



**PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN REPORT
for
ROCKY SAUGEEEN RIVER BRIDGE ON HIGHWAY 6
MTO WEST REGION 59 STRUCTURE REHABILITATIONS
SITE 8-159, CONTRACT 2
GWP 3125-03-00
GREY COUNTY, ONTARIO**

PETO MacCALLUM LTD.
165 CARTWRIGHT AVENUE
TORONTO, ONTARIO
M6A 1V5
Phone: (416) 785-5110
Fax: (416) 785-5120
Email: toronto@petomaccallum.com

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PML Ref.: 13KF006B
Index No.: 144FIR and 145FDR
GEOCRES No: 41A-234
November 26, 2014



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for

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MTO WEST REGION 59 STRUCTURE REHABILITATIONS
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PRELIMINARY FOUNDATION INVESTIGATION REPORT

for

Rocky Saugeen River Bridge on Highway 6
MTO West Region 59 Structure Rehabilitations
Site 8-159, Contract 2, GWP 3125-03-00
Grey County, Ontario

1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed rehabilitation of the Rocky Saugeen River Bridge on Highway 6 in Grey County, Ontario. The proposed rehabilitation is a part of the assignment for the rehabilitation of 59 structures in MTO West Region along Highways 4, 6, 401, 402 and 403. The study was carried out by Peto MacCallum Ltd. (PML) for MMM Group Limited (MMM) on behalf of the Ministry of Transportation of Ontario (MTO).

A Technical Memorandum was also prepared as a part of this assignment (reference: DRAFT Foundation Technical Memorandum for Rocky Saugeen River Bridge on Highway 6, issued July 10, 2014). The purpose of the technical memorandum was to summarize the subsurface and groundwater conditions based on available Geocres reports for the design project terms of reference and to update the foundation design recommendations provided in the available reports to the Limit State design terminology in conformance with the requirements of the Canadian Highway Bridge Design Code (CHBDC).

The purpose of this report was to summarize the subsurface stratigraphy encountered at the proposed structure site during the present preliminary investigation to supplement geotechnical data for temporary roadway protection.

For subsurface conditions from previous foundation investigations reference should be made to the Technical Memorandum. The present Foundation Investigation and Design Report should be read in conjunction with the Technical Memorandum.



2. SITE BACKGROUND AND GEOLOGY

The Rocky Saugeen River Bridge on Highway 6 is located about 6.0 km northwest of Durham in Grey County, Ontario. The current bridge is a three span reinforced concrete T-beam bridge that carries two lanes of traffic on Highway 6. A key plan is shown in Figure 1.

The Rocky Saugeen River water elevation is subjected to considerable variations due to the presence of a dam located 650 m north east of the bridge location. In addition, there are farm lands including residences in the surrounding areas of the bridge. A camping ground is located about 600 m north east of the bridge.

Physiographically, the site is situated in the region known as the Horseshoe moraines which includes shallow till and rock ridges with many drumlins. The limestone bedrock in the area belongs to Guelph Formation of Middle and Lower Silurian period.

In the previous investigation (GEOCRES NO. 41A00-001, dated 1956), a total of five (5) boreholes were investigated to 3.5 to 7.0 m, elevation 316.9 to 322.3. Limestone rocks were encountered in shallow depths in the boreholes. The subsurface in the boreholes included bedrock overlaid by sand and gravel deposits with limestone fragments and boulder pieces. Rock was cored in all five boreholes from 0.5 to 1.6 m, elevation 319.9 to 325.3 to the termination depths of boreholes 3.5 to 7.0 m, elevation 316.9 to 322.3.

3. FIELD INVESTIGATION

A total of two boreholes, RS-1 and RS-2, were drilled on July 16, 2014 at the site location. The boreholes were selected by PML and the survey of the boreholes was conducted by MMM. The boreholes locations are shown in Drawing RS-1.

The two boreholes were drilled through the soil cover to 3.9 and 10.4 m. The boreholes were advanced using continuous flight solid augers powered by a truck mounted D-50 rig, supplied and



operated by a specialist drilling contractor. The drilling crew worked under the full-time supervision of a member of our engineering staff.

Representative samples of the soils encountered in the boreholes were recovered at frequent depth intervals. In the boreholes advanced with conventional drill rigs, soil samples were obtained using a split spoon sampler in conjunction with standard penetration tests. Where standard penetration tests were not carried out the consistency/compactness of the encountered soils was estimated from manual examination or the rate (ease) of advance of the augers.

The boreholes were backfilled in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures using a bentonite/cement mixture grout and asphalt patch.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open boreholes.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to our laboratory for detailed visual examination and soil classification. The laboratory test program for the current subsurface investigation comprised the following tests:

- Natural moisture content determinations (12)
- Grain size analyses (5)

The results of the laboratory natural moisture content determinations and grain size analyses are shown on the Record of Borehole sheets RS-1 and RS-2. The grain size distribution charts are presented on Figures GS-RS-1 to GS-RS-5.



4. SUBSURFACE CONDITIONS

Reference is made to the appended Record of Boreholes RS-1 and RS-2 sheets for details of the subsurface and groundwater conditions including soil classifications, inferred stratigraphy, standard penetration test N values, grain size distribution and moisture content test results. The boundaries between soil strata have been established at the borehole locations only. Between and beyond the boreholes, the boundaries are assumed and may vary.

4.1 Pavement Structure

A 170 and 230 mm thick asphaltic concrete over 530 and 470 mm thick gravelly sand layer was encountered in boreholes RS-1 and RS-2, respectively, which extended to 0.7 m, elevation 328.9 and 329.5. Cobbles were encountered in the gravelly sand layer. Two N values recorded were 30 and 41. Two moisture content determinations were 8 and 13%.

4.2 Fill

The pavement structure was underlain by a layer of loose to dense fill material in boreholes RS-1 and RS-2 at 0.7 m, elevation 328.9 and 329.5, respectively and extended to 3.9 and 10.4 m, elevation 326.3 and 319.2, respectively. The fill layer encountered included sandy gravel, sand and gravel and gravel units with inclusions of cobbles, boulder pieces and limestone pieces. N values recorded in the fill units ranged between 6 and 40. High N values of 50 blows for 3 cm penetration were recorded in borehole RS-2 at 5.3 m, elevation 324.3, due to probable boulder pieces and at 10.4 m, elevation 319.8, due to probable bedrock.

