

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M11-190

DIST. 6 REGION

W.P. No. 131-85-02/03

CONT. No. 93-23

W. O. No.

STR. SITE No. 37-198

HWY. No. 400

LOCATION Hwy 400 at Sheppard Ave. &
Retaining Wall

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

G.I.-30 SEPT. 1976

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 93-23



Ministry of
Transportation

INDEX

<u>Page No:</u>	<u>DESCRIPTION</u>
1	Index
2	Abbreviations & Symbols
3 - 52	Foundation Investigation Report for Sheppard Avenue Underpass W.P. 131-85-02, Site 37-198 Hwy. 400, District 6, Toronto Sheppard Avenue and Bartor Rd. Underpass W.P. 131-85-04, Site 37-1019 Hwy. 400, District 6, Toronto

Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

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

FOUNDATION INVESTIGATION REPORT

for

Sheppard Avenue Underpass

W.P. 131-85-02, Site 37-198

Hwy 400, District 6, Toronto

1.0 INTRODUCTION

The Foundation Design Section of the Ministry of Transportation, Ontario, under Consultant Agreement No: 4238-9088-235, has retained the services of Strata Engineering Corporation to carry out a foundation investigation at the site of a new underpass to be located at Sheppard Avenue and Highway 400. The new structure is intended to accommodate:

- widening of Sheppard Avenue to 6 lanes;
- construction of Torbarrie Road located adjacent to and immediately to the east of Highway 400;
- widening of Highway 400 north and south bound lanes; and
- construction of Highway 400 north and south bound detour lanes.

The terms of reference for this study are outlined in Consultants Agreement No: 4238-9088-235 dated 1988 10 18. This report is submitted in compliance with those terms of reference.

2.0 SITE AND GEOLOGY

The site is located at the junction of Highway 400 and Sheppard Avenue in North York, Ontario. This is primarily a residential/commercial land use area.

The topography of the site is relatively flat. This general area has been subject to past continental glaciation, and the overburden reflects several advances and retreats of the ice with accompanying interstadial stages, represented by mostly glacial lake deposits interspersed within till sheets. The youngest till sheet is the Wildfield Till which is underlain by the Peel ponding deep water deposits followed by Halton Till. The bedrock is shale of the Georgian Bay formation, and occurs at depths in excess of 13 m below present ground level.

3.0 FIELD AND LABORATORY WORK

The field work was commenced on 1989 01 25, using a truck mounted CME 55 drill rig until 1989 02 06 at which time a bombardier mounted CME 55 drill rig was mobilized to the site for reasons of accessibility. Drilling was completed by 1989 02 23. In all, 14 boreholes (BH # 1 to 14) were drilled, at locations as shown on Drawings 1318502-A.* All boreholes were advanced using hollow stem augers.

Samples in the dense or hard fill and till strata were obtained using the Standard Penetration Test (SPT) with the accompanying N values being noted in blows per 0.3 m. Samples taken in a firm to stiff silty clay/clayey silt stratum were obtained using both the SPT and 50 and 75 mm diameter thin wall tubes. The thin wall tube samples were obtained by manually or hydraulically pushing them into the soil. Such sampling was usually followed by a field vane test to determine the in situ undrained shear strength.

* SHEET NO 174 OF THE CONTRACT DWG'S.

All but one of the boreholes were advanced to bedrock. In selected boreholes, BX size core samples were taken to confirm bedrock type and quality.

Dynamic cone penetration resistance tests were conducted in two boreholes (BH 3 and 7) with the accompanying blow count values being noted in blows per 0.3 m.

Upon completion, and wherever possible, the boreholes were left open to observe groundwater levels periodically. Water level observations were continued until 1989 05 10. All boreholes on Sheppard Avenue (BH 1, 2, 6, 8 and 9) had to be backfilled immediately upon completion. Therefore, reliable water level readings for these boreholes are not available. All other boreholes were left open for as long as feasible before they were backfilled.

Boreholes were located in the field by measuring from existing landmarks. Ground elevations at the borehole locations were obtained from Plan E-72-400-1.

Recovered soil samples were placed in moisture proof containers and immediately shipped to our laboratory for further visual examination, classification and testing. Tests were carried out for: moisture contents, Atterberg Limits, grain size distributions, consolidation characteristics, and undrained shear strength (both quick triaxial and unconfined compression). The results of the field boring program and laboratory tests are shown on Borehole Log Sheets 1 to 14 and Figures 1 to 7 in the Appendix.

All rock cores were examined immediately upon recovery from the core barrel. Core recoveries and RQD's were measured in the field.

4.0 SUBSOIL CONDITIONS

4.1 General

The subsoil conditions across the site are fairly uniform. Below a variable cover of surficial fill materials, the predominant soil type is a stiff to hard glacial till. This is underlain by a firm to stiff deep water deposit of silty clay/clayey silt which in turn is underlain by a glacial till over shale bedrock.

4.2 Surficial Materials

Surficial materials encountered at this site consisted of topsoil or asphalt pavement.

4.2.1 Topsoil

The topsoil consists of a slightly organic clayey silt. Its thickness was found to vary from 75 to 150 mm. Topsoil up to 200 mm thick was also found below existing fill materials.

4.2.2 Asphalt and Granular Base Materials for Sheppard Avenue

The asphalt pavement on Sheppard Avenue ranges in thickness between 180 mm and 480 mm, with an average thickness of about 250 mm. The sand and gravel base thickness ranged from 300 mm on the east side of the existing bridge to 1.1 m on the west side of the existing bridge.

4.2.3 Sheppard Avenue Fill

The existing Sheppard Avenue approach fills are approximately 7 to 8 m in height above the surrounding lands. The fill material is a clayey silt with some sand and trace of gravel. The following table summarizes its characteristics:

Soil Type:	Clayey Silt with some sand, trace gravel and occasional cobbles (Fill)		
Upper Elevation:	153.5 m		
Thickness (m):	Range: 6.8 to 7.5	Ave: 7.0	
Colour:	Brown		
N Values (blows/0.3 m):	Range: 8 to 37	Ave: 18	
Consistency:	Firm to Hard		
Water Content (%):	Range: 15 to 25	Ave: 20	
Atterberg Limits (%):	$W_L = 26$; $W_P = 12$; $I_P = 14$ (see Fig. 1)		
Unit Weight (kN/m ³):	22		

4.2.4 Highway 400 Median Pavement Structure

The asphalt pavement thickness on Highway 400 at Borehole 5 in the median area was 355 mm. Sand and gravel base material was 1.2 m in total thickness.

4.3 Clayey Silt (Upper Glacial Till)

A cohesive glacial till was found immediately below the existing fill and topsoil throughout the site. This upper glacial till stratum consists of a clayey silt, some sand, and trace of gravel. The following table summarizes its characteristics:

Soil Type:	Clayey silt, some sand and trace gravel (glacial till)	
Upper Elevation:	146.5 m	
Thickness (m):	Range: 3.1 to 4.3	Ave: 3.5
	(The deposit becomes thinner towards the east).	
Colour:	Brown to mottled to grey	
N Values (blows/0.3 m):	Range: 12 to 64	Ave: 30
Consistency:	Stiff to Hard	
Water Content (%):	Range: 15 to 30	Ave: 20
Atterberg Limits (%):	$W_L = 32$; $W_P = 18$; $I_P = 14$ (see Fig. 2)	
Unit Weight (kN/m^3):	22	

A perched groundwater table was generally encountered within this stratum.

4.4 Clayey Silt/Silty Clay

The upper glacial till stratum is underlain by a deposit of clayey silt to silty clay, with trace of sand. The consistency of this stratum varied generally between firm and stiff. Consolidation Tests (Figs. 4 and 5) indicate the deposit is almost normally consolidated. The following table summarizes its characteristics:

Soil Type:	Clayey silt/silty clay with trace sand	
Upper Elevation:	143.4 m	
Thickness (m):	Range: 1.6 to 5.3	Ave: 3.0
Colour:	Grey	
N Values (blows/0.3 m)	Range: 4 to 15	Ave: 9
Consistency:	Firm to Stiff	
Water Content (%):	Range: 21 to 37	Ave: 25
Atterberg Limits (%):	$W_L = 35$; $W_P = 19$; $I_P = 16$ (see Fig. 3)	
Unit Weight (kN/m^3):	22	

Shear Strength (kPa) as determined by various methods:

Field Vane:	Range: 30 to 85	Ave: 50
Quick Triaxial:	26 to 45	
Unconfined:	27 to 52	
Strain at failure ($e_f - \%$)	12 - 15	
Sensitivity:	Range: 2 to 4	Ave: 3
Preconsolidation Pressure Range (see also Figs.4 and 5):		
Below existing fill (BH 2)	130 - 180 kPa	
Below existing ground (BH 14)	100 - 110 kPa	

4.5 Clayey Silt (Lower Glacial Till)

The clayey silt/silty clay stratum is underlain by a lower glacial till comprising clayey silt, some sand, and trace of gravel. This stratum was found only on the east side of the proposed Hwy 400 Detour NBL. Its thickness was 3 m at the proposed east abutment location. The following table summarizes its characteristics:

Soil Type:	Clayey silt, some sand and gravel (glacial till)	
Upper Elevation:	140.7 m	
Thickness (m):	Range: 3.0 to 9.0	Ave: 6.0
Colour:	Grey	
N Values (blows/0.3 m)	Range: 8 to 105	Ave: N/A
Consistency:	Firm to Hard	
Water Content (%):	Range: 8 to 31	Ave: 15
Atterberg Limits (%):	$W_L = 23$; $W_p = 10$; $I_p = 13$ (see Fig. 6)	
Unit Weight (kN/m^3):	22	

The Standard Penetration Resistance N values were generally higher in the most eastern part of the site, and tended to increase with depth.

4.6 Sandy Silt Glacial Till

The lowest overburden material encountered at this site was a sandy silt glacial till containing some clay and trace of gravel; occasional cobbles and boulders are suspected to be present based on resistance to auger penetration. The stratum is thickest (9.3 m) at the proposed west bridge abutment location, and gradually thins out to 2 m at the proposed east abutment location, disappearing completely to the east of this abutment. The clay content increases with depth. Some Standard Penetration Resistance N values were very low in the upper part of this layer probably as a result of localized "boiling" under unbalanced hydrostatic conditions. These low N values, therefore, should not be considered as indicative of the in situ soil density.

The following table summarizes the main characteristics of this stratum:

Soil Type:	Sandy silt with some clay gravel (glacial till)
Upper Elevation:	140.5 m
Thickness (m):	Range: 2.0 to 9.3 Ave: 5.0
Colour:	Grey
N Values (blows/0.3 m):	Range: 0 to 128 Ave: N/A
Density Index:	Compact to V. Dense
Water Content (%):	Range: 7 to 17 Ave: 10
Atterberg Limits:	Not Plastic
Grain Size (%):	Gravel: 0 to 12; Sand: 31 to 36; Silt and Clay: 53 to 69 (see Fig. 7)
Unit Weight (kN/m ³):	22

4.7 Shale Bedrock

Shale bedrock was encountered at elevations ranging between 130 m at the west abutment location and 134 m at the east abutment location.

Therefore, the depth to bedrock varies between 20 and 24 m at the existing structure location (as measured from the surface of Sheppard Ave.)

The bedrock is thinly bedded and highly weathered in the upper 1 to 2 m. It was possible to sample the bedrock with the split-spoon sampler at and just below the overburden contact (as in BH's: 2,4,5,6,9,10. The quality of the bedrock was determined by core evaluation in BH's: 1,3,7,8 and 12. Core recoveries ranged between 60 and 100 per cent. The RQD values were generally low, and are ascribed to the thin bedding. The shale is generally hard below the weathered zone. Occasional dolomite and limestone beds, up to 160 mm thick, are present within the upper 3 m of the formation.

5.0 GROUNDWATER CONDITIONS

Groundwater levels were monitored during the course of the field investigation and wherever possible, note was taken of the depth at which water was encountered in each borehole during drilling. Groundwater measurements were continued on a frequent basis until their levels had stabilized. Measurement data are given below:

Borehole #	Init.	1989										
	W.L.	02/28	03/02	03/07	03/14	03/16	05/10					
1	138.9	(not stabilized - backfilled)										
2	No W.L.											
3	145.7	145.7										
4	145.4	145.4										
5	141.7	(was backfilled on completion)										
6	No W.L.											
7	143.0	144.7	145.4	145.5	145.6	145.9	146.2					
8	139.5	(not stabilized - backfilled)										
9	137.5	(not stabilized - backfilled)										
10	No W.L.	145.6	145.7	145.7	145.8	145.8	Caved					
14	No W.L.	143.2	143.7	145.1	145.4	145.4	146.5					

From the above, it is concluded that the groundwater at this site is at elevation 146 m. or about 1 m below prevailing ground level.

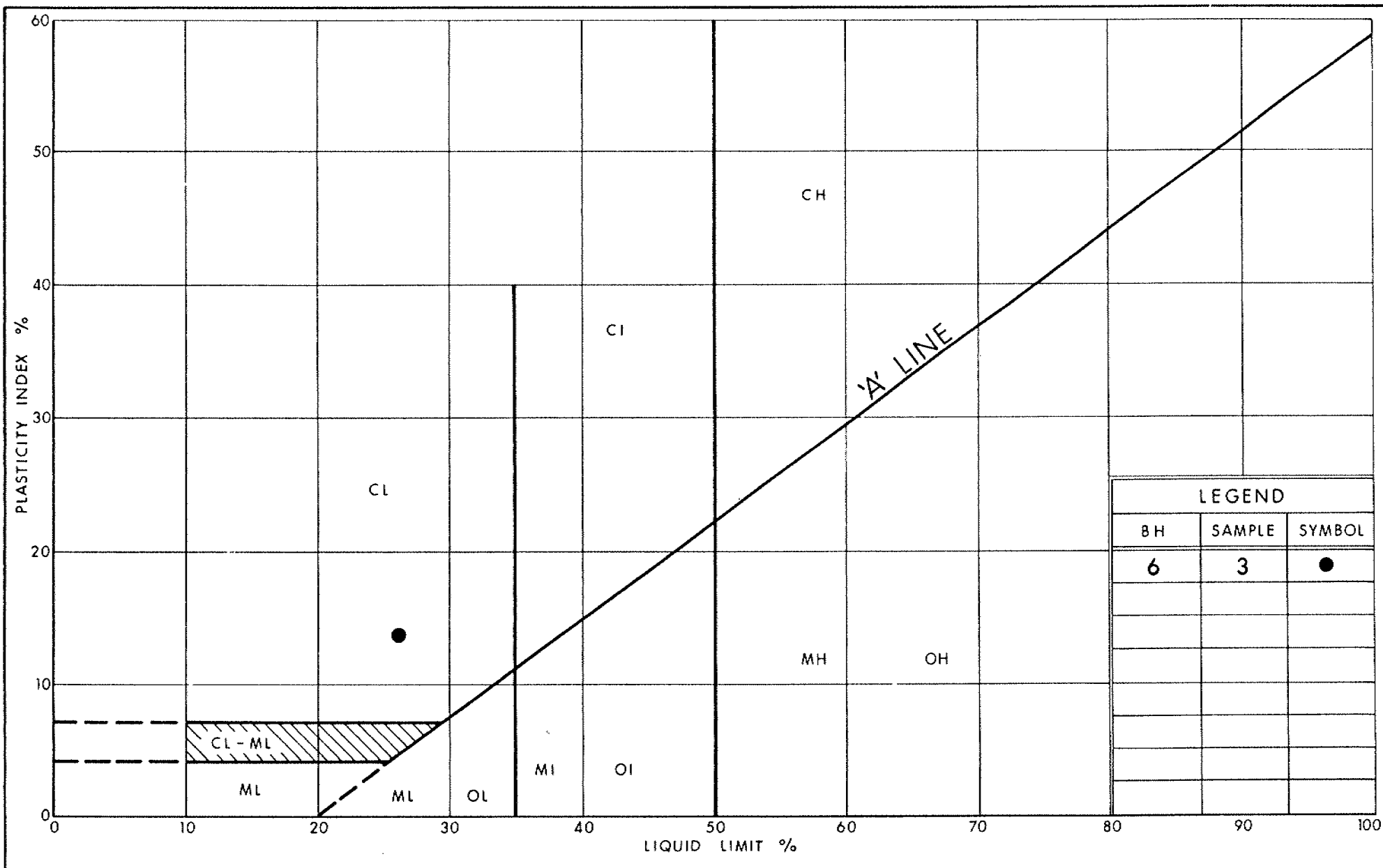
Note: The preceding report is a copy of the factual information from the Foundation Report prepared by STRATA ENGINEERING CORPORATION (consulting geotechnical engineers for this project), under the technical supervision of the M.T.O. Foundation Design Section.



D. Dundas
D. Dundas, P. Eng.
Sr. Foundation Engineer

M. Devata
M. Devata, P. Eng.
Chief Foundation Engineer

A P P E N D I X



Ministry of
Transportation

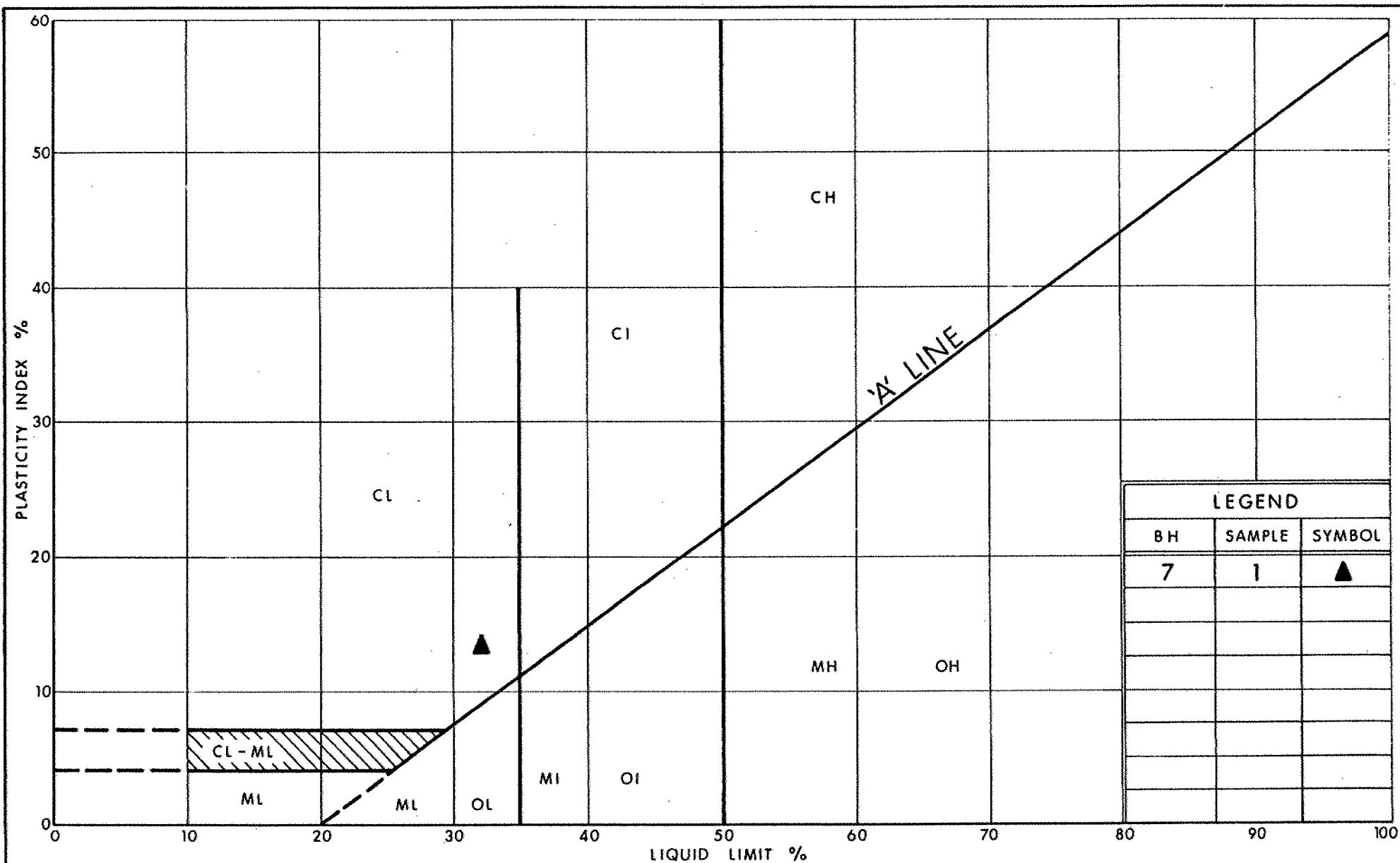
PLASTICITY CHART CLAYEY SILT (Fill)

