

G.I.-30 SEPT. 1976

GEOCRES No. 30M5-153DIST. 4 REGION                     W.P. No. 83-74-07CONT. No.                     W. O. No.                     STR. SITE No.                     HWY. No. QEWLOCATION QEW From CNR TOHwy 403 High Mast LIGHTINGNo. of PAGES -                     =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     REMARKS:

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 83-74-07

DIST 4

HWY Q.E.W.

STR SITE

High Mast Lighting  
Q.E.W. from C.N.R. to Hwy. 403

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# FOUNDATION INVESTIGATION REPORT

For

High Mast Lighting

Q.E.W. from C.N.R. to Hwy. 403,

W.P. 83-74-07

District 4, Burlington

## INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation performed at the above-mentioned site. Fieldwork consisted of eleven sample boreholes, four of which were accompanied by dynamic cone penetration tests. The boreholes were advanced between 85 02 05 and 85 02 18. A track mounted auger machine was utilized for this investigation. Borings were advanced for depths ranging from 5.6 to 9.4 m. Bedrock was cored in all eleven boreholes utilizing BXL size rock coring equipment. In addition to the eleven boreholes described above, an additional 3 boreholes have been incorporated into this report from other projects in the same area.

## SITE DESCRIPTION

The site is located within the ultimate QEW/403 interchange between Brant St. and the CNR crossing, in the City of Burlington, Regional Municipality of Halton.

As part of the ultimate Hwy. 403/QEW interchange, it is proposed to illuminate the interchange area with 14 high mast light poles. The height of the poles is anticipated to be 35 m. Note that the numbering system used to identify the boreholes is the same as that used to identify the light poles.

This site is located within the physiographic region known as the South Slope. The area is characterized by a ground moraine of limited relief. The bedrock underlying the site is a red shale with greenish siltstone of the Queenston Formation.

## SUBSURFACE CONDITIONS

### General

The boundaries of the various subsoil types are shown in the Record of Borehole Sheets located in the Appendix. The locations and elevations of the borings are also shown on these sheets. This report must be read in conjunction with the above-noted items.

The subsoil conditions are quite uniform across the site. Exposed at ground surface at all boreholes locations is a heterogeneous mixture of silty clay, sand, and gravel (glacial till). Underlying the till material is a red shale bedrock of the Queenston Formation.

The various soil types encountered are described in the following paragraphs.

#### Heterogeneous Mixture of Silty Clay, Sand, and Gravel (Glacial Till)

This deposit is the predominant soil type across this site. It was encountered at all borehole locations and varied in thickness from 0.5 m at borehole 1 to 7.1 m at borehole 13. Occasional cobbles and boulders were encountered throughout the deposit during the drilling operation.

The results of Atterberg Limit and water content testing are plotted in envelope form on the Plasticity Chart, Figure No. 1, and are summarized as follows:

		Range	Average
Water Content	(w ) %	6-25	10
Liquid Limit	(w <sub>L</sub> ) %	19-54	28
Plastic Limit	(w <sub>p</sub> ) %	11-26	17
Plasticity Index	(I <sub>p</sub> ) %	5-29	10

The results of grain size distribution tests are plotted in envelope form on Figure No. 2 in the Appendix.

Standard Penetration Test 'N' values ranged from 10 to over 100 blows per 0.3 m which indicates that the consistency of the deposit varies from stiff to hard but generally hard.

An approximate 0.5 m thick clay layer was encountered within the till deposit at boreholes 12, 13 and 14. In addition, an approximate 0.5 m thick layer of silty sand to sand was encountered within the till deposit at boreholes 4, 6, 7, 8, 10 and 14.

#### Bedrock

Bedrock was proven at all boreholes by obtaining BXL rock cores. The top of the bedrock varied in elevation from 92.8 m at borehole 11 to 106.9 m at borehole 1. The bedrock is a red shale with green siltstone of the Queenston

Formation. The upper portion of the bedrock, from 0 m at borehole 11 to 3.3 m at borehole 1, is in a highly weathered state with layers of broken shale and silty clay.

The core recovery attained ranged from 37% to 100%.

The Rock Quality Designation (RQD) for the bedrock ranged from 0% to 100% with a mean of 51%.

A detailed description of the rock core was prepared by Mr. E. Magni, MTC Soils and Aggregate Geologist, and his report is located in the Appendix.

