

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-55

DIST. 6 REGION

W.P. No. 48-71-11

CONT. No. 90-82

W. O. No.

STR. SITE No. 24-309

HWY. No. 427

LOCATION Turning Roadway, NE over  
Goreway Dr.

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

G.I.-30 SEPT. 1976

DIST. No 6  
CONT No  
WP No 48-71-11

TURNING ROADWAY N-E OVER  
GOREWAY DRIVE.  
(APPROX. 1.1 MI. NORTH OF DIXON RD.)  
GENERAL ARRANGEMENT

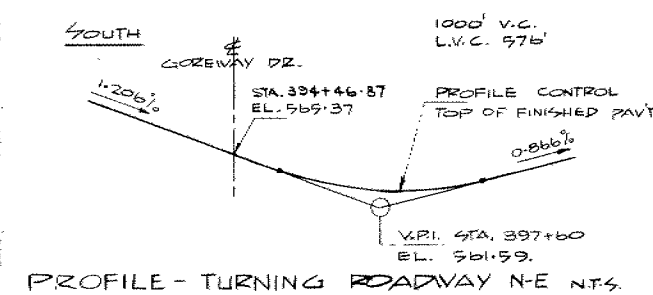
Morrison, Hershfield,  
Burgess & Huggins, Limited  
Consulting Engineers

SHEET

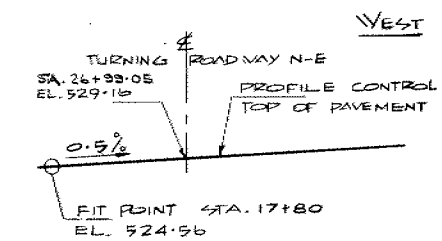


GENERAL NOTES:-

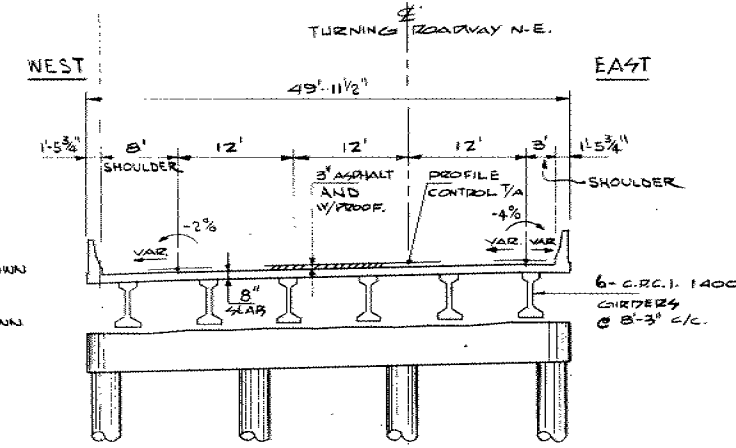
- 1- CLASS OF CONCRETE :-  
• PRESTRESSED GIRDERS - 35 MPa.  
• DECK, DIAPHRAGMS, PIERS, PIER BEAMS, ABUTMENTS AND BARRIER WALLS - 30 MPa.  
• FOOTINGS AND REMAINDER - 20 MPa.
- 2- CLEAR COVER TO REINFORCING STEEL:-  
• FOOTINGS 4" ± 1"  
• PIER COLUMNS AND BEAMS, ABUTMENTS AND WINGWALLS FRONT SURFACES 3" ± 3/4"  
• ABUTMENTS AND WINGWALLS BACK SURFACES 2 1/2" ± 3/4"  
• DECK TOP 2 1/2" ± 3/4" AND BOTTOM 1 1/2" ± 3/4"  
• BARRIER WALLS AND APPROACH SLABS 2 1/2" ± 3/4"  
• REMAINDER 2 1/2" ± 3/4" UNLESS OTHERWISE NOTED.
- 3- REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.  
• BARS MARKED WITH THE SUFFIX 'C' SHALL BE COATED BARS.
- 4- CONSTRUCTION NOTES:-  
• THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 1/8"
- 5- CONCRETE QUANTITIES:-  
• CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE LUMP SUM TENDER ITEMS:-  
a) CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS --- 243 cu yd  
b) CONCRETE IN DECK AND DIAPHRAGMS --- 353 cu yd  
c) CONCRETE IN BARRIER WALLS --- 51 cu yd  
d) CONCRETE IN APPROACH SLABS --- 59 cu yd  
e) CONCRETE IN SLOPE PAVING --- 97 cu yd



PROFILE - TURNING ROADWAY N-E N.T.S.



PROFILE - GOREWAY DRIVE - N.T.S.

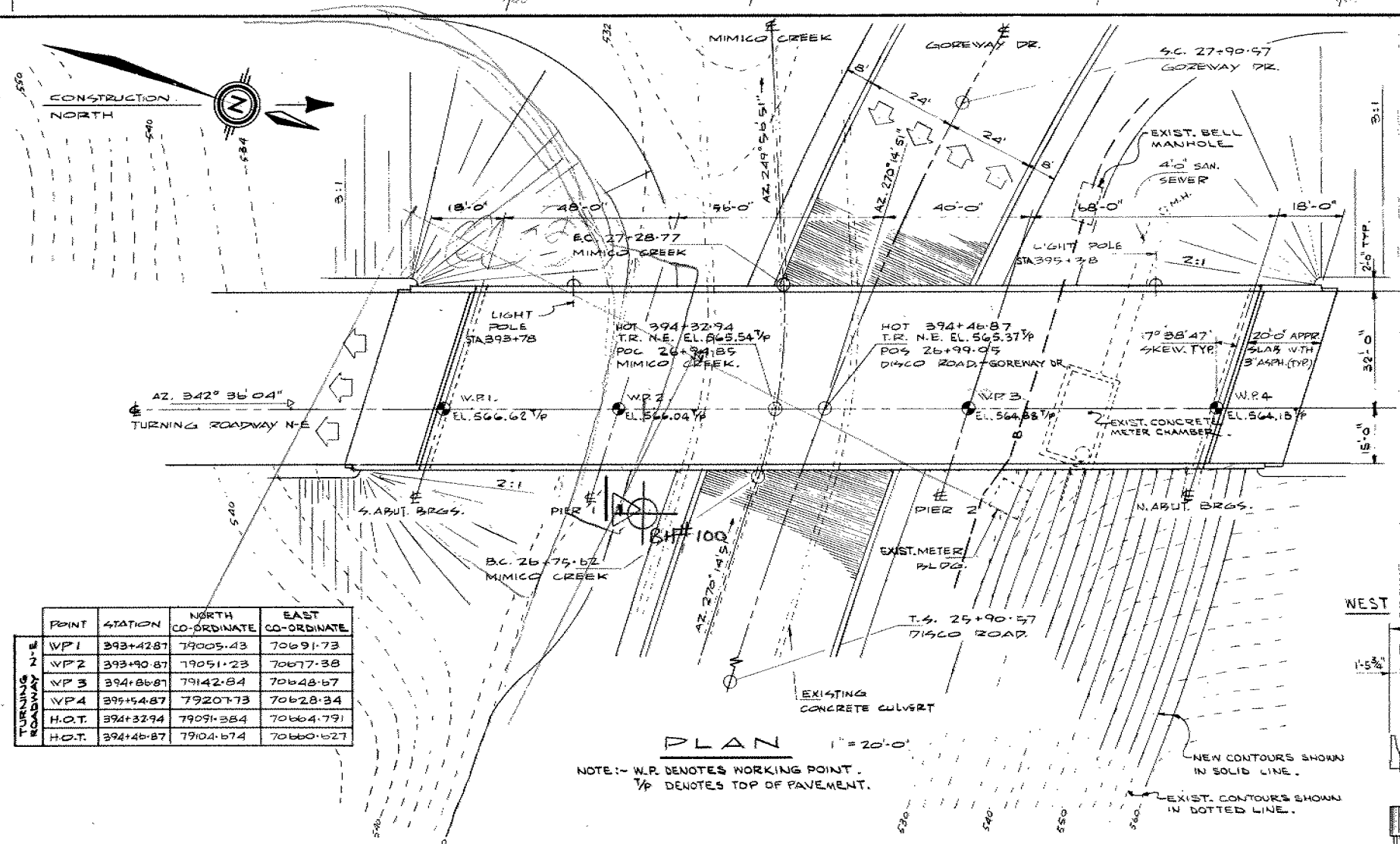


1:10

poorly worked.

LIST OF DRAWINGS:-

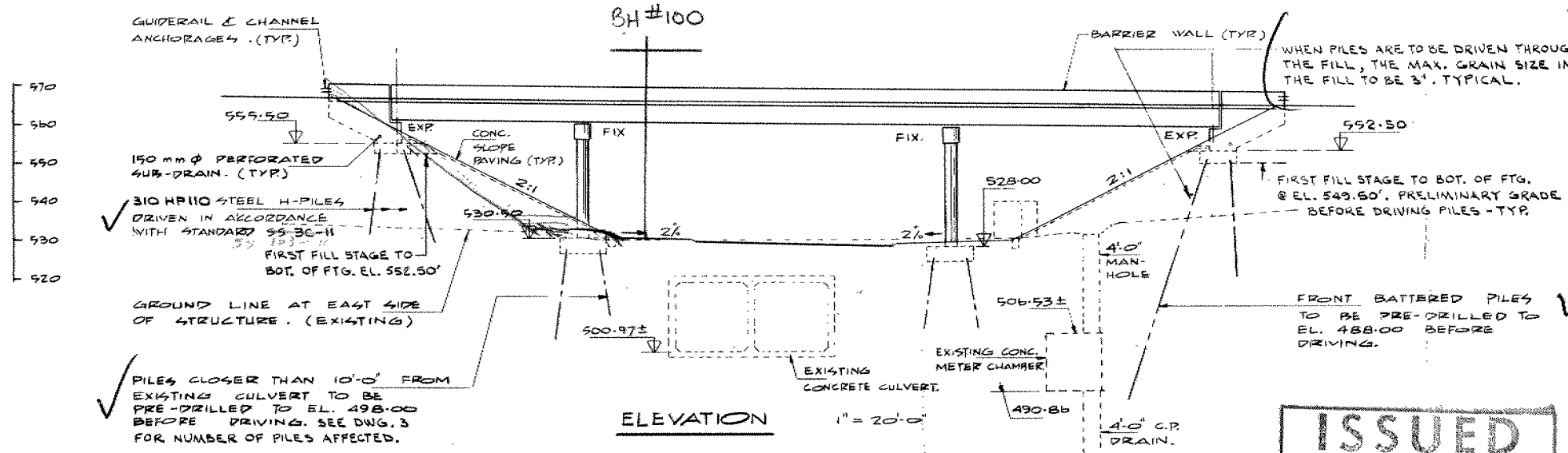
- 24-309-1, GENERAL ARRANGEMENT.
- 2, BOREHOLE LOCATIONS & SOIL STRATA.
- 3, FOUNDATION
- 4, SOUTH ABUTMENT
- 5, NORTH ABUTMENT
- 6, WINGWALL DETAILS.
- 7, PIER, BEAM AND BEARING DETAILS
- 8, DECK LAYOUT AND SREED ELEVATIONS.
- 9, PRESTRESSED GIRDERS.
- 10, DECK REINFORCING DETAILS.
- 11, BARRIER WALL.
- 12, 20 FT. APPROACH SLAB.
- 13, STANDARD DETAILS I.
- 14, STANDARD DETAILS II.
- 15, STANDARD DETAILS III.
- 16, DETAILS OF CONCRETE SLOPE PAVING.
- 17, PILE DRIVING-STEAM AND DIESEL HAMMERS.
- 18, BRIDGE DATE AND SITE NUMBER DATA.
- 19, AS CONSTRUCTED ELEV. AND DIMENSIONS



PLAN

NOTE:- W.P. DENOTES WORKING POINT.  
T/P DENOTES TOP OF PAVEMENT.

POINT	STATION	NORTH CO-ORDINATE	EAST CO-ORDINATE
VP1	393+42.87	79005.43	70691.73
VP2	393+90.87	79051.23	70677.38
VP3	394+86.87	79142.84	70648.67
VP4	395+48.87	79207.73	70628.34
H.O.T.	394+32.94	79091.384	70664.791
H.O.T.	394+46.87	79104.674	70660.627



ELEVATION

P.M. ELEV. 527.83.  
TABLET SET IN CONC. PASE OF LIGHT STR. AT ENTRANCE TO BOROUGH OF ETOWA YARD 387' RT. OF STA. 390+28 & HWY. 427.

ISSUED  
JUL 30 1981  
MORRISON, HERSHFIELD  
BURGESS & HUGGINS, LTD.  
DRAWING OFFICE



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SDB	CHECK	A.T. LOADING CHOC A79 DATE JULY 8
DRAWING	PK	CHECK	J.C. SITE No 24-309 DWG 1.

DIST. No 6  
CONT No  
WP No 48-71-11

TURNING ROADWAY N-E OVER  
GOREWAY DRIVE.  
(APPROX. 1.1 MI. NORTH OF DIXON RD.)  
FOUNDATION

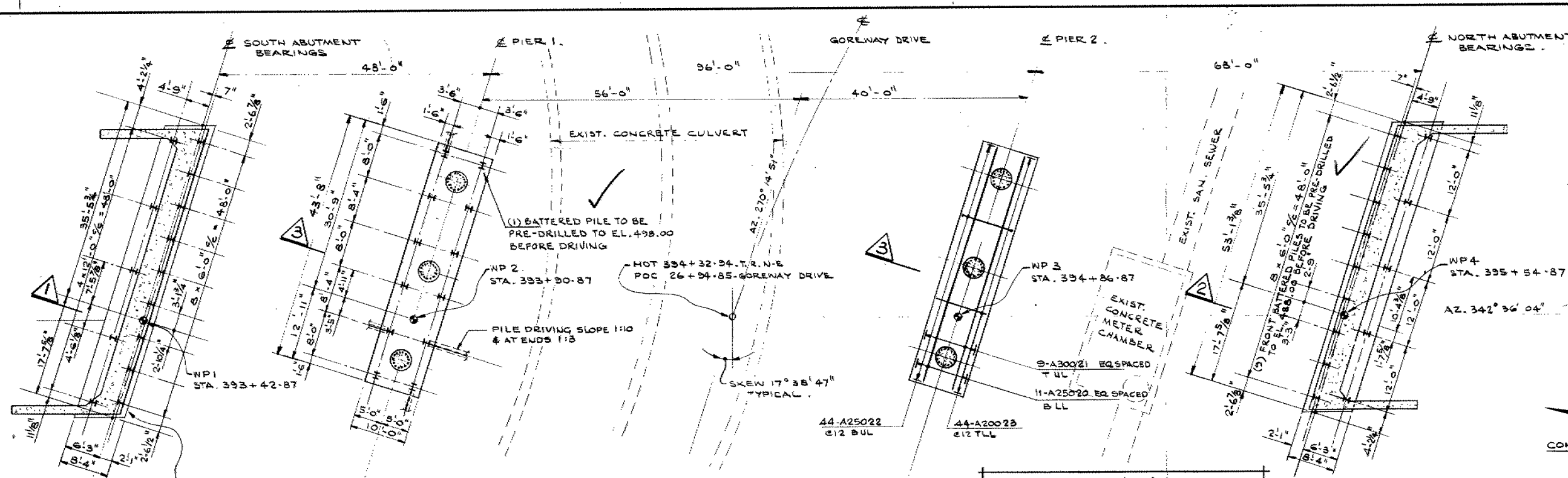
SHEET

Morrison, Harshfield,  
Burgess & Huggins, Limited  
Consulting Engineers

MURPH



TURNING ROADWAY N-E.  
PROFILE CONTROL



SEE ENLARGED LAYOUT  
BELOW FOR ABUTMENT FOOTING  
REINFORCING DETAILS.

### FOUNDATION PLAN

3/32" = 1'-0"

FOR WORKING POINT (W.P.) CO-ORDINATES,  
SEE TABLE ON DRAWING 1.

