

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M13-63

DIST. 6 REGION

W.P. No. 153-80-09

CONT. No. 89-22

W. O. No.

STR. SITE No. 37-73-330

HWY. No. 427

LOCATION Hwy 7 Underpass

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. 6
CONT No
WP No 153-80-07
HWY. 7 UNDERPASS
AT HWY. 427
GENERAL ARRANGEMENT



NOTES

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400
UNLESS OTHERWISE SPECIFIED.
BAR MARK WITH SUFFIX 'C' SHALL BE
COATED BARS.

CLASS OF CONCRETE

ABUTMENT FOOTINGS 20 MPa
ABUTMENTS, WINGWALLS 30 MPa
PIER FOOTING 30 MPa
PIER COLUMNS & DECK 35 MPa
BARRIER WALLS 30 MPa
APPROACH SLABS 30 MPa
AND AS NOTED

CLEAR COVER TO REINFORCING STEEL

FOOTINGS 100 ± 25 mm
ABUTMENTS & WINGWALLS:
FRONT FACE 50 ± 20 mm
BACK FACE 70 ± 20 mm
PIER COLUMNS 60 ± 20 mm
DECK: TOP 70 ± 20 mm
BOTTOM 50 ± 10 mm
BARRIER WALLS 70 ± 20 mm
APPROACH SLABS 75 ± 25 mm
AND AS NOTED

CONSTRUCTION NOTES

THE CONTRACTOR SHALL FINISH THE
BEARING SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATIONS TO A TOLERANCE
OF ± 3 mm.

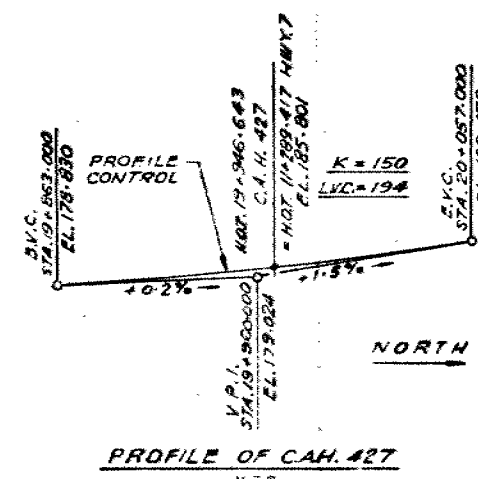
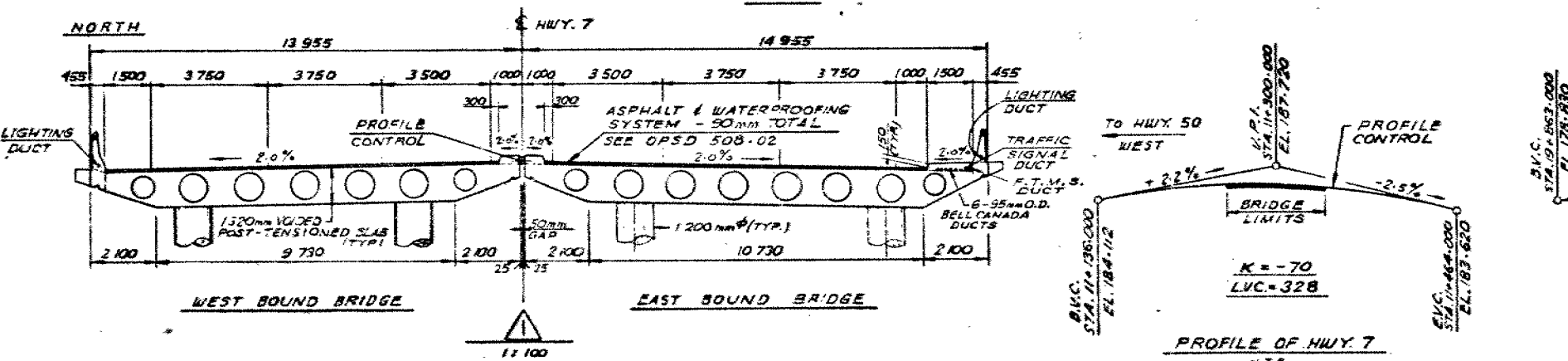
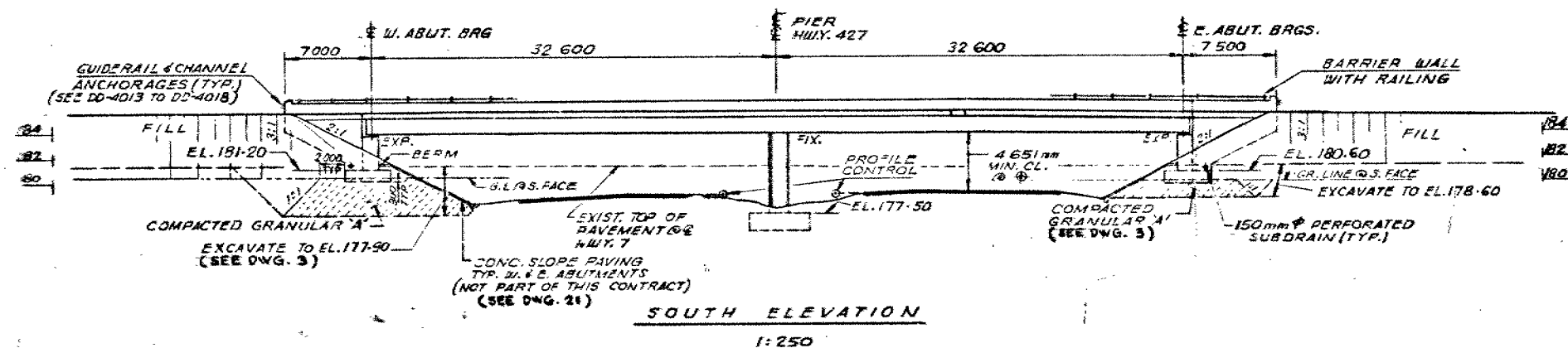
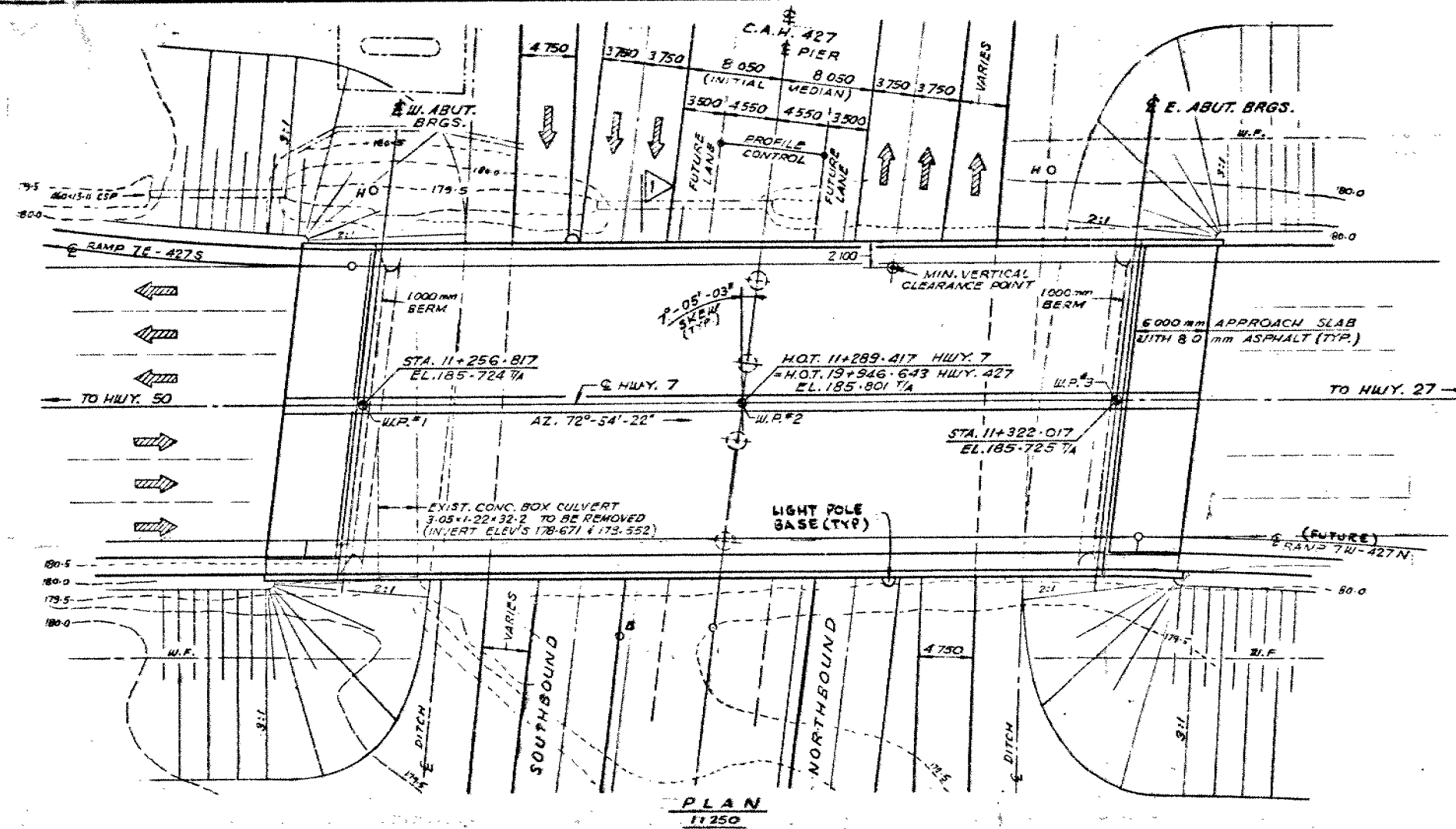
NOTE:

CONC. SLOPE PAVING, NOT
PART OF THIS CONTRACT.

W.P. DENOTES WORKING POINT
T/A DENOTES TOP OF ASPHALT

LIST OF DRAWINGS

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DATE	BY	DESCRIPTION
DESIGN	CH	CHECK
DRAWING	CH	CHECK
DATE	JUNE 85	
DWG	1	

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 89-22



Ministry of
Transportation and
Communications



I N D E X

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NOTE: For the purposes of this Contract, this report supersedes all other reports prepared by or for the Ministry in connection with the above-noted project.

EXPLANATION OF TERMS USED IN REPORT

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

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 1" 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 Y	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
T_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{T_r}$

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 = $w_L - w_p$	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						

FOUNDATION INVESTIGATION REPORT

For

Highway 7 Underpass

W.P. 153-80-07, Site 37-73-330

Hwy. 427, District 6, TorontoINTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 09 17 and 84 09 19. The fieldwork consisted of 6 sampled boreholes; one borehole was advanced by means of solid stem augers and the others by using hollow stem augers. The boreholes ranged in depth from 9.6 to 13.9 m.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately one kilometer west of Highway 27 in the Township of Vaughan in the Regional Municipality of York.

Land use in the area is predominantly agricultural, with some commercial use in the northwest corner. Topography across the site is generally flat.

The site is located in the physiographic region known as the "Peel Plain" which is characterized by a level to undulating "till or boulder clay" plain, and is well drained by the Credit, Oakville and Etobicoke Creeks, which have cut deep valleys in the overburden. Locally, drainage at the site is presently accomplished by means of creeks, roadside ditches, and a 1.2 x 3.4 m concrete box culvert under Highway 7 at the west end of the site.

The overburden is underlain by shale bedrock of the Georgian Bay Formation (formerly known as Meaford-Dundas).

