

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-129DIST. 4 REGION                     W.P. No. 158-75-03CONT. No. 80-20W. O. No.                     STR. SITE No. 24-384HWY. No. 403LOCATION Winston Churchill Blvd.  
HudspassNo. of PAGES -                     

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     REMARKS:



**GENERAL NOTES**  
CLASS OF CONCRETE  
DECK & BARRIER WALLS 5000 P.S.I.  
PIER COLUMNS 5000 P.S.I.  
REMAINDER 3000 P.S.I.  
REINFORCING STEEL GRADE  
CSA STANDARD G30.12-11077 GRADE 400MP  
CLEAR COVER ON REINFORCING STEEL  
FOOTINGS & ABUTMENTS 3"  
PIER COLUMNS 2"  
DECK TOP 1"  
DECK BOTTOM 1"  
APPROACH SLABS AND/OR AS NOTED ON DRAWINGS.

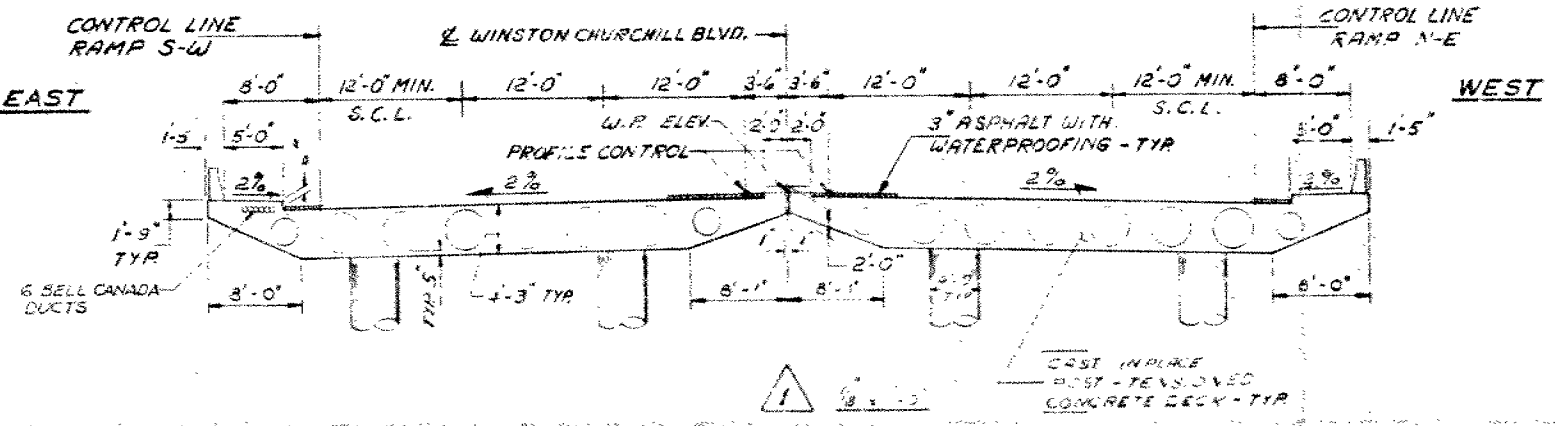
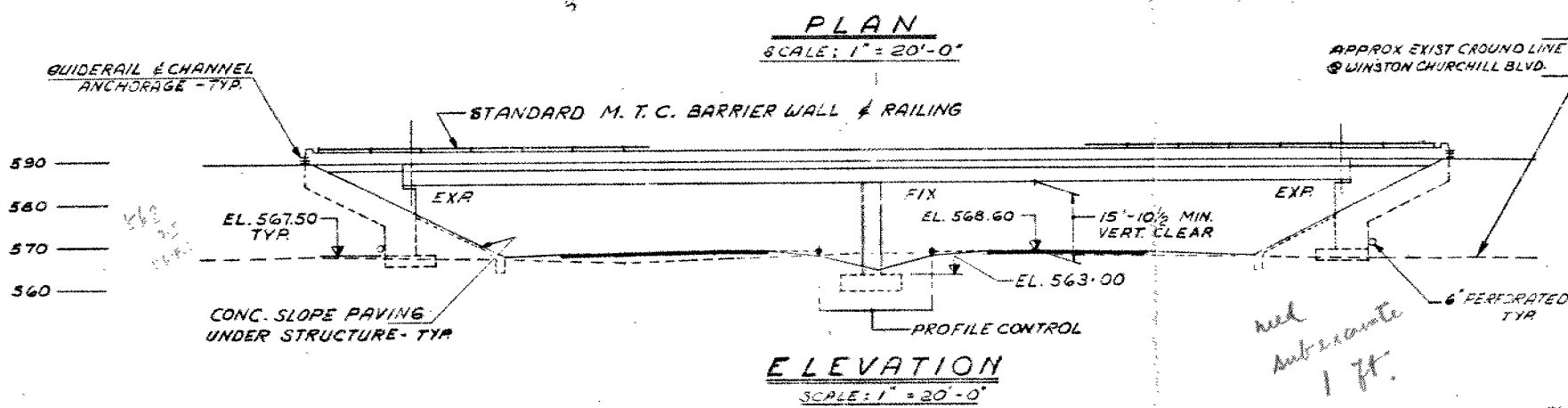
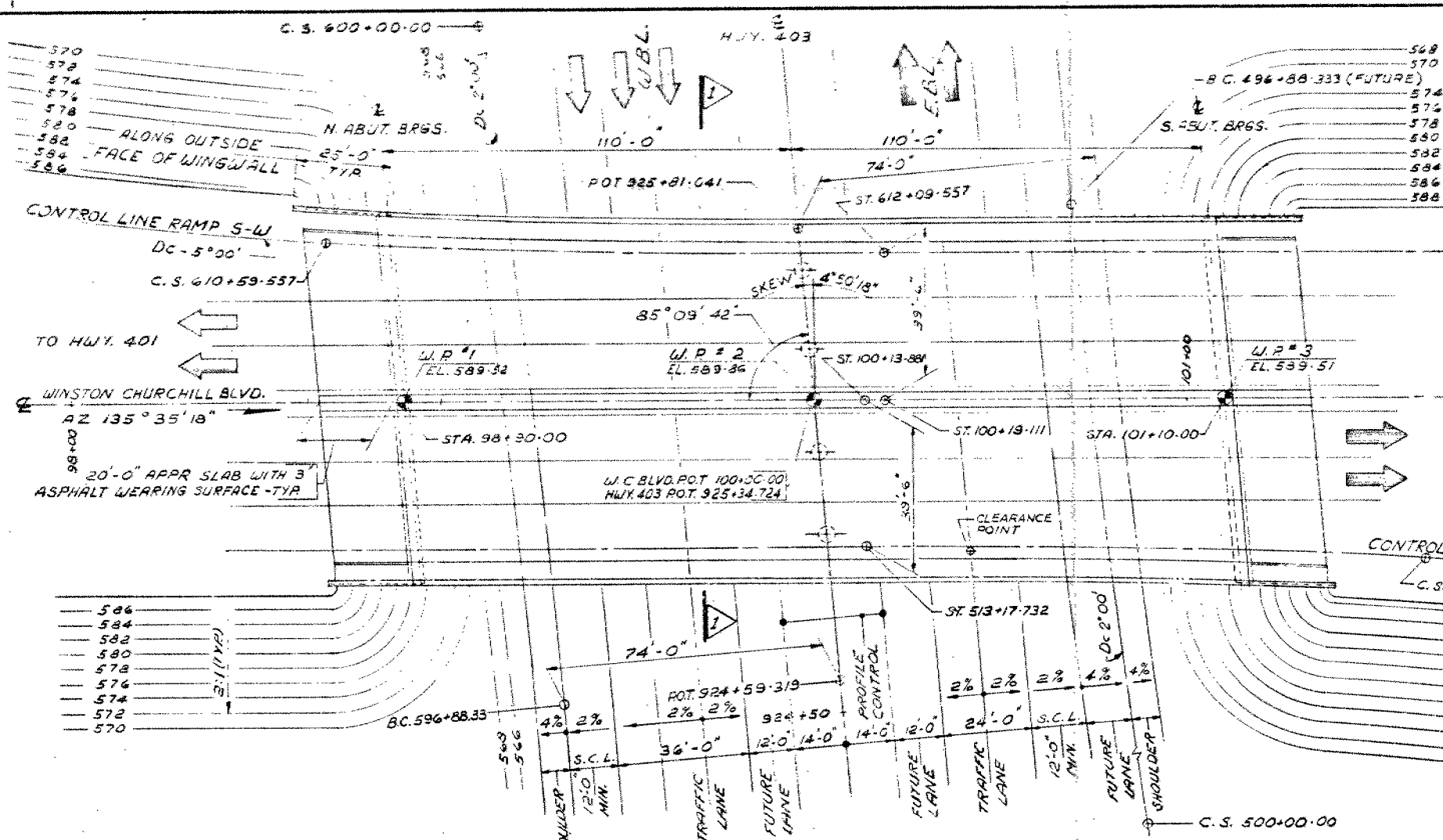
**NOTES**  
1) W.P. DENOTES WORKING POINT  
2) REFER TO GRADING DRAWINGS FOR CATCH BASINS OFF STRUCTURE.  
**CONSTRUCTION NOTES**  
THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm \frac{1}{8}$ ".  
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED, STRESSED AND GROUTED.

