

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-229DIST. CR REGION                     W.P. No. 697-93-00CONT. No. 96-75W. O. No.                     STR. SITE No.                     HWY. No. 410LOCATION H.M.L. - Steeles Ave. to  
Hwy 7 NNo. of PAGES -                     =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     REMARKS:

# **FOUNDATION INVESTIGATION REPORT**

**CONTRACT NO. 96-75**



**Ontario**

**Ministry of  
Transportation**

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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

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**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

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

### 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
$S_t$	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						

# FOUNDATION INVESTIGATION REPORT

For

High Mast Lighting

Hwy 410, Steeles Avenue to Highway 7N

W.P. 697-93-00, Central Region

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## INTRODUCTION

This report presents soil information for the forty-four high mast light poles proposed at the above mentioned site. Soils information was obtained from previous subsurface investigations in the area. This report was produced at the request of Central Region Structural Section.

## SITE CONDITIONS

The site extends 6 km from approximately 600 m north of Steeles Avenue to Highway 7N (Bovaird Drive) in the City of Brampton, Region of Peel.

Land use along this stretch is primarily residential, with the highway corridor essentially isolated from it by a series of earth cuts and embankment fills.

The site is located in the physiographic region known as the Peel Plain that is a characteristically flat to undulating glacial till or boulder clay plain underlain by bedrock of the Dundas-Meaford formation. A partially buried esker east of Highway 410 has been a source of aggregate material in the past.

## SUBSURFACE CONDITIONS

The appended Record of Borehole sheets have been selected from previous projects to represent the soil conditions for this project. In general, the native soil is comprised of competent cohesive and non cohesive deposits of glacial origin. It is underlain by shale bedrock that is present at shallow depths at the south end of the site to approximate Sta 13+000.

The closest boreholes (listed below) should be referred to for the soil conditions and groundwater levels at the HML locations. The elevations indicated on the log sheets may differ from present day elevations.

W.P. No.	BH No.	Northing	Easting	Elevation (m)
WP 21-79-16	21	4 838 659.7	287 358.3	199.3
WP 21-79-16	16	4 838 752.7	287 260.0	199.5
WP 21-79-16	3	4 838 828.0	287 135.5	201.5
WP 21-79-01	5	4 839 232.0	286 778.0	207.9
WP 21-79-02	5	4 839 485.0	286 507.0	214.1
WP 21-79-03	3	4 839 677.4	286 339.1	212.5
WO 73-11115	6	4 839 843.0	286 148.7	216.9
WO 73-11115	9	4 839 974.0	286 021.3	215.1
WO 73-11115	11	4 840 060.6	285 935.9	216.0.
WO 73-11115	14	4 840 192.6	285 809.4	221.9

WO 73-11115	16	4 840 278.5	285 725.6	222.7
WP 21-79-05	5	4 840 447.1	285 617.1	220.2
WP 21-79-05	1	4 840 385.5	285 567.7	221.1
WO 73-11115	22	4 840 547.0	285 466.2	220.6
WP 21-79-06	2	4 841 201.7	284 816.3	231.5
WP 21-79-07	3	4 841 567.0	284 513.0	235.9
WP 21-79-07	6	4 841 560.5	284 467.0	236.7
WP 21-79-08	3	4 841 890.5	284 142.5	243.3
WO 88-11005	1	4 842 416.5	283 670.0	243.4
WP 21-79-09	2	4 842 660.2	283 425.3	245.4

The Record of Borehole Sheets are appended together with a drawing showing the borehole locations.

### MISCELLANEOUS

This report was prepared by B.Bennett, Foundation Engineer, and reviewed and approved by D. Dundas, Senior Foundation Engineer.



*D. Dundas*  
 D. Dundas, P. Eng.  
 Senior Foundation Engineer

## APPENDIX

WP 697-93-00

RECORD OF BOREHOLE No 21

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 659.7; E 287 358.3

ORIGINATED BY DT

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & BXL Rock Core

COMPILED BY DT

DATUM Geodetic DATE 84-01-19, 20

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 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					
199.3	Ground Surface													
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	29									
			2	SS	34									5 15 47 33
			3	SS	27									
			4	SS	34									6 28 51 15
195.0	V. Stiff to Hard		5	SS	26									
4.3	Grey Shale Bedrock		6	SS	100	3cm								
	Weathered Shale randomly interbedded with limestone seams 20-110 mm thick		7	BXL RC	90% REC									RQD = 23%
192.6	Weathered													
6.7	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



**WP 697-93-00** **RECORD OF BOREHOLE No 16** **METRIC**

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 752.7; E 287 260.0 ORIGINATED BY HS

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY DT

DATUM Geodetic DATE 84-01-16 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
199.5	Ground Surface													
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	49	*	199							8 23 52 17
197.5	Hard		2	SS	63		198							
2.0	Grey Shale Bedrock													
197.2	Weathered													
2.3	End of Borehole Refusal to Auger *Note: Water level not observed													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

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

WP 697-93-00

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 828.0; E 287 135.5 ORIGINATED BY DT  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & BXL Rock Core COMPILED BY DT  
DATUM Geodetic DATE 84-01-11, 12 CHECKED BY SP

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			20	40	60	80	100		
201.5	Ground Surface													
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	7		201							12 19 43 26
			2	SS	21		200							
			3	SS	71		199							18 6 51 25
198.6	Firm to Hard													
2.9	Grey Shale Bedrock		4	SS	60	10cm	198							
	Highly Weathered Limestone layer interbedded with shale seams		5	SS	100	15cm	197							RQD = 46%
	Shale with randomly interbedded limestone seams 10-75 mm thick. Highly Weathered		7	BXL RC	62% REC		196							RQD = 13%
			8	BXL RC	100% REC		195							RQD = 63%
193.5	Unweathered						194							
8.0	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



WP 697-93-00

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-01 (FORMERLY) LOCATION Co-ords 4,839,232 N.; 286,778 E. ORIGINATED BY R.M.  
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.  
DATUM Gondetie DATE 1982 07 15 CHECKED BY J.P.L.

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
207.9 0.0	GROUND SURFACE 0.17 m topsoil															
	Brown hard SILTY CLAY some sand trace gravel  (Glacial Till)		1	SS	19											
			2	SS	37											
			3	SS	50/	10 cm										
205.3 2.6	Grey weathered SHALE with hard limestone layers.		4	RC NXL RQD	100% 23%											
			5	RC NXL RQD	100% 30%											
202.1 5.8	END OF BOREHOLE															

OFFICE REPORT ON SOIL EXPLORATION

Hole dry  
before  
coring.  
W.L. 206.7m  
after coring

12 35 37 16

Augering  
↑  
Diamond  
Drilling  
↓

During  
drilling  
steady pres-  
sure and  
water return

WP 697-93-00

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-02 (FORMERLY) LOCATION Co-ords. 4,839,485 N; 286,507 E. ORIGINATED BY NS  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY NS  
DATUM Geodetic DATE 82-07-05 CHECKED BY

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			20	40	60	80	100		
214.11	Ground Level													
0.00	Topsoil		1	SS	5	*	214.00							
0.30	Silty clay, some sand, trace of gravel. (Till)		2	SS	25		213.00							
			3	SS	31		212.00							4 1" 4" 32
	Very Stiff to Hard		4	SS	51		211.00							6 1" 4" 25
	Brown and grey-brown becoming grey at elevation 210.1.		5	SS	36		210.00							
			6	SS	23		209.00							
208.61			7	AS			208.00							
5.50	Shale Bedrock weathered.		8	SS	60/50mm									
207.31														
6.80	End of Borehole. Refusal on Auger.													
	* Groundwater not encountered.													

\*3, \*5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

WP 697-93-00			RECORD OF BOREHOLE No 3				METRIC							
WP 21-79-03 (FORMERLY)			LOCATION Co-ords N 4 839 677.4; E 286 339.1				ORIGINATED BY H.S.							
DIST 6 HWY 410			BOREHOLE TYPE Solid Stem Auger & Rock Core				COMPILED BY T.J.K.							
DATUM Geodetic			DATE 1981 12 08 and 09				CHECKED BY <i>EP</i>							
ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	'N' VALUES			20	40					
212.5	Ground Surface													
0.0	(Glacial Till)						212							
	Silty Clay some sand trace of gravel		1	SS	31		211							0 4 71 25
	Very Stiff to Hard		2	SS	26		210							
	Detached slabs and weathered fragments of shale and limestone		3	SS	72		209							
208.4			4	SS	100	15 cm	208							
4.1	Interbedded soft shales and very hard dolomitic limestone		5	SS	100	13 cm	207							
206.1			6	BX RC	95% REC									
6.4	End of Borehole													
	* Borehole water level after 24 hours													

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

WP697-93-00

RECORD OF BOREHOLE NO 6

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 4 839 843 N, 286 148.7 E

W.P. 134-73-01

BORING DATE March 4, 1974

ORIGINATED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. 55

COMPILED BY V.K.