SUBSURFACE CONDITIONSGeneral

The subsurface conditions are generally uniform across the site. The surficial material at this site is a silty clay, with sand, trace of gravel, and was proven to a maximum depth of 2.9 m. On the north side, the upper 1.4 m was found to be a fill comprised of the same material. A stratum of silt with sand, to silt was found across the site underlying the silty clay, with sand deposit. This non-cohesive deposit varies in thickness from 1.7 to 5.3 m. Underlying the silt with sand to silt stratum is a deposit of silty clay with very thin silt seams and varies from 3.3 to 7.9 m in thickness. The deposit underlying the

silty clay zone is a heterogeneous mixture of silty clay, sand and gravel ranging from 2.0 to 3.6 m thick. Shale bedrock was encountered beneath the silty clay deposit at depths ranging from 10.7 to 13.7 m.

The boundaries between the soil types, in-situ and laboratory test results as well as groundwater levels are shown in the Record of Borehole Sheets. The location and elevation of each borehole is shown on Drawing 1538007-A* along with three sections indicating estimated stratigraphical sections based on borehole data.

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

SILTY CLAY, SOME SAND, TRACE GRAVEL (Fill)

A cohesive fill material was encountered in the northerly portion of the site, where the borings were advanced through the roadway embankment. The thickness of the fill material was 1.4 m.

The fill material is generally comprised of silty clay, some sand, trace gravel. The parent material appears to be the underlying deposit of silty clay, and is described in detail below.

Based on 'N' values ranging from 2 to 12 the fill is assessed to have undergone poor to moderate compaction.

SILTY CLAY, SOME SAND, TRACE GRAVEL

A mottled silty clay, some sand, trace gravel was found as a surficial deposit in the southerly portion of the site, and underlies the fill in the northern boreholes. The stratum is approximately 2.0 m thick and is found at an elevation of 179.3 to 179.6.

Atterberg Limits tests were carried out on 4 samples of this cohesive material. Results, plotted on Fig. 1 indicate that this stratum is a silty clay of intermediate plasticity, with the exception of an isolated layer in BH 2, which indicates a silty clay of low plasticity. Natural water content of this material varied between 11.5 and 19.5%.

Based on the interpretation of Standard Penetration test 'N' values ranging from 6 to 43; this cohesive material is assessed a consistency ranging from firm to hard.

*NOTE: Refer to Drawing No. 2 of the Contract Drawings.

SILT WITH SAND TO SILT

This deposit of silt with sand to silt was found underlying the stratum of silty clay, some sand, trace of gravel and overlying the silty clay with silt seams. The thickness of the stratum varies from 1.7 to 5.3 m. The silt with sand portion of the deposit was only encountered in the western and northeastern sections of the site.

Results of grain size distribution testing conducted on samples from this stratum are plotted on Fig. 2. Two distinct envelopes can be observed, one for the silt with sand portion of the deposit and the other the silt portion.

The results of Atterberg Limits testing carried out on 5 samples from this deposit are plotted on Fig. 3 in the Appendix. This testing indicates some portions of the stratum may exhibit slight plasticity, but the overall deposit is assessed to be non-cohesive in nature.

Based on the interpretation of Standard Penetration test 'N' values, ranging from 37 to 130 blows/20 cm, the denseness of this deposit is described as dense to very dense.

SILTY CLAY WITH SILT SEAMS

This deposit found to be 3.3 to 7.7 m thick was encountered across the site directly below the silt with sand to silt layer. The thin silt seams are present throughout the stratum at approximately 40 mm intervals and are 1 to 2 mm thick. At the eastern investigated section of the site occasional boulders or cobbles were encountered in the lower portion of this deposit.

Atterberg limits testing carried out on samples from this cohesive deposit are shown on Fig. 4 in the Appendix. The results indicate the stratum varies from a silty clay of low to intermediate plasticity (CL-CI group), generally tending to be more plastic with depth. The natural water content of the samples is between 16.5 and 20%.

Interpretation of the Standard Penetration test 'N' values ranging from 30 to 100 blows/5 cm indicate that this material has a consistency which is very stiff to hard.

HETEROGENEOUS MIXTURE OF SILTY CLAY, SAND AND GRAVEL (Glacial Till)

This deposit of glacial origin was sampled in two boreholes. The stratum probably extends across the site, however, sampling did not encounter the deposit in some locations due to sample spacing. The glacial deposit was immediately overlying the shale bedrock. The thickness varies from 2.0 to 3.6 and was encountered at an elevation ranging from 169.3 to 170.6.

The results of Atterberg Limits testing carried out on samples from this deposit are plotted on Fig. 5 and indicate that the matrix is a silty clay of low plasticity (CL group).

Based on Standard Penetration test 'N' values of 47 to 100 blows/5 cm, the consistency of the layer is interpreted as being hard.

SHALE BEDROCK

Bedrock was established in 5 of the 6 boreholes; either by means of obtaining split-spoon samples or augering techniques. Based on this information, it is inferred that the bedrock elevation varies between 167.0 and 168.6. The bedrock tends to dip from the northwest end of the site to the southeast end.

The bedrock is a grey shale of the Georgian Bay Formation, and generally weathered in the upper zone as evidenced by split-spoon samples recovered. No attempt was made to establish the boundary between the weathered and unweathered zone of the bedrock.

GROUNDWATER CONDITIONS

The groundwater level established from readings in a piezometer adjacent to BH 5 and water level readings taken in open boreholes on the same day and 24 hours after borehole completion, indicate the water level to be at the approximate elevation of 179.0 which is generally 0.3 m below the ground surface.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. D. Thanasse, Engineering Student, and Mr. H. Sturm, Project Foundations Engineer, utilizing equipment owned and operated by the Longyear Soil Investigation company of Toronto. This report was written by Mr. D. Thanasse, under the supervision of Mr. Sturm, and reviewed by Mr. M. Devata, Chief Foundations Engineer (East).



D. H. Dundas

D. H. Dundas, P. Eng.
Sr. Foundations Engineer

M. Devata

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

APPENDIX

RECORD OF BOREHOLE No 1

METRIC


W P 153-80-07 LOCATION Co-ords. N 4 847 594.3; E 293 963.6 ORIGINATED BY HS
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY DT
 DATUM Geodetic DATE 84 09 17 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							SHEAR STRENGTH		WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							10 20 30			
180.8	Ground Surface																	
0.0	Silty Clay with Sand trace gravel (Fill)																	
179.4	Soft		1	SS	2'													
1.4	Silty Clay some sand trace gravel		2	SS	6													
	Firm		3	SS	8													
177.9	Silt with Sand traces of clay and gravel		4	SS	133									2 37 57 4				
2.9	Very Dense		5	SS	100/	13 cm												
	Silty Clay Seam Hard		6	SS	90													
	Silt																	
	Very Dense		7	SS	145/	23 cm								0 0 94 6				
			8	SS	91/	15 cm												
172.7	Silty Clay with very thin Silt Seams																	
8.1	Hard		9	SS	85													
171.2																		
9.6	End of Borehole																	
	* Water Level Assumed at Point where Borehole Caved																	

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 603.8; E 293 993.2 ORIGINATED BY HS
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 17 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 (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH									
180.7	Ground Surface							○ UNCONFINED + FIELD VANE		WATER CONTENT (%)							
0.0	Silty Clay some sand trace gravel (Fill) Stiff		1	SS	12		180										
179.3																	
1.4	Silty Clay some sand trace gravel Very Stiff		2	SS	23		179										
177.8			3	SS	26		178										
2.9	Silt Very Dense		4	SS	72		177							0 0 94 6			
			5	SS	56												
176.1																	
4.6			6	SS	39		176										
	Silty Clay with Very Thin Silt Seams Hard		7	SS	31		175										
							174										
			8	SS	30		173										
							172										
			9	SS	40		171										
170.6																	
10.1	Heterogeneous Mixture of Silty Clay, Sand and Gravel (Glacial Till) Hard		10	SS	55		170										
							169										
			11	SS	100	13 cm	168										
167.0																	
166.8	Weathered Shale bedrock		12	SS	140	10 cm	167										
13.9	End of Borehole Refusal to Auger Note: Water Level Taken immediately after completion of Augering.																


+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 613.2; E 294 021.8 ORIGINATED BY HS & DT
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 18 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
180.7	Ground Surface													
0.0	Silty Clay with sand trace gravel (Fill) Stiff		1	SS	11		180							
179.3	Silty Clay some sand trace gravel Stiff		2	SS	14	*	179							
1.4														
178.6	Silt with Sand traces of clay and gravel Dense Silty Clay Seam Hard		3	SS	37		178						OH	5 30 56 9
2.1			4	SS	41		177							
	Silt		5	SS	146		176							0 1 94 5
	Very Dense		6	SS	90		175							
175.2							174							
5.5	Silty Clay with very Thin Silt Seams Hard		7	SS	73		173							
			8	SS	35		172							
							171							
							170							
			9	SS	43		169							
	Occasional Cobbles or Boulders													
168.0														
12.7	End of Borehole Refusal to Auger Probable Bedrock													
	* Note: Water Level not determined													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 563.0; E 293 967.0
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 84 09 18
 ORIGINATED BY DT
 COMPILED BY DT
 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 (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%) 10 20 30
179.3	Ground Surface															
0.0	Silty Clay some sand trace gravel Firm		1	SS	6		179									
177.9							178									
1.4	Silt with Sand traces of clay and gravel		2	SS	66		177			○	H			16 35 38 11		
			3	SS	130/	18 cm				○						
	Occasional Cobbles or Boulders		4	SS	100/	15 cm	176			○	H					
			5	SS	114		175				H			6 33 47 14		
	Silty Clay Seam Hard		6	SS	70		174									
	Silt Very Dense		7	SS	63		173									
172.6							172									
6.7	Silty Clay with very Thin Silt Seams		8	SS	60		171									
	Hard						170									
169.3							169									
10.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till)		9	SS	47		168			○						
	Hard															
167.3																
167.0	Weathered Shale Bedrock		10	SS	100/	8 cm										
12.3	End of Borehole															

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

OFFICE REPORT ON SOIL EXPLORATION

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5										METRIC									
W P 153-80-07		LOCATION Co-ords. N 4 847 568.4; E 293 993.6		ORIGINATED BY DT															
DIST 6 HWY 427		BOREHOLE TYPE Hollow Stem Auger		COMPILED BY DT															
DATUM Geodetic		DATE 84 09 19		CHECKED BY <i>[Signature]</i>															
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%) 10 20 30										
179.3	Ground Surface																		
0.0	Silty Clay some sand trace gravel Firm to Hard		1	SS	7														
			2	SS	43					42%									
177.2																			
2.1	Silt Very Dense		3	SS	81						0 0 94 6								
			4	SS	127														
			5	SS	171														
			6	SS	114														
173.8																			
5.5	Silty Clay with Very Thin Silt Seams Hard		7	SS	53														
			8	SS	59														
168.6																			
168.4	Weathered Shale Bedrock		9	SS	70/8 cm														
10.9	End of Borehole																		
Water Table Elevations Measured <table border="1"> <thead> <tr> <th>Date</th> <th>Elevation</th> </tr> </thead> <tbody> <tr> <td>84-09-20</td> <td>179.2</td> </tr> <tr> <td>84-10-12</td> <td>179.0</td> </tr> <tr> <td>84-11-08</td> <td>179.1</td> </tr> </tbody> </table>												Date	Elevation	84-09-20	179.2	84-10-12	179.0	84-11-08	179.1
Date	Elevation																		
84-09-20	179.2																		
84-10-12	179.0																		
84-11-08	179.1																		

