

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-132

DIST. 6 REGION

W.P. No. ~~165~~ 156-75-04

CONT. No. 81-50

W. O. No.

STR. SITE No. 24-439

HWY. No. 403

LOCATION Mavis Rd. Underpass

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ontario

Ministry of
Transportation and
Communications

Other maps
at back →

GENERAL NOTES

CLASS OF CONCRETE
DECK 5000 P.S.I.
PIER COLUMNS & BARRIER WALLS 4000 P.S.I.
REMAINDER 3000 P.S.I.

REINFORCING STEEL GRADE 40
REINFORCING BARS WITH DESIGNATION C-11
END OF BAR MARKS SHALL BE COATED BARS

CLEAR COVER TO REINFORCING STEEL
FOOTINGS & ABUTMENTS 12"
PIER COLUMNS 12"
DECK TOP 12"
DECK BOTTOM 12"
APPROACH SLABS 12"
AND AS NOTED IN DRAWING

CONSTRUCTION NOTES

THE CONTRACTOR SHALL FINISH THE
BEARING SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATIONS WITH A TOLERANCE
OF 1/8"
NO CONCRETE SHALL BE PLACED ABOVE
THE ABUTMENT BEARING SEATS UNTIL
THE CONCRETE IN THE DECK HAS BEEN
PLACED, STRESSED AND GROUTED

LIST OF DRAWINGS

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

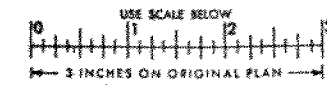
CONCRETE QUANTITIES

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

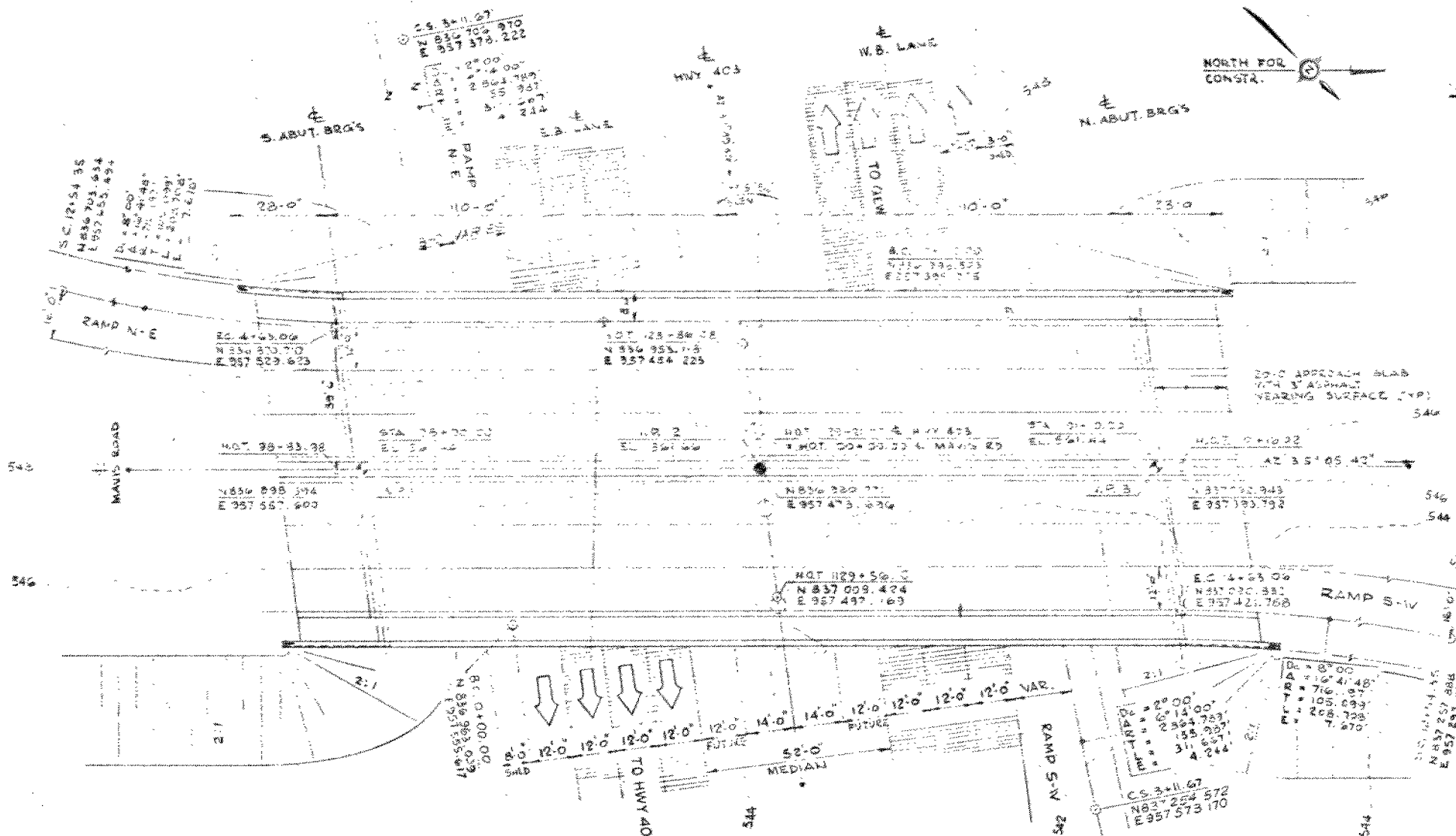
1. CONCRETE IN PIERS, ABUTMENTS AND
WINGWALLS 3000 P.S.I. 476 CY
4000 P.S.I. 35 CY
2. PRESTRESSED CONCRETE BRIDGE
DECK 2379 CY
3. CONCRETE IN BARRIER WALLS 42 CY
4. CONCRETE IN APPROACH SLABS 116 CY
5. CONCRETE IN SLOPE PAVING 68 CY



FOR REDUCED PLAN



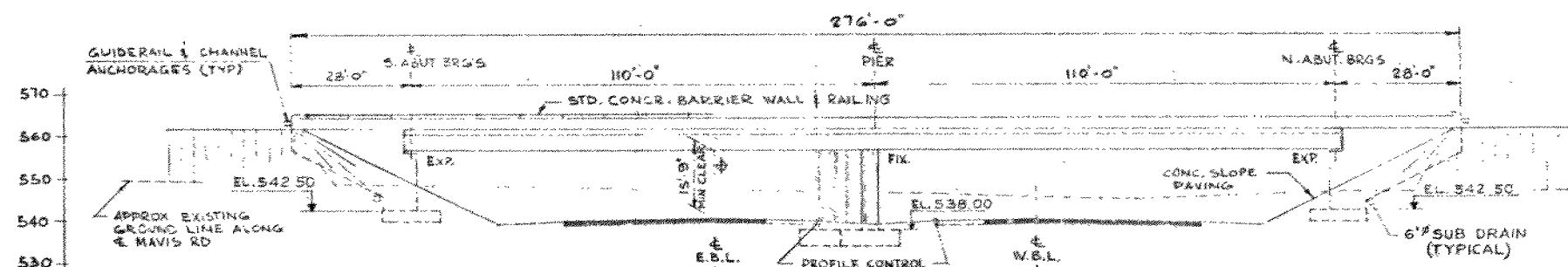
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING	45 30-21
DRAWING	CHECK	SITE	24-155 DWG



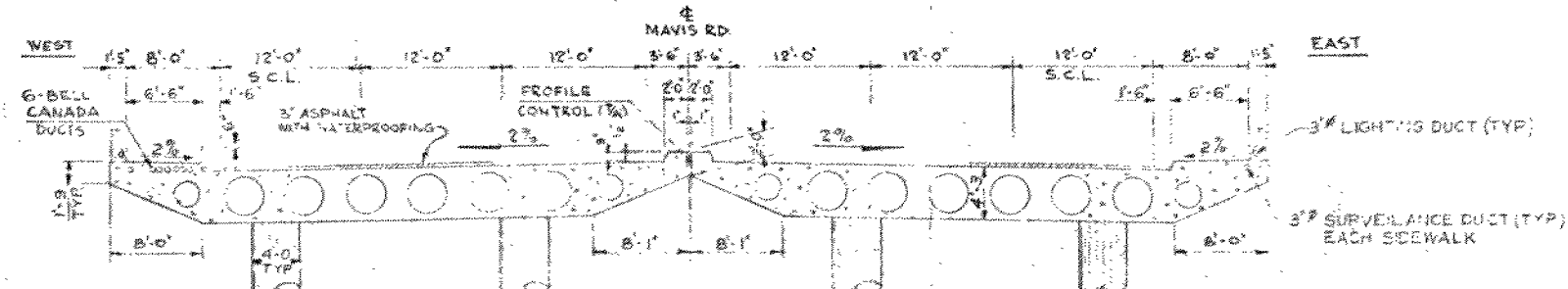
PLAN
SCALE: 1" = 20'-0"

- NOTES
- 1) W.P. DENOTES WORKING POINT
 - 2) REFER TO GRADING DRAWINGS FOR
CATCH BASINS OFF STRUCTURE

SKIEW
SIN. 0.1264683
COS. 0.9919707
TAN. 0.1274920



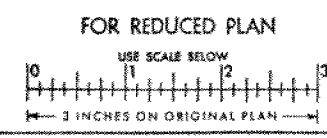
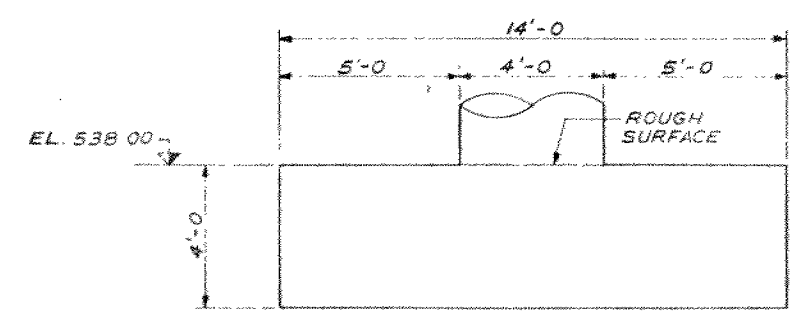
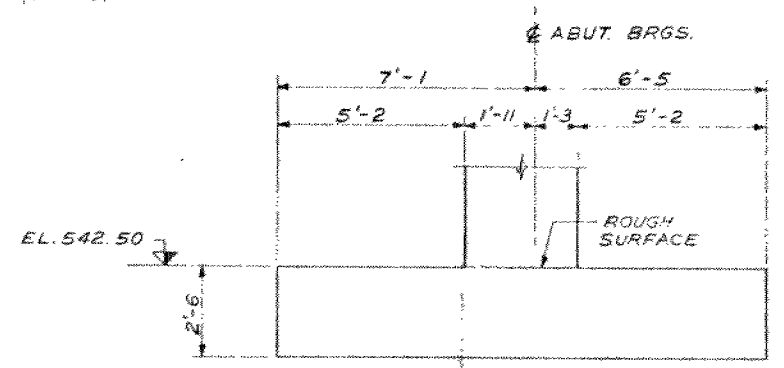
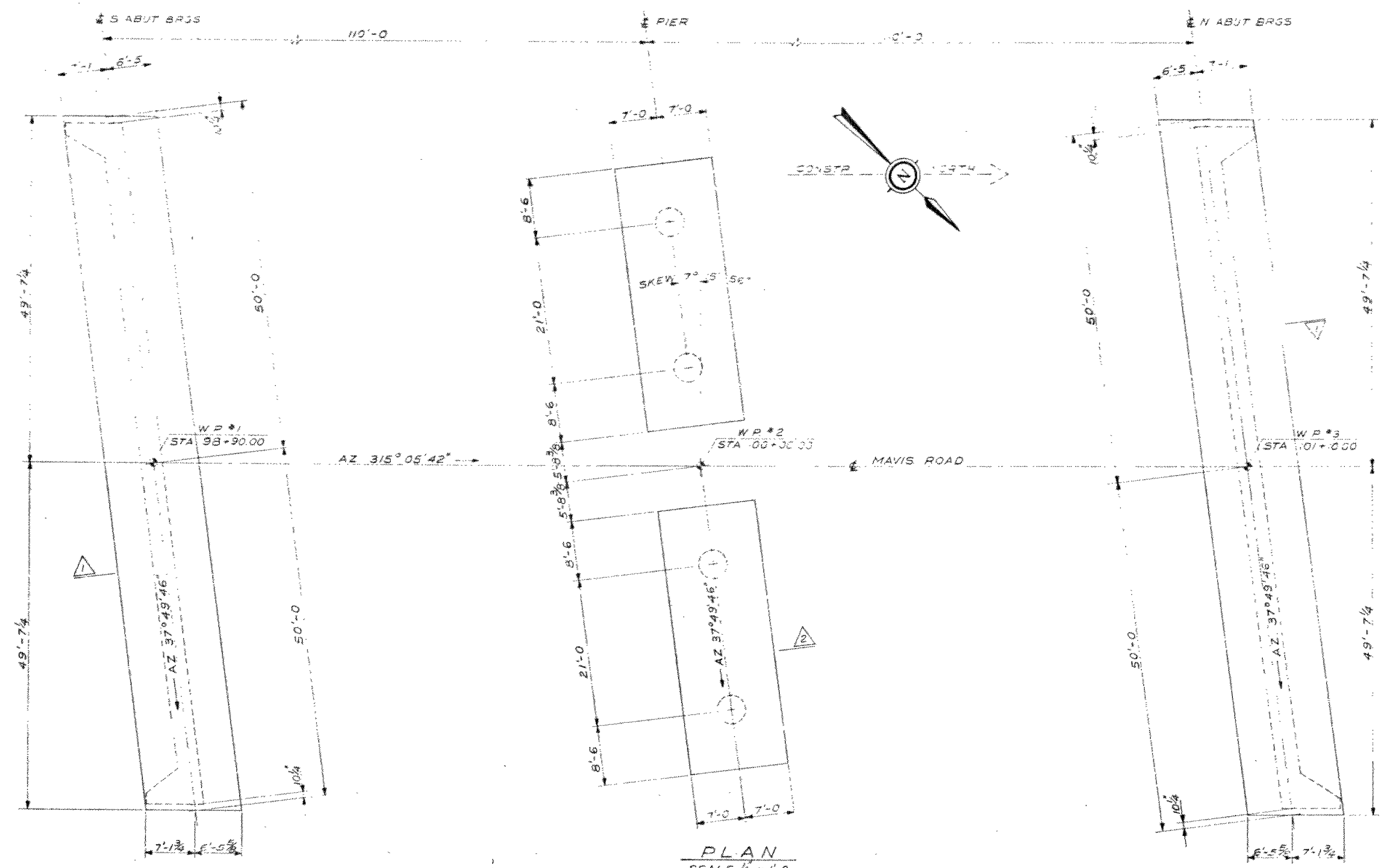
ELEVATION
SCALE: 1" = 20'-0"



TYP. DECK SECTION
SCALE: 1/8" = 1'-0"

COORDINATES

N.P.	NORTH	EAST
1	836322.660	337559.343
2	836380.771	337475.626
3	837052.662	337338.243



REVISIONS

NO.	DATE	BY	DESCRIPTION
1			DESIGN / K
2			CHECK S.S.
3			LOADING
4			DATE
5			DWG

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 81-50



Ministry of
Transportation and
Communications



INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3- 36	Foundation Investigation Reports For W.P. 156-75-04 Mavis Road Underpass W.P. 156-75-05 CPR Subway East of Credit River

NOTE: For purposes of the contract these reports
supercede all other foundation reports prepared
by or for the Ministry in connection with the
above mentioned projects.