#### Groundwater

The groundwater level was found to vary between elevation 98.5 m and 106.5 m by taking overnight readings in the open boreholes. However, owing to the relatively impervious nature of the till deposit and the water used in the rock coring operation, this may not represent a true stabilized condition.

## DISCUSSION AND RECOMMENDATIONS

As part of the reconstruction of the Hwy. 403/Q.E.W. interchange, it is proposed to illuminate the interchange area with a total of 14 high mast light poles. The height of each pole is anticipated to be 35 m.

Conventional spread footings for these light poles would likely be quite expensive. However, high mast light poles have been installed economically in many areas of North America and Europe using a design method proposed by B.B. Broms and others in which the poles are supported on a concrete caisson pile. The Structural Office has decided to adopt this same method described by Broms in two separate papers; Broms, B.B. "Lateral Resistance of Piles in Cohesive Soils", Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 90, No. SM2, Paper 3825, March 1964.; and "Lateral Resistance of Piles in Cohesionless Soils", Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 90, No. SM3, Paper 3909, May, 1964.

In the following paragraphs, the feasibility of constructing concrete caissons at the site is discussed and the various parameters to be used in the caisson design are provided.

It is understood that all of the poles, No.'s 1-14, will be installed in the original ground in areas where no significant amount of fill will be placed.

At all locations, the subsoil conditions are quite similar as shown on the borehole logs. (Note that the borehole numbers correspond to the pole numbers). Depending on the length of the caissons, some may be located wholly within the overburden, with the remainder partly in overburden and partly in shale bedrock. In all cases, the material located within the zone of frost protection, (1.2 m) should be neglected in the calculation of lateral resistance.

For the cohesive soils located at this site, the coefficient of horizontal subgrade reaction should be computed in accordance with the following formula: (The design parameters are presented in Imperial Units, since the design example provided by the Structural Office used Imperial Units throughout).

$$K_h = \frac{n_1 n_2 80 q_u}{D}$$

Where:

$K_h$  - coefficient of horizontal subgrade reaction (lb/in<sup>3</sup>)

D - diameter of concrete caisson pile (in)

$n_1$  - coefficient as defined below:

Unconfined Compressive Strength  
 $q_u$  (Tons/ft<sup>2</sup>)

$n_1$

Less than 0.5

0.32

0.5 to 2.0

0.36

Greater than 2.0

0.40

$n_2$  - coefficient based on pile material = 1.15 for concrete

$q_u$  - unconfined compressive strength (psi)

For this site the following parameters are recommended:

Material	Unconfined Compressive Strength $q_u$ MPa (psi)		Unit Weight kN/m <sup>3</sup> (lb/ft <sup>3</sup> )	
Overburden	0.6	(80)	23	(145)
Weathered Shale	1.0	(145)	24	(150)
Sound Shale	10.0	(1450)	26	(165)

For rock anchors installed in the sound shale bedrock, an ultimate bond strength of 80 psi should be assumed to apply.

#### CAISSON CONSTRUCTION

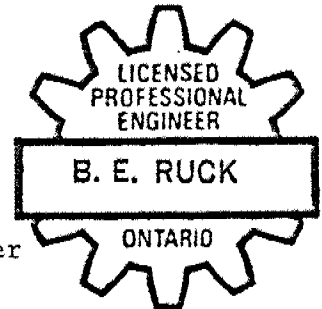
Conditions at this site are favourable for the construction of concrete caissons utilizing conventional augering equipment. Seepage into the augered holes is not anticipated to be a major problem. Augered holes should stand up without support for several hours, however, concrete should be placed as soon as possible after augering to prevent softening of the soil.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Messrs. R. Thomas and D. Graham, Student Specialist Engineers using equipment owned and operated by Atcost Soil Drilling, Concord; and Dominion Soil Investigation Ltd. Scarborough. This report was written by Mr. B. Ruck, Project Foundations Engineer and reviewed by Mr. K.G. Selby, Chief Foundations Engineer, West.

