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W.P. No. 157-75-03
(see also ~~802-93-01~~)

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W. O. No. _____

STR. SITE No. 24-222

HWY. No. 403

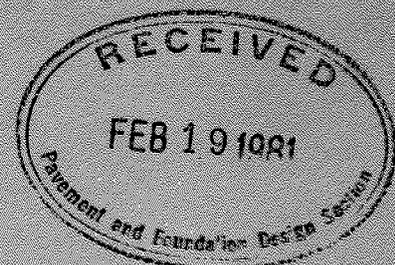
LOCATION Credit River

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____



FOUNDATION INVESTIGATION REPORT

CONTRACT NO 81-39



Ontario

Ministry of
Transportation and
Communications

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NOTE: For purposes of the contract this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 1/2" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

- μ COEFFICIENT OF FRICTION
- δ ANGLE OF WALL FRICTION
- k_o COEFFICIENT OF EARTH PRESSURE AT REST
- k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
- k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
- i ANGLE OF INCLINATION OF SURCHARGE
- w SLOPE ANGLE-BACKFACE OF WALL
- β ANGLE OF SLOPE
- N_c, N_q, N_c BEARING CAPACITY FACTORS
- D_f DEPTH OF FOOTING
- B, L FOOTING DIMENSIONS

INDEX PROPERTIES

- γ UNIT WEIGHT OF SOIL (BULK DENSITY)
- γ_w UNIT WEIGHT OF WATER
- γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
- γ' UNIT WEIGHT OF SUBMERGED SOIL
- G_s SPECIFIC GRAVITY OF SOLIDS
- e VOIDS RATIO
- e_o INITIAL VOIDS RATIO
- e_{max} e IN LOOSEST STATE
- e_{min} e IN DENSEST STATE
- D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
- n POROSITY
- w WATER CONTENT
- w_L LIQUID LIMIT
- w_p PLASTIC LIMIT
- w_S SHRINKAGE LIMIT
- I_p PLASTICITY INDEX = $w_L - w_p$
- I_L LIQUIDITY INDEX = $\frac{w - w_p}{w_L - w_p}$
- I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_p}$
- A_c ACTIVITY = $\frac{I_p \text{ of soil}}{w_L - 2w_p \text{ of Soil Fraction}}$
- O_m ORGANIC MATTER CONTENT
- S_r DEGREE OF SATURATION
- S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

- ϕ ANGLE OF SHEARING RESISTANCE
 - τ_f PEAK SHEAR STRENGTH
 - τ_R RESIDUAL SHEAR STRENGTH
 - c COHESION INTERCEPT
 - $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 - u PORE WATER PRESSURE
 - u_e EXCESS u
 - r_u PORE PRESSURE RATIO
 - q_u UNCONFINED COMPRESSIVE STRENGTH
 - s_u UNDRAINED SHEAR STRENGTH
 - ϵ LINEAR STRAIN
 - γ SHEAR STRAIN
 - ν POISSON'S RATIO
 - E MODULUS OF ELASTICITY
 - G MODULUS OF SHEAR DEFORMATION
 - k_s MODULUS OF SUBGRADE REACTION
 - m, n STABILITY COEFFICIENTS
 - A, B PORE PRESSURE COEFFICIENTS
- NOTE:** EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

- h HYDRAULIC HEAD OR POTENTIAL
- q RATE OF DISCHARGE
- v VELOCITY OF FLOW
- i HYDRAULIC GRADIENT
- j SEEPAGE FORCE PER UNIT VOLUME
- η COEFFICIENT OF VISCOSITY
- k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
- k_h k IN HORIZONTAL DIRECTION
- k_v k IN VERTICAL DIRECTION
- m_v COEFFICIENT OF VOLUME CHANGE
- c_v COEFFICIENT OF CONSOLIDATION
- C_c COMPRESSION INDEX
- C_r RECOMPRESSION INDEX
- d DRAINAGE PATH DISTANCE
- T_v TIME FACTOR
- U DEGREE OF CONSOLIDATION
- O_r OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT

For

Credit River Bridge
W.P. 157-75-03, Site 24-222
Hwy. 403, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during July 8, 1976 and during the periods of June 8 to 22, 1978, and April 16 to 18, 1980. The earliest investigation was done for feasibility purposes and consisted of one sampled borehole advanced by augering and diamond drilling techniques to a depth of 30 feet below the ground surface. In the 1978 investigation, a total of 16 sampled boreholes were put down by means of an auger machine equipped with hollow stem continuous flight augers and solid stem augers. The borings ranged in depth from 19 to 46 feet below the ground surface. In addition, bedrock was proven by obtaining BXL size rock core. The 1980 investigation consisted of an additional 8 boreholes put down by means of hollow stem continuous flight augers to depths of 20 to 30 feet below ground surface. Bedrock was proven by obtaining BXL size rock core samples.

SITE AND GEOLOGY

The site is located about 1½ miles south of Eglinton Avenue and about 250 feet east of Mississauga Road in the City of Mississauga, Regional Municipality of Peel.

At this site the Credit River is winding from north to south and has eroded a valley which is about 1100 feet wide from crest to crest and about 70 feet deep. The sides of the valley are found to be as steep as 1½:1 with the steep faces being on the concave side of the river. In certain locations subsoil strata and bedrock formations are exposed on the sides of the valley. The tabeland on either side of the valley is relatively flat, being gently sloping down towards the south.

Physiographically the site is situated in the border region of the "Peel Plain" and the "South Slope". The predominant deposit in this area is known to be a cohesive glacial till. The underlying bedrock is a shale of the Dundas-Meaford formation.

SUBSURFACE CONDITIONS

General

The overburden has a thickness of up to 32 feet in the tableland bordering the valley, but diminishes to 3 to 11 feet thick at the valley floor. The overburden at this site generally consists of a glacial till composed of clayey silt, some sand and gravel. However, in the valley floor the Credit River has eroded the glacial till and the upper portion of the bedrock and redeposited a sand and gravel with trace of silt and clay. Across the site, the overburden is underlain by shale bedrock.

Factual data on the subsoil conditions is shown on the Borehole Record Sheets. The locations and elevations of the borings, together with the estimated stratigraphical profile and sections, are shown on Contract Drawing Nos. 24-222-2 and 2A. A description of the subsoil and bedrock conditions is given below.

Glacial Till

This deposit is encountered on the tableland on either side of the valley and has a thickness of up to 32 feet. It is composed of a heterogeneous mixture of clayey silt, sand and gravel. Typical grain size distribution curves of the material from this deposit are shown in an envelope form on Figure 1. Geotechnical identity indices of the glacial till as determined from laboratory testing are summarized below.

		<u>Range</u>
Natural Moisture Content (W) %		9-12
Liquid Limit	(W _L) %	19-38
Plastic Limit	(W _p) %	13-23

The results of the Atterberg Limit Testing are also plotted on the Plasticity Chart, Figure 2, which indicate the glacial deposit is cohesive with a low to medium plasticity (CL TO CI zone).

The Standard Penetration Test 'N' values ranged from 10 blows to over 100 blows per foot, generally increasing with depth, indicating that the consistency of the glacial till varies from stiff to hard, but generally hard.

Sand and Gravel, Trace of Clay and Silt

This flood plain deposit was encountered in the river valley. It appears to be confined to areas below contour 392.0 and extends to bedrock for a thickness of 3 to 11 feet. This deposit is alluvial in origin and is composed of sand and gravel with a trace of clay and silt. Typical grain size distribution of the material in this deposit is shown in an envelope form on Figure 3. However, in certain locations the matrix (material passing sieve #40) exhibits slight plasticity. The Standard Penetration Test 'N' values varying randomly from 13 to 53 blows per foot indicate that this deposit has a compact to very dense relative density.

Bedrock (Shale Interbedded With Limestone)

Bedrock was encountered at elevation 437 on the west bank of the valley, at elevation 378 to 398 in the valley floor, and at elevation 420 to 425 on the east bank of the valley. Bedrock may be described as shale interbedded with limestone. The shale is soft to medium hard, somewhat fissile and weathered in the upper portion. The depth of weathering was found to be one to two feet on the west bank of the valley and up to 10 feet on the east bank of the valley. However, in the valley the weathered bedrock was up to 8 to 15 feet thick. The recovery ratio is high, generally close to 100%. However, the average RQD was found to be in the order of 30% to 50%, suggesting the shale is a poor quality rock.

Groundwater Conditions

The groundwater levels were observed by measuring in the open boreholes during and immediately after the field investigation. The groundwater levels were found to vary as high as elevation 454 (on the tableland) and as low as elevation 385 to elevation 390 (in the valley floor), generally constituting a hydraulic

gradient towards the river. Since the water level in the Credit River was at elevation 390, which was higher than some of the observed water levels in the boreholes, it is believed that the water levels in the boreholes probably were not stabilized during the period of observations.

M. MacLean

M. MacLean, P. Eng.
Project Foundations Engineer

M. Devata

M. Devata, P. Eng.
Sr. Foundations Engineer

APPENDIX

RECORD OF BOREHOLE No 9

8

W P 157-75-03 LOCATION Coords. N 15,828,140; E 950,880 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE H.S. Auger, NX Casing, BXL Rock Core and Cone Test COMPILED BY V.K.
 DATUM Geodetic DATE July 8, 1976 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES																
462.0	Ground Level																				
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Occasional Gravel (Glacial Till) Hard Brown Grey		1	SS	38	↓							0 16 54 30								
			2	SS	47																
			3	SS	109																
			4	SS	49																
			5	SS	39																
			6	SS	74																
437.5																					
24.5	Sound Shale Interbedded With Limestone		7	RC BXL	100% Rec																
431.7																					
30.3	End of Borehole																				

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵ : Numbers refer to Sensitivity
 20
 15 → 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 11

9

W P 157-75-03 LOCATION Coords. N 15,828,055; E 950,965 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 22, 1978 CHECKED BY ep

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
462.8	Ground Level											
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Some Gravel		1	SS	10							
			2	SS	48							7 23 45 25
	Brown Grey (Glacial Till)		3	SS	20							
			4	SS	11							15 24 42 19
	Stiff to Hard		5	SS	25							
			6	SS	29							
			7	SS	85							7 21 45 27
437.0			8	SS	110	4"						
25.8	Weathered											
27.0	Sound Shale Interbedded With Limestone		9	RC BXL	100% Rec							RQD = 46%
431.5												
31.3	End of Borehole											

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12

10

W P 157-75-03 LOCATION Coords. N 15,828,256; E 951,024 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
391.5	Ground Level											
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	35	+						47 41 10 2
384.0	Compact to Dense		2	SS	29							61 20 15 4
7.5	Weathered		3	SS	50							
			4	SS	88							
376.5	Sound, Shale Interbedded With Limestone		5	RC	100%							
371.3	End of Borehole											
20.2												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13

11

W P 157-75-03 LOCATION Coords. N 15,828,192; E 951,085 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 22, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE						
390.9	Ground Level									
0.0	Sand and Gravel Trace of Clay and Silt Compact		1	SS	26	6" 4"		○		62 25 10 3
384.9			2	SS	103					
6.0			3	SS	1057					
376.1			4	SS	1167					
14.8			5	RC BXL	100% Rec					
371.9	Weathered Sand, Shale Interbedded With Limestone									RQD = 44%
19.0	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 5 (% STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 14

12

W P 157-75-03 LOCATION Coords. N 15,828,442; E 951,219 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 8, 1978 CHECKED BY *[Signature]*

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			20	40					
393.7	Ground Level													
0.0	Sand and Gravel Trace of Clay and Silt Compact to Dense		1	SS	19									41 41 14 4
			2	SS	53									36 42 17 5
382.2			3	SS	13									
11.5			4	SS	100%									
			5	RC	50% Rec									RQD = 100%
			6	BXL	Rec									RQD = 0%
373.2	Weathered		7	RC	39% Rec									RQD = 28%
20.5	Sound Shale Interbedded With Limestone		8	RC	100% Rec									RQD = 21%
			9	BXL	Rec									RQD = 71%
365.7			10	RC	100%									
28.0	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 15

13

W P 157-75-03 LOCATION Coords. N 15,828,380; E 951,281 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 8, 1978 CHECKED BY [Signature]

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			20	40	60	80	100					
391.6	Ground Level																
0.0	Sand and Gravel Trace of Clay and Silt	[Pattern]	1	SS	19							○	[Line]			48 27 19 6	
	Compact to Dense		2	SS	22								[Line]	○		43 34 16 7	
379.6			3	SS	56												
12.0	Weathered	[Pattern]	4	SS	100%	4"										25 15 49 11	
375.8			5	BXL	70% Rec												
15.8	Sound Shale Interbedded With Limestone	[Pattern]	6	RC	100% Rec											RQD = 25%	
370.9																	
20.7	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15-5 (%) STRAIN AT FAILURE
 10



RECORD OF BOREHOLE No 16

14

W P 157-75-03 LOCATION Coords. N 15,828,584; E 951,332 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 12, 1978 CHECKED BY [Signature]

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	20						40
404.4	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	44								13 24 44 19	
			2	SS	100/	4"								
			3	SS	100/	1"								
393.4	Weathered		4	SS	100/	5"								
11.0			5	SS	100/	4"								
			6	SS	150/	3"								
			7	SS	100/	3"								
378.4	Sound, Shale Interbedded With Limestone		8	RC	100%								RQD = 40%	
26.0					BXL	Rec								
374.4	End of Borehole													
30.0														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity 20
 15 ◇ 5 (%) STRAIN AT FAILURE
 10



RECORD OF BOREHOLE No 17

15

W P 157-75-03 LOCATION Coords. N 15,828,538; E 951,378 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 13, 1978 CHECKED BY [Signature]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE			'N' VALUES	20					
398.6	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Stiff to Hard		1	SS	12								0 9 66 25
			2	SS	29								
388.6			3	SS	65								
10.0	Weathered		4	SS	105/6"								
			5	SS	100/5"								
			6	SS	140/3"								
374.6	Sound, Shale Interbedded With Limestone		7	RC	100%								RQD = 55%
24.0			BXL	Rec									
369.6													
29.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 - 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 18

16

W P 157-75-03 LOCATION Coords. N 15,828,492; E 951,425 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone COMPILED BY C.P.
 DATUM Geodetic DATE June 12, 1978 Test CHECKED BY [Signature]

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	20					
389.7	Ground Level												
0.0	Sand and Gravel Trace of Silt and Clay, Compact	[Pattern]	1	SS	25								66 21 10 3
383.2			2	SS	124/	11"							10 10 55 25
6.5	Weathered	[Pattern]	3	SS	100/	5"							RQD = 51%
374.7			4	RC BXL	75% Rec								RQD = 48%
15.0	Sound, Shale Interbedded With Limestone	[Pattern]	5	RC BXL	100% Rec								
369.7													
20.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 19

17

W P 157-75-03 LOCATION Coords. N 15,828,632; E 951,411 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 14, 1978 CHECKED BY [Signature]

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	20	40						60
404.8	Ground Level														
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	100%	5"								32 34 27 7	
			2	SS	31										
394.3			3	SS	100%	5"									16 32 34 18
10.5			4	SS	100%	5"									
			5	SS	100%	4"									
384.8	Weathered														
20.0	Sound, Shale Interbedded With Limestone		6	RC	100%										
379.2			BXL	Rec											RQD = 68%
25.6	End of Borehole														

+³, x⁵: Numbers refer to Sensitivity 20
 15-0.5 (%) STRAIN AT FAILURE
 10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 20

18

W P 157-75-03 LOCATION Coords. N 15,828,572; E 951,472 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 13, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									'N' VALUES
402.7	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	24							40 38 16 6	
			2	SS	100/7	5"		106/5"					27 12 41 20
			3	SS	100/7	6"							
390.2			4	SS	100/7	6"							
12.5	Weathered		5	SS	180/7	4"							
			6	SS	106/7	5"							
377.7	Sound, Shale Interbedded With Limestone		7	RC	100%							RQD = 71%	
372.5			BXL	Rec									
30.2	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity

20
15
10
5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 21

19

W P 157-75-03 LOCATION Coords. N 15,828,777; E 951,519 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 19, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
441.9	Ground Level											
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	28	↓		○				4 19 49 28
			2	SS	30							12 28 40 20
			3	SS	81							
			4	SS	61							
424.9			5	SS	120/ 5"							
423.4	Weathered											
18.5	Sound, Shale Interbedded With Limestone		6	NC BXL	100% Rec							RQD = 0%
419.4												
22.5	End of Borehole											

+3, x⁵: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 22

20

W P 157-75-03 LOCATION Coords. N 15,828,732; E 951,566 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

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	20						40
441.1	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard Boulders		1	SS	37								23 16 41 20	
			2	SS	46									0 28 52 20
			3	SS	66									
			4	SS	47									
			5	SS	100/		1"							
422.1			6	SS	123/	6"								
19.0	Weathered													
416.4														
24.7	Sound, Shale Interbedded With													
411.1	Limestone		7	RC BXL	100% Rec								RQD = 59%	
30.0	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 23

21

W P 157-75-03 LOCATION Coords. N 15,828,688; E 951,614 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY C.P.
 DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	N' VALUES			20	40					
440.7	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard	[Strat Plot]	1	SS	33	4"	440			WATER CONTENT (%) 10 20 30			15 18 46 21	
			2	SS	48									
			3	SS	42									
			4	SS	73									
			5	SS	116									
421.2			6	SS	1007									
19.5	Weathered					420								
415.7	Sound, Shale Interbedded With Limestone	[Strat Plot]	7	RC	100%									
410.5			BXL	Rec										RQD = 41%
30.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity
 20
 15
 10

RECORD OF BOREHOLE No 24

22

W P 157-75-03 LOCATION Coords. N 15,828,887; E 951,622 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									'N' VALUES
454.2	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	26							11 19 39 31	
			2	SS	32								3 24 53 20
			3	SS	44								
			4	SS	41								
			5	SS	33								
			6	SS	28								
			7	SS	50								10 31 50 19
			8	SS	25								
422.2	Weathered		9	SS	130/6"								
32.0													
415.2	Sound, Shale Interbedded With Limestone		10	RC	100%							RQD = 43%	
39.0													
410.2													
44.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 → 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 25

23

W P 157-75-03 LOCATION Coords. N 15,828,850; E 951,676 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 19, 1978 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
451.4	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	33	↓	450					11 20 48 21	
	Hard		2	SS	36								
			3	SS	70								
			4	SS	50								
			5	SS	35								
			6	SS	54								
			7	SS	63								
			8	SS	112								
419.4	Weathered		9	SS	100/2"				440				
32.0			10	SS	165/4"				430				
410.4	Sound, Shale Interbedded With Limestone								420				
41.0							410						
405.2			11	RC BXL	100% Rec							RQD = 63%	
46.2	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15-20.5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 26

24

W P 157-75-03 LOCATION Coords. N 15,828,795; E 951,716 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 20, 1978 CHECKED BY

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	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
445.3	Ground Level											
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)	1	SS	23	↓	440		○				9 34 42 15
	Very Stiff to Hard	2	SS	22								
		3	SS	43								
		4	SS	31								
		5	SS	31								
		6	SS	25								
422.3	Weathered	7	SS	100/6"								
23.0												
415.3	Sound, Shale Interbedded With Limestone	8	RC	100%								RQD = 45%
30.0												
410.3	End of Borehole		BXL	Rec								
35.0												

+³, x⁵: Numbers refer to
Sensitivity

20
15 ○ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 51

25

W P 157-75-03 LOCATION Co-ords. N 15 828 215; E 950 966 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

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	20	40	60	80					
389.7	Ground Level															
0.0	Sand & Gravel Dense															
386.7	Trace of Silt		1	SS	125											
3.0	Weathered Shale		2	SS	125	6"										
382.7			3	SS	100	6"										
7.0																
	Sound Shale with Limestone Layers		4	RC BXL	REC 20%											RQD 0%
			5	RC BXL	REC 100%											RQD 70%
			6	RC BXL	REC 67%											RQD 25%
368.9			7	RC BXL	REC 100%											RQD 75%
20.8	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity 20
 15 x 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 53

27

W P 157-75-03 LOCATION Co-ords. N 15 828 306; E 951 073 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE			'N' VALUES	20	40	60	80					
391.0	Ground Level															
0.0	Sand and Gravel Trace of Silt and Clay Compact	[Strat Plot]	1	SS	25										50 26 20 4	
384.0			2	SS	27											51 31 14 4
7.0	Glacial Till Hard	[Strat Plot]	3	SS	48											
380.5			4	SS	101											
10.5	Weathered Shale	[Strat Plot]	5	SS	100											
377.5			6	RC	25%	REC										RQD = 0%
13.5	Sound Shale with Limestone Layers	[Strat Plot]	7	BXL	15%										RQD = 10%	
			8	RC	20%	REC										RQD = 60%
			9	BXL	90%											RQD = 80%
367.5	End of Borehole	[Strat Plot]														
23.5																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 54

28

W P 157-75-03 LOCATION Co-ords. N 15 828 235; E 951 140 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								WATER CONTENT (%) 10 20 30
390.7	Ground Level															
0.0	Sand and Gravel Trace of Silt and Clay Compact		1	SS	21	↓										
382.7			2	SS	20											
8.0			3	SS	44											
376.2	Weathered Shale		4	SS	100/		4"									
14.5			5	SS	100/		2"									
370.7	Sound Shale with Limestone Layers			RC	REC											
20.0			6	BXL	40%										RQD 25%	
	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to : 20
Sensit : 15 - 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 56

30

W P 157-75-03 LOCATION Co-ords. N 15 828 350; E 951 254 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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	20	40	60	80						100	SHEAR STRENGTH
											○ UNCONFINED	+	FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x	LAB VANE	10	20	30		
389.1	Ground Level																	
0.0	Sand and Gravel		1	SS	20													
	Trace of Silt and Clay		2	SS	39													
382.1	Compact to Dense Cobbles & Boulders		3	SS	32													
7.0	Glacial Till Hard		4	SS	100%	5"												
378.6			5	SS	100%	3"												
10.5	Weathered Shale		6	SS	100%	3"												
373.1																		
16.0	Sound Shale with Limestone Layers		7	RC BXL	REC 100%												RQD 80%	
364.1	End of Borehole																	
25.0																		

+3, x5: Numbers refer to
Sensitivity

20
15 - 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 57

31

W P 157-75-03 LOCATION Co-ords. N 15 828 546; E 951 305 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						WATER CONTENT (%)	
404.9	Ground Level																GR SA SI CL		
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Glacial Till Hard		1	SS	23														
398.4			2	BXL	90%														
6.5	Weathered Shale and Limestone Layers 4" - 6" Thick Alternating Layers of Glacial Till 5" - 24" Thick		3	RC	50%														
			4	RC	REC														
			5	BXL	80%														
			6	RC	REC														
385.9			7	SS	30/	3"													
19.0	Sound Shale Bedrock with Limestone Layers			RC	REC														
374.9			8	BXL	100%													RQD 80%	
30.0	End of Borehole																		

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 58

32

W P 157-75-03 LOCATION Co-ords. N 15 828 462; E 951 366 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