### NOTES:-

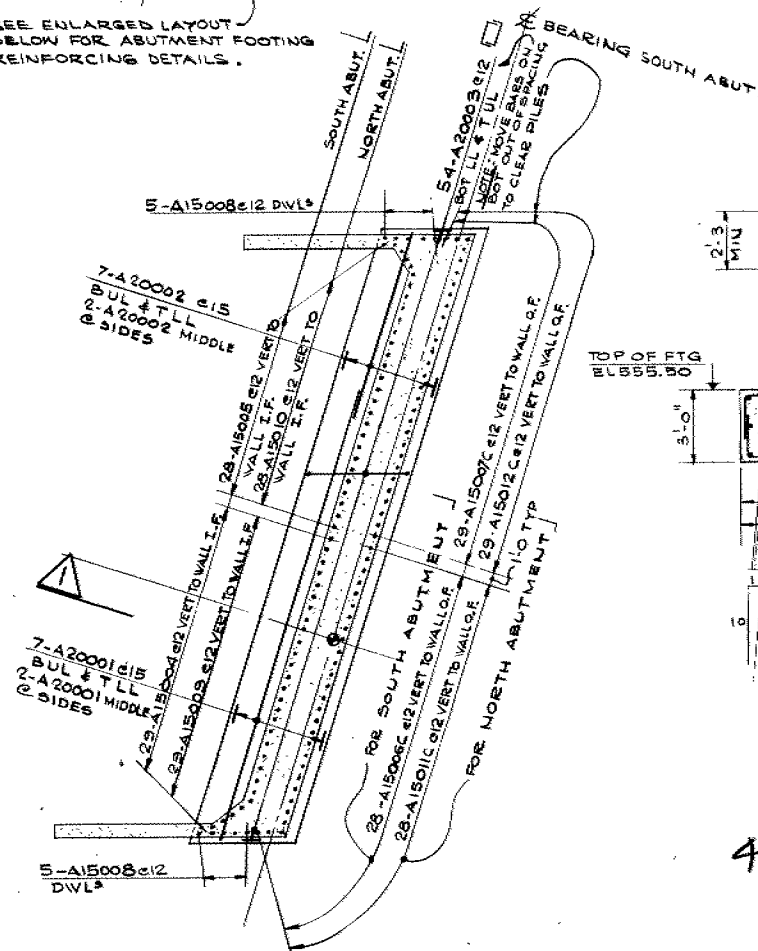
- 1 - I.F. DENOTES INSIDE FACE; O.F. DENOTES OUTSIDE FACE.
- 2 - UNLESS OTHERWISE NOTED, MINIMUM LAPS FOR REINFORCING STEEL SHALL BE: 15M = 2'-3", 20M = 2'-8", 25M = 4'-0", 30M = 5'-0".
- 3 - FOR ABUTMENTS AND WINGWALLS SEE DRAWINGS 4, 5 & 6
- 4 - LAYOUT DIMENSIONS FOR PILES ARE GIVEN AT THE UNDERSIDE OF PIER AND ABUTMENT FOOTINGS.
- 5 - HEAVY VIBRATORY COMPACTING EQUIPMENT SHOULD NOT BE ALLOWED TO OPERATE WITHIN 20 FEET OF THE EXISTING BOX CULVERT.

### PILE DATA

LOCATION	NO. REQ'D	APPROX. LENGTH	TYPE	PILE DRIVING NOTE
SOUTH ABUT.	9	75' 78"	310HP10	PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS 103-11 USING AN ULTIMATE CAPACITY OF 180 TONS (1794 KN) PER PILE.
	5	71' 74"	310HP10	
PIER 1.	10	40' 45"	310HP10	
	2	40' 45"	310HP10	
PIER 2.	10	40' 45"	310HP10	
	2	40' 45"	310HP10	
NORTH ABUT.	9	75' 78"	310HP10	
	5	71' 74"	310HP10	

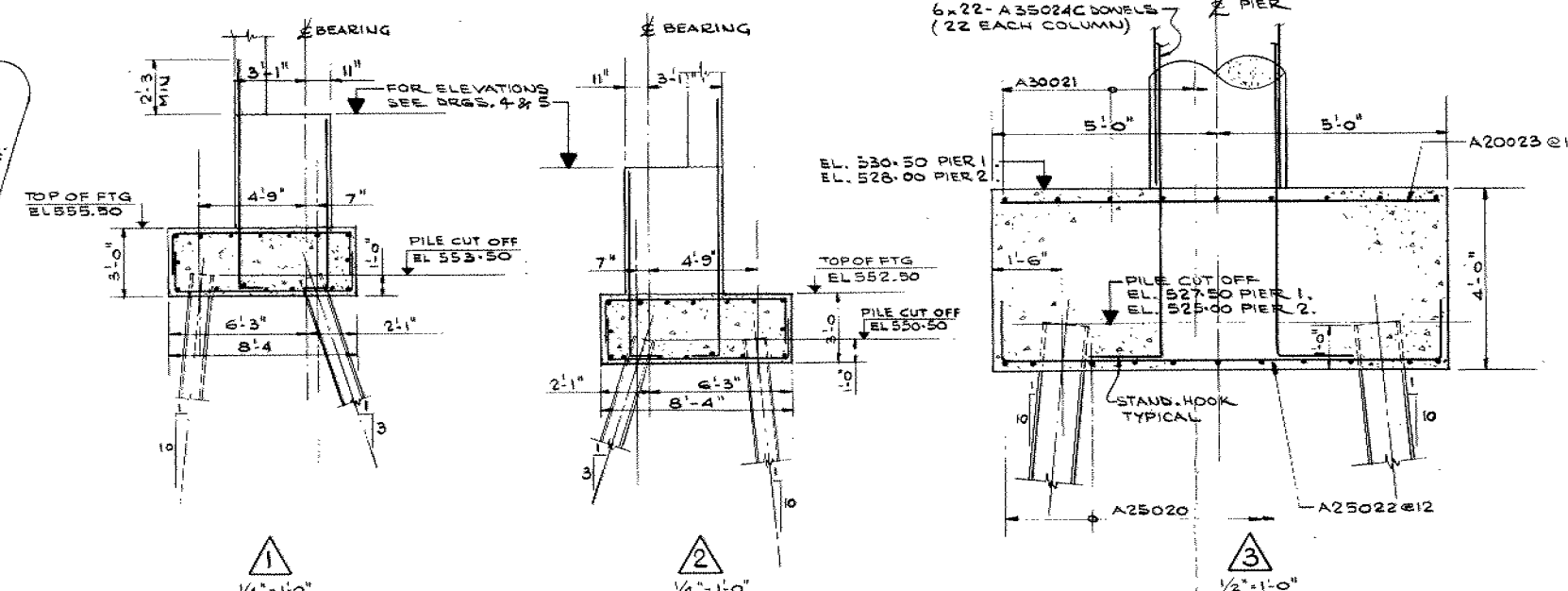
LENGTHS SHOWN ARE THE THEORETICAL LENGTHS BELOW CUTOFF

✓ PILES MARKED WITH \* SHALL BE PROVIDED WITH DRIVING SHOES IN ACCORDANCE WITH SS 3-1. COBBLES AND DEBRIS MAY BE ENCOUNTERED AT PIER 2 UNDER THE OLD CHANNEL OF MINICO CREEK.



### REINFORCEMENT LAYOUT FOR ABUTMENT FOOTINGS.

(SOUTH ABUT. AS SHOWN, NORTH OPPOSITE HAND)  
1/8" = 1'-0"

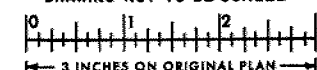


480

475-480

Pier 1 485  
2 480

DRAWING NOT TO BE SCALED



REVISIONS	DATE	BY	DESCRIPTION
DESIGN SSS	CHECK AT	LOADING CHBDC A78	DATE JULY '91
DRAWING SSS	CHECK AT	CITE No 24-303	DWG 3

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 90-32



Ministry of  
Transportation and  
Communications

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	Turning Roadway N-E Structure Over Goreway Drive W.P. 48-71-11, Site 24-309
	Turning Roadway N. to 409E Structure and Retaining Wall A-1 W.P. 404-65-01, Site 37-989
	F.T.M.S. Overhead Signs Hwy. 427 S.B. to Turning Roadway Over Hwy. 409 W.P. 48-71-22, Site -

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.

**'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 & 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. CIU = 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 SAMPLE  
BS BLOCK SAMPLE  
CS CHUNK SAMPLE  
TW THINWALL OPEN  
TP THINWALL PISTON  
OS OSTERBERG 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  
 $w$  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 =  $\frac{w - w_P}{I_P}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{I_P}$   
 $A_c$  ACTIVITY =  $\frac{I_P \text{ of soil}}{2.2 \mu m \text{ Soil Fraction}}$   
 $O_m$  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  
 $\tau_f$  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:  
 $\phi'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'$  = EFFECTIVE NORMAL STRESS

##### 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  
 $\alpha_v$  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)



## EXPLANATION OF TERMS USED IN REPORT

2A

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{v0}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

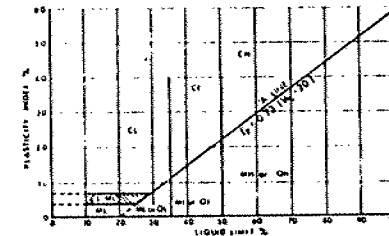
### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	*q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kn}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kn}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

# EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM

EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM												
FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 75 μm AND BASING FRACTIONS ON ESTIMATED MASS)					GRP SYMP	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA				
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN 75 μm (THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	GRAVELS	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZE			GM	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX. % OF SAND & GRAVEL; MAX. SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION; & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS.	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPEND ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SW, SP MORE THAN 5% GW, GC, SH, SC 5% TO 12% BORDENLINE CASES REQ. USE OF DUAL SYMBOLS			
		GRAVEL WITH FINES (APPRECIABLE AMOUNT OF FINES)	PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES		NOT MEETING ALL GRADATION REQUIREMENTS FOR GW			
			NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES		ATTENBERG LIMITS BELOW A-LINE, OR $e_p$ LESS THAN 4			
		PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES	ATTENBERG LIMITS ABOVE A-LINE WITH $e_p$ GREATER THAN 7					
	SANDS	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZES & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES			SM	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES		GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS.	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPEND ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SW, SP MORE THAN 5% GW, GC, SH, SC 5% TO 12% BORDENLINE CASES REQ. USE OF DUAL SYMBOLS		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES			NOT MEETING ALL GRADATION REQUIREMENTS FOR SW		
			NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES			ATTENBERG LIMITS BELOW A-LINE OR $e_p$ LESS THAN 4		
		PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES	ATTENBERG LIMITS ABOVE A-LINE WITH $e_p$ GREATER THAN 7					
	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN 425 μm											
	FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN 75 μm (THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50%	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML			INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS.	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPEND ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SW, SP MORE THAN 5% GW, GC, SH, SC 5% TO 12% BORDENLINE CASES REQ. USE OF DUAL SYMBOLS
NONE				QUICK	NONE	CL	CLAYEY SILTS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	NOT MEETING ALL GRADATION REQUIREMENTS FOR GW				
MEDIUM TO HIGH				NONE TO VERY SLOW	MEDIUM	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS	ATTENBERG LIMITS BELOW A-LINE OR $e_p$ LESS THAN 4				
LIQUID LIMIT BETWEEN 50% AND 50%			NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	ML	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS	ATTENBERG LIMITS ABOVE A-LINE WITH $e_p$ GREATER THAN 7				
			HIGH	NONE	MEDIUM TO HIGH	CL	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW				
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OL	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	ATTENBERG LIMITS ABOVE A-LINE WITH $e_p$ GREATER THAN 7				
LIQUID LIMIT GREATER THAN 50%		SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACIOUS OR DIATOMACEOUS FINE SANDY SILTS, ELASTIC SILTS	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW					
		HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS	ATTENBERG LIMITS BELOW A-LINE OR $e_p$ LESS THAN 4					
		MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY	ATTENBERG LIMITS ABOVE A-LINE WITH $e_p$ GREATER THAN 7					
HIGHLY ORGANIC SOILS					Pe	PEAT & OTHER HIGHLY ORGANIC SOILS						

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION



PLASTICITY CHART  
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

BOUNDARY CLASSIFICATIONS: SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE GM-GC.  
WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BENDER



## FOUNDATION INVESTIGATION REPORT

For

Turning Roadway N-E Structure

Over Goreway Drive

W.P.48-71-11, Site 24-309

Hwy. 427, District 6, TorontoINTRODUCTION:

This report summarizes the factual data obtained from a foundation investigation program performed at the above mentioned structural site.

The majority of the fieldwork was carried out during the period of January 17 to 21, 1972 and consisted of eight sampled boreholes, each accompanied by a dynamic cone penetration test. These borings ranged from 26.5 to 51.5 feet below ground surface at the time of the investigation, with bedrock being cored in 4 of these borings for a maximum depth of 11.5 feet.

An additional sampled borehole (BH 100) was advanced on January 26, 1982 for a depth of 36.5 feet below the existing ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately north of the existing Goreway Dr. / Disco Rd. and Hwy. 427 overpass, approximately 1.1 miles north of Dixon Rd., at the boundaries of the Borough of Etobicoke and the City of Mississauga.

At present the Mimico Creek has been channelized through a twin 43 x 21 ft. concrete box culvert with the old creek channel backfilled to an approximate elevation 530±.

The surrounding terrain is flat to gently undulating in relief between about elevation 527 to 536. This area has been developed for small industrial enterprises.

The site is located in the physiographic region known as the "Peel Plain." The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area

under investigation, the moraine is primarily composed of a cohesive glacial till whose thickness generally ranges 35 to 65 feet. In this region the Humber River, Etobicoke and Mimico Creeks have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog, although in many of the interstream areas drainage is still imperfect. The overburden is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period. Available geological information indicates that the surface of the bedrock varies somewhere between elevation 460 and elevation 475.

#### Subsurface Conditions

The predominant natural stratum underlying the fill material consists of a cohesive glacial fill which varies in thickness from 34 to 46 feet. Shale bedrock was encountered immediately below this deposit.

The boundaries between the various deposits, as determined by borehole information, are shown on the accompanying Record of Borehole Sheets. The locations and elevations of the boreholes as well as estimated stratigraphical sections based on borehole data from the initial investigation are shown on Drawing 2. Ground conditions shown on the drawing related to the time of the investigation, prior to any construction activity in the area.

A brief description of the soil types and bedrock encountered at the time of the investigation are as follows.

#### Fill Material

Based on the recent boring (BH 100) at the site, the fill material beside the culvert was found to consist of 7.0 feet of very stiff silty clay some sand and a trace of gravel overlying same 19 feet of very loose to compact sand to silty coarse sand and gravel. Occasional zones of the reworked cohesive till were encountered within this granular fill.

### Silty Clay, Sand and Gravel (Glacial Till)

Underlying the existing fill and originally surficial across the site is a cohesive glacial till deposit consisting of a heterogeneous mixture of silty clay with sand and gravel.

The thickness of this glacial till varies from 34 feet to 46 feet. Occasional layers of sand and gravel, up to 2 feet in thickness, were encountered randomly throughout the deposit. The lower 5 to 10 feet of the stratum often contains numerous fragments and detached slabs of bedrock. Grain-size distribution curves, for samples of the cohesive stratum, obtained with 2" O.D. sampling equipment, are shown on Figure No. 2 in Appendix I.

Atterberg limit tests were performed on samples of the glacial till. The results, which are shown on the borelog sheets and on the Plasticity Chart, Figure #1, are tabulated below:

			<u>Range</u>
Liquid Limit	(W <sub>L</sub> )	(%)	15 - 37
Plastic Limit	(W <sub>p</sub> )	(%)	13 - 23
Natural Moisture Content	(W)	(%)	6 - 18

Based on these values it is estimated that the cohesive deposit has a matrix, which is an inorganic silty clay of low to intermediate plasticity (CL-CI).

The Standard Penetration Tests, carried out within this glacial till stratum, are plotted on the Record of Borehole sheets. This testing gave 'N' values which ranged from 2 blows/ft. to in excess of 100 blows/ft. The lower 'N' values occurred in the upper few feet of the deposit. This would indicate that this zone has been softened by weathering. Based on this testing it is estimated that the consistency of this cohesive deposit varies from firm to hard, being generally in the very stiff to hard range.

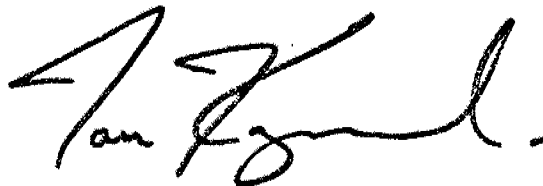
### Shale Bedrock

The cohesive glacial till stratum is directly underlain by bedrock which was proven in four of the boreholes by obtaining up to 11.5 feet of BX size rock core samples. In addition, the surface of the bedrock, at a number of other boring locations, was inferred to exist at the level where the hammer driven casing met practical refusal. Over the site the bedrock surface was found to vary randomly between elevations 468 and 475. The bedrock is composed of a grey shale which is in a relatively sound condition as evidenced by the high percentage of core recovery. An exception to this pattern occurs at BH#20; here the upper 5 feet is in a weathered condition.

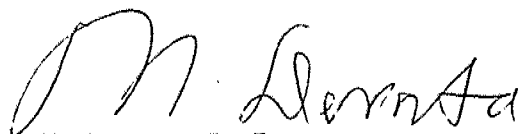
### GROUNDWATER CONDITIONS

The groundwater level conditions across the site, during the period of the investigation (January 1972), were observed by taking readings in the open boreholes. The results of the readings are shown on the Borelog sheets, as well as on Drawing No. 2.

The observations indicate that the groundwater level is located between elevations 505 and 507, which corresponds to levels which range from 4 to 21 feet below ground surface at the time of investigation. These levels correspond closely to the water level in the creek, which was at about elevation 502 to 503.