*Brian Ruck*

B.E. Ruck, P. Eng.  
Project Foundations Engineer



*K.G. Selby*

K.G. Selby, P. Eng.  
Chief Foundations Engineer  
(West)

## APPENDIX

## 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 (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	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

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

### STRESS AND STRAIN

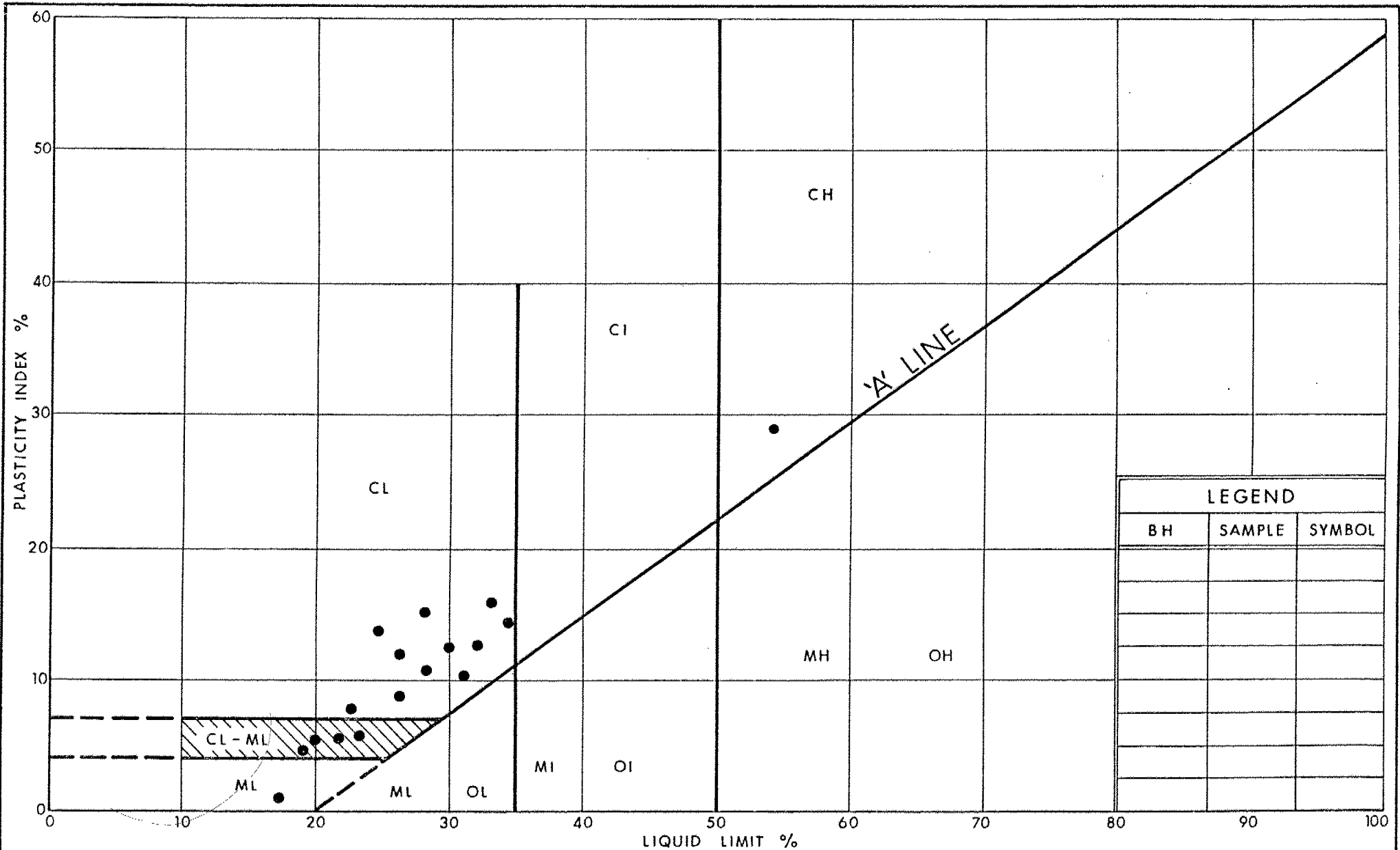
$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_f$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kn/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
P	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kn/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kn/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						



