

**FOUNDATION INVESTIGATION REPORT
PAYS PLAT RIVER BRIDGE REPLACEMENT
HIGHWAY 17, DISTRICT OF THUNDER BAY, ONTARIO
G.W.P. 6071-09-00, SITE #48C-20**

Geocres Number: 42D-38

Report to

MMM Group Limited

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained during a foundation investigation conducted at the site of the proposed replacement of the Pays Plat River Bridge on Highway 17, in the Thunder Bay District, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, record of borehole sheets, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited (MMM), under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

A foundation investigation was previously carried out at the site for the existing Pays Plat River and Pays Plat Creek bridges. The factual data from the archive foundation report (Foundation Investigation, Pays Plat River and Creek Bridge Sites; Trow, Soderman and Associates, February 12, 1958; Geocres No. 42D-008) is provided in Appendix D for information purposes.

2 SITE DESCRIPTION

The bridge site is located on Highway 17 approximately 56 km southeast of Nipigon or 6.0 km northwest of Rossport. The existing bridge is a six span structure with a total span length of 73.2 m and a width of 11.4 m (including a steel deck sidewalk added along the north side) as indicated on the contract drawings prepared for bridge rehabilitation in July 1998. The existing approach embankments vary in height from 4 m at the abutments to 2-3 m in a distance of approximately 15 m away from the abutments.

The Pays Plat River flows southerly into the Lake Superior through a broad flat valley. The land surrounding the site is treed with residences located to the east of the bridge. A small church and cemetery are located to the north of the west approach, and a sheet pile wall lines the river's edge below the cemetery. At the bridge location, Highway 17 travels in a predominantly northwest to southeast

direction along the north edge of Lake Superior. Photographs of the bridge and surrounding area are presented in Appendix C.

The site lies within the physiographic region known as the Wawa Subprovince of the Superior Province of the Canadian Shield. Based on Ontario Geological Survey (OGS) Map 2518, titled “Surficial Geology of Northern Ontario”, dated 1987, the site is located in an area of “the mainly glaciofluvial deposits, including shallow water, glaciolacustrine and glaciomarine deposits”. Based on OGS Map 2545, titled “Bedrock Geology of Ontario”, dated 1991, the bedrock is of the Archean age and consists of intrusive rocks, mainly massive to foliated granodiorite and granite.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at this site were carried out in two stages. Between June 21 and July 6, 2013, four boreholes designated Boreholes PPR-01 to PPR-04 were drilled at the abutments and approaches for the then-proposed rehabilitation of the bridge, and were advanced to depths ranging from 10.1 to 32.1 m below existing highway grade. Subsequently between April 21 and 25, 2015, Boreholes PPR-05 and PPR-06 were drilled through the bridge deck to depths of 33.7 and 33.0 m near the proposed pier locations for the replacement bridge. Dynamic cone penetration tests were advanced approximately 4 m west and east of Boreholes PPR-02 and PPR-03, respectively, to supplement the sampled borehole information.

Details of the drilling program, including borehole locations, drilling depths, and completion details are summarized in Table 3.1 below.

Table 3.1 – Details of Boreholes

Location	Boreholes	Drilling and Coring Depth/ Base of Hole Elevation (m)	Completion Details
West Approach	PPR-01	15.8 / 170.7	Borehole backfilled with bentonite holeplug to 0.6 m, concrete mix to 0.1 m then asphalt to surface.
West Abutment	PPR-02	27.6 / 158.8	Standpipe piezometer consisting of 19 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen installed.
West Pier	PPR-05	33.7* / 152.8	Borehole backfilled with bentonite holeplug and cuttings to river bottom. Bridge deck patched with quickset ready mix concrete.
East Pier	PPR-06	33.0* / 153.5	Borehole backfilled with bentonite holeplug and cuttings to river bottom. Bridge deck patched with quickset ready mix concrete.
East Abutment	PPR-03	32.1 / 154.5	Standpipe piezometer consisting of 19 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen installed.
East Approach	PPR-04	10.1 / 176.5	Borehole backfilled with bentonite holeplug to 0.6 m, concrete to 0.1 m then asphalt cold patch to surface.

* Depth below bridge deck surface.

The locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing included in Appendix E.

All boreholes were advanced using a CME55 truck-mounted drill rig in combination with hollow stem augers and NW casing/coring methods. Samples of the encountered soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear tests were conducted in cohesive soils for determination of undrained shear strengths using MTO Standard “N” size vane and a calibrated torque wrench.

A member of Thurber’s technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber’s laboratory for further examination and testing. The ground surface elevations at the borehole locations were obtained from the drawings provided by MMM.

Groundwater conditions in the open boreholes were observed during the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen were installed in Boreholes PPR-02 and PPR-03. Following the final water level reading, the piezometers were decommissioned in general accordance with MOE Regulation 903.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets included in Appendix A. Selected samples were also subjected to grain size analysis and Atterberg Limits testing, and the results of this testing program are summarized on the Record of Borehole sheets in Appendix A, and are shown on the figures included in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A consisting of details of the encountered soils. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and observations during drilling; therefore they represent transitions between soil types rather than exact geological boundaries. The subsurface conditions may vary between and beyond the borehole locations. The model of the soil stratigraphy is illustrated on the “Borehole Locations and Soil Strata” drawing in Appendix E.

An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the subsurface stratigraphy encountered below the existing embankment fill and riverbed at the site consists of cohesionless glaciofluvial sands and silts overlying a cohesive glaciolacustrine clay deposit, underlain by a lower cohesionless silt layer and sand to sand and gravel deposits. Bedrock was encountered in one borehole drilled in the river channel.

Descriptions of the individual strata are presented below.

5.1 Asphalt and Concrete

Asphalt pavement was encountered in Boreholes PPR-01 to PPR-04. The thickness of the asphalt ranged from 65 to 115 mm. Boreholes PPR-02 and PPR-03 were advanced through the approach slabs and encountered 200 and 330 mm of concrete beneath the asphalt layer. Boreholes PPR-05 and PPR-06, which were advanced through the bridge deck, encountered 300 mm of concrete.

5.2 Embankment Fill

Embankment fill was encountered below the asphalt and approach slabs in Boreholes PPR-01 to PPR-04. The fill consists of gravelly sand with occasional cobbles. In Boreholes PPR-02 and PPR-03, located in the immediate vicinity of the abutments, the fill extended to depths of 2.7 and 4.0 m (Elev. 183.7 and 182.6), respectively. In Boreholes PPR-01 and PPR-04, located approximately 15 m away from the abutments, the fill extended to depths of 1.2 and 3.0 m (Elev. 185.3 and 183.6).

SPT 'N' values recorded in the embankment fill ranged from 19 to 86 blows per 0.3 m penetration, indicating a compact to very dense relative density. One value of 100 blows for 0.125 m penetration was also obtained. The higher SPT 'N' values are probably indicative of the presence of cobbles.

Moisture contents of the fill materials ranged from 2 to 25%, typically 10 to 20%.

The results of grain size analyses conducted on fill samples are provided on the Record of Borehole sheets in Appendix A, and are illustrated in Figure B1 of Appendix B. The results are also summarized below:

Gravel %	20 to 46
Sand %	49 to 70
Silt and Clay %	5 to 10

5.3 Sands and Silts

A cohesionless deposit of sands and silts was encountered in all boreholes either below the embankment fill or below the river channel. The deposit typically consisted of silty sand to sand and silt, however the composition locally varied from sand, trace silt, to silt, trace sand. In Borehole PPR-06 advanced in the river, a 0.5 m thick layer of organic silt and sand was encountered on the river bottom.

The thickness of the deposit ranged from 8.0 to 9.3 m, with the lower boundary sloping down from 9.8 m depth (Elev. 176.7) in Borehole PPR-01 on the west side of the river to 13.3 m depth (Elev. 173.3) in Borehole PPR-03 on the east side of the river. The sand and silt was interrupted by a 1.6 m thick layer of silty clay below 7.2 m depth in Borehole PPR-01. Borehole PPR-04 located on the east approach was terminated in this deposit at a depth of 10.1 m (Elev. 176.5).

SPT 'N' values recorded in this deposit varied from zero (Weight of Rod to Weight of Hammer) to 24 blows per 0.3 m of penetration, indicating a very loose to compact relative density. Natural moisture contents ranged between 18% and 58% with the majority of values being between 22% and 35%.

The results of grain size analyses conducted on samples of the upper cohesionless deposit are provided on the Record of Borehole sheets in Appendix A, and are illustrated in Figure B2 and B3 of Appendix B. The results of the grain size analyses are summarized below:

	<u>Silt</u>	<u>Silty Sand/Sand & Silt</u>	<u>Sand</u>
Gravel %	0	0	0 to 3
Sand %	19	47 to 67	76 to 91
Silt %	72	29 to 45	
Clay %	9	4 to 9	6 to 24

5.4 Silty Clay to Clay

A layer of grey to greyish brown silty clay to clay underlies the upper cohesionless deposit in all boreholes, except in Borehole PPR-04. The deposit, where fully penetrated, was between 8.0 and 11.6 m thick with the lower boundary encountered at depths of 18.7 to 24.4 m (Elev. 167.7 to 162.1). Borehole PPR-01 was terminated in this deposit at 15.8 m depth (Elev. 170.7). Stratification, varving and occasional sand and silt seams were noted in this deposit.

SPT 'N' values recorded in the silty clay/clay varied between zero blows per 0.3 m penetration (Weight of Rod to Weight of Hammer) to 5 blows per 0.3 m of penetration. Field vane shear tests (VST) measured undrained shear strengths ranging from 22 to 48 kPa, with the majority of values between 25 and 30 kPa. Based on the SPT and VST data, the consistency of the deposit varied from soft to firm.

The sensitivity of the deposit, calculated as a ratio of undisturbed strength to remoulded strength, ranged from 2 to 5.5, however typically being 2 to 3, suggesting that the silty clay/clay is of normal sensitivity.

The results of grain size analyses conducted on samples of the clay are provided on the Record of Borehole sheets in Appendix A, and are illustrated in Figures B4 and B5 of Appendix B. The results are summarized as follows:

Gravel %	0
Sand %	0 to 5
Silt %	19 to 60
Clay %	35 to 81

The results of Atterberg Limits testing conducted on samples of the silty clay/clay are provided on the Record of Borehole sheets in Appendix A and are illustrated on the Plasticity Charts

(Figures B8 and B9). Liquid limits typically ranged from 41 to 55 and the plasticity index typically ranged from 21 to 32, indicating medium to high plasticity of the deposit. Single samples obtained liquid limits of 33 and 65, and corresponding plasticity indices of 13 and 39, indicating respective low and high plasticity.

Natural moisture contents of the silty clay ranged from 23% to 55 %, typically 35% to 55%.

5.5 Lower Silt

In Boreholes PPR-02, PPR-03, PPR-05 and PPR-06, the silty clay/clay is underlain by a layer of silt with trace to some clay and sand. The silt layer was 2.0 to 6.4 m thick, and extended to depths ranging from 20.7 to 28.7 m (Elev. 165.7 to 157.8).

SPT ‘N’ values recorded in the silt layer ranged from 7 to 23 blows per 0.3 m penetration, indicating a loose to compact relative density. Natural moisture contents were measured to be between 19 and 32%.

The results of grain size analyses conducted on samples of the deposit are provided on the Record of Borehole sheets in Appendix A and are plotted in Figure B6 of Appendix B. The results are summarized below:

Gravel %	0
Sand %	0 to 11
Silt %	74 to 82
Clay %	8 to 26

5.6 Silty Sand to Sand and Gravel

A deposit of grey/brown silty sand to sand and gravel was encountered below the lower silt layer in Boreholes PPR-02, PPR-03, PPR-05 and PPR-06. Typically this deposit becomes coarser with depth, comprising sand to silty sand with trace to some gravel in the upper part, and sand and gravel with trace silt below this upper zone. Occasional cobbles and boulders were noted in this deposit.