- LIST OF DRAWINGS**  
24-384-1. GENERAL PLAN  
-2. BOREHOLE LOCATIONS & SOIL STRATA  
-3. FOOTING LAYOUT & DETAILS  
-4. FOOTING REINFORCEMENT  
-5. WEST & EAST ABUTMENTS  
-6. PIER COLUMNS  
-7. DECK LAYOUT, SKEW ELEV AND BEARINGS  
-8. CABLE DETAILS I  
-9. CABLE DETAILS II  
-10. DECK REINFORCEMENT I  
-11. DECK REINFORCEMENT II  
-12. BARRIER WALL WITH SIDEWALK  
-13. STEEL RAILING (SINGLE TUBE)  
-14. 20 FT. APPROACH SLAB  
-15. DETAILS OF CONC SLOPE PAVING  
-16. AS CONSTRUCTED ELEV & DIM.  
-17. STANDARD DETAILS I  
-18. STANDARD DETAILS II  
-19. STANDARD DETAILS III

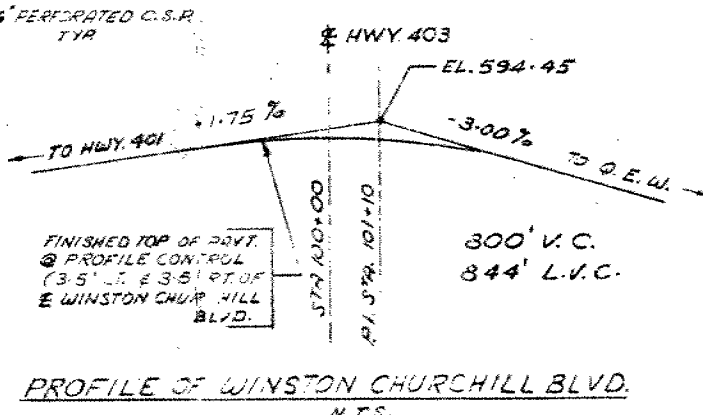
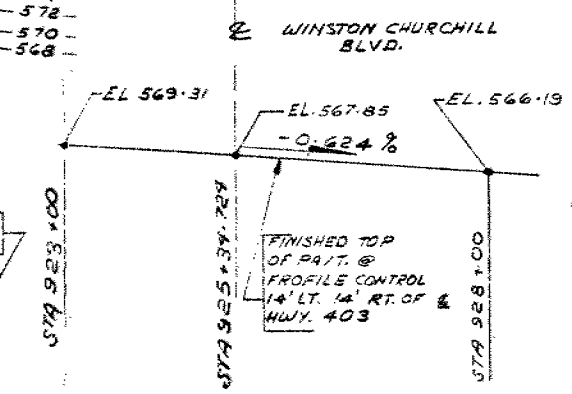


**CONCRETE QUANTITIES**  
CONCRETE QUANTITIES ARE LISTED BELOW FOR APPROPRIATE CONCRETE LUMP SUM ITEMS.

ITEM	QUANTITY	UNIT
1. CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS	554	CY
2. PRESTRESSED CONCRETE BRIDGE DECK	2,393	CY
3. CONCRETE IN BARRIER WALLS	41	CY
4. CONCRETE IN APPROACH SLABS	120	CY
5. CONCRETE IN SLOPE PAVING	79	CY



**NOTES**  
1) W.P. DENOTES WORKING POINT  
2) REFER TO GRADING DRAWINGS FOR CATCH BASINS OFF STRUCTURE.  
**SKEW**  
SIN. 0.0843445  
COS. 0.9954367  
TAN. 0.0846461



**REVISIONS**

NO.	DATE	BY	DESCRIPTION
1			
2			
3			



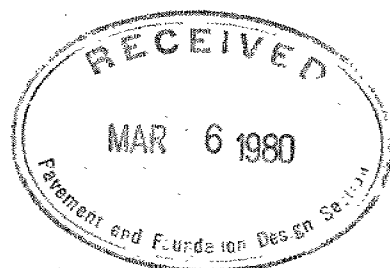
# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 80-20



Ontario

Ministry of  
Transportation and  
Communications



## INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3-17	Foundation Investigation Report W.P. 158-75-03 Winston Churchill Blvd. Underpass

Note: For purposes of the contract this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above mentioned project.

## EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS  $N_c$ .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

$S_u$ (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS &amp; SYMBOLS

## LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG.  $\bar{C}IU$  = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

## FIELD SAMPLING

SS SPLIT SPOON  
WS WASH SAMPLE  
ST SLOTTED TUBE SAMPLER  
LS BLOCK SAMPLE  
CS CHTR SAMPLE  
TW THINWALL OPEN  
TP THINWALL PISTON  
OS OSTEOMYX SAMPLE  
FS FOIL SAMPLE  
RC ROCK CORE  
PH T.W. ADVANCED HYDRAULICALLY  
PM T.W. ADVANCED MANUALLY

## EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_A$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_p$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE  
 $\omega$  SLOPE ANGLE-BACKFACE OF WALL  
 $\beta$  ANGLE OF SLOPE  
 $N_q, N_c$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
 $L, I$  FOOTING DIMENSIONS

## INDEX PROPERTIES

$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$   $e$  IN LOOSEST STATE  
 $e_{min}$   $e$  IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_P$  PLASTIC LIMIT  
 $w_S$  SHRINKAGE LIMIT  
 $I_P$  PLASTICITY INDEX =  $w_L - w_P$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_P}{I_P}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{I_P}$   
 $A_c$  ACTIVITY =  $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ Soil Fraction}}$   
 $O_m$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION

## STRENGTH PARAMETERS

$c$  ANGLE OF SHEARING RESISTANCE  
 $\tau_f$  PEAK SHEAR STRENGTH  
 $\tau_r$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_e$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $m, n$  STABILITY COEFFICIENTS  
 $A, B$  PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;

## HYDRAULIC TERMS

$h$  HYDRAULIC HEAD OR POTENTIAL  
 $q$  RATE OF DISCHARGE  
 $v$  VELOCITY OF FLOW  
 $i$  HYDRAULIC GRADIENT  
 $J$  SEEPAGE FORCE PER UNIT VOLUME  
 $\eta$  COEFFICIENT OF VISCOSITY  
 $k$  COEFFICIENT OF HYDRAULIC CONDUCTIVITY  
 $k_h$   $k$  IN HORIZONTAL DIRECTION  
 $k_v$   $k$  IN VERTICAL DIRECTION  
 $m_v$  COEFFICIENT OF VOLUME CHANGE  
 $c_v$  COEFFICIENT OF CONSOLIDATION  
 $C_c$  COMPRESSION INDEX  
 $C_r$  RECOMPRESSION INDEX  
 $d$  DRAINAGE PATH DISTANCE  
 $T_v$  TIME FACTOR  
 $U$  DEGREE OF CONSOLIDATION  
 $O_r$  OVERCONSOLIDATION RATIO (OCR)

## FOUNDATION INVESTIGATION REPORT

For

Winston Churchill Blvd. Underpass  
W.P. 158-75-03, Site No. 24-384  
District 4, Hamilton

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### INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of August 15 to August 17, 1977. The field-work consisted of seven sampled boreholes advanced by means of a continuous flight auger machine equipped with hollow stem (3¼" I.D.) augers.

The boreholes ranged in depths from 20.5 to 60.0 feet below the ground surface.

### SITE DESCRIPTION AND GEOLOGY

The site is located about one mile north of Burnhamthorpe Road in the City of Mississauga, Regional Municipality of Peel.

The topography of the area is flat to gently undulating. The land is developed for farming purposes. Physiographically, the site is situated in the region of "South Slope". The characteristic deposit in the vicinity of the area under investigation is composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock of Meaford-Dundas formation, Ordovician Period.

### SUBSURFACE CONDITIONS

#### General

The subsurface conditions were found to be quite uniform over the site. Under a thin layer of topsoil is a stratum of cohesive glacial till which is underlain by a layered deposit

of clayey silt and silt with trace of sand. Detailed descriptions of the various soil types encountered as well as all field and laboratory test results are given in the Record of Borehole Sheets contained in the report Appendix. The estimated stratigraphical profile and sections shown in Drawing No. 24-384-2 are based upon this information. From ground level downwards the various soil types encountered are as follows:

#### Glacial Till

Underlying a thin (max. 12") layer of topsoil a deposit of cohesive glacial till was encountered at all locations over the site. The glacial till varies in thickness from 24.0 to 31.0 feet and is comprised of a heterogeneous mixture of clayey silt, sand and gravel. Standard Penetration Tests gave 'N' values ranging from 20 blows to over 100 blows per foot, indicating that the glacial till has a very stiff to hard consistency, but, generally hard.

The physical properties of the glacial till as determined from laboratory testing are summarized below:

	<u>Range</u>
Liquid Limit ( $W_L$ ) %	21 - 28
Plastic Limit ( $W_P$ ) %	12 - 15
Moisture Content (W) %	9 - 15

The results of the Atterberg Limit Tests are shown on a Plasticity Chart (Fig. 1) and the typical grain size distribution curves are presented as an envelope in Fig. 2 in the Appendix of this report.

The Atterberg Limits indicate that the cohesive stratum is inorganic and of low plasticity.

At one location a distinct 3 foot thick layer of dense silty sand was sandwiched immediately beneath the glacial till deposit and above the layered clayey silt stratum.



### Clayey Silt With a Trace of Sand and Seams of Silt (Layered)

Underlying the cohesive glacial till stratum is a deposit of clayey silt with a trace of sand and seams of silt in a layered condition. The material is made up of irregular layers of clayey silt and silt with traces of sand. Standard Penetration Tests for the overall deposit gave 'N' values well over 100 blows per foot indicating that this layered stratum has a hard consistency in the cohesive portion and very dense relative density in the noncohesive portion of the deposit.

The physical properties of the cohesive portion of the deposit as determined from laboratory testing gave the following results:

	<u>Range</u>
Liquid Limit ( $W_L$ ) %	22 - 28
Plastic Limit ( $W_P$ ) %	15 - 18
Moisture Content (W) %	11 - 21

The results of the Atterberg Limit Tests are shown on a Plasticity Chart (Fig. 1) and the typical grain size distribution curves are presented in an envelope form in Fig. 3 in the Appendix of this report.

The Atterberg Limits indicate that the clayey silt layers of the deposit are inorganic and of low plasticity.


### Groundwater

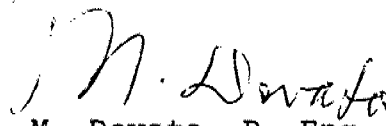
The groundwater levels were observed by measuring in the open borehole during and after the completion of the foundation investigation. The groundwater levels were found to vary between elevations 567 (B.H. 3) and 541 (B.H. 5) which corresponds to depths of 3 feet to 26 feet below the existing ground surface.

The erratic variation of the water levels in the boreholes was attributed primarily due to the presence of irregular

layers of silt in the lower layered deposit of clayey silt.

The groundwater levels are shown on the Record of Borehole Sheets, as well as on Drawing No. 24-384-2.