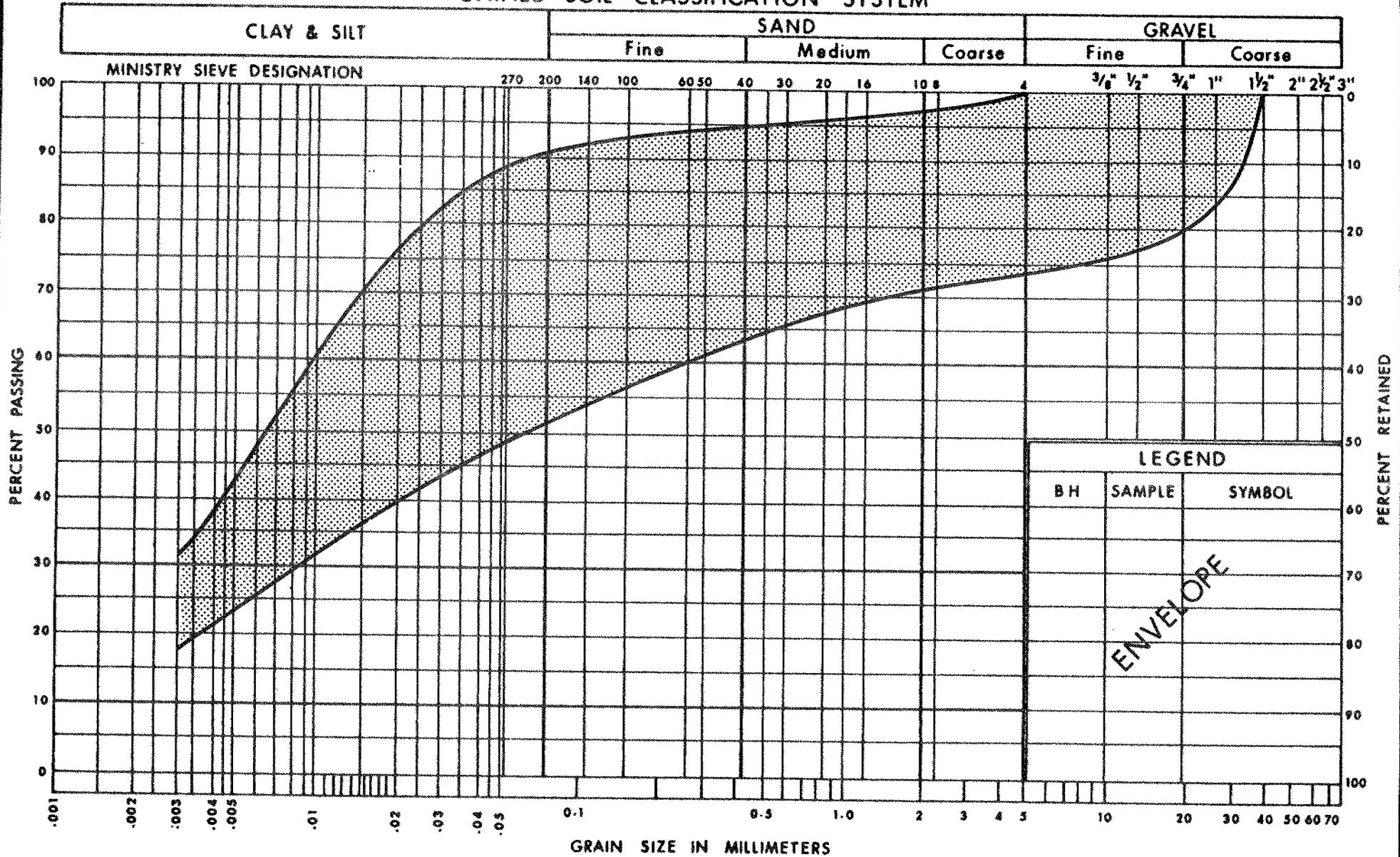
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
390.5	Ground Level															
0.0	Sand & Gravel Trace of Silt & Clay Compact With Organic Inclusions	1	1	SS	24											
383.5		2	2	SS	15											
7.0	Glacial Till Hard	3	3	SS	45											
381.0		4	4	SS	167/	9"										
9.5	Weathered	5	5	SS	100/	5"										
	Shale Bedrock with Limestone Layers	6	6	SS	100/	3"										
371.0		7	7	RC BXL	REC 80%											
19.5	Sound															RQD 50%
365.5																
25.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL

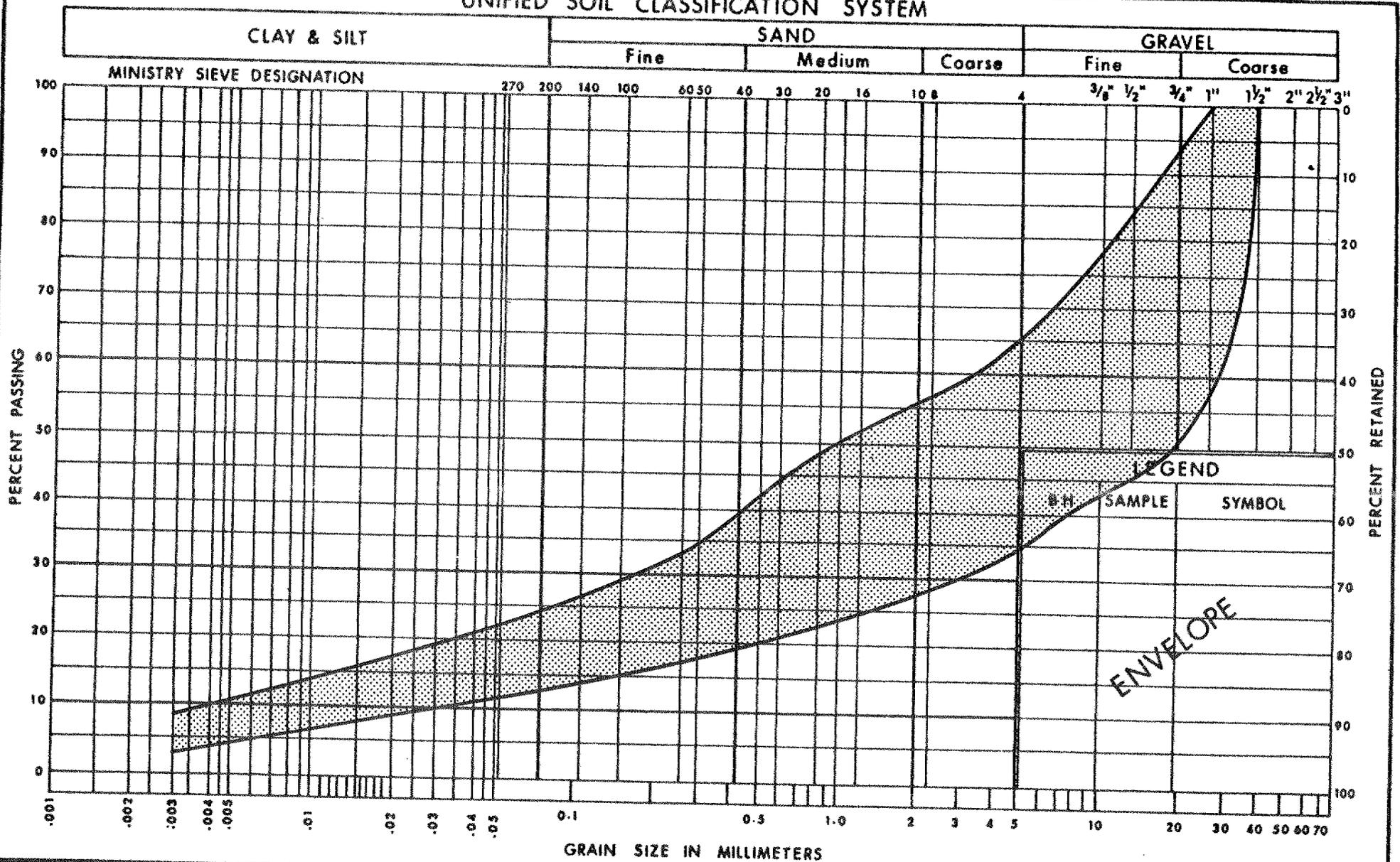


Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(Glacial Till)

FIG No 1
W P 157-75-03

UNIFIED SOIL CLASSIFICATION SYSTEM



9, 11
21, 23

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

COUT 81-39

WP 157-75-03 DIST 6
HWY 403 STR SITE 24-222
Credit River Bridge

DISTRIBUTION

G.C.E. Burkhardt (3)
R.D. Gunter
M.R. Ernesaks
D.E. Thrasher (2)

C. Grebski
G.A. Wrong
B. J. Giroux
R.S. Pillar

R. Hore

R. Fitzgibbon)
J. Anderson) cover only
G. Sloan)

Files ✓

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	28 D 15	JDD
TUBES	-	-
ROCK CORES	The remainder of lot	MH

FOUNDATION INVESTIGATION REPORT

For

Credit River Bridge
W.P. 157-75-03, Site 24-222
Hwy. 403, District 6, Toronto

INTRODUCTION

This report contains the results of the foundation investigations carried out by the Soil Mechanics Section at the site of the above mentioned project on July 8, 1976 and also during the period of June 8, 1978 to June 22, 1978. The earlier investigation was done for feasibility study purposes and consisted of one sampled borehole advanced by augering and diamond drilling techniques to a depth of 30 feet below the ground surface. In the later investigation, a total of 16 sampled boreholes were put down by means of an auger machine equipped with hollow stem continuous flight augers and solid stem augers. The borings ranged in depth from 19 to 46 feet below the ground surface. In addition, bedrock was proven by obtaining BXL size rock core.

SITE AND GEOLOGY

The site is located about 1½ miles south of Eglinton Avenue and about 250 feet east of Mississauga Road in the City of Mississauga, Regional Municipality of Peel.

At this site the Credit River is winding from north to south and has eroded a valley which is about 1100 feet wide from crest to crest and about 70 feet deep. The sides of the valley are found to be as steep as 1½:1 with the steep faces being on the concave side of the river. In certain locations subsoil strata and bedrock formations are exposed on the sides of the valley. The tableland on either side of the valley is relatively flat, being gently sloping down towards the south.

Physiographically the site is situated in the border region of "Peel Plains" and "South Slope". The predominant deposit in this area is known to be a cohesive glacial till. The underlying bedrock is a shale of the Dundas-Meaford formation.

SUBSURFACE CONDITIONS

General

The overburden has a thickness of up to 32 feet in the tableland bordering the valley, but it diminishes to 6 to 11 feet thick at the valley floor. The overburden at this site generally consists of a glacial till composed of clayey silt, some sand and gravel. However, in the valley floor the Credit River has eroded the glacial till and the upper portion of the bedrock and redeposited a sand and gravel with trace of silt and clay. Across the site, the overburden is underlain by shale bedrock.

Factual data on the subsoil conditions is shown on the Borehole Record Sheets. The locations and elevations of the borings, together with the estimated stratigraphical profile and sections, are shown on Drawing No. 1577503-A. A description of the subsoil and bedrock conditions is given below.

Glacial Till

This deposit is encountered on the tableland on either side of the valley and has a thickness of up to 32 feet. It is composed of a heterogeneous mixture of clayey silt, sand and gravel. Typical grain size distribution curves of the material from this deposit are shown in an envelope form on Figure 1. Geotechnical identity indices of the glacial till as determined from laboratory testing are summarized below.

		<u>Range</u>
Natural Moisture Content (W)	%	9-12
Liquid Limit	(W _L) %	19-38
Plastic Limit	(W _P) %	13-23

The results of the Atterberg Limit Testing are also plotted on the Plasticity Chart, Figure 2, which indicate the glacial deposit is cohesive with a low to medium plasticity.

The Standard Penetration Test 'N' values ranged from 10 blows to over 100 blows per foot, generally increasing with depth, indicating that the consistency of the glacial till varies from stiff to hard, but generally hard.

Sand and Gravel, Trace of Clay and Silt

This flood plain deposit was encountered in the river valley. It appears to be confined to areas below contour 392.0 and extends to bedrock for a thickness of 6 to 11 feet. This deposit is alluvial in origin and is composed of sand and gravel with a trace of clay and silt. Typical grain size distribution of the material in this deposit is shown in an envelope form on Figure 3. However, in certain locations the matrix (material passing sieve #40) exhibits slight plasticity. The Standard Penetration Test 'N' values varying randomly from 13 to 53 blows per foot indicate that this deposit has a compact to very dense relative density.

Bedrock (Shale Interbedded With Limestone)

Bedrock was encountered at elevation 437 on the west bank of the valley, at elevation 380 to 395 in the valley floor, and at elevation 420 to 425 on the east bank of the valley. Bedrock may be described as shale interbedded with limestone. The shale is soft to medium hard, somewhat fissile and weathered in the upper portion. The depth of weathering was found to be one to two feet on the west bank of the valley and up to 10 feet on the east bank of the valley. However, in the valley the weathered bedrock was up to 8 to 15 feet thick. The recovery ratio is high, generally close to 100%. However, the average RQD was found to be in the order of 30% to 50%, suggesting the shale is a poor quality rock.

Groundwater Conditions

The groundwater levels were observed by measuring in the open boreholes during and immediately after the field investigation. The groundwater levels were found to vary as high as elevation 454 (on the tableland) and as low as elevation 385 to elevation 388 (in the valley floor), generally constituting a hydraulic gradient towards the river. Since the water level in the Credit River was at elevation 390, which was higher than some of the observed water levels in the boreholes, it is believed that the water levels in the boreholes probably were not stabilized during the period of observation.

DISCUSSION AND RECOMMENDATIONS

The proposed Hwy. 403 crosses the Credit River approximately 1½ miles south of Eglinton Avenue in the City of Mississauga. At this location, the Credit River has eroded a valley some 1100 feet wide and 70 feet deep. Four structural schemes have been proposed to span Hwy. 403 over this valley. The four alternative schemes will have the same profile grade which has been set at about elevation 460 at the river crossing.

Our recommendations for the respective structure foundations and related approaches are as shown on the following pages.

It should be noted that if the six span twin structure scheme is adopted, a supplementary investigation will be required. This investigation can only be initiated once the preliminary design drawings with the exact location of the footings are available. In all cases for footings and pile caps there should be a minimum of 4 feet of earth cover for frost protection purposes. The lateral forces on the foundations can be resisted either by batter piles in the case of piled foundations or by frictional resistance on the underside of the spread footings. To estimate the frictional force a coefficient of friction of 0.5 can be assumed if the footing is founded on shale bedrock, or an adhesion of 2000 psf. if the footing is founded on the cohesive glacial till stratum.

Temporary dewatering measures may be required for the construction of the pier footings within the valley floor in order to place the concrete in a relatively dry condition. However, for the construction of the abutment footings no dewatering problems are anticipated since these footings will be situated in a cohesive subsoil above the prevailing groundwater level.

As an alternative the entire structure elements for any of the above schemes can be supported on caissons into the sound shale bedrock. The capacity of such caisson foundations can only be determined depending upon the diameter of the caisson, depth of embedment in the overburden and the extent of socketing into the bedrock. It may be necessary to install temporary protective steel liners within the overburden and below the rock surface in order to eliminate seepage into the caissons. For preliminary estimating purposes it can be assumed that a 48" ϕ concrete

A

THREE SPAN TWIN STRUCTURES

<u>Footings Element</u>	<u>Station</u> <u>Approximate ϕ Bearing</u>	<u>Reference Boreholes</u>	<u>Recommendations</u>
West Abutment	1018+60	9, 11	Spread footings in glacial till at or below elev. 450 with an allowable bearing pressure up to 3 tsf or alternately on end-bearing steel 'H' piles driven into the weathered bedrock (estimated tip elevation 435)
West Pier	1020+40	12, 13	Spread footings within the bedrock. Allowable bearing pressure up to 5 tsf at or below elev. 384 and 10 tsf at or below elev. 377
East Pier	1023+10	14, 15	Spread footings within the bedrock. Allowable bearing pressure up to 5 tsf at or below elev. 380 and 10 tsf at or below elev. 373
East Abutment	1024+90	16, 17, 18	Abutment perched in the approach fills supported on end-bearing steel 'H' piles driven into the shale bedrock (estimated tip elev. 392 at the north limits and 383 at the south limits) Pile capacity depends on the particular section chosen.

B
FOUR SPAN TWIN STRUCTURE

<u>Footing Element</u>	<u>Approximate Footing ∅ Bearing</u>	<u>Reference Boreholes</u>	<u>Recommendations</u>
West Abutment	1018+60	9, 11	Same as for the three span scheme
West Pier	1020+40	12, 13	Same as for the three span scheme
Center Pier	1023+10	14, 15	Same as for the east pier in the three span scheme
East Pier	1025+80	19, 20	Spread footings in the glacial till at or below elev. 398 with an allowable bearing pressure up to 4 tsf or spread footings within the bedrock with an allowable bearing pressure up to 5 tsf at or below elev. 393 at the north limits and elev. 390 at the south limits.
East Abutment	1027+60	21, 22, 23	Spread footings within the glacial till at or below elev. 435 with an allowable bearing pressure up to 3 tsf or on end-bearing steel 'H' piles driven into bedrock (estimated tip elev. 421)

C
FIVE SPAN TWIN STRUCTURE

<u>Footing Element</u>	<u>Approximate Footing ∅ Bearing</u>	<u>Reference Boreholes</u>	<u>Recommendations</u>
West Abutment	1018+60	9, 11	Same as for four span scheme
Pier #1	1020+40	12, 13	Same as for west pier in the four span scheme
Pier #2	1023+10	14, 15	Same as for center pier in the four span scheme
Pier #3	1025+80	19, 20	Same as for east pier in the four span scheme
Pier #4	1027+60	21, 22, 23	Same as for east abutment in the four span scheme
East Abutment	1029+10	24, 25, 26	Spread footings within the glacial till at or below elev. 451 at the north limits and elev. 441 at the south limits with an allowable bearing pressure up to 3 tsf. Alternatively on end-bearing steel 'H' piles driven into bedrock (estimated tip elev. 420)

D

SIX SPAN TWIN STRUCTURE

<u>Footing Element</u>	<u>Approximate Footing Ø Bearing</u>	<u>Recommendations</u>
West Abutment	1018+30	Same as for five span scheme
Pier #1	1019+50	Same as for pier #1 in the five span scheme
Pier #2	1021+10	Same as for pier #1 in the five span scheme
Pier #3	1022+70	Same as for pier #2 in the five span scheme
Pier #4	1024+30	Same as for east abutment in the three span scheme
Pier #5	1025+90	Same as for pier #3 in the five span scheme
East Abutment	1027+10	Same as for pier #4 in the five span scheme

caisson extended at least 3 feet into the sound shale bedrock should provide a safe design load of 400 tons per caisson. It should be noted that the depth of the embedment into the bedrock should be based on the magnitude of the vertical uplift and also the lateral resistance requirements. These aspects can only be discussed in detail once the design details become available. To minimize dewatering requirements for pier footings in the river valley, it may be advantageous to extend these large diameter concrete caissons to the underside of the deck of the high level bridge.

Approaches

The west approach will require fills up to 8 feet in height, whichever scheme is adopted. The overall slope of the valley, including this additional fill, will be stable provided the new fill is constructed with 2:1 slopes.

Depending on which alternative scheme is chosen, the east approach may require fills up to 60 feet in height. In order to ensure stability these fills should be constructed in accordance with the following recommendations:

- Fills up to 30 feet in height can be constructed with a 2:1 slope
- Fills in excess of 30 feet and up to 60 feet in height should be constructed with mid-height counter-balancing berms. The berming requirement is shown below in Figure A.

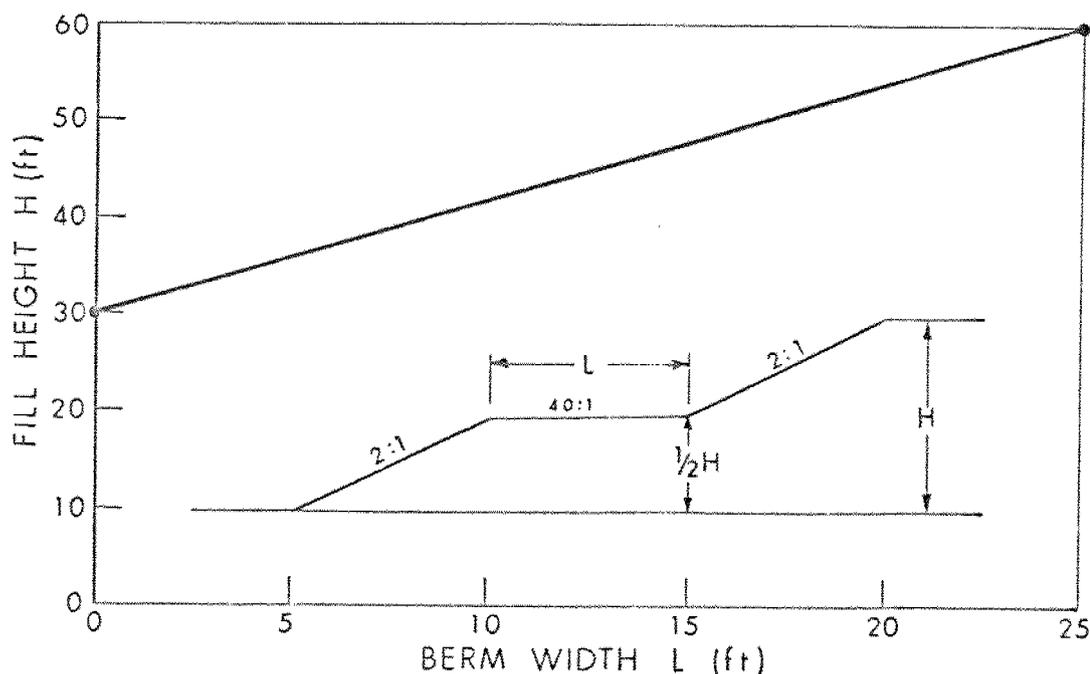


Figure A

- Prior to placing the fills, the existing slopes should be benched and the topsoil should be stripped as per current MTC practices.

It should be noted that the above mentioned recommendations were based on the assumption that locally available glacial till material (bulk unit weight $\gamma = 140$ pcf) will be used for embankment construction.

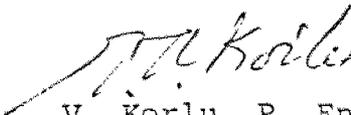
It is estimated that settlements in the order of 7 to 10 inches can be estimated within the embankment due to its own weight. In order to minimize post construction maintenance problems due to settlements within the fill material, it is desirable to place these high fills well in advance of the paving operations. To prevent negative skin frictional forces on the east abutment piles it is recommended that these high fills should be constructed and left in place for a minimum period of 3 months.

Related Considerations

If the abutments are relatively rigid then a coefficient of earth pressure at rest (k_0) of 0.5 should be assumed to estimate the earth pressure. However, if some movement at the top of the abutment wall is permitted, then a coefficient of active pressure (K_a) of 0.33 can be used. In order to relieve the build-up of excess hydrostatic pressure behind the abutment wall, free draining granular material should be used as backfill and suitable drainage measures should be provided.

MISCELLANEOUS

The fieldwork was carried out under the supervision of Mr. V. Korlu. This report was prepared by Mr. V. Korlu and Mr. B. Ly and was reviewed by Mr. M. Devata.


V. Korlu, P. Eng.
Project Engineer




M. Devata, p. Eng.
Supervising Engineer

September, 1978

FIELD AND LABORATORY WORK

The subsoil investigation was performed at this site in two stages by carrying out 17 sampled boreholes. Wherever possible, the boreholes were accompanied by a dynamic cone penetration test. The borings were advanced by a continuous flight auger machine (commercially known as C.M.E. 55, H.S.M.V.) adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The samples were hammered into the soil according to the specifications of the Standard Penetration Test. Bedrock was proven in boreholes by obtaining BXL size rock core samples.

Groundwater level observations were carried out during the time of the investigation in the open boreholes. The soil, bedrock and groundwater conditions encountered at the borehole locations are presented in the Record of Borehole Sheets. The locations and elevations of the various boreholes were provided by personnel from Construction Office, Central Region. The elevations in this report are referred to a geodetic datum. Boring locations and elevations are shown on Drawing No. 1577503-A. All samples were subjected to careful visual examinations in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected representative samples to determine the physical properties of the various soil types encountered, namely:

Natural Moisture Content

Atterberg Limit

Grain Size Distribution

The results of this testing are plotted on the Record of Borehole Sheets and summarized on Figure 1 to 3, all contained in the Appendix of this report.

