



FOUNDATION INVESTIGATION REPORT

for

**EASTBOUND 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. 10-286/1
CENTRAL REGION, ONTARIO**

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PART A –FOUNDATION INVESTIGATION REPORT
for
Eastbound Queen Elizabeth Way Overpass at Ford Drive
GWP 2163-10-00, Site 10-286/1
Town of Oakville
Regional Municipality of Halton, 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) eastbound 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 3, 4, 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 eastbound 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 25, 2015 and comprised 3 new boreholes (15-1, 15-3 and 1-NEW) drilled to depths ranging from 5.8 m to 8.8 m. The records of the current boreholes and of the GEOCRES boreholes 3, 4, 13-23 and 13-24 are attached in Appendix FIR-B. The locations of the boreholes are shown on Drawing EBFD-1, provided in Appendix FIR-C.

The locations of the new boreholes were established in the field by PML. All three 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 (15-1 and 15-3) 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 three boreholes were collected and provided on the Record of Borehole sheets and on Drawing EBFD-1.

During drilling the target termination criterion of 100 blows per 0.3 m penetration or refusal on bedrock was met for all three 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	13
Grain Size Distribution Analyses	5
Atterberg Limits	4



The grain size distribution curves of selected soil samples are presented on Figures EBFD-GS-1 to EBFD-GS-3. The results of the Atterberg Limits tests are given on Figures EBFD-PC-1 and EBFD-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 EBFD-1 and Drawing EBFD-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 EBFD-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 15-1 and 15-3 were charged with drilling water to facilitate the rock coring operations.

5.2.1 Fill

Asphalt, 150 mm to 230 mm in thickness was present surficially in boreholes 15-1, 15-3 and 1-NEW advanced on the shoulder of the QEW eastbound lane. Asphalt is underlain by non-cohesive sand and gravel pavement fill which extends to elevation 128.6 in borehole 15-1, 130.5 in borehole 15-3 and 128.6 in borehole 1-NEW.

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.

Sandy gravel fill was encountered underlying the pavement fill in borehole 15-3. The sandy gravel fill was 0.7 m thick and extended to elevation 129.8. The results of the grain size distribution analysis performed on the sandy gravel fill sample is presented in Figure EBFD-GS-1. Cobbles were observed within the sandy gravel fill layer in borehole 15-3.

Clayey silt fill material was encountered underlying the pavement fill in boreholes 15-1 and 1-NEW. The thickness of the clayey silt fill was 1.3 m in borehole 15-1 and 1.6 m in borehole 1-NEW. The clayey silt fill extended to elevation 127.3 and 127.0 in boreholes 15-1 and 1-NEW, respectively.

SPT-N values of the clayey silt fill ranged from 4 to 13, indicating firm to stiff consistency. Organic inclusions were observed within the clayey silt fill in borehole 1-NEW.



The results of grain size distribution analysis for a sample collected from the cohesive fill is shown on Figure EBFD-GS-2. The Atterberg plasticity chart is presented on Figure EBFD-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	20
Sand	31
Silt	29
Clay	20

The liquid and plastic limits of the fill were 29 and 16 respectively, with the corresponding plasticity index of 13. The moisture content determinations ranged from 16 to 27%, 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 3 and 4. The deposit ranged in thickness from 2.2 m to 2.3 m and penetrated into weathered shale bedrock at elevation 126.3 in borehole 3 and 128.0 in borehole 4.

Clayey silt / silty clay was encountered in boreholes 15-1, 15-3, 1-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 extends to highly weathered shale bedrock at elevation 125.9 in borehole 15-1, 128.6 in borehole 15-3, 126.2 in borehole 1-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 15-1, 15-3 and 13-24.

SPT-N values of the clayey silt / silty clay ranged from 6 to 49 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 EBFD-GS-3 and EBFD-PC-2.



Table 5.2.2 summarizes the results of the grain size distribution analyses conducted on the native soil from boreholes 15-1, 15-3 and 1-NEW.

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

MATERIAL	PERCENTAGE
Gravel	0-24
Sand	6-28
Silt	32-52
Clay	16-52

The clayey silt to silty clay had a liquid limit ranging from 27 to 44, a plastic limit ranging from 17 to 22 and a corresponding plasticity index ranging from 10 to 22. The moisture content of the deposit ranged from 13 to 24%, 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) Approach	1-NEW	3.0	126.2
South (Construction West) Abutment	15-1	3.6	125.9
	13-23	3.7	126.1
	3	2.3	126.3
North (Construction East) Abutment	15-3	2.6	128.6
	13-24	1.8	129.7
	4	2.2	128.0



The bedrock in 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 15-1, 15-3 and 1-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.

GEOCRETS 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 3, 4, 15-1, 15-3, 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 15-1 and 15-3 is given in Table A, attached in Appendix FIR-E. Photographs of the bedrock cores retrieved from borehole 15-1 and 15-3 are also attached in Appendix FIR-E.

The measured core recovery varied between 43% and 100%. The Rock Quality Designation (RQD) determined from the rock cores ranged from 11% to 83%, typically 25% to 70% thus indicating a poor to fair quality bedrock.

The low RQD values of 11% and 18%, presented in boreholes 15-1 and 15-3 respectively, likely reflect local conditions of weathered bedrock that differ from the RQD values of 40% to 83% seen in the slightly weathered bedrock in 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 (15-1, 15-3 and 1-NEW). Boreholes 15-1 and 15-3 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 ranged from 1.2 to 1.8 m below the ground surface. However, an indication was not provided in the GEOCRESS 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



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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 Eastbound construction east 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'_{vo}	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 15-1

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 185.5 N ; 290 788.9 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 23 and 24, 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									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%)										
129.5	Ground Surface							20	40	60	80	100					
0.0	180 mm asphalt over sand and gravel, trace silt																
128.6	Compact Grey/red (PAVEMENT FILL)		1	SS	13		129										
0.9	Clayey silt mixed with sand and gravel		2	SS	14												
127.3	Stiff Red/brown Moist (FILL)		3	SS	8		128										20 31 29 20
2.2	Silty clay, trace sand		4	SS	14		127										0 6 42 52
	Stiff Red/brown Moist																
	some sand shale fragments		5	SS	23		126										
125.9	Very stiff																
3.6	Highly weathered shale bedrock silty clay seams Grey/red		6	SS	50/10cm		125										
							124										
123.7	Shale with interbedded limestone bedrock		7	RC NQ	REC 78%		123										RQD 31%
5.8	Slightly weathered to moderately weathered Low to medium strength Poor to very poor quality		8	RC NQ	REC 43%		122										RQD 11%
120.7	End of borehole						121										
8.8																	
	* Borehole charged with coring water																

