



FOUNDATION INVESTIGATION REPORT

for

**WESTBOUND QUEEN ELIZABETH WAY OVERPASS AT FORD DRIVE
QUEEN ELIZABETH WAY AND HIGHWAY 403
TOWN OF OAKVILLE
REGIONAL MUNICIPALITY OF HALTON, ONTARIO
G.W.P. 2163-10-00, SITE NO. 10-286/2
CENTRAL REGION, ONTARIO**

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PART A – FOUNDATION INVESTIGATION REPORT
for
Westbound Queen Elizabeth Way Overpass at Ford Drive
Queen Elizabeth Way and Highway 403
Town of Oakville
Regional Municipality of Halton, Ontario
GWP 2163-10-00, Site 10-286/2
Central Region, Ontario

1. INTRODUCTION

This report presents the factual findings obtained from the geotechnical foundation investigation carried out for the detail design of the replacement of the existing structure carrying the Queen Elizabeth Way (QEW) westbound lane traffic over Ford Drive in the Town of Oakville, Regional Municipality of Halton. The foundation investigation was conducted by Peto MacCallum Ltd. (PML), retained as a sub-consultant to Stantec Consulting Ltd. (Stantec) on behalf of the Ministry of Transportation of Ontario (MTO).

The QEW passes over Ford Drive at approximate Station 23+387 QEW chainage based on the preliminary General Arrangement (GA) drawing ('Pre-GA1.dwg') prepared by MTO in August 2016. The replacement structure is proposed to be constructed along the same alignment as the existing bridge.

This report provides subsurface information pertaining to the proposed structure and approaches within approximately 20 m of the abutments. A review of the following reports for the existing structure was carried out.

1. Preliminary Foundation Investigation and Design Report
QEW Overpass at Ford Drive - Reconstruction
Queen Elizabeth Way / Highway 403 Improvements
Oakville, Ontario
W.O. 09-20007
GEOCREs No. 30M5-297
Thurber Engineering Ltd. dated October 15, 2013
2. Foundation Investigation Report
QEW Over Ford Drive
W.P. 125-66-17, Site 10-286
QEW, District 4, Hamilton
GEOCREs No. 30M5-116
Engineering Materials Office – Soil Mechanics Section dated January 25, 1978



The subsurface information from GEOCREs boreholes 5, 6, 13-23 and 13-24 advanced as part of the previous investigations (GEOCREs Nos. 30M5-116 and 30M5-297) is considered to be relevant and used in this report.

All elevations in this report are expressed in meters.

2. SITE DESCRIPTION

The site is situated approximately 0.5 km south of the QEW / Highway 403 interchange. The existing structure carries the QEW westbound traffic over Ford Drive. The performance of the existing structure foundations and related approach embankments appears to be satisfactory.

Lands within the QEW / Highway 403 right of way near the project site are generally vacant and grass covered. The topography of the area is gently sloping down towards the south. The Ford Drive roadway is located within a cut, some 6 to 8 m below the QEW road grade.

Outside of the highway right of ways, land use primarily includes commercial and light industrial buildings and businesses. The Ford Motor Company occupies the majority of the land to the south of the QEW / Highway 403. Site photographs are included in Appendix FIR-A.

3. FIELD INVESTIGATION PROCEDURES

The field work for this study was carried out during the period of November 22 to November 27, 2015 and comprised 4 new boreholes (15-2, 15-2A, 15-4 and 2-NEW) drilled to depths ranging from 0.6 to 7.9 m. The records of the current boreholes and of the GEOCREs boreholes 5, 6, 13-23 and 13-24 are attached in Appendix FIR-B. The locations of the boreholes are shown on Drawing WBFD-1, provided in Appendix FIR-C.

The locations of the new boreholes were established in the field by PML. All four boreholes were advanced using continuous flight hollow and solid stem augers, powered by a truck mounted D50 drill rig, supplied and operated by Tri-Phase Group, a specialist drilling subcontractor,



working under the full-time supervision of a member of the PML engineering staff. Two boreholes (15-2A and 15-4) were extended 3.0 m into bedrock using NQ diamond rock coring equipment.

Representative soil samples were recovered at 0.75 m and 1.5 m depth intervals using the standard penetration test (SPT) method. Standard penetration tests were conducted to assess the strength characteristics of the substrata. The results of the field tests and observations are reported on the Record of Borehole sheets, provided in Appendix FIR-B.

Soils were identified and described in accordance with the MTO soil classification manual procedures. The groundwater conditions in the boreholes were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, where encountered, by measuring the groundwater level in the open boreholes.

Surveying of the boreholes was conducted after drilling by Callon Dietz Inc., under contract to Stantec and the coordinates and ground surface elevations of all four boreholes were collected and provided on the Record of Borehole sheets and on Drawing WBFD-1.

During drilling the target termination criterion of 100 blows per 0.3 m penetration or refusal on bedrock was met for all boreholes. The boreholes were backfilled in accordance with the MTO guideline and MOE Reg. 903 for borehole abandonment procedures.

4. LABORATORY TEST PROCEDURES

The recovered soil samples were returned to the PML laboratory in Toronto for detailed visual examination, laboratory testing and classification. Table 4.0 provides the types and quantities of the laboratory tests completed for the foundation investigation.

Table 4.0: Laboratory Testing Program

LABORATORY TEST	QUANTITY
Natural Moisture Content	10
Grain Size Distribution Analyses	5
Atterberg Limits	4



The grain size distribution curves of selected soil samples are presented on Figures WBFD-GS-1 to WBFD-GS-3. The results of the Atterberg Limits tests are given on Figures WBFD-PC-1 and WBFD-PC-2. All of the laboratory figures from the current and previous investigations are provided in Appendix FIR-D and the test results are summarized on the Record of Borehole sheets, provided in Appendix FIR-B.

5. SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

The project area lies within the physiographic region known as the South Slope. The South Slope is bounded by the Peel Plain to the north and the Iroquois Plain to the south. The physiographic region extends from the Niagara escarpment to the Trent River and covers approximately 2,435 square kilometers. The South Slope is characterized by glacial deposits overlying shale bedrock of the Queenston and Meaford-Dundas Formations. (L.J. Chapman and D.F. Putnam, *The Physiography of Southern Ontario*, 3rd Edition, 1984).

Locally, the Meaford-Dundas Formation is a medium gray shale with good fissility and resistant interbeds of gray fossiliferous limestones and siltstones.

5.2 Subsurface Conditions

Reference is made to the Record of Borehole sheets for details of the subsurface conditions including soil classifications, bedrock descriptions, inferred stratigraphy, boundary elevations, SPT data and groundwater observations.

A stratigraphic profile and sections along the proposed abutments were prepared from the borehole data and are shown on Drawing WBFD-1 and Drawing WBFD-2, respectively. The boundaries between soil strata were established at borehole locations only. The soil boundaries between and beyond the boreholes are assumed and may vary from what is shown on Drawing WBFD-1.



The subsurface stratigraphy revealed in the boreholes generally comprised fill layers and a cohesive deposit of clayey silt / silty clay overlying low to medium strength, highly weathered shale bedrock. Limestone interbedded with slightly weathered shale bedrock was encountered within the Meaford-Dundas Formation, underlying the highly weathered shale.

Groundwater was not observed in any of the boreholes during or upon completion of augering. Boreholes 15-2A and 15-4 were charged with drilling water to facilitate the rock coring operations.

5.2.1 Fill

Asphalt, 150 to 250 mm in thickness, was present surficially in boreholes 15-2, 15-2A, 15-4 and 2-NEW advanced on the shoulder of the QEW westbound lane. Asphalt is underlain by non-cohesive sand and gravel pavement fill which extends to elevation 129.1 in borehole 15-2, 129.0 in borehole 15-2A, 130.0 in borehole 15-4 and 131.1 in borehole 2-NEW. The results of a grain size distribution analysis performed on a sample of gravelly sand fill from borehole 2-NEW are presented in Figure WBFD-GS-1.

Borehole 15-2 encountered refusal on probable concrete at elevation 129.1.

Underlying the 150 mm of asphalt in boreholes 13-23 and 13-24 was sand and gravel fill. The non-cohesive fill is compact to dense in relative density with SPT-N values ranging from 19 to 31. The sand and gravel fill was 1.3 m thick in both boreholes and penetrated at elevation 128.2 and 130.0 in boreholes 13-23 and 13-24, respectively.

Clayey silt to silty clay fill material was encountered underlying the pavement fill in boreholes 15-2A and 2-NEW. The thickness of the cohesive fill was 1.5 m in borehole 15-2A and 0.8 m in borehole 2-NEW. The clayey silt to silty clay fill extended to elevation 127.5 and 130.3 in boreholes 15-2A and 2-NEW respectively.



SPT-N values of the clayey silt fill ranged from 18 to 49, indicating very stiff to hard consistency. Weathered shale fragments were observed in the cohesive fill in borehole 2-NEW.

