

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30MB-79

DIST. 6 REGION

W.P. No. 164-79-06

CONT. No. 88-79

W. O. No.

STR. SITE No.

HWY. No. 400

LOCATION High Mast Lighting  
between Hwy 401 & 407 (East Hwy 400)

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

TAE!

B.H. IS NOT  
BACK FILLED. GET  
A STABLE ▼ AND  
THEN BACK FILL IT!

JAN.

# RECORD OF BOREHOLE No C-15(C-24-9) METRIC

WP 164-79-06

LOCATION Co-ords: N 4 848 771 ; E 301 945

ORIGINATED BY JF

DIST 6 HWY 400

BOREHOLE TYPE Solid Stem Auger/Cone Test

COMPILED BY TCK

DATUM Geodetic

DATE 88 08 19

CHECKED BY TCK

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>	UNIFORMITY COEFFICIENT U <sub>c</sub>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
190.8	Ground Level																
0.0	TOP SOIL																
190.2			1	LASKY SAMPLE													
0.6			2	SS	31												
	Clayey silt to silt																
	Some sand																
	Trace gravel																
	Stiff to Hard																
	(Glacial Till)																
185.2			4	SS	82												
5.6																	
	Silt with sand																
	Trace of gravel																
	O.C. Clayey silt layers																
	Compact to V. Dense																
	(Glacial Till)																
182.3																	
8.5																	
	Heterogeneous mixture																
	of silt, sand and gravel																
	Very dense																
	(Glacial Till)																
179.9																	
10.9	END OF BOREHOLE																

# RECORD OF BOREHOLE No C-7 (C-32-6) METRIC

W.P. 164-79-06

LOCATION C-7 only: N 4 847 780; E 302 046.5

ORIGINATED BY PD

DIST 6 HWY 400

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY TCK

DATUM Geodetic

DATE 88 12 06

CHECKED BY TCK

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>	UNSATURATED WATER CONTENT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) (GR SA SI CL)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	VALUES		20	40	60	80	100					
189.6 0.0	Ground Level															
5	Clayey silt to silt		1	SS	21											0 19 51 30
	Some Sand		2	SS	16											
10	Trace Gravel Brown Grey		3	SS	26											2 23 45 30
15	Occ. Silt and Sand layers		4	SS	196											
20	Stiff to Hard		5	SS	340											0 21 54 25
25	(Glacial Till)		6	SS	258/15cm											
181.1 8.5	Silt with Sand		7	SS	228											
	Trace of Gravel and clay		8	SS	216/15cm											7 36 33 4
	Very loose															
40	(Glacial Till)		9	SS	255/15cm											
177.2 12.4	END OF Borehole															
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Ministry of  
Transportation and  
Communications

C-7 (C-32-6)

C-15 (C-24-9)

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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

*CONT 88-79*

WP 164-79-06 DIST 6

HWY 400/407 STR SITE

High Mast Lighting Along Hwy. 400  
Between  
Finch Avenue and Hwy. 407 Interchange

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FOUNDATION INVESTIGATION REPORT  
For  
High Mast Lighting Along Hwy. 400  
Between  
Finch Avenue and Hwy. 407 Interchange  
W.P. 164-79-06  
District 6, Toronto

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation performed at the above-mentioned site between 88-02-08 and 88-02-16. The field work consisted of advancing one borehole at each high mast lighting location (HML) in order to establish soil parameters for the design of the 18 HML foundation among the proposed 20 HML locations. Boreholes ranged from 12.4 to 15.7 m in depth and all 18 boreholes were accompanied by cone penetration tests.

SITE DESCRIPTION

The site is extended along Hwy. 400 between Finch Avenue and Hwy. 407 interchange. The site is located in the physiographic region known as the "Peel Plain" as described by the physiography of Southern Ontario (Chapman and Putnam, 1984). The site is characterized by a level to gently undulating topography sloping gradually towards the south.

SUBSURFACE CONDITIONS

General

Due to the large area of the site along Hwy. 400, the surface conditions for the High Mast Lighting vary considerably depending upon the location. However, in general, the underlying soil consists mainly of a hard layer of cohesive glacial till of varying thickness. The till deposits are interbedded with some continuous lacustrine layers and frequent random discontinuous silt to sand pockets. Underneath this layer, hard silty clay with trace of sand layer is encountered at two borehole locations. Only 2.5 metres of this material was proven at Boreholes C-1 and C-6. Bedrock was not encountered during the

investigation, but is reported to be composed of Shale with limestone laminations and located below elevation 120 ± metres.

More detailed description of the subsoil deposits and the fill material will be presented.

1. Clayey silt to silt

A layer of clayey silt to silt with sand and a trace of gravel extends from the ground surface or below the fill material to the various depths. The material changes in colour from brown to grey at approximate elevations between 180.7 m and 190.9 m as shown on borehole logs.

The results from laboratory tests performed on this material are summarized as follows:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	7.0-19.5
Liquid Limit ( $W_L$ )	15.0-32.0
Plastic Limit ( $W_p$ )	11.0-18.0
Plastic Index ( $I_p$ )	4.0-16.0

The Atterberg Limit Test results are illustrated on the plasticity charts (See Figure 1). From the chart it is evident that the layer can be classified as an inorganic clayey silt to silt with low plasticity (CL or CL-ML).

Grain size distribution tests were carried out on these materials. Figure 2 in the Appendix shows the results in envelope form.

Standard Penetration Test 'N' values between 10 and over 100 blows/0.3 m indicated that the soil can be interpreted as being stiff to hard.

2. Silt with sand

Silt layers were encountered within or below the clayey silt to silt deposit.



The Atterberg Limit Test results are shown on the plasticity chart (Seet Figure 3). From the chart it is evident that this layer can be classified as silt with some sand trace of gravel and clay (ML). Grain size distribution analyses were carried out on these materials. Figure 4 in Appendix shows the results in envelope form.

In this stratum, the 'N' values ranged from 15 to over 100 blows/0.3 m indicating a state of compaction described as compact to very dense.

### 3. Silty clay

This lacustrine deposit has been described as silty clay. The thickness of this deposit was not fully explored along the sites, but it is in excess of 2.5 metres.

Atterberg Limit Test results are summarized below:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	20.0-22.0
Liquid Limit ( $W_L$ )	38.5-47.5
Plastic Limit ( $W_p$ )	16.0-18.0
Plastic Index ( $I_p$ )	22.5-29.5

The Atterberg Limit Test results are illustrated on the Plasticity Chart (Figure 5).

Grain size distribution were carried out on these samples (BH #C-1 SA #7 and BH #6 SA #8). Figure 6 shows the results. Standard Penetration Test 'N' values between 79 and over 100 blows/0.3 m indicate that the deposit is in hard state.

### 4. Fill Material

The soil used in the fills consists of a brown clayey silt to silt with some sand and trace of gravel.

No index tests were carried out on these samples. However, from the visual observation, it is apparent that the fill materials are similar to the layer of clayey silt to silt immediately below the original ground. It is therefore likely that the fill material came from the immediate vicinity. The thickness of this layer ranges between 1.8 metres at BH #C-4 and 7.1 metres at BH #C-14. Standard Penetration Test 'N' values between 17 and 49 indicate that the fill material is in a very stiff to hard state.

The results of all field and laboratory testing, along with the summary of the subsoil conditions encountered in each borehole are shown on the Record of Borehole Sheets (See Appendix).

#### GROUNDWATER CONDITIONS

Groundwater conditions were observed through the measurements of water levels in the open boreholes. Groundwater level in the Boreholes was found to range between elevation 182.3 m and 191.2 m which corresponds to some 0.1 to 8.2 m below the existing ground surface.

## DISCUSSION AND RECOMMENDATIONS

Along the area around Hwy. 400 between Finch Avenue and Hwy. 407 interchange, it is proposed to install 20 High Mast Lightings.

A foundation investigation was carried out between 88-02-08 and 88-02-16 at the above-noted site in order to establish soil parameters for the design of the 18 HML foundation among the proposed 20 HML. The investigation consisted of advancing 1 borehole at each of the HML locations to a depth ranging between 12.4 and 15.7 m below the ground level.

Table 1 indicate the proposed location of each of the 30 m high HML. As shown on Table 1, since the proposed HML location for C-7 and C-15 is situated in the private properties and further permission to enter this properties could not be obtained within the limited time, the site investigation for this location was deferred to a later date. It should be noted that since a proposed HML location is situated on the slope of Hwy. 400 embankment, actual borehole location for HML #9 moved toward easterly about 4.0 m from the original location. It should be also noted that the proposed location for HML #8 was moved toward easterly about 2.0 m to allow for the overhead hydro line clearance.

### Design Consideration

The High Mast Lighting foundations will be supported on a single concrete caissons and the design should be in accordance with the method described by Broms as per the following 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

Lateral Resistance of Piles in Cohesionless Soils.

Journal of the Soil Mechanics and Foundation Division, ASCE,  
Vol. 90, No. SM3  
Paper 3909, May 1964

Design of Laterally Landed piles

Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 91, No. SM 3  
May 1985.

The soil parameters provided in Table 2 are recommended for the design of the HML foundations. The following notation has been adopted:

- $\phi$  = apparent angle of friction for cohesionless soils  
 $q_u$  = unconfined compressive strength in kPa ( $q_u = 2 \times C_u$ ) for  
cohesive soils  
 $\gamma$  = bulk unit weight in  $\text{kN/m}^3$

The material within the zone of frost penetration depth should not be included in calculations of lateral resistance. At this site, the depth of frost penetration is 1.2 m.

Construction Considerations

The investigation revealed that the subsurface conditions across the site are generally varied, but consist of Glacial Till with some gravel and varying amounts of cobbles and boulders.