RECORD OF BOREHOLE No 15-3

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 242.4 N ; 290 787.1 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 24 and 25, 2015 CHECKED BY G.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	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	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)									
131.2	Ground Surface						20	40	60	80	100										
0.0	150 mm asphalt over sand and gravel																				
130.5	Compact Grey/ Moist brown (PAVEMENT FILL)		1	SS	20																
0.7	Sandy gravel some silt, trace clay cobbles		2	SS	12								○					44	38	14	4
129.8																					
1.4	Compact Reddish Moist brown (FILL)		3	SS	49																
	Clayey silt with sand, with gravel																				
128.6			4	SS	24								○								
2.6	Hard to Red/ Moist Very stiff brown																				
	Highly weathered shale bedrock silty clay seams		5	SS	88/23cm								○								
126.3			6	SS	50/8cm								○								
4.9	Shale with interbedded limestone bedrock																				
	Slightly weathered to unweathered		7	RC NQ	REC 70%																RQD 18%
	Medium strength																				
	Very poor to fair quality		8	RC NQ	REC 100%																RQD 67%
123.3																					
7.9	End of borehole																				

RECORD OF BOREHOLE No 1-NEW

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 174.1 N ; 290 789.7 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 and 23, 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 (%) 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												
129.2	Ground Surface						20	40	60	80	100									
0.0	230 mm asphalt over sand and gravel (PAVEMENT FILL)		1	SS	14															
128.6	Clayey silt some sand, trace gravel organic inclusions		2	SS	13								○							
0.6	Stiff Reddish Moist to firm brown (FILL)		3	SS	4								○							
127.0																				
2.2	Silty clay, trace sand		4	SS	13								○							
126.2	Stiff Grey Moist												○							
3.0	Highly weathered shale bedrock silty clay seams Grey/red		5	SS	50/10cm															
			6	SS	50/8cm								○							
123.4			7	SS	50/3cm															
5.8	End of borehole Refusal to augering																			
	* Borehole dry upon completion of 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				WATER CONTENT (%)								
129.7							20	40	60	80	100						GR	SA	SI	CL
0.0	ASPHALT: (150mm)																			
0.2	SAND and GRAVEL, some silt Dense to Compact Brown to Reddish Brown Damp (FILL)		1	SS	31															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															
			4	SS	8															
			5	SS	19															0 4 40 56
126.1																				
3.7	SHALE, with limestone interbeds, highly weathered, grey		6	SS	50/ 0.125															
	Start coring at 6.1m																			
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds Clay seam (200mm) at 6.1m		1	RUN																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																			
	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																RUN #2 TCR=100% SCR=97% RQD=83% UCS=72MPa (Average)
	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 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									
	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 (%) 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				
131.5								20	40	60	80	100						
0.0	ASPHALT: (150mm)							20	40	60	80	100						
0.2	SAND and GRAVEL, some silt Compact Brown Damp (FILL)		1	SS	30		131											
			2	SS	28													
130.0							130											
1.5	Silty CLAY, trace sand, occasional shale fragments		3	SS	16													
129.7	Very Stiff Reddish Brown																	
1.8	SHALE, with limestone interbeds, highly weathered, grey		4	SS	50/ 0.150		129											
	Start coring at 3.3m		5	SS	50/ 0.100													
			1	RUN			128											
							127											
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds		2	RUN			126											
	Clay seam (25mm) at 5.5m, 5.6m, 5.7m																	
	Horizontal fracture at 5.5m, 5.6m, 5.9m, 6.0m																	
	Limestone interbeds (25mm) at 5.9m, 6.0m, 6.1m and (100mm) at 5.5m																	
	Highly broken zones: 250mm at 4.8m 50mm at 5.2m 50mm at 5.4m		3	RUN			125											
	Limestone interbeds (25mm to 75mm) at 6.6m, 6.9m, 7.0m, 7.3m, 7.6m, 7.7m						124											
	Horizontal fracture at 6.4m, 6.5m, 6.6m, 6.7m, 6.9m, 7.0m, 7.4m, 7.8m																	
123.6																		
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 7.9m AND WATER LEVEL AT 3.9m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.																	

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 3

W P L25-06-17 LOCATION Co-ords N 15 803 724; E 954 012 ORIGINATED BY CTJ
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY CTJ
 DATUM Geodetic DATE March 23, 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 (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
422.0	Ground Level							20 40 60 80 100								
0.0	Clayey Silt To Silty Clay, Some Sand, Trace Of Gravel		1	SS	46		420									
414.5	Hard		2	SS	32											
412.3	(Weathered)		3	SS	112											
9.5	(Sound)		4	BXL	91% REC		410								RQD 30%	
	Shale Bedrock (See Below)*		5	BXL	100% REC		400								RQD 63%	
392.3																
29.7	End Of Borehole															
	*Intermittent shale, shaly limestone & limestone, fine tex- ture, soft to med.hard light grey, shale is fissile, thin bedding with Limestone (med. hard, fine texture, light grey, fossil- iferous) seams from 12'8" to 13'6" 19'6" to 20'2" 25'3" to 26'2"															

RECORD OF BOREHOLE No 4

W P 125-66-17 LOCATION Co-ords N 15 803 823; E 954 023 ORIGINATED BY CTJ
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY CTJ
 DATUM Geodetic DATE March 22, 1977 CHECKED BY RS

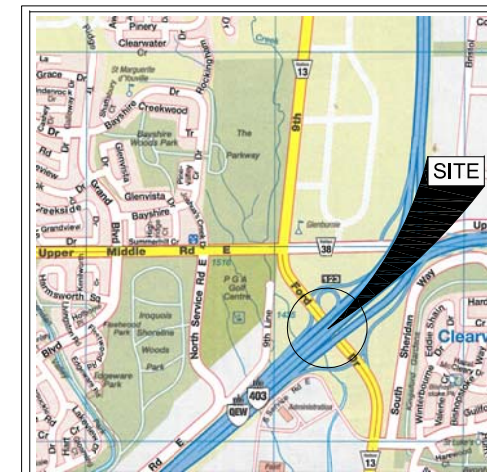
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										10 20 30		
427.1	Ground Level																			
0.0	Clayey Silt To Silty Clay, Some Sand Traces Of Gravel (Reworked) Very Stiff		1	SS	16		420									5 31 39 25				
420.0			2	SS	111/8"															
7.1			3	SS	131/9"															
417.1	(Weathered)		4	BXL	84% REC		410									RQD 25%				
10.0	(Sound)		5	BXL	100% REC											RQD 15%				
	Shale Bedrock (See Below)*		6	BXL	97% REC											RQD 60%				
397.9							400													
29.2	End Of Borehole																			
	*Intermittent Shale, Shaly Limestone & Limestone Beds, Soft To Hard, Fine Texture, Shale ls Fissile, Light Grey Colour, Thin hori- zontal Bedding With Limestone (Hard, Fine Texture fossiliferous) seams from 11'10" to 12'4" 13' 6" to 14'2" 22' 2" to 22'6" 23' 0" to 23'10" 28'10" to 29'2"																			