The results of grain size distribution analysis for a sample collected from the cohesive fill is shown on Figure WBFD-GS-2. The Atterberg plasticity chart is presented on Figure WBFD-PC-1. Table 5.2.1 summarizes the results of the grain size distribution analysis conducted on the sample of clayey silt fill material.

Table 5.2.1: Grain Size Distribution – Fill

MATERIAL	PERCENTAGE
Gravel	10
Sand	26
Silt	43
Clay	21

The liquid and plastic limits of the fill samples were 27 and 17, respectively, with the corresponding plasticity index of 10. The moisture content determination was 15%, corresponding to a moist soil condition.

5.2.2 Clayey Silt / Silty Clay

A cohesive deposit of clayey silt / silty clay was present surficially in boreholes 5 and 6. The deposit ranged in thickness from 2.1 to 2.4 m and penetrated into weathered shale bedrock at elevation 126.4 in borehole 5 and 128.5 in borehole 6.

Clayey silt / silty clay was encountered in boreholes 15-2A, 15-4, 2-NEW, 13-23 and 13-24, overlain by the fill material. The thickness of the cohesive deposit ranged from 0.3 m to 2.2 m and extended to highly weathered shale bedrock at elevation 126.1 in borehole 15-2A, 129.2 in borehole 15-4, 129.3 in borehole 2-NEW, 126.1 in borehole 13-23 and 129.7 in borehole 13-24.



Shale bedrock fragments were encountered in the cohesive deposit in boreholes 15-2A, 2-NEW and 13-24.

SPT-N values of the clayey silt / silty clay ranged from 6 to 54 indicating firm to hard consistency, typically stiff to very stiff consistency. The results of grain size distribution analyses and Atterberg limits testing conducted on three samples of the native clayey silt to silty clay are presented in respective Figures WBFD-GS-3 and WBFD-PC-2. Table 5.2.2 summarizes the results of the grain size distribution analyses conducted on the native soil from boreholes 15-2A, 15-4 and 2-NEW.

Table 5.2.2: Grain Size Distribution – Clayey Silt / Silty Clay

MATERIAL	PERCENTAGE
Gravel	4-16
Sand	6-14
Silt	49-60
Clay	21-37

The clayey silt to silty clay had a liquid limit ranging from 27 to 36, a plastic limit ranging from 17 to 20 and a corresponding plasticity index ranging from 10 to 16. The moisture content of the deposit ranged from 8 to 18%, below the plastic limit, indicating a moist soil condition.

5.2.3 Bedrock

Bedrock was contacted or inferred by split spoon refusal and auger grinding below the native clayey silt to silty clay material in the three boreholes drilled during the current investigation and in the four boreholes drilled from the previous investigations. The depths and elevations at which the top of the bedrock was encountered are summarised in Table 5.2.3.



Table 5.2.3: Depths and Elevations of Bedrock Surface

STRUCTURE ELEMENT	BOREHOLE	BEDROCK SURFACE	
		DEPTH (m)	ELEVATION (m)
South (Construction West) Abutment	15-2A	3.6	126.1
	13-23	3.7	126.1
	5	2.4	126.4
North (Construction East) Abutment	15-4	2.2	129.2
	13-24	1.8	129.7
	6	2.1	128.5
North (Construction East) Approach	2-NEW	2.4	129.3

The bedrock in the Meaford-Dundas Formation comprised a grey to dark grey highly to slightly weathered low to medium strength shale bedrock with limestone interbeds. The shale bedrock has thin horizontal bedding and dipping to vertical joints. Seams or layers of clayey silt / silty clay were also noted within the highly weathered zones of the bedrock. The shale bedrock is susceptible to wetting/drying cycles and not durable upon exposure to the elements.

During the drilling operation of boreholes 15-2A, 15-4 and 2-NEW, within the shale bedrock formation, auger refusal was encountered on the limestone interbeds. The limestone interbeds are significantly harder to penetrate than the highly weathered shale bedrock.

GEOCRE 30M5-297 conducted unconfined compression strength (UCS) testing of the bedrock with results ranging from 42 to 97 MPa, indicating a medium to strong bedrock strength classification. The values were interpreted from point load tests conducted on intact cores.

The rock cores retrieved from boreholes 5, 6, 15-2A, 15-4, 13-23 and 13-24 are described on the corresponding borehole logs attached in Appendix FIR-B. A detailed description of the bedrock cores retrieved from boreholes 15-2A and 15-4 is given in Table A, attached in Appendix FIR-E. Photographs of the bedrock cores retrieved from borehole 15-2A and 15-4 are also attached in Appendix FIR-E.



The measured core recovery varied between 33% and 100%. The Rock Quality Designation (RQD) determined from the rock cores ranged from 7% to 83%, typically 50% to 70%, thus indicating a fair quality bedrock.

The low RQD value of 7%, presented in boreholes 15-2A, likely reflects local conditions of weathered bedrock that differ from the RQD values of 50% to 83% seen in the slightly weathered bedrock in borehole 15-4 and the MTO GEOCRETS reports.

5.2.4 Groundwater

During the process of augering, groundwater was not detected in any of the boreholes drilled during the current investigation (15-2, 15-2A, 15-4 and 2-NEW). Boreholes 15-2A and 15-4 were charged with drilling water during the process of coring the bedrock.

Boreholes 13-23 and 13-24 drilled during October 2013 were also dry upon completion of augering and charged with drilling water to facilitate the coring operation.

Groundwater levels observed during the 1978 investigation was 1.1 m below the ground surface. However, an indication was not provided in the GEOCRETS 30M5-116 report whether the recorded water level was a result of the coring operation.

It should be noted that groundwater levels are susceptible to seasonal fluctuations. In particular, the groundwater level may increase after the spring snowmelt or periods of significant and/or prolonged precipitation events.



6. CLOSURE

The field work was carried out under the supervision of Mr. S. Aziz, under the direction of Mr. K. R. Daly, P.Eng. The drilling equipment was supplied and operated by Tri-Phase Group. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.

This Foundation Investigation Report was prepared by Mr. K. R. Daly, P.Eng., Project Engineer and reviewed by Mr. G.O. Degil, PhD, P.Eng., Senior Engineer. Mr. C. M. P. Nascimento, P. Eng., Project Manager and MTO Designated Principal Contact conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.



Kyle R. Daly, P.Eng.
Project Engineer, Geotechnical Services



Carlos M.P. Nascimento, P.Eng.
Project Manager and
MTO Designated Principal Contact

KD/CN/GD:nk



APPENDIX FIR - A

Site Photographs



Photograph 1: Existing structures carrying QEW EB and WB Lanes over Ford Drive.



Photograph 2: Taken near the QEW Westbound construction west abutment.



APPENDIX FIR – B

Explanation of Terms Used in Report

Record of Borehole Sheets

GEOCRES Boreholes Logs from 30M5-297 and 30M5-116

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 15-2

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 186.0 N ; 290 756.5 E ORIGINATED BY S.A.
DIST Central BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY K.D.
DATUM Geodetic HWY QEW DATE November 26, 2015 CHECKED BY G.D.

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 (%)		
								<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>										<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> <div>w_p w w_L</div>		
129.7 0.0	Ground Surface																			
129.1 0.6	150 mm asphalt over sand and gravel																			
	(PAVEMENT FILL)																			
	End of borehole																			
	Refusal on probable concrete																			

RECORD OF BOREHOLE No 15-2A

1 of 1

METRIC

G.W.P.	2163-10-00	LOCATION	Coords: 4 817 184.0 N ; 290 756.5 E	ORIGINATED BY	S.A.
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DIST Central BOREHOLE TYPE Continuous Flight Hollow Stem Augers and NQ Coring COMPILED BY K.D.

DATUM Geodetic HWY QEW DATE November 26 and 27, 2015 CHECKED BY G.D.

[illegible]

RECORD OF BOREHOLE No 15-4

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 243.1 N ; 290 754.4 E ORIGINATED BY S.A.
DIST Central BOREHOLE TYPE Continuous Flight Hollow Stem Augers and NQ Coring COMPILED BY K.D.
DATUM Geodetic HWY QEW DATE November 25 and 26, 2015 CHECKED BY G.D.

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/m³	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									
131.4	Ground Surface						20	40	60	80	100									
0.0	150 mm asphalt over sand and gravel, trace silt																			
	Compact Brown Moist		1	SS	14															
	(PAVEMENT FILL)		2	SS	23															
130.0																				
1.4	Clayey silt trace sand, trace gravel		3	SS	40															
129.2	Hard Reddish Moist brown																			
2.2	Highly weathered shale bedrock silty clay seams		4	SS	50/10cm															
	Red/grey		5	SS	85/13cm															
126.5			6	SS	50/10cm															
4.9	Shale with interbedded limestone bedrock		7	RC NQ	REC 95%															
	Slightly weathered to moderately weathered																			
	Medium strength																			
	Fair quality		8	RC NQ	REC 98%															
123.5																				
7.9	End of borehole																			
	* Borehole charged with coring water																			

RECORD OF BOREHOLE No 2-NEW

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 253.9 N ; 290 753.8 E ORIGINATED BY S.A.
DIST Central HWY QEW BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY K.D.
DATUM Geodetic DATE November 22, 2015 CHECKED BY G.D.