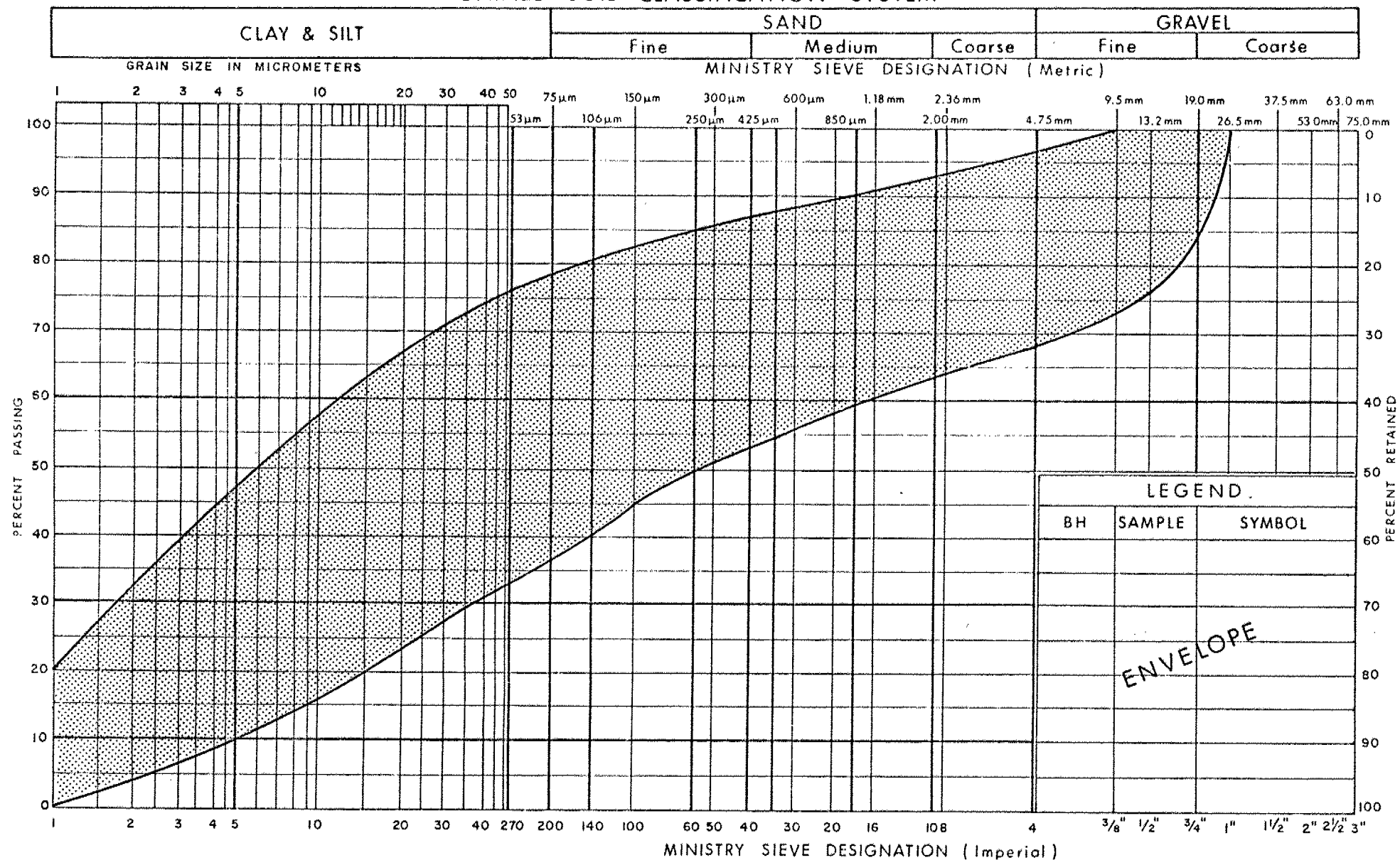
Ministry of  
Transportation and  
Communications

**PLASTICITY CHART**  
**HETEROGENEOUS MIXTURE OF SILTY CLAY, SAND & GRAVEL**  
 (Glacial Till)

FIG No 1

W P 83-74-07

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
**HETEROGENEOUS MIXTURE OF SILTY CLAY, SAND & GRAVEL**  
 (Glacial Till)