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BUGS/FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT	WATER CONTENT		
216.9	711.7										
0.0	0.0										
	Silty clay and some sand and traces of gravel and organics		1	SS	14	710					
	Fill Material		2	SS	14	216.4					
213.5	700.7										
3.4	11.0					700					
	Het. Mix. of clayey silt, sand and gravel		3	SS	81	213.4					
	Brown Grey		4	SS	135	2"					
	(Glacial Till)		5	SS	100	690					
208.51	683.9					210.3					
	Hard		6	SS	100	4"					
8.39	27.8					680					
A	End of Borehole					207.3					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

WP 697-93-00

RECORD OF BOREHOLE NO 9

Co-ords. 4 839 974 N, 286 021.3E

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 15,879,180 N., 938,390 E.

ORIGINATED BY V.K.

W.P. 134-73-01

BORING DATE March 1, 1974

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. - 55

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT $w_L$			BULK DENSITY	REMARKS
ELEV. ft.	DEPTH ft.	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE ft./m	BLOWS / FOOT	PLASTIC LIMIT $w_p$	WATER CONTENT $w$	WATER CONTENT %	WATER CONTENT %		
215.1	705.8	Ground Level											
0.0	0.0	Silt with some sand and traces of gravel and clay very dense	1	SS	152								3 35 58 4
213.6	700.8		2	SS	143								W.L. 699.8 213.3
1.5	5.0	Brown Grey Het. mix. of clayey silt, sand and gravel (Glacial Till)	3	SS	100	3"							29 18 38 15
			4	SS	100	5"							
		Hard	5	SS	100	4"							
208.1	682.8												
7.0	23.0	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH				FOUNDATIONS OFFICE							
WP 697-93-00				RECORD OF BOREHOLE NO 11							
JOB 73-11115 (FORMERLY)				LOCATION Co-ords. 4 840 040.6N, 285 935.9 E							
W.P. 134-73-01				BORING DATE February 28, 1974							
DATUM Geodetic				BOREHOLE TYPE Auger and sample with C.M.F. - 55							
				ORIGINATED BY V.K.							
				COMPILED BY V.K.							
				CHECKED BY <u>      </u>							
SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS		
ELEV. m	DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT (C.G. 3m)	ELEV. SCALE			W <sub>L</sub>	W <sub>P</sub>
216.0	0.0	Ground Level									
0.0	0.0	Het. mix. of clayey silts and sand		1	SS	105					
				2	SS	100	200				
		Brown Grey		3	SS	100	213.4				
		Gravel (Glacial Till)		4	SS	100	690				
		Hard					210.3				
207.6	681.3	End of Borehole					680				
8.4	27.5						207.3				

OFFICE REPORT ON SOIL EXPLORATION



DESIGN SERVICES BRANCH <b>WP 697-93-00</b>				<b>RECORD OF BOREHOLE No 14</b>				FOUNDATIONS OFFICE			
JOB 73-11115 (FORMERLY)				LOCATION Co-ords. 4 840 192.6N, 285 809.4E Co-ords. 15,879,897 N., 937,695E.				ORIGINATED BY V.K.			
W.P. 134-73-01				BORING DATE February 27, 1974				COMPILED BY V.K.			
DATUM Geodetic				BOREHOLE TYPE Auger and sample with C.M.E. - 55				CHECKED BY			

SOIL PROFILE			SAMPLES		ELEV. SCALE ft./m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_P$ WATER CONTENT $w$ $w_p \quad w \quad w_L$ WATER CONTENT % 10 20 30	BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH ft./m	DESCRIPTION	STRAT. PLT	NUMBER TYPE	BLOWS (FOOT)					
221.9 0.0	727.9 0.0	Ground Level							
		Clayey Silt to silty clay with some sand and traces of gravel		1 SS 26					
		Fill Material		2 SS 18	720 219.5				
				3 SS 64					9 31 46 14
				4 SS 64	710 216.4				
216.1 5.8	708.9 19.0	Very Stiff to Hard		5 SS 100 5"					14 31 45 10
		Het. Mix. of clayey silt, sand and gravel (Glacial Till)		6 SS 100 7"	700 213.4				w.l. 702.9 214.2
		Grey		7 SS 100 2"					9 27 48 16
211.8 10.1	694.7 33.2	Hard							
		End of Borehole			690 210.3				

OFFICE REPORT ON SOIL EXPLORATION

FOUNDATIONS OFFICE

CHECKED BY [Signature]

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

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 1

METRIC

W P 21-79-05 (FORMERLY) LOCATION Co-ords. N 4 840 385.5; E 285 567.7 ORIGINATED BY V.K.  
DIST 6 HWY 410 BOREHOLE TYPE Continuous Flight Auger - BXL Core COMPILED BY R.Z.  
DATUM Geodetic DATE 74 01 29 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100/28 cm					
221.1	Ground Surface													GR SA SI CL
0.0	Silty Clay of low plasticity with Sand and Gravel Very Stiff to Hard		1	SS	17		220							22 25 41 12
			2	SS	47		218							0 31 55 14
			3	SS	128									
			4	SS	146/	28 cm								
			5	SS	100/	13 cm								
215.9	Brown Grey		6	SS	100/	20 cm	216							
5.2	Grey Silt Some Sand Very Dense		7	SS	100/	13 cm	214							0 23 76 1
			8	SS	106									
212.6	Grey (Glacial Till) Silty Clay, Sand and Varying amounts of Gravel		9	SS	100/	8 cm	212							
	Hard		10	SS	108/	15 cm	210							
			11	SS	100/	5 cm								14 35 41 10
			12	SS	100/	5 cm	208							
206.6	Limestone Bedrock		13	RC BXL REC	92%		206							
204.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-05 (FORMERLY) LOCATION Co-ords. N 4 840 447.1; E 285 617.1 ORIGINATED BY V.K.  
DIST 6 HWY 410 BOREHOLE TYPE Continuous Flight Auger - BXL Core COMPILED BY R.Z.  
DATUM Geodetic DATE 74 01 29 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 (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80	100
								SHEAR STRENGTH								WATER CONTENT (%)	
							○ UNCONFINED	+	FIELD VANE								
							● QUICK TRIAXIAL	x	LAB VANE								
220.2	Ground Level														GR SA SI CL		
0.0	Brown																
	Silty Clay of Low Plasticity With Sand and Gravel		1	SS	45										0 41 46 13		
			2	SS	117										0 23 65 12		
			3	SS	100	15 cm									3 27 54 16		
216.4	Hard		4	SS	135	25 cm											
3.8	Silty Sand With Occ. Layers of Silt		5	SS	118	25 cm											
			6	SS	159	25 cm											
	Dense to Very Dense		7	SS	37										0 85 (15)		
	Brown		8	SS	113												
	Grey																
	Some Gravel		9	SS	166										22 54 (24)		
			10	SS	100	15 cm											
208.3																	
11.9	Grey (Glacial Till)		11	SS	100	8 cm											
	Silty Clay, Sand, Varying Amt's of Gravel																
205.6	Hard																
14.6	Limestone Bedrock		12	BXL RC	67% REC												
203.7	Partly Fractured		13	BXL RC	67% REC												
16.3	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

WP 697-93-00

## RECORD OF BOREHOLE NO 22

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 4840 547.0N, 285 466.2 E

ORIGINATED BY V.K.