FIG No 1

W P 131-85-02

400 & Sheppard

10



Ministry of
Transportation

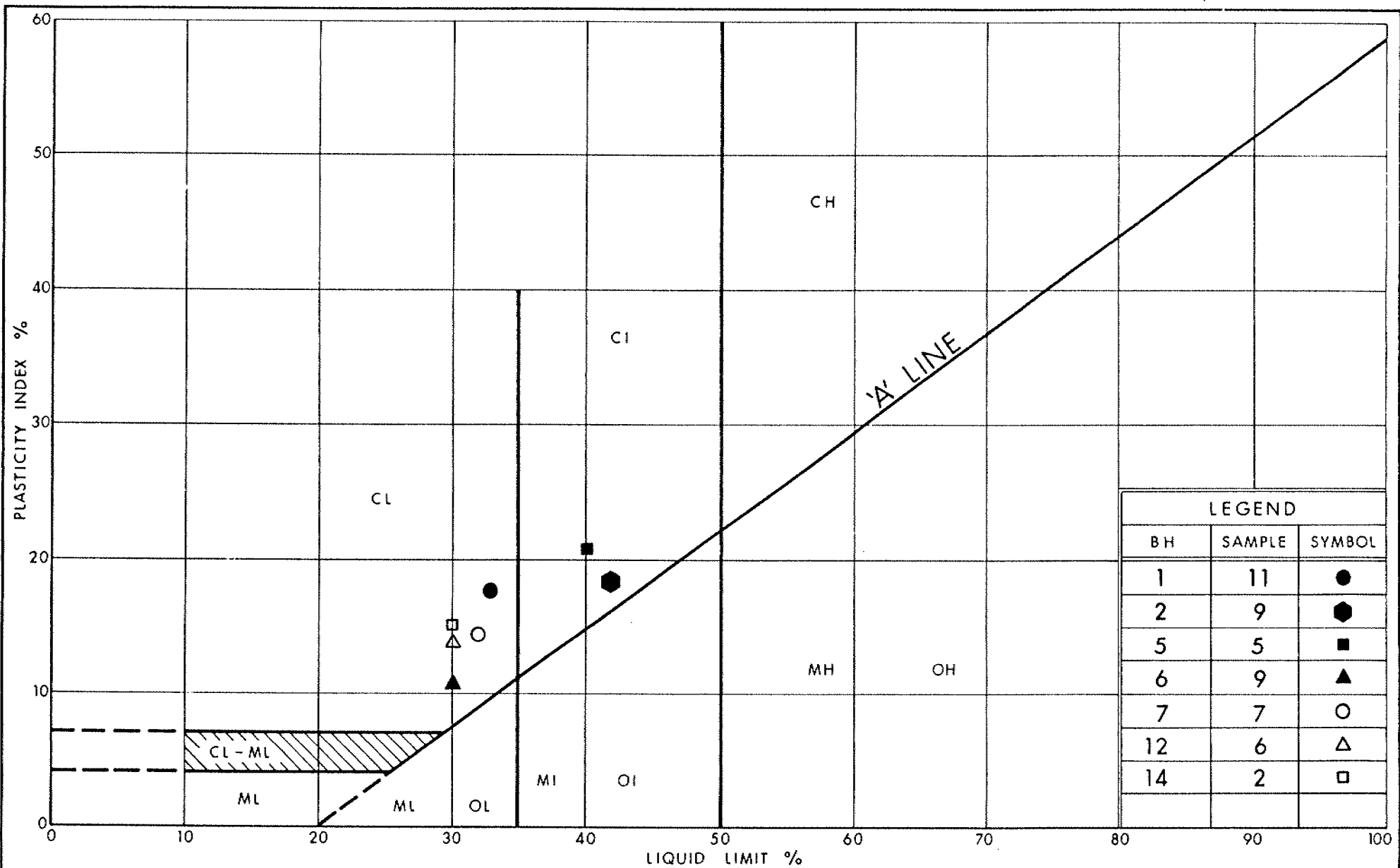
PLASTICITY CHART CLAYEY SILT (Upper Glacial Till)

FIG No 2

W P 131-85-02

400 & Sheppard

17



Ontario

Ministry of
Transportation

PLASTICITY CHART CLAYEY SILT / SILTY CLAY

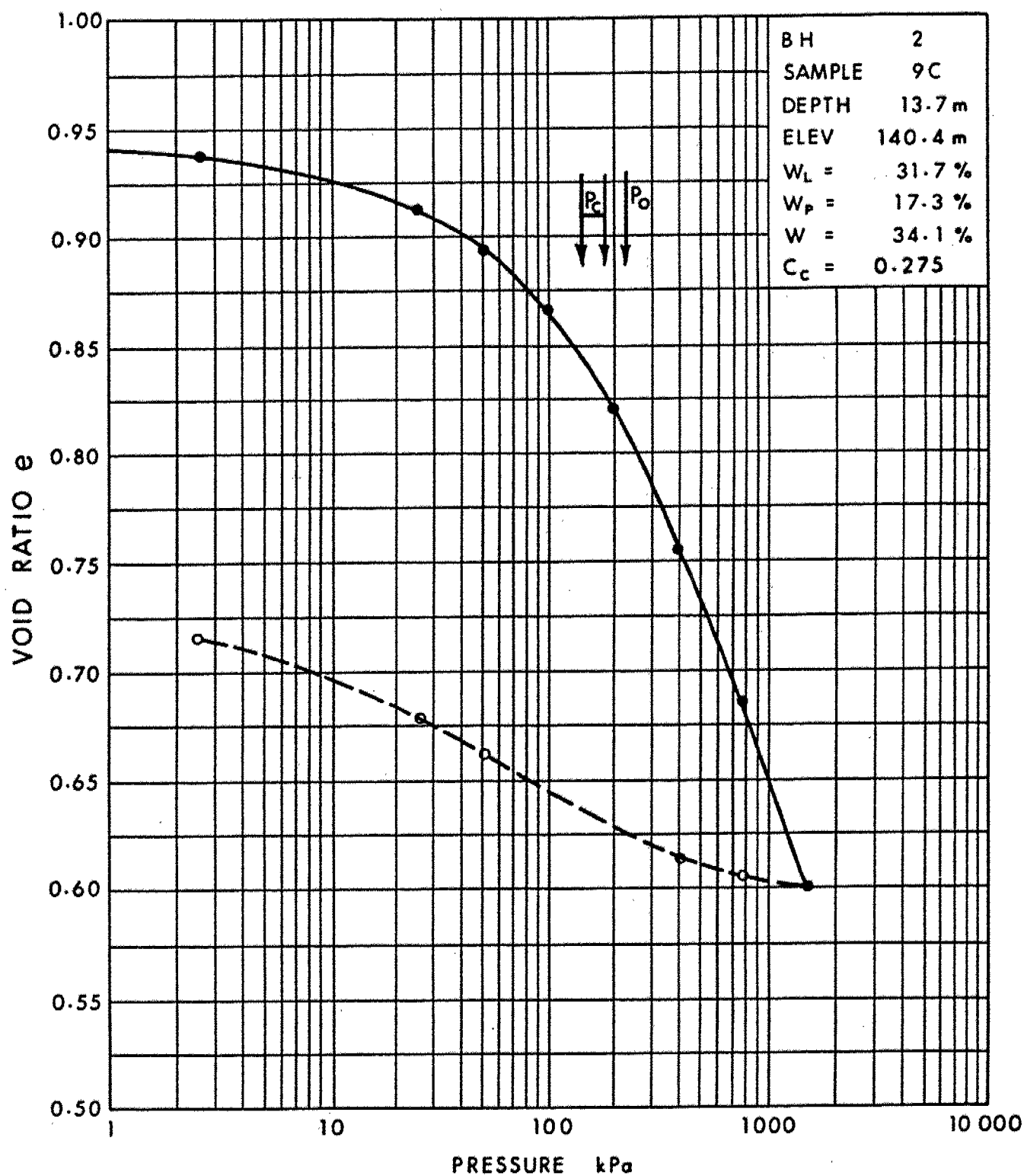
FIG No 3

W P 131-85-02

400 & Sheppard

∞

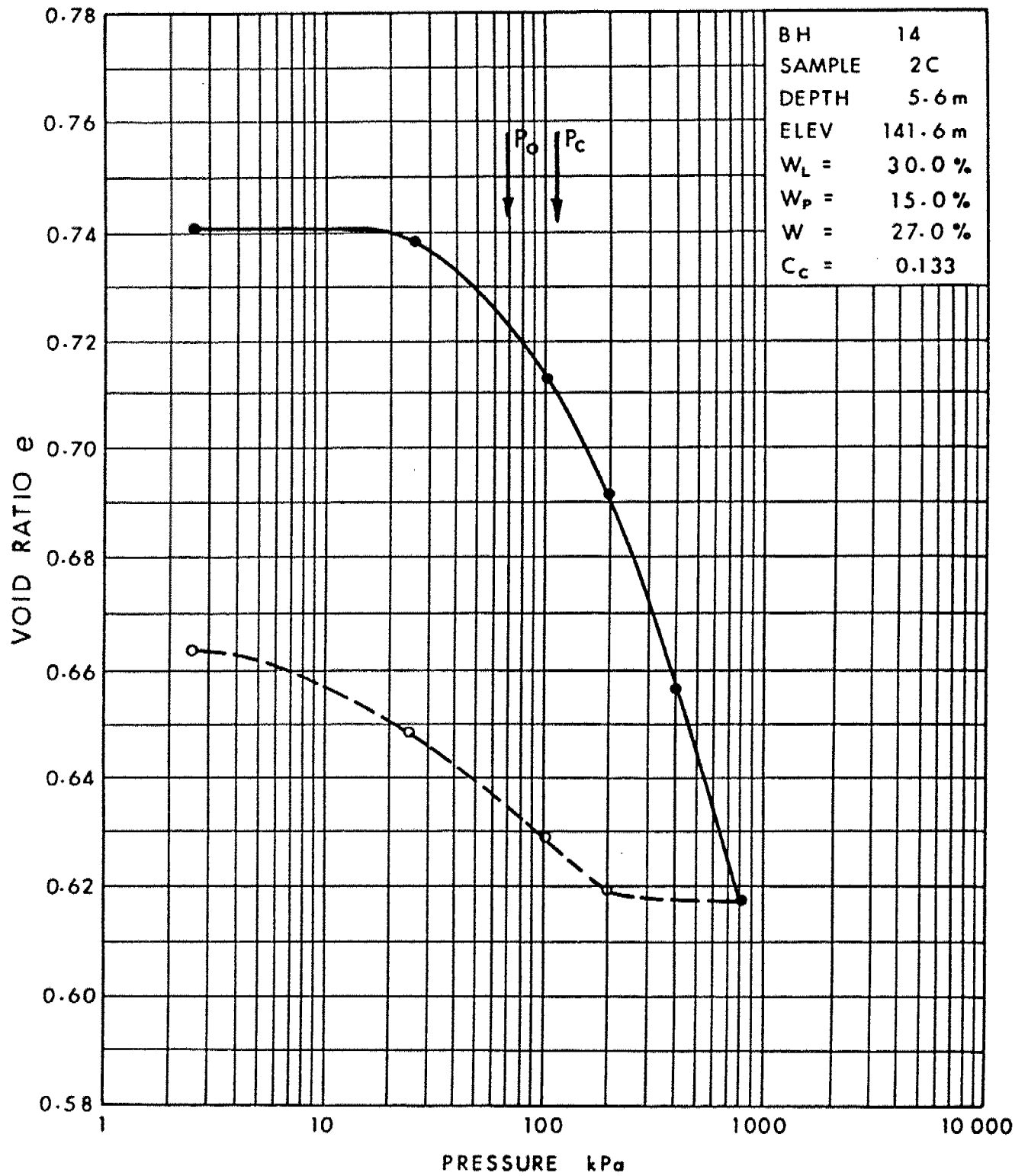
VOID RATIO - PRESSURE CURVE



WP 131-85-02

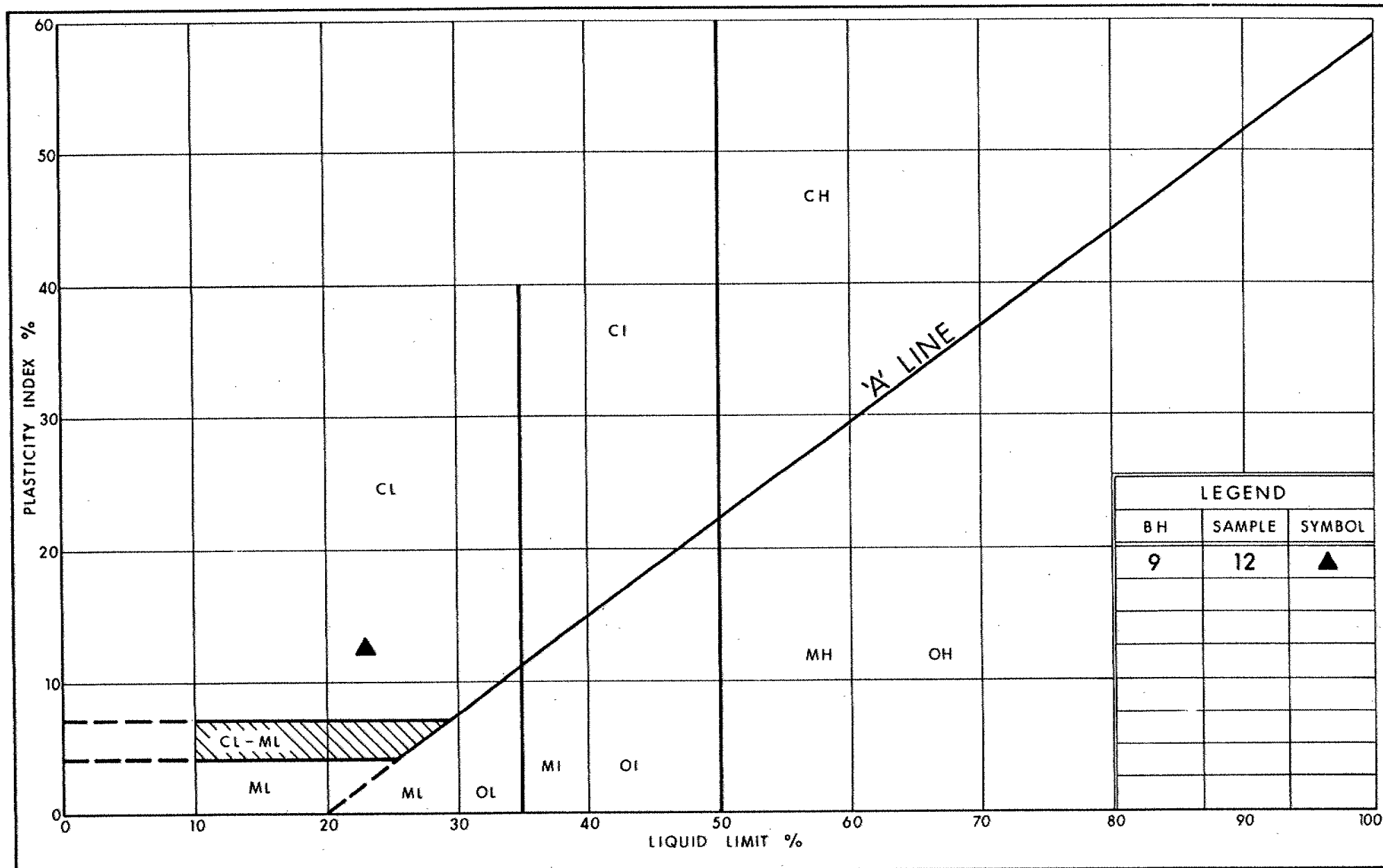
Fig 4

VOID RATIO - PRESSURE CURVE



WP 131-85-02

Fig 5



Ministry of
Transportation

Ontario

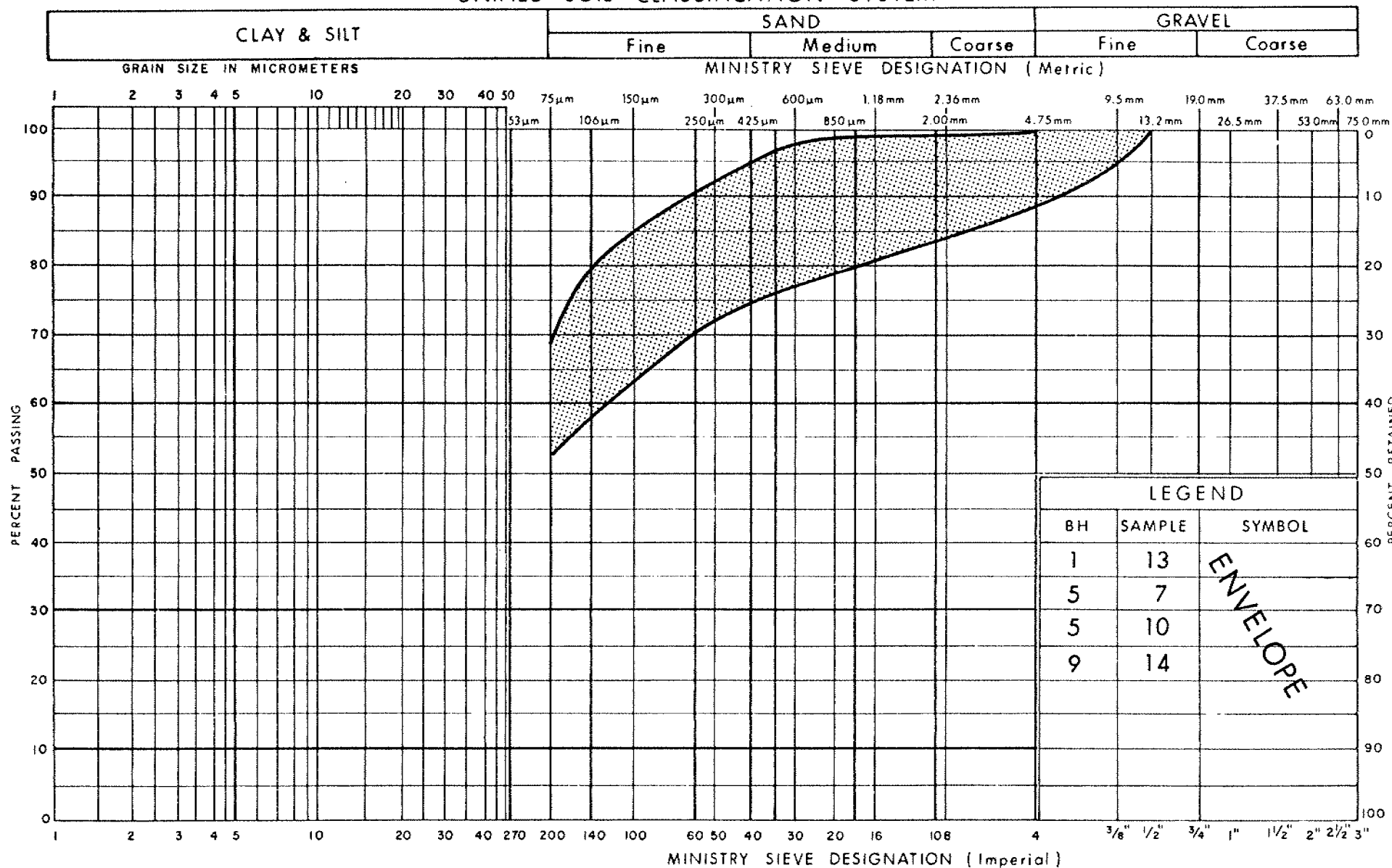
PLASTICITY CHART CLAYEY SILT (Lower Glacial Till)

FIG No 6

W P 131-85-02

400 & Sheppard

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT, SOME CLAY TRACE GRAVEL
(Glacial Till)

FIG No 7

W P 131-85-02

400 & Sheppard

22

RECORD OF BOREHOLE No 1

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 819.8; E. 302 624.6 ORIGINATED BY EH
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 01 31 and 1989 02 01 CHECKED BY CM

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					
154.1	Road Surface						154										
0.0	Asphalt																
153.0	Sand and Gravel (Granular Base)																
1.1			1	SS	8												
	Clayey Silt with some Sand		2	SS	8												
	Brown																
	Firm to V. Stiff		3	SS	17												
	(Fill)		4	SS	10												
	Occasional		5	SS	28												
	Cobbles		6	SS	50												
146.2			7	SS	21												
7.9	Clayey Silt, some Sand		8	SS	33												
	Brown to Grey																
	V. Stiff to Hard		9	SS	36												
	(Glacial Till)																
142.6			10	SS	11												
11.5	Clayey Silt		11	SS	8												
	Grey																
	Stiff																
139.5			12	TW	PH												
14.6			13	SS	36												
	Sandy Silt, some Clay, trace Gravel		14	SS	46												
	Grey		15	SS	99												
	Dense to V. Dense		16	SS	128												
	(Glacial Till)		17	SS	61												
	occasional thin Sand seams																
130.2			18	SS	70												
23.9	Shale Bedrock		19	BX	Rec. 80%												
128.1	Thinly bedded																
26.0	End of Borehole																
	* W.L. not stabilized																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RQD = 0%

Free Water
encountered
at 8.0 m ±
depth

W.L. on
1989 02 01

02 36 (62)

22.7

21.3

RECORD OF BOREHOLE No 2

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 808.1; E. 302 626.1 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 02 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
154.1	Road Surface						154							
153.7	Asphalt													
153.0	Sand and Gravel													
147.1	Clayey Silt with some Sand Brown Stiff to V. Stiff (Fill) trace Organics		1	SS	47	*	152							Cobble encountered
			2	SS	10		150							
			3	SS	16		148							
			4	SS	14		146							
147.1			5	SS	34		144							
7.0	Clayey Silt, some Sand, occasional Sand Lenses Mottled V. Stiff to Hard (Glacial Till)		6	SS	64		142							Free Water encountered at 8.0 m \pm depth
			7	SS	27		140							
142.8			8	SS	15		138							
11.3	Silty Clay, trace Sand Grey Stiff		9	TW	PH		136							
139.2			10	SS	18		134							
14.9	Sandy Silt, trace Clay and Gravel Grey Compact to V. Dense increasing Clay content with depth (Glacial Till)		11	SS	0		132							Consol. Test (fig.4)
			12	SS	14		130							
			13	SS	67/13cm									Probable "boiling" of soil
			14	SS	63									
			15	SS	37									
130.3			16	SS	100/5cm									
129.9	Probable Bedrock													
24.2	End of Borehole * W.L. not obtained													

+3, x5: Numbers refer to
Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 131-85-02