T. J. Kazmierowski, P. Eng.  
Foundations Engineer



M. Devata, P. Eng.  
Senior Foundations Engineer

## 8

W.P. 48-71-11

[illegible]

# RECORD OF BOREHOLE No. 5

9

LOCATION Co-ords. 15,879,007 N; 970,654 E. ORIGINATED BY VK  
W.P. 48-71-11 BORING DATE Jan. 17, 1972 COMPILED BY TST  
DATUM Geodetic BOREHOLE TYPE Penn Drill & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — $w_L$	BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	PLASTIC LIMIT — $w_p$			WATER CONTENT — $w$
							20 40 60 80 100	WATER CONTENT % $w_p$ — $w$ — $w_L$			
							SHEAR STRENGTH P.S.F.				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
526.0	Ground Level										
0.0	Het.mix.of Silty Clay sand and gravel.  Very Stiff - Hard  Glacial Till		1	SS	25	520				13 26 46 15	
			2	SS	61						
			3	SS	46						
					4	SS	21	510			7 39 45 9 ≡ 506.5
					5	SS	16				
					6	SS	47				
					7	SS	72	500			2 11 47 40
					8	SS	81				
					9	SS	128				
					10	SS	68	490			
					11	SS	98				
					12	SS	60/61				
479.5											
46.5	End of Borehole					480					



## 10

W.P. 48-71-11

BORING DATE Jan. 21, 1972

ORIGINATED BY VK

COMPILED BY TST

CHECKED BY VK.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— W <sub>L</sub> Plastic Limit ——— W <sub>P</sub> Water Content ——— W	BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WATER CONTENT %		
							20    40    60    80    100	W <sub>P</sub> W      W <sub>L</sub>		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	10    20    30		
512.5	Ground Level									
0.0	Het. mix. of Silty Clay and sand		1	SS	7	510				0 18 67 15
	Stiff - Hard		2	SS	9					$\nabla$ 506.5'
	Glacial Till		3	SS	11					
			4	SS	74	500				40 28 24 8
	Sand and Gravel		5	SS	100/3"					
			6	SS	100/4"					
			7	SS	161	490				
485.7			8	SS	100/4"					
26.5	End of Borehole					480				

## 11

W.P.	48-71-11	LOCATION	Co-ords. 15,879,062 N; 970,636 E.	ORIGINATED BY	VK
DATUM	Geodetic	BORING DATE	Jan. 19, 1972	COMPILED BY	TST
		BOREHOLE TYPE	Penn Drill & Cone Test	CHECKED BY	<i>SK</i>

[illegible]

# RECORD OF BOREHOLE No. 14

12

W.P. 48-71-11 LOCATION Co-ords. 15,879,120 N; 970,675 E. ORIGINATED BY VK  
 BORING DATE Jan. 21, 1972 COMPILED BY TST  
 DATUM Geodetic BOREHOLE TYPE Penn Drill & Cone Test CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — $w_p$	WATER CONTENT — $w$		
510.5	Ground Level										
0.0	Het. mix. of Silty Clay sand and gravel	1	SS	4	510						
	Firm - Hard	2	SS	26							
	Glacial Till	3	SS	56	500						
		4	SS	31							
		5	SS	65							
		6	SS	47							
		7	SS	66	490						
		8	SS	35							
	Sand and Gravel	9	SS	103/9"	480						
		10	SS	60/1"							
470.3		11	SS	80/1 1/2"	470						
40.2	Shale Bedrock	12	BXL	100%							
464.5	Sound										
46.0	End of Borehole										

505.

## 13

W.P. 48-71-11 LOCATION Co-ords. 15,879,119 N; 970,612 E. ORIGINATED BY VK  
 DATUM Geodetic BORING DATE Jan. 18, 1972 COMPILED BY TST  
 BOREHOLE TYPE Diamond Drill & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— w <sub>L</sub> PLASTIC LIMIT ——— w <sub>p</sub> WATER CONTENT ——— w			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	SHEAR STRENGTH P.S.F.				
								o UNCONFINED + FIELD VANE • QUICK TRIAXIAL x LAB. VANE				
510.3	Ground Level											
0.0	Het. mix. of Silty Clay sand & gravel		1	SS	2	510						
			2	SS	53							
	Hard		3	SS	33	500						
	Glacial Till		4	SS	71 3'9"							
			5	SS	77 6"							
			6	SS	72	490						
			7	SS	120							
			8	SS	120							
478.8			9	SS	113	480						
31.5	End of Borehole					470						



## 15

W.P. 48-71-11 LOCATION Co-ords. 15,879,196 N; 970,593 E. ORIGINATED BY VK  
 DATUM Geodetic BORING DATE Jan 1972 COMPILED BY TST  
 BOREHOLE TYPE Diamond Drill & Cone Test CHECKED BY [Signature]

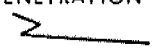
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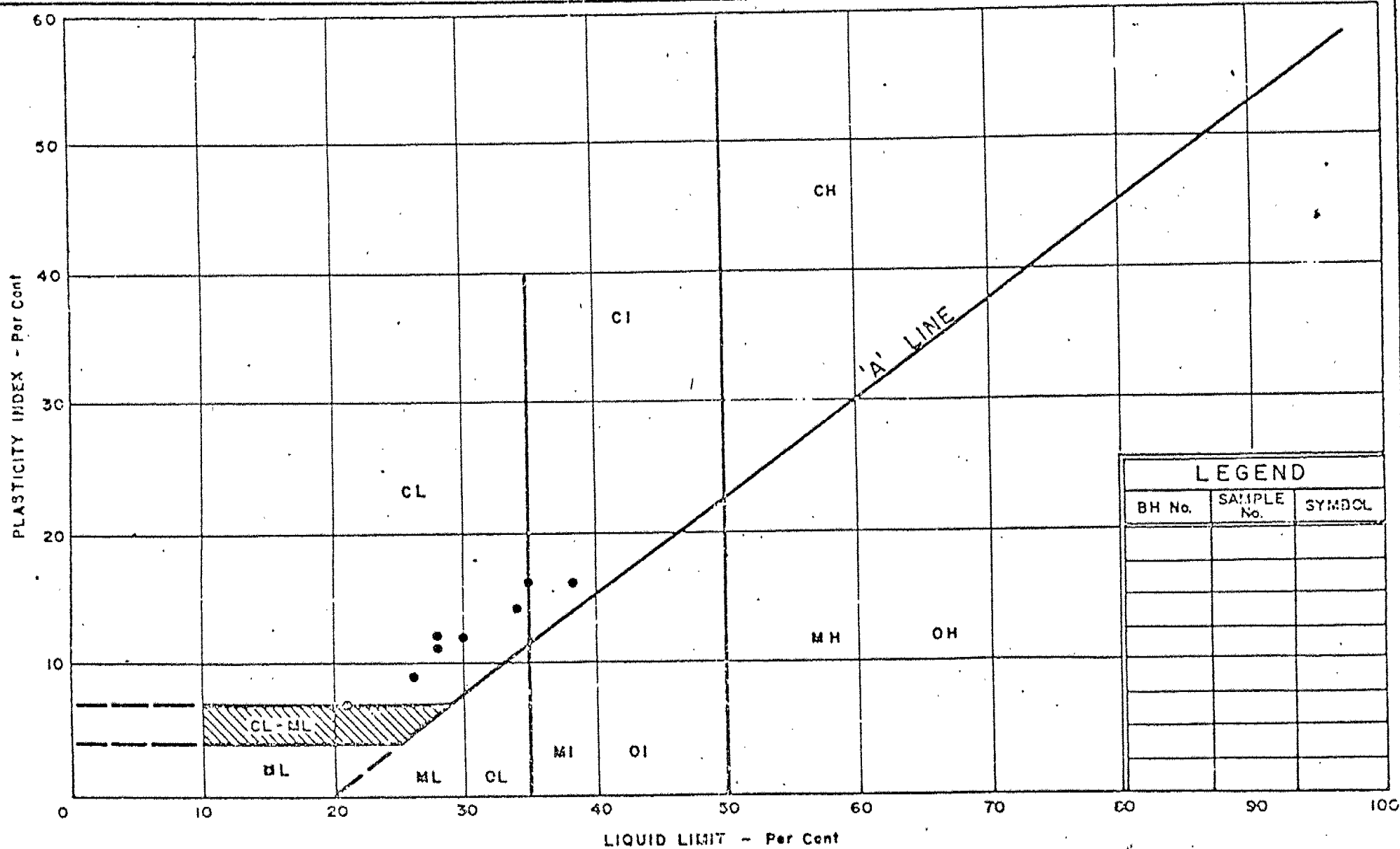


# RECORD OF BOREHOLE No 100

16

W P 48-71-11 LOCATION CO-ORDS. 15,879,065 N 970,701 E ORIGINATED BY V.P.  
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY T.J.K.  
 DATUM Geodetic DATE 82 01 26 CHECKED BY 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
530.0	Ground Surface													
0.0	Silty Clay													
	Some Sand													
	Trace of Gravel													
	Very Stiff													
523.0			1	SS	18									
			2	SS	16									
7.0	(Fill)		3	SS	12									
	Sand and Gravel		4	SS	5									
	Trace of Silt		5	SS	3									
	Silty Clay with		6	SS	10									
	Gravel, Some Sand		7	SS	25									
	To		8	SS	19									
	Silty Coarse Sand &		9	SS	12									
	Gravel		10	SS	10									
503.8	Very Loose to Compact													
26.2	(Glacial Till)		11	SS	21									
	Silty Clay Trace to		12	SS	113/9"									
	With Sand and Gravel		13	SS	64									
	Very Stiff to Hard		14	SS	92									
493.5														
36.5	End of Borehole													



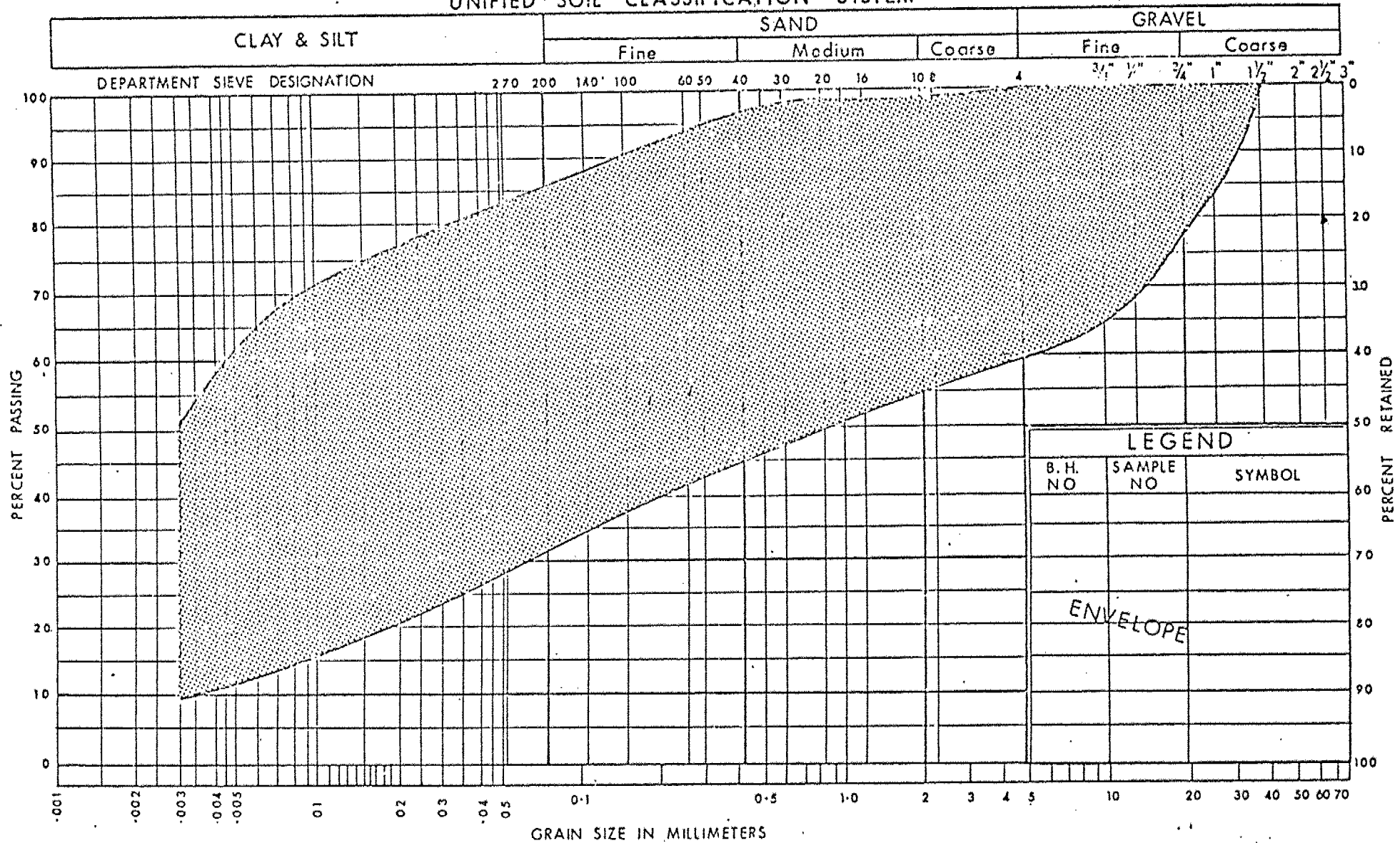
PLASTICITY CHART  
GLACIAL TILL

WP. No. 48 - 71 - 11

JOB No.

FIG. 1

# UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
GLACIAL TILL

W.P. No. 48 - 71 - 11

JOB No.

FIG. 2

FOUNDATION INVESTIGATION REPORT  
For  
Turning Roadway N to 409E Structure  
and Retaining Wall A-1  
W.P.404-65-01, Site 37-989  
Hwy. 409, District 6, Toronto

INTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation program carried out in February of 1972 at the above mentioned site.

A total of 11 boreholes, 9 of which were accompanied by a dynamic cone penetration test, was carried out at the site during the course of the field investigation. The boreholes and the cone penetration tests were advanced by means of a continuous flight auger machine (Penn Drill) or a diamond drill rig, both of which were adapted for soil sampling purposes.

Borings ranged in depth from 46.3 to 77.9 feet below ground surface at the time of investigation with bedrock being cored in 4 of the borings for a maximum depth of 8.6 feet.

SITE DESCRIPTION AND GEOLOGY

The area under investigation is located south-east of the junction of Mimico Creek and Indian Line Road, in the Borough of Etobicoke, Metropolitan Toronto. The terrain in this area is generally flat to gently undulating, varying in elevation between 524 and 536. At the time of the investigation the east end of the site was intercepted by a narrow valley, generally grass and brush covered, ranging in depth from 13 to 17 feet below the surrounding terrain. The surrounding region has been developed for small industrial enterprises.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area under investigation, the moraine is primarily composed of a cohesive glacial till whose thickness generally ranges from 47 to 73 feet.

In this region the Humber River, Etobicoke and Mimico Creeks have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog, although in many of the interstream areas drainage is still imperfect. The overburden is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period. Available geological information indicates that the surface of the bedrock varies somewhere between elevation 460 and 475.

### Subsurface Conditions

#### General

The predominant stratum across the site is a cohesive glacial till, the thickness of which varies from 47 to 75 feet. In certain locations this cohesive deposit is overlain by 11 to 12 feet of fill material, composed of silty clay with some sand and a trace of gravel. The cohesive glacial till deposit is underlain by shale bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying Record of Boreholes Sheets. The locations and elevations of the structure related boreholes as well as estimated stratigraphical sections based on borehole data are shown on Drawing No.2. For soils information relating to the retaining wall, reference should be made to the Record of Borehole Sheets 6 & 7 in the appendix.

#### Fill Material

At certain locations, overlying the glacial till stratum is fill material composed of a mixture of silty clay with some sand and trace of gravel. The thickness of the fill material ranges from 11 feet at BH#13 to 12 feet at BH#12.

Standard penetration testing carried out in the material gave 'N' values which varied from 11 blows/ft. to 85 blows/ft. indicating that the fill is moderately to well compacted.

### Glacial Till (Heterogeneous Mixture of Silty Clay, Sand and Gravel)

Directly beneath a thin cover of topsoil (1 foot or less) or under the fill material is the predominant glacially derived stratum across the site, which is composed of a heterogeneous mixture of silty clay, sand and gravel. The thickness of this glacial till varies from 47 feet at BH 7 to 70 feet at BH 10. Occasional granular layers consisting of silt to sandy silt with trace of gravel up to 11 feet in thickness were encountered randomly throughout the deposit. The lower 3 to 21 feet (i.e. below elevation 475 to 485) of the stratum often contains numerous fragments and slabs of shale. Grain-size distribution curves for samples of the cohesive stratum, obtained with 2" O.D. sampling equipment, are shown on Figure No. 2 in Appendix I.

Atterberg limit tests were performed on samples of the glacial till. The results, which are shown on the borelog sheets and on the Plasticity Chart, Figure #1, are tabulated below:

			<u>Range</u>
Liquid Limit	(W <sub>L</sub> )	(%)	18 - 40
Plastic Limit	(W <sub>P</sub> )	(%)	12 - 21
Natural Moisture Content	(W)	(%)	7 - 28

Based on these values it is estimated that the glacial deposit has a cohesive matrix, of inorganic silty clay of low to intermediate plasticity (CL-CI).