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												
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
					WATER CONTENT (%)															
					20	40	60	80	100	20	40	60								
131.7 0.0	Ground Surface																			
131.1 0.6	250 mm asphalt over sand and gravel some silt, trace clay (PAVEMENT FILL)		1	SS	28													35 46 15 4		
	Silty clay, some sand weathered shale fragments		2	SS	49								○							
130.3 1.4	Hard Reddish Moist brown (FILL)												○					16 14 49 21		
	Clayey silt some sand, some gravel weathered shale fragments		3	SS	54								○							
129.3 2.4	Hard Reddish Moist brown		4	SS	82/28cm								○							
	Highly weathered shale bedrock																			
	Red Moist		5	SS	50/8cm								○							
	Red/grey																			
	Grey		6	SS	50/8cm								○							
125.5 6.2	End of borehole		7	SS	50/8cm															
	Refusal to augering																			

RECORD OF BOREHOLE No 13-23

1 OF 2

METRIC

W.P. _____ LOCATION N 4 817 184.8 E 290 769.4 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.25 - 2013.05.25 CHECKED BY LRB

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				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100			20 40 60				
129.7																
0.0	ASPHALT: (150mm)															
0.2	SAND and GRAVEL, some silt Dense to Compact Brown to Reddish Brown Damp (FILL)		1	SS	31		129								39 46 15 (SI+CL)	
			2	SS	19											
128.2																
1.5	Silty CLAY, trace sand Firm to Very Stiff Reddish Brown		3	SS	6		128									
			4	SS	8		127								0 4 40 56	
			5	SS	19											
126.1							126									
3.7	SHALE, with limestone interbeds, highly weathered, grey		6	SS	50/ 0.125		125									
	Start coring at 6.1m						124									
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds Clay seam (200mm) at 6.1m		1	RUN			123								RUN #1 TCR=100% SCR=80% RQD=53% UCS=97MPa (Average)	
	Limestone interbeds (25mm to 75mm) at 6.3m, 6.4m, 6.5m, 6.7m, 6.8m, 7.0m, 7.2m and (125mm) at 7.4m Vertical fracture (125mm) at 7.4m						122								RUN #2 TCR=100% SCR=97% RQD=83% UCS=72MPa (Average)	
	Horizontal fracture at 6.4m, 6.5m, 6.6m, 6.7m, 6.8m, 6.9m, 7.7m, 7.9m, 8.1m, 8.5m, 8.7m		2	RUN			121									
	Limestone interbeds (25mm) at 7.6m, 7.9m, 8.0m, 8.2m, 8.5m, 8.9m, 9.1m and (75mm) at 8.7m															
120.6																
9.1	END OF BOREHOLE AT 9.1m. BOREHOLE OPEN TO 9.1m AND WATER LEVEL AT 4.8m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-23

2 OF 2

METRIC

W.P. _____ LOCATION N 4 817 184.8 E 290 769.4 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.25 - 2013.05.25 CHECKED BY LRB

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.																

RECORD OF BOREHOLE No 13-24

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 241.5 E 290 767.3 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.24 - 2013.05.25 CHECKED BY LRB

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			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
131.5								20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE




RECORD OF BOREHOLE No 5

W P 125-66-17 LOCATION Co-ords N 15 803 726; E 953 841 ORIGINATED BY VK
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core & Cone Test COMPILED BY VK
DATUM Geodetic DATE March 22, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
422.7	Ground Level													
0.0	Clayey Silt To Silty Clay, Trace Of Sand Very Stiff Brown To Hard Grey		1	SS	16		420							
414.7			2	SS	37									
8.0			3	SS	100									
411.7	(Weathered)													
11.0	(Sound)		4	BXL	100% REC		410							RQD 0%
	Shale Bedrock* (See Below)		5	BXL	100% REC									RQD 0%
			6	BXL	100% REC		400							RQD 70%
			7	BXL	90% REC									RQD 20%
391.7	End Of Borehole													
31.0	*Intermittent Thin Beds Of Shale, Shaly Limestone & Limestone (Dark Grey Colour, Fine Texture, Soft To Hard, Shale Is Fissile, Thin Horizontal Bed- ding) With Limestone Seams (Light Grey, Fine Texture, Hard) From 14'4" to 15'4" 17'3" to 18'6" 21'0" to 21'9" 26'0" to 27'6"													

RECORD OF BOREHOLE No 6

W P 125-66-17 LOCATION Co-ords N 15 803 824; E 953 833 ORIGINATED BY VK
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core & Cone Test COMPILED BY VK
 DATUM Geodetic DATE March 21, 1977 CHECKED BY RS