'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. $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ 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
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{w_L - w_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_P}$
 A_c ACTIVITY = $\frac{I_P}{w_L - w_P}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(undisturbed)}{S_u(remoulded)}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_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
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν 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:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = 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
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

For

Mavis Road Underpass
W.P. 156-75-04, Site 24-439
Hwy. 403, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of July 21-26, 1978. The fieldwork consisted of 6 sampled boreholes advanced by means of a continuous flight auger machine equipped with solid and hollow stem augers. In addition, diamond drilling techniques were employed to obtain BXL size core of the bedrock. The boreholes ranged in depth from 25 to 33 feet below the ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about 2 miles west of Hwy. 10 and 1 mile north of Burnhamthorpe Road in the City of Mississauga, Regional Municipality of Peel.

The land immediately adjacent to the site has a gentle topography and is used for farming. Physiographically the site is situated in the border region of "Peel Plain" and "South Slope". The characteristic deposit in the vicinity of the area under investigation is composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock of Meaford, Dundas formation, Ordovician Period.

SUBSURFACE CONDITIONS

General

Surficial deposits over the site are variable, consisting of two distinct strata; a shallow surficial layer of clayey silt with some sand and traces of gravel and organics ranging in thickness from 5.0 feet to 8.0 feet and a more extensive surficial deposit of silt with seams of clay ranging from 10.0 feet to 14.0

feet. Underlying the surficial clayey silt deposit and generally overlying bedrock is a stratum of silty sand with gravel and trace of clay explored for depths of 11.5 feet to 16.5 feet. Underlying the surficial deposit of silt with seams of clay and immediately above bedrock is a clayey silt stratum with occasional seams of silt, sand and gravel. Bedrock consisting of interbedded shales and limestones was encountered below these final two strata.

The boundaries between the various soil types are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on borehole data, is shown on Contract Drawing #24-439-2.

The various subsoil types encountered are briefly described in the following paragraphs

Clayey Silt, Some Sand, Trace Gravel (Surficial)

The primary surficial deposit overlying the majority of the site consists of a clayey silt, some sand, trace of gravel, ranging in depths from 5.0 feet to 8.0 feet. In 3 of the 4 boreholes, where this stratum was penetrated, organics, ranging in percentage content by weight from 0.2% to 0.87%, were well dispersed. Composition of the components of this cohesive stratum are shown in the grain size distribution chart in Figure 1. Typical Atterberg Limits and identity indices performed on selected representative samples are summarized in the following table and plotted on the plasticity chart, Figure 2.

		<u>Range</u>	<u>Average</u>
Moisture Content	(W) %	14-20	17
Liquid Limit	(W _L) %	22-32	24
Plastic Limit	(W _p) %	16-18	17
Plasticity Index	(I _p) %	6-15.5	11

These results indicate the deposit to be generally a clayey silt of low plasticity (CL).

Standard Penetration Test 'N' values range from 9 blows per foot to 33 blows per foot, with the majority being in the order of

10 blows per foot. The consistency of this surficial stratum based on these values may be considered as firm to stiff.

Silt With Seams of Clay

Overlying the remainder of the site is a deposit of well graded silt with seams of clay, which was penetrated to a maximum depth of 14.0 feet. A plot of grain size distribution is shown in an envelope form on Figure 1. The 'N' values ranged from as low as 17 blows per foot to as high as 90 blows per foot, indicating a relative density for this deposit which varies from compact to very dense.

Silty Sand With Gravel

Generally, underlying the surficial cohesive stratum and overlying bedrock is a deposit of silty sand with gravel and trace of clay. The deposit was found to range in thickness from 11.5 feet to 16.5 feet. Grain size distribution curves for this material are shown on Figure 3. The 'N' values range from 41 blows per foot to in excess of 100 blows per foot, indicating a relative density for this stratum ranging from dense to very dense, but generally very dense.

Clayey Silt

A clayey silt stratum with occasional sand seams and cobbles was found to underlie the surficial non-cohesive stratum at the site. This deposit was penetrated to a maximum thickness of 14.0 feet and found to overlie bedrock at the site. The clayey silt interrupted by silt seams was also encountered for a depth of 7.0 feet in Borehole No. 3.

A plot of grain size distribution curves obtained from representative samples are shown on Figure 4.

Typical Atterberg Limits and identity indices performed on selected representative samples are summarized in the following table and plotted on the plasticity chart, Figure 2.

		<u>Range</u>	<u>Average</u>
Moisture Content	(W) %	21-30	25
Liquid Limit	(W _L) %	24-29	27
Plastic Limit	(W _p) %	17-20	18
Plasticity Index	(I _p) %	7-10	9

These results indicate the material to be an inorganic clayey silt of low plasticity (CL).

The 'N' values range from 11 blows per foot to 100+ blows per foot, indicating a consistency range from stiff to hard, but generally very stiff in nature.

Bedrock

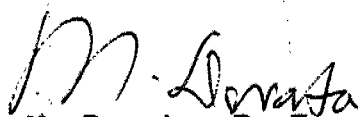
Bedrock consisting of interbedded fossiliferous limestone and fissile shales, was found to vary from elevation 522.4 to elevation 526.0 over the site. These elevations would indicate that bedrock is sloping at a shallow angle to the south in the area. Generally, bedrock can be assumed sound, with localized weathered zones ranging in the upper 6 to 18 inches of the strata.

Groundwater

Overnight groundwater level readings taken in open boreholes during the period of investigation indicated water elevations ranging from elevation 543.6 to elevation 541.3 which corresponds to depths of approximately 7.0+ feet over the site.



M. MacLean, P. Eng.
Project Foundations Engineer



M. Devata, P. Eng.
Sr. Foundations Engineer


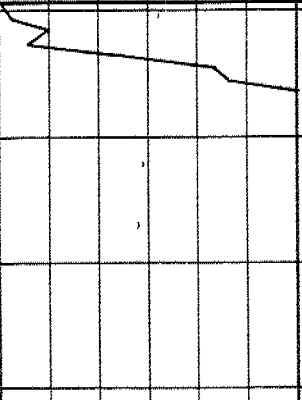
APPENDIX



RECORD OF BOREHOLE No 1

8

W P 156-75-04 LOCATION Coords. N 15,836,862; E 957,526 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 21, 1978 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH		Wp W WL				
							○ UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL x LAB VANE							
550.6	Ground Level									10 20 30			GR SA SI CL	
0.0	Silt With Seams of Clay		1	SS	29		550						0 0 84 16	
			2	SS	58		540							
			3	SS	90									
536.6	Brown - Grey Compact to Very Dense		4	SS	33									
14.0	Clayey Silt With Occasional Seams of Sand & Occasional Boulders		5	SS	27		530							0 0 87 13
	Very Stiff to Hard		6	SS	1007		5"							Case & Wash Hole 19.7 to 28.2 ft.
				BXL										
522.4														
28.2	Limestone Bedrock Interbedded With Shale, Sound			BXL	100% Rec		520							
517.4														
33.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 3

9

W P 156-75-04 LOCATION Coords. N 15,836,924; E 957,588 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" H.S.M.V. & Solid Stem, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 26, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
547.4	Ground Level																
0.0	Clayey Silt With Some Sand & Traces of Gravel & Organics, Stiff		1	SS	9											Org. 0.2%	4 15 66 15
542.4			2	SS	32												0 0 90 10
5.0	Silt With Seams of Clay Brown Grey		3	SS	18												
	Loose to Dense		4	SS	25												
530.4			5	SS	19												
17.0	Clayey Silt With Seams of Silt		6	SS	16												0 0 80 20
523.4	Very Stiff																
24.0	Weathered - Interbedded Shale & Limestone Bedrock			BXL	100% Rec												
518.4	Sound																
29.0	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

10

W P 156-75-04 LOCATION Coords. N 15,836,948; E 957,442 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 24, 1978 CHECKED BY

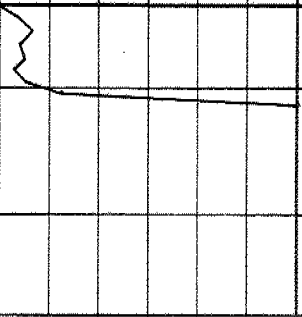
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
549.6	Ground Level													
0.0	Clayey Silt With Some Sand and Traces of Gravel and Organics Firm		1	SS	9								0.87%	2 14 64 20
541.6			2	SS	11									
8.0	Silty Sand With Gravel and Trace of Clay		3	SS	79		540							41 33 21 5
	Brown		4	SS	100	6"								
	Grey		5	SS	80									
	Very Dense		6	SS	117		530							30 38 27 5
525.1														
24.5	Interbedded Shale and Limestone				100%									
520.1	Bedrock, Sound			BXL	Rec									
29.5	End of Borehole													



RECORD OF BOREHOLE No 6

11

W P 156-75-04 LOCATION Coords. N 15,837,015; E 957,510 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 25, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							SHEAR STRENGTH
546.5	Ground Level													GR SA SI CL	
0.0	Clayey Silt With Some Sand & Traces of Gravel & Organics, Stiff		1	SS	10								Org. 0.27%	4 13 61 22	
541.5			2	SS	61										43 36 25 6
5.0	Silty Sand With Gravel and Trace of Clay		3	SS	41										
	Very Dense		4	SS	73										39 28 27 6
			5	SS	145										
			6	SS	100/6"										28 64 6 2
526.0															
20.5	Weathered Limestone Bedrock			BXL	100% Rec										
521.7	Interbedded With Shale														
24.8	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

12

W P 156-75-04 LOCATION Coords. N 15,837.031; E 957.356 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 25, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
548.0	Ground Level												
0.0	Silt With Seams of Clay Compact		1	SS	17								0 0 85 15
			2	SS	29								
538.0	Brown		3	SS	30								0 0 84 16
10.0	Grey		4	SS	17								
	Clayey Silt		5	SS	11								0 0 86 14
			6	SS	72								
524.9	Stiff to Hard												
23.1	Interbedded Shale & Limestone Bedrock			BXL	100% Rec								
519.7	Sound												
28.3	End of Borehole												

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



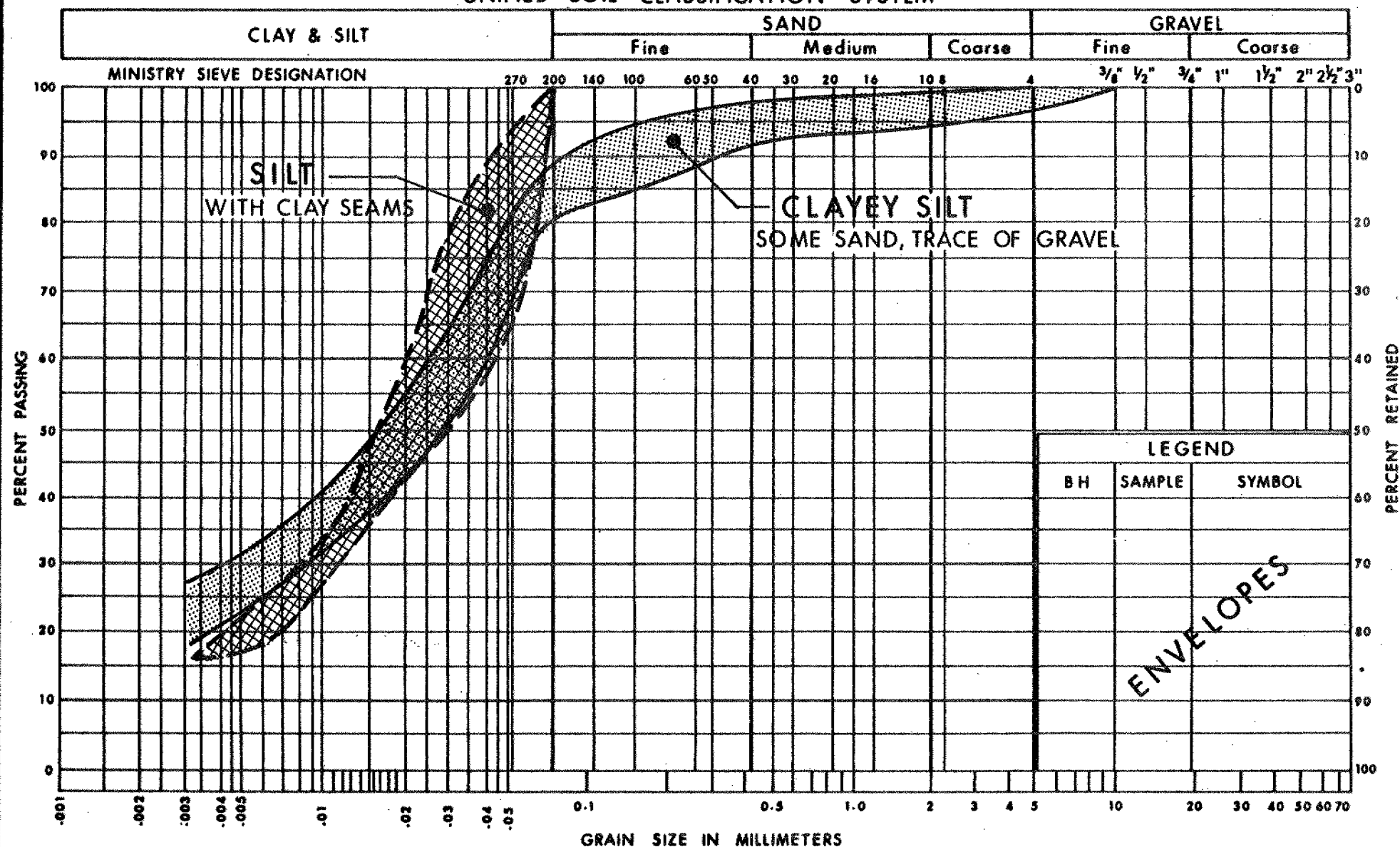
RECORD OF BOREHOLE No 9

13

W P 156-75-04 LOCATION Coords. N 15,837,100; E 957,425 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3/4" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 25, 1978 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100						
545.5	Ground Level												GR SA SI CL
0.0	Clayey Silt With Trace of Sand		1	SS	9								0 10 66 24
537.5	Stiff to Hard		2	SS	33								
8.0	Silty Sand With Gravel and Trace of Clay		3	SS	64								23 58 15 4
			4	SS	60								
	Very Dense		5	SS	68								54 34 10 2
526.0													
19.5	Limestone Bedrock Interbedded With				100%								
521.0	Shale. Sound				BXL Rec								
24.5	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