Borehole RS-1 was terminated at 3.9 m, elevation 325.7, where auger refusal was met on probable bedrock.

Grain size distribution charts of the fill samples are presented in Figures GS-1 to GS-5. Moisture content determinations of the fill samples ranged between 5 and 12%.



4.3 Probable Bedrock

Probable bedrock was encountered in boreholes RS-1 and RS-2 at 3.9 and 10.4 m, elevation 325.7 and 319.8, respectively.

In the previous investigation report (GEOCREC No. 41A00-001, dated 1956), bedrock was encountered between elevations 319.9 and 325.3 at the bridge site. It should be noted that in the original investigation the bedrock in borehole BH 1 at the south abutment location was encountered at elevation 322.3 and in borehole BH 4 at the north abutment location the bedrock was encountered at elevation 325.3.

4.4 Groundwater

Groundwater was not encountered in borehole RS-1 during and after augering. In borehole RS-2, groundwater was encountered at 6.1 m, elevation 324.1, during augering. Upon completion of augering, groundwater was not encountered in borehole RS-2.

The water level of the Rocky Saugeen River was at elevation 323.4 in September 2013 and at approximate elevation 323.2 in July 2014.

It should be noted that the groundwater level is subjected to fluctuations in the river level due to seasonal and rainfall patterns.

5. MISCELLANEOUS

Mr. S. Aziz carried out the field investigation for this study under the supervision of Mr. N. Rahman, P.Eng. Fisher Environmental Ltd. supplied the drilling equipment for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.



6. CLOSURE

This preliminary report was prepared by Mr. N. Rahman, P.Eng and was reviewed by Mr. R. Ng, PhD, P.Eng., Senior Project Engineer. Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



Nazibur Rahman, P.Eng.
Project Engineer, Geotechnical Services

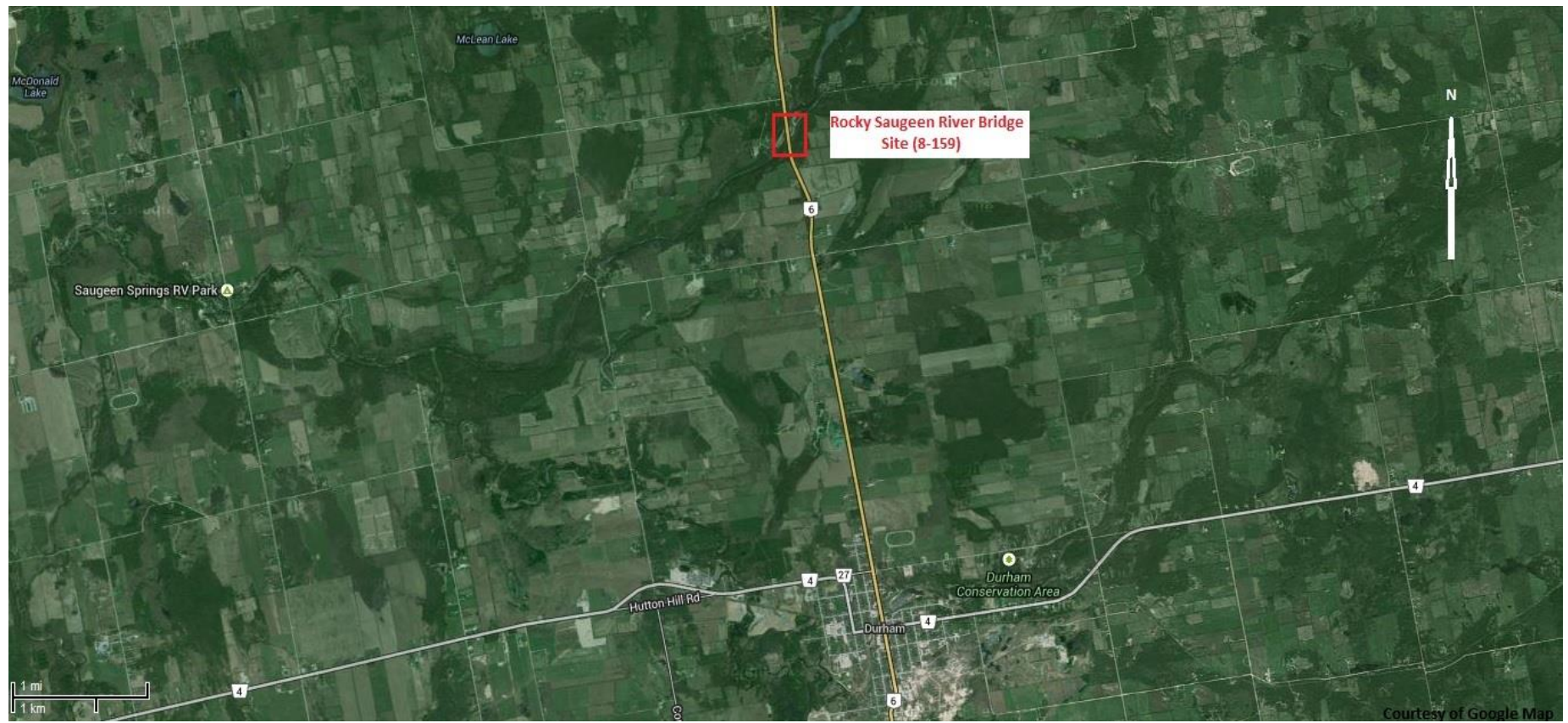


Robert Ng, MBA, PhD, P.Eng.
Senior Project Engineer



Brian R. Gray, M.Eng, P.Eng.
MTO Designated Principal Contact
NR/RN/BRG:nr-mi-jk

Figure 1 – Key Plan



EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S SPLIT SPOON	T P THINWALL PISTON
W S WASH SAMPLE	O S OSTERBERG SAMPLE
S T SLOTTED TUBE SAMPLE	R C ROCK CORE
B S BLOCK SAMPLE	P H T W ADVANCED HYDRAULICALLY
C S CHUNK SAMPLE	P M T W ADVANCED MANUALLY
T W THINWALL OPEN	F S FOIL SAMPLE
F V FIELD VANE	

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{v0}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m ³	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m ³	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m ³	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m ³ /s	RATE OF DISCHARGE
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL	WTP		WETTER THAN PLASTIC LIMIT	j	kN/m ³	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No. RS-1

1 of 1

METRIC

G.W.P. 3125-03-00 **LOCATION** Co-ordinates: 4 899 553.4 N ; 198 299.5 E **ORIGINATED BY** S.A.
DIST London **HWY** 6 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** N.R.
DATUM Geodetic **DATE** July 16, 2014 **CHECKED BY** B.R.G.