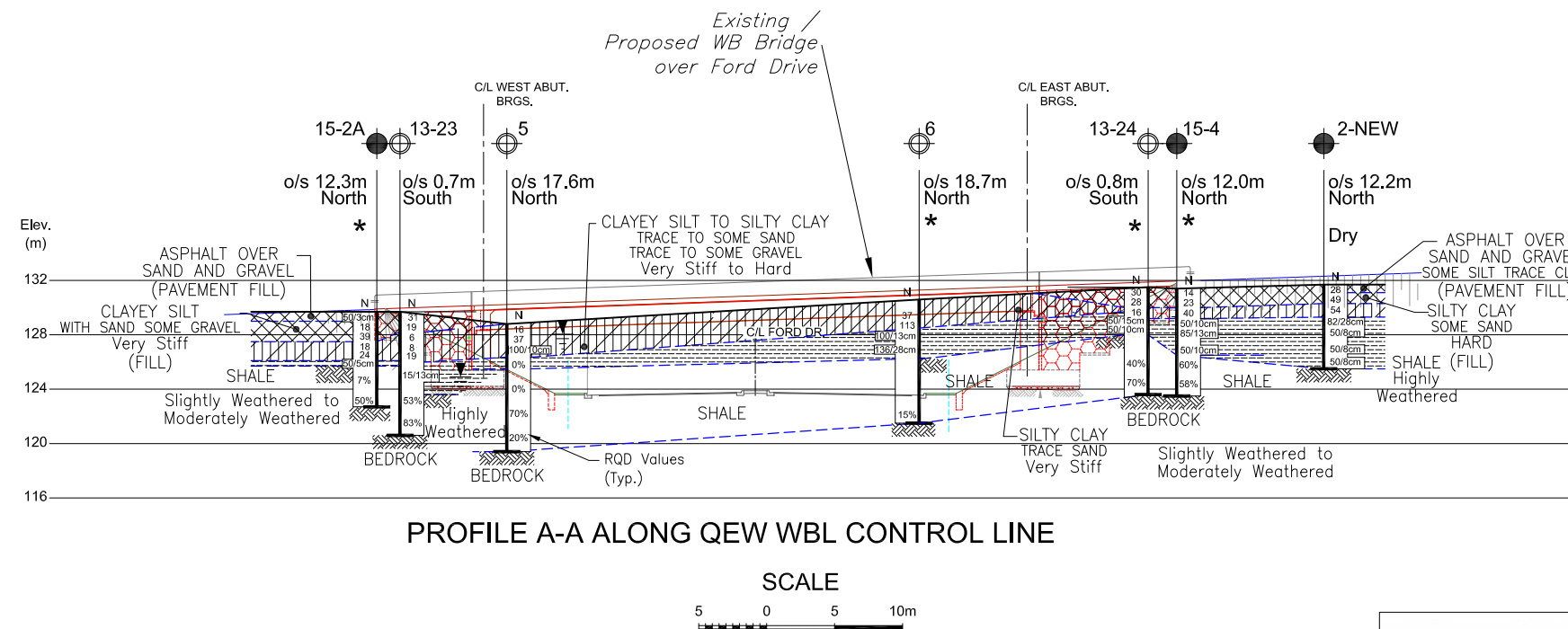
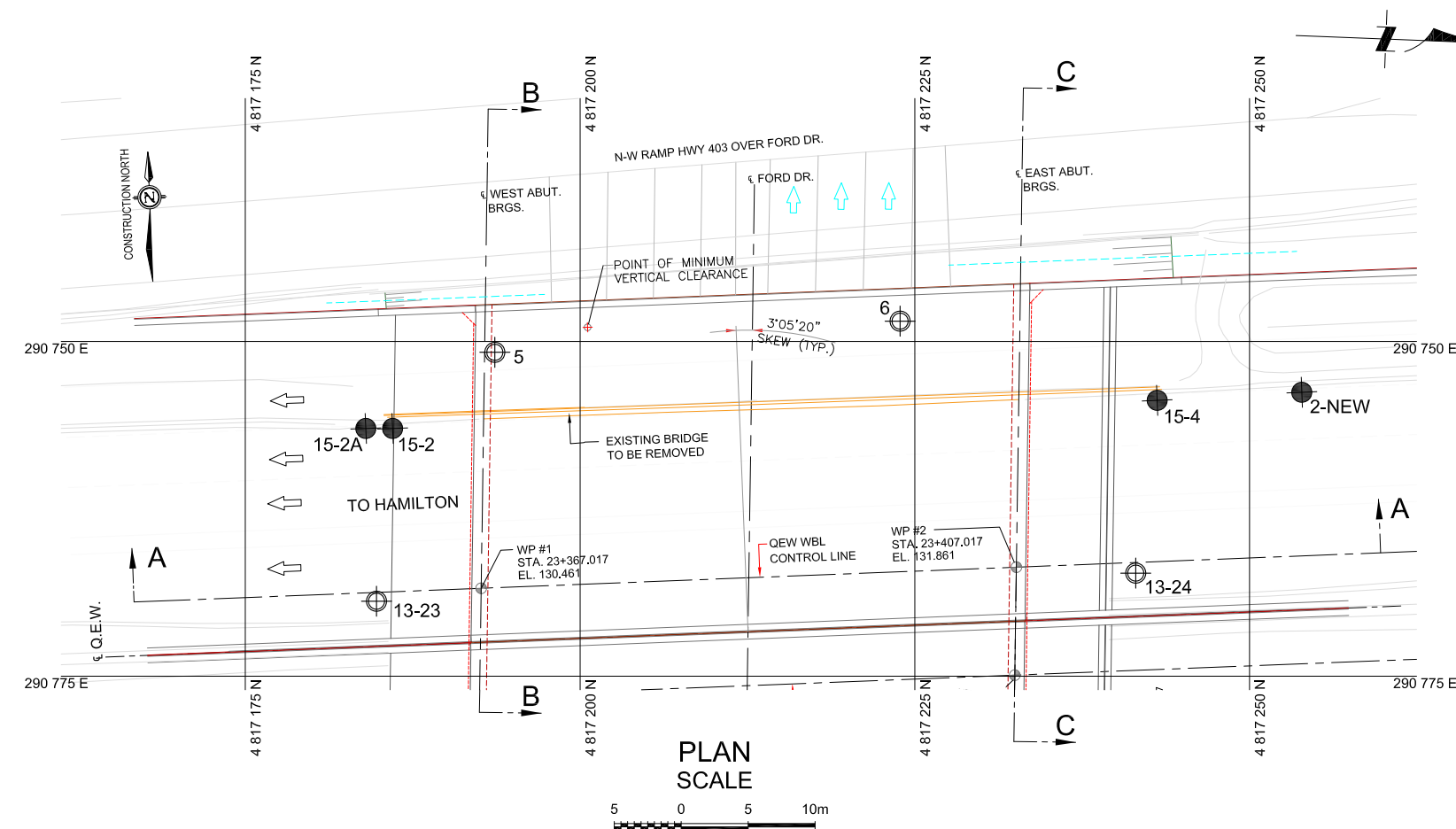
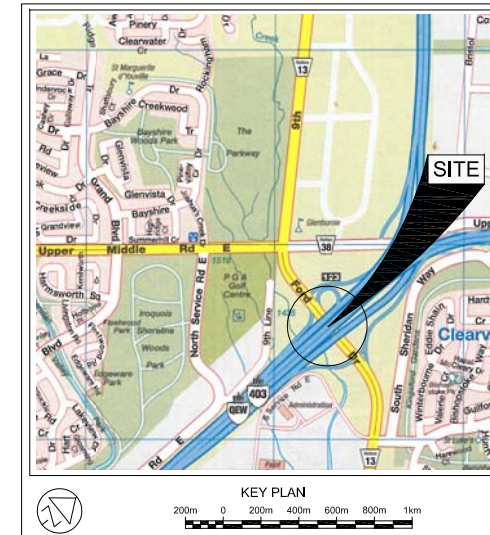
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100								SHEAR STRENGTH			WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								10 20 30					
428.5	Ground Level														GR SA SI CL						
0.0	Clayey Silt To Silty Clay, Trace Of Sand Occ. Cobbles		1	SS	37																
421.5	Hard, Brown		2	SS	113																
7.0	Shale Bedrock * (See Below)		3	SS	100	5"															
414.0	(Weathered)		4	SS	136	11"															
14.5	(Sound)		5	BXL	100%	REC															
			6	BXL	75%	REC															
			7	BXL	100%	REC															
			8	BXL	100%	REC															
398.5															RQD 15%						
30.0	End Of Borehole																				
From	*Intermittent Shale, Shaly Limestone And Shale Beds (Soft To Med. Hard, Fine Texture Shale is Fissile, Thin Horizontal Bedding With Limestone Seams (Med. Hard, Fine Texture, Light Grey Colour, Fossiliferous, Shale Seams Present) 21'3" to 24'2" 26'3" to 27'5" Note: Waterlevel not established																				



APPENDIX FIR – C

Drawing WBFD-1 – Borehole Locations and Soil Strata

Drawing WBFD-2 – Soil Strata



LEGEND			
	Borehole		
	Geocres Report Borehole (30M5-116 & 30M5-297)		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60 Cone, 475 J/blow)		
	WL at time of investigation March 1977, May 2013 and Nov. 2015		
*	Water level not established		
	Head		
	ARTESIAN WATER		
	Encountered		
	PIEZOMETER		

BH No	ELEVATION	NORTHINGS	EASTINGS
15-2	129.7	4 817 186.0	290 756.5
15-2A	129.7	4 817 184.0	290 756.5
15-4	131.4	4 817 243.1	290 754.4
2-NEW	131.7	4 817 253.9	290 753.8
GEOCRES REPORT BOREHOLES			
13-23	129.7	4 817 184.8	290 769.4
13-24	131.5	4 817 241.5	290 767.3
5	128.8	4 817 193.6	290 750.8
6	130.6	4 817 223.9	290 748.5

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

DATE	BY	DESCRIPTION

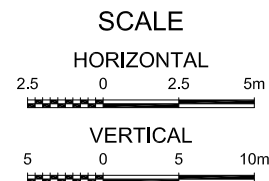
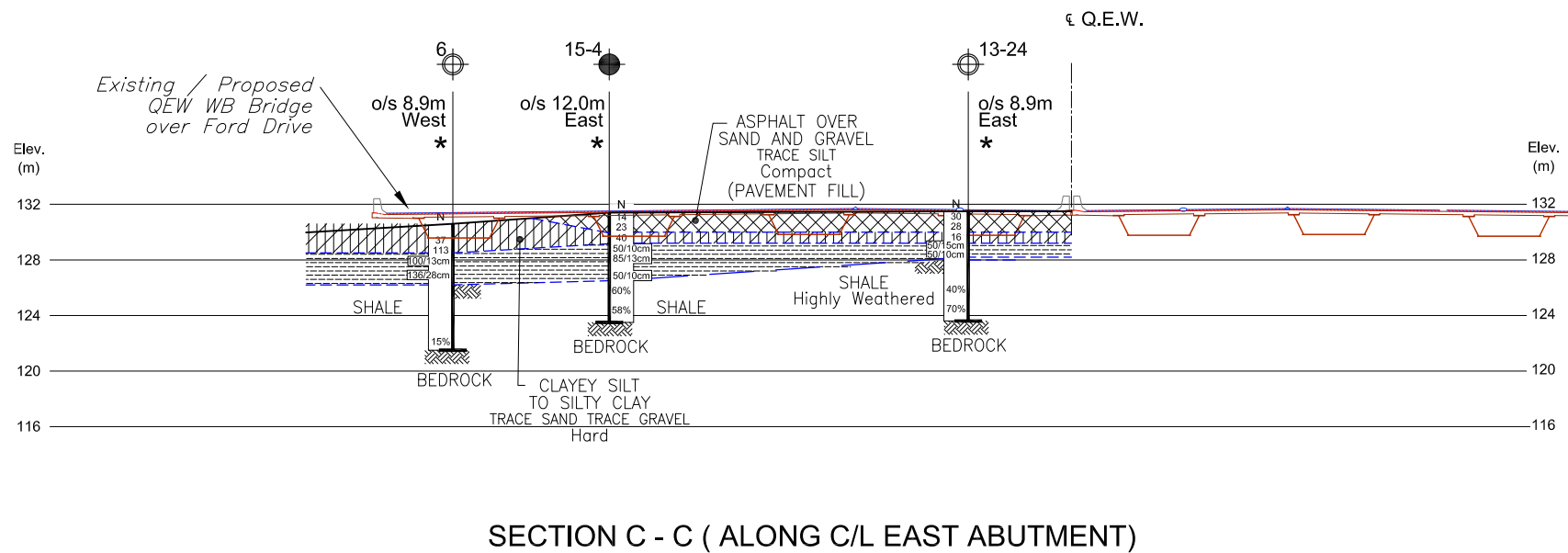
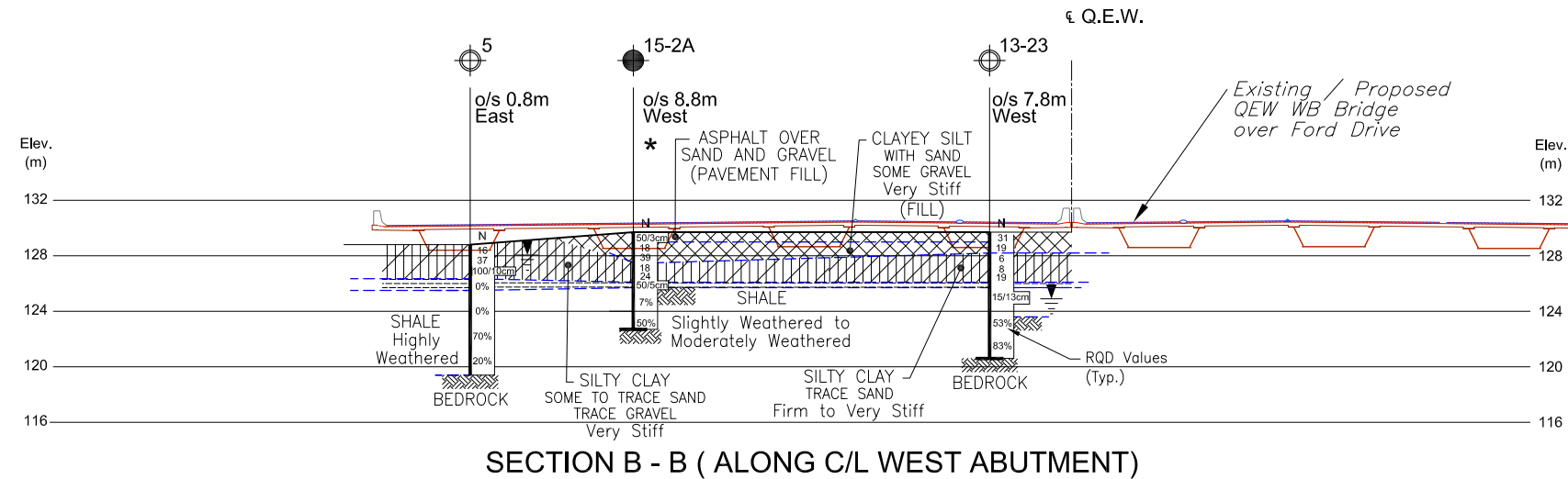
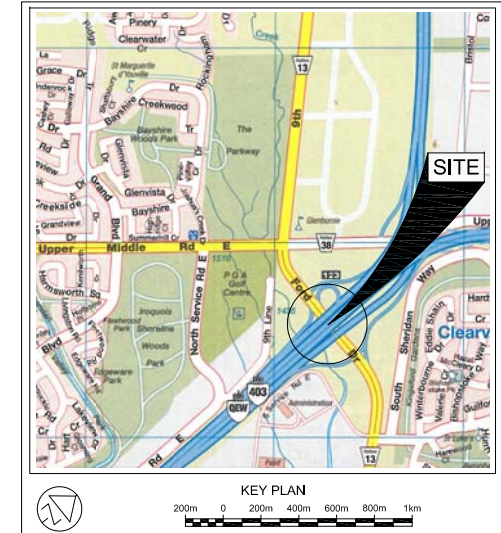
Geocres No. 30M5-326			
HWY No	QEW / 403	DIST	CENTRAL
SUBMT	NA	CHECKED	KD
DATE	APRIL 05, 2017	SITE	10-286/2
DRAWN	NA	CHECKED	GD
APPROVED	CN	DWG	WBFD-1