APPENDIX



RECORD OF BOREHOLE No 9

W P 157-75-03 LOCATION Coords. N 15,828,140; E 950,880 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE H.S. Auger, NX Casing, BXL Rock Core and COMPILED BY V.K.
 DATUM Geodetic DATE July 8, 1976 Cone Test CHECKED BY [Signature]

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	WATER CONTENT (%)										
462.0	Ground Level															GR SA SI CL												
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Occasional Gravel (Glacial Till) Hard Brown Grey		1	SS	38	↓	460	150	450	440						0 16 54 30												
			2	SS	47																							
			3	SS	109																							
			4	SS	49																							
			5	SS	39																							2 20 52 26
			6	SS	74																							
437.5	24.5		7	RC	100%																							
	431.7			BXL	Rec																							
30.3	End of Borehole																											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11

W P 157-75-03 LOCATION Coords. N 15,828,055; E 950,965 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.E.
 DATUM Geodetic DATE June 22, 1978 CHECKED BY *ep.*

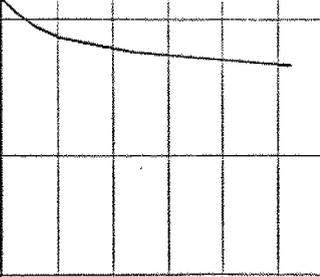
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
462.8	Ground Level															GR SA SI CL	
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Some Gravel		1	SS	10											7 23 45 25	
			2	SS	48												15 24 42 19
	Brown Grey (Glacial Till)		3	SS	20												7 21 45 27
	Stiff to Hard		4	SS	11												
			5	SS	25												
			6	SS	29												
			7	SS	85												
437.0			8	SS	150'												
25.8	Weathered																
27.0	Sound Shale Interbedded With Limestone		9	RC	100%											RQD = 46%	
431.5				BXL	Rec												
31.3	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to consistency
 20
 15-5 (% STRAIN AT FAILURE)
 10

RECORD OF BOREHOLE No 12

W.P. 157-75-03 LOCATION Coords. N 15,828,256; E 951,024 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY [Signature]

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						
391.5	Ground Level													
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	35	390							47 41 10 2	
384.0	Compact to Dense		2	SS	29									61 20 15 4
7.5	Weathered		3	SS	50									
376.5			4	SS	88									
15.0	Sound, Shale Interbedded With Limestone		5	RC BXL	100% Rec									
371.3														
20.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15
10
5 (% STRAIN AT FAILURE)



Highway Engineering Division

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 13

W.P. 257-75-03 LOCATION Coords. N 15,828,192; E 951,085 ORIGINATED BY V.K.
 DIST. 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 22, 1978 CHECKED BY [Signature]

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	20	40	60	80						100
											○ UNCONFINED	+					
											● QUICK TRIAXIAL	×					
											WATER CONTENT (%)						
											10	20	30				
390.9	Ground Level																
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	26												
384.9	Compact		2	SS	103												62 25 10 3
6.0			3	SS	105	6"											
			4	SS	116	4"											
376.1	Weathered Sand, Shale interbedded with Limestone		5	RC BXL	100% Rec												RQD = 44%
19.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 14

W P 157-75-03 LOCATION Coords. N 15,828,442; E 951,219 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 8, 1978 CHECKED BY [Signature]

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	20	40	60	80						100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	
393.7	Ground Level																		
0.0	Sand and Gravel Trace of Clay and Silt Compact to Dense		1	SS	19											41 41 14 4			
			2	SS	53												36 42 17 5		
			3	SS	13														
382.2	Weathered		4	SS	100%												RQD = 100%		
11.5			5	SC	110%													RQD = 0%	
			6	RC BXL	50% Rec														RQD = 28%
			7	RC BXL	39% Rec														RQD = 21%
373.2	Sound Shale Interbedded With Limestone		8	RC BXL	100% Rec													RQD = 71%	
20.5			9	RC	100%														
			10	RC	100%														
365.7	End of Borehole																		
28.0																			

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 15

W P 157-75-03 LOCATION Coords. N 15,828,380; E 951,281 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 8, 1978 CHECKED BY [Signature]

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			20	40	60	80	100						WATER CONTENT (%)
391.6	Ground Level																	
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	19	4"										48 27 19 6		
	Compact to Dense		2	SS	22												43 34 16 7	
379.6			3	SS	56													
12.0	Weathered		4	SS	100%													25 15 49 11
375.8		5	BXL	70% Rec														
15.8	Sound Shale Interbedded With Limestone	6	RC	100% Rec													RQD = 25%	
370.9																		
20.7	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 5 (%): STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 16

W P 157-75-03 LOCATION Coords. N 15,828,584; E 951,332 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY C.P.
 DATUM Geodetic DATE June 12, 1978 CHECKED BY SP.

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	20	40	60	80						100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE
404.4	Ground Level																	
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	44													
			2	SS	100/	4"												
			3	SS	100/	1"												
393.4	Weathered		4	SS	100/	5" ↓												
11.0			5	SS	100/	4"												
			6	SS	150/	3"												
			7	SS	100/	3"												
378.4	Sound, Shale Interbedded With Limestone		8	RC BXL	100% Rec													
26.0 374.4																	RQD = 40%	
30.0	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 17

W P 157-75-03 LOCATION Coords. N 15,828,538; E 951,378 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 13, 1978 CHECKED BY [Signature]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
398.6	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Stiff to Hard	[Strat Plot]	1	SS	12								0 9 66 25
			2	SS	29								
388.6			3	SS	65								
10.0	Weathered	[Strat Plot]	4	SS	1057	6"							
			5	SS	1007	5"							
374.6			6	SS	1707	3"							
24.0	Sound, Shale Interbedded With Limestone	[Strat Plot]	7	RC	100%								RQD = 55%
369.6				BXL	Rec								
29.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (%) STRAIN AT FAILURE



HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 18

W P 157-75-03 LOCATION Coords. N 15,828,492; E 951,425 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone COMPILED BY G.P.
 DATUM Geodetic DATE June 12, 1978 Test CHECKED BY [Signature]

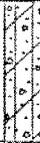
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
389.7	Ground Level												
0.0	Sand and Gravel Trace of Silt and Clay, Compact	[Stratigraphic Column]	1	SS	25		380					GR SA SI CL 66 21 10 3 10 10 55 25 RQD = 51% RQD = 48%	
383.2			2	SS	124/	11"							
6.5	Weathered		3	SS	100/	5"							
374.7			4	RC BXL	75% Rec								
15.0	Sound, Shale Interbedded With Limestone		5	RC BXL	100% Rec								
369.7						370							
20.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity 20
 15 \diamond 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 19

W P 157-75-03 LOCATION Coords. N 15,828,632; E 951,411 ORIGINATED BY V.E.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 14, 1978 CHECKED BY [Signature]

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			20	40	60	80	100						
404.8	Ground Level																	
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	100%	5"										32 34 27 7		
			2	SS	31													
394.3			3	SS	100%	5"												16 32 34 18
10.5			4	SS	100%	5"												
			5	SS	100%	4"												
384.8	Weathered																	
20.0	Sound, Shale Interbedded With Limestone		6	RC	100%													
379.2			BXL	Rec													RQD = 68%	
25.6	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to Sensitivity
 20
 15 *5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 20

W P 157-75-03 LOCATION Coords. N 15,828,572; E 951,472 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 13, 1978 CHECKED BY [Signature]

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40						60
402.7	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard	1	SS	24									40 38 16 6	
		2	SS	100/	5"									27 12 41 20
		3	SS	100/	6"									
390.2		4	SS	100/	6"									
12.5		5	SS	160/	4"									
		6	SS	100/	5"									
377.7	Weathered													
25.0	Sound, Shale Interbedded With Limestone	7	RC	100%										
372.5		BXL	Rec										RQD = 71%	
30.2	End of Borehole													

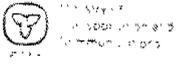
OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 21

W P 157-75-03 LOCATION Coords. N 15,828,777; E 951,519 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 19, 1978 CHECKED BY [Signature]

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	20						40
441.9	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	28								4 19 49 28	
			2	SS	30									12 28 40 20
			3	SS	81									
			4	SS	61									
424.9			5	SS	120	5"								
423.4	Weathered Sound, Shale													
18.5	Interbedded With Limestone													
419.4			6	RC BXL	100% Rec								RQD = 0%	
22.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



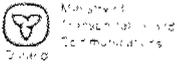
RECORD OF BOREHOLE No 22

W P 157-75-03 LOCATION Coords. N 15,828,732; E 951,566 ORIGINATED BY Y.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

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	PLASTIC LIMIT W _p
441.1	Ground Level														
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard Boulders		1	SS	37										
			2	SS	46										23 16 41 20
			3	SS	66										
			4	SS	47										0 28 52 20
			5	SS	100		1"								
422.1			6	SS	125	6"									
19.0	Weathered														
416.4															
24.7	Sound, Shale Interbedded With Limestone		7	RC	100%									RQD = 59%	
411.1															
30.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)



RECORD OF BOREHOLE No 23

W P 157-75-03 LOCATION Coords. N 15,828,688; E 951,614 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

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	20	40	60	80						100
											○ UNCONFINED	+	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x	10	20	30		
440.7	Ground Level																
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	33											15 18 46 21	
			2	SS	48												6 30 47 17
			3	SS	42												
			4	SS	73												
			5	SS	116												
421.2					6	SS	100/	4"									
19.5	Weathered																
415.7																	
25.0	Sound, Shale Interbedded With Limestone		7	RC	100%											RQD = 41%	
410.5					BXL	Rec											
30.2	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to 20
15 - 5 (%) STRAIN AT FAILURE
10
Sensitivity



Virginia Department of Transportation
Communications

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 24

W P 157-75-03 LOCATION Coords. N 15,828,887; E 951,622 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY [Signature]

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	20					
454.2	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	26								11 19 39 31
			2	SS	32								3 24 53 20
			3	SS	44								
			4	SS	41								
	Very Stiff to Hard		5	SS	33								
			6	SS	28								
			7	SS	50								10 31 50 10
422.2			8	SS	25								
32.0	Weathered		9	SS	110	6"							
415.2													
39.0	Sound, Shale Interbedded With Limestone		10	RC BXL	100% Rec								RQD = 43%
410.2													
44.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 25

W P 157-75-03 LOCATION Coords. N 15,828,850; E 951,676 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core & Cone Test COMPILED BY G.F.
 DATUM Geodetic DATE June 19, 1978 CHECKED BY [Signature]

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	NUMBER	TYPE	IN' VALUES			20	40						60
451.4	Ground Level													
0.0	Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)	1	SS	33									11 20 48 21 8 32 42 18	
	Hard	2	SS	36										
		3	SS	70										
		4	SS	50										
		5	SS	35										
		6	SS	54										
		7	SS	63										
		8	SS	112										
419.4			9	SS			100/2"							
32.0	Weathered	10	SS	165/4"										
410.4														
41.0	Sound, Shale Interbedded with Limestone	11	RC BXL	100% Rec										
405.2													RQD = 63%	
46.2	End of Borehole													

OFFICE REPORT ON SOIL SAMPLING

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 26

W P 157-75-03 LOCATION Coords. N 15,828,795; E 951,716 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 20, 1978 CHECKED BY [Signature]

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
445.3	Ground Level														
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)	[Stratigraphic Column]	1	SS	23	↓	440	[D.C.P. Plot]	112/6"	○					
	Very Stiff to Hard		2	SS	22										
			3	SS	43										
			4	SS	31										
			5	SS	31										
			6	SS	25										
422.3	Weathered		7	SS	100/6"		420								
415.3	Sound, Shale Interbedded With Limestone		8	RC BXL	100% Rec										RQD = 45%
35.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15
10

(%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications

Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 13			
14'6"	15'0"	Limestone - dolomitic, silty light grey with reddish tint, fine textured, hard with 1" seam of dark grey shale.			
15'0"	19'0"	Shale, reddish-grey, medium hard, partly fissile, with numerous thin lenses of grey limestone.			core broken and ground.
		Hole No. 14			
14'0"	14'10"	Limestone, grey, mottled, medium to coarse textured, fossiliferous, vuggi.			
14' 10"	23'5"	Shale, dark grey, partly fissile with thin lenses of limestone.			4' of core missing core badly broken and ground.

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

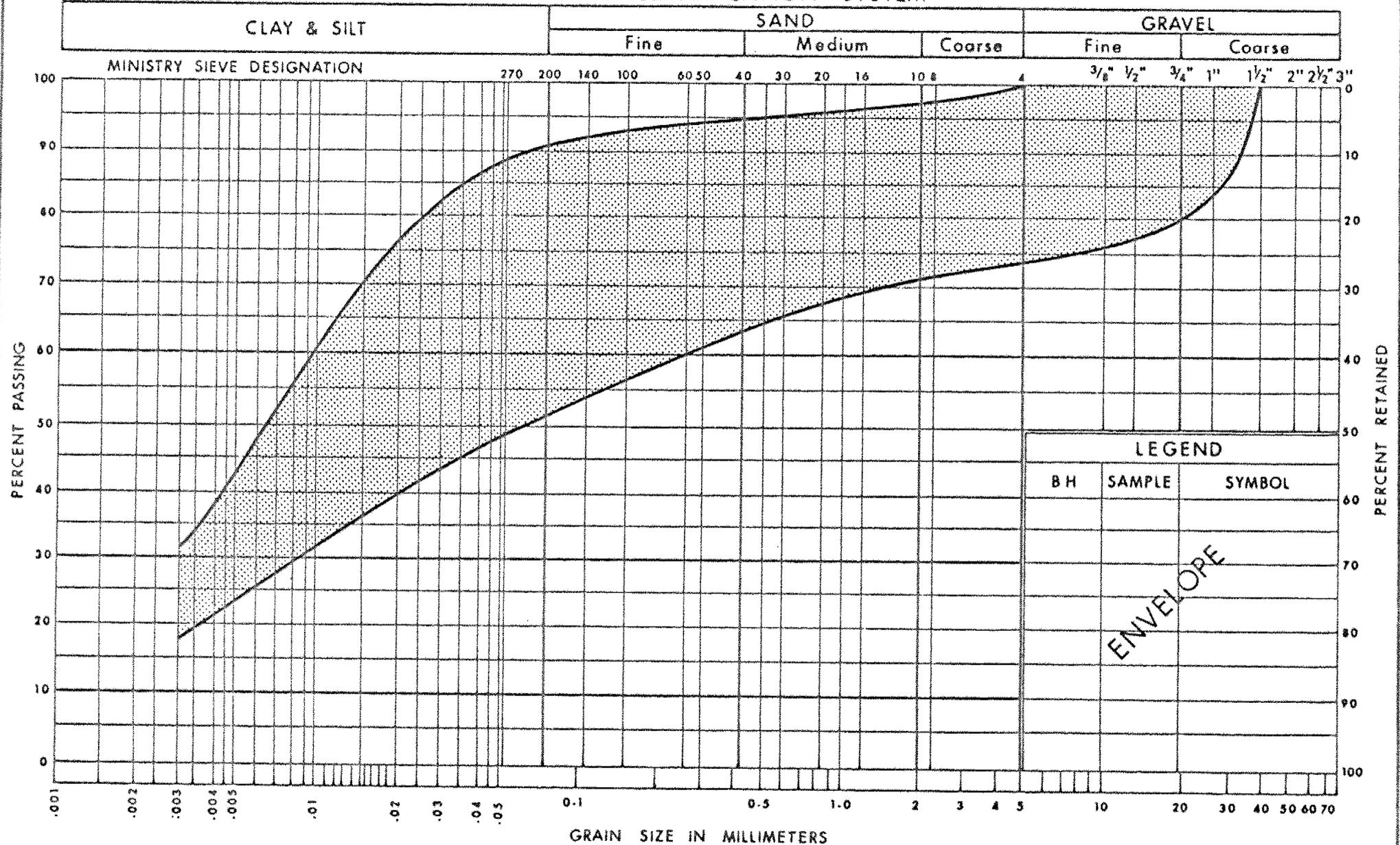
 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

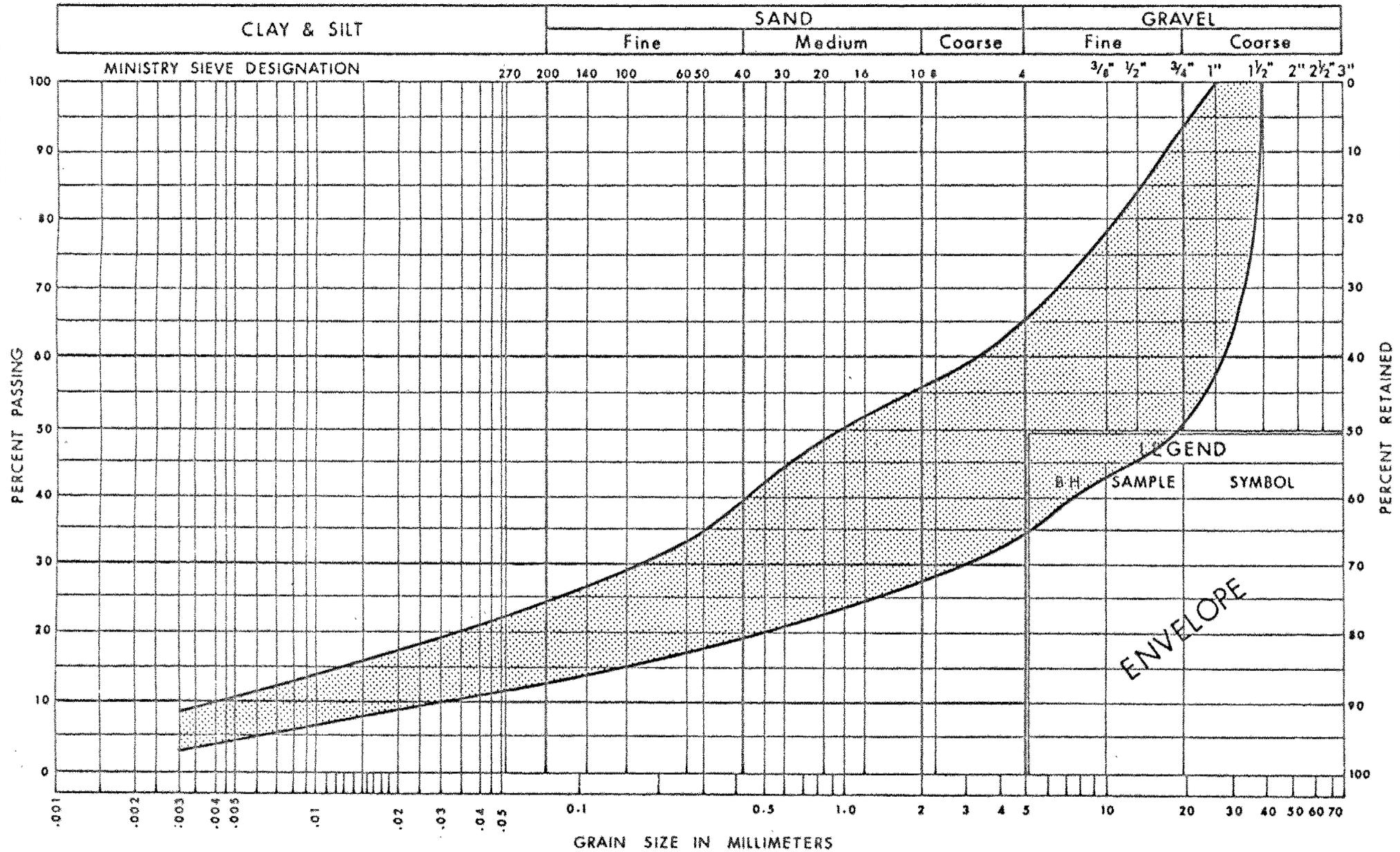
FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
Hole No. 22					
24'4"	29'1"	Shale dark grey, medium hard, partly fissile with two 2" limestone seams and numerous limestone lenses.			4" of core missing.
29'1"	30'0"	Limestone, light to grey, medium to coarse textured, hard, fossiliferous with thin seams of shale.			
Hole No. 23					
25'0"	25'6"	Shale, dark grey, medium hard			Core broken
25'6"	27'0"	Shale, dark grey, medium hard interbedded with grey, fine textured hard limestone.			
27'0"	27'9"	Shale, dark grey, medium hard, partly fissile.			
27'9"	29'0"	Shale, dark grey, medium hard, interbedded with grey, fine textured, medium hard shaly limestone.			
29'0"	32'2"	Limestone, light grey, coarse textured, hard fossiliferous with 2 1/2" seam of dark grey shale.			28'7"-29'-11" - vertical fracture.