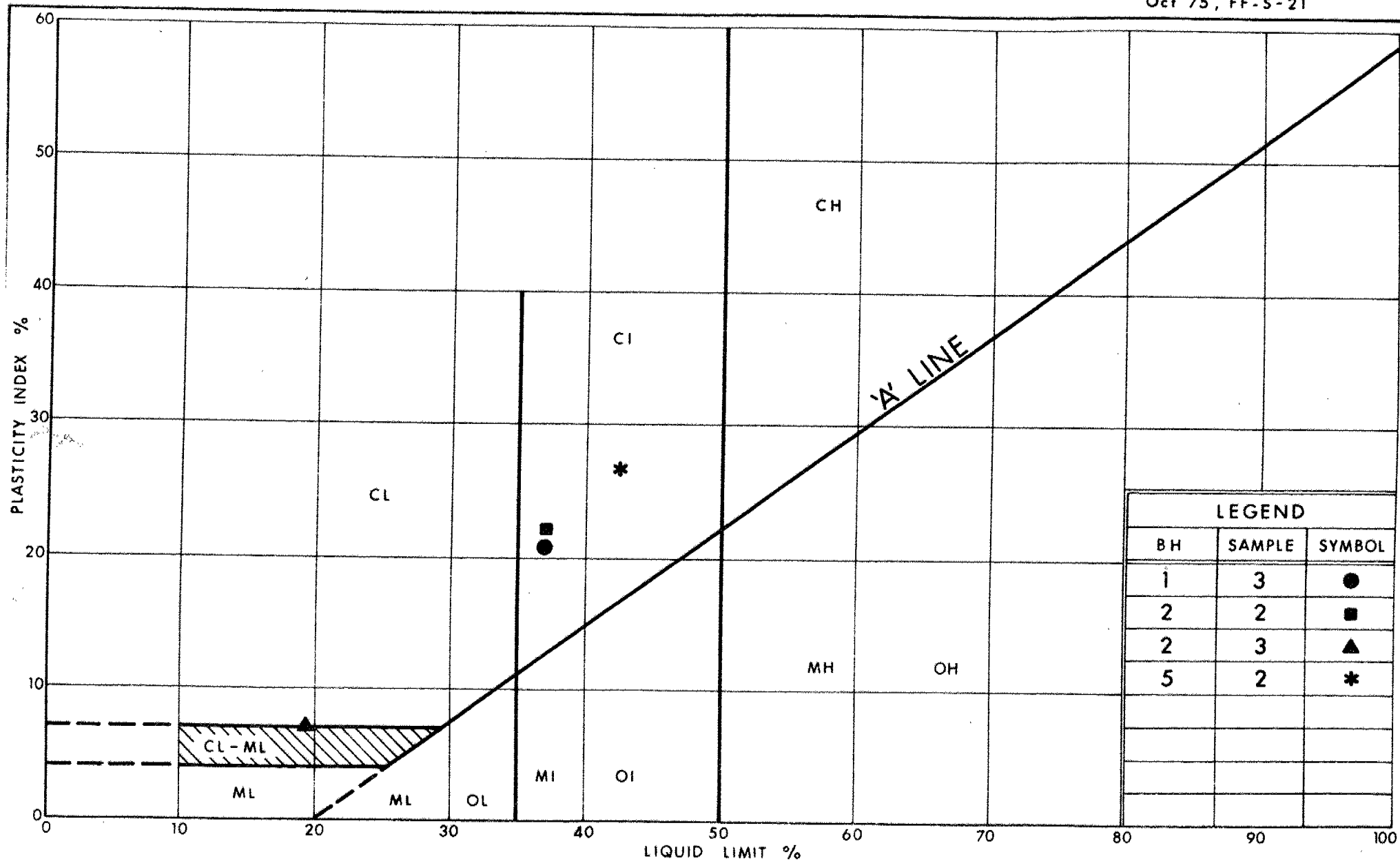
RECORD OF BOREHOLE No 6

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 580.0; E 294 027.5
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 84 09 19
 ORIGINATED BY DT
 COMPILED BY DT
 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	SHEAR STRENGTH					
179.6	Ground Surface							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
0.0	Silty Clay some sand trace gravel Very Stiff to Hard		1	SS	29		179							
			2	SS	37		178							
177.5			3	SS	83		177							
2.1	Silt Very Dense		4	SS	96		176							0 0 96 4
			5	SS	97		175							
175.2			6	SS	53		174							
4.4			7	SS	32		173							
	Silty Clay with very Thin Silt Seams		8	SS	47		172							
			9	SS	39		171							
			10	SS	80		170							
							169							
							168							
167.5	Occasional Cobbles or Boulders		11	SS	100	5 cm								
167.4	Weathered Shale Bedrock													
12.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



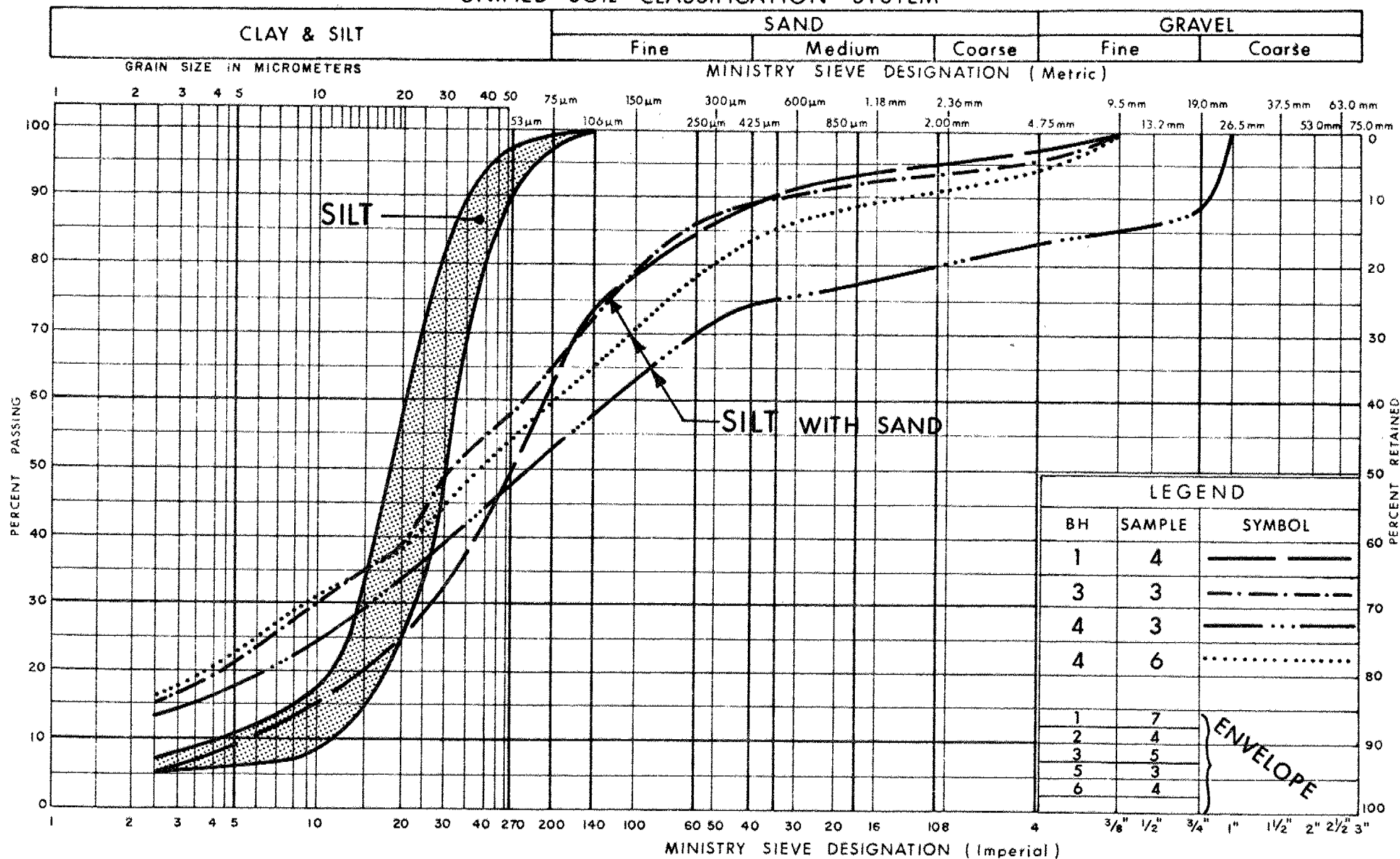
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PLASTICITY CHART SILTY CLAY, SOME SAND TRACE OF GRAVEL

FIG No 1

W P 153-80-07

UNIFIED SOIL CLASSIFICATION SYSTEM



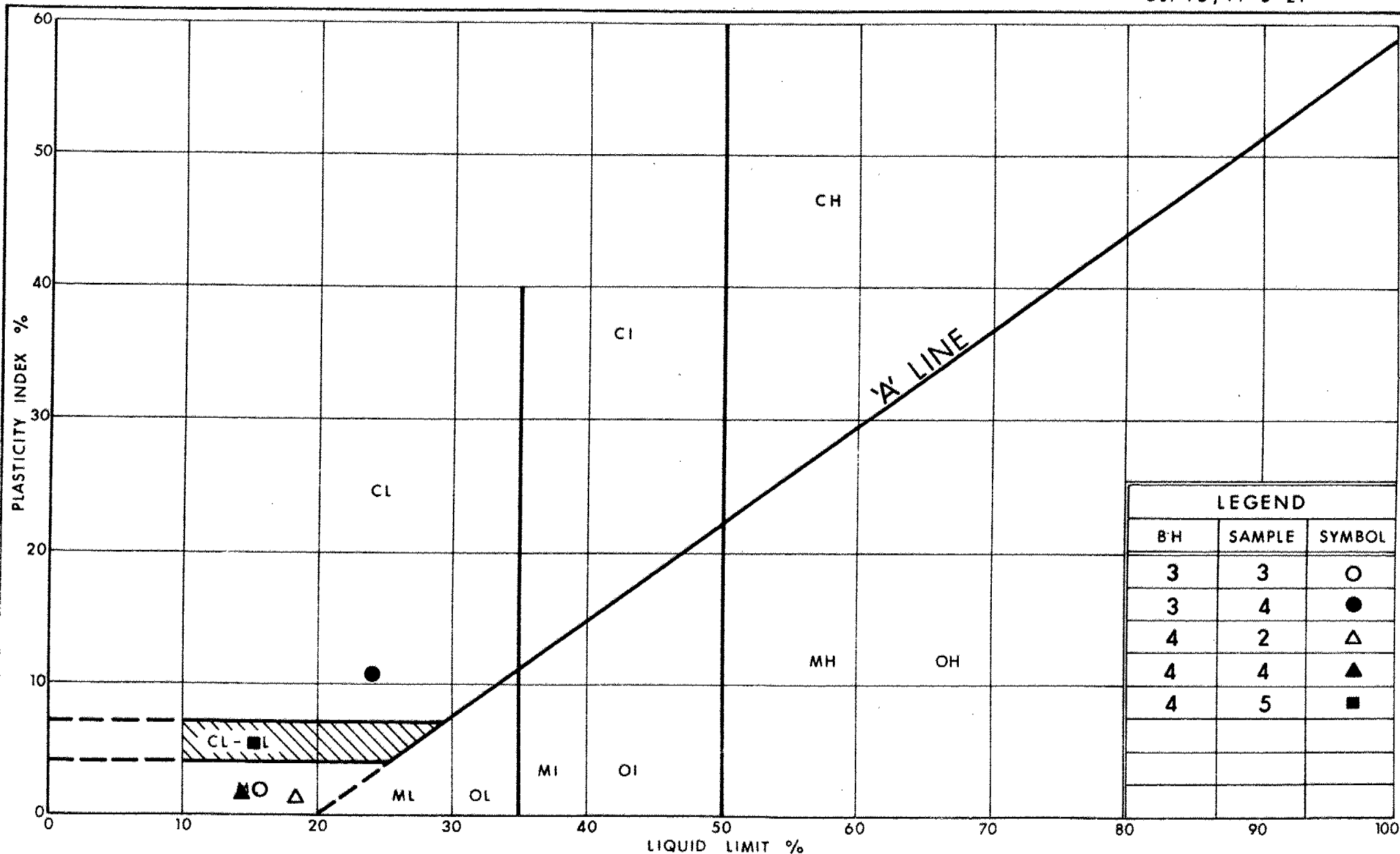
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GRAIN SIZE DISTRIBUTION
SILT WITH SAND TO SILT

