

GEOCRES No. 30M15-75

DIST. _____ REGION _____

W.P. No. _____

CONT. No. GGE-332

W. O. No. _____

STR. SITE No. _____

HWY. No. GO-ALRT

LOCATION Brock St. Realignment

Watermain and Sanitary Sewer Relocation

Service Road to Byron Street

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____



Ontario

Ministry of
Transportation and
Communications

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GO-ALRT P.O. #M0090

*

NOTE: NO FND REPORT
WAS ISSUED FOR
THIS. JUST A MEMO
(84-07-04) AND A
CONTRACT REPORT

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

GEOCREs No 30M15-75

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
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{VO}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

3

FOUNDATION INVESTIGATION REPORT
for
- Site 'A' -
Brock Street Realignment
GO-ALRT Contract No. GGE-332
Watermain Relocation
Victoria and Brock Streets

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 05 29 and 84 05 31. The investigation consisted of 8 sampled boreholes (BH 1 to BH 8) advanced by means of hollow stem augers to depths ranging from 4.0 to 7.0 m below the existing ground surface. Two of the boreholes were also accompanied by cone penetration tests.

SITE DESCRIPTION AND GEOLOGY

The site is located in the Town of Whitby, Regional Municipality of Durham, approximately 400 m south of Hwy. 401 and 1 km north of Lake Ontario. Eight holes were bored along the north side of Victoria St., 5 west and 3 east of Brock St.

The site is situated in the physiographical region known as the Iroquois Plain which is generally characterized by a combination of till plains, drumlins, and lacustrine deposits. The overburden of this plain is typically underlain by a black shale of the Whitby Formation. Topography in the vicinity of the site is flat to gently rolling.

SUBSURFACE CONDITIONS

The predominant deposit across the site is a glacial till. Two distinct till deposits have been identified. In the upper zone the till is cohesive. Underlying the upper till is a second glacial till deposit which becomes less cohesive with depth to a point where it becomes cohesionless. Overlying the till deposit is between 1 and 3 m of fill. The proposed municipal service relocation will primarily lie within the cohesive till or the cohesive fill.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The locations and elevations of the borings along with a profile showing an estimated stratigraphical section based on borehole data are shown on Drawing Site 'A' - 1 in the Appendix.

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

Fill (Gravelly Sand)

Gravelly sand fill was encountered in BH #2, 4, 6, 7 and 8. The thickness of this fill varies from 0.9 to 1.3 m and is found as the surficial material in all cases. Generally, this gravelly sand fill was encountered at the shoulder area of Victoria St. or at areas of driveways.

Grain size distribution tests were not conducted on samples of this non-cohesive material, however, based on visual observation of samples recovered, it appears that this fill is composed of approximately 70% sand and gravel size particles.

Interpretation of Standard Penetration test 'N' values indicate that this fill is in a very loose to compact state.

Fill (Silty Clay)

Silty clay fill was found in BH #1, 2, 3, and 5. The thickness of this fill varies in thickness from 1.2 to 2.7 m and is found as the surficial material or immediately underlying the gravelly sand fill. This light brown fill appears to have a 'corky' texture when a sample is opened up.

Atterberg Limits tests were carried out on two samples of this cohesive material. Results, plotted on Fig. 1, indicate that this fill exhibits the behaviour of clay of high plasticity (CH group). Natural water content of this material varied between 23% and 30% in the two samples tested.

The results of grain size distribution tests carried out on the same two samples are shown on Fig. 2 and can be summarized as follows:

	Range %	Average %
Gravel	0	0
Sand	2 - 6	4
Silt	43 - 52	48
Clay	46 - 51	49

Based on these results, the fill can be described as a silty clay, trace sand.

Interpretation of Standard Penetration test 'N' values ranging from 10 to 23 blows/0.3 m indicates that the fill has a stiff to very stiff consistency.

Silty Clay with Sand (Glacial Till)

This is the upper of two distinct glacial deposits encountered at this site. This till was found in BH 1-5, west of Brock St. This material was not found east of Brock St. This light brown deposit varies in thickness from 1.1 to 1.9 m and is found underlying either the silty clay fill or the gravelly sand fill.

Atterberg Limits tests were carried out on 3 samples of this material and the results are plotted on Fig. 3. Results indicate that the till matrix is generally a silty clay of low plasticity (CL group). One sample, however, did plot in the CL-ML group (silt of slight plasticity to silty clay of low plasticity). Natural water content of this till ranged from 12.5 to 15.5% with an average of 14%.

The results of grain size distribution tests carried out on 3 samples of this material are shown on Fig. 4 and can be summarized as follows:

	Range %	Average %
Gravel	5 - 9	5
Sand	26 - 35	32
Silt	40 - 43	41
Clay	18 - 25	21

Based on this information this cohesive glacial till can be described as a silty clay, with sand, trace gravel.

Interpretation of Standard Penetration test 'N' values ranging from 8 to 22 blows/0.3 m indicate that this till has a stiff to very stiff consistency. Three vane tests carried out on this till indicate the material to be very stiff.

Heterogeneous Mixture Silty Clay, Sand, Gravel (Glacial Till)

This dark brown till was the lower of the two tills found at this site and was encountered in all boreholes with the exception of BH 2. West of Brock St. this material underlies the upper glacial till deposit previously described. East of Brock St., this till underlies the fill.

It should be noted that this till deposit is cohesive in the upper zones but becomes less cohesive with depth. In BH 1, 3, 7, and 8, augering was advanced to a depth where this till became non-cohesive. The approximate boundary is indicated on the appropriate log sheets in the Appendix. If the slightly cohesive or non-cohesive zones of this till are subjected to an unbalanced hydrostatic pressure, boiling may possibly result.

Atterberg Limits tests were carried out on 5 samples of this material and results are plotted on Fig. 5. The limits indicate that the fines of this till primarily plot in the CL-ML zone (sandy silt of slight plasticity to silty clay of low plasticity), with one sample plotting in the ML zone (silt of slight plasticity). Natural water content of this till stratum ranged from 7 to 9.5% with an average of 8.5%.

Grain size distribution tests carried out on the same 5 samples of this material are shown on Fig. 6 in envelope form, and can be summarized as follows:

Gravel	8 - 30%
Sand	38 - 60%
Silt	19 - 27%
Clay	7 - 12%

The variation in sand and gravel contents can be attributed to the fact that the stratum generally appears to decrease in fines content with depth.

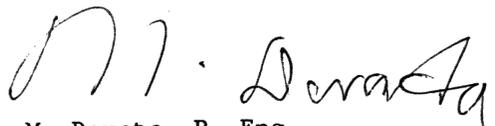
Interpretation of Standard Penetration 'N' values in the cohesive zones of this till indicates that the material has a stiff to hard consistency. In the non-cohesive zones, the till is generally in a very dense state.

Groundwater Conditions

Stabilized groundwater conditions were established when possible by measuring in open boreholes. The measurements indicate that the groundwater level varied from 1.5 to 2.8 m below the ground surface. It should be noted that in BH #7 and 8, no groundwater was evident in the boreholes 1 hr after the borehole was opened.



L. Politano
Project Foundation Engineer



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

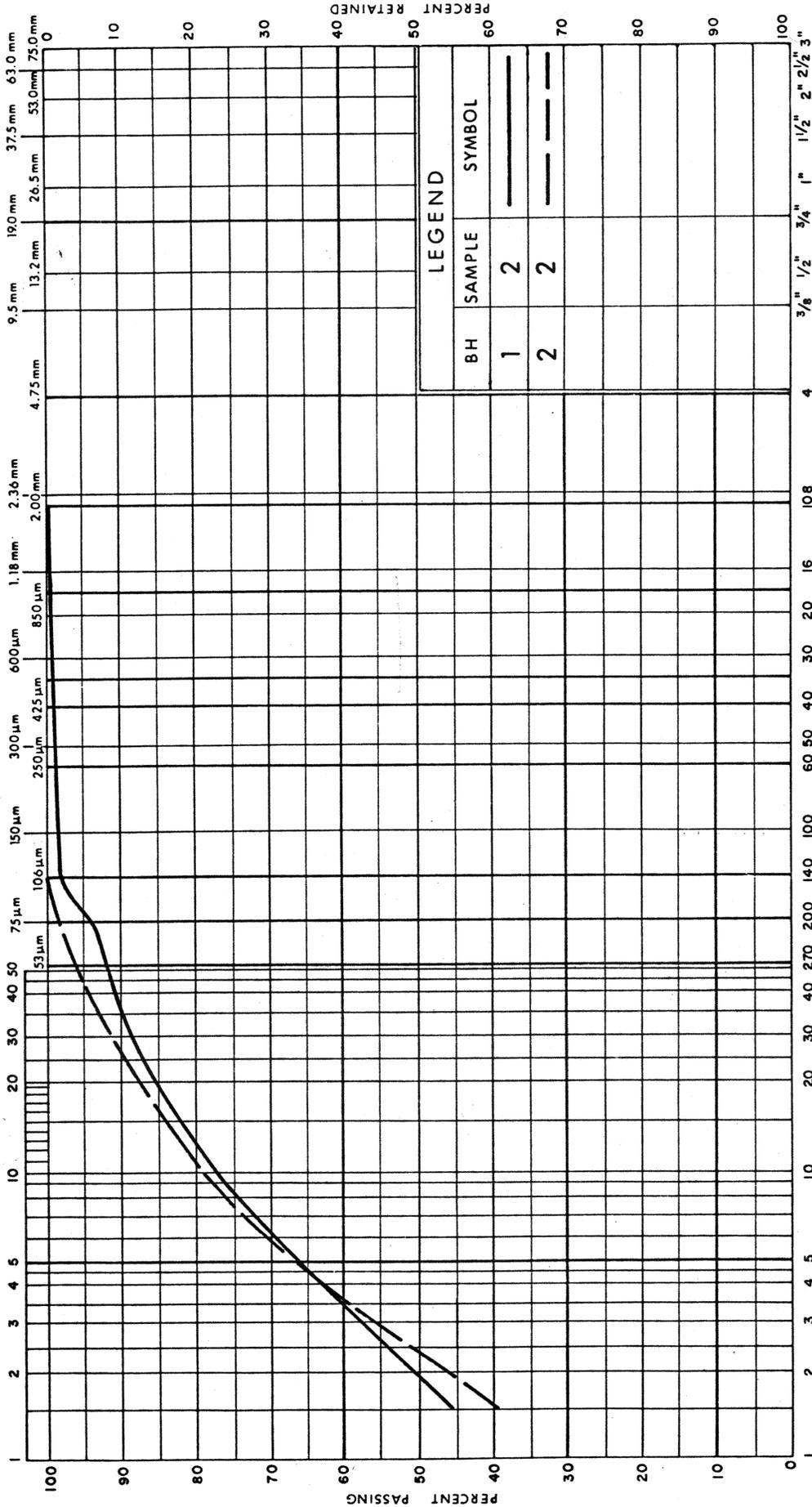
A P P E N D I X

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
Fine		Medium	Coarse	Fine	Coarse	

