the test, including but not limited to a crane or other lifting device for Bi-Directional Static Load Test device and instrumentation, manual labor, and hand tools as required by Bi-Directional Static Load Test supplier.
4. Equipment and labor sufficient to erect the protected work area and monitoring reference beam system, to be constructed to the requirements of the Engineer and Bi-Directional Static Load Test supplier.
5. Air compressor (minimum 150 cfm) for pump operation during load testing.
6. Strain Gauges – the Contractor or the Bi-Directional Static Load Test supplier shall supply the number of strain gauges as required at each level. The number of strain gauges shall be determined by the test supplier, but no less than 1 gauge per soil layer plus 3 levels around the O-cells: one level above each O-Cell plus one level below the upper O-cell. All cost for supplying strain gauges will be included in the price bid for Bi-Directional Static Load Testing of technique shaft, and additional payment will not be made for this equipment. The barrette pile should be approximately 1 m above grade or water level for axial testing.

For the technique shaft, proposed instrumentation location shall be submitted to the Contract Administrator a minimum of 5 working days prior to the fabrication of the technique shaft reinforcement cage. The Contract Administrator will provide comments for the final instrumentation locations within 3 working days after receiving this information.

Strain and pressure gage instrumentation, displacement transducers, Thermal Integrity Profiling, Bi-Directional Static Load Test devices and any other materials and equipment required by Bi-Directional Static Load Test supplier shall be installed on the reinforcing cage.

The Bi-Directional Static Load Test cells, hydraulic supply lines and other instruments will be assembled and made ready for installation under the direction of Bi-Directional Static Load Test supplier and the Contract Administrator, in a suitable area, adjacent to the test shaft, to be provided by the Contractor. The Bi-Directional Static Load Test assemblies shall be welded to the rebar cage or carrying frame. The plane of the bottom plate(s) of the Bi-Directional Static Load Test cell(s) shall be set at right angles to the long axis of the cage. The Contractor shall use the utmost care in handling the test assembly so as not to damage the instrumentation during installation. The Contractor shall limit the deflection of the cage while lifting the cage from the horizontal position to vertical so as not to damage the instrumentation. The Contractor shall provide support bracing, strong backs, etc. to maintain the deflection within the specified tolerance. The Bi-Directional Static Load Test assemblies must remain perpendicular to the long axis of the reinforcing cage throughout the lifting and installation process.

When the technique shaft excavation has been completed, cleaned, and inspected and accepted by Contract Administrator, the Bi-Directional Static Load Test assembly and the reinforcing steel may be installed. Tremie concrete shall be used to concrete the barrettes. At least four concrete test cylinders, in addition to those specified elsewhere, shall be made from the concrete used in the technique shaft, to be tested at the direction of Bi-Directional Static Load Test supplier. At least one of these test cylinders shall be tested prior to the load test and at least two cylinders shall be tested on the day of the load test.

7.11.04 Testing Procedure

Prior to the BDSLT, Thermal Integrity Profiling (TIP) testing shall be conducted on the technique shaft to measure the geometry of the barrettes. Refer to Section 7.07.01 for the description of the TIP test.

The load testing shall be performed by a qualified Geotechnical Engineer. The Geotechnical Engineer must have a demonstrated knowledge of load testing procedures and have performed at least five Bi-Directional Static Load Tests within the past 5 years.

The load test shall be performed in general compliance with ASTM D8169/D8169M using the Quick Load Test Method for Individual Piles and be tested to failure as per ASTM D8169/D8169M or to the maximum capacity of the O-cell, whichever is reached first. The test shall be carried out using a two-level O-cell arrangement. The lower O-cell shall be activated first to evaluate base resistance and lower shaft resistance. Upon completion of the lower-cell loading sequence, the upper O-cell shall be activated to evaluate shaft resistance in the upper portion of the barrette. Loads shall be applied in increments equaling 10% of the anticipated test load of 110 MN. The magnitude of the load increments should not be changed during the test.

Loads shall be applied at the prescribed intervals until the nominal resistance of the technique shaft is reached in either base resistance or side resistance, until the maximum capacity or maximum stroke of Bi-Directional Static Load Test device is reached, or unless otherwise directed by the Contract Administrator at each load increment, or decrement movement indicators shall be read at 1, 2, 4 and 8-minute intervals while the load is held constant. At the end of the final load increment, the load shall be removed in

decrements of approximately 20% of the maximum test load. Each decrement shall be maintained for 4 minutes. Final rebound readings shall be taken after a minimum of 8 minutes after removal of the test load.

Any drilling or construction activities shall not commence or continue within a 30 m radius of technique shaft.

After the completion of the load test, and at the direction of the Contract Administrator, the Contractor shall remove any equipment, material, waste, etc. which are not to be a part of the finished structure.

7.11.05 Instrumentation

Direct movement indicator measurements should be made of the following: Bi-Directional Static Load Test device expansion either directly or with telltales (minimum. of three indicators required), upward top-of-shaft displacement (minimum of two indicators required) and shaft compression above Bi-Directional Static Load Test device (minimum. of two indicators required). Displacement sensors used to measure Bi-Directional Static Load Test device expansion and top-of-shaft displacement should have a minimum travel of 150 mm and be capable of being read to the nearest 0.0025 mm division. When Bi-Directional Static Load Test device expansion is measured directly, Linear Vibrating Wire Displacement Transducers (LVWDTs) capable of measuring the full stroke of the bi-directional static load test device will be used (typically 150 mm). Displacement sensors used to measure shaft compression should have a minimum travel of 25 mm and be capable of being read to the nearest 0.0025 mm division.

7.11.06 Test Results

The Contractor will supply to the Contract Administrator an electronic copy of the final report of the load test, as prepared by Bi-Directional Static Load Test device. An initial data report containing the load-movement curves and data tables will be provided to the Contract Administrator within 3 working days of the completion of load testing, to allow evaluation of the test results. A final report on the load testing shall be submitted to the Contract Administrator within 7 calendar days after completion of the load testing.

8.0 QUALITY ASSURANCE

8.01.01 Temperature Requirements

The temperature of concrete components meeting the requirements of the Control of Temperature and Temperature Difference subsection shall be acceptable. Concrete components not meeting the requirements of the Control of Temperature and Temperature Difference subsection shall be deemed rejectable. Determination of the temperature shall be based on measurements made using Contractor-supplied temperature sensor sets and, when installed at the Owner's discretion, Contract Administrator-supplied temperature sensor sets.

9.0 MEASUREMENT FOR PAYMENT

9.01 Actual Measurement

9.01.01 Barrette Piles – 1.5 m x 2.8 m

Measurement of barrette piles shall be by length in metres of the depth along the centreline between the approved bearing surface at the bottom and the specified elevation at the top.

9.01.02 Thermal Integrity Profiling (TIP) Testing

Measurement will be for thermal integrity profiling per barrette pile**.**

9.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

10.0 BASIS FOR PAYMENT

10.01 Supply and Installation of Barrette Piles – Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material required to do the work.

For payment purposes, 50% of the work under this item shall be paid when satisfactory performance of the equipment has been demonstrated to the Contract Administrator. The Contractor shall submit a Request to Proceed once Guide walls are constructed and barrette installation has been demonstrated to the Contract Administrator by the installation of 5% of barrette piles.

Another 40% shall be paid by progress payments proportional to the work completed. The remaining 10% shall be paid on the satisfactory completion of the installation of barrette piles.

10.02 Supply and Installation of Thermal Wires and Thermal Acquisition Ports for Thermal Integrity Profiling (TIP) Testing – Item
Technique Shaft – Item
Bi-Directional Static Load Test – Item

Payment at the Contract price for the above tender items shall be full compensation for all Labour, Equipment, and Material to do the work.

AMENDMENT TO OPSS 903

Non-Standard Special Provision

903.07 CONSTRUCTION

903.07.02.07 Monitoring of Driven Piles

903.07.02.07.03 Driving to a Specific Ultimate Resistance

903.07.02.07.03.01 General

Clause 903.07.02.07.03.01 of OPSS 903 is deleted in its entirety and replacing it with the following:

Piles are to be driven to a specified ultimate resistance that shall be determined using the High-Strain Dynamic Testing at end of initial driving and during retapping.

If the ultimate axial resistance is not achieved, the Contract Administrator shall be notified, and retap/restrike shall be conducted after initial driving as specified in the Contract Documents.

If a pile encounters practical refusal at a higher elevation than the design pile tip elevation, the Contractor shall immediately notify the Contract Administrator (CA).

A Request to Proceed shall be submitted to the Contract Administrator after the design ultimate resistance is achieved.

The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

903.07.02.07.03.01 Driving to Bedrock

Clause 903.07.02.07.03.03 of OPSS 903 is amended by deleting the last paragraph

903.07.02.07.06 Retapping Tests on Piles

Section 903.07.02.07.06 is deleted in its entirety and replaced by the following:

In each pile group, a minimum 10% of the piles rounded up to the next whole number, but not fewer than two piles, shall be re-tapped not sooner than the number of days after installation of the individual pile specified in the table below:

Structure	Foundation Element	Minimum Number of Days before Retapping
Highway 400 SBL / NBL Overpasses at 9th Line	North Abutment	14
	South Abutment	14
Highway 400 N-E Ramp Bridge over 9th Line	North Abutment	14
	South Abutment	14
Highway 400 E-N Ramp Bridge over 9th Line	North Abutment	14
	South Abutment	14
Highway 400 N-E Ramp Flyover Bridge	West Abutment	14
	East Abutment	14
Highway 400 E-S Ramp Flyover Bridge	West Abutment	14
	East Abutment	14
Hwy 400 BBP WBL Arch Culvert	East Pile Cap	14
	West Pile Cap	14
Hwy 400 BBP EBL Arch Culvert	East Pile Cap	14
	West Pile Cap	14

The above shall be carried out to confirm that the ultimate axial geotechnical resistance has been achieved and/or sustained. The Contract Administrator may require additional high-strain dynamic testing during retapping.

PRESENCE OF COBBLES, BOULDERS, AND OTHER OBSTRUCTIONS

Notice to Contractor

The Contractor shall be alerted to the potential presence of cobbles, boulders, and construction debris within the existing embankment fill, the silty sand to sandy silt upper till, and the 100-blow sandy clay to clay lower till deposits. Considerations of the presences of such obstructions must be made in the selection of appropriate equipment and procedures for excavations, and installation of temporary protection systems and deep foundations. Contractor's equipment must be able to advance through any such obstructions.

THURBER

APPENDIX K

P-y Curves

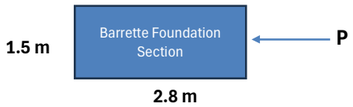
P-Y Curves

Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Strong Axis

Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long

P loads at each depth are in metres



March 2026

Elev. (m)	256.2		255.2		254.2		253.2		252.2		251.2		250.2		249.2		248.2		247.2		246.2		245.2		244.2		243.2		242.2	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 3	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6.0	286.3	0.002	12.4	0.002	14.0	0.002	15.5	0.002	17.0	0.002	18.5	0.002	20.0	0.002	21.5	0.002	23.0	6.0	820.6	6.0	918.2	6.0	1016.2	6.0	1114.2	6.0	1212.3	6.0	1310.5
	12.0	468.6	0.012	43.5	0.012	48.9	0.012	54.2	0.012	59.5	0.012	64.8	0.012	70.1	0.012	75.4	0.012	80.6	12.0	1518.8	12.0	1712.2	12.0	1907.3	12.0	2103.3	12.0	2300.2	12.0	2497.8
	18.0	553.9	0.024	51.7	0.024	58.1	0.024	64.5	0.024	70.8	0.024	77.1	0.024	83.4	0.024	89.6	0.024	95.9	18.0	2035.7	18.0	2316.9	18.0	2603.1	18.0	2892.9	18.0	3185.7	18.0	3480.8
	24.0	588.0	0.120	77.3	0.120	86.9	0.120	96.4	0.120	105.9	0.120	115.3	0.120	124.7	0.120	134.0	0.120	143.4	24.0	2380.4	24.0	2734.4	24.0	3098.9	24.0	3471.3	24.0	3850.8	24.0	4235.9
	30.0	600.7	0.2	91.9	0.2	103.4	0.2	114.7	0.2	125.9	0.2	137.1	0.2	148.3	0.2	159.4	0.2	170.5	30.0	2594.5	30.0	3003.6	30.0	3429.4	30.0	3869.0	30.0	4320.9	30.0	4783.3
	36.0	605.4	1.2	137.5	1.2	154.6	1.2	171.5	1.2	188.3	1.2	205.0	1.2	221.6	1.2	238.3	1.2	255.0	36.0	2721.7	36.0	3169.5	36.0	3640.2	36.0	4130.6	36.0	4639.1	36.0	5163.7
	42.0	607.1	2.4	163.4	2.4	183.9	2.4	203.9	2.4	223.9	2.4	243.7	2.4	263.6	2.4	283.4	2.4	303.3	42.0	2795.2	42.0	3268.8	42.0	3770.7	42.0	4297.8	42.0	4848.1	42.0	5420.1
	48.0	607.7	6.0	205.6	6.0	231.2	6.0	256.5	6.0	281.6	6.0	306.5	6.0	331.5	6.0	356.4	6.0	381.3	48.0	2837.0	48.0	3327.5	48.0	3850.2	48.0	4402.5	48.0	4982.8	48.0	5589.6
	54.0	607.9	12.0	244.5	12.0	274.9	12.0	305.0	12.0	334.8	12.0	364.6	12.0	394.2	12.0	423.8	12.0	453.5	54.0	2860.7	54.0	3361.7	54.0	3898.1	54.0	4467.4	54.0	5068.6	54.0	5700.1
	60.0	608.0	18.0	270.5	18.0	304.2	18.0	337.5	18.0	370.5	18.0	403.4	18.0	436.3	18.0	469.0	18.0	501.8	60.0	2873.9	60.0	3381.5	60.0	3926.7	60.0	4507.4	60.0	5122.7	60.0	5771.7
	66.0	608.0	24.0	290.7	24.0	327.0	24.0	362.7	24.0	398.2	24.0	433.5	24.0	468.7	24.0	504.0	24.0	539.2	66.0	2881.3	66.0	3393.0	66.0	3943.8	66.0	4531.8	66.0	5156.6	66.0	5817.6
	72.0	608.0	48.0	345.7	48.0	388.8	48.0	431.3	48.0	473.5	48.0	515.6	48.0	557.5	48.0	599.3	48.0	641.3	72.0	2885.5	72.0	3399.6	72.0	3953.9	72.0	4546.8	72.0	5177.9	72.0	5847.1
	78.0	608.0	72.0	382.6	72.0	430.3	72.0	477.3	72.0	524.0	72.0	570.5	72.0	616.9	72.0	663.3	72.0	709.7	78.0	2887.8	78.0	3403.4	78.0	3960.0	78.0	4555.9	78.0	5191.2	78.0	5865.8
	84.0	608.0	96.0	411.1	96.0	462.4	96.0	512.9	96.0	563.1	96.0	613.1	96.0	662.9	96.0	712.8	96.0	762.7	84.0	2889.1	84.0	3405.7	84.0	3963.5	84.0	4561.4	84.0	5199.5	84.0	5877.9
	90.0	608.0	120.0	434.7	120.0	488.9	120.0	542.3	120.0	595.4	120.0	648.3	120.0	700.9	120.0	753.6	120.0	806.3	90.0	2889.9	90.0	3406.9	90.0	3965.7	90.0	4564.8	90.0	5204.7	90.0	5885.5
	96.0	608.0	144.0	454.9	144.0	511.7	144.0	567.6	144.0	623.2	144.0	678.5	144.0	733.7	144.0	788.8	144.0	844.0	96.0	2890.3	96.0	3407.7	96.0	3966.9	96.0	4566.8	96.0	5207.9	96.0	5890.5
	102.0	608.0	168.0	472.8	168.0	531.8	168.0	589.9	168.0	647.6	168.0	705.1	168.0	762.5	168.0	819.7	168.0	877.2	102.0	2890.5	102.0	3408.1	102.0	3967.7	102.0	4568.1	102.0	5209.9	102.0	5893.6
	108.0	608.0	192.0	488.9	192.0	549.9	192.0	609.9	192.0	669.6	192.0	729.0	192.0	788.4	192.0	847.5	192.0	906.9	108.0	2890.6	108.0	3408.3	108.0	3968.1	108.0	4568.9	108.0	5211.1	108.0	5895.5
	114.0	608.0	216.0	503.5	216.0	566.3	216.0	628.2	216.0	689.6	216.0	750.9	216.0	811.9	216.0	872.9	216.0	934.0	114.0	2890.7	114.0	3408.4	114.0	3968.4	114.0	4569.3	114.0	5211.9	114.0	5896.8
	120.0	608.0	240.0	517.0	240.0	581.4	240.0	644.9	240.0	708.0	240.0	770.9	240.0	833.6	240.0	896.2	240.0	958.9	120.0	2890.7	120.0	3408.5	120.0	3968.5	120.0	4569.6	120.0	5212.4	120.0	5897.6
			300.0	517.0	300.0	581.4	300.0	644.9	300.0	708.0	300.0	770.9	300.0	833.6	300.0	896.2	300.0	958.9												

Elev. (m)	241.2		240.2		239.2		238.2		237.2		236.2		235.2		234.2		233.2		232.2		231.2		230.2		229.2		228.2		227.2	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	6.0	1408.7	6.0	1506.9	6.0	1605.2	6.0	1703.4	6.0	1799.9	6.0	1896.1	6.0	1992.1	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9
	12.0	2695.5	12.0	2893.7	12.0	3092.0	12.0	3290.3	12.0	3476.4	12.0	3659.5	12.0	3842.4	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8
	18.0	3777.4	18.0	4075.7	18.0	4374.6	18.0	4674.2	18.0	4937.7	18.0	5192.2	18.0	5446.2	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0
	24.0	4625.5	24.0	5019.0	24.0	5415.0	24.0	5812.9	24.0	6139.4	24.0	6448.0	24.0	6755.7	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5
	30.0	5254.3	30.0	5733.0	30.0	6217.4	30.0	6706.3	30.0	7081.6	30.0	7428.0	30.0	7773.4	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1
	36.0	5701.7	36.0	6252.3	36.0	6812.7	36.0	7381.1	36.0	7792.7	36.0	8164.2	36.0	8534.6	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2
	42.0	6010.7	42.0	6618.8	42.0	7241.6	42.0	7876.4	42.0	8314.4	42.0	8701.6	42.0	9087.6	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5
	48.0	6219.8	48.0	6872.4	48.0	7544.2	48.0	8232.4	48.0	8688.9	48.0	9085.6	48.0	9481.0	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4
	54.0	6359.4	54.0	7045.2	54.0	7754.6	54.0	8484.4	54.0	8953.9	54.0	9355.9	54.0	9756.8	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7
	60.0	6451.6	60.0	7161.8	60.0	7899.3	60.0	8660.9	60.0	9139.3	60.0	9544.1	60.0	9947.9	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2
	66.0	6512.2	66.0	7240.0	66.0	7998.2	66.0	8783.5	66.0	9268.1	66.0	9674.3	66.0	10079.7	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3
	72.0	6551.9	72.0	7292.1	72.0	8065.4	72.0	8868.3	72.0	9357.0	72.0	9763.8	72.0	10169.7	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2
	78.0	6577.8	78.0	7326.8	78.0	8110.9	78.0	8926.7	78.0	9418.2	78.0	9825.1	78.0	10231.7	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3
	84.0	6594.7	84.0	7349.9	84.0	8141.6	84.0	8966.8	84.0	9460.3	84.0	9867.1	84.0	10272.7	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9
	90.0	6605.6	90.0	7365.2	90.0	8162.4	90.0	8994.4	90.0	9489.1	90.0	9895.7	90.0	10301.7	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2
	96.0	6612.7	96.0	7375.4	96.0	8176.4	96.0	9013.2	96.0	9508.8	96.0	9915.1	96.0	10320.7	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5
	102.0	6617.4	102.0	7382.0	102.0	8185.8	102.0	9026.1	102.0	9522.3	102.0	9928.4	102.0	10333.7	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9
	108.0	6620.5	108.0	7386.5	108.0	8192.1	108.0	9034.9	108.0	9531.5	108.0	9937.5	108.0	10342.7	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0
	114.0	6622.4	114.0	7389.4	114.0	8196.4	114.0	9041.0	114.0	9537.9	114.0	9943.6	114.0	10348.7	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0
	120.0	6623.7	120.0	7391.4	120.0	8199.3	120.0	9045.1	120.0	9542.2	120.0	9947.8	120.0	10352.7	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0
															300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0

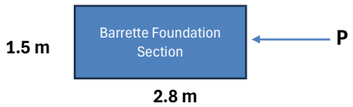
P-Y Curves

Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Strong Axis

Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long

P loads at each depth are in metres



March 2026

Elev. (m)	226.2		225.2		224.2		223.2		222.2		221.2		220.2		219.2		218.2		217.2		216.2		215.2		214.2		213.2		212.2	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9
	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8
	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0
	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5
	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1
	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2
	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5
	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4
	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7
	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2
	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3
	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2
	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3
	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9
	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2
	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5
	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9
	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0
	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0
	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0
	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0