REF MTO Drawing: Pre-GA1.dwg August 2016

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING WBFD-2 FOR SECTIONS B-B AND C-C.
- 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.



LEGEND			
	Borehole		
	Geocres Report Borehole (30M5-116 & 30M5-297)		
N	Blows/0.3m (Std. Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60 Cone, 475 J/blow)		
	WL at time of investigation March 1977, May 2013 and Nov. 2015		
*	Water level not established		
	Head		
	ARTESIAN WATER		
	Encountered		
	PIEZOMETER		
BH No	ELEVATION	NORTHINGS	EASTINGS
REFER TO DWG. WBFD-1 FOR DETAILS			

NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING WBFD-1 FOR BOREHOLE AND SECTION LOCATION PLAN AND PROFILE A-A.
- 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.



- 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. 30M5-326

HWY No	QEW / 403			DIST	CENTRAL
SUBMT	NA	CHECKED	KD	DATE	APRIL 05, 2017
				SITE	10-286/2
DRAWN	NA	CHECKED	GD	APPROVED	CN
				DWG	WBFD-2



APPENDIX FIR – D

Figure WBFD-GS-1 – Grain Size Distribution for Gravelly Sand Fill

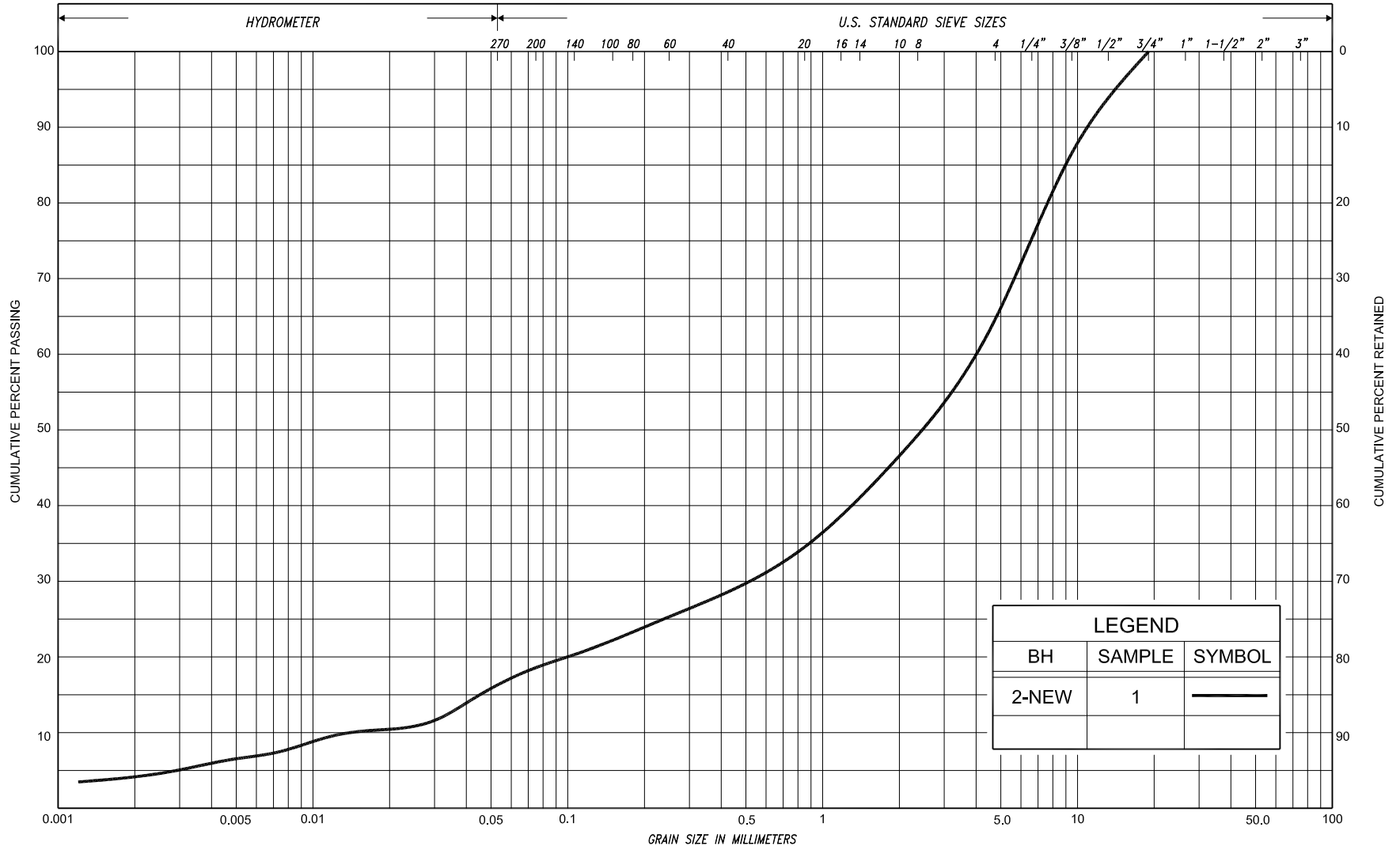
Figure WBFD-GS-2 – Grain Size Distribution for Clayey Silt Fill