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			20 40 60 80 100									
								SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
330.2	Ground Surface																
0.0	170mm asohalt over gravelly sand, cobbles		1	SS	30		330										
	(PAVEMET FILL)																
329.5	Sandy gravel some silt, trace clay cobbles		2	SS	15		329									44 33 19 4	
0.7	Compact Brown moist																
			3	SS	18												
	Sand, with gravel some silt, trace clay						328										
	Loose Brown Moist		4	SS	6											27 49 20 4	
	(FILL)																
			5	SS	7		327										
326.3	End of borehole																
3.9	Refusal on probable bedrock																
	* Borehole dry																
	NOTE: Caved-in at 1.0m																

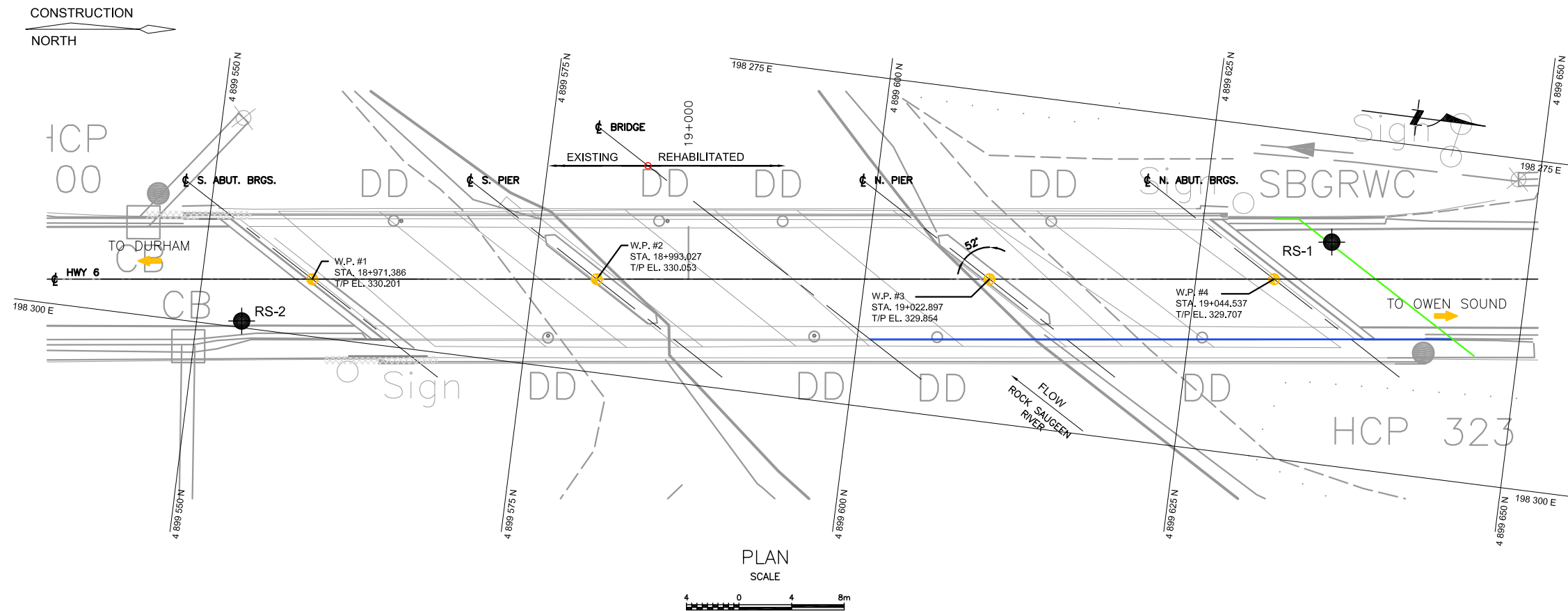
RECORD OF BOREHOLE No. RS-2

1 of 1

METRIC

G.W.P. 3125-03-00 **LOCATION** Co-ordinates: 4 899 634.9 N ; 198 283.1 E **ORIGINATED BY** S.A.
DIST London **HWY** 6 **BOREHOLE TYPE** Continuous Flight Solid Stem Augers **COMPILED BY** N.R.
DATUM Geodetic **DATE** July 16, 2014 **CHECKED BY** B.R.G.