Caissons will be located below the prevailing groundwater in granular subsoil. In view of this, the following special provision should be included in the contract:

"The contractor shall install concrete footings in earth for high mast poles. At the various pole locations, soil deposits consist of mixtures of silts, sands and gravels with occasional cobbles and boulders. Groundwater is likely to be encountered from 0.1 to eight metres below

the existing ground surface. The soil is highly susceptible to conditions of unbalanced hydrostatic head and seepage forces and is likely to 'boil' and become unstable under such conditions. The contractor shall maintain the stability of the soil in the sides and bases of the holes for the concrete footings at all times from commencement of their construction to the placing of concrete."

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Ken Zasitko, project technician. The equipment was owned and operated by Master Soil Investigation Toronto.

This report was written by T. C. Kim, Foundation Engineer and viewed by M. Devata, Chief Foundation Engineer (East).



*Tae C. Kim*  
Tae C. Kim, P.Eng.  
Foundation Engineer

*M. Devata*

M. Devata, P.Eng.  
Chief Foundation Engineer  
(East)

TABLE 1

HML BOREHOLE LOCATION

Co-ordinates of Actual Borehole Location

HML BH	Co-ordinates	
C-1	N 4,847,100.5	E 302,139.5
C-2	N 4,847,192	E 302,042
C-3	N 4,847,347.5	E 302,102
C-4	N 4,847,419.5	E 302,000
C-5	N 4,847,574.5	E 302,067.5
C-6	N 4,847,636	E 301,963
C-7	NOT SURVEYED (IN PRIVATE PROPERTY)	
C-8	N 4,847,810	E 301,919.5
C-9	N 4,847,981	E 301,988.5
C-10	N 4,848,160.5	E 301,965
C-11	N 4,848,330	E 301,841
C-12	N 4,848,360	E 301,943
C-13	N 4,848,533	E 301,803
C-14	N 4,848,570.5	E 301,924
C-15	NOT SURVEYED (IN PRIVATE PROPERTY)	
C-16	N 4,848,939.5	E 302,010
C-17	N 4,849,119	E 301,976
C-18	N 4,849,225.5	E 301,800
C-19	N 4,849,340.5	E 301,892.5
C-20	N 4,849,602.5	E 301,803

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	$\phi$ DEGREE	$q^u$ kPa	kN/m <sup>3</sup>
C-1	182.9	180.5	Cohesive	Hard		180	20.4
	180.5	178.9	Non-Cohesive	Very Dense	40		21.2
	178.9	170.3	Cohesive	Hard		450	21.2
C-2	184.7	182.3	Cohesive	Very Stiff		120	19.9
	182.3	180.7	Non-Cohesive	Very Dense	38		21.2
	180.7	172.1	Cohesive	Hard		450	21.2
C-3	187.5	180.4	Cohesive	Hard		230	20.7
	180.4	177.4	Cohesive	Hard		450	21.2
	177.4	174.9	Non-Cohesive	Very Dense	40		21.2

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-4	188.2	186.4	Cohesive	Very Stiff		140	20.1
	186.4	182.7	Cohesive	Hard		420	21.2
	182.7	175.6	Non-Cohesive	Very Dense	40		21.2
C-5	190.3	186.3	Cohesive	Hard		200	20.4
	186.3	183.3	Non-Cohesive	Very Dense	40		21.2
	183.3	177.7	Cohesive	Hard		500	21.2
C-6	188.7	180.1	Cohesive	Hard		380	21.2
	180.1	177.1	Non-Cohesive	Very Dense	40		21.2
	177.1	176.1	Cohesive	Hard		420	21.2



WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-8	189.0	186.5	Cohesive	Very Stiff		130	20.1
	186.5	176.6	Cohesive	Hard		450	21.2
C-9	187.5	185.1	Cohesive	Very Stiff		95	19.6
	185.1	180.5	Cohesive	Hard		330	21.2
	180.5	177.4	Non-Cohesive	Dense	36		21.0
	177.4	174.9	Non-Cohesive	Very Dense	40		21.2
C-10	187.7	183.7	Cohesive	Very Stiff		110	19.9
	183.7	182.0	Cohesive	Hard		450	21.2
	182.0	179.1	Non-Cohesive	Dense	34		20.7
	179.1	176.1	Cohesive	Hard		500	21.2
	176.1	175.1	Non-Cohesive	Dense	34		20.7

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-11	187.9	185.3	Cohesive	Very Stiff		140	20.1
	185.3	180.9	Cohesive	Hard		420	21.2
	180.9	177.8	Non-Cohesive	Dense to Very Dense	38		21.2
	177.8	175.5	Cohesive	Hard		450	21.2
C-12	190.1	186.0	Cohesive	Very Stiff		100	19.9
	186.0	180.0	Cohesive	Hard		420	21.2
	180.0	177.5	Cohesive	Very stiff to Hard		110	20.4
C-13	189.9	177.3	Cohesive	Hard		420	21.2

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

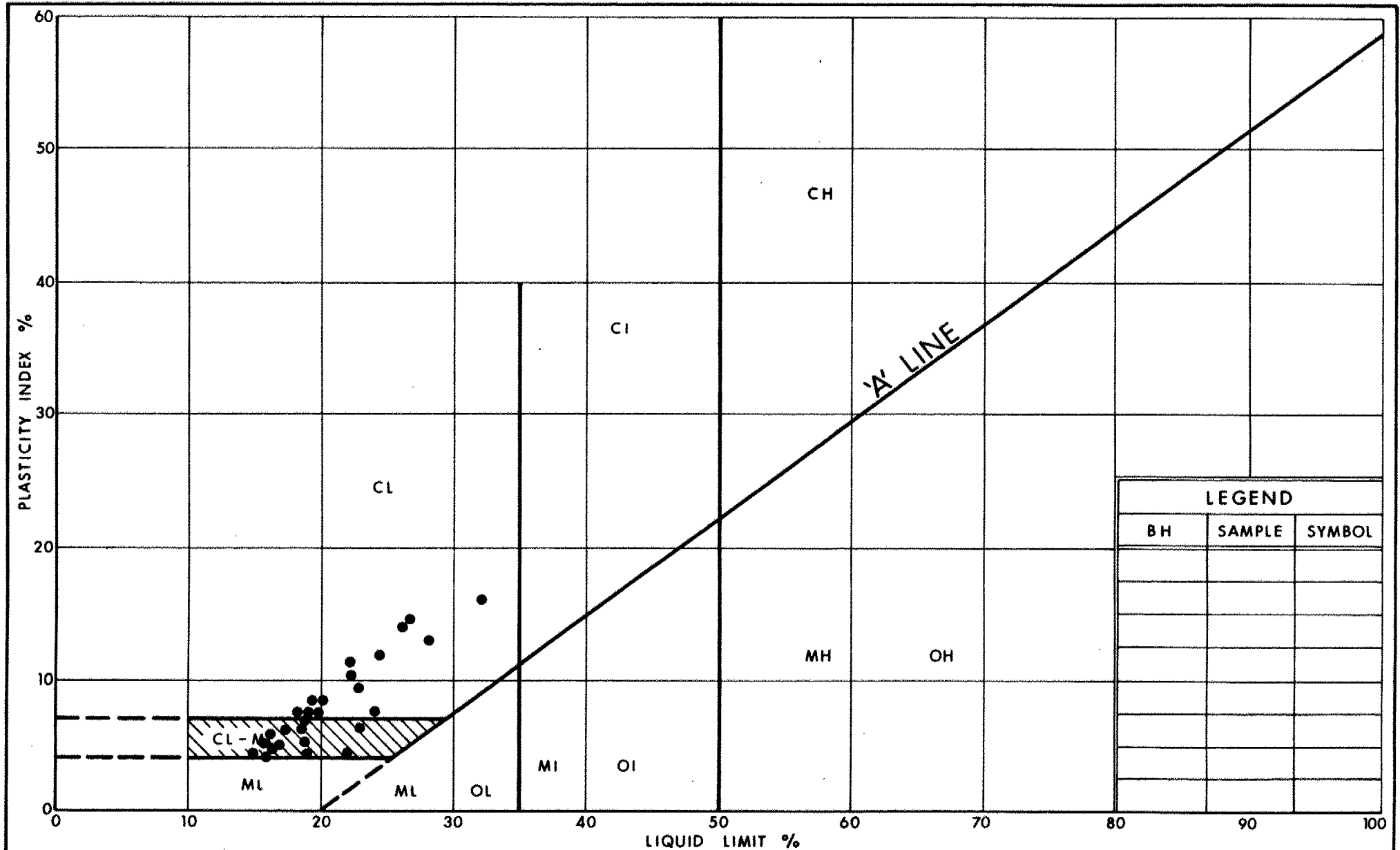
POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	0 DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-14	197.3	191.6	Cohesive	Very Stiff		150	20.1
	191.6	188.7	Cohesive	Hard		190	21.2
	188.7	181.6	Cohesive	Hard		330	21.2
C-16	191.7	189.3	Cohesive	Stiff		60	19.3
	189.3	179.1	Cohesive	Hard		420	21.2
C-17	191.0	186.9	Cohesive	Very Stiff		150	20.1
	186.9	178.4	Cohesive	Hard		330	21.2

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	0 DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-18	192.3	186.7	Cohesive	Hard		230	20.7
	186.7	179.7	Cohesive	Hard		420	21.2
C-19	191.0	187.0	Cohesive	Very Stiff		100	19.9
	187.0	183.8	Cohesive	Hard		230	21.0
	183.8	178.4	Cohesive	Hard		410	21.2
C-20	198.1	192.5	Cohesive	Very Stiff		110	19.9
	192.5	182.4	Cohesive	Hard		410	21.2

