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DIST. 2 REGION

W.P. No. 479-89-05

CONT. No. 92-06

W. O. No.

STR. SITE No. 23-209

HWY. No. 401

LOCATION Hwy 401 & CPR Overhead

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

*CONT 92-06*

WP 479-89-05 DIST 2  
HWY 401 STR SITE 23-209

C.P.R. Overhead

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A. Ho (2) ✓  
C.M. Bond  
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# FOUNDATION INVESTIGATION REPORT

For

C.P.R. Overhead

W.P. 479-89-05, Site 23-209

Hwy. 401, District 2, London

## INTRODUCTION

This report contains the results of a soil investigation carried out at the above mentioned site to provide information for the design and construction of the proposed widening of C.P.R. Overhead.

The field work for this project was carried out between 90 07 16 and 90 07 23, and comprised of six sampled boreholes and Dynamic Cone Penetration Test adjacent to four of the boreholes.

Boreholes were advanced to a maximum depth of 18.8 m (El. 264.3 m) below the existing ground level using a continuous flight hollow stem auger.

## SITE DESCRIPTION

The site under investigation is located about 1.1 km west of Hwy. 19 at the crossing of Hwy. 401 and C.P.R. Overhead in the Township of Southwest Oxford.

The topography of the site with the exception of the existing crossing (embankment fill) is generally undulating with ridges to the east and northwest. The site in question is located in a valley and modified to the present condition by the construction of the existing C.P.R. Overhead.

The ridges are moraines of calcareous clay or silty clay while in the valley it is common to find alluvium of gravel, sand or silt. Physiographically the area is located in the region known as the "Mount Elgin Ridges".

## SUBSURFACE CONDITIONS

### General

The underlying subsoil at this site, with the exception of the embankment fill, consists of loose to compact sand with varying proportions of silt and gravel underlain by a thin layer of stiff to hard cohesive glacial till which overlies dense to very dense sand and gravel. The sand and gravel deposit is underlain by very dense non cohesive glacial till. For classification purposes, the soils encountered at this site can be divided into five different zones.

- a) Embankment Fill
- b) Sand with/some Silt
- c) Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)
- d) Sand and Gravel, trace Silt
- e) Heterogeneous Mixture of Gravel, Sand and Silt (Glacial Till)

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. Two stratigraphical sections and a profile along median are shown on Drwg. No. 4798905-A. This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

### a) Embankment Fill

This fill which was placed to raise the finished grade of the Hwy. 401 consists mainly of Sandy material. The fill on the west side of the overhead bridge is about 5.6 m high and was observed to be in a compact to very dense state of compaction (N-values 20 blows/30 cm to 112 blows/30 cm). However, on the east side of the bridge, the fill is about 9.4 m high and consists of layers of sand and sandy silt with varying proportions of gravel and clay sized particles. The Standard Penetration Test results vary over a wide range (7 blows/30 cm to 45 blows/30 cm) indicating loose to dense state of compaction.

b) Sand with/some Silt

This sandy deposit was encountered in all the boreholes immediately below the topsoil with the exception of boreholes located on Hwy. 401 shoulder. The thickness of this deposit varies from 1.4 m to 6.5 m and extends to El. 280.9 m to 279.4 m. However, the upper 0.5 m to 1.4 m is contaminated with organics. The results of the Gradation Tests carried out on representative soil samples are shown on Figure 1 in an envelope form. These test results indicate that this deposit in the southwestern corner is predominantly composed of sand (Sand 88% to 93%, Silt 7% to 12%), however, the samples from the north and east side of the bridge indicate higher silt content (Silt 30%, Sand 64%). The Standard Penetration Test results vary from 6 blows/30 cm to 19 blows/30 cm. These results indicate that this stratum is in a loose to compact state of compaction.

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

This cohesive glacial till deposit was encountered in all the boreholes, with the exception of boreholes located in the southwest corner in the depth range of 1.4 m to 2.2 m (El. 280.9 m to 279.4 m) below the existing ground level. The thickness of this till deposit varies from 0.8 m to 2.2 m and extends to elevation 280.1 m to 277.9 m. The Gradation Test results are shown on Figure 2 in an envelope form. These results indicate 21% to 72% clayey silt, 13% to 35% sand and 15% to 49% Gravel. The results of the Atterberg Limit Test are shown on Figure 3. The natural moisture content of this deposit varies from 7% to 13.5% with an average value of 10.3%. The Standard Penetration Test results indicate stiff to hard consistency (13 blows/30 cm to 82 blows/30 cm).

d) Sand and Gravel, trace Silt

This deposit was encountered immediately below the cohesive till layer. The thickness of this deposit was observed to vary from 4.6 m to 6.7 m and extends to El. 274.8 m to 272.7 m. The Gradation Test results are shown on Figure 4 in an envelope form. These test results indicate 28% to 56%

Gravel, 34% to 60% Sand and 3% to 12% Silt. The Standard Penetration Test results indicate that this stratum is in a compact to very dense state of compaction (N-values 22 blows/30 cm to over 100 blows/30 cm).

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

This non cohesive glacial till deposit underlies the sand and gravel layer. The Gradation Test results are shown on Figure 5 in an envelope form. These results indicate 16% to 50% gravel, 39% to 49% sand and 7% to 45% silt. The natural moisture content varies from 6.5% to 8% with an average value of 7.1%. This stratum is in a very dense state of compaction and complete refusal to Standard Penetration Test was observed (N-values over 100 blows/30 cm). This deposit extends to the depth probed (i.e. El. 264.3 m), however, the full extent of this glacial deposit was not proven.

Groundwater Conditions

The groundwater was encountered in all four boreholes located at the bottom of the embankment, and was observed between El. 279.8 m and 277.9 m. The groundwater level at each borehole location is as follows:

Borehole (No.)	Elevation (m)
1	278.9
2	277.9
3	279.3
4	279.8

## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to widen the existing C.P.R. Overhead bridge 1.1 km west of Hwy. 19 to provide additional lane on both sides of the Hwy. 401.