Elev. (m)	211.2		210.2		209.2		208.2		207.2		206.2		205.2		204.2		203.2		202.2		201.2		200.2		199.2		198.2		197.2	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9	0.002	25.9
	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8	0.012	90.8
	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0	0.024	108.0
	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5	0.120	161.5
	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1	0.2	192.1
	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2	1.2	287.2
	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5	2.4	341.5
	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4	6.0	429.4
	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7	12.0	510.7
	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2	18.0	565.2
	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3	24.0	607.3
	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2	48.0	722.2
	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3	72.0	799.3
	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9	96.0	858.9
	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2	120.0	908.2
	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5	144.0	950.5
	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9	168.0	987.9
	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0	192.0	1021.0
	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0	216.0	1052.0
	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0	240.0	1080.0
	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0	300.0	1080.0

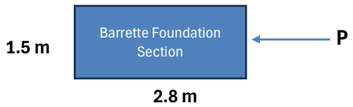
P-Y Curves

Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Strong Axis

Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long

P loads at each depth are in metres



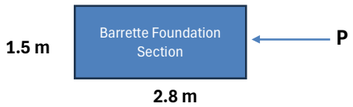
March 2026

Elev. (m)	196.2		195.2		194.2		193.2		192.2		191.2		190.2		189.2		188.2		187.2		186.2		185.2		184.2		183.2		182.2	
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)	PY at Depth: 65	Load Intensity p (kN/m)	PY at Depth: 66	Load Intensity p (kN/m)	PY at Depth: 67	Load Intensity p (kN/m)	PY at Depth: 68	Load Intensity p (kN/m)	PY at Depth: 69	Load Intensity p (kN/m)	PY at Depth: 70	Load Intensity p (kN/m)	PY at Depth: 71	Load Intensity p (kN/m)	PY at Depth: 72	Load Intensity p (kN/m)	PY at Depth: 73	Load Intensity p (kN/m)	PY at Depth: 74	Load Intensity p (kN/m)	PY at Depth: 75	Load Intensity p (kN/m)	PY at Depth: 76	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.002	25.9	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5
	0.012	90.8	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6
	0.024	108.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0
	0.120	161.5	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0
	0.2	192.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1
	1.2	287.2	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4
	2.4	341.5	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1
	6.0	429.4	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9
	12.0	510.7	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0
	18.0	565.2	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0
	24.0	607.3	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0
	48.0	722.2	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0
	72.0	799.3	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0
	96.0	858.9	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0
	120.0	908.2	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0
	144.0	950.5	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0
	168.0	987.9	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0
	192.0	1021.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0
	216.0	1052.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0
	240.0	1080.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0
	300.0	1080.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0

Elev. (m)	181.2		180.2		179.2		178.2		177.2		176.2		175.2		174.2		173.2		172.2		171.2		170.2		169.2		168.2		167.2	
Depth (m)	PY at Depth: 77	Load Intensity p (kN/m)	PY at Depth: 78	Load Intensity p (kN/m)	PY at Depth: 79	Load Intensity p (kN/m)	PY at Depth: 80	Load Intensity p (kN/m)	PY at Depth: 81	Load Intensity p (kN/m)	PY at Depth: 82	Load Intensity p (kN/m)	PY at Depth: 83	Load Intensity p (kN/m)	PY at Depth: 84	Load Intensity p (kN/m)	PY at Depth: 85	Load Intensity p (kN/m)	PY at Depth: 86	Load Intensity p (kN/m)	PY at Depth: 87	Load Intensity p (kN/m)	PY at Depth: 88	Load Intensity p (kN/m)	PY at Depth: 89	Load Intensity p (kN/m)	PY at Depth: 90	Load Intensity p (kN/m)	PY at Depth: 91	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5
	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6
	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0
	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0
	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1
	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4
	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1
	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9
	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0
	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0
	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0
	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0
	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0
	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0
	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0
	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0
	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0
	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0
	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0
	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0
	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Strong Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



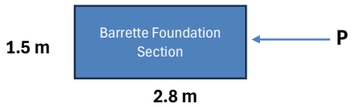
March 2026

Elev. (m)	166.2		165.2		164.2		163.2		162.2		161.2		160.2		159.2		158.2		157.2		156.2		155.2		154.2		153.2		152.2	
Depth (m)	PY at Depth: 92	Load Intensity p (kN/m)	PY at Depth: 93	Load Intensity p (kN/m)	PY at Depth: 94	Load Intensity p (kN/m)	PY at Depth: 95	Load Intensity p (kN/m)	PY at Depth: 96	Load Intensity p (kN/m)	PY at Depth: 97	Load Intensity p (kN/m)	PY at Depth: 98	Load Intensity p (kN/m)	PY at Depth: 99	Load Intensity p (kN/m)	PY at Depth: 100	Load Intensity p (kN/m)	PY at Depth: 101	Load Intensity p (kN/m)	PY at Depth: 102	Load Intensity p (kN/m)	PY at Depth: 103	Load Intensity p (kN/m)	PY at Depth: 104	Load Intensity p (kN/m)	PY at Depth: 105	Load Intensity p (kN/m)	PY at Depth: 106	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5
	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6
	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0
	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0
	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1
	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4
	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1
	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9
	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0
	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0
	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0
	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0
	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0
	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0
	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0
	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0
	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0
	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0
	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0
	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0
	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0

Elev. (m)	151.2		150.2		149.2		148.2		147.2		146.2		145.2		144.2		143.2		142.2		141.2		140.2		139.2		138.2		137.2	
Depth (m)	PY at Depth: 107	Load Intensity p (kN/m)	PY at Depth: 108	Load Intensity p (kN/m)	PY at Depth: 109	Load Intensity p (kN/m)	PY at Depth: 110	Load Intensity p (kN/m)	PY at Depth: 111	Load Intensity p (kN/m)	PY at Depth: 112	Load Intensity p (kN/m)	PY at Depth: 113	Load Intensity p (kN/m)	PY at Depth: 114	Load Intensity p (kN/m)	PY at Depth: 115	Load Intensity p (kN/m)	PY at Depth: 116	Load Intensity p (kN/m)	PY at Depth: 117	Load Intensity p (kN/m)	PY at Depth: 118	Load Intensity p (kN/m)	PY at Depth: 119	Load Intensity p (kN/m)	PY at Depth: 120	Load Intensity p (kN/m)	PY at Depth: 121	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0
	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.002	41.5	0.5	36000.0
	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	0.010	181.6	2.9	45000.0
	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0	0.019	216.0		
	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0	0.096	323.0		
	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1	0.2	384.1		
	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4	1.0	574.4		
	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1	1.9	683.1		
	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9	4.8	858.9		
	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0	9.6	1021.0		
	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0	14.4	1130.0		
	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0	19.2	1215.0		
	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0	38.4	1444.0		
	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0	57.6	1599.0		
	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0	76.8	1718.0		
	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0	96.0	1816.0		
	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0	115.2	1901.0		
	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0	134.4	1976.0		
	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0	153.6	2043.0		
	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0	172.8	2104.0		
	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0	192.0	2160.0		
	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0	240.0	2160.0		

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Strong Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



March 2026

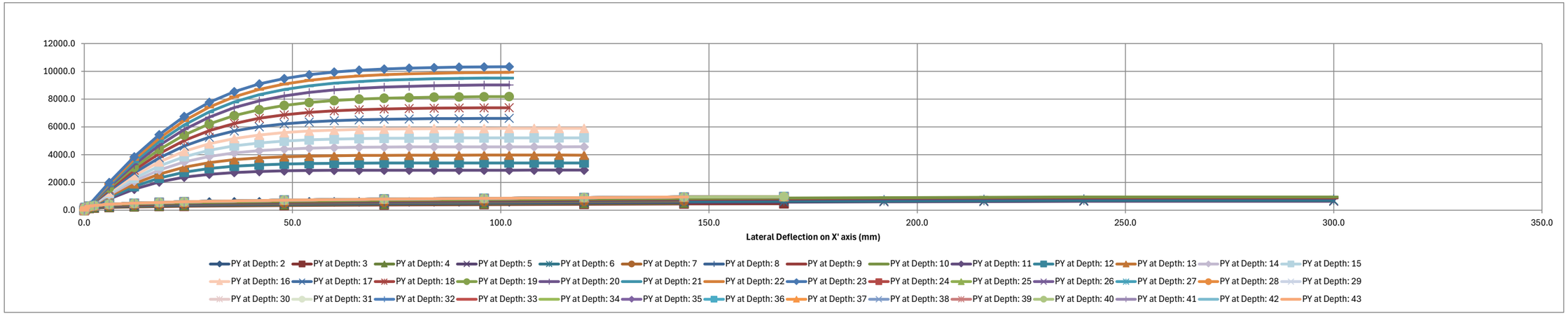
Elev. (m)	136.2		135.2		134.2																							
Depth (m)	PY at Depth: 122	Load Intensity p (kN/m)	PY at Depth: 123	Load Intensity p (kN/m)	PY at Depth: 124	Load Intensity p (kN/m)																						
Static	0.0	0.0	0.0	0.0	0.0	0.0																						
	0.5	36000.0	0.5	36000.0	0.5	36000.0																						
	2.9	45000.0	2.9	45000.0	2.9	45000.0																						

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

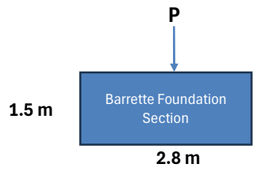
NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Weak Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



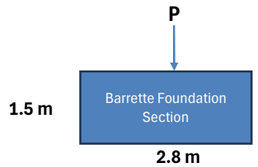
March 2026

Elev. (m)	256.2		255.2		254.2		253.2		252.2		251.2		250.2		249.2		248.2		247.2		246.2		245.2		244.2		243.2		242.2	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 3	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15.0	712.6	0.006	62.8	0.006	67.7	0.006	72.4	0.006	77.1	0.006	81.8	0.006	86.4	0.006	91.0	0.006	95.5	15.0	1889.4	15.0	2124.3	15.0	2362.1	15.0	2601.7	15.0	2843.2	15.0	3086.0
	30.0	1156.7	0.030	93.9	0.030	101.2	0.030	108.3	0.030	115.3	0.030	122.2	0.030	129.2	0.030	136.0	0.030	142.8	30.0	2943.8	30.0	3354.2	30.0	3778.7	30.0	4214.9	30.0	4661.5	30.0	5117.3
	45.0	1357.7	0.060	111.7	0.060	120.4	0.060	128.8	0.060	137.2	0.060	145.4	0.060	153.6	0.060	161.8	0.060	169.9	45.0	3351.9	45.0	3855.4	45.0	4385.6	45.0	4939.6	45.0	5516.3	45.0	6113.9
	60.0	1435.4	0.3	167.0	0.3	180.1	0.3	192.6	0.3	205.1	0.3	217.4	0.3	229.7	0.3	241.9	0.3	254.1	60.0	3486.8	60.0	4029.7	60.0	4607.5	60.0	5217.8	60.0	5859.9	60.0	6532.7
	75.0	1463.6	0.6	198.7	0.6	214.1	0.6	229.1	0.6	243.9	0.6	258.6	0.6	273.1	0.6	287.6	0.6	302.1	75.0	3529.0	75.0	4086.9	75.0	4683.8	75.0	5318.1	75.0	5989.2	75.0	6697.0
	90.0	1473.6	3.0	297.0	3.0	320.2	3.0	342.6	3.0	364.7	3.0	386.6	3.0	408.4	3.0	430.1	3.0	451.8	90.0	3541.9	90.0	4105.3	90.0	4709.6	90.0	5353.3	90.0	6036.7	90.0	6759.9
	105.0	1477.1	6.0	353.3	6.0	380.8	6.0	407.4	6.0	433.7	6.0	459.8	6.0	485.7	6.0	511.4	6.0	537.3	105.0	3545.9	105.0	4111.2	105.0	4718.2	105.0	5365.6	105.0	6053.9	105.0	6783.6
	120.0	1478.4	15.0	444.2	15.0	478.7	15.0	512.3	15.0	545.3	15.0	578.1	15.0	610.6	15.0	643.1	15.0	675.7	120.0	3547.1	120.0	4113.0	120.0	4721.0	120.0	5369.9	120.0	6060.2	120.0	6792.5
	135.0	1478.8	30.0	528.3	30.0	569.4	30.0	609.2	30.0	648.6	30.0	687.5	30.0	726.3	30.0	764.8	30.0	803.5	135.0	3547.5	135.0	4113.7	135.0	4722.0	135.0	5371.3	135.0	6062.4	135.0	6795.9
	150.0	1478.9	45.0	584.6	45.0	630.1	45.0	674.2	45.0	717.7	45.0	760.9	45.0	803.7	45.0	846.4	45.0	889.2	150.0	3547.6	150.0	4113.9	150.0	4722.3	150.0	5371.9	150.0	6063.3	150.0	6797.2
	165.0	1479.0	60.0	628.2	60.0	677.0	60.0	724.5	60.0	771.3	60.0	817.5	60.0	863.7	60.0	909.6	60.0	955.5	165.0	3547.7	165.0	4114.0	165.0	4722.4	165.0	5372.1	165.0	6063.6	165.0	6797.6
	180.0	1479.0	120.0	747.0	120.0	805.1	120.0	861.6	120.0	917.2	120.0	972.3	120.0	1026.8	120.0	1081.6	120.0	1136.5	180.0	3547.7	180.0	4114.0	180.0	4722.4	180.0	5372.1	180.0	6063.7	180.0	6797.8
	195.0	1479.0	180.0	826.8	180.0	891.1	180.0	953.5	180.0	1014.8	180.0	1075.5	180.0	1136.3	180.0	1197.0	180.0	1257.2	195.0	3547.7	195.0	4114.0	195.0	4722.5	195.0	5372.2	195.0	6063.7	195.0	6797.9
	210.0	1479.0	240.0	888.3	240.0	957.5	240.0	1024.5	240.0	1090.5	240.0	1156.5	240.0	1221.5	240.0	1286.5	240.0	1351.7	210.0	3547.7	210.0	4114.0	210.0	4722.5	210.0	5372.2	210.0	6063.7	210.0	6797.9
	225.0	1479.0	300.0	939.3	300.0	1012.2	300.0	1083.4	300.0	1153.2	300.0	1222.5	300.0	1291.7	300.0	1360.0	300.0	1428.5	225.0	3547.7	225.0	4114.0	225.0	4722.5	225.0	5372.2	225.0	6063.7	225.0	6797.9
	240.0	1479.0	360.0	983.2	360.0	1059.4	360.0	1133.9	360.0	1206.9	360.0	1279.4	360.0	1351.9	360.0	1423.4	360.0	1495.2	240.0	3547.7	240.0	4114.0	240.0	4722.5	240.0	5372.2	240.0	6063.7	240.0	6797.9
	255.0	1479.0	420.0	1021.4	420.0	1101.4	420.0	1178.4	420.0	1254.7	420.0	1329.4	420.0	1405.2	420.0	1479.9	420.0	1553.9	255.0	3547.7	255.0	4114.0	255.0	4722.5	255.0	5372.2	255.0	6063.7	255.0	6797.9
	270.0	1479.0	480.0	1056.3	480.0	1138.6	480.0	1218.4	480.0	1297.4	480.0	1375.4	480.0	1452.4	480.0	1529.4	480.0	1606.9	270.0	3547.7	270.0	4114.0	270.0	4722.5	270.0	5372.2	270.0	6063.7	270.0	6797.9
	285.0	1479.0	540.0	1088.3	540.0	1172.6	540.0	1254.9	540.0	1336.1	540.0	1416.4	540.0	1495.6	540.0	1575.4	540.0	1654.7	285.0	3547.7	285.0	4114.0	285.0	4722.5	285.0	5372.2	285.0	6063.7	285.0	6797.9
	300.0	1479.0	600.0	1117.3	600.0	1203.8	600.0	1288.3	600.0	1371.8	600.0	1454.3	600.0	1535.6	600.0	1617.9	600.0	1699.4	300.0	3547.7	300.0	4114.0	300.0	4722.5	300.0	5372.2	300.0	6063.7	300.0	6797.9

Elev. (m)	241.2		240.2		239.2		238.2		237.2		236.2		235.2		234.2		233.2		232.2		231.2		230.2		229.2		228.2		227.2	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	15.0	3329.7	15.0	3574.5	15.0	3819.7	15.0	4065.7	15.0	4311.9	15.0	4558.7	15.0	4805.5	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8
	30.0	5580.6	30.0	6050.8	30.0	6526.4	30.0	7007.3	30.0	7492.0	30.0	7980.5	30.0	8471.7	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0
	45.0	6729.9	45.0	7363.3	45.0	8011.5	45.0	8674.7	45.0	9349.6	45.0	10036.7	45.0	10732.9	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0
	60.0	7233.5	60.0	7961.5	60.0	8714.1	60.0	9491.7	60.0	10290.5	60.0	11110.8	60.0	11948.9	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7
	75.0	7439.2	75.0	8215.4	75.0	9023.1	75.0	9863.5	75.0	10732.8	75.0	11631.6	75.0	12556.2	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1
	90.0	7520.8	90.0	8319.8	90.0	9154.6	90.0	10026.9	90.0	10933.2	90.0	11873.9	90.0	12847.9	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0
	105.0	7552.8	105.0	8362.2	105.0	9209.8	105.0	10098.2	105.0	11022.9	105.0	11985.5	105.0	12984.3	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8
	120.0	7565.3	120.0	8379.3	120.0	9232.9	120.0	10128.0	120.0	11062.5	120.0	12036.6	120.0	13048.5	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0
	135.0	7570.2	135.0	8386.2	135.0	9242.5	135.0	10141.3	135.0	11079.6	135.0	12059.2	135.0	13078.6	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0
	150.0	7572.1	150.0	8389.0	150.0	9246.5	150.0	10146.6	150.0	11087.6	150.0	12070.0	150.0	13092.7	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0
	165.0	7572.8	165.0	8390.1	165.0	9248.1	165.0	10149.6	165.0	11091.1	165.0	12074.8	165.0	13098.7	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0
	180.0	7573.1	180.0	8390.6	180.0	9248.8	180.0	10150.6	180.0	11092.1	180.0	12076.8	180.0	13101.7	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0
	195.0	7573.2	195.0	8390.8	195.0	9249.1	195.0	10150.6	195.0	11093.1	195.0	12077.8	195.0	13102.8	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0
	210.0	7573.3	210.0	8390.8	210.0	9249.2	210.0	10150.6	210.0	11093.1	210.0	12078.0	210.0	13103.7	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0
	225.0	7573.3	225.0	8390.9	225.0	9249.3	225.0	10150.8	225.0	11093.1	225.0	12078.8	225.0	13103.8	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0
	240.0	7573.3	240.0	8390.9	240.0	9249.3	240.0	10150.8	240.0	11093.1	240.0	12078.8	240.0	13103.8	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0
	255.0	7573.3	255.0	8390.9	255.0	9249.3	255.0	10151.6	255.0	11093.6	255.0	12078.8	255.0	13104.7	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0
	270.0	7573.3	270.0	8390.9	270.0	9249.3	270.0	10151.6	270.0	11093.6	270.0	12078.8	270.0	13104.7	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0
	285.0	7573.3	285.0	8390.9	285.0	9249.3	285.0	10151.6	285.0	11093.6	285.0	12078.8	285.0	13104.7	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0
	300.0	7573.3	300.0	8390.9	300.0	9249.3	300.0	10151.6	300.0	11093.6	300.0	12078.8	300.0	13104.7	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0
															750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0		

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Weak Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



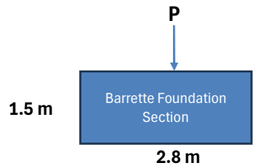
March 2026

Elev. (m)	226.2		225.2		224.2		223.2		222.2		221.2		220.2		219.2		218.2		217.2		216.2		215.2		214.2		213.2		212.2	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8
	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0
	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0
	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7
	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1
	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0
	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8
	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0
	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0
	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0
	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0
	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0
	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0
	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0
	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0
	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0
	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0
	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0
	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0
	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0
	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0

Elev. (m)	211.2		210.2		209.2		208.2		207.2		206.2		205.2		204.2		203.2		202.2		201.2		200.2		199.2		198.2		197.2	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8	0.006	151.8
	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0	0.030	227.0
	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0	0.060	270.0
	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7	0.3	403.7
	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1	0.6	480.1
	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0	3.0	718.0
	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8	6.0	853.8
	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0	15.0	1074.0
	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0	30.0	1277.0
	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0	45.0	1413.0
	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0	60.0	1518.0
	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0	120.0	1806.0
	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0	180.0	1998.0
	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0	240.0	2147.0
	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0	300.0	2270.0
	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0	360.0	2376.0
	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0	420.0	2470.0
	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0	480.0	2554.0
	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0	540.0	2630.0
	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0	600.0	2700.0
	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0	750.0	2700.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Weak Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