APPENDIX FIR – C

Drawing EBFD-1 – Borehole Locations and Soil Strata

Drawing EBFD-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
15-1	129.5	4 817 185.5	290 788.9
15-3	131.2	4 817 242.4	290 787.1
1-NEW	129.2	4 817 174.1	290 789.7
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
3	128.6	4 817 193.2	290 803.9
4	130.2	4 817 223.5	290 807.1

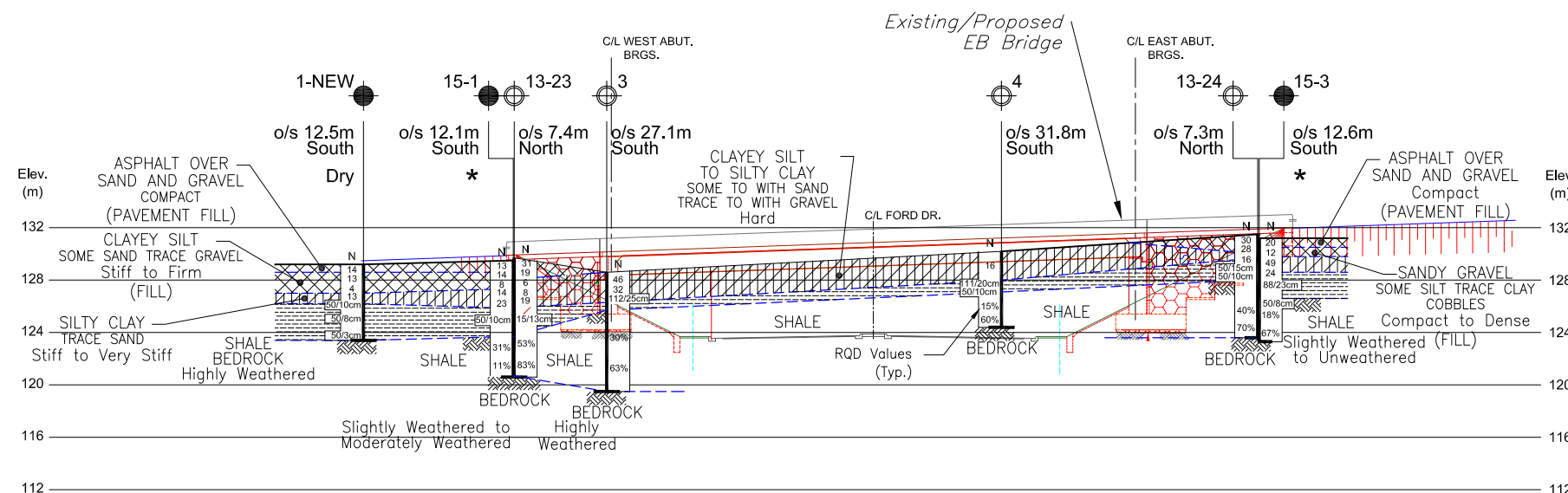
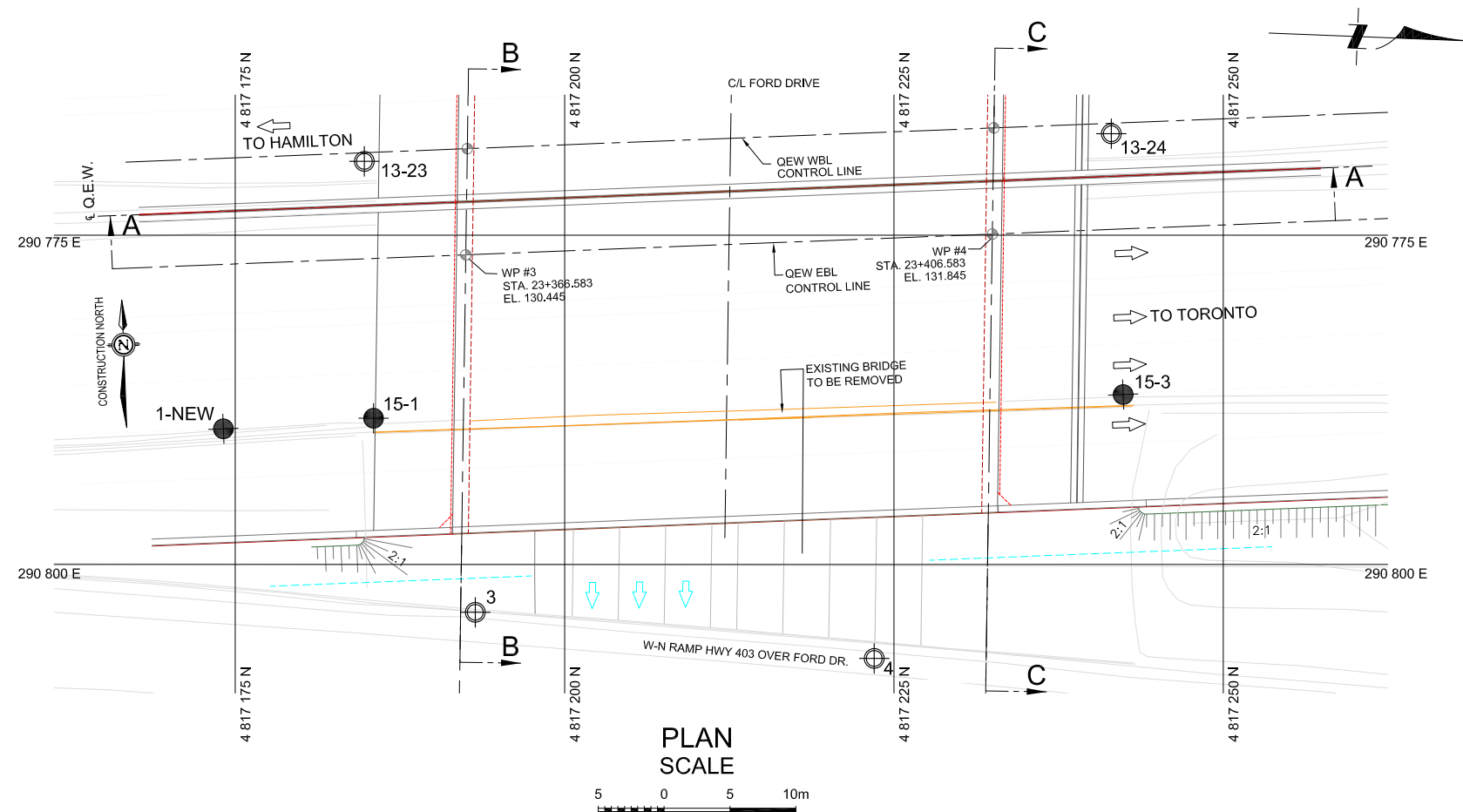
NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

DATE	BY	DESCRIPTION

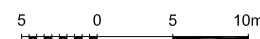
Geocres No. 30M5-327			
HWY No	QEW / 403	DIST	CENTRAL
SUBMD	NA	CHECKED	KD
DATE	APRIL 05, 2017	SITE	10-286/1
DRAWN	NA	CHECKED	GD
APPROVED	CN	DWG	EBFD-1