FIG No 2

W P 153-80-07



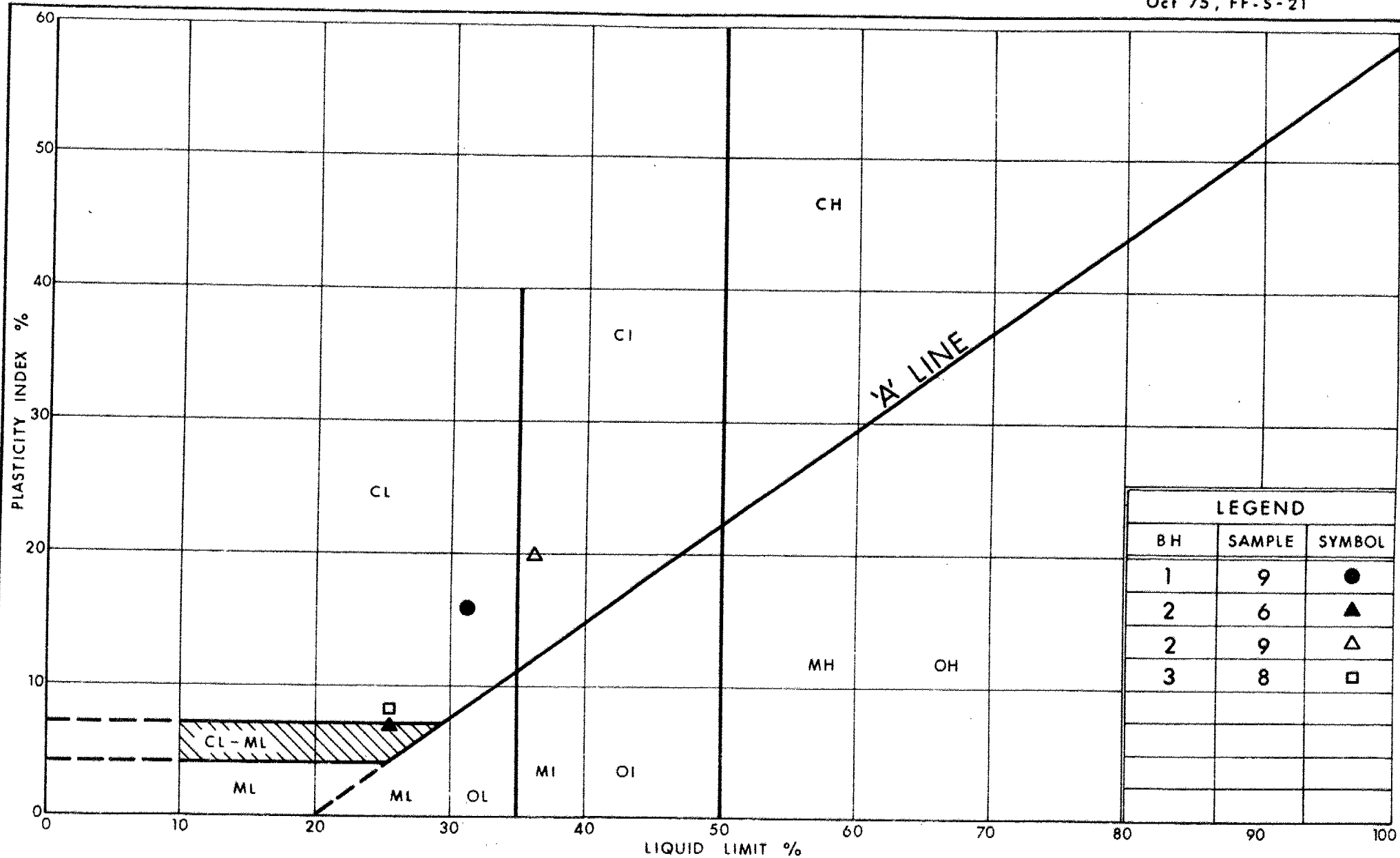
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PLASTICITY CHART SILT WITH SAND, TRACE OF CLAY AND GRAVEL

FIG No 3

W P 153-80-07

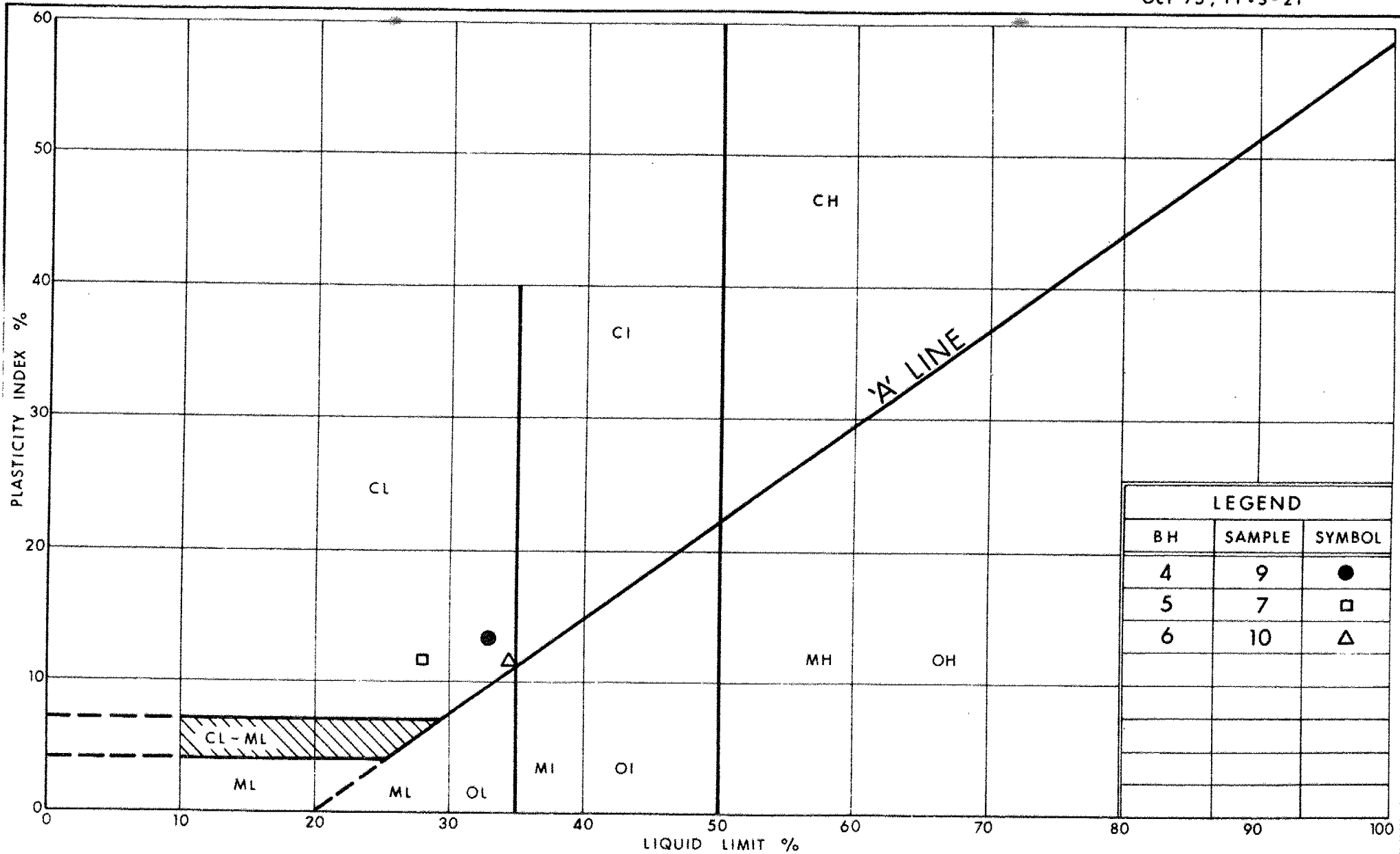


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PLASTICITY CHART SILTY CLAY WITH SILT SEAMS

FIG No 4

W P 153-80-07



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

FIG No 5

W P 153-80-07



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foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 153-80-07

DIST 6

HWY 427

STR SITE 37-73-330

Highway 7 Underpass

DISTRIBUTION

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FOUNDATION INVESTIGATION REPORT

For

Highway 7 Underpass

W.P. 153-80-07, Site 37-73-330

Hwy. 427, District 6, Toronto

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 09 17 and 84 09 19. The fieldwork consisted of 6 sampled boreholes; one borehole was advanced by means of solid stem augers and the others by using hollow stem augers. The boreholes ranged in depth from 9.6 to 13.9 m.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately one kilometer west of Highway 27 in the Township of Vaughan in the Regional Municipality of York.

Land use in the area is predominantly agricultural, with some commercial use in the northwest corner. Topography across the site is generally flat.

The site is located in the physiographic region known as the "Peel Plain" which is characterized by a level to undulating "till or boulder clay" plain, and is well drained by the Credit, Oakville and Etobicoke Creeks, which have cut deep valleys in the overburden. Locally, drainage at the site is presently accomplished by means of creeks, roadside ditches, and a 1.2 x 3.4 m concrete box culvert under Highway 7 at the west end of the site.

The overburden is underlain by shale bedrock of the Georgian Bay Formation (formerly known as Meaford-Dundas).

SUBSURFACE CONDITIONS

General

The subsurface conditions are generally uniform across the site. The surficial material at this site is a silty clay, with sand, trace of gravel, and was proven to a maximum depth of 2.9 m. On the north side, the upper 1.4 m was found to be a fill comprised of the same material. A stratum of silt with sand, to silt was found across the site underlying the silty clay, with sand deposit. This non-cohesive deposit varies in thickness from 1.7 to 5.3 m. Underlying the silt with sand to silt stratum is a deposit of silty clay with very thin silt seams and varies from 3.3 to 7.9 m in thickness. The deposit underlying the

silty clay zone is a heterogeneous mixture of silty clay, sand and gravel ranging from 2.0 to 3.6 m thick. Shale bedrock was encountered beneath the silty clay deposit at depths ranging from 10.7 to 13.7 m.

The boundaries between the soil types, in-situ and laboratory test results as well as groundwater levels are shown in the Record of Borehole Sheets. The location and elevation of each borehole is shown on Drawing 1538007-A along with three sections indicating estimated stratigraphical sections based on borehole data.

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

SILTY CLAY, SOME SAND, TRACE GRAVEL (Fill)

A cohesive fill material was encountered in the northerly portion of the site, where the borings were advanced through the roadway embankment. The thickness of the fill material was 1.4 m.

The fill material is generally comprised of silty clay, some sand, trace gravel. The parent material appears to be the underlying deposit of silty clay, and is described in detail below.