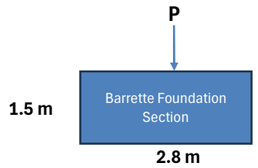
March 2026

Elev. (m)	196.2		195.2		194.2		193.2		192.2		191.2		190.2		189.2		188.2		187.2		186.2		185.2		184.2		183.2		182.2	
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)	PY at Depth: 65	Load Intensity p (kN/m)	PY at Depth: 66	Load Intensity p (kN/m)	PY at Depth: 67	Load Intensity p (kN/m)	PY at Depth: 68	Load Intensity p (kN/m)	PY at Depth: 69	Load Intensity p (kN/m)	PY at Depth: 70	Load Intensity p (kN/m)	PY at Depth: 71	Load Intensity p (kN/m)	PY at Depth: 72	Load Intensity p (kN/m)	PY at Depth: 73	Load Intensity p (kN/m)	PY at Depth: 74	Load Intensity p (kN/m)	PY at Depth: 75	Load Intensity p (kN/m)	PY at Depth: 76	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.006	151.8	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2
	0.030	227.0	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1
	0.060	270.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0
	0.3	403.7	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5
	0.6	480.1	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3
	3.0	718.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0
	6.0	853.8	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0
	15.0	1074.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0
	30.0	1277.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0
	45.0	1413.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0
	60.0	1518.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0
	120.0	1806.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0
	180.0	1998.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0
	240.0	2147.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0
	300.0	2270.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0
	360.0	2376.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0
	420.0	2470.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0
	480.0	2554.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0
	540.0	2630.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0
	600.0	2700.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0
	750.0	2700.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0

Elev. (m)	181.2		180.2		179.2		178.2		177.2		176.2		175.2		174.2		173.2		172.2		171.2		170.2		169.2		168.2		167.2	
Depth (m)	PY at Depth: 77	Load Intensity p (kN/m)	PY at Depth: 78	Load Intensity p (kN/m)	PY at Depth: 79	Load Intensity p (kN/m)	PY at Depth: 80	Load Intensity p (kN/m)	PY at Depth: 81	Load Intensity p (kN/m)	PY at Depth: 82	Load Intensity p (kN/m)	PY at Depth: 83	Load Intensity p (kN/m)	PY at Depth: 84	Load Intensity p (kN/m)	PY at Depth: 85	Load Intensity p (kN/m)	PY at Depth: 86	Load Intensity p (kN/m)	PY at Depth: 87	Load Intensity p (kN/m)	PY at Depth: 88	Load Intensity p (kN/m)	PY at Depth: 89	Load Intensity p (kN/m)	PY at Depth: 90	Load Intensity p (kN/m)	PY at Depth: 91	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2
	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1
	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0
	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5
	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3
	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0
	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0
	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0
	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0
	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0
	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0
	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0
	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0
	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0
	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0
	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0
	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0
	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0
	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0
	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0
	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Weak Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



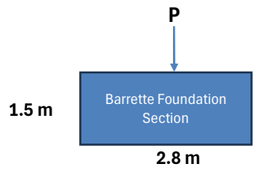
March 2026

Elev. (m)	166.2		165.2		164.2		163.2		162.2		161.2		160.2		159.2		158.2		157.2		156.2		155.2		154.2		153.2		152.2	
Depth (m)	PY at Depth: 92	Load Intensity p (kN/m)	PY at Depth: 93	Load Intensity p (kN/m)	PY at Depth: 94	Load Intensity p (kN/m)	PY at Depth: 95	Load Intensity p (kN/m)	PY at Depth: 96	Load Intensity p (kN/m)	PY at Depth: 97	Load Intensity p (kN/m)	PY at Depth: 98	Load Intensity p (kN/m)	PY at Depth: 99	Load Intensity p (kN/m)	PY at Depth: 100	Load Intensity p (kN/m)	PY at Depth: 101	Load Intensity p (kN/m)	PY at Depth: 102	Load Intensity p (kN/m)	PY at Depth: 103	Load Intensity p (kN/m)	PY at Depth: 104	Load Intensity p (kN/m)	PY at Depth: 105	Load Intensity p (kN/m)	PY at Depth: 106	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2
	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1
	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0
	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5
	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3
	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0
	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0
	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0
	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0
	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0
	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0
	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0
	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0
	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0
	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0
	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0
	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0
	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0
	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0
	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0
	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0

Elev. (m)	151.2		150.2		149.2		148.2		147.2		146.2		145.2		144.2		143.2		142.2		141.2		140.2		139.2		138.2		137.2	
Depth (m)	PY at Depth: 107	Load Intensity p (kN/m)	PY at Depth: 108	Load Intensity p (kN/m)	PY at Depth: 109	Load Intensity p (kN/m)	PY at Depth: 110	Load Intensity p (kN/m)	PY at Depth: 111	Load Intensity p (kN/m)	PY at Depth: 112	Load Intensity p (kN/m)	PY at Depth: 113	Load Intensity p (kN/m)	PY at Depth: 114	Load Intensity p (kN/m)	PY at Depth: 115	Load Intensity p (kN/m)	PY at Depth: 116	Load Intensity p (kN/m)	PY at Depth: 117	Load Intensity p (kN/m)	PY at Depth: 118	Load Intensity p (kN/m)	PY at Depth: 119	Load Intensity p (kN/m)	PY at Depth: 120	Load Intensity p (kN/m)	PY at Depth: 121	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0
	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	0.005	259.2	1.2	90000.0
	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	0.024	454.1	7.2	112500.0
	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0	0.048	540.0		
	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5	0.240	807.5		
	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3	0.5	960.3		
	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0	2.4	1436.0		
	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0	4.8	1708.0		
	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0	12.0	2147.0		
	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0	24.0	2554.0		
	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0	36.0	2826.0		
	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0	48.0	3037.0		
	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0	96.0	3611.0		
	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0	144.0	3996.0		
	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0	192.0	4294.0		
	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0	240.0	4541.0		
	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0	288.0	4753.0		
	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0	336.0	4939.0		
	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0	384.0	5107.0		
	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0	432.0	5260.0		
	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0	480.0	5400.0		
	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0	600.0	5400.0		

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (Piers 1, 2 and 3)

Barrette 2.8m x 1.5 m - Weak Axis
Assuming Underside of Pile Cap at Elev. 256.7 m, 122.8 m long
P loads at each depth are in metres



March 2026

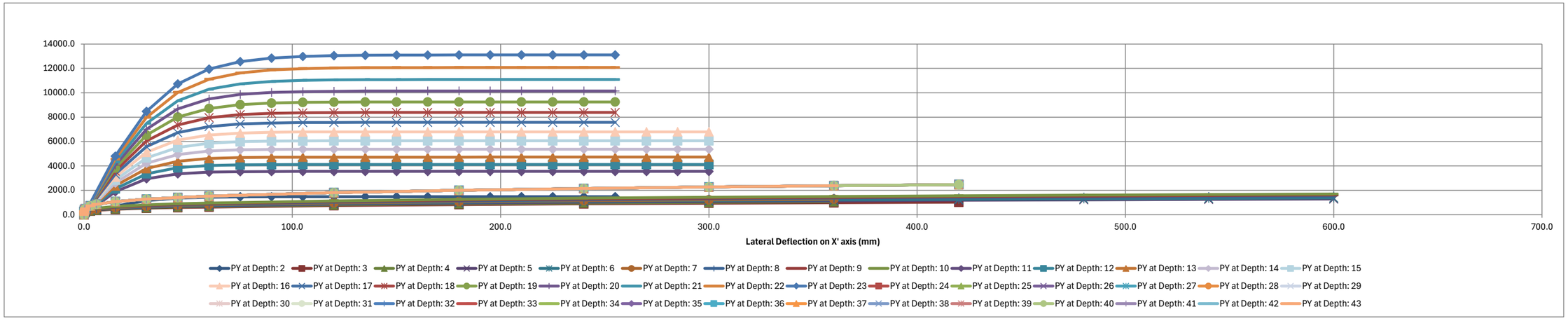
Elev. (m)	136.2		135.2		134.2																							
Depth (m)	PY at Depth: 122	Load Intensity p (kN/m)	PY at Depth: 123	Load Intensity p (kN/m)	PY at Depth: 124	Load Intensity p (kN/m)																						
Static	0.0	0.0	0.0	0.0	0.0	0.0																						
	1.2	90000.0	1.2	90000.0	1.2	90000.0																						
	7.2	112500.0	7.2	112500.0	7.2	112500.0																						

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

Elev. (m)	254.3		253.3		252.3		251.3		250.3		249.3		248.3		247.3		246.3		245.3		244.3		243.3		242.3		241.3		240.3	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 3	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.001	1.2	0.001	1.6	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	1.5	207.7	1.5	232.4	1.5	257.2
	0.003	6.2	0.003	7.8	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	3.1	408.0	3.1	455.7	3.1	503.4
	0.006	12.3	0.006	15.6	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	4.6	594.4	4.6	662.1	4.6	729.5
	0.031	30.0	0.031	38.0	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	6.1	762.2	6.1	846.1	6.1	929.3
	0.061	35.7	0.061	45.2	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	7.7	909.0	7.7	1005.0	7.7	1100.0
	0.3	53.4	0.3	67.6	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	9.2	1034.0	9.2	1138.5	9.2	1241.6
	0.6	63.5	0.6	80.3	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	10.7	1138.1	10.7	1248.1	10.7	1356.3
	1.5	79.9	1.5	101.0	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	12.3	1223.2	12.3	1336.3	12.3	1447.3
	3.1	95.0	3.1	120.1	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	13.8	1291.8	13.8	1406.3	13.8	1518.5
	4.6	105.1	4.6	132.9	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	15.4	1346.5	15.4	1461.1	15.4	1573.5
	6.1	112.9	6.1	142.8	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	16.9	1389.4	16.9	1503.6	16.9	1615.5
	12.3	134.3	12.3	169.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	18.4	1423.1	18.4	1536.3	18.4	1647.5
	18.4	148.6	18.4	188.1	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	20.0	1449.3	20.0	1561.4	20.0	1671.7
	24.6	159.7	24.6	202.1	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	21.5	1469.5	21.5	1580.5	21.5	1689.8
	30.7	168.9	30.7	213.6	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	23.0	1485.1	23.0	1594.9	23.0	1703.4
	36.8	176.8	36.8	223.6	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	24.6	1497.0	24.6	1605.9	24.6	1713.6
	43.0	183.7	43.0	232.4	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	26.1	1506.3	26.1	1614.3	26.1	1721.2
	49.1	190.1	49.1	240.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	27.6	1513.3	27.6	1620.5	27.6	1726.8
	55.3	195.7	55.3	247.4	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	29.2	1518.6	29.2	1625.2	29.2	1731.1
	61.4	200.9	61.4	254.0	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	30.7	1522.8	30.7	1628.8	30.7	1734.2
	76.8	200.9	76.8	254.0	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3						

Elev. (m)	239.3		238.3		237.3		236.3		235.3		234.3		233.3		232.3		231.3		230.3		229.3		228.3		227.3		226.3		225.3	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.5	281.8	1.5	306.5	1.5	331.2	1.5	355.9	1.5	380.5	1.5	405.1	1.5	429.8	1.5	454.4	1.5	479.0	1.5	503.6	1.5	528.2	1.5	552.8	1.5	577.4	1.5	602.1	1.5	626.6
	3.1	550.9	3.1	598.3	3.1	645.6	3.1	692.9	3.1	740.0	3.1	787.2	3.1	834.3	3.1	881.3	3.1	928.3	3.1	975.2	3.1	1022.2	3.1	1069.1	3.1	1115.9	3.1	1162.8	3.1	1209.6
	4.6	796.5	4.6	863.2	4.6	929.7	4.6	996.0	4.6	1062.1	4.6	1128.0	4.6	1193.8	4.6	1259.5	4.6	1325.0	4.6	1390.5	4.6	1455.8	4.6	1521.2	4.6	1586.4	4.6	1651.5	4.6	1716.6
	6.1	1011.7	6.1	1093.7	6.1	1175.1	6.1	1256.3	6.1	1336.9	6.1	1417.4	6.1	1497.5	6.1	1577.5	6.1	1657.2	6.1	1736.8	6.1	1816.1	6.1	1895.4	6.1	1974.5	6.1	2053.5	6.1	2132.4
	7.7	1193.8	7.7	1286.9	7.7	1379.1	7.7	1470.9	7.7	1562.0	7.7	1652.9	7.7	1743.2	7.7	1833.3	7.7	1923.1	7.7	2012.6	7.7	2101.8	7.7	2190.9	7.7	2279.8	7.7	2368.6	7.7	2457.1
	9.2	1343.1	9.2	1443.7	9.2	1543.3	9.2	1642.1	9.2	1740.3	9.2	1838.0	9.2	1935.1	9.2	2031.9	9.2	2128.3	9.2	2224.4	9.2	2320.2	9.2	2415.8	9.2	2511.2	9.2	2606.4	9.2	2701.4
	10.7	1462.6	10.7	1567.9	10.7	1672.0	10.7	1775.2	10.7	1877.7	10.7	1979.6	10.7	2081.0	10.7	2181.9	10.7	2282.4	10.7	2382.6	10.7	2482.5	10.7	2582.2	10.7	2681.6	10.7	2780.8	10.7	2879.9
	12.3	1556.4	12.3	1664.2	12.3	1770.8	12.3	1876.6	12.3	1981.4	12.3	2085.7	12.3	2189.5	12.3	2292.8	12.3	2395.7	12.3	2498.3	12.3	2600.6	12.3	2702.6	12.3	2804.4	12.3	2906.1	12.3	3007.5
	13.8	1628.8	13.8	1737.8	13.8	1845.5	13.8	1952.4	13.8	2058.5	13.8	2164.0	13.8	2269.0	13.8	2373.5	13.8	2477.7	13.8	2581.6	13.8	2685.1	13.8	2788.5	13.8	2891.7	13.8	2994.7	13.8	3097.4
	15.4	1684.0	15.4	1793.3	15.4	1901.3	15.4	2008.6	15.4	2115.0	15.4	2221.1	15.4	2326.5	15.4	2431.7	15.4	2536.4	15.4	2640.9	15.4	2745.1	15.4	2849.1	15.4	2953.0	15.4	3056.6	15.4	3160.2
	16.9	1725.7	16.9	1834.8	16.9	1942.6	16.9	2049.8	16.9	2156.2	16.9	2262.3	16.9	2367.8	16.9	2473.1	16.9	2578.0	16.9	2682.8	16.9	2787.2	16.9	2891.5	16.9	2995.7	16.9	3099.7	16.9	3203.6
	18.4	1757.1	18.4	1865.5	18.4	1973.0	18.4	2079.8	18.4	2186.1	18.4	2291.9	18.4	2397.4	18.4	2502.6	18.4	2607.4	18.4	2712.2	18.4	2816.7	18.4	2921.0	18.4	3025.3	18.4	3129.5	18.4	3233.4
	20.0	1780.4	20.0	1888.2	20.0	1995.2	20.0	2101.7	20.0	2207.6	20.0	2313.2	20.0	2418.4	20.0	2523.4	20.0	2628.1	20.0	2732.7	20.0	2837.2	20.0	2941.5	20.0	3045.7	20.0	3149.9	20.0	3253.9
	21.5	1797.8	21.5	1905.0	21.5	2011.5	21.5	2117.5	21.5	2223.0	21.5	2328.3	21.5	2433.2	21.5	2538.1	21.5	2642.6	21.5	2747.1	21.5	2851.4	21.5	2955.7	21.5	3059.8	21.5	3164.0	21.5	3267.9
	23.0	1810.7	23.0	1917.3	23.0	2023.2	23.0	2128.9	23.0	2234.0	23.0	2339.1	23.0	2443.8	23.0	2548.3	23.0	2652.8	23.0	2757.1	23.0	2861.3	23.0	2965.4	23.0	3069.5	23.0	3173.6	23.0	3277.5
	24.6	1820.2	24.6	1926.3	24.6	2031.8	24.6	2137.0	24.6	2241.9	24.6	2346.7	24.6	2451.2	24.6	2555.6	24.6	2659.9	24.6	2764.0	24.6	2868.2	24.6	2972.2	24.6	3076.2	24.6	3180.2	24.6	3284.1
	26.1	1827.2	26.1	1932.8	26.1	2038.0	26.1	2142.9	26.1	2247.5	26.1	2352.1	26.1	2456.4	26.1	2560.6	26.1	2664.8	26.1	2768.8	26.1	2872.9	26.1	2976.8	26.1	3080.8	26.1	3184.7	26.1	3288.5
	27.6	1832.4	27.6	1937.7	27.6	2042.5	27.6	2147.1	27.6	2251.5	27.6	2355.9	27.6	2460.0	27.6	2564.2	27.6	2668.3	27.6	2772.2	27.6	2876.1	27.6	2980.0	27.6	3083.9	27.6	3187.8	27.6	3291.6
	29.2	1836.3	29.2	1941.2	29.2	2045.7	29.2	2150.2	29.2	2254.4	29.2	2358.6	29.2	2462.6	29.2	2566.7	29.2	2670.6	29.2	2774.5	29.2	2878.4	29.2	2982.2	29.2	3086.1	29.2	3189.9	29.2	3293.6
	30.7	1839.1	30.7	1943.8	30.7	2048.1	30.7	2152.4	30.7	2256.5	30.7	2360.5	30.7	2464.5	30.7	2568.4	30.7	2672.3	30.7	2776.1	30.7	2880.0	30.7	2983.7	30.7	3087.6	30.7	3191.3	30.7	3295.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

Elev. (m)	224.3		223.3		222.3		221.3		220.3		219.3		218.3		217.3		216.3		215.3		214.3		213.3		212.3		211.3		210.3	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	1.5	651.2	1.5	675.8	1.5	700.4	1.5	725.0	1.5	749.6	1.5	774.2	1.5	798.7	1.5	823.3	1.5	847.9	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7
	3.1	1256.4	3.1	1303.2	3.1	1350.0	3.1	1396.7	3.1	1443.5	3.1	1490.2	3.1	1536.9	3.1	1583.6	3.1	1630.3	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5
	4.6	1781.7	4.6	1846.7	4.6	1911.6	4.6	1976.5	4.6	2041.4	4.6	2106.2	4.6	2171.1	4.6	2235.8	4.6	2300.5	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0
	6.1	2211.2	6.1	2289.9	6.1	2368.6	6.1	2447.1	6.1	2525.6	6.1	2604.1	6.1	2682.5	6.1	2760.8	6.1	2839.1	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3
	7.7	2545.7	7.7	2634.0	7.7	2722.2	7.7	2810.4	7.7	2898.4	7.7	2986.4	7.7	3074.3	7.7	3162.1	7.7	3250.0	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1
	9.2	2796.3	9.2	2891.0	9.2	2985.6	9.2	3080.1	9.2	3174.5	9.2	3268.8	9.2	3363.0	9.2	3457.1	9.2	3551.1	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5
	10.7	2978.8	10.7	3077.5	10.7	3176.0	10.7	3274.6	10.7	3373.0	10.7	3471.2	10.7	3569.5	10.7	3667.6	10.7	3765.7	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4
	12.3	3108.8	12.3	3210.0	12.3	3311.0	12.3	3411.9	12.3	3512.8	12.3	3613.5	12.3	3714.1	12.3	3814.7	12.3	3915.2	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9
	13.8	3200.1	13.8	3302.7	13.8	3405.2	13.8	3507.5	13.8	3609.7	13.8	3711.9	13.8	3814.0	13.8	3916.0	13.8	4017.9	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7
	15.4	3263.6	15.4	3366.9	15.4	3470.1	15.4	3573.3	15.4	3676.3	15.4	3779.3	15.4	3882.2	15.4	3985.1	15.4	4087.8	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6
	16.9	3307.4	16.9	3411.0	16.9	3514.7	16.9	3618.2	16.9	3721.7	16.9	3825.1	16.9	3928.5	16.9	4031.8	16.9	4135.1	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4
	18.4	3337.4	18.4	3441.2	18.4	3545.1	18.4	3648.8	18.4	3752.5	18.4	3856.1	18.4	3959.7	18.4	4063.3	18.4	4166.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8
	20.0	3357.9	20.0	3461.8	20.0	3565.7	20.0	3669.6	20.0	3773.3	20.0	3877.1	20.0	3980.8	20.0	4084.4	20.0	4188.1	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5
	21.5	3371.9	21.5	3475.8	21.5	3579.7	21.5	3683.6	21.5	3787.4	21.5	3891.1	21.5	3994.9	21.5	4098.6	21.5	4202.4	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7
	23.0	3381.5	23.0	3485.3	23.0	3589.2	23.0	3693.1	23.0	3796.9	23.0	3900.6	23.0	4004.4	23.0	4108.1	23.0	4211.9	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3
	24.6	3388.0	24.6	3491.8	24.6	3595.7	24.6	3699.4	24.6	3803.2	24.6	3907.0	24.6	4010.7	24.6	4114.4	24.6	4218.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2
	26.1	3392.4	26.1	3496.2	26.1	3600.0	26.1	3703.8	26.1	3807.5	26.1	3911.2	26.1	4015.0	26.1	4118.7	26.1	4222.4	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7
	27.6	3395.4	27.6	3499.1	27.6	3602.9	27.6	3706.7	27.6	3810.4	27.6	3914.1	27.6	4017.8	27.6	4121.5	27.6	4225.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3
	29.2	3397.4	29.2	3501.1	29.2	3604.9	29.2	3708.6	29.2	3812.3	29.2	3916.0	29.2	4019.7	29.2	4123.4	29.2	4227.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1
	30.7	3398.8	30.7	3502.5	30.7	3606.2	30.7	3709.9	30.7	3813.6	30.7	3917.3	30.7	4021.0	30.7	4124.7	30.7	4228.4	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3
																			76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3