MINISTRY SIEVE DESIGNATION (Metric)

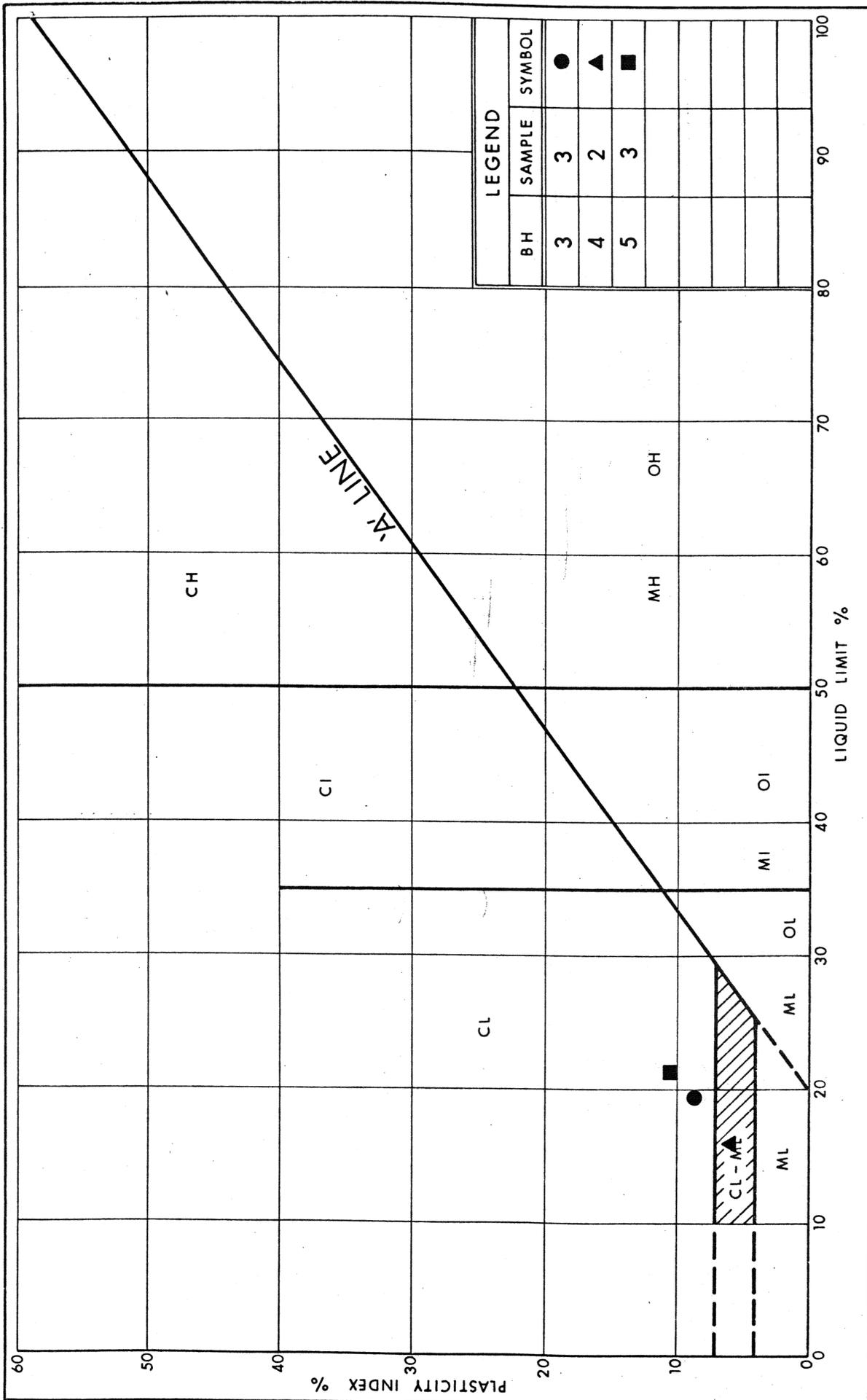
GRAIN SIZE IN MICROMETERS



LEGEND

BH	SAMPLE	SYMBOL
1	2	—
2	2	- - -

Oct 75, FF-S-21



PLASTICITY CHART
SILTY CLAY WITH SAND (Glacial Till)