REF MTO Drawing: Pre-GA1.dwg August 2016

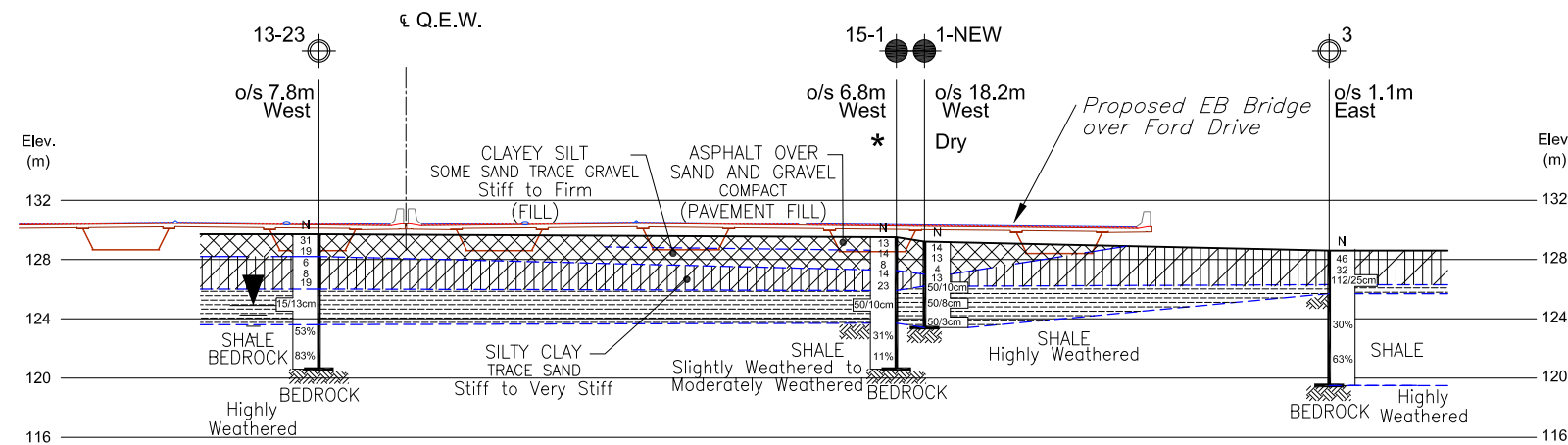
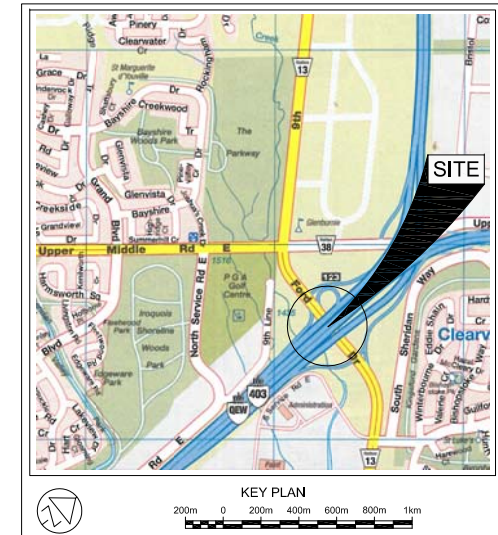


PROFILE A - A ALONG QEW EBL CONTROL LINE
SCALE

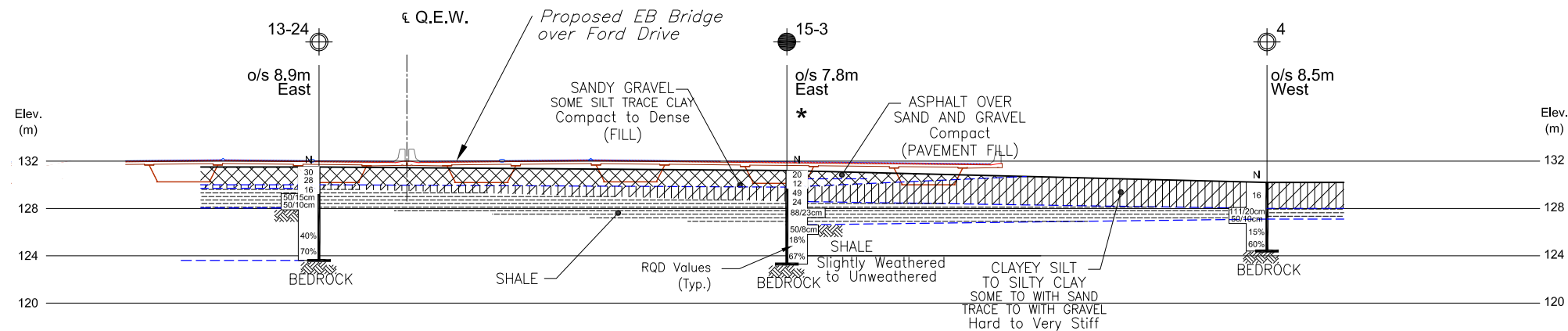


NOTES:

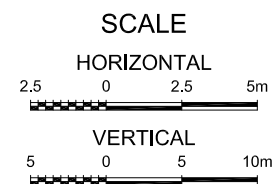
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING EBFD-2 FOR SECTIONS B-B AND C-C.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.



SECTION B - B (ALONG C/L WEST ABUTMENT)



SECTION C - C (ALONG C/L EAST ABUTMENT)



NOTES:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
- REFER TO DRAWING EBFD-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.

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		

REFER TO DWG. EBFD-1, FOR DETAILS



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. 30M5-327			
HWY No	QEW / 403	DIST	CENTRAL
SUBMT	NA	CHECKED	KD
DATE	APRIL 05, 2017	SITE	10-286/1
DRAWN	NA	CHECKED	GD
APPROVED	CN	DWG	EBFD-2