The existing bridge is a single span reinforced concrete rigid frame beams structure. The clear span between the face of the abutments is about 13.6 m. The abutments as well as the deck slab appear in good condition. However, wing walls are distressed and cracks at an angle of about 60° to the horizontal were observed on all four wing walls. In addition, the reinforcement of the deck slab has been corroded at several locations. The embankments are sloping at 2H:1V and appear in very good conditions.

It appears from the structural drawings of the existing bridge that the abutments are supported on 483 mm internal diameter casing (890 kN/pile), whereas the wing walls are supported on 406 mm internal diameter casing (535 kN/pile). However, the founding level of the casings are not available.

### Structure Foundations

It is our opinion that the subsoil condition at the site would permit shallow foundation for the proposed structures. However, the existing piles under the wing walls will interfere with the proposed footings and the option of shallow foundation will not be feasible with the existing arrangement. In view of this, it is recommended that the abutments and wing walls be supported on steel H-piles driven to noncohesive glacial till deposit which will be encountered in the depth range of El. 274.5 m to 272.5 m.

The maximum allowable load for the steel H-pile section selected may be used for the design purposes. For the purposes of the O.H.B.D.C., the following values are recommended:

	<u>HP 310x110</u>	<u>HP 310x79</u>
Factored Bearing Capacity at U.L.S.	1600 kN	1150 kN (130T)
Bearing Capacity at S.L.S. Type II	1150 kN	900 kN (100T)

Driving of piles shall be carefully monitored and controlled employing the Hiley Dynamic Pile Driving formula driven in accordance with MTO Standards SS103-10 or SS103-11 assuming an ultimate capacity as follows:

<u>Pile Type</u>	<u>Ultimate Capacity (kN)</u>
HP 310x79	2700
HP 310x110	3450

As indicated before, the founding level of the existing piles are not available and the capacity of the piles cannot be estimated. If these piles are proposed to be incorporated in the new design, the details such as founding level, method of construction and type of bearing end (closed or open) should be checked and made available to this office for the estimation of pile capacity. In the absence of these details, no comments can be made on the load carrying capacity of the existing piles. The proposed structures may be supported on steel H-piles, neglecting the bearing capacity of the existing piles.

Earth pressure for the design of the abutments and wing walls should be computed as per Section 6.1.2.2. of the O.H.B.D.C., and an unyielding foundation condition may be assumed for the computations. The Granular 'A' or 'B' backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular fill.

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction $\phi$	35°	30°
Unit Weight (kN/m <sup>3</sup> ) $\gamma$	22.8	21.2

#### Approach Embankment

Considering the subsoil conditions at this site, no stability problems are anticipated for the approach embankment constructed with 2H:1V side



slopes. The embankment fill should consist of well compacted acceptable material. The topsoil as well as any spongy or soft areas observed within the base width of the embankment should be removed before placing the fill.

The benching for the approach fill shall be carried out in accordance with OPSD 208.01.

#### Other Considerations

The pile tips should be reinforced with pile driving shoes as per MTO Standards (DD-3301 latest revision).

The pile caps should have a minimum of 1.2 m earth cover to protect against the frost penetration.

#### MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer, and J. LeMessurier, Student Engineer Trainee. The equipment used was owned and operated by Master Soil Investigation Ltd. This report was prepared by M. Vasavithasan and reviewed by P. Payer, Senior Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



*M. Vasavithasan*

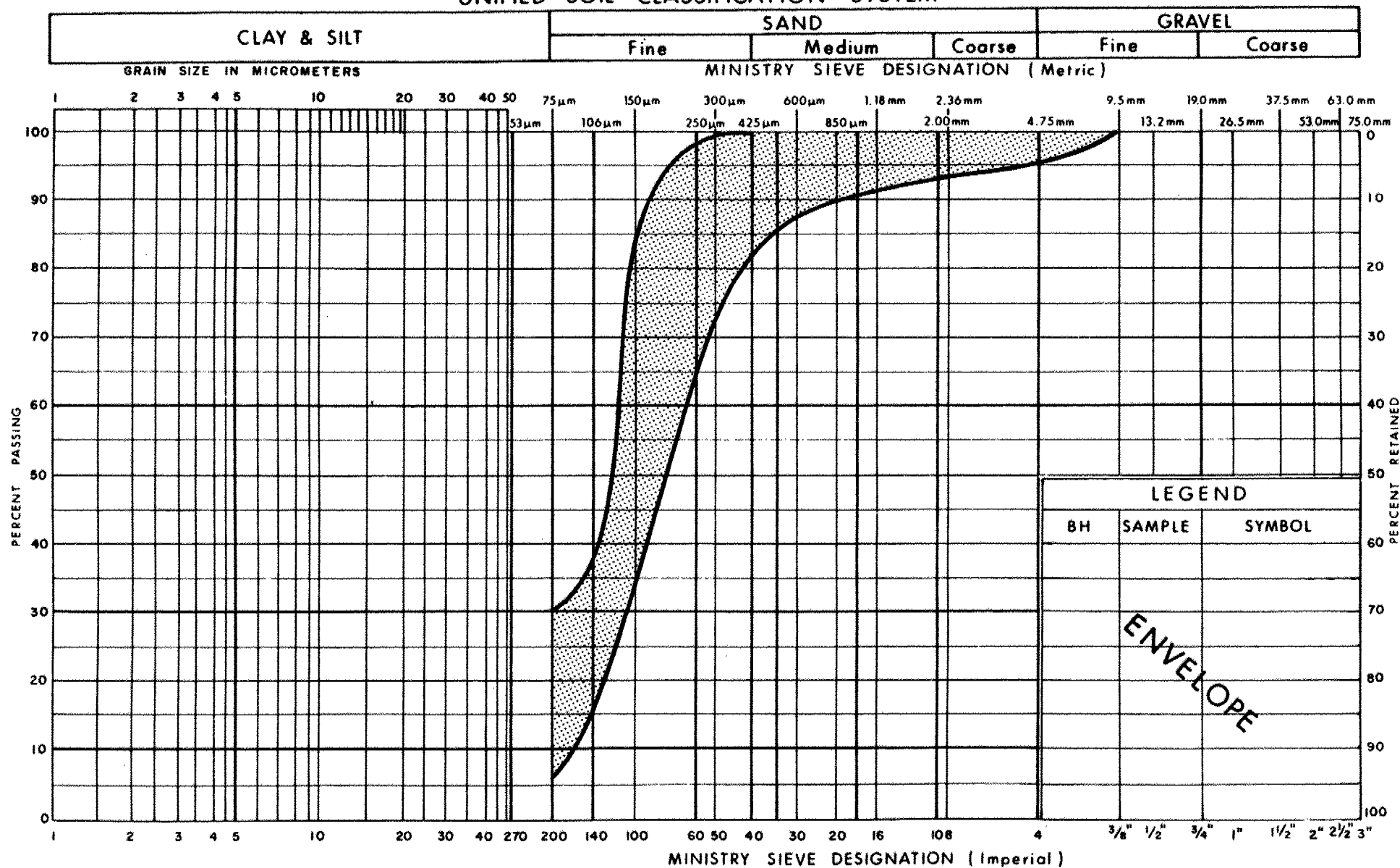
M. Vasavithasan, P.Eng.  
Foundation Engineer