## APPENDIX



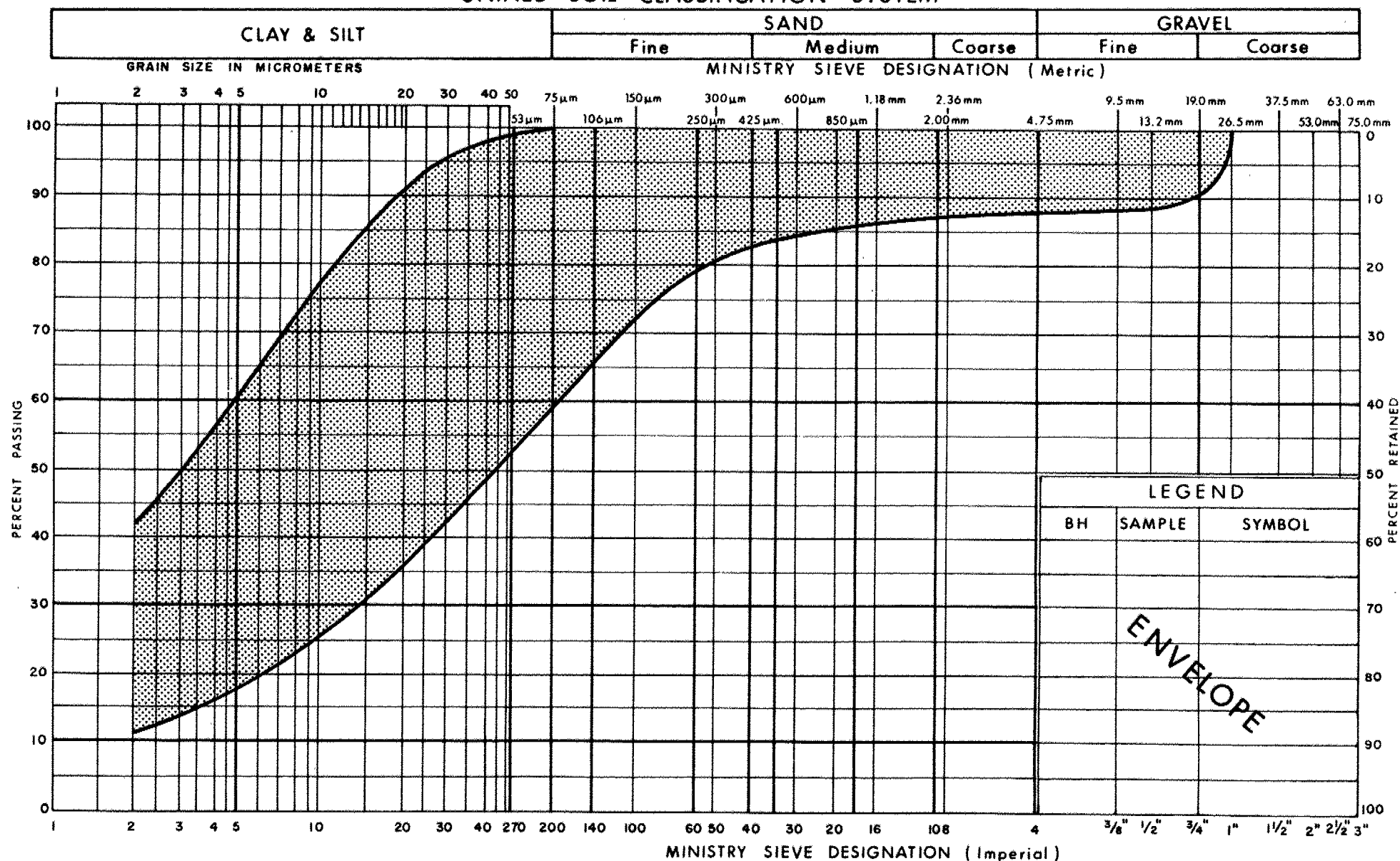
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# PLASTICITY CHART CLAYEY SILT TO SILT (Glacial Till)

FIG No 1

W P 164-79-06

## UNIFIED SOIL CLASSIFICATION SYSTEM

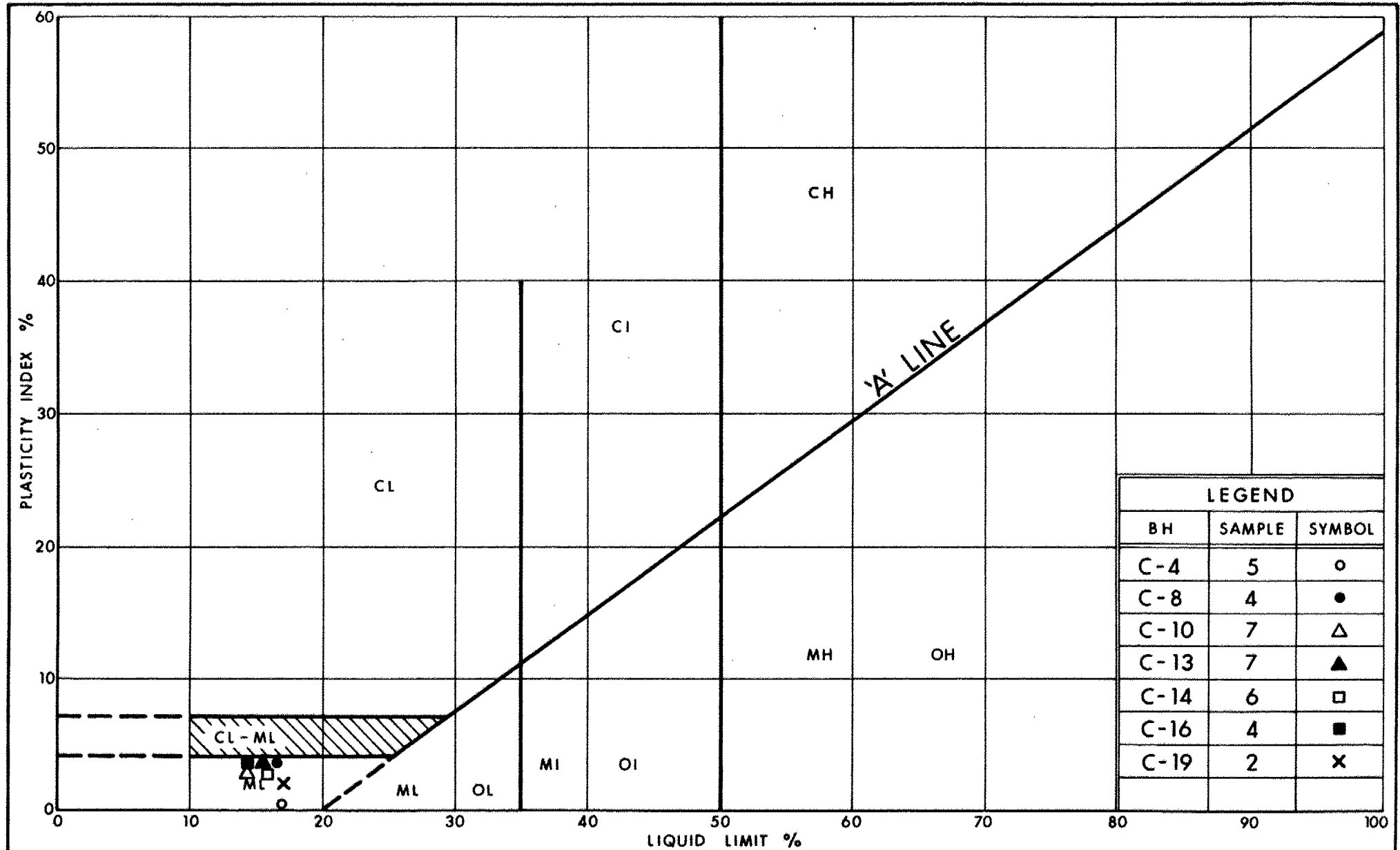


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**GRAIN SIZE DISTRIBUTION**  
**CLAYEY SILT TO SILT**  
(Glacial Till)