LOCATION CO-ORDS N. 4 843 784.6; E. 302 630.1

ORIGINATED BY EH

DIST 6 HWY 400

BOREHOLE TYPE Hollow Stem Auger and Cone Test

COMPILED BY EH

DATUM Geodetic

DATE 1989 02 16

CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa		PLASTIC LIMIT W _p	W	LIQUID LIMIT W _L		
147.2	Ground Surface							20 40 60 80 100						
0.0	Topsoil							○ UNCONFINED + FIELD VANE						
	Clayey Silt with some Sand		1	SS	21		146	● QUICK TRIAXIAL x LAB VANE						
	Brown													
	V. Stiff													
	(Glacial Till)		2	SS	22		144							
143.2														
4.0	Clayey Silt, trace Sand		3	SS	5		142							
	Grey		4	TW	PM		140							
	Firm to Stiff		5	SS	8									
137.9			6	SS	41		138							
9.3	Sandy Silt, trace Clay and Gravel		7	SS	73		136							
	Grey		8	SS	73		134							
	Dense to V. Dense		9	SS	42		132							
	(Glacial Till)		10	SS	36									
130.9			11	SS	60A		130							
16.3	Shale Bedrock Thinly bedded		12	BX	Rec. 100%									
	occasional Dolomite Beds (100mm thick)		13	BX	Rec. 100%									
128.1														
19.1	End of Borehole													

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Free Water
encountered
at 9.1 m ±
depth

RQD = 0%

RQD = 55%

W.L. on
1989 02 28

RECORD OF BOREHOLE No 4

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 766.9; E. 302 625.8 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 06 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ KN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
147.0	Ground Surface															
0.0	Topsoil															
	Clayey Silt with some Sand Brown V. Stiff (Glacial Till)		1	SS	18	146									22.7	W.L. on 1989 02 28
143.3			2	SS	27	144										
3.7	Clayey Silt Grey Firm to Stiff		3	SS	15	142										
140.5			4	SS	4	140										
6.5	Sandy Silt, some Clay, trace Gravel Grey Dense to V. Dense (Glacial Till)		5	TW	PH	138										
			6	SS	51	136										
133.8			7	SS	41	134									23.8	
133.0	Shale Bedrock		8	SS	58/15cm											
14.0			9	SS	60/0cm											
	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
15
20
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

METRIC

W P 131-85-02

LOCATION CO-ORDS N. 4 843 812.6; E. 302 658.9

ORIGINATED BY EH

DIST 6 HWY 400

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY EH

DATUM Geodetic

DATE 1989 02 03

CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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					
148.1	Road surface																
147.7	Asphalt																
0.4	Sand and Gravel																
146.9																	
1.2	Clayey Silt with some Sand		1	SS	13												
	Brown		2	SS	25												
	Stiff to V. Stiff (Glacial Till)		2	SS	23												
142.9																	
5.2	Silty Clay, occasional Sand Partings Grey Stiff		4	SS	14												
			5	TW	PH												
139.9																	
8.2	Sandy Silt, some Clay, trace Gravel		6	SS	15												
	occasional Sand Lenses		7	SS	12												
	Grey		8	SS	113												
	Compact to V. Dense		9	SS	60/	8cm											
	(Glacial Till)		10	SS	80												
131.5			11	SS	100	13cm											
16.6	Shale Bedrock		12	SS	60/	3cm											
130.1																	
18.0	End of Borehole																
	* W.L. not stabilized																

RECORD OF BOREHOLE No 6

METRIC

W.P. 131-85-02 LOCATION CO-ORDS N. 4 843 840.2; E. 302 691.0 ORIGINATED BY MP
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 01 25 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							W _p	W	W _L
								SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
								20 40 60 80 100					10 20 30				
154.1	Road Surface					*	154										
153.5	Asphalt						152										
0.6	Sand and Gravel						150										
	Clayey Silt with some Sand		1	SS	9		148										
	Brown		2	SS	17												
	Stiff to V. Stiff	3	SS	23													
	(Fill)	4	SS	19													
146.2			5	SS	29			146									
7.9	Clayey Silt, some Sand, trace Gravel	6	SS	52			144										
	Brown	7	SS	19			142										
	V. Stiff to Hard	8	SS	6			140										
	(Glacial Till)	9	TW	PM			138										
142.5			10	TW	PM			136									
11.6	Clayey Silt, trace Sand		11	SS	15			134									
	Grey		12	SS	39												
	Firm		13	SS	72												
139.2			14	SS	65/0cm												
14.9	Sandy Silt, some Clay																
	Grey																
	Compact to Dense																
	(Glacial Till)																
134.6																	
19.5	Shale Bedrock																
132.8																	
21.3	End of Borehole																
	* W.L. not obtained																

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 131-85-02/03 LOCATION CO-ORDS N. 4 843 808.3; E. 302 697.6 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY EH
 DATUM Geodetic DATE 1989 02 17 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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				
146.5 0.0	Ground Surface															
	Clayey Silt, trace Sand		1	SS	21		146								22.0	W.L. on 1989 03 16
	V. Stiff to Hard (Glacial Till) brown grey		2	SS	39		144								22.0	
142.4 4.1	Clayey Silt, trace Sand		3	SS	18										21.7	Free Water encountered at 3.2m ± depth
	Grey		4	SS	6		142									
	Soft to Firm		5	TW	PH											
139.2 7.3	Sandy Silt, some clay occasional Sand Lenses		6	SS	4		140									
	Grey		7	TW	PM											
	Compact to V. Dense increasing Clay content with depth (Glacial Till)		8	SS	18		138									
133.1	Granitic Boulder		9	SS	12											
	Shale Bedrock Thinly Bedded occasional Dolomite and Limestone Beds (110 to 160mm Thick)		10	SS	81		136									
130.6 15.9	End of Borehole		11	SS	55		134									
			12	BX	Rec. 59%		132									RQD = 0%
			13	BX	Rec. 92%											RQD = 18%

RECORD OF BOREHOLE No 8

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 846.4; E. 302 711.3 ORIGINATED BY MP
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 01 26 CHECKED BY CM

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 kPa			WATER CONTENT (%)		
																		○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
153.8	Road Surface																						
153.4	Asphalt																						
0.4	Sand and Gravel																						
	Clayey Silt with some Sand		1	SS	11		152																
	Brown		2	SS	19		150																
	Stiff to V. Stiff (Fill)		3	SS	14		148																
			4	SS	21		146																
145.9			5	SS	10		144																
7.9	Clayey Silt, trace Sand		6	SS	51		142																
	Brown		7	SS	41		140																
142.0	Stiff to Hard (Glacial Till)		8	SS	14		138																
11.8	Silty Clay		9	SS	9		136																
	Grey		10	TW	PH		134																
139.2	Stiff		11	SS	9		132																
14.6	Clayey Silt, some Sand		12	SS	76																		
	Grey, V. Dense (Glacial Till)		13	SS	63																		
136.4	Sandy Silt, some Clay		14	BX	Rec. 20%																		
17.4	Grey, V. Dense (Glacial Till)		15	BX	Rec. 89%																		
134.1	Shale Bedrock Thinly Bedded occasional Dolomite Beds (100mm Thick)																						
19.7																							
131.2																							
22.6	End of Borehole																						
	* W.L. not stabilized																						

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9										METRIC									
W P 131-85-02		LOCATION CO-ORDS N. 4 843 834.6; E. 302 713.3				ORIGINATED BY EH													
DIST 6 HWY 400		BOREHOLE TYPE Hollow Stem Auger				COMPILED BY EH													
DATUM Geodetic		DATE 1989 01 30				CHECKED BY CM													
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	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						20	40
153.8	Road Surface																		
153.3	Asphalt																		
0.5	Sand and Gravel																		
	Clayey Silt with some Sand		1	SS	12														
	Brown		2	SS	8														
	Firm to Hard (Fill)		3	SS	27														
			4	SS	37														
			5	SS	26														
145.9			6	SS	12														
7.9	Clayey Silt, some Sand		7	SS	13														
	Mottled		8	SS	46														
	Stiff to Hard (Glacial Till)		9	SS	24														
141.9																			
11.9	Clayey Silt Grey		10	SS	18														
140.3	V. Stiff																		
13.5	Clayey Silt, some Sand and Gravel		11	SS	12														
	Grey		12	TW	PH														
	Stiff (Glacial Till)		13	SS	8														
136.1																			
17.7	Sandy Silt, some Clay		14	SS	82														
134.3	Grey, V. Dense (Glacial Till)																		
133.7	Shale Bedrock		15	SS	100/5cm														
20.1	End of Borehole																		
	* W.L. not stabilized																		

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 817.0; E. 302 717.7 ORIGINATED BY EII/MP
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EII
 DATUM Geodetic DATE 1989 02 22 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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			20	40	60	80	100					
147.7	Ground Surface															
0.0	Topsoil															
145.9	Silty Sand, trace Gravel Brown, Compact to Dense, (Fill)		1	SS	27							o				
1.8	Clayey Silt, some Sand Brown to Mottled Stiff to V. Stiff (Glacial Till)		2	SS	14							o				
142.8			3	SS	19											
4.9	Clayey Silt, trace Sand Grey Firm		4	SS	13											
140.7			5	SS	8											
7.0	Clayey Silt, trace Sand and Gravel Grey Stiff (Glacial Till)		6	TW	PM											
137.6			7	SS	9											
10.1	Sandy Silt, some Clay Grey Compact to V. Dense (Glacial Till)		8	SS	10											
135.4			9	SS	13											
12.3	Shale Bedrock		10	SS	86											
134.5			11	SS	50/23cm											
13.2	End of Borehole															

+3, x⁵: Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 14

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 787.4; E. 302 701.5 ORIGINATED BY MP
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 02 22 CHECKED BY CM

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

$+^3, x^5$: Numbers refer to Sensitivity

15 ϕ 5 (%) STRAIN AT FAILURE

FOUNDATION INVESTIGATION REPORT
FOR
Sheppard Ave. and Bartor Rd. Underpass
W.P. 131-85-04, Site No. 37-1019
Hwy. 400, District 6, Toronto

INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned site. It is proposed to widen the existing Sheppard Ave. underpass at Bartor Rd. with an extension immediately south and adjacent to the existing structure.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately adjacent and south of the existing Sheppard Ave. underpass at Bartor Rd., approximately 100 m west of the Sheppard Ave. underpass at Hwy. 400 in the City of North York. The existing structure is a rigid frame structure with reinforced concrete girders and counterfort abutments and wing walls. The structure presently carries four lanes of traffic and pedestrian sidewalks on Sheppard Ave. over the two lane Bartor Rd.

Land use in the area is multi-purpose consisting of commercial, residential, recreational and industrial developments. A large golf course exists south-east of the proposed site.

Physiographically, the site is located in the region known as the "Peel Plain". This region is characterized by a level-to-undulating "till or boulder clay" deposited by the glacier during the Wisconsinan period. Glaciofluvial and glaciolacustrine deposits are also founded randomly interbedded in the soil stratigraphy. Bedrock in the region consists of shale or limestone of the Georgian Bay Shale Formation of the Ordovician period.

FIELD INVESTIGATION

The field work was carried out between 89 01 16 and 89 01 24 and consisted of five sampled boreholes and two dynamic cone penetration tests. Continuous

flight hollow stem augering techniques were used to advance the boreholes through the overburden. Bedrock was proven at the proposed west abutment location utilizing conventional rock coring methods.

Subsoil samples were retrieved at selected depths by means of a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586) and by a Shelby tube sampler. In situ vane tests were carried out wherever applicable, in order to determine the undrained shear strength of the cohesive material. The samples were identified in the field and then transported to the laboratory for further visual examination and testing on selected samples.

Water levels were obtained in the open boreholes and monitored until stabilized levels were achieved.

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

SUBSURFACE CONDITIONS

General

Subsoil conditions are generally uniform across the site. The native surficial layer consists of a soil that varies randomly from a clayey silt to silty clay that appears to be of glaciolacustrine origin. This stratum extends to a maximum thickness of 8.4 metres and consists of an upper dessicated crust underlain by a weaker, more compressible soil. Underlying this layer is a deposit of a heterogeneous mixture of clayey silt/silt, sand and gravel (glacial till) interbedded with a layer of silt with sand. This deposit was explored to a maximum thickness of 8.1 metres. The till deposit is underlain by shale bedrock.

Fill material consisting of an irregular mixture of sand, gravel and clayey silt compromises the approach material for the existing overpass structure and overlies the native surficial layer of clayey silt to silty clay at the site. Up to 6.4 metres of the fill material was identified at the selected sampling locations.

The boundaries between the various soil types, in situ and laboratory test results, as well as stabilized groundwater levels, are shown on the attached Record of Borehole Sheets provided in the Appendix. A plan of the site illustrating the locations and elevations of the boreholes and subsoil stratigraphical sections are provided on Dwg. 1318504-A.*

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

The approach material for the existing Sheppard Rd. overpass structure explored in the investigation consists of an irregular mixture of clayey silt, sand gravel (fill) that generally exhibits a cohesive behaviour. Figure 1 illustrates a typical grain size distribution for the material. The cohesive fill matrix that extends for a thickness of approximately 5.4 metres, underlies the granular roadway base that is approximately 1 metre in thickness.

The fill material is generally very stiff indicating an equivalent compact state of condition achieved during placement and subsequent loading.

Clayey Silt to Silty Clay

The native surficial deposit spread across the site consists of a soil that varies randomly in behaviour from a clayey silt to a silty clay. This layer ranges in thickness from 7.0 m to 8.4 m and can be subdivided into an upper dessicated, oxidized crust of thickness ranging from 2.7 m to 4.8 m overlying a grey saturated, weaker layer. Organic inclusions and occasional sand seams exist in the upper dessicated layer and "till-like" zones also exist randomly throughout the entire layer.

Atterberg Limits were obtained to evaluate the behaviour of this surficial layer and the results are plotted in Figure 2. A summary of the indices is provided in Tables 1 & 2 below.

* SHEET NO 205 OF THE CONTRACT DWG'S

Table 1 - Clayey Silt

	<u>Range (%)</u>	<u>Average (%)</u>
Moisture Content (w)	13-18	15
Liquid Limit (w_L)	23-32	28
Plastic Limit (w_p)	14-18	15
Plasticity Index (I_p)	9-14	13

Table 2 - Silty Clay

	<u>Range (%)</u>	<u>Average (%)</u>
Moisture Content (w)	22-34	26
Liquid Limit (w_L)	37-50	42
Plastic Limit (w_p)	19-23	21
Plasticity Index (I_p)	18-27	21

The results reveal that the deposit varies from a clayey silt of low plasticity to silty clay of intermediate plasticity.

Grain size distribution envelopes for the material are plotted in Figure 3.

Undrained shear strengths and associated consistencies of the deposit were determined by interpretation of 'N' values of the Standard Penetration Test, in situ vane tests and laboratory unconfined compression tests. The results, plotted on the boreholes in the Appendix and summarized on Table 3 below reveal that a generally very stiff to hard dessicated upper crust extending in thickness ranging from 2.7 m to 4.8 m overlies a weaker layer of generally firm to stiff consistency of thickness ranging from 2.3 m to 4.3 m.

Table 3 - Undrained Shear Strength
(Cu) (kPa)

<u>Layer</u>	<u>'N' Value</u>		
	<u>Blows/0.3 m</u>	<u>Field Vane</u>	<u>Lab Test</u>
Upper dessicated crust	13-46	N/A	N/A
Lower unoxidized	4-9	40-70	40-50

The results of a consolidation test (e - log p curve) of a representative sample of the lower weaker layer is shown in Figure 4. The test indicates that this layer has been preconsolidated in the past to an effective pressure some 375 kPa in excess of the existing effective overburden pressure.

Clayey Silt/Silt, some sand, trace gravel (Glacial Till)

Underlying the native surficial clayey silt to silty clay stratum exists a till deposit of glacial origin that consists of a heterogeneous mixture of clayey silt to silt, some sand, trace gravel interbedded with a layer of silt with sand layers. The deposit was explored for a maximum thickness of 6.8 m and was founded to overly bedrock.

The main component of the till deposit varies randomly from a low plasticity silt [ML] to a low plasticity clayey silt [CL]. Figure 5 illustrates the Atterberg Limits attained from the testing of the behaviour of this main component.

Based on 'N' values obtained from the Standard Penetration Test, the deposit can be considered as very dense (for the non-cohesive zones) or hard (for the cohesive zones).

Within the deposit, a layer of silt with sand is present. This layer is generally found interbedded between the surficial clayey silt to silty clay and the clayey silt/silt till deposit and ranges in thickness from 1.5 to 5.5 m. The denseness of this layer as determined by 'N' values of the Standard Penetration Test varies from dense to very dense but is generally very dense.

Although not encountered during the field investigation, boulders and cobbles are a characteristic component of glacial till deposits and consequently may exist in the deposit.

Bedrock

The glacial till deposit is underlain by bedrock which was proven at the proposed west abutment extension location by obtaining 3.5 metres of BQ size rock core samples. The bedrock surface exists at elevation 132.5 m.

The bedrock is a grey shale that is generally moderately to highly weathered and interbedded with clay seams and limestone. Detailed descriptions of the bedrock are attached in Table 4 in the Appendix, entitled "Description of Rock Core".

Core recoveries and rock quality designations (RQD) were determined in situ to evaluate the competence and integrity of the rock. Recoveries ranged from 58 to 94% and all RQD's were 0 (zero) %. It can be concluded from these results and visual examination that the shale is weak to very weak rock.

Groundwater Conditions

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. At the time of the field investigations, the stabilized groundwater elevations varied from 141.2 m to 142.3 m which is equivalent to depths ranging from 4.0 to 6.5 m below the natural ground surface. The stabilized groundwater level appears to coincide with the dessicated layer - weaker soil interface in the native surficial clayey silt to silty clay.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of F. Pinder, Engineer Trainee, utilizing equipment owned and operated by Master Soil Investigation. This report was written by F. Pinder and T. Sangiuliano and reviewed by Mr. M.S. Devata, Chief Foundation Engineer.