APPENDIX FIR – D

Figure EBFD-GS-1 – Grain Size Distribution for Sandy Gravel Fill

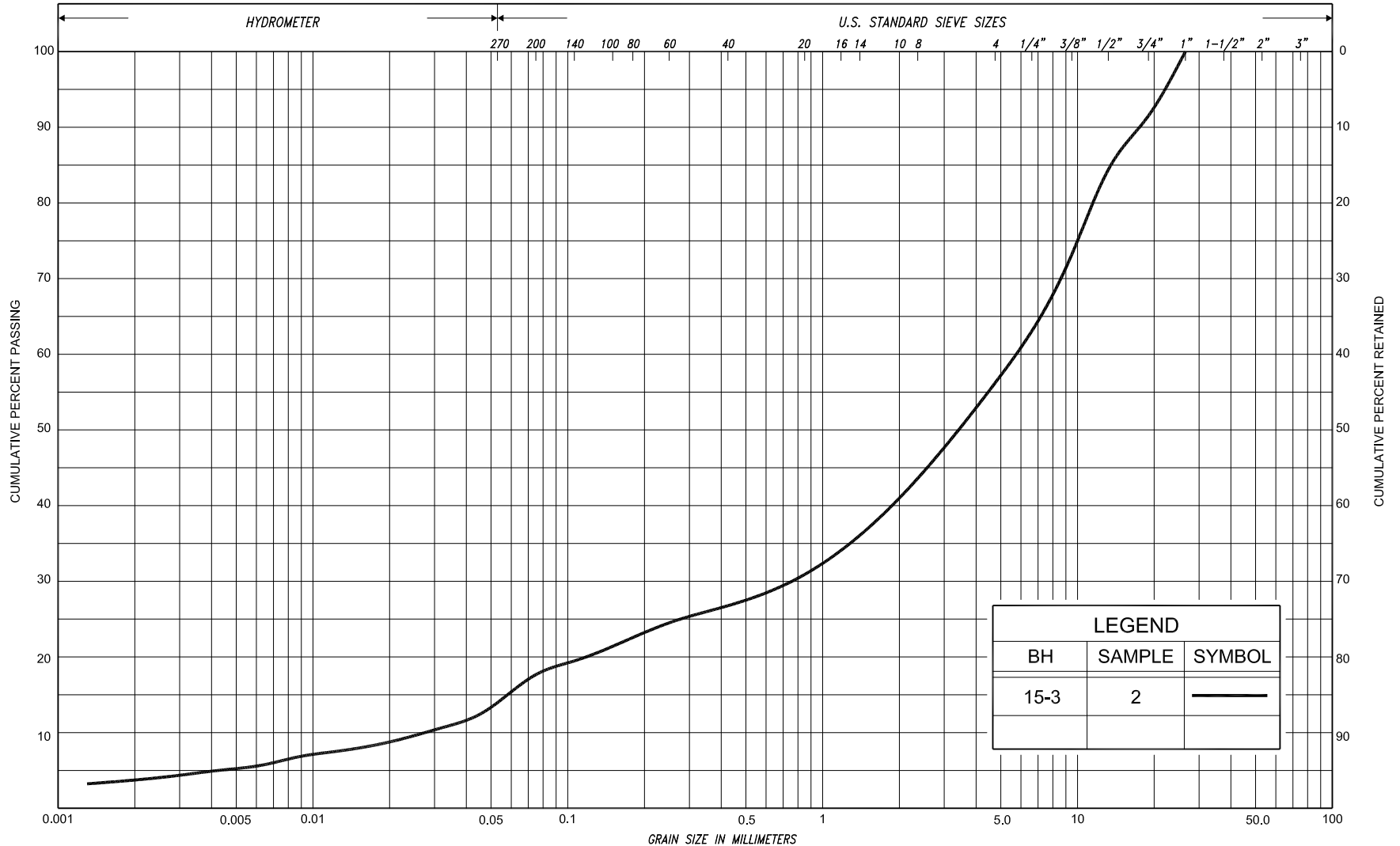
Figure EBFD-GS-2 – Grain Size Distribution for Clayey Silt Fill

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

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

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

Figure B1 and B2 – GEOCRETS 30M5-297 Laboratory Test Results



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											

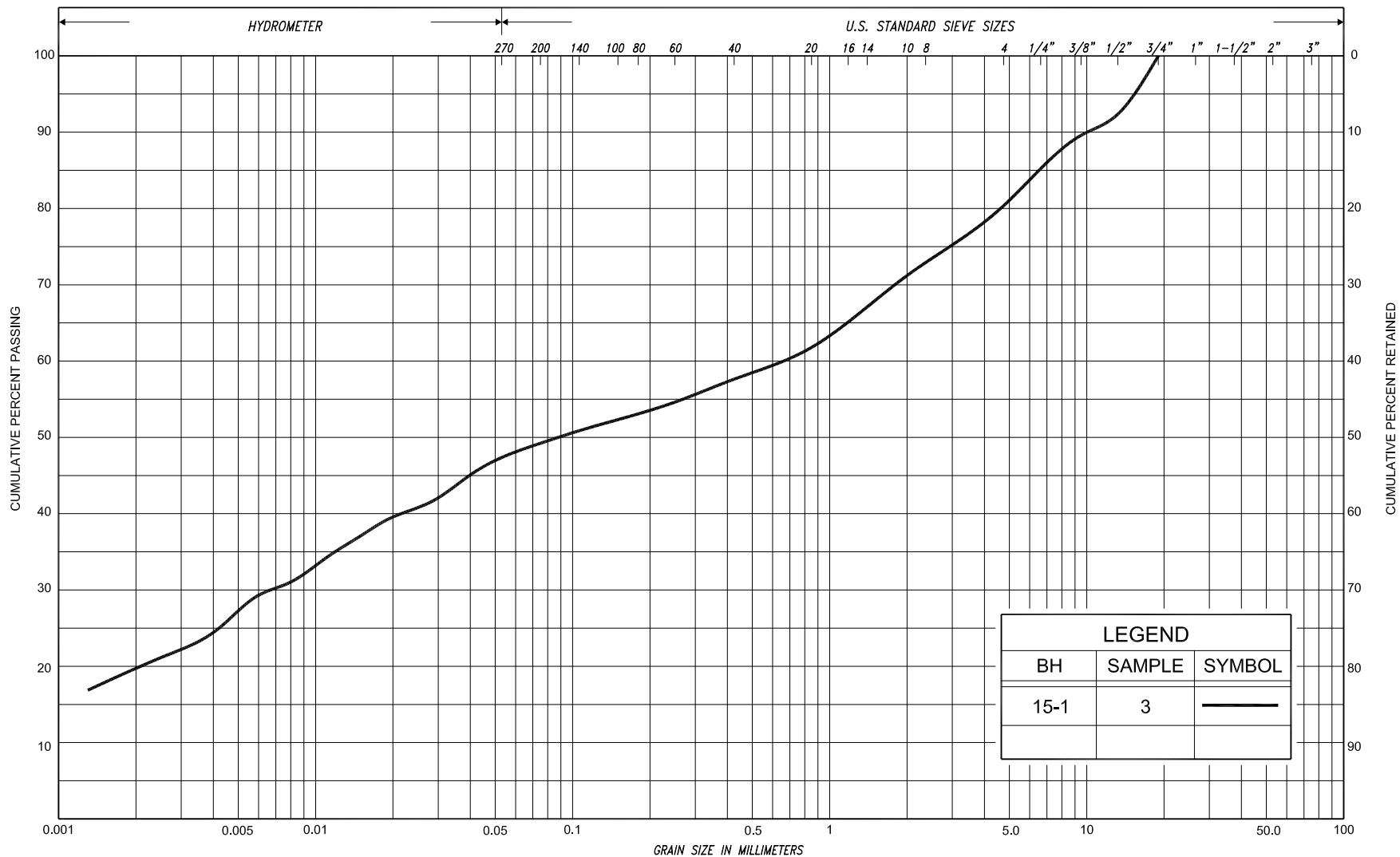


GRAIN SIZE DISTRIBUTION SANDY GRAVEL, some silt, trace clay (GM) (FILL)