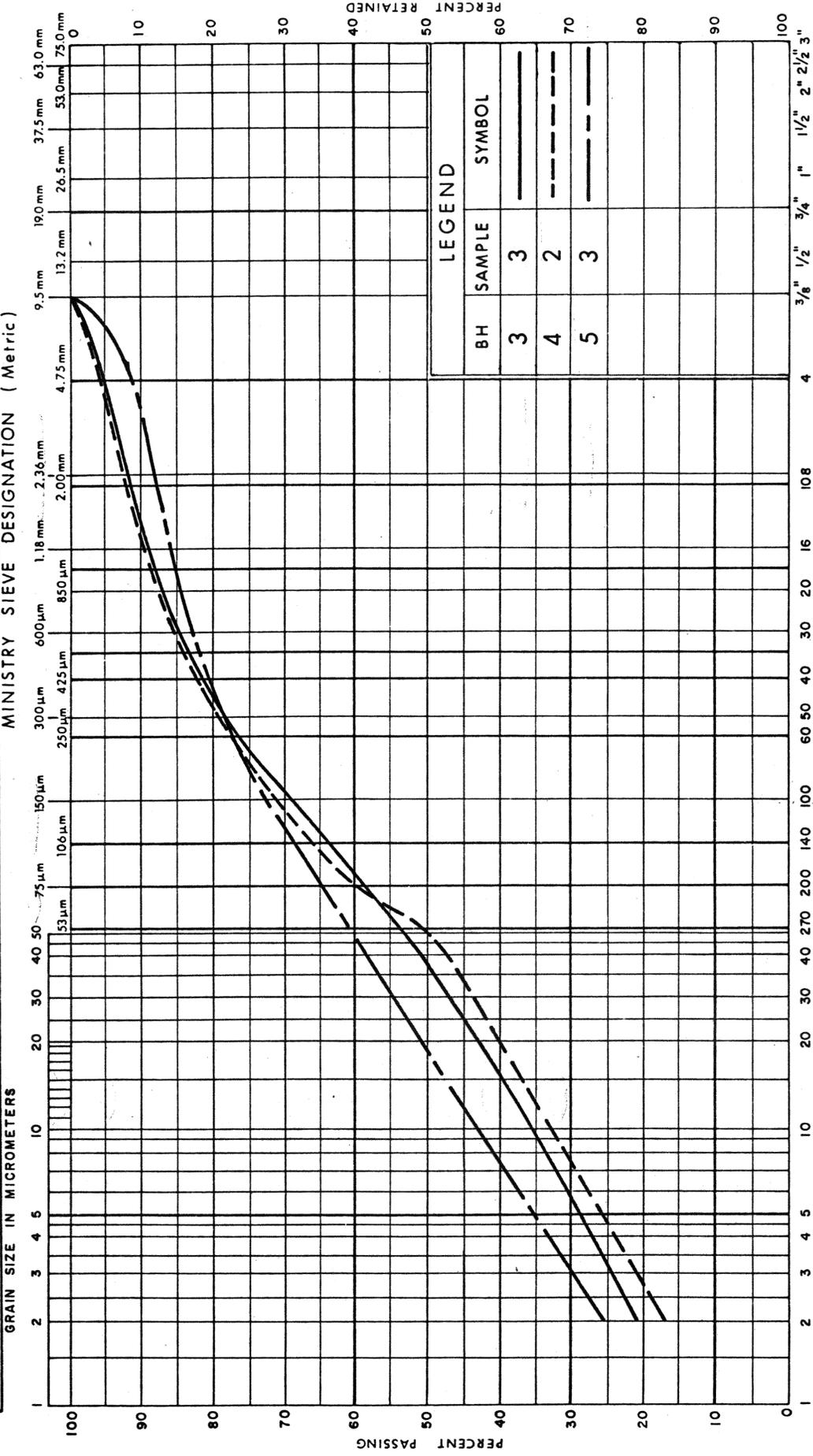
FIG No 3

P.O. M0090

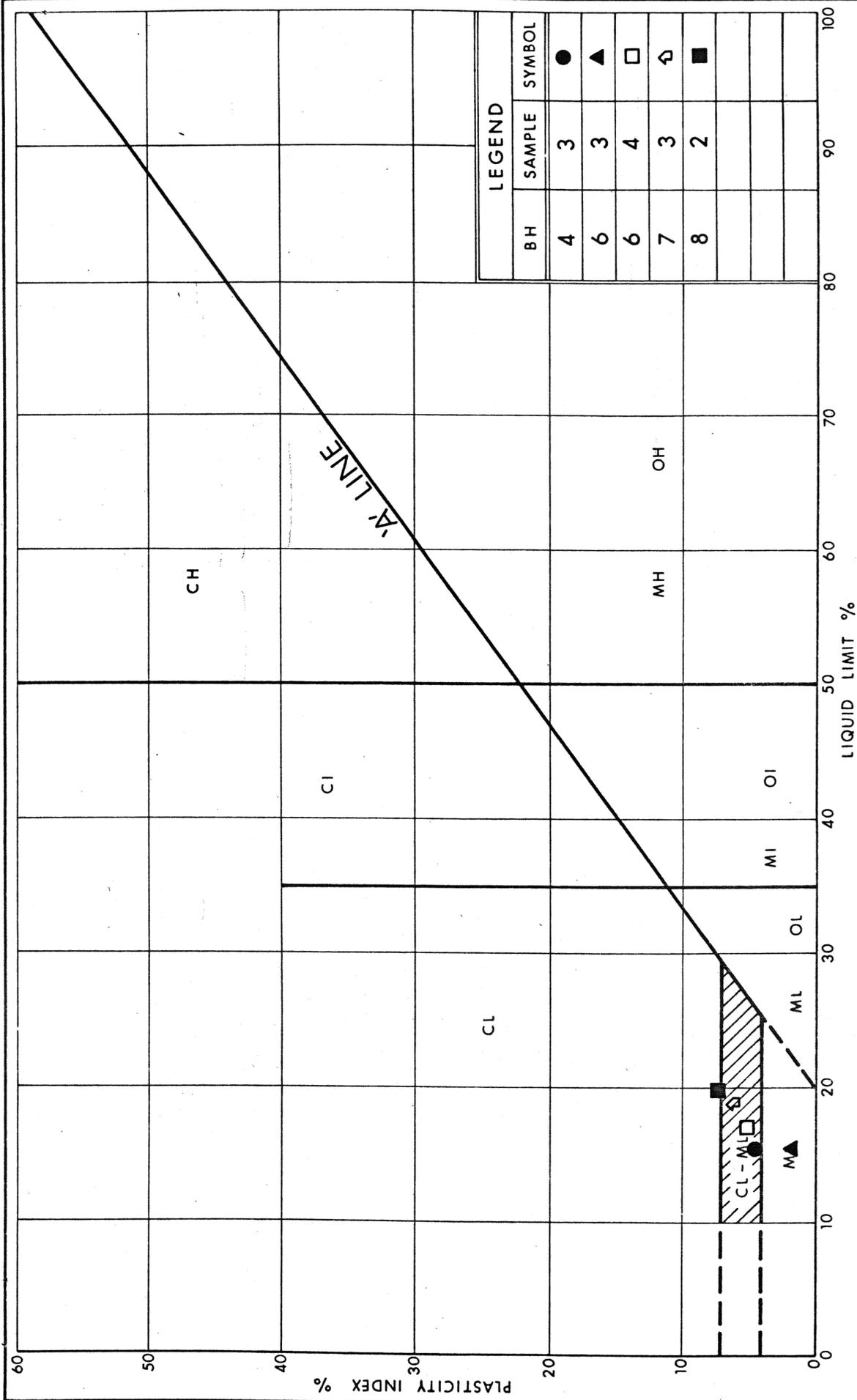
SITE 'A'

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
Fine		Medium		Coarse		Coarse
MINISTRY SIEVE DESIGNATION (Metric)						



Oct 75, FF-S-21



LEGEND		
BH	SAMPLE	SYMBOL
4	3	●
6	3	▲
6	4	□
7	3	◊
8	2	■

PLASTICITY CHART
 HET MIXTURE OF
 SILTY CLAY, SAND, GRAVEL (Glacial Till)

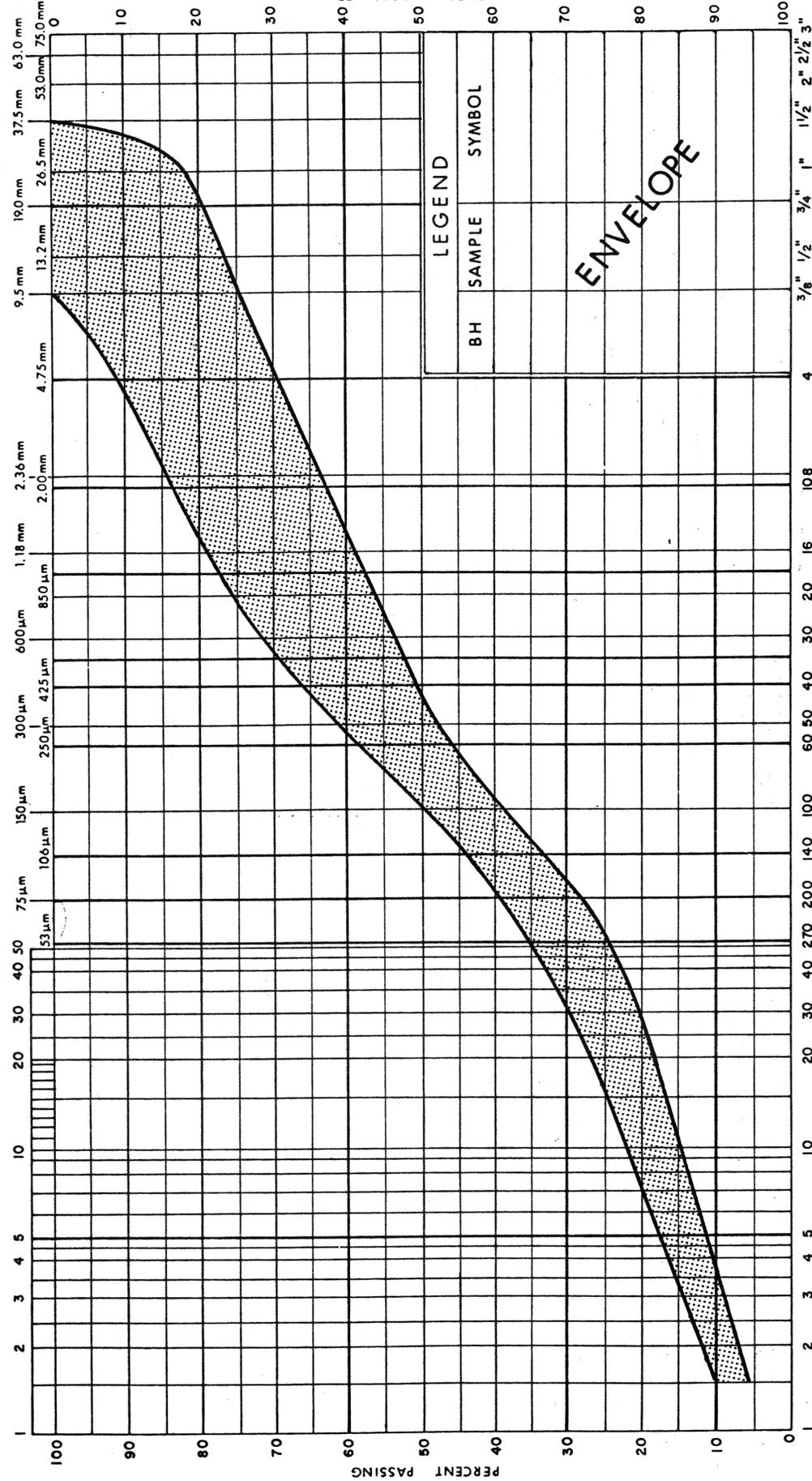
FIG No 5
 P. O. M0090
 SITE 'A'



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)



RECORD OF BOREHOLE No 1

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 925.0; E 350 058.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY IR
 DATUM Geodetic DATE 84 05 29 CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40					
79.2	Ground Surface													
0.0	Fill Silty Clay trace sand Stiff to Very Stiff trace organics		1	SS	11									
			2	SS	23									
76.5			3	SS	10									
2.7	Silty Clay with sand trace gravel (Glacial Till)		4	SS	8									
			5	SS	12									
75.1	Stiff		6	SS	9									
4.1	Heterogeneous Mixture Silty Clay and sand, some gravel (Glacial Till)		7	SS	10									
			8	SS	8									
			9	SS	9									
			10	SS	6									
			11	SS	39									
72.2	Dense to Very Dense		12	SS	72									
7.0	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 2

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 933.7; E 350 084.6 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY IR
 DATUM Geodetic DATE 84 05 30 CHECKED BY *IR*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
79.7	Ground Surface												
0.0	Fill												
78.6	Gravelly Sand some silt trace clay Very Loose		1	SS	4								
1.1	Fill												
76.8	Silty Clay trace sand Stiff to Very Stiff		2	SS	16								0 2 52 46
2.9	Silty Clay with sand, trace gravel (Glacial Till) Stiff		3	SS	14								
75.7	End of Borehole		4	SS	12								
4.0	End of Cone Test												
75.1													
4.6													

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 3

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 946.3; E 350 123.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 30 CHECKED BY *CP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
81.0	Ground Surface																
0.0	Fill																
	Silty Clay trace sand Very Stiff		1	SS	16												
79.8																	
1.2	Silty Clay with sand, trace gravel (Glacial Till)		2	SS	10												
	Stiff		3	SS	10												
78.1	Het. Mixture, Silty Clay and Sand, some gravel (Glacial Till) Becoming less cohesive with depth	4	SS	14													
2.9	non-cohesive	5	SS	10													
76.9	Compact																
4.1	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 4

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 960.3; E 350 166.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 30 CHECKED BY *IR*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						10
82.3	Ground Surface																	
0.0	Fill																	
81.4	Gravelly Sand, some silt, trace clay		1	SS	10													
0.9	Loose to Compact																	
80.2	Silty Clay, with sand, trace gravel (Glacial Till)		2	SS	10													5 34 43 18
	Stiff																	
80.2	Heterogeneous Mixture		3	SS	16													
2.1	Silty Clay, and sand, some gravel (Glacial Till)																	
	Becoming less cohesive with depth		4	SS	8													
78.2	Stiff to Very Stiff		5	SS	14													
4.1	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity

20
15 $\frac{1}{5}$ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 966.8; E 350 189.3 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 30 CHECKED BY *IR*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60						80
83.3	Ground Surface															
0.0	Fill		1	SS	10											
	Silty Clay trace sand		2	SS	14											
	Stiff															
81.7	Silty Clay, with sand, trace gravel (Glacial Till)		3	SS	22										9 26 40 25	
1.6	Very Stiff		4	SS	16											
79.8	Het. Mixture, Silty Clay, and sand, some gravel (Glacial Till)															
3.5	Very Stiff	5	SS	22												
79.2	End of Borehole															
4.1																

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 6

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 984.5; E 350 249.7
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 84 05 30