*M. Devata*  
M. Devata, P.Eng.

Chief Foundation Engineer

## APPENDIX

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

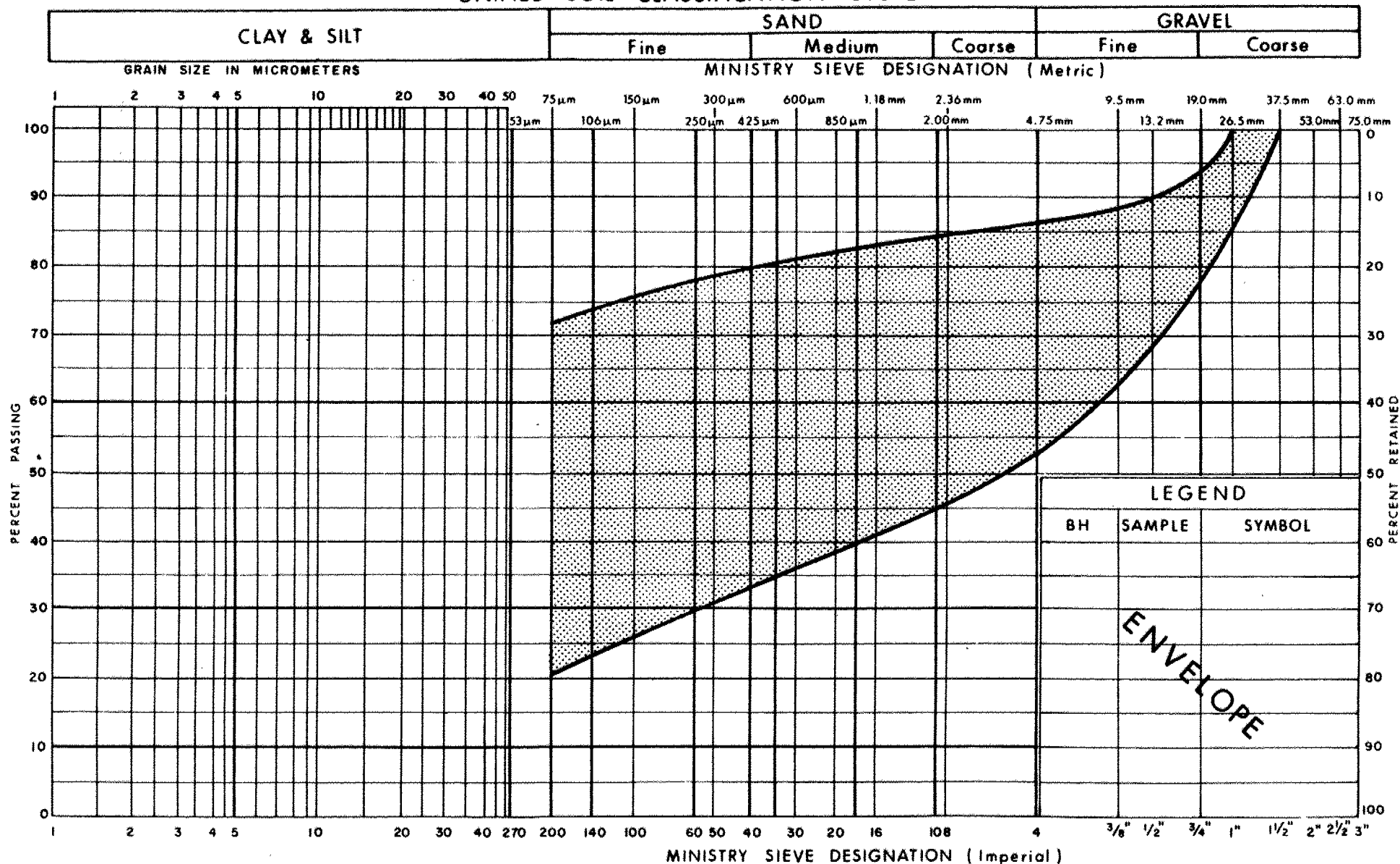
Ministry of  
Transportation

**GRAIN SIZE DISTRIBUTION**  
SAND, SOME/WITH SILT, TRACE OF GRAVEL

FIG No 1

W P 479-89-05

## UNIFIED SOIL CLASSIFICATION SYSTEM

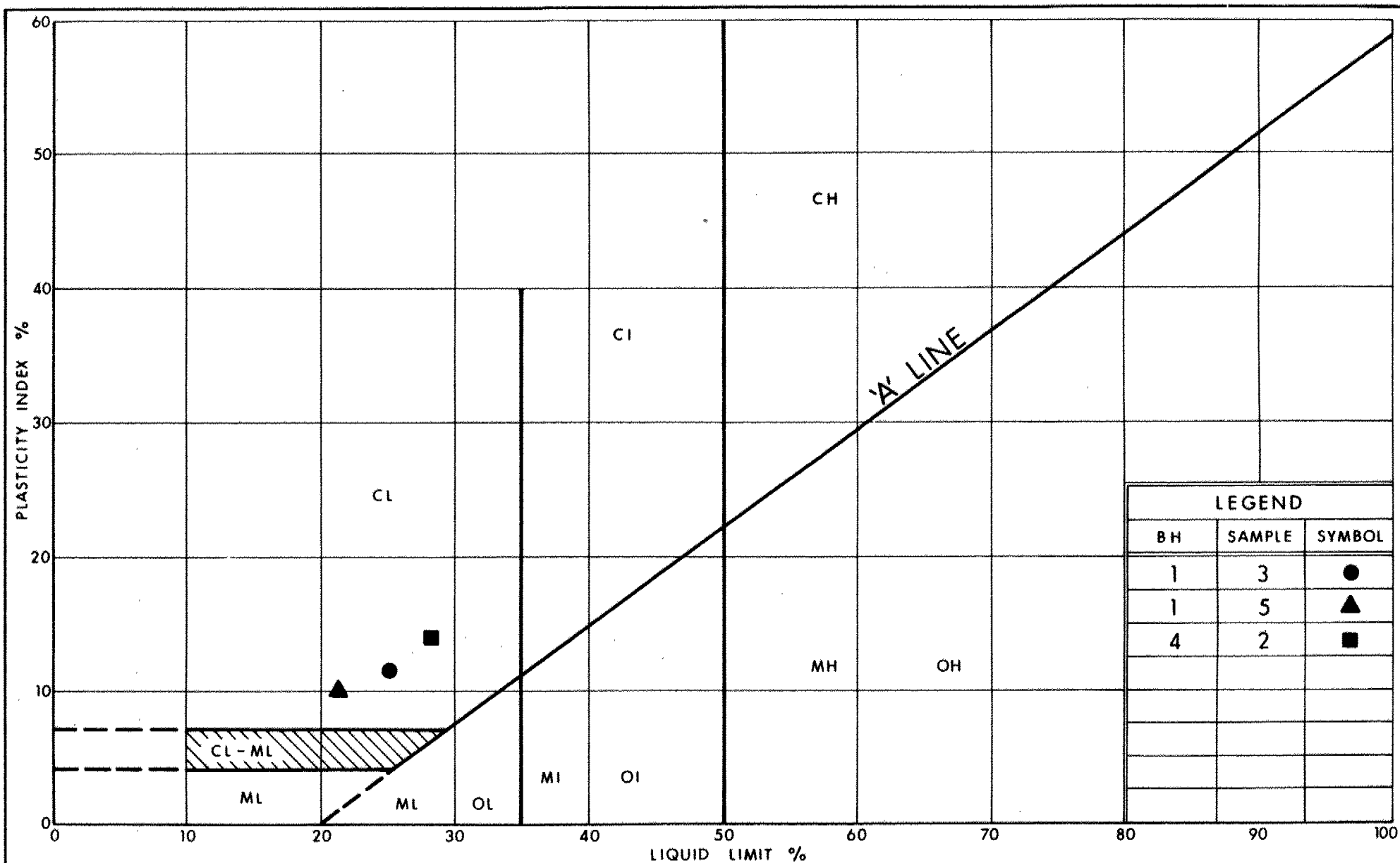


Ministry of  
Transportation