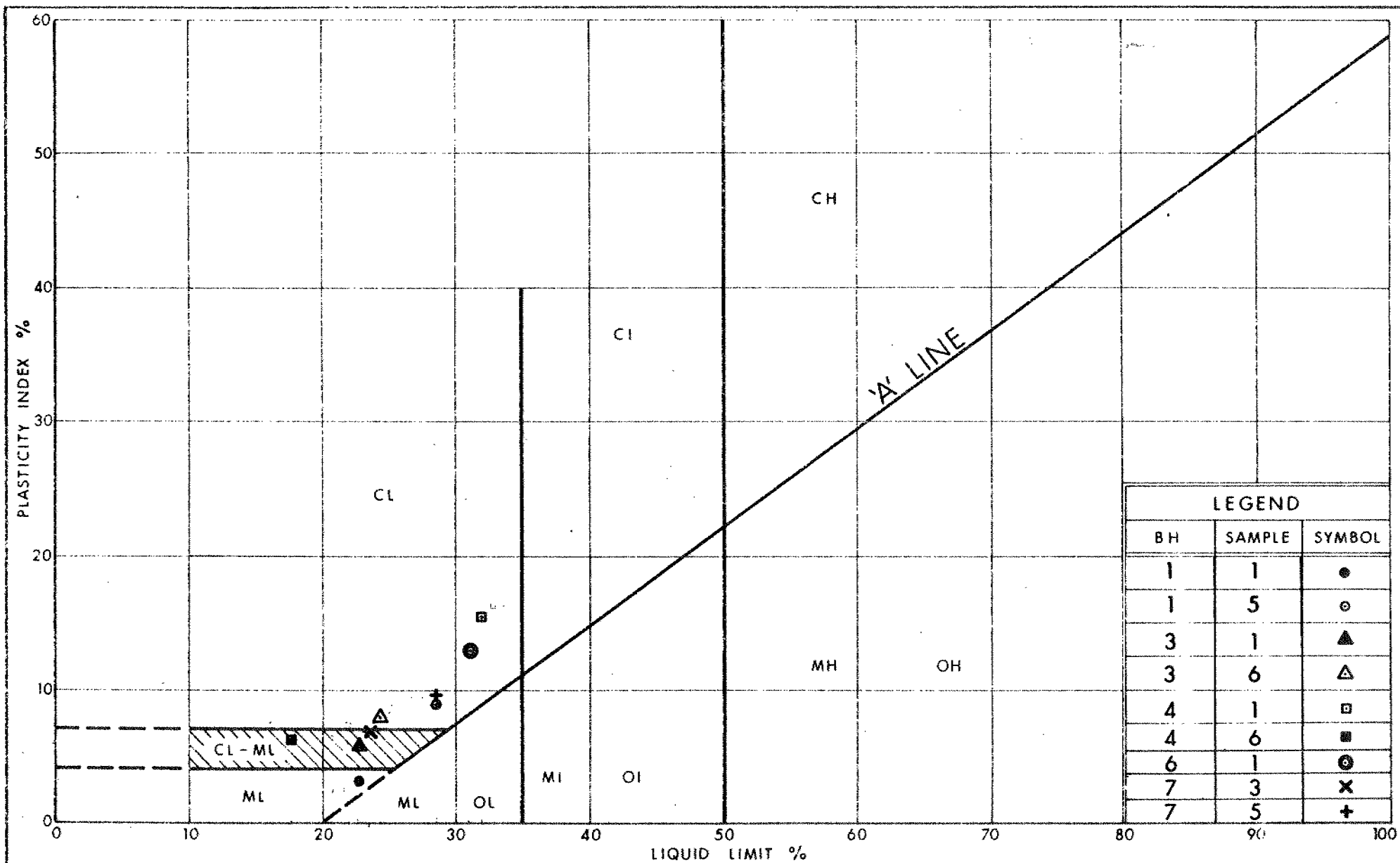


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GRAIN SIZE DISTRIBUTION SURFICIAL DEPOSITS

FIG No 1

W P 156 - 75 - 04



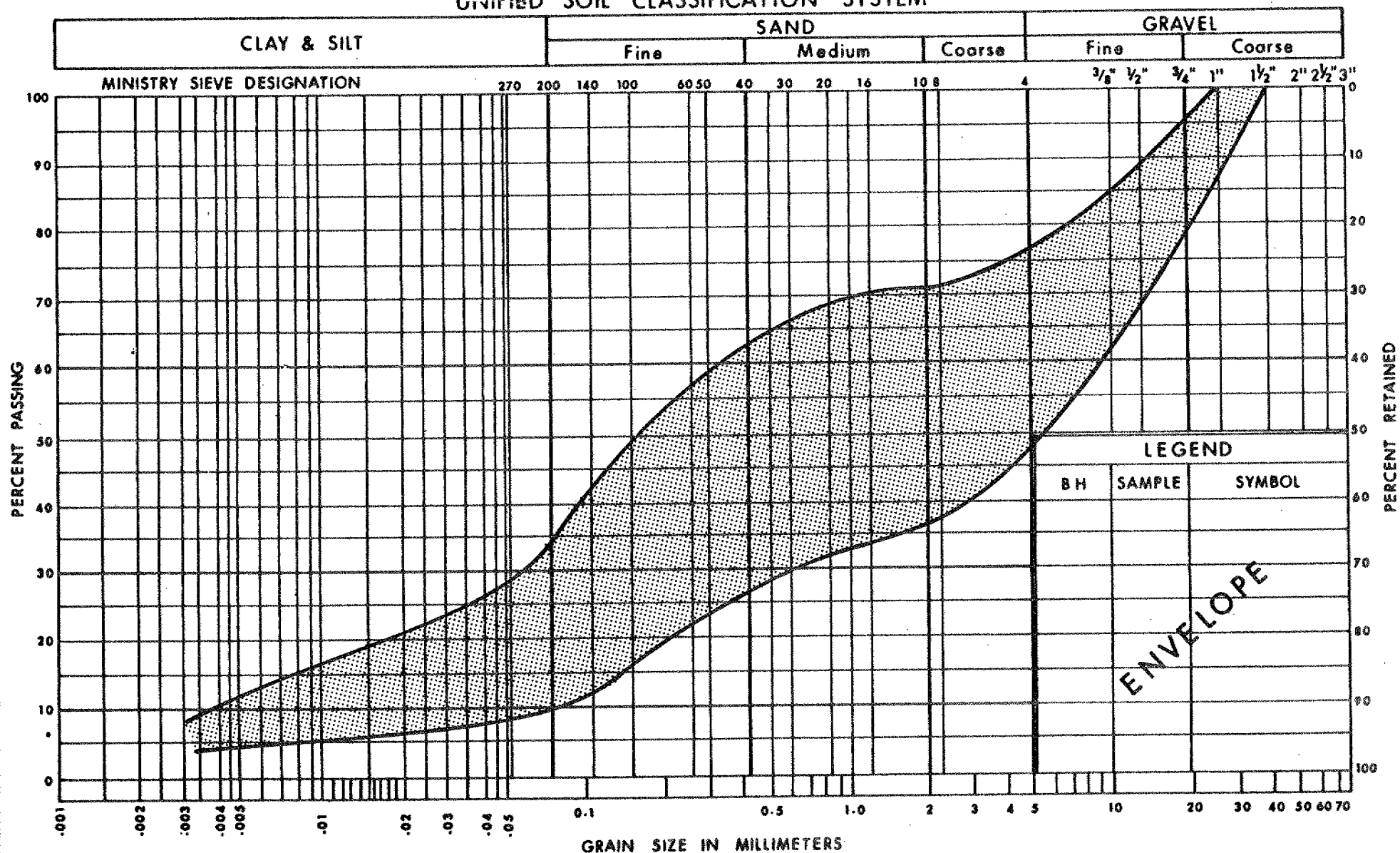
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PLASTICITY CHART CLAYEY SILT

FIG No 2

W P 156 - 75 - 04

UNIFIED SOIL CLASSIFICATION SYSTEM



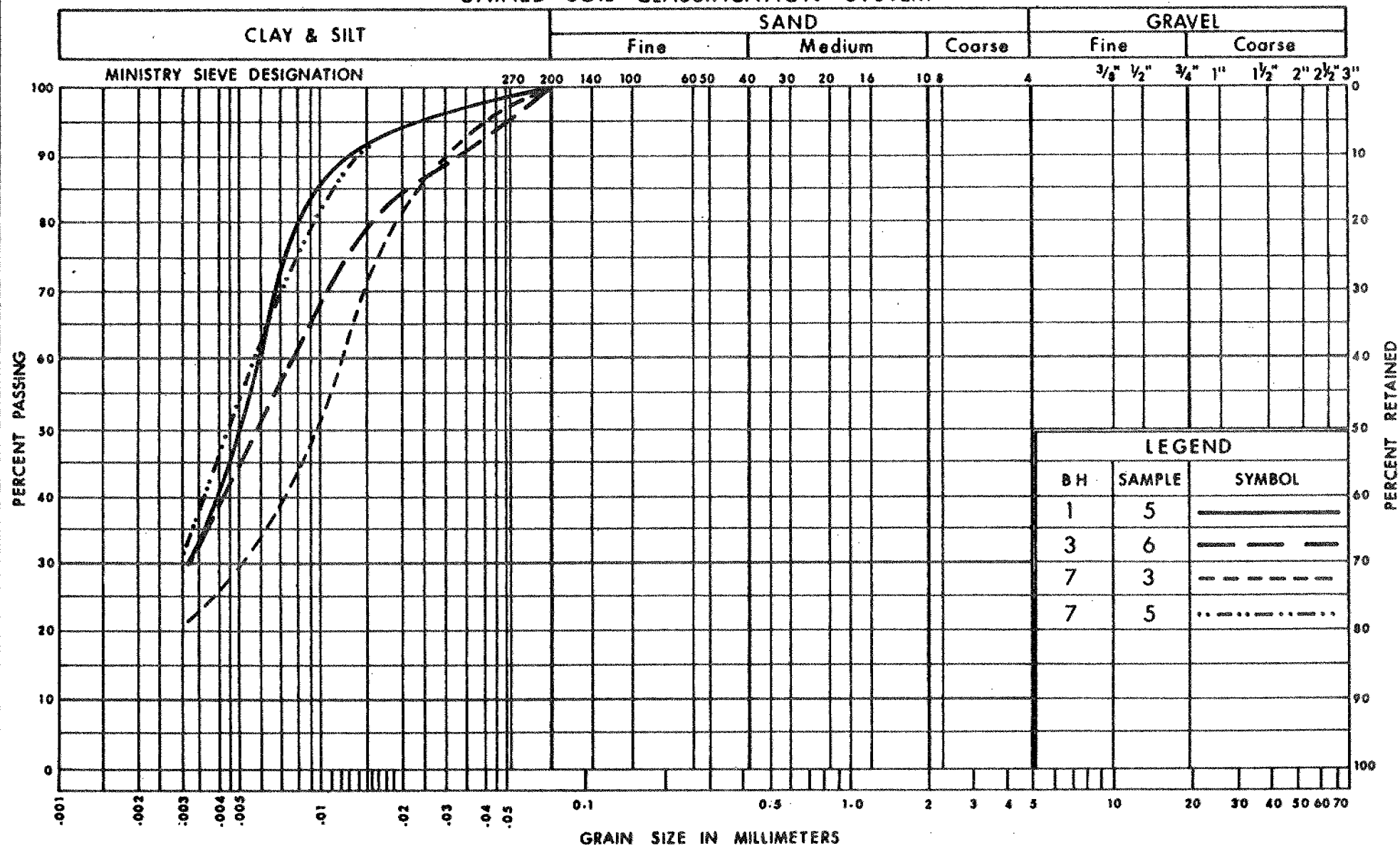
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GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH GRAVEL & TRACE OF CLAY

FIG No 3

WP 156-75-04

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
CLAYEY SILT

FIG No 4

WP 156 - 75 - 04

FOUNDATION INVESTIGATION REPORT

For

CPR Subway East of Credit River
W.P. 156-75-05, Site 24-369
Hwy. 403, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of September 6 to September 13, 1978. The fieldwork consisted of 10 sampled boreholes advanced by means of an auger machine which was equipped with solid and hollow stem continuous flight augers. In addition, diamond drilling techniques were employed to obtain BXL size rock core samples of the bedrock. The boreholes ranged in depth from 41.0 to 51.0 feet below ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about 1½ miles south of Eglinton Avenue and about one mile west of Creditview Road in the City of Mississauga, Regional Municipality of Peel.

The land immediately adjacent to the site has a gentle topography and is sloping down westward.

Physiographically the site is situated in the border region of the "Peel Plain" and the "South Slope". The characteristic deposit in the vicinity of the area under investigation is mainly a cohesive glacial till underlain by shale or limestone bedrock.

SUBSURFACE CONDITIONSGeneral

The subsurface conditions at this site were found to be generally uniform. Under a thin layer of topsoil the overburden material is a cohesive glacial till which was investigated to its full depth in all the boreholes. The overburden is underlain by

limestone bedrock. At one location the glacial till is overlain by a 7.5 foot thick layer of silt. A detailed description of the subsoil and bedrock conditions encountered in the investigation is given in the Record of Borehole Sheets. The estimated stratigraphical profile and sections shown on Contract Drawing No. 24-396-2 are based on this information. From ground level downwards the subsurface conditions are described as follows.

Silt

In one location in the north west portion of the site and immediately below ground surface the cohesive glacial till is overlain by a silt layer having a total thickness of 7.5 feet which appears to be a localized deposit. Based on one Standard Penetration 'N' value of 39 blows/foot it is estimated that the relative density of this surficial stratum is dense. One typical grain size distribution curve obtained from a sample of this material gave the following:

Sand 2%; Silt 89%; Clay 9%

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

Underlying a thin (maximum 12") layer of topsoil a deposit of cohesive glacial till was encountered at most locations over the site. The glacial till varies in thickness from 36 feet to 46.5 feet. The cohesive glacial till is composed of a heterogeneous mixture of clayey silt, sand and gravel. Occasional boulders and also seams of silt and sand were encountered within this deposit. The Standard Penetration Test 'N' values are generally in excess of 100 blows per foot with occasional values of 46 to 77 blows/foot indicating that the glacial till has a hard consistency. The physical properties of the glacial till as determined from laboratory testing are summarized below.

	<u>Range</u>
Liquid Limit (W _L)%	21-34
Plastic Limit (W _p)%	11-18
Moisture Content (W)%	5-13

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

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

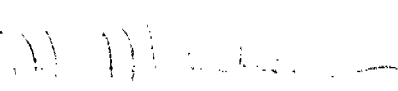
Bedrock (Limestone With Occasional Shale Seams)

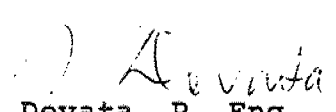
Bedrock was encountered immediately below the cohesive glacial till overburden. The bedrock was proven at all borehole locations (except B.H. #1) by obtaining BXL size rock core samples. The dominant type of bedrock encountered across the site is identified as medium hard limestone interbedded with occasional seams of shale.

The bedrock surface in the area investigated varies from elevation 433.5 to 442.8. The bedrock in general was found to be sound. However, in certain locations the upper 1 to 2 feet of the bedrock was found to be in a weathered condition. The recovery ratio was generally high, being close to 100% with few exceptions and the average RQD was found to be in the order of 30% to 50%.

Groundwater Conditions

The groundwater conditions were observed in the open boreholes during and after the completion of the foundation investigation. These observations indicate the boreholes were generally dry to their full depth except in one area (B.H. #8 and #9) where the water was observed some 23 to 29 feet below ground surface which corresponds to elevation 455 to elevation 451. It should be noted that in view of the impervious nature of the subsoil, the water levels may not have been stabilized during the short period of investigation.