The Standard Penetration Tests, carried out within this glacial till stratum, are plotted on the Record of Borehole sheets. This testing gave 'N' values which ranged from 8 blows/ft. to in excess of 100 blows/ft., generally increasing with depth. Based on this testing it is estimated that the consistency of the cohesive deposit varies from stiff to hard.

### Shale Bedrock

The cohesive glacial till stratum is directly underlain by bedrock which was proven in four of the boreholes by obtaining up to 8.6 feet of

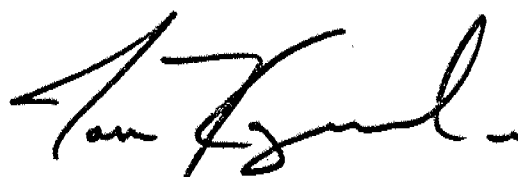


BX size rock core samples. In addition, the surface of the bedrock, at a number of other boring locations, was inferred to exist at a level where the hammer driven BX casing or motor powered auger met practical refusal. Over the site the bedrock surface was found to vary randomly between elevations 456 to 482. The bedrock is composed of a grey shale which is in a relatively sound condition as evidenced by the high percentage of core recovery.

#### GROUNDWATER CONDITIONS

The groundwater level condition across the site, during the period of the investigation (January and February, 1972) were observed by taking readings in the open boreholes. The results of the readings are shown on the Record of Borehole Sheets as well as on Drawing No. 2.

The observations indicate that the groundwater level is located between elevations 493 and 530, which corresponds to levels which range from 3 to 33 feet below ground surface at the time of investigation.



T. J. Kazmierowski, P. Eng.  
Foundations Engineer

M. Devata, P. Eng.  
Senior Foundations Engineer

# RECORD OF BOREHOLE NO 6

23

W.P. 404-65-01 LOCATION 15,877,454 N. 972,440 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 22 & 23, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Cone Penetration & Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT $w_L$			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT $w_p$				
							20	40	60	80	100	WATER CONTENT $w$				
SHEAR STRENGTH P.S.F.							$w_p$ $w$ $w_L$			WATER CONTENT %						
○ UNCONFINED + FIELD VANE										10 20 30			P.C.F. GR. SA. SI. CL.			
● QUICK TRIAXIAL x LAB VANE																
527.6	Ground elevation.															
	Het. mixture of clayey silt, with sand & gravel.		1	SS	15											
	(Brown)		2	SS	42	520										
	(Grey)		3	SS	62											
	Glacial Till		4	SS	30											
	Very stiff to hard.		5	SS	37	510										
501.6			6	SS	31											
26.0	Sandy silt, with some gravel-very dense.		7	SS	42											
498.6			8	SS	74	500										
29.0			9	SS	103											
			10	SS	54	490										
			11	SS	60 1/2"											
481.3	With shale fragments.		12	SS	70 1/2"	480										
46.3	End of borehole.					470										

20  
15 5 % STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE NO 7

W.P. 404-65-01 LOCATION 15,877,467 N. 972,341 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 21, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill & Cone Penetration CHECKED BY —

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
527.1	Ground level.															
	Het. mixture of clayey silt, sand, and gravel.		1	SS	41											
			2	SS	34	520										
			3	SS	78											
	(Brown)		4	SS	34											
	(Grey)		5	SS	36	510										
	Glacial till. Hard.		6	SS	34											
			7	SS	34											
503.1			8	SS	45	500										
24.0	Sandy silt, with some gravel - Dense		9	SS	110											
500.1			10	SS	82	490										
27.0			11	SS	40											
			12	SS	86	480										
480.1	Probable Bedrock.					470										
47.0	End of borehole.															

## RECORD OF BOREHOLE NO 8

25

W.P. 404-65-01 LOCATION 15,877,484 N. 972,243 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 17 & 18, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
525.7	Ground surface.															
	Het. mixture of clayey silt, sand & gravel.		1	SS	37	520										El. 521.6
			2	SS	35											3 23 55 19
	(Brown)		3	SS	38											
	(Grey)		4	SS	33											
			5	SS	27	510										
	Glacial Till.		6	SS	33											
503.7	Very stiff to hard.		7	SS	26											
22.0	Silty sand with some gravel - Dense.		8	SS	49	500										
499.7			9	SS	76											
26.0			10	SS	108	490										
			11	SS	96											
485.7	Silt with sand.		12	SS	100/8"	480										
40.0			13	SS	100/2"											
42.0			14	SS	100/4"											
480.7	With fragments of shale.					470										
45.0																
						460										
460.2	Probably bedrock.															
65.5	End of borehole.					450										

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

# RECORD OF BOREHOLE NO 9

26

W.P. 404-65-01 LOCATION 15,877,434N. 972,234 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 21, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — $w_p$				
							20	40	60	80	100	WATER CONTENT — $w$				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				

20  
15 5 % STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE NO 10

W.P. 404-65-01 LOCATION 15,877,500 N. 972,044 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 16, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
526.0	Ground surface.															
	Het. mixture of clayey silt, sand & gravel. (Brown) (Grey)		1	SS	58	520										3 24 49 24
			2	SS	69											
			3	SS	40											
	Glacial Till. Very stiff to hard.		4	SS	26											
			5	SS	24	510										
			6	SS	34											
505.0			7	SS	72											
21.0	Sandy silt with some gravel.		8	SS	56	500										
499.0	Very dense - Grey.		9	SS	69											
27.0			10	SS	100/3"	490										
491.0			11	SS	100/3"											
35.0	Sandy silt to silt with some gravel. Very dense - Grey.		12	SS	100/5"	480										
481.0			13	SS	151/0"	470										
45.0			14	SS	100/3"	460										
476.0																
50.0	With fragments of shale.															
456.0	Probable bedrock.					450										
70.0	End of borehole.															



## RECORD OF BOREHOLE NO 11

W.P. 404-65-01 LOCATION 15,877,565 N. 971,873 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 14, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — $w_p$				
							20	40	60	80	100	WATER CONTENT — $w$				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE					$w_p$ — $w$ — $w_L$			P.C.F.	GR. SA. SI. CL.	
						● QUICK TRIAXIAL × LAB VANE					10 20 30					
524.9	Ground elevation															
	Net. mixture of clayey silt, sand & gravel.		1	SS	51	520									El. 522.2	
	(Brown)		2	SS	64										9 30 43 18	
	(Grey)		3	SS	35											
	Glacial Till.		4	SS	31	510										
	Hard.		5	SS	32											
			6	SS	47											
			7	SS	31											
			8	SS	97	500										
			9	SS	62											
489.9						490										
35.0	Silty sand with some gravel - Dense		10	SS	133											
37.0			11	SS	100/5"											
			12	SS	100/5"	480										
474.9			13	SS	100/5"											
50.0	With shale fragments.					470										
465.4																
59.5	Shale - Bedrock		14	BXL RC	Rec 100%	460										
459.9	Sound - Grey															
65.0						450										

## RECORD OF BOREHOLE NO 12

W.P. 404-65-01

LOCATION 15,877,662 N. 971,669 E.

ORIGINATED BY V.K.

BORING DATE Feb. 22, 1972

COMPILED BY T.S.T.

DATUM Geodetic

BOREHOLE TYPE Penn Drill.

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %					
							20 40 60 80 100					$w_p$ — $w$ — $w_L$					
						O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					10 20 30						
536.1	Ground elevation.																
524.1 12.0	Fill material. Clayey silt, with some sand & trace of gravel. Stiff to hard. (Grey) Het. mixture of clayey silt, sand & gravel.  (Brown) (Grey)  Glacial Till.  Hard.		1	SS	35	530											
			2	SS	11												
			3	SS	85												
			4	SS	41	520											
			5	SS	71												
			6	SS	86												
			7	SS	34												
			8	SS	32	510											
			9	SS	100/5"	500											
			10	SS	100/5"												
			11	SS	100/5"												
						12	SS	119	490								
			486.1 50.0	Silt to sandy silt.		13	SS	47									
			52.0						480								
			14	SS	100/1"												
471.6	Probable bedrock.					470											
64.5	End of borehole.																

El. 516.6  
in open  
B.H.  
Feb. 28/72

7 37 53 3

 E.L. 516.6  
in open  
B.H.  
Feb. 28/72

7 37 53 3

## RECORD OF BOREHOLE NO 13

W.P. 404-65-01 LOCATION 15,877,785 N. 971,477 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 17, 18 & 24, 1972 COMPILED BY S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill Washboring CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
536.7	Ground elevation															
0.0	Fill material. Clayey silt, with some sand & trace of gravel. Very stiff to hard.		1	SS	27	530										El. 530 y. 2 10 29 40 15
			2	SS	15											
			3	SS	38											
524.7			4	SS	48											
12.0	Het. mixture of clayey silt, sand & gravel. (Brown) (Grey) Glacial Till.		5	SS	59	520										
			6	SS	78											
			7	SS	37											
			8	SS	24	510										
			9	SS	28											
501.7			10	SS	007	500										
35.0	Silt to sandy silt, with trace of gravel. Very dense - Grey.		11	SS	607											
			12	SS	087	490										
490.7			13	SS	110											
46.0																
479.7						480										
57.0	Silty sand.		14	SS	100	470										
59.0	With fragments of shale.		15	SS	100	460										
463.2																
73.5	Shale bedrock		16	RC	Rec.	460										
458.8	Sound - Grey			BXL	100%											
77.9	End of borehole.															
						450										

20  
 15  $\diamond$  5 % STRAIN AT FAILURE  
 10

## RECORD OF BOREHOLE NO 14

W.P. 404-65-01 LOCATION 15,877,908 N. 971,330 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 11, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Dri. CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — $w_p$				
							20	40	60	80	100	WATER CONTENT — $w$				
							SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						O UNCONFINED + FIELD VANE					$w_p$ — $w$ — $w_L$			P.C.F.		
						• QUICK TRIAXIAL x LAB VANE					10 20 30					
528.6	Ground elevation.															
0.0	Her. mixture of clayey silt, sand & gravel.		1	SS	15											
			2	SS	42											
			3	SS	82											
	(Brown)		4	SS	88											
	(Grey)		5	SS	28											
	Glacial Till.		6	SS	28											
	Very stiff to hard.		7	SS	104											
			8	SS	104											
			9	SS	186/11"											
493.6			10	SS	167											
35.0	Silt to sandy silt.		11	SS	71											
37.0			12	SS	100											
			13	SS	100/11"											
478.6	With shale fragments.															
476.1	Probable bedrock.															
52.5	End of borehole.															

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

# RECORD OF BOREHOLE NO 15

32

W.P. 404-65-01 LOCATION 15,878,034 N. 971,222 E. ORIGINATED BY V.K.  
 BORING DATE Feb. 9 & 10, 1972 COMPILED BY T.S.T.  
 DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
528.0	Ground level.															
	Het. mixture of clayey silt, sand & gravel.		1	SS	10											
			2	SS	8	520										
	(Brown)		3	SS	66											
	(Grey)		4	SS	34											
	Glacial Till.		5	SS	29	510										
	Stiff to hard.		6	SS	27											
			7	SS	42											
			8	SS	67											
			9	SS	183	500										
			10	SS	77											
			11	SS	78	490										
485.0	Silt to sandy silt.															
43.0	V. dense - Grey.		12	SS	84											
481.0																
47.0			13	SS	100	480										
478.0	With fragments of shale.															
50.0																
470.2	Probable bedrock.					470										
57.8	End of borehole.															
						460										

20  
15 5 % STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE NO. 16

33

W.P. 404-65-01

DATUM Geodetic

LOCATION 15,878,001 N. 971,176 E.

BORING DATE Feb. 8 & 9, 1972

BOREHOLE TYPE Penn Drill

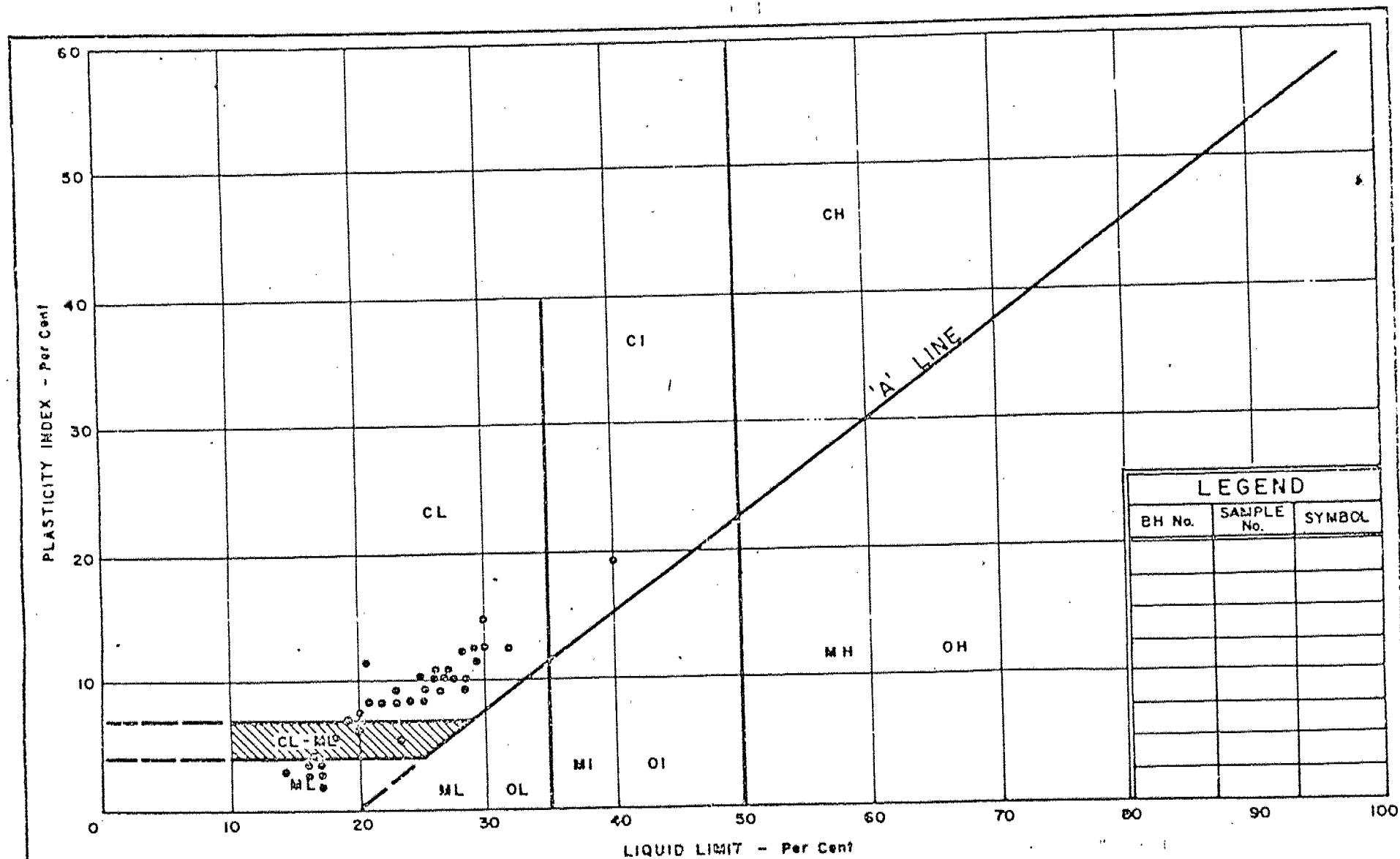
ORIGINATED BY V.K.