FIG No 2

W P 164-79-06



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Ontario

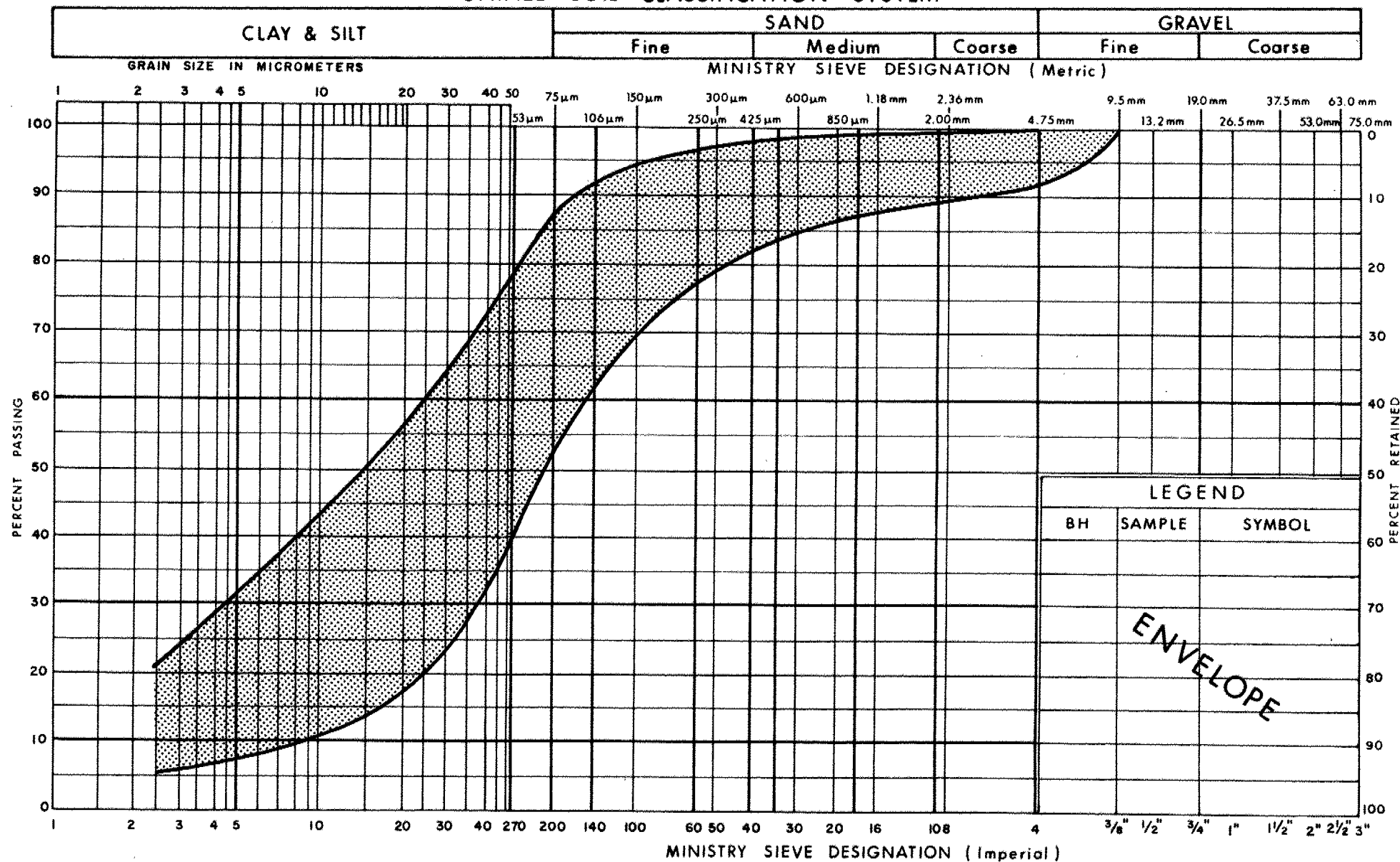
# PLASTICITY CHART SILT WITH SAND

FIG No 3

W P 164-79-06



## UNIFIED SOIL CLASSIFICATION SYSTEM

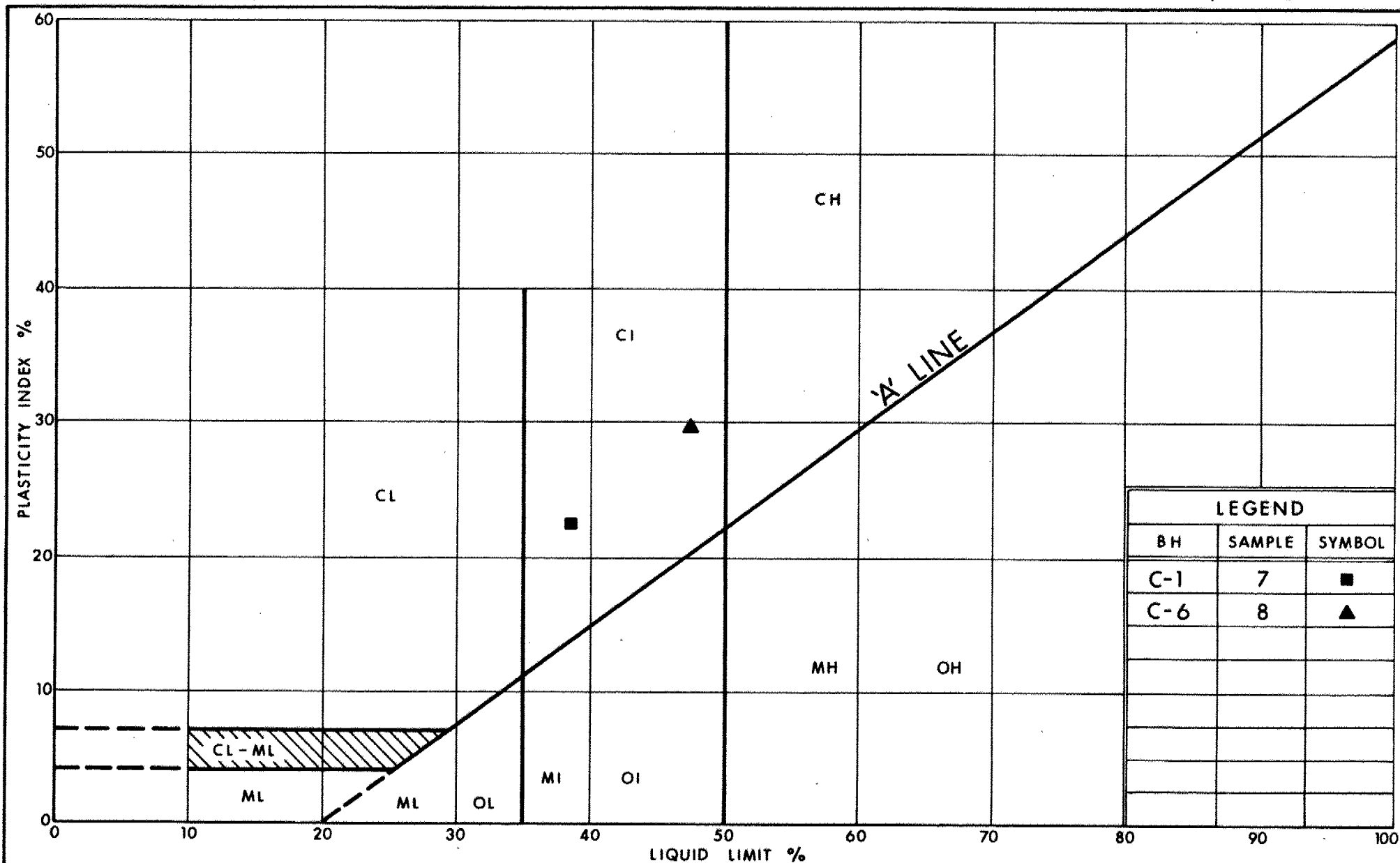


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GRAIN SIZE DISTRIBUTION  
SILT WITH SAND

FIG No 4

W P 164-79-06



LEGEND		
BH	SAMPLE	SYMBOL
C-1	7	■
C-6	8	▲



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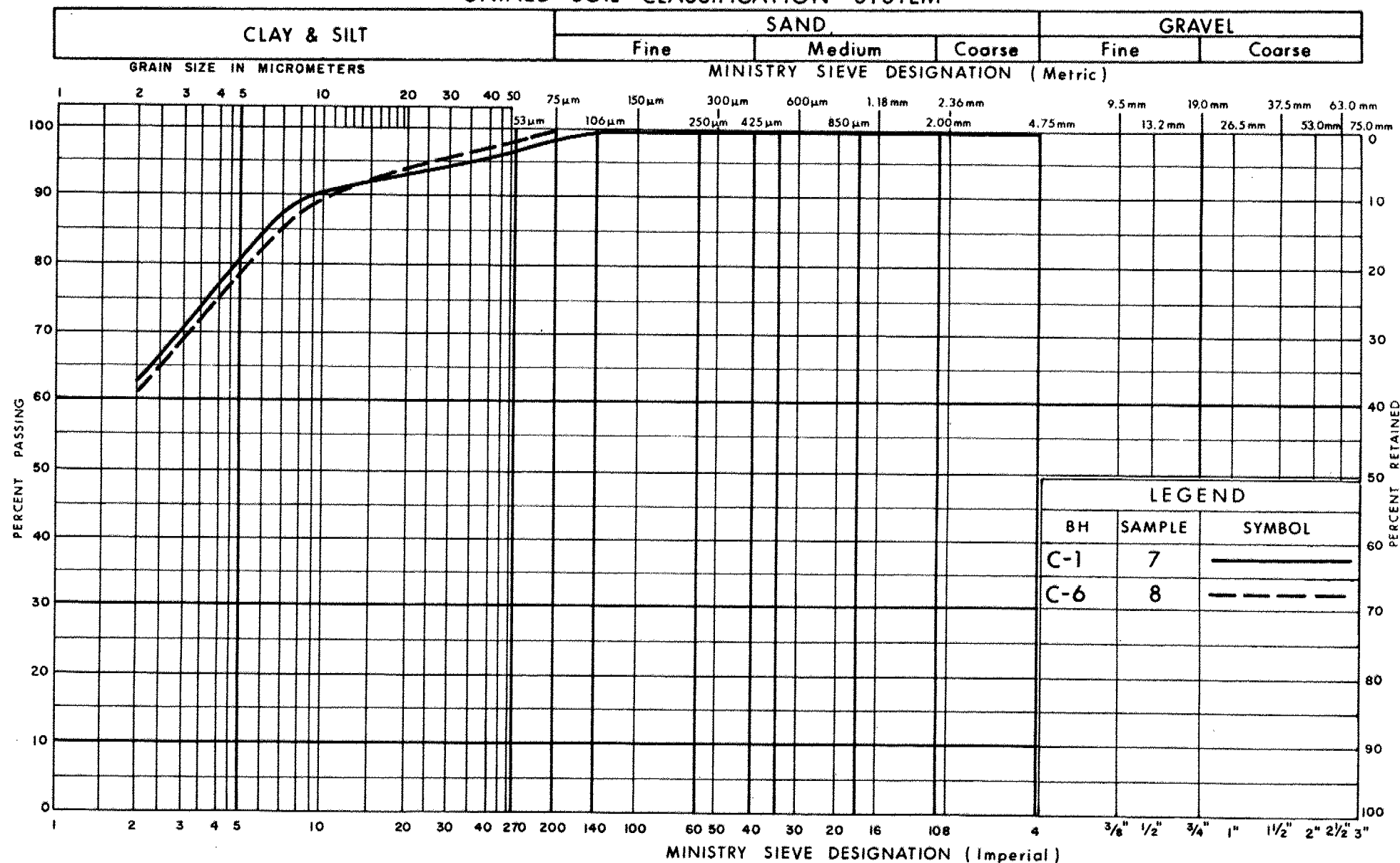
Ontario