FIG No. EBFD-GS-1

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								

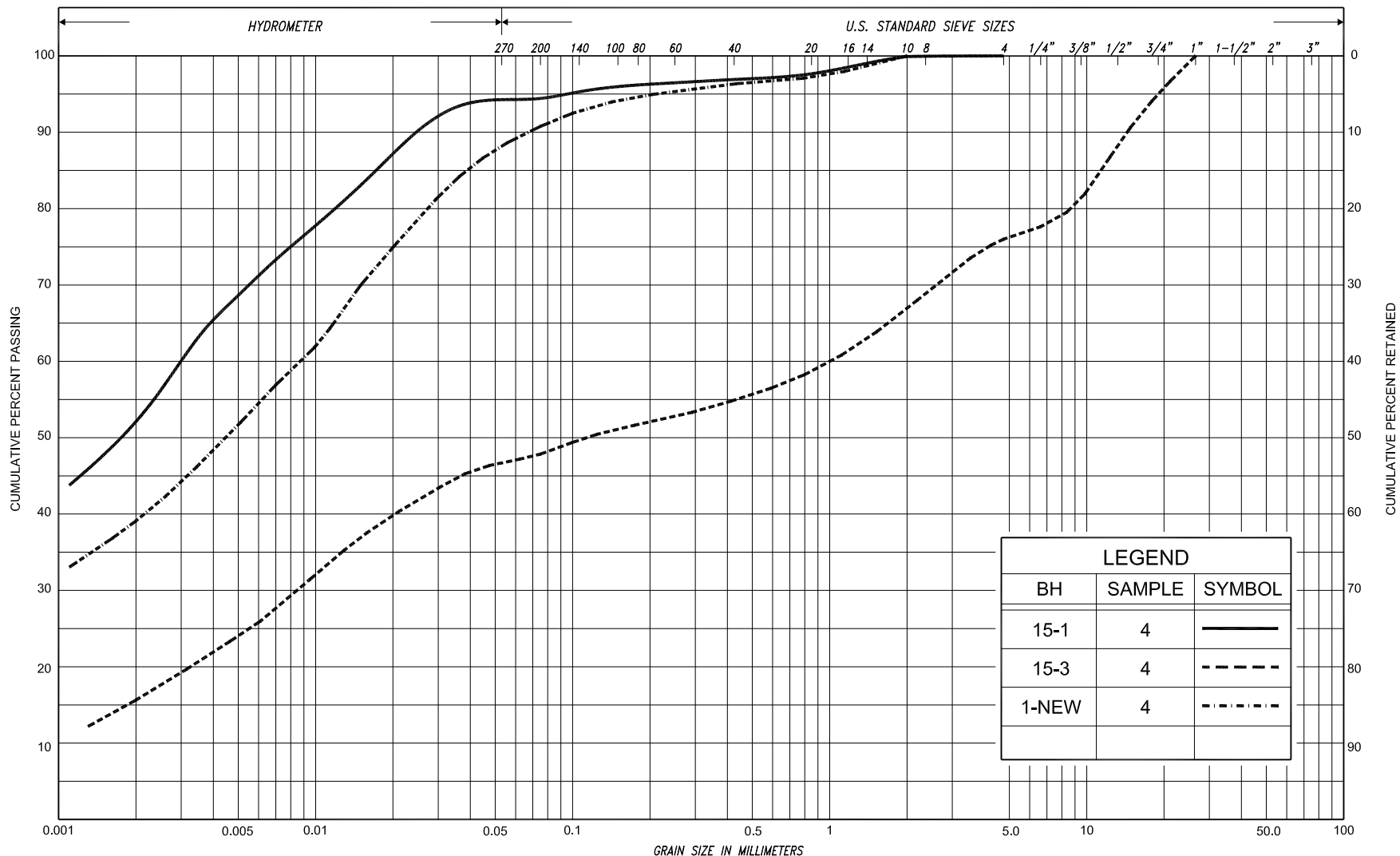


GRAIN SIZE DISTRIBUTION CLAYEY SILT, sandy, with gravel (CL) (FILL)

FIG No. EBFD-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																	
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU	
					SAND													