M. MacLean, P. Eng.
Project Foundations Engineer


M. Devata, P. Eng.
Sr. Foundations Engineer

APPENDIX



RECORD OF BOREHOLE No 1

22

W P 156-75-05 LOCATION Coords. N 15,830,962; E 953,079 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 6, 1978 CHECKED BY

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
480.4	Ground Level											
U.U.	Topsoil											
	Heterogeneous Mixture of Clayey Silt Sand and Gravel (Glacial Till)		1	SS	95							6 24 46 24
			2	SS	131							
	Brown		3	SS	128							
	Grey		4	SS	122/10"							
	With Boulders			BXL	22"							
			5	SS	98							20 23 41 16
			6	SS	153/9"							
	Hard		7	SS	100/5"							
437.9	With Frequent Boulders		8	SS	100/1"							
42.5	Auger Refusal End of Borehole Note: Borehole Was Dry and Open											

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

23

W P 156-75-05 LOCATION Coords. N 15,830,933; E 953,118 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 7, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE *PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
479.8	Ground Level													GR SA SI CL
0.0	Topsoil													
	Heterogeneous Mixture of Clayey Silt Sand and Gravel (Glacial Till)		1	SS	158	10"	470							12 16 44 28
			2	SS	145	10"								
	Brown Grey Occasional Boulders		3	SS	97		460							23 18 41 18
			4	SS	68									
			5	SS	120	6"								
	Hard		6	SS	132	10"	450							32 21 32 15
442.8			7	SS	170	11"								
37.0	Limestone Bedrock		8	BXL	90%		440							
438.3	Sound				Rec.									
41.5	End of Borehole													
	Note: Borehole Was Dry and Open													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

24

W P 156-75-05 LOCATION Coords. N 15,830,885; E 953,184 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem; Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 7, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE - PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	10 20 30					
480.4	Ground Level						480							GR SA SI CL
0.0	Topsoil													
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	0007	5"								16 13 46 25
			2	SS	1507	11"								
	Brown Grey With Random Boulders		3	SS	1607	9"								11 23 42 24
			4	SS	77									
			5	SS	0007	3"								
			6	SS	0107	4"								41 20 24 15
	Hard		7	SS	1067	4"								
442.4														
38.0	Limestone Bedrock													
437.4	Sound		8	BXL	90Z Rec.		440							
43.0	End of Borehole													
	Note: Borehole Was Dry and Open													

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to
Sensitivity

20
15 - 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

25

W P 156-75-05 LOCATION Coords. N 15,830,839; E 953,248 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem; Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 8, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
480.3	Ground Level															
0.0	Topsoil															
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	112		480									12 15 46 27
			2	SS	135		470									
	Brown Grey		3	SS	143											6 25 41 28
	With Occasional Boulders		4	SS	95		460									
			5	SS	67											15 21 45 19
	Hard		6	SS	100/6"		450									
			7	SS	100/5"											
442.3																
38.0	Limestone Bedrock		8	BXL	95% Rec.		440									
438.4	Sound															
41.9	End of Borehole															
	Note: Borehole Was Dry and Open															

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 5

26

W P 156-75-05 LOCATION Coords. N 15,830,900; E 953,032 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 13, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE * PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L		
480.0	Ground Level													GR SA SI CL
0.0	Topsoil													
	Heterogeneous Mixture of Clayey Silt Sand and Gravel (Glacial Till)		1	SS	112									9 12 43 36
			2	SS	100/6"		470							
			3	SS	135									
			4	SS	77		460							10 22 42 26
			5	SS	156									
	Brown Grey		6	SS	126		450							23 22 40 15
			7	SS	100/6"									
			8	SS	100/3"		440							
433.5	Hard		9	SS	100/2"									
46.5	Weathered													
429.0	Limestone Bedrock Sound		10	BXL	65% Rec.		430							
51.0	End of Borehole													
	Note: Borehole Was Dry and Open													

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 6

27

W P 156-75-05 LOCATION Coords. N 15,830,870; E 953,072 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 11, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							SHEAR STRENGTH		WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE						● QUICK TRIAXIAL	x LAB VANE	○	○
479.2	Ground Level									10	20	30		GR SA SI CL				
0.0	Topsoil																	
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	135		470							6 13 51 30				
			2	SS	135													
			3	SS	174		460											
	Brown Grey		4	SS	92									22 20 42 16				
	Occasional Silt Seams		5	SS	80		450											
			6	SS	145	10"												
	Hard		7	SS	160	10"	440							45 17 25 13				
438.7																		
40.5	Weathered		8	BXL	65%													
434.2	Limestone Bedrock Sound				Rec.													
45.0	End of Borehole																	
	Note: Borehole Was Dry and Open																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

28

W P 156-75-05 LOCATION Coords. N 15,830,822; E 953,135 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 11, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100					
478.9	Ground Level													
0.0	Topsoil													
	Heterogeneous Mixture of Clayey Silt Sand and Gravel (Glacial Till)		1	SS	122		470							20 21 39 20
			2	SS	115									
			3	SS	46		460							8 23 48 21
			4	SS	85									
	Brown Grey		5	SS	116.9"		450							12 26 37 25
			6	SS	100.6"									
	Hard		7	SS	100.3"		440							
438.9														
40.0	Limestone Bedrock With Thin Bands of Shale													
433.9	Sound		8	BXL	90% Rec.									
45.0	End of Borehole													
	Note: Borehole Was Dry and Open													

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



RECORD OF BOREHOLE No 8

29

W P 156-75-05 LOCATION Coords. N 15,830,774; E 953,200 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL & Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 11, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L		
478.4	Ground Level													
0.0	Topsoil													
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	125		470	100/ 6"		o				41 9 33 17
			2	SS	137									
			3	SS	165/ 9"		460			o				4 20 48 28
	Brown Grey		4	SS	120									
	With Occasional Boulders and Seams of Silt and Sand		5	SS	115		450							
	Hard		6	SS	100					o				28 20 47 5
442.4			7	SS	100/ 1"									
36.0	Limestone Bedrock With Bands of Shale		8	SS	100% Rec.		440							
437.4	Sound													
41.0	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 9

30

W P 156-75-05 LOCATION Coords. N 15,830,744; E 953,240 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger - Solid Stem, Core Drill - BXL and Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 11, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
479.7	Ground Level															
0.0	Topsoil															
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	135		470									7 7 51 35
			2	SS	140.7"											
			3	SS	157											
			4	SS	120.8"		460									15 22 30 33
	Brown Grey		5	SS	76											
	With Occasional Boulders and Seams of Silt and Sand		6	SS	145		450									41 31 22 6
			7	SS	100.6"											
439.7	Hard						440									
40.0	Weathered															
434.7	Limestone Bedrock With Seams of Shale, Sound		8	BXL	60% Rec.											
45.0	End of Borehole															

+³, x⁵: Numbers refer to
Sensitivity

20
15 ± 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

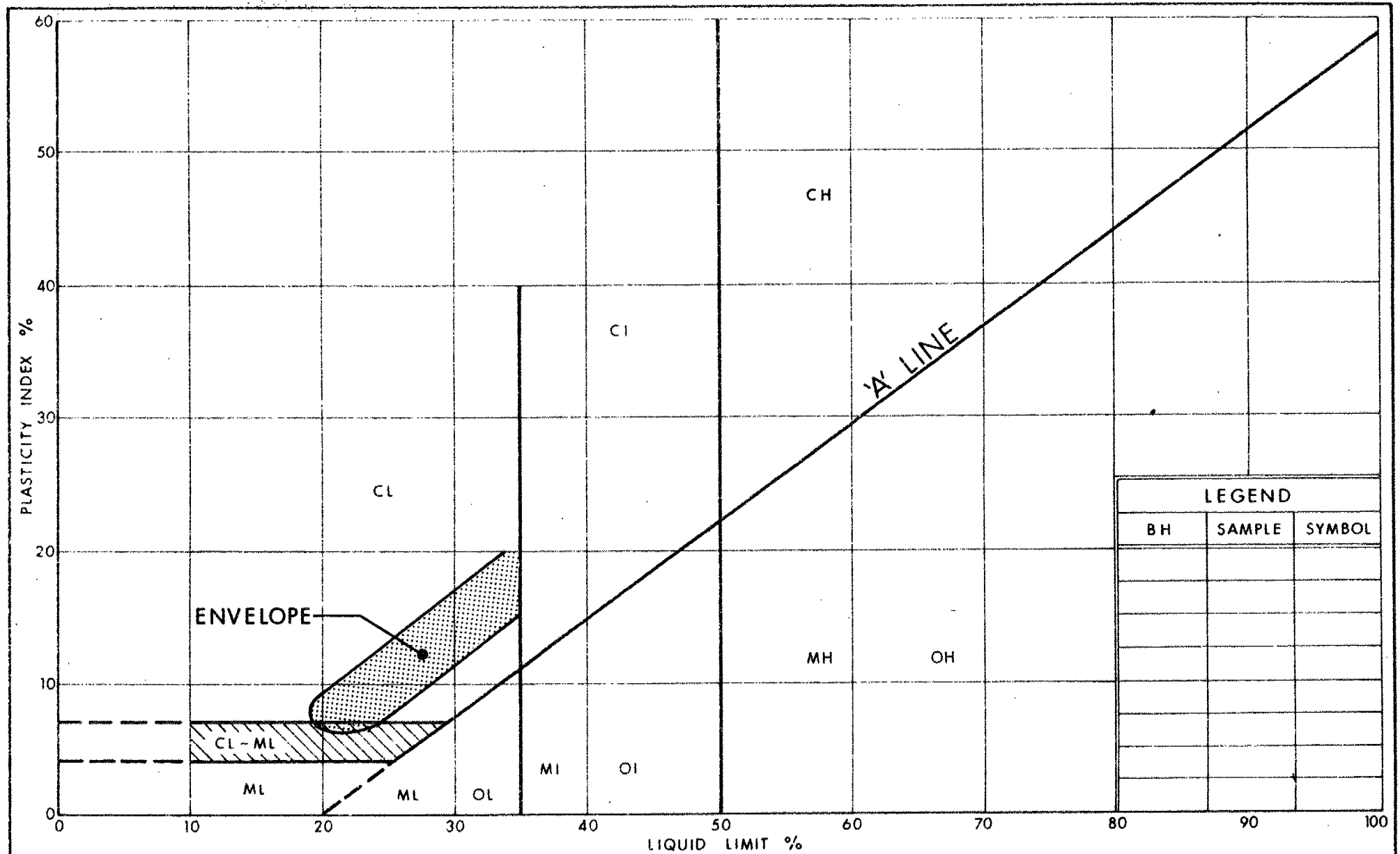
31

W P 156-75-05 LOCATION Coords. N 15,830,810; E 953,289 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE Auger-Solid Stem, Core Drill - BXL and Cone Test COMPILED BY V.K.
DATUM Geodetic DATE September 8, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
480.2	Ground Level															GR SA SI CL
472.7	Brown Silt With Seams of Clay Dense		1	SS	39		480									0 2 89 9
7.5	Heterogeneous Mixture of Clayey Silt Sand and Gravel (Glacial Till)		2	SS	117		470									
	Brown Grey		3	SS	110/6"											
	With Occasional Boulders		4	SS	123		460									29 21 38 12
			5	SS	74											
			6	SS	110/3"		450									
	Hard		7	SS	100/6"											42 8 39 11
442.2																
38.0	Limestone Bedrock With Seams of Shale		8	BXL	100% Rec.		440									
437.2	Sound															
43.0	End of Borehole															
	Note: Borehole Was Dry and Open															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ontario

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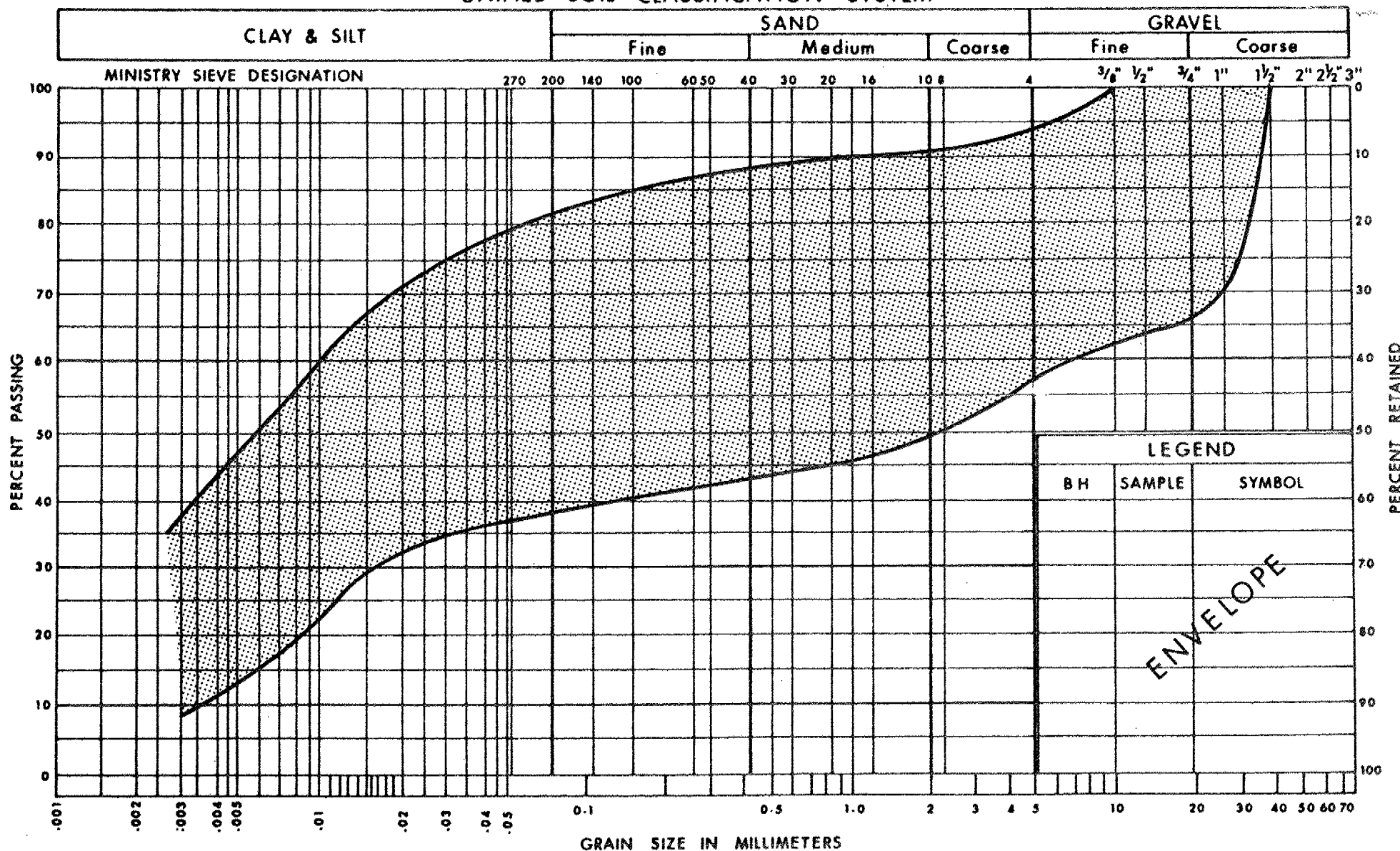
PLASTICITY CHART GLACIAL TILL

HET. MIX. OF CLAYEY SILT, SAND & GRAVEL

FIG No 1

W P 156 - 75 - 05

UNIFIED SOIL CLASSIFICATION SYSTEM



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

FIG No 2

W P 156-75-05



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Communications

Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1

DIP

PROPERTY _____
LOCATION _____
LATITUDE _____
DEPARTURE _____
BEARING _____

W.P.156-75-05

Mississauga
Dist. 6

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____

DATUM _____

DATE STARTED _____

DATE COMPLETED _____

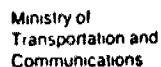
DRILLED BY _____

LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		Hole #1				
21'	26'	Limestone, light grey colour, hard to medium hard, fine texture.				core broken, ground and missing
		Hole #2				
37'	41'5"	Limestone, light grey colour, soft to medium hard, fine to medium texture, fossiliferous.				
		Hole #3				
38'	43'	Same as hole #2 and medium hard.				
		Hole #4				
38'	41'9"	Same as hole #2 and medium hard.				
		Hole #5				
46'5"	51'0"	Same as hole #2 and medium hard.				broken ground and missing core consolidated mud and broken shale 8" at bottom of core.