*for*   
P.J. Stuart, P. Eng.  
Foundations Engineer

  
M. Devata, P. Eng.  
Senior Foundations Engineer

## APPENDIX

RECORD OF BOREHOLE No 1

W P 158-75-03 LOCATION Co-ords N 15,821,368; E. 944,431 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3/4" H.S. Auger and Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE August 15, 1977 CHECKED BY JS

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100						
568.0	Ground Level												
0.0	Topsoil												
	Het. Mixture of clayey silt, sand and gravel (Glacial Till)		1	SS	50								0 30 52 18
	Very Stiff to Hard		2	SS	38								7 26 47 20
	Brown		3	SS	37								4 28 48 20
	Grey		4	SS	32								
			5	SS	23								
			6	SS	21								
544.0													
24.0	Clayey Silt With Seams of Silt and Trace of Sand		7	SS	163								0 6 74 20
			8	SS	127								
531.5	Hard or Very Dense		9	SS	150								0 0 90 10
36.5	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

W P 158-75-03 LOCATION Co-ords N 15,821,438; E. 944,503 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger and Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE August 15, 1977 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100					
566.2	Ground Level													
0.0	Topsoil													
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	20		560							3 35 50 22
			2	SS	34									12 26 43 19
			3	SS	46									
	Brown		4	SS	41									
	Grey		5	SS	100	6"	550		100/ 10"					14 25 45 16
			6	SS	143	10"								
542.2			7	SS	140	10"	540							0 1 79 20
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	132	11"								
529.7	Hard or Very Dense		9	SS	118		530							0 0 59 41
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

W P 158-75-03 LOCATION Cor-ords N 15,821,517; E. 944,425 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 16, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH						WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
568.7	Ground Level													
0.0														
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	135	10"							7 25 45 23	
			2	SS	45								15 25 39 21	
	Hard		3	SS	75								25 18 40 17	
	Brown		4	SS	86								3 6 84 7	
	Grey		5	SS	66								0 1 80 19	
			6	SS	70									
544.7			7	SS	100	6"								
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	160	11"								
532.2	Hard or Very Dense		9	SS	175	9"								
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

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

20  
15  
10  
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4 (Formerly W.O. 76-11005)

W P 158-75-03 LOCATION Co-ords N. 15,821,474: E. 944,365 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE H.S. 3 1/2" Auger (CME 55 M.V.) & Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE July 5, 1976 CHECKED BY A.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	10 20 30					
565.0	Ground Level													
0.0	Het. Mix. of Clayey Silt With Sand, Occ. Gravel (Glacial Till) Very Stiff to Hard		1	SS	26		560							0 28 53 19
			2	SS	30									
	Brown		3	SS	72									0 35 49 16
	Grey		4	SS	60									
			5	SS	36		550							
			6	SS	94									0 1 79 20
			7	SS	100	11"	540							
534.0			8	SS	120									
31.0	Clayey Silt With Seams of Silt and Trace of Sand Hard		9	SS	95	9"	530							0 2 86 12
			10	SS	90									
			11	SS	95	9"	520							
505.0							510							
60.0	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

W P 158-75-03 LOCATION Co-ords N. 15,821,525; E. 944,277 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 15, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
567.1	Ground Level													
0.0	Topsoil													
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	36		560							1 26 52 21
			2	SS	36									
			3	SS	120/	11"								31 21 31 17
	Brown		4	SS	170/	11"								
	Grey		5	SS	62		550							19 22 44 15
			6	SS	95									
543.1			7	SS	130									
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	170/	9"	540							0 1 73 26
	Hard or Very Dense													
530.6			9	SS	123									0 1 89 10
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 6

W P 158-75-03 LOCATION Co-ords N. 15,821,447; E. 944,354. ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger & Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE August 17, 1977 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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 (%)								
567.0	Ground Level								10	20	30						
0.0	Topsoil																
	Het. Mixture of Clayey Silt, Sand and Occasional Gravel		1	SS	85		560						0 26 47 27				
	Glacial Till		2	SS	49												
	Hard Brown		3	SS	46												
	Grey		4	SS	90								0 29 55 16				
			5	SS	50		550										
546.5			6	SS	75								0 1 78 21				
20.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 7

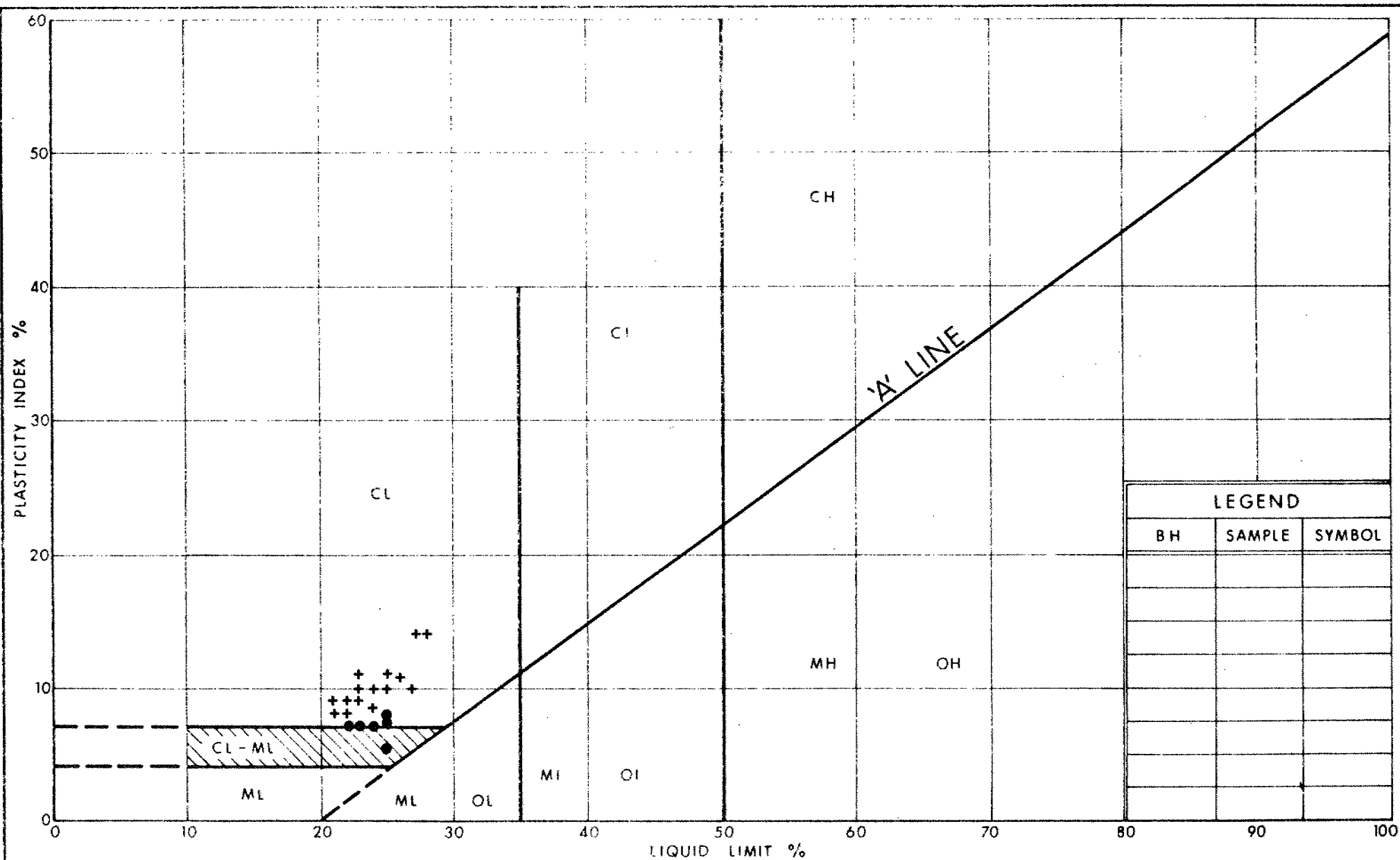
W P 158-75-03 LOCATION Co-ords N. 15,821,595; E. 944,349 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger & Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE August 16, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
567.7	Ground Level												
0.0	Topsoil												
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard Brown		1	SS	23								4 29 46 21
			2	SS	68								7 31 45 17
			3	SS	50								
			4	SS	55								
	Grey		5	SS	34								1 29 51 19
			6	SS	47								
544.7													
23.0	Silty Sand, fine												
541.7	Dense		7	SS	132								0 34 62 4
26.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	155	10"							0 1 79 20
531.2	Hard or Very Dense		9	SS	135	6"							
36.5	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

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

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

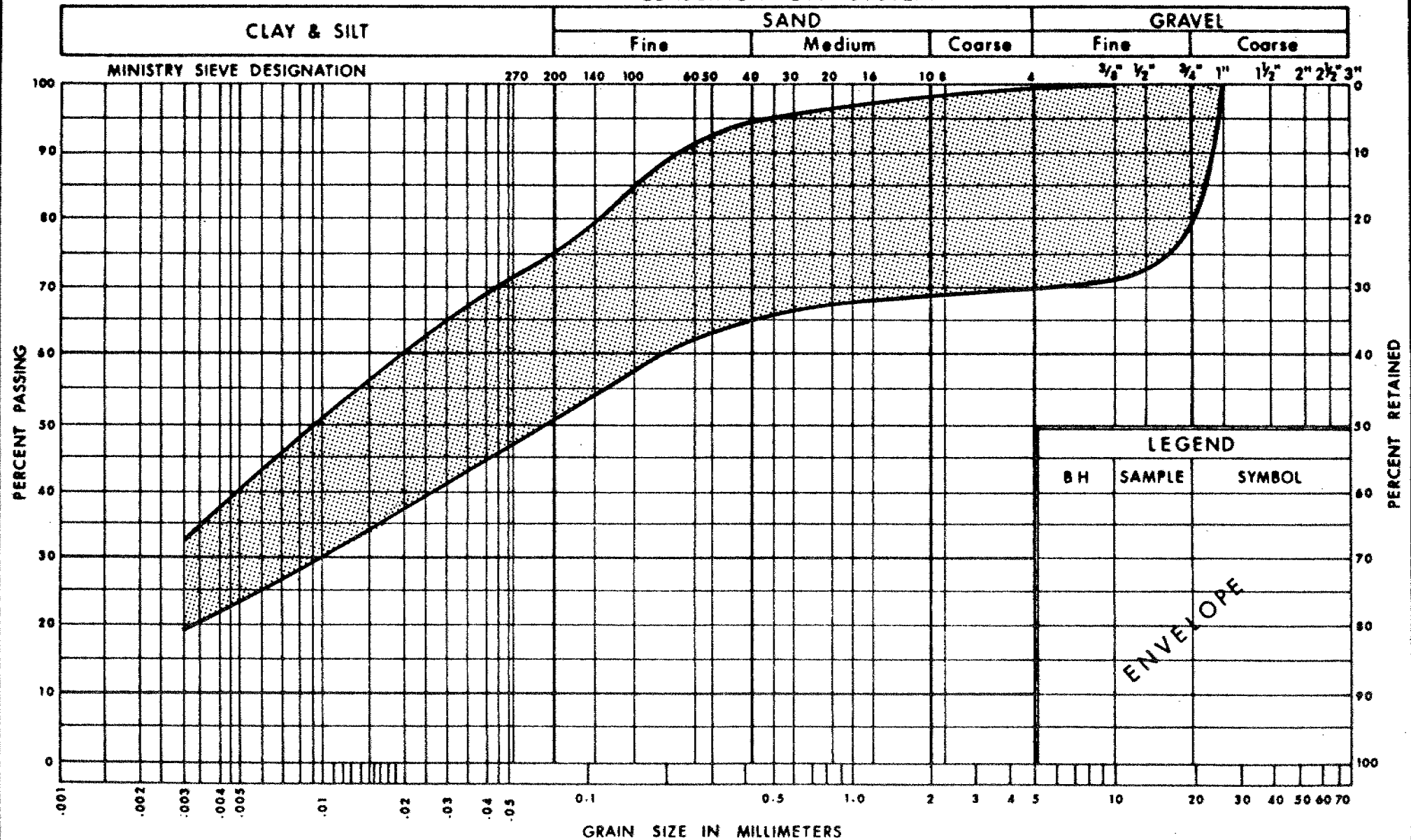
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Communications