FIG No 2

W P 83-74-07

# DESCRIPTION OF ROCK CORE - W.P. 83-74-07

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
LS1	2.43 - 3.99	84	43	2.43 - 3.76	Shale (95%), red, slightly to moderately weathered, closely spaced joints with siltstone (5%), green, with highly weathered zones at 3.35 - 3.58 and 3.66 - 3.76 m
	3.99 - 5.54	92	39		
	5.54 - 6.05	100	40	3.76 - 6.05	Shale (60%), red, unweathered, medium spaced joints, with siltstone (40%), green, unweathered
LS2	4.01 - 5.64	95	72	4.01 - 7.19	Shale (90%), red, unweathered, medium spaced joints, with siltstone (10%), green, unweathered
	5.64 - 7.19	97	97		
LS3	4.14 - 5.69	100	49	4.14 - 5.69	Shale (75%), red, unweathered, medium spaced joints, with siltstone (25%), green, unweathered
LS4	3.86 - 5.16	90	65	3.86 - 4.34	Shale, highly weathered; assumed zone of core loss
	5.16 - 6.12	100	52	4.34 - 6.12	Shale (75%), red, unweathered, medium spaced joints, with siltstone (25%), green, unweathered
LS5	3.71 - 5.18	100	24	3.71 - 4.06	Shale (90%), red, moderately weathered, very closely spaced joints, with siltstone (10%), green, slightly weathered, with highly weathered zone from 4.52 - 4.55 m
	5.18 - 5.87	100	81	4.06 - 5.87	Shale (60%), red, unweathered, closely spaced joints, with siltstone (40%), green, unweathered
LS8	5.84 - 7.34	98	88	5.84 - 7.34	Shale (80%), red, unweathered, medium spaced joints, with siltstone (20%), green, unweathered

\* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

# DESCRIPTION OF ROCK CORE - W.P. 83-74-07

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
LS10	6.15 - 7.70	100	97	6.15 - 8.03	Shale (80%), red, unweathered, medium spaced joints, with siltstone (20%), green, unweathered
	7.70 - 8.03	100	77		
LS11	6.68 - 8.15	98	59	6.68 - 8.15	Shale (75%), red, unweathered, medium spaced joints, with siltstone (25%), green, unweathered
LS12	7.39 - 9.27	97	77	7.39 - 9.27	Shale (90%), red, unweathered, medium spaced joints, with siltstone (10%), green, unweathered
LS13	7.49 - 9.42	95	41	7.49 - 7.72	Shale, red, moderately weathered, with occasional siltstone layers
				7.72 - 9.42	Shale (60%), red, unweathered, medium spaced joints, with siltstone (40%), green, unweathered, with moderately weathered zone from 8.91 to 9.04 m
LS14	6.15 - 8.00	90	51	6.15 - 6.45	Shale, red, moderately weathered
				6.45 - 8.00	Shale (90%), red, unweathered, closely spaced joints, becoming unweathered, with siltstone (10%), green, unweathered, with highly weathered zones 7.19 to 7.21 and 6.86 to 6.88 m

\* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

# RECORD OF BOREHOLE No 1

METRIC

W P 83-74-07 LOCATION N 4 799 849 E 278 122 ORIGINATED BY DG  
 DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Auger & BXL Rock Coring COMPILED BY DG  
 DATUM Geodetic DATE 85 02 15 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
107.4	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay, Sand																
106.9	Gravel Hard																
0.5	Bedrock    Weathered Sound   Queenston Shale		1	SS	70/	23 cm											
			2	SS	100/	13 cm											
			3	SS	100/	10 cm											
			4	BXL RC	REC 84%												RQD 43%
			5	BXL RC	REC 92%												RQD 39%
			6	BXL RC	REC 100%												RQD 40%
101.4	End of Borehole																
6.0																	

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 2

METRIC

W P 83-74-07 LOCATION N 4 799 828 E 278 418 ORIGINATED BY DG  
 DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Core COMPILED BY DG  
 DATUM Geodetic DATE 85 02 11 CHECKED BY DG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W <sub>p</sub>	W	W <sub>L</sub>	WATER CONTENT (%)					
104.5 0.0	Heterogeneous Mixture of Silty Clay, Sand, Gravel Hard		1	SS	42												
103.1 1.4	Bedrock		2	SS	88												
			3	SS	86	15 cm											
			Recovery 0%														
			4	SS	70	10 cm											
	Weathered Sound																
	Queenston Shale		5	BXL RC	REC 95%											RQD 72%	
			6	BXL RC	REC 97%											RQD 97%	
97.3 7.2	End of Borehole																

# RECORD OF BOREHOLE No 3

METRIC

W P 83-74-07 LOCATION N 4 799 775 E 278 237 ORIGINATED BY DG  
 DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
 DATUM Geodetic DATE 85 02 18 CHECKED BY LD