DATE OF EXAMINATION _____

OB-MT-113



HOLE NO. _____ SHEET NO. 2

017

PROPERTY	W.P. 156-75-05
LOCATION	Mississauga
	District 6
LATITUDE	
DEPARTURE	
BEARING	

TOTAL FOOTAGE

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		Hole #6			
40'5"	45'0"	Same as hole #2 and medium hard.			broken ground and missing core.
		Hole #7			
40'0"	45'0"	Same as hole #2 and medium hard.			broken ground and missing core with consolidated mud and shale particles alternately throughout core between limestone bedding.
		Hole #8			
36'0"	41'0"	Same as hole #2 and medium hard.			shale and mud at 38'8" - 39'0" 40'0" - 40'6"
		Hole #9			
40'0"	45'0"	Same as hole #2 and medium hard.			broken ground and missing core ground shale and mud at end of core for uncertain footage.

DATE OF EXAMINATION _____

OP-NT-113



HOLE NO. _____ SHEET NO. 3

219

PROPERTY _____ W.P. 156-75-05
LOCATION _____ Mississauga
_____ District 6

LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE _____

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION October 3rd, 1978

B.K. Glassford

08-427-113

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 156-75-04

DIST 6

HWY 403

STR SITE 24-439

Mavis Road Underpass

CONT 81-50

DISTRIBUTION

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R. Fitzgibbon)

J. Anderson) cover only

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SAMPLE DISPOSITION NOTICE

TYPE	DISCARD AFTER	RECOMM. BY
JARS	78 11 15	M.D.
TUBES	—	—
ROCK CORES	Re covered of root	M.D.

FOUNDATION INVESTIGATION REPORT

For

Mavis Road Underpass
W.P. 156-75-04, Site 24-439
Hwy. 403, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of July 21-26, 1978. The fieldwork consisted of 6 sampled boreholes advanced by means of a continuous flight auger machine equipped with solid and hollow stem augers. In addition, diamond drilling techniques were employed to obtain BXL size core of bedrock. The boreholes ranged in depth from 25 to 33 feet below the ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about 2 miles west of Hwy. 10 and 1 mile north of Burnhamthorpe Road in the City of Mississauga, Regional Municipality of Peel.

The land immediately adjacent to the site has a gentle topography and is used for farming. Physiographically the site is situated in the border region of "Peel Plain" and "South Slope". The characteristic deposit in the vicinity of the area under investigation is composed of cohesive glacial till and granular deposits. The overburden is underlain by shale bedrock of Meaford, Dundas formation, Ordovician Period.

SUBSURFACE CONDITIONS

General

Surficial deposits over the site are variable, consisting of two distinct strata; a shallow surficial layer of clayey silt with some sand and traces of gravel and organics ranging in thickness from 5.0 feet to 8.0 feet and a more extensive surficial deposit of silt with seams of clay ranging from 10.0 feet to 14.0

feet. Underlying the surficial clayey silt deposit and generally overlying bedrock is a stratum of silty sand with gravel and trace of clay explored for depths of 11.5 feet to 16.5 feet. Underlying the surficial deposit of silt with seams of clay and immediately above bedrock is a clayey silt stratum with occasional seams of silt, sand and gravel. Bedrock consisting of interbedded shales and limestones was encountered below these final two stratums.

The boundaries between the various soil types are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on borehole data, is shown on Drawing No. 1567504.

The various subsoil types encountered are briefly described in the following paragraphs

Clayey Silt, Some Sand, Trace Gravel (Surficial)

The primary surficial deposit overlying the majority of the site consists of a clayey silt, some sand, trace of gravel, ranging in depths from 5.0 feet to 8.0 feet. In 3 of the 4 boreholes, where this stratum was penetrated, organics ranging in percentage content by weight from 0.2% to 0.87%, were well dispersed. Composition of the components of this cohesive stratum are shown in the grain size distribution chart in Figure 1. Typical Atterberg Limits and identity indices performed on selected representative samples are summarized in the following table and plotted on the plasticity chart, Figure 2.

		<u>Range</u>	<u>Average</u>
Moisture Content	(W) %	14-20	17
Liquid Limit	(W _L) %	22-32	24
Plastic Limit	(W _p) %	16-18	17
Plasticity Index	(I _p) %	6-15.5	11

These results indicate the deposit to be generally a clayey silt of low plasticity (CL).

Standard Penetration Test 'N' values range from 9 blows per foot to 33 blows per foot, with the majority being in the order of

10 blows per foot. The consistency of this surficial stratum based on these values may be considered as firm to stiff.

Silt With Seams of Clay

Overlying the remainder of the site is a deposit of well graded silt with seams of clay, penetrated to a maximum depth of 14.0 feet. A plot of grain size distribution is shown in an envelope form on Figure 1. The 'N' values ranged from as low as 17 blows per foot to as high as 90 blows per foot, indicating a relative density for this deposit which varies from compact to very dense.

Silty Sand With Gravel

Generally, underlying the surficial cohesive stratum and overlying bedrock is a deposit of silty sand with gravel and trace of clay. The deposit was found to range in thickness from 11.5 feet to 16.5 feet. Grain size distribution curves for this material are shown on Figure 3. The 'N' values range from 41 blows per foot to in excess of 100 blows per foot, indicating a relative density for this stratum ranging from dense to very dense, but generally very dense.

Clayey Silt

A clayey silt stratum with occasional sand seams and cobbles was found to underlie the surficial non-cohesive stratum at the site. This deposit was penetrated to a maximum thickness of 14.0 feet and found to overlie bedrock at the site. The clayey silt interrupted by silt seams was also encountered for a depth of 7.0 feet in Borehole No. 3.

A plot of grain size distribution curves obtained from representative samples are shown on Figure 4.

Typical Atterberg Limits and identity indices performed on selected representative samples are summarized in the following table and plotted on the plasticity chart, Figure 2.

		<u>Range</u>	<u>Average</u>
Moisture Content	(W) %	21-30	25
Liquid Limit	(W _L) %	24-29	27
Plastic Limit	(W _P) %	17-20	18
Plasticity Index	(I _P) %	7-10	9

These results indicate the material to be an inorganic clayey silt of low plasticity (CL).

The 'N' values range from 11 blows per foot to 100+ blows per foot, indicating a consistency range from stiff to hard, but generally very stiff in nature.

Bedrock

Bedrock consisting of interbedded fossiliferous limestone and fissile shales, was found to vary from elevation 522.4 to elevation 526.0 over the site. These elevations would indicate that bedrock is sloping at a shallow angle to the south in the area. Generally, bedrock can be assumed sound, with localized weathered zones ranging in the upper 6 to 18 inches of the strata.

Groundwater

Overnight groundwater level readings taken in open boreholes during the period of investigation indicated water elevations ranging from elevation 543.6 to elevation 541.3 which corresponds to depths of approximately 7.0+ feet over the site.

DISCUSSION AND RECOMMENDATIONS

A twin two span post-tensioned concrete underpass structure is presently being contemplated to carry Mavis Road over the proposed Hwy. 403. The planned structure will have a combined span length of 220 feet and a deck width of 98 feet. At the proposed intersection, the profile grade of Hwy. 403 will be at elevation 539.8 and that of Mavis Road will be at elevation 561.6. With the existing ground at elevation 545 \pm , the required earth work will entail minimal cuts of up to 9 \pm feet along Hwy. 403 and approach fills up to 16 \pm feet above existing ground for Mavis Road.

In summary, non-uniform glacio-alluvial deposits consisting of clayey silts and silts underlain by silty sands and clayey silts overlying competent bedrock at depths of 22 to 26 feet extend over the site.

Our recommendations for the foundation of the structure and the related earth works are as follows:

Structure Foundations

Abutments: Perched type spread footings founded in the approach fills within a zone composed of well compacted Granular 'A' material can be designed using an allowable bearing pressure of 2.5 tsf.

Alternatively, abutment footings can be supported on end bearing piles driven to competent bedrock at approximate elevation 522 \pm . Piles driven to competent bedrock can be designed for the maximum allowable capacity (ie. 12,000 psi for steel 'H' section pile) of the pile section chosen.

Closed type spread footings can also be used to support abutment foundations. An allowable bearing pressure of 2.5 tsf can be used to design spread footings founded at elevation 540 or lower.

In order to resist lateral forces acting on the abutment foundations, frictional forces between the footing bases and foundation soil can be calculated using a coefficient of friction of 0.7 for the granular 'A' pad or concrete mat and 0.6 for the natural ground conditions. Backfill behind the abutments should be composed of well compacted free-draining granular material with provisions made for adequate drainage. The lateral earth pressure exerted on the abutment walls by the granular backfill can be computed assuming a unit weight of 130 pcf for the backfill and a coefficient of earth pressure of:

$K_a = 0.35$ for the "active" case where rotation about the base is allowed

$K_o = 0.5$ for the "at rest" case where no rotation or translation about the base is permitted

Pier: The center pier foundation should be supported on spread footings founded at or below elevation 540. At this elevation the soil can be expected to support an allowable design bearing pressure of up to 3.0 tsf.

Other Considerations

During footing excavation, any organic material encountered within the plan limits of the footing should be subexcavated to its full depth and replaced with well compacted Granular 'A' material or mass concrete to the desired footing elevation.

In order to minimize damage during driving to bedrock and to facilitate penetration of bouldery zones, all pile tips should be reinforced with welded steel flange plates as per current M.T.C. standards.

Considering the overconsolidated nature of the subsoils, spread footings founded at or below the recommended elevations and designed for the maximum allowable bearing pressure, should undergo less than 1 inch of differential settlement, occurring during or shortly after construction.

Abutment and pier spread footings should be placed on undisturbed natural ground, or, due to construction activity or weather conditions, on a well compacted granular 'A' pad or low strength concrete mat.

The underside of all footings or pile caps should have a minimum of four feet of earth cover for frost protection purposes.

No major dewatering problems are anticipated for footings in the surficial cohesive deposit. However, if wet conditions prevail at the time of construction, pumping from sumps may be required to control seepage at the bottom of the excavation. For excavations into the silt and/or silty sand strata below prevailing groundwater level, a positive dewatering scheme will be necessary.

Approaches

The approach fills in the order of 16 feet for Mavis Road can be constructed safely with standard 2:1 side slopes. Prior to placement of the earth fills, the topsoil should be subexcavated to their full depth for a minimum distance of 50 feet behind the abutments and replaced with compacted earth fill.

The required cuts for Hwy. 403 can also be made with the standard 2:1 slopes. To insure drained site conditions, excavation of the drainage ditch should proceed in advance of cut operations.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. V. Korlu, Project Engineer. The equipment used was owned and operated by Atcost Soil Drilling Inc., Toronto.

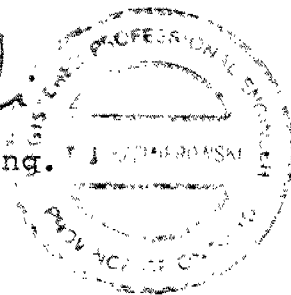
This report was written by Mr. V. Korlu and Mr. T. Kazmierowski and reviewed by Mr. M. Devata, Supervising Engineer

Tom Kazmierowski

T. Kazmierowski, P. Eng.
Project Engineer

M. Devata

M. Devata, P. Eng.
Supervising Engineer



September, 1978

APPENDIX

FIELD AND LABORATORY WORK

The subsoil investigation was performed at this site by carrying out 6 sampled boreholes. The boreholes were accompanied by a dynamic cone penetration test. The borings were advanced by a continuous flight auger machine (commercially known as C.M.E. 55 H.S.M.V.) adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The samples were hammered into the soil according to the specifications of Standard Penetration Tests. Bedrock was proven in boreholes by obtaining BXL size rock core samples.

Groundwater level observations were carried out during the time of investigation in the open boreholes.

The soil, bedrock and groundwater conditions encountered at the borehole locations are presented in the Record of Borehole Sheets. The locations and elevations of the various boreholes were provided by personnel from the Construction Office, Central Region. The elevations in this report are referred to a Geodetic datum. Boring locations and elevations are shown on Drawing No. 1567504-A. All samples were subjected to careful visual examinations in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected representative samples to determine the physical properties of the various soil types encountered, namely:

- Natural Moisture Contents

- Atterberg Limits

- Grain Size Distribution

The results of this testing are plotted on the Record of Borehole Sheets and summarized on Figure 1 to 4, all contained in Appendix 1 of this report.



RECORD OF BOREHOLE No 1

W P 156-75-04 LOCATION Coords. N 15,836,862; E 957,526 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/4" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 21, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
550.6	Ground Level													GR SA SI CL
0.0	Silt With Seams of Clay		1	SS	29		550							0 0 84 16
			2	SS	58									
			3	SS	90									
536.6	Brown Grey Compact to Very Dense		4	SS	33		540							
14.0	Clayey Silt With Occasional Seams of Sand & Occasional Boulders		5	SS	27									0 0 87 13
			6	SS	1007	5"	530							Case & Wash Hole 19.7 to 28.2 ft.
	Very Stiff to Hard			BXL										
522.4														
28.2	Limestone Bedrock Interbedded With			BXL	100%		520							
517.4	Shale, Sound				Rec									
33.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 3

W P 156-75-04 LOCATION Coords. N 15,836,924; E 957,588 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" H.S.M.V. & Solid Stem, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 26, 1978 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
547.4	Ground Level																
0.0	Clayey Silt With Some Sand & Traces of Gravel & Organics, Stiff		1	SS	9											Org. 0.2%	4 15 66 15
542.4			2	SS	32												
5.0	Silt With Seams of Clay Brown Grey		3	SS	18												0 0 90 10
	Loose to Dense		4	SS	25												
530.4			5	SS	19												
17.0	Clayey Silt With Seams of Silt		6	SS	16												0 0 80 20
523.4	Very Stiff																
24.0	Weathered - Interbedded Shale & Limestone Bedrock																
518.4	Sound			BXL	100% Rec												
29.0	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

W P 156-75-04 LOCATION Coords. N 15,836,948; E 957,442 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/4" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 24, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
549.6	Ground Level																
0.0	Clayey Silt With Some Sand and Traces of Gravel and Organics Firm		1	SS	9											0.87%	2 14 64 20
541.6			2	SS	11												
8.0	Silty Sand With Gravel and Trace of Clay		3	SS	79		540										41 33 21 5
	Brown Grey		4	SS	100/6"	6"											
	Very Dense		5	SS	80												
			6	SS	117		530										30 38 27 5
525.1																	
24.5	Interbedded Shale and Limestone				100%												
520.1	Bedrock. Sound			BXL	Rec												
29.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