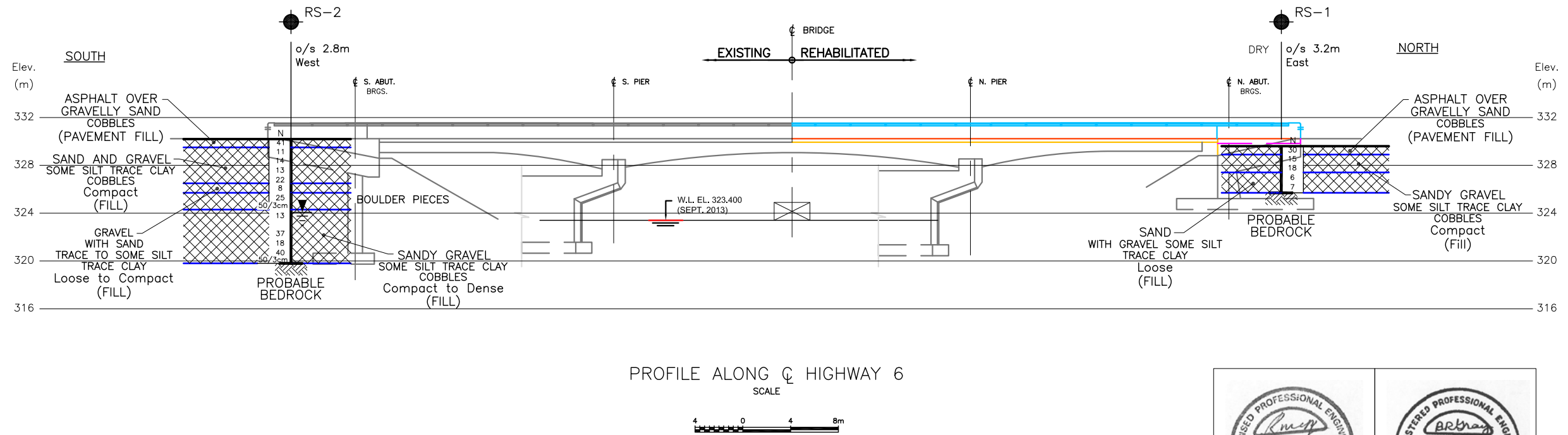
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					WATER CONTENT (%)												
329.6	Ground Surface						20	40	60	80	100						
0.0	230mm asphalt over gravelly sand, cobbles		1	SS	41												
328.9	Dense Brown/ Moist grey (PAVMENT FILL)		2	SS	11												
0.7	Sand and gravel some silt, trace clay cobbles																
	Compact Brown Moist		3	SS	14												
			4	SS	13											40 40 17 3	
			5	SS	22												
	Gravel, with sand trace to some silt trace clay		6	SS	8												
	Loose to compact																
	boulder pieces		7	SS	25											67 21 10 2	
			8	SS	50/3cm												
323.7	(FILL)																
5.9	Sandy gravel some silt, trace clay cobbles					▽*											
	Compact Brown Wet to dense		9	SS	13												
	limestone pieces		10	SS	37											46 33 17 4	
			11	SS	18												
			12	SS	40												
319.2			13	SS	50/3cm												
10.4	End of borehole Refusal on probable bedrock																
	* 2014 07 16																
	▽ Water level observed during drilling																
	NOTE: Caved-in at 8.2m																



LEGEND

	Borehole
	Borehole and cone
	Cone penetration test
N	Blows/0.3m (Std. Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
	W L at time of investigation July 2014.
	Head
	ARTESIAN WATER
	Encountered
	PIEZOMETER

BH No	ELEVATION	COORDINATES	
		NORTHINGS	EASTINGS
RS-1	329.6	4 899 634.9	198 283.1
RS-2	330.2	4 899 553.4	198 299.5



- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH RECORD OF BOREHOLES AND REPORT
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



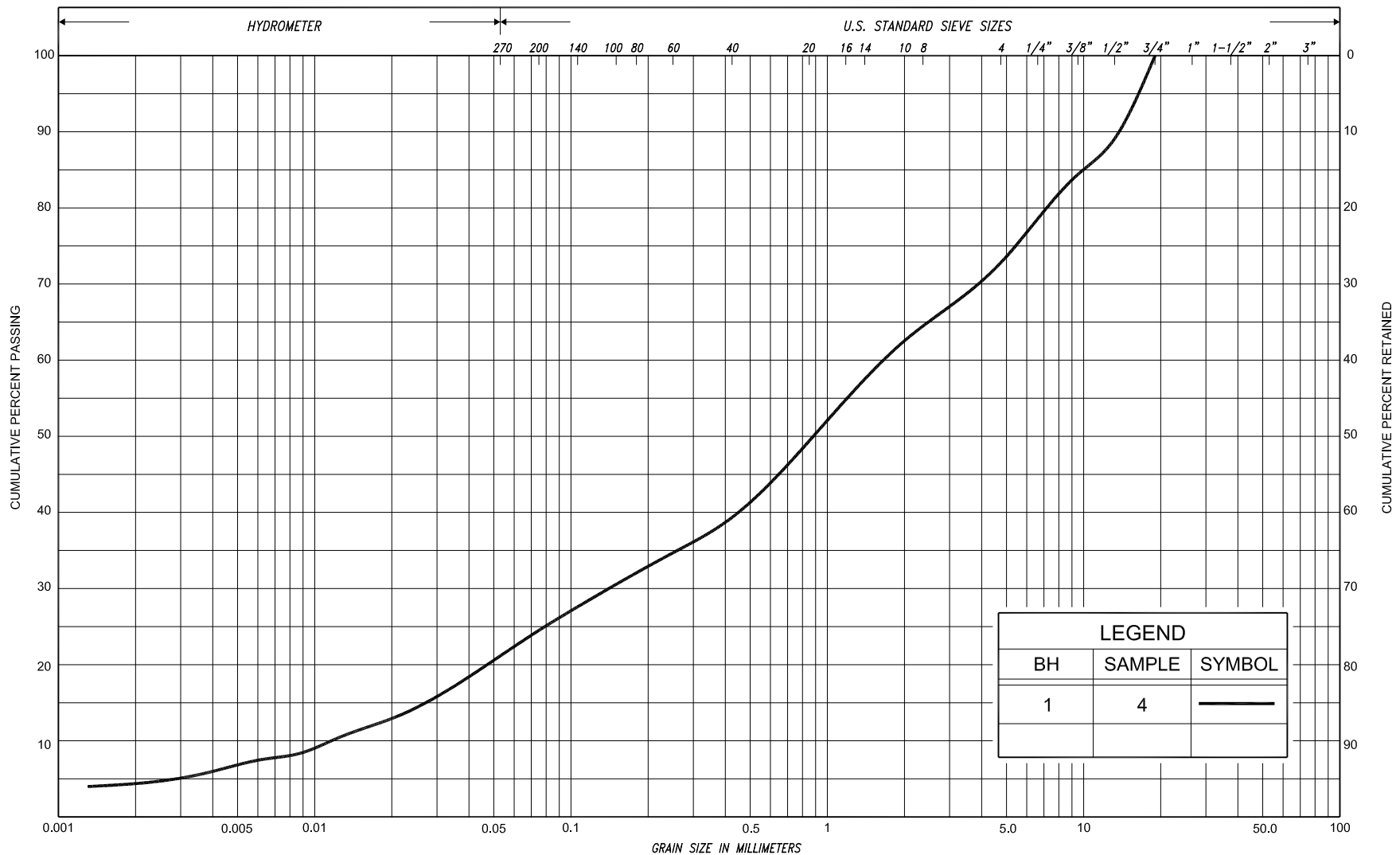
Reference MMM Drawings:
S381 3001-305-007.GA.dwg; s381 3001-305-000XG.dwg
and s381 3001-300-001XG.dwg dated April 2014