W.P. 131-73-01

BORING DATE February 18, 1971

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. - 55

CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

		SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH FT.		DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE			WATER CONTENT % 10    20    30				
m														
220.6	723.6	Ground Level					ELEV. SCALE ft./m							
0.0	0.0	Sandy silt to silty sand with occasional gravel and seams of clay					720							GR SA SI CL
		Very Dense		1	SS	94	219.5							22 35 39 4
		Brown Grey		2	SS	55								
				3	SS	163	710							0 62 ( 38)
				4	SS	166	216.4							0 4 ( 96)
				5	SS	100 1/4"	11"							0 9 81 10
213.9	701.6			6	SS	59								
6.7	22.0	Het. Mix. of clayey silt, sand and gravel (Glacial Till)		7	SS	92	700							0 5 71 24
		Grey		8	SS	50	213.4							
				9	SS	124								0 2 80 18
				10	SS	100 1/4"	690							
				11	SS	100 1/4"	210.3							
208.3	683.1	Hard												
12.3	40.5	End of Borehole					680							
							207.3							

 20  
15 5 % STRAIN AT FAILURE  
10

WP 697-93-00

RECORD OF BOREHOLE No 2

METRIC

W P 21-79-06 (FORMERLY) LOCATION Co-ords N 4 841 201.7; E 284 816.3 ORIGINATED BY HS  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY HS  
DATUM Geodetic DATE 1983 07 18 CHECKED BY EP

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 [%]
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 (%)		
231.5 0.0	Ground Surface													GR SA SI CL
	Silty Clay With Sand Some Gravel Very Stiff to Hard		1	SS	20		230							
			2	SS	35									
228.7 2.8			3	SS	41									18 29 33 20
			4	SS	54		228							
	Silt With Sand Trace Clay Trace Gravel		5	SS	81									6 55 34 5
			6	SS	104	23 cm	226							21 34 40 5
			7	SS	90	13 cm								
224.2 7.3	Very Dense						224							
			8	SS	85	18 cm								11 43 40 6
	Occasional Cobbles or Boulders		9	SS	90	23 cm	222							9 49 35 7
	Sand With Silt Trace Clay Trace Gravel Very Dense		10	SS	90	10 cm	220							
			11	SS	100	14 cm								
217.2 14.3	End of Borehole		12	SS	100	23 cm	218							6 66 24 4

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-07 (FORMERLY)

DIST 6 HWY 410

DATUM Geodetic


LOCATION Co-ords N 4 841 567.0 E 284 513.0

BOREHOLE TYPE Hollow Stem Auger

DATE 83 05 20, 24, 25

ORIGINATED BY R.M.

COMPILED BY H.S.

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
235.9	Ground Surface																
0.0	Silty Clay with Sand some Gravel		1	SS	22											19 36 31 15	
			2	SS	22												7 47 35 11
			3	SS	17												6 30 47 17
			4	SS	51												
			5	SS	105	10cm											
	Very Stiff to Hard		6	SS	45												
			7	SS	49												9 35 42 14
227.4			8	SS	34												
8.5	Sand some Silt trace of Clay trace to some Gravel		9	SS	58												18 64 14 4
			10	SS	14												
			11	SS	17												0 90 9 1
			12	SS	15												
			13	SS	47												
	Compact to Very Dense		14	SS	38												19 64 14 3
			15	SS	42												
214.3	Shale (90%) with occasional Limestone layers		16	RC.													
21.6			16	BXL													
211.9																	
24.0	End of Borehole																

REC. ROD. WEATHERING SLIGHT

89% OX UNWEATHERED

+3, x5: Numbers refer to Sensitivity

WP 697-93-00 RECORD OF BOREHOLE No 6 METRIC

W P 21-79-07 (FORMERLY) LOCATION Co-ords N 4 841 560.5 E 284 467.0 ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Wash Boring COMPILED BY H.S.

DATUM Geodetic DATE 83 05 26, 27, 30 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 (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
236.7	Ground Surface																GR SA SI CL
0.0	Sand with Silt some Gravel Dense		1	SS	31		236										15 51 34 0
234.6			2	SS	36												
2.1	Silty Clay with Sand some Gravel		3	SS	9		234										15 45 29 11
			4	SS	12												
			5	SS	22		232										
			6	SS	38		230										
			7	SS	25												15 19 48 16
			8	SS	33		228										
	Stiff to Hard		9	SS	30		226										12 46 25 17
224.8			10	SS	38		224										4 57 29 10
11.9	Sand some Silt some Gravel trace of Clay		11	SS	65		222										23 67 9 1
			12	SS	30		220										
			13	SS	40		218										21 59 18 2
			14	SS	62		216										20 66 12 2
	Compact to Very Dense		15	SS	23		214										13 64 20 3
			16	SS	62												
	Limestone Boulders		17	RC.													
			18	RC.													
	Gravel with Sand some Silt trace Clay		19	SS	39												50 24 17 9
212.4			20	RC. BXL			212										
24.3	Shale (80% Grey with randomly interbedded Limestone (20%) layers 13 to 75 mm thick		21	RC. BXL			210										
209.6																	
27.1	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



WP 697-93-00

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-08 (FORMERLY) LOCATION Co-ords N 4 841 890.5; E 284 142.5 ORIGINATED BY HS  
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS  
DATUM Geodetic DATE 1983 07 25, 27 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
243.3	Ground Surface													
0.0	Silty Clay With Sand Some Gravel		1	SS	32		242							
			2	SS	6									
	Clay		3	SS	13									
			4	SS	33		240							
	Firm to Very Stiff		5	SS	29									6 29 44 21
			6	SS	31									
238.1							238							
5.2	Sand and Gravel		7	SS	20									61 25 10 4
			8	SS	23		236							1 90 7 2
	Sand Some Silt Trace Clay Trace Gravel		9	SS	42		234							
	Sand and Gravel		10	SS	100		232							68 27 4 1
	Compact to Very Dense		11	SS	22									2 91 6 1
	Sand and Gravel		12	SS	30		230							46 47 6 1
			13	SS	15		228							
226.1			14	SS	26		226							5 71 20 4
17.2	Silty Clay With Sand Some Gravel	Hard	15	SS	100	10 cm	224							
224.4														
18.9	Cobbles or Boulders		16	SS	72		222							5 85 9 1
			17	SS	83									
	Sand and Gravel		18	SS	89		220							56 36 8 0
			19	SS	60		218							0 73 25 2
	Sand Some Silt Trace of Clay Trace of Gravel Very Dense		20	SS	95		216							
			21	SS	96	15 cm								
			22	SS	105	15 cm	214							0 52 45 3
213.1														
30.2														

Continued

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

20  
15 5 (%) STRAIN AT FAILURE  
10

Continued

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 3 Continued METRIC

W P 21-79-08 (FORMERLY) LOCATION Co-ords N 4 841 890.5; E 284 142.5 ORIGINATED BY HS  
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS  
DATUM Geodetic DATE 1983 07 25, 27 CHECKED BY *GP*

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					
213.1	Continued																
30.2	Highly Weathered Grey Shale		23	SS	150	13 cm	212										
211.3																	
32.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 1

METRIC

W/O 88-11005 (FORMERLY)

LOCATION Sta. 16+920; o/s 24.0m Rt of Hwy 410

ORIGINATED BY F.P.

DIST 6 HWY 410

BOREHOLE TYPE Cone Test, Solid-Stem Augers

COMPILED BY F.P.