W P 156-75-04 LOCATION Coords. N 15,837,015; E 957,510 ORIGINATED BY V.K.
 DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
 DATUM Geodetic DATE July 25, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
546.5	Ground Level																
0.0	Clayey Silt With Some Sand & Traces of Gravel & Organics, Stiff		1	SS	10		540									Org. 0.27%	4 13 61 22
541.5			2	SS	61												43 36 25 6
5.0	Silty Sand With Gravel and Trace of Clay		3	SS	41												
	Very Dense		4	SS	73												
			5	SS	145		530										39 28 27 6
526.0			6	SS	100/6"												
20.5	Weathered Limestone Bedrock			BXL	100% Rec												28 64 6 2
521.7	Interbedded With Shale																
24.8	End of Borehole																


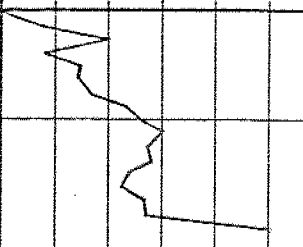
+³, x⁵: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

W P 156-75-04 LOCATION Coords. N 15,837,031; E 957,356 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 25, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
548.0	Ground Level															
0.0	Silt With Seams of Clay Compact		1	SS	17		540						o			0 0 85 15
			2	SS	29											
538.0	Brown		3	SS	30											
10.0	Gray		4	SS	17											
	Clayey Silt		5	SS	11											
			6	SS	72											
524.9	Stiff to Hard						530									0 0 86 14
23.1	Interbedded Shale & Limestone Bedrock															
519.7	Sound			BXL	100% Rec											
28.3	End of Borehole															

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

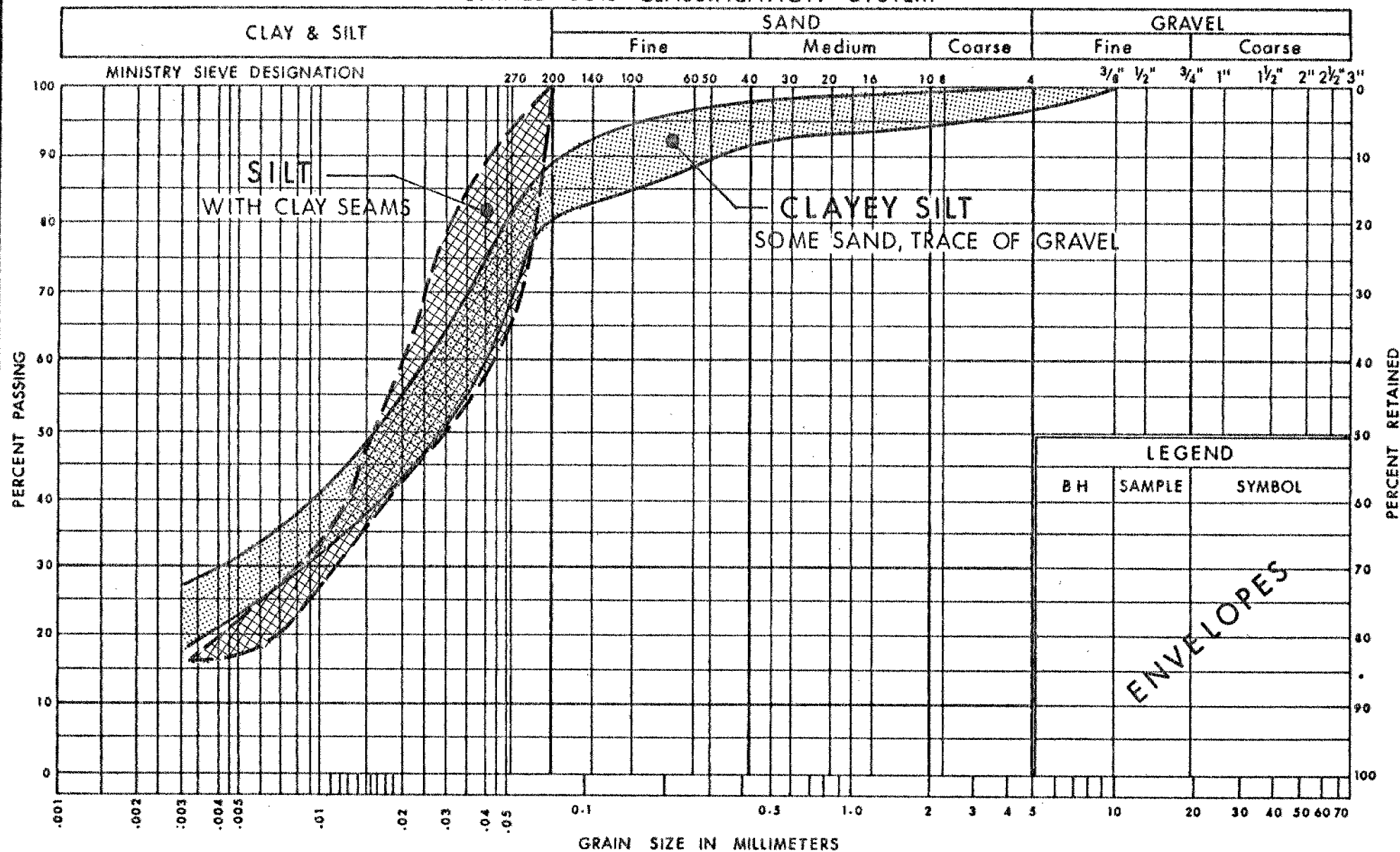


RECORD OF BOREHOLE No 9

W P 156-75-04 LOCATION Coords. N 15,837,100; E 957,425 ORIGINATED BY V.K.
DIST 6 HWY 403 BOREHOLE TYPE 3 1/2" S.S. Auger, BXL Core Drill COMPILED BY V.K.
DATUM Geodetic DATE July 25, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
545.5	Ground Level																
0.0	Clayey Silt With Trace of Sand		1	SS	9		540										0 10 66 24
537.5	Stiff to Hard		2	SS	33												
8.0	Silty Sand With Gravel and Trace of Clay		3	SS	64												23 58 15 4
			4	SS	60												
	Very Dense		5	SS	68		530										54 34 10 2
526.0	Limestone Bedrock Interbedded With																
521.0	Shale, Sound					BXL Rec											
24.5	End of Borehole																

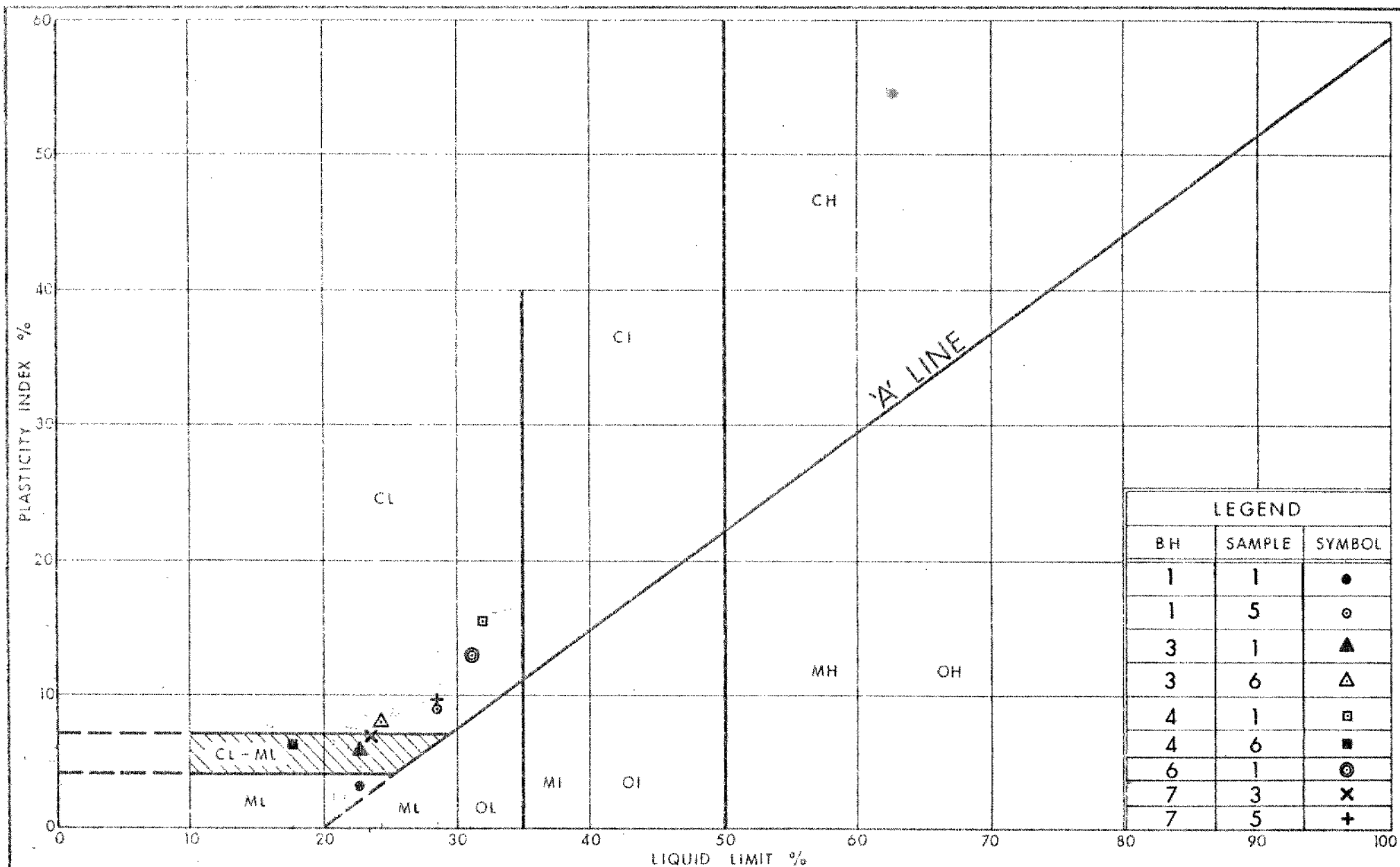
UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION SURFICIAL DEPOSITS

FIG No 1

W P 156 - 75 - 04



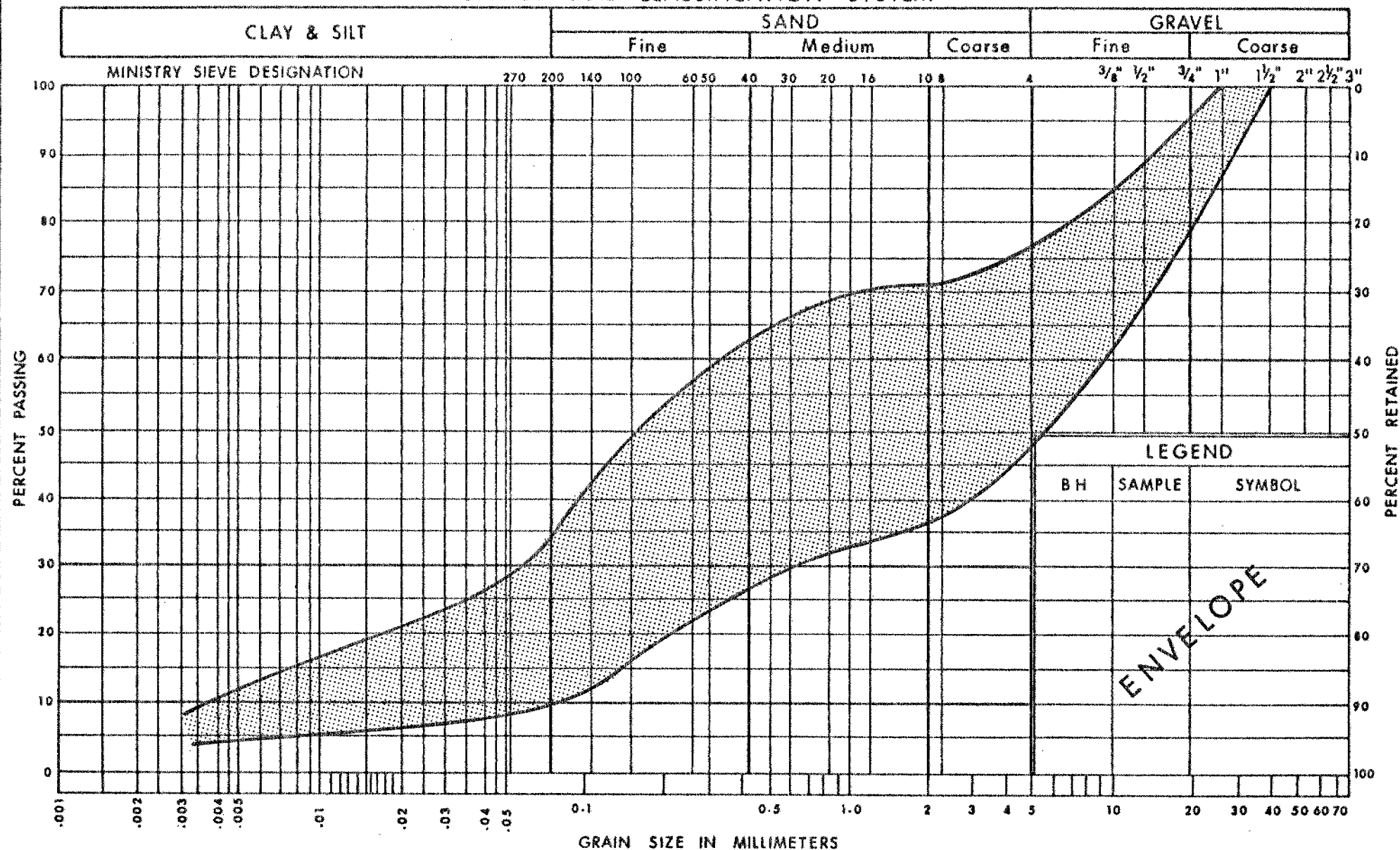
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PLASTICITY CHART CLAYEY SILT