PLASTICITY CHART  
COHESIVE GLACIAL TILL  
CLAYEY SILT WITH SEAMS OF SILT

FIG No 1

W P 158 - 75 - 03

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

 Ministry of  
Transportation and  
Communications

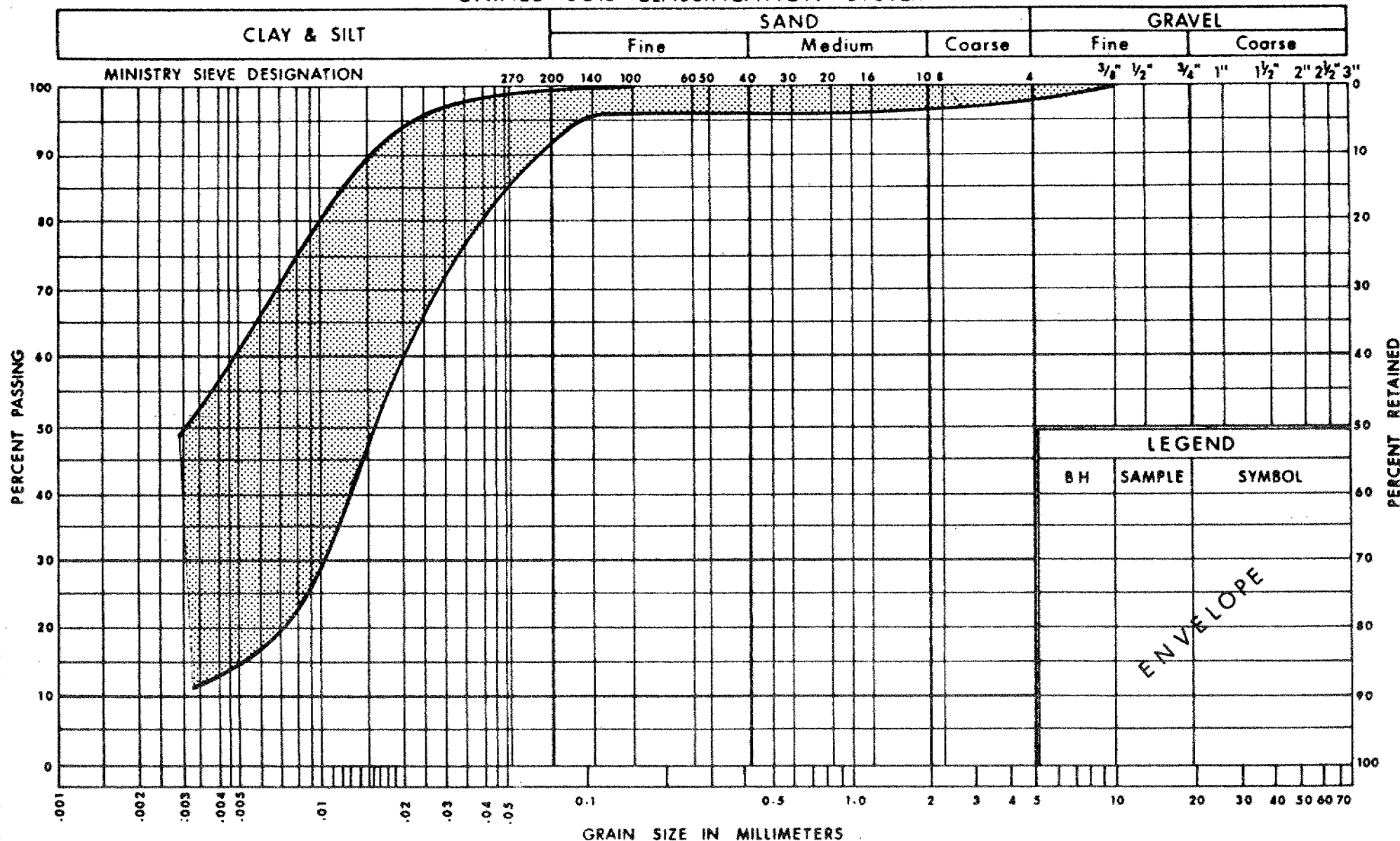
 GRAIN SIZE DISTRIBUTION  
GLACIAL TILL

HET MIX OF CLAYEY SILT, SAND &amp; GRAVEL

FIG No 2

W P. 158-75-03

## UNIFIED SOIL CLASSIFICATION SYSTEM



**Ontario**

Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT  
WITH SEAMS OF SILT & TRACE OF SAND

FIG No 3

W P 158-75-03

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 158-75-03

DIST 4

*CONT 80-20*

HWY 403

STR SITE 24-384

Winston Churchill Blvd. Underpass

DISTRIBUTION

G.C.E. Burkhardt (3)  
R.D. Gunter  
M.R. Ernesaks  
D.E. Thrasher (2)

C. Grebski  
G.A. Wrong  
B.J. Giroux  
R.S. Pillar

R. Hore

R. Fitzgibbon )  
J. Anderson )  
G. Sloan )

Files ✓

cover only

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	77 10 20	<i>MD</i>
TUBES		
ROCK CORES		

# FOUNDATION INVESTIGATION REPORT

For

Winston Churchill Blvd. Underpass  
W.P. 158-75-03, Site No. 24-384  
District 4, Hamilton

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## INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of August 15 to August 17, 1977. The fieldwork consisted of seven sampled boreholes advanced by means of a continuous flight auger machine equipped with hollow stem ( $3\frac{1}{4}$ " I.D.) augers.

The boreholes ranged in depths from 20.5 to 60.0 feet below the ground surface.

## SITE DESCRIPTION AND GEOLOGY

The site is located about one mile north of Burnhamthorpe Road in the City of Mississauga, Regional Municipality of Peel.

The topography of the area is flat to gently undulating. The land is developed for farming purposes. Physiographically, the site is situated in the region of "South Slope". The characteristic deposit in the vicinity of the area under investigation is composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock of Meaford - Dundas formation, Ordovician Period.

This physiographic region is well drained by the Credit, Oakville and Etobicoke Creeks, which have cut deep valleys into the overburden. However, in many of the interstream areas drainage is still imperfect.

## SUBSURFACE CONDITIONS

### General

The subsurface conditions were found to be quite uniform over the site. Under a thin layer of topsoil is a stratum of cohesive glacial till which is underlain by a layered deposit of clayey silt and silt with trace of sand. Detailed descriptions of the various soil types encountered in each borehole are given in the Record of Borehole Sheets. The estimated stratigraphical profile and sections shown in Drawing No. 1587503 A are based upon this information. From ground level downwards the various soil types encountered are as follows:

### Glacial Till

Underlying a thin (max. 12") layer of topsoil a deposit of cohesive glacial till was encountered at all locations over the site. The glacial till varies in thickness from 24.0 to 31.0 feet. The cohesive glacial till is comprised of a heterogeneous mixture of clayey silt, sand and gravel. The Standard Penetration Tests gave 'N' values ranging from 20 blows to over 100 blows per foot, indicating that the glacial till has a very stiff to hard consistency, but, generally hard.

The physical properties of the glacial till as determined from laboratory testing are summarized below:

	<u>Range</u>
Liquid Limit ( $W_L$ ) %	21-28
Plastic Limit ( $W_p$ ) %	12-15
Moisture Content (W) %	9-15

The results of the Atterberg Limit Tests are shown on Plasticity Chart (Fig. 1) and the typical grain size distribution curves are presented in an envelope form in Fig. 2 which are included in the Appendix of this report.

The Atterberg Limits indicate that the cohesive stratum is inorganic and of low plasticity.

At one location a distinct 3 foot thick layer of dense silty sand was sandwiched immediately beneath the glacial till deposit and above the layered clayey silt stratum.

### Clayey Silt With Trace of Sand and Seams of Silt (Layered)

Underlying the cohesive glacial till stratum is a deposit of clayey silt with trace of sand and seams of silt in a layered condition. The material is made up of irregular layers of clayey silt and silt with traces of sand. The Standard Penetration Tests for the overall deposit gave 'N' values well over 100 blows per foot indicating that the layered stratum has a hard consistency in the cohesive portion and very dense relative density in the noncohesive portion of the deposit.

The physical properties of the cohesive portion of the deposit as determined from laboratory testing gave the following results:



	<u>Range</u>
Liquid Limit ( $W_L$ ) %	22-28
Plastic Limit ( $W_p$ ) %	15-18
Moisture Content ( $W$ ) %	11-21

The results of the Atterberg Limit Tests are shown on Plasticity Chart (Fig. 1) and the typical grain size distribution curves are presented in an envelope form in Fig. 3 which are included in the Appendix of this report.

The Atterberg Limits indicate that the clayey silt layers of the deposit are inorganic and of low plasticity.