COMPILED BY T.S.T.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
530.9	Ground elevation					530										
	Het. mixture of clayey silt, sand & gravel.		1	SS	16											
	Very stiff to hard.		2	SS	38											
	(Brown)		3	SS	45											
	(Gray)		4	SS	50											
	Glacial till.		5	SS	31											
			6	SS	28											
			7	SS	149	510										
			8	SS	146											
			9	SS	98	500										
495.9			10	SS	41											
35.0	Silt to sandy silt, with trace of gravel.		11	SS	63	490										
488.9	Dense to very dense. (Grey)															
42.0																
485.9			12	SS	141	480										
45.0	With shale fragments															
482.0																
48.9	Shale - Bedrock.		13	BXL RC	90%	480										
	Sound - Grey.		14	BXL RC	100%											
473.4																
57.5	End of borehole.					470										
						460										

20  
15 5 % STRAIN AT FAILURE  
10



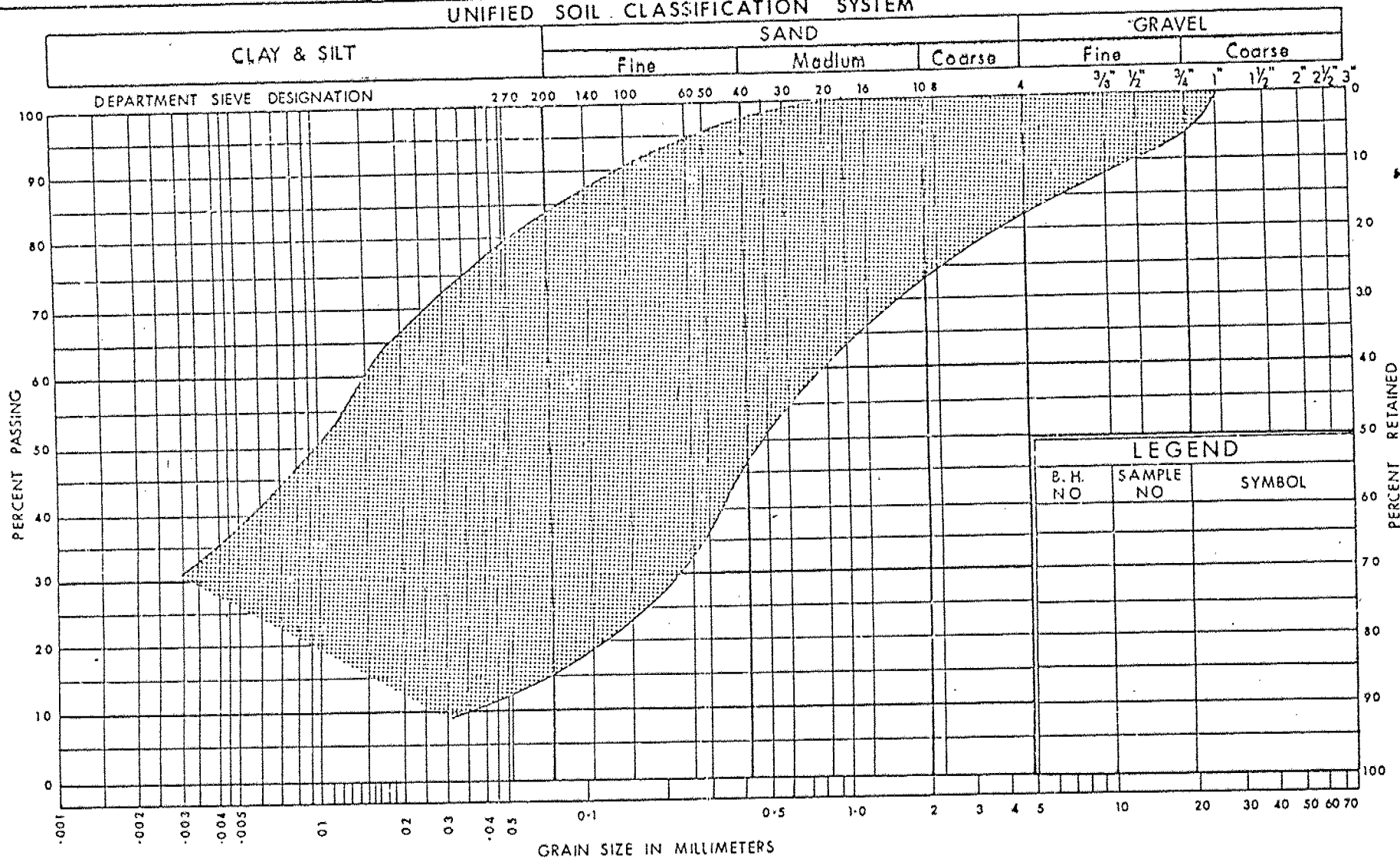
PLASTICITY CHART  
GLACIAL TILL

W.P. No. 404 - 65-01

**JOB No.**

FIGURE No. 1

# UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
GLACIAL TILL

W.P. No. 404-65-01

JOB No.

FIGURE No. 2

35



## FOUNDATION INVESTIGATION REPORT

For

F.T.M.S. - Overhead Signs

Hwy. 427 SB to Turning Roadway

Over Hwy. 409

W.P. 48-71-22

District 6, TorontoINTRODUCTION

The following is a summary of the results of a foundation investigation implemented at the aforementioned site. Installation of three standard overhead signs is proposed at stations on the existing Hwy. 427 SBL and the proposed Turning Roadway N-E. The purpose of the investigation was to:

- 1) determine the subsurface conditions at the locations of the signs.
- 2) provide pertinent geotechnical parameters.

SITE DESCRIPTION

The site coincides with the stations of the three independent signs. Sign No. 1 is located at the approach fills placed in preparation for construction of the proposed 6-span Turning Roadway N-E. It is located at the junction of the proposed Turning Roadway and the Ramp N-409 W. Sign No. 2 is positioned at the junction of Hwy. 427 SB and Turning Roadway N-E. The sign is located approximately 100 m south of the Hwy. 427 SB-CNR overpass. Sign No. 3 is located further north approximately 150 m north of the Hwy. 427 SB Woodbine Entrance Overpass.

The areas of investigation are located in the City of Etobicoke. The surrounding terrain is flat to gently undulating. Numerous structures have been constructed in association with Hwy. 427 including overpasses at the crossing of the Mimico Creek Complex - Goreway Drive, Canadian National Railway and Hwy. 409.

Geologically, the site is located in the physiographic region known as the "Peel Plain". The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area under investigation, the moraine is primarily composed of a cohesive glacial till whose thickness generally ranges from 10.6 m-19.8 m (35 to 65 ft). The overburden is underlain by grey shale bedrock of the Dundas-Meaford formation.

Approach fills ranging in depths of 6 to 11 m overly the glacial till at the sign locations.

#### Field Investigation

A total of six sampled boreholes were advanced, one per leg of the proposed overhead signs, between 88 03 29 and 88 04 01. Dynamic cone penetration tests accompanied the sampled boreholes.

Continuous flight solid stem auger equipment was used to advance the boreholes with subsoil samples retrieved by a split spoon sampler in accordance with the Standard Penetration (ASTM D 1586). The samples were identified in the field and then transported to the laboratory for applicable testing on selected samples.

Water levels were obtained in the open boreholes until approximate stabilized levels were observed.

Survey information related to location and elevation of boreholes was provided by Surveys and Plans, Central Region.

#### Subsurface Conditions

At each 'leg' location, depths of approach fills ranging from 6.0 m at Sign No. 1 to 11 m at Sign No. 2 overly the parent overconsolidated heterogeneous mixture of clayey silt, sand and gravel (glacial till). The approach fills consist of a cohesive mixture of clayey silt, sand and gravel. Organic inclusions were found throughout the fills. The fills are generally in a compact state of condition. The underlying virgin soil is cohesive and generally of low plasticity. The

consistency of the deposit to the depths penetrated (3 m to 6 m) ranged from very stiff to hard.

Water levels were obtained in the open boreholes until approximate stabilized levels were observed. In general, the phreatic surface of the water table is approximately 1 m beneath the fill-parent soil interface.

Factual data on the subsurface conditions is contained on the Record of Borehole Sheets. A plan of the site illustrating the locations of the boreholes are provided on Dwg. 487122-A.

A detailed description of the subsurface conditions encountered is given below.

Fill (Irregular Mixture of Clayey Silt, Sand and Gravel)

The approach fills at Hwy. 427 SB (FTMS signs #1 & #2) and fills deposited in preparation for Turning Roadway NE (FTMS sign #3) are cohesive and generally in a moderately compact state. The fill material consists of a mixture of clayey silt, sand and gravel. Grain size distribution curves for the fill material are illustrated in Figure 1.

Atterberg Limits were also obtained and the results are plotted in Figure 2. A summary of the indices and unit weights are provided in Table 1 below.

TABLE 1

	<u>Range</u>	<u>Avg.</u>
Natural Moisture Content (w)	7.5-21.5	14.6
Liquid Limit ( $w_L$ )	17-46.5	32.2
Plastic Limit ( $w_p$ )	11-21.5	16.9
Unit Weight ( $kN/m^3$ )	20.2-22.8	21.8

The results reveal that the fill is cohesive and ranges in plasticity from low to high. Generally, the fill is of low plasticity.

'N' values as determined by the SPT confirm that the consistency of the fill ranges from stiff to hard.

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

A heterogeneous unstratified mixture of clayey silt, sand and gravel underlies the approach fills at the locations of the overhead signs. Grain size distribution curves for the soil as determined by mechanical analyses is given in Figure 3. Atterberg Limits were also obtained to evaluate the behaviour of the fine grained portion of the material and the results are plotted in Figure 4. A summary of the indices are proved in Table 2 below. Unit weights are also included.

TABLE 2

	<u>Range</u>	<u>Avg.</u>
Natural Moisture Content (w)	11.5-15	13.4
Liquid Limit ( $w_L$ )	23.5-26	24.5
Plastic Limit ( $w_p$ )	13.5-16.5	14.8
Unit Weight ( $kN/m^3$ )	21.7-22.6	22.1

It is evident from the results that the deposit is cohesive and predominantly of low plasticity. It should be noted that although not encountered during the investigation, it is characteristic of tills to contain occasional cobbles and boulders and consequently these may be encountered in this deposit.

The consistency of the deposit as indicated by 'N' values of the Standard Penetration Test ranges from very stiff to hard, but generally is in a hard condition.

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer, utilizing equipment owned and operated by Master Soil Drilling, Toronto. This report was written by T. Sangiuliano and reviewed by Mr. M. S. Devata, Chief Foundation Engineer (East).



A handwritten signature in cursive script, appearing to read 'T. Sangiuliano'.

Tony Sangiuliano, P.Eng.  
Foundations Engineer

A handwritten signature in cursive script, appearing to read 'M. Devata'.

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

APPENDIX

RECORD OF BOREHOLE No 1										METRIC			
W P 48-71-22		LOCATION Sta. 389 + 26; o/s 50.0' Lt. (Imperial Chainage)				ORIGINATED BY TS							
DIST 6 HWY 427/409		BOREHOLE TYPE Cone Test, Solid Stem Auger				COMPILED BY TS							
DATUM Geodetic		DATE 88 04 01				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 KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH (Feet) (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
569.2 0.0	173.5 0.0	Ground Surface											
		Irregular Mixture of Clayey Silt, Sand and Gravel (Fill) Brown/Grey Very Stiff to Hard											
			1	SS	30								
			2	SS	33								
			3	SS	31								
			4	SS	26								
			5	SS	30								
		Organic inclusions											
			6	SS	30								
			7	SS	25								
			8	SS	35								
532.7 36.5	162.4 11.1	Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till)											
			9	SS	48								
			10	SS	58								
522.7 46.5	159.3 14.2	Brown, hard											
			11	SS	65								
		End of Borehole											
		* Dry Hole											

OFFICE REPORT ON SOIL EXPLORATION

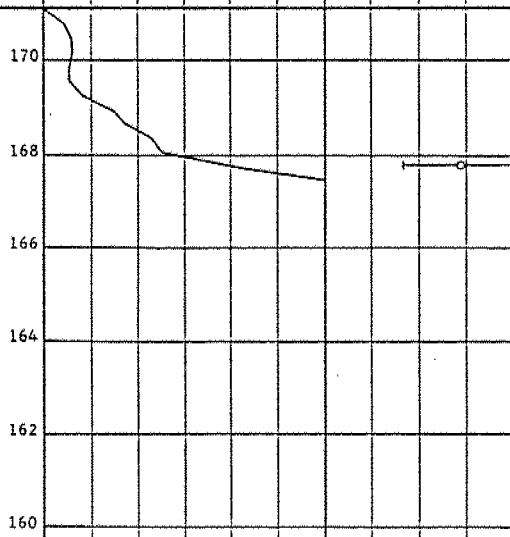




RECORD OF BOREHOLE No 3										METRIC						
W P 48-71-22		LOCATION Sta. 406 + 50: o/s 111.0' Lt. (Imperial Chainage)				ORIGINATED BY TS										
DIST 6		HWY 427/409		BOREHOLE TYPE Cone Test, Solid Stem Auger		COMPILED BY TS										
DATUM Geodetic		DATE 88 03 29		CHECKED BY												
SOIL PROFILE			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 (%)		
ELEV (feet)	DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20						40	60
568.2	173.2	Ground Surface														
0.0	0.0	Irregular Mixture of Clayey Silt Sand and Gravel (Fill) Occ. Organics Stiff to Very Stiff Brown/Grey											22.1	1 22 52 25		
				1	SS	23										
				2	SS	24										
				3	SS	26										
				4	SS	32										
				5	SS	13										
				6	SS	26										
537.4	163.8	Het. Mixture of Clayey Silt Sand and Gravel (Glacial Till) Hard Brown Grey		7	SS	15									21.9	2 25 50 23
30.8	9.4			8	SS	48										
				9	SS	60										
				10	SS	61										
				11	SS	48										
				12	SS	47										
				13	SS	30										
516.7	157.5			14	SS	46										
51.5	15.7	End of Borehole														

RECORD OF BOREHOLE No 4										METRIC					
W P 48-71-22		LOCATION Sta. 406 + 50; o/s 26.0' Lt. (Imperial Chainage)				ORIGINATED BY TS									
DIST 6 HWY 427/409		BOREHOLE TYPE Cone Test, Solid Stem Auger				COMPILED BY TS									
DATUM Geodetic		DATE 88 03 29				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 (%)
ELEV DEPTH (feet) (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
567.6 0.0	173.0 0.0	Ground Surface													
		Irregular Mixture of Clayey Silt, Some Sand, Trace Gravel (Fill)													
			1	SS	40										
		Some Organics													
			2	SS	12										
			3	SS	10										
			4	SS	22										
		Brown/Grey Stiff to Very Stiff													
			5	SS	20										
537.6 30.0	163.9 9.1	Het. Mixture of Clayey Silt, Sand and Gravel (Glacial Till)													
			6	SS	37										
			7	SS	71										
		Brown Grey													
			8	SS	131										
525.1 41.5	160.4 12.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

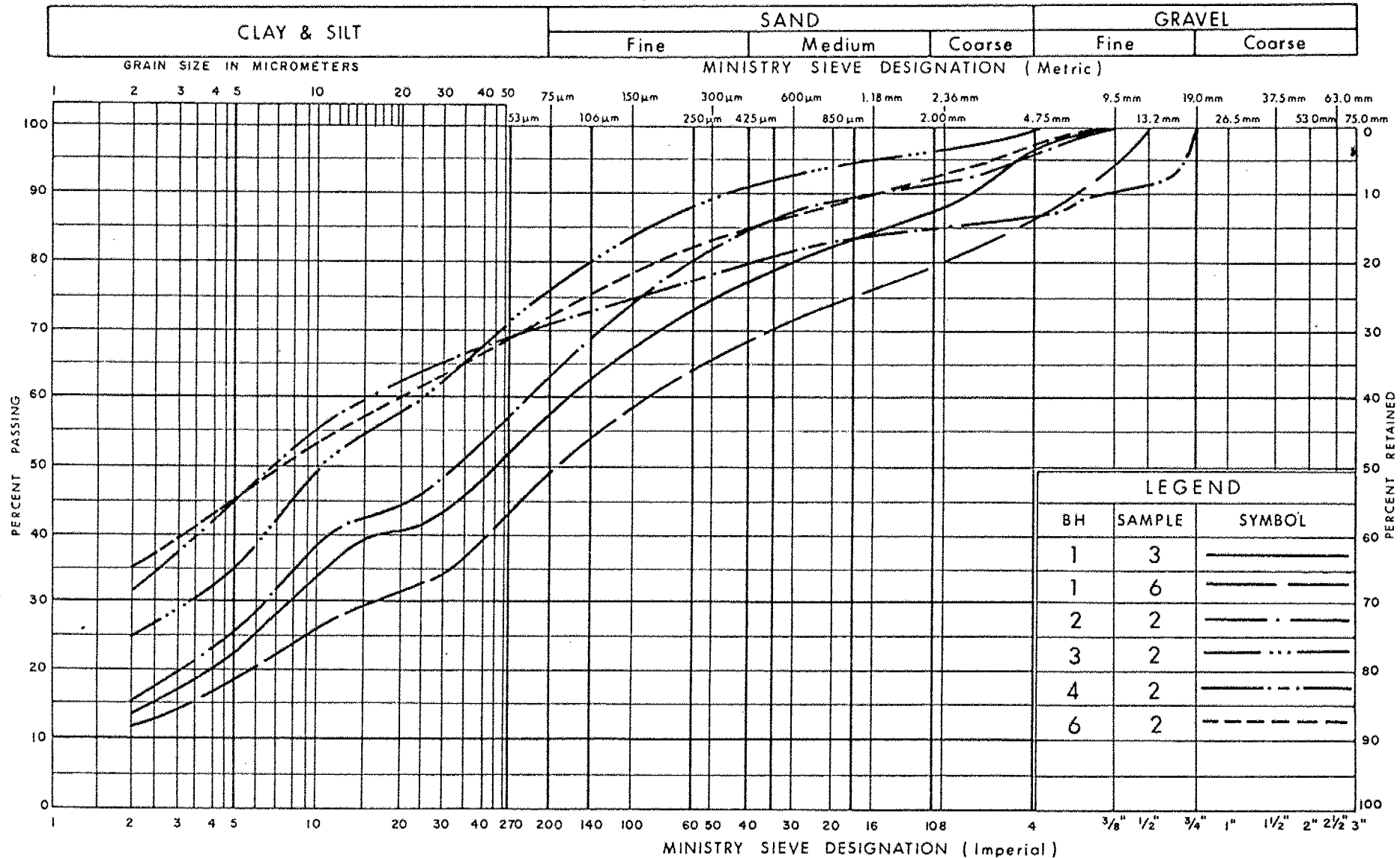
RECORD OF BOREHOLE No 5										METRIC				
W P 48-71-22		LOCATION Sta. 422 + 90; o/s 83.0' Lt. (Imperial Chainage)				ORIGINATED BY TS								
DIST 6 HWY 427/409		BOREHOLE TYPE Cone Test, Solid Stem Auger				COMPILED BY TS								
DATUM Geodetic		DATE 88 03 31				CHECKED BY								
SOIL PROFILE			SAMPLES			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 (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	WATER CONTENT (%)					
561.4 0.0	171.1 0.0	Ground Surface												
541.4 20.0	165.0 6.1	Irregular Mixture of Clayey Silt Sand and Gravel (Fill)  Brown/Grey Stiff	1	SS	18									
			2	SS	16									
			3	SS	10									
			4	SS	16									
			5	SS	14									
			6	SS	30									
			7	SS	30									
			8	SS	18									
			9	SS	19									
			10	SS	16									
519.9 41.5	158.5 12.6	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6										METRIC				
W P 48-71-22		LOCATION Sta. 422 + 90; o/s 26.0' Rt. (Imperial Chainage)					ORIGINATED BY TS							
DIST 6 HWY 427/409		BOREHOLE TYPE Cone Test, Solid Stem Auger					COMPILED BY TS							
DATUM Geodetic		DATE 88 03 30					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 (%)
ELEV DEPTH (feet) (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	WATER CONTENT (%)					
561.4	171.1	Ground Surface												
0.0	0.0	Irregular Mixture of Clayey Silt Sand and Gravel (Fill)  Brown/Grey  Stiff to Very Stiff  Organic Inclusions												
			1	SS	16									
			2	SS	16									
			3	SS	18									
			4	SS	23									
		5	SS	30										
541.4	165.0	Het. Mix. of Clayey Silt, Sand and Gravel  Brown Grey (Glacial Till)	6	SS	20									
20.0	6.1		7	SS	41									
			8	SS	20									
529.9	161.5	V. Stiff to Hard												
31.5	9.6	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