Elev. (m)	209.3		208.3		207.3		206.3		205.3		204.3		203.3		202.3		201.3		200.3		199.3		198.3		197.3		196.3		195.3	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.000	2.7
	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.002	13.6
	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.005	27.1
	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.025	82.6
	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.049	98.3
	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.2	146.9
	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.5	174.7
	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.2	219.7
	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	2.5	261.3
	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	3.7	289.2
	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	4.9	310.7
	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	9.8	369.5
	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	14.7	409.0
	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	19.7	439.5
	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	24.6	464.7
	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	29.5	486.3
	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	34.4	505.5
	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	39.3	522.6
	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	44.2	538.2
	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	49.1	552.6
	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	61.4	552.6

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

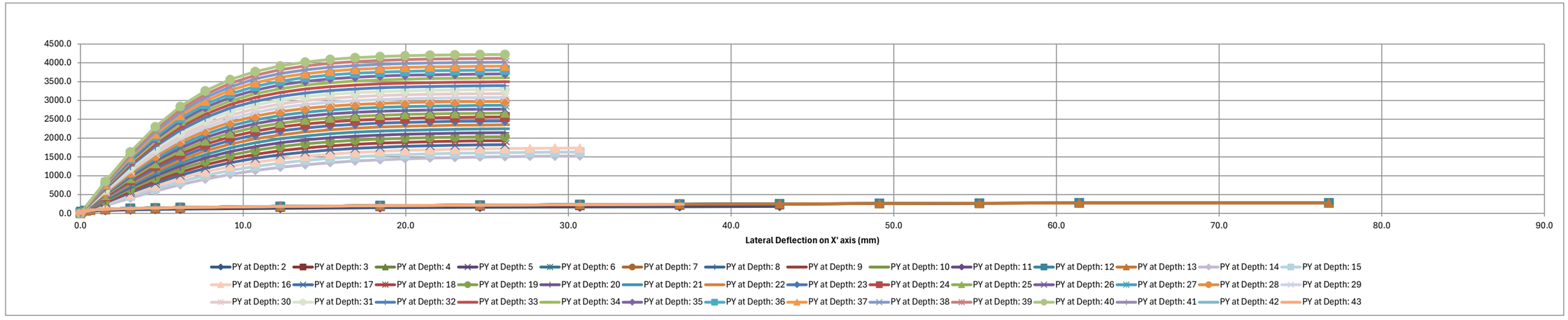
Elev. (m)	194.3		193.3		192.3		191.3		190.3		189.3		188.3															
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)	PY at Depth: 65	Load Intensity p (kN/m)	PY at Depth: 66	Load Intensity p (kN/m)	PY at Depth: 67	Load Intensity p (kN/m)	PY at Depth: 68	Load Intensity p (kN/m)														
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0														
	0.000	2.7	0.000	2.7	0.000	2.7	0.000	2.7	0.000	2.7	0.000	2.7	0.000	2.7														
	0.002	13.6	0.002	13.6	0.002	13.6	0.002	13.6	0.002	13.6	0.002	13.6	0.002	13.6														
	0.005	27.1	0.005	27.1	0.005	27.1	0.005	27.1	0.005	27.1	0.005	27.1	0.005	27.1														
	0.025	82.6	0.025	82.6	0.025	82.6	0.025	82.6	0.025	82.6	0.025	82.6	0.025	82.6														
	0.049	98.3	0.049	98.3	0.049	98.3	0.049	98.3	0.049	98.3	0.049	98.3	0.049	98.3														
	0.2	146.9	0.2	146.9	0.2	146.9	0.2	146.9	0.2	146.9	0.2	146.9	0.2	146.9														
	0.5	174.7	0.5	174.7	0.5	174.7	0.5	174.7	0.5	174.7	0.5	174.7	0.5	174.7														
	1.2	219.7	1.2	219.7	1.2	219.7	1.2	219.7	1.2	219.7	1.2	219.7	1.2	219.7														
	2.5	261.3	2.5	261.3	2.5	261.3	2.5	261.3	2.5	261.3	2.5	261.3	2.5	261.3														
	3.7	289.2	3.7	289.2	3.7	289.2	3.7	289.2	3.7	289.2	3.7	289.2	3.7	289.2														
	4.9	310.7	4.9	310.7	4.9	310.7	4.9	310.7	4.9	310.7	4.9	310.7	4.9	310.7														
	9.8	369.5	9.8	369.5	9.8	369.5	9.8	369.5	9.8	369.5	9.8	369.5	9.8	369.5														
	14.7	409.0	14.7	409.0	14.7	409.0	14.7	409.0	14.7	409.0	14.7	409.0	14.7	409.0														
	19.7	439.5	19.7	439.5	19.7	439.5	19.7	439.5	19.7	439.5	19.7	439.5	19.7	439.5														
	24.6	464.7	24.6	464.7	24.6	464.7	24.6	464.7	24.6	464.7	24.6	464.7	24.6	464.7														
	29.5	486.3	29.5	486.3	29.5	486.3	29.5	486.3	29.5	486.3	29.5	486.3	29.5	486.3														
	34.4	505.5	34.4	505.5	34.4	505.5	34.4	505.5	34.4	505.5	34.4	505.5	34.4	505.5														
	39.3	522.6	39.3	522.6	39.3	522.6	39.3	522.6	39.3	522.6	39.3	522.6	39.3	522.6														
	44.2	538.2	44.2	538.2	44.2	538.2	44.2	538.2	44.2	538.2	44.2	538.2	44.2	538.2														
	49.1	552.6	49.1	552.6	49.1	552.6	49.1	552.6	49.1	552.6	49.1	552.6	49.1	552.6														
	61.4	552.6	61.4	552.6	61.4	552.6	61.4	552.6	61.4	552.6	61.4	552.6	61.4	552.6														

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

Elev. (m)	254.3		253.3		252.3		251.3		250.3		249.3		248.3		247.3		246.3		245.3		244.3		243.3		242.3		241.3		240.3	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 3	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.001	1.5	0.001	1.9	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	1.8	243.0	1.8	271.6	1.8	300.2
	0.004	7.7	0.004	9.6	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	3.6	477.1	3.6	532.4	3.6	587.5
	0.007	15.4	0.007	19.2	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	5.3	694.7	5.3	773.0	5.3	850.9
	0.036	32.4	0.036	40.5	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	7.1	890.2	7.1	987.1	7.1	1083.3
	0.071	38.6	0.071	48.1	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	8.9	1060.7	8.9	1171.7	8.9	1281.4
	0.4	57.7	0.4	71.9	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	10.7	1205.5	10.7	1326.2	10.7	1445.2
	0.7	68.6	0.7	85.5	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	12.4	1325.9	12.4	1452.8	12.4	1577.6
	1.8	86.2	1.8	107.6	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	14.2	1423.9	14.2	1554.4	14.2	1682.5
	3.6	102.5	3.6	127.9	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	16.0	1502.6	16.0	1634.6	16.0	1764.1
	5.3	113.5	5.3	141.6	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	17.8	1565.1	17.8	1697.3	17.8	1827.0
	7.1	121.9	7.1	152.1	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	19.6	1614.2	19.6	1745.8	19.6	1875.0
	14.2	145.0	14.2	180.9	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	21.3	1652.4	21.3	1783.0	21.3	1911.4
	21.3	160.5	21.3	200.2	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	23.1	1682.0	23.1	1811.4	23.1	1938.7
	28.5	172.4	28.5	215.2	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	24.9	1704.9	24.9	1833.0	24.9	1959.3
	35.6	182.3	35.6	227.5	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	26.7	1722.5	26.7	1849.3	26.7	1974.7
	42.7	190.8	42.7	238.1	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	28.4	1735.9	28.4	1861.7	28.4	1986.1
	49.8	198.3	49.8	247.4	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	30.2	1746.3	30.2	1871.0	30.2	1994.7
	56.9	205.2	56.9	255.8	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	32.0	1754.1	32.0	1878.0	32.0	2001.0
	64.0	211.3	64.0	263.5	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	33.8	1760.1	33.8	1883.3	33.8	2005.8
	71.1	216.9	71.1	270.5	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	35.6	1764.7	35.6	1887.3	35.6	2009.2
	88.9	216.9	88.9	270.5	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0						

Elev. (m)	239.3		238.3		237.3		236.3		235.3		234.3		233.3		232.3		231.3		230.3		229.3		228.3		227.3		226.3		225.3	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.8	328.8	1.8	357.4	1.8	386.0	1.8	414.6	1.8	443.1	1.8	471.6	1.8	500.1	1.8	528.7	1.8	557.2	1.8	585.7	1.8	614.2	1.8	642.7	1.8	671.2	1.8	699.7	1.8	728.2
	3.6	642.5	3.6	697.4	3.6	752.2	3.6	806.9	3.6	861.5	3.6	916.1	3.6	970.6	3.6	1025.1	3.6	1079.5	3.6	1133.9	3.6	1188.2	3.6	1242.5	3.6	1296.8	3.6	1351.1	3.6	1405.3
	5.3	928.5	5.3	1005.7	5.3	1082.6	5.3	1159.4	5.3	1235.9	5.3	1312.2	5.3	1388.4	5.3	1464.4	5.3	1540.2	5.3	1616.0	5.3	1691.7	5.3	1767.4	5.3	1842.8	5.3	1918.3	5.3	1993.7
	7.1	1178.7	7.1	1273.5	7.1	1367.7	7.1	1461.5	7.1	1554.9	7.1	1647.9	7.1	1740.7	7.1	1833.2	7.1	1925.5	7.1	2017.6	7.1	2109.5	7.1	2201.2	7.1	2292.8	7.1	2384.2	7.1	2475.6
	8.9	1389.8	8.9	1497.4	8.9	1604.1	8.9	1710.2	8.9	1815.7	8.9	1920.7	8.9	2025.2	8.9	2129.4	8.9	2233.3	8.9	2336.9	8.9	2440.2	8.9	2543.4	8.9	2646.2	8.9	2749.0	8.9	2851.5
	10.7	1562.6	10.7	1678.8	10.7	1793.9	10.7	1908.2	10.7	2021.7	10.7	2134.7	10.7	2247.1	10.7	2359.1	10.7	2470.5	10.7	2581.8	10.7	2692.6	10.7	2803.3	10.7	2913.7	10.7	3023.8	10.7	3133.8
	12.4	1700.5	12.4	1822.0	12.4	1942.3	12.4	2061.7	12.4	2180.2	12.4	2298.1	12.4	2415.3	12.4	2532.1	12.4	2648.3	12.4	2764.3	12.4	2879.9	12.4	2995.2	12.4	3110.3	12.4	3225.1	12.4	3339.7
	14.2	1808.4	14.2	1932.9	14.2	2056.1	14.2	2178.3	14.2	2299.6	14.2	2420.2	14.2	2540.2	14.2	2659.7	14.2	2778.8	14.2	2897.4	14.2	3015.8	14.2	3134.0	14.2	3251.8	14.2	3369.4	14.2	3486.8
	16.0	1891.5	16.0	2017.3	16.0	2141.8	16.0	2265.4	16.0	2388.0	16.0	2510.1	16.0	2631.5	16.0	2752.5	16.0	2873.0	16.0	2993.2	16.0	3113.1	16.0	3232.7	16.0	3352.2	16.0	3471.4	16.0	3590.4
	17.8	1954.6	17.8	2080.8	17.8	2205.7	17.8	2329.8	17.8	2452.9	17.8	2575.5	17.8	2697.5	17.8	2819.2	17.8	2940.4	17.8	3061.3	17.8	3181.9	17.8	3302.4	17.8	3422.5	17.8	3542.6	17.8	3662.4
	19.6	2002.3	19.6	2128.2	19.6	2252.9	19.6	2376.9	19.6	2500.1	19.6	2622.7	19.6	2744.8	19.6	2866.7	19.6	2988.0	19.6	3109.2	19.6	3230.2	19.6	3350.9	19.6	3471.5	19.6	3592.0	19.6	3712.2
	21.3	2038.0	21.3	2163.3	21.3	2287.6	21.3	2411.2	21.3	2534.1	21.3	2656.5	21.3	2778.5	21.3	2900.3	21.3	3021.7	21.3	3142.9	21.3	3263.9	21.3	3384.7	21.3	3505.4	21.3	3626.0	21.3	3746.5
	23.1	2064.4	23.1	2189.2	23.1	2312.9	23.1	2436.0	23.1	2558.5	23.1	2680.7	23.1	2802.4	23.1	2924.0	23.1	3045.3	23.1	3166.4	23.1	3287.3	23.1	3408.1	23.1	3528.8	23.1	3649.4	23.1	3769.9
	24.9	2084.2	24.9	2208.1	24.9	2331.3	24.9	2453.9	24.9	2576.0	24.9	2697.9	24.9	2819.4	24.9	2940.7	24.9	3061.8	24.9	3182.7	24.9	3303.6	24.9	3424.3	24.9	3544.9	24.9	3665.5	24.9	3785.9
	26.7	2098.7	26.7	2222.0	26.7	2344.6	26.7	2466.8	26.7	2588.5	26.7	2710.1	26.7	2831.3	26.7	2952.4	26.7	3073.3	26.7	3194.1	26.7	3314.8	26.7	3435.4	26.7	3556.0	26.7	3676.5	26.7	3796.9
	28.4	2109.5	28.4	2232.2	28.4	2354.3	28.4	2476.1	28.4	2597.5	28.4	2718.7	28.4	2839.7	28.4	2960.6	28.4	3081.4	28.4	3202.0	28.4	3322.6	28.4	3443.1	28.4	3563.6	28.4	3684.0	28.4	3804.3
	30.2	2117.4	30.2	2239.6	30.2	2361.3	30.2	2482.7	30.2	2603.9	30.2	2724.8	30.2	2845.7	30.2	2966.4	30.2	3086.9	30.2	3207.5	30.2	3328.0	30.2	3448.4	30.2	3568.8	30.2	3689.1	30.2	3809.4
	32.0	2123.2	32.0	2245.0	32.0	2366.3	32.0	2487.5	32.0	2608.4	32.0	2729.2	32.0	2849.8	32.0	2970.4	32.0	3090.8	32.0	3211.3	32.0	3331.7	32.0	3452.0	32.0	3572.3	32.0	3692.6	32.0	3812.8
	33.8	2127.5	33.8	2248.9	33.8	2370.0	33.8	2490.9	33.8	2611.6	33.8	2732.3	33.8	2852.7	33.8	2973.2	33.8	3093.5	33.8	3214.0	33.8	3334.3	33.8	3454.5	33.8	3574.8	33.8	3695.0	33.8	3815.2
	35.6	2130.7	35.6	2251.8	35.6	2372.6	35.6	2493.4	35.6	2613.9	35.6	2734.4	35.6	2854.8	35.6	2975.2	35.6	3095.4	35.6	3215.8	35.6	3336.0	35.6	3456.2	35.6	3576.4	35.6	3696.6	35.6	3816.8

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

Elev. (m)	224.3		223.3		222.3		221.3		220.3		219.3		218.3		217.3		216.3		215.3		214.3		213.3		212.3		211.3		210.3	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	1.8	756.7	1.8	785.1	1.8	813.6	1.8	842.1	1.8	870.6	1.8	899.1	1.8	927.5	1.8	956.0	1.8	984.5	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3
	3.6	1459.6	3.6	1513.7	3.6	1567.8	3.6	1622.1	3.6	1676.2	3.6	1730.2	3.6	1784.4	3.6	1838.5	3.6	1892.5	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4
	5.3	2069.0	5.3	2144.3	5.3	2219.5	5.3	2294.7	5.3	2369.8	5.3	2444.9	5.3	2519.9	5.3	2594.9	5.3	2669.9	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8
	7.1	2566.8	7.1	2658.0	7.1	2749.0	7.1	2840.0	7.1	2930.9	7.1	3021.7	7.1	3112.5	7.1	3203.2	7.1	3293.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9
	8.9	2953.9	8.9	3056.2	8.9	3158.4	8.9	3260.5	8.9	3362.4	8.9	3464.3	8.9	3566.0	8.9	3667.8	8.9	3769.4	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9
	10.7	3243.7	10.7	3353.3	10.7	3462.9	10.7	3572.2	10.7	3681.5	10.7	3790.7	10.7	3899.7	10.7	4008.7	10.7	4117.6	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1
	12.4	3454.2	12.4	3568.6	12.4	3682.7	12.4	3796.7	12.4	3910.6	12.4	4024.5	12.4	4138.1	12.4	4251.7	12.4	4365.3	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2
	14.2	3604.1	14.2	3721.2	14.2	3838.2	14.2	3955.1	14.2	4071.7	14.2	4188.4	14.2	4304.9	14.2	4421.4	14.2	4537.7	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3
	16.0	3709.3	16.0	3828.0	16.0	3946.6	16.0	4065.1	16.0	4183.4	16.0	4301.7	16.0	4419.9	16.0	4538.1	16.0	4656.1	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3
	17.8	3782.2	17.8	3901.8	17.8	4021.3	17.8	4140.7	17.8	4260.0	17.8	4379.3	17.8	4498.4	17.8	4617.6	17.8	4736.6	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5
	19.6	3832.4	19.6	3952.5	19.6	4072.4	19.6	4192.3	19.6	4312.2	19.6	4431.9	19.6	4551.6	19.6	4671.3	19.6	4790.9	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0
	21.3	3866.8	21.3	3987.1	21.3	4107.3	21.3	4227.4	21.3	4347.5	21.3	4467.5	21.3	4587.5	21.3	4707.4	21.3	4827.3	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0
	23.1	3890.3	23.1	4010.7	23.1	4131.0	23.1	4251.2	23.1	4371.4	23.1	4491.5	23.1	4611.6	23.1	4731.7	23.1	4851.8	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9
	24.9	3906.3	24.9	4026.7	24.9	4147.0	24.9	4267.3	24.9	4387.5	24.9	4507.7	24.9	4627.8	24.9	4748.0	24.9	4868.1	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5
	26.7	3917.2	26.7	4037.6	26.7	4157.8	26.7	4278.1	26.7	4398.3	26.7	4518.5	26.7	4638.7	26.7	4758.8	26.7	4879.0	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1
	28.4	3924.6	28.4	4044.9	28.4	4165.2	28.4	4285.4	28.4	4405.6	28.4	4525.8	28.4	4645.9	28.4	4766.1	28.4	4886.2	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7
	30.2	3929.7	30.2	4049.9	30.2	4170.1	30.2	4290.3	30.2	4410.5	30.2	4530.6	30.2	4650.8	30.2	4770.9	30.2	4891.1	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7
	32.0	3933.1	32.0	4053.3	32.0	4173.4	32.0	4293.6	32.0	4413.8	32.0	4533.9	32.0	4654.0	32.0	4774.2	32.0	4894.3	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7
	33.8	3935.4	33.8	4055.5	33.8	4175.7	33.8	4295.8	33.8	4416.0	33.8	4536.1	33.8	4656.2	33.8	4776.3	33.8	4896.4	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7
	35.6	3936.9	35.6	4057.1	35.6	4177.2	35.6	4297.3	35.6	4417.4	35.6	4537.5	35.6	4657.7	35.6	4777.7	35.6	4897.8	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0
																			88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0

Elev. (m)	209.3		208.3		207.3		206.3		205.3		204.3		203.3		202.3		201.3		200.3		199.3		198.3		197.3		196.3		195.3	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	3.6
	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.003	18.2
	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.006	36.4
	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.028	95.7
	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.057	113.8
	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.3	170.2
	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.6	202.4
	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.4	254.5
	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	2.8	302.7
	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	4.3	335.0
	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	5.7	359.9
	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	11.4	428.0
	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	17.1	473.7
	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	22.8	509.0
	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	28.5	538.2
	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	34.1	563.3
	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	39.8	585.5
	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	45.5	605.4
	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	51.2	623.4
	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	56.9	640.1
	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	71.1	640.1

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (West Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 254.8 m, 66.8 m long
P loads at each depth are in metres