#### Groundwater

The groundwater levels were observed by measuring in the open borehole during and after the completion of the foundation investigation. The groundwater levels were found to vary between elevations 567 (B.H. 3) and 541 (B.H. 5) which corresponds to depths of 3 feet to 26 feet below the existing ground surface.

The erratic variation of the water levels in the boreholes was attributed primarily due to the presence of irregular layers of silt in the lower layered deposit of clayey silt.

The groundwater levels are shown on the Record of Borehole Sheets, as well as on Drawing No. 1587503 A.

## DISCUSSION AND RECOMMENDATIONS

As part of the new Hwy. 403 construction an underpass structure has been proposed at the crossing of the new Hwy. 403 and the existing Winston Churchill Blvd. It is understood that the Winston Churchill Blvd. will be widened to a four lane road in this area.

In the vicinity of the proposed structure the existing grade of the Winston Churchill Blvd. varies from 567.0 (south side) to 568.0 (north side). The revised grade of the Winston Churchill Blvd. will be at elevation 589.0. The proposed grade of Hwy. 403 will be at elevation 568.0. This will necessitate fills up to 22 feet.

A two span structure (110'-110') consisting of closed type abutments with a centre pier are presently being considered at this crossing.

### Pier Foundations

The pier may be founded on spread footings located within competent glacial till stratum at or below elevation 565.0 with an allowable load of up to 4 t.s.f. A minimum earth cover of 4 feet from the base of the footings should be provided for frost protection requirements.

No major dewatering problems are anticipated for the construction of foundations since the subsoil is relatively impervious. Furthermore, the groundwater level was found to be well below the footing foundation level, except in the area of the east side of the footing location. It is believed that any seepage or surface run-off into the excavation could be controlled by pumping from sumps. It should be noted that the foundation excavation base should be kept dry at all times prior to the placing of concrete.

### Abutment Foundations

In case closed type abutments are contemplated, the recommendations will be similar to those of pier foundations.

However, if perched abutments are contemplated they should be supported on a core of well compacted granular 'A' material above the natural subsoil as per our current practices. An allowable load of 2.5 t.s.f. may be used for design purposes. All the topsoil should be removed to the full base width of the granular core.

Approaches

No stability problems are anticipated for the proposed approach fills if constructed with 2:1 slopes.

Related Conditions

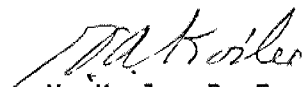
The abutments should be designed to withstand a lateral earth pressure exerted by the backfill and this pressure is dependent on the deformation characteristics of the retaining structure. If some movement of the top of the wall is permitted, then a coefficient of active earth pressure ( $K_a$ ) of 0.35 can be used. On the other hand, if the structure is designed as rigid frame, then a coefficient of earth pressure at rest ( $K_o$ ) of 0.5 should be used. To compute the sliding resistance between the rough concrete footing base and cohesive subsoil, an adhesion value of 2000 p.s.f. should be used.

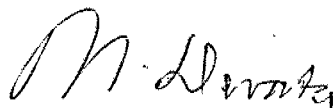
MISCELLANEOUS

The fieldwork was carried out during August 15 to 17, 1977 under the supervision of Mr. V. Korlu, Project Engineer, who also prepared this report.

The drilling equipment was owned and operated by D.S.I.L. Drilling Inc. of Toronto.

This report was reviewed by Mr. M. Devata, Supervising Engineer.

  
V. Korlu, P. Eng.  
Project Engineer

  
M. Devata, P. Eng.  
Supervising Engineer



MD/VK/gs  
October, 1977

## APPENDIX

## FIELD AND LABORATORY WORK

Seven sampled boreholes, each accompanied by a dynamic cone penetration test, were carried out at this site. The six boreholes (1, 2, 3, 5, 6 and 7) were carried out during recent field investigation while one borehole (No. 4) was carried out earlier during a preliminary investigation.

The borings were advanced by a continuous flight auger machine (commercially known as C.M.E. 75, H.S.M.V.) adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split spoon sampler at required depths. The sampler was hammered into the soil according to the specifications of the Standard Penetration Test.

Groundwater level observations were carried out during the time of investigation in the open boreholes. The soil and groundwater conditions encountered at the boring locations are presented in the Record of Borehole Sheets. The locations and elevations of the various boreholes were provided by personnel from Construction Office, Central Region. The elevations in this report are referred to a Geodetic Datum. Boring locations and elevations are shown on Drawing No. 1587503 A.

All samples were subjected to careful visual examination in the field and subsequently in the laboratory. Following this examination laboratory tests were carried out on selected representative samples to determine the physical properties of the various soil types encountered, namely:

- Natural Moisture Content

- Atterberg Limits

- Grain Size Distribution

The results of this testing are plotted on the Record of Borehole Sheets and summarized on Fig. 1 to 3, all contained in Appendix 1 of this report.

# RECORD OF BOREHOLE No 1

4,822,352.7 287,862.6

W P 158-75-03 LOCATION Co-ords N 15,821,368; E. 944,431 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 15, 1977 CHECKED BY J.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
568.0	Ground Level													
0.0	Topsoil													
	Het. Mixture of clayey silt, sand and gravel (Glacial Till)		1	SS	50		560							0 30 52 18
	Very Stiff to Hard		2	SS	38									7 26 47 20
	Brown		3	SS	37									
	Grey		4	SS	32									4 28 48 20
			5	SS	23		550							
			6	SS	21									
544.0			7	SS	163									0 6 74 20
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	127		540							
531.5	Hard or Very Dense		9	SS	150									0 0 90 10
36.5	End of Borehole													

# RECORD OF BOREHOLE No 2

4822,3743 287884.5

W P 158-75-03 LOCATION Co-ords N 15,821,438; E. 944,503 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 15, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
566.2	Ground Level													
0.0	Topsoil													
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard		1	SS	20		560							3 35 50 22
			2	SS	34									12 26 43 19
			3	SS	46									14 25 45 16
	Brown		4	SS	41									
	Grey		5	SS	100	6"	550		100/10"					
			6	SS	143	10"								
542.2			7	SS	140	10"	540							0 1 79 20
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	132	11"								
529.7	Hard or Very Dense		9	SS	118		530							0 0 59 41
36.5	End of Borehole													

## RECORD OF BOREHOLE No 3

W P 158-75-03 LOCATION Cor-ords N 15,821,517; E. 944,425 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3½" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 16, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
568.7	Ground Level																GR SA SI CL
0.0	Topsoil																
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	135		560										7 25 45 23
			2	SS	45												15 25 39 21
	Hard		3	SS	75												25 18 40 17
	Brown		4	SS	86												3 6 84 7
	Grey		5	SS	66												0 1 80 19
			6	SS	70												
544.7			7	SS	100	6"											
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	160	11"	540										
532.2	Hard or Very Dense		9	SS	175	9"											
36.5	End of Borehole																

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

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 4 (Formerly W.O. 76-11005)

W P 158-75-03 LOCATION Co-ords N. 15,821,474; E. 944,365 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE H.S. 3½" Auger (CME 55 M.V.) & Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE July 5, 1976 CHECKED BY AS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
565.0	Ground Level															GR SA SI CL
0.0	Het. Mix. of Clayey Silt With Sand, Occ. Gravel (Glacial Till) Very Stiff to Hard		1	SS	26		560									0 28 53 19
			2	SS	30											
	Brown		3	SS	72											0 35 49 16
	Grey		4	SS	60											
			5	SS	36		550									
			6	SS	94											0 1 79 20
			7	SS	100	11"	540									
534.0			8	SS	120											
31.0	Clayey Silt With Seams of Silt and Trace of Sand Hard		9	SS	95	9"	530									0 2 86 12
			10	SS	90											
			11	SS	95	9"	520									
							510									
505.0																
60.0	End of Borehole															

## RECORD OF BOREHOLE No 5

W P 158-75-03 LOCATION Co-ords N. 15,821,525; E. 944,277 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3½" H.S. Auger and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 15, 1977 CHECKED BY RS

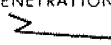
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
567.1	Ground Level													GR SA SI CL
0.0	Topsoil													
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	36		560							1 26 52 21
	Hard		2	SS	36									31 21 31 17
	Brown		3	SS	120	11"								19 22 44 15
	Grey		4	SS	170	11"								
			5	SS	62		550							
			6	SS	95									
543.1			7	SS	130									0 1 73 26
24.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	170	9"	540							
	Hard or Very Dense													
530.6			9	SS	123									0 1 89 10
36.5	End of Borehole													

+3, x5: Numbers refer to Sensitivity

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

## RECORD OF BOREHOLE No 6

W P 158-75-03 LOCATION Co-ords N. 15,821,447; E. 944,354 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/4" H.S. Auger & Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 17, 1977 CHECKED BY K.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						x LAB VANE	10	20
567.0	Ground Level													GR SA SI CL				
0.0	Topsoil																	
	Het. Mixture of Clayey Silt, Sand and Occasional Gravel		1	SS	85		560							0 26 47 27				
	Glacial Till		2	SS	49													
	Hard Brown		3	SS	46													
	Grey		4	SS	90									0 29 55 16				
			5	SS	50		550											
546.5			6	SS	75									0 1 78 21				
20.5	End of Borehole																	