Based on 'N' values ranging from 2 to 12 the fill is assessed to have undergone poor to moderate compaction.

SILTY CLAY, SOME SAND, TRACE GRAVEL

A mottled silty clay, some sand, trace gravel was found as a surficial deposit in the southerly portion of the site, and underlies the fill in the northern boreholes. The stratum is approximately 2.0 m thick and is found at an elevation of 179.3 to 179.6.

Atterberg Limits tests were carried out on 4 samples of this cohesive material. Results, plotted on Fig. 1 indicate that this stratum is a silty clay of intermediate plasticity, with the exception of an isolated layer in BH 2, which indicates a silty clay of low plasticity. Natural water content of this material varied between 11.5 and 19.5%.

Based on the interpretation of Standard Penetration test 'N' values ranging from 6 to 43; this cohesive material is assessed a consistency ranging from firm to hard.

SILT WITH SAND TO SILT

This deposit of silt with sand to silt was found underlying the stratum of silty clay, some sand, trace of gravel and overlying the silty clay with silt seams. The thickness of the stratum varies from 1.7 to 5.3 m. The silt with sand portion of the deposit was only encountered in the western and northeastern sections of the site.

Results of grain size distribution testing conducted on samples from this stratum are plotted on Fig. 2. Two distinct envelopes can be observed, one for the silt with sand portion of the deposit and the other the silt portion.

The results of Atterberg Limits testing carried out on 5 samples from this deposit are plotted on Fig. 3 in the Appendix. This testing indicates some portions of the stratum may exhibit slight plasticity, but the overall deposit is assessed to be non-cohesive in nature.

Based on the interpretation of Standard Penetration test 'N' values, ranging from 37 to 130 blows/20 cm, the denseness of this deposit is described as dense to very dense.

SILTY CLAY WITH SILT SEAMS

This deposit found to be 3.3 to 7.7 m thick was encountered across the site directly below the silt with sand to silt layer. The thin silt seams are present throughout the stratum at approximately 40 mm intervals and are 1 to 2 mm thick. At the eastern investigated section of the site occasional boulders or cobbles were encountered in the lower portion of this deposit.

Atterberg limits testing carried out on samples from this cohesive deposit are shown on Fig. 4 in the Appendix. The results indicate the stratum varies from a silty clay of low to intermediate plasticity (CL-CI group), generally tending to be more plastic with depth. The natural water content of the samples is between 16.5 and 20%.

Interpretation of the Standard Penetration test 'N' values ranging from 30 to 100 blows/5 cm indicate that this material has a consistency which is very stiff to hard.

HETEROGENEOUS MIXTURE OF SILTY CLAY, SAND AND GRAVEL (Glacial Till)

This deposit of glacial origin was sampled in two boreholes. The stratum probably extends across the site, however, sampling did not encounter the deposit in some locations due to sample spacing. The glacial deposit was immediately overlying the shale bedrock. The thickness varies from 2.0 to 3.6 and was encountered at an elevation ranging from 169.3 to 170.6.

The results of Atterberg Limits testing carried out on samples from this deposit are plotted on Fig. 5 and indicate that the matrix is a silty clay of low plasticity (CL group).

Based on Standard Penetration test 'N' values of 47 to 100 blows/5 cm, the consistency of the layer is interpreted as being hard.

SHALE BEDROCK

Bedrock was established in 5 of the 6 boreholes; either by means of obtaining split-spoon samples or augering techniques. Based on this information, it is inferred that the bedrock elevation varies between 167.0 and 168.6. The bedrock tends to dip from the northwest end of the site to the southeast end.

The bedrock is a grey shale of the Georgian Bay Formation, and generally weathered in the upper zone as evidenced by split-spoon samples recovered. No attempt was made to establish the boundary between the weathered and unweathered zone of the bedrock.

GROUNDWATER CONDITIONS

The groundwater level established from readings in a piezometer adjacent to BH 5 and water level readings taken in open boreholes on the same day and 24 hours after borehole completion, indicate the water level to be at the approximate elevation of 179.0 which is generally 0.3 m below the ground surface.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to construct a grade separated interchange on Hwy. 7 at the proposed Hwy. 427 location, which lies between Hwys. 27 and 50. This proposed interchange will entail construction of a two span (33 m, 33 m) structure to carry Hwy. 7 over Hwy. 427. The proposed profile grades will require earth cuts in the order of 2.3 m on Hwy. 427 and fills up to 4.2 m on Hwy. 7.

The subsoil was investigated to a maximum depth of 13.9 m with the dominant deposit being a silty clay with silt seams encountered 4.4 to 8.1 m below the ground surface. Overlying this dominant deposit is a stratum of silt with sand to silt which in turn is overlain by a surficial deposit of silty clay, some sand, trace gravel. These deposits are underlain by a hard heterogeneous mixture of silty clay, sand and gravel. Underlying the above mentioned subsoils is grey shale bedrock.

The following recommendations pertain to the design and construction of the structure foundations and related earthworks.

STRUCTURE FOUNDATIONS

ABUTMENTS

If perched abutments are contemplated they can be founded on steel tube piles driven into the hard silt with sand to silt deposit. A concrete filled steel tube 324 mm x 6.3 mm @ 49.72 kg/m pile should be used. The pile should be driven closed ended in accordance with MTC standards SS 103-10 or SS 103-11. For design and estimating purposes the pile tip elevations and bearing capacities for steel tube piles are given below.

ABUTMENT	REFERENCE BOREHOLE(S)	ESTIMATED PILE TIP ELEVATIONS (m)	FACTORED AXIAL BEARING CAPACITY @ U.L.S.	AXIAL BEARING CAPACITY @ S.L.S. TYPE II
West	1 & 4	177.0	350 kN	250 kN
East	3 & 6	176.0	350 kN	250 kN

Alternatively, the abutments can be founded on spread footings within the competent stratum of silt with sand to silt. Founding elevations with corresponding bearing capacities are provided on the following page.

STRUCTURE ELEMENT	REFERENCE BOREHOLES	FOUNDING ELEVATION (m)	FACTORED BEARING CAPACITY @ U.L.S.	BEARING CAPACITY @ S.L.S. TYPE II
West Abutment	1 & 4	177.5	900 kPa	500 kPa
East Abutment	3 & 6	177.5	850 kPa	400 kPa

Dewatering of the footing excavations will be required in order to prevent "boiling" of the base of the excavation. This can be accomplished by using oversized perimeter ditches around footing excavations and pumping from sumps. Another alternative would be to use vacuum wells.

PIER

The pier can be founded on spread footings at elevation 177.5. For design, a factored bearing capacity of 850 kPa at the U.L.S. may be used and a bearing capacity of 400 kPa may be used at the S.L.S. Type II. However, if the pier is founded at an elevation of 176.0 or lower a factored bearing capacity of 700 kPa at the U.L.S. and a bearing capacity of 300 kPa at the S.L.S. Type II should be used.

Unwatering of the footing excavation will be required as measured water levels are approximately 1.6 m above the base of the proposed excavation. The founding soils at this location are silts which are subject to "boiling" under unbalanced hydrostatic head. Unwatering may be accomplished by pumping from perimeter drains situated well below the base of the excavation.

MISCELLANEOUS CONSIDERATIONS

All structure elements should be provided with a minimum of 1.2 m of earth cover for frost protection purposes.

The maximum gradation of all fill placed within the zone of pile penetration should be restricted to 75 mm.

The abutments should be backfilled with a free draining granular material as per SP 121 and earth pressures against the abutment wall should be computed as per Subsection 6.6.1.2 of the O.H.B.D.C. Manual. The soil properties to be used in earth pressure calculations are as follows:

	ϕ	(kN/m ³)
Granular 'A'	35°	22
Granular 'B'	30°	21

No stability problems are anticipated for permanent embankment slopes constructed to a 2:1 geometry.

MISCELLANEOUS .

The fieldwork for this investigation was carried out under the supervision of Mr. D. Thanasse, Student Engineer and Mr. H. Sturm, Project Foundations Engineer, utilizing equipment owned and operated by Longyear Soil Investigation, Toronto. This report was written by Mr. D. Thanasse, under the supervision of Mr. H. Sturm; and reviewed by Mr. M. Devata, Chief Foundations Engineer.

D. D. Thanasse

D. D. Thanassé
Student Engineer



M. Devata

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

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (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

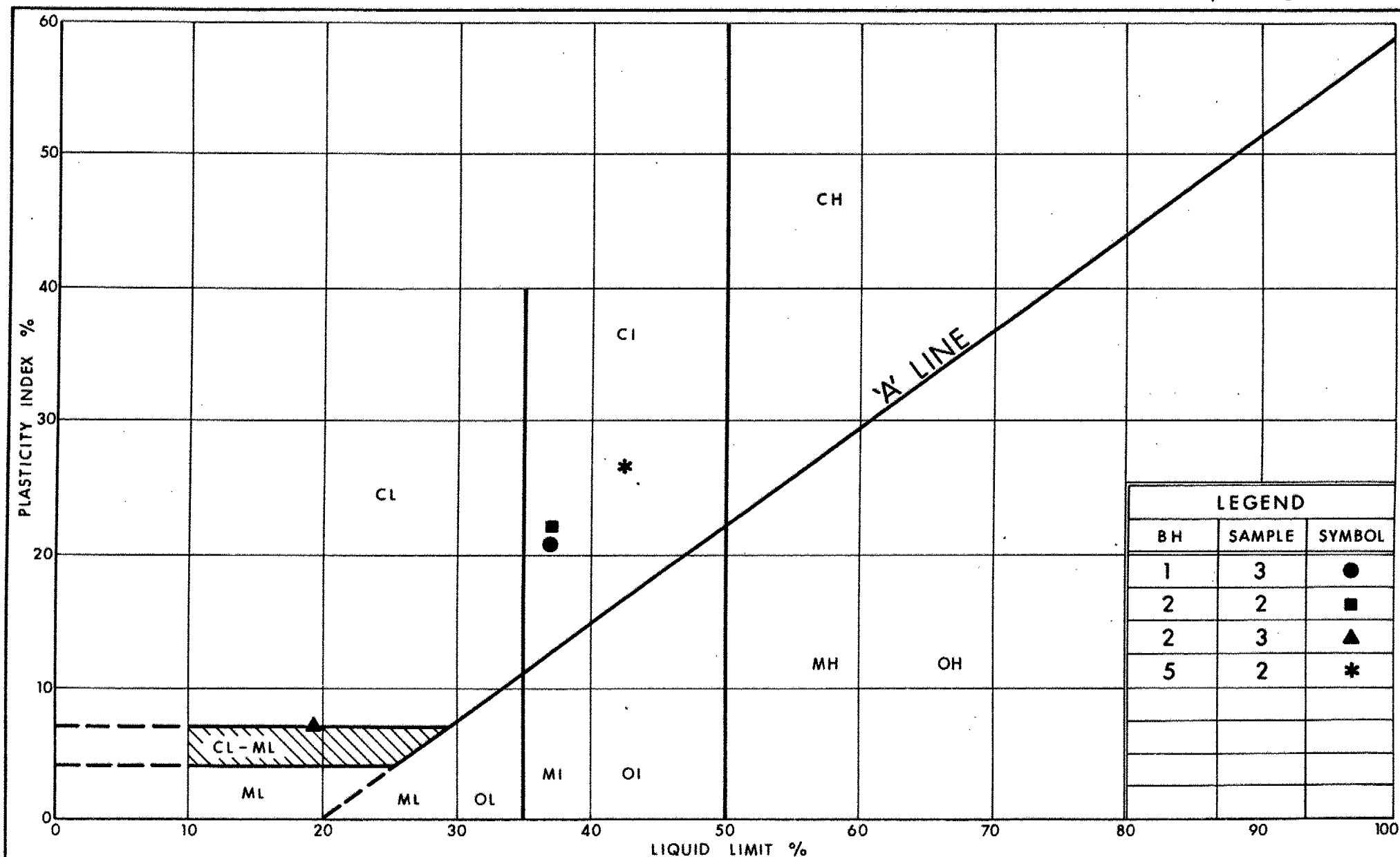
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	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'_{v0}	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_f	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 = $w_L - w_p$	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						