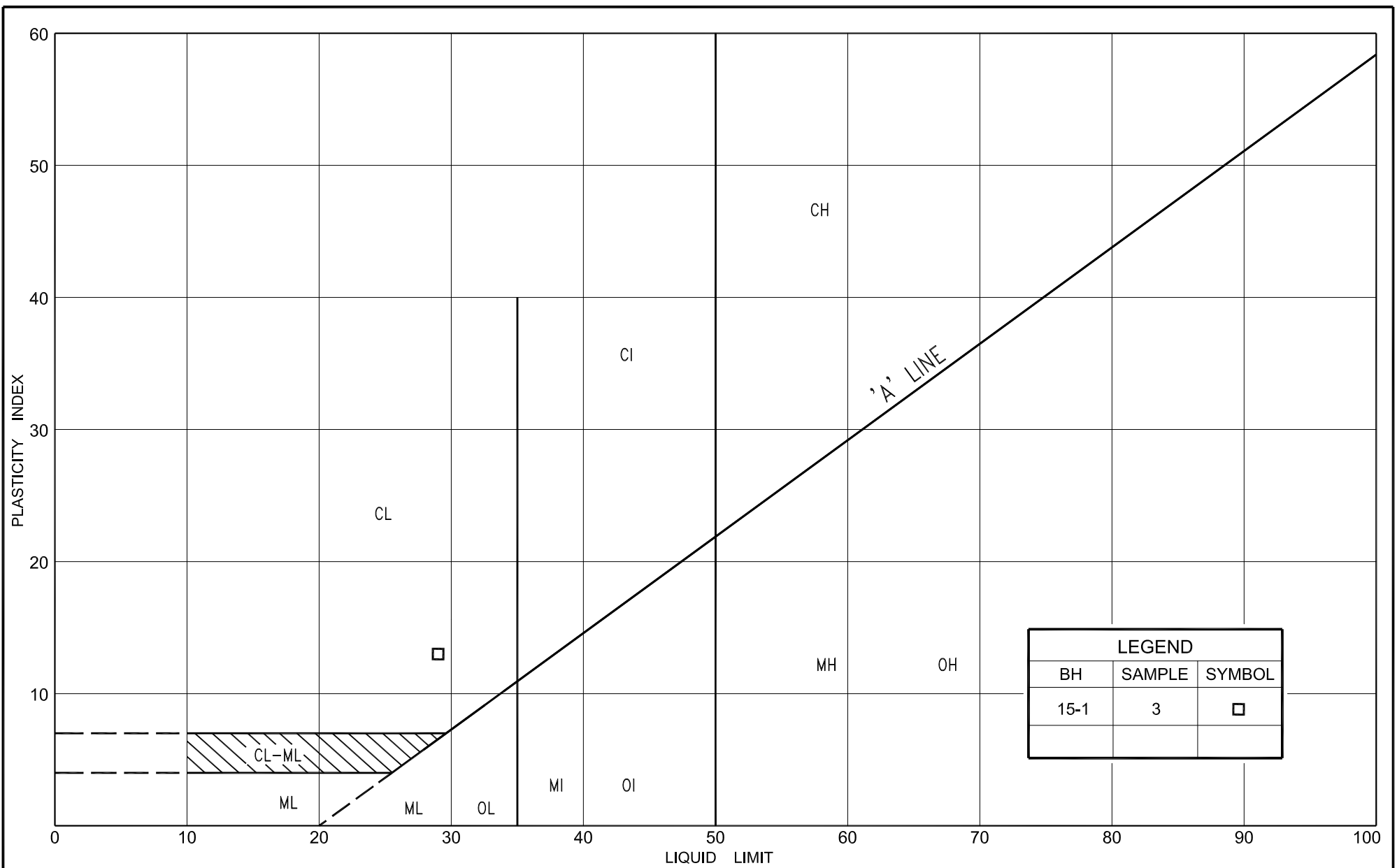


GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILTY CLAY trace to with sand, trace to with gravel (CL-CI)

FIG No. EBFD-GS-3

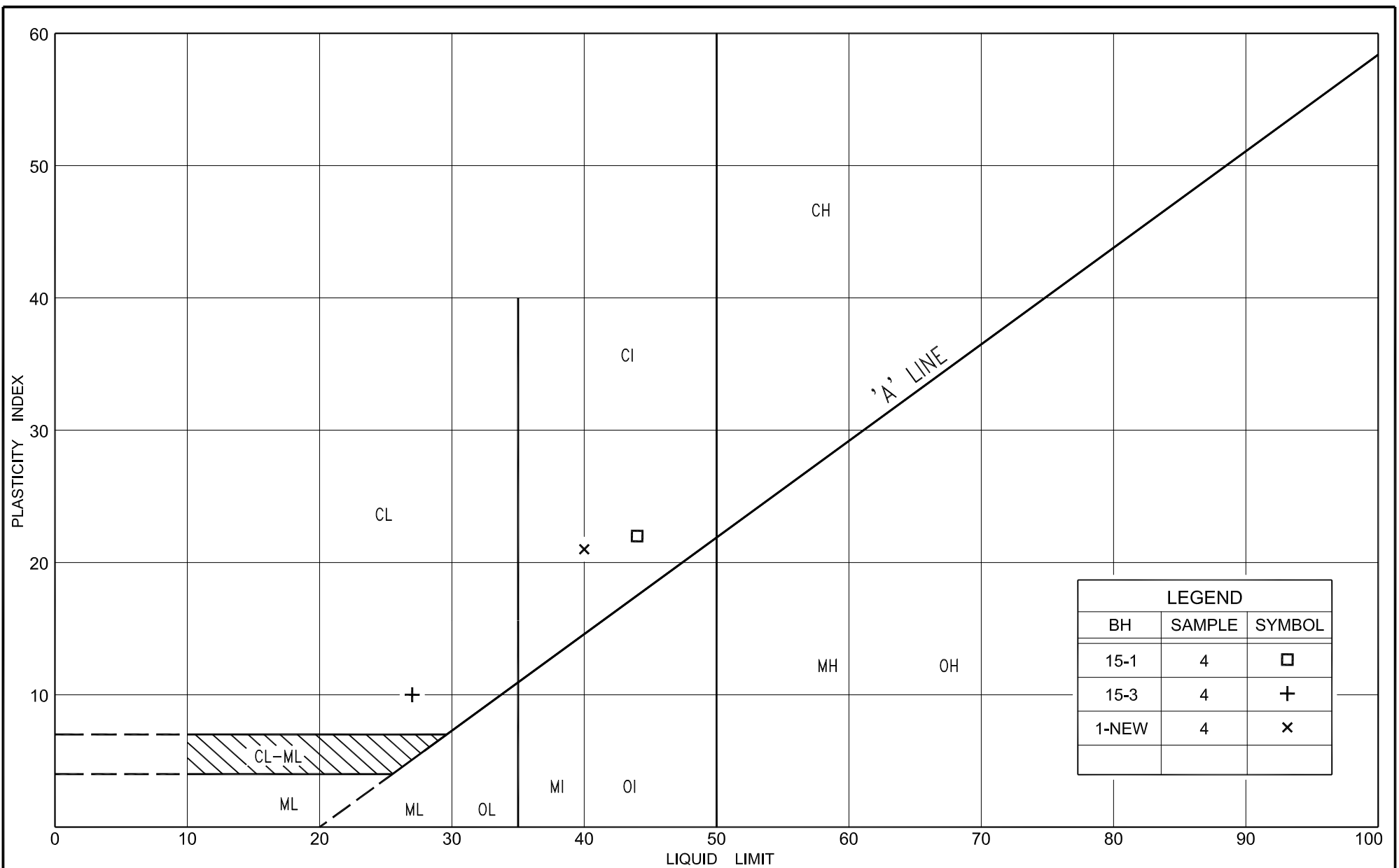
HWY: 403 / QEW

G.W.P. No. 2163-10-00



PLASTICITY CHART
 CLAYEY SILT, sandy, with gravel (CL)
 (FILL)