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

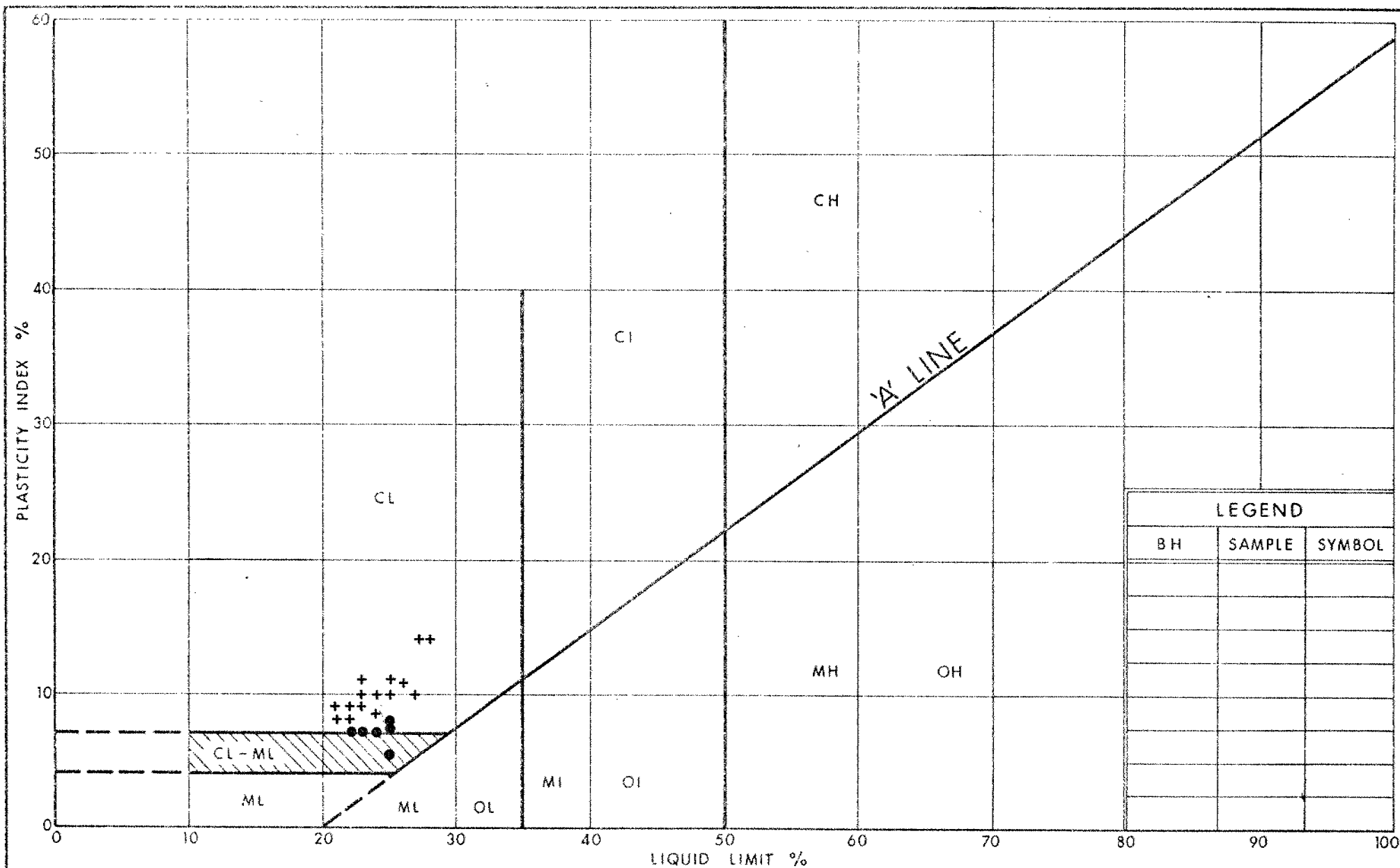
## RECORD OF BOREHOLE No 7

W P 158-75-03 LOCATION Co-ords N. 15,821,595; E. 944,349 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" H.S. Auger & Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE August 16, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
567.7	Ground Level																
0.0	Topsoil																
	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Very Stiff to Hard Brown		1	SS	23		560										4 29 46 21
			2	SS	68												7 31 45 17
			3	SS	50												1 29 51 19
	Grey		4	SS	55												
			5	SS	34		550										
			6	SS	47												
544.7																	
23.0	Silty Sand, fine		7	SS	132		540										0 34 62 4
541.7	Dense																
26.0	Clayey Silt With Seams of Silt and Trace of Sand		8	SS	155	10"											0 1 79 20
531.2	Hard or Very Dense		9	SS	135	6"											
36.5	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

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



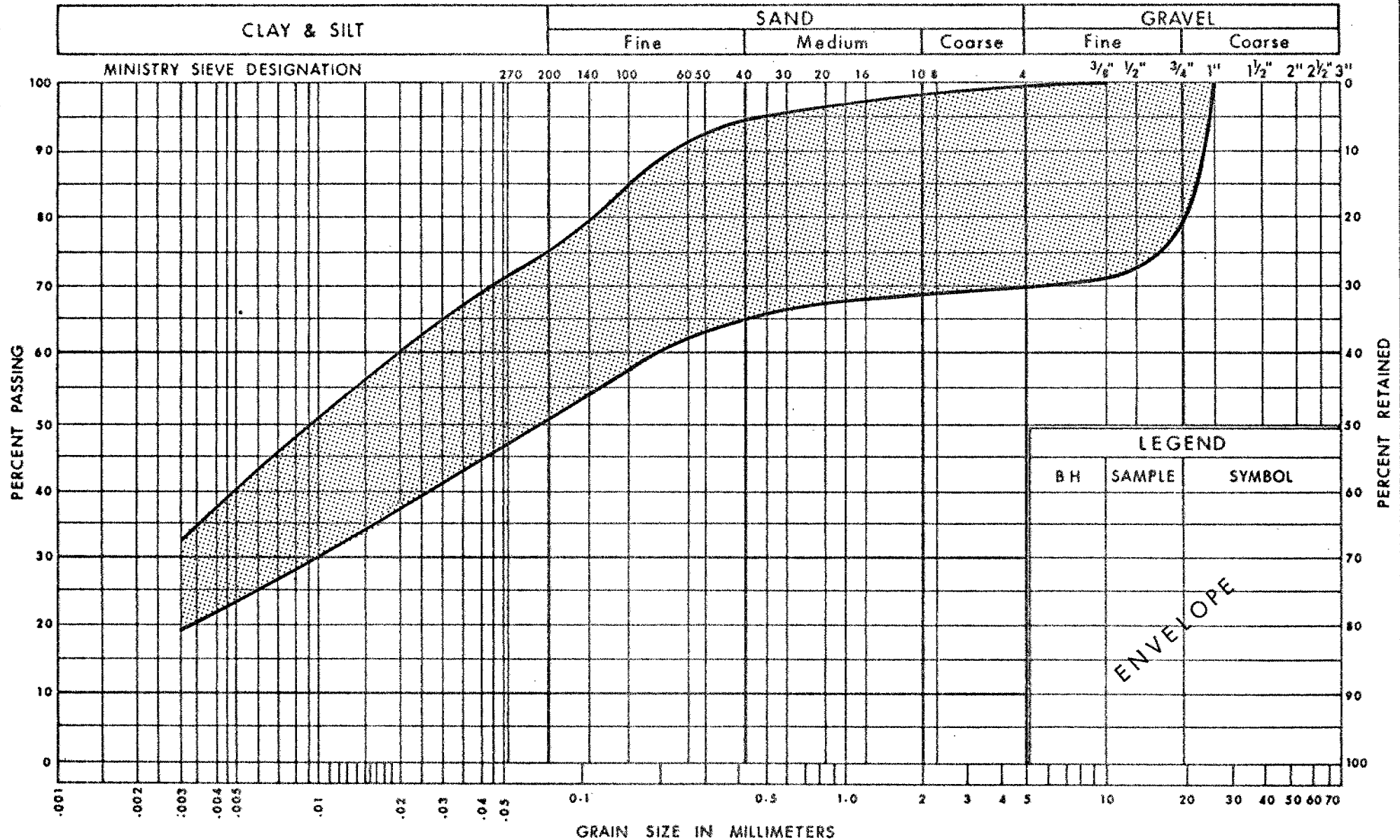
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Communications

PLASTICITY CHART  
+ COHESIVE GLACIAL TILL  
• CLAYEY SILT WITH SEAMS OF SILT

FIG No 1

W P 158 - 75 - 03

## UNIFIED SOIL CLASSIFICATION SYSTEM



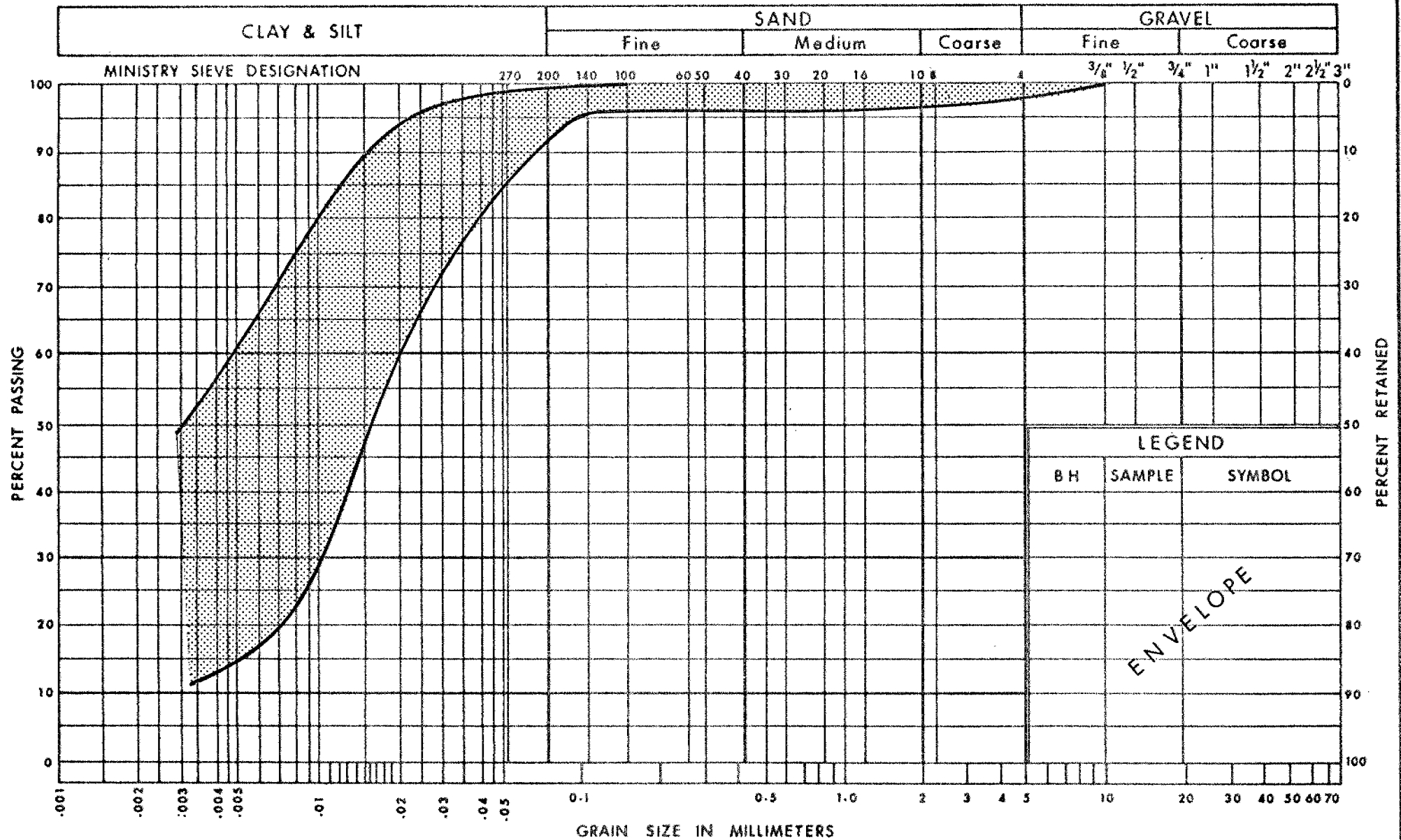
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Communications