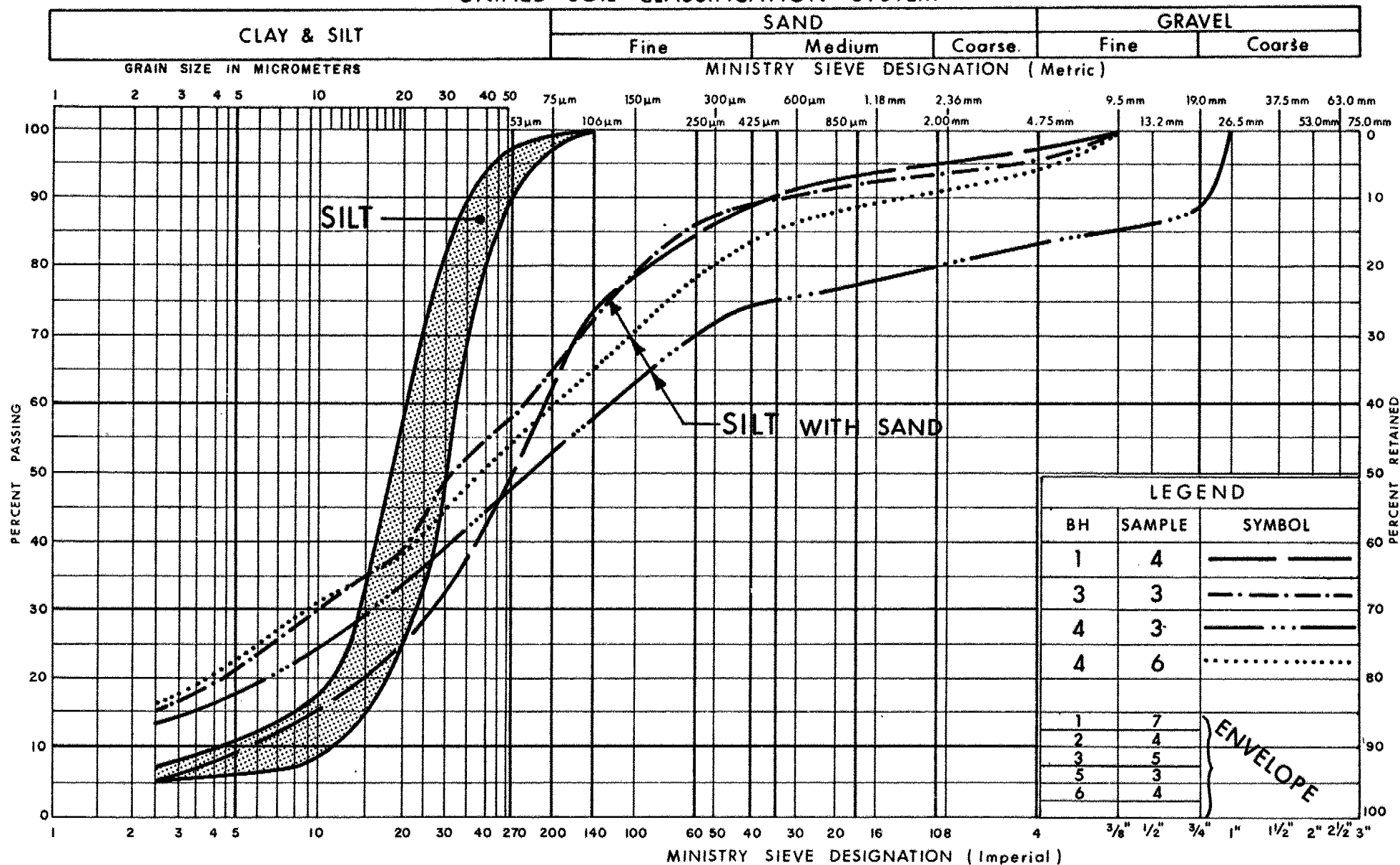
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PLASTICITY CHART
SILTY CLAY, SOME SAND TRACE OF GRAVEL

FIG No 1

W P 153-80-07

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

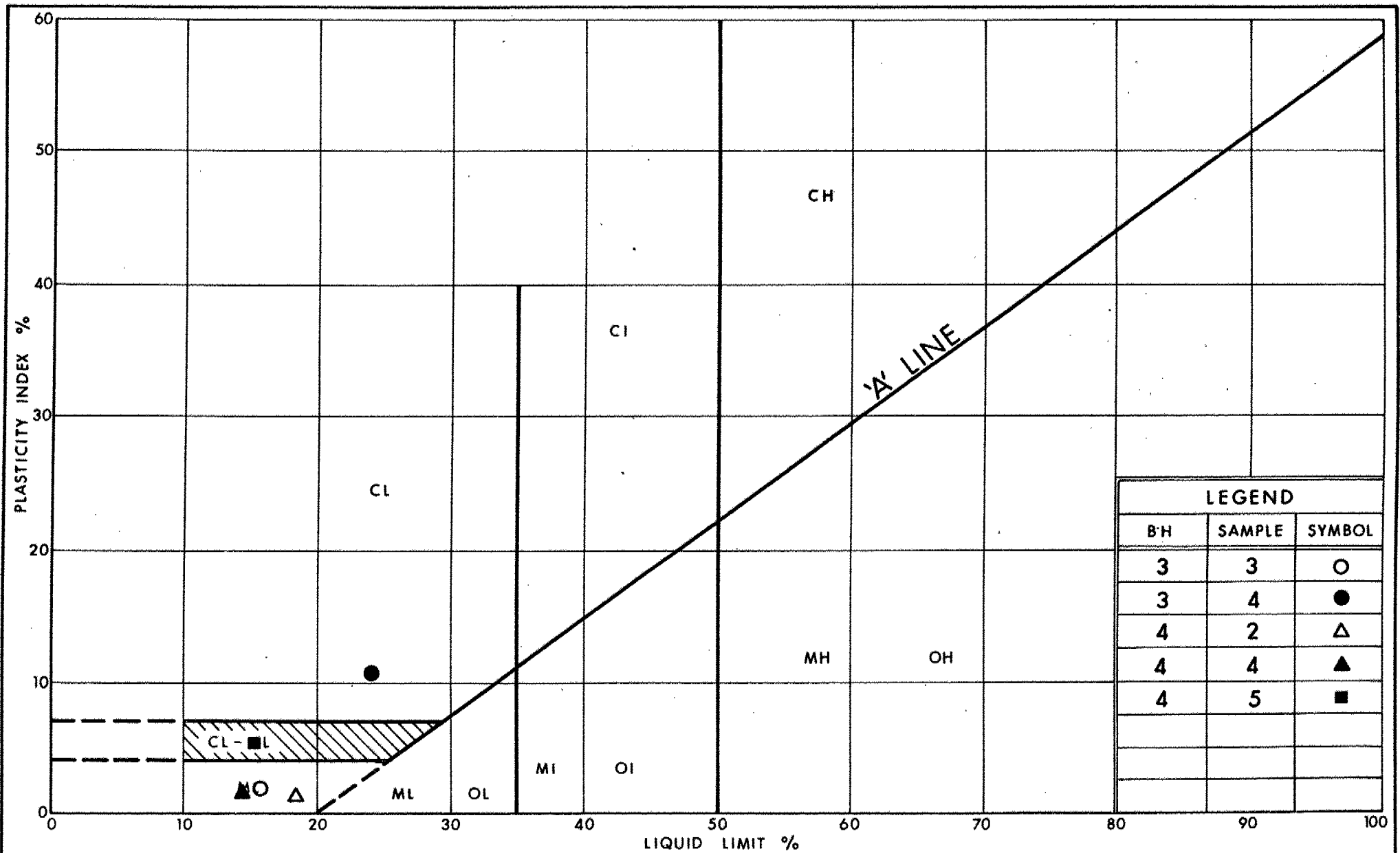
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GRAIN SIZE DISTRIBUTION