The deposit was fully penetrated in Borehole PPR-05, where it was 1.9 m thick and extended to bedrock at 30.6 m depth (Elev. 155.9). Boreholes PPR-02, PPR-03 and PPR-06 were advanced 4.5 to 6.9 m into this deposit, and terminated at depths of 27.6 to 33.0 m (Elev. 158.8 to 153.5).

The deposit was typically very dense as indicated by SPT ‘N’ values ranging from 59 blows per 0.3 m of penetration to 105 blows per 0.05 m penetration. Lower N values of 17 and 6 blows per 0.3 m of penetration were measured in Borehole PPR-05; these values probably result from hydraulic disturbance of the soil, as “blow back” was observed in the drill casing during drilling at that depth.

Natural moisture contents of 7% to 22% were measured in samples of this deposit.

The results of grain size analyses conducted on samples of this deposit are provided on the Record of Borehole sheets in Appendix A and are plotted in Figure B7 of Appendix B. The results are summarized as follows:

	<u>Silty Sand</u>	<u>Sand</u>	<u>Sand & Gravel</u>
Gravel %	9	4 to 10	51
Sand %	55	76 to 93	37
Silt %	25		
Clay %	11	3 to 14	12

5.7 Bedrock

Bedrock was encountered below the silty sand in Borehole PPR-05 at a depth of 30.6 m (Elev. 155.9).

The bedrock was classified as a granitic gneiss and consisted of red and pink granite incorporated into greyish black gneiss. In the recovered rock cores, the rock was fresh with occasional fractured zones noted. The measured Total Core Recovery (TCR) was 100% for both core runs, and the Rock Quality Designation (RQD) ranged from 96% to 98%, indicating excellent rock quality. Fracture Index (FI) values between 0 and 6 were obtained for the recovered rock cores.

The unconfined compressive strength (UCS) of the rock, estimated from the results of point load tests conducted on the rock core samples, ranged from 89 to 140 MPa (average for each run), indicating a strong to very strong intact rock. The point load test results are included on the Record of Borehole PPR-05 sheet in Appendix A. The point load test sheets with details of the testing and photographs of the rock core are enclosed in Appendix B.

5.8 Water Levels

Water levels in the boreholes were observed during the drilling operations and upon completion of drilling. Water was used during the drilling and coring operations, and therefore the water levels measured on completion may not reflect prevailing groundwater levels at the site.

Standpipe piezometers were installed in Boreholes PPR-02 and PPR-03 to monitor groundwater levels after drilling. The water levels measured in the open boreholes and in the piezometers are summarized in Table 5.1.

Table 5.1: Water Level Measurements

Borehole Number	Date	Water Level (Depth/Elev.) in metres	Comments
PPR -01	June 21, 2013	4.8 / 181.7	Water level on completion of drilling. Borehole open to 15.8 m depth.
PPR-02	July 5, 2013	2.5 / 183.9	Water level in open borehole.
	May 2, 2014	3.8 / 182.6	Water level in piezometer; piezometer sealed at 22.7 m depth.
PPR-03	July 6, 2013	2.8 / 183.8	Water level in open borehole.
	May 2, 2014	3.5 / 183.1	Water level in piezometer; piezometer sealed at 21.9 m depth.
PPR-04	June 21, 2013	3.4 / 183.2	Water level on completion of drilling. Borehole open to 10.1 m depth.
PPR-05	April 25, 2015	183.0	Water level in the river.
PPR-06	April 23, 2015	183.0	Water level in the river.

The preliminary General Arrangement drawing indicates the following water levels in Pays Plat River:

Elev. 182.6 – April 2011

Elev. 183.8 - high water level, from drawing dated February 1958.

The water level in the river and groundwater levels are expected to fluctuate seasonally and are subject to precipitation patterns, and therefore may vary from the levels presented herein.

5.9 Previous Foundation Investigation

A foundation investigation was previously carried out at the site for the existing Pays Plat River and Pays Plat Creek bridges. The factual data from the archive foundation report (Foundation Investigation, Pays Plat River and Creek Bridge Sites; Trow, Soderman and Associates, February 12, 1958; Geocres No. 42D-008) is provided in Appendix D for information purposes. The approximate locations of the previous boreholes are included on the Borehole Locations and Soil Strata Drawing in Appendix E.

In general, the subsurface stratigraphy encountered during the previous investigation is consistent with that encountered during the current study, comprising a sand layer overlying clay, underlain by a layer of sand to silt. A 1.5 to 2.4 m thick transitional zone comprising layers of sand and clayey silt is noted between the upper sand deposit and the underlying clay.

6 MISCELLANEOUS

Eastern Ontario Diamond Drilling supplied the drill rigs and conducted the drilling, sampling and in-situ testing operations. Truck-mounted CME #55 drill rigs were used for the duration of the investigation.

The drilling and sampling operations were supervised in the field by Ms. Eckie Siu, Mr. George Azzopardi and Mr. Matthew Whalen. Mr. Mark Farrant, P.Eng. directed the field operations.

The report was prepared by Ms. Anna Piascik, P.Eng., and reviewed by Mr. Murray Anderson, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects.

THURBER ENGINEERING LTD.

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Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

EXPLANATION OF ROCK LOGGING TERMS


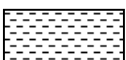

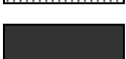

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

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

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

UNIFIED SOILS CLASSIFICATION

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

RECORD OF BOREHOLE No PPR-01

1 OF 2

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 135.6 E 263 747.6 ORIGINATED BY GA
HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2013.06.21 - 2013.06.21 CHECKED BY RPR

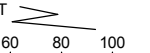


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
186.5	GROUND SURFACE							20	40	60	80	100					
0.0 0.1	ASPHALT: (65mm)		1	SS	19		186										
	Gravelly SAND Compact to Dense Brown Moist (FILL)		2	SS	30												
185.3																	
1.2	SAND and SILT, trace clay Loose Brown to Grey Wet		3	SS	15		185										
			4	SS	13		184										
			5	SS	6		183									0 47 45 8	
							182										
			6	SS	4		181										
							180									0 50 42 8	
179.3							179										
7.2	Silty CLAY, varved Firm Grey Moist		8	SS	4		178										
177.7							177										
8.8	SAND and SILT, trace clay Loose Grey Moist		9	SS	8												
176.7																	
9.8	Silty CLAY, varved																

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE						DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT 	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE					SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)
			NUMBER								
	Continued From Previous Page										
	Silty CLAY , varved Soft to Firm Grey Moist										
			10	SS	2						
			11	SS	2						
			12	SS	2						
			13	SS	4						
170.7 15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 4.8m ON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, CONCRETE TO 0.1m THEN ASPHALT PATCH TO SURFACE.										

RECORD OF BOREHOLE No PPR-02

1 OF 3

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 140.0 E 263 759.9 ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.07.05 - 2013.07.05 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
186.4	GROUND SURFACE							20 40 60 80 100							
0.0	ASPHALT: (65mm)							20 40 60 80 100							
0.1	CONCRETE: (200mm)							20 40 60 80 100							
0.2	Gravelly SAND, trace silt, occasional cobbles Compact to Very Dense Brown Moist (FILL)		1	SS	44		186								
			2	SS	23		185								30 65 5 (SI+CL)
	Cobbles at 2.3m depth		3	SS	100/ 0.125		184								
183.7															
2.7	SAND and SILT to Silty SAND, trace clay Compact to Very Loose Brown to Grey Wet		4	SS	12		183								
			5	SS	2		182								
			6	SS	4		181								
			7	SS	4		180								
							179								0 67 29 4
							178								
177.7															
8.7	SILT, trace sand Very loose Grey Moist		8	SS	3		177								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PPR-02

2 OF 3

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 140.0 E 263 759.9 ORIGINATED BY ES
HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2013.07.05 - 2013.07.05 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
175.7														
10.7	Silty CLAY , occasional sand seams Soft to Firm Grey Moist		9	SS	1									0 0 44 56
			10	SS	0									
			1	TW										
			11	SS	0									
			12	SS	0									0 0 39 61
168.0			13	SS	1									0 11 81 8
18.4	SILT , trace clay, trace to some sand Loose Grey Moist													

Continued Next Page

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

RECORD OF BOREHOLE No PPR-02

3 OF 3

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 140.0 E 263 759.9 ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.07.05 - 2013.07.05 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _P	W	W _L		GR	SA	SI	CL
	Continued From Previous Page							20	40	60	80	100							
165.7																			
20.7	SAND , trace to some gravel, trace silt, occasional cobbles and boulders Very dense Brown Moist		14	SS	77									o					
161.4																			
25.0	SAND and GRAVEL , with cobbles and boulders Very Dense Brown Wet		15	SS	113/ 0.25									o					
	</																		

4 93 3
(SI+CL)

RECORD OF BOREHOLE No PPR-03

1 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 142.0 E 263 838.9 ORIGINATED BY ES
HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2013.07.06 - 2013.07.06 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L		
186.6	GROUND SURFACE						20	40	60	80	100					
0.0	ASPHALT: (100mm)															
0.1	CONCRETE: (330mm)															
186.3																
0.3	SAND and GRAVEL, occasional cobbles Compact to Dense Brown Moist (FILL)		1	SS	37											
			2	SS	19											
			3	SS	33											
			4	SS	27											
182.6																
4.0	SAND, trace gravel, trace silt Compact to Loose Brown Wet		5	SS	14											
			6	SS	9											
179.4																
7.2	SAND and SILT, trace clay Loose Grey Wet		7	SS	5											
			8	SS	5											

Continued Next Page

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

RECORD OF BOREHOLE No PPR-03

2 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 142.0 E 263 838.9 ORIGINATED BY ES
HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2013.07.06 - 2013.07.06 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
173.3			9	SS	8									0 56 37 7
174			10	SS	5									
173	Silty CLAY Soft to Firm Grey Moist		11	SS	3									0 0 21 79
172			1	TW										
170			12	SS	0									
169														
168			13	SS	0									
167														

Continued Next Page

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

RECORD OF BOREHOLE No PPR-03

3 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 142.0 E 263 838.9 ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.07.06 - 2013.07.06 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)			
163.4	Occasional silt seams		14	SS	5			3.0				
23.2	SILT, trace clay, trace to some sand Compact Grey Moist		15	SS	15							0 11 81 8
160.1	SAND, trace to some gravel, occasional cobbles and boulders Very dense Grey Moist		16	SS	59							10 76 14 (Si+CL)
26.5			17	SS	100							
157.1	SAND and GRAVEL, occasional cobbles Very Dense				0.075							
29.5												

Continued Next Page

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

RECORD OF BOREHOLE No PPR-03

4 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 142.0 E 263 838.9 ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.07.06 - 2013.07.06 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								W P W W L						
								WATER CONTENT (%)						
								20 40 60						
154.5	SAND and GRAVEL , occasional cobbles Very Dense Brown Wet	◊	18	SS	100/ 0.050		156						○	
		◊					155							
32.1	END OF BOREHOLE AT 32.1m. WATER LEVEL AT 2.8m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 02/14 3.5 183.1		19	SS	100/ 0.10								○	

RECORD OF BOREHOLE No PPR-04

1 OF 2

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 146.4 E 263 851.2 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.21 - 2013.06.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL				
186.6	GROUND SURFACE						186									20	70	10 (SI+CL)					
0.0	ASPHALT: (115mm)																						
0.1	Gravelly SAND, occasional cobbles Dense to Very Dense Brown Moist (FILL)		1	SS	50																		
			2	SS	84																		
			3	SS	50																		
			4	SS	86																		
183.6																							
3.0	SAND, some silt to silty, occasional wood fibres Compact to Loose Grey Wet		5	SS	14																		
			6	SS	15																		
			7	SS	6																		
			8	SS	24																		
			9	SS	23																		

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PPR-04







































2 OF 2

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 146.4 E 263 851.2 ORIGINATED BY GA
 HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.21 - 2013.06.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			<div>PLASTIC LIMIT</div> <div>NATURAL MOISTURE CONTENT</div> <div>LIQUID LIMIT</div> <div>W P W W L</div>	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE				● QUICK TRIAXIAL	×	LAB VANE
176.5 10.1	Continued From Previous Page END OF BOREHOLE AT 10.1m. BOREHOLE OPEN TO 10.1m AND WATER LEVEL AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, CONCRETE TO 0.1m THEN ASPHALT PATCH TO SURFACE.															