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 <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
106.7	Ground Surface										
0.0	Heterogeneous Mixture of Silty Clay Some Sand Trace Gravel (Glacial Till) Very Stiff to Hard		1	SS	21						8 15 44 33
104.6			2	SS	93/	20 cm					
2.1			3	SS	60/	8 cm					
	Bedrock		4	SS	100/	10 cm					
	Weathered Sound										
	Queenston Shale		5	BXL RC	REC 100%						RQD 49%
101.0	End of Borehole										
5.7											

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity  
 20  
 15 5 (%) STRAIN AT FAILURE  
 10



# RECORD OF BOREHOLE No 4

METRIC

W P 83-74-07 LOCATION N 4 799 668 E 278 145 ORIGINATED BY DG  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
105.8	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel Hard		1	SS	31		105										
	Silty Sand		2	SS	95		104										30 26 38 6
103.1	Occasional Boulders		3	SS	75	10 cm	103										
2.7	Bedrock		4	SS	100	1 cm	102										RQD 65%
	Weathered Sound		5	BXL BC	REC 90%		101										
	Queenston Shale		6	BXL RC	REC 100%		100										RQD 52%
99.7																	
6.1	End of Borehole						99										



# RECORD OF BOREHOLE No 5

METRIC

W P 83-74-07 LOCATION N 4 799 690 E 728 000 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 13 CHECKED BY 10

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
106.1	Ground Surface					106										
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel		1	SS	24	105										
	Very Stiff to Hard		2	SS	61	104										
	Occasional Boulders		3	SS	100/8 cm	103										
103.4	Bedrock		4	SS	100/15 cm	102										
2.7	Weathered Sound		5	BXL RC	REC 100%	101										RQD 24%
	Queenston Shale		6	BXL RC	REC 100%	100										RQD 81%
100.2	End of Borehole															
5.9																

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 6

METRIC

W P 83-74-07 LOCATION Formerly B.H. 2 W.P. 199-77-05 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Auger & BXL Rock Coring COMPILED BY BR  
DATUM Geodetic DATE 85 02 04 CHECKED BY LD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
105.2	Ground Level																
0.0	Heterogeneous Mixture of Sandy Silt with gravel trace clay		1	SS	36		105										
	Sand layer		2	SS	63/10 cm		104										37 26 31 6
	Hard Glacial Till		3	SS	100/20 cm		103										18 30 43 9
102.4			4	SS	100/15 cm		102										
2.8	Bedrock		5	SS	Hammer Bouncing		101										
	Weathered Sound		6	BXL RC	REC 77%		100										RQD 55%
99.3																	
5.9	End of Borehole						99										

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 7

METRIC

W P 83-74-07 LOCATION Formerly B.H. 4 W.P. 199-77-02 ORIGINATED BY BR  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core COMPILED BY JC  
DATUM Geodetic DATE 84 11 08 - 13 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 <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
104.6	Ground Level											
0.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till) Stiff to Hard		1	SS	12							
	Sand layer		2	SS	10							0 67 17 16
			3	SS	42							
			4	SS	45/8	cm						17 49 25 9
100.6			5	SS	65							
4.0	Bedrock		6	SS	80/13	cm						
			7	RC	REC 37%							RQD = 0%
			8	RC	REC 45%							RQD = 0%
	Weathered Sound Queenston Shale		9	RC	93%							RQD = 0%
			10	RC	REC 95%							RQD = 0%
			11	RC	REC 95%							RQD = 63%
97.2			12	RC	REC 100%							RQD = 100%
7.4	End of Borehole											

+3, x5: Numbers refer to Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



## METRIC

W P 83-74-07 LOCATION N 4 799 341 E 278 002 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 08 CHECKED BY [Signature]

[illegible]

+3, x5; Numbers refer to Sensitivity

15  $\phi$  5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 9

METRIC

W P 83-74-07 LOCATION Formerly B.H. 6 W.P. 199-77-03  
DIST 4 HWY 403 & QEW BOREHOLE TYPE SS Auger and BQ Rock Coring  
DATUM Geodetic DATE 84 11 22

ORIGINATED BY JC  
COMPILED BY JC  
CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
104.1	Ground Level																
0.0	Fill Fine Silty Sand						104										
102.9	Loose		1	SS	8		103										
1.2	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till)  Stiff to Hard		2	SS	11		102										
			3	SS	16		101										4 22 50 24
			4	SS	100	8 cm	100										17 28 48. 7
			5	SS	100	25 cm	99										17 18 59 6
			6	SS	100		98										
			7	SS	100	8 cm	97										
98.5	Bedrock Queenston Shale Weathered Sound		8	RC	REC 50%		96										RQD = 0%
5.6			9	RC	REC 98%												RQD = 60%
96.8	End of Borehole																
7.3																	