FIG No 2

W P. 156 - 75 - 04

UNIFIED SOIL CLASSIFICATION SYSTEM



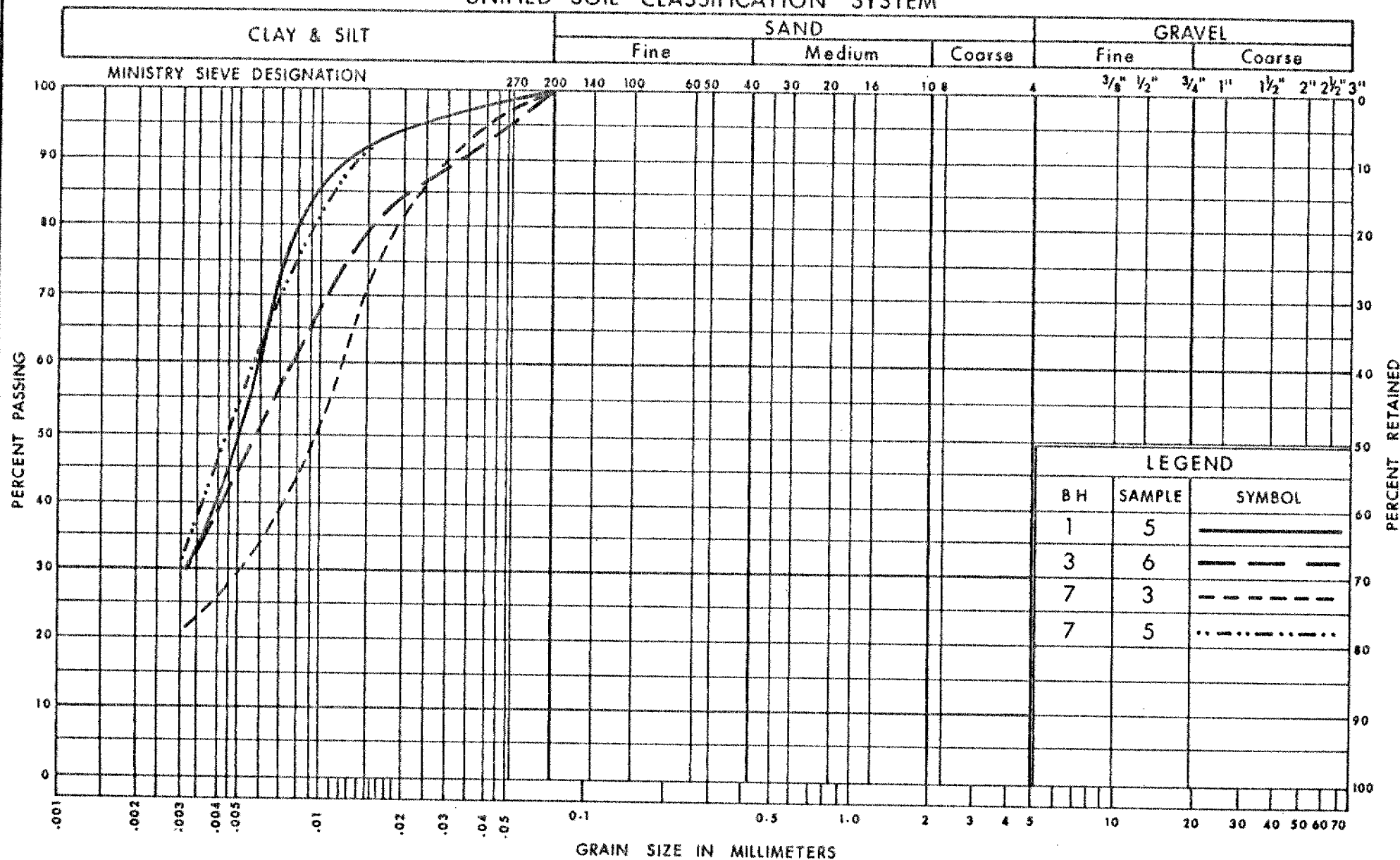
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Communications

GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH GRAVEL & TRACE OF CLAY

FIG No 3

W P 156-75-04

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
CLAYEY SILT

FIG No 4

WP 156 - 75 - 04

EXPLANATION OF TERMS USED IN REPORT

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

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 (FSF)	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

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ 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
 ω SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c, N_{γ} BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

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

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_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
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

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

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE:
 σ' = EFFECTIVE NORMAL STRESS

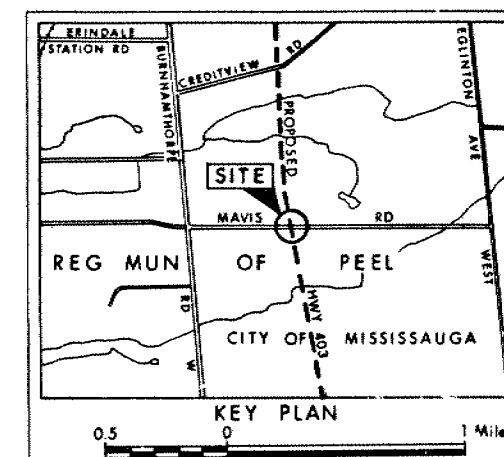
CONT No
WP No 156-75-04

MAVIS RD U' PASS

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊗ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ↓ WL at time of investigation July 1978

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	550.6	15 836 862	957 526
3	547.4	15 836 924	957 588
4	549.6	15 836 948	957 442
6	546.5	15 837 015	957 510
7	548.0	15 837 031	957 356
9	545.5	15 837 100	957 425

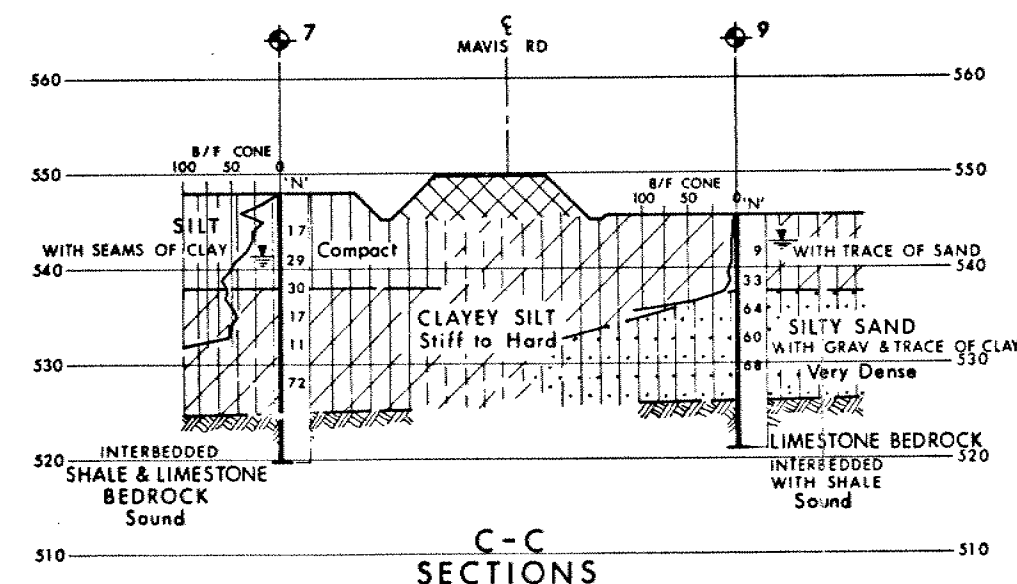
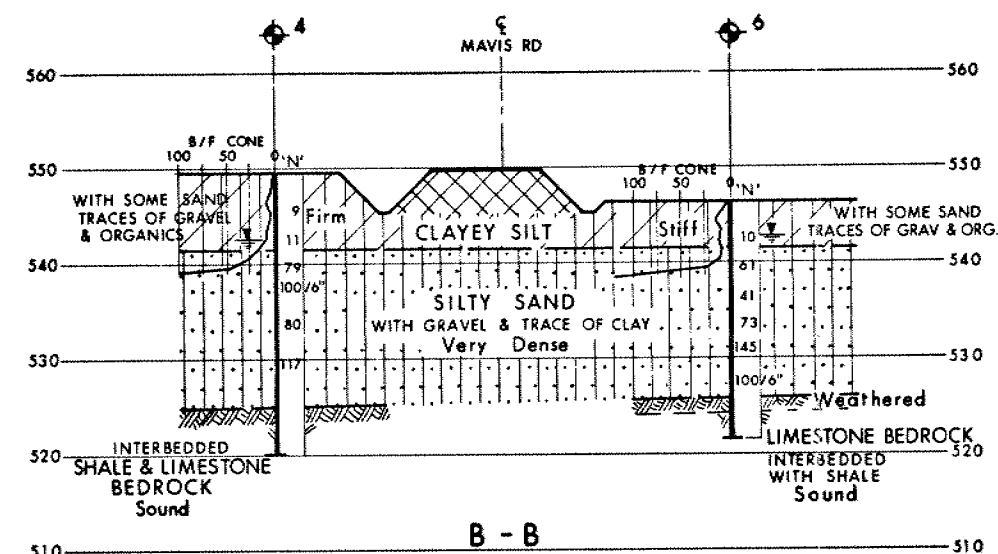
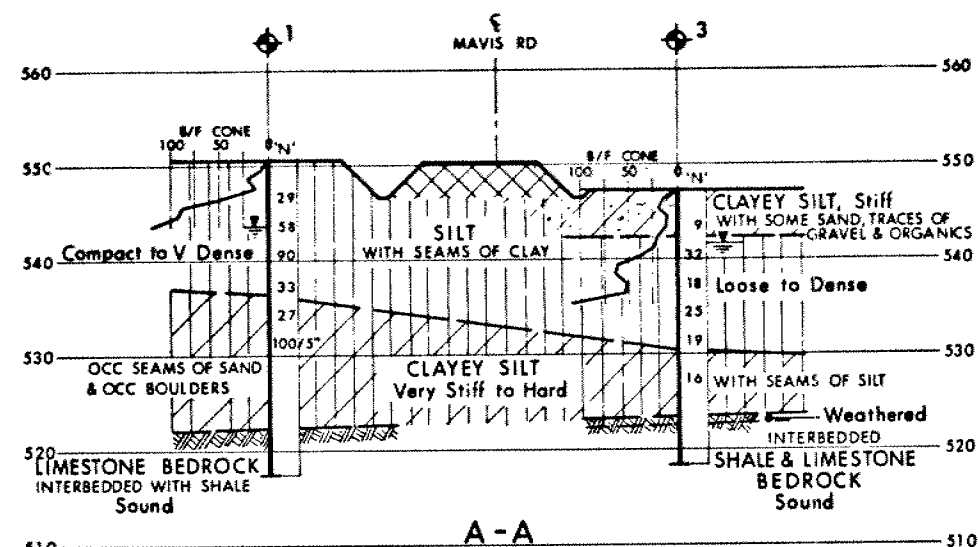
NOTE

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

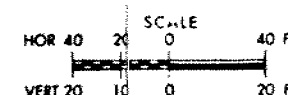
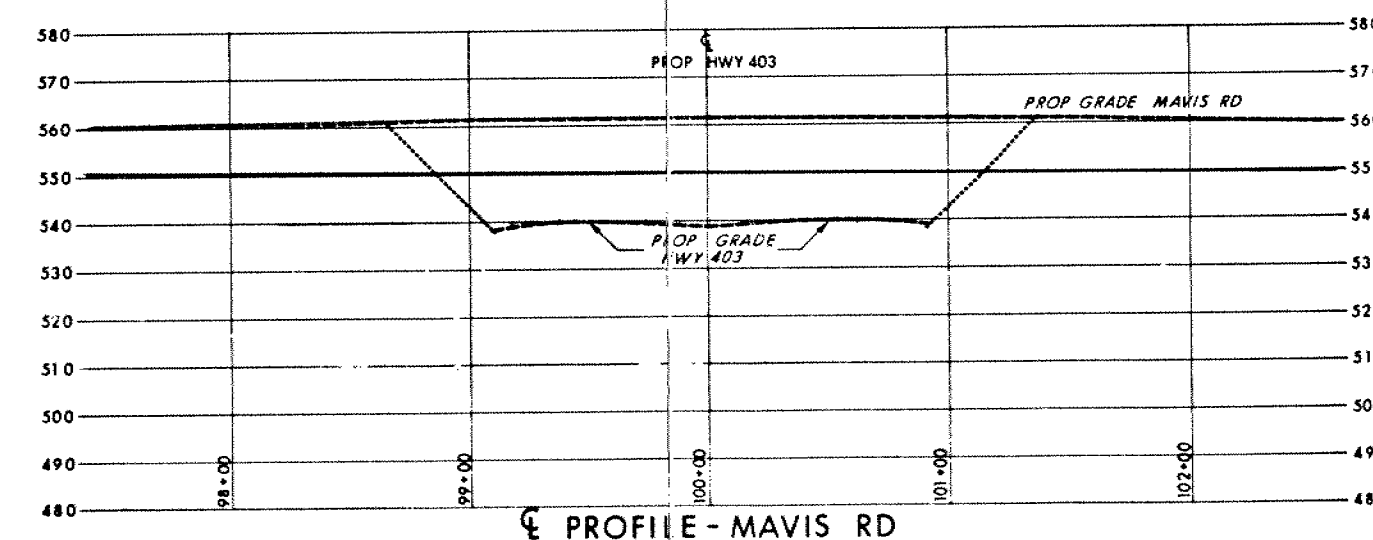
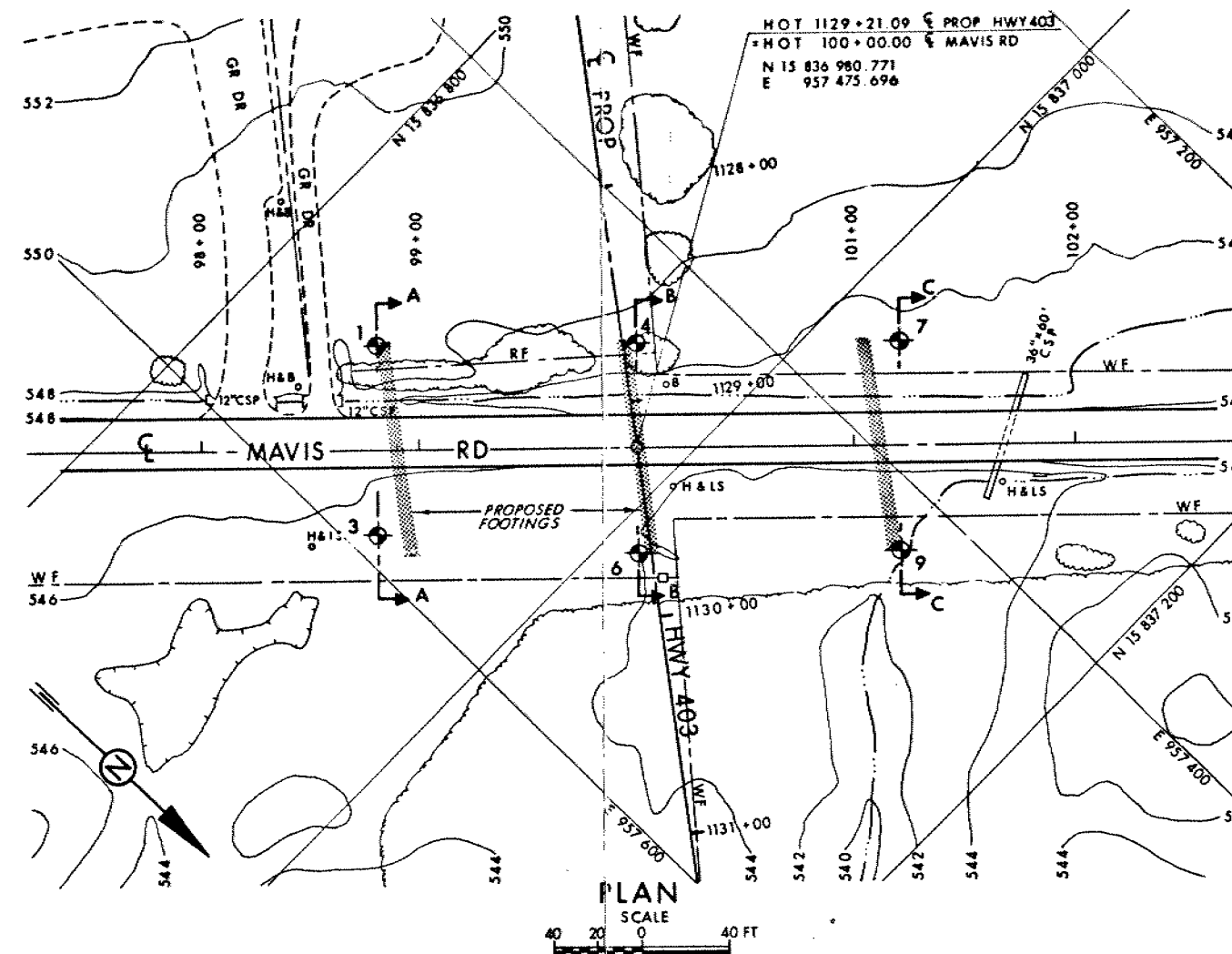
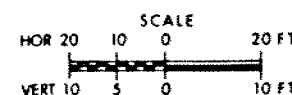
REVISIONS	DATE	BY	DESCRIPTION

GEOCREC No 30M12-132

HWY No 403
SUBMITTAL CHECKED BY DATE Sept 28, 1978 SITE 24-439
DRAWN BY R.S. CHECKED BY DATE 1567504-A



NOTE
MAVIS RD ELEVATIONS
TAKEN FROM SURVEY NOTES.