DATE OF EXAMINATION _____

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. CUU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

SS SPLIT SPOON
 WS WASH SAMPLE
 ST SLOTTED TUBE SAMPLE
 BS BLOCK SAMPLE
 CS CHUNK SAMPLE
 TW THINWALL OPEN
 TP THINWALL PISTON
 OS OSTERBERG SAMPLE
 FS FOIL SAMPLE
 RC ROCK CORE
 FH T.W. ADVANCED HYDRAULICALLY
 FM T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE 
 w SLOPE ANGLE-BACKFACE OF WALL 
 β ANGLE OF SLOPE 
 N_c, N_q, N_γ BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_p - w_L$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{w_L - w_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w_p}{w_L - w_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

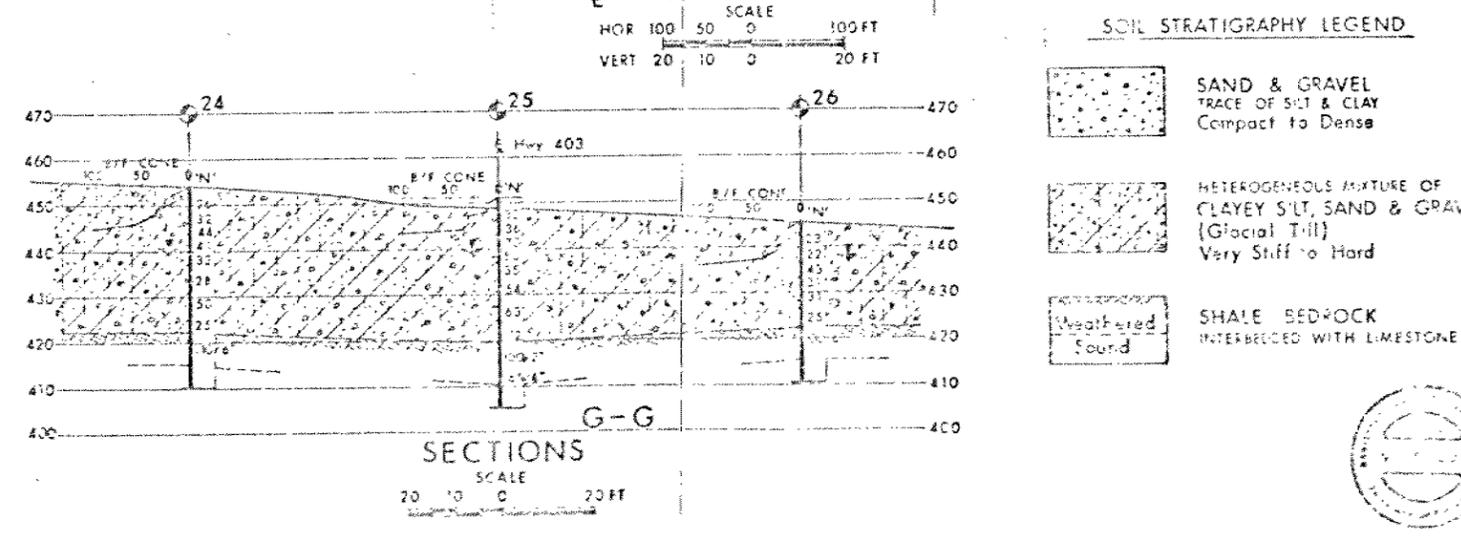
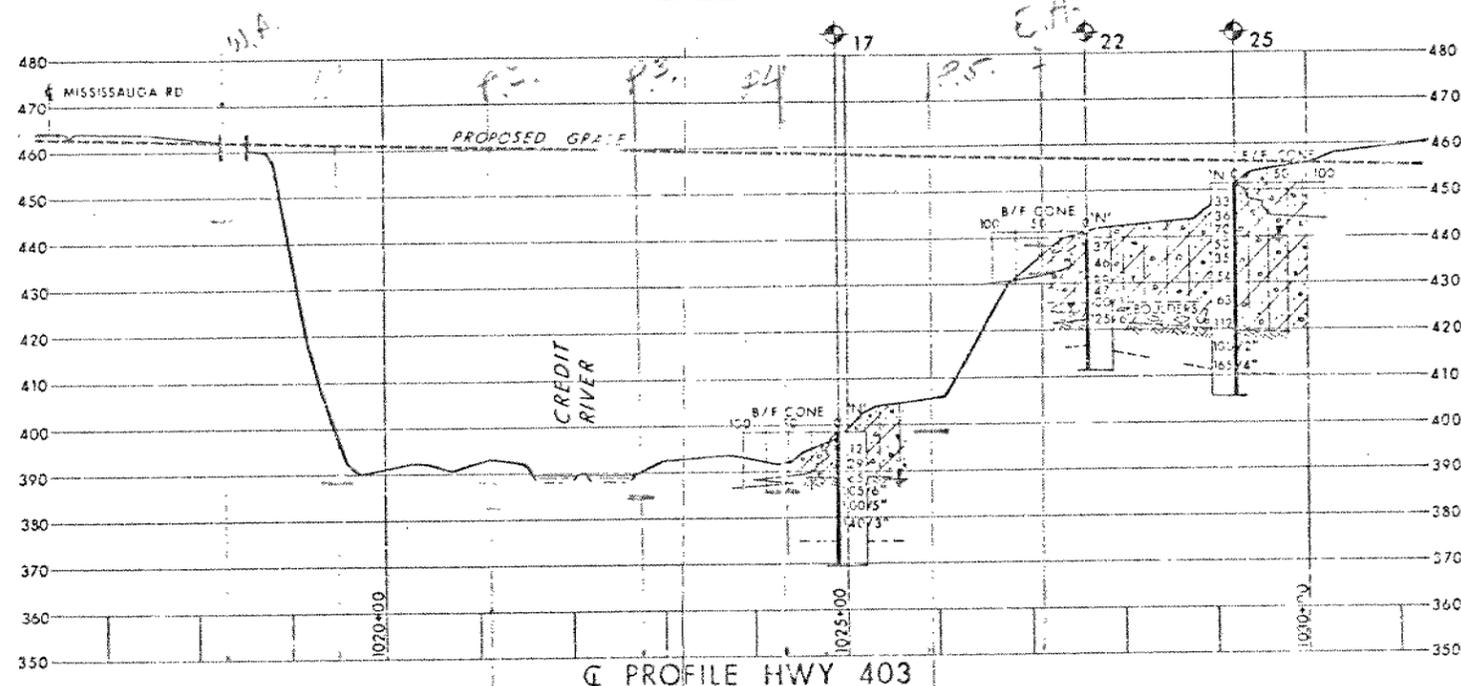
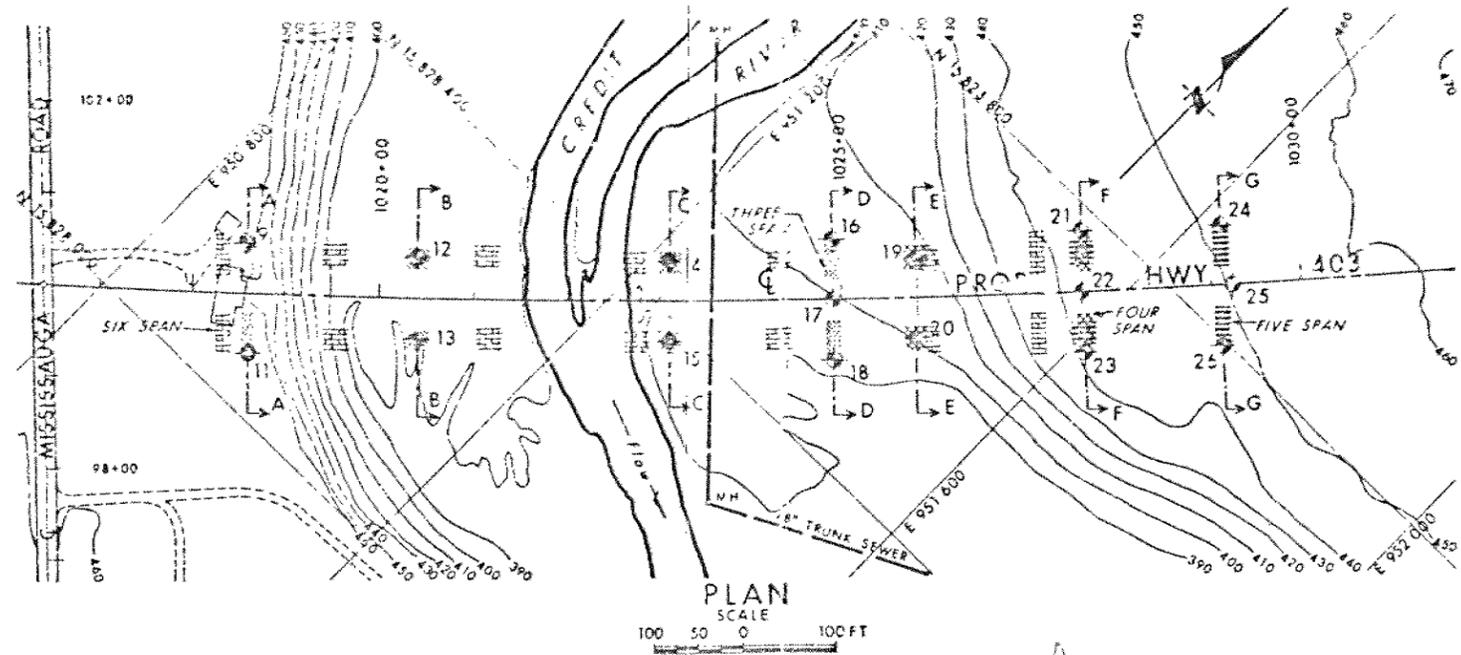
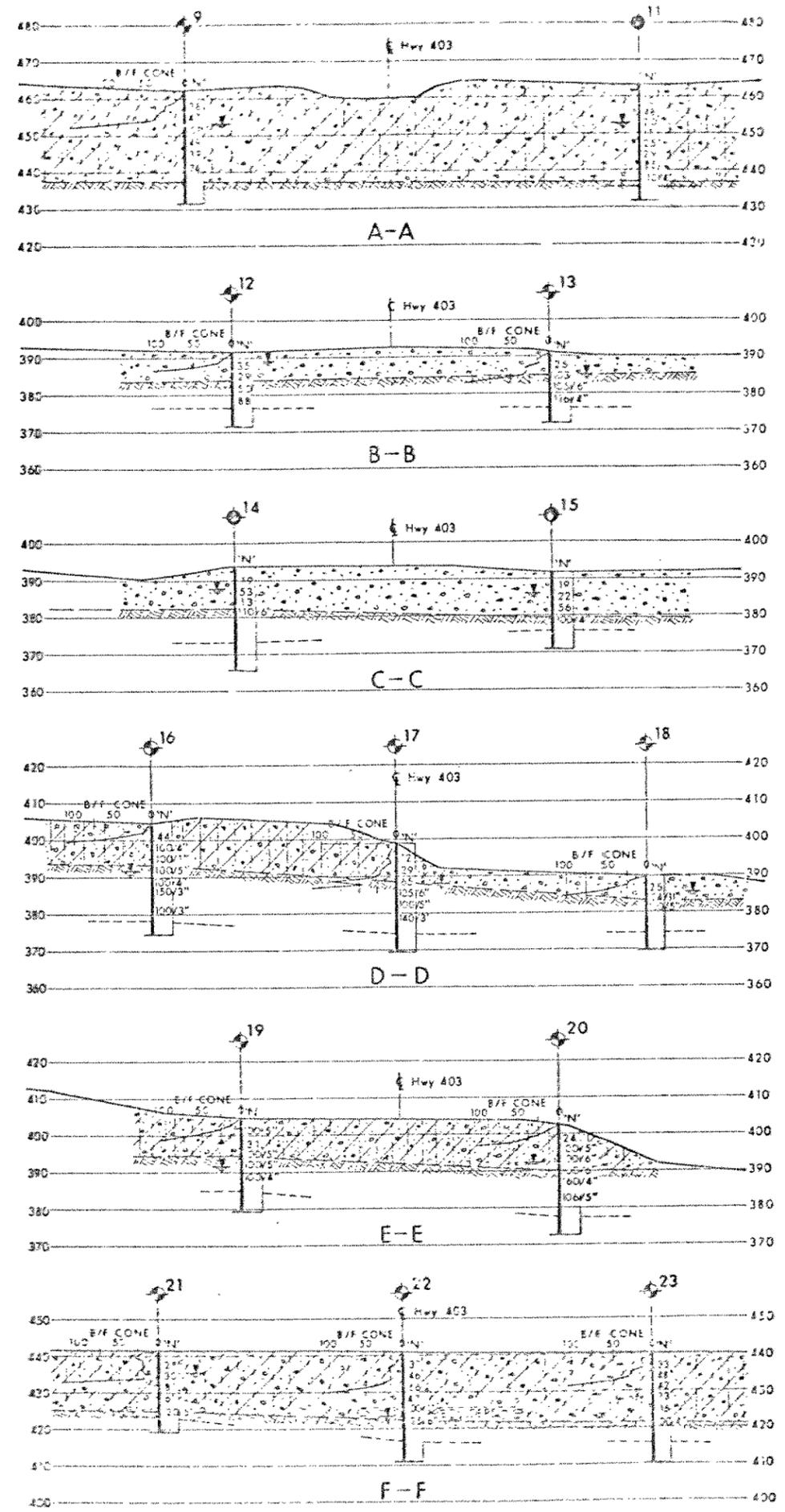
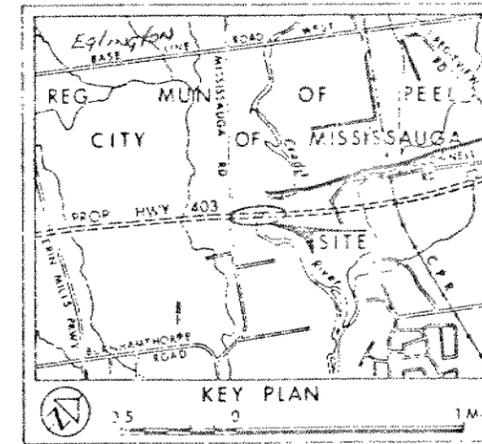
STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_b MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/ft (Std Pen Test, 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- WL at time of investigation June 1976
WL for BH# 9; July 1976

No	ELEVATION	CO ORDINATES	
		NORTH	EAST
9	462.0	15 828 140	950 880
11	462.8	15 828 055	950 965
12	391.5	15 828 256	951 024
13	390.9	15 828 192	951 035
14	393.7	15 828 442	951 219
15	391.6	15 828 380	951 281
16	404.4	15 828 584	951 332
17	398.6	15 828 538	951 378
18	387.7	15 828 492	951 425
19	404.8	15 828 632	951 411
20	402.7	15 828 572	951 472
21	441.9	15 828 777	951 519
22	441.1	15 828 732	951 566
23	440.7	15 828 686	951 614
24	454.2	15 828 887	951 622
25	451.4	15 828 850	951 676
26	445.3	15 828 795	951 716

SOIL STRATIGRAPHY LEGEND

- SAND & GRAVEL
TRACE OF SILT & CLAY
Compact to Dense
- HETEROGENEOUS MIXTURE OF
CLAYEY SILT, SAND & GRAVEL
(Glacial Till)
Very Stiff to Hard
- WEATHERED
SHALE
- SHALE BEDROCK
INTERBEDDED WITH LIMESTONE

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

REVISIONS

NO	DATE	BY	REASON

Geodes No 30412-131
Scale: 1" = 100' (Plan), 1" = 20' (Profile)
Date: May 1976

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

CONT 81-39

WP 157-75-03

DIST 6

HWY 403

STR SITE 24-222

Addendum to
Credit River Bridge

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ADDENDUM TO FOUNDATION INVESTIGATION REPORT

For

Credit River Bridge
W.P. 157-75-03, Site 24-222
Hwy. 403, Dist. 6, Toronto

This addendum contains the results of fieldwork carried out on 80-04-16 to 80-04-18 at the above mentioned project. The original Foundation Investigation Report for this project was issued on 78-09-21. The scope of that investigation included an assessment for four different structural schemes incorporating three to six span concepts. On 79-09-14 our office received the final structural drawings showing a six span concept with span ratios somewhat different than originally anticipated. In view of the variation in subsurface and bedrock conditions at this site, it was deemed necessary to carry out eight additional borings in the immediate area of the proposed piers for design and construction purposes. Because of property and access problems it was not possible to carry out the required borings until the spring of 1980. These borings have now been completed as well as the laboratory testing and drafting. The results of the additional fieldwork is appended to this addendum by means of eight Borehole Log Sheets and two Stratigraphical Drawings.

The subsurface conditions revealed by the additional boreholes reflect those encountered in the original foundation investigation and for a more complete description of subsurface conditions than given on the additional eight Borehole Log Sheets, reference should be made to the original Foundation Investigation and Design Report.

On the sheet following are summarized the complete foundation design and construction requirements as indicated by the recent completed borings.

It is important to note that our input to the structural contract package will include two stratigraphical drawings.

If you have any questions please do not hesitate to contact this office.



M. MacLean
Project Foundations Engineer



M. Devata
Senior Foundations Engineer

ELEMENT	STATION	REFERENCE B.H.	GROUND ELEVATION	OVERBURDEN TYPE	WEATHERED BEDROCK ELEVATION	SOUND BEDROCK ELEVATION	*FOOTING ELEVATION	RECOMMENDED DESIGN LOAD **	DEWATERING SCHEME REQUIRED
W Abut. WBL	1018+30	9	462.0	Glacial Till	437.5	437.5	434.5	Up to 10 TSF	NO
EBL		11	462.8	Glacial Till	437.0	436.7	434.5		
Pier 1 WBL	1019+50	51	389.7	Sand & Gravel	386.7	382.7	371.5	Up to 10 TSF	YES
EBL		52	390.0	Glacial Till	387.0	383.0	371.5		
Pier 2 WBL	1021+10	53	391.0	Sand & Till	380.5	377.5	371.5	Up to 10 TSF	YES
EBL		54	390.7	Sand & Gravel	382.7	376.2	371.5		
Pier 3 WBL	1022+70	55	392.4	Sand & Gravel	378.2	374.4	368.5	Up to 10 TSF	YES
EBL		56	389.1	Sand & Till	378.6	373.1	371.5		
Pier 4 WBL	1024+30	57	404.9	Till & Weathered Rock	385.9	385.9	371.0	Up to 10 TSF	YES
EBL		58	390.5	Sand & Till	381.0	371.0	370.0		
Pier 5 WBL	1025+90	19	404.8	Glacial Till	394.3	384.8	381.5	Up to 10 TSF	YES
EBL		20	402.7	Glacial Till	390.2	377.7	374.5		
E Abut. WBL	1027+10	21	441.9	Glacial Till	424.9	423.4	432.0	3 TSF	NO
EBL		23	441.1	Glacial Till	421.2	415.7	426.0		

* Refers to structural steel scheme. In some instances concrete scheme has a lower F.T.G. elevation.

** Recommended design load in sound bedrock.

RECORD OF BOREHOLE No 51

W P 157-75-03 LOCATION Co-ords. N 15 828 215; E 950 966 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

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						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	10 20 30							
389.7	Ground Level													
0.0	Sand & Gravel Dense													
386.7	Trace of Silt		1	SS	125									
3.0	Weathered Shale		2	SS	125 ³	6"								
382.7			3	SS	100 ⁵	6"								
7.0	Sound Shale with Limestone Layers		4	RC BXL	REC 20%	380							RQD 0%	
			5	RC BXL	REC 100%								RQD 70%	
			6	RC BXL	REC 67%								RQD 25%	
368.9			7	RC BXL	REC 100%	370							RQD 75%	
20.8	End of Borehole													

³, ⁵: Numbers refer to Sensitivity 20
 15 \diamond 5 (%) STRAIN AT FAILURE
 10



RECORD OF BOREHOLE No 52

W P 157-75-03 LOCATION Co-ords N 15 828 145; E 951 023 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY GP
 DATUM Geodetic DATE April 18, 1980 CHECKED BY _____

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									WATER CONTENT (%)
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					10	20	30				
390.0	Ground Level																
0.0	Glacial Till	Hard															
387.0			1	SS	100%	5"											
3.0	Weathered Shale		2	SS	100%	5"											
383.0			3	SS	100%	2"											
7.0	Sound Shale with Limestone Layers		4	SS	100%	2"	380										
			5	SS	100%	1"											
			6	RC	REC												
				BXL	70%												RQD 35%
				RC	100%	REC											RQD 30%
				RC	100%	REC											RQD 100%
				RC	REC												
				BXL	90%												RQD 48%
366.0					9												
24.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 53

W P 157-75-03 LOCATION Co-ords. N 15 828 306; E 951 073 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W			W _L	GR	SA	SI	CL
391.0	Ground Level																				
0.0	Sand and Gravel Trace of Silt and Clay Compact		1	SS	25	3" REC REC REC												50 26 20 4			
384.0			2	SS	27																
7.0			3	SS	48																51 31 14 4
380.5	Glacial Till Hard		4	SS	101																
10.5	377.3		5	SS	100																
13.5	Weathered Shale		6	RC	REC															RQD = 0%	
	Sound Shale with Limestone Layers		7	BXL	15%																RQD = 10%
			8	RC	50%																
367.5			9	BXL	90%															RQD = 80%	
23.5	End of Borehole																				

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to 20
Sensitivity 15 \pm 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 54

W P 157-75-03 LOCATION Co-ords. N 15 828 235; E 951 140 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100	SHEAR STRENGTH
											○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT (%)				
390.7	Ground Level																	
0.0	Sand and Gravel Trace of Silt and Clay	[Pattern]	1	SS	21	↓												
382.7			2	SS	20													
8.0	Compact Weathered Shale	[Pattern]	3	SS	44	4"												
376.2			4	SS	100/													
14.5	Sound Shale with Limestone Layers	[Pattern]	5	SS	100/	2"												
370.7			6	RC BXL	REC 40%													RQD 25%
20.0	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitiv
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 55

W P 157-75-03 LOCATION Co-ords, N 15 828 420; E 951 192 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH					W _p	W			W _L		
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT (%)				
392.4	Ground Level																		
0.0	Sand and Gravel		1	SS	36		390												
	Trace of Silt & Clay		2	SS	19														
	Compact to Dense		3	SS	33														
	Numerous Cobbles and		4	SS	22														
	Boulders		5	SS	79/			10"	380										
378.2			6	SS	100/			4"											
13.5	Weathered Shale																		
374.4																			
18.0	Sound Shale with Limestone Seams		7	RC BXL	REC 80%												RQD 45%		
367.4																			
25.0	End of Borehole																		

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 56

W P 157-75-03 LOCATION Co-ords. N 15 828 350; E 951 254 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								WATER CONTENT (%) 10 20 30
389.1	Ground Level															
0.0	Sand and Gravel Trace of Silt and Clay Compact to Dense Cobbles & Boulders	0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0	1	SS	20	5" 3" 3"										
382.1			2	SS	39											
7.0	Glacial Till Hard		3	SS	32											
378.6			4	SS	100											
10.5	Weathered Shale		5	SS	100											
373.1			6	SS	100											
16.0	Sound Shale with Limestone Layers		7	RC BXL	REC 100%											RQD 80%
364.1																
25.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 ◇ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 57

W P 157-75-03 LOCATION Co-ords. N 15 828 546; E 951 305 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH							
404.9	Ground Level														
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Glacial Till Hard	[Pattern]	1	SS	23										
398.4			2	RC	90	10"									
6.5	Weathered Shale and Limestone Layers 4" - 6" Thick Alternating Layers of Glacial Till 5" - 24" Thick	[Pattern]	3	BXL	50%										
			4	RC	REC										
			5	BXL	80%										
			6	RC	90%	REC									
385.9			7	SS	30	3"									
19.0	Sound Shale Bedrock with Limestone Layers	[Pattern]	8	RC	REC										
374.9				BXL	100%										RQD 80%
30.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 58

W P 157-75-03 LOCATION Co-ords. N 15 828 462; E 951 366 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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	20	40					
390.5	Ground Level													
0.0	Sand & Gravel		1	SS	24									
	Trace of Silt & Clay Compact With Organic Inclusions		2	SS	15									
383.5	Glacial Till Hard		3	SS	45									
381.0	Weathered Shale Bedrock with Limestone Layers		4	SS	1677	9"								
9.5			5	SS	1007	5"								
				6	SS	1007	3"							
371.0	Sound			RC	REC									
19.5				BXL	80%									RQD 50%
365.5	End of Borehole													
25.0														

OFFICE REPORT ON SOIL EXPLORATION

+3, x^S: Numbers refer to Sensitivity
 20
 15 ◇ 5 (%) STRAIN AT FAILURE
 10

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
Jointing	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
Bedding	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}U$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE 
 w SLOPE ANGLE-BACKFACE OF WALL 
 β ANGLE OF SLOPE 
 N_c, N_q, N_γ BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

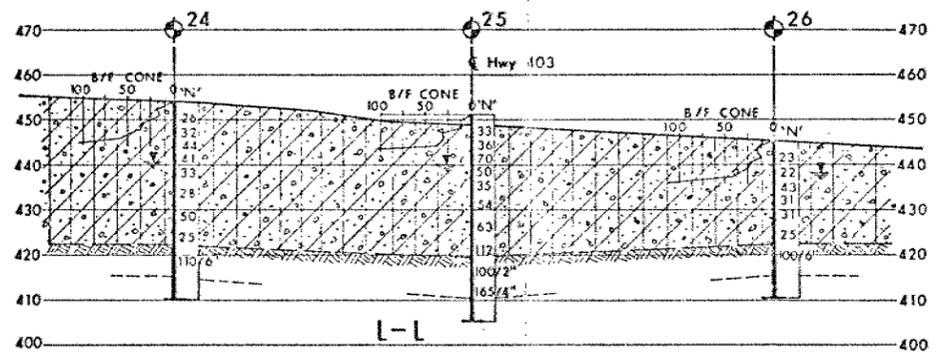
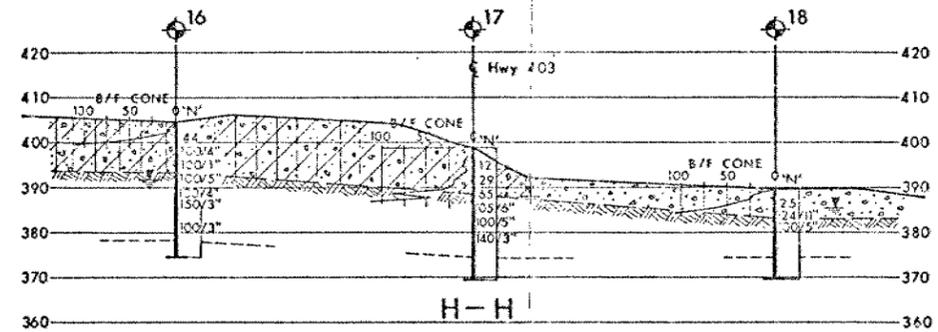
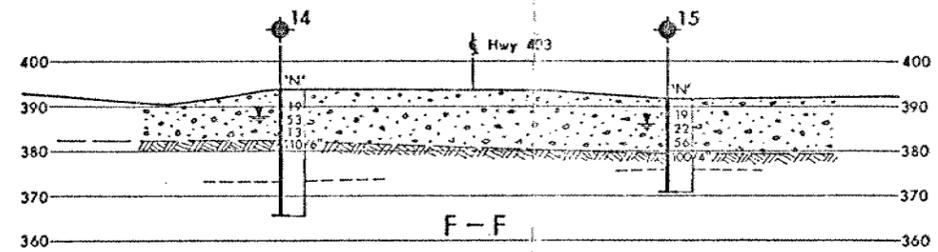
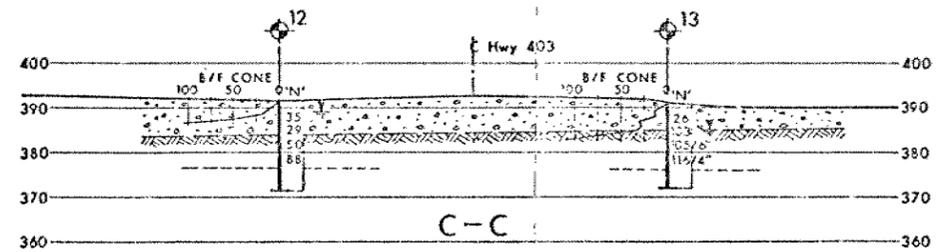
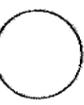
STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_B MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

H HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS



SOIL STRATIGRAPHY LEGEND

- SAND & GRAVEL
TRACE OF SILT & CLAY
Compact to Dense
- HETEROGENEOUS MIXTURE OF
CLAYEY SILT, SAND & GRAVEL
(Glacial Till)
Very Stiff to Hard
- SHALE BEDROCK
INTERBEDDED WITH LIMESTONE

SECTIONS
SCALE
20 10 0 20 FT

NOTE:
The complete foundation investigation file for this project may be examined at the Engineering Materials Office, Downsview. Information contained in this file and any supplementary files is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

SEE DWG 24-222-2

KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/ft (Std Pen Test 350ft lbs energy)
- Blows/ft (60° Cone, 350ft lbs energy)
- WL at time of investigation June 1978

No	ELEVATION		

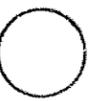
-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 30M12-131

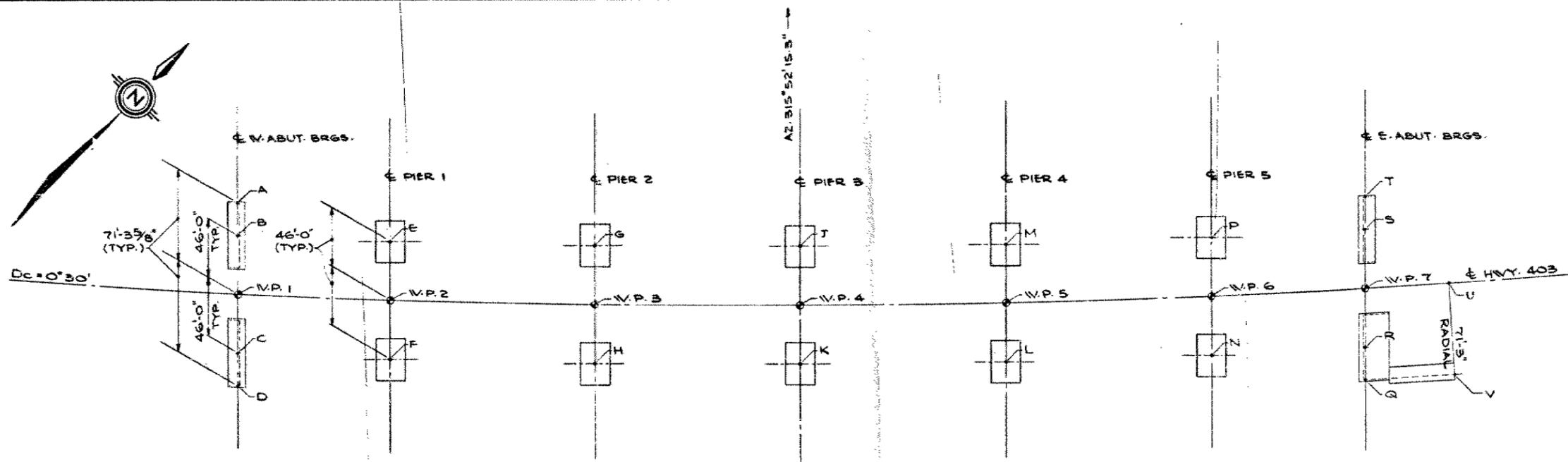
Hwy No Prop 403
SITE 24-222
DATE May 28, 1980
DRAWN BY
CHECKED BY

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO P.M.S.-208 (Formerly O.S.M.T. 208 75-10)



PRECAST GIRDER SCHEME

NOTES:
ALL CENTRE LINES ARE PARALLEL.



FOOTING LAYOUT
N.T.S.

POINT	STATION	CO-ORDINATES	
		N	E
A	1018+27.24	15828135.89	950851.10
B	---	15828117.73	950868.72
W.P. 1	1018+30	15828084.71	950900.75
C	---	15828051.69	950932.78
D	1018+32.72	15828033.54	950950.38
E	---	15828198.39	950957.57
W.P. 2	1019+50	15828165.37	950989.60
F	---	15828132.30	951021.63
G	---	15828307.36	951074.72
W.P. 3	1021+10	15828274.34	951106.75
H	---	15828241.32	951138.78
J	1022+70	15828417.96	951190.34
W.P. 4	1022+70	15828384.94	951223.37
K	1022+70	15828351.92	951254.40
L	---	15828464.12	951368.46
W.P. 5	1024+30	15828497.14	951336.43
M	---	15828530.16	951304.40
N	---	15828577.91	951480.95
W.P. 6	1025+90	15828610.93	951448.92
P	---	15828643.95	951416.89
Q	1027+07.28	15828646.11	951381.88
R	---	15828664.27	951364.26
W.P. 7	1027+10	15828697.29	951332.23
S	---	15828730.31	951500.20
T	1027+12.75	15828748.47	951482.59
U	1027+78.09	15828746.68	951579.10
V	1027+78.09	15828697.79	951630.93



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE No 24-222	1976

Mr. C.S. Grebski
Head, Central Section
Structural Office
2nd Floor, West Building

1979 06 05

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Re: Hwy. 403, Credit River Crossing
W.P. 157-75-03, Site 24-222
District 6, Toronto

We have reviewed the Preliminary Bridge Plan Drawing 24-222-P2 which depicts a steel girder scheme as an alternative to the prestressed concrete girder scheme shown earlier in Drawing 24-222-P1. Both schemes have the same footing arrangements.

As mentioned in our memorandum dated 79 01 16, an additional investigation will be required because most of the footings have been relocated some distance from our boring and the sub-surface conditions are known to be quite variable across the site. The fieldwork will commence this summer. The results, together with our comments, will be submitted immediately to the Structural Office for any necessary modifications in the design.

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/MD/gs

cc: G.C.E. Burkhardt
Files ✓



Memorandum

To: Mr. M. Devata,
Supervising Engineer,
Soil Mechanics Section,
Central Building, Downsview.

From: Structural Office,
West Building, Downsview.

Attention: Mr. V. Korlu,
Project Engineer.

Date: 79 01 18

Our File Ref. 24-222

In Reply to

Subject: Hwy. 403, Credit River Crossing,
W. P. 157-75-03, Site 24-222,
District 6.

This will acknowledge receipt of your memo regarding the above subject.

The only item we do not agree with is in the last paragraph. As we stated at the meeting, we will leave the 2:1 slope at the west approach. There are two reasons for this. The reasoning for the 1 1/2:1 change is as you stated for erosion control. In our opinion a 2:1 slope is better than 1 1/2:1 for erosion control. Also, the preliminary plan has been approved by the Credit River Conservation Authority and hence we do not wish to submit a second plan with the indicated changes for their approval. Obtaining approval for the existing plan required several office meetings and a field meeting by G. Burkhardt.

If you feel strongly about this point please let us know and we will meet with you again.

CSG/cf


C. S. Grebski,
Head, Central Section.

c.c. G. Burkhardt
W. Lin



Mr. C.S. Grebski
Head, Central Section
Structural Office
2nd Floor, West Building

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

79 01 16

Re: Hwy. 403, Credit River Crossing
W.P. 157-75-03, Site 24-222
District 6, Toronto

We have reviewed the Preliminary Bridge Plan Drawing 24-222-P1 for the above mentioned structure and submit the following comments.

According to your drawing a new 6 span structure concept has been proposed. This scheme suggests that the new footings in some cases will be located 40 to 80 feet away from the locations shown on our foundation investigation report.

The subsoil conditions at the Credit River Valley are quite variable. The overburden has a thickness of up to 32 feet in the tableland bordering the valley but it diminishes to 6 to 11 feet thick at the valley floor. The predominant overburden at this site generally consists of a glacial till. However, in the valley floor, the Credit River has eroded this glacial till and also the upper portion of the weathered shale bedrock. The eroded valley floor is covered with recent flood plain deposits such as sand and gravel.

Since the subsoil and bedrock conditions are quite variable across the site, a meeting was held on 79 01 15 at the Soil Mechanics Section office to discuss the foundation requirements for the new 6 span structure scheme. This meeting was attended by Messrs. C.S. Grebski, W. Lin, M. Devata and V. Korlu. It was concluded that due to the size of the structure and loading requirements for the foundations, an additional subsurface investigation will be necessary for the new scheme. This Section will initiate necessary fieldwork during early summer of this year and the results will be submitted immediately to the Structural Office for necessary modifications of the footing elevations for the piers and pile lengths for the abutments. It was also agreed that the final drawings will be issued after the submission of this new information. For preliminary purposes the discussions and recommendations contained in our

cont'd.....

foundation report can be used except for the abutment foundations. It is understood that the Structural Office will carry out a cost analysis between the deep spread footings and pile foundation alternatives at the east and west abutment supports.

In our opinion the west approach slope of the rock cut should be $1\frac{1}{2}:1$ with a mid-height berm rather than a continuous slope of 2:1.

V. Korlu
Project Engineer

For: M. Devata
Supervising Engineer

VK/MD/gs

cc: G.C.E. Burkhardt
M.R. Ernesaks
D.A. MacDonald
Files /

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCREs No. SOMR-131

DIST. 6 REGION _____

W.P. No. 802-98-01

CONT. No. 94-57

W. O. No. _____

STR. SITE No. 24-222

HWY. No. 403

LOCATION Hwy 403 & Credit River

No OF PAGES - _____



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 94-57



Ministry of
Transportation

Ontario

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Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

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.

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:

RQD (%)	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
WS	WASH SAMPLE	OS	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

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_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_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

PHYSICAL PROPERTIES OF SOIL

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

FOUNDATION INVESTIGATION REPORT

for

Credit River Bridge

W.P. 802-93-01, Site 24-222

Hwy. 403, District 6, Toronto

NOTE: All measurements are in imperial units. The foundation drawings (Contract Dwgs. No. 2 & 3) are in imperial units. Imperial stations cannot be directly converted to metric stations. The surface conditions and contours shown on the drawing may not reflect existing surface conditions.

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during July 8, 1976 and during the periods of June 8 to 22, 1978, and April 16 to 18, 1980. The earliest investigation was done for feasibility purposes and consisted of one sampled borehole advanced by augering and diamond drilling techniques to a depth of 30 feet below the ground surface. In the 1978 investigation, a total of 16 sampled boreholes were put down by means of an auger machine equipped with hollow stem continuous flight augers and solid stem augers. The borings ranged in depth from 19 to 46 feet below the ground surface. In addition, bedrock was proven by obtaining BXL size rock core. The 1980 investigation consisted of an additional 8 boreholes put down by means of hollow stem continuous flight augers to depths of 20 to 30 feet below ground surface. Bedrock was proven by obtaining BXL size rock core samples.

SITE AND GEOLOGY

The site is located about 1½ miles south of Eglinton Avenue and about 250 feet east of Mississauga Road in the City of Mississauga, Regional Municipality of Peel.

At this site the Credit River is winding from north to south and has eroded a valley which is about 1100 feet wide from crest to crest and about 70 feet deep. The sides of the valley are found to be as steep as 1½:1 with the steep faces being on the concave side of the river. In certain locations subsoil strata and bedrock formations are exposed on the sides of the valley. The tableland on either side of the valley is relatively flat, being gently sloping down towards the south.

Physiographically the site is situated in the border region of the "Peel Plain" and the "South Slope". The predominant deposit in this area is known to be a cohesive glacial till. The underlying bedrock is a shale of the Dundas-Meaford formation.

SUBSURFACE CONDITIONS

General

The overburden has a thickness of up to 32 feet in the tableland bordering the valley, but diminishes to 3 to 11 feet thick at the valley floor. The overburden at this site generally consists of a glacial till composed of clayey silt, some sand and gravel. However, in the valley floor the Credit River has eroded the glacial till and the upper portion of the bedrock and redeposited a sand and gravel with trace of silt and clay. Across the site, the overburden is underlain by shale bedrock.

Factual data on the subsoil conditions is shown on the Borehole Record Sheets. The locations and elevations of the borings, together with the estimated stratigraphical profile and sections, are shown on Contract Drawing Nos. 2 and 3. A description of the subsoil and bedrock conditions is given below.

Glacial Till

This deposit is encountered on the tableland on either side of the valley and has a thickness of up to 32 feet. It is composed of a heterogeneous mixture of clayey silt, sand and gravel. Typical grain size distribution curves of the material from this deposit are shown in an envelope form on Figure 1. Geotechnical identity indices of the glacial till as determined from laboratory testing are summarized below.

		<u>Range</u>
Natural Moisture Content	(W) %	9 - 12
Liquid Limit	(W _L) %	19 - 38
Plastic Limit	(W _p) %	13 - 23

The results of the Atterberg Limit Testing are also plotted on the Plasticity Chart, Figure 2, which indicate the glacial deposit is cohesive with a low to medium plasticity (CL to CI zone).

The Standard Penetration Test 'N' values ranged from 10 blows to over 100 blows per foot, generally increasing with depth, indicating that the consistency of the glacial till varies from stiff to hard, but generally hard.

Sand and Gravel, Trace of Clay and Silt

This flood plain deposit was encountered in the river valley. It appears to be confined to areas below contour 392.0 and extends to bedrock for a thickness of 3 to 11 feet. This deposit is alluvial in origin and is composed of sand and gravel with a trace of clay and silt. Typical grain size distribution of the material in this deposit is shown in an envelope form on Figure 3. However, in certain locations the matrix (material passing sieve #40) exhibits slight plasticity. The Standard Penetration Test 'N' values varying randomly from 13 to 53 blows per foot indicate that this deposit has a compact to very dense relative density.

Bedrock (Shale Interbedded with Limestone)

Bedrock was encountered at elevation 437 on the west bank of the valley, at elevation 378 to 398 in the valley floor, and at elevation 420 to 425 on the east bank of the valley. Bedrock may be described as shale interbedded with limestone. The shale is soft to medium hard, somewhat fissile and weathered in the upper portion. The depth of weathering was found to be one to two feet on the west bank of the valley and up to 10 feet on the east bank of the valley. However, in the valley the weathered bedrock was up to 8 to 15 feet thick. The recovery ratio is high, generally close to 100%. However, the average RQD was found to be in the order of 30% to 50%, suggesting the shale is a poor quality rock.

Groundwater Conditions

The groundwater levels were observed by measuring in the open boreholes during and immediately after the field investigation. The groundwater levels were found to vary as high as elevation 454 (on the tableland) and as low as elevation 385 to elevation 390 (in the valley floor), generally constituting a hydraulic gradient towards the river. Since the water level in the Credit River was at elevation 390, which was higher than some of the observed water levels in the boreholes, it is believed that the water levels in the boreholes probably were not stabilized during the period of observations.



P. Payer

P. Payer, P. Eng.
Sr. Foundation Engineer



D. Dundas

D. Dundas, P. Eng.
Chief Foundation Engineer
(Acting)

APPENDIX

RECORD OF BOREHOLE No 9 **IMPERIAL**

WP 802-93-01 LOCATION Coords. N 15,828,140; E 950,880 ORIGINATED BY V.K.

W P 157-75-03 DIST 6 HWY 403 BOREHOLE TYPE H.S. Auger, NX Casing, BXL Rock Core and Cone Test COMPILED BY V.K.

DATUM Geodetic DATE July 8, 1976 CHECKED BY [Signature]

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			SHEAR STRENGTH								WATER CONTENT (%)	
							20 40 60 80 100									
462.0	Ground Level															
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Occasional Gravel (Glacial Till) Hard Brown Grey		1	SS	38	↓	460							0 16 54 30		
			2	SS	47		450									
			3	SS	109											
			4	SS	49											
			5	SS	39											
			6	SS	74											
437.5																
24.5	Sound Shale															
431.7	Interbedded With Limestone		7	RC BXL	100% Rec											
30.3	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
20
15
10

20
15
10 (%) STRAIN AT FAILURE

WP 802-93-01 **RECORD OF BOREHOLE No 11** **IMPERIAL**

W P 157-75-03 LOCATION Coords. N 15,828,055; E 950,965 ORIGINATED BY V.K.

DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE June 22, 1978 CHECKED BY [Signature]

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			20	40	60	80	100					
462.8	Ground Level																
0.0	Heterogeneous Mixture of Clayey Silt With Sand and Some Gravel		1	SS	10											7 23 45 25	
			2	SS	48												15 24 42 19
	Brown Grey (Glacial Till)		3	SS	20												7 21 45 27
	Stiff to Hard		4	SS	11												
			5	SS	25												
			6	SS	29												
			7	SS	85												
437.0			8	SS	110	4"											
25.8	Weathered																
27.0	Sound Shale Interbedded With Limestone		9	RC	100%											RQD = 46%	
431.5				BXL	Rec												
31.3	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

WP 802-93-01 **RECORD OF BOREHOLE No 12** **IMPERIAL**
 W P ~~157-75-03~~ LOCATION Coords. N 15,828,256; E 951,024 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT (LIQUID LIMIT)			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80		100	W	W _L		
391.5	Ground Level																
0.0	Sand and Gravel Trace of Clay and Silt	[Strat Plot Pattern]	1	SS	35	↓	[Cone Penetration Plot]										
384.0	Compact to Dense		2	SS	29												
7.5	Weathered		3	SS	50												
376.5			4	SS	88												
15.0	Sound, Shale Interbedded With Limestone		5	RC BXL	100% Rec												
171.3	End of Borehole																
20.2																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
15 ⚡ 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 **RECORD OF BOREHOLE No 13** **IMPERIAL**

W P ~~157-75-03~~ LOCATION Coords. N 15,828,192; E 951,085 ORIGINATED BY V.K.

DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.

DATUM Geodetic DATE June 22, 1978 CHECKED BY [Signature]

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	20					
390.9	Ground Level												
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	26								62 25 10 3
384.9	Compact		2	SS	103								
6.0			3	SS	1057	6"							
376.1	Weathered Sand, Shale Interbedded With Limestone		4	SS	1167	4"							
14.8			5	RC BXL	100% Rec								
371.9													RQD = 44%
19.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
15 → 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 RECORD OF BOREHOLE No 14 **IMPERIAL**
 W P 157-75-03 LOCATION Coords. N 15,828,442; E 951,219 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE June 8, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH										
393.7	Ground Level																	
0.0	Sand and Gravel Trace of Clay and Silt Compact to Dense	[Strat Plot]	1	SS	19	6" 8"	390					41 41 14 4						
			2	SS	53													
382.2			3	SS	13													
11.5			4	SS	100%													
	Weathered	[Strat Plot]	6	RC BXL	50% Rec	380						RQD = 100%						
373.2			7	RC BXL	39% Rec							370					RQD = 0%	
20.5	Sound Shale Interbedded With Limestone	[Strat Plot]	8	RC BXL	100% Rec	370											RQD = 28%	
			9	RC	100%							365.7						RQD = 21%
			10	RC	100%													RQD = 71%
28.0	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

WP 802-93-01 **RECORD OF BOREHOLE No 15** **IMPERIAL**

W P ~~157-75-03~~ LOCATION Coords. N 15,828,380; E 951,281 ORIGINATED BY V.K.

DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing and BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE June 8, 1978 CHECKED BY *[Signature]*

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100	WATER CONTENT (%)
391.6	Ground Level																	
0.0	Sand and Gravel Trace of Clay and Silt		1	SS	19	4"										48 27 19 6		
	Compact to Dense		2	SS	22													43 34 16 7
379.6			3	SS	56													
12.0	Weathered		4	SS	1007													25 15 49 11
375.8			5	BXL	70% Rec													
15.8	Sound Shale Interbedded With Limestone		6	RC BXL	100% Rec													RQD = 25%
370.9																		
20.7	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
15 \diamond 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 RECORD OF BOREHOLE No 16 **IMPERIAL**
W P 157-75-03 LOCATION Coords. N 15,828,584; E 951,332 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
DATUM Geodetic DATE June 12, 1978 CHECKED BY G.P.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									'N' VALUES
404.4	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	44								
			2	SS	100%	4"							
			3	SS	100%	1"							
393.4			4	SS	100%	5"							
11.0			5	SS	100%	4"							
			6	SS	150%	3"							
			7	SS	100%	3"							
378.4	Weathered Sound, Shale Interbedded With Limestone		8	RC BXL	100% Rec								
26.0 374.4												RQD = 40%	
30.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity
20
15-5 (%) STRAIN AT FAILURE
10

WP 802-93-01 **RECORD OF BOREHOLE No 17** **IMPERIAL**

W P ~~157-75-03~~ LOCATION Coords. N 15,828,538; E 951,378 ORIGINATED BY V.K.

DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.

DATUM Geodetic DATE June 13, 1978 CHECKED BY *GP*

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
398.6	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Stiff to Hard		1	SS	12								0 9 66 25
			2	SS	29								
388.6			3	SS	65								
10.0	Weathered		4	SS	100/6"								
			5	SS	100/5"								
374.6			6	SS	100/3"								
24.0	Sound, Shale Interbedded With Limestone		7	RC	100%								RQD = 55%
369.6			BXL	Rec									
29.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to Sensitivity 20
15 ⊕ 5 (%) STRAIN AT FAILURE
10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
389.7	Ground Level												GR SA SI CL
0.0	Sand and Gravel Trace of Silt and Clay, Compact		1	SS	25								66 21 10 3
383.2			2	SS	124/	11"							10 10 55 25
6.5	Weathered		3	SS	100/	5"							
374.7			4	RC BXL	75% Rec		380						RQD = 51%
15.0	Sound, Shale Interbedded With Limestone		5	RC BXL	100% Rec								RQD = 48%
369.7							370						
20.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
20
15 ○ 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 RECORD OF BOREHOLE No 19 IMPERIAL
 W P 157-75-03 LOCATION Coords. N 15,828,632; E 951,411 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 14, 1978 CHECKED BY [Signature]

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						WATER CONTENT (%)
404.8	Ground Level													
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	100%	5"							32 34 27 7	
			2	SS	31									
394.3			3	SS	100%	5"								16 32 34 18
10.5			4	SS	100%	5"								
			5	SS	100%	4"								
384.8	Weathered													
20.0	Sound, Shale Interbedded With Limestone		6	RC	100%								RQD = 68%	
379.2				BXL	Rec									
25.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to 20
Sensitivity 15 5 (%) STRAIN AT FAILURE
10



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			20	40	60	80						100
402.7	Ground Level															
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard	1	SS	24		400									40 38 16 6	
		2	SS	1007	5"											
		3	SS	1007	6"											27 12 41 20
390.2		4	SS	1007	6"		390									
12.5		5	SS	1607	4"											
		6	SS	1067	5"											
372.7	Weathered															
25.0		7	RC BXL	100% Rec												
372.5	Sound, Shale Interbedded With Limestone														RQD = 71%	
30.2	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

*³, x⁵: Numbers refer to Sensitivity
20
15 ϕ -S (%) STRAIN AT FAILURE
10

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
441.9	Ground Level											
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	28							4 19.49 28
			2	SS	30							12 28 40 20
			3	SS	81							
			4	SS	61							
424.9			5	SS	120/5"							
423.4	Weathered Sound, Shale											
18.5	Interbedded With Limestone		6	RC BXL	100% Rec							RQD = 0%
419.4												
22.5	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

+3', x5: Numbers refer to
Sensitivity

20
15
10

5 (% STRAIN AT FAILURE)

WP 802-93-01

RECORD OF BOREHOLE No 22

IMPERIAL

W P 157-75-89 LOCATION Coords. N 15,828,732; E 951,566 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE			'N' VALUES	20					
441.1	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	37								23 16 41 20
			2	SS	46								
			3	SS	66								
			4	SS	47								0 28 52 20
	Boulders		5	SS	100%	1"							
422.1			6	SS	125%	6"							
19.0	Weathered												
416.4													
24.7	Sound, Shale Interbedded With		7	RC	100%								
411.1	Limestone			BXL	Rec								RQD = 59%
30.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

*³, *⁵: Numbers refer to Sensitivity
 20
 15 → 5 (%) STRAIN AT FAILURE
 10



WP 802-93-01 **RECORD OF BOREHOLE No 23 IMPERIAL**

W P ~~157-75-03~~ LOCATION Coords. N 15,828,688; E 951,614 ORIGINATED BY V.K.

DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.

DATUM Geodetic DATE June 16, 1978 CHECKED BY [Signature]

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	20					
440.7	Ground Level												
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard	[Stratigraphic Column]	1	SS	33	4"							15 18 46 21
			2	SS	48								
			3	SS	42								
			4	SS	73								
			5	SS	116								
421.2			6	SS	1007								
19.5	Weathered												
415.7	Sound, Shale Interbedded With Limestone	[Stratigraphic Column]											
25.0			7	RC	100%								RQD = 41%
410.5	End of Borehole												
30.2													

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity
20
15 - 5 (%) STRAIN AT FAILURE
10

WP 802-93-01

RECORD OF BOREHOLE No 24

IMPERIAL

W P ~~157-75-03~~ LOCATION Coords. N 15,828,887; E 951,622 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, BX Casing, BXL Rock Core & Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 21, 1978 CHECKED BY *[Signature]*

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	WATER CONTENT (%)
454.2	Ground Level															GR SA SI CL		
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	26											11 19 39 31		
			2	SS	32													
			3	SS	44													3 24 53 20
			4	SS	41													
			5	SS	33													
			6	SS	28													
			7	SS	50													10 31 50 19
422.2					8	SS	25											
32.0	Weathered		9	SS	110	6"												
415.2																		
39.0	Sound, Shale Interbedded With Limestone		10	RC	100%	Rec										RQD = 43%		
410.2																		
44.0	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

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

WP <u>802-93-01</u>		RECORD OF BOREHOLE No 25				IMPERIAL	
W P <u>157-75-03</u>		LOCATION <u>Coords. N 15,828,850; E 951,676</u>				ORIGINATED BY <u>V.K.</u>	
DIST <u>6</u> HWY <u>403</u>		BOREHOLE TYPE <u>Solid Auger, NX Casing, BXL Rock Core & Cone Test</u>				COMPILED BY <u>G.P.</u>	
DATUM <u>Geodetic</u>		DATE <u>June 19, 1978</u>				CHECKED BY <u>[Signature]</u>	

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	'N' VALUES			20	40	60					
451.4	Ground Level														
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	33		450								
	Hard		2	SS	36										11 20 48 21
			3	SS	70										
			4	SS	50										
			5	SS	35										
			6	SS	54										
			7	SS	63										
			8	SS	112										
419.4			9	SS	100/2"										
32.0	Weathered		10	SS	165/4"										
410.4			11	RC	100% BXL Rec										
41.0	Sound, Shale Interbedded With Limestone														RQD = 63%
405.2															
46.2	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

WP 802-93-01 RECORD OF BOREHOLE No 26 **IMPERIAL**
 W P 157-75-03 LOCATION Coords. N 15,828,795; E 951,716 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE Solid Auger, NX Casing, BXL Rock Core and Cone Test COMPILED BY G.P.
 DATUM Geodetic DATE June 20, 1978 CHECKED BY [Signature]

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60					
445.3	Ground Level														
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)	[Stratigraphic Column]	1	SS	23	↓	440	112/6"	○						
	Very Stiff to Hard		2	SS	22										
			3	SS	43										
			4	SS	31										
			5	SS	31										
			6	SS	25										
422.3	Weathered	7	SS	100/6"	6"	420									
23.0															
415.3	Sound, Shale Interbedded With Limestone	[Stratigraphic Column]	8	RC	100%										
30.0															RQD = 45%
410.3	End of Borehole	[Stratigraphic Column]													
35.0															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10

WP 802-93-01 **RECORD OF BOREHOLE No 51 IMPERIAL**

W P 157 75 03 LOCATION Co-ords. N 15 828 215; E 950 966 ORIGINATED BY MM & GP

DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE April 17, 1980 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W			W _L	GR
389.7	Ground Level																	
0.0	Sand & Gravel Dense																	
386.7	Trace of Silt																	
3.0	Weathered Shale		1	SS	125													
382.7			2	SS	125	6"												
7.0			3	SS	100	6"												
	Sound Shale with Limestone Layers		4	RC	REC													RQD 0%
			5	BXL	20%													RQD 70%
			6	RC	REC													RQD 25%
368.9			7	BXL	67%													RQD 75%
20.8	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 RECORD OF BOREHOLE No 52 IMPERIAL
 W P 157-75-03 LOCATION Co-ords N 15 828 145; E 951 023 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY GP
 DATUM Geodetic DATE April 18, 1980 CHECKED BY _____

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40					
390.0	Ground Level													
0.0	Glacial Till	Hard	1	SS	100%	5"								
387.0	Weathered Shale		2	SS	100%	5"								
3.0			3	SE	100%	2"								
383.0			4	SS	100%	2"								
7.0			5	SS	100%	1"								
	Sound Shale with Limestone Layers		6	RC BXL	REC 70%									
			7	RC	100% REC									
			8	RC	100% REC									
			9	RC BXL	REC 90%									
366.0														
24.0	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (%): STRAIN AT FAILURE

WP 802-93-01

RECORD OF BOREHOLE No 53

IMPERIAL

W P ~~157-75-03~~ LOCATION Co-ords. N 15 828 306; E 951 073 ORIGINATED BY MM & GP
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 17, 1980 CHECKED BY

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
391.0	Ground Level																
0.0	Sand and Gravel Trace of Silt and Clay Compact	[Pattern]	1	SS	25											50 26 20 4	
384.0			2	SS	27												51 31 14 4
7.0	Glacial Till Hard	[Pattern]	3	SS	48												
380.5			4	SS	101												
10.5	Weathered Shale	[Pattern]	5	SE	100Z												
377.5			6	RC	52Z	3" REC											RQD = 0Z
13.5	Sound Shale with Limestone Layers	[Pattern]	7	BXL	15Z												
367.5			8	RC	50Z	REC											RQD = 10Z
			9	BXL	90Z	REC											RQD = 60Z
23.5	End of Borehole															RQD = 80Z	

OFFICE REPORT ON SOIL EXPLORATION

*3, x5: Numbers refer to Sensitivity 20
 15 5 (%) STRAIN AT FAILURE
 10

WP 802-93-01 RECORD OF BOREHOLE No 54 IMPERIAL

WP ~~157-75-93~~ LOCATION Co-ords. N 15 828 235; E 951 140 ORIGINATED BY MM & GP

DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger, BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE April 17, 1980 CHECKED BY

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	NUMBER	TYPE	'N' VALUES			20	40	60	80					
390.7	Ground Level														
0.0	Sand and Gravel Trace of Silt and Clay	1	SS	21	↓										
382.7	Compact	2	SS	20											
8.0	Weathered Shale	3	SS	44											
376.2		4	SS	100/7	4"										
14.5		5	SS	106/7	2"										
370.7	Sound Shale with Limestone Layers	6	RC BXL	REC 40%										RQD 25%	
20.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

* 3, x 5 : Numbers refer to 20
Sensitivity 15 - 5 (%) STRAIN AT FAILURE
10

WP 802-93-01 **RECORD OF BOREHOLE No 55** **IMPERIAL**

W P 157-75-09 LOCATION Co-ords. N 15 828 420; E 951 192 ORIGINATED BY M.M.

DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
392.4	Ground Level															
0.0	Sand and Gravel Trace of Silt & Clay Compact to Dense Numerous Cobbles and Boulders	0.0	1	SS	36	10" 4"										
		0.0	2	SS	19											
		0.0	3	SS	33											
		0.0	4	SS	22											
378.2		0.0	5	SS	79/											
13.5		0.0	6	SS	100/											
374.4	Weathered Shale															
18.0	Sound Shale with Limestone Seams		7	RC BXL	REC 80%										RQD 45%	
367.4																
25.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
20
15 ϕ 5 (%) STRAIN AT FAILURE
10

WP 802-93-01

RECORD OF BOREHOLE No 56

IMPERIAL

W P ~~157-75-03~~ LOCATION Co-ords. N 15 828 350; E 951 254 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY

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			20	40	60	80	100					
389.1	Ground Level																
0.0	Sand and Gravel	[Stratigraphic Pattern]	1	SS	20	5"	380										
	Trace of Silt and Clay		2	SS	39												
	Compact to Dense		3	SS	32												
382.1	Cobbles & Boulders		4	SS	100%												
7.0	Glacial Till		5	SS	100%												
378.6	Hard		6	SS	100%												
10.5	Weathered Shale																
373.1	Sound Shale with																
16.0	Limestone Layers																
364.1			7	RC	REC												
25.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (%) STRAIN AT FAILURE

WP 802-93-01 RECORD OF BOREHOLE No 57 IMPERIAL

W P ~~157-75-03~~ LOCATION Co-ords. N 15 828 546; E 951 305 ORIGINATED BY M.M.

DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.

DATUM Geodetic DATE April 16, 1980 CHECKED BY

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE			'N' VALUES	20	40	60					
404.9	Ground Level														
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Glacial Till Hard	[Strat Plot]	1	SS	23	10"									
398.4			2	RC	90%										
6.5	Weathered Shale and Limestone Layers 4" - 6" Thick Alternating Layers of Glacial Till 5" - 24" Thick	[Strat Plot]	3	BXL	50%										
			4	RC	REC										
			5	BXL	80%										
385.9			6	RC	90%	REC									
19.0	Sound Shale Bedrock with Limestone Layers	[Strat Plot]	7	SS	30%	3"									
374.9			8	RC	REC										
30.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

*3, x5: Numbers refer to 20
Sensitivity 15-5 (%) STRAIN AT FAILURE
10

WP 802-93-01 RECORD OF BOREHOLE No 58 **IMPERIAL**
 W P ~~157-35-03~~ LOCATION Co-ords. N 15 828 462; E 951 366 ORIGINATED BY M.M.
 DIST 6 HWY 403 BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY G.P.
 DATUM Geodetic DATE April 16, 1980 CHECKED BY _____

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							
390.5	Ground Level														GR SA SI CL
0.0	Sand & Gravel														
	Trace of Silt & Clay Compact		1	SS	24										
383.5	With Organic Inclusions		2	SS	15										
381.0	Glacial Till Hard		3	SS	45										
9.5	Weathered		4	SS	167	9"									
			5	SS	100	5"									
	Shale Bedrock with Limestone Layers		6	SS	100	3"									
371.0															
19.5	Sound		7	RC BXL	REC 80%										RQD 50%
365.5															
25.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

* 3, x 5 : Numbers refer to Sensitivity 20
 15 - 5 (%) STRAIN AT FAILURE
 10



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

DIP
90°

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY Z. Koniuszy

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 11			
27'0"	31'0"	Shale, dark grey, medium hard, partly fissile, interbedded with thin layers and lenses of limestone, grey fine to medium textured, hard.			
31'0"	32'0"	Limestone, grey, fine to medium texture, hard with thin lenses of black shale.			3" of core missing.
		Hole No. 12			
15'0"	20'0"	Shale, dark grey, medium hard, partly fissile with very thin seams of limestone, grey, fine textured hard.			one 1 1/2" seam of limestone core broken

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
Hole No. 13					
14'6"	15'0"	Limestone - dolomitic, silty light grey with reddish tint, fine textured, hard with 1" seam of dark grey shale.			
15'0"	19'0"	Shale, reddish-grey, medium hard, partly fissile, with numerous thin lenses of grey limestone.			core broken and ground.
Hole No. 14					
14'0"	14'10"	Limestone, grey, mottled, medium to coarse textured, fossiliferous, vuggy.			
14' 10"	23'5"	Shale, dark grey, partly fissile with thin lenses of limestone.			4' of core missing core badly broken and ground.

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP _____

PROPERTY W.P. 157-75-03
LOCATION Hwy. 403 and Credit River

LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 16			
26'0"	30'0"	Shale, dark grey, medium hard with one 2½" and few thinner seams of grey hard limestone, fine to medium grained.			core partially broken.
		Hole No. 17			
24'0"	25'0"	Shale, dark grey, partly fissile, with thin lenses of dolomitic limestone grey, medium textured, medium hard			core broken
25'0"	25'10"	Limestone (dolomitic) - shaly, grey medium textured, medium hard with ½" lense of dark shale.			
25'10"	29'0"	Shale, dark grey, partly fissile with thin lenses of limestone. Two of 1½" lenses of limestone.			

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 18			
10'8"	12'4"	Shale, dark grey to red grey, medium hard, partly fissile interbedded with limestone shaly grey to red, hard			First 2" of core ground.
12'4"	15'0"	Shale, dark grey, medium hard			Core broken and ground.
15'0"	20'0"	Shale, dark grey to red grey, medium hard, partly fissile, with few thin lenses of grey hard limestone. One 2" limestone lense.			1 1/2 ft. of core missing.
		Hole No. 19			
20'6"	25'8"	Shale, dark grey, medium hard, partly fissile, with very thin lenses of limestone.			

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 22			
24'4"	29'1"	Shale dark grey, medium hard, partly fissile with two 2" limestone seams and numerous limestone lenses.			4" of core missing.
29'1"	30'0"	Limestone, light to grey, medium to coarse textured, hard, fossiliferous with thin seams of shale.			
		Hole No. 23			
25'0"	25'6"	Shale, dark grey, medium hard			Core broken
25'6"	27'0"	Shale, dark grey, medium hard interbedded with grey, fine textured hard limestone.			
27'0"	27'9"	Shale, dark grey, medium hard, partly fissile.			
27'9"	29'0"	Shale, dark grey, medium hard, interbedded with grey, fine textured, medium hard shaly limestone.			
29'0"	32'2"	Limestone, light grey, coarse textured, hard fossiliferous with 2 1/2" seam of dark grey shale.			28'7"-29'-11" - vertical fracture.

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP _____

PROPERTY W.P. 157-75-03
 LOCATION Hwy. 403 and Credit River

 LATITUDE _____
 DEPARTURE _____
 BEARING _____

 TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No. 24			
39'0"	39'4"	Limestone, grey, fine textured, hard fossiliferous			core broken
39'4"	40'2"	Shale, dark grey, medium hard with 1 1/2" seam of grey, hard limestone			
40'2"	40'8"	Limestone, grey, fine textured, hard			vertical fracture
40'8"	41'9"	Shale, dark grey, medium hard, partly fissile			
41'9"	42'3"	Limestone, grey, coarse textured (semicristalline), hard fossiliferous.			
42'3"	44'0"	Shale, dark grey, medium hard, partly fissile, very thin seams of grey hard limestone.			vertical fracture on end of core.

DATE OF EXAMINATION _____



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. _____

DIP _____

PROPERTY LOCATION W.P. 157-75-03
Hwy. 403 and Credit River

LATITUDE _____
DEPARTURE _____
BEARING _____

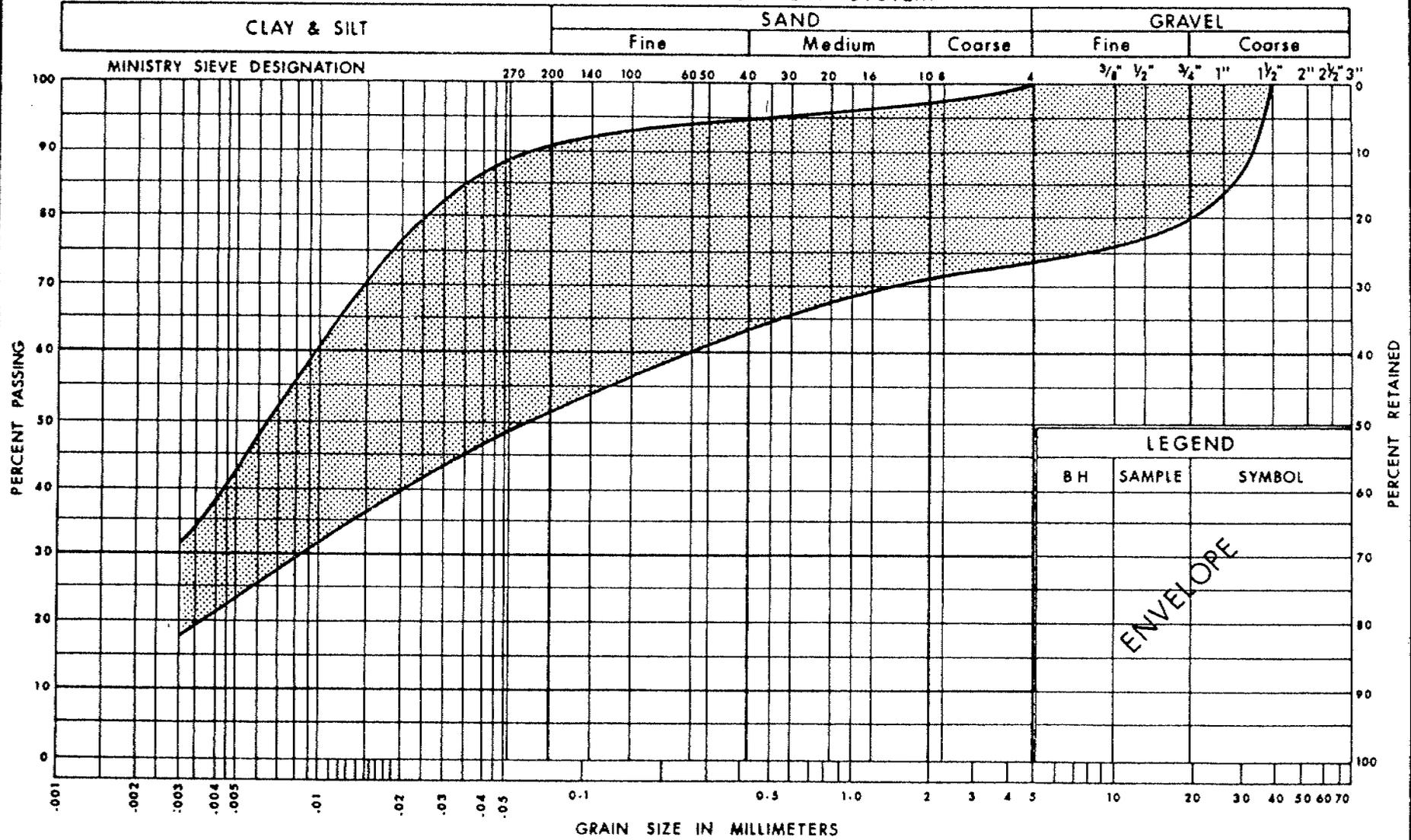
TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole No 25			
41'0"	45'5"	Shale, dark grey with reddish sections, medium hard with thin lenses of fine textured, hard limestone.			
45'5"	46'3"	Limestone, grey with reddish tint, fine textured, hard with 3" seam of reddish shale.			Vertical fracture through out limestone.
		Hole No 26			
30'0"	32'9"	Shale, dark grey, partly fissile with thin lenses of fine to medium textured grey shaly limestone.			
32'9"	33'2"	Limestone, grey, hard fossiliferous			
33'5"	33'11"	Limestone, grey, hard, fossiliferous			Core broken
33'11"	35'0"	Shale, dark grey, medium hard			

DATE OF EXAMINATION _____

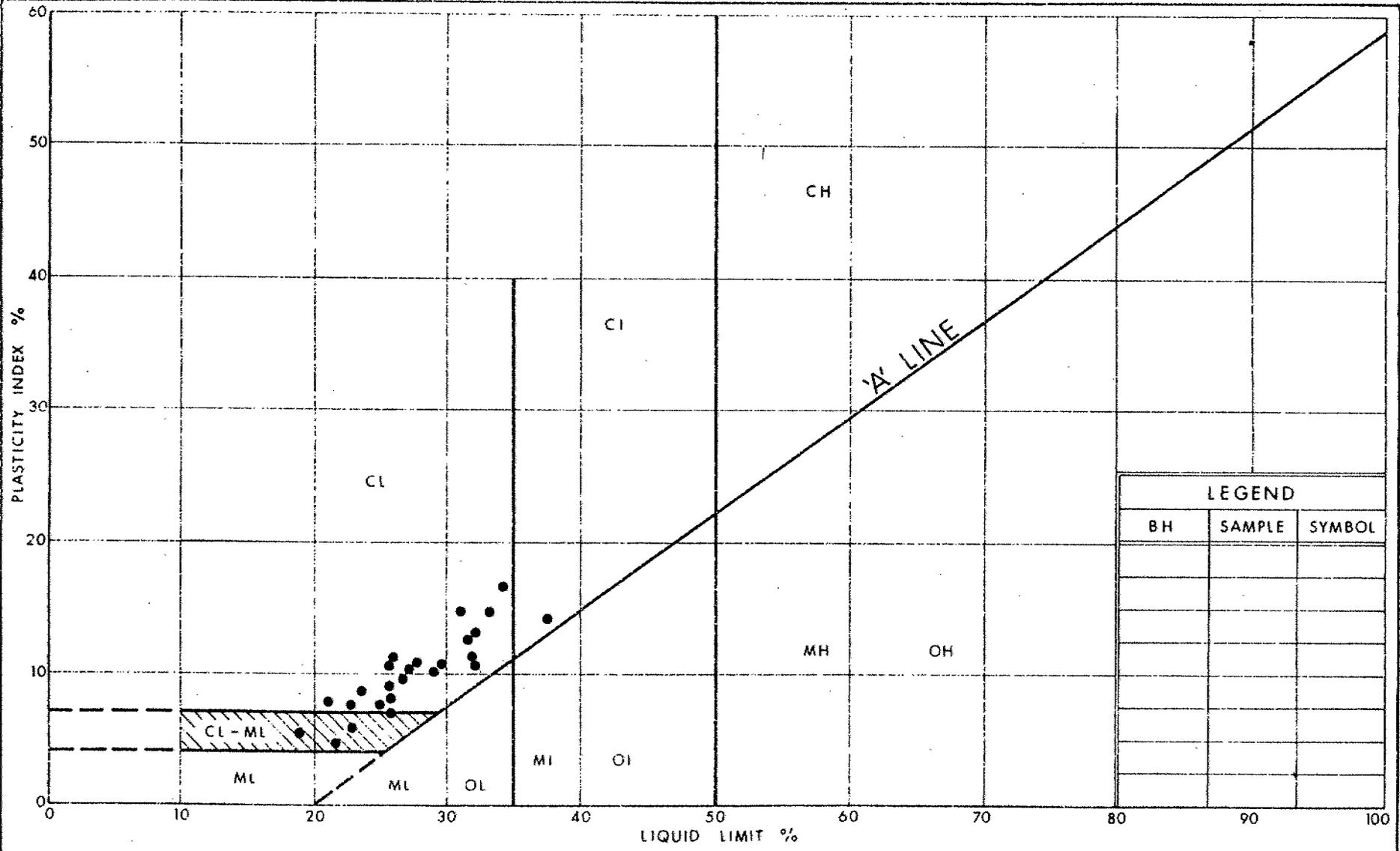
UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications
Ontario

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(Glacial Till)