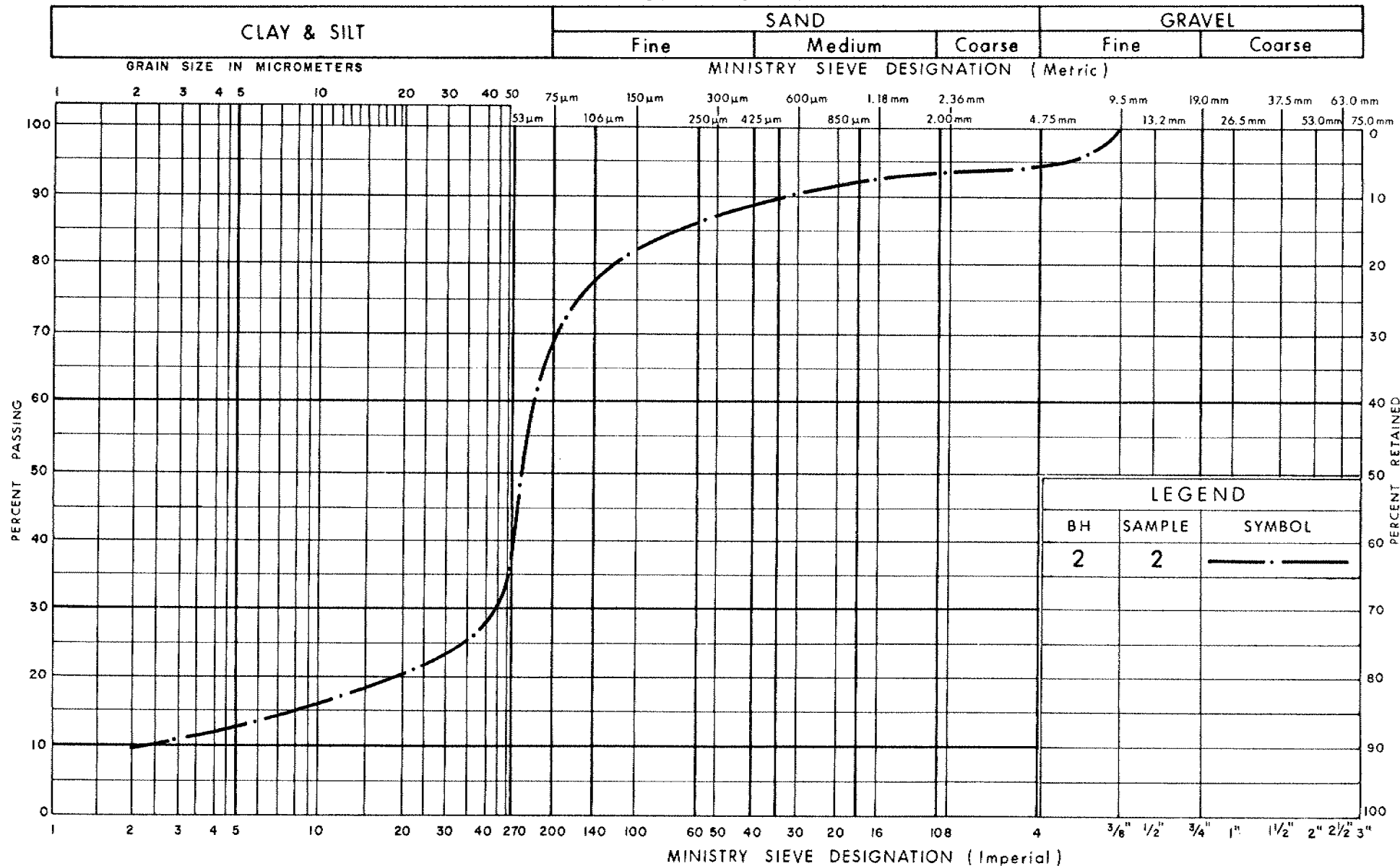


D. Dundas
D. Dundas, P. Eng.
Sr. Foundation Engineer

M. Devata
M. Devata, P. Eng.
Chief Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

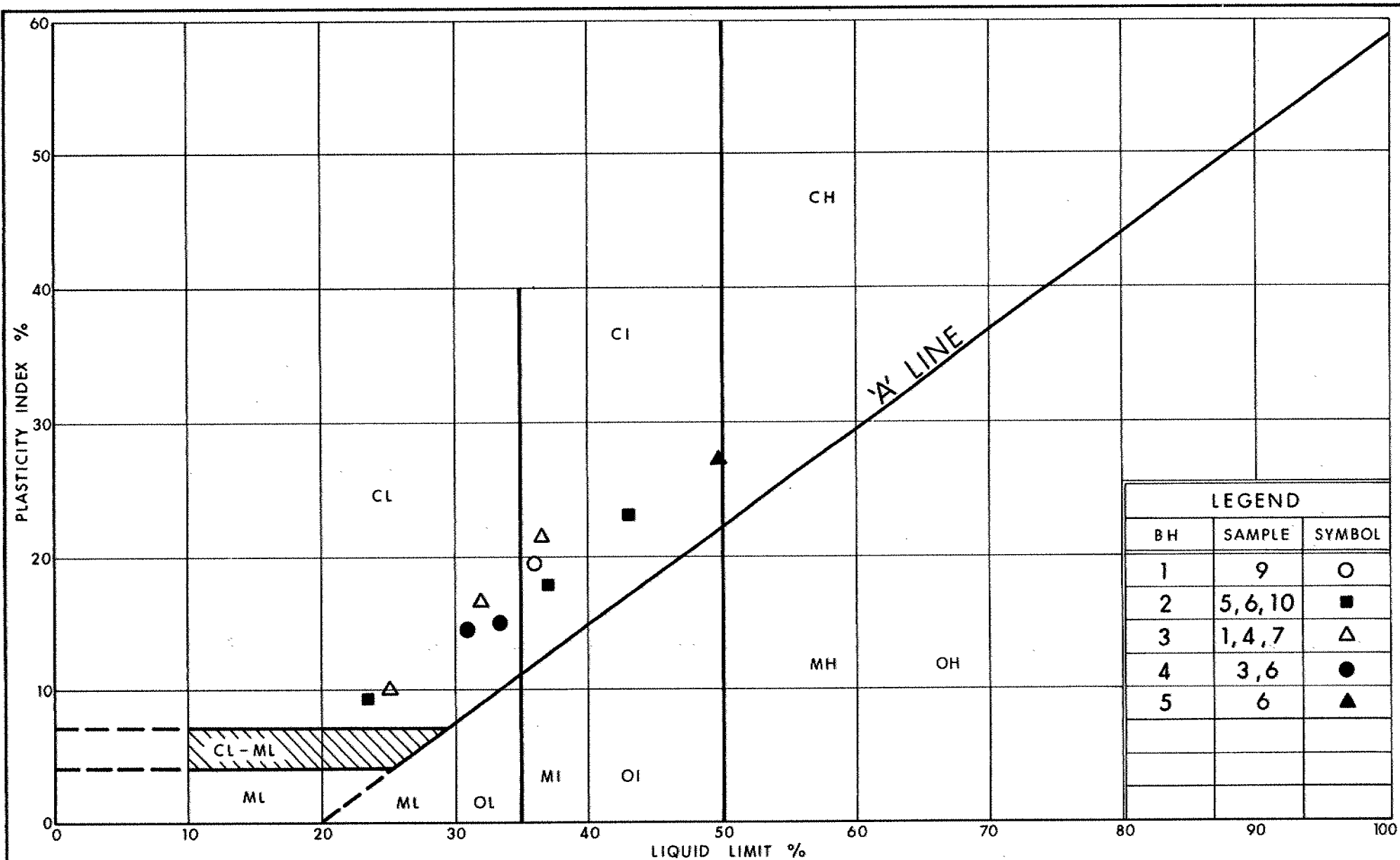


Ministry of
Transportation

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

FIG No 1

W P 131-85-04



Ministry of
Transportation

Ontario

PLASTICITY CHART CLAYEY SILT TO SILTY CLAY

FIG No 2

W P 131-85-04



VOID RATIO - PRESSURE CURVES

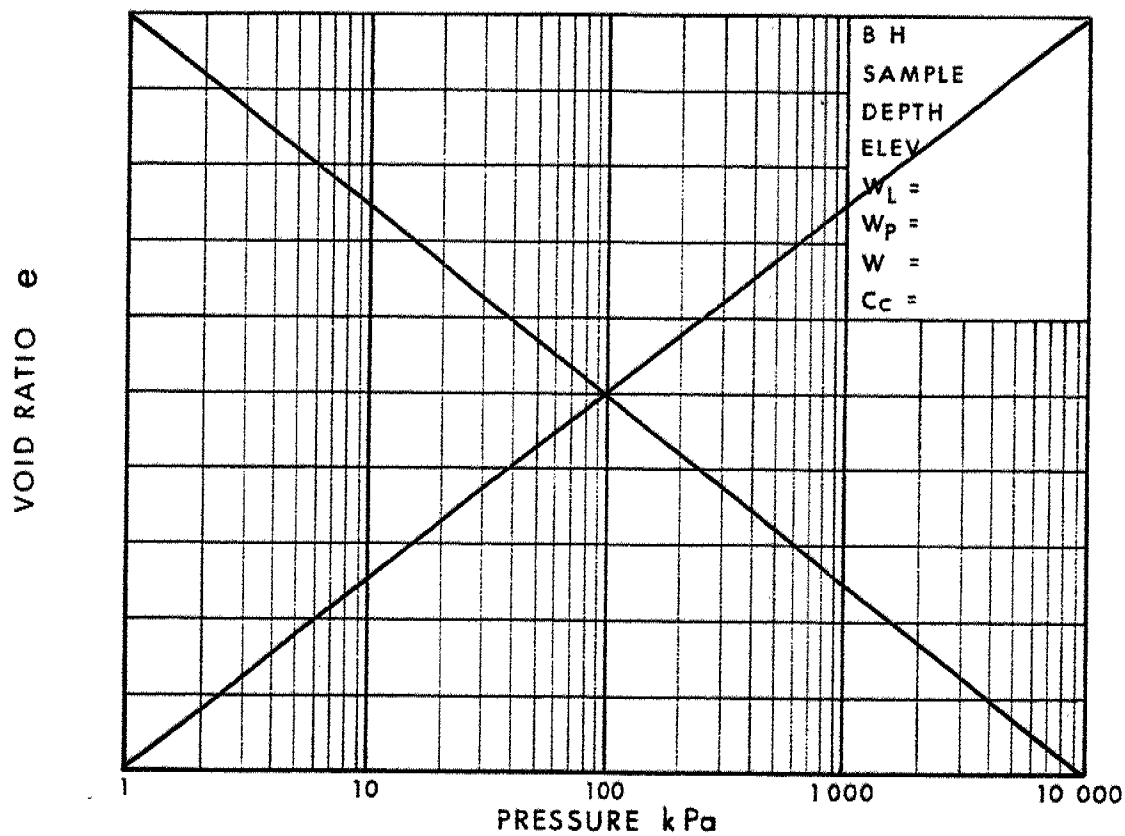
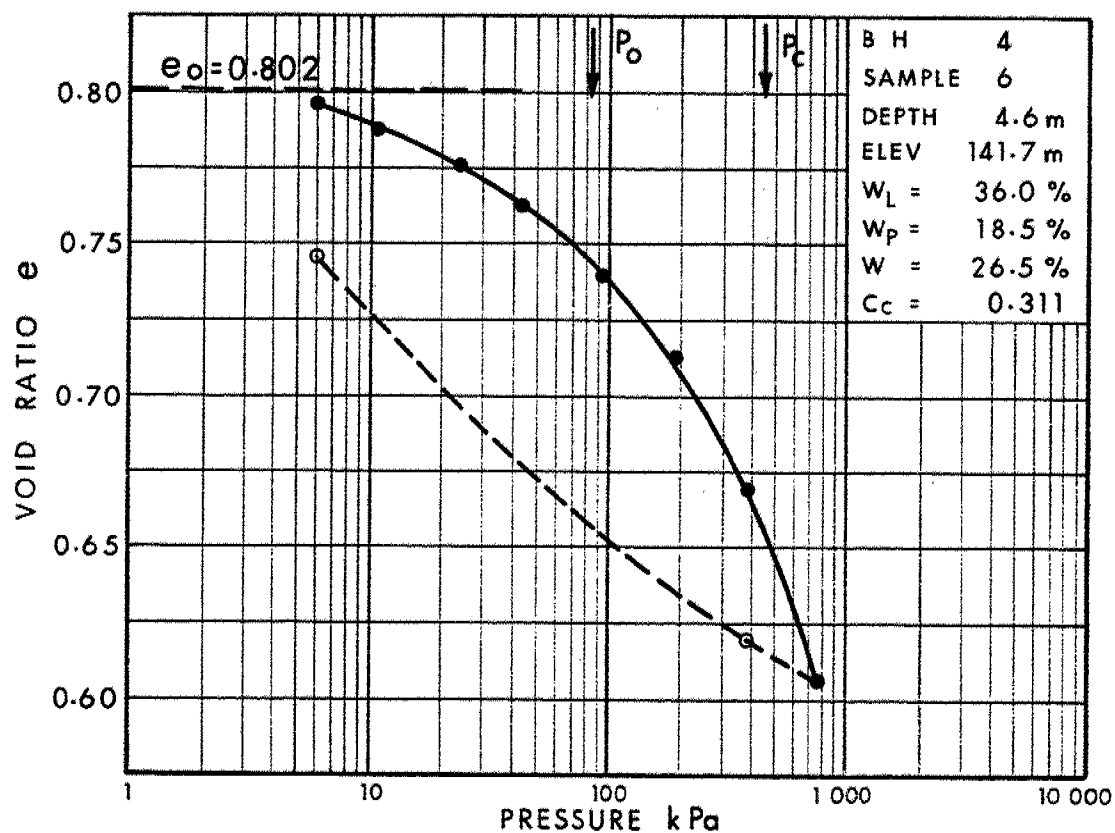
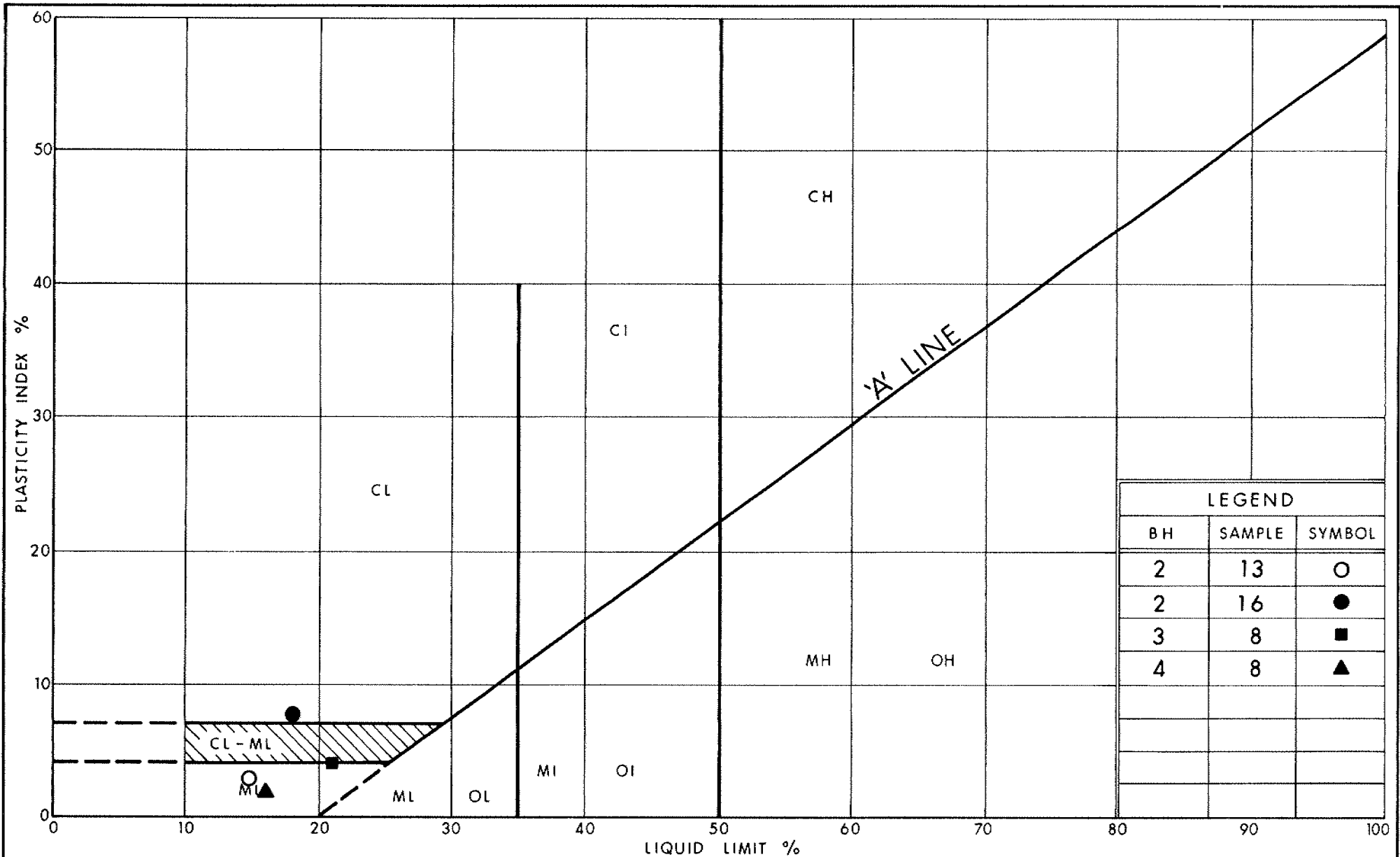


Fig 4

W P 131-85-04



Ministry of
Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT / SILT (Glacial Till)
SOME SAND, TRACE GRAVEL

FIG No 5

W P 131-85-04

Table 4 - ROCK CORE DESCRIPTION
WP 131-85-04

1../1

		CORE RECOVERY			CORE DESCRIPTION	
BH #	RC #	DEPTH (m)	CR* (%)	RQD* (%)	DEPTH (m)	DESCRIPTION
4	13	13.82-14.30	58	0	13.82-17.35	SHALE, medium grey, very thinly laminated; very fine grained; weak to very weak rock; moderately to highly weathered, completely weathered in sections, several clay seams 3-7 cm (thick) are also present; very close to extremely close spaced fractures: bedding joints, horizontal. Single bed of LIMESTONE from 14.30-14.40.
	14	14.30-15.37	55	0		
	15	15.37-16.92	80	0		
	16	16.92-17.35	94	0		

Logged by: S. A. Senior, Soils and Aggregates Section.

*CR = CORE RECOVERY (NOTE: Depths are approximated in zones of poor core recovery.)

*RQD = ROCK QUALITY DESIGNATION

RECORD OF BOREHOLE No 1

METRIC

W P 131-85-04 LOCATION Co-ords: N 4 843 787.3; E 302 573.4 ORIGINATED BY FP
 DIST 6 HWY 400 BOREHOLE TYPE Cone Test, Hollow-stem Auger COMPILED BY FP
 DATUM Geodetic DATE 89 01 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
152.9	Ground Surface										
0.0						*	152				
	Irregular Mixture of Clayey Silt, Sand and Gravel		1	SS	13		150				
	(Fill)		2	SS	13		148				
	Brown, Stiff		3	SS	11		146				
146.5			4	SS	23		144				
6.4			5	SS	35		142				
	Trace Organics		6	SS	46		140				
			7	SS	32		138				
143.1	Hard		8	SS	30		136				
9.8	Firm to Stiff		9	SS	11		134				
	Clayey Silt to Silty Clay occ Sand Seams		10	SS	13						
			11	SS	9						
			12	SS	7						
138.9			13	SS	8						
14.0			14	SS	21						
	Silt with Sand V. Dense		15	SS	105						
	Clayey Silt / Silt Some Sand, Trace Gravel Grey, Hard / V. Dense		16	SS	60 / 13 cm						
132.8	(Glacial Till)		17	SS	60 / 10 cm						
20.1	End of Borehole										
	* groundwater elevation not determined										

RECORD OF BOREHOLE No 2

METRIC

W P 131-85-04 LOCATION Co-ords: N 4 843 798.2; E 302 606.1 ORIGINATED BY FP
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY FP
 DATUM Geodetic DATE 89 01 17 CHECKED BY DD

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					
153.9	Ground Surface															
0.0																
	Irregular Mixture of Sand, Gravel and Clayey Silt Brown, Stiff to Hard (Fill)		1	SS	15											
			2	SS	34											6 25 60 9
			3	SS	19											
147.7			4	SS	29											
6.2			5	SS	27											
	Trace Organics		6	SS	24											0 25 52 23
			7	SS	42											0 10 67 23
			8	SS	40											
	V. Stiff to Hard		9	SS	24											
142.9			10	SS	20											0 3 47 50
11.0	Firm to Stiff															
	Clayey Silt to Silty Clay		11	SS	11											
			12	TW	PH											
139.3																
14.6			13	SS	10											
	Silt with Sand Compact to Dense		14	SS	37											0 39 53 8
			15	SS	91											
	Clayey Silt / Silt Some Sand, Trace Gravel Grey, Hard / V. Dense (Glacial Till)		16	SS	95											
			17	SS	58											
131.2			18	SS	60											
22.7	End of Borehole															
	Probable Bedrock															

METRIC

SOIL PROFILE	SAMPLES	TEST	IN	DYNAMIC CONE PENETRATION
--------------	---------	------	----	--------------------------

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 4

METRIC

W P 131-85-04 LOCATION Co-ords: N 4 843 782.8; E 302 584.6 ORIGINATED BY FP
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger, BQ Rock Core COMPILED BY FP
 DATUM Geodetic DATE 89 01 22 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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	20 40 60 80 100					
146.3	Ground Surface													
0.0	Trace Organics		1	SS	20		146							
			2	SS	21									
143.6	Very Stiff		3	SS	27		144							5 27 39 29
2.7	Firm to Stiff	Brown Grey	4	SS	13									
			5	SS	9									
	Clayey Silt to Silty Clay occ. Sand Seams		6	TW	PH		142						19.7	0 1 68 31
			7	SS	5									
139.3							140							
7.0			8	SS	5									3 32 60 5
	Loose						138							
	Silt with Sand V. Dense		9	SS	94									
135.8							136							
10.5	Clayey Silt / Silt Some Sand, Trace Gravel Grey, Hard / V. Dense (Glacial Till)		10	SS	57									
			11	SS	57		134							
132.5			12	SS	60	10 cm								
13.8	Bedrock Shale with Interbedded Clay Seams		13	RC	Rec 58%		132							RQD = 0
			14	RC	55%									RQD = 0
				BQ	Rec		130							
	Weathered		15	RC	80%									RQD = 0
129.0	Unweathered		16	RC	Rec 94%									RQD = 0
17.3	End of Borehole													

RECORD OF BOREHOLE No 5

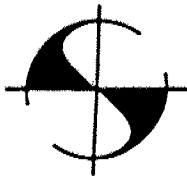
METRIC

W P 131-85-04 LOCATION Co-ords: N 4 843 761.3; E 302 570.0
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 89 01 24
 ORIGINATED BY FP
 COMPILED BY FP
 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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					
147.0	Ground Surface																
0.0																	
	Trace Organics		1	SS	34		146										
			2	SS	23												
			3	SS	14												
143.5	Stiff to Hard		4	SS	14		144										
3.5	Firm to Stiff		5	SS	7												
	Clayey Silt to Silty Clay		6	SS	6		142										
			7	TW	PH												
139.7			8	SS	4		140										
7.3	Silt with Sand V. Dense		9	SS	37		138										
	Clayey Silt / Silt Some Sand, Trace Gravel Grey, Hard / V. Dense (Glacial Till)		10	SS	49		136										
			11	SS	114												
133.3			12	SS	60		134										
13.7	End of Borehole (Probable Bedrock)					10 cm											

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



STRATA ENGINEERING CORP.

Tel.: (416) 441-2560

RESEARCH . ENGINEERING . SCIENCE

Suite 410, 170 The Donway West,
Don Mills, Ontario, Canada M3C 2G3
Telex: 06-966637, Fax: (416) 441-4161

FOUNDATION INVESTIGATION REPORT
for
Sheppard Avenue Underpass
W.P. 131-85-02, Site 37-198
and
Sheppard Avenue Retaining Wall
W.P. 131-85-03,
Hwy 400, District 6, Toronto
CONT 93-23

June 30, 1989

GEOCRES # 30M11-190

Distribution:

Ministry of Transportation - 13 Copies
Strata File S-88-233 - 1 copy

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 SITE AND GEOLOGY	2
3.0 FIELD AND LABORATORY WORK	2
4.0 SUBSOIL CONDITIONS	4
4.1 General	4
4.2 Surficial Materials	4
4.2.1 Topsoil	4
4.2.2 Asphalt and Granular Base Materials for Sheppard Avenue	4
4.2.3 Sheppard Avenue Fill	5
4.2.4 Highway 400 Median Pavement Structure	5
4.3 Clayey Silt (Upper Glacial Till)	6
4.4 Clayey Silt/Silty Clay	7
4.5 Clayey Silt (Lower Glacial Till)	8
4.6 Sandy Silt Glacial Till	9
4.7 Shale Bedrock	10
5.0 GROUNDWATER CONDITIONS	11
6.0 DISCUSSION AND RECOMMENDATIONS - UNDERPASS STRUCTURE	12
6.1 General	12
6.2 Existing Structure	13
6.3 Foundation Design	14
6.4 Pile Lengths	14
6.5 Pile Capacities	14
6.6 Earth Pressures	15
6.7 Approach Embankments	15
6.7.1 Stability	15
6.7.2 Settlements	17
6.8 Construction Considerations	17
6.8.1 Construction Staging	17
6.8.2 Pile Driving	18
6.8.3 Embankment Widening	18
6.8.4 Dewatering	18
6.8.5 Roadway Protection	18
7.0 DISCUSSION AND RECOMMENDATIONS - PROPOSED RETAINING WALL	19
7.1 General	19
7.2 Conventional Retaining Wall - Foundation Design	19
7.3 Alternatives to Conventional Retaining Wall	20
7.3.1 Reinforced Earth	20
7.3.2 Geogrid Reinforced Fill	20
8.0 CLOSURE	21

FOUNDATION INVESTIGATION REPORT

for

Sheppard Avenue Underpass

W.P. 131-85-02, Site 37-198

and

Sheppard Avenue Retaining Wall

W.P. 131-85-03

Hwy 400, Districk 6, Toronto

1.0 INTRODUCTION

The Foundation Design Section of the Ministry of Transportation, Ontario, under Consultant Agreement No: 4238-9088-235, has retained the services of Strata Engineering Corporation to carry out a foundation investigation at the site of a new underpass to be located at Sheppard Avenue and Highway 400. The new structure is intended to accommodate:

- widening of Sheppard Avenue to 6 lanes;
- construction of Torbarrie Road located adjacent to and immediately to the east of Highway 400;
- widening of Highway 400 north and south bound lanes; and
- construction of Highway 400 north and south bound detour lanes.