DATUM Geodetic

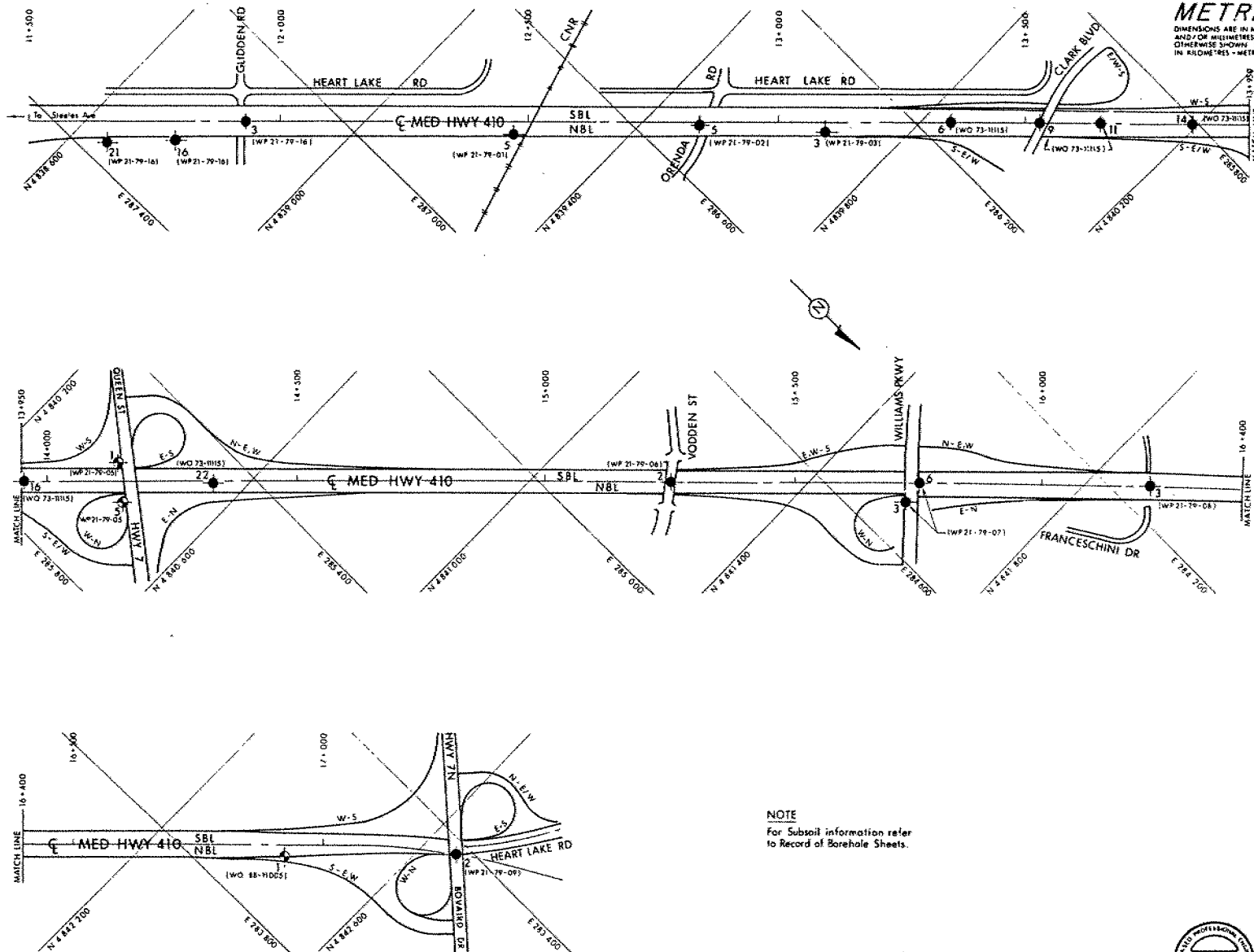
DATE 88 12 13

CHECKED BY D.D.

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						SHEAR STRENGTH kPo
243.4	Asphalt Surface												GR SA SI CL	
242.9	Sand (Fill)													
0.5	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	10	*	Augered						7 31 44 18	
			2	SS	32									
			3	SS	50									
			4	SS	23									
			5	SS	19									
			6	SS	18									
			7	SS	16									
			8	SS	9									
			9	SS	93									
			10	SS	60									
235.7														
7.7	End of Borehole *CWL Not Established													

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00										RECORD OF BOREHOLE No 2										METRIC	
W P 21-79-09 (FORMERLY) LOCATION CO-ORDS N 4 842 660.2 ; E 283 425.3										ORIGINATED BY B.D.											
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger										COMPILED BY B.D.											
DATUM Geodetic DATE 1982 02 11										CHECKED BY C.M.											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>						
245.4	Ground Surface																				
0.0	220 mm TOPSOIL																				
	SILTY CLAY (of low plasticity) to SILT (slightly cohesive) with Sand, trace Gravel (Glacial Till) Very Stiff to Hard		1	SS	20																
			2	SS	37																
			3	SS	39																
241.6			4	SS	160																
3.8																					
	SANDY SILT TO SILTY SAND Brown-Grey Very Dense		5	SS	152																
			6	SS	118																
			7	SS	83																
			8	SS	61																
			9	SS	62																
			10	SS	56																
232.2																					
13.2	Well Graded SAND and GRAVEL trace of Silt (Glacial Till) Very Dense, Grey		11	SS	103																
230.0			12	SS	90	15 cm															
15.4	END OF BOREHOLE																				



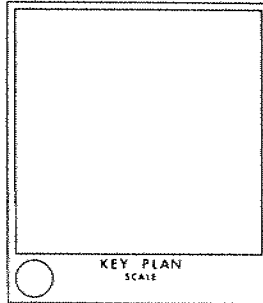
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR KILOMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES - METRES

CONT No  
WP No 697-93-00

H.M.I. POLES ON HWY 410  
(Between Steeles Ave & Hwy 7N)  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



**LEGEND**

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Bore/0.3m (Std Pen Test, 475 J/blow)
- COHE Bore/0.3m (100° Cone, 475 J/blow)
- W/L at time of investigation

FORMERLY	No	ELEVATION	CO-ORDINATES	
			NORTH	EAST
WP 21-79-16	21	199.3	4838 659.7	287 356.3
	16	199.5	4838 752.7	287 260.0
	3	201.3	4838 828.0	287 135.5
WP 21-79-01	5	207.9	4839 232.0	286 778.0
	5	214.1	4839 485.0	286 507.0
	3	212.5	4839 677.4	286 339.1
WP 21-79-02	6	216.9	4839 843.0	286 144.7
	9	215.1	4839 974.3	286 071.3
	11	216.0	4840 060.6	285 935.9
WP 21-79-03	14	221.9	4840 192.6	285 809.4
	16	222.7	4840 278.5	285 725.6
	1	221.1	4840 365.5	285 567.7
WP 21-79-05	5	220.2	4840 447.1	285 617.1
	22	220.6	4840 547.0	285 466.2
	2	231.5	4841 207.7	284 616.3
WP 21-79-06	3	235.9	4841 267.0	284 515.0
	6	236.7	4841 560.5	284 467.0
	3	243.3	4841 890.5	284 142.5
WP 21-79-08	1	243.4	4842 416.5	283 670.0
	2	245.4	4842 660.2	283 425.3

**NOTE**  
For Subsoil information refer  
to Record of Borehole Sheets.

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

**NOTE** The complete foundation investigation and design report for  
this project and other related documents may be examined at the  
Engineering Materials Office. Information contained in  
this report and related documents is specifically excluded in  
accordance with the conditions of Section 2.0 of the O.P.S. Gen. Cond.



**PLANS**  
SCALE  
80m 0 80m

FILE COPY



Ministry  
of  
Transportation

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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

**ENGINEERING MATERIALS OFFICE**  
**FOUNDATION DESIGN SECTION**

*CONT 96-75*

WP 697-93-00 REGION Central  
HWY 410 STR SITE

High Mast Lighting  
Hwy. 410, Steeles Avenue to Highway 7N

**DISTRIBUTION**

V.F. Boehnke (3)  
D. Billings  
S. Lo (2)  
B. Peltier (3)  
M. Holowka  
N. Bot  
F. Bacchus (Cover Only)  
File

GEOCRES 30M12-229

DATE

SEP 19 1996

**FOUNDATION INVESTIGATION REPORT**  
For  
High Mast Lighting  
Hwy 410, Steeles Avenue to Highway 7N  
W.P. 697-93-00, Central Region

## **INTRODUCTION**

This report presents soil information for the forty-four high mast light poles proposed at the above mentioned site. Soils information was obtained from previous subsurface investigations in the area. This report was produced at the request of Central Region Structural Section.

## **SITE CONDITIONS**

The site extends 6 km from approximately 600 m north of Steeles Avenue to Highway 7N (Bovaird Drive) in the City of Brampton, Region of Peel.

Land use along this stretch is primarily residential, with the highway corridor essentially isolated from it by a series of earth cuts and embankment fills.

The site is located in the physiographic region known as the Peel Plain that is a characteristically flat to undulating glacial till or boulder clay plain underlain by bedrock of the Dundas-Meaford formation. A partially buried esker east of Highway 410 has been a source of aggregate material in the past.

## **SUBSURFACE CONDITIONS**

The appended Record of Borehole sheets have been selected from previous projects to represent the soil conditions for this project. In general, the native soil is comprised of competent cohesive and non cohesive deposits of glacial origin. It is underlain by shale bedrock that is present at shallow depths at the south end of the site to approximate Sta 13+000.

The closest boreholes (listed below) should be referred to for the soil conditions and groundwater levels at the HML locations. The elevations indicated on the log sheets may differ from present day elevations.

W.P. No.	BH No.	Northing	Easting	Elevation (m)
WP 21-79-16	21	4 838 659.7	287 358.3	199.3
WP 21-79-16	16	4 838 752.7	287 260.0	199.5
WP 21-79-16	3	4 838 828.0	287 135.5	201.5
WP 21-79-01	5	4 839 232.0	286 778.0	207.9
WP 21-79-02	5	4 839 485.0	286 507.0	214.1
WP 21-79-03	3	4 839 677.4	286 339.1	212.5
WO 73-11115	6	4 839 843.0	286 148.7	216.9
WO 73-11115	9	4 839 974.0	286 021.3	215.1
WO 73-11115	11	4 840 060.6	285 935.9	216.0
WO 73-11115	14	4 840 192.6	285 809.4	221.9



WO 73-11115	16	4 840 278.5	285 725.6	222.7
WP 21-79-05	5	4 840 447.1	285 617.1	220.2
WP 21-79-05	1	4 840 385.5	285 567.7	221.1
WO 73-11115	22	4 840 547.0	285 466.2	220.6
WP 21-79-06	2	4 841 201.7	284 816.3	231.5
WP 21-79-07	3	4 841 567.0	284 513.0	235.9
WP 21-79-07	6	4 841 560.5	284 467.0	236.7
WP 21-79-08	3	4 841 890.5	284 142.5	243.3
WO 88-11005	1	4 842 416.5	283 670.0	243.4
WP 21-79-09	2	4 842 660.2	283 425.3	245.4

The Record of Borehole Sheets are appended together with Drawing No. 6979300-A, showing the borehole locations in plan.