METRIC

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	20 40 60 80 100			20 40 60 80 100	W _P W W _L	WATER CONTENT (%)							
186.5	GROUND SURFACE																	
0.0	BRIDGE DECK																	
186.2																		
0.3																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
																		
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+³, ×³: Numbers refer to Sensitivity

ONTMT4S 1197.GPJ 2015TEMPLATE(MTO).GDT 6/12/15

RECORD OF BOREHOLE No PPR-05

2 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 138.1 E 263 784.0 ORIGINATED BY MNW
 HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2015.04.24 - 2015.04.25 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
<div><div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div><div><div><div>204060</div><div>WATER CONTENT (%)</div></div><div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div></div></div>													
	Continued From Previous Page												
175.1			6	SS	9		176						
11.4	SILT , some sand, trace clay Very Loose Greyish Brown Wet		7	SS	2		175						
173.5							174						
13.0	Silty CLAY to CLAY , varved Very Soft to Soft Greyish Brown to Grey Wet		8	SS	0		173						
							172	5.5 +					
			9	SS	0		171						
							170						
			10	SS	0		169						
							168						
			11	SS	0		167						
			12	SS	0								

Continued Next Page

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

RECORD OF BOREHOLE No PPR-05

3 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 138.1 E 263 784.0 ORIGINATED BY MNW
HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2015.04.24 - 2015.04.25 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
Continued From Previous Page								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								20 40 60 80 100 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)					
164.2	With lenses of silt		13	SS	0		166						0 0 38 62
22.3	SILT , trace clay, trace sand, with varves of silty clay Compact to Loose Light and Dark Greyish Brown Wet		14	SS	15		164						0 0 74 26
			15	SS	23		163						
			16	SS	7		162						
							161						
							160						
							159						
157.8	Silty SAND , trace clay, trace gravel, occasional cobbles Compact Greyish Brown Wet		17	SS	17		158						
28.7							157						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PPR-05

4 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 138.1 E 263 784.0 ORIGINATED BY MNW
HWY 17 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2015.04.24 - 2015.04.25 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								<div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div>										
	Continued From Previous Page							20	40	60	80	100						
155.9			18	SS	6		156										9 55 25 11	
30.6	GRANITIC GNEISS, red/pink and dark grey, occasional fractures, strong to very strong																	FI
																		6
																		3
			1	RUN			155											3
																	1	
																	1	
							154										1	
			2	RUN													1	
																	2	
152.8							153										1	
33.7	END OF BOREHOLE AT 33.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND SLOUGH TO SURFACE. BRIDGE DECK PATCHED WITH QUICKSET CONCRETE.																	

RECORD OF BOREHOLE No PPR-06

1 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 143.7 E 263 813.2 ORIGINATED BY MNW
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.21 - 2015.04.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
186.5	GROUND SURFACE													
0.0	BRIDGE DECK													
186.2														
0.3														
183.0														
3.5	ICE/WATER													
182.4														
4.1	Organic SILT and SAND, trace gravel: (FROZEN)		1	SS	36									
181.9	Dark Brown/Black Wet													
4.6	Silty SAND to SAND and SILT, trace clay Loose to Very Loose Greyish Brown Wet		2	SS	2									
			3	SS	5									
			4	SS	2									0 62 29 9
			5	SS	4									0 54 37 9
			6	SS	7									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PPR-06

2 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 143.7 E 263 813.2 ORIGINATED BY MNW
 HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2015.04.21 - 2015.04.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
	Continued From Previous Page							20 40 60 80 100					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
								WATER CONTENT (%)					
								20 40 60					
175.1			7	SS	14		176						
11.4	SILT, some sand, trace clay Loose Greyish Brown Wet		8	SS	8		175						
173.7							174						
12.8	Silty CLAY to CLAY, varved Very Soft to Soft Greyish Brown Wet		9	SS	1		173						0 5 60 35
			10	SS	0		172						
							171						
			11	SS	0		170						
							169						
			12	SS	2		168						0 0 26 74
							167						
			13	SS	0								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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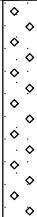
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PPR-06

3 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 143.7 E 263 813.2 ORIGINATED BY MNW
HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.04.21 - 2015.04.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
Continued From Previous Page							20 40 60 80 100 WATER CONTENT (%) 20 40 60								
162.1			14	SS	0		166								
			15	SS	2		164								
							163								
							162								
			16	SS	12		161								
							160								
							159								
			17	SS	15		158								
							157								
28.5	SAND and GRAVEL , trace silt, occasional cobbles Very Dense Grey Moist		18	SS	62										

Continued Next Page

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

RECORD OF BOREHOLE No PPR-06

4 OF 4

METRIC

WP# 6071-09-00 LOCATION Pays Plat River Bridge N 5 416 143.7 E 263 813.2 ORIGINATED BY MNW
HWY 17 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2015.04.21 - 2015.04.23 CHECKED BY AMP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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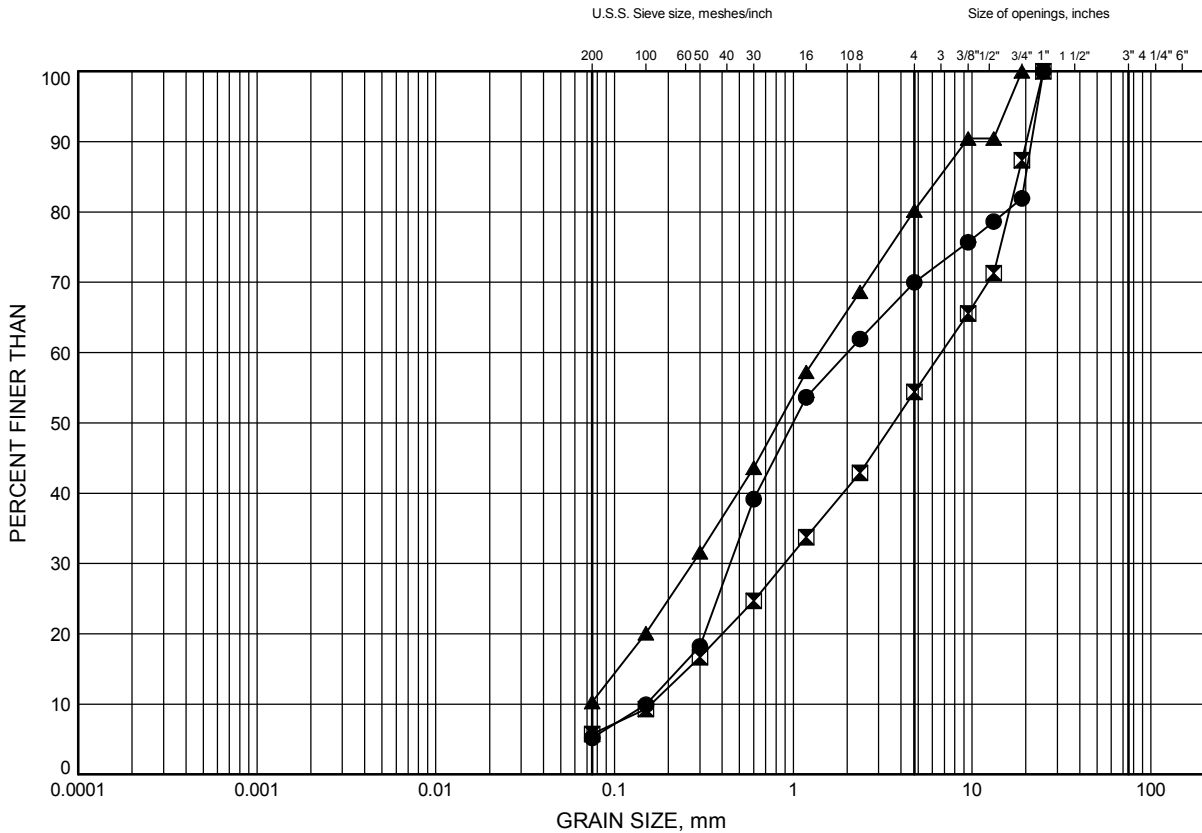
Appendix B

Laboratory Test Results

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B1

GRAVELLY SAND to SAND & GRAVEL FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-02	1.83	184.57
⊠	PPR-03	2.59	184.01
▲	PPR-04	1.83	184.77

Date June 2015
WP# 6071-09-00

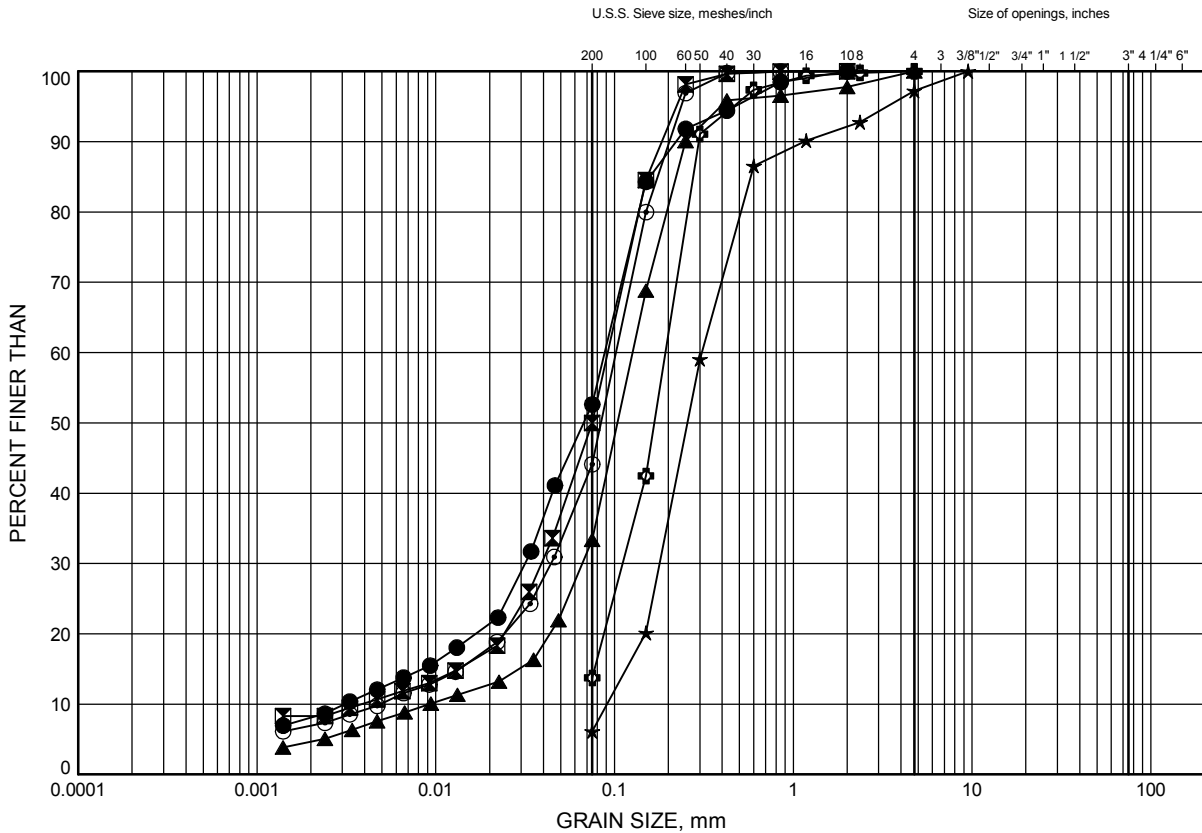


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B2

Upper SAND & SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-01	3.35	183.15
⊠	PPR-01	6.40	180.10
▲	PPR-02	7.92	178.48
★	PPR-03	6.40	180.20
⊙	PPR-03	10.97	175.63
⊕	PPR-04	4.88	181.72