FIG No 1
WP ~~157-75-03~~
WP 802-93-01

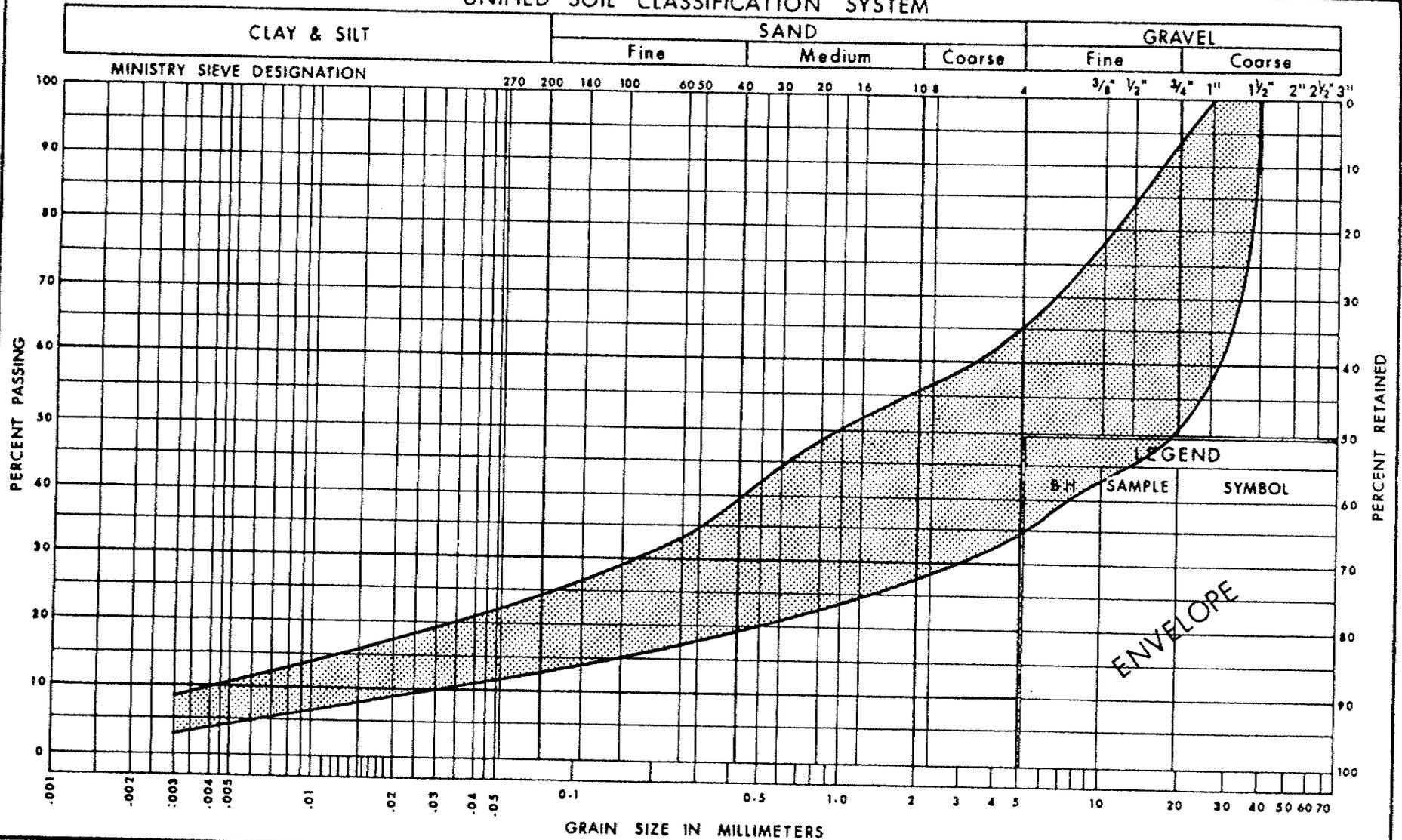



 Ministry of
 Transportation and
 Communications
 Ontario

PLASTICITY CHART
 HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
 (Glacial Till)

FIG No 2
 WP ~~157-75-03~~
 WP 802-93-01

UNIFIED SOIL CLASSIFICATION SYSTEM



FOUNDATION INVESTIGATION REPORT

For

Proposed Structure Over

Mullet Creek and Hwy. 403

W.P. 803-93-01, Site 24-386

District 6, Toronto

NOTE: All measurements are in imperial units. The foundation drawing (Contract Dwg No. 2) is in imperial units. Imperial stations cannot be directly converted to metric stations. The surface conditions and contours shown on the drawing may not reflect existing surface conditions.

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of June 21 and 22, 1977.

The fieldwork consisted of 12 sampled boreholes advanced by means of a continuous flight auger equipped with solid and hollow stem (3-1/4" I.D.) augers. In addition, diamond drilling techniques were employed to obtain BXL size rock core samples of bedrock. The boreholes ranged in depths from 6.5 to 11 feet below the ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about a half mile west of Credit River or immediately west of Mississauga Road and one mile south of Eglinton Avenue, in the City of Mississauga, Regional Municipality of Peel.

The topography of the general area is gently sloping in a southerly direction. The site is located in the Mullet Creek Valley whose width is approximately 250 feet. The valley floor is at approximate

elevation 448 and the valley banks are at elevation 465. The creek meanders in a southerly direction. The clear width of the creek is about 20 feet and the water level in the creek is about elevation 445. The land is developed for farming purposes. Physiographically, the site is situated in the border regions of "Peel Plains" and "South Slope". The characteristic deposit in the vicinity of the area under investigation is composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock of Meaford, Dundas formation, Ordovician Period.

This physiographic region is well drained by the Credit, Oakville and Etobicoke Creeks, which have cut deep valleys into the overburden, although in many of the interstream areas drainage is still imperfect.

SUBSURFACE CONDITIONS

General

The subsurface conditions were found to be quite uniform over the site. Under a thin layer of topsoil is a stratum of cohesive glacial till, a heterogeneous mixture of clayey silt, sand and gravel. The overburden is underlain by interbedded layers of shale and limestone bedrock which was proven in all boreholes. Detailed descriptions of the soil and rock types encountered in each borehole are given in the Record of Borehole Sheets. The estimated stratigraphical profile and sections shown on Drawing No. 2 of the Contract Drawings are based upon this information.

Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel)

Underlying a thin layer up to 12 inches of topsoil, is a deposit of cohesive glacial till comprised of a heterogeneous mixture of clayey silt, sand and gravel. The cohesive glacial till material was encountered at all locations except in B.H. No's 8, 9 and 11. The glacial till varied in thickness from 3.5 to 6.0 feet. The Standard Penetration Tests gave "N" values ranging from 13 to over 100 blows per foot indicating that the cohesive stratum has stiff to hard consistency.

The physical properties of the clayey silt layer, as determined from laboratory testing, are summarized below:

	<u>Range</u>
Liquid Limit (w_L) %	25 - 34
Plastic Limit (w_P) %	16 - 20
Moisture Content (w) %	7 - 21

The results of the Atterberg Limit Tests are shown on Plasticity Chart (Fig. 1) and the typical grain size distribution curves are presented in an envelope form in Fig. 2 which are included in the Appendix of this report.

The Atterberg Limits indicate that the cohesive stratum is inorganic and of low plasticity.

The boreholes No. 8, 9 and 11 were put in the creek through 6 inches of water. Under the water a deposit of 1.5 to 2.5 ft. thick alluvial silty sand and gravel was found overlying the bedrock.

Bedrock (Shale to Shaley Limestone)

Bedrock was encountered immediately below the cohesive glacial till overburden, or immediately beneath the alluvial deposit in the creek floor. It consists of interbedded layers of shale and limestone. The surface of the bedrock in the area investigated varies from elevation 442.0 to 445.0 and appears to be dipping slightly in a westerly direction. The bedrock was found to be generally sound. However, in certain locations, the upper 6" to 18" of the bedrock appeared to be slightly weathered.

Groundwater

The groundwater levels were observed by measuring in the open boreholes during and after the completion of the foundation investigation. The groundwater levels were found to vary between

elevations 445.8 and 444.1 which corresponds to depths of 3.0 to 3.5 feet below the existing ground surface. The water level in the Mullet Creek during the time of investigation (June 22, 1977) was 445.0.

The groundwater levels are shown on the record of Borehole Sheets, as well as on Contract Drawing No. 2.

MISCELLANEOUS

The fieldwork was carried out during June 21 and 22, 1977 under the supervision of Mr. V. Korlu, Project Engineer, who also prepared this report.

The drilling equipment was owned and operated by Dominion Soil Ltd. of Toronto. This report was reviewed by Mr. M. Devata, Supervising Engineer.



B. Bennett
 B. Bennett, P. Eng.
 Sr. Foundation Engineer
 (Acting)



D. Dundas
 D. Dundas, P. Eng.
 Chief Foundation Engineer
 (Acting)

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 1

IMPERIAL

WP ~~157-75-05~~ LOCATION Co-ords. N 15,827,211; E 950,002 ORIGINATED BY VK
 DIST 6 HWY 403 BORING DATE June 22, 1977 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger - BXL Core CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
447.6	Ground Level															
0.0	TOPSOIL															
1.0	Heterogeneous mixture of clayey silt, sand & gravel (Glacial till) Stiff		1	SS	28										31 33 24 12	
442.1																
5.5	Weathered Sound Shaly limestone Bedrock		2	BXL	Rec 70%	440									RQD 9%	
437.1																
10.5	End of Borehole															
	<p><u>Bedrock Description</u></p> <p>From 5'5" to 5'11" Limestone, grey, medium textured, medium hard, fossiliferous with sandy sections.</p> <p>From 5'11" to 10'5" Shale, grey, soft fissile with shaly sections.</p>															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

IMPERIAL

WP 803-93-01 LOCATION Co-ords. N 15,827,282; E 949,964 ORIGINATED BY VK
 WP 157-75-05 DIST 6 HWY 403 BORING DATE June 22, 1977 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger - BXL Core CHECKED BY RS

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L	PLASTIC LIMIT w_p	WATER CONTENT w	UNIT WEIGHT γ	REMARKS
			NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
448.3	Ground Level															
0.0	Topsoil															
1.0	Heterogeneous mixture of clayey silt, sand, gravel.															
444.3	(Glacial till) Stiff		1	SS	13											11 36 37 16
4.0	Shaly Limestone															
439.3	Bedrock Sound		2	BXL	Rec 100	440										RQD 40%
9.0	End of Borehole															
	<p><u>Bedrock Description</u></p> <p>From 4'0" to 6'0" Limestone, grey, medium textured, medium hard to hard, fossiliferous.</p> <p>From 6'0" to 10'5" Shale, grey, soft, fissile with shaly sections.</p>															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 3

IMPERIAL

WP 157-75-05

LOCATION Co-ords. N 15,827,355; E 949,932

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 21, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			UNIT WEIGHT Y	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L			GR	SA
448.4	Ground Level																	
0.0	Topsoil																	
1.0	Heterogeneous mixture of clayey silt, sand, & gravel. (Glacial Till), Hard	[Symbol]	1	SS	45													
442.4			2	SS	100	5"												
6.0	Weathered																	
437.4	Sound Shaly Limestone Bedrock	[Symbol]	3	BXL	Rec 90%	440												RQD 7%
11.0	End of Borehole																	
	<p><u>Bedrock Description</u></p> <p>From 6' to 7' Limestone, grey, medium textured, hard.</p> <p>From 7' to 9'3" Shale, grey, soft, fissile with shaly sections.</p> <p>From 9'3" to 9'9" Limestone, light grey, medium textured, hard, fossiliferous.</p> <p>From 9'9" to 11' Shale, grey, soft, fissile with shaly sections.</p>																	

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 4

IMPERIAL

WP 157-75-05

LOCATION Co-ords. N 15,827,230; E 950,025

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 22, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		'N' VALUES	20	40	60	80	100	w_p		
446.9	Ground Level													
0.0	Topsoil													
1.0	Het. mix. of cl. si. sa. & gr. (Gl. Till) Hard		1	SS	38									28 31 31 10
443.4														
3.5	Shaly Limestone													
438.4	Sound Bedrock		2	BXL	Rec 100%	440								RQD 38%
8.5	End of Borehole													
	<u>Bedrock Description</u>													
	From 3'5" to 5'5" Limestone, grey, medium textured, medium hard to hard, fossiliferous.													
	From 5'5" to 7'5" Shale, grey, soft, fissile with shaly sections.													
	From 7'5" to 8'5" Limestone, light grey, medium to coarse textured, medium hard, fossiliferous.													

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

IMPERIAL

WP 803-93-01

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,301; E 949,986

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 22, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	w	W_L		
447.7	Ground Level															
0.0	Topsoil															
1.0	Heterogeneous mixture of clayey silt, sand & gr		1	SS	45									13	15 55 17	
443.7	(Glacial till) Hard															
4.0	Shaly Limestone		2	BXL	Rec											
438.7	Bedrock Sound				100%	440									RQD 45%	
9.0	End of Borehole															
	<u>Bedrock Description</u>															
	From 4'0" to 6'4" Limestone, grey, medium textured, medium hard, fossiliferous.															
	From 6'4" to 8'5" Shale, grey, soft, fissile with shaly sections.															
	From 8'5" to 9' Limestone, grey, medium textured, medium hard, fossiliferous.															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 6

IMPERIAL

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,376; E 949,961

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 21, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY R S

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w		
448.0	Ground Level														
0.0	TOPSOIL														
1.0	Het. mix. of cl. si. sa. & s. l.		1	SS	16										7 50 35 8
444.0	gr. (Gl. Till) V. Stiff														
4.0	Shaly Limestone		2	BXL	Rec										RQD 28%
439.0	Bedrock Sound				100										
9.0	End of Borehole														
	<p><u>Bedrock Description</u></p> <p>From 4' to 6'3" Limestone, grey, medium textured, hard, fossiliferous.</p> <p>From 6'3" to 9' Shale, grey, soft, fissile, with shaly sections.</p>														

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 7

IMPERIAL

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,333; E 950,024

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 22, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RC

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_l PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_l			10
447.9	Ground Level															
0.0	Topsoil															
1.0	Heterogeneous mixture of clayey silt, sa. & gr. (Glacial till) V. Stiff	1	SS	22												
443.4																45 31 16 8
4.5	Shaly Limestone	2	BXL	Rec												
438.4	Bedrock Sound			100	440											RQD 7%
9.5	End of Borehole															
	<p><u>Bedrock Description</u></p> <p>From 4'5" to 6'6" Limestone, grey, medium textured, medium hard, fossiliferous.</p> <p>From 6'6" to 8'7" Shale, grey, soft, fissile with shaly sections.</p> <p>From 8'7" to 9'2" Limestone, grey, medium textured, medium hard, fossiliferous</p> <p>From 9'2" to 9'5" Shale, grey, soft, fissile.</p>															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 8

IMPERIAL

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,263; E 950,063

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 22, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY PS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_l PLASTIC LIMIT w_p			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WATER CONTENT w w_p — w — w_l				
444.8	Water Level															
442.8	Sl. sa. sgr. (alluvial)															
2.0	Shaly Limestone		1	BXL	Rec	440										
437.8	Bedrock Sound						100 %									
7.0	End of Borehole															
	<p><u>Bedrock Description</u></p> <p>From 2' to 3' Limestone, grey, medium to coarse textured, medium hard, fossiliferous.</p> <p>From 3' to 5' Shale, grey, soft, fissile with shaly sections.</p> <p>From 5' to 5'10" Limestone, grey, medium to coarse textured, medium hard, fossiliferous.</p> <p>From 5'10" to 6'4" Shale, grey, soft, fissile.</p> <p>From 6'4" to 6'7" Limestone, grey, medium to coarse textured, medium hard, fossiliferous.</p> <p>From 6'7" to 7' Shale, grey, soft, fissile.</p>															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 9

IMPERIAL

WP ~~157-75-05~~ LOCATION Co-ords. N 15,827,404; E 949,986

DIST 6 HWY 403 BORING DATE June 21, 1977

ORIGINATED BY VK

COMPILED BY VK

DATUM Geodetic BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p		
445.0	Water Level													
0.0	Water													
442.0	Silty sand & gravel (alluvial)													
3.0	Weathered													
437.0	Sound Shaly Limestone Bedrock		1	BXL	Rec 96%	440								RQD 53%
8.0	End of Borehole													
	<p><u>Bedrock Description</u></p> <p>From 3' to 3'6" Limestone, grey, fine to medium textured, hard.</p> <p>From 3'6" to 6'2" Shale, grey, soft, fissile.</p> <p>From 6'2" to 6'9" Limestone, grey, fine textured, hard, fossiliferous with thin seams of shale.</p> <p>From 6'9" to 8' Shale, grey, soft, fissile, interbedded with shaly sections.</p>													

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

IMPERIAL

WP 803-93-01

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,281; E 950,084

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 21, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
448.5	Ground Level															
0.0	Topsoil															
445.0	Het. mix. of cl, si, sa. & gr. (Cl. Till) Hard		1	SS	55											34 7 47 12
3.5	Shaly Limestone															
440.0	Bedrock Sound		2	BXL	Rec 100 %											RQD 40%
8.5	End of Borehole															
	<p><u>Bedrock Description</u></p> <p>From 3'5" to 5'1" Limestone, grey, medium textured, medium hard, fossiliferous.</p> <p>From 5'1" to 7'3" Shale, grey, soft, fissile, with shaly sections.</p> <p>From 7'3" to 8'5" Limestone, grey, medium textured, medium hard, interbedded with grey shale. Fossiliferous.</p>															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 11

IMPERIAL

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,353; E 950,047

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 21, 1977

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY RS

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		'N' VALUES	20	40	60	80	100	w_p	w		
445.1	Water Level														
443.6	St. Sa. & Gr. (Alluvial)		1	wash											GR SA SI CL
1.5	Shaly Limestone		2	BXL	Rec										RQD 49%
438.6	Bedrock Sound				100										
6.5	End of Borehole														
	<u>Bedrock Description</u>														
	From 1'5" to 2'11" Limestone, grey, medium textured, medium hard, fossiliferous.														
	From 2'11" to 5'0" Shale, grey, reddish, soft, fissile with shaly sections.														
	From 5'0" to 5'11" Limestone, light grey, medium textured, medium hard, fossiliferous.														
	From 5'11" to 6'5" Shale, grey, reddish, soft, fissile.														

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

WP 803-93-01

RECORD OF BOREHOLE NO 12

IMPERIAL

WP ~~157-75-05~~

LOCATION Co-ords. N 15,827,422; E 950,008

ORIGINATED BY VK

DIST 6 HWY 403

BORING DATE June 21, 1977

COMPILED BY VK

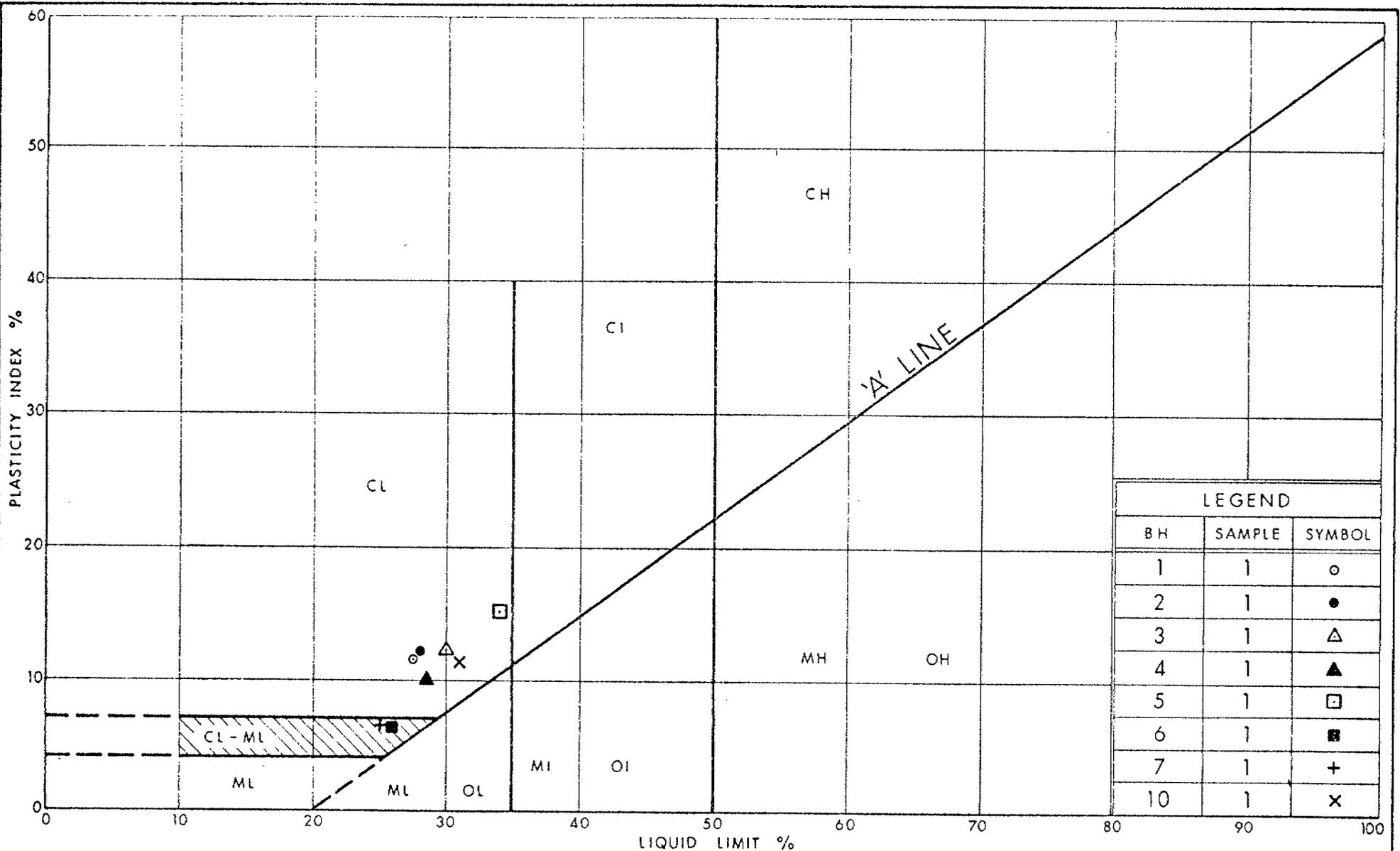
DATUM Geodetic

BOREHOLE TYPE Auger - BXL Core

CHECKED BY CS

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT Y	REMARKS		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L			GR	SA
447.4	Ground Level																
0.0	Topsoil																
1.0	Het. mix. of cl. si. sa. & gr. (Gl. Till) Hard	1	SS	118, 9%													43 22 25 10
443.4																	
4.0	Shaly Limestone	2	BXL	Rec													RQD 16%
438.4	Bedrock Sound			100%	440												
9.0	End of Borehole																
	<p><u>Bedrock Description</u></p> <p>From 4' to 6' Limestone, grey, med. textured, med. hard fossiliferous.</p> <p>From 6' to 6'7" Shaly limestone.</p> <p>From 6'7" to 7'3" Limestone, grey, medium textured, medium hard, fossiliferous.</p> <p>From 7'3" to 7'10" Shale with thin seams of limestone.</p> <p>From 7'10" to 9' Limestone, grey to pink, medium textured, medium hard, fossiliferous.</p>																