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

FIG No 2

W P 479-89-05



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Transportation

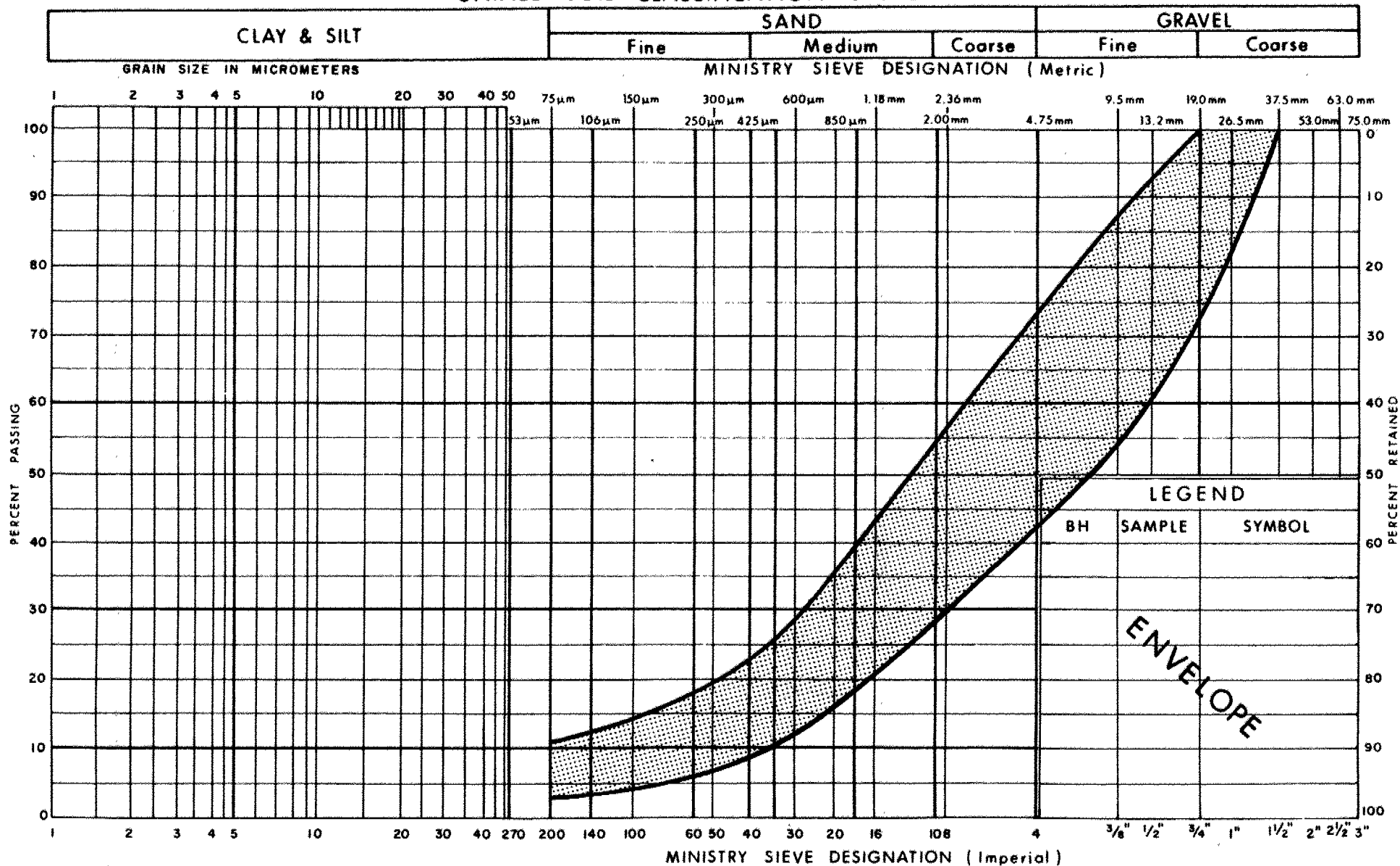
Ontario

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

FIG No 3

W P 479-89-05

## UNIFIED SOIL CLASSIFICATION SYSTEM



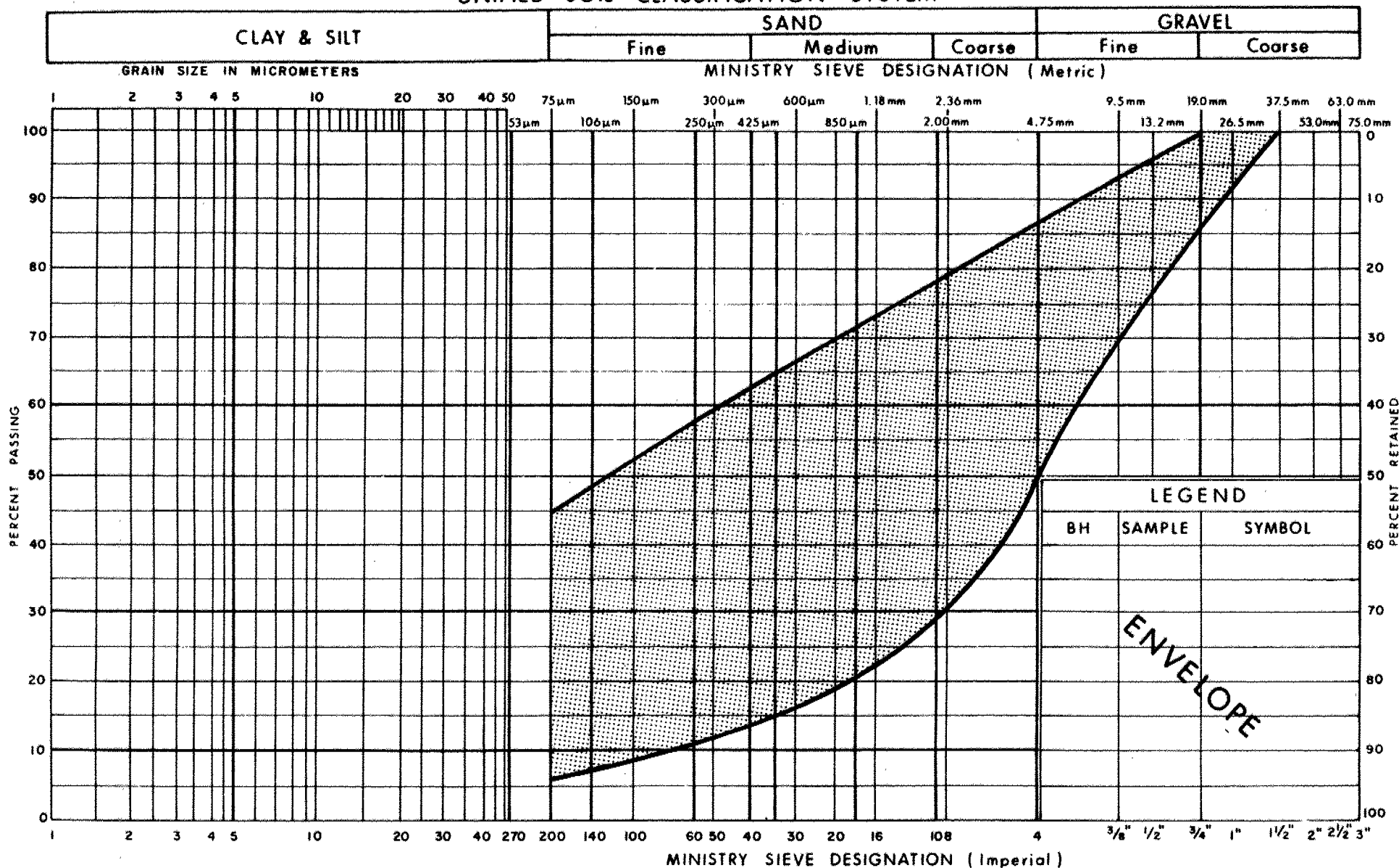
Ministry of  
Transportation

# GRAIN SIZE DISTRIBUTION SAND & GRAVEL, TRACE OF SILT

FIG No 4

W P 479-89-05

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

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

FIG No 5

W P 479-89-05

## 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 = $w_L - w_p$	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>2</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						