Date June 2015
WP# 6071-09-00



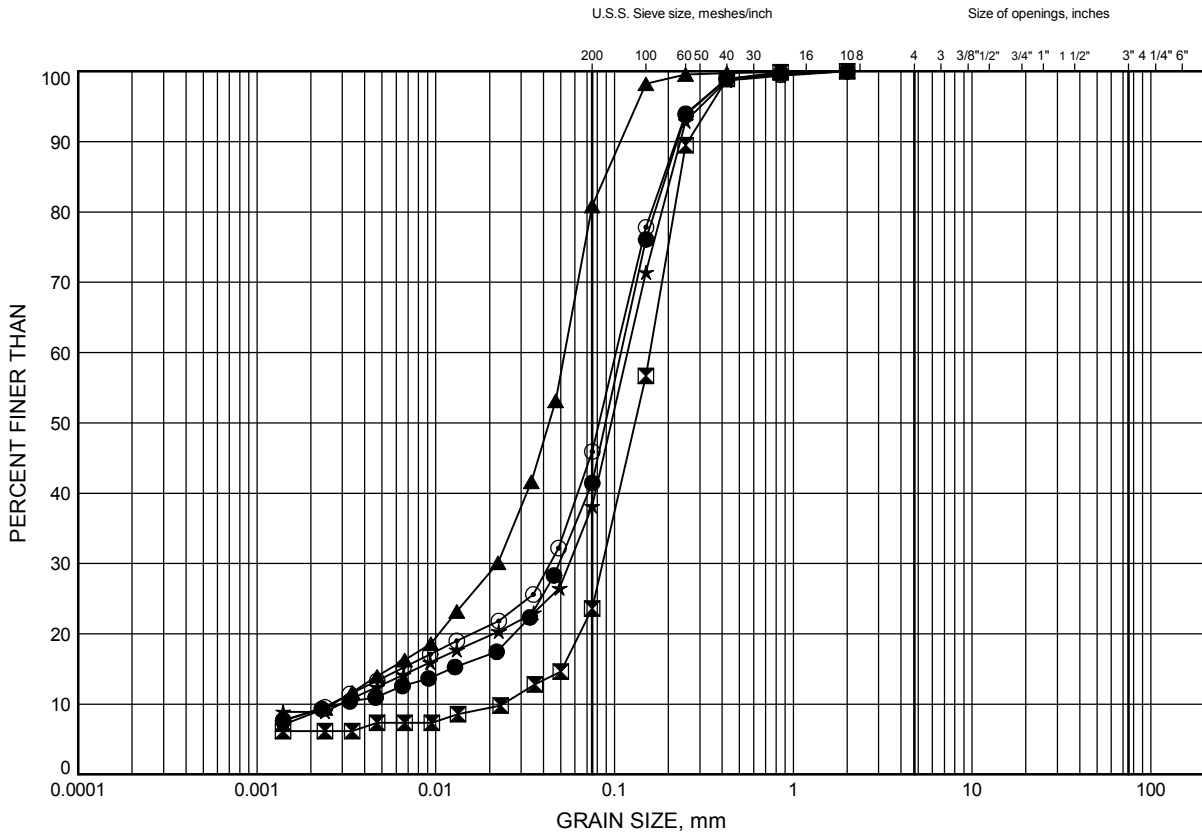
Prep'd MFA
Chkd. MRA

Pays Plat River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B3

Upper SAND & SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-04	7.92	178.68
⊠	PPR-05	9.14	177.36
▲	PPR-05	12.19	174.31
★	PPR-06	7.16	179.34
⊙	PPR-06	7.92	178.58

Date June 2015
WP# 6071-09-00

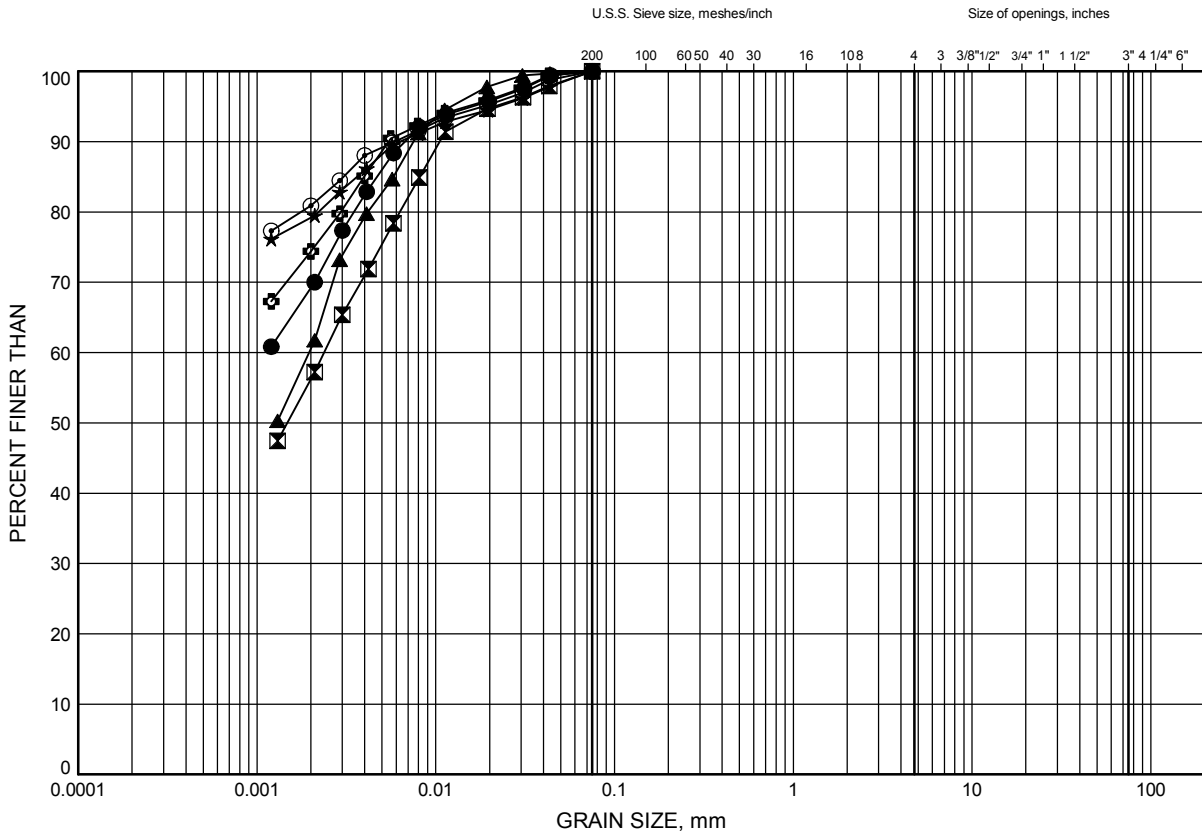


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY to CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-01	14.02	172.48
⊠	PPR-02	10.97	175.43
▲	PPR-02	17.07	169.33
★	PPR-03	14.02	172.58
⊙	PPR-05	15.24	171.26
⊕	PPR-06	18.29	168.21

Date June 2015
WP# 6071-09-00

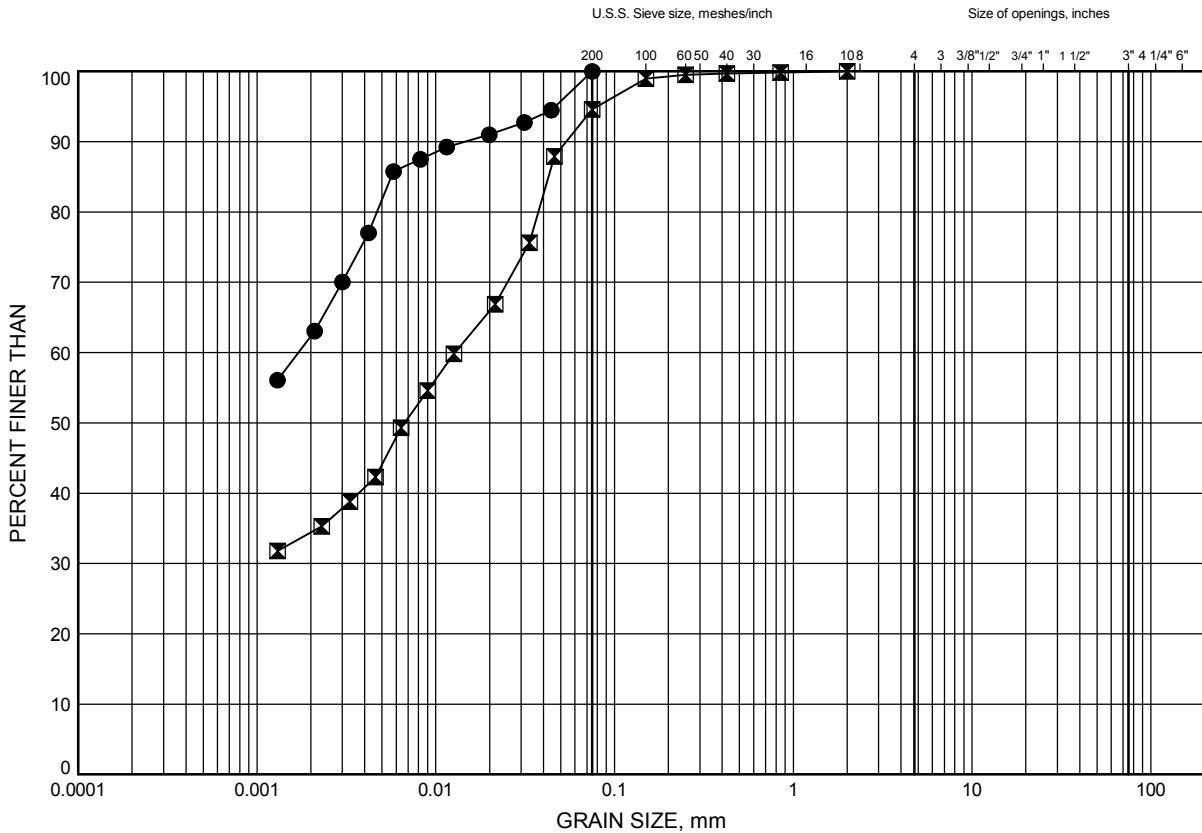


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY, With Silt Seams



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-05	21.34	165.16
⊠	PPR-06	13.72	172.78

Date June 2015
WP# 6071-09-00

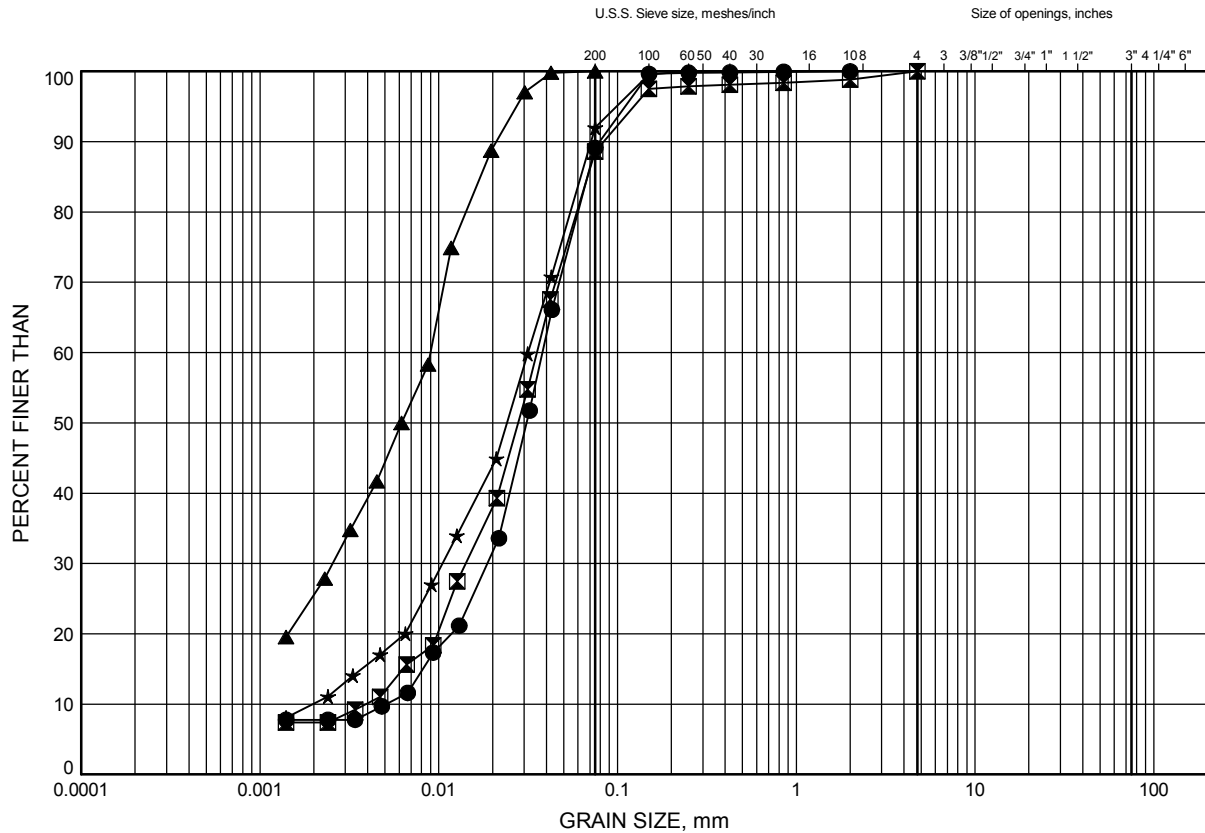


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B6

Lower SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-02	18.59	167.81
⊠	PPR-03	24.69	161.91
▲	PPR-05	23.01	163.49
★	PPR-06	25.91	160.59