March 2026

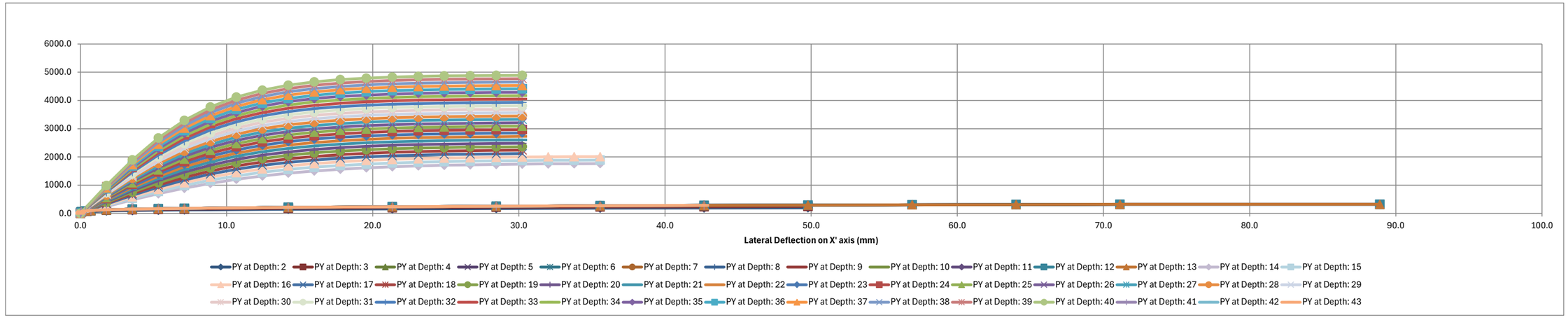
Elev. (m)	194.3		193.3		192.3		191.3		190.3		189.3		188.3															
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)	PY at Depth: 65	Load Intensity p (kN/m)	PY at Depth: 66	Load Intensity p (kN/m)	PY at Depth: 67	Load Intensity p (kN/m)	PY at Depth: 68	Load Intensity p (kN/m)														
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0														
	0.001	3.6	0.001	3.6	0.001	3.6	0.001	3.6	0.001	3.6	0.001	3.6	0.001	3.6														
	0.003	18.2	0.003	18.2	0.003	18.2	0.003	18.2	0.003	18.2	0.003	18.2	0.003	18.2														
	0.006	36.4	0.006	36.4	0.006	36.4	0.006	36.4	0.006	36.4	0.006	36.4	0.006	36.4														
	0.028	95.7	0.028	95.7	0.028	95.7	0.028	95.7	0.028	95.7	0.028	95.7	0.028	95.7														
	0.057	113.8	0.057	113.8	0.057	113.8	0.057	113.8	0.057	113.8	0.057	113.8	0.057	113.8														
	0.3	170.2	0.3	170.2	0.3	170.2	0.3	170.2	0.3	170.2	0.3	170.2	0.3	170.2														
	0.6	202.4	0.6	202.4	0.6	202.4	0.6	202.4	0.6	202.4	0.6	202.4	0.6	202.4														
	1.4	254.5	1.4	254.5	1.4	254.5	1.4	254.5	1.4	254.5	1.4	254.5	1.4	254.5														
	2.8	302.7	2.8	302.7	2.8	302.7	2.8	302.7	2.8	302.7	2.8	302.7	2.8	302.7														
	4.3	335.0	4.3	335.0	4.3	335.0	4.3	335.0	4.3	335.0	4.3	335.0	4.3	335.0														
	5.7	359.9	5.7	359.9	5.7	359.9	5.7	359.9	5.7	359.9	5.7	359.9	5.7	359.9														
	11.4	428.0	11.4	428.0	11.4	428.0	11.4	428.0	11.4	428.0	11.4	428.0	11.4	428.0														
	17.1	473.7	17.1	473.7	17.1	473.7	17.1	473.7	17.1	473.7	17.1	473.7	17.1	473.7														
	22.8	509.0	22.8	509.0	22.8	509.0	22.8	509.0	22.8	509.0	22.8	509.0	22.8	509.0														
	28.5	538.2	28.5	538.2	28.5	538.2	28.5	538.2	28.5	538.2	28.5	538.2	28.5	538.2														
	34.1	563.3	34.1	563.3	34.1	563.3	34.1	563.3	34.1	563.3	34.1	563.3	34.1	563.3														
	39.8	585.5	39.8	585.5	39.8	585.5	39.8	585.5	39.8	585.5	39.8	585.5	39.8	585.5														
	45.5	605.4	45.5	605.4	45.5	605.4	45.5	605.4	45.5	605.4	45.5	605.4	45.5	605.4														
	51.2	623.4	51.2	623.4	51.2	623.4	51.2	623.4	51.2	623.4	51.2	623.4	51.2	623.4														
	56.9	640.1	56.9	640.1	56.9	640.1	56.9	640.1	56.9	640.1	56.9	640.1	56.9	640.1														
	71.1	640.1	71.1	640.1	71.1	640.1	71.1	640.1	71.1	640.1	71.1	640.1	71.1	640.1														

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

Elev. (m)	257.9		257		255.9		254.9		253.9		252.9		251.9		250.9		249.9		248.9		247.9		246.9		245.9		244.9		243.9	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 2.9	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.5	76.3	1.5	112.8	1.5	157.1	0.001	1.7	0.001	1.7	0.001	1.7	1.5	162.5	1.5	187.3	1.5	212.0	1.5	236.7	1.5	261.4	1.5	286.1	1.5	310.8	1.5	335.4	1.5	360.1
	3.1	136.8	3.1	212.2	3.1	303.2	0.003	8.5	0.003	8.5	0.003	8.5	3.1	320.2	3.1	368.1	3.1	416.0	3.1	463.6	3.1	511.1	3.1	558.6	3.1	605.9	3.1	653.2	3.1	700.4
	4.6	176.5	4.6	290.4	4.6	430.2	0.006	17.0	0.006	17.0	0.006	17.0	4.6	468.5	4.6	537.0	4.6	604.9	4.6	672.4	4.6	739.5	4.6	806.3	4.6	872.8	4.6	939.1	4.6	1005.2
	6.1	199.5	6.1	346.7	6.1	534.3	0.031	41.3	0.031	41.3	0.031	41.3	6.1	604.4	6.1	689.7	6.1	774.0	6.1	857.4	6.1	940.0	6.1	1022.0	6.1	1103.6	6.1	1184.7	6.1	1265.5
	7.7	211.8	7.7	384.6	7.7	615.5	0.061	49.1	0.061	49.1	0.061	49.1	7.7	725.6	7.7	824.0	7.7	920.6	7.7	1015.9	7.7	1110.1	7.7	1203.3	7.7	1295.7	7.7	1387.5	7.7	1478.7
	9.2	218.1	9.2	409.1	9.2	676.6	0.3	73.5	0.3	73.5	0.3	73.5	9.2	831.2	9.2	939.0	9.2	1044.5	9.2	1147.9	9.2	1249.9	9.2	1350.7	9.2	1450.4	9.2	1549.4	9.2	1647.6
	10.7	221.3	10.7	424.5	10.7	721.2	0.6	87.4	0.6	87.4	0.6	87.4	10.7	921.5	10.7	1035.6	10.7	1146.6	10.7	1255.3	10.7	1362.2	10.7	1467.7	10.7	1571.9	10.7	1675.3	10.7	1777.8
	12.3	222.9	12.3	433.9	12.3	753.0	1.5	109.9	1.5	109.9	1.5	109.9	12.3	997.4	12.3	1115.1	12.3	1229.3	12.3	1341.0	12.3	1450.5	12.3	1558.6	12.3	1665.5	12.3	1771.3	12.3	1876.2
	13.8	223.6	13.8	439.6	13.8	775.5	3.1	130.7	3.1	130.7	3.1	130.7	13.8	1060.2	13.8	1179.6	13.8	1295.3	13.8	1408.2	13.8	1519.0	13.8	1628.2	13.8	1736.2	13.8	1843.2	13.8	1949.3
	15.4	224.0	15.4	443.1	15.4	791.2	4.6	144.6	4.6	144.6	4.6	144.6	15.4	1111.6	15.4	1231.3	15.4	1347.3	15.4	1460.3	15.4	1571.3	15.4	1680.8	15.4	1789.1	15.4	1896.5	15.4	2003.0
	16.9	224.2	16.9	445.2	16.9	802.0	6.1	155.4	6.1	155.4	6.1	155.4	16.9	1153.3	16.9	1272.4	16.9	1387.7	16.9	1500.4	16.9	1611.0	16.9	1720.2	16.9	1828.4	16.9	1935.6	16.9	2042.1
	18.4	224.3	18.4	446.5	18.4	809.4	12.3	184.8	12.3	184.8	12.3	184.8	18.4	1186.8	18.4	1304.7	18.4	1419.1	18.4	1530.9	18.4	1640.9	18.4	1749.5	18.4	1857.2	18.4	1964.2	18.4	2070.4
	20.0	224.4	20.0	447.2	20.0	814.5	18.4	204.5	18.4	204.5	18.4	204.5	20.0	1213.5	20.0	1330.1	20.0	1443.3	20.0	1554.1	20.0	1663.3	20.0	1771.3	20.0	1878.4	20.0	1984.9	20.0	2090.9
	21.5	224.4	21.5	447.7	21.5	818.0	24.6	219.7	24.6	219.7	24.6	219.7	21.5	1234.8	21.5	1349.9	21.5	1461.7	21.5	1571.6	21.5	1679.9	21.5	1787.3	21.5	1893.9	21.5	1999.9	21.5	2105.5
	23.0	224.4	23.0	448.0	23.0	820.4	30.7	232.3	30.7	232.3	30.7	232.3	23.0	1251.6	23.0	1365.2	23.0	1475.9	23.0	1584.8	23.0	1692.3	23.0	1799.0	23.0	1905.2	23.0	2010.8	23.0	2116.0
	24.6	224.4	24.6	448.1	24.6	822.1	36.8	243.2	36.8	243.2	36.8	243.2	24.6	1264.9	24.6	1377.0	24.6	1486.6	24.6	1594.7	24.6	1701.5	24.6	1807.7	24.6	1913.3	24.6	2018.6	24.6	2123.5
	26.1	224.4	26.1	448.2	26.1	823.2	43.0	252.7	43.0	252.7	43.0	252.7	26.1	1275.4	26.1	1386.1	26.1	1494.8	26.1	1602.0	26.1	1708.4	26.1	1814.0	26.1	1919.3	26.1	2024.2	26.1	2128.9
	27.6	224.4	27.6	448.3	27.6	823.9	49.1	261.3	49.1	261.3	49.1	261.3	27.6	1283.5	27.6	1393.2	27.6	1501.0	27.6	1607.6	27.6	1713.4	27.6	1818.7	27.6	1923.6	27.6	2028.2	27.6	2132.7
	29.2	224.4	29.2	448.3	29.2	824.4	55.3	269.1	55.3	269.1	55.3	269.1	29.2	1290.0	29.2	1398.7	29.2	1505.7	29.2	1611.8	29.2	1717.1	29.2	1822.0	29.2	1926.7	29.2	2031.1	29.2	2135.4
	30.7	224.4	30.7	448.3	30.7	824.8	61.4	276.3	61.4	276.3	61.4	276.3	30.7	1295.0	30.7	1402.9	30.7	1509.3	30.7	1614.8	30.7	1719.8	30.7	1824.5	30.7	1929.0	30.7	2033.2	30.7	2137.4
							76.8	276.3	76.8	276.3	76.8	276.3																		

Elev. (m)	242.9		241.9		240.9		239.9		238.9		237.9		236.9		235.9		234.9		233.9		232.9		231.9		230.9		229.9		228.9	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	1.5	384.7	1.5	409.4	1.5	434.0	1.5	458.6	1.5	483.2	1.5	507.8	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7
	3.1	747.5	3.1	794.6	3.1	841.6	3.1	888.6	3.1	935.6	3.1	982.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5
	4.6	1071.1	4.6	1136.9	4.6	1202.6	4.6	1268.2	4.6	1333.6	4.6	1399.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0
	6.1	1345.9	6.1	1426.1	6.1	1506.0	6.1	1585.7	6.1	1665.2	6.1	1744.6	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3
	7.7	1569.5	7.7	1659.9	7.7	1749.9	7.7	1839.7	7.7	1929.1	7.7	2018.4	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1
	9.2	1745.3	9.2	1842.5	9.2	1939.2	9.2	2035.6	9.2	2131.6	9.2	2227.4	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5
	10.7	1879.8	10.7	1981.1	10.7	2082.0	10.7	2182.5	10.7	2282.6	10.7	2382.5	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4
	12.3	1980.6	12.3	2084.3	12.3	2187.5	12.3	2290.5	12.3	2392.9	12.3	2495.2	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9
	13.8	2054.9	13.8	2159.9	13.8	2264.3	13.8	2368.5	13.8	2472.2	13.8	2575.8	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7
	15.4	2109.0	15.4	2214.5	15.4	2319.5	15.4	2424.3	15.4	2528.6	15.4	2632.8	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6
	16.9	2148.2	16.9	2253.7	16.9	2358.9	16.9	2463.9	16.9	2568.5	16.9	2672.9	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4
	18.4	2176.3	18.4	2281.8	18.4	2386.9	18.4	2491.8	18.4	2596.4	18.4	2700.9	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8
	20.0	2196.4	20.0	2301.7	20.0	2406.6	20.0	2511.4	20.0	2615.9	20.0	2720.3	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5
	21.5	2210.8	21.5	2315.8	21.5	2420.5	21.5	2525.2	21.5	2629.5	21.5	2733.8	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7
	23.0	2221.0	23.0	2325.7	23.0	2430.3	23.0	2534.8	23.0	2638.9	23.0	2743.2	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3
	24.6	2228.3	24.6	2332.8	24.6	2437.1	24.6	2541.5	24.6	2645.5	24.6	2749.7	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2
	26.1	2233.4	26.1	2337.7	26.1	2442.0	26.1	2546.1	26.1	2650.1	26.1	2754.1	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7
	27.6	2237.1	27.6	2341.2	27.6	2445.3	27.6	2549.4	27.6	2653.2	27.6	2757.2	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3
	29.2	2239.6	29.2	2343.7	29.2	2447.7	29.2	2551.7	29.2	2655.4	29.2	2759.4	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1
	30.7	2241.5	30.7	2345.4	30.7	2449.3	30.7	2553.3	30.7	2657.0	30.7	2760.8	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3
													76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

Elev. (m)	227.9		226.9		225.9		224.9		223.9		222.9		221.9		220.9		219.9		218.9		217.9		216.9		215.9		214.9		213.9	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7
	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5
	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0
	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3
	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1
	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5
	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4
	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9
	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7
	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6
	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4
	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8
	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5
	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7
	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3
	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2
	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7
	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3
	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1
	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3
	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3

Elev. (m)	212.9		211.9		210.9		209.9		208.9		207.9		206.9		205.9		204.9		203.9		202.9		201.9		200.9		199.9		198.9	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7	0.001	1.7
	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5	0.003	8.5
	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0	0.006	17.0
	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3	0.031	41.3
	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1	0.061	49.1
	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5	0.3	73.5
	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4	0.6	87.4
	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9	1.5	109.9
	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7	3.1	130.7
	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6	4.6	144.6
	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4	6.1	155.4
	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8	12.3	184.8
	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5	18.4	204.5
	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7	24.6	219.7
	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3	30.7	232.3
	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2	36.8	243.2
	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7	43.0	252.7
	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3	49.1	261.3
	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1	55.3	269.1
	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3	61.4	276.3
	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3	76.8	276.3

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

HP310x110 Strong Axis
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

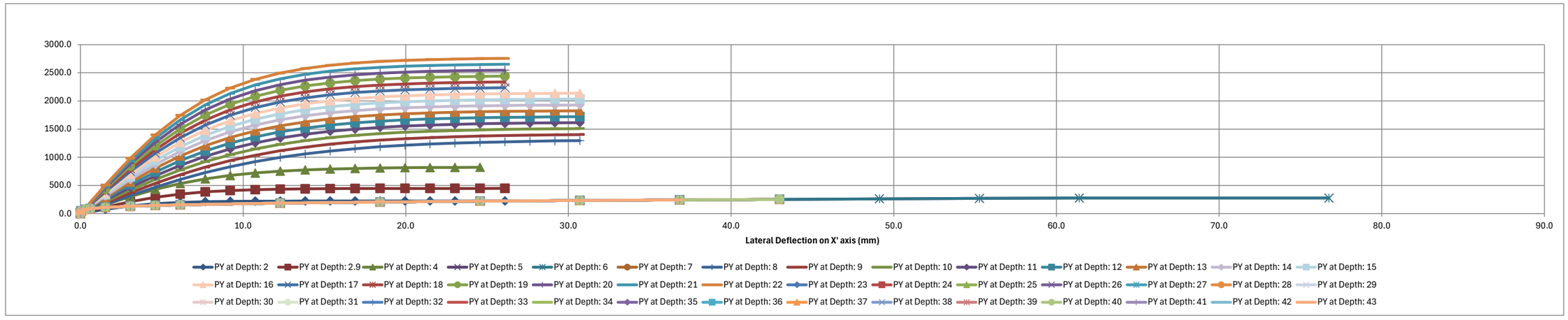
Elev. (m)	197.9		196.9		195.9																							
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)																						
Static	0	0	0	0	0	0																						
	0.000614	1.696	0.000614	1.696	0.0004912	2.714																						
	0.00307	8.482	0.00307	8.482	0.002456	13.57																						
	0.00614	16.96	0.00614	16.96	0.004912	27.14																						
	0.0307	41.32	0.0307	41.32	0.02456	82.63																						
	0.0614	49.13	0.0614	49.13	0.04912	98.27																						
	0.307	73.47	0.307	73.47	0.2456	146.9																						
	0.614	87.37	0.614	87.37	0.4912	174.7																						
	1.535	109.9	1.535	109.9	1.228	219.7																						
	3.07	130.7	3.07	130.7	2.456	261.3																						
	4.605	144.6	4.605	144.6	3.684	289.2																						
	6.14	155.4	6.14	155.4	4.912	310.7																						
	12.28	184.8	12.28	184.8	9.824	369.5																						
	18.42	204.5	18.42	204.5	14.74	409																						
	24.56	219.7	24.56	219.7	19.65	439.5																						
	30.7	232.3	30.7	232.3	24.56	464.7																						
	36.84	243.2	36.84	243.2	29.47	486.3																						
	42.98	252.7	42.98	252.7	34.38	505.5																						
	49.12	261.3	49.12	261.3	39.3	522.6																						
	55.26	269.1	55.26	269.1	44.21	538.2																						
	61.4	276.3	61.4	276.3	49.12	552.6																						
	76.75	276.3	76.75	276.3	61.4	552.6																						

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

Elev. (m)	257.9		257		255.9		254.9		253.9		252.9		251.9		250.9		249.9		248.9		247.9		246.9		245.9		244.9		243.9	
Depth (m)	PY at Depth: 2	Load Intensity p (kN/m)	PY at Depth: 2.9	Load Intensity p (kN/m)	PY at Depth: 4	Load Intensity p (kN/m)	PY at Depth: 5	Load Intensity p (kN/m)	PY at Depth: 6	Load Intensity p (kN/m)	PY at Depth: 7	Load Intensity p (kN/m)	PY at Depth: 8	Load Intensity p (kN/m)	PY at Depth: 9	Load Intensity p (kN/m)	PY at Depth: 10	Load Intensity p (kN/m)	PY at Depth: 11	Load Intensity p (kN/m)	PY at Depth: 12	Load Intensity p (kN/m)	PY at Depth: 13	Load Intensity p (kN/m)	PY at Depth: 14	Load Intensity p (kN/m)	PY at Depth: 15	Load Intensity p (kN/m)	PY at Depth: 16	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.8	87.5	1.8	129.9	1.8	181.3	0.001	2.3	0.001	2.3	0.001	2.3	1.8	188.6	1.8	217.3	1.8	245.9	1.8	274.5	1.8	303.1	1.8	331.7	1.8	360.3	1.8	388.9	1.8	417.4
	3.6	152.8	3.6	240.3	3.6	346.3	0.004	11.4	0.004	11.4	0.004	11.4	3.6	371.4	3.6	427.0	3.6	482.4	3.6	537.6	3.6	592.7	3.6	647.6	3.6	702.4	3.6	757.2	3.6	811.8
	5.3	191.8	5.3	321.9	5.3	484.2	0.007	22.8	0.007	22.8	0.007	22.8	5.3	543.6	5.3	622.8	5.3	701.5	5.3	779.6	5.3	857.3	5.3	934.7	5.3	1011.7	5.3	1088.5	5.3	1165.1
	7.1	212.1	7.1	376.3	7.1	591.3	0.036	47.9	0.036	47.9	0.036	47.9	7.1	701.1	7.1	799.9	7.1	897.4	7.1	994.0	7.1	1089.7	7.1	1184.8	7.1	1279.2	7.1	1373.2	7.1	1466.7
	8.9	221.8	8.9	410.0	8.9	670.0	0.071	56.9	0.071	56.9	0.071	56.9	8.9	841.5	8.9	955.5	8.9	1067.4	8.9	1177.8	8.9	1286.7	8.9	1394.6	8.9	1501.7	8.9	1608.0	8.9	1713.7
	10.7	226.3	10.7	430.0	10.7	725.4	0.4	85.1	0.4	85.1	0.4	85.1	10.7	964.0	10.7	1088.8	10.7	1210.8	10.7	1330.7	10.7	1448.7	10.7	1565.4	10.7	1680.9	10.7	1795.6	10.7	1909.3
	12.4	228.4	12.4	441.6	12.4	763.4	0.7	101.2	0.7	101.2	0.7	101.2	12.4	1068.5	12.4	1200.6	12.4	1329.1	12.4	1455.0	12.4	1578.7	12.4	1700.9	12.4	1821.6	12.4	1941.3	12.4	2060.0
	14.2	229.3	14.2	448.2	14.2	788.8	1.8	127.3	1.8	127.3	1.8	127.3	14.2	1156.4	14.2	1292.6	14.2	1424.9	14.2	1554.1	14.2	1680.9	14.2	1806.1	14.2	1929.8	14.2	2052.3	14.2	2173.9
	16.0	229.7	16.0	451.9	16.0	805.6	3.6	151.3	3.6	151.3	3.6	151.3	16.0	1229.1	16.0	1367.3	16.0	1501.1	16.0	1631.8	16.0	1760.1	16.0	1886.6	16.0	2011.6	16.0	2135.5	16.0	2258.4
	17.8	229.9	17.8	454.0	17.8	816.6	5.3	167.5	5.3	167.5	5.3	167.5	17.8	1288.6	17.8	1427.1	17.8	1561.2	17.8	1692.1	17.8	1820.7	17.8	1947.4	17.8	2072.8	17.8	2197.1	17.8	2320.5
	19.6	230.0	19.6	455.1	19.6	823.8	7.1	180.0	7.1	180.0	7.1	180.0	19.6	1336.7	19.6	1474.5	19.6	1608.0	19.6	1738.4	19.6	1866.5	19.6	1993.0	19.6	2118.1	19.6	2242.4	19.6	2365.7
	21.3	230.1	21.3	455.8	21.3	828.4	14.2	214.0	14.2	214.0	14.2	214.0	21.3	1375.4	21.3	1511.9	21.3	1644.3	21.3	1773.7	21.3	1901.0	21.3	2026.9	21.3	2151.5	21.3	2275.4	21.3	2398.5
	23.1	230.1	23.1	456.2	23.1	831.4	21.3	236.9	21.3	236.9	21.3	236.9	23.1	1406.3	23.1	1541.1	23.1	1672.1	23.1	1800.5	23.1	1926.9	23.1	2052.0	23.1	2176.0	23.1	2299.3	23.1	2422.0
	24.9	230.1	24.9	456.4	24.9	833.4	28.5	254.5	28.5	254.5	28.5	254.5	24.9	1430.8	24.9	1564.0	24.9	1693.5	24.9	1820.7	24.9	1946.1	24.9	2070.5	24.9	2193.9	24.9	2316.7	24.9	2438.9
	26.7	230.1	26.7	456.5	26.7	834.6	35.6	269.1	35.6	269.1	35.6	269.1	26.7	1450.2	26.7	1581.6	26.7	1709.8	26.7	1835.9	26.7	1960.4	26.7	2084.1	26.7	2206.9	26.7	2329.2	26.7	2451.0
	28.4	230.1	28.4	456.5	28.4	835.5	42.7	281.7	42.7	281.7	42.7	281.7	28.4	1465.5	28.4	1595.3	28.4	1722.2	28.4	1847.2	28.4	1971.1	28.4	2094.0	28.4	2216.3	28.4	2338.2	28.4	2459.8
	30.2	230.1	30.2	456.6	30.2	836.0	49.8	292.7	49.8	292.7	49.8	292.7	30.2	1477.6	30.2	1605.8	30.2	1731.6	30.2	1855.8	30.2	1978.9	30.2	2101.3	30.2	2223.2	30.2	2344.7	30.2	2466.0
	32.0	230.1	32.0	456.6	32.0	836.3	56.9	302.7	56.9	302.7	56.9	302.7	32.0	1487.0	32.0	1614.0	32.0	1738.8	32.0	1862.2	32.0	1984.7	32.0	2106.7	32.0	2228.2	32.0	2349.4	32.0	2470.4
	33.8	230.1	33.8	456.6	33.8	836.5	64.0	311.7	64.0	311.7	64.0	311.7	33.8	1494.4	33.8	1620.2	33.8	1744.2	33.8	1867.0	33.8	1989.0	33.8	2110.6	33.8	2231.8	33.8	2352.8	33.8	2473.5
	35.6	230.1	35.6	456.6	35.6	836.7	71.1	320.0	71.1	320.0	71.1	320.0	35.6	1500.2	35.6	1625.0	35.6	1748.3	35.6	1870.6	35.6	1992.2	35.6	2113.5	35.6	2234.4	35.6	2355.2	35.6	2475.8
							88.9	320.0	88.9	320.0	88.9	320.0																		