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41A-234

HWY No	4	DIST	LONDON
SUBMD	NA	CHECKED	NR
DATE	NOV. 26, 2014	SITE	8-159
DRAWN	NA	CHECKED	RN
APPROVED	BRG	DWG	RS-1



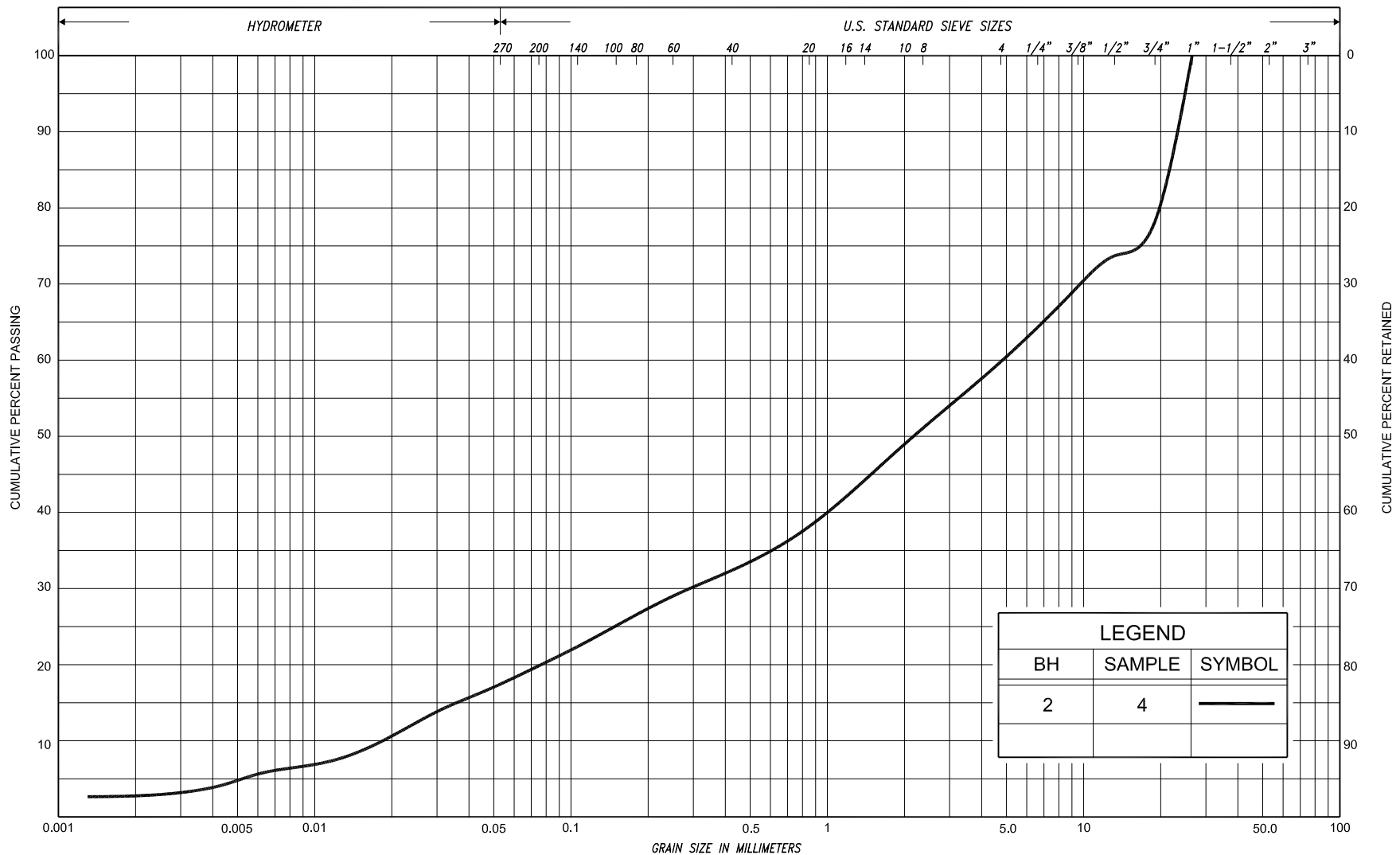
LEGEND		
BH	SAMPLE	SYMBOL
1	4	—

SILT & CLAY				FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL				COBBLES	UNIFIED			
CLAY	FINE		MEDIUM SILT		COARSE		FINE		MEDIUM SAND		COARSE		GRAVEL				COBBLES	M.I.T.
CLAY		SILT			V. FINE	FINE	MED.	COARSE		GRAVEL							U.S. BUREAU	



GRAIN SIZE DISTRIBUTION SAND, with gravel, some silt, trace clay (FILL)