The terms of reference for this study are outlined in Consultants Agreement No: 4238-9088-235 dated 1988 10 18. This report is submitted in compliance with those terms of reference.

2.0 SITE AND GEOLOGY

The site is located at the junction of Highway 400 and Sheppard Avenue in North York, Ontario. This is primarily a residential/commercial land use area.

The topography of the site is relatively flat. This general area has been subject to past continental glaciation, and the overburden reflects several advances and retreats of the ice with accompanying interstadial stages, represented by mostly glacial lake deposits interspersed within till sheets. The youngest till sheet is the Wildfield Till which is underlain by the Peel ponding deep water deposits followed by Halton Till. The bedrock is shale of the Georgian Bay formation, and occurs at depths in excess of 13 m below present ground level.

3.0 FIELD AND LABORATORY WORK

The field work was commenced on 1989 01 25, using a truck mounted CME 55 drill rig until 1989 02 06 at which time a bombardier mounted CME 55 drill rig was mobilized to the site for reasons of accessibility. Drilling was completed by 1989 02 23. In all, 14 boreholes (BH # 1 to 14) were drilled, at locations as shown on Drawings 1318502-A and 1318503-A. All boreholes were advanced using hollow stem augers.

Samples in the dense or hard fill and till strata were obtained using the Standard Penetration Test (SPT) with the accompanying N values being noted in blows per 0.3 m. Samples taken in a firm to stiff silty clay/clayey silt stratum were obtained using both the SPT and 50 and 75 mm diameter thin wall tubes. The thin wall tube samples were obtained by manually or hydraulically pushing them into the soil. Such sampling was usually followed by a field vane test to determine the in situ undrained shear strength.

All but one of the boreholes were advanced to bedrock. In selected boreholes, BX size core samples were taken to confirm bedrock type and quality.

Dynamic cone penetration resistance tests were conducted in two boreholes (BH 3 and 7) with the accompanying blow count values being noted in blows per 0.3 m.

Upon completion, and wherever possible, the boreholes were left open to observe groundwater levels periodically. Water level observations were continued until 1989 05 10. All boreholes on Sheppard Avenue (BH 1, 2, 6, 8 and 9) had to be backfilled immediately upon completion. Therefore, reliable water level readings for these boreholes are not available. All other boreholes were left open for as long as feasible before they were backfilled.

Boreholes were located in the field by measuring from existing landmarks. Ground elevations at the borehole locations were obtained from Plan E-72-400-1.

Recovered soil samples were placed in moisture proof containers and immediately shipped to our laboratory for further visual examination, classification and testing. Tests were carried out for: moisture contents, Atterberg Limits, grain size distributions, consolidation characteristics, and undrained shear strength (both quick triaxial and unconfined compression). The results of the field boring program and laboratory tests are shown on Borehole Log Sheets 1 to 14 and Figures 1 to 7 in the Appendix.

All rock cores were examined immediately upon recovery from the core barrel. Core recoveries and RQD's were measured in the field.

4.0 SUBSOIL CONDITIONS

4.1 General

The subsoil conditions across the site are fairly uniform. Below a variable cover of surficial fill materials, the predominant soil type is a stiff to hard glacial till. This is underlain by a firm to stiff deep water deposit of silty clay/clayey silt which in turn is underlain by a glacial till over shale bedrock.

4.2 Surficial Materials

Surficial materials encountered at this site consisted of topsoil or asphalt pavement.

4.2.1 Topsoil

The topsoil consists of a slightly organic clayey silt. Its thickness was found to vary from 75 to 150 mm. Topsoil up to 200 mm thick was also found below existing fill materials.

4.2.2 Asphalt and Granular Base Materials for Sheppard Avenue

The asphalt pavement on Sheppard Avenue ranges in thickness between 180 mm and 480 mm, with an average thickness of about 250 mm. The sand and gravel base thickness ranged from 300 mm on the east side of the existing bridge to 1.1 m on the west side of the existing bridge.

4.2.3 Sheppard Avenue Fill

The existing Sheppard Avenue approach fills are approximately 7 to 8 m in height above the surrounding lands. The fill material is a clayey silt with some sand and trace of gravel. The following table summarizes its characteristics:

Soil Type:	Clayey Silt with some sand, trace gravel and occasional cobbles (Fill)		
Upper Elevation:	153.5 m		
Thickness (m):	Range: 6.8 to 7.5	Ave: 7.0	
Colour:	Brown		
N Values (blows/0.3 m):	Range: 8 to 37	Ave: 18	
Consistency:	Firm to Hard		
Water Content (%):	Range: 15 to 25	Ave: 20	
Atterberg Limits (%):	$W_L = 26$; $W_P = 12$; $I_P = 14$ (see Fig. 1)		
Unit Weight (kN/m^3):	22		

4.2.4 Highway 400 Median Pavement Structure

The asphalt pavement thickness on Highway 400 at Borehole 5 in the median area was 355 mm. Sand and gravel base material was 1.2 m in total thickness.

4.3 Clayey Silt (Upper Glacial Till)

A cohesive glacial till was found immediately below the existing fill and topsoil throughout the site. This upper glacial till stratum consists of a clayey silt, some sand, and trace of gravel. The following table summarizes its characteristics:

Soil Type:	Clayey silt, some sand and trace gravel (glacial till)	
Upper Elevation:	146.5 m	
Thickness (m):	Range: 3.1 to 4.3	Ave: 3.5
(The deposit becomes thinner towards the east).		
Colour:	Brown to mottled to grey	
N Values (blows/0.3 m):	Range: 12 to 64	Ave: 30
Consistency:	Stiff to Hard	
Water Content (%):	Range: 15 to 30	Ave: 20
Atterberg Limits (%):	$W_L = 32$; $W_P = 18$; $I_P = 14$ (see Fig. 2)	
Unit Weight (kN/m^3):	22	

A perched groundwater table was generally encountered within this stratum.

4.4 Clayey Silt/Silty Clay

The upper glacial till stratum is underlain by a deposit of clayey silt to silty clay, with trace of sand. The consistency of this stratum varied generally between firm and stiff. Consolidation Tests (Figs. 4 and 5) indicate the deposit is almost normally consolidated. The following table summarizes its characteristics:

Soil Type:	Clayey silt/silty clay with trace sand	
Upper Elevation:	143.4 m	
Thickness (m):	Range: 1.6 to 5.3	Ave: 3.0
Colour:	Grey	
N Values (blows/0.3 m)	Range: 4 to 15	Ave: 9
Consistency:	Firm to Stiff	
Water Content (%):	Range: 21 to 37	Ave: 25
Atterberg Limits (%):	$W_L = 35$; $W_P = 19$; $I_P = 16$ (see Fig. 3)	
Unit Weight (kN/m^3):	22	

Shear Strength (kPa) as determined by various methods:

Field Vane:	Range: 30 to 85	Ave: 50
Quick Triaxial:	26 to 45	
Unconfined:	27 to 52	
Strain at failure ($e_f - \%$)	12 - 15	
Sensitivity:	Range: 2 to 4	Ave: 3
Preconsolidation Pressure Range (see also Figs.4 and 5):		
Below existing fill (BH 2)	130 - 180 kPa	
Below existing ground (BH 14)	100 - 110 kPa	

4.5 Clayey Silt (Lower Glacial Till)

The clayey silt/silty clay stratum is underlain by a lower glacial till comprising clayey silt, some sand, and trace of gravel. This stratum was found only on the east side of the proposed Hwy 400 Detour NBL. Its thickness was 3 m at the proposed east abutment location and increased to 9 m at the east end of the proposed retaining wall. The following table summarizes its characteristics:

Soil Type:	Clayey silt, some sand and gravel (glacial till)	
Upper Elevation:	140.7 m	
Thickness (m):	Range: 3.0 to 9.0	Ave: 6.0
Colour:	Grey	
N Values (blows/0.3 m)	Range: 8 to 105	Ave: N/A
Consistency:	Firm to Hard	
Water Content (%):	Range: 8 to 31	Ave: 15
Atterberg Limits (%):	$W_L = 23$; $W_P = 10$; $I_P = 13$ (see Fig. 6)	
Unit Weight (kN/m^3):	22	

The Standard Penetration Resistance N values were generally higher in the most eastern part of the site, and tended to increase with depth.

4.6 Sandy Silt Glacial Till

The lowest overburden material encountered at this site was a sandy silt glacial till containing some clay and trace of gravel; occasional cobbles and boulders are suspected to be present based on resistance to auger penetration. The stratum is thickest (9.3 m) at the proposed west bridge abutment location, and gradually thins out to 2 m at the proposed east abutment location, disappearing completely to the east of this abutment. The clay content increases with depth. Some Standard Penetration Resistance N values were very low in the upper part of this layer probably as a result of localized "boiling" under unbalanced hydrostatic conditions. These low N values, therefore, should not be considered as indicative of the in situ soil density.

The following table summarizes the main characteristics of this stratum:

Soil Type:	Sandy silt with some clay gravel (glacial till)
Upper Elevation:	140.5 m
Thickness (m):	Range: 2.0 to 9.3 Ave: 5.0
Colour:	Grey
N Values (blows/0.3 m):	Range: 0 to 128 Ave: N/A
Density Index:	Compact to V. Dense
Water Content (%):	Range: 7 to 17 Ave: 10
Atterberg Limits:	Not Plastic
Grain Size (%):	Gravel: 0 to 12; Sand: 31 to 36; Silt and Clay: 53 to 69 (see Fig. 7)
Unit Weight (kN/m ³):	22

4.7 Shale Bedrock

Shale bedrock was encountered at elevations ranging between 130 m at the west abutment location and 134 m at the east abutment location. Along the proposed retaining wall, the bedrock elevation varied from just over 135 m near the west limit to below elevation 132 m at the eastern limit of the wall. Therefore, the depth to bedrock varies between 20 and 24 m at the existing structure location (as measured from the surface of Sheppard Ave.) and 12 to 17 m along the retaining wall (as measured from present ground surface).

The bedrock is thinly bedded and highly weathered in the upper 1 to 2 m. It was possible to sample the bedrock with the split-spoon sampler at and just below the overburden contact (as in BH's: 2,4,5,6,9,10, and 11). The quality of the bedrock was determined by core evaluation in BH's: 1,3,7,8 and 12. Core recoveries ranged between 60 and 100 per cent. The RQD values were generally low, and are ascribed to the thin bedding. The shale is generally hard below the weathered zone. Occasional dolomite and limestone beds, up to 160 mm thick, are present within the upper 3 m of the formation.

5.0 GROUNDWATER CONDITIONS

Groundwater levels were monitored during the course of the field investigation and wherever possible, note was taken of the depth at which water was encountered in each borehole during drilling. Groundwater measurements were continued on a frequent basis until their levels had stabilized. Measurement data are given below:

	Init.	1989					
Borehole #	W.L.	02/28	03/02	03/07	03/14	03/16	05/10
1	138.9	(not stabilized - backfilled)					
2	No W.L.						
3	145.7	145.7					
4	145.4	145.4					
5	141.7	(was backfilled on completion)					
6	No W.L.						
7	143.0	144.7	145.4	145.5	145.6	145.9	146.2
8	139.5	(not stabilized - backfilled)					
9	137.5	(not stabilized - backfilled)					
10	No W.L.	145.6	145.7	145.7	145.8	145.8	Caved
11	No W.L.	144.3	144.7	145.2	145.4	145.4	145.9
12	No W.L.	142.7	143.1	143.8	144.4	144.4	144.7
13	No W.L.						
14	No W.L.	143.2	143.7	145.1	145.4	145.4	146.5

From the above, it is concluded that the groundwater at this site is at elevation 146 m, or about 1 m below prevailing ground level.

6.0 DISCUSSION AND RECOMMENDATIONS - UNDERPASS STRUCTURE

6.1 General

It is proposed to construct a new underpass at the site of the existing crossing of Sheppard Avenue and Highway 400 in the City of North York. The new structure is intended to accommodate:- widening of Sheppard Avenue to 6 lanes;

- construction of Torbarrie Road located to the east of Highway 400;
- widening of Highway 400 north and south bound lanes; and
- construction of Highway 400 north and south bound detour lanes.

The proposed new structure will be a three span bridge at a skew angle of just over 83 degrees, with spans of 20 m, 33 m, and 35 m from east to west. The deck will be 33 m wide to accommodate six lanes, a median curb, and two sidewalks.

A proposed deck elevation of 155.5 m will result in new approach fill heights, above prevailing ground, of some 8.5 m maximum. The centreline of the new alignment coincides roughly with the south edge of the existing bridge.

This investigation shows the presence of two glacial till layers between which a moderately compressible clayey silt/silty clay stratum is present. Shale bedrock occurs at depths of about 13 to 14 m below prevailing ground level. The groundwater level is near or just below the existing ground level.

6.2 Existing Structure

The existing Sheppard Avenue bridge was constructed some 30 years ago. This monolithic concrete single span bridge was founded on timber piles. A check of the original design drawings in the MTO Structural Office Archives shows the following:

Pile cut-off elevation: 146.8 to 148.7 m

Pile embedment in concrete footings: 150 to 300 mm

Top of footing elevation: 147.4 m.

Footing width: 1.68 to 3.0 m (varies depending on location)

Pile batter: 12:1 for exterior piles in a row

: vertical for interior locations within a row

Pile spacing: 0.8 m to 1.3 m

Pile lengths: 9.1 m

(Note: The imperial units dimensions indicated on the original drawings have been converted into SI units shown above).

From this information it appears that the existing timber piles are founded in end bearing within the lower glacial till stratum. It would also appear from this data that the existing foundation elements will not interfere with pile driving for the new structure but may interfere with any proposed road protection schemes. It is therefore advised that a copy of the existing bridge foundation design drawings be included in the contract documents provided to bidders, or be made available to them for review.

6.3 Foundation Design

Due to the compressible nature of the clayey silt/silty clay stratum, piers and abutments of the proposed new underpass will experience intolerable total and differential settlements (greater than 25 mm and 15 mm respectively) if they are supported on spread footings. Therefore, the most feasible design is to found them on end bearing piles driven to bedrock.

All pile caps should be provided with a minimum earth cover of 1.2 m for protection against frost action.

6.4 Pile Lengths

Piles driven to bedrock will have the following estimated toe elevations:

West Abutment:	from 130 m to 131 m
West Pier:	from 131 m to 132 m
East Pier:	from 133 m to 135 m
East Abutment:	from 134 m to 136 m

Pile lengths will range between 10 m and 16 m.

6.5 Pile Capacities

Steel H Piles (eg. 310 x 110 HP) may be designed for the following load capacities:

Factored Axial Capacity at ULS:	1600 kN
Axial Capacity at SLS Type II:	1150 kN

6.6 Earth Pressures

Backfill to abutments and retaining walls should consist of Granular A or B material, for which the following properties are recommended:

Granular A: $\phi = 35.0^\circ$ $\gamma = 22.8 \text{ kN/m}^3$ $k_A = 0.27$ $k_0 = 0.43$

Granular B: $\phi = 30.0^\circ$ $\gamma = 21.2 \text{ kN/m}^3$ $k_A = 0.33$ $k_0 = 0.50$

where ϕ is the effective angle of internal friction, γ is the unit weight of material and k_A is the coefficient of active earth pressure. Use the k_0 values in design if the deck is likely to prevent movement at the top of the abutments.

Surcharge effects resulting from any sloping ground above the top of the retention system, and/or live loads, should be taken into account as per Clause 6 - 6.1.2.4 of the OHBD Code.

Lateral pressures should be computed in accordance with Clause 6 - 6.1.2.1 of the OHBD Code.

6.7 Approach Embankments

6.7.1 Stability

The maximum height of the proposed approach fills will be in the order of 8.5 m. Due to the firm to stiff consistency of the underlying clayey silt/silty clay stratum, the deep seated stability of the new fills was checked using Bishop's circular arc method of analysis for total stress conditions. The following factors of safety were obtained:

Slope Stability Analysis Assumptions:

Height of Slope = 9.0 m

Undrained shear strength (clayey silt/silty clay), c_u = 40 kPa

Undrained shear strength (glacial till and fill), c_u = 100 kPa

Angle of internal friction, ϕ = 0 deg.

Calculated Factors of Safety (F):

West side of Highway 400	2:1 slope	F = 2.2
--------------------------	-----------	---------

East side of Highway 400	Vertical slope (Retaining Wall)	F = 1.8
--------------------------	------------------------------------	---------

1:1 slope	F = 2.0
-----------	---------

Therefore, no problems are anticipated due to a deep-seated type of failure of the proposed approach fills provided that the final fill height does not exceed elevation 156.0 m.

It is recommended that slopes steeper than 2:1 (H:V) and greater than about 8 m in height be provided with a mid-height bench of 1 m width to control erosion due to runoff. The benching should be appropriately drained in a controlled manner to conduct accumulated water safely away from the fill slope face.

6.7.2 Settlements

Calculations based on the results of the two consolidation tests indicate maximum settlements of in the order of 125 mm under the shoulder of the new fill. This value decreases to about 25 mm at the proposed location of the new median of Sheppard Avenue due to less new fill being added in this area.

About 90 per cent of the total settlements estimated above will occur over a period of 50 years, with 50 per cent being attained within the first 15 years after construction.

In all areas where new fill is to be added, about 75 mm to 150 mm of topsoil will need to be stripped to minimize settlements and danger of lateral sliding.

6.8 Construction Considerations

6.8.1 Construction Staging

It is likely the new structure will be built in two stages in order to minimize traffic disruption. In the first stage, the south half may be built (3 lanes) and traffic diverted from the existing Sheppard Avenue to permit demolition of the existing bridge. After demolition of the existing bridge, construction of the north half may be accomplished.

The location of the proposed abutments and piers is quite distinct and apart from the existing abutment and pier locations. Therefore, no interference is expected from the existing footings during pile driving. This feature should be verified during final design stages. The need to remove the existing pile caps for the proposed roadway design of Torbarrie Road and the widening of Highway 400 should also be verified during final design stages.

6.8.2 Pile Driving

Steel H piles should be provided with toe reinforcement to enable penetration through the lower glacial till and the sandy silt till deposits to shale bedrock.

6.8.3 Embankment Widening

Widen embankments as per benching specification OPSD 208.01. All topsoil below new fills should be stripped. Existing fill material removed during benching may be used in building new fills provided that the soil is free of organics and is near or at its optimum moisture content for proper compaction.

6.8.4 Dewatering

No major dewatering problems are anticipated for excavations no deeper than elevation 146 m±. Seepage quantities through the upper glacial till soil are expected to be sufficiently low to be handled by conventional pumping from sumps if the excavation base lies below elevation 146 m.

6.8.5 Roadway Protection

The construction of the new abutment and pier footing pile caps will involve excavation of the existing embankments. Provide roadway protection either with interlocking sheet piles driven into the lower glacial till stratum, or with conventional soldier piles and timber lagging. For the latter option, the Foundation Design Section should be consulted for slope angles and lengths of tie backs and grouted zones.

For computation of lateral earth pressures from the existing fill material, assume $\phi = 30^\circ$; $c_u = 15$ kPa; $\gamma = 21$ kN/m³

7.0 DISCUSSION AND RECOMMENDATIONS - PROPOSED RETAINING WALL

7.1 General

Due to limited property availability in the southeast quadrant of Sheppard Avenue and Hwy. 400, it is proposed to contain the south side of the east approach fill within the available right-of-way by means of a conventional reinforced concrete retaining wall. This wall will likely range in height from 1 m at the east end of the east approach embankment to about 5 m near the east abutment location.

The subsurface conditions below the proposed wall were investigated by means of Boreholes 10 to 13 inclusive. A stratigraphic plot is shown on Drawing 1318503-A. The soil conditions are substantially the same as those found at the new underpass location. However, bedrock at the east end of the proposed retaining wall lies below a depth of 16 m.

7.2 Conventional Retaining Wall - Foundation Design

Due to the possibility of settlements occurring within the clayey silt/silty clay stratum, a conventional reinforced cantilevered concrete retaining wall will need to be supported on piles driven either to the bedrock or into the lower glacial till stratum.

The estimated pile toe penetration elevations are given below for each borehole drilled along the alignment of the proposed retaining wall (refer to Drawing 1318503-A):

- BH 7 Elev. 135 m (within lower glacial till)
- BH 10 Elev. 135 m (on bedrock)
- BH 11 Elev. 135.5 m (on bedrock)
- BH 12 Elev. 134 m (within lower glacial till)
- BH 13 Elev. 131.5 m (within lower glacial till)

Steel H piles should be designed for the capacities as given earlier for the structure foundations (see Section 6.4). Piles expected to terminate in end bearing within the sandy silt glacial till stratum should be driven to a final set of 15 blows per 25 mm, under an applied hammer energy rated at 30,000 J. Pile toes should be reinforced to facilitate penetration into the glacial till or to bedrock through the till.

7.3 Alternatives to Conventional Retaining Wall

7.3.1 Reinforced Earth

Consideration may be given to the use of reinforced earth in lieu of a conventional retaining wall. Such walls can accommodate both total and differential settlements of the order of magnitude expected at this site. Since reinforced earth is a proprietary product, its design should be coordinated through the Foundation Design Section.