Elev. (m)	242.9		241.9		240.9		239.9		238.9		237.9		236.9		235.9		234.9		233.9		232.9		231.9		230.9		229.9		228.9	
Depth (m)	PY at Depth: 17	Load Intensity p (kN/m)	PY at Depth: 18	Load Intensity p (kN/m)	PY at Depth: 19	Load Intensity p (kN/m)	PY at Depth: 20	Load Intensity p (kN/m)	PY at Depth: 21	Load Intensity p (kN/m)	PY at Depth: 22	Load Intensity p (kN/m)	PY at Depth: 23	Load Intensity p (kN/m)	PY at Depth: 24	Load Intensity p (kN/m)	PY at Depth: 25	Load Intensity p (kN/m)	PY at Depth: 26	Load Intensity p (kN/m)	PY at Depth: 27	Load Intensity p (kN/m)	PY at Depth: 28	Load Intensity p (kN/m)	PY at Depth: 29	Load Intensity p (kN/m)	PY at Depth: 30	Load Intensity p (kN/m)	PY at Depth: 31	Load Intensity p (kN/m)
Static	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	1.8	446.0	1.8	474.5	1.8	503.0	1.8	531.5	1.8	560.0	1.8	588.5	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3
	3.6	866.4	3.6	921.0	3.6	975.4	3.6	1029.9	3.6	1084.2	3.6	1138.6	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4
	5.3	1241.5	5.3	1317.7	5.3	1393.8	5.3	1469.7	5.3	1545.4	5.3	1621.1	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8
	7.1	1559.9	7.1	1652.7	7.1	1745.2	7.1	1837.6	7.1	1929.5	7.1	2021.5	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9
	8.9	1818.8	8.9	1923.5	8.9	2027.8	8.9	2131.7	8.9	2235.2	8.9	2338.6	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9
	10.7	2022.3	10.7	2134.9	10.7	2246.9	10.7	2358.5	10.7	2469.7	10.7	2580.7	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1
	12.4	2178.0	12.4	2295.4	12.4	2412.2	12.4	2528.7	12.4	2644.6	12.4	2760.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2
	14.2	2294.7	14.2	2414.8	14.2	2534.4	14.2	2653.5	14.2	2772.2	14.2	2890.7	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3
	16.0	2380.6	16.0	2502.2	16.0	2623.2	16.0	2743.8	16.0	2864.0	16.0	2984.0	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3
	17.8	2443.3	17.8	2565.4	17.8	2687.1	17.8	2808.4	17.8	2929.3	17.8	3050.0	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5
	19.6	2488.5	19.6	2610.8	19.6	2732.6	19.6	2854.2	19.6	2975.3	19.6	3096.3	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0
	21.3	2521.1	21.3	2643.2	21.3	2764.9	21.3	2886.4	21.3	3007.6	21.3	3128.7	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0
	23.1	2544.3	23.1	2666.2	23.1	2787.7	23.1	2909.1	23.1	3030.1	23.1	3151.2	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9
	24.9	2560.9	24.9	2682.5	24.9	2803.8	24.9	2925.0	24.9	3045.9	24.9	3166.8	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5
	26.7	2572.7	26.7	2694.0	26.7	2815.1	26.7	2936.1	26.7	3056.8	26.7	3177.6	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1
	28.4	2581.1	28.4	2702.1	28.4	2823.0	28.4	2943.8	28.4	3064.4	28.4	3185.0	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7
	30.2	2587.0	30.2	2707.9	30.2	2828.6	30.2	2949.2	30.2	3069.7	30.2	3190.2	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7
	32.0	2591.2	32.0	2711.9	32.0	2832.4	32.0	2953.0	32.0	3073.3	32.0	3193.8	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7
	33.8	2594.2	33.8	2714.8	33.8	2835.2	33.8	2955.6	33.8	3075.9	33.8	3196.2	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7
	35.6	2596.3	35.6	2716.8	35.6	2837.1	35.6	2957.4	35.6	3077.6	35.6	3197.9	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0
													88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

Elev. (m)	227.9		226.9		225.9		224.9		223.9		222.9		221.9		220.9		219.9		218.9		217.9		216.9		215.9		214.9		213.9	
Depth (m)	PY at Depth: 32	Load Intensity p (kN/m)	PY at Depth: 33	Load Intensity p (kN/m)	PY at Depth: 34	Load Intensity p (kN/m)	PY at Depth: 35	Load Intensity p (kN/m)	PY at Depth: 36	Load Intensity p (kN/m)	PY at Depth: 37	Load Intensity p (kN/m)	PY at Depth: 38	Load Intensity p (kN/m)	PY at Depth: 39	Load Intensity p (kN/m)	PY at Depth: 40	Load Intensity p (kN/m)	PY at Depth: 41	Load Intensity p (kN/m)	PY at Depth: 42	Load Intensity p (kN/m)	PY at Depth: 43	Load Intensity p (kN/m)	PY at Depth: 44	Load Intensity p (kN/m)	PY at Depth: 45	Load Intensity p (kN/m)	PY at Depth: 46	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3
	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4
	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8
	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9
	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9
	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1
	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2
	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3
	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3
	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5
	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0
	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0
	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9
	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5
	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1
	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7
	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7
	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7
	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7
	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0
	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0

Elev. (m)	212.9		211.9		210.9		209.9		208.9		207.9		206.9		205.9		204.9		203.9		202.9		201.9		200.9		199.9		198.9	
Depth (m)	PY at Depth: 47	Load Intensity p (kN/m)	PY at Depth: 48	Load Intensity p (kN/m)	PY at Depth: 49	Load Intensity p (kN/m)	PY at Depth: 50	Load Intensity p (kN/m)	PY at Depth: 51	Load Intensity p (kN/m)	PY at Depth: 52	Load Intensity p (kN/m)	PY at Depth: 53	Load Intensity p (kN/m)	PY at Depth: 54	Load Intensity p (kN/m)	PY at Depth: 55	Load Intensity p (kN/m)	PY at Depth: 56	Load Intensity p (kN/m)	PY at Depth: 57	Load Intensity p (kN/m)	PY at Depth: 58	Load Intensity p (kN/m)	PY at Depth: 59	Load Intensity p (kN/m)	PY at Depth: 60	Load Intensity p (kN/m)	PY at Depth: 61	Load Intensity p (kN/m)
Static	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3	0.001	2.3
	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4	0.004	11.4
	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8	0.007	22.8
	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9	0.036	47.9
	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9	0.071	56.9
	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1	0.4	85.1
	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2	0.7	101.2
	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3	1.8	127.3
	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3	3.6	151.3
	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5	5.3	167.5
	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0	7.1	180.0
	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0	14.2	214.0
	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9	21.3	236.9
	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5	28.5	254.5
	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1	35.6	269.1
	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7	42.7	281.7
	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7	49.8	292.7
	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7	56.9	302.7
	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7	64.0	311.7
	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0	71.1	320.0
	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0	88.9	320.0

P-Y Curves
Bradford Bypass: Highway 400 E-S Ramp (East Abutment)

Pipe Pile 355.6mm x 12.7mm
Assuming Underside of Pile Cap at Elev. 258.4 m, 63.4 m long
P loads at each depth are in metres

March 2026

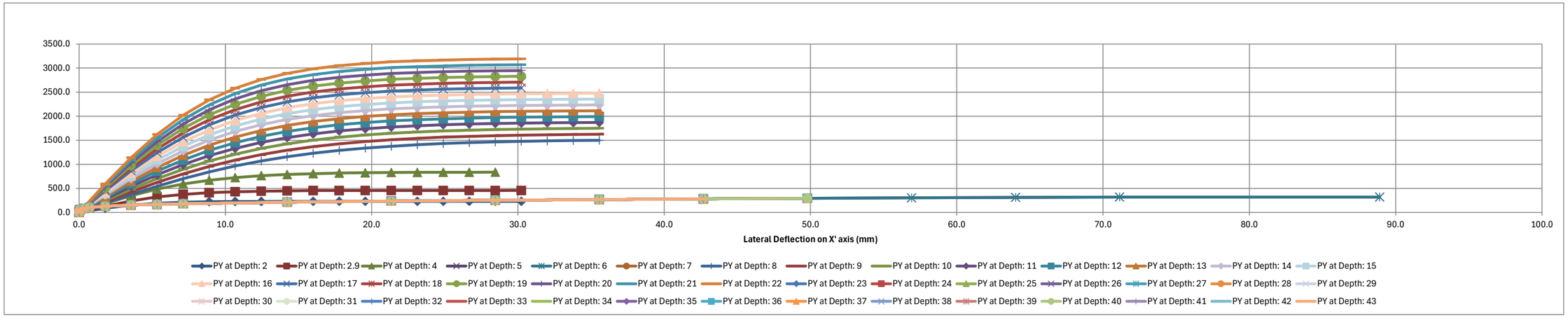
Elev. (m)	197.9		196.9		195.9																							
Depth (m)	PY at Depth: 62	Load Intensity p (kN/m)	PY at Depth: 63	Load Intensity p (kN/m)	PY at Depth: 64	Load Intensity p (kN/m)																						
Static	0.000	0.0	0.000	0.0	0.000	0.0																						
	0.001	2.3	0.001	2.3	0.001	3.6																						
	0.004	11.4	0.004	11.4	0.003	18.2																						
	0.007	22.8	0.007	22.8	0.006	36.4																						
	0.036	47.9	0.036	47.9	0.028	95.7																						
	0.071	56.9	0.071	56.9	0.057	113.8																						
	0.4	85.1	0.4	85.1	0.3	170.2																						
	0.7	101.2	0.7	101.2	0.6	202.4																						
	1.8	127.3	1.8	127.3	1.4	254.5																						
	3.6	151.3	3.6	151.3	2.8	302.7																						
	5.3	167.5	5.3	167.5	4.3	335.0																						
	7.1	180.0	7.1	180.0	5.7	359.9																						
	14.2	214.0	14.2	214.0	11.4	428.0																						
	21.3	236.9	21.3	236.9	17.1	473.7																						
	28.5	254.5	28.5	254.5	22.8	509.0																						
	35.6	269.1	35.6	269.1	28.5	538.2																						
	42.7	281.7	42.7	281.7	34.1	563.3																						
	49.8	292.7	49.8	292.7	39.8	585.5																						
	56.9	302.7	56.9	302.7	45.5	605.4																						
	64.0	311.7	64.0	311.7	51.2	623.4																						
	71.1	320.0	71.1	320.0	56.9	640.1																						
	88.9	320.0	88.9	320.0	71.1	640.1																						

The following assumptions were made in the analysis:

1. The analysis was completed for a vertical element (i.e. no inclination)
2. These curves are for static loading. Seismic effects have not been included.
3. The effects of construction disturbance is not considered.

NOTES:

1. **The p-y data provided is unfactored**. Lateral resistance or deflection calculated based on these parameters should be factored using the geotechnical resistance factors (Øgu and Øgs) provided in the CHBDC
2. If lateral spacing between an adjacent structural element is less than four equivalent diameters, suitable reduction factors based on center to center spacing should be applied based on tables of the CHBDC



THURBER

APPENDIX L

Stability Figures

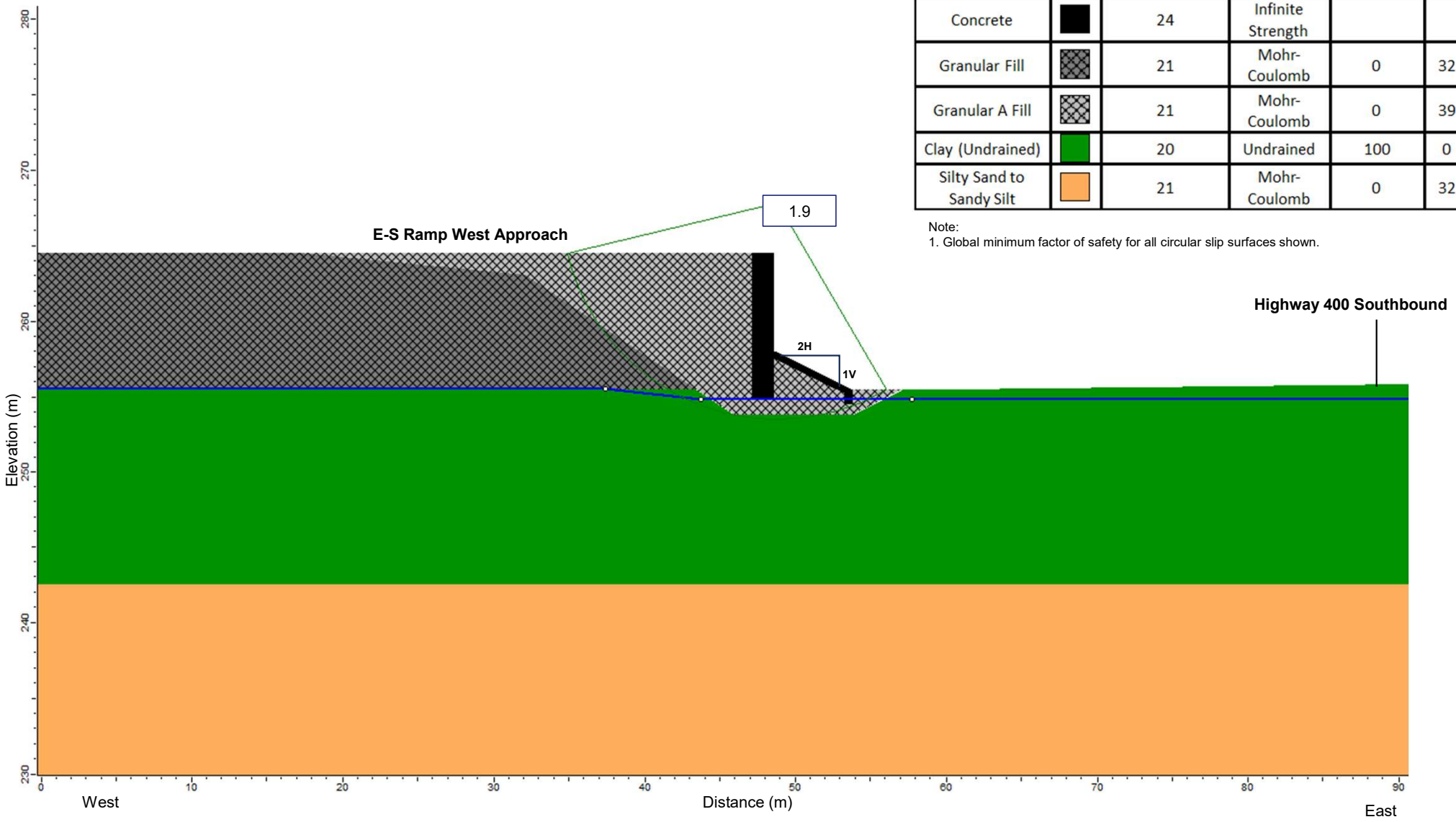
THURBER

Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Short Term Condition
Front Slope at West Abutment

Figure L1

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		21	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Clay (Undrained)		20	Undrained	100	0
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.



Date: March 2026
Thurber Project: 48856

Analysis By: ZE / ACK
Checked By: CN

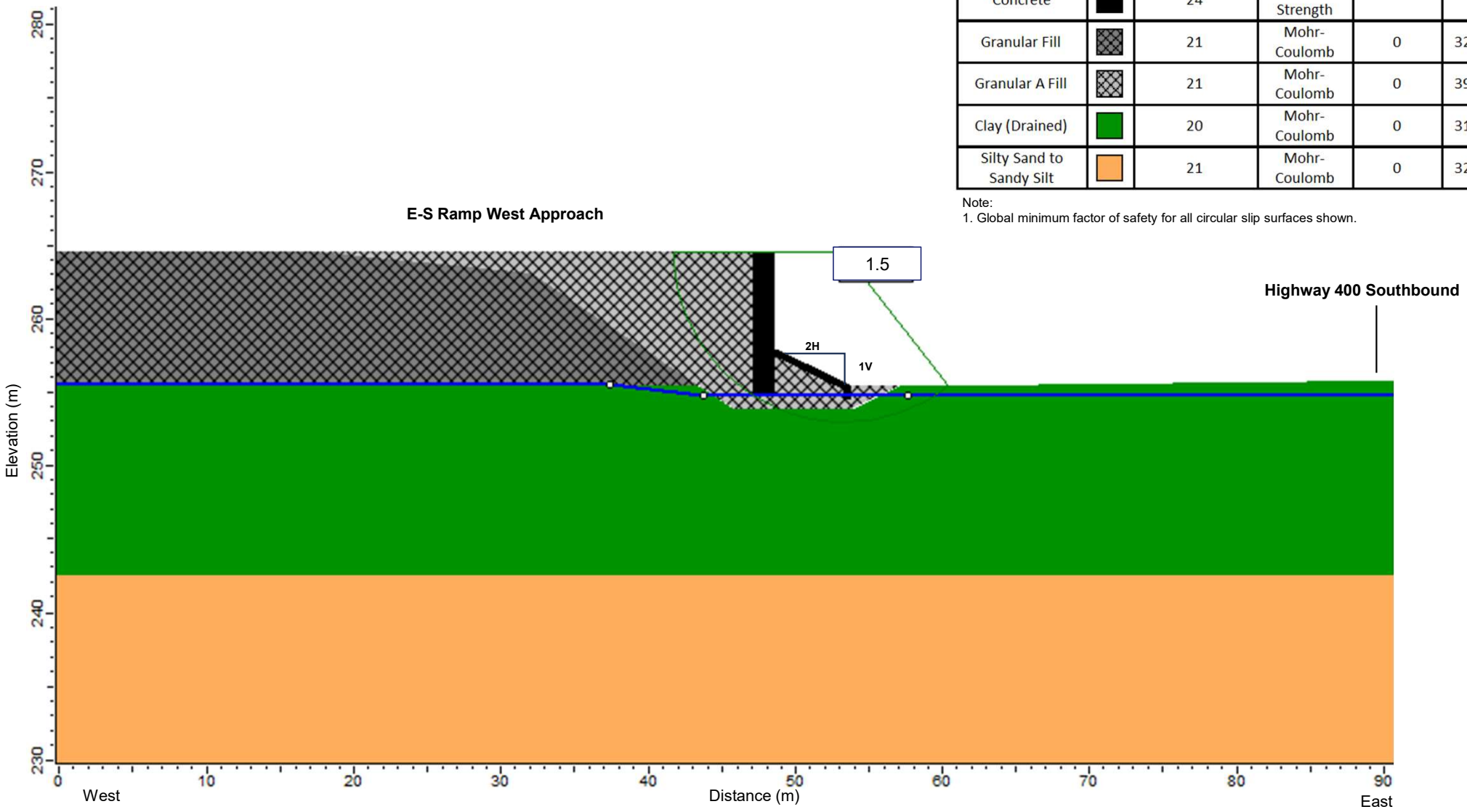
THURBER

Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Long Term Condition
Front Slope at West Abutment

Figure L2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		21	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Clay (Drained)		20	Mohr-Coulomb	0	31
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.