FIG No. RS-GS-1
HWY: 6
G.W.P. No. 3125-03-00

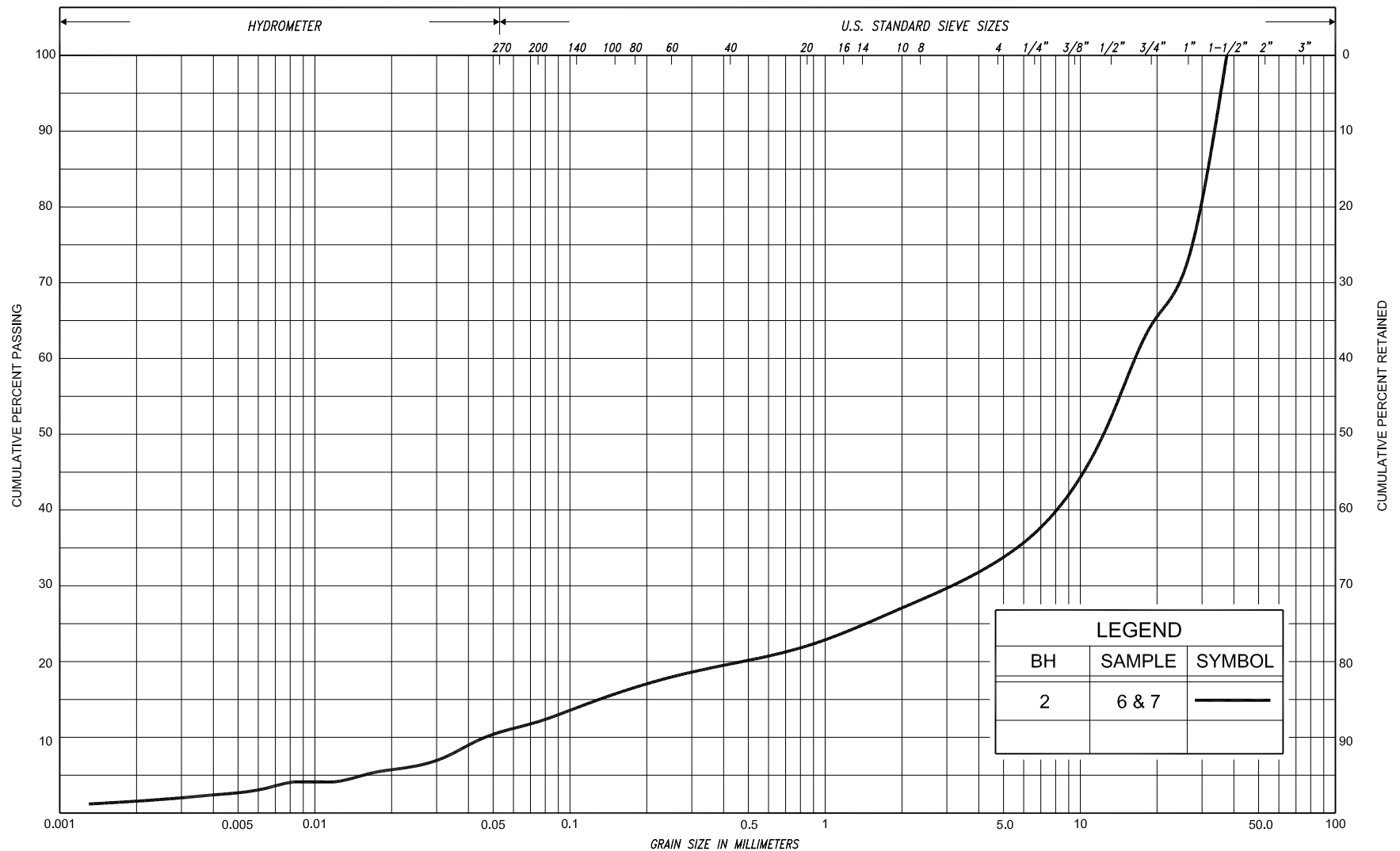


SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED	
					SAND											
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES
	SILT							SAND								
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL					U.S. BUREAU
						SAND										



GRAIN SIZE DISTRIBUTION SAND AND GRAVEL, some silt, trace clay (FILL)

FIG No. RS-GS-2
HWY: 6
G.W.P. No. 3125-03-00

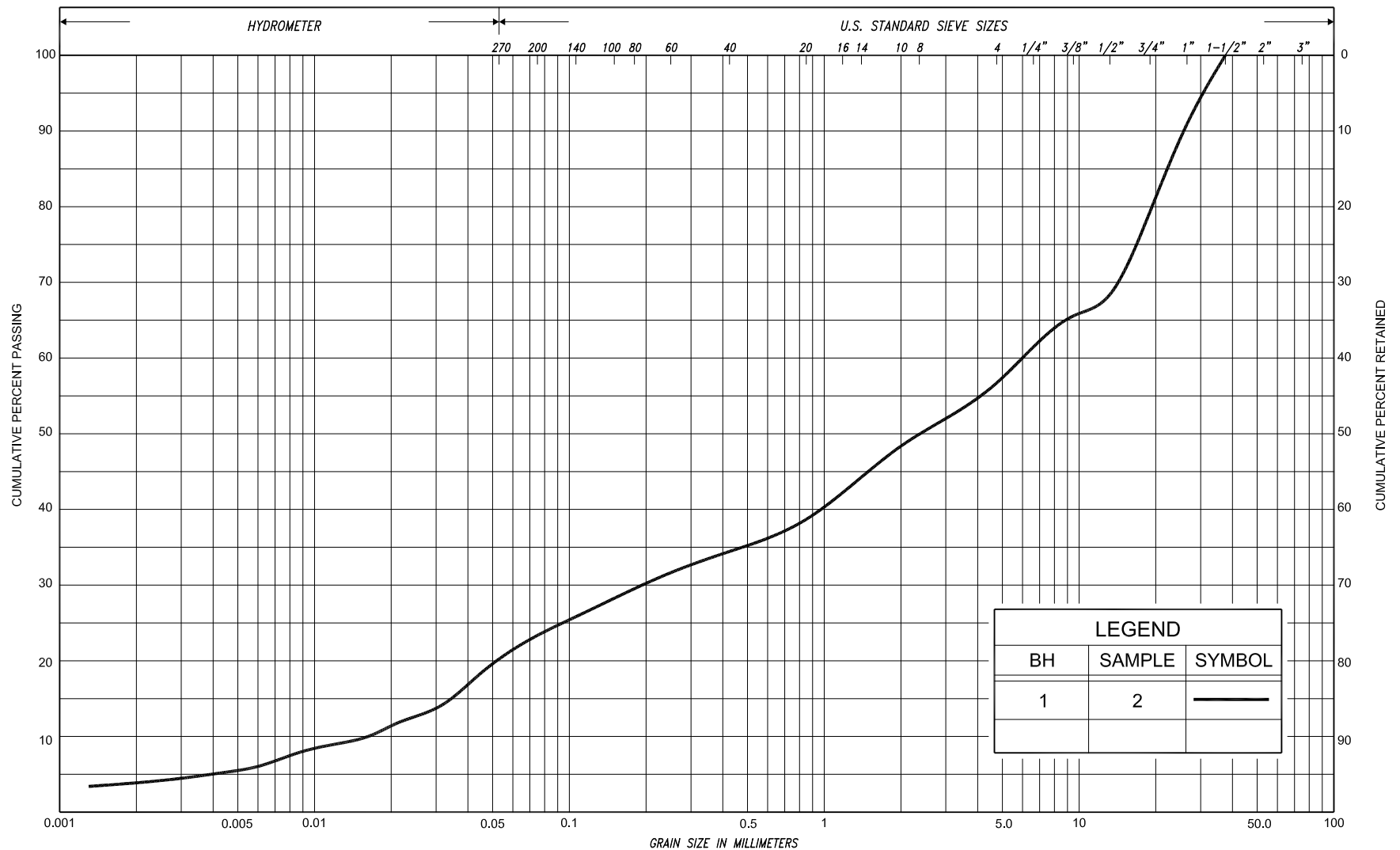


SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED
				SAND									
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		GRAVEL				COBBLES	M.I.T.
	SILT			SAND									
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU
				SAND									