**GRAIN SIZE DISTRIBUTION  
GLACIAL TILL**  
HET MIX OF CLAYEY SILT, SAND & GRAVEL

FIG No 2

WP 158-75-03

## UNIFIED SOIL CLASSIFICATION SYSTEM



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Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
**CLAYEY SILT**  
WITH SEAMS OF SILT & TRACE OF SAND

FIG No 3

W P 158-75-03

# EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERTURDEN PRESSURE ARE DENOTED THUS  $N_c$ .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 1/2" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

$S_u$ (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSITY: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	MODERATE	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS & SYMBOLS

### LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG.  $C\bar{U}$  = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

### FIELD SAMPLING

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

### EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_a$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_p$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE  
 $\omega$  SLOPE ANGLE-BACKFACE OF WALL  
 $\beta$  ANGLE OF SLOPE  
 $N_q, N_c, N_{\gamma}$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
B.L. FOOTING DIMENSIONS

### INDEX PROPERTIES

$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$   $e$  IN LOOSEST STATE  
 $e_{min}$   $e$  IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_p$  PLASTIC LIMIT  
 $w_s$  SHRINKAGE LIMIT  
 $I_p$  PLASTICITY INDEX =  $w_L - w_p$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_p}{w_L - w_p}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{w_L - w_p}$   
 $A_c$  ACTIVITY =  $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$   
 $Om$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

### STRENGTH PARAMETERS

$\phi$  ANGLE OF SHEARING RESISTANCE  
 $\tau_c$  PEAK SHEAR STRENGTH  
 $\tau_p$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_e$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $m, n$  STABILITY COEFFICIENTS  
 $A, B$  PORE PRESSURE COEFFICIENTS

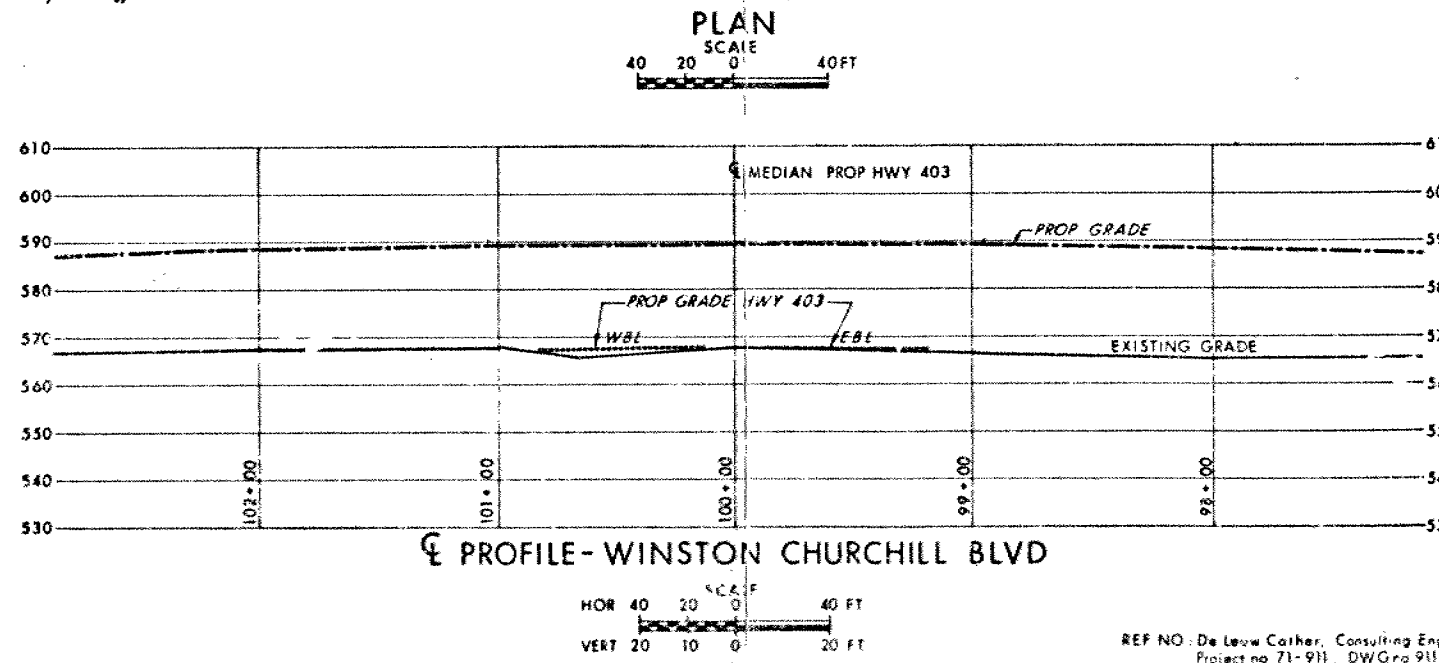
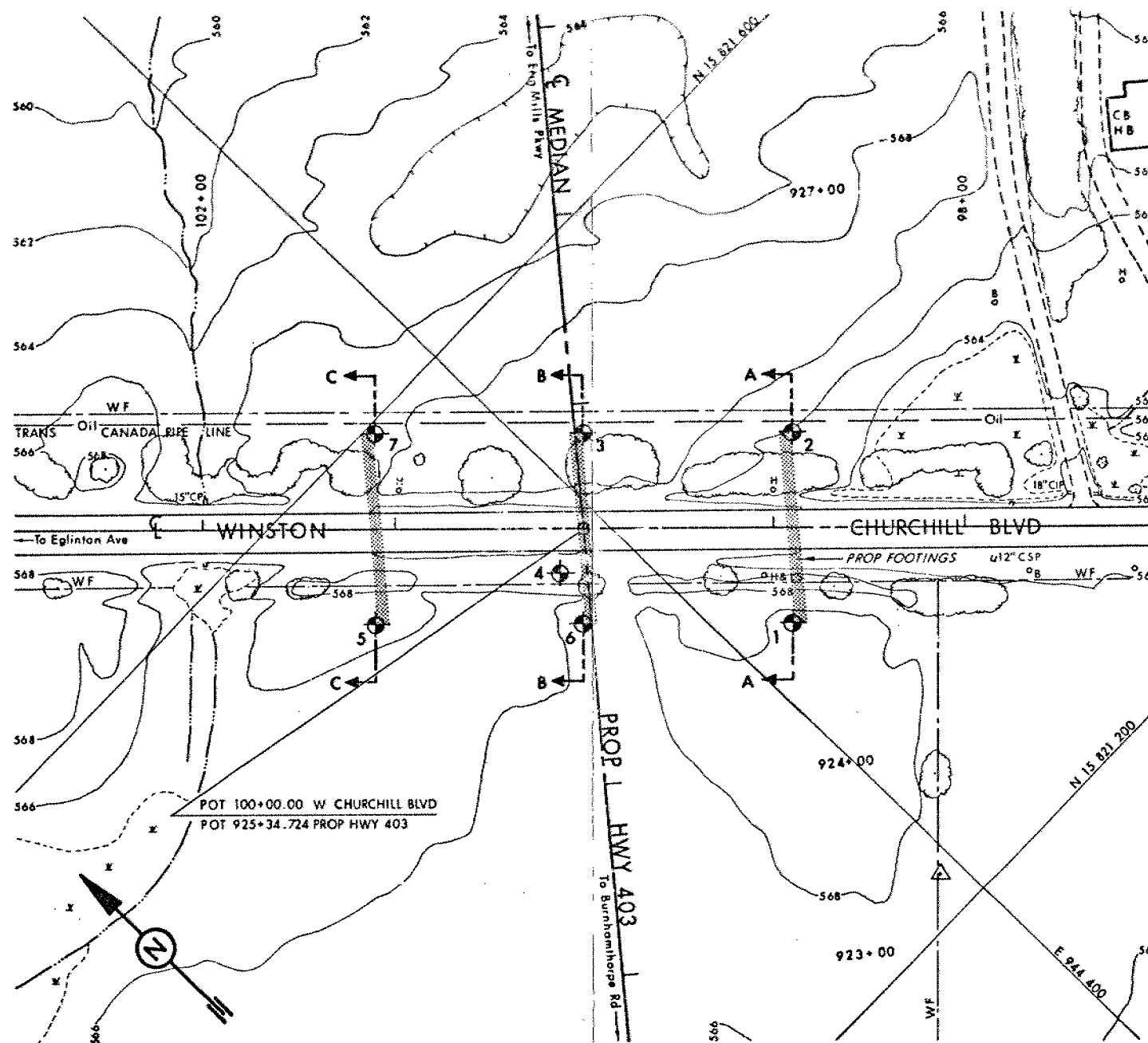
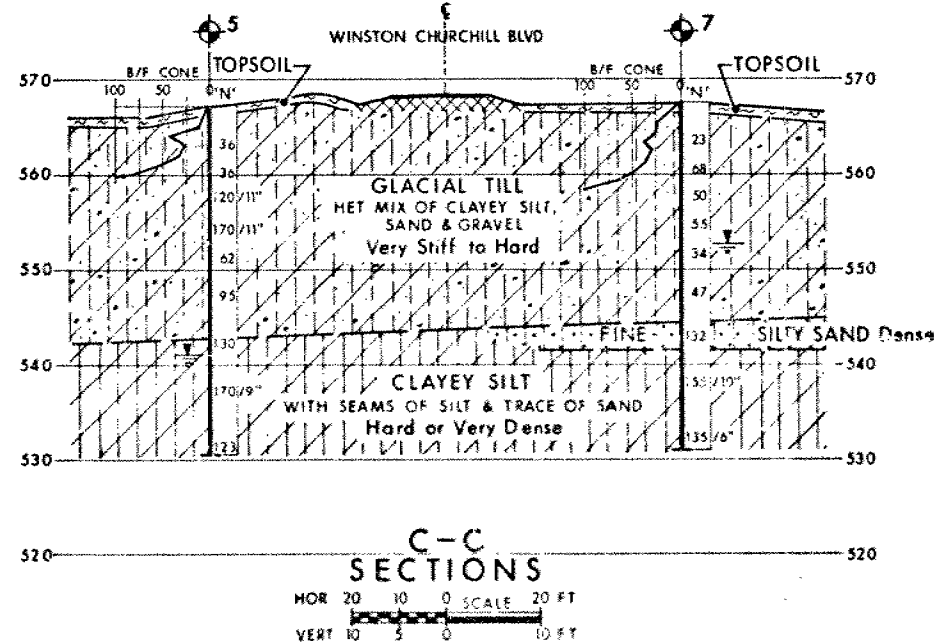
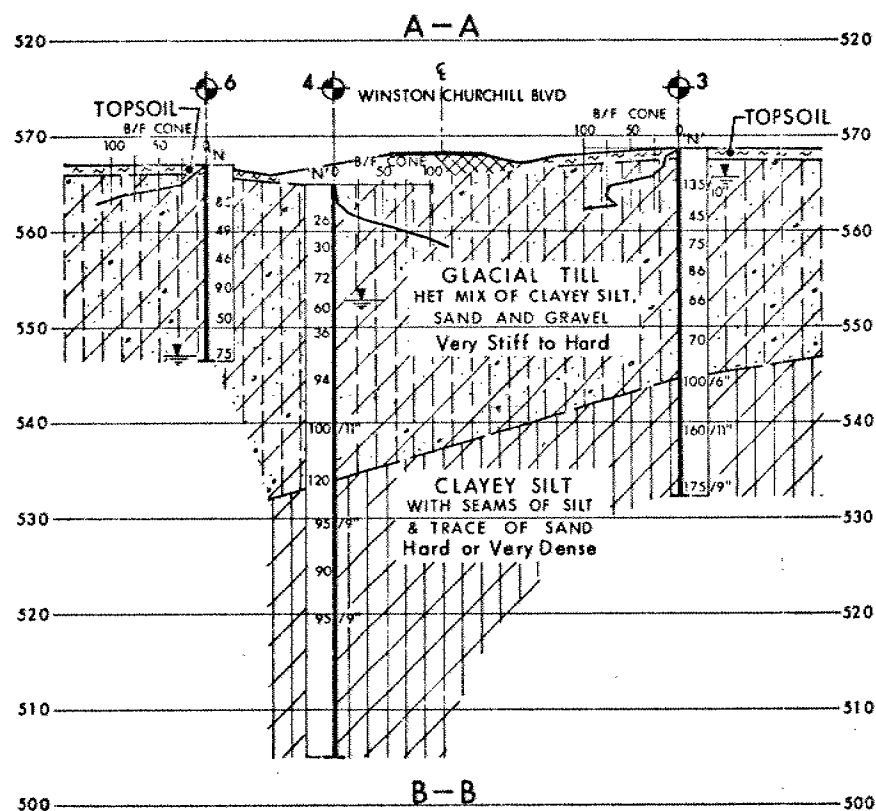
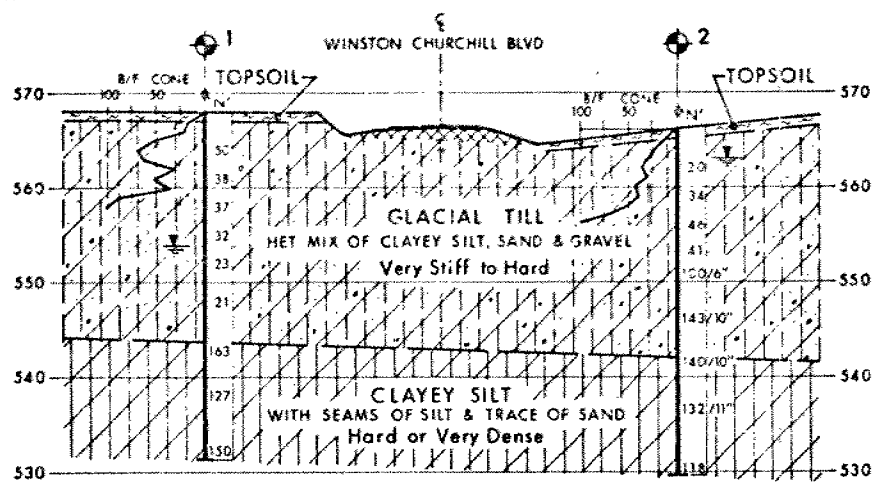
### HYDRAULIC TERMS