# RECORD OF BOREHOLE No 1 1 OF 1 METRIC

W.P. 479 - 89 - 05 LOCATION CO - ORDS. N 4 765 225.2; E 193 527.8 ORIGINATED BY M V&J L  
 DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V  
 DATUM GEODETIC DATE 90 07 16 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
282.6														
0.0	Trace of Organics		1	SS	10		282							
280.4	SAND With Silt, Trace of Gravel, Loose		2	SS	7		280							6 64 (30)
2.2	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL		3	SS	38		280							21 35 (44)
278.2	Hard ( Glacial Till )		4	SS	82		278							49 30 (21)
4.4			5	SS	52		278							
			6	SS	22		276							45 52 (3)
	SAND and GRAVEL, Trace of Silt, Compact to Dense		7	SS	28		276							
			8	SS	42		274							
			9	SS	94		274							
272.7			10	SS	41		272							51 39 (10)
9.9			11	SS	80	/3cm	272							
			12	SS	100	/10cm	270							
							268							
	Heterogeneous Mixture of GRAVEL, SAND and SILT, Very Dense ( Glacial Till )		13	SS	100	/10cm	266							30 49 (21)
264.3			14	SS	100	/3cm								
18.3	End of Borehole													

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 479 - 89 - 05 LOCATION CO - ORDS. N 4 765 240.5; E 193 545.9 ORIGINATED BY M V&J L  
 DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V  
 DATUM GEODETIC DATE 90 07 16 & 90 07 17 CHECKED BY P P

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					
281.6	Ground Surface																
0.0	Trace of Organics		1	SS	19												
279.4	SAND With Silt, Trace of Gravel, Compact		2	SS	18												
2.2	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Very Stiff to Hard ( Glacial Till )		3	SS	17												
277.9			4	SS	41												
3.7			5	SS	31												43 46 (11)
	SAND and GRAVEL, Trace of Silt, Dense		6	SS	47												
			7	SS	36												55 34 (11)
			8	SS	48												
273.3			9	SS	56												
8.3			10	SS	120	/23cm											31 43 (26)
	Heterogeneous Mixture of GRAVEL, SAND and SILT, Very Dense ( Glacial Till )		11	SS	120	/18cm											
			12	SS	120	/15cm											
267.7			13	SS	85	/8cm											
13.9	End of Borehole																

# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 479 - 89 - 05 LOCATION CO - ORDS. N 4 765 167.3; E 193 574.8 ORIGINATED BY M.V&J.L.  
DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M.V.  
DATUM GEODETTIC DATE 90 07 17 & 90 07 18 CHECKED BY P.P.

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				
286.3	Ground Surface														
0.0	Trace of Organics														
			1	SS	6										
	SAND, Some Silt, Loose to Compact		2	SS	12										
			3	SS	16										0 93 (7)
			4	SS	12										
279.8			5	SS	54										0 88 (12)
6.5			6	SS	105										
	SAND and GRAVEL, Trace of Silt, Very Dense		7	SS	66										
			8	SS	74										33 56 (11)
			9	SS	100	/8cm									
			10	SS	79										
274.8			11	SS	76										56 36 (8)
11.5			12	SS	101										
	Heterogeneous Mixture of GRAVEL, SAND and SILT, Very Dense ( Glacial Till )		13	SS	87	/15cm									16 39 (45)
			14	SS	100	/9cm									
			15	SS	100	/10cm									
267.5	Boulders														
18.8	End of Borehole														
	Note: From 17.6 m to 18.8 m Borehole Was Advanced by Tri - Coning														

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 479 - 89 - 05 LOCATION GO - QROS. N 4 765 182.7; E 193 594.6 ORIGINATED BY M V&J L  
DIST 2 HWY 401 BOREHOLE TYPE CONE TEST & HOLLOW STEM AUGER COMPILED BY M V  
DATUM GEODETIC DATE 90 07 17 TO 90 07 19 CHECKED BY P P

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 7 KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
282.3	Ground Surface													
0.0	SAND With Organic Silt, Loose		1	SS	7		282							
280.9			2	SS	13		280							15 13 (72)
1.4 280.1	Het. Mix. of CLAYEY SILT, SAND & GRAVEL, Stiff (Till)		3	SS	36		278							48 48 (4)
2.2			4	SS	120	/23cm	276							
			5	SS	42		274							
			6	SS	55		272							
			7	SS	120	/23cm	270							
			8	SS	29									
			9	SS	91									28 60 (12)
273.4			10	SS	120	/23cm								
8.9			11	SS	120	/10cm								
			12	SS	120	/15cm								
			13	SS	120	/20cm								
268.4														50 43 (7)
13.9	End of Borehole													

# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 479 - 89 - 05 LOCATION CO - ORDS. N 4 765 181.2; E 193 558.1 ORIGINATED BY M. V&J L  
 DIST 2 HWY 401 BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY M V  
 DATUM GEODETIC DATE 90 07 18 CHECKED BY P P

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT UNIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W <sub>p</sub>	W		
291.0	Hwy. 401 Shoulder															
0.0	SAND With Gravel, Some Silt, Compact to Very Dense ( Fill )		1	SS	30	DRY										
			2	SS	20											
			3	SS	34											
			4	SS	35											
			5	SS	112											
			6	SS	58											
285.4	Loose ----- SAND, Some Silt, Trace of Gravel, Very Dense		7	SS	5											
5.6			8	SS	62											
			9	SS	156											
281.4	End of Borehole															
9.6																