GRAIN SIZE DISTRIBUTION GRAVEL, with sand, trace to some silt, trace clay (FILL)

FIG No. RS-GS-3
HWY: 6
G.W.P. No. 3125-03-00



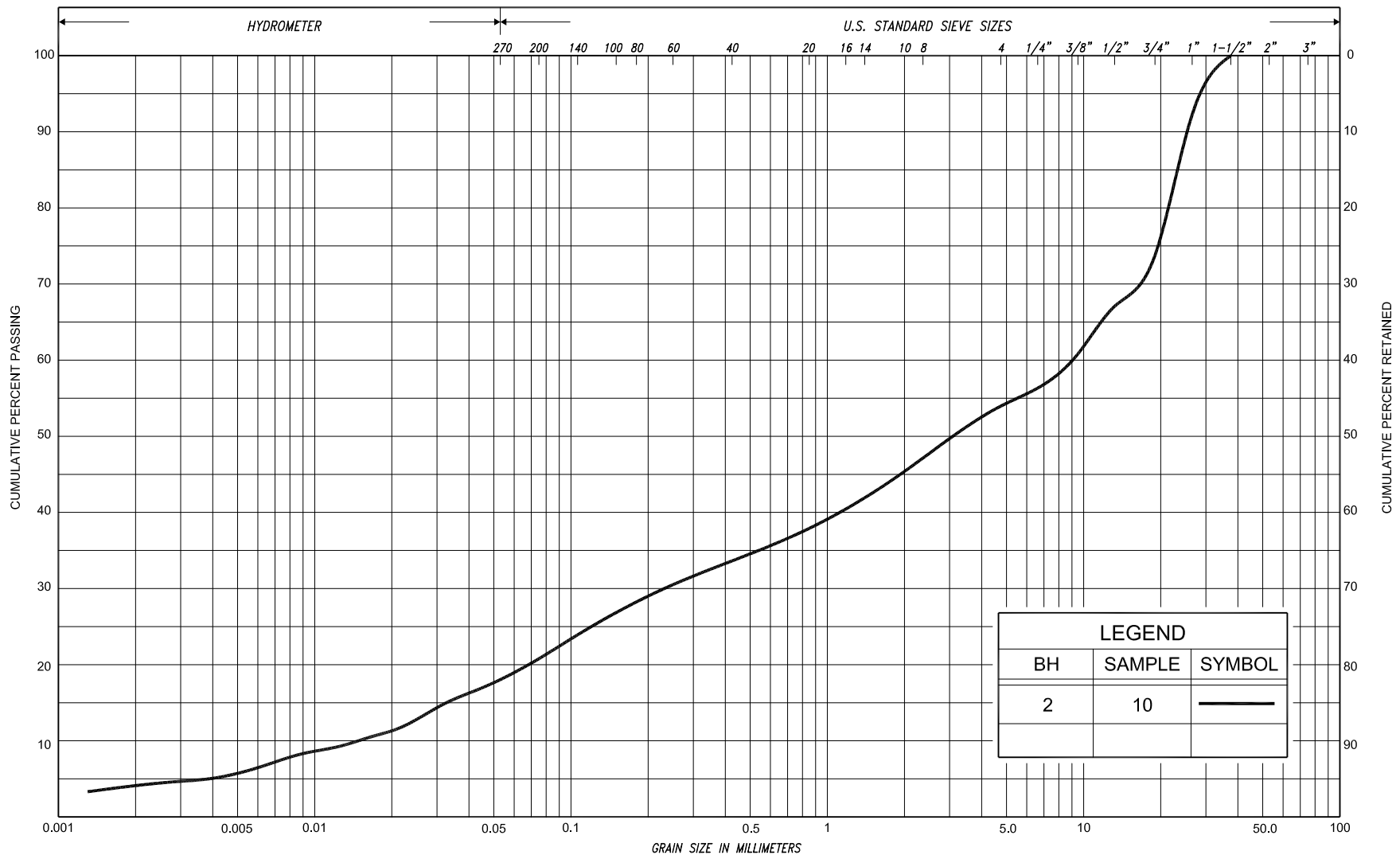
LEGEND		
BH	SAMPLE	SYMBOL
1	2	—

SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM	COARSE	FINE	MEDIUM	SAND	COARSE	GRAVEL		COBBLES	M.I.T.
		SILT			V. FINE	FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
CLAY		SILT		SAND								



GRAIN SIZE DISTRIBUTION SANDY GRAVEL, some silt, trace clay (FILL)

FIG No. RS-GS-4
HWY: 6
G.W.P. No. 3125-03-00



LEGEND		
BH	SAMPLE	SYMBOL
2	10	—

SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED			
				SAND														
CLAY	FINE		MEDIUM SILT		COARSE		FINE		MEDIUM SAND		COARSE		GRAVEL				COBBLES	M.I.T.
CLAY			SILT			V. FINE		FINE		MED.		COARSE		GRAVEL				U.S. BUREAU
						SAND												



PRELIMINARY FOUNDATION DESIGN REPORT

for

**ROCKY SAUGEE RIVER BRIDGE ON HIGHWAY 6
MTO WEST REGION 59 STRUCTURE REHABILITATIONS
SITE 8-159, CONTRACT 2
GWP 3125-03-00
GREY COUNTY, ONTARIO**

PETO MacCALLUM LTD.
165 CARTWRIGHT AVENUE
TORONTO, ONTARIO
M6A 1V5
Phone: (416) 785-5110
Fax: (416) 785-5120
Email: toronto@petomaccallum.com

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Table 1 – List of Standard Specifications Referenced in Report
Non-Standard Specific Provision (NSSP)

PRELIMINARY FOUNDATION DESIGN REPORT

for

Rocky Saugeen River Bridge on Highway 6
MTO West Region 59 Structure Rehabilitations
Site 8-159, Contract 2, GWP 3125-03-00
Grey County, Ontario

1. INTRODUCTION

This part of the report provides preliminary foundation engineering analysis and recommendations for preliminary design and construction of temporary roadway protection to be used in the rehabilitation of the Rocky Saugeen River Bridge on Highway 6 in the Grey County, Ontario. The study was carried out by Peto MacCallum Ltd. (PML) for MMM Group Limited (MMM) on behalf of the Ministry of Transportation of Ontario (MTO).