Date June 2015
WP# 6071-09-00

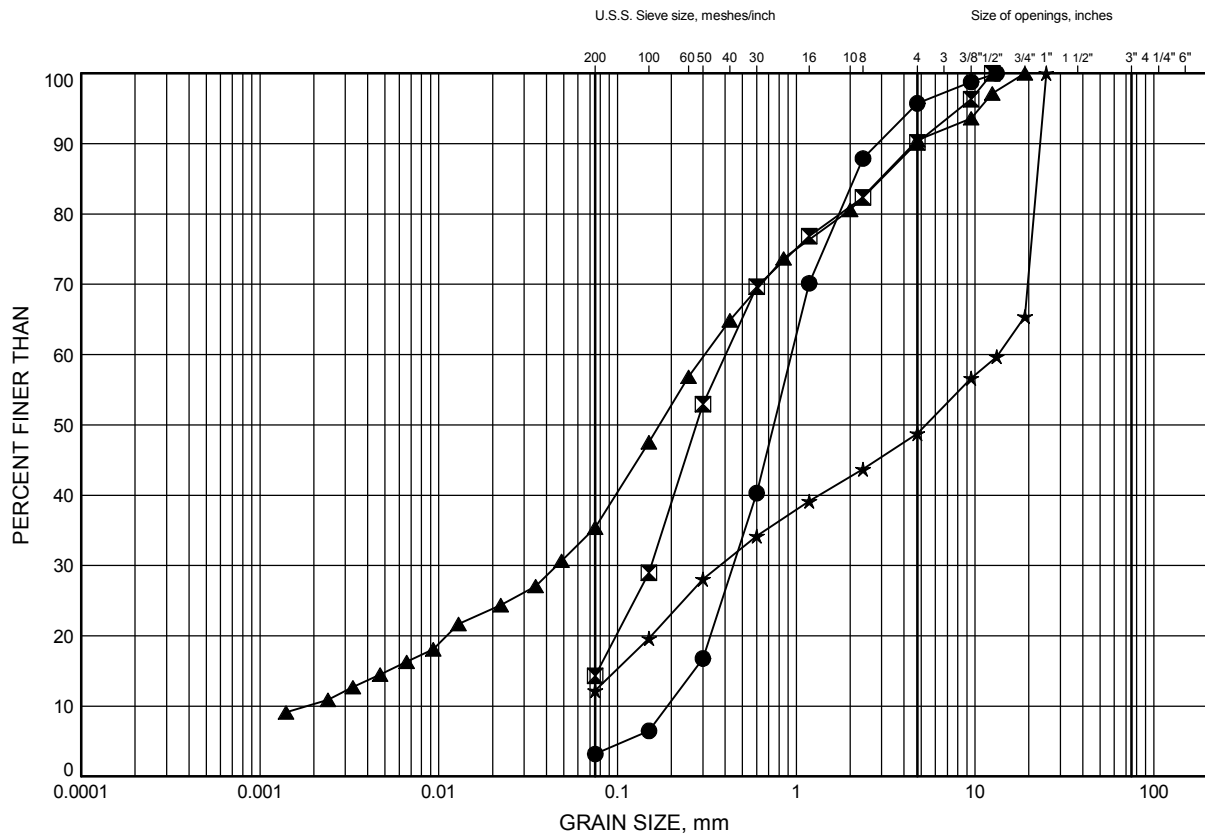


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge GRAIN SIZE DISTRIBUTION

FIGURE B7

SILTY SAND to SAND & GRAVEL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-02	24.59	161.81
⊠	PPR-03	27.74	158.86
▲	PPR-05	30.18	156.32
★	PPR-06	30.25	156.25

Date June 2015
WP# 6071-09-00

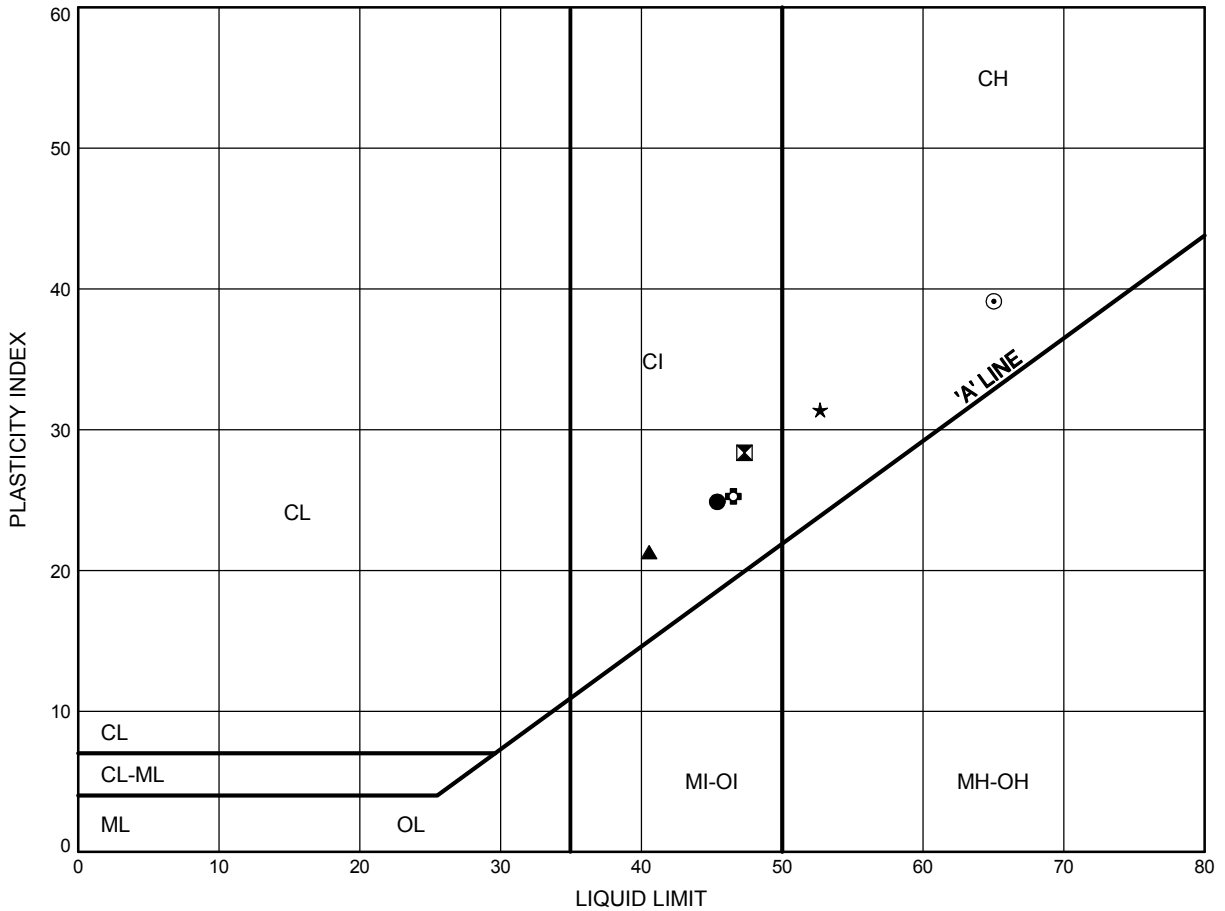


Prep'd MFA
Chkd. MRA

Pays Plat River Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

SILTY CLAY to CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-01	14.02	172.48
⊠	PPR-02	10.97	175.43
▲	PPR-02	17.07	169.33
★	PPR-03	14.02	172.58
⊙	PPR-05	15.24	171.26
⊕	PPR-05	21.34	165.16

Date June 2015
 WP# 6071-09-00

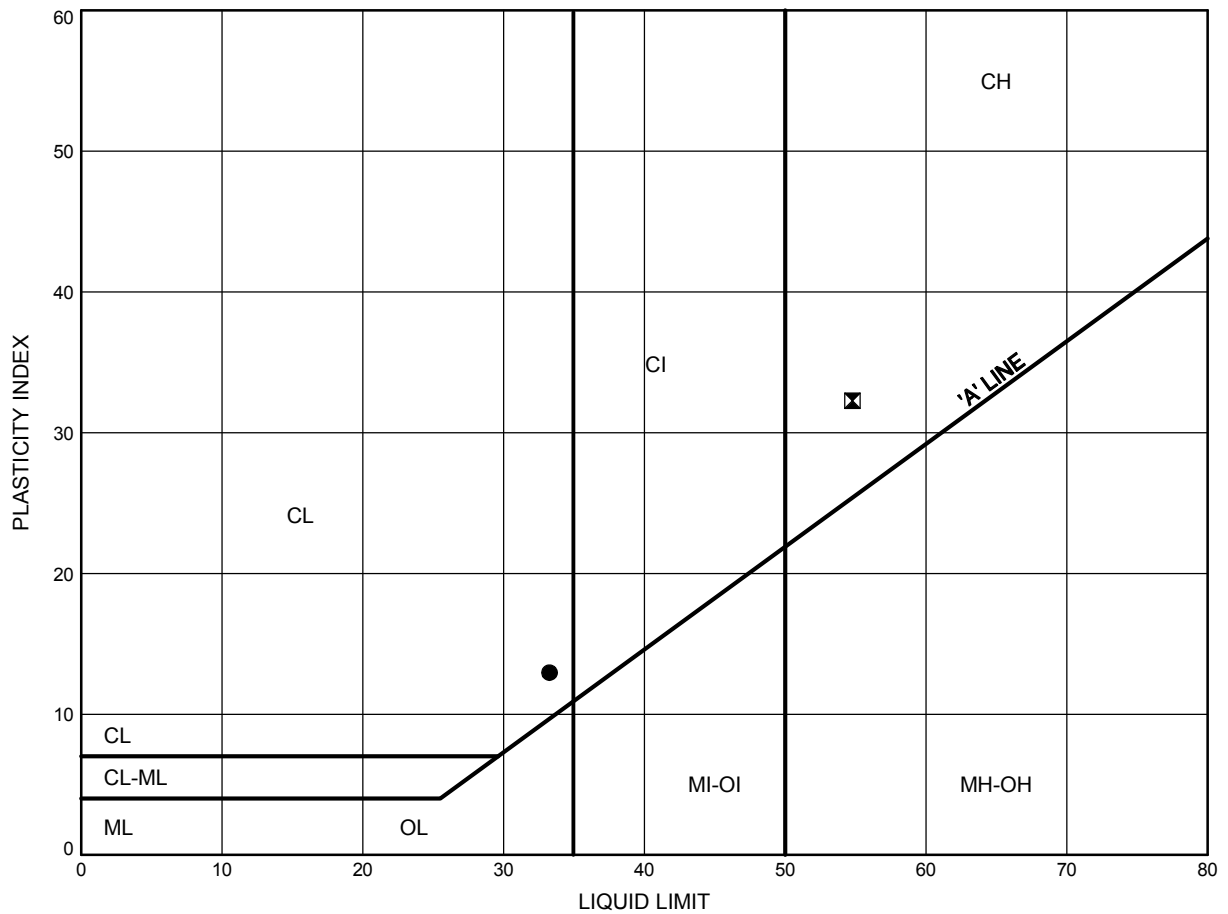


Prep'd MFA
 Chkd. MRA

Pays Plat River Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE B9

SILTY CLAY to CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PPR-06	13.72	172.78
⊠	PPR-06	18.29	168.21

Date June 2015
 WP# 6071-09-00



Prep'd MFA
 Chkd. MRA



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

Job No : 19-1351-197

Client : MMM Group Ltd.