7.3.2 Geogrid Reinforced Fill

From the site survey information contained on the supplied E Plan, it would appear that there is sufficient room to enable the construction, on the south side of the east approach fill, with 1:1 side slopes. Such a slope would remain entirely within the presently available right-of-way. In order to stabilize the 1:1 side slope, the fill would need to be reinforced with geogrids. Stability analyses show an adequate margin of safety against a deep-seated type of failure (see Section 6.7.1 above).


If this option is elected, the Foundation Design Section should be contacted for more detailed design information (geogrid type, spacing, length, and granular materials).

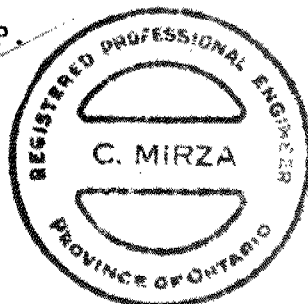
8.0 CLOSURE

The field investigation was carried out by Mr. Ed Harvey, working directly under the supervision of Mr. C. Mirza, P.Eng. All drilling equipment was rented from Master Soils Investigations Limited of Weston, Ontario.

We gratefully acknowledge the cooperation of several Ministry and Metropolitan Toronto staff who arranged for property clearances, road occupancy permits, and traffic control on Highway 400.

Respectfully submitted:
STRATA ENGINEERING CORP.


Cam Mirza, P.Eng.
Principal



A P P E N D I X

Explanation of Terms Used in Report

Office Record of Boreholes 1 - 14

Figures 1 - 7

Drawing 1318502 - A

Drawing 1318503 - A



STRATA ENGINEERING CORP.

EXPLANATION OF TERMS USED IN REPORT

N VALUE THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 31mm 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 N

DYNAMIC CONE PENETRATION TEST CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (31mm O.D. 60° CONE ANGLE) DRIVEN BY 473 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	MID CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
σ_v	l	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN f: failure
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	l	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No 1

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 819.8; E. 302 624.6 ORIGINATED BY EH
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 01 31 and 1989 02 01 CHECKED BY CM

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			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
							20 40 60 80 100													
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE													
154.1	Road Surface						154													
0.0	Asphalt																			
153.0	Sand and Gravel (Granular Base)																			
1.1			1	SS	8															
	Clayey Silt with some Sand		2	SS	8															
	Brown																			
	Firm to V. Stiff		3	SS	17															
	(Fill)		4	SS	10															
	Occasional		5	SS	28															
	Cobbles		6	SS	50	8cm														
146.2			7	SS	21		146													
7.9	Clayey Silt, some Sand		8	SS	33															
	Brown to Grey																			
	V. Stiff to Hard		9	SS	36		144													
	(Glacial Till)																			
142.6			10	SS	11		142													
11.5	Clayey Silt		11	SS	8		140													
	Grey																			
	Stiff																			
139.5			12	TW	PH		138													
14.6			13	SS	36		136													
	Sandy Silt, some Clay, trace Gravel		14	SS	46		134													
	Grey																			
	Dense to V. Dense		15	SS	99		132													
	(Glacial Till)		16	SS	128															
	occasional thin Sand seams		17	SS	61															
130.2			18	SS	70	0cm	130													
23.9	Shale Bedrock		19	BX	Rec. 80%															
128.1	Thinly bedded																			
26.0	End of Borehole																			
	* W.L. not stabilized																			

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 808.1; E. 302 626.1 ORIGINATED BY EH
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 02 02 CHECKED BY CM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
154.1	Road Surface															
153.7	Asphalt															
153.0	Sand and Gravel															
1.1	Clayey Silt with some Sand		1	SS	47	*							o			Cobble encountered
	Brown		2	SS	10									o		
	Stiff to V. Stiff		3	SS	16									o		
	(Fill)		4	SS	14									o		
	trace Organics															
147.1															22.3	
7.0	Clayey Silt, some Sand, occasional Sand Lenses Mottled V. Stiff to Hard		5	SS	34								o			Free Water encountered at 8.0 m ± depth
			6	SS	64									o		21.6
	(Glacial Till)		7	SS	27									o		22.3
142.8																
11.3	Silty Clay, trace Sand		8	SS	15									o		
	Grey		9	TW	PH											
	Stiff															Consol. Test (fig.4)
139.2			10	SS	18									o		
14.9	Sandy Silt, trace Clay and Gravel		11	SS	0									o		Probable "boiling" of soil
	Grey		12	SS	14									o		
	Compact to V. Dense		13	SS	67/13cm									o		
	increasing Clay --- content with depth		14	SS	63									o		
	(Glacial Till)		15	SS	37									o		
130.3																
129.9	Probable Bedrock		16	SS	100/5cm									o		
24.2	End of Borehole															
	* W.L. not obtained															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 784.6; E. 302 630.1 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY EH
 DATUM Geodetic DATE 1989 02 16 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
147.2	Ground Surface																	
0.0	Topsoil																	
	Clayey Silt with some Sand		1	SS	21		146							W.L. on 1989 02 28				
	Brown																	
	V. Stiff		2	SS	22		144						23.0					
	(Glacial Till)																	
143.2			3	SS	5		142											
4.0	Clayey Silt, trace Sand		4	TW	PM		140											
	Grey		5	SS	8													
	Firm to Stiff																	
137.9			6	SS	41		138											
9.3	Sandy Silt, trace Clay and Gravel		7	SS	73		136							Free Water encountered at 9.1 m ± depth				
	Grey		8	SS	73		134											
	Dense to V. Dense		9	SS	42		132											
	(Glacial Till)		10	SS	36													
130.9			11	SS	60A		130											
16.3	Shale Bedrock		12	BX	Rec. 100%									RQD = 0%				
	Thinly bedded		13	BX	Rec. 100%									RQD = 55%				
	occasional Dolomite Beds (100mm thick)																	
128.1																		
19.1	End of Borehole																	

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 766.9; E. 302 625.8 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 06 CHECKED BY CM

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					
147.0	Ground Surface																
0.0	Topsoil																
	Clayey Silt with some Sand		1	SS	18		146										
	Brown																
	V. Stiff		2	SS	27		144										
143.3	(Glacial Till)																
3.7	Clayey Silt		3	SS	15		142										
	Grey																
140.5	Firm to Stiff		4	SS	4		140										
6.5	Sandy Silt, some Clay, trace Gravel		5	TW	PH												
	Grey		6	SS	51		138										
	Dense to V. Dense																
	(Glacial Till)		7	SS	41		136										
133.8																	
13.2	Shale Bedrock		8	SS	58	15cm	134										
133.0			9	SS	60	0cm											
14.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 812.6; E. 302 658.9 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 03 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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					
148.1	Road surface																
147.7	Asphalt																
0.4 146.9	Sand and Gravel																
1.2	Clayey Silt with some Sand		1	SS	13												
	Brown		2	SS	25												
	Stiff to V. Stiff (Glacial Till)		2	SS	23												
142.9 5.2	Silty Clay, occasional Sand Partings Grey Stiff		4	SS	14												
			5	TW	PH												
139.9 8.2	Sandy Silt, some Clay, trace Gravel		6	SS	15												
	occasional Sand Lenses		7	SS	12												
	Grey		8	SS	113												
	Compact to V. Dense		9	SS	60/	8cm											
	(Glacial Till)		10	SS	80												
131.5 16.6	Shale Bedrock		11	SS	100/	13cm											
130.1 18.0	End of Borehole		12	SS	60/	3cm											
	* W.L. not stabilized																

+3, x5: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 840.2; E. 302 691.0
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 1989 01 25
 ORIGINATED BY MP
 COMPILED BY EH
 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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					
154.1	Road Surface																
153.5	Asphalt						154										
0.6	Sand and Gravel																
	Clayey Silt with some Sand		1	SS	9	*	152							o		22.7	
	Brown		2	SS	17		150							o			
	Stiff to V. Stiff		3	SS	23		148							o		23.2	
	(Fill)		4	SS	19		146							o			
146.2			5	SS	29		144							o		21.1	
7.9	Clayey Silt, some Sand, trace Gravel		6	SS	52		142							o		20.4	
	Brown		7	SS	19		140							o			
142.5	(Glacial Till)		8	SS	6		138							o			
11.6	Clayey Silt, trace Sand		9	TW	PM		136							o			
	Grey		10	TW	PM		134							o			
139.2	Firm		11	SS	15									o			
14.9	Sandy Silt, some Clay		12	SS	39									o			
	Grey		13	SS	72									o			
134.6	Compact to Dense (Glacial Till)		14	SS	65	0cm								o			
19.5	Shale Bedrock													o			
132.8														o			
21.3	End of Borehole													o			
	* W.L. not obtained													o			

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

METRIC

W P 131-85-02/03 LOCATION CO-ORDS N. 4 843 808.3; E. 302 697.6 ORIGINATED BY EH
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY EH
DATUM Geodetic DATE 1989 02 17 CHECKED BY CM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
146.5	Ground Surface							20 40 60 80 100						GR SA SI CL
0.0	Clayey Silt, trace Sand		1	SS	21		146						22.0	W.L. on 1989 03 16
	V. Stiff to Hard (Glacial Till)		2	SS	39		144						22.0	
	brown grey		3	SS	18								21.7	Free Water encountered at 3.2m ± depth
142.4	Clayey Silt, trace Sand		4	SS	6		142							
4.1	Grey		5	TW	PH									
	Soft to Firm		6	SS	4		140							
139.2			7	TW	PM									
7.3	Sandy Silt, some clay occasional Sand Lenses		8	SS	18		138							
	Grey		9	SS	12									
	Compact to V. Dense increasing Clay content with depth (Glacial Till)		10	SS	81		136							
			11	SS	55		134							
133.1	Granitic Boulder													
13.4	Shale Bedrock Thinly Bedded occasional Dolomite and Limestone Beds (110 to 160mm Thick)		12	BX	Rec. 59%		132							RQD = 0%
			13	BX	Rec. 92%									RQD = 18%
130.6														
15.9	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 8

METRIC

W.P. 131-85-02 LOCATION CO-ORDS N. 4 843 846.4; E. 302 711.3 ORIGINATED BY MP
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 01 26 CHECKED BY CM

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					
153.8	Road Surface																
153.4	Asphalt																
0.4	Sand and Gravel																
	Clayey Silt with some Sand		1	SS	11		152										
	Brown		2	SS	19		150										
	Stiff to V. Stiff (Fill)		3	SS	14		148										
			4	SS	21		146										
145.9			5	SS	10		144										
7.9	Clayey Silt, trace Sand		6	SS	51		142										
	Brown		7	SS	41		140										
142.0	Stiff to Hard (Glacial Till)		8	SS	14		138										
11.8	Silty Clay		9	SS	9		136										
	Grey		10	TW	PH		134										
139.2	Stiff		11	SS	9		132										
14.6	Clayey Silt, some Sand		12	SS	76												
	Grey		13	SS	63												
136.4	Stiff (Glacial Till)		14	BX	Rec. 20%												
17.4	Sandy Silt, some Clay		15	BX	Rec. 89%												
	Grey, V. Dense (Glacial Till)																
134.1	Shale Bedrock Thinly Bedded occasional Dolomite Beds (100mm Thick)																
19.7																	
131.2	End of Borehole																
22.6	* W.L. not stabilized																

W.L. on
1989 01 27

RQD = 13%

RQD = 15%

RECORD OF BOREHOLE No 9

METRIC

W P 131-85-02 LOCATION CO-ORDS N. 4 843 834.6; E. 302 713.3 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 01 30 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

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					
153.8	Road Surface																
153.3	Asphalt																
0.5	Sand and Gravel																
	Clayey Silt with some Sand		1	SS	12		152										
	Brown		2	SS	8		150										
	Firm to Hard (Fill)		3	SS	27		148										
			4	SS	37		146										
			5	SS	26		144										
145.9			6	SS	12		142										
7.9	Clayey Silt, some Sand		7	SS	13		140										
	Mottled		8	SS	46		138										
	Stiff to Hard (Glacial Till)		9	SS	24		136										
141.9			10	SS	18		134										
11.9	Clayey Silt Grey		11	SS	12		132										
140.3	V. Stiff		12	TW	PH		130										
13.5	Clayey Silt, some Sand and Gravel		13	SS	8		128										
	Grey		14	SS	82		126										
	Stiff (Glacial Till)		15	SS	100/5cm		124										
136.1	Sandy Silt, some Clay						122										
17.7	Grey, V. Dense (Glacial Till)						120										
134.3	Shale Bedrock						118										
133.7							116										
20.1	End of Borehole						114										
	* W.L. not stabilized						112										

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

RECORD OF BOREHOLE No 10

METRIC

W P 131-85-02/03 LOCATION CO-ORDS N. 4 843 817.0; E. 302 717.7 ORIGINATED BY EH/MP
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 22 CHECKED BY CM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	Wp	W	Wl		
147.7	Ground Surface															
0.0	Topsoil		1	SS	27											
145.9	Silty Sand, trace Gravel Brown, Compact to Dense, (Fill)		2	SS	14											
1.8	Clayey Silt, some Sand Brown to Mottled Stiff to V. Stiff (Glacial Till)		3	SS	19											
142.8			4	SS	13											
4.9	Clayey Silt, trace Sand Grey Firm		5	SS	8											
140.7			6	TW	PM											
7.0	Clayey Silt, trace Sand and Gravel Grey Stiff (Glacial Till)		7	SS	9											
137.6			8	SS	10											
10.1	Sandy Silt, some Clay Grey Compact to V. Dense (Glacial Till)		9	SS	13											
135.4			10	SS	86											
12.3	Shale Bedrock		11	SS	50/23cm											
134.5																
13.2	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 11

METRIC

W P 131-85-03 LOCATION CO-ORDS N. 4 843 825.5; E. 302 745.0 ORIGINATED BY MP/EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 21 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
147.5	Ground Surface																
0.0	Topsoil																
146.3	Silty Sand, Brown Compact, (Fill)		1	SS	20		146							o			
1.2																	
	Clayey Silt, some Sand, trace Gravel Brown, Hard (Glacial Till)		2	SS	36										o		
143.4			3	SS	35		144								o		
4.1	Clayey Silt		4	SS	10		142									o	
	Grey																
140.6	Stiff		5	TW	PH												
6.9							140										
	Clayey Silt, some Sand		6	SS	8										o		
	Grey																
	V. Soft to Firm (Glacial Till)		7	SS	8		138								o		
			8	SS	0											o	
135.6							136										
11.9	Shale Bedrock		9	SS	64										o		
134.4			10	SS	110	15cm									o		
13.1	End of Borehole																

RECORD OF BOREHOLE No 12

METRIC

W P 131-85-03 LOCATION CO-ORDS N. 4 843 838.7; E. 302 777.7 ORIGINATED BY EH
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
 DATUM Geodetic DATE 1989 02 22 CHECKED BY CM

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
147.2	Ground Surface															
0.0	Topsoil															
145.7	Clayey Silt, some Sand, Brown V. Stiff. (Fill)		1	SS	17											
1.5			2	SS	42											
	Clayey Silt Brown V. Stiff to Hard (Glacial Till)		3	SS	23											
143.2																
4.0	Clayey Silt		4	SS	12											
	Grey		5	SS	10											
	Stiff		6	TW	PH											
140.0																
7.2	Clayey Silt, some Sand, trace Gravel		7	SS	5											
	Grey		8	SS	4											
	Firm to Hard (Glacial Till)		9	SS	31											
			10	SS	97											
			11	SS	84											
			12	SS	96											
130.7																
16.5	Shale Bedrock Thinly Bedded		13	SS	90A											
	occasional Dolomite Beds		14	BX	Rec. 83%											
			15	BX	Rec. 2%											
127.5																
19.7	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

W.L. on
1989 03 16

00 15 (85)

RQD = 0%
Core Barrel
jammed,
no recovery

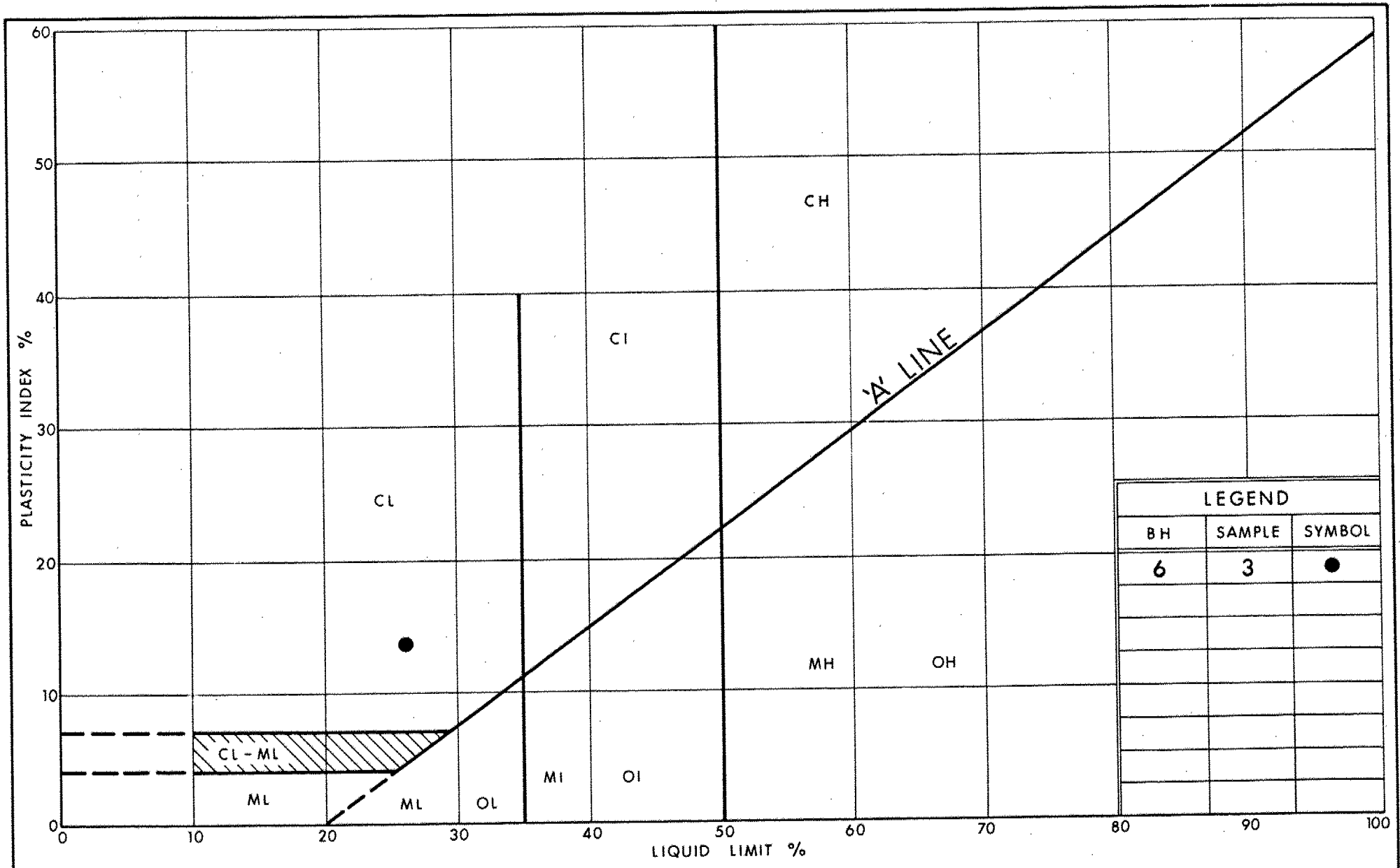
METRIC

WP 131-85-03 LOCATION CO-ORDS N. 4 843 868.6; E. 302 836.5 ORIGINATED BY EH
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger COMPILED BY EH
DATUM Geodetic DATE 1989 02 23 CHECKED BY CM

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

[illegible]



Ontario

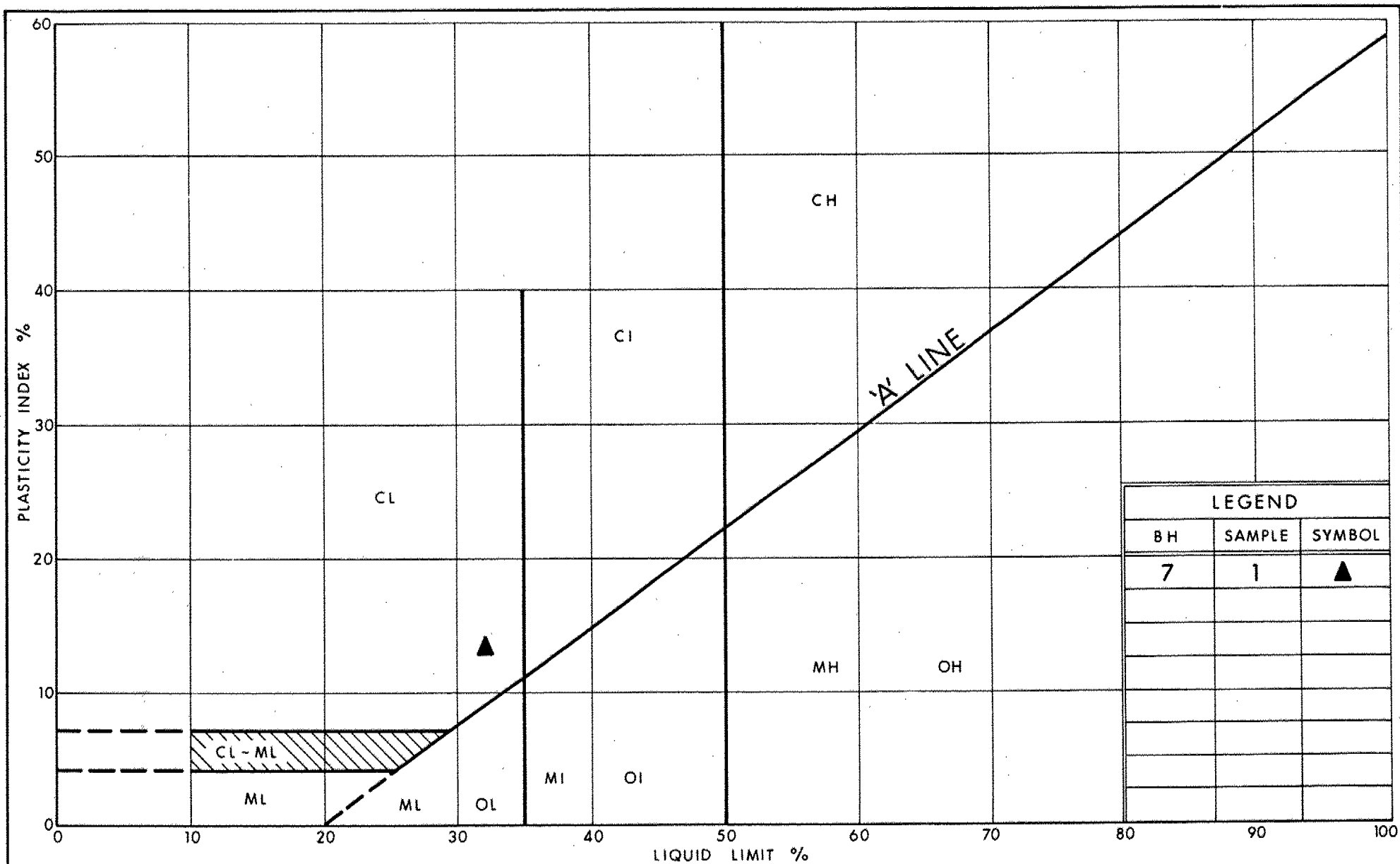
Ministry of
Transportation

PLASTICITY CHART CLAYEY SILT (Fill)