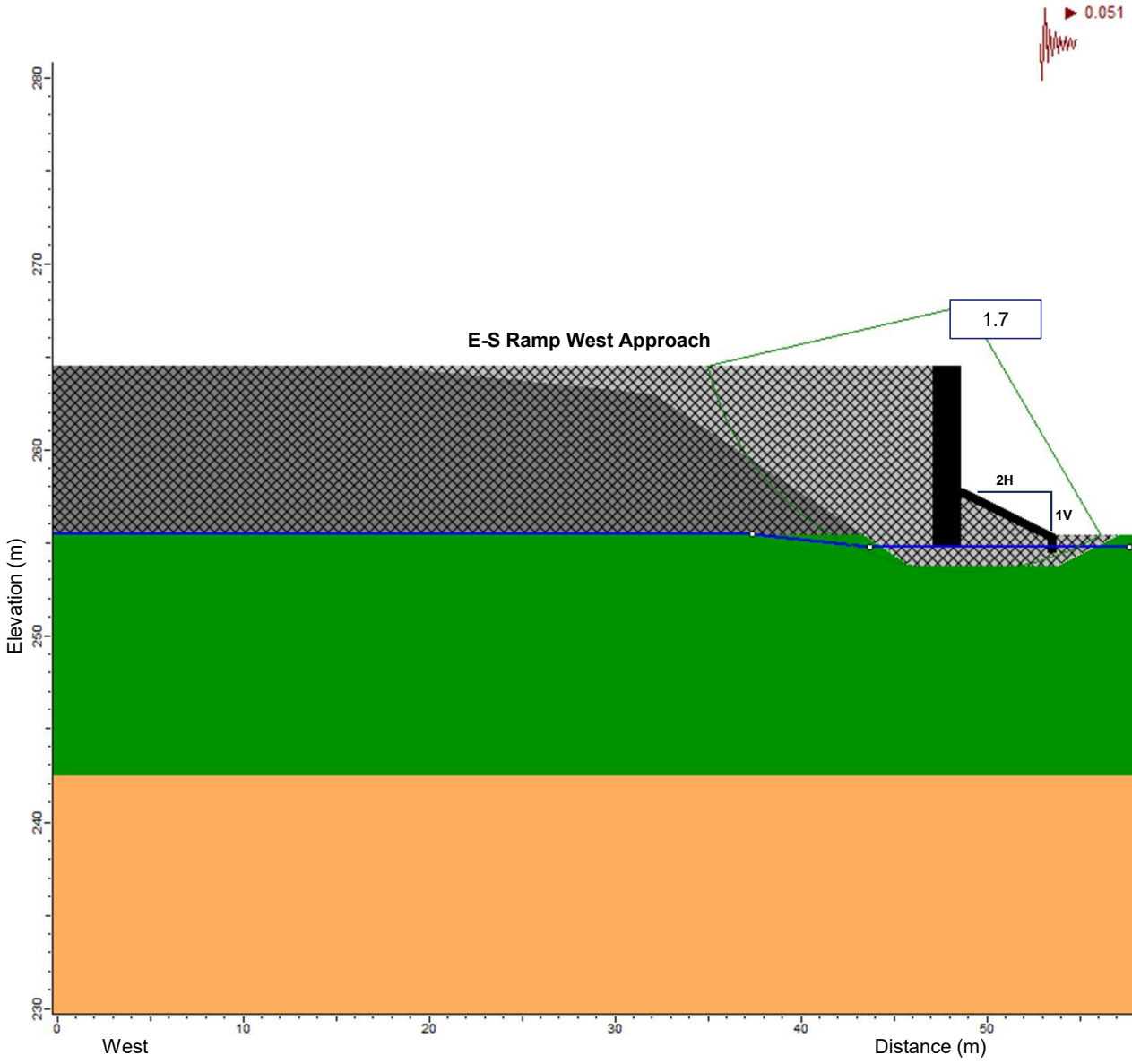
Date: March 2026
Thurber Project: 48856

Analysis By: ZE / ACK
Checked By: CN

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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Seismic Condition
Front Slope at West Abutment

Figure L3



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		21	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Clay (Undrained)		20	Undrained	100	0
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.

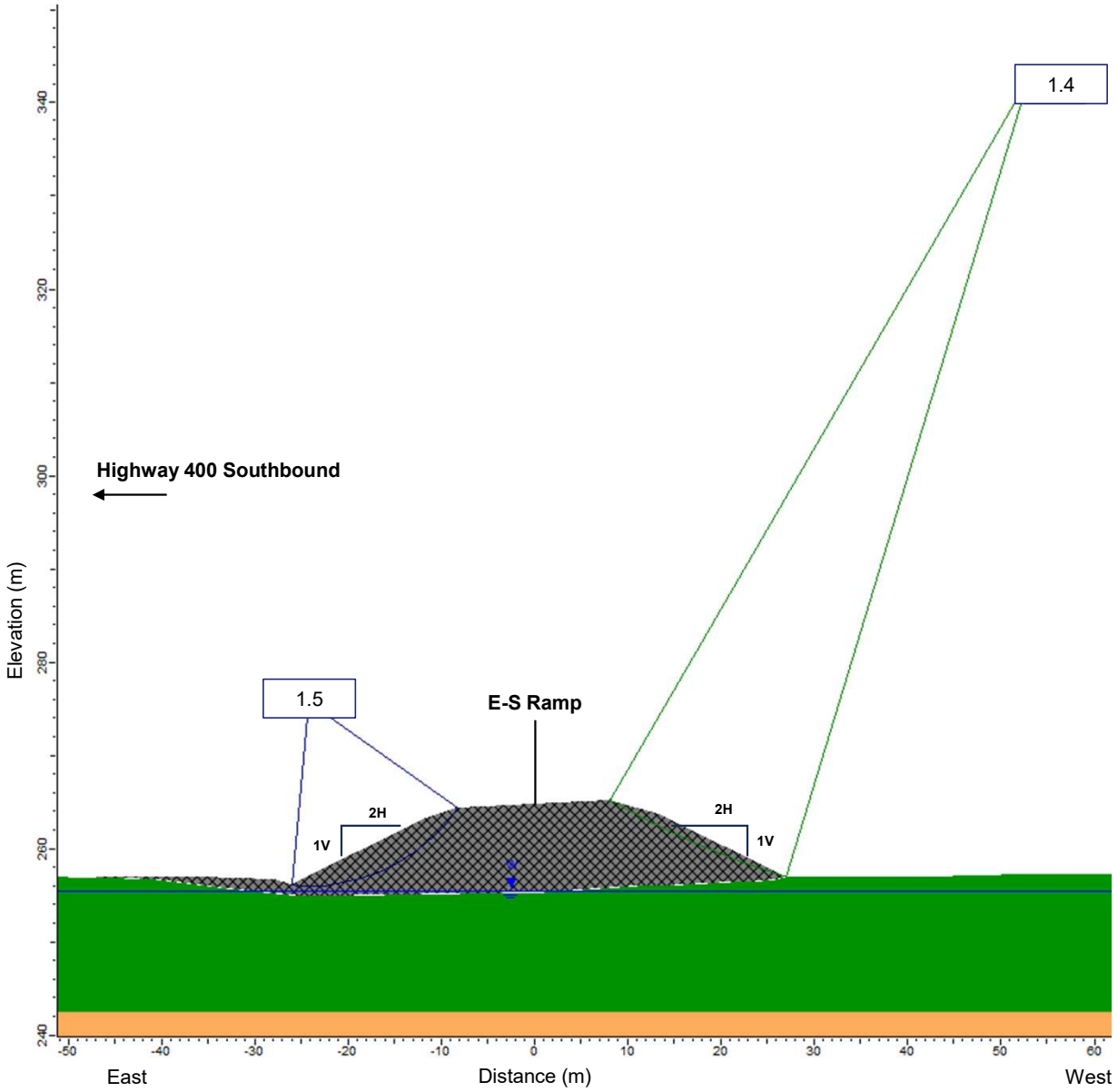
Date: March 2026
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Checked By: CN

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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Short Term Condition
East and West Slopes at West Approach (STA 11+957)

Figure L4



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		20	Mohr-Coulomb	0	32
Clay (Undrained)		20	Undrained	100	0
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.

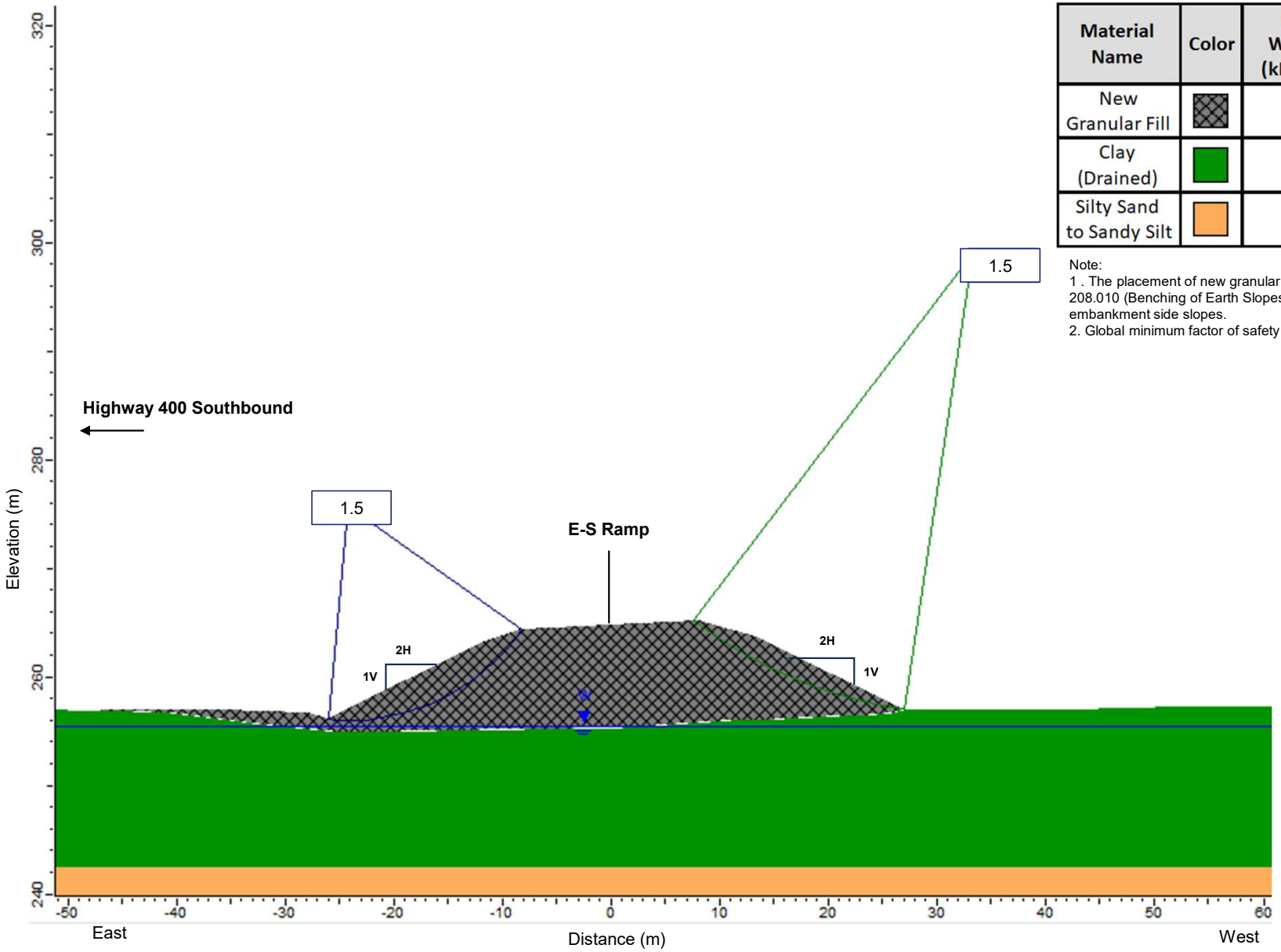
Date: March 2026
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Analysis By: ZE / ACK
Checked By: CN

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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Long Term Condition
East and West Slopes at West Approach (STA 11+957)

Figure L5



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		20	Mohr-Coulomb	0	32
Clay (Drained)		20	Mohr-Coulomb	0	31
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.

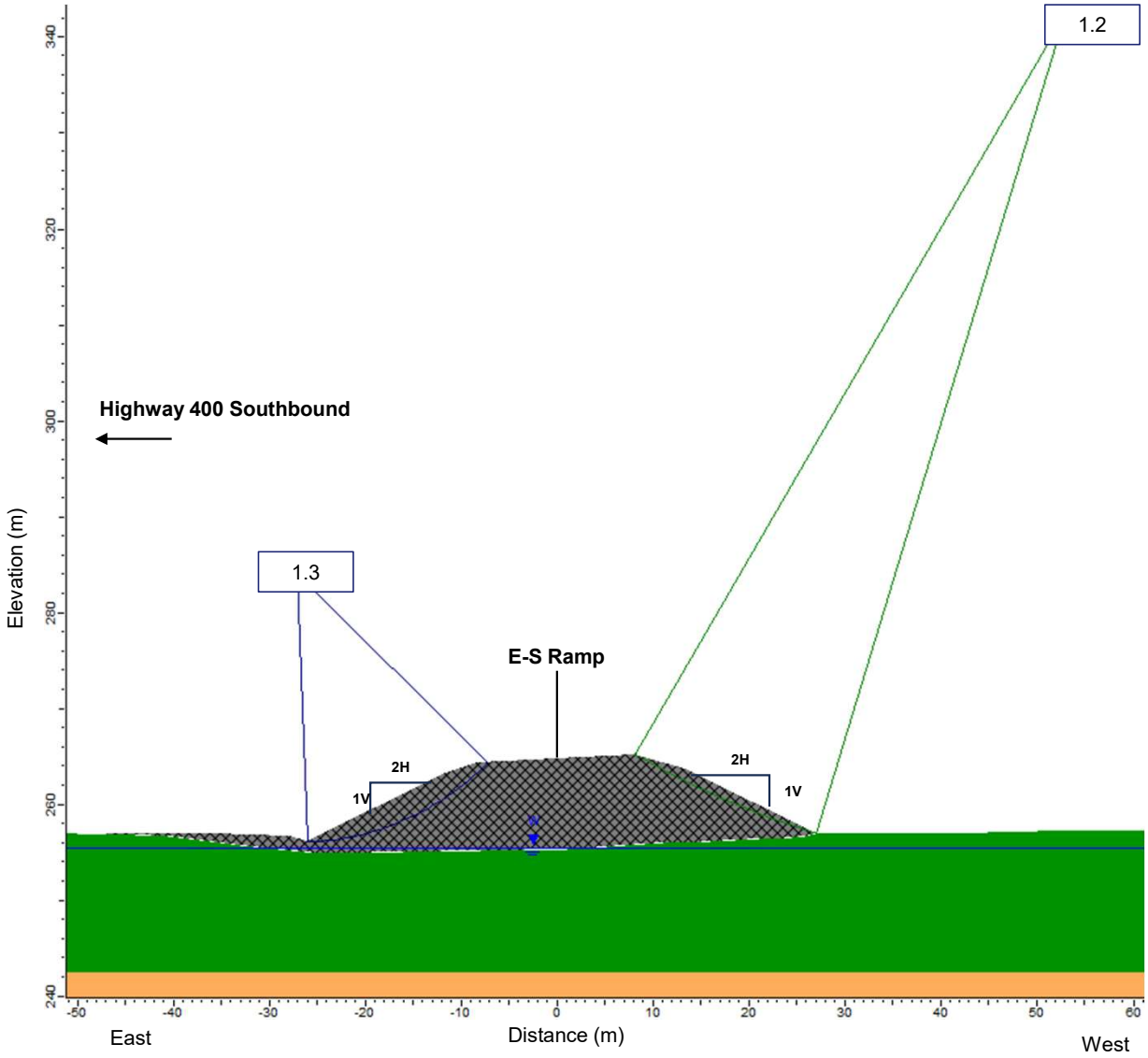
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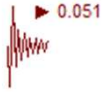
Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Seismic Condition
East and West Slopes at West Approach (STA 11+957)

Figure L6



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		20	Mohr-Coulomb	0	32
Clay (Seismic)		20	Undrained	90	0
Silty Sand to Sandy Silt		21	Mohr-Coulomb	0	32

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.



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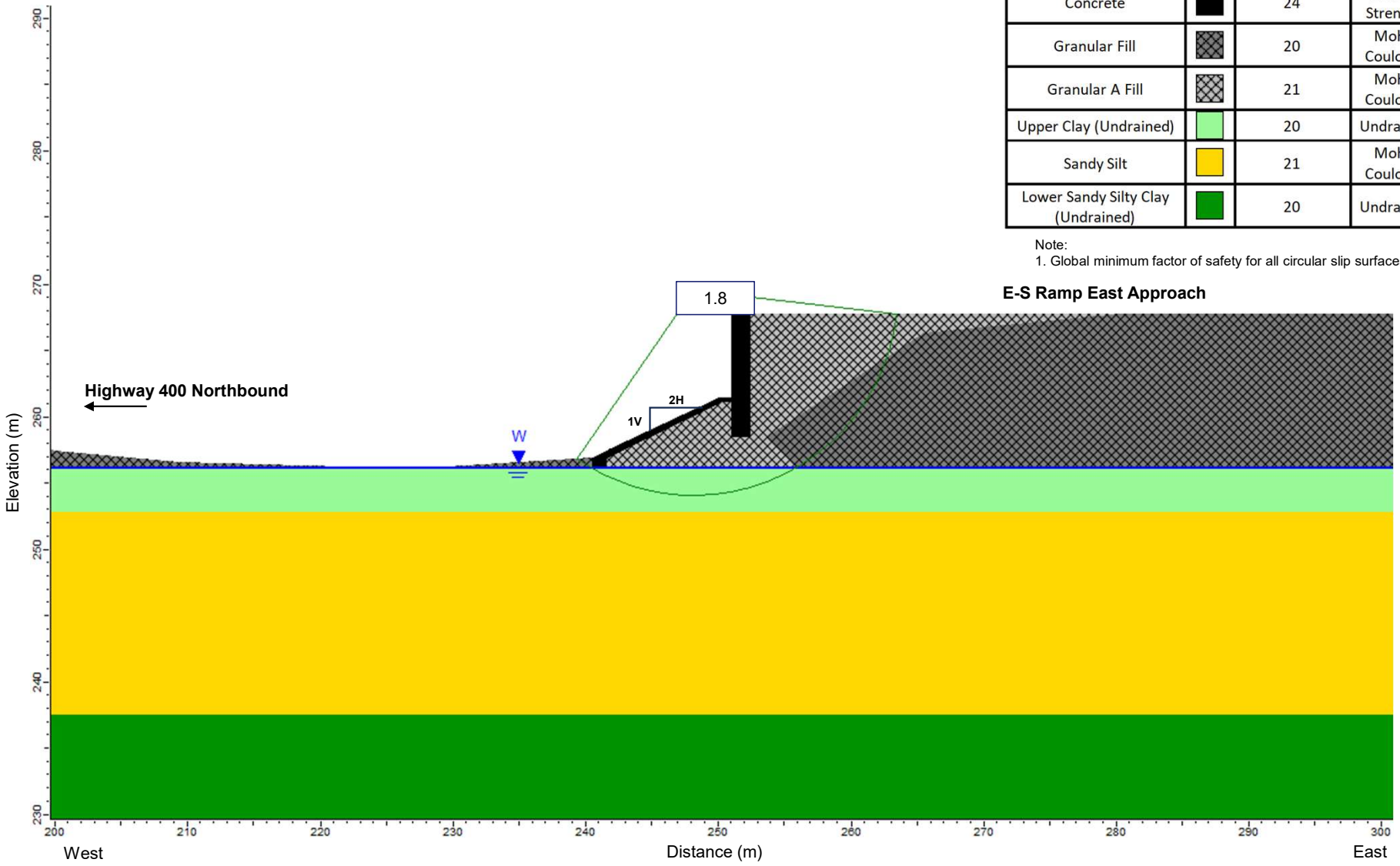
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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Short Term Condition
Front Slope at East Abutment

Figure L7

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		20	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Upper Clay (Undrained)		20	Undrained	90	0
Sandy Silt		21	Mohr-Coulomb	0	32
Lower Sandy Silty Clay (Undrained)		20	Undrained	100	0

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.