## DISCUSSION AND RECOMMENDATIONS

It is proposed to install forty-four high mast lighting poles (P1 through P44) on Hwy 410, between Steeles Avenue and Highway 7N.

The High Mast Lighting poles will be founded on single reinforced concrete caissons. The foundations for HML should be designed in accordance with the methods described by B.B. Broms in the following two 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.

Broms, B.B.; Lateral Resistance of Piles in Cohesionless Soils,  
Journal of the Soil Mechanics and Foundations Division,  
ASCE, Vol.90, No.SM3, Paper 3909, May 1964.

There are two options for the design of the HML foundations:

### Option 1

Assume that the soil condition at any HML pole location is similar to the soil condition in the borehole logs closest to the proposed HML location. The details of boreholes to be used for design are as follows:

<i>W.P. No.</i>	<i>BH No.</i>	<i>N (metric)</i>	<i>E (metric)</i>	<i>Elevation (m)</i>	<i>Pole</i>
WP 21-79-16	21	4 838 659.7	287 358.3	199.3	P1
WP 21-79-16	16	4 838 752.7	287 260.0	199.5	P2
WP 21-79-16	3	4 838 828.0	287 135.5	201.5	P3, P4
WP 21-79-01	5	4 839 232.0	286 778.0	207.9	P5, P6
WP 21-79-02	5	4 839 485.0	286 507.0	214.1	P7, P8
WP 21-79-03	3	4 839 677.4	286 339.1	212.5	P9, P10
WO 73-11115	6	4 839 843.0	286 148.7	216.9	P11
WO 73-11115	9	4 839 974.0	286 021.3	215.1	P12
WO 73-11115	11	4 840 060.6	285 935.9	216.0	P13
WO 73-11115	14	4 840 192.6	285 809.4	221.9	P14
WO 73-11115	16	4 840 278.5	285 725.6	222.7	P15
WP 21-79-05	5	4 840 447.1	285 617.1	220.2	P16, P18
WP 21-79-05	1	4 840 385.5	285 567.7	221.1	P17, P19
WO 73-11115	22	4 840 547.0	285 466.2	220.6	P20, P21, P22, P23, P24
WP 21-79-06	2	4 841 201.7	284 816.3	231.5	P25, P26, P27
WP 21-79-07	3	4 841 567.0	284 513.0	235.9	P28, P29, P30
WP 21-79-07	6	4 841 560.5	284 467.0	236.7	P31, P32
WP 21-79-08	3	4 841 890.5	284 142.5	243.3	P33, P34, P35, P36, P37
WO 88-11005	1	4 842 416.5	283 670.0	243.4	P38, P39, P40
WP 21-79-09	2	4 842 660.2	283 425.3	245.4	P41, P42, P43, P44

Use the following soil parameters to design the HML foundations:

*Non-Cohesive Soil Layers:*

$\phi$  = Angle of Internal Friction =  $32^\circ$   
 $\gamma$  = Unit Weight =  $21.2 \text{ kN/m}^3$   
Water Level = As shown on the log sheet closest to the HML location.

*Cohesive Soil Layers:*

$Q_u$  = Unconfined Compressive Strength =  $200 \text{ kPa}$   
 $\gamma$  = Unit Weight =  $20.5 \text{ kN/m}^3$   
Water Level = As shown on the log sheet closest to the HML location.

*Shale Bedrock:*

$Q_u$  = Unconfined Compressive Strength =  $750 \text{ Kpa}$   
 $\gamma$  = Unit Weight =  $22.5 \text{ kN/m}^3$   
Water Level = As shown on the log sheet closest to the HML location.

For any existing fill overlying the native soil following parameters should be used taking into consideration that only half of the fill height would provide lateral support:

$\phi$  =  $30^\circ$   
 $\gamma$  =  $20 \text{ kN/m}^3$

It should be assumed that soil in the zone of frost penetration does not provide any lateral resistance. The depth of frost penetration at this site is 1.2m.

Option 2

If the project schedule does not permit for a detailed design of the foundation using soil parameters, then all the caisson foundations could be designed to be 8m deep, at the discretion of the designer.

**Construction Considerations**

It is recommended that a non-standard special provision for the construction of HML foundations, be incorporated in the contract. A copy of the latest NSSP is appended to this report.

## MISCELLANEOUS

This report was prepared by B. Bennett, Foundation Engineer, and reviewed and approved by D. Dundas, Senior Foundation Engineer.



*B. Bennett*

B. Bennett, P. Eng.  
Foundation Engineer



*D. Dundas*

D. Dundas, P. Eng.  
Senior Foundation Engineer

## APPENDIX

## **Non Standard Special Provision**

**Item Description:** Concrete Footing for High Mast Light Poles

---

### **Construction**

The Contractor is advised that variable types of subsurface material may be encountered at the high mast light pole locations; for additional information regarding soil conditions the Contractor is referred to the Foundation Investigation Report.

For bidding purposes it may be assumed that:

- Ground water is at or near the surface.
- If cohesionless material is encountered, it would be susceptible to disturbance under conditions of unbalanced hydrostatic head.
- If glacial deposits are encountered, there is a probability that occasional cobbles and boulders may be encountered within the deposit.

The Contractor is responsible for constructing the high mast pole foundations without disturbing the material at the sides or bases of the foundations.

A professional engineer, experienced in caisson installation shall be retained by the Contractor to certify that the subsurface conditions encountered during construction of the caissons reflect those identified in the Foundation Investigation Report. Any discrepancies shall be reported to the Contract Administrator.

The base of the caissons shall be cleaned of loose or soft materials and inspected prior to pouring concrete. Caisson inspection shall be carried out and approved by a professional engineer as outlined above. Complete documentation of the inspection and installation of each caisson shall be maintained and submitted to the Contract Administrator.

### **Basis of Payment**

Payment at the contract price for the above tender item shall be full compensation for all labour, equipment and materials required to do the work.

WP 697-93-00

RECORD OF BOREHOLE No 21

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 659.7; E 287 358.3

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & BXL Rock Core

DATUM Geodetic DATE 84-01-19, 20

ORIGINATED BY DT

COMPILED BY DT

CHECKED BY *AP*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
199.3	Ground Surface																
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	29												
			2	SS	34											5 15 47 33	
			3	SS	27												
			4	SS	34											6 28 51 15	
195.0	V. Stiff to Hard		5	SS	26												
4.3	Grey Shale Bedrock		6	SS	100/3cm												
	Weathered Shale randomly interbedded with limestone seams 20-110 mm thick		7	BXL RC	90% REC											RQD = 23%	
192.6	Weathered																
6.7	End of Borehole																

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



WP 697-93-00

RECORD OF BOREHOLE No 16

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 752.7; E 287 260.0  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger  
DATUM Geodetic DATE 84-01-16  
ORIGINATED BY HS  
COMPILED BY DT  
CHECKED BY CP

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					
199.5	Ground Surface																
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	49	*	199										8 23 52 17
197.5	Hard		2	SS	63		198										
2.0	Grey Shale Bedrock																
197.2	Weathered																
2.3	End of Borehole Refusal to Auger *Note: Water level not observed																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10





WP 697-93-00

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-16 (FORMERLY) LOCATION Co-ords. N 4 838 828.0; E 287 135.5 ORIGINATED BY DT  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & BXL Rock Core COMPILED BY DT  
DATUM Geodetic DATE 84-01-11, 12 CHECKED BY SP

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
201.5	Ground Surface																GR SA SI CL
0.0	Heterogeneous Mixture Silty Clay Trace to Some Sand, Gravel (Glacial Till)		1	SS	7		201										12 19 43 26
			2	SS	21		200										
			3	SS	71		199										18 6 51 25
198.6	Firm to Hard																
2.9	Grey Shale Bedrock		4	SS	60	10cm	198										
	Highly Weathered Limestone layer interbedded with shale seams		5	SS	100	15cm	197										RQD = 46%
	Shale with randomly interbedded limestone seams 10-75 mm thick. Highly Weathered		6	BXL RC	100% REC		196										RQD = 13%
			7	BXL RC	62% REC		195										
			8	BXL RC	100% REC		194										RQD = 63%
193.5	Unweathered																
8.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

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

20  
15 5 (%) STRAIN AT FAILURE  
10



Highway Engineering Division  
Engineering Materials Office - Soil Mechanics Section