ORIGINATED BY IR
 COMPILED BY IR
 CHECKED BY *EP*

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES			20	40	60					
85.6	Ground Surface														
0.0	Fill Gravelly Sand, some silt, trace clay Compact		1	SS	17	*									
84.5			2	SS	13										
1.1	Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till)		3	SS	27									8 61 24 7	
	Becoming less cohesive with depth		4	SS	69									23 48 20 9	
	Stiff to Hard		5	SS	60										
80.7			6	SS	60										
4.9	End of Borehole														
	* Note: Water Table not established														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 $\frac{1}{5}$ (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 7

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 998.5; E 350 292.8 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY *EP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
87.0	Ground Surface															
0.0	Fill Gravelly Sand some silt, trace clay Compact		1	SS	24											
85.7																
1.3	Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till) Becoming less cohesive with depth		2	SS	40											
			3	SS	37											
			4	SS	>100											
82.3			5	SS	>100											
4.7	End of Borehole															
	* Note: No water in hole after 1 hour															

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 8

METRIC

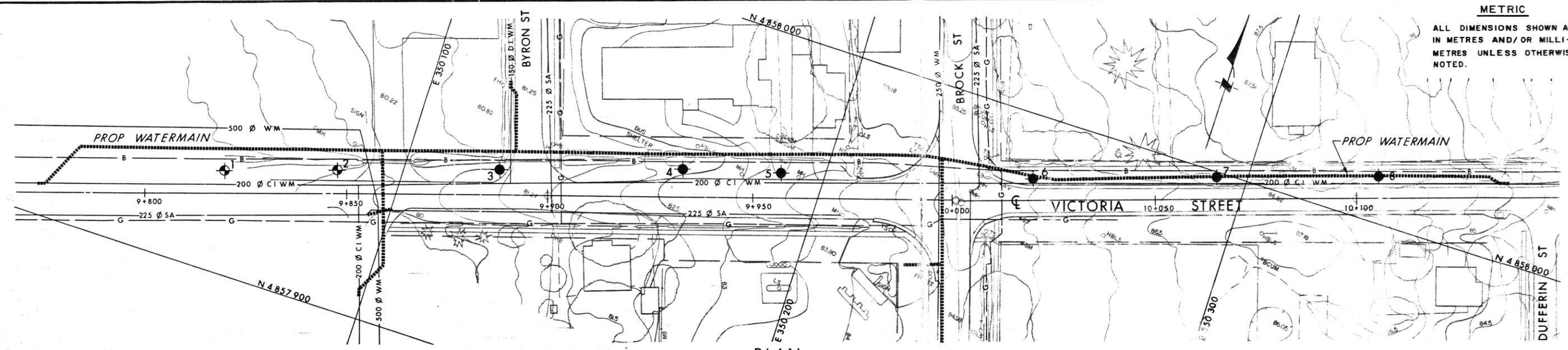
P.O. M0090 LOCATION Co-ords. N 4 858 011.0; E 350 331.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY *EP*

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
86.5	Ground Surface																
0.0	Fill Gravelly Sand, some silt, trace clay						86										
85.5	Compact		1	SS	24	*											
1.0	Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till)		2	SS	36		85									15	46 28 11
	Becoming less cohesive with depth		3	SS	57		84										
	Very Stiff to Hard		4	SS	93		83										
81.8	Non-Cohesive Very Dense		5	SS	103		82										
4.7	End of Borehole * Note: No water in hole after 1½ hour																

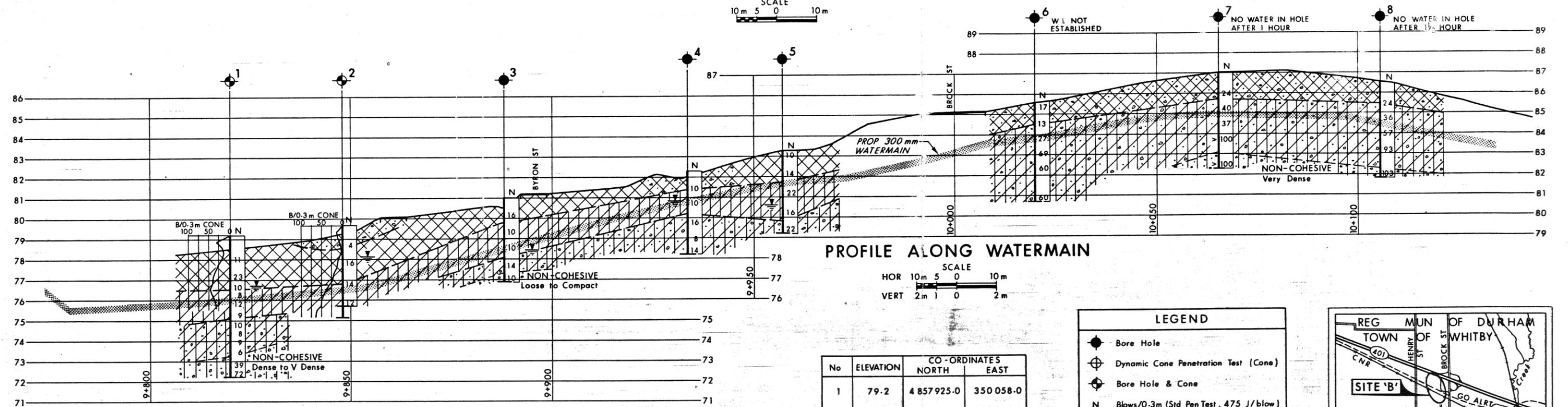
OFFICE REPORT ON SOIL EXPLORATION

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

METRIC
ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLI-METRES UNLESS OTHERWISE NOTED.



PLAN
SCALE
10m 5 0 10m



PROFILE ALONG WATERMAIN
SCALE
HOR 10m 5 0 10m
VERT 2m 1 0 2m

SOIL STRATIGRAPHY LEGEND

- | | | | |
|--|---|--|---|
| | FILL GRAVELLY SAND
SOME SILT, TRACE OF CLAY
Loose to Compact | | SILTY CLAY WITH SAND, TRACE OF GRAVEL (Glacial Till)
Stiff to Very Stiff |
| | FILL SILTY CLAY, TRACE OF SAND
Stiff to Very Stiff | | HET MIXTURE OF SILTY CLAY AND SAND
SOME GRAVEL (Glacial Till)
Stiff to Hard
BECOMING LESS COHESIVE WITH DEPTH |

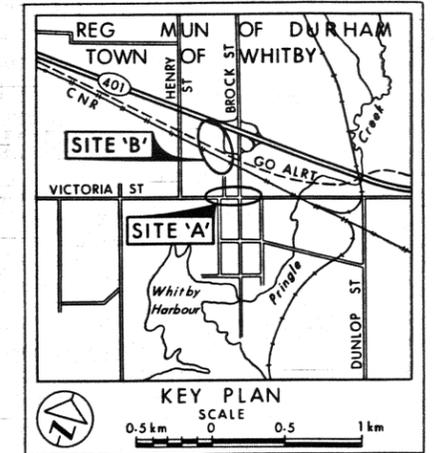
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	79.2	4 857 925.0	350 058.0
2	79.7	4 857 933.7	350 084.6
3	81.0	4 857 946.3	350 123.0
4	82.3	4 857 960.3	350 166.0
5	83.3	4 857 966.8	350 189.3
6	85.6	4 857 984.5	350 249.7
7	87.0	4 857 998.5	350 292.8
8	86.5	4 858 011.0	350 331.0

Geocres No 30M15-75

- 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 84 05

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.



GO-ALRT REF

REFERENCE DRAWINGS		REVISIONS		DRAWN BY:	DESIGNED BY:	ENGINEERING MATERIALS OFFICE FOUNDATION DESIGN SECTION	 Ministry of Transportation and Communications	DURHAM REGION			
84 04 06	U-003 Sheet 60			GP	LP				BROCK ST (RR 46) REALIGNMENT		
	Totten sims hubicki associates			84 07 17					VICTORIA & BROCK STREETS WATERMAIN RELOCATION		
				CHK'D BY:	APPROVED BY:		BOREHOLE LOCATIONS & SOIL STRATA				
				SCALE: FULL SIZE ONLY			CONTRACT NO				
				AS NOTED			GGE-332				
							DWG NO				
							SITE 'A'-1				
							REV SHEET				
							PROJECT MANAGER				

23

FOUNDATION INVESTIGATION REPORT
for
- Site 'B' -
Brock Street Realignment
GO-ALRT Contract No. GGE-332
Watermain and Sanitary Sewer Relocation
Service Road to Byron St.

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 05 31 and 84 06 01. The investigation consisted of 8 sampled boreholes (BH 9 to BH 16) advanced by means of hollow stem augers to depths ranging from 4.1 to 6.6 m below the existing ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located along the Service Rd. and Byron St. some 100 m south of Hwy. 401, just west of Brock St., and approximately 1 km north of Lake Ontario. The site is situated in the Town of Whitby, Regional Municipality of Durham.

The site lies in the physiographical region known as the Iroquois Plain which is generally characterized by a combination of till plains, drumlins, and lacustrine deposits. The overburden of this plain is typically underlain by a black shale of the Whitby Formation. Topography in the vicinity of the site is flat to gently rolling.

SUBSURFACE CONDITIONS

The predominant deposit across the site is a glacial till. Two distinct till deposits have been identified. In the upper till, the soil matrix is composed of a greater percentage of fine particles than that of the lower till. Overlying the till is between 2 and 3 m of fill. The proposed services relocation will primarily lie within the till strata.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The locations and elevations of the borings along with a profile showing estimated stratigraphical sections based on borehole data are shown on Drawing Site 'B' - 1 in the Appendix.

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

Fill (Gravelly Sand)

This fill material was encountered in BH #12, 14, and 16. Thickness of the fill varied from 0.6 to 2.5 m. In BH 14 and 16 the material was found to immediately overlie the natural glacial deposit. In BH 12, this gravelly sand fill was underlain by the silty clay fill.

Results of grain size distribution tests conducted on 2 samples of this material are shown on Fig. 1 and can be summarized as follows:

Gravel	37 - 43%
Sand	34 - 43%
Silt	9 - 19%
Clay	5 - 10%

Based on this information this non-cohesive fill material is described as a gravelly sand, some silt, trace clay.

Interpretation of Standard Penetration test 'N' values indicate that this material is in a compact state.