Project Name : Pays Plat River Bridge

Date Drilled : 25-Apr-15

Core Size : NQ BH No : PPR-05

Date Tested : 07-May-15

Tester : ISP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	31.1	D	12.3	47.2	Long	122.0		Very Strong
2	1	31.8	D	22.4	47.2	Long	222.6		Very Strong
3	1	32.1	D	7.6	47.2	Long	75.6		Strong
4	2	32.7	D	9.0	47.5	Long	88.8		Strong
5	2	33.5	D	8.9	47.3	Long	88.4		Strong
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* 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 $0.7 \times D$ on either side of test point.

Last Modified: August 15, 2013



Photograph of Rock Core recovered from Borehole PPR-05

Appendix C

Site Photographs



Photograph 1 – Pays Plat River Bridge Looking East



Photograph 2 – Pays Plat River Bridge Looking West



Photograph 3 - South Bridge Elevation - Looking West



Photograph 4 - North Bridge Elevation - Looking West

Appendix D

Factual Data from the Previous Foundation Investigation Report Geocres No. 42D-008

TROW SODERMAN AND ASSOCIATES

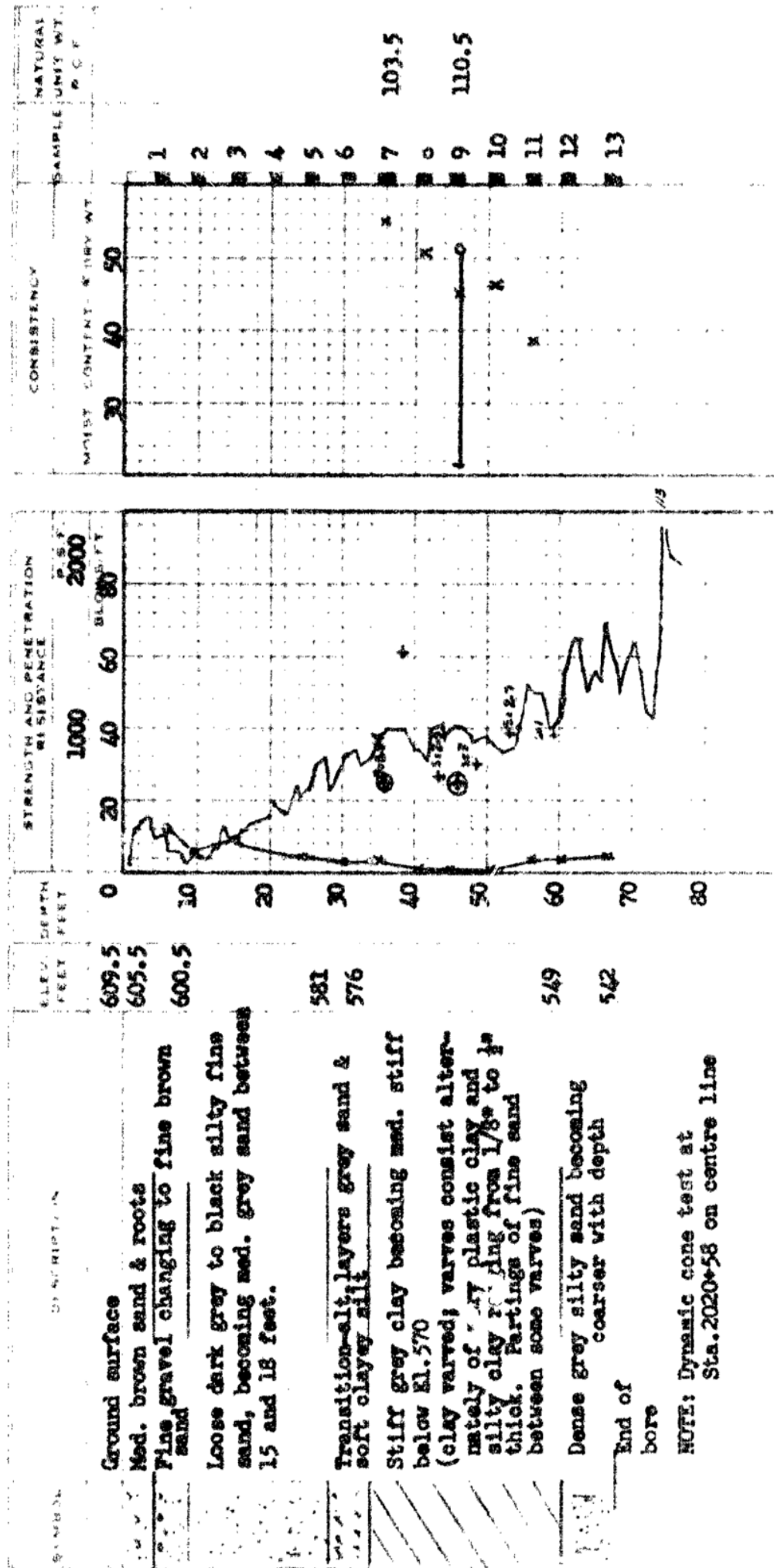
FOR INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Pays Plat River
LOCATION Hwy. 17, near Rossport, Ont.
HOLE LOCATION See diag. 1
HOLE ELEVATION AND DATUM 609.5

BOREHOLE NO. 1
FIELD SUPERVISOR KP
DRILLER WL
PREP WT

LEGEND

- 1. 1/4" SPLIT TUBE
- 2. SHELBY TUBE
- 3. SPLIT TUBE
- 4. DIA. CONE
- 5. CASING
- 6. SHELBY
- 7. UNCONFINED COMPRESSION (QU)
- 8. VANE TEST (C) AND SENSITIVITY (S)
- 9. NATURAL MOISTURE AND LIQUIDITY INDEX
- 10. LIQUID LIMIT
- 11. PLASTIC LIMIT

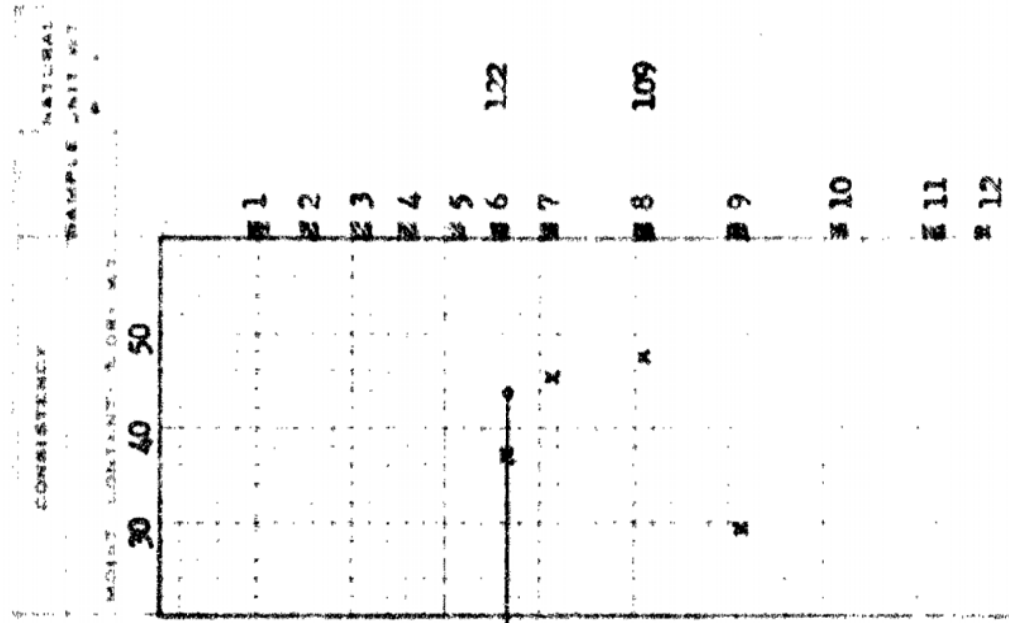


NOTE: Dynamic cone test at Sta. 2020+58 on centre line

RAY#17 near Rosport, Ont.
RAY#17 near Rosport, Ont.

108 EL. 601

2. 544.4.854
1-2 LANCING
VANE TEST
NATURAL M
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CL29/J152

TROW SOOERMANN AND ASSOCIATES

Pays Platt River

Hwy. #17 near Rossport, Ont.

See Dwg. 1

601

3 and 4

BOREHOLE NO.

FIELD SUPERVISOR KP

DRILLER WL

PREP WT

STRENGTH AND PENETRATION RESISTANCE

FEET DEPTH

FEET DEPTH

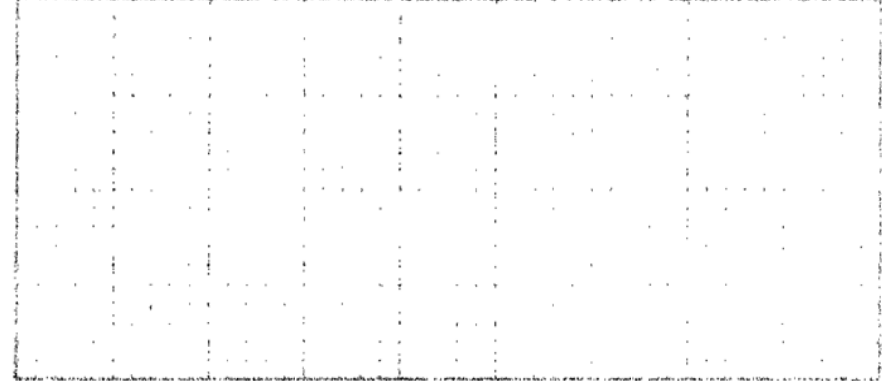
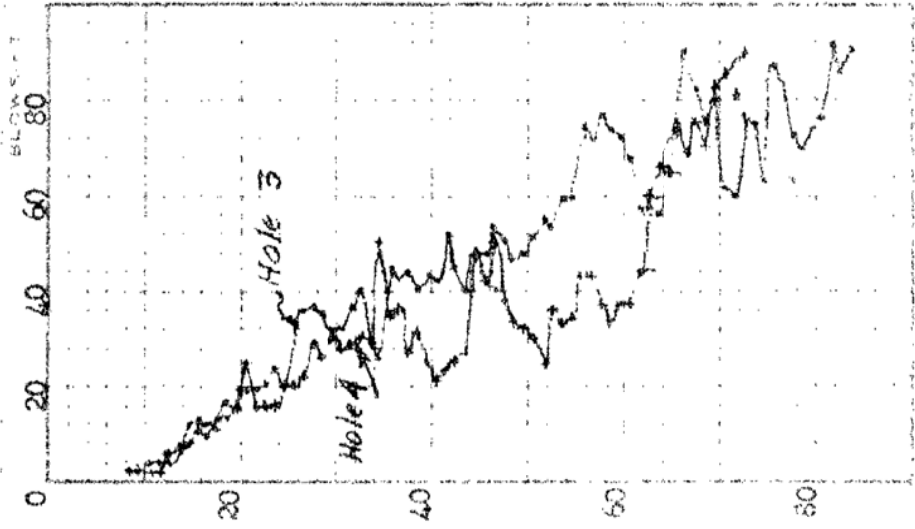
Surface of Ice

River bed

Dynamic Cone Penetration Tests only

Hole 3 = Sta. 2022+13 on centre L.