## PLASTICITY CHART SILTY CLAY

FIG No 5

W P 164-79-06

## UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION  
SILTY CLAY

FIG No 6

W P 164-79-06

## EXPLANATION OF TERMS USED IN REPORT

**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

$c_u$ (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

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

**JOINTING AND BEDDING:**

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
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 = $w_L - w_p$	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						

# RECORD OF BOREHOLE No C-1

METRIC

W P 164-79-06 LOCATION Co-ords. N. 4 847 100.5; E 302 139.5 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 08 CHECKED BY TCK

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						
182.9	Ground Level													
0.0														
	Brown Grey Silt, Trace Sand Very Dense (Lacustrine)		1	SS	31		182							
			2	SS	130		180							
	Clayey Silt Trace to Some Sand Trace Gravel Occ. Silt and Sand Layers Hard (Glacial Till)		3	SS	100	10 cm	178							
			4	SS	100	15 cm	176							10 19 46 25
	Sand		5	SS	110	25 cm	174							
172.8			6	SS	84		172							
10.1	Silty Clay Trace of Sand Occ. Silt Pocket (Lacustrine)		7	SS	72									0 2 36 62
170.3	Hard		8	SS	136	23 cm								
12.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-2

METRIC

W P 164-79-06 LOCATION Co-ords. N. 4 847 192.0; E 302 042.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 15 CHECKED BY TCK

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					
184.7	Ground Level												
0.0													
			1	SS	20	*							
	Silt, Trace Sand Very Dense (Lacustrine)		2	SS	58			120/ 25cm					
	Clayey Silt Trace to some Sand Trace Gravel Occ. Silt and Sand Layers Occ. Cobbles Hard (Glacial Till)		3	SS	116/	28 cm							
			4	SS	101								2 15 53 30
			5	SS	72								
176.1													
8.6	Clayey Silt/Silt Occ. Silt Layers Hard (Lacustrine)		6	SS	103								
			7	SS	84								0 0 79 21
173.0													
11.7	Clayey Silt **												
172.1	Hard (Glacial Till)		8	SS	58								
12.6	End of Borehole												
	<p><b>*NOTE</b> Ground Water Level Not Established</p> <p><b>**</b> Trace Sand and Gravel Occ. Silt Pockets</p>												

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-3

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 847 347.5; E 302 102.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 08 CHECKED BY TCK

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>		
187.5	Ground Level												
0.0	Clayey Silt Some Sand Trace Gravel Occ. Sand Layers Hard (Fill)		1	SS	37								
185.0			2	SS	31								
2.5	Brown Grey  Clayey Silt to Silt Trace to Some Sand Trace Gravel Occ. Silt and Sand Layers Hard (Glacial Till)		3	SS	31								4 29 56 11
			4	SS	45	88 2 10							
			5	SS	100	28 cm							2 22 52 24
			6	SS	108	25 cm							
177.4													
10.1	Silt and Sand Trace Gravel Very Dense (Lacustrine)		7	SS	85								
174.9			8	SS	97								
12.6	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-4

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 847 419.5; E 302 000.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 16 CHECKED BY TCK

OFFICE REPORT ON SOIL EXPLORATION

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						
188.2	Ground Level													
0.0	Clayey Silt Some Sand Trace Gravel Very Stiff (Fill)													
186.4			1	SS	23									
1.8	Clayey Silt Some Sand Trace Gravel Hard		2	SS	53									
	Brown Grey													
182.7	(Glacial Till)		3	SS	100/	13 cm								2 25 54 19
5.5	Silt Some Sand Trace Gravel and Clay Occ. Sand Layers Very Dense (Lacustrine)		4	SS	113									
			5	SS	100/	15 cm								1 11 83 5
178.2			6	SS	132/	25 cm								
10.0	Silt, Some Sand Trace Gravel, Very Dense (Glacial Till)		7	SS	142/	23 cm								
176.6														
11.6	Sand, Trace Gravel Very Dense (Lacustrine)		8	SS	79									
175.6														
12.6	End of Borehole													



# RECORD OF BOREHOLE No C-5

METRIC

W P 164-79-06 LOCATION Co-ords. N. 4 847 574.5; E 302 067.5 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 16 CHECKED BY TCK

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
								SHEAR STRENGTH kPa							WATER CONTENT (%)		
190.3	Ground Level													GR SA SI CL			
0.0	Clayey Silt Some Sand Trace Gravel Hard (Fill)		1	SS	30	*											
187.8																	
2.5	Clayey Silt, Some Sand Trace Gravel, Hard (Glacial Till)		2	SS	33									0 24 55 21			
186.3																	
4.0	Sand to Silt Very Dense (Lacustrine)		3	SS	103/	25 cm											
183.3			4	SS	100/	25 cm											
7.0	Clayey Silt to Silt Trace to some Sand Trace Gravel Occ. Silt and Sand Layers Hard (Glacial Till)		5	SS	109												
			6	SS	102												
			7	SS	150/	20 cm								1 2 56 41			
177.7			8	SS	109/	25 cm											
12.6	End of Borehole																
	* Note Water Level not Established																

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-6

METRIC

W P 164-79-06 LOCATION Co-ords. N 847 636.0; E 301 963.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 15 CHECKED BY TCK

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	10 20 30					
188.7 0.0	Ground Level													GR SA SI CL
	Clayey Silt to Silt Trace to Some Sand Trace Gravel Occ. Silt and Sand Layers Hard (Glacial Till)		1	SS	32		188							
			2	SS	100	10 cm	186							
	Brown Grey		3	SS	43	80-2-16	184							1 24 56 19
	Silt, Tr. Sand & Gravel		4	SS	43		182							
			5	SS	100	13 cm	180							1 21 68 10
180.1 8.6	Silt Trace of Sand (Glacial Till) Very Dense		6	SS	100	13 cm	178							
177.1 11.6	Silty Clay, Hard (Lacustrine)		7	SS	155									
176.1 12.6	End of Borehole		8	SS	84									0 0 40 60

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No C-8

METRIC

W P 164-79-06 LOCATION Co-ords. N 847 810.0; E 301 919.5 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 15 CHECKED BY TCK

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100		W <sub>p</sub>	W	W <sub>L</sub>		
189.0	Ground Level												
0.0	Clayey Silt Some Sand Trace Gravel Very Stiff (Fill)		1	SS	22								
186.5			2	SS	107								
2.5			3	SS	74								
	Brown Grey												
	Clayey Silt to Silt												
	Some Sand		4	SS	103								1 20 64 15
	Trace Gravel												
	Occ. Silt and Sand Layers		5	SS	100/	13cm							
	Hard (Glacial Till)		6	SS	100/	13cm							
	Silt with Sand		7	SS	100/	8 cm							0 25 70 5
	Trace Clay												
176.6			8	SS	100/	8 cm							
12.4	End of Borehole												

# RECORD OF BOREHOLE No C-9

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 847 981.0; E 301 988.5 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 08 CHECKED BY TCK

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	SHEAR STRENGTH kPa						WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
187.5	Ground Level															
0.0	Clayey Silt Some Sand Trace Gravel Occ. Silt and Sand Pockets Very Stiff to Hard (Glacial Till)		1	SS	16								3 31 52 14			
			2	SS	46											
			3	SS	53											
			4	SS	52											
180.5																
7.0	Sand and Gravel Loose to Very Dense (Lacustrine)	5	SS	9	180											
		6	SS	75	178											
177.4	Silt with Sand Trace Gravel and clay Very Dense (Glacial Till)	7	SS	59	176											
10.1																
174.9			8	SS	100	10 cm							6 39 50 5			
12.6	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-10

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 160.5; E 301 965.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 08 CHECKED BY TCK

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	100					
187.7	Ground Level													
0.0	Clayey Silt Some Sand Trace Gravel Very Stiff (Fill)					88 2 10								
185.9			1	SS	19		186							
1.8	Clayey Silt Trace to Some Sand Trace Gravel Brown Grey		2	SS	19		184							
	Occ. Sand Layers Very Stiff to Hard (Glacial Till)		3	SS	97		182							1 20 59 20
182.0			4	SS	50		180							
5.7	Silt and Sand Compact to Dense (Lacustrine)		5	SS	25		178							
179.1			6	SS	125/	25cm	176							
8.6	Clayey Silt to Silt Some Sand Trace Gravel Occ. Sand and Cobbles, Hard (Glacial Till)	Silt With Sand	7	SS	100/	15 cm								9 33 46 12
176.1			8	SS	38									
11.6	Sand and Gravel Dense													
175.1														
12.6	End of Borehole													