Fill (Silty Clay)

Silty clay fill was encountered in 6 boreholes (BH 9-13, 15) and ranged in thickness from 1.3 to 3.2 m. This fill was found as the surficial material or immediately underlying the gravelly sand fill (BH 12).

The results of Atterberg Limits testing carried out on 1 sample of this cohesive material are illustrated on Fig. 2 and show that the fill matrix is a silty clay of intermediate plasticity (CI group). Natural water content in the 1 sample was measured to be 23%.

The results of grain size distribution testing carried out on 1 sample of this material are shown on Fig. 3 and can be summarized as follows:

Clay	35%
Silt	45%
Sand	16%
Gravel	4%

Based on its distribution, this material can be described as a silty clay, trace to some sand, trace gravel.

Interpretation of Standard Penetration test 'N' values ranging from 10 to 30 blows/0.3 m reveals that the fill has a generally stiff to very stiff consistency.

Silty Clay with Sand (Glacial Till)

This is the upper of two distinct glacial deposits encountered at this site and was found in BH9-12, 14, 15. The thickness of this stratum ranged from 0.6 m in BH 11 to 2.0 m in BH 10. In all boreholes, this material was found to directly underlie the fill.

Results of Atterberg Limits tests carried out on 7 samples of this material indicate that the till matrix is a silty clay of low plasticity (CL-group). The natural water content of this material varied from 13.5 to 20% in the 7 samples tested, with an average value of 15%. Results of the Atterberg Limits tests are shown on Fig. 4.

Results of grain size distribution testing conducted on the same 7 samples are shown on Fig. 5 in envelope form, and can be summarized as follows:

	Range %	Average %
Gravel	2 - 10	7
Sand	22 - 38	31
Silt	35 - 40	38
Clay	15 - 35	24

Based on this distribution, this till can be described as a silty clay with sand, trace gravel.

Interpretation of Standard Penetration test 'N' values indicates that this cohesive material has a consistency of firm to very stiff.

Heterogeneous Mixture Silty Clay, Sand, Gravel (Glacial Till)

This is the lower of the two till deposits at this site and was encountered in all boreholes with the exception of BH 16. This layer was proven to its full depth in BH 9, 10, 11 where the thickness was in the order of 0.5 m. It appears that the till layer became thicker in the remainder of the boreholes, however, its extent was not proven.

Results of Atterberg Limits tests were carried out on 4 samples of this cohesive material and show that the till matrix is a sandy silt of slight plasticity to a silty clay of low plasticity (CL-ML group). Natural water content in this material was constant at about 8%. Fig. 6 shows the results of the Atterberg Limits tests.

Grain size distribution tests were conducted on 5 samples of this till material are shown on Fig. 7 in envelope form, and can be summarized as follows:

	Range %	Average %
Gravel	22 - 28	25
Sand	40 - 44	42
Silt	18 - 28	24
Clay	6 - 12	9

Interpretation of Standard Penetration test 'N' values indicate that this material has a consistency of firm to hard, but generally very stiff.

Silty Sand

Within the cohesive heterogeneous mixture of silty clay, sand, gravel as described above, an isolated pocket of non-cohesive silty sand was encountered in BH 14 at elev. 81.9 ±. The thickness of this pocket was interpreted to be approximately 0.4 m. Based on visual inspection of a sample of this material, this pocket consisted of approximately 60% sand and gravel, and 40% silt and clay size particles. Interpretation of the Standard Penetration test 'N' value of 24 blows/0.3 m indicates that the non-cohesive pocket is in a compact state.

Sand, Some Silt

Sand was encountered in BH 9, 10, 11 at an elevation of approximately 80, immediately below the heterogeneous mixture of silty clay, sand, gravel.

Two grain size distribution tests were conducted on samples of this material. The results are shown on Fig. 8 and can be summarized as follows:

Gravel	4 - 6%
Sand	61 - 77%
Silt	16 - 28%
Clay	3 - 5%

It is to be noted, however, that these two grain size distribution tests were conducted on samples obtained from the upper zone of this deposit in BH 10 and the results may not be representative of the material.

It appears that in this stratum the gravel and sand content increases with depth. Based on visual inspection, sample 9 of BH 11 was composed of approximately 30% gravel and 60% sand.

Interpretation of Standard Penetration test 'N' values indicate that this material is in a compact to dense state.

When subjected to an unbalanced hydrostatic pressure, this material may be susceptible to boiling.

Silty Clay

Immediately underlying the fill in BH 16, silty clay was encountered at elevation 82.1.

Results of Atterberg Limits testing conducted on two samples of this material are shown on Fig. 9 and indicate that this deposit can be classified as a silty clay of intermediate plasticity. Natural water content varied from 32.5 to 39.5%.

One grain size distribution test was conducted on this material and results indicate 33% clay, 61% silt, 6% sand, and zero % gravel sized particles. Results are shown on Fig. 10.

Interpretation of Standard Penetration test 'N' values, varying from 5 to 14 blows/0.3 m, indicate that this cohesive material has a firm to stiff consistency.

GROUNDWATER CONDITIONS

Stabilized groundwater conditions are established when possible measuring in open boreholes. The measurements indicate that the groundwater level varied from 1.9 to 2.7 m below the ground surface. It should be noted that in BH 13 no groundwater was evident in the borehole 1 hour after the borehole was opened.