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

WP 697-93-00				RECORD OF BOREHOLE No 5				METRIC							
W P 21-79-01 (FORMERLY) LOCATION Co-ords 4,839,232 N.; 286,778 E.				ORIGINATED BY R.H.											
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core				COMPILED BY R.H.											
DATUM Geodetic DATE 1982 07 15				CHECKED BY J.P.L.											
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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER			TYPE	'N' VALUES	20	40	60					
207.9 0.0	GROUND SURFACE 0.17 m Topsoil														
	Brown hard SILTY CLAY some sand trace gravel (Glacial Till)		1	SS	19									21.1	Hole dry before coring. W.L. 206.7m after coring
			2	SS	37										12 35 37 16
205.3 2.6			3	SS	50/	10 cm									Augering ↑ Diamond Drilling ↓
	Grey weathered SHALE with hard limestone layers.		4	RC	100%										During drilling steady pressure and water return
				NXL	23%										
			5	RC	100%										
				NXL	30%										
202.1 5.8	END OF BOREHOLE														

OFFICE REPORT ON SOIL EXPLORATION

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

WP 697-93-00

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-02 (FORMERLY) LOCATION Co-ords. 4,839,485 N; 286,507 E. ORIGINATED BY NS  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY NS  
DATUM Geodetic DATE 82-07-05 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
214.11	Ground Level																GR SA SI CL
0.00	Topsoil		1	SS	5	*	214.00							0			
0.50	Silty clay, some sand, trace of gravel. (Till)		2	SS	25		213.00							0			
			3	SS	31		212.00							0			4 17 47 32
	Very Stiff to Hard		4	SS	51		211.00							0			6 17 48 29
	Brown and grey-brown becoming grey at elevation 210.1.		5	SS	36		210.00							0			
			6	SS	25		209.00							0			
208.61			7	AS			208.00							0			
5.50	Shale Bedrock weathered.		8	SS	60/50mm									0			
207.51																	
6.80	End of Borehole. Refusal on Auger.																
	* Groundwater not encountered.																

\*3, \*5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

WP 697-93-00

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-03 (FORMERLY) LOCATION Co-ords N 4 839 677.4; E 286 339.1 ORIGINATED BY H.S.  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger & Rock Core COMPILED BY T.J.K.  
DATUM Geodetic DATE 1981.12.08 and 09 CHECKED BY *GP*

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					
212.5	Ground Surface																
0.0	(Glacial Till)																
	Silty Clay some sand trace of gravel		1	SS	31												
	Very Stiff to Hard		2	SS	26												
	Detached slabs and weathered fragments of shale and limestone		3	SS	72												
			4	SS	100	15 cm											
208.4																	
4.1	Interbedded soft shales and very hard dolomitic limestone		5	SS	100	13 cm											
			6	BX RC	95% REC												
206.1																	
6.4	End of Borehole																
	* Borehole water level after 24 hours																

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH

WP697-93-00

RECORD OF BOREHOLE NO 6

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 15,878,750 N, 938,808 E

W.P. 134-73-01

BORING DATE March 4, 1974

ORIGINATED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. 55

COMPILED BY V.K.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft/m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ $w$ $w_L$				BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				WATER CONTENT % 10 20 30 40					
216.9 0.0	711.7 0.0	Ground Level				710										
		Silty clay and some sand and traces of gravel and organics		1	SS	14	216.4									
		Fill Material														
213.5 3.4	700.7 11.0	Stiff		2	SS	14									0 16 57 27	
		Het. Mix. of clayey silt, sand and gravel				700									w.l.	
				3	SS	81	213.4								701.3 (213.8)	
		Brown clayey		4	SS	135/2"									23 13 40 24	
		(Glacial Till)				690										
208.51 8.39	683.9 27.8	Hard		5	SS	100/6"	210.3								0 32 46 22	
		End of Borehole		6	SS	100/4"										
						680										
						207.3										

20  
15 5 % STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

WP 697-93-00

RECORD OF BOREHOLE NO 9

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 4 839 974 N, 286 021.3 E

W.P. 134-73-01

BORING DATE March 1, 1974

ORIGINATED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. - 55

COMPILED BY V.K.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft/m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT (0.3 in)		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT % $w_p$ — $w$ — $w_L$ 10 20 30			
215.1 0.0	705.8 0.0	Ground Level										
213.6	700.8	Silt with some sand and traces of gravel and clay very dense	1	SS	152	700						3 35 58 4
1.5	5.0	Brown Grey Het. mix. of clayey silt, sand and gravel (Glacial Till)	2	SS	143	213.4						▼ w.l. = 699.8 213.3
			3	SS	100	690						29 18 38 15
			4	SS	100	210.3						
		Hard	5	SS	100	207.3						
208.1	682.8											
7.0	23.0	End of Borehole				680 207.3						

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

WP 697-93-00

RECORD OF BOREHOLE NO 11

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION

Co-ords. 4 840 060.6N, 285 935.9 E  
Co-ords. 15,879,464 N., 938,110 E.

ORIGINATED BY V.K.

W.P. 134-73-01

BORING DATE

February 28, 1974

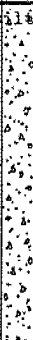
COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE

Auger and sample with C.M.E. - 55

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft/m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT 0-30		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT % $w_p$ $w$ $w_L$ 10 20 30				
216.0 0.0	708.8 0.0	Ground Level												
		Het. mix. of clayey silts sand and  Brown Grey  Gravel (Glacial Till)  Hard		1	SS	105								
				2	SS	100	700 213.4							
				3	SS	100	"							
				4	SS	100	690 210.3							
207.6 8.4	681.3 27.5	End of Borehole				680 207.3								

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH										FOUNDATIONS OFFICE									
WP 697-93-00										RECORD OF BOREHOLE NO 14									
JOB 73-11115 (FORMERLY)										LOCATION Co-ords. 4. 840 192.6N, 285 809.4E									
W.P. 134-73-01										BORING DATE February 27, 1974									
DATUM Geodetic										BOREHOLE TYPE Auger and sample with C.M.E. - 55									
ORIGINATED BY V.K.										COMPILED BY V.K.									
CHECKED BY																			
SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		PLASTIC LIMIT		WATER CONTENT		BULK DENSITY		REMARKS				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	W <sub>p</sub>	W <sub>L</sub>	W <sub>p</sub>	W <sub>L</sub>	W <sub>p</sub>	W <sub>L</sub>	γ	P.C.F.	GR.SA.SI.CL.			
221.9	Ground Level																		
0.0	0.0		1	SS	26														
	Fill Material		2	SS	18	720													
			3	SS	64	219.5													
			4	SS	64	710													
216.1	708.9		5	SS	100	216.4													
5.8	19.0		6	SS	100	700													
	Het. Mix. of clayey silt, sand and gravel (Glacial Till)		7	SS	100	213.4													
	Grey																		
211.8	694.7																		
10.1	33.2																		
	End of Borehole					690													
						210.3													

20  
15 5 % STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



MINISTRY OF TRANSPORT AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH

WP 697-93-00

RECORD OF BOREHOLE NO 16

FOUNDATIONS OFFICE

JOB 73-11115 (FORMERLY)

LOCATION Co-ords. 4 840 278.5 N, 285 125.6 E  
Co-ords. 15,880,179 N., 937,420 E.

ORIGINATED BY V.K.

W.P. 134-73-01

BORING DATE February 26, 1974

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Auger and sample with C.M.E. - 55

CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$	REMARKS	
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE ft./m	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT % $w_p$ $w$ $w_L$			
222.7	730.6	Ground Level				720								
0.0	0.0	Clayey Silt with some sand and traces of gravel and organics		1	SS	15	222.9							
		Fill Material		2	SS	15	720							6 26 50 18
				3	SS	22	219.5							
217.2	712.6	Very Stiff		4	SS	58	710							15 25 44 16
5.5	18.0	Silt with some sand and traces of gravel and clay		5	SS	100	216.1							w.l. 711.6 217.0
214.8	704.6	Grey Hard		6	SS	105	700							3 80 (.17)
7.9	26.0	Sand with traces of silt and gravel		7	SS	132	213.1							
		Grey		8	SS	100	690							
209.5	687.3	Very Dense		9	SS	100	210.3							
13.2	43.3	End of Borehole					680							
							207.3							

20  
15 5 % STRAIN AT FAILURE  
10



Ministry of  
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WP 697-93-00

RECORD OF BOREHOLE No 1

METRIC

W P 21-79-05 (FORMERLY) LOCATION Co-ords. N 4 840 385.5; E 285 567.7

ORIGINATED BY V.K.

DIST 6 HWY 410 BOREHOLE TYPE Continuous Flight Auger - EXL Core

COMPILED BY R.Z.