$h$  HYDRAULIC HEAD OR POTENTIAL  
 $q$  RATE OF DISCHARGE  
 $v$  VELOCITY OF FLOW  
 $i$  HYDRAULIC GRADIENT  
 $j$  SEEPAGE FORCE PER UNIT VOLUME  
 $\eta$  COEFFICIENT OF VISCOSITY  
 $k$  COEFFICIENT OF HYDRAULIC CONDUCTIVITY  
 $k_h$   $k$  IN HORIZONTAL DIRECTION  
 $k_v$   $k$  IN VERTICAL DIRECTION  
 $m_v$  COEFFICIENT OF VOLUME CHANGE  
 $c_v$  COEFFICIENT OF CONSOLIDATION  
 $C_c$  COMPRESSION INDEX  
 $C_r$  RECOMPRESSION INDEX  
 $d$  DRAINAGE-PATH DISTANCE  
 $T_v$  TIME FACTOR  
 $U$  DEGREE OF CONSOLIDATION  
 $O_r$  OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'$  = EFFECTIVE NORMAL STRESS



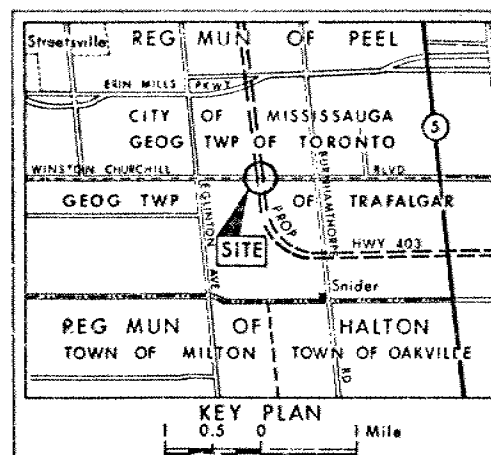
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO



CONT No  
WP No 158-75-03

WINSTON CHURCHILL BLVD U'PASS SHEET

BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation Aug 1977
- W.L. for Bore Hole No 4 July 1976

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	568.0	15 821 368	944 431
2	566.2	15 821 438	944 503
3	568.7	15 821 517	944 425
4	565.0	15 821 474	944 365
5	567.1	15 821 525	944 277
6	567.0	15 821 447	944 354
7	567.7	15 821 595	944 349

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

REVISIONS	DATE	BY	DESCRIPTION

REF NO: De Leuw Cather, Consulting Eng's & Plan's  
Project no 71-911, DWG no 911-701

HWY No PROPOSED 403  
SHEED V.A. 20/7/75 DATE Sept 26, 1977 SITE 24-384  
DRAWN BY: J. H. 1587503-A

Mr. C.S. Grebski  
Structural Section  
2nd Floor, West Building

Soil Mechanics Section  
Engineering Materials Office  
Room 315, Central Building

79 05 22

Mr. W. Lin

Re: Hwy. 403 Underpass at Winston Churchill Blvd.  
W.P. 158-75-03, Site 24-384  
Hwy. 403, District 6, Toronto

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As agreed earlier in a structural review meeting, this Section would carry out a supplementary investigation to determine the thickness of the existing granular sub-base on Winston Churchill Blvd. and the condition of the underlying subsoil in order to ensure that the abutment footings of the proposed underpass would be founded in competent natural ground and not on the roadway fill material. We have now completed the field-work. Our findings and comments are as follows.

The existing Winston Churchill Blvd. appears to be constructed on a 15 to 18 inch thick sand and gravel sub-base which is placed on a competent glacial till stratum. The contact between the sandy sub-base and the glacial till is at about elevation 565 at the south abutment location and at about elevation 566 at the north abutment location. Further, the upper one foot or so of the glacial till appears to be somewhat softened.

According to the design drawings for this project, the underside of the north and the south abutment footings will be at elevation 565. In our opinion, this founding elevation would be satisfactory for the north abutment footings. At the south abutment location, this founding elevation could be maintained provided the underlying subsoil is subexcavated to elevation 564 and backfilled with mass concrete. Please ensure that an item for this quantity of mass concrete is included in the contract.

B. Ly  
Senior Engineer

For: M. Devata  
Supervising Engineer

BL/MD/gs

cc: D. MacDonald  
M. Ernesaks  
G.C. Burkhardt  
Files ✓

Mr. C.S. Grebski  
Head, Central Section  
Structural Office  
2nd Floor, West Building

Soil Mechanics Section  
Engineering Materials Office  
Room 315, Central Building

88 08 28

Mr. W. Lin

Re: Hwy. 403 Underpass at Winston Churchill Blvd.  
W.P. 158-75-03, Site 24-384  
Hwy. 403, District 6, Toronto

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We have reviewed the final bridge drawings (24-384-1 and 3) for the above mentioned structure. The abutment footings should be placed on undisturbed soil. Therefore, the existing roadway fill material at the abutment locations should be completely removed prior to construction of the abutment footings.

B. Ly  
Senior Engineer

BL/gs

cc: Files ✓

Mr. W. L. Lin  
Design Engineer, Central Section  
Structural Office  
West Bldg, Downsview

Soil Mechanics Section  
Engineering Materials Office  
3rd Floor, Central Building

78 03 21

Re: Hwy #403 Underpass  
at Winston Churchill Blvd.,  
W.P. 158-75-03, Site 24-384  
District 6, Toronto

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As per your request, we have reviewed the Preliminary Bridge Plan Drawing 24-384-P1 for the above structure. The designs of the foundations and the approaches are satisfactory to us.

B. Ly  
Senior Engineer

For: M. Devata  
Supervising Engineer

BL/ig

cc: Files ✓