## UNIFIED SOIL CLASSIFICATION SYSTEM



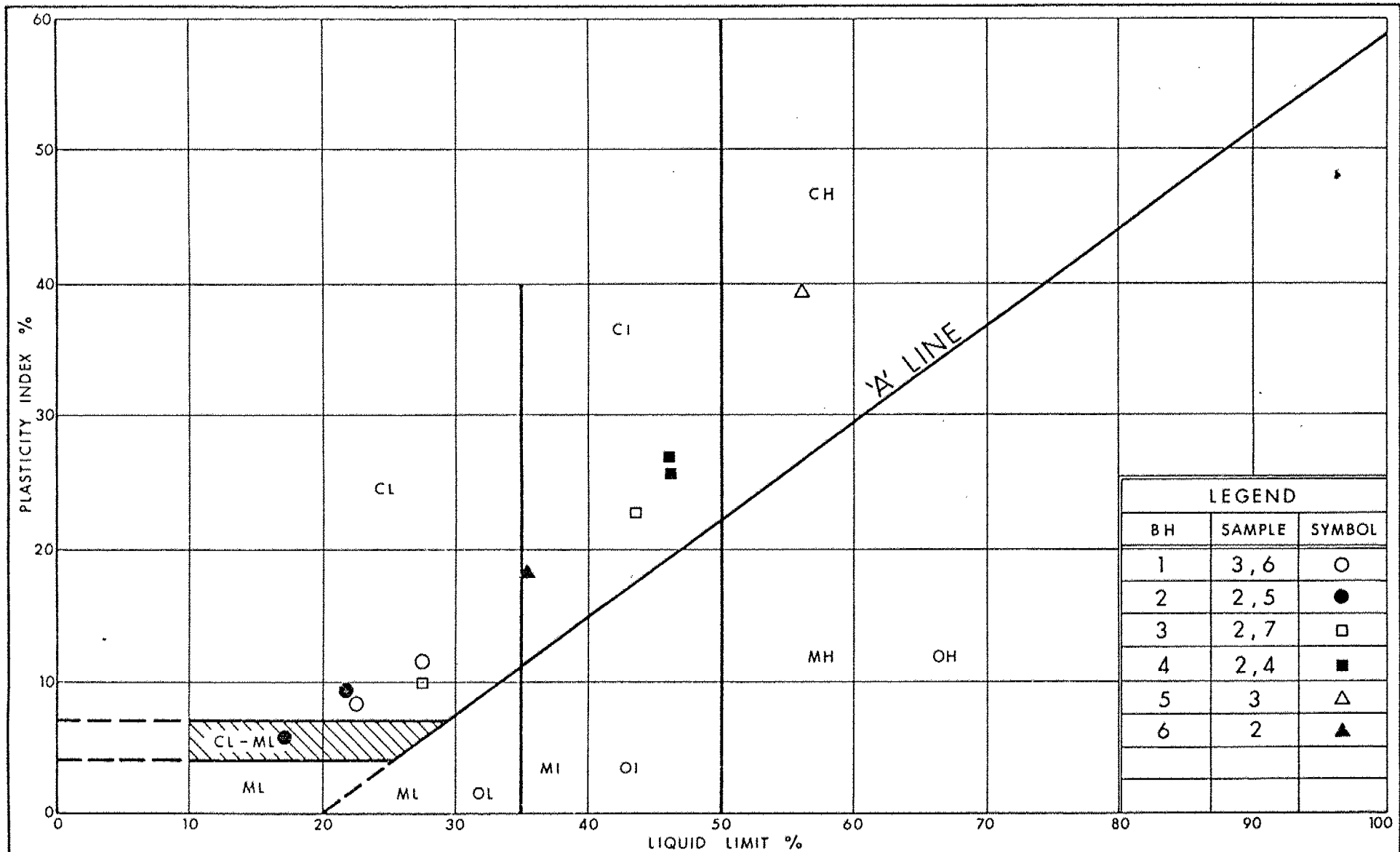
Ontario

Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
IRREGULAR MIXTURE OF  
CLAYEY SILT, SAND & GRAVEL (Fill)

FIG No 1

WP 48-71-22



Ministry of  
Transportation

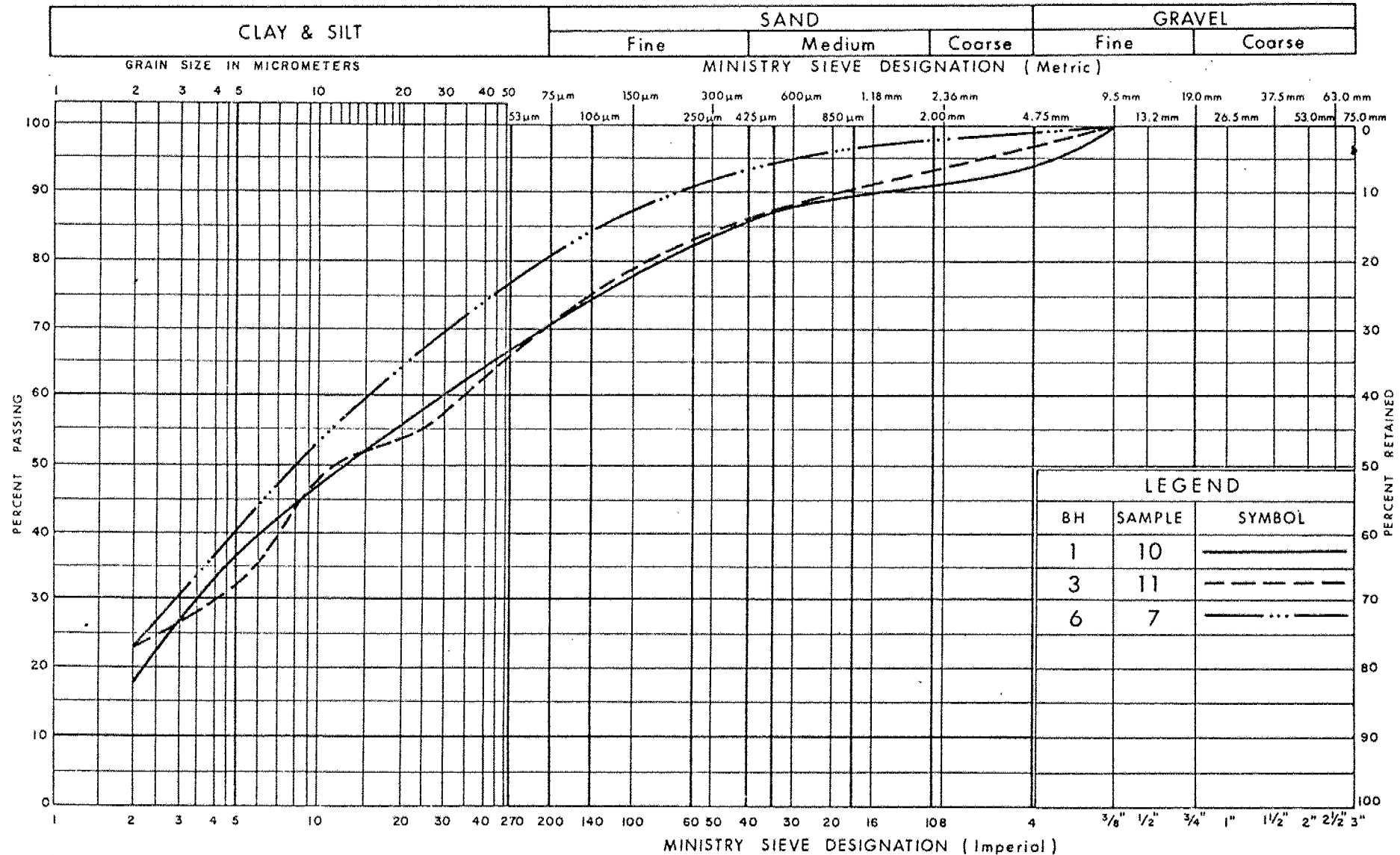
Ontario

# PLASTICITY CHART IRREGULAR MIXTURE OF CLAYEY SILT, SAND & GRAVEL (Fill)

FIG No 2

W P 48-71-22

## UNIFIED SOIL CLASSIFICATION SYSTEM



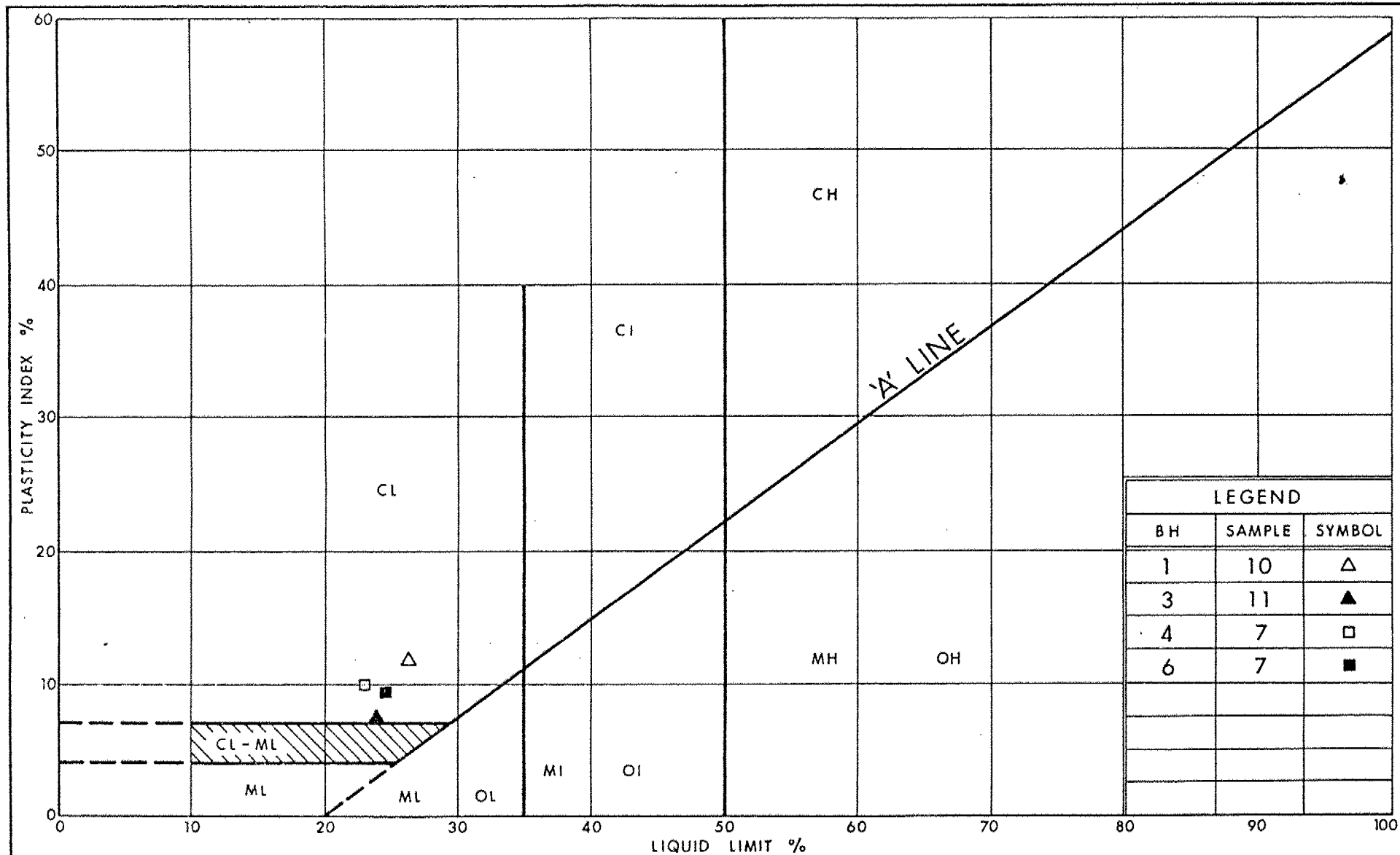
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Transportation

Ontario

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

FIG No 3

WP 48-71-22



Ministry of  
Transportation

Ontario

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

FIG No 4

W P 48-71-22





# RECORD OF BOREHOLE No 100

~~METRIC~~

W P 48-71-11

LOCATION Sta. 393+97.0 O/S 28' RT.

ORIGINATED BY V.P.

DIST 6 HWY 427

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY T.J.K.

DATUM Geodetic

DATE 82-01-26

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							
530.0	Ground Surface													
0.0	Silty Clay some sand trace of gravel Very stiff		1	SS	18									
527.0			2	SS	16									
7.0	(F.11)		3	SS	12									
	Sand and gravel trace of silt		4	SS	5									
			5	SS	3									
	Silty clay with gravel some sand		6	SS	10									
	To		7	SS	25									
	Silty coarse sand and gravel		8	SS	19									
	Very loose		9	SS	12									
503.8	to Compact		10	SS	10									
26.2	(Glacial Till)		11	SS	21									
	Silty Clay		12	SS	113/9"									
	trace to with sand and gravel		13	SS	69									
493.5	Very stiff		14	SS	92									
36.5	to Hard													
	End of borehole													

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

To: Mr. G. C. E. Burkhardt, (4) FROM: Foundations Office,  
Regional Structural Planning Eng., Design Services Branch,  
Central Region, Central Bldg., Downsview.  
90 Floral Parkway,  
ATTENTION: Downsview, Ontario. DATE: May 4, 1972.

OUR FILE REF.

IN REPLY TO

MAY 8 1972

SUBJECT:

30M12-55

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Ramp N-Belfield E. Structure  
At The Crossing of Hwy. #427  
And Goreway Drive Extension  
District No. 6 (Toronto)  
W.O. 72-11003 -- W.P. 48-71-11

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ao  
Attach.

cc: Messrs. D. W. Farren  
B. R. Davis  
A. Rutka  
P. J. Harvey  
H. Greenland  
B. J. Giroux  
T. J. Kovich  
G. A. Wrong  
B. A. Singh  
McCormick, Rankin & Associates Ltd.

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files  
Documents ✓

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  2. SITE AND GEOLOGY.
  3. FIELD AND LABORATORY WORK.
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  7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Ramp N-Belfield E. Structure  
At The Crossing of Hwy. #427  
And Goreway Drive Extension  
District No. 6 (Toronto)  
W.O. 72-11003 -- W.P. 48-71-11

---

1. INTRODUCTION:

It is proposed to extend the present airport expressway northerly toward Finch Avenue; this expressway will closely follow existing Indian Line Rd. This expressway will be designated as Hwy. #427. In connection with this expressway a major complex will be required at the crossing of proposed Hwy. #427 and i) the Mimico Creek Diversion and ii) the Disco Road realignment - Goreway Drive extension. This is known as the Mimico Creek Complex. The western portion of this complex is located in the Town of Mississauga, County of Peel, while the eastern portion is in the borough of Etobicoke, Metropolitan Toronto.