DATUM Geodetic DATE 74 01 29

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
221.1	Ground Surface													GR SA SI CL
0.0	Silty Clay of low plasticity with Sand and Gravel Very Stiff to Hard		1	SS	17		220							22 25 41 12
			2	SS	47									
			3	SS	128									
			4	SS	146/	28 cm	218	100/28 cm						0 31 55 14
			5	SS	100/	13 cm								
215.9	Brown Grey		6	SS	100/	20 cm	216							
5.2	Grey Silt Some Sand Very Dense		7	SS	100/	13 cm	214							0 23 76 1
			8	SS	106									
212.6														
8.5	Grey (Glacial Till) Silty Clay, Sand and Varying amounts of Gravel		9	SS	100/	8 cm	212							
	Hard		10	SS	108/	15 cm	210							
			11	SS	100/	5 cm								14 35 41 10
							208							
206.6			12	SS	100/	5 cm								
14.3	Limestone Bedrock		13	RC EXL REC	922 REC		206							
204.6														
16.9	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

WP 697-93-00

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-05 (FORMERLY) LOCATION Co-ords. N 4 840 447.1; E 285 617.1 ORIGINATED BY V.K.  
DIST 6 HWY 410 BOREHOLE TYPE Continuous Flight Auger - BXL Core COMPILED BY R.Z.  
DATUM Geodetic DATE 74 01 29 CHECKED BY *EP*

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
220.2	Ground Level															
0.0	brown															
	Silty Clay of Low Plasticity With Sand and Gravel		1	SS	45											
			2	SS	117											
			3	SS	100	15 cm										
216.4	Hard		4	SS	135	25 cm										
3.8			5	SS	118	25 cm										
	Silty Sand With Occ. Layers of Silt		6	SS	159	25 cm										
	Dense to Very Dense		7	SS	37											
	Brown Grey		8	SS	113											
	Some Gravel		9	SS	166											
			10	SS	100	15 cm										
208.3																
11.9	Grey (Glacial Till)		11	SS	100	8 cm										
	Silty Clay, Sand, Vary- ing Amt's of Gravel															
205.6	Hard															
14.6	Limestone Bedrock		12	BXL RC	67% REC											
203.7	Partly Fractured		13	BXL RC	67% REC											
16.3	End of Borehole															

3, x 5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

15  $\frac{20}{10}$  5 % STRAIN AT FAILURE



WP 697-93-00

RECORD OF BOREHOLE No 2

METRIC

W P 21-79-06 (FORMERLY) LOCATION Co-ords N 4 841 201.7; E 284 816.3

ORIGINATED BY HS

DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Augers

COMPILED BY HS

DATUM Geodetic DATE 1983 07 18

CHECKED BY SP

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					
231.5	Ground Surface																GR SA SI CL
0.0	Silty Clay With Sand Some Gravel Very Stiff to Hard		1	SS	20		230										
			2	SS	35												
228.7			3	SS	41												18 29 33 20
2.8			4	SS	54		228										6 55 34 5
	Silt With Sand Trace Clay Trace Gravel		5	SS	81												21 34 40 5
			6	SS	104	23 cm	226										
			7	SS	90	13 cm											
224.2	Very Dense						224										11 43 40 6
7.3			8	SS	85	18 cm											
	Occasional Cobbles or Boulders		9	SS	90	23 cm	222										9 49 35 7
	Sand With Silt Trace Clay Trace Gravel Very Dense		10	SS	90	10 cm	220										
			11	SS	100	14 cm											
217.2							218										
			12	SS	100	23 cm											6 66 24 4
14.3	End of Borehole																

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

20  
15  
10  
5  
[%] STRAIN AT FAILURE

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RECORD OF BOREHOLE No 3

METRIC

W P 21-79-07 (FORMERLY) LOCATION Co-ords N 4 841 567.0 E 284 513.0 ORIGINATED BY R.M.  
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY H.S.  
DATUM Geodetic DATE 83 05 20, 24, 25 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
235.9	Ground Surface															GR SA SI CL
0.0			1	SS	22		234									19 36 31 15
	Silty Clay with Sand some Gravel		2	SS	22											7 47 35 11
			3	SS	17											6 30 47 17
			4	SS	51											
			5	SS	106	10cm										
			6	SS	45											
	Very Stiff to Hard		7	SS	49		228									9 35 42 14
227.4			8	SS	34		226									
8.5	Sand some Silt trace of Clay trace to some Gravel		9	SS	58											18 64 14 4
			10	SS	14		224									
			11	SS	17		222									0 90 9 1
	Compact to Very Dense		12	SS	15		220									
			13	SS	47		218									
			14	SS	38		216									19 64 14 3
			15	SS	42											
214.3							214									
21.6																
	Shale (90%) with occasional Limestone layers		16	BXL			212									
211.9																
24.0	End of Borehole															

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

20  
15  
10

(%) STRAIN AT FAILURE

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# RECORD OF BOREHOLE No 6

METRIC

W P 21-79-07 (FORMERLY) LOCATION Co-ords N 4 841 560.5 E 284 467.0  
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Wash Boring  
DATUM Geodetic DATE 83 05 26, 27, 30

ORIGINATED BY R.M.  
COMPILED BY H.S.  
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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
236.7	Ground Surface																
0.0	Sand with Silt some Gravel Dense		1	SS	31		236										15 51 34 0
234.6			2	SS	36												
2.1	Silty Clay with Sand some Gravel		3	SS	9		234										15 45 29 11
			4	SS	12												
			5	SS	22		232										
			6	SS	38		230										
			7	SS	25												15 19 48 18
			8	SS	33		228										
	Stiff to Hard		9	SS	30		226										12 46 25 17
224.8			10	SS	38		224										4 57 29 10
11.9	Sand some Silt some Gravel trace of Clay		11	SS	65		222										23 67 9 1
			12	SS	30		220										
			13	SS	40		218										21 59 18 2
			14	SS	62												20 66 12 2
	Compact to Very Dense		15	SS	23		216										13 64 20 3
			16	SS	62												
	Limestone Boulders		17	RC			214	REC	RQD	Weathering							
			18	RC				38%	15%	Unweathered							
	Gravel with Sand some Silt trace Clay		19	SS	39			88%	0%								50 24 17 9
212.4							212	94%	39%	Slight							
24.3	Shale (80% Grey with randomly interbedded Limestone (20%) Layers 13 to 75 mm thick		20	RC						Unweathered							
209.6			21	RC				97%	39%								
27.1	End of Borehole						210										

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



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RECORD OF BOREHOLE No 3

METRIC

W P 21-79-08 (FORMERLY) LOCATION Co-ords N 4 841 890.5; E 284 142.5 ORIGINATED BY HS  
DIST 5 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS  
DATUM Geodetic DATE 1983 07 25. 27 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
243.3	Ground Surface							○ UNCONFINED + FIELD VANE		10 20 30			GR SA SI CL	
0.0	Silty Clay With Sand Some Gravel		1	SS	32		242							
			2	SS	6									
	Clay		3	SS	13									
	Firm to Very Stiff		4	SS	33		240						6 29 44 21	
			5	SS	29									
238.1			6	SS	31									
5.2							238							
	Sand and Gravel		7	SS	20								61 25 10 4	
							236							
	Sand Some Silt Trace Clay Trace Gravel		8	SS	23								1 90 7 2	
			9	SS	42		234							
	Sand and Gravel		10	SS	100								68 27 4 1	
	Compact to Very Dense		11	SS	22		232						2 91 6 1	
							230							
	Sand and Gravel		12	SS	30								46 47 6 1	
			13	SS	15		228							
226.1			14	SS	26								5 71 20 4	
17.2	Silty Clay With Sand Some Gravel	Hard	15	SS	100	10 cm	226							
224.4							224							
18.9	Cobbles or Boulders		16	SS	72								5 85 9 1	
			17	SS	83		222							
	Sand and Gravel		18	SS	89		220						56 36 8 0	
			19	SS	60		218						0 73 25 2	
	Sand Some Silt Trace of Clay Trace of Gravel Very Dense		20	SS	95									
			21	SS	96	15 cm	216							
			22	SS	105	15 cm	214						0 52 45 3	
213.1														

30.2

Continued

\*3, x5: Numbers refer to  
Sensitivity

20  
15-25 (%) STRAIN AT FAILURE  
10

Continued



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RECORD OF BOREHOLE No 3 Continued

METRIC

W P 21-79-08 (FORMERLY) LOCATION Co-ords N 4 841 890.5: E 284 142.5 ORIGINATED BY HS  
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS  
DATUM Geodetic DATE 1983 07 25, 27 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					
213.1	Continued																
30.2	Highly Weathered Grey Shale		23	SS	150	13 B	212										
211.3																	
32.0	End of Borehole																

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

20  
15 5 (%) STRAIN AT FAILURE  
10

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RECORD OF BOREHOLE No 1  
CO-ORDS: N 4842 416.5; E 283 670.0

METRIC

WO 88-11005 (FORMERLY) LOCATION Sta. 16+920; o/s 24.0m Rt of Hwy 410 &  
DIST 6 HWY 410 BOREHOLE TYPE Cone Test, Solid-Stem Augers ORIGINATED BY F.P.  
DATUM Geodetic DATE 88 12 13 COMPILED BY F.P.  
CHECKED BY D.D.