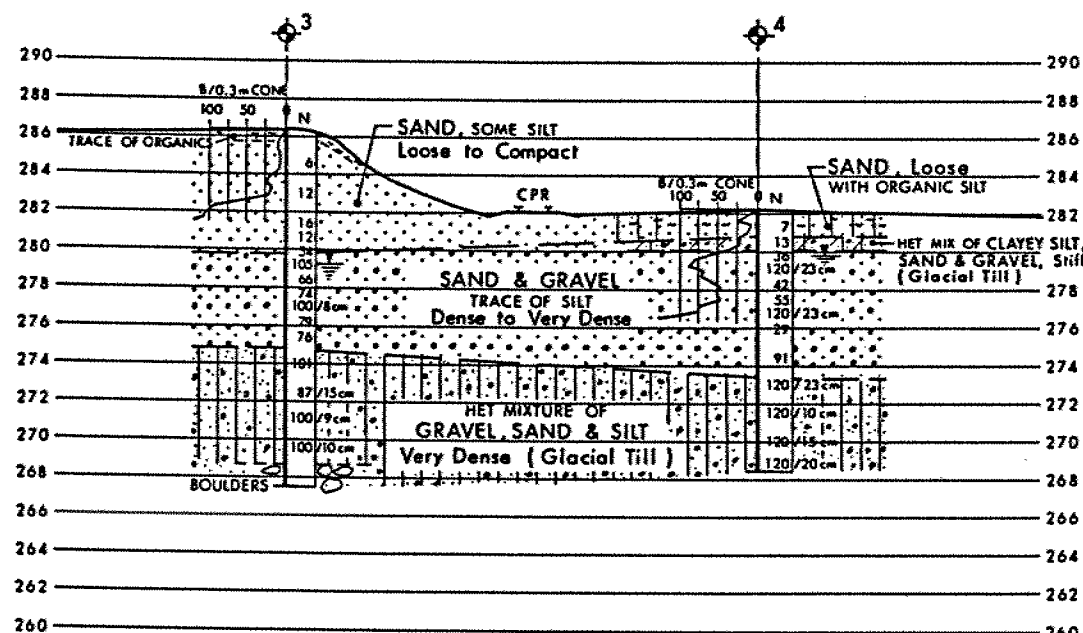
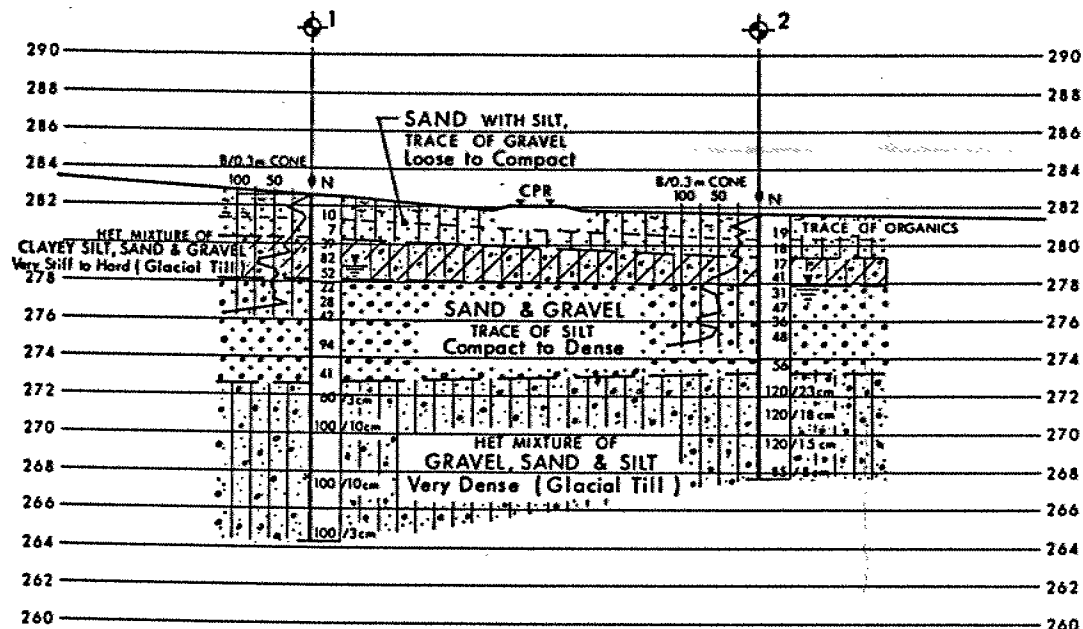
# RECORD OF BOREHOLE No 6