The Foundations Office was requested to carry out a subsurface investigation for the various components associated with the Mimico Creek complex. The request was contained in a memo from Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated December 29, 1971. Subsequently, an investigation was carried out by this Office to determine the subsoil, bedrock and groundwater conditions in this area.

This report will be concerned with the Ramp N-Belfield-E structure to be constructed at the crossing of Hwy. #427 and the Goreway Drive extension. As such it presents the factual information obtained in this specific area, as well as recommendations pertaining to the foundation design of the proposed

structure and the stability and settlement considerations associated with the approach fills.

Foundation reports for the other proposed structures within this complex will be presented in the following reports:

	<u>Report No.</u>
Twin Overpass Structures - Hwy. #427 (N.B.L. and S.B.L.) & Goreway Drive (Ext.) - Disco Road (realignment)	72-11002
Box Culvert - Mimico Creek Diversion	72-11004

## 2. SITE AND GEOLOGY:

The area under investigation is located in the immediate vicinity of Mimico Creek and Indian Line Road, which is partially in the Town of Mississauga and partially in Metropolitan Toronto. The east flowing Mimico Creek meanders along the floor of a valley which ranges from 100 to 180 ft. in width. The creek channel is about 15 to 20 feet wide and 10 feet in depth with the water level varying between elevations 502 to 504 (3 to 4 feet of water). The grass and brush covered valley banks range from 22 to 26 feet in height. They are standing at slopes which vary from 2:1 to 3:1.

The surrounding terrain is flat to gently undulating in relief between about elevation 527 to 536. This area has been developed for small industrial enterprises.

Twin 517 feet long Bailey Bridge structures exist at the crossing of Indian Line Road and Mimico Creek.

The site is located in the physiographic region known as the "Peel Plain." The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area under investigation, the moraine is primarily composed of a cohesive glacial till whose thickness generally ranges 35 to 65 feet. In this region the Humber River, Etobicoke and Mimico Creeks have cut deep valleys into the overburden. There is, therefore, no large

undrained depression, swamp or bog, although in many of the instream areas drainage is still imperfect. The overburden is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period. Available geological information indicates that the surface of the bedrock varies somewhere between elevation 460 and elevation 475.

3. FIELD AND LABORATORY WORK:

A total of eight boreholes, all of which were accompanied by a dynamic cone penetration test, was carried out at the site during the course of the field investigation. The boreholes and the cone penetration tests were advanced by means of a continuous flight auger machine (Penn Drill) or a diamond drill rig, both of which were adapted for soil sampling purposes.

Samples were obtained at required depths in a 2-inch O.D. split-spoon sampler which was hammered into the soil. The method of driving the split-spoon conformed to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Bedrock was proven at four of the boring locations by obtaining BX size rock core samples.

During sampling and drilling operations, detailed logs of the borings were made. These logs contain a record of the drilling and sampling techniques used, together with the soil types and bedrock encountered. The location and elevation of all the boreholes are shown on Drawing No. W.O. 72-11003A, together with estimated stratigraphical sections across the site. Surveying at the site was carried out by the personnel from the Central Region Engineering Survey Section. The elevations given in this report are referred to a Geodetic datum.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following

physical properties of the overburden:

Natural Moisture Content

Atterberg Limits

Grain-Size Distribution

The results of these tests are plotted on the Record of Borelog sheets as well as the figures located in Appendix I of this report.

#### 4. SUBSOIL AND BEDROCK CONDITIONS:

##### 4.1) General:

The predominant stratum across this structure site is a cohesive glacial till, the thickness of which varies from 34 feet to 46 feet. This cohesive deposit is underlain <sup>by</sup> shale bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. The stratigraphical sections, shown on Drawing No. 72-11003A, have been inferred from this data. From ground surface downward, the soil types and bedrock encountered are as follows.

##### 4.2) Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel):

Directly beneath a thin topsoil cover (1 foot or less) is the predominant stratum across the site, which is composed of a heterogeneous mixture of clayey silt with sand and gravel. The thickness of this glacial till varies from 34 feet (B.H. #19) to 46 feet (B.H. #4). Occasional layers of sand and gravel, up to 2 feet in thickness, were encountered randomly throughout the deposit. The lower 5 to 10 feet of the stratum often contains numerous shale fragments. Grain-size distribution curves, for samples of the cohesive stratum, obtained with 2" O.D. sampling equipment, are shown on Figure No. 2 in Appendix I.

Atterberg limit tests were performed on samples of

the glacial till. The results, which are shown on the borelog sheets and on the Plasticity Chart, Figure #1, are tabulated below:

Liquid Limit	(W <sub>L</sub> )	(%)	<u>Range</u> 15 - 37
Plastic Limit	(W <sub>p</sub> )	(%)	13 - 23
Natural Moisture Content	(W)	(%)	6 - 18

Based on these values it is estimated that the cohesive deposit has a matrix, which is inorganic and of low to intermediate plasticity.

The Standard Penetration Tests, carried out within this glacial till stratum, are plotted on the Record of Borehole sheets. This testing gave 'N' values which ranged from 2 blows/ft. to in excess of 100 blows/ft. The lower 'N' values occurred in the upper few feet of the deposit. This would indicate that this zone has been softened by weathering. Based on this testing it is estimated that the consistency of this cohesive deposit varies from firm to hard, being generally in the very stiff to hard range.

#### 4.3) Shale Bedrock:

The cohesive glacial till stratum is directly underlain by bedrock which was proven in four of the boreholes by obtaining up to 11.5 feet of BX size rock core samples. In addition, the surface of the bedrock, at a number of other boring locations, was inferred to exist at the level where the hammer driven casing met practical refusal. Over the site the bedrock surface was found to vary randomly between elevations 468 and 475. The bedrock is composed of a grey shale which is in a relatively sound condition as evidenced by the high percentage of core recovery. An exception to this pattern occurs at B.H. #20; here the upper 5 feet is in a weathered condition.

#### 5. GROUNDWATER CONDITIONS:

The groundwater level conditions across the site,



during the period of the investigation (January 1972), were observed by taking readings in the open boreholes. The results of the readings are shown on the Borelog sheets, as well as on Drawing No. 72-11003A.

The observations indicate that the groundwater level is located between elevations 505 and 507, which corresponds to levels which range from 4 to 21 feet below existing ground surface. These levels correspond closely to the water level in the creek, which was at about elevation 502 to 503.

## 6. DISCUSSION AND RECOMMENDATIONS:

### 6.1) General:

It is proposed to extend the present airport expressway northerly toward Finch Ave. following closely to the existing Indian Line Rd. This expressway will be designated as Hwy. #427. Interchanges are contemplated at the crossings of Dixon Rd., Belfield Expressway (Hwy. #409), Rexdale Blvd. and Finch Ave. In addition, structures will be required at the crossing of the Mimico Creek complex, American Drive, proposed Goreway Drive, Canadian National Railway, the Woodbine Racetrack Entrance and Morningstar Drive. At present the northern limit of this project has not been decided upon.

The Mimico Creek complex can be divided into three different parts:

- i) Mimico Creek Diversion and related retaining walls,
- ii) proposed overpass structures at the crossing of Hwy. #427 (N.B.L. and S.B.L.) and Disco Rd. (realignment) - Goreway Drive, and
- iii) proposed structure for a ramp N-Belfield E.

A plan (unnumbered) showing the proposed scheme for the Mimico Creek complex was provided by McCormick and Rankin Consulting Engineers, Port Credit, Ontario.

This report will deal with the proposed Ramp N-Belfield E. structure. Reports for i) and ii) will be presented under separate cover (W.O. 72-11004 and 2, respectively).

The Mimico Creek diversion will be carried beneath the Goreway Drive extension and the Disco Rd. realignment in a 7,100 feet long double concrete box culvert approximately 39 feet wide and 20 feet high. It is understood that the profile grade of the invert of the culvert will vary from elevation 502, at the west end, to 500 at the east end, which corresponds to depths of from 7 to 18 feet below existing ground surface. Outside of these limits the diversion will be located in an open channel section. The depth of the channel will vary from 10 to 30 feet with side slopes of  $2\frac{1}{2}:1$ .

The proposed profile grade of the 48 feet wide Goreway Drive extension - Disco Road realignment, in the vicinity of the proposed structures, will range from 526 to 531. To reach this grade line fills varying from 5 to 25 feet in height will have to be built. In some areas the roadway complex will be located immediately above the double concrete box culvert.

The proposed ramp N-Belfield-E structure will cross the culvert structure - Goreway Drive extension at a point about 50 feet west of the existing Indian Line Rd. bailey bridge structures. The 55 feet wide structure is to have three spans (70' - 90' - 68'). Fill will have to be placed to form the north and south approaches to this structure, as well as the twin Hwy. #427 (N.B.L. and S.B.L.) overpass structures located immediately to the east. The approaches to all three structures will be located on common fills. The profile grade of Hwy. #427, in the vicinity of the structures, will vary from elevation 556 to 567. At these grades the clear height of the approaches in the longitudinal and transverse direction will range from 33 to 36 feet and 30 to 52 feet, respectively.

The predominant stratum across the site is composed of a 34 to 46 feet thick cohesive glacial till which is underlain by shale bedrock.

In the subsections to follow the foundation support for the Ramp N-Belfield-E structure will be discussed. The

stability and settlement considerations associated with the common approaches will be discussed in detail in the report for the twin overpass structures (Report No. W.O. 72-11002).

6.2) Probable Sequence of Construction:

It is understood that the sequence of construction on the Mimico Creek complex will be as follows:

- i) Construction of the proposed Mimico Creek diversion in the dry (both the rigid frame culvert and open channel sections) as well as the ancillary retaining walls. Two possible schemes are being considered for the support of the piers associated with the twin Hwy. #427 overpass structures as well as the ramp N-E structure. The first is to found the piers on spread footings located in the parent glacial till stratum. The alternative is to found them on pile or deep foundations with the pier pile caps located at a relatively high elevation in the fill placed to form the Goreway Drive Extension - Disco Rd. realignment. If the former is adopted, and if scheduling permits, it would be advantageous to construct the pier foundations jointly with the box culvert. By doing this a common excavation could be utilized thus minimizing the material handling on this project.
- ii) Channelize Mimico Creek through the diverted section.
- iii) Backfill the existing Mimico Creek Channel.
- iv) Construct embankments required to form the Disco Rd. realignment - Goreway Drive extension sections.
- v) Place and compact fill to form the common approaches to the three structures, then construct the remaining foundations and superstructures.

6.3) Foundations - Ramp N-Belfield-E Structure:

6.3.1) Piers:

1) Spread Footing Support:

The predominant stratum across the site is a competent cohesive glacial till. The piers, therefore, can be supported on spread footings founded in this stratum. An allowable bearing value of up to 4.0 t.s.f. can be used in the design of footings founded at or below elevation 502. At least 4 feet of earth cover should be provided above the base of the foundations in order to satisfy the frost protection requirements in the area.

The footing excavations will extend some 8 to 11 feet below the existing ground surface. Temporary cuts of this height should be inherently stable with respect to a deep-seated rotational type of failure in the subsoil, providing the slopes are no steeper than 1:1. If steeper working faces are required, then the excavation should be sheeted in accordance with the provisions set forth in the Trench Excavators Act. As discussed previous the footing may be constructed along with the double concrete box culvert required for the Mimico Creek diversion, so that a common excavation could be utilized.

The spread footings - culvert excavation will be located anywhere from 5 to 10 feet below the groundwater level recorded during the period of the investigation. The excavation will be carried out in a relatively impervious glacial till, therefore, no major dewatering problems are anticipated. The subsurface investigation has indicated that occasional random water bearing sand and gravel layers are located within the cohesive glacial till. If the excavation intersects such zones some groundwater seepage can be expected. This could be handled using conventional techniques, such as pumping from sumps. If these isolated granular zones are encountered at the footing founding level "boiling" may develop in these zones due to the unbalanced hydrostatic groundwater pressure head. This would reduce the bearing capacity of this portion of the foundation subsoil. In this regard it is recommended that all isolated granular zones encountered at footing level, be completely

subexcavated. The subexcavation should then be brought up to grade using mass concrete.

The foundation subsoil will settle due to the imposed foundation loading. The subsoil is composed of a competent cohesive glacial till, thus the settlement will be of a recompression nature. For a spread footing foundation, of the size contemplated, imposing the aforementioned pressure, it is estimated that the settlement will not exceed 3/4 inch, provided the subsoil is not softened by groundwater seepage or uncontrolled surface runoff. It may be advantageous to protect the subsoil, at the footing foundation level, by covering it with a lean concrete working slab immediately after completion of the excavation.

ii) Deep Foundation Support:

As an alternative the piers could be founded on end-bearing piles driven to practical refusal within the lower portion of the glacial till deposit. Under these circumstances the pile caps could be located at a relatively high elevation in the fill placed to form the Goreway Dr. extension. In any event, 4 feet of earth cover should be provided above the underside of the pile caps for frost protection purposes. The pile driving in the field should be controlled by employing the Hiley Dynamic Pile Driving Formula. For estimating purposes it can be assumed that the full capacity of the piles will be realized at the tip elevations quoted below:

<u>Pier</u>	<u>Estimated Pile Tip Elev.</u>	<u>Refer to</u>
South	485 to 490	B.H.'s #9 and 10
North	475 to 480	B.H.'s #14 and 15

Piles driven as recommended could be designed for the ultimate capacity of the pile section chosen (e.g. 12BP74 steel H-piles can be designed using an allowable load of 95 tons/pile). No rock or bouldery fill should be placed in areas where piles are to be driven.

In some areas the end bearing piles may be located in

close proximity to the culvert structure. In these instances some complications may develop during the pile driving. If this proves to be the case consideration could be given to founding the piers on caissons located in the glacial till as outlined in the table to follow:

<u>Pier</u>	<u>Estimated Base Elev. of Caisson</u>
South	490
North	490 (West End) to 480 (East End)

Caissons could be installed through the denser portions of the glacial till using churn drilling operations. The allowable bearing pressure of the caissons will be dependent on the diameter adopted. For preliminary estimating purposes an allowable load of 200 tons per caisson can be used in designing a 30 inch diameter installation.

As noted on the individual borelog sheets some water bearing granular layers are present within the glacial till. If these are intercepted some seepage may occur in the caisson with subsequent loss of ground. In order to ensure the integrity of the caisson, under these circumstances, it may be necessary to place tremie concrete under water in the lower portion of the unit.

#### 6.3.2) Abutments:

The abutments for this structure can be 'perched' within the approach fills and supported on end-bearing piles driven to either practical refusal within the hard cohesive glacial till stratum or alternatively to bedrock. The pile driving in the field should be controlled by employing the Hiley Dynamic Pile Driving Formula. For estimating purposes it can be assumed that the design capacity of the piles will be realized at the tip elevations presented below:

<u>Abutment Location</u>	<u>Estimated Tip Elevation</u>
South	480 to 485
North	475 to 480

The approach fills will induce some settlement in the glacial till subsoil. This settlement will place a negative skin frictional load on the piling sections employed. This effect will have to be taken into consideration when designing the piles, this could be accomplished by using a design capacity equivalent to approximately 85 percent of the ultimate capacity of the pile section chosen. For example, 12 BP 74 steel H-piles could be designed using an allowable load of 80 tons/pile.

No bouldery or rock fill should be placed in areas where piles are to be driven.

#### 6.4) Approaches:

As discussed previously, common approaches will be constructed to the twin Hwy. #427 structures, as well as the ramp N-Belfied-E structure. The clear height of the approaches will vary from 34 to 52 feet in the longitudinal and transverse directions, respectively. To realize these grades fills up to 50 feet in height will have to be placed. Under the proposed scheme side slopes ranging from 2:1 to 3:1 are to be employed, in addition provisions have been made to allow for berms (maximum 20 feet in length) in some of the more critical areas. It is understood that a locally available cohesive type of material will be used as fill.

Recommendations pertaining to the placement and compaction of the cohesive fill, as well as the stability of the critical embankment fill sections in this complex are presented in detail in the report for the twin Hwy. #427 structures (W.O. 72-11002).

Also included in Report W.O. 72-11002 is an estimate of the magnitude and time-rate of settlement to be expected in the glacial till due to the load application.

#### 7. MISCELLANEOUS:

The field work for this project was carried out during the period of January 17 to 21, 1972, under the supervision of Mr. V. Korlu, Project Foundations Engineer.

The drilling equipment was owned and operated by Master Soil Investigation Ltd., Toronto.

This report was written by Mr. S. A. Ahmad, Project Foundations Engineer and reviewed by Mr. M. Devata, Supervising Foundations Engineer.

*Shahen Ahmad*

S. A. Ahmad, P. Eng.



*M. Devata*

M. Devata, P. Eng.

SAA/ao  
May 4, 1972.



APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 72-11003 LOCATION Co-ords. 15,879,005 N; 970,717 E. ORIGINATED BY VK  
W.P. 48-71-11 BORING DATE Jan. 18, 1972 COMPILED BY TST  
DATUM Geodetic BOREHOLE TYPE Pen Drill & Cone Test CHECKED BY *SK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
518.4	Ground Level															
0.0	Het. mix. of clayey silt, sand and occ. gravel.		1	SS	20											
			2	SS	29											
			3	SS	28	510										
	Very Stiff to Hard		4	SS	40											
			5	SS	27											
	Glacial Till		6	SS	49	500										
			7	SS	101											
			8	SS	31											
			9	SS	100/6"	490										
			10	SS	76/6"											
			11	SS	60/3"	480										
472.9			12	SS	90/3"											
45.5	Shale Bedrock		13	BXL	100%	470										
467.9	Sound		14	RC	100%											
50.5	End of Borehole															

506.5  
8-31-45 16

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

## FOUNDATION SECTION

JOB 72-11003

LOCATION Co-ords. 15,879,007 N; 970,654 E.

ORIGINATED BY VK

W.P. 48-71-11

BORING DATE Jan. 17, 1972

COMPILED BY TST

DATUM Geodetic

BOREHOLE TYPE Penn Drill & Cone Test

CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— $w_L$	BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— $w_p$			WATER CONTENT ——— $w$
							SHEAR STRENGTH P.S.F.	$w_p$ ——— $w$ ——— $w_L$	WATER CONTENT %		
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
526.0	Ground Level										
0.0	Het. mix. of clayey silt sand and gravel.		1	SS	25	520					
			2	SS	61						
	Very Stiff - Hard		3	SS	46						
			4	SS	21						
	Glacial Till		5	SS	16	510					
			6	SS	47						
			7	SS	72						
			8	SS	81	500					
			9	SS	128						
			10	SS	68	490					
			11	SS	98						
479.5			12	SS	60/6"						
46.5	End of Borehole					480					

## FOUNDATION SECTION

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$		BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT		PLASTIC LIMIT — $w_p$				
							20	40	60	80			100
							SHEAR STRENGTH P.S.F.		WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		$w_p$ — $w$ — $w_L$				
									10 20 30				
512.5	Ground Level												
0.0	Het. mix. of clayey silt and sand		1	SS	7	510						0 18 67 15	
	Stiff - Hard		2	SS	9								506.5
	Glacial Till		3	SS	14								
			4	SS	74	500							
	Sand and Gravel		5	SS	100	3"							40 28 24 8
			6	SS	100	4"							
			7	SS	161		490						
485.7			8	SS	100	4"							
26.5	End of Borehole												
						480							

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 72-11003 LOCATION Co-ords. 15,879,062 N; 970,636 E. ORIGINATED BY VK  
W.P. 48-71-11 BORING DATE Jan. 19, 1972 COMPILED BY TST  
DATUM Geodetic BOREHOLE TYPE Penn Drill & Cone Test CHECKED BY *SK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_P$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$		
513.5	Ground Level															
0.0	Het. mix. of clayey silt, sand & gravel		1	SS	17	510										
			2	SS	112											
	Very Stiff - Hard		3	SS	30											
	Glacial Till		4	SS	46	500										
			5	SS	38											
			6	SS	78											
			7	SS	93	490										
	<del>Sand and Gravel</del>		8	SS	69/76"											
			9	SS	90/41"	480										
			10	SS	61/3"											
			11	SS	60/3"	470										
468.4	with shale frags.		12	SS	100/41"											
45.1	Shale Bedrock															
463.0	Sound		13	BXL	100%											
50.5	End of Borehole															

4 33 53 10  
506.

19 36 35 10

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 14

## FOUNDATION SECTION

JOB 72-11003

LOCATION Co-ords. 15,879,120 N; 970,675 E.

ORIGINATED BY VK

W.P. 48-71-11

BORING DATE Jan. 21, 1972

COMPILED BY TST

DATUM Geodetic

BOREHOLE TYPE Penn Drill & Cone Test

CHECKED BY *AK*

[illegible]



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 19

FOUNDATION SECTION

JOB 72-11003 LOCATION Co-ords. 15,879,195 N; 970.657 E.

ORIGINATED BY VK

W.P. 48-71-11 BORING DATE Jan.17,1972

COMPILED BY TST

DATUM Geodetic BOREHOLE TYPE Diamond Drill & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT %			
509.5	Ground Level											
0.0	Het. mix. of clayey silt, sand & gravel.		1	SS	27							
			2	SS	79							
	Very Stiff - Hard		3	SS	76	500						
	Glacial Till		4	SS	69							
			5	SS	61							
			6	SS	25	490						
			7	SS	35							
	Sand Seam		8	SS	42							
			9	SS	110	480						
476.2			10	SS	112/9"							
33.3	End of Borehole Probable Bedrock					470						

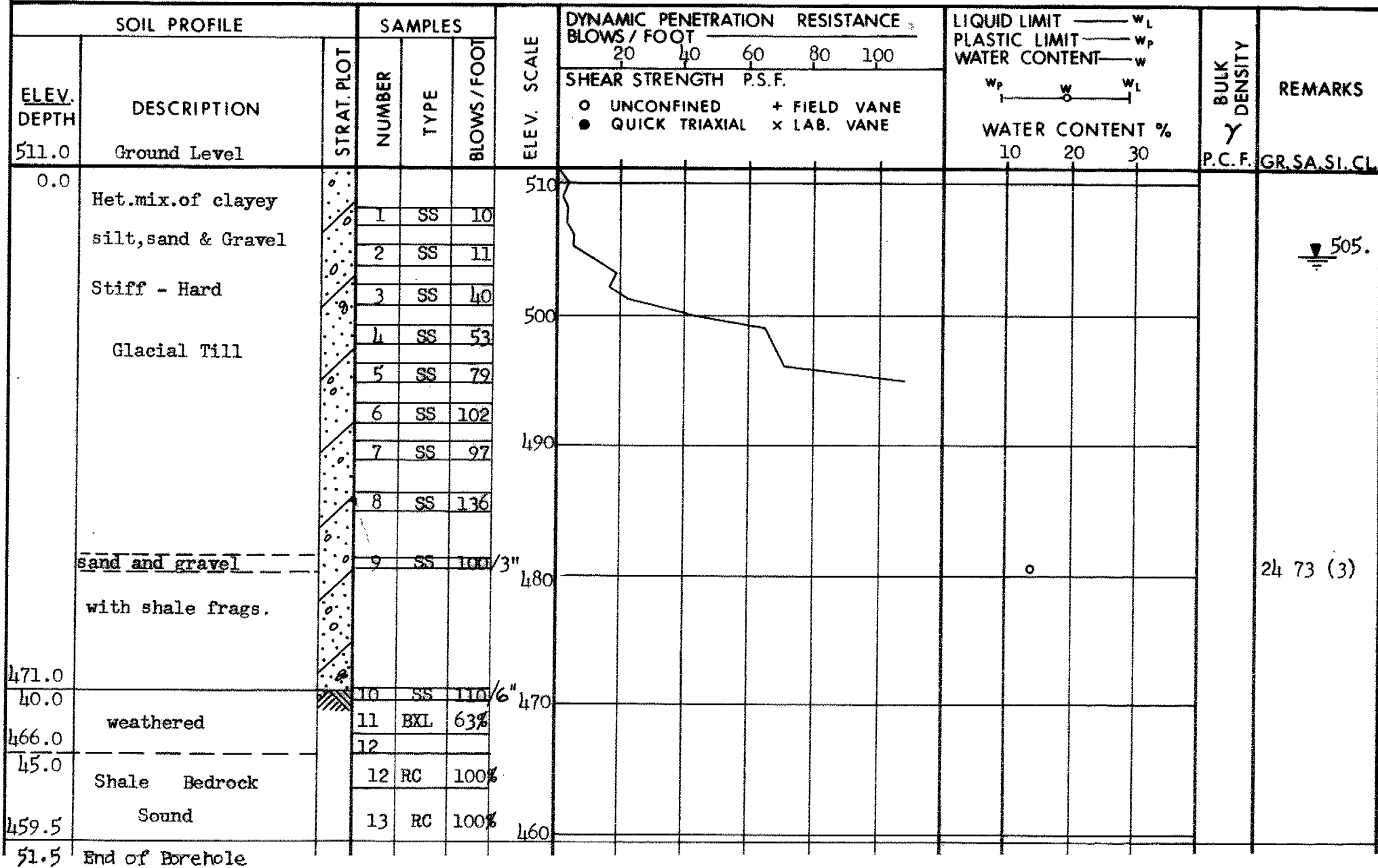


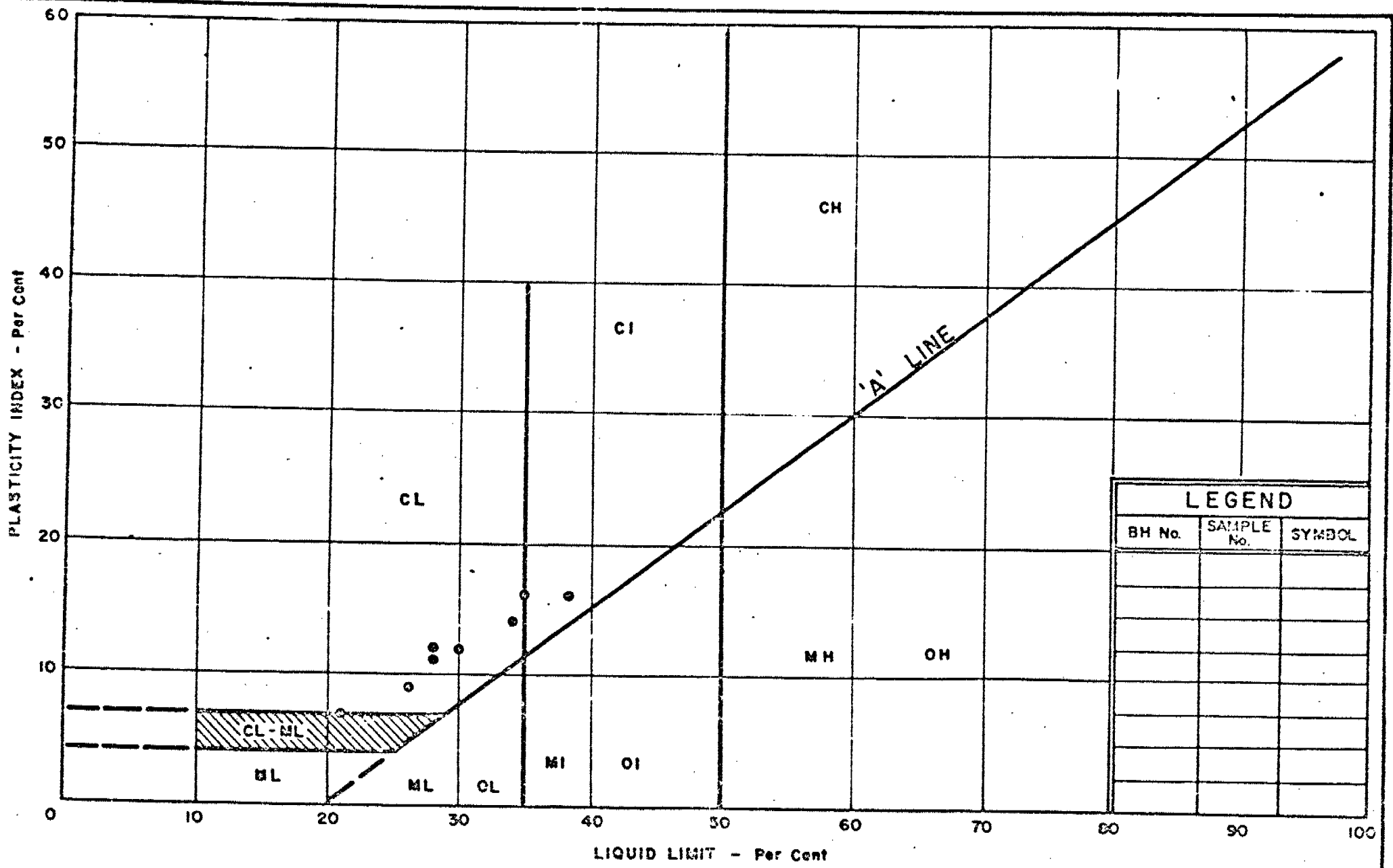
DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

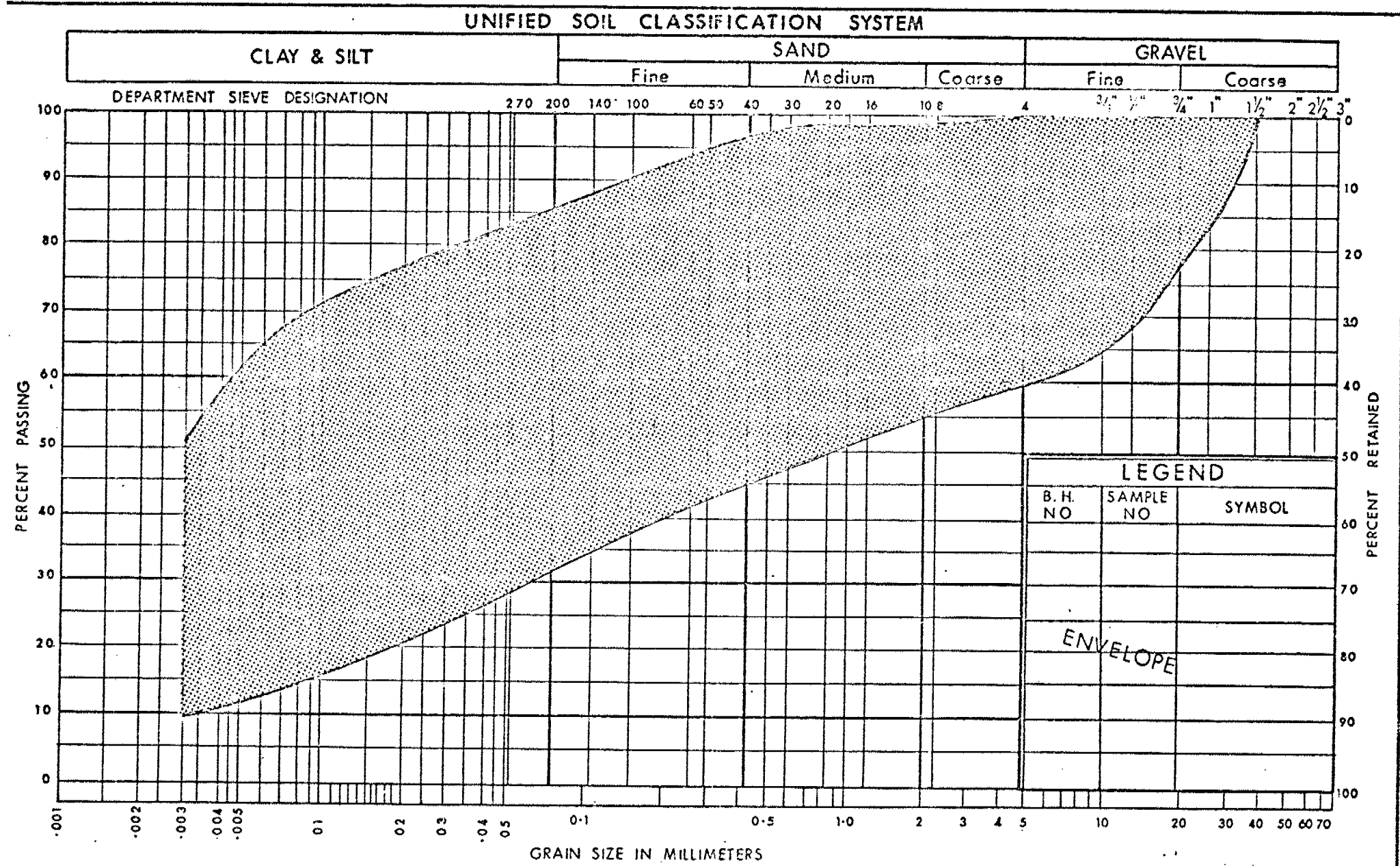
RECORD OF BOREHOLE No. 20

FOUNDATION SECTION

JOB 72-11003 LOCATION Co-ords. 15,879,196 N; 970,593 E. ORIGINATED BY VK  
W.P. 48-71-11 BORING DATE Jan 1972 COMPILED BY TST  
DATUM Geodetic BOREHOLE TYPE Diamond Drill & Cone Test CHECKED BY [Signature]







## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
s	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
$I_c$	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
$c_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	$= 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

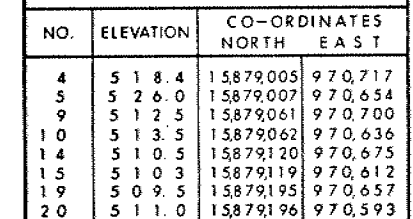
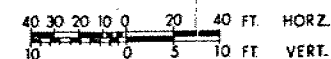
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

APPROVED *[Signature]* CONT. NO. \_\_\_\_\_