L. Politano
Project Foundation Engineer



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

A P P E N D I X

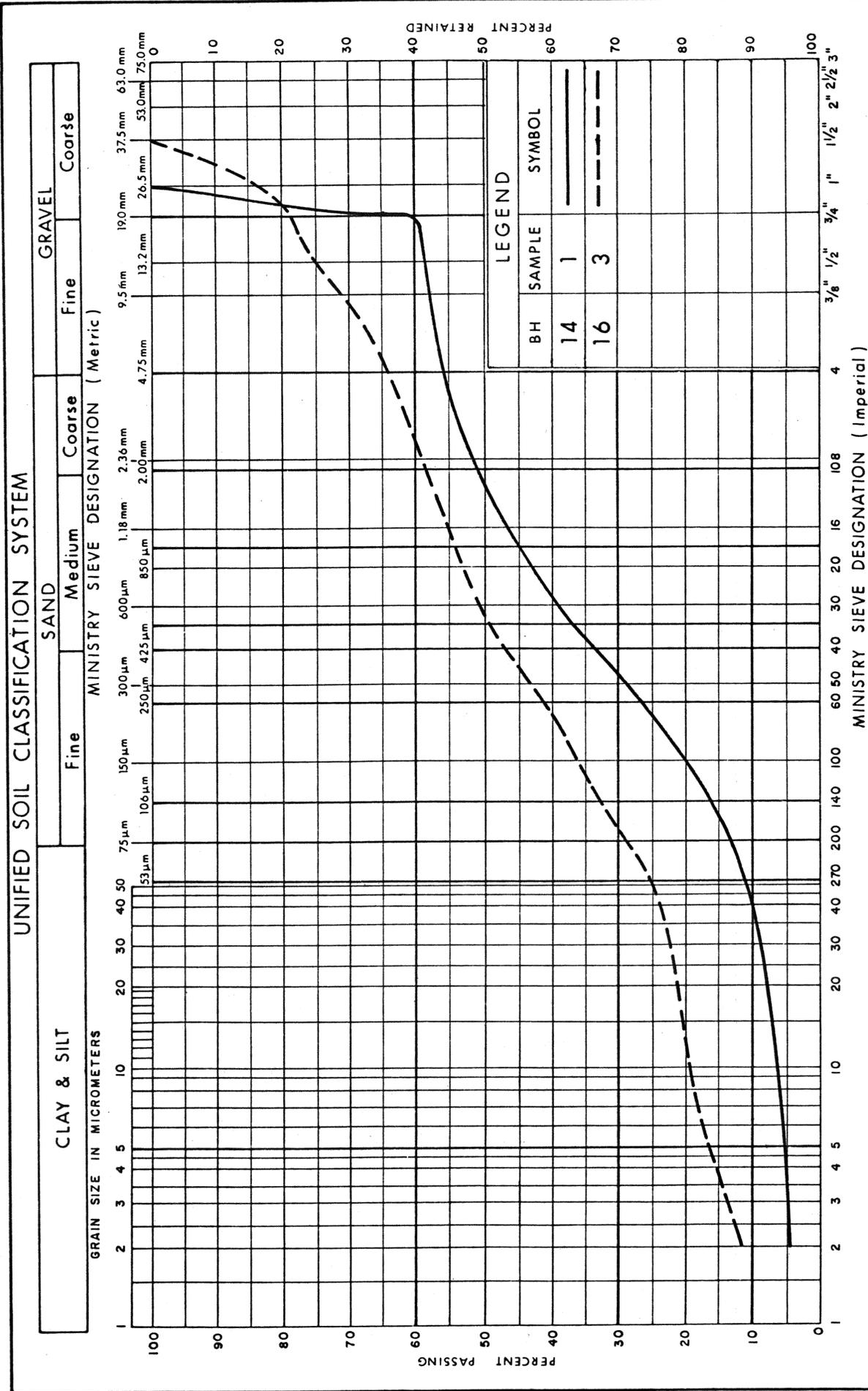


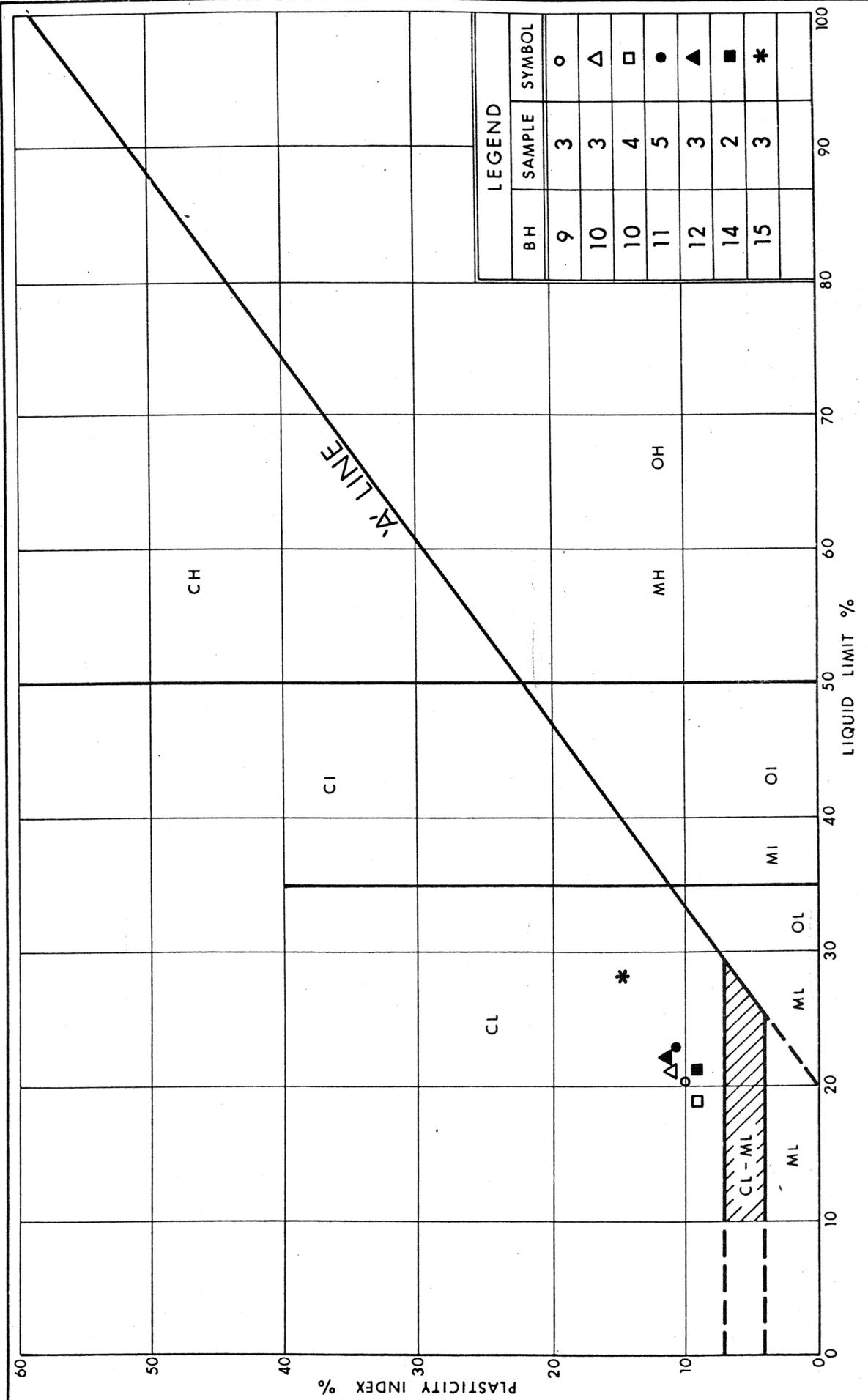
FIG No 1

P.O. M0090

SITE 'B'

GRAIN SIZE DISTRIBUTION FILL (GRAVELLY SAND)

Oct 75, FF-S-21

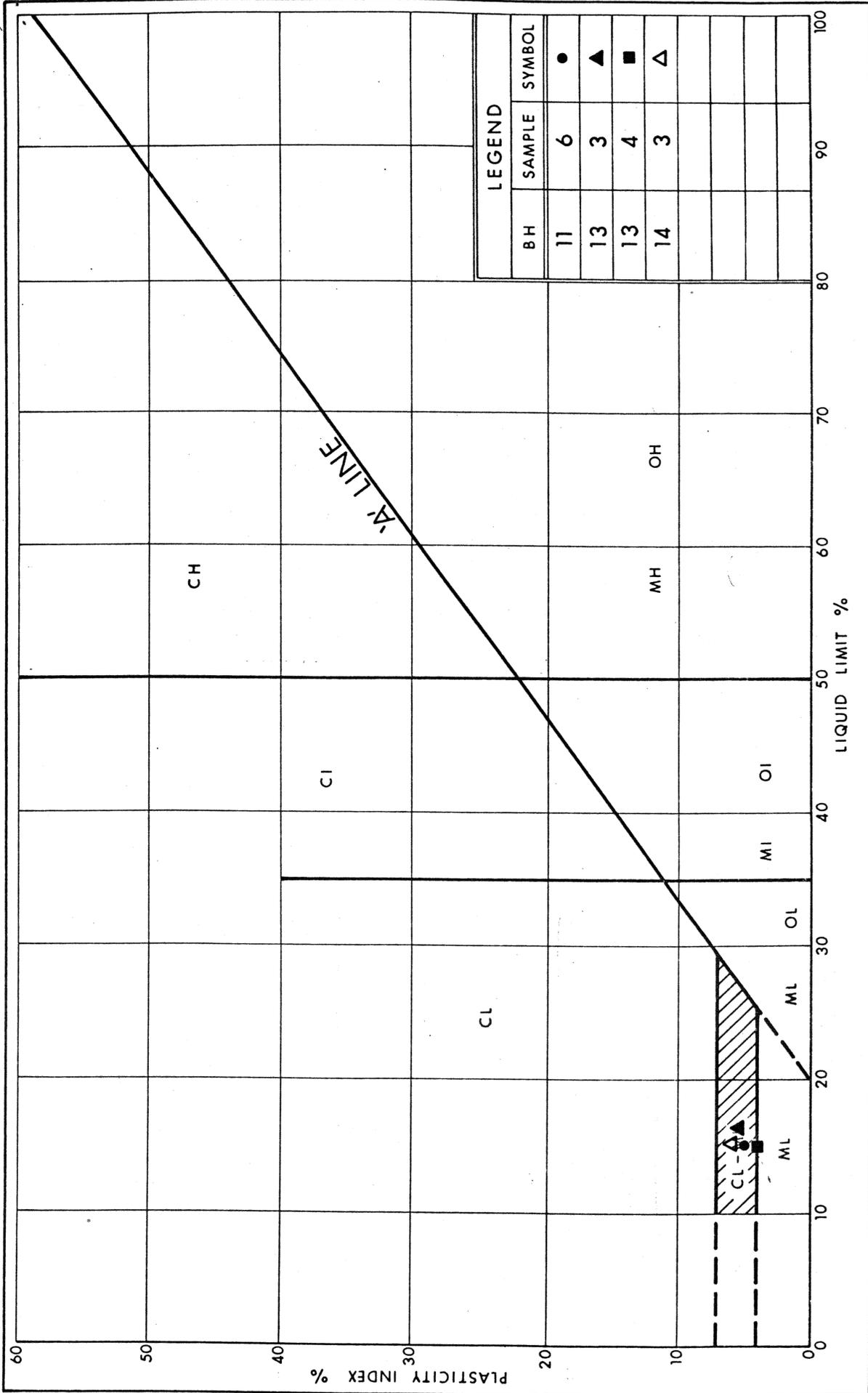


LEGEND		
BH	SAMPLE	SYMBOL
9	3	○
10	3	△
10	4	□
11	5	●
12	3	▲
14	2	■
15	3	*

FIG No 4
 P.O. M0090
 SITE 'B'

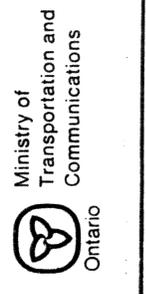
PLASTICITY CHART
 SILTY CLAY WITH SAND (Glacial Till)

Oct 75, FF-S-21



PLASTICITY CHART
 HET MIXTURE OF
 SILTY CLAY, SAND, GRAVEL (Glacial Till)

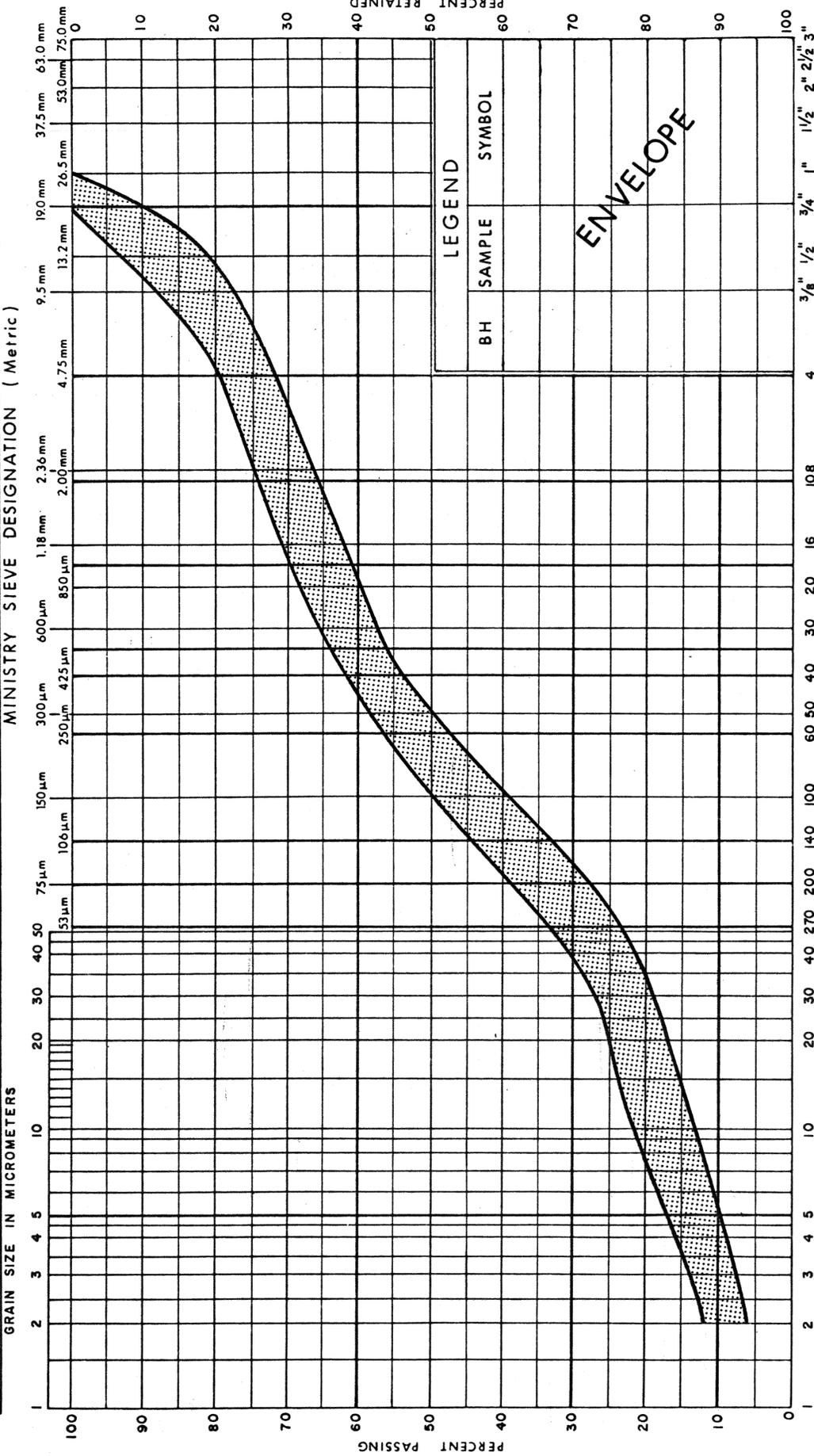
FIG No 6
 P.O. M0090
 SITE 'B'