Hole 4 = Sta. 2021+80 on centre L.



CL29/J152

TROW SODERMAN AND ASSOCIATES

Pays Flat River
Highway 17 near Rossport, Ont.

See Dwg. 1

EL. 601

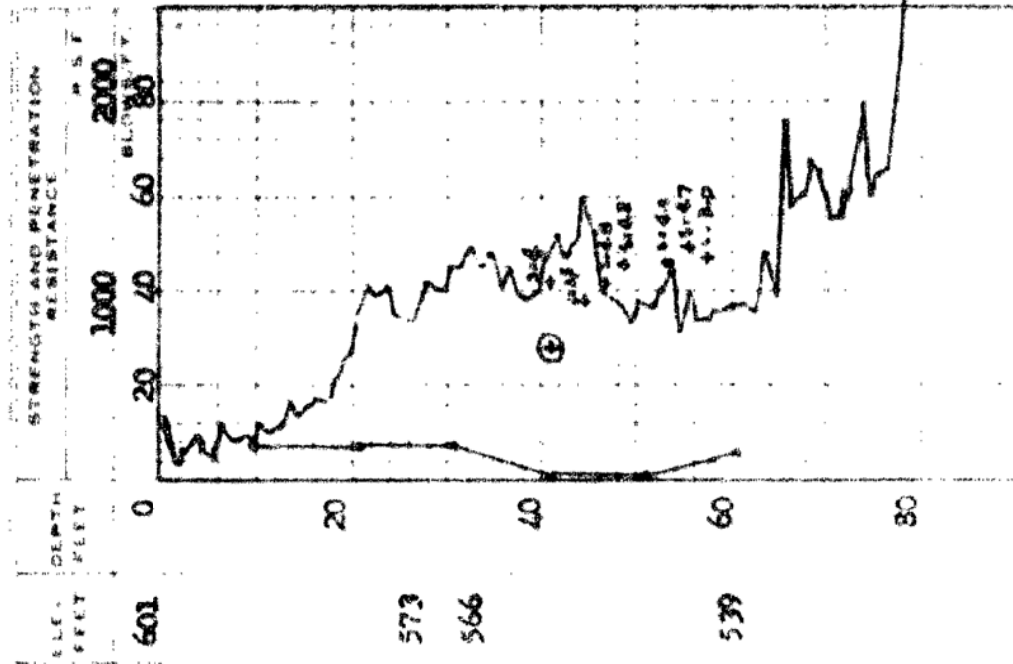
CONTINUED NO. 5
FIELD SUPERVISOR
WILLIAM M. L.
PREP WT

DRAWING NO. 5

TESTED

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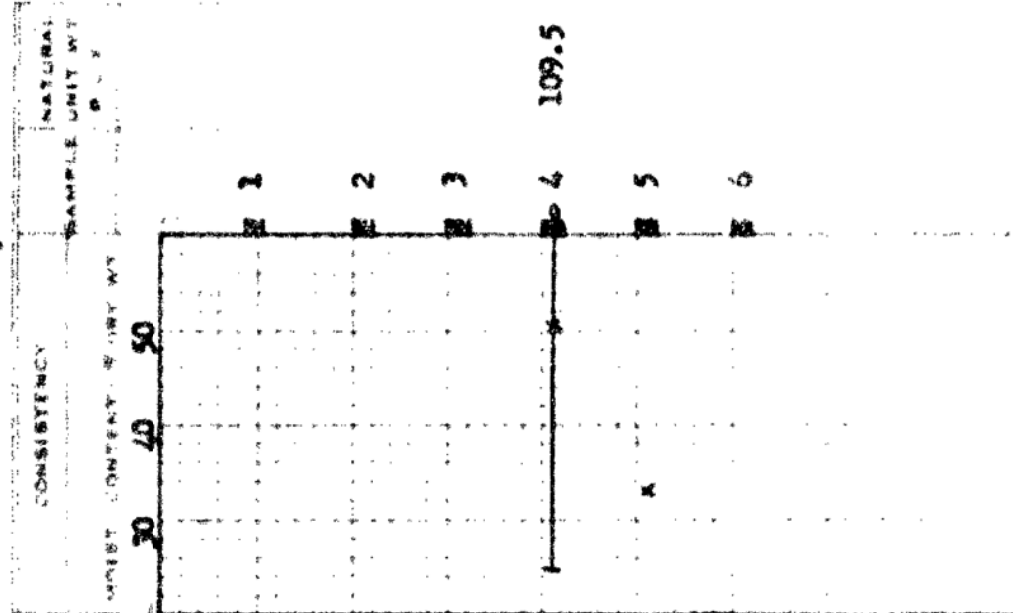
Ground surface
1 ft. topsoil & organics

Med. to coarse grey sand

Transition-Alt. layers of grey sand
and soft clayey silt

Stiff grey clay
(as in hole 1)

End of bore

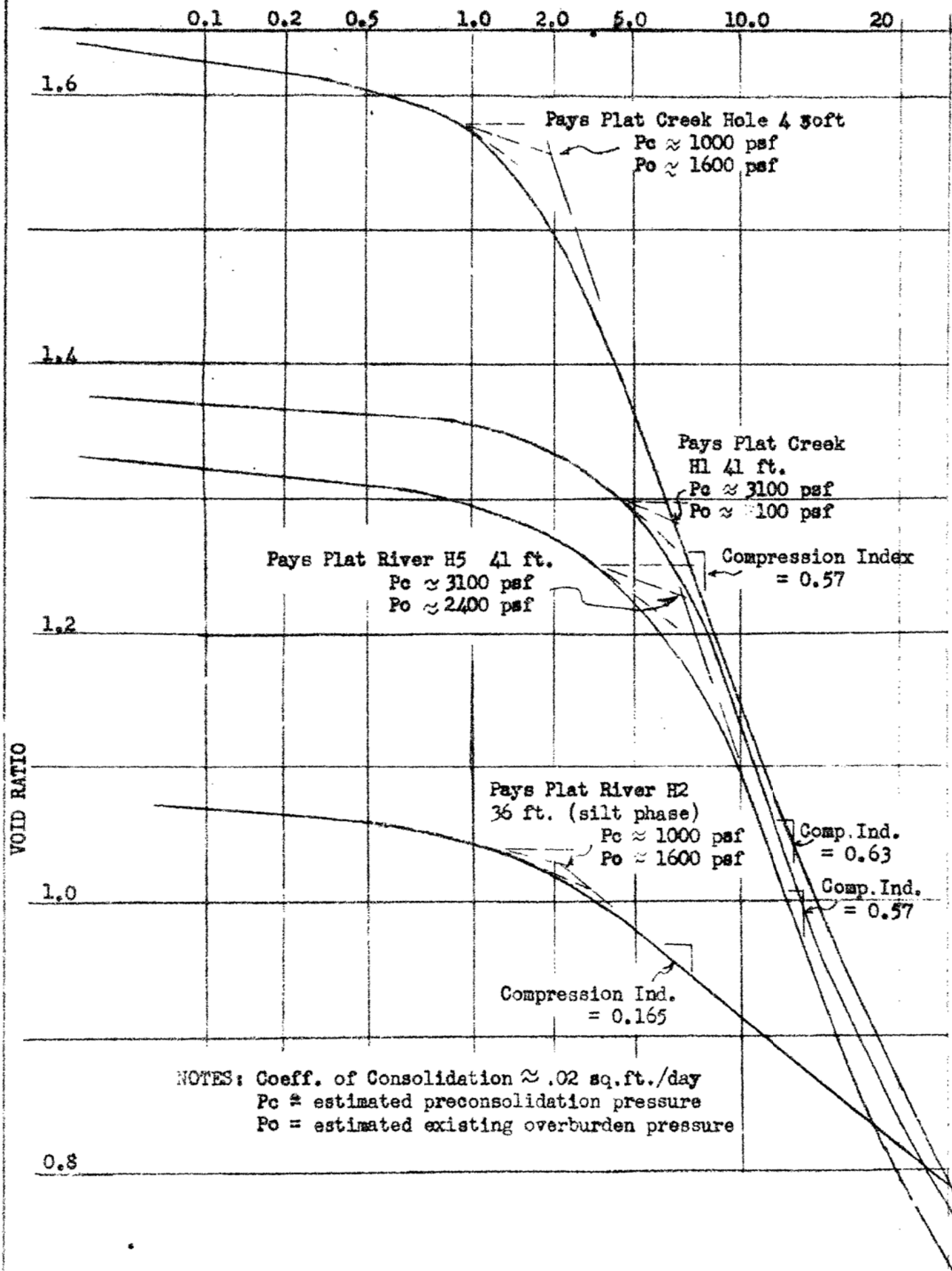


SUMMARY OF FIELD AND LABORATORY TEST MEASUREMENTS
PAYS PLAT RIVERTABLE NO. 1
C129J152

Elev. Ft.	Hole	Stand. Pene. Test Blows/ft.					Shearing Resistance P.s.f.			Consistency %			Dry. Wt.			Natural Unit Weight P.c.f.		
		1	2	5	1	Vane	Cu	2	Vane	Cu	3	Vane	Cu	1	2	5		
600		5																
596																		
592		8																
588			4	6														
584		4	4															
580		3	6	6														
576			10															
572		4	4	6														
568		push																
564			4															
560		push	push	push														
556		push																
552		4																
548		4	push	push														
544																		
540		5	push	6														
536																		
532																		

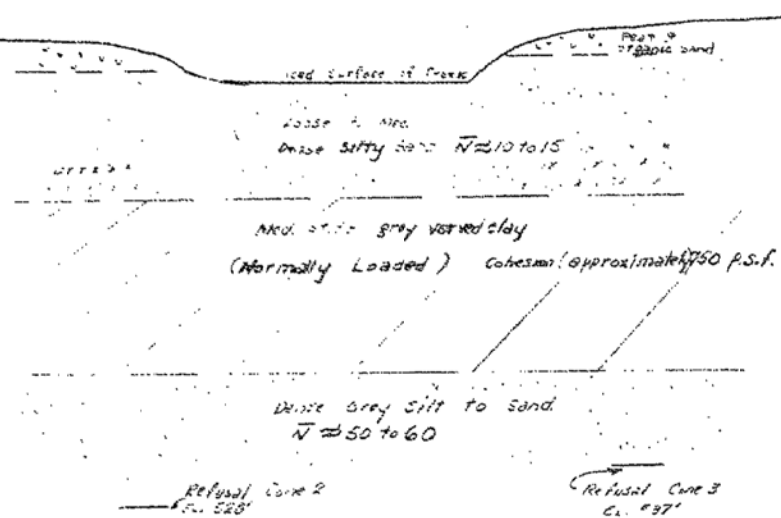
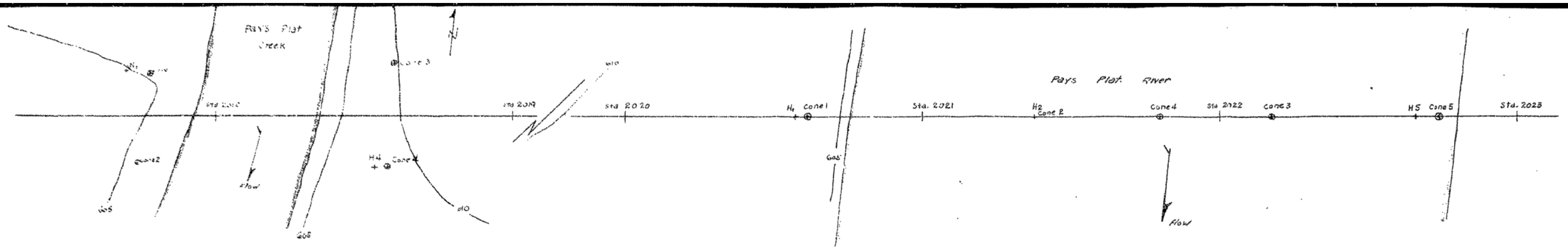
SYMBOLS