Ministry  
of  
Transportation

# RECORD OF BOREHOLE No C-11

METRIC

W P 164-79-06 LOCATION Co-ords. N. 4 848 330.0; E 301 841.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 11 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ 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						
187.9	Ground Level										
0.0											
	Clayey Silt to Silt		1	SS	23		186				
	Trace to Some Sand										
	Trace Gravel										
	Occ. Silt and		2	SS	66		184				
	Sand Layers										
	Very Stiff to Hard		3	SS	99		182				
	(Glacial Till)										
			4	SS	94		180				
	Brown										
	Grey		5	SS	43		178				
	Silt with										
	Sand		6	SS	73		176				
	Dense to										
	Very Dense		7	SS	100						
			8	SS	100/8 cm						
175.5											
12.4	End of Borehole										

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

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-12

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 360.0; E 301 943.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 10 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	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								
190.1	Ground Level												
0.0	Clayey Silt Some Sand Trace Gravel Occ. Sand Layers		1	SS	20								
187.6	Very Stiff (Fill)												
2.5	Clayey Silt to Silt Trace to Some Sand Trace Gravel Occ. Silt and Sand Layers		2	SS	14								
	Brown Grey		3	SS	48								
	Stiff to Hard (Glacial Till)		4	SS	105								
			5	SS	96								
			6	SS	80								
180.0	Clayey Silt/Silt Trace Gravel Very Stiff to Hard (Lacustrine)		7	SS	36								
10.1			8	SS	25								
177.5													
12.6	End of Borehole												

# RECORD OF BOREHOLE No C-13

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 533.0; E 301 803.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 11 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
189.9	Ground Level													
0.0														
			1	SS	78		188		120/28 cm					
			2	SS	46		186							
			3	SS	100/13		184							
			4	SS	123		182							
			5	SS	94		180							
			6	SS	54		178							
			7	SS	77									
			8	SS	85									
177.3														
12.6	End of Borehole													

+3, x5: Numbers refer to Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No C-14

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 570.5; E 301 924.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 10 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ 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						
197.3	Ground Level										
0.0	Clayey Silt Some Sand Trace Gravel Occ. Silt and Sand Layers Very Stiff to Hard (Fill)		1	SS	18		196				
			2	SS	30		194				
			3	SS	20		192				
			4	SS	49		190				
190.2			5	SS	20		188				
7.1	Silt Brown Grey		6	SS	73		186				2 33 51 14
	Clayey Silt to Silt Some Sand Trace Gravel Occ. Silt and Sand Layers Very Stiff to Hard (Glacial Till)		7	SS	33		184				
			8	SS	60		182				
			9	SS	38						11 17 56 16
181.6			10	SS	42						
15.7	End of Borehole										

# RECORD OF BOREHOLE No C-16

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 939.5; E 302 010.0 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 09 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ 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						
191.7	Ground Level										
0.0	Clayey Silt to Silt With Some Sand Trace Gravel Occ. Silt and Sand Layers Stiff to Hard (Glacial Till)		1	SS	10		190				
			2	SS	84		188	120/18 cm			
	Brown Grey		3	SS	100/	15 cm	186				
	Silt With Sand		4	SS	100/	15 cm	184				
			5	SS	75		182				
			6	SS	67		180				
			7	SS	102						
179.1			8	SS	39						
12.6	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION



## METRIC

W P 164-79-06 LOCATION Co-ords. N 4 849 119.0; E 301 976.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 10 CHECKED BY TCK

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

15 20  
10

# RECORD OF BOREHOLE No C-18

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 849 225.5; E 301 800.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 10 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
192.3	Ground Level						192					
0.0							190					
	Brown Grey		1	SS	33	88 2 11	188	120/23 cm				
	Clayey Silt Hard (Lacustrine)		2	SS	31		186					
	Clayey Silt Trace to Some Sand Trace of Gravel Occ. Silt and Sand Layers Occ. Cobbles Hard (Glacial Till)		3	SS	46		184					5 17 58 20
	Clayey Silt Hard (Lacustrine)		4	SS	65		182					
			5	SS	70		180					
			6	SS	44							
			7	SS	156/28 cm							0 5 78 17
179.7			8	SS	97							
12.6	End of Borehole											

# RECORD OF BOREHOLE No C-19

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 849 340.5; E 301 892.5 ORIGINATED BY KZ  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
 DATUM Geodetic DATE 88 02 11 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH $kPo$ ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT Wp NATURAL MOISTURE CONTENT W LIQUID LIMIT Wl WATER CONTENT (%) 10 20 30	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
191.0	Ground Level										
0.0											
	Brown Grey Silt, Some Clayey Silt Very Stiff (Lacustrine)		1	SS	18		190				
			2	SS	15		188		10		1 13 71 15
			3	SS	47		186	120/25 cm			
	Clayey Silt Trace to Some Sand Trace Gravel		4	SS	28		184				
	Occ. Silt and Sand Layers		5	SS	62		182				
	Very Stiff to Hard		6	SS	83		180				
	(Glacial Till)		7	SS	80						0 5 66 29
178.4			8	SS	76						
12.6	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION



Ministry  
of  
Transportation

# RECORD OF BOREHOLE No C-20

METRIC

W P 164-79-06 LOCATION Co-ords. N 4 849 602.5; E 301 803.0 ORIGINATED BY KZ  
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY KZ  
DATUM Geodetic DATE 88 02 11 CHECKED BY TCK

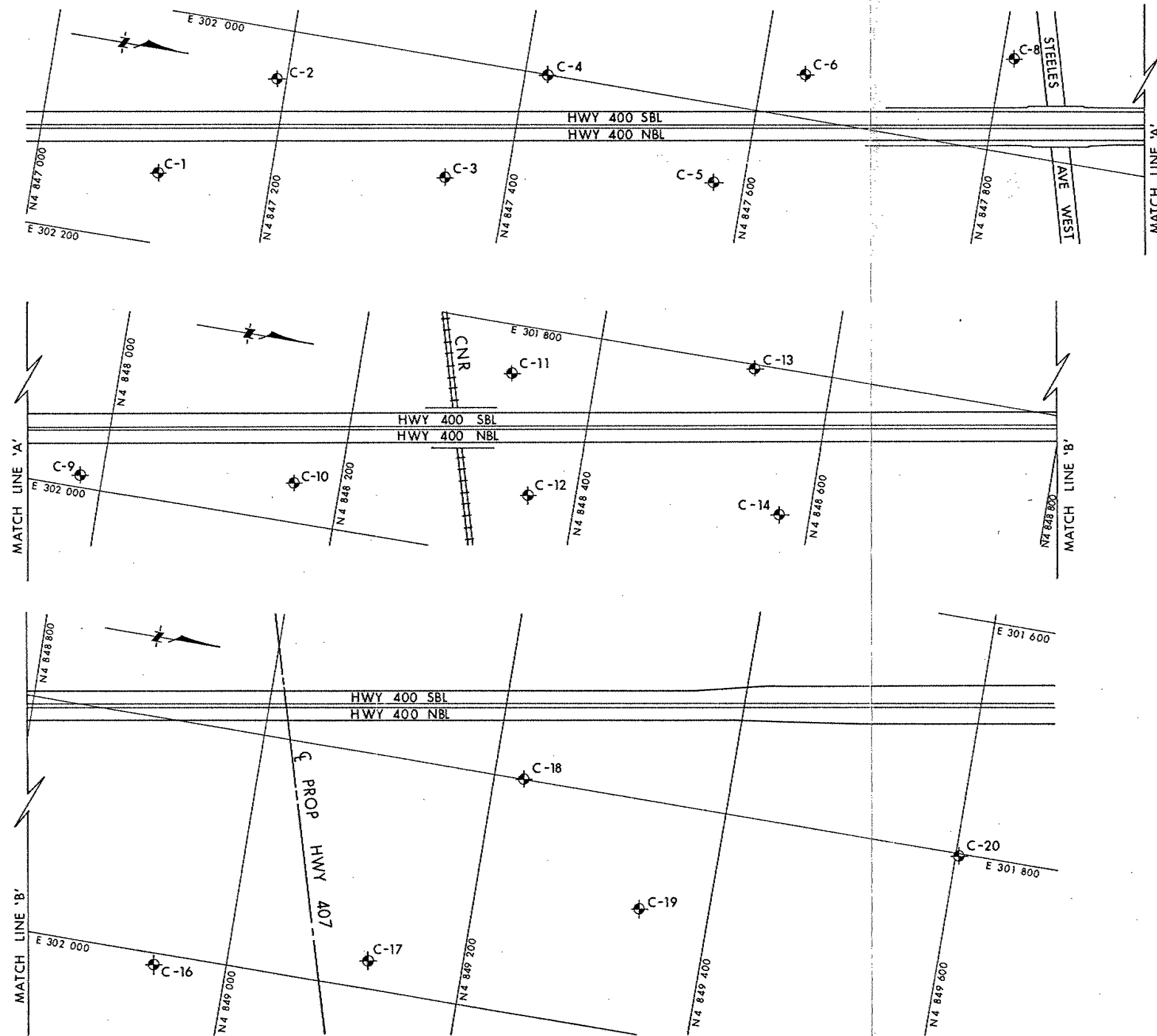
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT Wp NATURAL MOISTURE CONTENT W LIQUID LIMIT Wl WATER CONTENT (%) 10 20 30	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
198.1	Ground Level										
0.0	Clayey Silt Trace of Sand Trace of Gravel Trace of Organics Very Stiff (Fill)		1	SS	17						
			2	SS	17						
194.1			3	SS	20						
4.0			4	SS	53						
	Brown Grey		5	SS	73	88 2 16					
	Clayey Silt Trace to Some Sand Trace Gravel Occ. silt and Sand Layers Very Stiff to Hard (Glacial Till)		6	SS	100	5 cm					1 10 59 30
			7	SS	101	20 cm					
			8	SS	72						
			9	SS	88						
183.4											
14.7	Clayey Silt to Silt										
182.4	Hard (Lacustrine)		10	SS	32						
15.7	End of Borehole										