OFFICE REPORT ON SOIL EXPLORATION



LEGEND		
BH	SAMPLE	SYMBOL
1	1	○
2	1	●
3	1	△
4	1	▲
5	1	□
6	1	■
7	1	+
10	1	x



Ontario

Ministry of
Transportation and
Communications

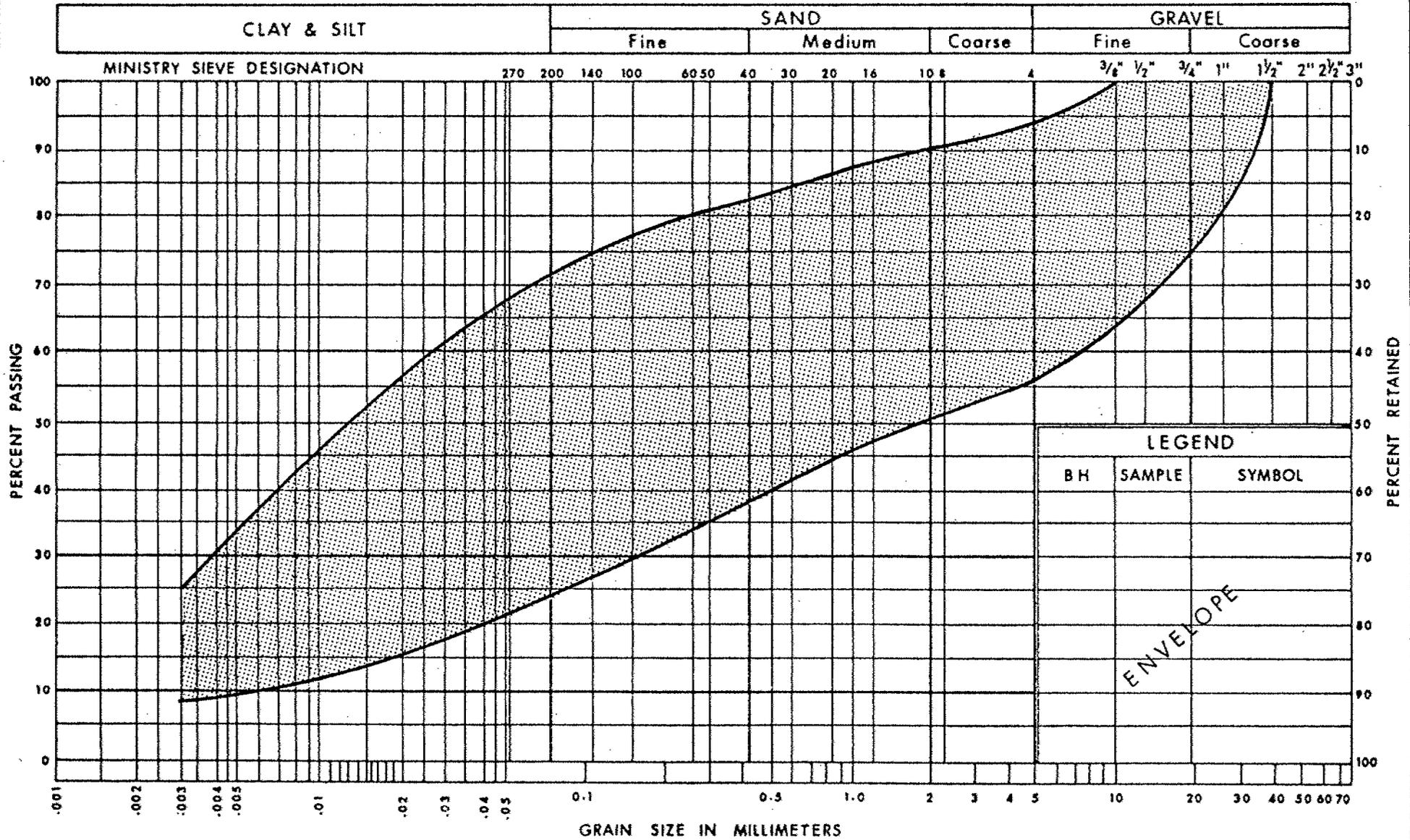
PLASTICITY CHART
GLACIAL TILL
HET MIX OF CLAYEY SILT WITH SAND & GRAVEL

FIG No 1

WP ~~157-75-05~~

WP 803-93-01

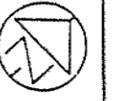
UNIFIED SOIL CLASSIFICATION SYSTEM



P.S.E. 1000
 DATE: 24-4-94

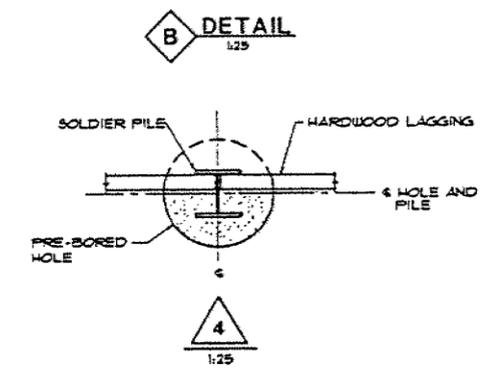
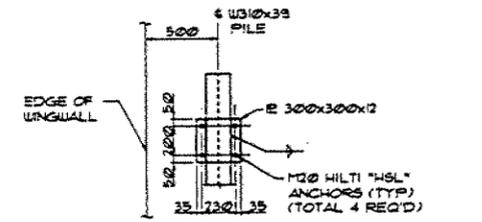
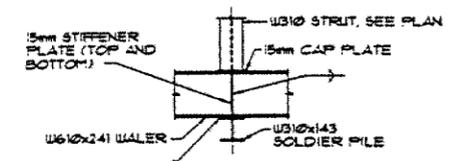
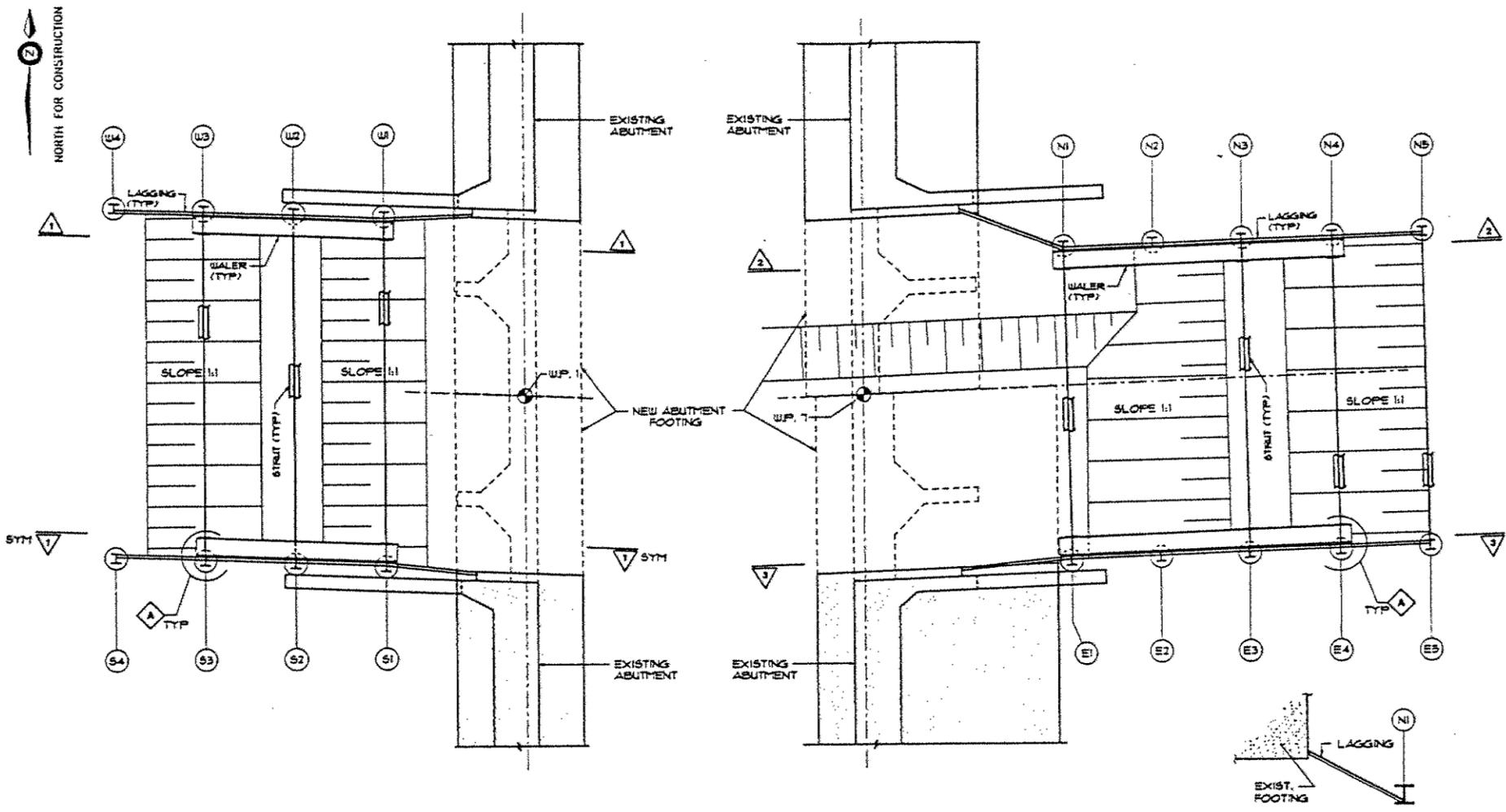
METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

CONT. No. 94-57
 WP. No. 802-93-01

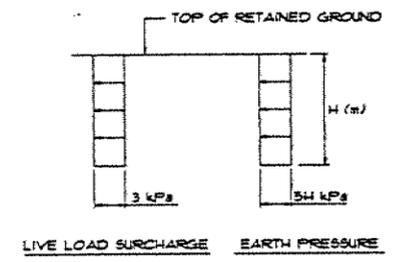


HWY 403 - CREDIT RIVER
 BRIDGE WIDENING
 ROADWAY PROTECTION

SHEET
 131

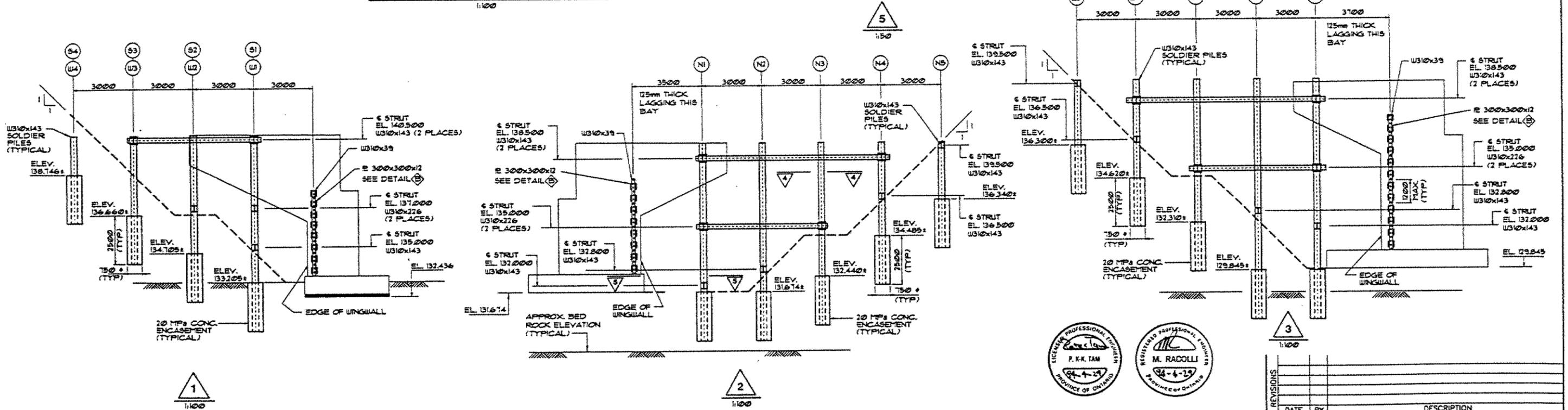


- NOTES:**
1. ALL STRUCTURAL STEEL FOR PILES, WALERS, STRUTS AND CONNECTIONS, ETC. SHALL CONFORM TO C.S.A. G40.21 - GRADE 300W.
 2. ALL WELDING OF STRUCTURAL STEEL SHALL CONFORM TO C.S.A. W59 AND BE PERFORMED BY QUALIFIED WELDERS.
 3. LAGGING SHALL BE HARDWOOD OF FULL THICKNESS OF 100mm, UNLESS NOTED ON DRAWING.
 4. CONCRETE ENCASMENT FOR PILES SHALL BE CAST AGAINST UNDISTURBED GROUND.
 5. AFTER CONSTRUCTION IS COMPLETED, ALL SHORING TO BE CUT OFF ONE METER BELOW GRADE.
 6. ALL WALER BEAMS TO BE U610x241.
 7. ALL WELDS SHOWN OR IMPLIED TO BE 6mm FILLET.
 8. LATERAL PRESSURE DIAGRAM:



ROADWAY PROTECTION SHORING PLAN 1:100

JAM LAGGING AGAINST EXISTING FOOTING AND WEDGE AT PILE AS NECESSARY



REVISIONS	DATE	BY	DESCRIPTION

DESIGN #T. CHK. MR. CODE CMBDC-91 LOAD CLASS A | DATE APR 1994
 DRAWN D.C. CHK. #T. SITE 24-222 | STRUCT. SCHEME DWG. 4

memorandum



To: V. Boehnke
Head, Structural Section
Central Region

Date: 1994 03 28

Atten: R. Jeffries

From: Foundation Design Section
Room 315, Central Bldg.

Re: Shoring Design Scheme
Credit River Structure Widening
Hwy. #403
W.P. 802-93-01, Site 24-222
District #6 (Toronto)

As per your request the following design parameters are recommended for the proposed shoring scheme:

$$\begin{aligned}\phi &= 32.5^{\circ} \\ \gamma &= 22.4 \text{ kN/m}^3\end{aligned}$$

These average figures (glacial till and shale bedrock) were given to Mr. R. Radolli by telephone on March 18, 1994.

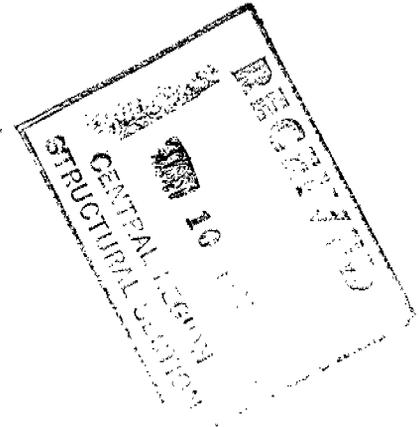
A handwritten signature in cursive script that reads "P. Payer".

P. Payer, P. Eng.
Sr. Foundation Engineer

PP/mmj

Our File: 93-1428-01

January 6, 1994



Ministry of Transportation
Structural Section
Atrium Tower, 4th Floor
1201 Wilson Avenue
DOWNSVIEW, Ontario
M3M 1J8

ATTENTION: Mr. R.A. Jeffries, P.Eng.

Highway 403 — Credit River Bridge Widening
Site 24-222 W.P. 801-93-00

Dear Sirs:

At our December 13, 1993 meeting with Foundation Design Section, we identified some inconsistencies between the founding levels recommended by the Foundation Design Section and the top of footing elevation shown on the General Arrangement drawing of the existing bridge (W.P. 157-75-03). Additionally, we requested clarification of some pier and abutment footing levels, since the existing north and south structures are, in some instances, founded at different elevations. The inconsistencies/clarifications to be resolved are summarized as follows:

East Abutment

Recommended bottom of footing elevations are:

WBL (north structure)	432.0 (ft.) ✓
EBL (south structure)	426.0 (ft.) ✓

This is consistent with what is shown on the General Arrangement of the existing structure.

In widening the bridge in the centre, we must decide which elevations to use for the new footing, and where the transition should occur.

WBL, EL. 432.0
EBL, EL. 426.0

... continued

Figure 1 attached shows our proposal for the east abutment. Because of the 6 ft. difference in abutment heights, we have separated the two abutments with an expansion joint. The 6 ft. variation is made in one step, at the joint. This is consistent with what has been done previously at the southeast wingwall of the south structure. The joint in the abutment mirrors the longitudinal joint in the superstructures.

Pier 5

Recommended bottom of footing elevations are:

WBL (north structure)	381.5 (ft.)
EBL (south structure)	374.5 (ft.)

At first, this appears to be inconsistent with elevations given on the General Arrangement. Bottom of footing elevations on the General Arrangement of the existing structure are:

WBL (north structure)	382.0 (ft.)
EBL (south structure)	375.0 (ft.)

In each case, the General Arrangement elevations are 0.5 ft. higher than recommended by Foundation Design Section. However, when the thickness of the mass concrete is considered, there is agreement between the two sets of elevations.

In determining the elevation for the new pier, we must interpolate between the values given. Given the slope of the sound bedrock, and the variation in the weathered bedrock layer, we are proposing an elevation for the bottom of footing at 375.0 (ft.). This is consistent with the lower elevation given on the General Arrangement, and is shown on Figure 2, attached.

Pier 4

Recommended bottom of footing elevations are:

WBL (north structure)	371.0 (ft.)
EBL (south structure)	370.0 (ft.)

This is inconsistent with elevations given on the General Arrangement of the existing structure. Bottom of footing elevations on the General Arrangement are:

WBL (north structure)	378.5 (ft.)
EBL (south structure)	367.5 (ft.)

... continued

The situation at Pier 4 is somewhat confusing. At the north structure the General Arrangement elevations are 7.5 ft. higher than the Foundation Design Section recommendations, while at the south structure, the General Arrangement elevations are 2.5 ft. lower.

From the original Foundation Design Report, sound bedrock is reported at elevations 385.9 (ft.) - WBL and 371.0 (ft.) - EBL. Additionally, there is a 10 ft. variation from north to south, in the thickness of the weathered rock. We cannot explain why the founding level recommended for the north structure is 14.9 ft. below sound bedrock, while that recommended for the south footing is only 1 ft. below sound bedrock.

In determining the elevation for the new pier, we have assumed the worst case scenario, i.e. bottom of footing elevation consistent with the south structure, 367.5 ft. This appears to be more consistent with the top of sound bedrock elevation at the south side of the bridge, and takes into account the large variability in the thickness of weathered bedrock. See Figure 3. Undermining of adjacent footings should not occur, since the excavation will be in sound bedrock.

Pier 3

Recommended bottom of footing elevations are:

WBL (north structure)	368.5 (ft.)
EBL (south structure)	371.5 (ft.)

This is inconsistent with elevation given on the General Arrangement of the existing structure. Bottom of footing elevations on the General Arrangement are:

WBL (north structure)	369.0 (ft.)
EBL (south structure)	369.0 (ft.)

We can only assume that the original designer decided to place both footings at the same elevation. The 369.0 (ft.) elevation is well below the reported sound bedrock elevations (374.4 (ft.) - WBL; 373.1 (ft.) - EBL).

We therefore propose to use 369.0 (ft.) as the bottom of footing elevation at Pier 3.

Pier 2

If the mass concrete below the footing is considered, then there is agreement at Pier 2 between the General Arrangement of the existing structure and the Foundation Design Section recommendations. Therefore, we proposed to use 372 (ft.) as the bottom of footing elevation at Pier 2.

... continued

Ministry of Transportation
Mr. R.A. Jeffries, P.Eng.

- 4 -

January 6, 1994

Pier 1

Recommended bottom of footing elevations are:

For both WBL and EBL 371.5 (ft.)

The General Arrangement of the existing structure indicates both footings were to be placed at Elev. 379.0 (ft.) *EL. 378.5*

The original Foundation Design Report indicates sound bedrock at 382.7 (ft.) - WBL and 383.0 (ft.) - EBL.

We are not certain why the Foundation Design Section recommendations are in excess of 10 ft. below sound bedrock. It appears that the original structural design, although well above recommended levels, is still founded well into the sound bedrock.

Based on the uniformity of both the sound bedrock elevation and in the thickness of weathered bedrock, we propose that we use Elev. 379.0 (ft.) as the founding elevation for Pier 1 (similar to General Arrangement).

West Abutment

There is agreement between the Foundation Design Section recommendations and the existing General Arrangement.

We are requesting that you review our proposed foundation levels with Foundation Design Section, so that a consensus can be reached regarding the bottom of footing elevations. *EL. 434.5*

Given the uncertainty that exists with respect to footing elevations, we suggest that a note be added to the drawings that indicates that foundation levels shown are approximate, and will be confirmed in the field. Additionally, we suggest that a Non-Standard Special Provision be incorporated into the contract that does not permit the placement of any footing concrete or mass concrete, until the founding bedrock has been inspected by a representative of the Foundation Design Section.

For design purposes, we will be using the worst case scenario in the design of the bridge piers. This may result in some nominal over design, but without an extensive field investigation, we feel this is the prudent course of action, given the project schedule.

At our December 13, 1993 meeting, we discussed some other aspects which we wish to confirm.

... continued

Ministry of Transportation
Mr. R.A. Jeffries, P.Eng.

- 5 -

January 6, 1994

Foundation Drawings

The Soil Stratigraphy drawings that normally form part of the structural drawing package will be prepared by Foundation Design Section.

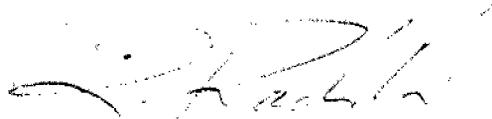
Sliding Friction Coefficients

The design of the abutments will require the sliding friction coefficients for both rock and till in Limit States format. The values given in the original report are based on the old working stress philosophy. It is our understanding that Foundation Design Section will be providing these values.

We trust the above clarifies the additional information which we will require to complete our design. Should another meeting be necessary to clarify any of the issues described above, we are available at your convenience.

Yours truly,

M.M. DILLON LIMITED



Reno Radolli, P.Eng.
Project Manager

RR:ms
Encls.

cc: B. Iyer — MTO, Foundation Design Section
K. Schipper — City of Mississauga
P. Tam — Dillon

MEMORANDUM



To: V. Boehnke
Head, Structural Section
Central Region

Date: November 3, 1993

Attn: R. Jeffries

From: Foundation Design Section
Room 315, Central Bldg.

Tel: 235-3731
Fax: 235-5240

Re: Foundation Recommendations
Credit River Bridge Widening, Hwy 403
W.P. 157-75-03, Site 24-222
District 6, Toronto

This memo is in response to your query regarding design recommendations as per OHBDC for the proposed Credit River Bridge widening along Hwy 403.

The existing six-span twin structure is supported on spread footings founded on sound bedrock or very stiff to hard cohesive glacial till stratum immediately overlying bedrock. Factored ULS capacities and the existing footing elevations as per contract drawings are given in the attached table. Due to the unyielding nature of the founding soil/bedrock, SLS type II bearing capacities will not control the design.

General Comments

The design shall take into account the influence of new footings on the adjacent existing footings.

At Pier 3, Pier 5 and east abutment locations, the design of the new footings should take into account differential founding elevations of the existing WBL and EBL structure footings.

Depending upon the groundwater level and the river water level at the time of construction, some advance dewatering may be required during construction of the new footings.

All foundations shall be provided with a minimum of 4 ft (1.2 m) of earth cover for frost protection purposes.

We trust that the above information is sufficient for your immediate needs. Please call this office if you need additional input from us.

A handwritten signature in cursive script, appearing to read "B. Iyer".

B. Iyer, P. Eng.
Senior Foundation Engineer

BI/jb

Recommended Design Capacities

Element	Existing Footing Elevation (Ft.)*	Factored ULS Capacity (kPa)	Founding Stratum
W. Abutment WBL EBL	434.5 434.5	3000 3000	Sound Bedrock Sound Bedrock
Pier 1 WBL EBL	371.5 371.5	3000 3000	Sound Bedrock Sound Bedrock
Pier 2 WBL EBL	371.5 371.5	3000 3000	Sound Bedrock Sound Bedrock
Pier 3 WBL EBL	368.5 371.5	3000 3000	Sound Bedrock Sound Bedrock
Pier 4 WBL EBL	371.0 370.0	3000 3000	Sound Bedrock Sound Bedrock
Pier 5 WBL EBL	381.5 374.5	3000 3000	Sound Bedrock Sound Bedrock
E. Abutment WBL EBL	432.0 426.0	1000 1000	Glacial Till Glacial Till

* Existing footing elevations are in imperial units and are as per contract drawings.