Figure WBFD-GS-3 – Grain Size Distribution for Clayey Silt to Silty Clay

Figure WBFD-PC-1 – Plasticity Chart for Clayey Silt Fill

Figure WBFD-PC-2 – Plasticity Chart for Clayey Silt to Silty Clay

Figures B1 and B2 – GEOCREC 30M5-297 Laboratory Test Results



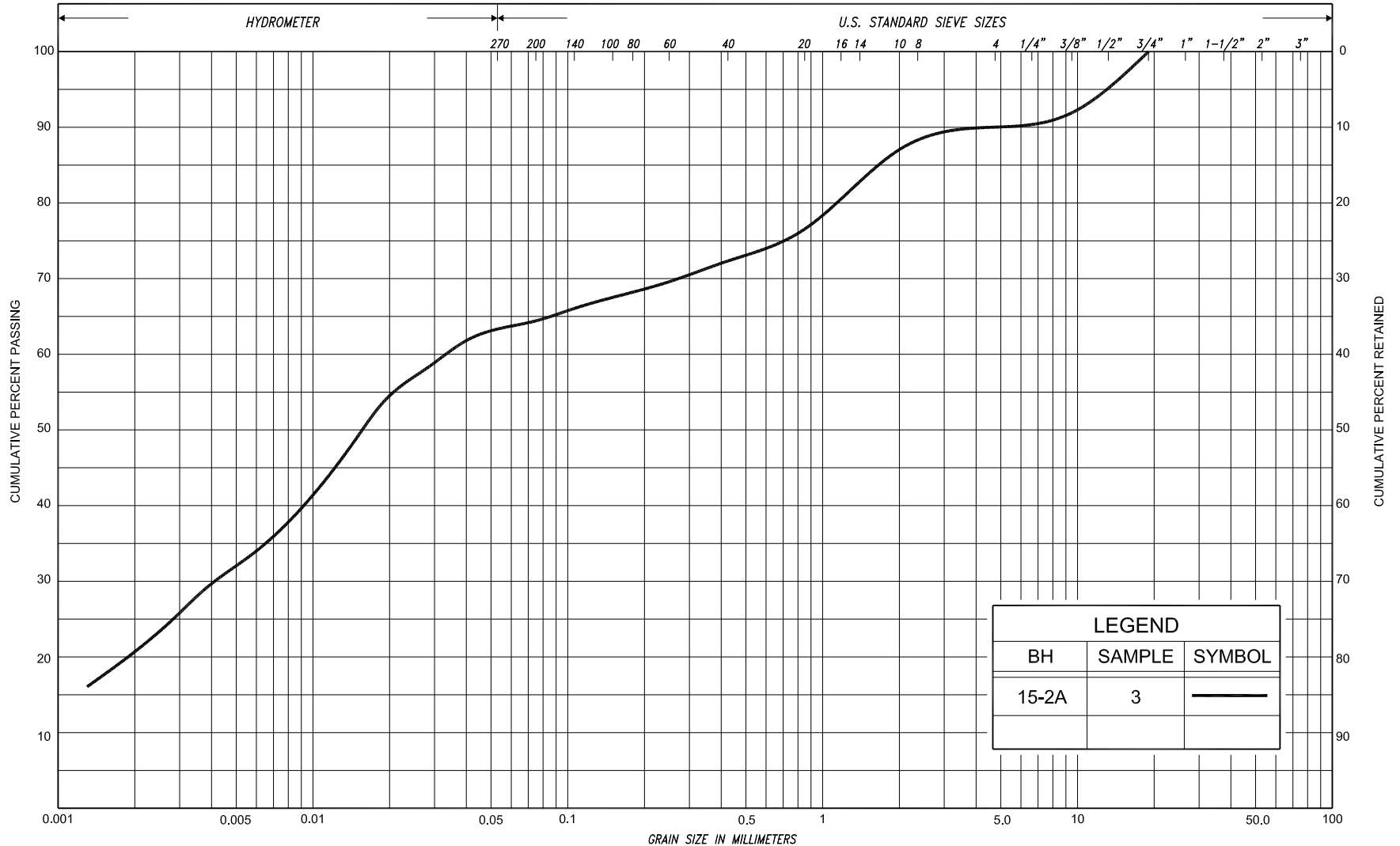
LEGEND		
BH	SAMPLE	SYMBOL
2-NEW	1	—

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



GRAIN SIZE DISTRIBUTION GRAVELLY SAND, some silt, trace clay (SM) (FILL)

FIG No.	WBFD-GS-1
HWY:	403 / QEW
G.W.P. No.	2163-10-00



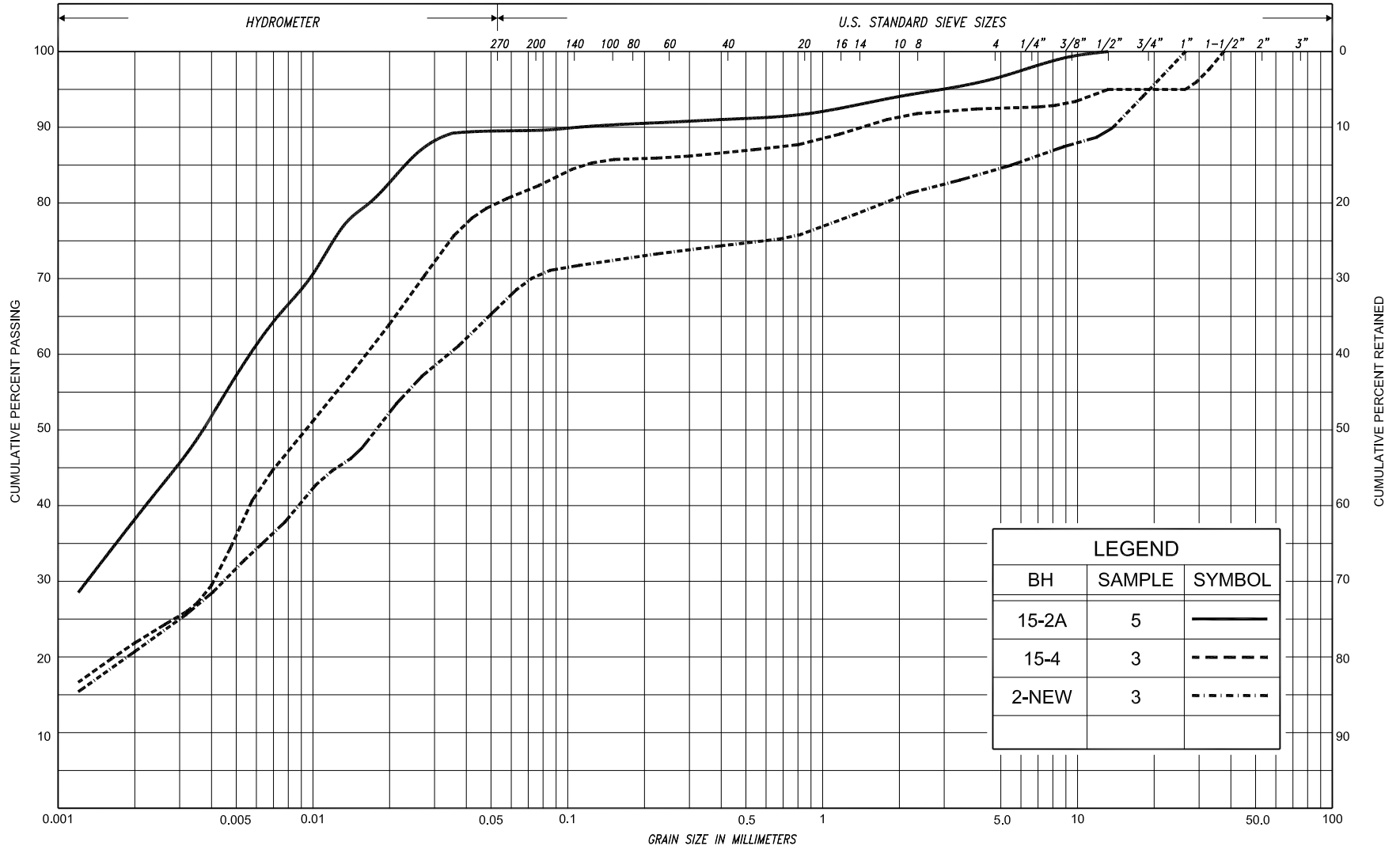
LEGEND		
BH	SAMPLE	SYMBOL
15-2A	3	—

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



GRAIN SIZE DISTRIBUTION
CLAYEY SILT, with sand, some gravel (CL)
(FILL)