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



PLAN

SCALE  
40m 20 0 20m 40m

**METRIC**

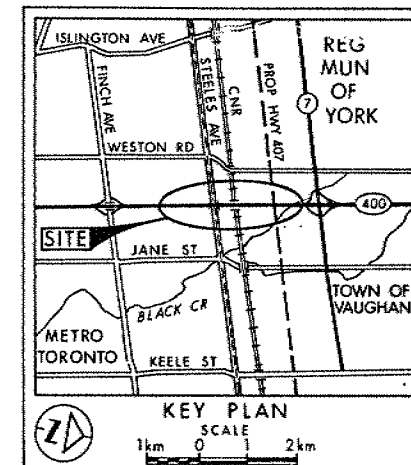
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 164-79-06

H.M.L. ALONG HWY 400  
BETWEEN FINCH AVE & HWY 407  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



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 88 02

No	ELEVATION	CO-ORDINATES NORTH	EAST
C-1	182.9	4 847 100.5	302 139.5
C-2	184.7	4 847 192.0	302 042.0
C-3	187.5	4 847 347.5	302 102.0
C-4	188.2	4 847 419.5	302 000.0
C-5	190.3	4 847 574.5	302 067.5
C-6	188.7	4 847 636.0	301 963.0
C-8	189.0	4 847 810.0	301 919.5
C-9	187.5	4 847 981.0	301 988.5
C-10	187.7	4 848 160.5	301 965.0
C-11	187.9	4 848 330.0	301 841.0
C-12	190.1	4 848 360.0	301 943.0
C-13	189.9	4 848 533.0	301 803.0
C-14	197.3	4 848 570.5	301 924.0
C-16	191.7	4 848 939.5	302 010.0
C-17	191.0	4 849 119.0	301 976.0
C-18	192.3	4 849 225.5	301 800.0
C-19	191.0	4 849 340.5	301 892.5
C-20	198.1	4 849 602.5	301 803.0

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

For Subsurface details refer to  
Record of Borehole sheets.

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 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION

Geocres No 30M13-79

HWY No 400	CHECKED	DATE 88 05 11	SITE
SUBM'D TCK	CHECKED	APPROVED	DWG 1647906-A
DRAWN DT	CHECKED		

# memorandum



To: V. Boehnke  
Head  
Structural Section  
Central Region

Date: 1991 04 30


Attn: D. Wong

From: Foundation Design Section  
Room 315, Central Bldg.

Re: High Mast Light  
W.P. 164-79-06  
Hwy. 400 Detour, District 6, Toronto

Further to your memo of May 13/91 and our conversation of May 29/91, we have reviewed the proposal to excavate near HML pole #18. From a geotechnical viewpoint we would recommend a minimum horizontal distance of 4m then a slope of 2H:1V or flatter. However due to the construction activity in the area, we recommend a minimum horizontal distance of 6m then a 2H:1V slope.

If there are any questions, please call.

  
D. Dundas, P. Eng.  
Sr. Foundation Engineer





HML C-7 LOCATION ( After drilling )  
1988. 12.06



HML C-7 LOCATION (Before pulling)  
1988.12.06

# memorandum

235-3731



To: Mr. G.C.E. Burkhardt  
Head, Structural Section  
Central Region

Date: 1989 02 06

Attn: Mr. Dennis Wong  
Structural Engineer

From: Foundation Design Section  
Room 315, Central Building

Subject: SUPPLEMENTARY SITE INVESTIGATION For  
High Mast Lighting Foundation Along Hwy. 400  
Between Finch Avenue and Hwy. 407 Interchange  
W.P. 164-79-06  
District 6, Toronto

We have completed the Supplementary Field Investigation for High Mast Lighting Foundations at two locations, in the vicinity of Hwy. 400/Steeles Avenue (C-7) and Hwy. 407 Interchange area (C-15).

The site is located in the physiographic region known as the "Peel Plain" as described by the physiography of Southern Ontario (Chapman and Putnam, 1984). The site is characterized by a level to gently undulating topography sloping gradually towards the south. The underlying soil consists mainly of a hard layer of cohesive glacial till of varying thickness ranging between 8.5 metres at BH #C-7 and 5 metres at BH #C-15. This cohesive till deposit is underlain by granular glacial till of varying thickness. Bedrock was not encountered during the investigation, but reported to be composed of shale with limestone laminations and located below elevation 120 ± metres. More detailed description of the subsoil deposits is presented in the Record of Boreholes. Land use is mainly for industrial and agricultural purposes.

Groundwater was observed in the open boreholes. Groundwater level in the boreholes was found to range between elevation 184.7 metres at BH #C-7 and elevation 188.4 metres at BH #C-15, which corresponds to some 4.9 to 2.4 metres below the existing ground surface.

Based on the site investigation, we present the following discussion and recommendations for the High Mast Lighting at the above sites.

## DISCUSSION AND RECOMMENDATIONS

A foundation investigation was carried out on 88 08 19 and on 88 12 06 at the above noted sites in order to establish soil parameters for the design of two additional HML foundations. The investigation consisted of advancing 1 borehole at each of the HML locations to a depth ranging between 10.9 and 12.4 metres below the ground level.

.../2

Table 1 indicates the proposed location of two additional 30 m high HML.

#### Design Considerations

The High Mast Lighting foundation will be supported on a single concrete caissons and the design should be in accordance with the method described by Broms as discussed in our previous report (W.P. 164-79-06, June 14, 1988).

The soil parameters provided in Table 2 are recommended for the design of the HML foundations. The following notation has been adopted:

$\phi$  = apparent angle friction for cohesionless soils  
 $q_u$  = unconfined compressive strength in kPa ( $q_u = 2 \times C_u$ )  
 $\gamma$  = bulk unit weight in kN/m<sup>3</sup>

The material within the zone of frost penetration depth should not be included in calculations of lateral resistance. At this site, the depth of frost penetration is 1.2 metres.

#### Construction Considerations

The investigation revealed that the subsurface conditions across the site are generally varied, but consist of cohesive or granular glacial till.

Caissons will be located below the prevailing groundwater in granular subsoil. In view of this, the special provision, which is included in our previous report, should be applied in the contract.

We believe that this memorandum meets with your present requirements. If you have any questions, please contact us.



Tae C. Kim, P.Eng.  
Foundation Design Engineer

for

Murty Devata, P.Eng.  
Chief Foundation Engineer

TCK/mls

Attachment

c.c.: Mr. K. Bassi

WP164-79-06  
(HML)

TABLE 1

HML BOREHOLE LOCATIONS

<u>HML BH</u>	<u>Co-ordinates</u>	<u>Elevations (m)</u>
C-7 (C-32-6)	N 4 847 780 E 302 046.5	189.6
C-15 (C-24-9)	N 4 848 771 E 301 945	190.8

WP164-79-06  
High Mast Lighting  
Hwy. 400/407

TABLE 2

SOIL PARAMETERS

POLE NO.	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	$\phi$ Degree	$q_u$	$\gamma$ kN/m <sup>3</sup>
C-7	189.6	185.5	Cohesive	Very Stiff		185	19.9
	185.5	181.1	Cohesive	Hard		500	21.2
	181.1	177.2	Non-cohesive	Very Dense	43		21.2
C-15	190.8	186.8	Cohesive	Very Stiff		230	20.4
	186.8	185.2	Cohesive	Hard		420	21.2
	185.2	182.3	Non-cohesive	Very Dense	36		21.2
	182.3	179.9	Non-cohesive	Very Dense	43		21.2



# RECORD OF BOREHOLE No C-7 (C-32-6) METRIC

W P 164-79-06 LOCATION Co-ords. N 4 847 780.0; E 302 046.5 ORIGINATED BY ED  
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY TCK  
DATUM Geodetic DATE 88 12 06 CHECKED BY TCK

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						
189.6	Ground Level													
0.0	Clayey Silt to Silt Some Sand Trace Gravel <u>Brown</u> Occasional Silt and Sand Layers Stiff to Hard (Glacial Till)		1	SS	21									0 19 51 30
			2	SS	16		188							2 23 45 30
			3	SS	26		186							
			4	SS	196		184							0 21 54 25
			5	SS	340		182							
			6	SS	250	15 cm	180							
181.1	Silt with Sand Trace of Gravel and Clay Very Dense (Glacial Till)		7	SS	228		178							
8.5			8	SS	216	15 cm								7 36 53 4
			9	SS	255	15 cm								
177.2	End of Borehole													
12.4														

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No C-15 (C-24-9) METRIC

W P 164-79-06 LOCATION Co-ords. N 4 848 771.0; E 301 945.0 ORIGINATED BY JF  
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Auger COMPILED BY TCK  
 DATUM Geodetic DATE 88 08 19 CHECKED BY TCK

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					
190.8	Ground Level																GR SA SI CL
0.0	Topsoil																
190.2			1	Laky Sample			190										5 17 48 30
0.6	Clayey Silt to Silt Some Sand Trace Gravel Stiff to Hard (Glacial Till)		2	SS	31		188										
			3	SS	25		186										0 8 72 20
185.2			4	SS	82		184										0 80 17 3 0 20 58 22
5.6	Silt With Sand Trace of Gravel Occ. Clayey Silt Layers Compact to Very Dense (Glacial Till)		5	SS	23		182										3 22 54 21
182.3			6	SS	82/15 cm		180										
8.5	Heterogeneous Mixture of Silt, Sand and Gravel Very Dense (Glacial Till)		7	SS	80/10 cm												33 30 30 7
179.9			8	SS	80/15 cm												
10.9	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

# memorandum



235-3731

To: Mr. G. C. E. Burkhardt  
Head, Structural Section  
Central Region

Date: 1988 04 07

Attn: D. Wong  
Structural Engineer

From: Foundation Design Section  
Room 315, Central Building

Re: HIGH MAST LIGHTING FOUNDATION  
ALONG HWY. 400 BETWEEN FINCH AVENUE  
AND HWY. 407 INTERCHANGE  
W.P. 164-79-06  
District 6, Toronto

We have completed the Field Investigation for High Mast Lighting Foundations at the above site. Due to the large area of the site along Hwy. 400 between Finch Avenue and Hwy. 407 interchange, the subsurface conditions for the High Mast Lighting vary considerably depending upon the location. However, the site is located in the physiographic region known as the "Peel Plain" as described by the physiography of Southern Ontario (Chapman and Putman. 1984)..