# RECORD OF BOREHOLE No 10

METRIC

W P 83-74-07 LOCATION N 4 799 311 E 278 132 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 08 - 85 02 13 CHECKED BY 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
102.0	Ground Surface													
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel		1	SS	17		101							
	Sand layer		2	SS	42		100							
	Very Stiff to Hard		3	SS	57		99							
	Occasional Boulders		4	SS	81		98							
			5	SS	51									
			6	SS	100	20 cm								16 27 51 6
			7	SS	100	15 cm	97							
96.2	Bedrock Weathered Sound						96							
5.8	Queenston Shale		8	BXL RC	REC 100%		95							RQD 97%
94.0			9	BXL RC	REC 100%		94							RQD 77%
8.0	End of Borehole						93							

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 11

METRIC

W P 83-74-07 LOCATION N 4 799 145 E 278 137 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Augers & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 07 CHECKED BY LSC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
99.5	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel  Hard  Occasional boulders		1	SS	31												
			2	SS	43												
			3	SS	49												
			4	SS	49												
			5	SS	64												
			6	SS	74												
			7	SS	57												
			8	SS	100												
92.8	Bedrock Sound  Queenston Shale		9	BXL RC	REC 98%	15 cm											
6.7							8 cm										
91.4	End of Borehole																
8.1																	

# RECORD OF BOREHOLE No 12

METRIC

W P 83-74-07 LOCATION N 4 799 140 E 277 952 ORIGINATED BY RT  
DIST 4 HWY 403 & GEW BOREHOLE TYPE Solid Stem Auger & BXL Rock Coring COMPILED BY DG  
DATUM Geodetic DATE 85 02 06 - 07 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
101.2	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel		1	SS	20		101										
	clay layer		2	SS	38		100										0 5 46 49
	Very Stiff to Hard		3	SS	66		99										
			4	SS	61		98										
	Occasional Boulders		5	SS	68		97										
			6	SS	59		96										
			7	SS	74/	15 cm	95										
			8	SS	100/	20 cm	94										
94.5	Bedrock						93										
6.7	Weathered Sound		9	BXL RC	REC 97%		92										
	Queenston Shale						91										RQD 77%
91.9	End of Borehole																
9.3																	

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 13

METRIC

W P 83-74-07 LOCATION N 4 799 228 E 277 831 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Auger & BXL Rock Core COMPILED BY DG  
DATUM Geodetic DATE 85 02 06 CHECKED BY 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N' VALUES			SHEAR STRENGTH					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					10 20 30				
104.6	Ground Surface							20	40	60	80	100					
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel		1	SS	17	 15 cm	104										3 19 48 30
	clay layer		2	SS	16		103										
			3	SS	44		102										
	Very Stiff to Hard		4	SS	64		101										
	Occasional boulders		5	SS	81/		100										
	(Glacial Till)		6	SS	74		99										
			7	SS	67		98										
			8	SS	100		97										
97.5	Bedrock		9	SS	100		23 cm	96									
7.1	Weathered Sound		10	BXL RC	REC 95%		95									RQD 41%	
95.2	Queenston Shale																
9.4																	