34

UNIFIED SOIL CLASSIFICATION SYSTEM

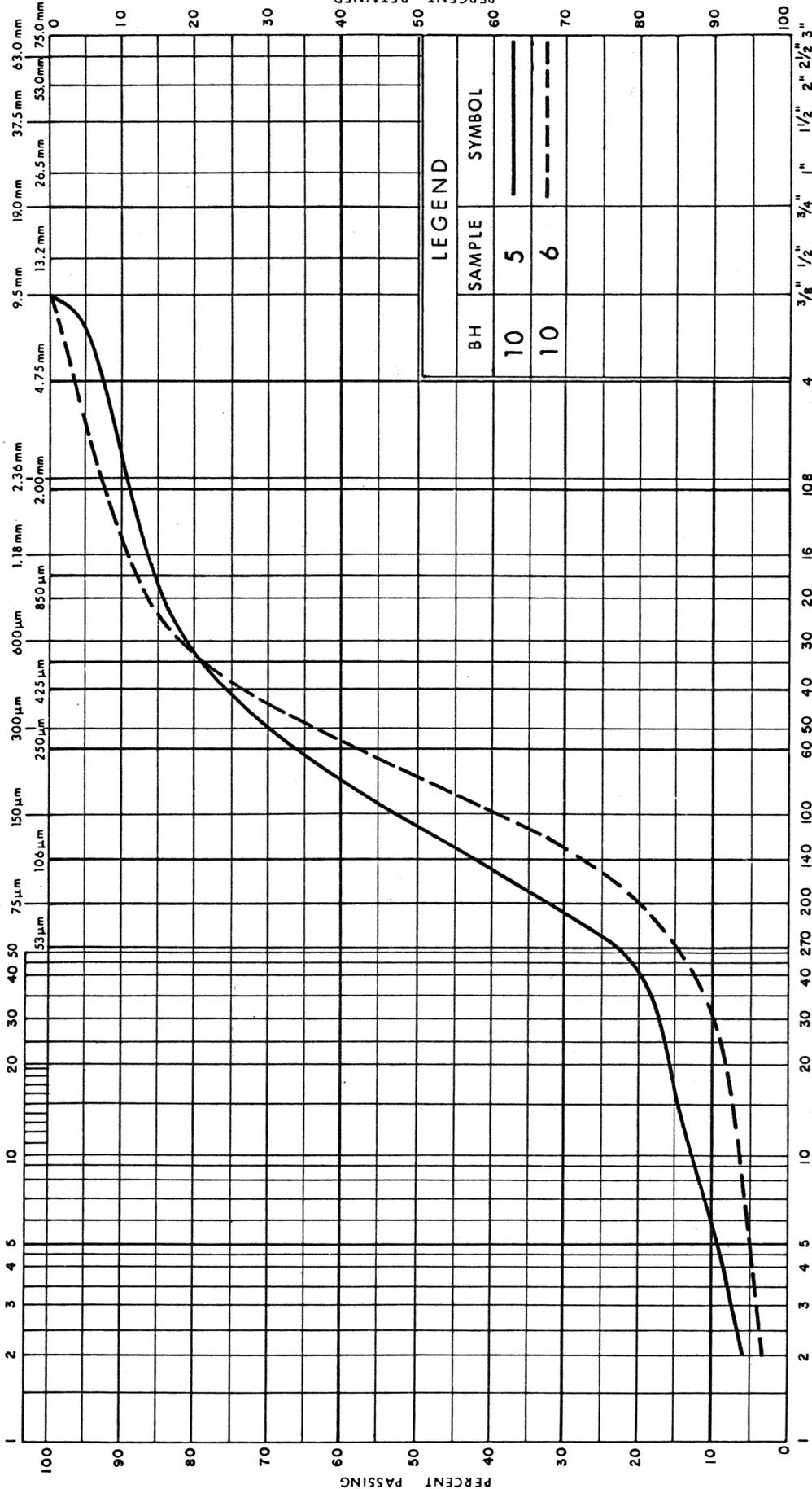
CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

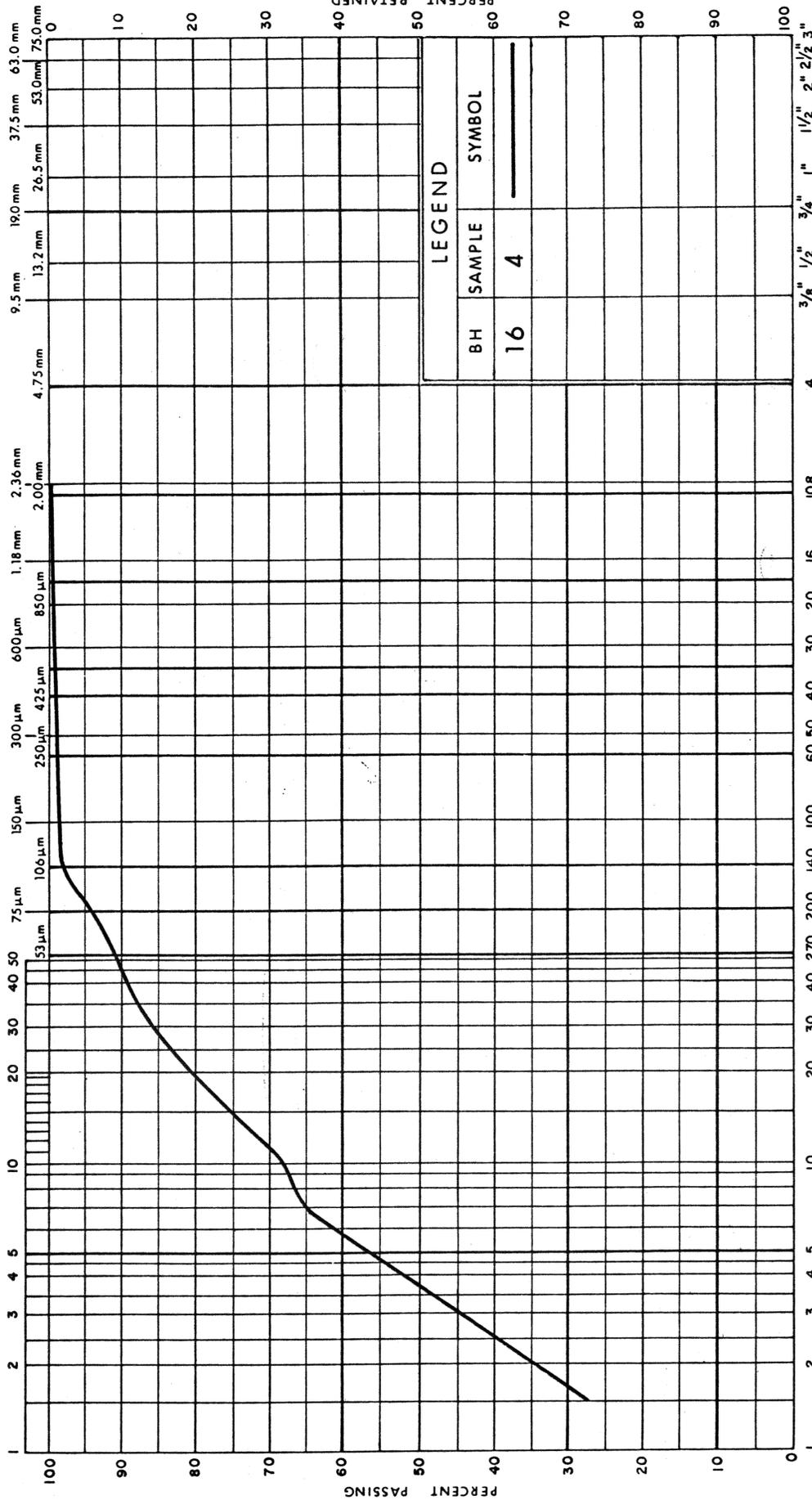
BH	SAMPLE	SYMBOL
10	5	—
10	6	- - -

MINISTRY SIEVE DESIGNATION (Imperial)

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
Fine		Medium	Coarse	Fine	Coarse	

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

BH	SAMPLE	SYMBOL
16	4	—

RECORD OF BOREHOLE No 9

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 148.0; E 350 056.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
83.3	Ground Surface														
0.0	Fill Silty Clay trace sand Very Stiff		1	SS	21										
82.0															
1.3	Silty Clay, with sand, trace gravel (Glacial Till) Stiff to Very Stiff		2	SS	13										
			3	SS	25										
80.5															
2.8	Het. Mixture Silty Clay, and sand, some gravel (Glacial Till) Hard		4	SS	41										8 35 40 17
79.9															
3.4	Sand, some silt trace gravel Dense		5	SS	43										27 45 23 5
79.0															
4.3	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 10

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 190.0; E 350 049.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY *IR*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
84.2	Ground Surface															
0.0	Fill					84										
	Silty Clay trace sand		1	SS	17	83										
	Very Stiff		2	SS	20											
82.2																
2.0	Silty Clay, with sand, trace gravel (Glacial Till)		3	SS	11	82										
	Stiff					81										
80.2																
4.0	Het. Mixture Silty Clay and sand, some gravel (Glacial Till) Stiff		4	SS	13	80									10 38 37 15	
79.7																
4.5	Sand, some silt trace gravel		5	SS	15	79									6 61 28 5	
	Increasing gravel content with depth		6	SS	13	79									4 77 16 3	
	Compact		7	SS	14	78										
-77.7																
6.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 11