FIG No 1

W P 131-85-02/03

400 & Sheppard



Ontario

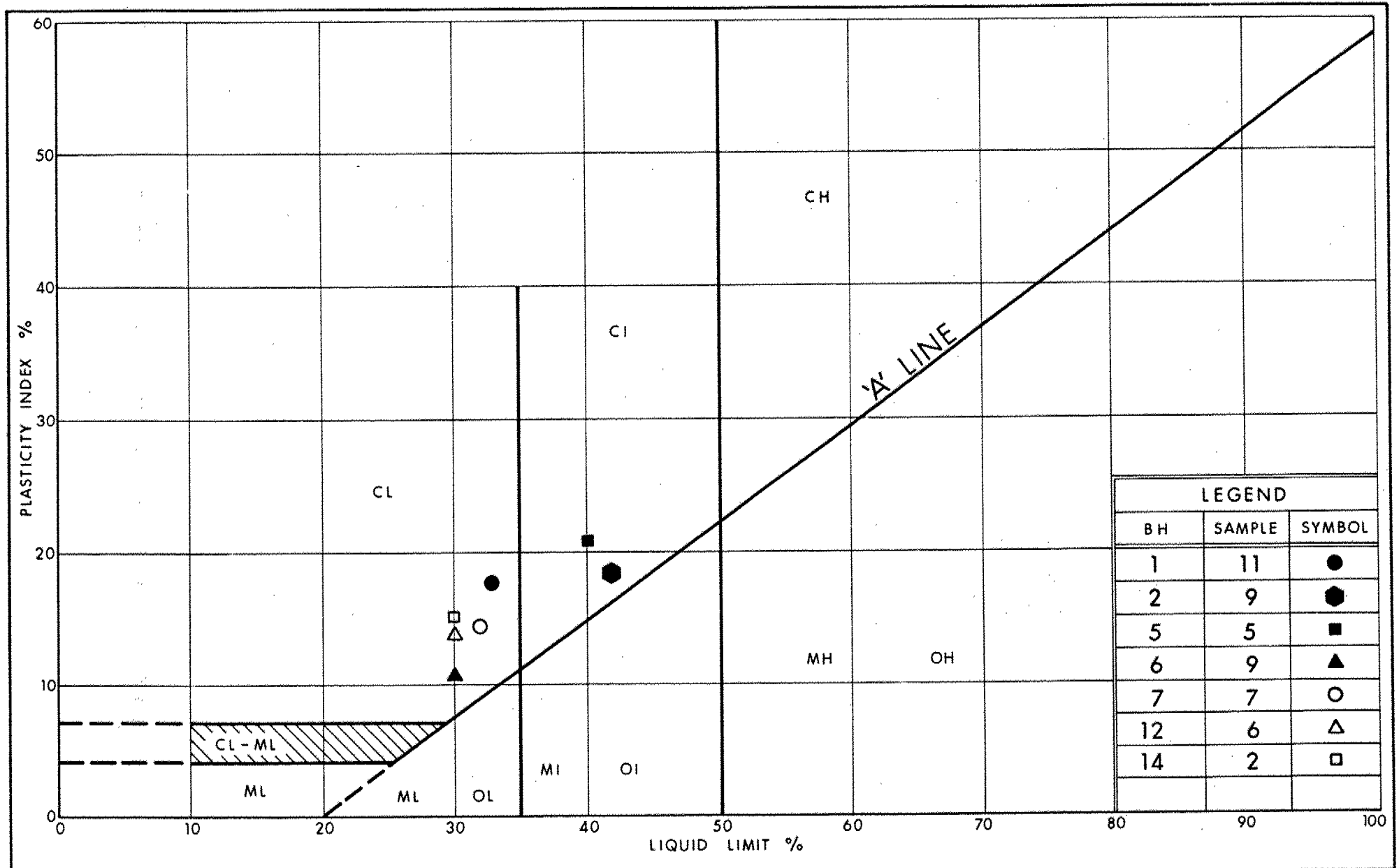
Ministry of
Transportation

PLASTICITY CHART CLAYEY SILT (Upper Glacial Till)

FIG No 2

W P 131-85-02/03

400 & Sheppard



Ministry of
Transportation
Ontario

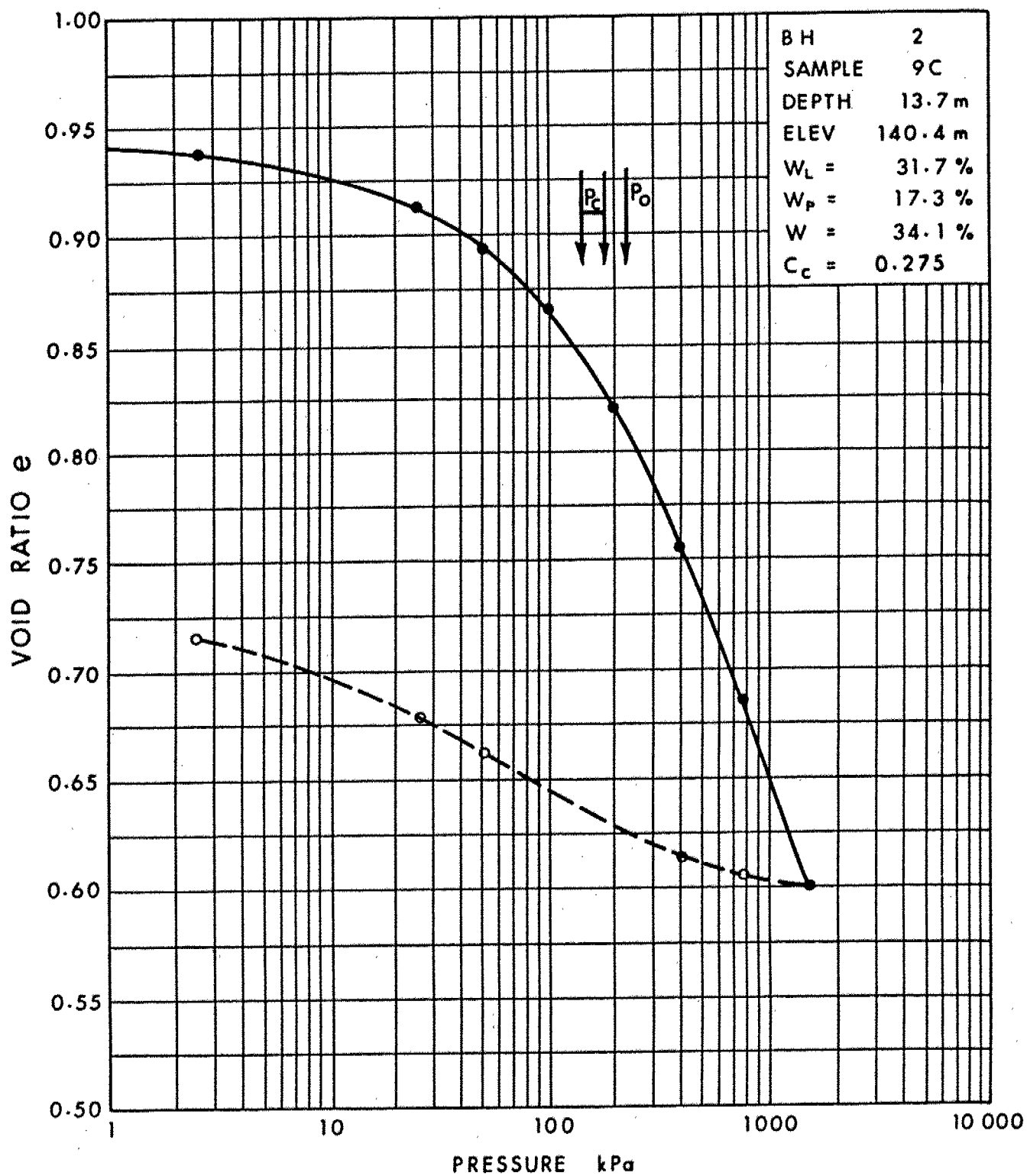
PLASTICITY CHART CLAYEY SILT / SILTY CLAY

FIG No 3

WP 131-85-02/03

400 & Sheppard

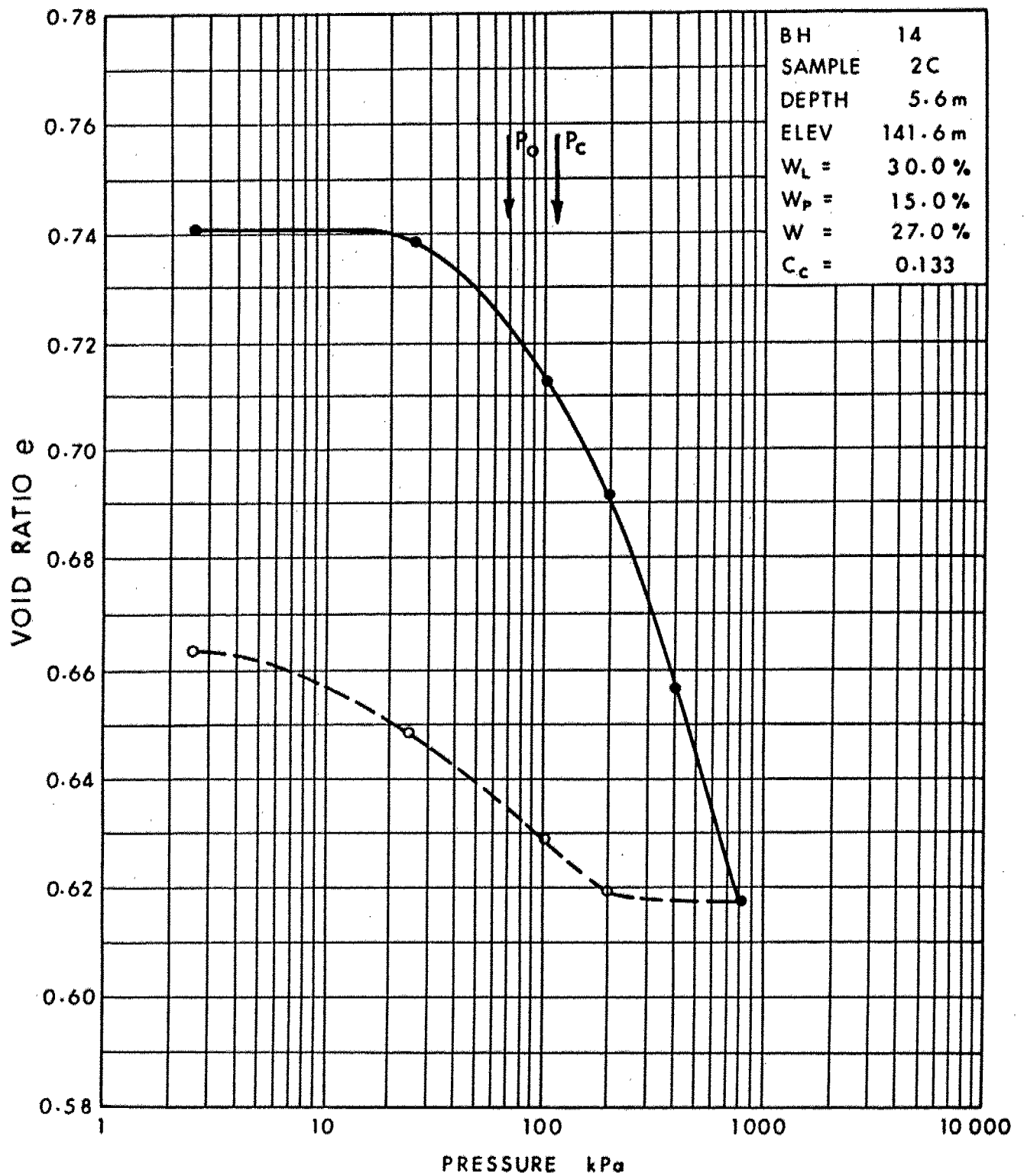
VOID RATIO - PRESSURE CURVE



WP 131-85-02

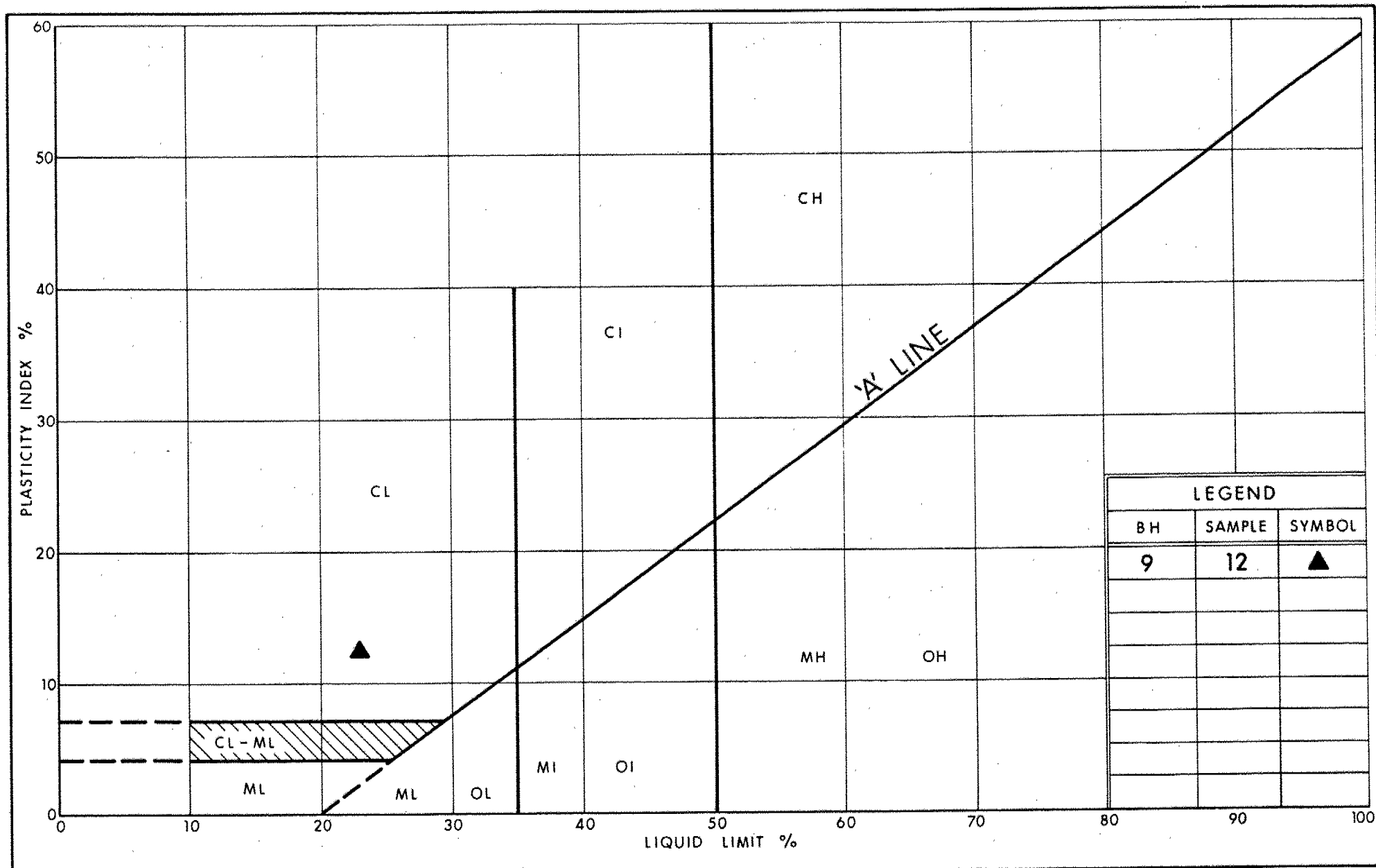
Fig 4

VOID RATIO - PRESSURE CURVE



WP 131-85-02

Fig 5



Ontario

Ministry of
Transportation

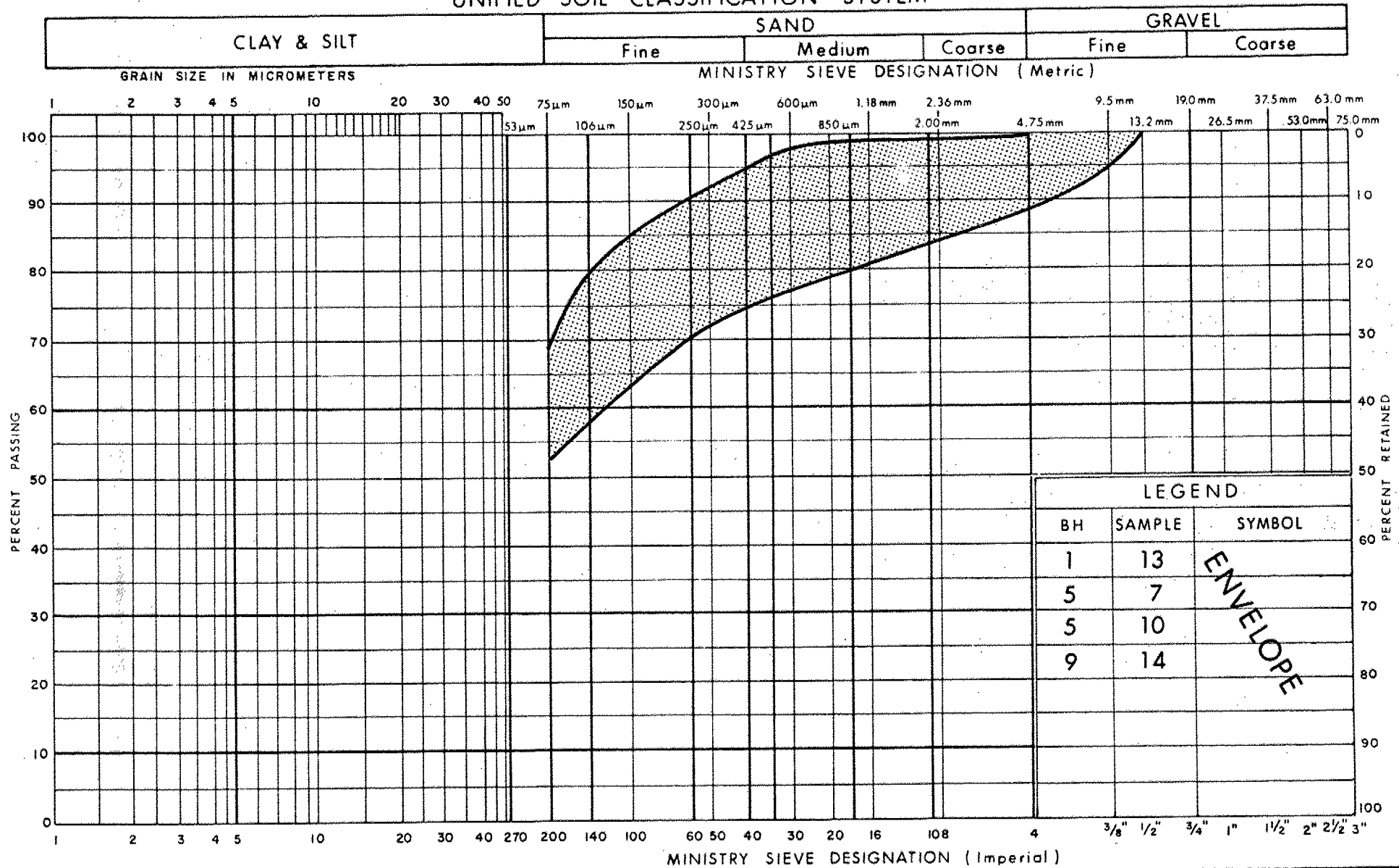
PLASTICITY CHART CLAYEY SILT (Lower Glacial Till)