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



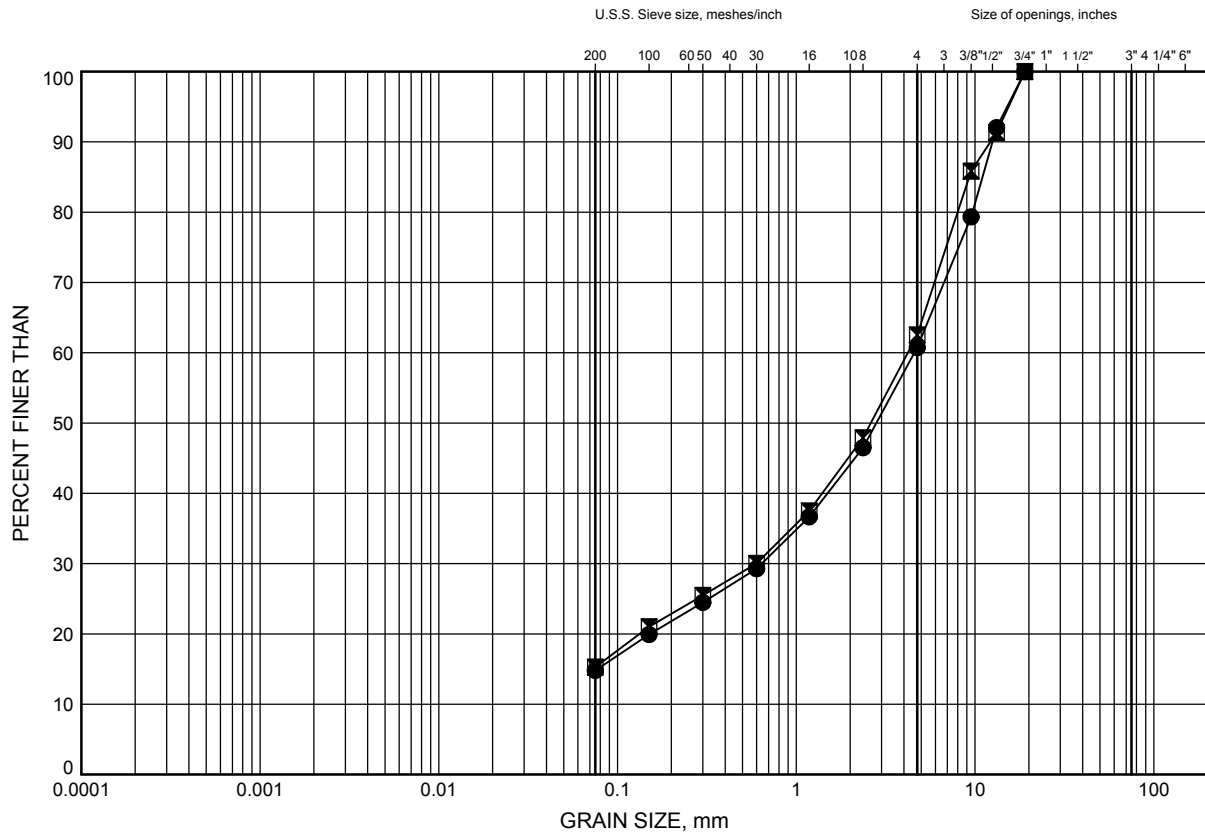
PLASTICITY CHART
CLAYEY SILT TO SILTY CLAY
 trace to with sand, trace to with gravel (CL-CI)

FIG No. EBFD-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.

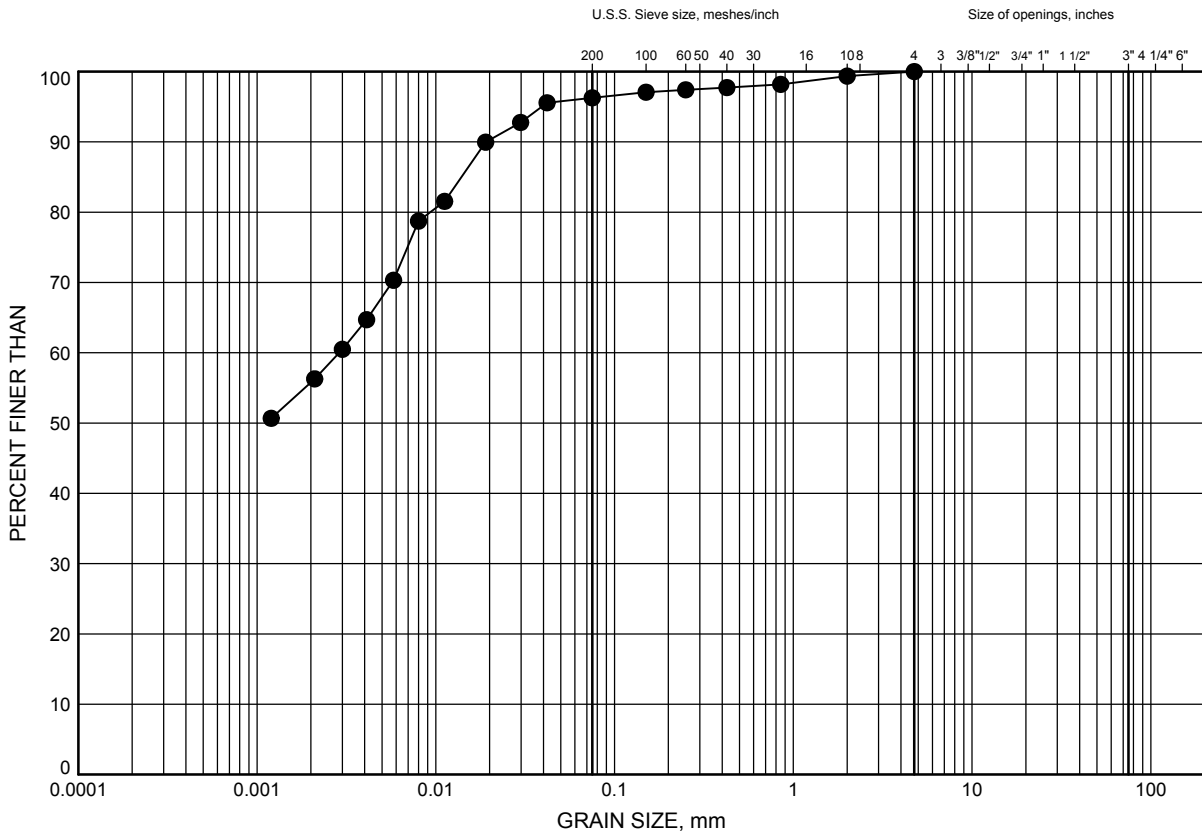


Prep'd SBP
Chkd.

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

Table A – Rock Core Descriptions
Rock Core Photographs



TABLE A

ROCK CORE DESCRIPTIONS

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
15-1	7	5.8 ⁽¹⁾ – 7.3	78	31	5.8 – 8.8	SHALE WITH INTERBEDDED LIMESTONE: Grey to dark grey, occasional dark grey to purple 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 in shale, slightly weathered to moderately weathered, close spaced flat partings, smooth to rough planar, tight, with dipping to vertical joints, poor to very poor quality.
	8	7.3 – 8.8	43	11		
15-3	7	4.9 ⁽²⁾ – 6.4	70	18	4.9 – 7.9	SHALE WITH INTERBEDDED LIMESTONE: Grey to dark grey, occasional dark grey shale, 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 unweathered, close spaced flat partings, smooth to rough planar, tight, with dipping to vertical joints, very poor to fair quality.
	8	6.4 – 7.9	100	67		

Notes:

Drilled: November 23 to 25, 2015

Logged: December, 2015

RQD = Rock Quality Designation

5.8⁽¹⁾, 4.9⁽²⁾: Bedrock core starts at 5.8 m at BH15-1, 4.9 m at BH15-3

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



Photograph 1: Cores retrieved from borehole 15-1. Rock cores 7 and 8 from 5.8 to 8.8 m. RQD values ranged were 31% and 11% respectively, indicating poor to very poor rock quality.



Photograph 2: Cores retrieved from borehole 15-3. Rock cores 7 and 8 from 4.9 to 7.9 m. RQD values were 18% and 67% respectively, indicating very poor to fair rock quality.