SILT WITH SAND TO SILT

FIG No 2

W P 153-80-07

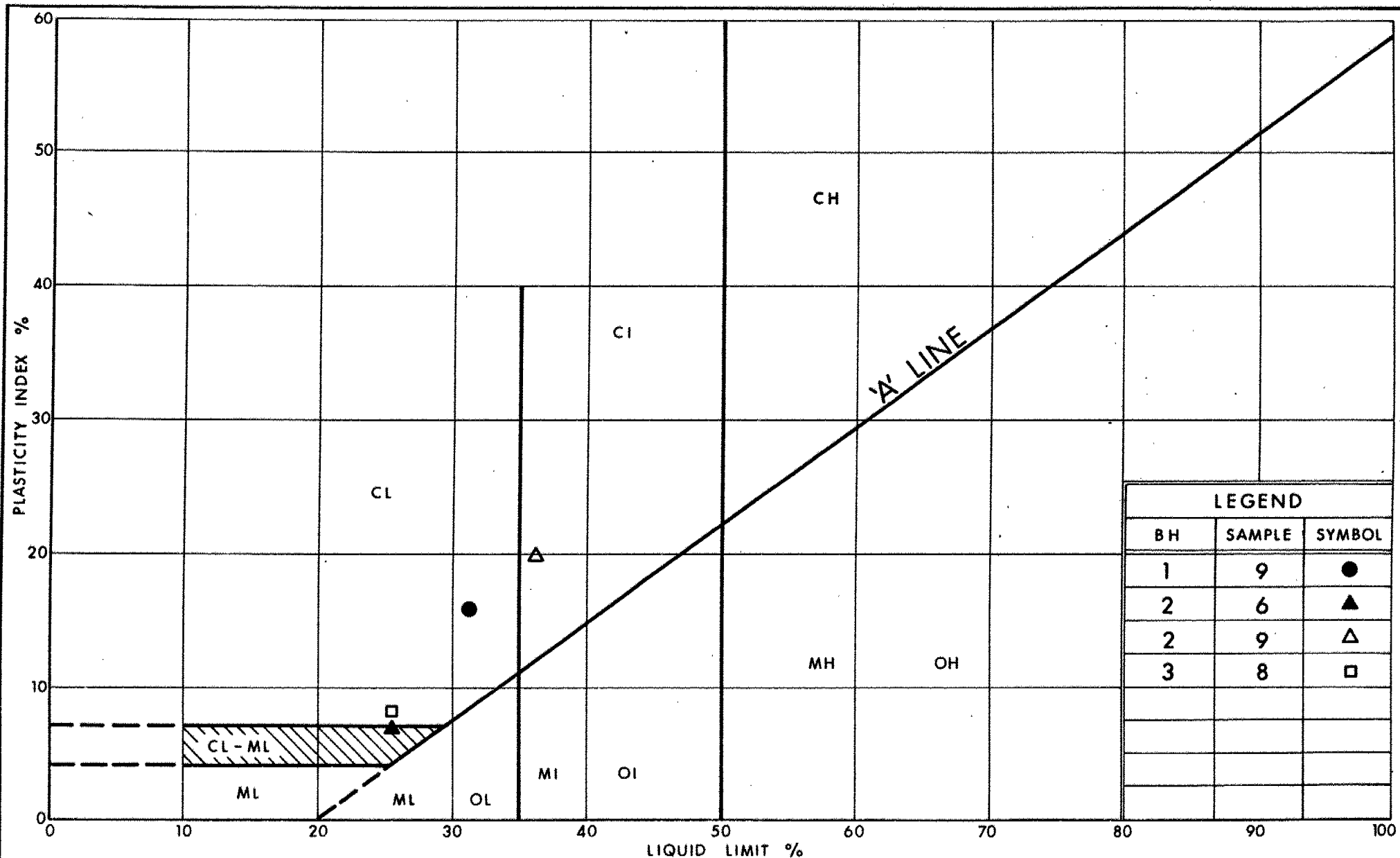


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PLASTICITY CHART SILT WITH SAND, TRACE OF CLAY AND GRAVEL

FIG No 3

W P 153-80-07

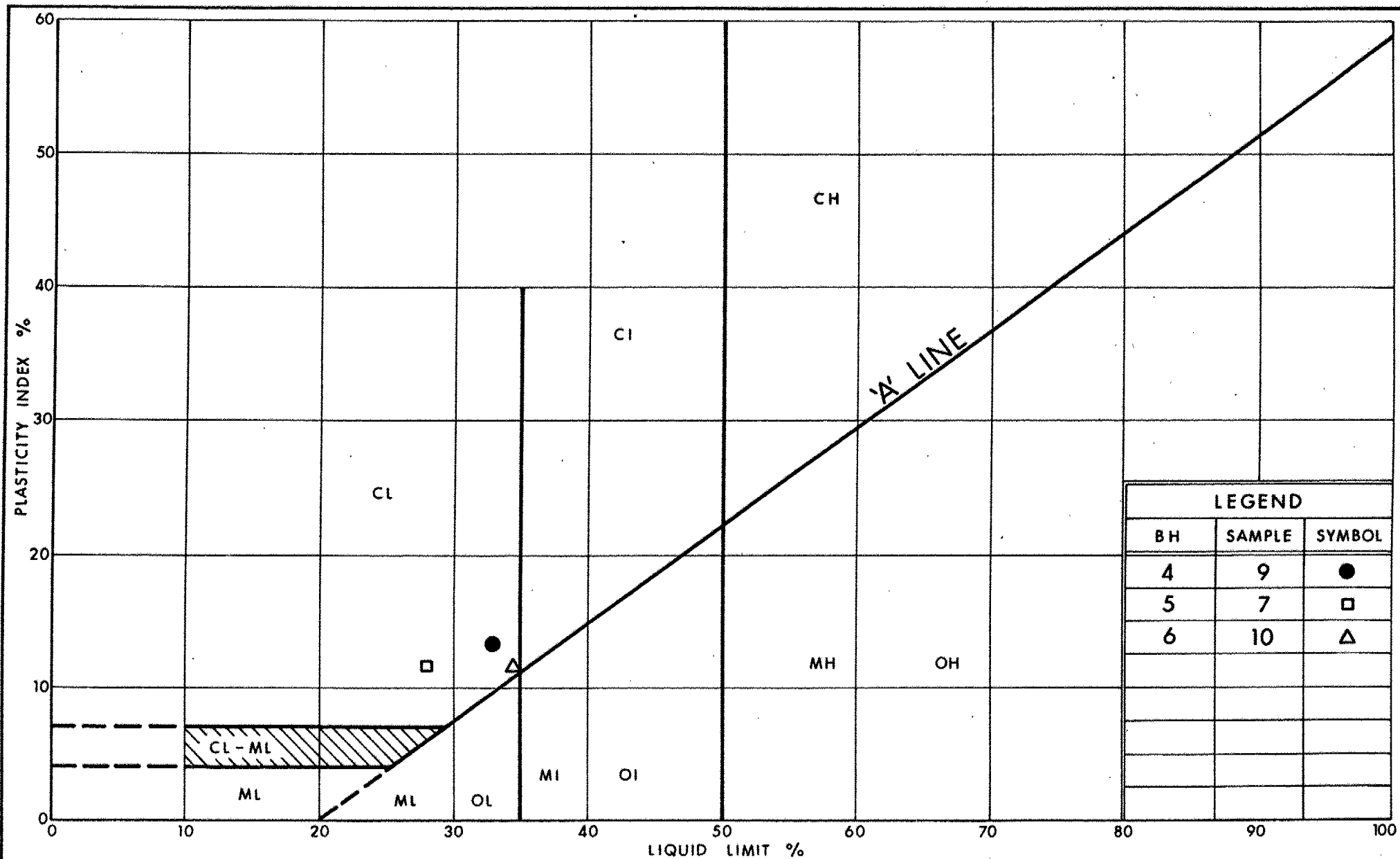


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PLASTICITY CHART SILTY CLAY WITH SILT SEAMS

FIG No 4

W P 153-80-07



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Communications

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

FIG No 5

W P 153-80-07

RECORD OF BOREHOLE No 1

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 594.3; E 293 963.6 ORIGINATED BY HS
DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 17 CHECKED BY *SP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100				W _p	W	W _L		
								SHEAR STRENGTH								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE					
180.8	Ground Surface															GR SA SI CL
0.0	Silty Clay with Sand trace gravel (Fill)															
179.4	Soft		1	SS	2		180									
1.4	Silty Clay some sand trace gravel		2	SS	6		179									
	Firm		3	SS	8		178									
177.9	Silt with Sand traces of clay and gravel		4	SS	133		177									2 37 57 4
2.9	Very Dense		5	SS	100/	13 cm										
	Silty Clay Seam Hard		6	SS	90		176									
	Silt						175									
	Very Dense		7	SS	145/	23 cm	174									0 0 94 6
							173									
172.7			8	SS	91/	15 cm	172									
8.1	Silty Clay with very thin Silt Seams															
	Hard		9	SS	85											
171.2																
9.6	End of Borehole															
	* Water Level Assumed at Point where Borehole Caved															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

W P 153-80-07

LOCATION Co-ords. N 4 847 603.8; E 293 993.2

ORIGINATED BY HS

DIST 6 HWY 427

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY DT

DATUM Geodetic

DATE 84 09 17

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	80	100					
180.7	Ground Surface																
0.0																	
179.3	Silty Clay some sand trace gravel (Fill) Stiff		1	SS	12		180										
1.4	Silty Clay some sand trace gravel Very Stiff		2	SS	23		179										
177.8			3	SS	26		178										
2.9	Silt Very Dense		4	SS	72		177										
			5	SS	56												
176.1			6	SS	39		176										
4.6	Silty Clay with Very Thin Silt Seams Hard		7	SS	31		175										
			8	SS	30		174										
			9	SS	40		173										
170.6			10	SS	55		172										
10.1	Heterogeneous Mixture of Silty Clay, Sand and Gravel (Glacial Till) Hard		11	SS	100	13 cm	171										
167.0			12	SS	140	10 cm	170										
166.8	Weathered Shale Bedrock						169										
13.9	End of Borehole Refusal to Auger Note: Water Level Taken immediately after completion of Augering.						168										
							167										

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 613.2; E 294 021.8 ORIGINATED BY HS & DT
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 18 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
180.7	Ground Surface																GR SA SI CL
0.0	Silty Clay with sand trace gravel (Fill) Stiff		1	SS	11		180										
179.3	Silty Clay some sand trace gravel Stiff		2	SS	14	*	179										
178.6	Silt with Sand traces of clay and gravel		3	SS	37		178							OH			5 30 56 9
2.1	Dense Silty Clay Seam Hard		4	SS	41		177										
	Silt		5	SS	146		176										0 1 94 5
	Very Dense		6	SS	90		175										
175.2			7	SS	73		174										
5.5	Silty Clay with very Thin Silt Seams		8	SS	35		173										
	Hard		9	SS	43		172										
	Occasional Cobbles or Boulders						171										
							170										
							169										
168.0	End of Borehole Refusal to Auger Probable Bedrock																
12.7	* Note: Water Level not determined																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 563.0; E 293 967.0 ORIGINATED BY DT
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 18 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 80 100									
								SHEAR STRENGTH									
179.3	Ground Surface													GR SA SI CL			
0.0	Silty Clay some sand trace gravel Firm		1	SS	6		179										
177.9							178										
1.4	Silt with Sand traces of clay and gravel		2	SS	66												
			3	SS	130/	18 cm	177							16 35 38 11			
	Occasional Cobbles or Boulders		4	SS	100/	15 cm	176										
			5	SS	114		175										
	Silty Clay Seam Hard		6	SS	70		174							6 33 47 14			
	Silt Very Dense		7	SS	63		173										
172.6							172										
5.7	Silty Clay with very Thin Silt Seams		8	SS	60		171										
	Hard						170										
169.3							169										
10.0	Heterogeneous Mixture of Silty Clay Sand and Gravel (Glacial Till)		9	SS	47		168										
	Hard																
167.3																	
167.0	Weathered Shale Bedrock		10	SS	100/	8 cm											
12.3	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 5

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 568.4; E 293 993.6 ORIGINATED BY DT
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 19 CHECKED BY *CP*

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 (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
179.3	Ground Surface												
0.0	Silty Clay some sand trace gravel		1	SS	7								
	Firm to Hard		2	SS	43								
177.2													
2.1	Silt		3	SS	81								
	Very Dense		4	SS	127								
			5	SS	171								
			6	SS	114								
173.8													
5.5	Silty Clay with Very Thin Silt Seams		7	SS	53								
	Hard		8	SS	59								
168.6													
168.4	Weathered Shale Bedrock		9	SS	70/8 cm								
10.9	End of Borehole												
	Water Table Elevations Measured												
	Date Elevation												
	84-09-20 179.2												
	84-10-12 179.0												
	84-11-08 179.1												

OFFICE REPORT ON SOIL EXPLORATION

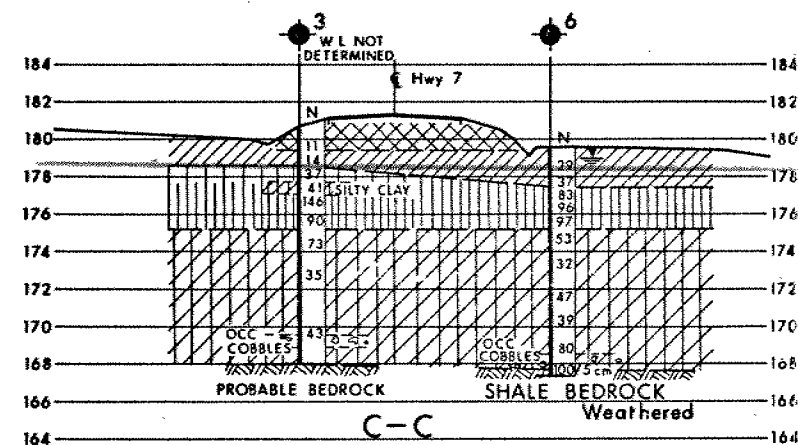
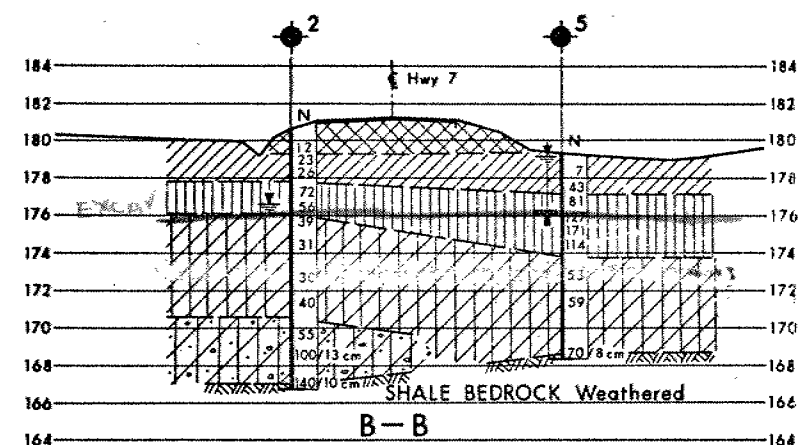
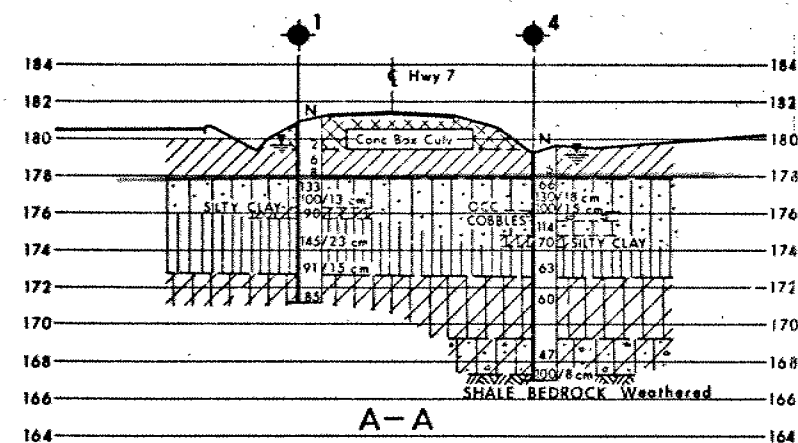
RECORD OF BOREHOLE No 6