Qa - undrained triaxial test at
overburden pressure
Cq - consolidated undrained test
Wn - natural moisture content
L.L. - Liquid Limit
P.L. - Plastic Limit



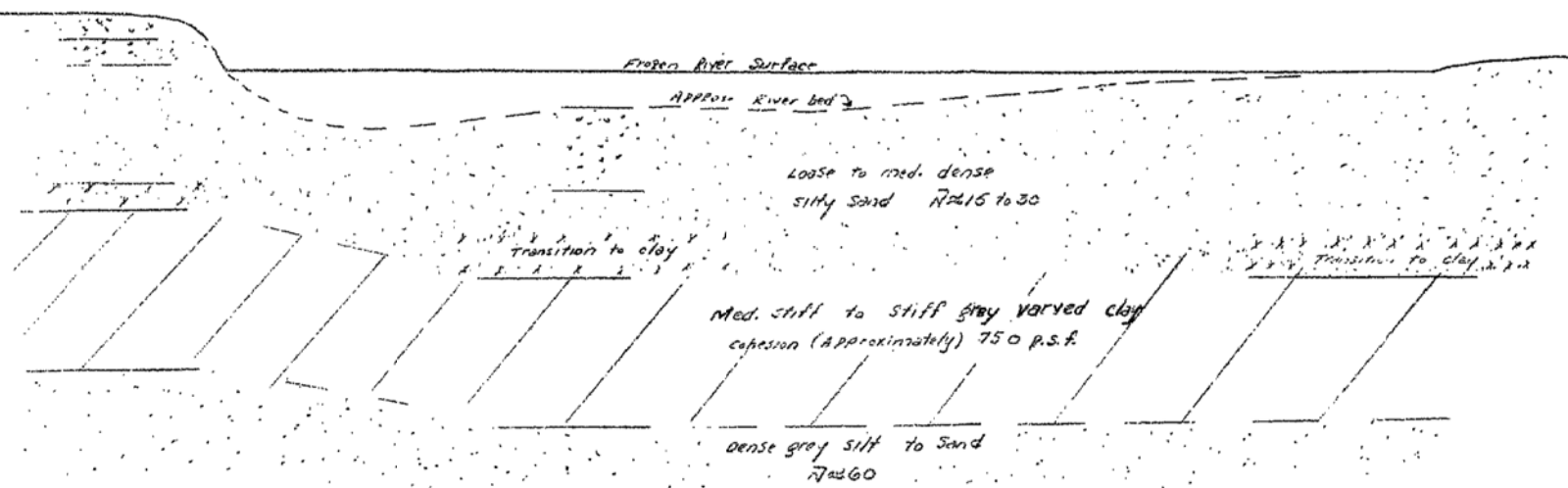
REPRESENTATIVE CONSOLIDATION CURVES FOR
THE VARVED CLAY

TROW SODERMAN & ASSOCIATES



Elev
600'
580'
560'
540'

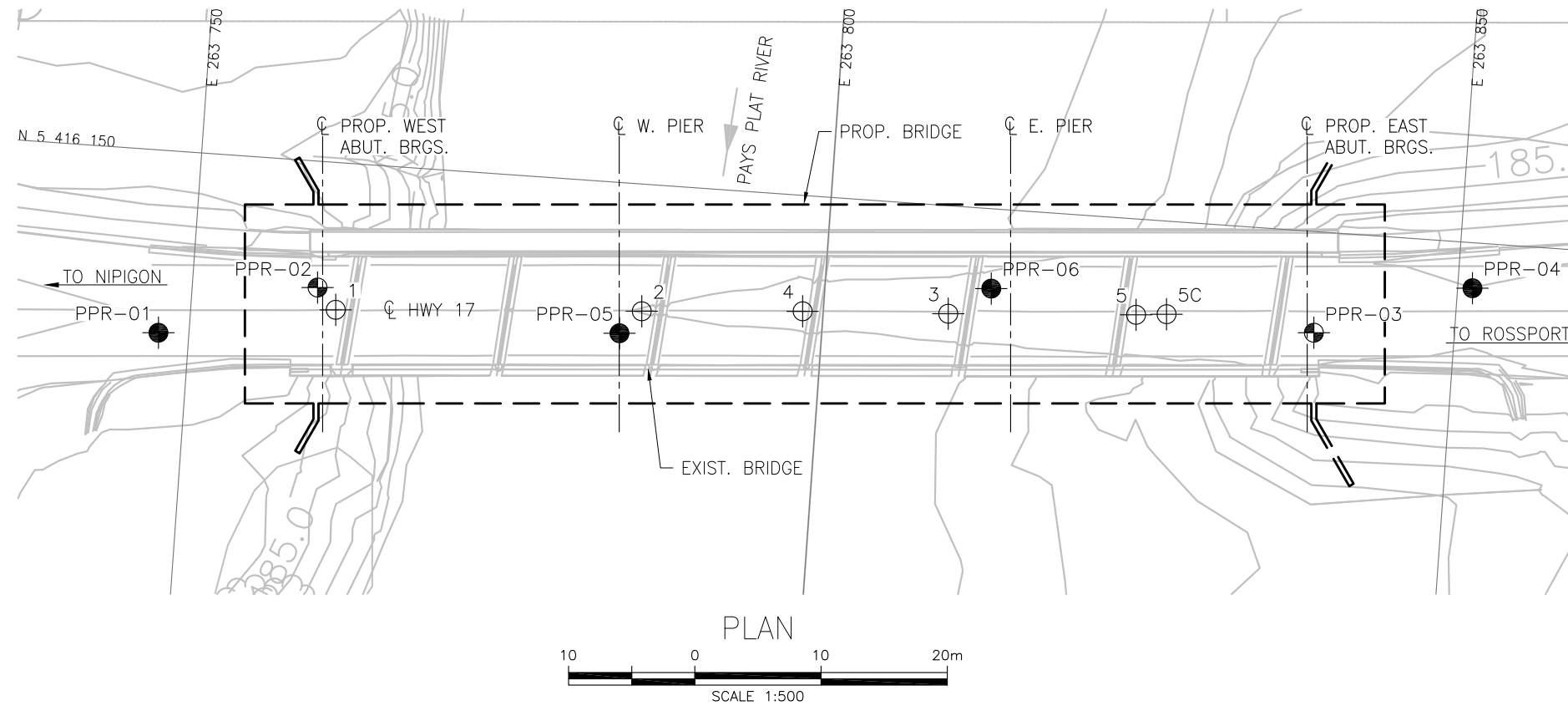
Note N Dynamic Cone (2" dia)
Blows/ft.



SKETCH OF SITE SHOWING BORE LOCATIONS
AND ESTIMATED SUBSOIL STRATIGRAPHY Scale Horiz. 1"=20ft.
Vert. 1"=20ft.

Appendix E

Borehole Locations and Soil Strata Drawing



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



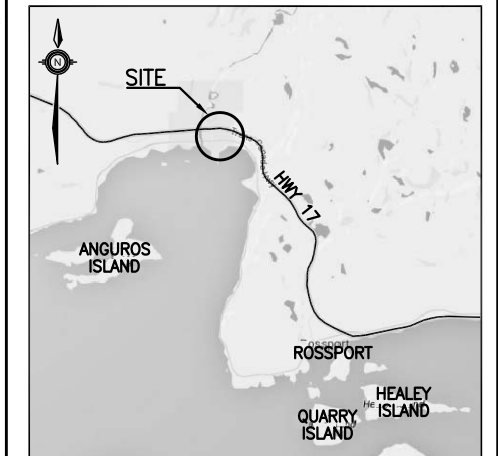
CONT No
WP No 6071-09-01

HIGHWAY 17
PAYS PLAT RIVER BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

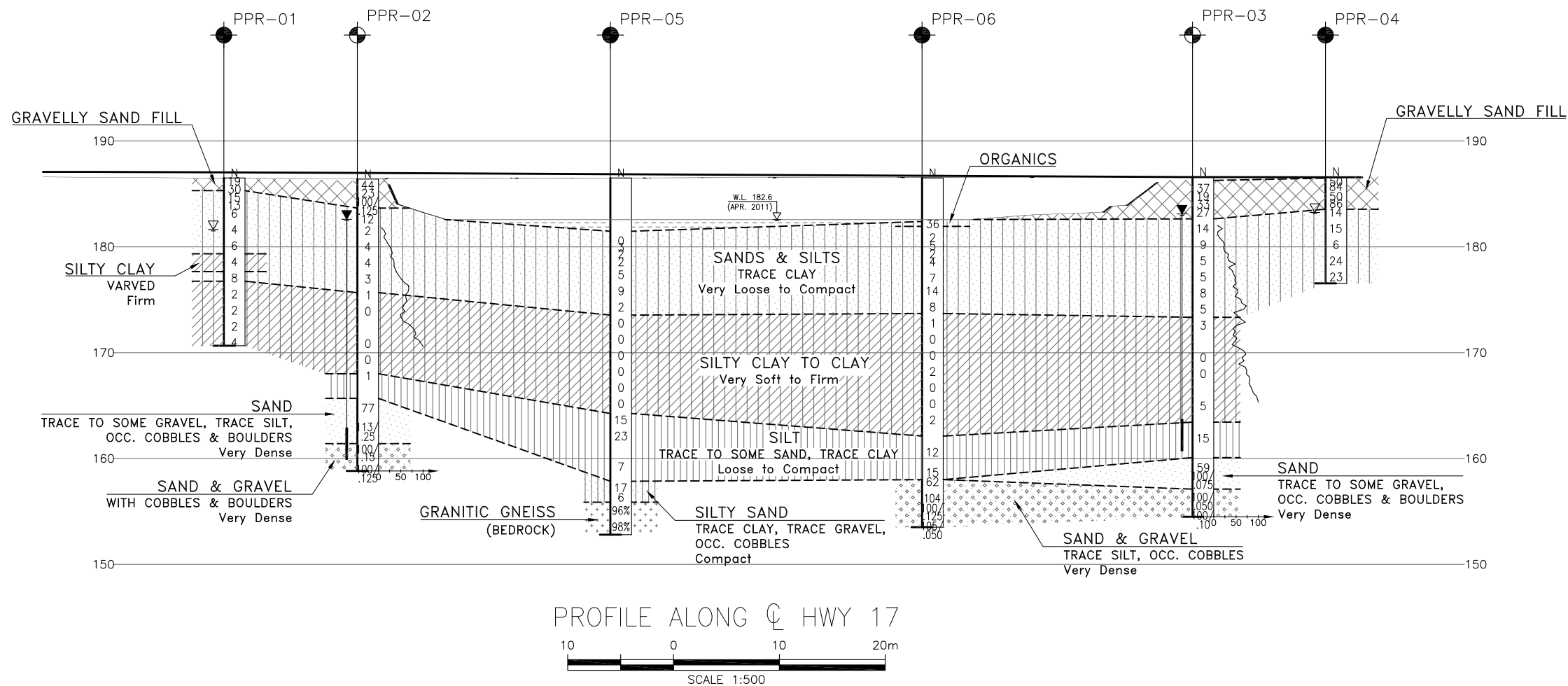
- | | |
|---|--|
|  | Borehole |
|  | Borehole & DCPT |
|  | Borehole & DCPT From Previous Study
(Geocres 42D-008) |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level In Open Borehole |
|  | Water Level In Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
PPR-01	186.5	5 416 135.6	263 747.6
PPR-02	186.4	5 416 140.0	263 759.9
PPR-03	186.6	5 416 142.0	263 838.9
PPR-04	186.6	5 416 146.4	263 851.2
PPR-05	186.5	5 416 138.1	263 784.0
PPR-06	186.5	5 416 143.7	263 813.2

-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.

GEOCRES No. 42D-38

[illegible]