FIG No.	WBFD-GS-2
HWY:	403 / QEW
G.W.P. No.	2163-10-00

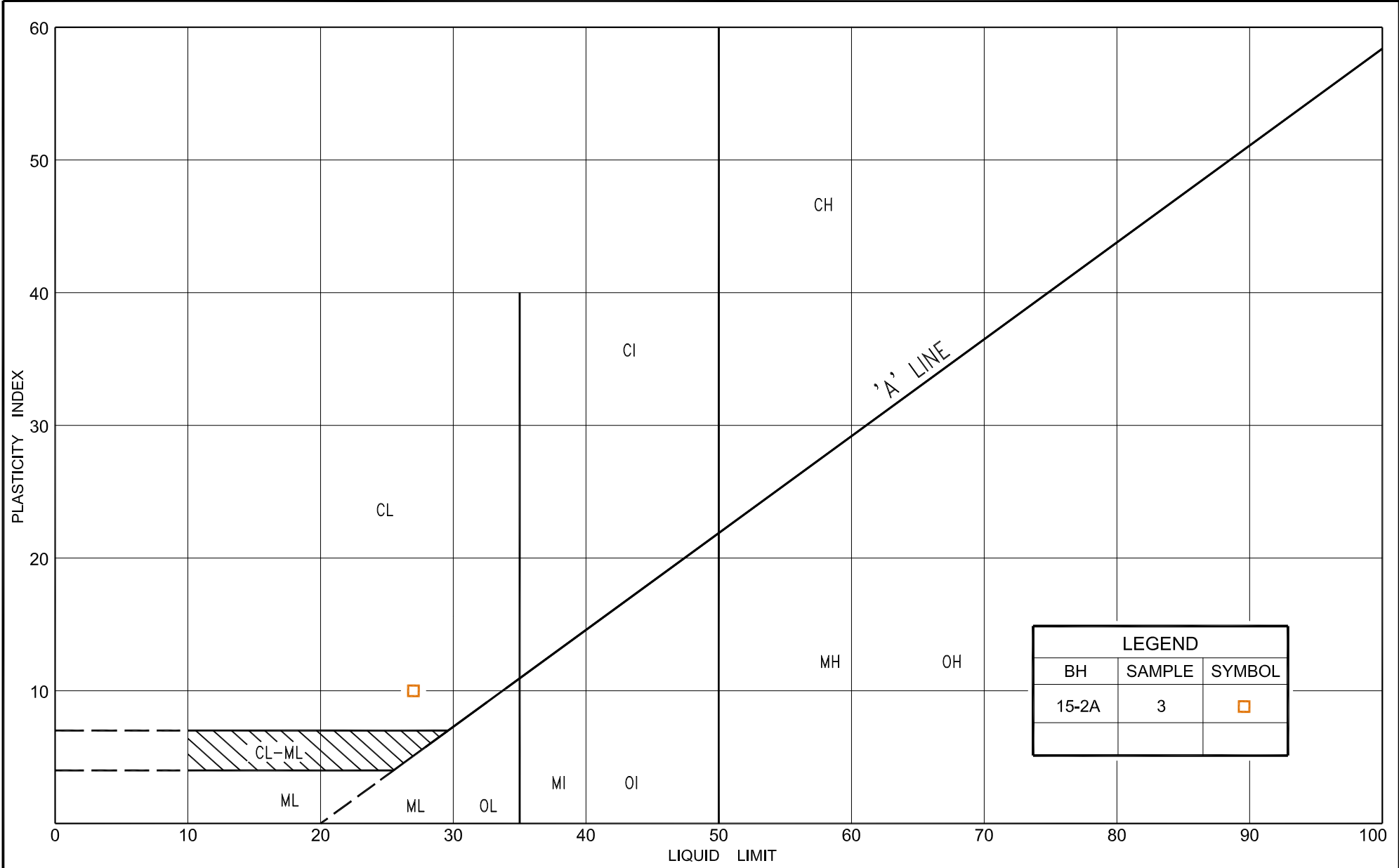


SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED
				SAND									
CLAY	FINE	MEDIUM	COARSE	FINE		MEDIUM	COARSE		GRAVEL			COBBLES	M.I.T.
	SILT			SAND									
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL					U.S. BUREAU
				SAND									



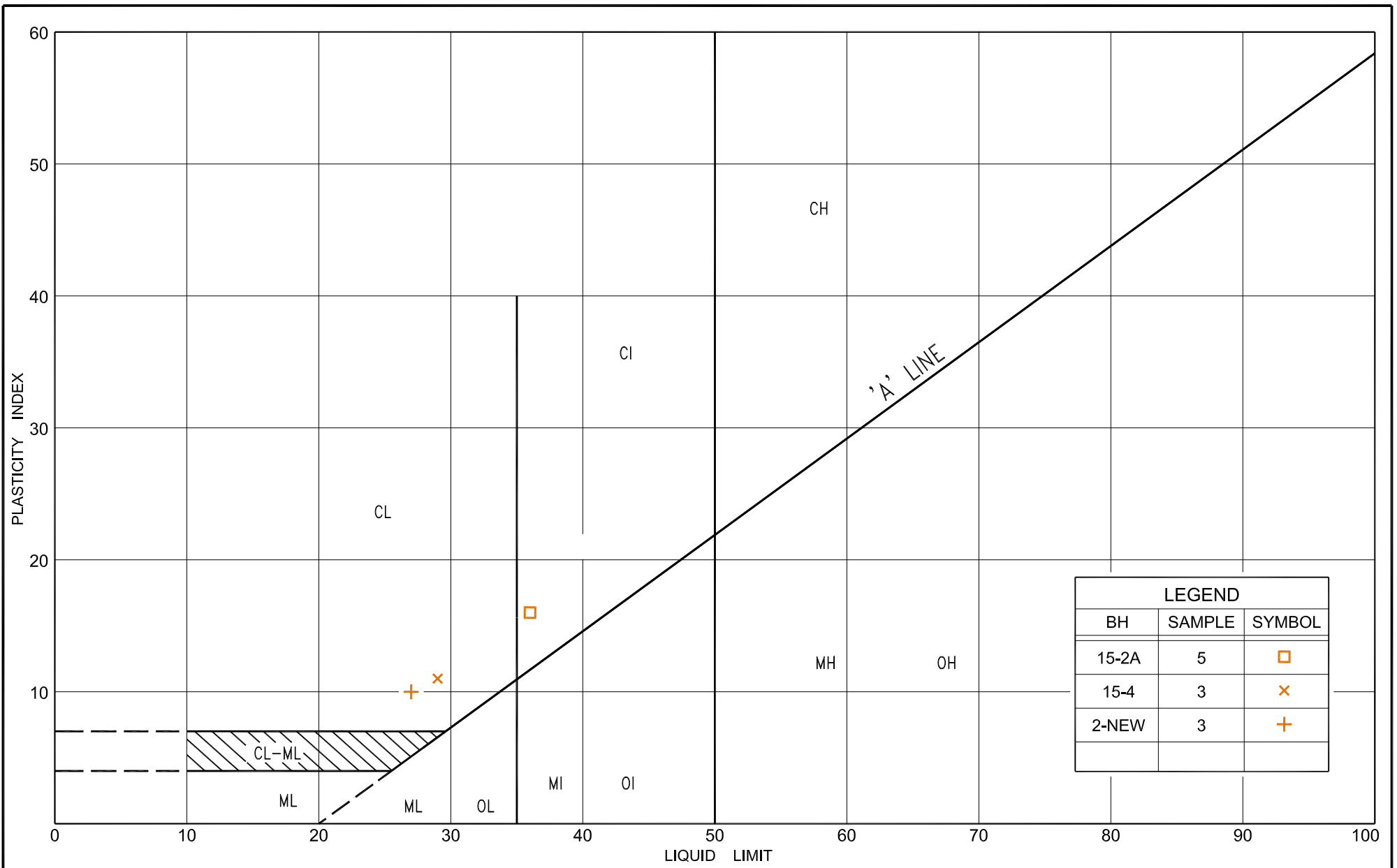
GRAIN SIZE DISTRIBUTION **CLAYEY SILT TO SILTY CLAY** trace to some sand, trace to some gravel (CL-CI)

FIG No. WBFD-GS-3
 HWY: 403 / QEW
 G.W.P. No. 2163-10-00



PLASTICITY CHART
 CLAYEY SILT, with sand, some gravel (CL)
 (FILL)