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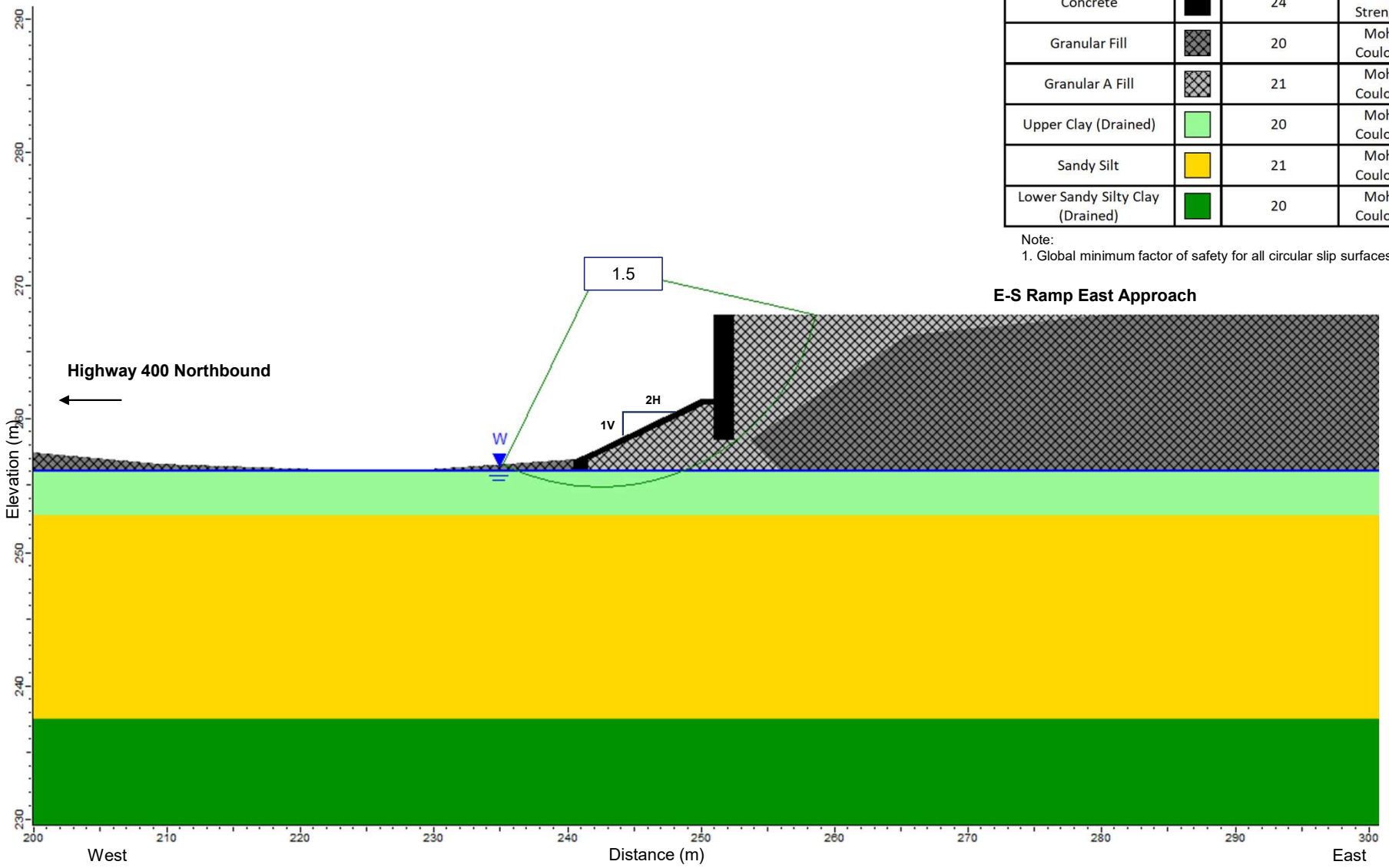
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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Long Term Condition
Front Slope at East Abutment

Figure L8

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		20	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Upper Clay (Drained)		20	Mohr-Coulomb	0	32
Sandy Silt		21	Mohr-Coulomb	0	32
Lower Sandy Silty Clay (Drained)		20	Mohr-Coulomb	0	31

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.



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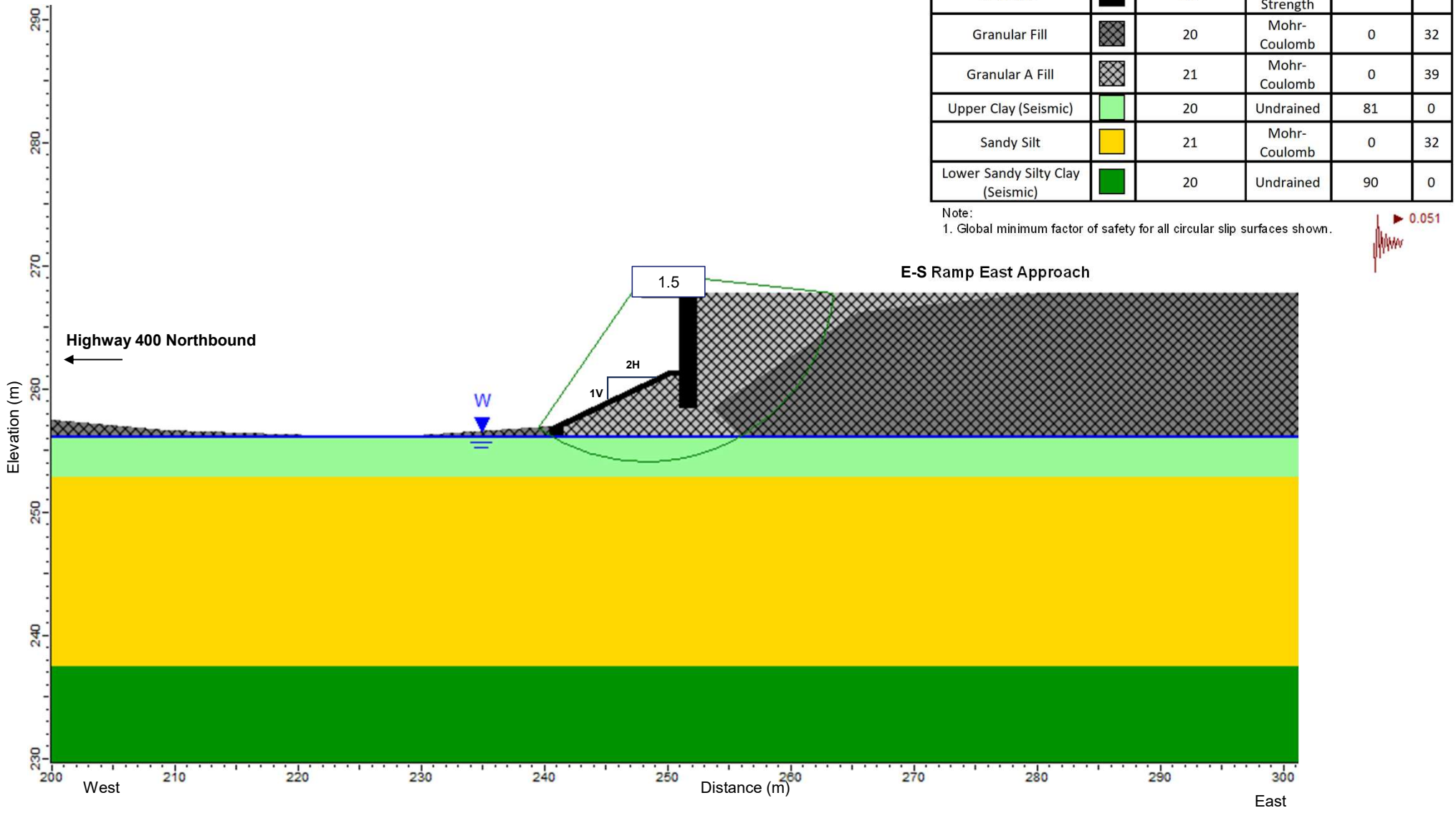
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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Seismic Condition
Front Slope at East Abutment

Figure L9

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Concrete		24	Infinite Strength		
Granular Fill		20	Mohr-Coulomb	0	32
Granular A Fill		21	Mohr-Coulomb	0	39
Upper Clay (Seismic)		20	Undrained	81	0
Sandy Silt		21	Mohr-Coulomb	0	32
Lower Sandy Silty Clay (Seismic)		20	Undrained	90	0

Note:
1. Global minimum factor of safety for all circular slip surfaces shown.



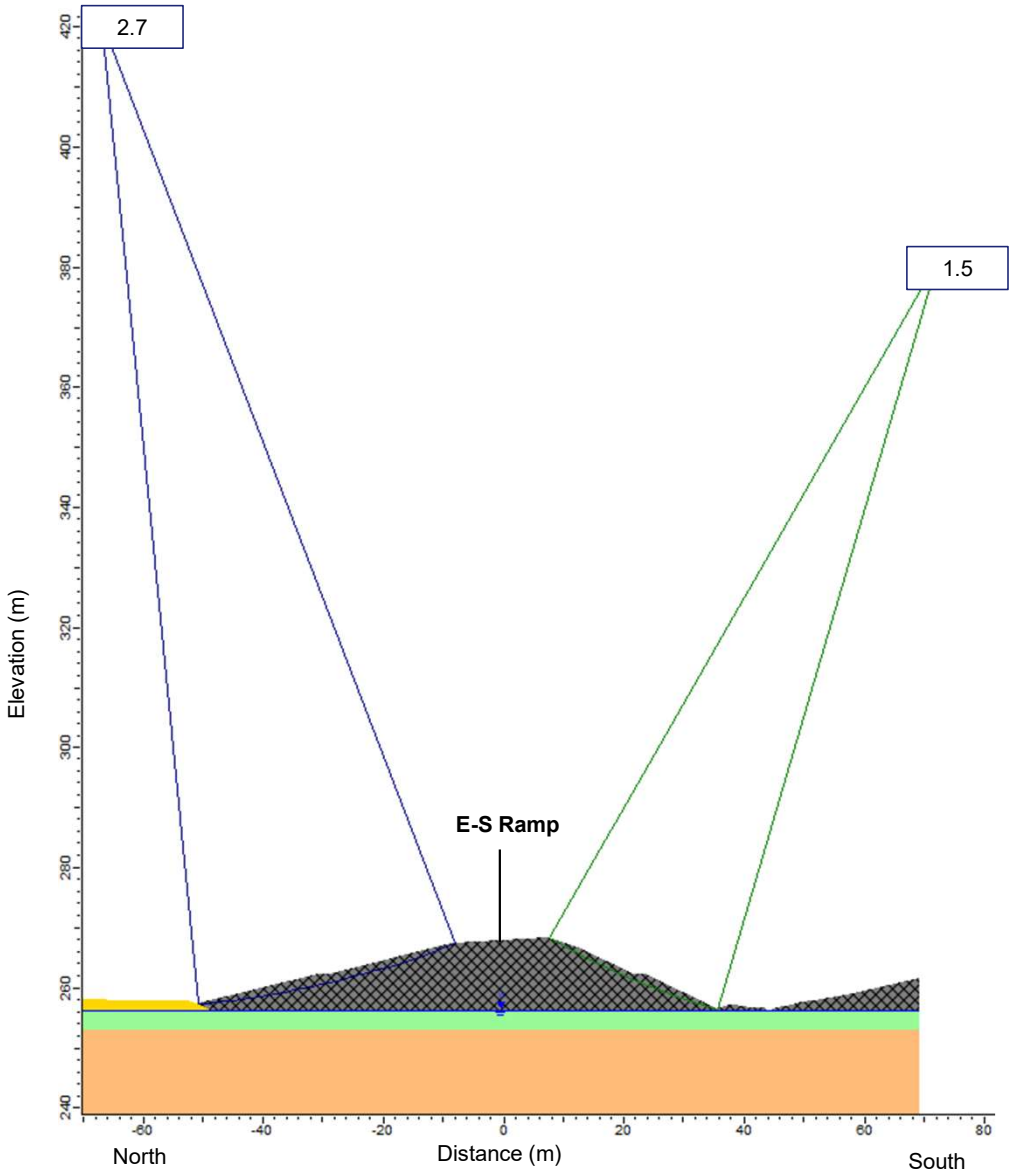
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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Short Term Condition
North and South Slopes at East Approach (STA 11+720)

Figure L10



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		21	Mohr-Coulomb	0	32
Silty Sand		20	Mohr-Coulomb	0	32
Silty Sand Till		20	Mohr-Coulomb	0	32
Upper Clay (Undrained)		20	Undrained	90	0
Sandy Silty Clay (Undrained)		20	Undrained	100	0

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.

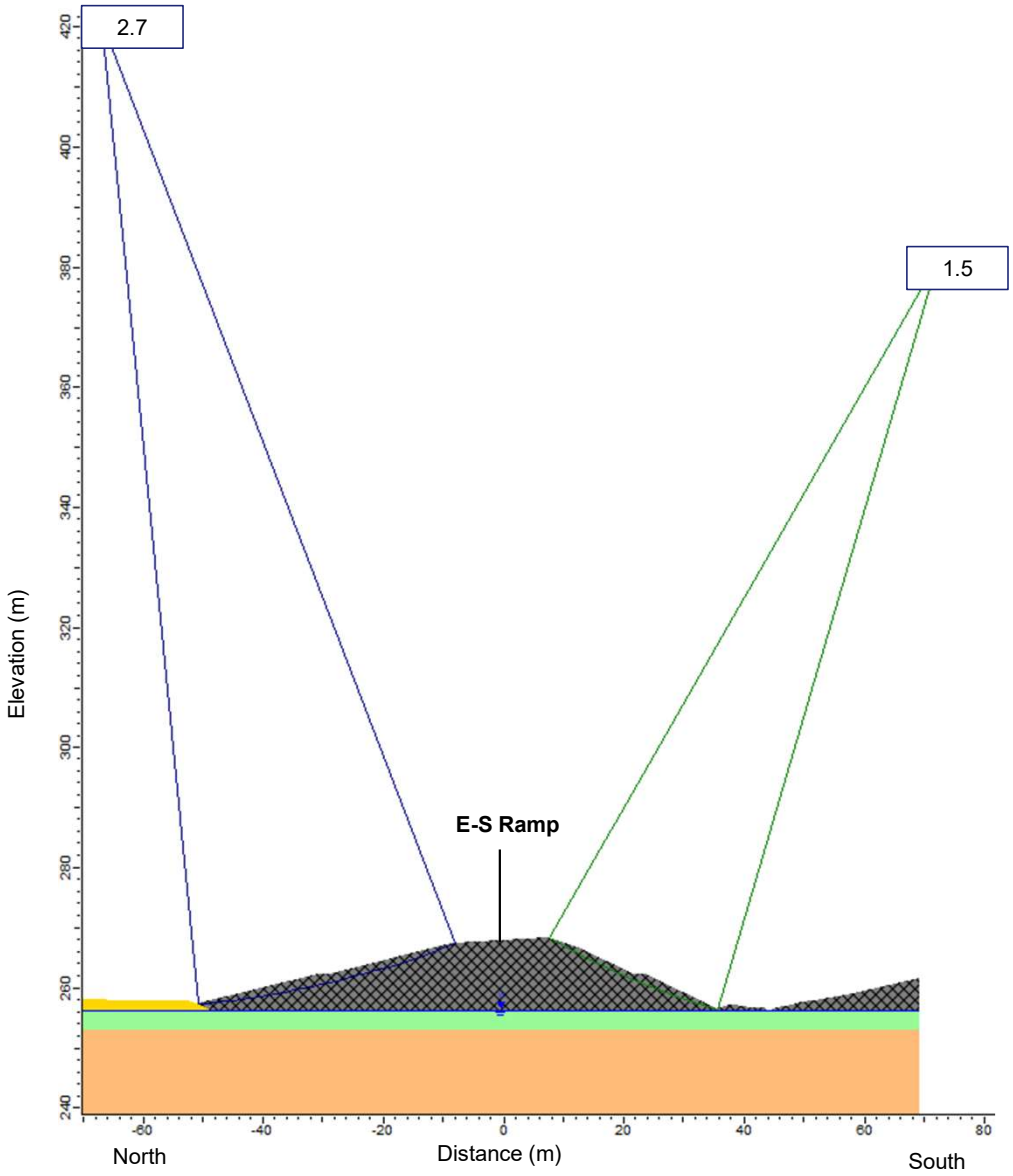
Date: March 2026
Thurber Project: 48856

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Checked By: CN

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Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Long Term Condition
North and South Slopes at East Approach (STA 11+720)

Figure L11



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		21	Mohr-Coulomb	0	32
Silty Sand		20	Mohr-Coulomb	0	32
Silty Sand Till		20	Mohr-Coulomb	0	32
Upper Clay (Drained)		20	Mohr-Coulomb	0	32
Sandy Silty Clay (Drained)		20	Mohr-Coulomb	0	31

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.

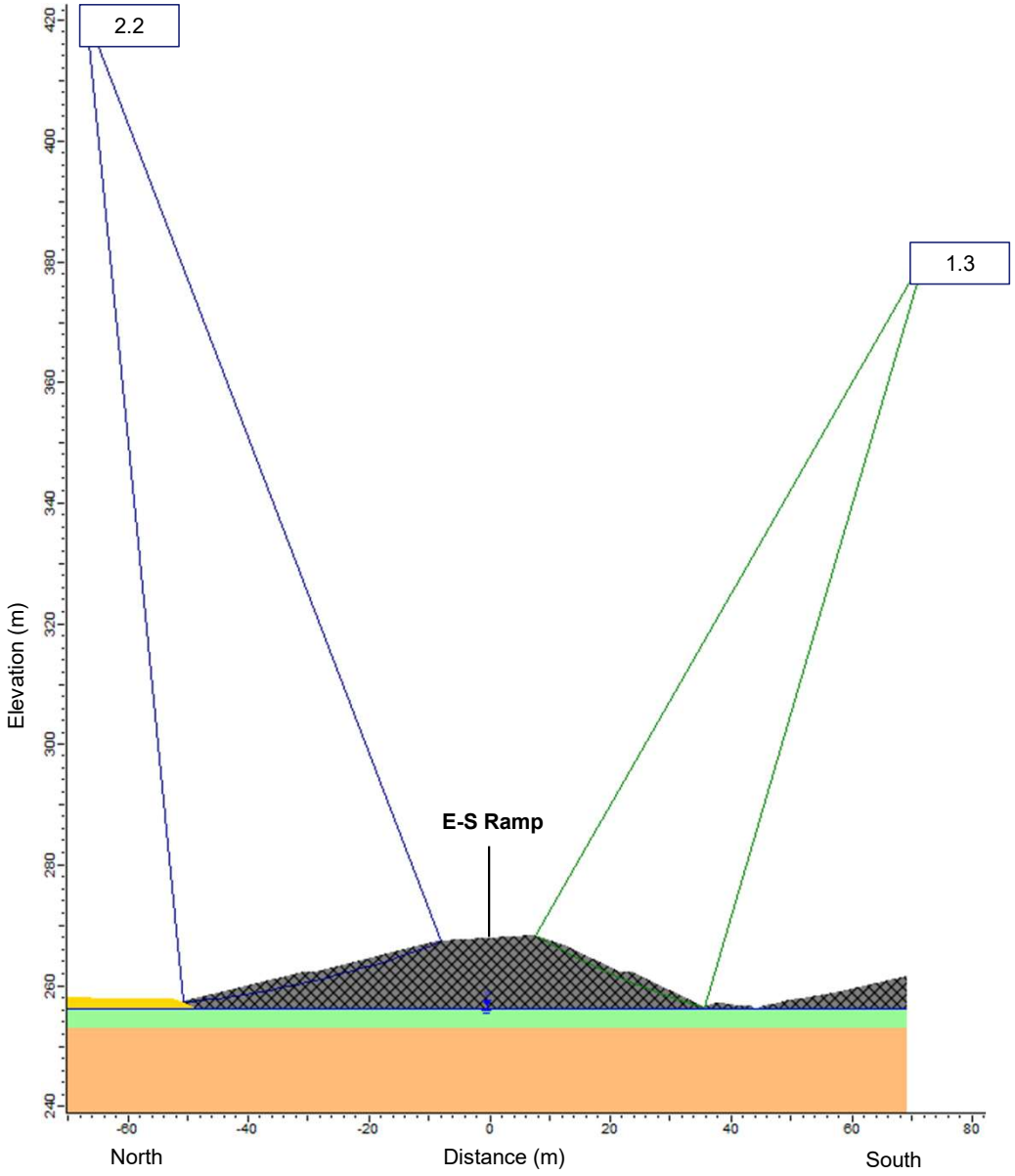
Date: March 2026
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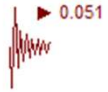
Bradford Bypass E-S Ramp Structure over Highway 400
Global Slope Stability – Seismic Condition
North and South Slopes at East Approach (STA 11+720)

Figure L12



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
New Granular Fill		21	Mohr-Coulomb	0	32
Silty Sand		20	Mohr-Coulomb	0	32
Silty Sand Till		20	Mohr-Coulomb	0	32
Upper Clay (Seismic)		20	Undrained	81	0
Sandy Silty Clay (Seismic)		20	Undrained	90	0

Note:
1 . The placement of new granular fill should be carried out in accordance with OPSD 208.010 (Benching of Earth Slopes) to integrate the new granular fill into the existing embankment side slopes.
2. Global minimum factor of safety for all circular slip surfaces shown.



Date: March 2026
Thurber Project: 48856

Analysis By: ZE / ACK
Checked By: CN