1 OF 1

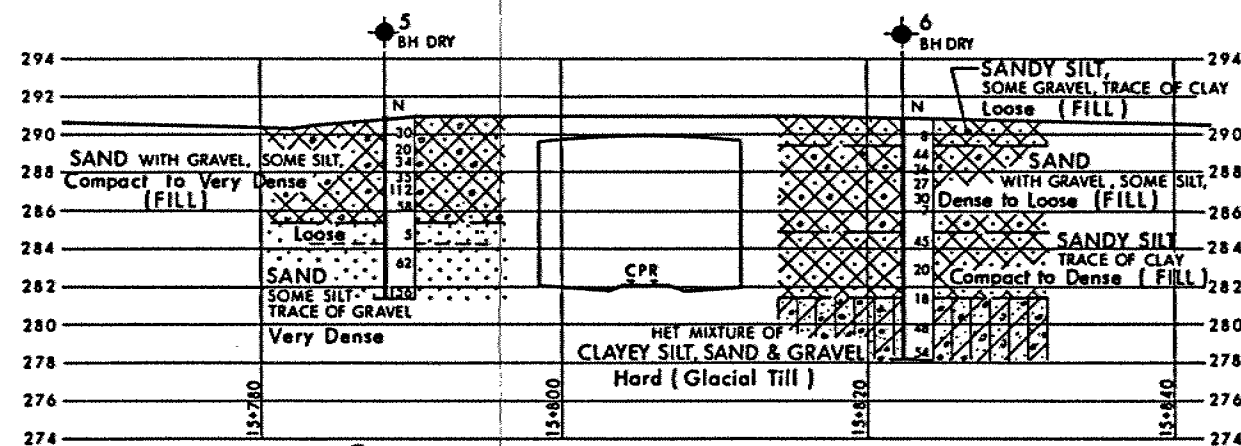
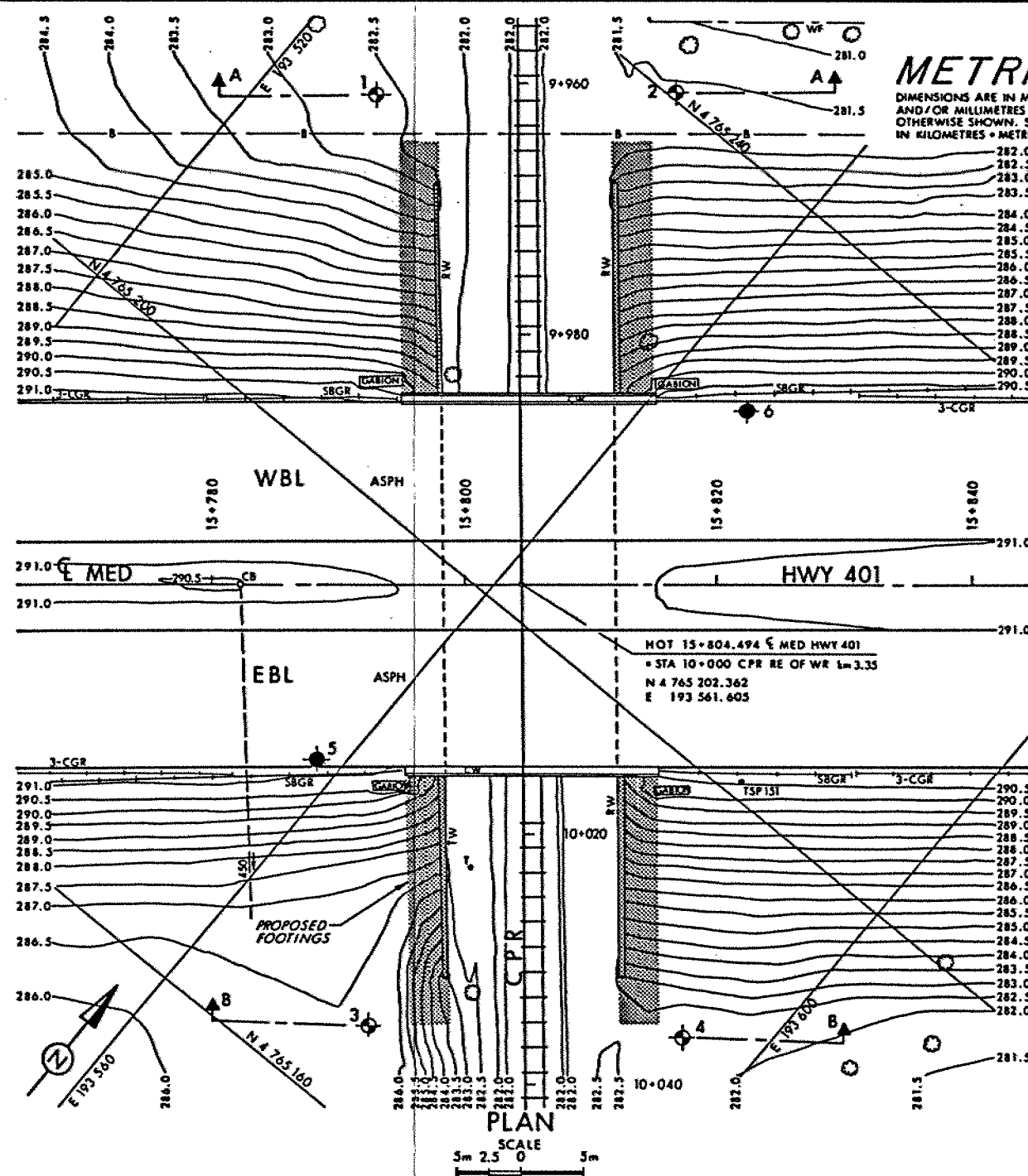
METRIC

W.P. 479 - 89 - 05 LOCATION CO - ORDS. N 4 765 224.5; E 193 566.4 ORIGINATED BY M V&J L  
 DIST 2 HWY 401 BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY M V  
 DATUM GEODETIC DATE 90 07 19 & 90 07 23 CHECKED BY P P

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 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
290.8	Hwy. 401 Shoulder																
0.0	SANDY SILT, Some Gravel, Trace of Clay, Loose ( Fill )		1	SS	8	DRY	290										
289.4			2	SS	44												
1.4			3	SS	36												
	SAND With gravel, Some Silt, Dense to Loose ( Fill )		4	SS	27		288										
			5	SS	30												
			6	SS	7		286										
284.9																	
5.9	SANDY SILT, Trace of Clay, Compact to Dense ( Fill )		7	SS	45		284										
			8	SS	20												
281.4							282										
9.4	Trace of Organics Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till )		9	SS	18												
			10	SS	48		280										
278.2			11	SS	54												
12.6	End of Borehole																



**SECTIONS**  
SCALE  
4m 2 0 4m



SCALE  
5m 2.5 0 5m HOR  
4m 2 0 4m VERT

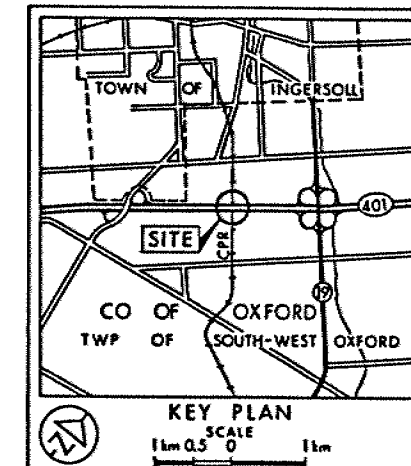
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES - METRES.

CONT No  
WP No 479-89-05

CPR OVERHEAD

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



**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 1990 07

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	282.6	4 765 225.2	193 527.8
2	281.6	4 765 240.5	193 545.9
3	286.3	4 765 167.3	193 574.8
4	282.3	4 765 182.7	193 594.6
5	291.0	4 765 181.2	193 558.1
6	290.8	4 765 224.5	193 566.4

**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 102-2 of Form 100.

DATE	BY	DESCRIPTION
1990 12 20	RS	DATE 1990 12 20 SITE 23-209
1990 12 20	RS	DWG 4798903-A