Memorandum

To: Mr. N. Sen
Project Manager
Planning & Design
Central Region

Attention:

From: Pavement & Foundation Design Section
Room 313, Central Building

Date: 81 02 04

Our File Ref.

In Reply to

Subject: Contract Review For Mavis Road and CPR
W.P. 156-75-04/05, Site 24-439 & 24-369
Hwy. 403, District 6, Toronto

The construction of the Mavis Road and CPR structures will be combined with grading in the area in a single contract. The following changes in this recently reviewed contract package should be made to meet foundation design requirements.

The contract should require that the storm sewers be placed and backfilled for at least 25 feet on either side of the Mavis Road and CPR structures prior to construction of the structure footings. It should also require that during this sewer construction the soil not be disturbed below an influence line. This line would extend horizontally from the base of the pier footing for 15 feet and then down at 1.5 to 1 at Mavis Road. At the CPR structure this influence line would extend downward at 2 to 1 from the bottom edge of the pier footing.


An unwatering item and Special Provision should be inserted in the contract to cover the pier footing and both abutment footings at Mavis Road. It is recommended that the S.P. read as follows:

The Contractor shall carry out all work necessary to prevent disturbance of the pier and abutment foundation excavations. He shall unwater the excavation in such a manner as to prevent the subsoil in the base of the excavation from 'boiling'. The level of the ground water shall be kept below the bottom of the excavation while carrying out the excavation work, and the water level shall be maintained below the foundation level until the pier footing has been placed.

Payment at the contract price for the item "Unwatering Structure Foundations" shall be full compensation for all labour, equipment and material to do the work according to the specifications and as set out in the contract.

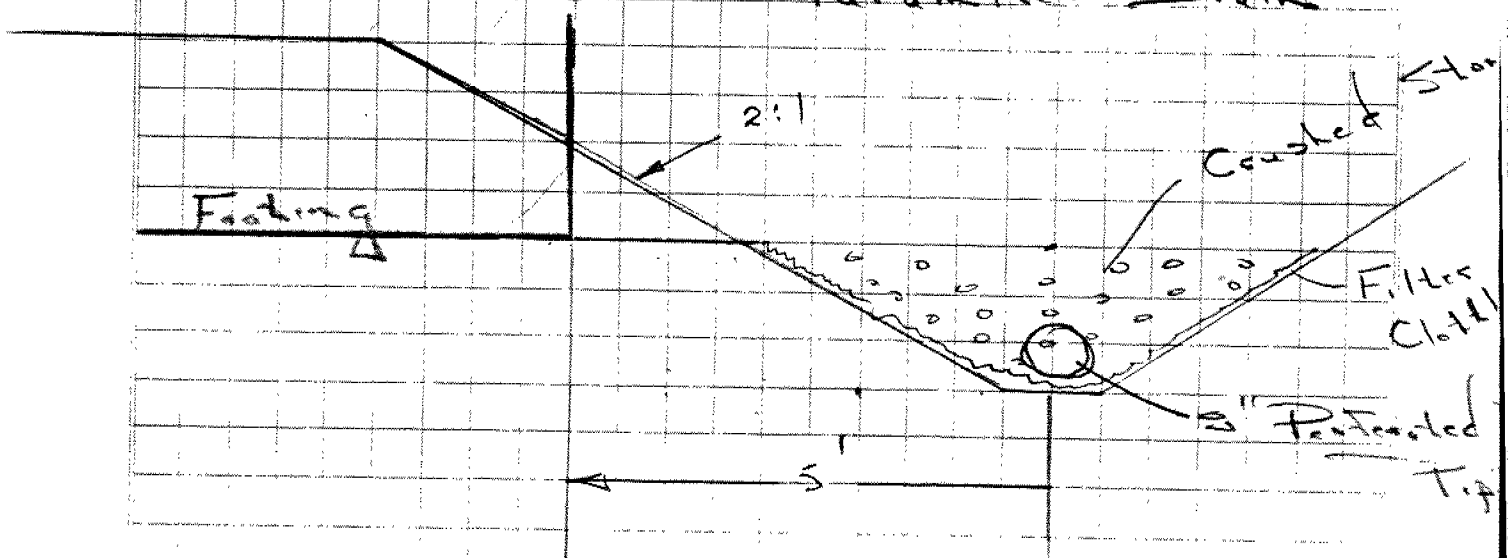
PJS:ea

cc: M. Bendayan
R. Northwood
B. Hurd

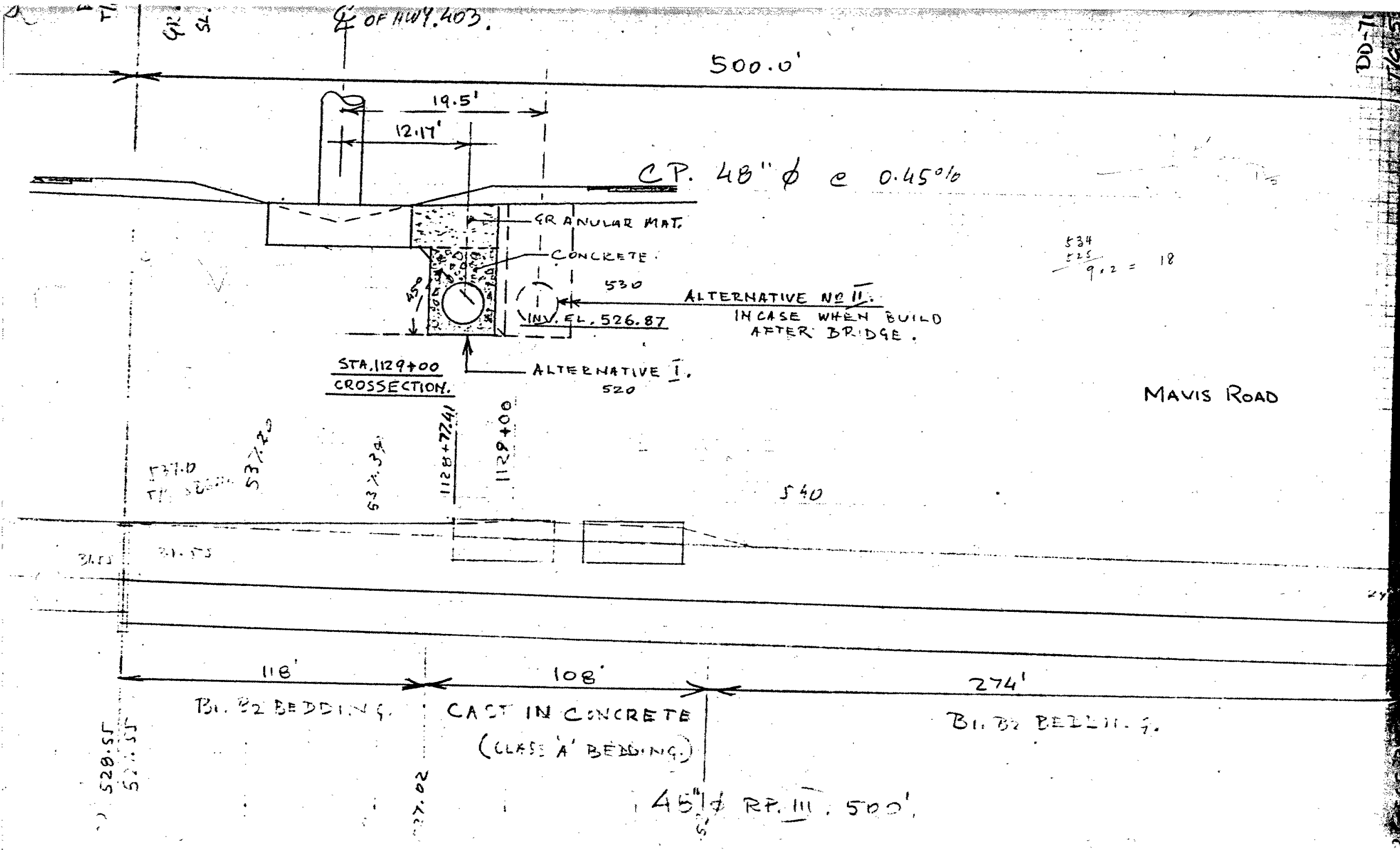

Peter J. Stuart
Foundations Engineer
For:
M. Devata
Senior Foundations Engineer

- ① Excavate to Hwy 403 subgrade elevation.
Full width
- ② Excavate to 2' above footing grade.
- ③ Install perimeter drains 4 sides
of footing as shown
- ④ Lower water level 1 foot
below footing grade and
maintain until footing complete
- ⑤ Complete excavation and construct foot.

Parameter Drain



DD-71
7/4/5



C.P. 48" ϕ @ 0.45%

$$\frac{534}{525} - 9.2 = 18$$

ALTERNATIVE NO. II.
IN CASE WHEN BUILD
AFTER BRIDGE.

STA. 1129+00
CROSS SECTION.
ALTERNATIVE I.
520

MAVIS ROAD

531.0
528.0
537.20

537.39

1128+77.41

1129+00

540

118' 108' 274'
B1, B2 BEDDING. CAST IN CONCRETE (CLASS 'A' BEDDING.) B1, B2 BEDDING.

45" ϕ R.P. III. 500'

520.55
527.55

527.02



Memorandum

To: Mr. G. C. E. Burkhardt,
Head,
Structural Office,
Central Region.

Attention: Mr. M. Bendayan.

From: Pav't. & Foundation Design Section,
Engineering Materials Office,
Room 315, Central Building,
Downsview.

Date: 79 10 05

Our File Ref.

In Reply to

Subject:

Re: Mavis Road Underpass,
W.P. 156-75-04, Site 24-439,
Hwy. 403, District 6, Toronto.

As per your request, we have reviewed the proposed construction of a 48" diameter sewer in the vicinity of the centre pier and submit the following comments.

- 1) To minimize disturbance to the foundation soil beneath the pier footing, a minimum spacing between the sewer trench and the footing as shown in Figure A should be maintained.
- 2) Since excavation for the pier footings and the sewer trench will be carried out in granular subsoil below the groundwater table, the following suggested sequence of construction should be considered in order to minimize the dewatering requirements for the proposed construction:
 - Excavate a pilot trench along the sewer line to an approximate elevation of 535. Maintain side slopes for the trench at 1.5:1 and also carry out pumping at all times.
 - Excavate the existing ground to Hwy. 403 subgrade elevation.
 - Excavate the trench for the sewer as shown in Figure A. The excavation should start from a point at the low end at least 100 feet away from the pier footing and proceed towards the foundation pier area. The sides and the face of this trench must not be steeper than 1.5:1. Further, pumping should be maintained at all times.
 - Install the sewer and backfill the trench as per current M.T.C. practices to 2 feet below the pier footing founding elevation. This shallow trench can be used as a sump for the construction of the pier footing.

- Construct the pier footings. Backfill the footings and the sewer trench.

It should be noted that no construction equipment nor stockpiling of material shall be allowed within 15 feet of the trench before it is backfilled.

Alternatively, the trench for the sewer can be cut with vertical sides provided they are supported by properly braced sheeting.

BL/MD/cy

c.c. C. G. S. Grebski
W. Lin
R. Northwood
K. Cameron
H. Chyc
Files ✓

B. Ly

B. Ly,
Foundation Engineer.
For: M. Devata,
Senior Foundation Engineer.

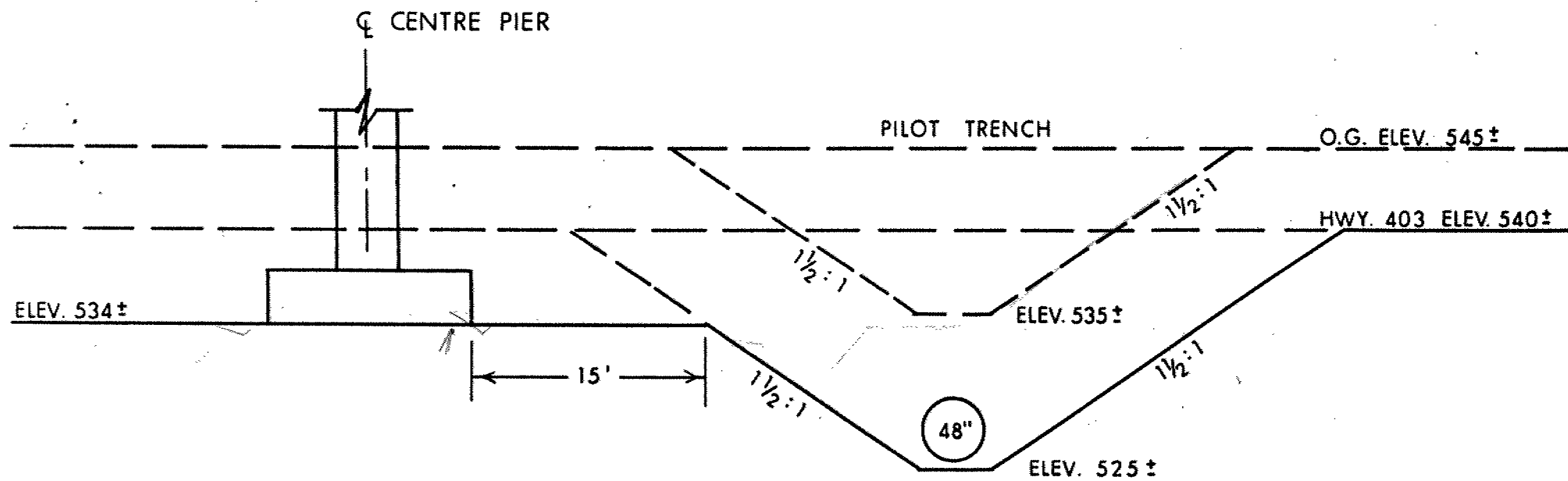


FIGURE A

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

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

78 10 19

Re: Hwy. 403 Underpass at Mavis Road
W.P. 156-75-04, Site 24-439
District 6, Toronto

We have reviewed the Preliminary Bridge Plan Drawing 24-439-P1 for the above mentioned structure and our comments are as follows.

1. For abutment footings founded on end-bearing piles driven to competent bedrock, the following tip elevations should be used:

South Abutment	Elev. 522+
North Abutment	Elev. 525+
2. All pile tips should be reinforced with welded steel flange plates to minimize damage during driving to bedrock.
3. Alternatively, abutment footings can be supported on spread footings founded at elevation 540 or lower with an allowable bearing pressure of 2.5 tsf for design purposes.
4. For footing excavations into the silt and/or silty sand stratum below prevailing groundwater levels, a positive dewatering scheme will be necessary to prevent 'boiling' of the foundation base material.

T. Kazmierowski
Project Engineer

TK/gs

cc: Files ✓