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 14

METRIC

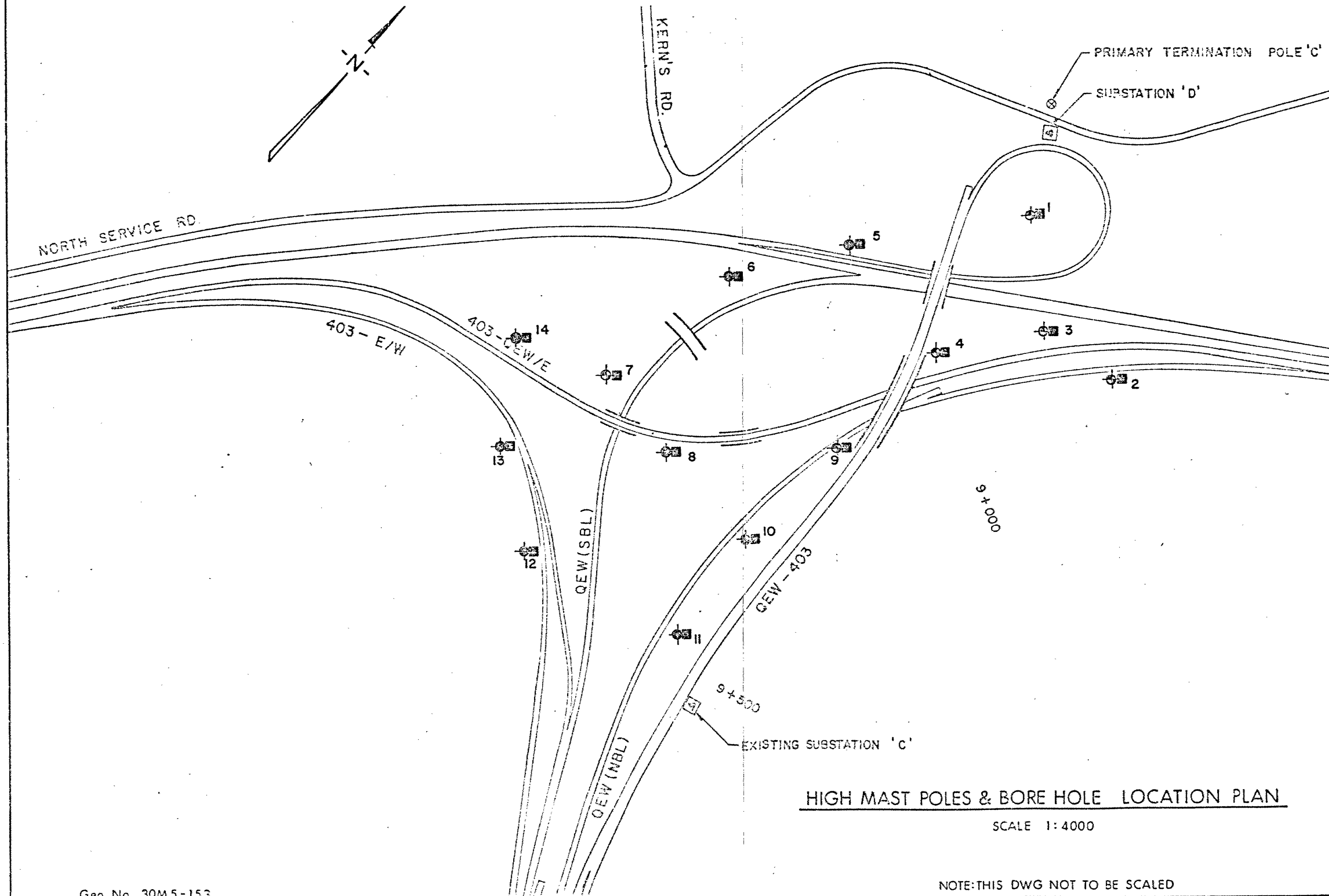
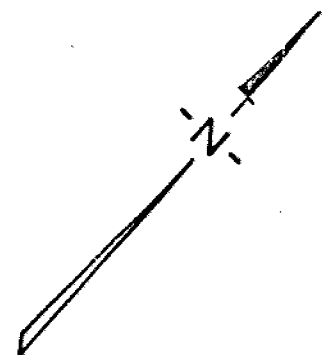
W P 83-74-07 LOCATION N 4 799 323 E 277 708 ORIGINATED BY RT  
DIST 4 HWY 403 & QEW BOREHOLE TYPE Solid Stem Auger & BXL Rock Core COMPILED BY DG  
DATUM Geodetic DATE 85 02 05 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
106.4	Ground Surface																
0.0	Heterogeneous Mixture of Silty Clay Sand, Gravel																
		Silty Clay Layer	1	SS	20												0 2 67 31
			2	SS	13												
			3	SS	17												
		Sand Seam															
			4	SS	52												
	Stiff to Hard (Glacial Till)		5	SS	82												
			6	SS	76	3 cm											13 49 29 9
			7	SS	100	15 cm											
100.6	Bedrock																
5.8	Weathered Sound		8	BXL RC	REC 10%												RQD 51%
98.4	Queenston Shale																
8.0	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10

WP 83-74-07



HIGH MAST POLES & BORE HOLE LOCATION PLAN

SCALE 1:4000

NOTE: THIS DWG NOT TO BE SCALED