The site is characterized by a level to gently undulating topography sloping gradually towards the south. The underlying soil consists mainly of a hard layer of cohesive glacial till of varying thickness. The till deposits are interbedded with some continuous lacustrine layers and frequent random discontinuous silt to sand pockets. Bedrock was not encountered during the investigation, but is reported to be composed of shale with limestone laminations and located below elevation 120± metres. Land use is mainly for industrial and agricultural purposes. Groundwater was observed in the boreholes at approximate elevations between 182.3 m and 191.2 m which corresponds to some 0.1 to 8.2 m below the existing ground surface.

.../2



Based on the site investigation, we present the following discussion and recommendations for the High Mast Lighting at the above sites.

#### DISCUSSION AND RECOMMENDATIONS

A foundation investigation was carried out between 88-02-08 and 88-02-16 at the above-noted site in order to establish soil parameters for the design of the 18 HML foundation among the proposed 20 HML. The investigation consisted of advancing 1 borehole at each of the HML locations to a depth ranging between 12.4 and 15.7 m below the ground level.

Table 1 indicate the proposed location of each of the 30 m high HML. As shown on Table 1, since the proposed HML location for C-7 and C-15 is situated in the private properties and further permission to enter this properties could not be obtained within the limited time, the site investigation for this location was deferred to a later date. It should be noted that since a proposed HML location is situated on the slope of Hwy. 400 embankment, actual borehole location for HML #9 moved toward easterly about 4.0 m from the original location. It should be also noted that the proposed location for HML #8 was moved toward easterly about 2.0 m to allow for the overhead hydro line clearance.

#### Design Consideration

The High Mast Lighting foundations will be supported on a single concrete caissons and the design should be in accordance with the method described by Broms as per the following 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

Lateral Resistance of Piles in Cohesionless Soils.

Journal of the Soil Mechanics and Foundation Division, ASCE,  
Vol. 90, No. SM3  
Paper 3909, May 1964

The soil parameters provided in Table 2 are recommended for the design of the HML foundations. The following notation has been adopted:

$\phi$  = apparent angle of friction for cohesionless soils  
 $q_u$  = unconfined compressive strength in kPa ( $q_u = 2 \times C_u$ ) for cohesive soils  
 $\gamma$  = bulk unit weight in kN/m<sup>3</sup>

The material within the zone of frost penetration depth should not be included in calculations of lateral resistance. At this site, the depth of frost penetration is 1.2 m.

Construction Considerations

The investigation revealed that the subsurface conditions across the site are generally varied, but consist of Glacial Till with some gravel and varying amounts of cobbles and boulders.

Caissons will be located below the prevailing groundwater in granular subsoil. In view of this, the following special provision should be included in the contract:

"The contractor shall install concrete footings in earth for high mast poles. At the various pole locations, soil deposits consist of mixtures of silts, sands and gravels with occasional cobbles and boulders. Groundwater is likely to be encountered from 0.1 to eight metres below the existing ground surface. The soil is highly susceptible to conditions of unbalanced hydrostatic head and seepage forces and is likely to 'boil' and become unstable under such conditions. The contractor shall maintain the stability of the soil in the sides and bases of the holes for the concrete footings at all times from commencement of their construction to the placing of concrete."

.../4

Our complete foundation investigation and design report will be submitted after the laboratory and drafting work is completed.

We believe that this memorandum meets with your present requirements. If you have any questions, please contact us.

  
Tae C. Kim, P.Eng.

Project Foundation Engineer

for

M. Devata, P.Eng.

Chief Foundation Engineer  
(East)

TCK/mls

Enclosure

c.c. Mr. J. Klowak

Mr. K. Bassi

Mr. W. Lachmaniuk (Giffels Assoc. Ltd.)

TABLE 1

HML BOREHOLE LOCATION

Co-ordinates of Actual Borehole Location

HML BH	Co-ordinates	
C-1	N 4,847,100.5	E 302,139.5
C-2	N 4,847,192	E 302,042
C-3	N 4,847,347.5	E 302,102
C-4	N 4,847,419.5	E 302,000
C-5	N 4,847,574.5	E 302,067.5
C-6	N 4,847,636	E 301,963
C-7	NOT SURVEYED (IN PRIVATE PROPERTY)	
C-8	N 4,847,810	E 301,919.5
C-9	N 4,847,981	E 301,988.5
C-10	N 4,848,160.5	E 301,965
C-11	N 4,848,330	E 301,841
C-12	N 4,848,360	E 301,943
C-13	N 4,848,533	E 301,803
C-14	N 4,848,570.5	E 301,924
C-15	NOT SURVEYED (IN PRIVATE PROPERTY)	
C-16	N 4,848,939.5	E 302,010
C-17	N 4,849,119	E 301,976
C-18	N 4,849,225.5	E 301,800
C-19	N 4,849,340.5	E 301,892.5
C-20	N 4,849,602.5	E 301,803

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-1	182.9	180.5	Cohesive	Hard		180	20.4
	180.5	178.9	Non-Cohesive	Very Dense	40		21.2
	178.9	170.3	Cohesive	Hard		450	21.2
C-2	184.7	182.3	Cohesive	Very Stiff		120	19.9
	182.3	180.7	Non-Cohesive	Very Dense	38		21.2
	180.7	172.1	Cohesive	Hard		450	21.2
C-3	187.5	180.4	Cohesive	Hard		230	20.7
	180.4	177.9	Cohesive	Hard		450	21.2
	177.4	174.9	Non-Cohesive	Very Dense	40		

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-4	188.2	186.4	Cohesive	Very Stiff		140	20.1
	186.4	182.7	Cohesive	Hard		420	21.2
	182.7	175.6	Non-Cohesive	Very Dense	40		21.2
C-5	190.3	186.3	Cohesive	Hard		200	20.4
	186.3	183.3	Non-Cohesive	Very Dense	40		21.2
	181.6	177.7	Cohesive	Hard		500	21.2
C-6	188.7	180.1	Cohesive	Hard		380	21.2
	180.1	176.1	Non-Cohesive	Very Dense	40		21.2

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-8	189.0	186.5	Cohesive	Very Stiff		130	20.1
	186.5	183.3	Cohesive	Hard		450	21.2
	183.3	176.6	Non-Cohesive	Very Dense	40		21.2
C-9	187.5	185.1	Cohesive	Very Stiff		95	19.6
	185.1	180.5	Cohesive	Hard		330	21.2
	180.5	177.4	Non-Cohesive	Dense	36		21.0
	177.4	174.9	Non-Cohesive	Very Dense	40		21.2
C-10	187.7	183.7	Cohesive	Very Stiff		110	19.9
	183.7	182.0	Cohesive	Hard		450	21.2
	182.0	179.1	Non-Cohesive	Very Dense	34		20.7
	179.1	176.1	Cohesive	Hard		500	21.2
	176.1	175.1	Non-Cohesive	Dense	34		20.7

WP. 164-79-01  
HIGH MAST LIGHTING  
HWY. 400-407

TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	Ø DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-11	187.9	185.3	Cohesive	Very Stiff		140	20.1
	185.3	180.9	Cohesive	Hard		420	21.2
	180.9	177.8	Non-Cohesive	Dense	38		21.2
	177.8	175.5	Cohesive	Hard		450	21.2
C-12	190.1	186.0	Cohesive	Very Stiff		100	19.9
	186.0	180.0	Cohesive	Hard		420	21.2
	180.0	177.5	Non-Cohesive	Dense	33		20.4
C-13	189.9	177.3	Cohesive	Hard		420	21.2



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TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	0 DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-14	197.3	191.6	Cohesive	Very Stiff		150	20.1
	191.6	188.7	Cohesive	Hard		190	21.2
	188.7	181.6	Cohesive	Hard		330	21.2
C-16	191.7	189.3	Cohesive	Stiff		60	19.3
	189.3	179.1	Cohesive	Hard		420	21.2
C-17	191.0	186.9	Cohesive	Very Stiff		150	20.1
	186.9	178.4	Cohesive	Hard		330	21.2

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TABLE 2 SOIL PARAMETERS

POLE	ELEVATION (m) FROM TO		TYPE OF SOIL	DENSENESS OR CONSISTENCY	0 DEGREE	q <sup>u</sup> kPa	kN/m <sup>3</sup>
C-18	192.3	186.7	Cohesive	Hard		230	20.7
	186.7	179.7	Cohesive			420	21.2
C-19	191.0	187.0	Cohesive	Very Stiff		100	19.9
	187.0	183.8	Cohesive	Hard		230	21.0
	183.8	178.4	Cohesive	Hard		410	21.2
C-20	198.1	192.5	Cohesive	Very Stiff		110	19.9
	192.5	182.4	Cohesive	Hard		410	21.2