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 223.0; E 350 040.6 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
84.8	Ground Surface																
0.0	Fill																
	Silty Clay trace sand		1	SS	11												
			2	SS	12												
	Stiff		3	SS	10											4 16 45 35	
81.6	organic		4	TW	PH												
3.2	Silty Clay, with sand trace gravel		5	SS	11											8 32 39 21	
81.0	(Glacial Till) Stiff																
3.8	Het. Mixture Silty Clay and sand, some gravel		6	SS	17											23 42 28 7	
80.4	(Glacial Till)																
4.4	Very Stiff		7	SS	25												
	Sand, some silt trace gravel		8	SS	25												
	Compact to Dense		9	SS	44												
78.3	End of Borehole																
6.5																	

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity 20
 15 $\frac{1}{5}$ (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 12

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 287.5; E 350 012.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80					
85.2	Ground Surface															
0.0	Fill Gravelly Sand some silt, trace clay						85									
84.6																
0.6	Fill Silty Clay trace sand Firm to Very Stiff		1	SS	7		84									
			2	SS	20											
83.1							83									
2.1	Silty Clay with sand, trace gravel (Glacial Till) Very Stiff		3	SS	30									6 31 36 27		
			4	SS	15		82									
81.5																
3.7	Het. Mixture Silty Clay and sand some gravel (Glacial Till)															
80.9	Very Stiff		5	SS	22		81									
4.3	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 13

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 328.0; E 349 998.8 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 05 31 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 _p	W			W _L	GR	SA
85.4	Ground Surface																		
0.0	Fill Silty Clay trace sand Stiff to Very Stiff	[X]	1	SS	10	*													
83.4			2	SS	16														
2.0	Heterogeneous Mixture Silty Clay and sand, some gravel (Glacial Till) Stiff to Very Stiff	[Dotted]	3	SS	29							o			28	42	18	12	
			4	SS	29								o			26	41	25	8
81.1			5	SS	13														
4.3	End of Borehole * No water in borehole after 1 hour																		

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 14

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 374.0; E 349 999.7 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 06 01 CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60						80
85.0	Ground Surface															
0.0	Fill Gravelly Sand some silt, trace clay Compact		1	SS	11										43 43 9 5	
83.8																
1.2	Silty Clay, with sand, trace gravel (Glacial Till) Stiff		2	SS	12										2 27 40 31	
82.9																
2.1	Het. Mixture, Silty clay, and sand, some gravel (Glacial Till) Very Stiff to Hard		3	SS	23										22 40 26 12	
82.1																
2.1	Silty Sand Pocket Becoming less cohesive with depth		4	SS	24											
81.5																
80.7																
4.3	End of Borehole * Note: Water table not stabilized, hole open 4 hours															

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 15

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 376.0; E 349 941.0 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 06 01 CHECKED BY SP.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
84.3	Ground Surface															
0.0	Fill Silty Clay trace sand Stiff	[X]	1	SS	12											
			2	SS	11											
82.2	Silty Clay with sand, trace gravel (Glacial Till) Firm to Stiff	[X]	3	SS	14											8 23 35 34
2.1			4	SS	7											
80.6	Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till) Firm	[X]	5	SS	5											
3.7																
79.6	End of Borehole															
4.7	* Note: Water table not stabilized, hole open 3 hours															

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE No 16

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 379.0; E 349 893.2 ORIGINATED BY IR
 DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
 DATUM Geodetic DATE 84 06 01 CHECKED BY *J.P.*

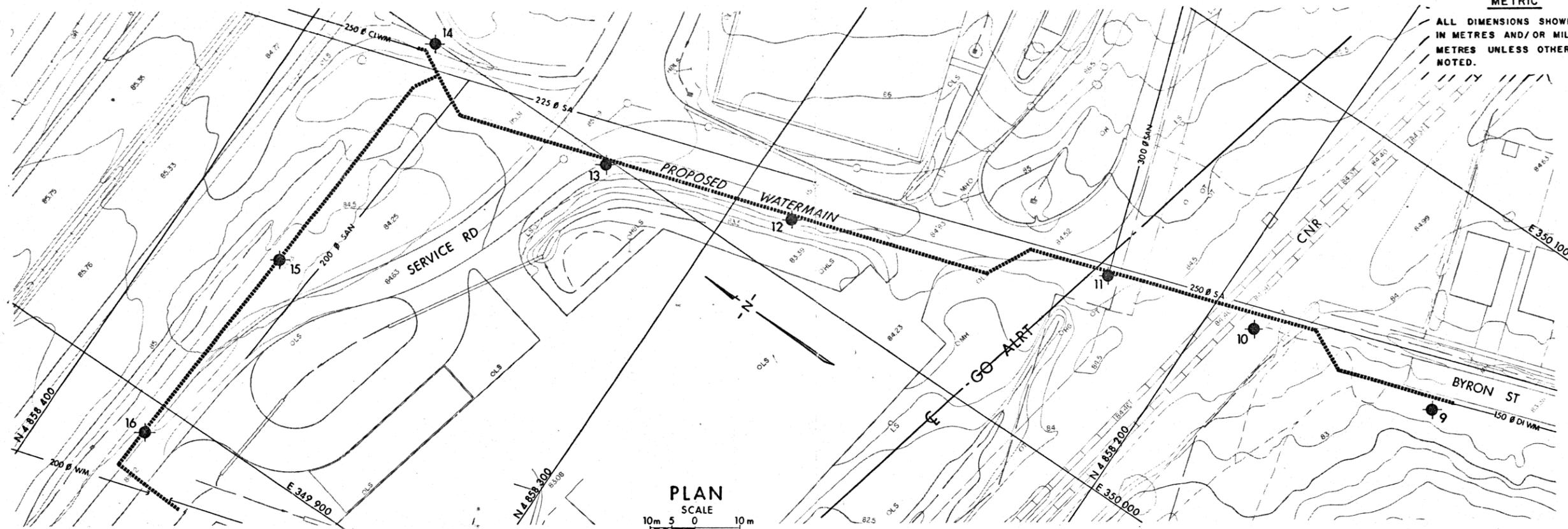
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE
84.6	Ground Surface													
0.0	Fill													
	Gravelly Sand some silt trace clay		1	SS	15									
	Compact		2	SS	24									
82.1			3	SS	5									36 34 19 11
2.5	Silty Clay trace sand		4	SS	14									0 6 61 33
	Firm to Stiff	5	SS	10										
80.3	End of Borehole													
4.3	* Note: Water table not stabilized, hole open 2½ hours													

OFFICE REPORT ON SOIL EXPLORATION

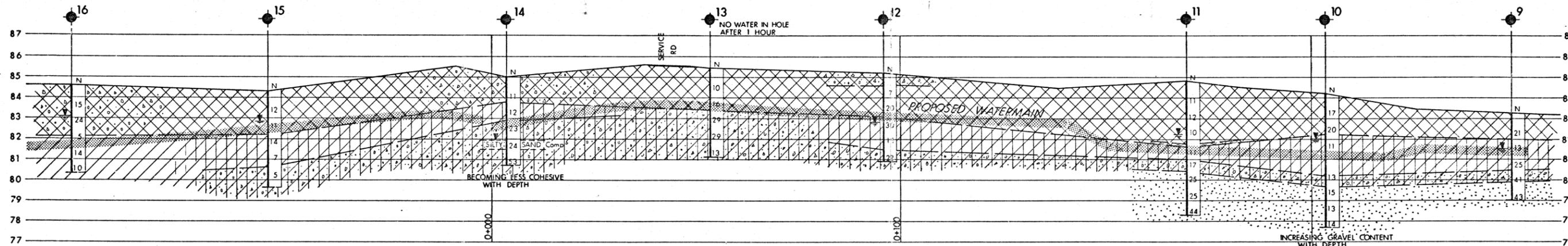
+3, x⁵: Numbers refer to Sensitivity 20
 15 5 (%) STRAIN AT FAILURE
 10

METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLI-METRES UNLESS OTHERWISE NOTED.



PLAN SCALE
10m 5 0 10m



PROFILE ALONG WATERMAIN

SCALE
HOR 10m 5 0 10m
VERT 2m 1 0 2m

SOIL STRATIGRAPHY LEGEND

- FILL GRAVELLY SAND SOME SILT, TRACE OF CLAY Compact
- SILTY CLAY WITH SAND, TRACE OF GRAVEL (Glacial Till) Firm to Very Stiff
- FILL SILTY CLAY TRACE OF SAND Firm to Very Stiff
- HET MIXTURE OF SILTY CLAY AND SAND SOME GRAVEL (Glacial Till) Firm to Hard
- SILTY CLAY TRACE OF SAND Firm to Stiff
- SAND SOME SILT, TRACE OF GRAVEL Compact to Dense

—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.

SEE DWG NO - SITE 'A'-1 FOR KEY PLAN

- 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)
 - WL at time of investigation 84 05 & 06
- Geocres No 30M15-75

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
9	83.3	4 858 148.0	350 056.0
10	84.2	4 858 190.0	350 049.0
11	84.8	4 858 223.0	350 040.6
12	85.2	4 858 287.5	350 012.0
13	85.4	4 858 328.0	349 998.8
14	85.0	4 858 374.0	349 999.7
15	84.3	4 858 376.0	349 941.0
16	84.6	4 858 379.0	349 893.2

GO-ALRT REF

REFERENCE DRAWINGS		REVISIONS		DRAWN BY: SO 84 07 19	DESIGNED BY:	ENGINEERING MATERIALS OFFICE FOUNDATION DESIGN SECTION		DURHAM REGION BROCK ST (RR 46) REALIGNMENT SERVICE ROAD TO BYRON ST WATERMAIN RELOCATION BOREHOLE LOCATIONS & SOIL STRATA
84 04 06	U-002 Sheet 59 Totten sims hubicki associates			CHK'D BY:	APPROVED BY:			
				SCALE: FULL SIZE ONLY AS SHOWN		PROJECT MANAGER		