FIG No.	WBFD-PC-1
HWY:	403 / QEW
G.W.P. No.	2163-10-00



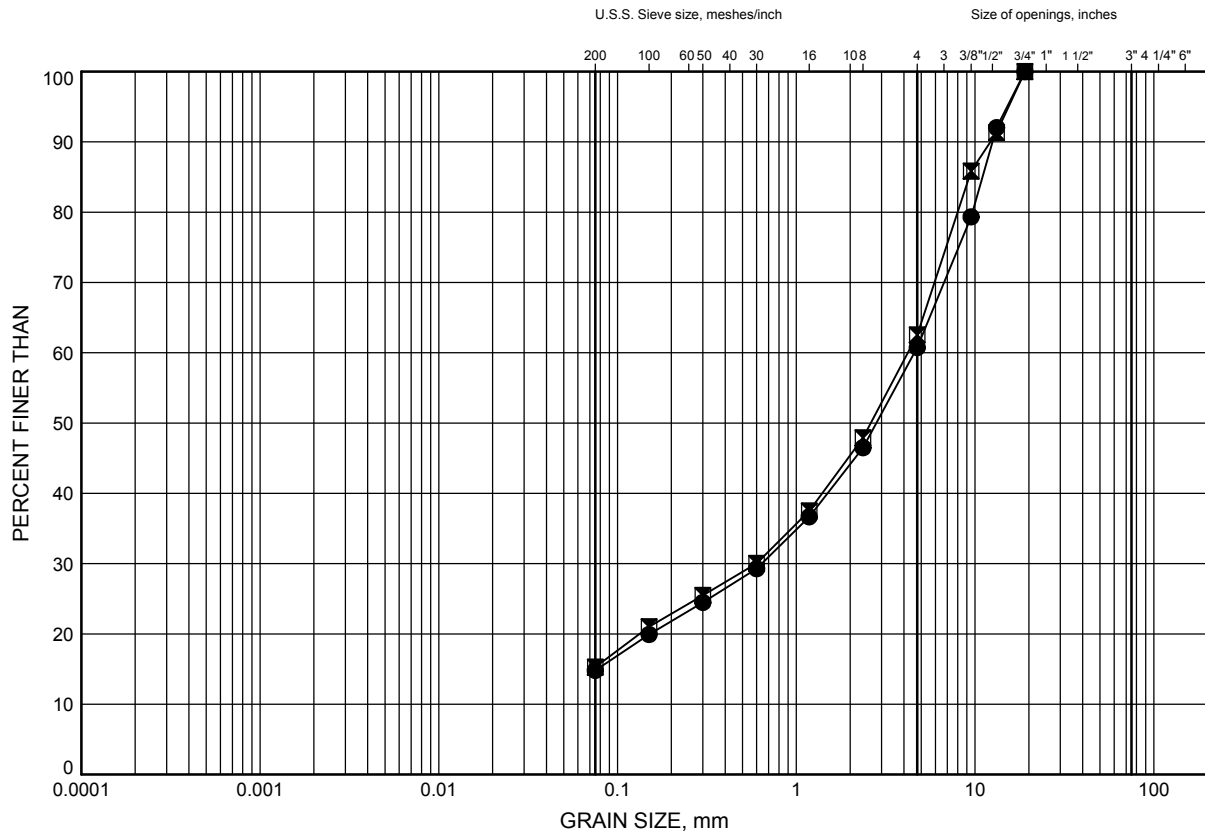
PLASTICITY CHART
 CLAYEY SILT TO SILTY CLAY
 trace to some sand, trace to some gravel (CL-CI)

FIG No. WBFD-PC-2
 HWY: 403 / QEW
 G.W.P. No. 2163-10-00

QEW and Hwy 403
GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND and GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-23	0.38	129.35
⊠	13-24	1.07	130.42

Date August 2013
W.P.

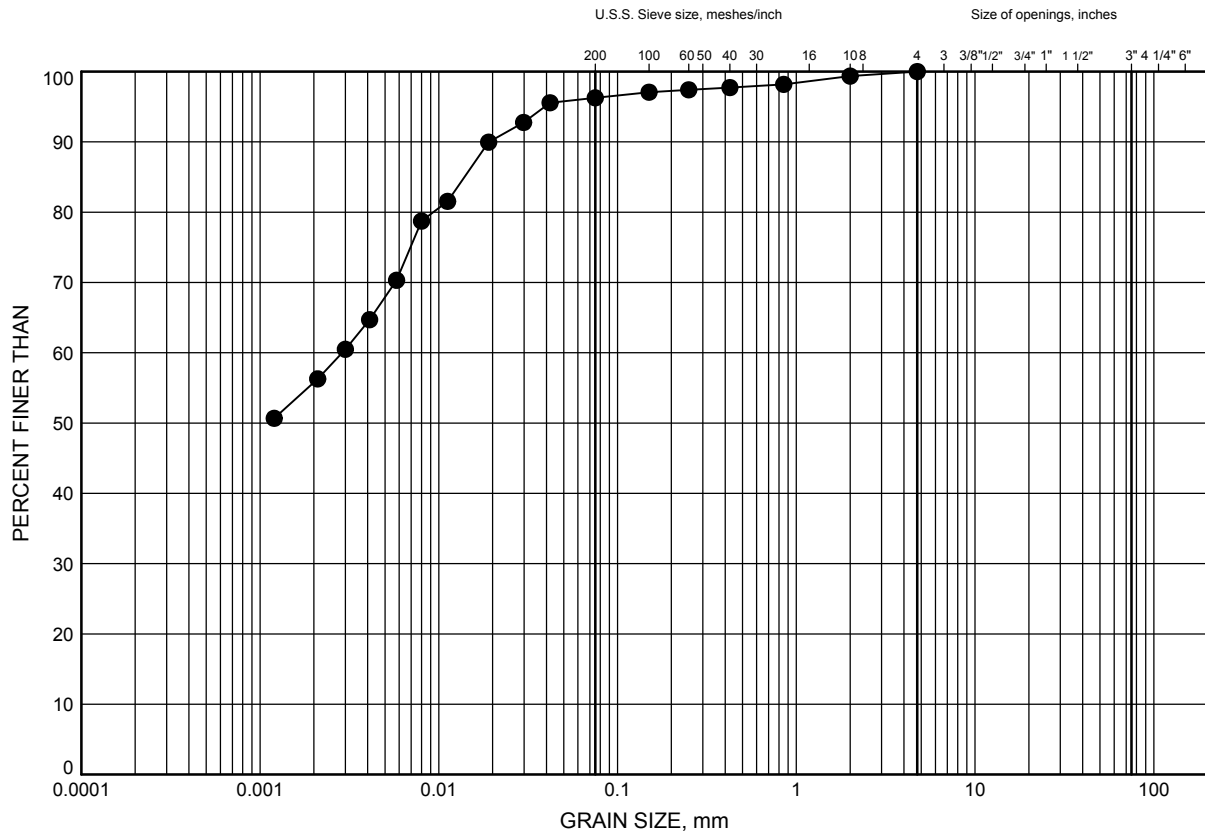


Prep'd SBP
Chkd.

QEW and Hwy 403
GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-23	2.59	127.14

Date August 2013
W.P.



Prep'd SBP
Chkd.



APPENDIX FIR – E

Rock Core Descriptions
Rock Core Photographs



ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
15-2A	7	4.0 ⁽¹⁾ – 5.5	33	7	4.0 – 7.0	SHALE WITH INTERBEDDED LIMESTONE: Grey to dark grey, occasional dark grey shale, fine crystalline to aphanitic, with few stylitic partings, small chert nodules, low to medium strength, occasional fossils, bedding in shale horizontal, laminated and fissile, slightly weathered to moderately weathered, close spaced flat partings, smooth to rough planar, tight, with dipping to vertical joints, very poor to poor quality.
	8	5.5 – 7.0	100	50		
15-4	7	4.9 ⁽²⁾ – 6.4	95	60	4.9 – 7.9	SHALE WITH INTERBEDDED LIMESTONE: Grey to dark grey, occasional dark grey shale, dark grey clay layer at 6.4 – 6.6 m, fine crystalline to aphanitic, with few stylitic partings, small chert nodules, medium strength, occasional fossils, bedding in shale horizontal, laminated and fissile, slightly weathered to moderately weathered, close spaced flat partings, smooth to rough planar, tight, with dipping to vertical joints, fair quality.
	8	6.4 – 7.9	98	58		

Notes:

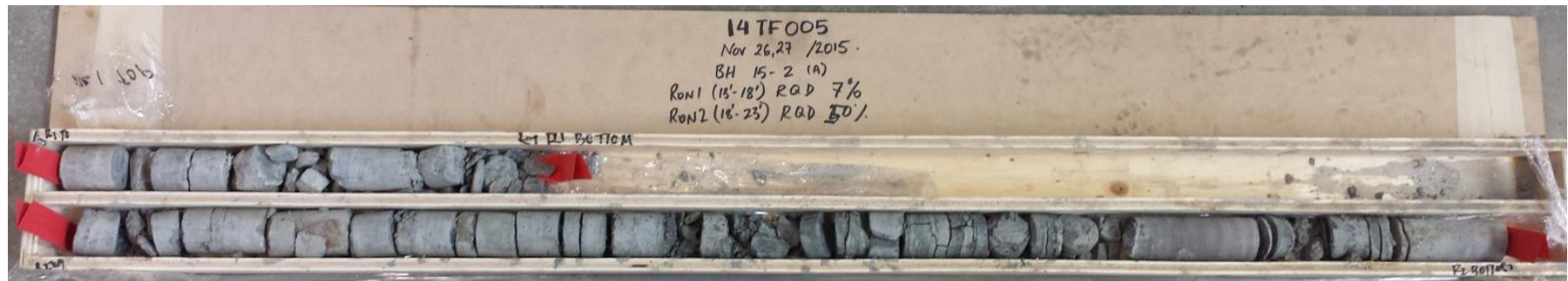
Drilled: November 25 to 27, 2015

Logged: December 18, 2015

RQD = Rock Quality Designation

4.0⁽¹⁾, 4.9⁽²⁾: Bedrock core starts at 4.0 m in borehole 15-2A and 4.9 m in borehole 15-4

Originated: JO/SAT/SA
 Compiled: JO/SAT
 Checked: SS/KD



Photograph 1: Cores retrieved from borehole 15-2A. Rock cores 7 and 8 from 4.0 to 7.0 m. RQD values were 7% and 50% respectively, indicating very poor to poor rock quality.



Photograph 2: Cores retrieved from borehole 15-4. Rock cores 7 and 8 from 4.9 to 7.9 m. RQD values were 60% and 58% respectively, indicating fair rock quality.