METRIC

W P 153-80-07 LOCATION Co-ords. N 4 847 580.0; E 294 027.5 ORIGINATED BY DT
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
 DATUM Geodetic DATE 84 09 19 CHECKED BY CP

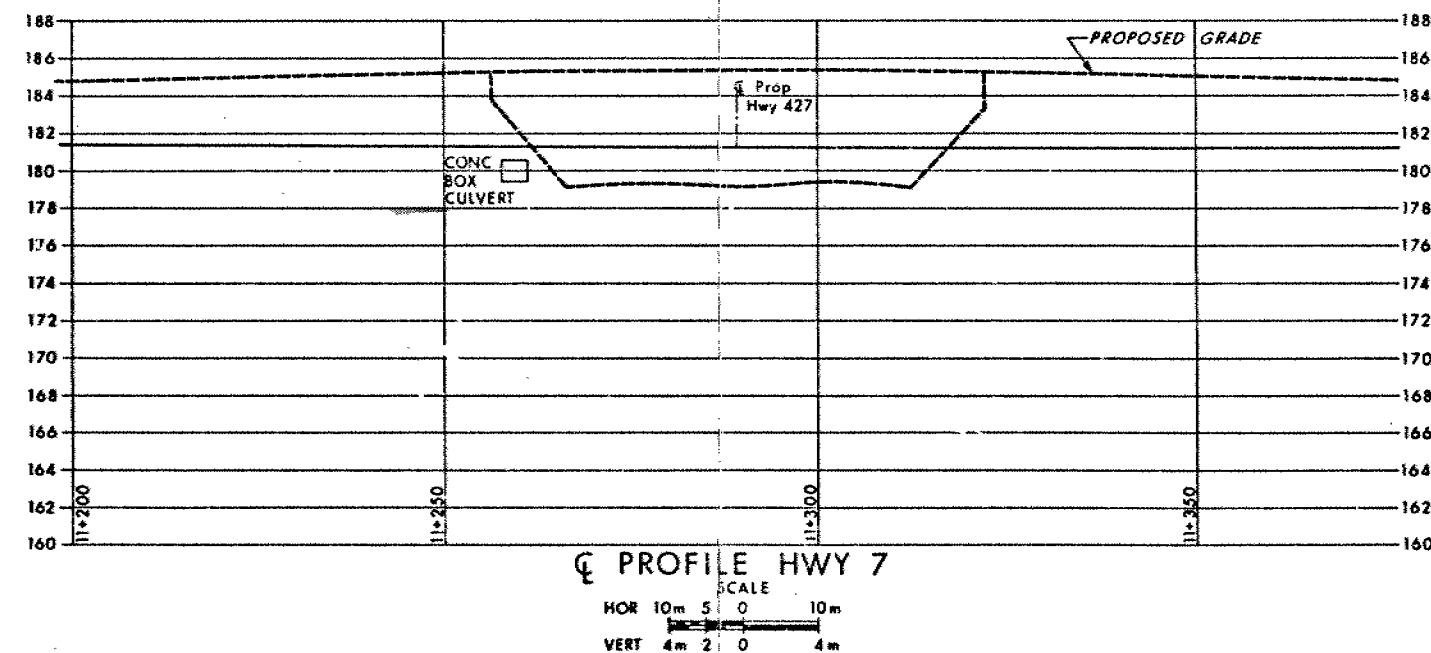
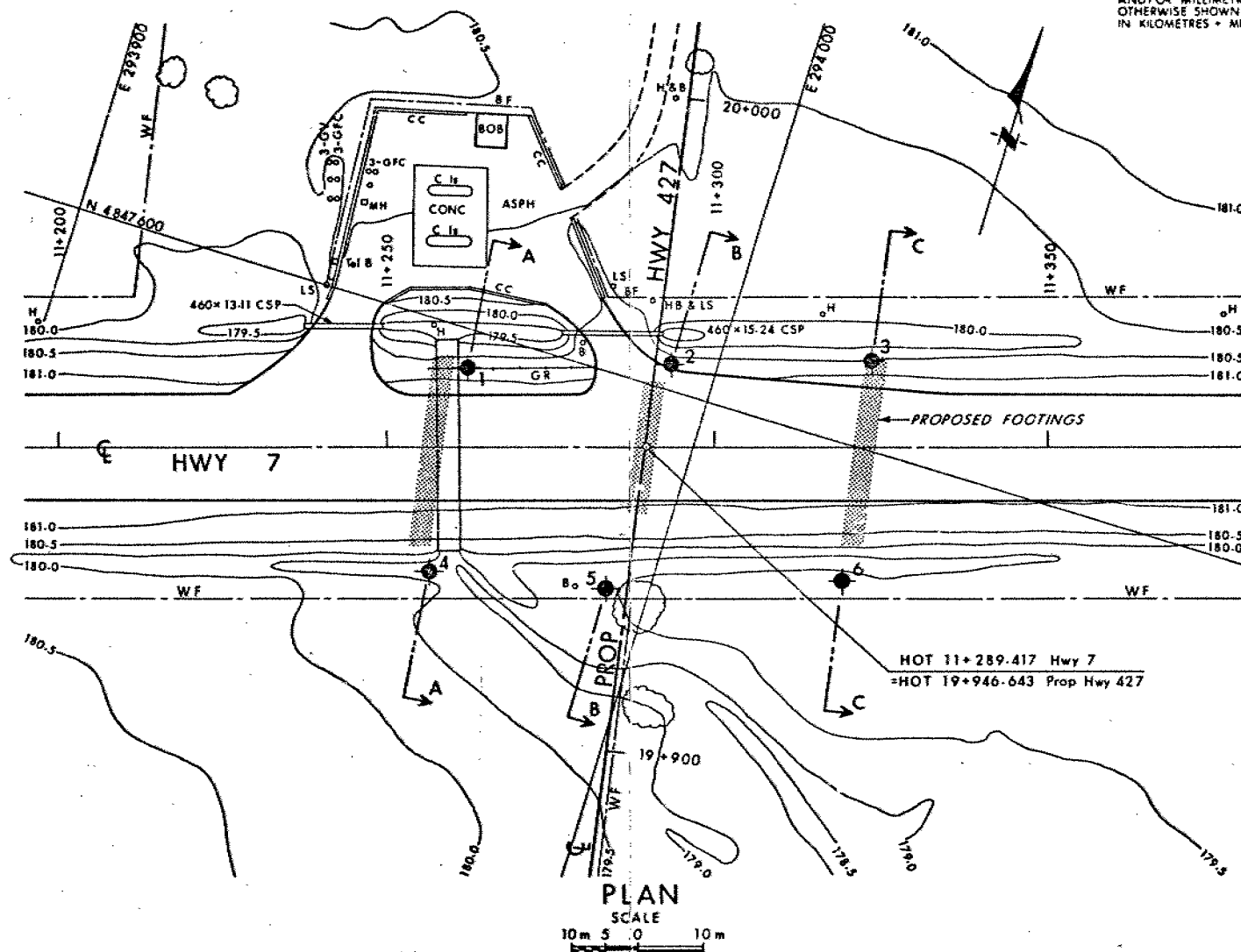
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
179.6	Ground Surface																
0.0	Silty Clay some sand trace gravel Very Stiff to Hard		1	SS	29		179										
			2	SS	37		178										
177.5																	
2.1	Silt Very Dense		3	SS	83		177										
			4	SS	96		176										
			5	SS	97												
175.2							175										
4.4			6	SS	53		174										
	Silty Clay with very Thin Silt Seams		7	SS	32		173										
							172										
			8	SS	47		171										
	Hard		9	SS	39		170										
			10	SS	80		169										
							168										
	Occasional Cobbles or Boulders																
167.5																	
167.4	Weathered Shale Bedrock		11	SS	100	5 cm											
12.2	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION



SOIL STRATIGRAPHY LEGEND

	SILTY CLAY WITH SAND, TRACE OF GRAVEL (FILL) Soft to Stiff		SILTY CLAY WITH SAND, TRACE OF GRAVEL (FILL) Firm to Hard
	SILTY CLAY WITH SAND, TRACE OF GRAVEL (FILL) Dense to Very Dense		SILTY CLAY WITH SAND, TRACE OF GRAVEL (FILL) Hard
	SILTY CLAY WITH SAND, TRACE OF GRAVEL (FILL) Very Dense		HET MIXTURE OF SILTY CLAY, SAND & GRAVEL (Glacial Till) Hard
	SHALE BEDROCK Weathered		



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

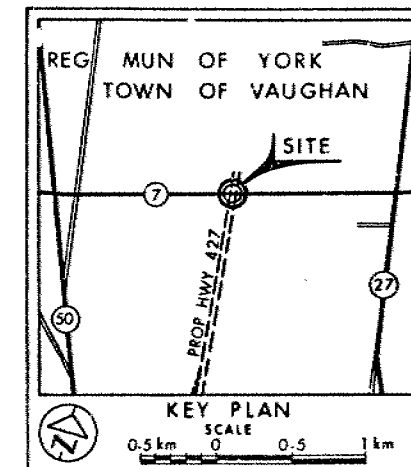
CONT No
WP No 153-80-07

HWY 7 UNDERPASS

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (5rd Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 1984 C9
- W.L. Not Determined in BH 3
- W.L. in Piezometer
- Clay Seal
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	180.8	4 847 594.3	293 963.6
2	180.7	4 847 603.8	293 993.2
3	180.7	4 847 613.2	294 021.8
4	179.3	4 847 563.0	293 967.0
5	179.3	4 847 568.4	293 993.6
6	179.6	4 847 580.0	294 027.5

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.

REV	DATE	BY	DESCRIPTION
1	1985 01 16		

Geocres No 30M13-63

HWY No 427	CHECKED BY	DATE 1985 01 16	DIST 6
SUBMIT H.S.	CHECKED BY	DATE 1985 01 16	SITE 37-73-330
DRAWN	CHECKED	APPROVED	DWG 1538007-A