Initially the existing abutments were planned to be converted to semi-integral abutments and the geotechnical investigation was completed for this purpose. However, it was later decided to carry out minor rehabilitations instead of conversion to semi-integral abutments.

The design recommendations report is completed for information only and is prepared for the installation of temporary roadway protection that may be required along the centreline of the northbound and southbound lanes at both ends of the bridges should there be the conversion to semi-integral abutments, which is at present not the adopted option.

In summary, a 170 and 230 mm thick layer of asphaltic concrete over a 530 and 470 mm thick layer of gravelly sand was encountered in boreholes RS-1 and RS-2, respectively, which extended to 0.7 m. The pavement structure was underlain by a layer of loose to dense fill in boreholes RS-1 and RS-2, which extended to 3.9 and 10.4 m, respectively. The fill layer encountered included sandy gravel, sand and gravel and gravel units with inclusions of cobbles, boulder and limestone pieces. Boreholes RS-1 and RS-2 were terminated at 3.9 m and 10.4 m, where auger refusal was met on probable bedrock.

It is noted that a Technical Memorandum was prepared under a separate cover as part of this assignment to summarize the subsurface and groundwater conditions based on available reports. This separate document was intended for the design project terms of reference and to update the



foundation design recommendations provided in the available reports to the Limit State design terminology in conformance with the requirements of the Canadian Highway Bridge Design Code (CHBDC). Reference should be made to this Technical Memorandum for additional foundation recommendations.

The elevations referred in this report are expressed in meters. A list of the Ontario Provincial Standard documents referenced in this report is enclosed in Table 1.

2. PRELIMINARY ENGINEERING DISCUSSION AND RECOMMENDATIONS

Probable bedrock was encountered in boreholes RS-1 and RS-2 at 3.9 and 10.4 m, elevation 325.7 and 319.8, respectively.

In the previous investigation report (GEOCREC No. 41A00-001, dated 1956), bedrock was encountered between elevations 319.9 and 325.3 at the bridge site. The bedrock in borehole BH 1 at the south abutment location was encountered at elevation 322.3 and in borehole BH 4 at the north abutment location the bedrock was encountered at elevation 325.3.

At the south abutment location, it is believed that during the construction of the bridge, the bedrock was excavated down to at least the foundation footing elevation 319.6. Hence, during the July 16, 2014 investigation, the probable bedrock was encountered in borehole RS-2 at the south abutment at approximate elevation of 319.8 above which various fill materials were encountered comprising sandy gravel, sand and gravel and gravel with inclusions of cobbles, boulder and limestone pieces.

2.1 Temporary Roadway Protection

In the initial design temporary roadway protection may be used during the rehabilitation of the Rocky Saugeen Bridge on Highway 6 for the conversion to semi-integral abutments. However, it is later decided that only minor rehabilitations will be carried out. The following section is provided for information only should the semi-integral conversion is adopted and temporary road protection is necessary.



The temporary roadway protection is expected to extend to a sufficient depth to allow for excavations at the abutments. It is anticipated that the excavation at the north abutment may extend up to 3.9 m and at the south abutment the excavation may extend up to 4.0 m. Temporary protection is feasible and should be constructed in accordance with OPSS 539. A minimum performance level of 2, according to OPSS 539 is recommended. The contractor is responsible for selection, preparation of a detailed design and performance for the roadway protection system. The presence of cobbles, limestone and boulder pieces within the fill material and the possibility of the granular fill migrating through the temporary protection should be considered during detailed design. A NSSP shall be included in the contract documents advising the Contractor that presence of cobbles, limestone and boulder pieces within the fill material should be considered during the selection, design and performance for the roadway protection system.

Provided adequate groundwater control is achieved, site soils are classified as Type 3 soils. However, if it is anticipated that the excavation will be below the groundwater level then the site soils will behave and considered to be as Type 4 soils according to Occupational Health and Safety Act, 1990 and Regulation 213/1991 for Construction Projects. Excavations in Type 3 soil should be cut back at an inclination of 1H:1V from the base of the excavation and excavations in Type 4 soil should be cut back an inclination of 1H:3V from the base of the excavation.

2.2 Groundwater Control

Groundwater was encountered only in borehole RS-2, near south abutment, at 6.1 m, elevation 324.1 during augering. In borehole RS-1, groundwater was not encountered during and after completion of augering.

It is expected that conventional filtered sump pumping techniques will be sufficient to control seepage of water into the excavation.



3. CLOSURE

This preliminary report was prepared by Mr. N. Rahman, P.Eng and was reviewed by Mr. R. Ng, PhD, P.Eng., Senior Project Engineer. Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

Yours very truly,

Peto MacCallum Ltd.



Nazibur Rahman, P.Eng.
Project Engineer, Geotechnical Services



Robert Ng, MBA, PhD, P.Eng.
Senior Project Engineer



Brian R. Gray, M.Eng, P.Eng.
MTO Designated Principal Contact

NR/RN/BRG:nr-mi



TABLE 1
LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

DOCUMENT	TITLE
OPSS 539	Construction Specification for Temporary Protection Systems

NON-STANDARD SPECIAL PROVISION (NSSP)

NSSP - Construction Specification for Temporary Protection Systems (Addition of OPSS 539)

The Contractor shall be advised that cobbles, limestone and boulder pieces were encountered within the fill material and that the Contractor shall use methods and equipment that will enable the design and construction of the temporary roadway protection system. The Contractor is responsible for selection, preparation of a detailed design and performance for the roadway protection system.