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100
								SHEAR STRENGTH kPa							WATER CONTENT (%)		
243.4	Asphalt Surface																
242.9	Sand (Fill)																
0.5	Heterogeneous Mixture of Clayey Silt, Sand and Gravel  (Glacial Till) Stiff to Hard		1	SS	10	*											
			2	SS	32												
			3	SS	50												
			4	SS	23												
			5	SS	19												
			6	SS	18												
			7	SS	16												
			8	SS	9												
			9	SS	93												
235.7			10	SS	60/8cm												
7.7	End of Borehole *GWL Not Established																

OFFICE REPORT ON SOIL EXPLORATION



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# RECORD OF BOREHOLE No 2

METRIC

W P 21-79-09 (FORMERLY) LOCATION CO-ORDS N 4 842 660.2; E 283 425.3

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY B.D.

DATUM Geodetic

DATE 1982 02 11

COMPILED BY B.D.

CHECKED BY C.M.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
245.4	Ground Surface											
0.0	220 mm TOPSOIL											
	SILTY CLAY (of low plasticity) to SILT (slightly cohesive) with Sand, trace Gravel (Glacial Till) Very Stiff to Hard		1	SS	20							
			2	SS	37							
			3	SS	39							
			4	SS	160							
241.6												
3.8			5	SS	152							
	SANDY SILT TO SILTY SAND Brown - Grey Very Dense		6	SS	118							
			7	SS	83							
			8	SS	61							
			9	SS	62							
			10	SS	56							
232.2												
13.2	Well Graded SAND and GRAVEL trace of Silt (Glacial Till) Very Dense, Grey		11	SS	103							
230.0												
15.4	END OF BOREHOLE		12	SS	90	15 cm						

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

## 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

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

### STRESS AND STRAIN

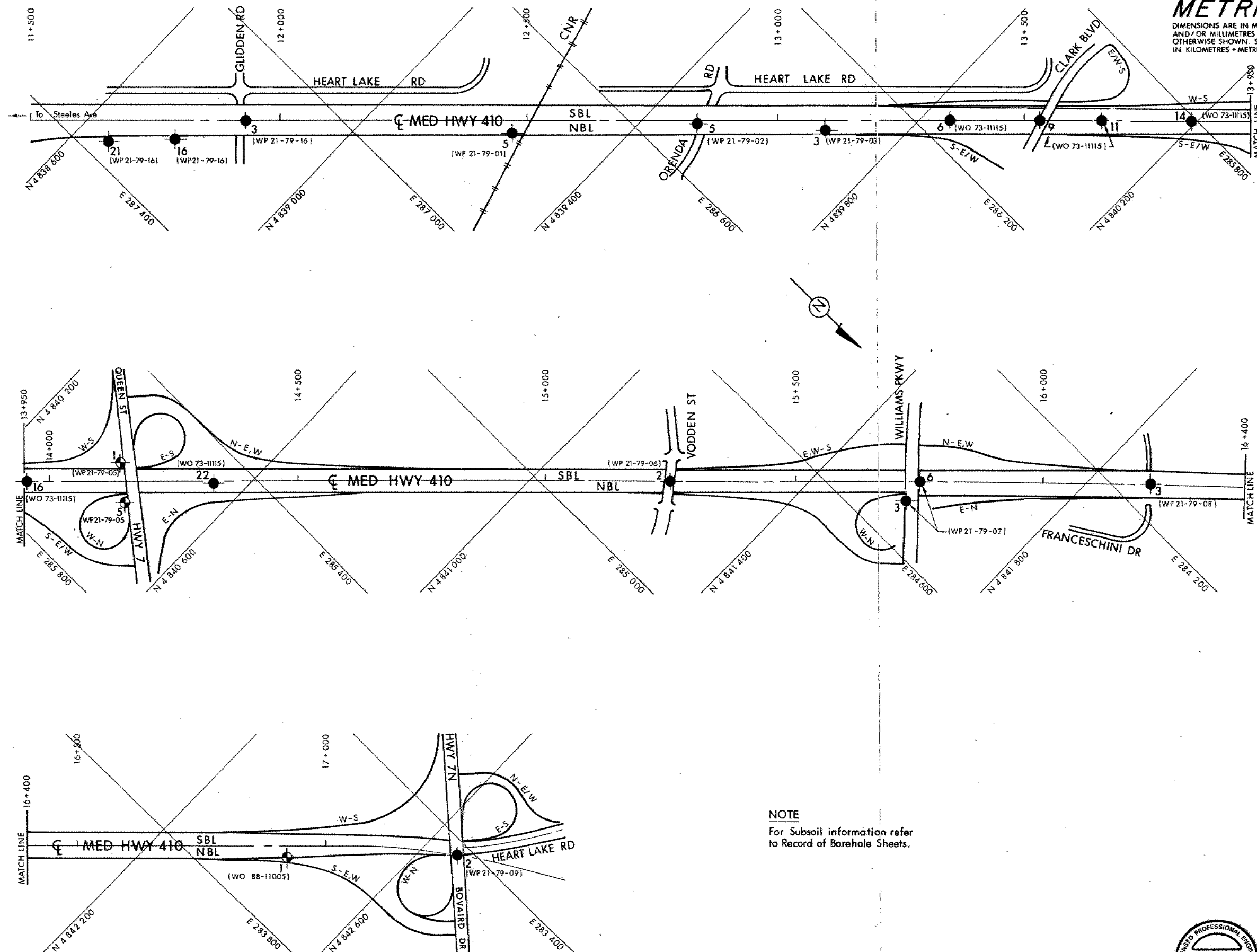
$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS 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
$S_t$	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
$\rho$	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 = $\frac{w_L - w_p}{I_p}$	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						



PLANS

SCALE

80m 0 80m

## NOTE

For Subsoil information refer to Record of Borehole Sheets.

METRIC

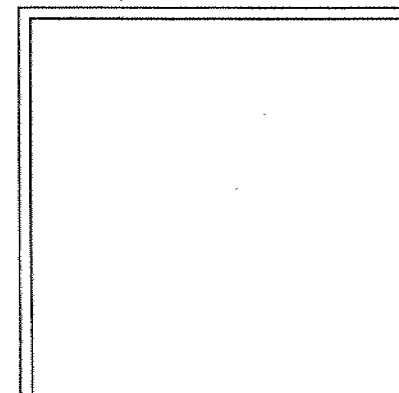
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 697-93-00

HML POLES ON HWY 410  
(Between Steeles Ave & Hwy 7N)  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN  
SCALE

## LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation

FORMERLY	No	ELEVATION	CO-ORDINATES	
			NORTH	EAST
WP 21-79-16	21	199.3	4838 659.7	287 358.3
	16	199.5	4838 752.7	287 260.0
	3	201.5	4838 828.0	287 135.5
WP 21-79-01	5	207.9	4839 232.0	286 778.0
WP 21-79-02	5	214.1	4839 485.0	286 507.0
WP 21-79-03	3	212.5	4839 677.4	286 339.1
	6	216.9	4839 843.0	286 148.7
	9	215.1	4839 974.0	286 021.3
WO 73-11115	11	216.0	4840 060.6	285 935.9
	14	221.9	4840 192.6	285 809.4
	16	222.7	4840 278.5	285 725.6
WP 21-79-05	1	221.1	4840 385.5	285 567.7
	5	220.2	4840 447.1	285 617.1
WO 73-11115	22	220.6	4840 547.0	285 466.2
WP 21-79-06	2	231.5	4841 201.7	284 816.3
WP 21-79-07	3	235.9	4841 567.0	284 513.0
	6	236.7	4841 560.5	284 467.0
WP 21-79-08	3	243.3	4841 890.5	284 142.5
WO 88-11005	1	243.4	4842 416.5	283 670.0
WP 21-79-09	2	245.4	4842 660.2	283 425.3

## NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV	DATE	BY	DESCRIPTION
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Geocres No 30M12-229

HWY No 410	DIST CR
SUBMD B B	CHECKED 96 DATE 1996 09 11 SITE
DRAWN R S	CHECKED 97 APPROVED DWG 6979300-A