FIG No 6

W P 131-85-02/03

400 & Sheppard

UNIFIED SOIL CLASSIFICATION SYSTEM



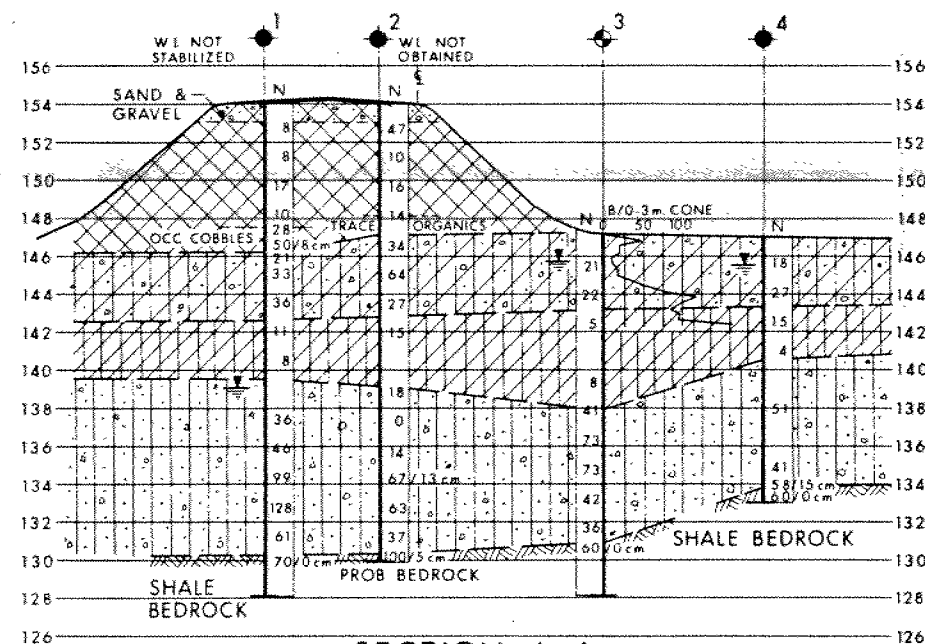
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT, SOME CLAY TRACE GRAVEL
(Glacial Till)

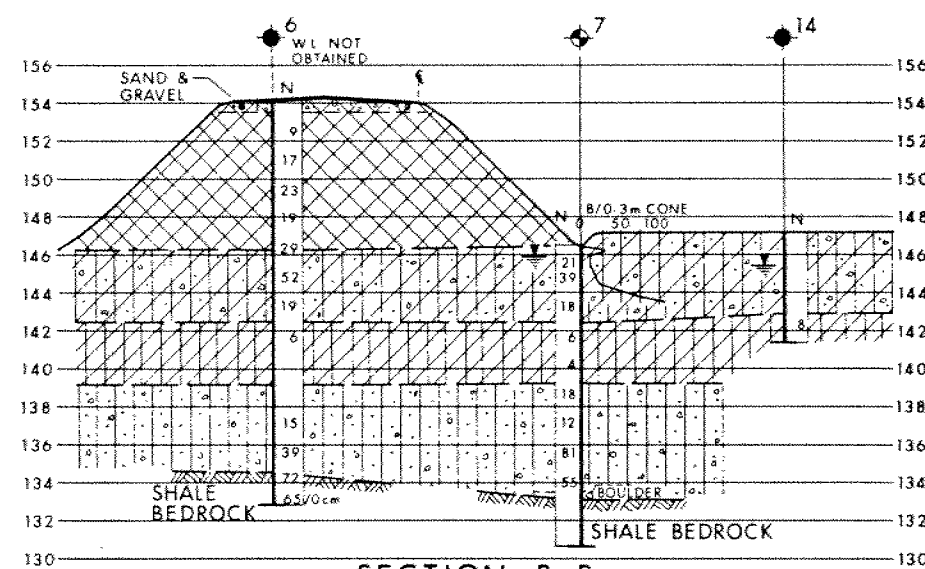
FIG No 7

W P 131-85-02/03

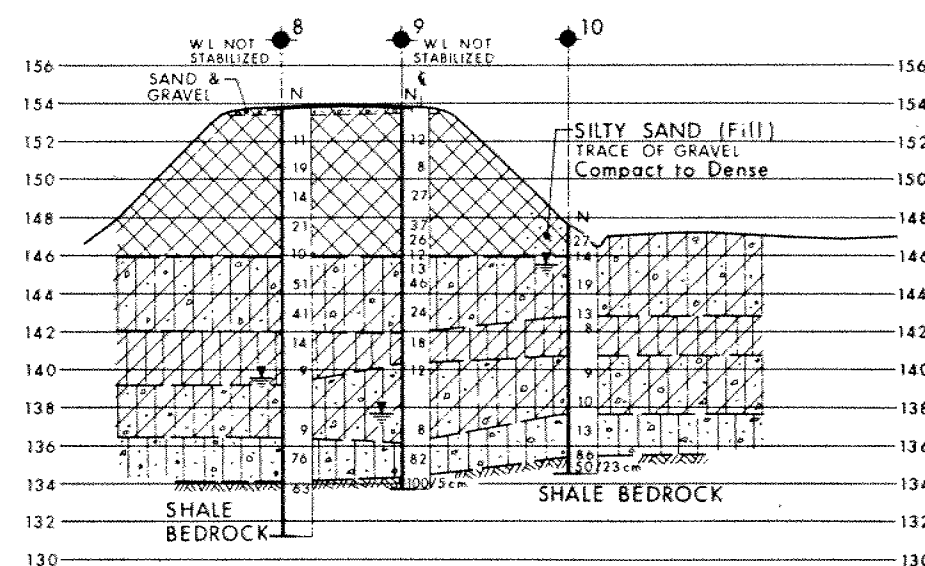
400 & Sheppard



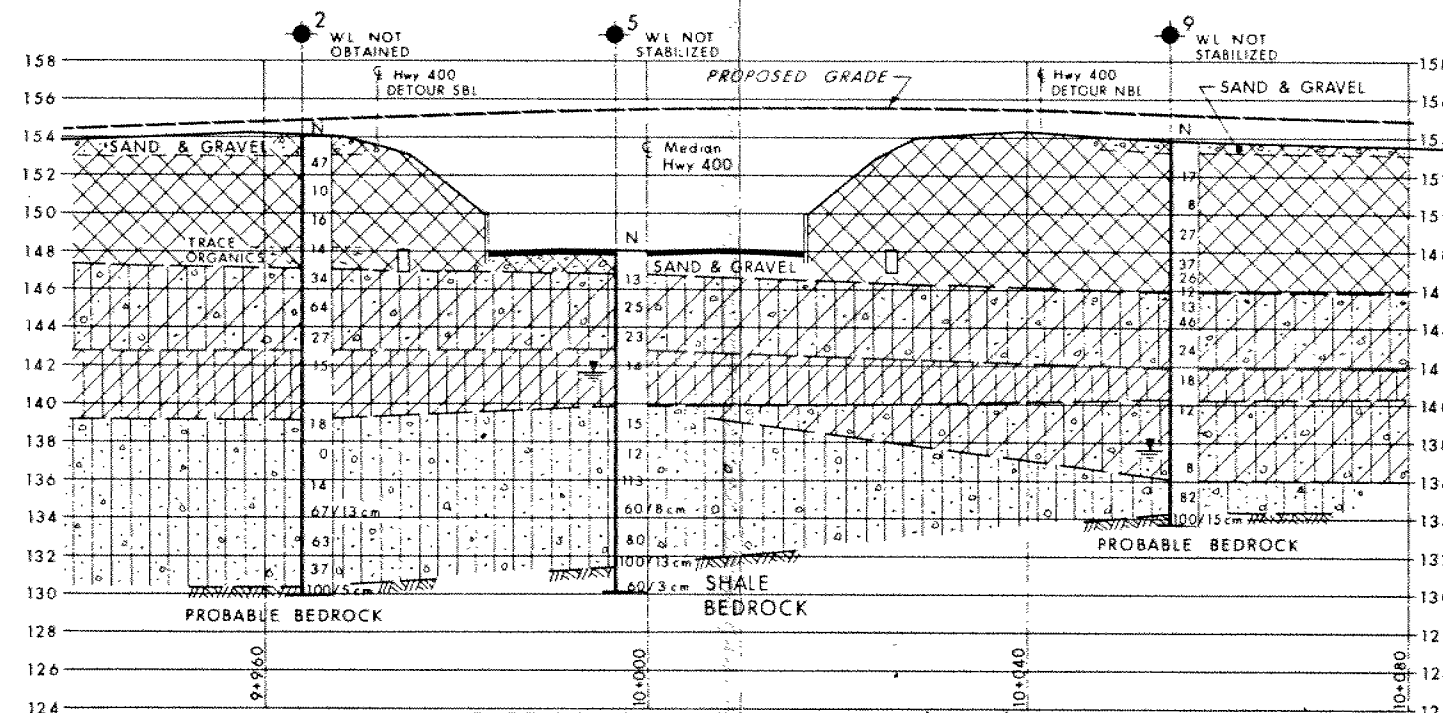
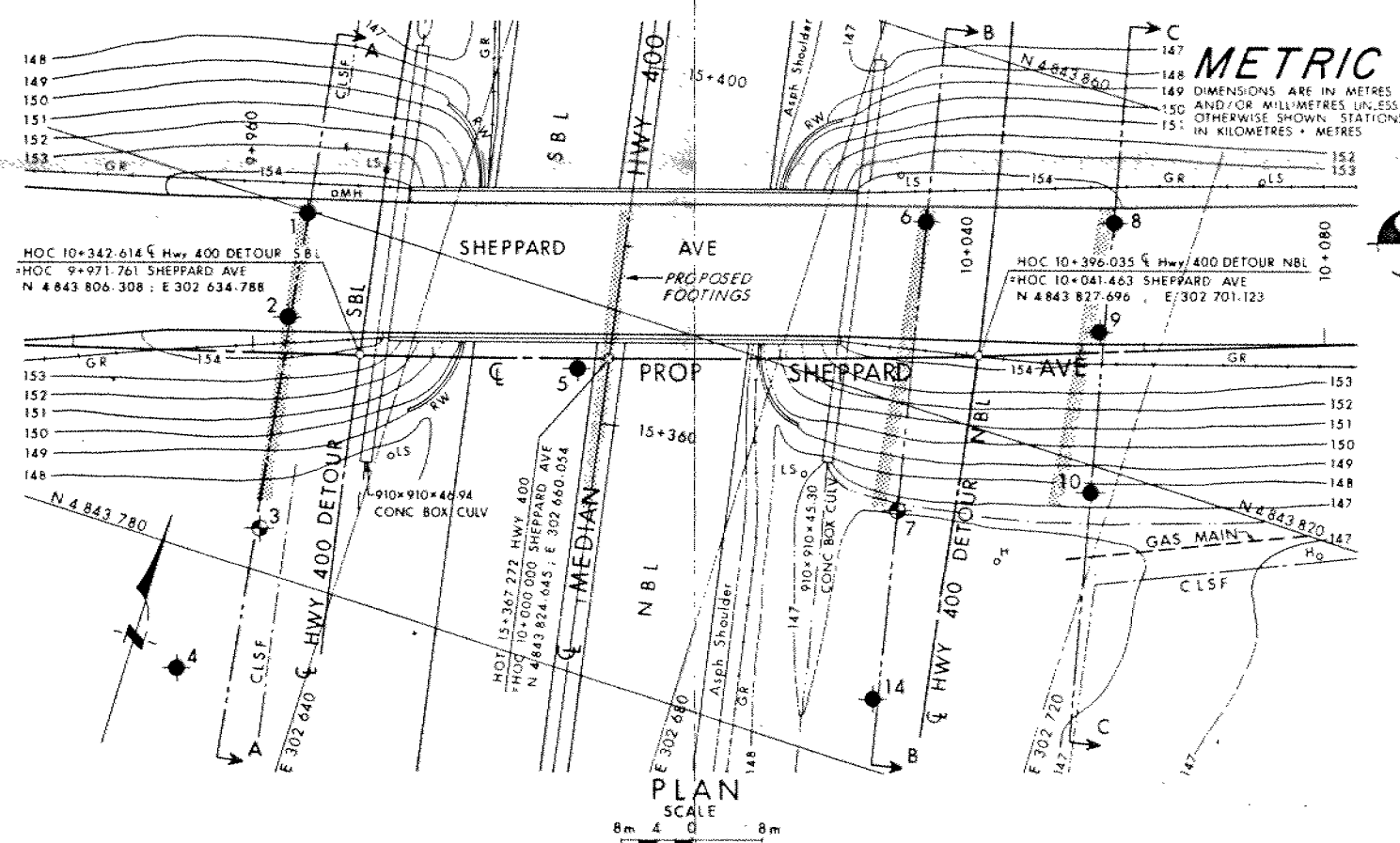
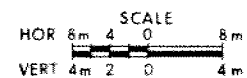
SECTION A-A



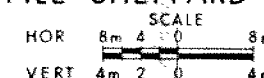
SECTION B-B



SECTION C - C



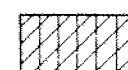
Q PROFILE SHEPPARD AVE (REV)



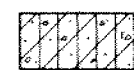
SOIL STRATIGRAPHY LEGEND



CLAYEY SILT (Fill)
WITH SOME SAND
Firm to Very Stiff



CLAYEY SILT / SILTY CLAY
TRACE OF SAND
Soft to Very Stiff



CLAYEY SILT, SOME SAND
TRACE OF GRAVEL
Stiff to Hard (Glacial Till)



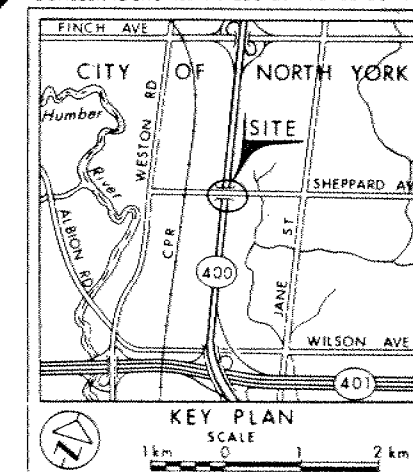
SANDY SILT, SOME CLAY
TRACE OF GRAVEL (Glacial Till)
Compact to Very Dense

CONT No
WP No 131-85-02





SHEPPARD AVE UNDERPASS

BORE HOLE LOCATIONS & SOIL STRAT.

STRATA ENGINEERING CORP.
CONSULTING ENGINEERS & GEOTECHNICAL SPECIALISTS



LEGEND

-  Bore Hole
 Dynamic Cone Penetration Test (Cone)
 Bore Hole & Cone
 N Blows/0.3m (Std Pen Test, 475 J/blow)
 CONE Blows/0.3m (60° Cone, 475 J/blow)
 W.L. at time of investigation 89.02

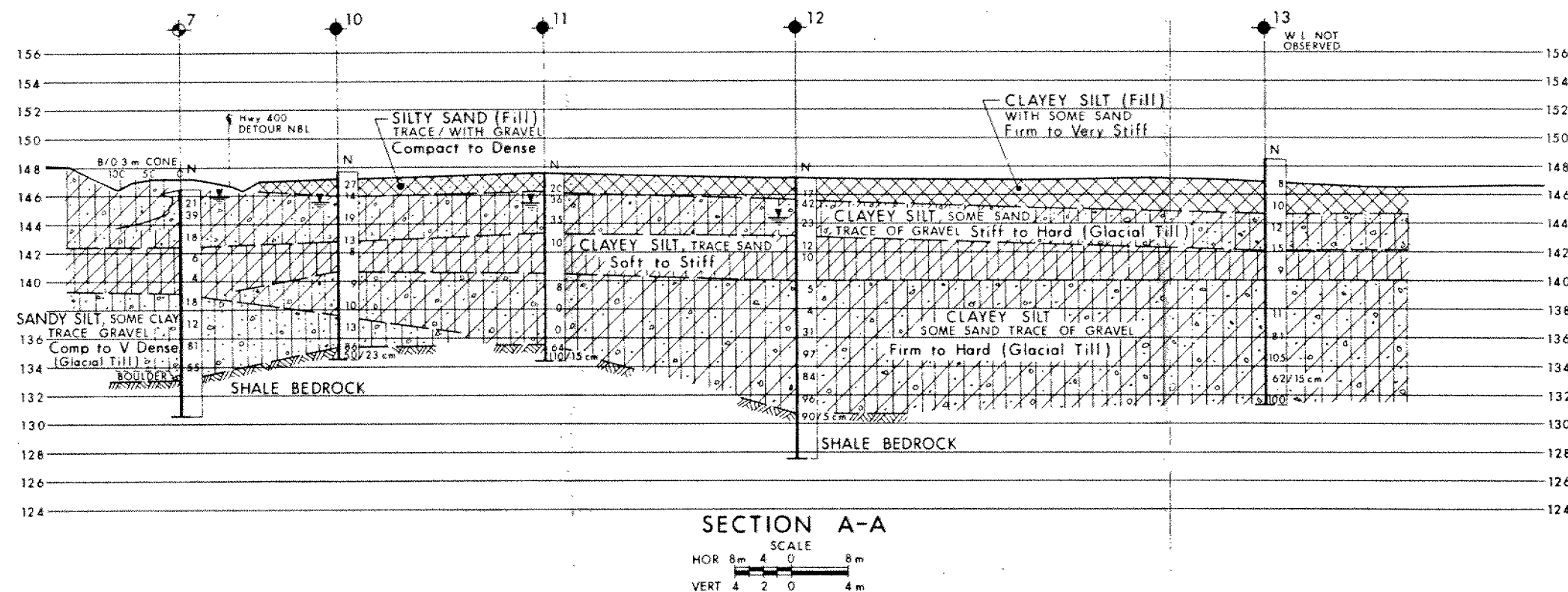
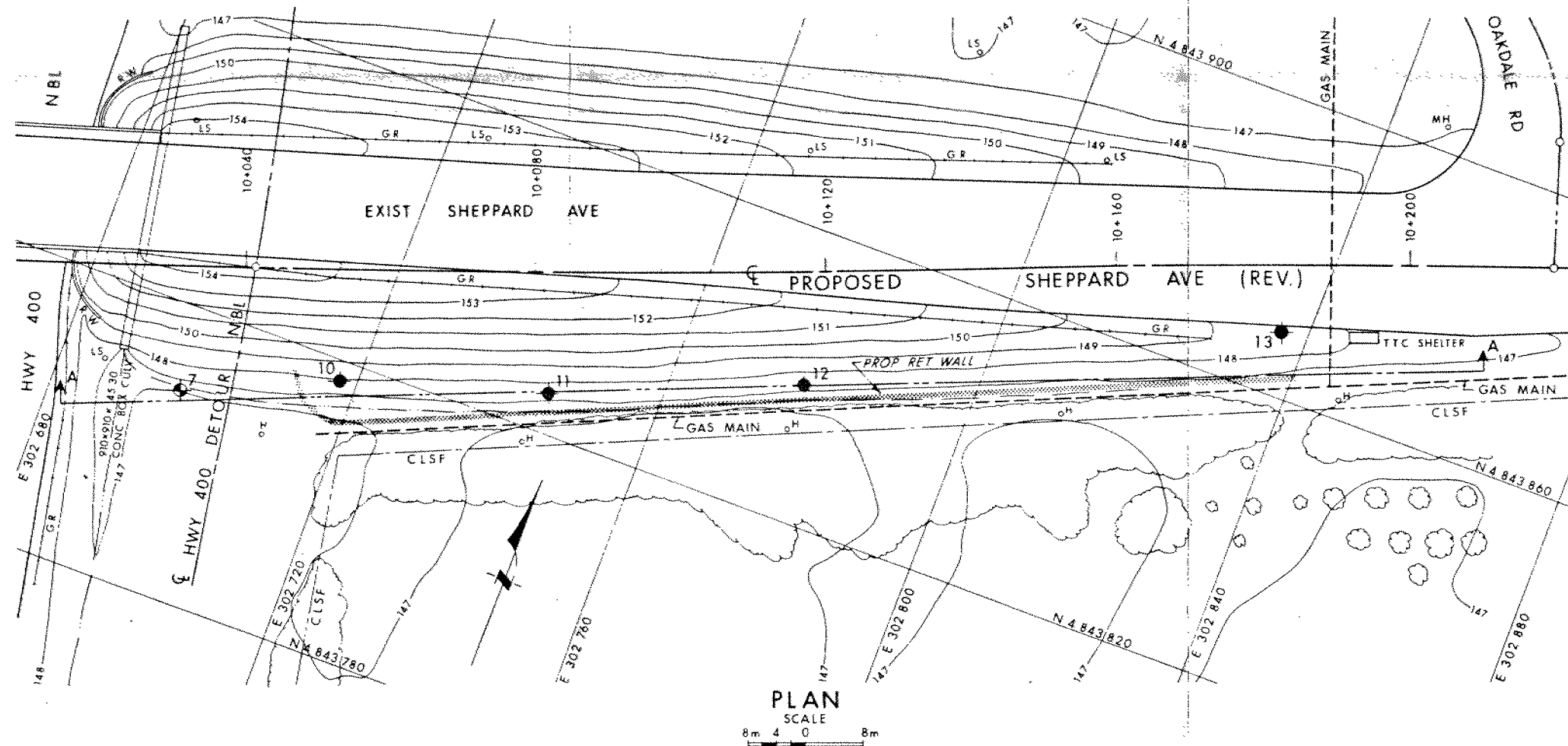
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	154.1	4 843 819.8	302 624.
2	154.1	4 843 808.1	302 626.
3	147.2	4 843 784.6	302 630.
4	147.0	4 843 766.9	302 625.
5	148.1	4 843 812.6	302 658.
6	154.1	4 843 840.2	302 691.
7	146.5	4 843 808.3	302 697.
8	153.8	4 843 846.4	302 711.
9	153.8	4 843 834.6	302 713.
10	147.7	4 843 817.0	302 717.
14	147.2	4 843 787.4	302 701.

==NOTE==

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

NOTE The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV					
	DATE	BY	DESCRIPTION		
Geocres No					
HWY No 400					DIST 6
SUBMIT	E H	CHECKED	C M	DATE 1989 05 19	SITE
DRAWN	S S	CHECKED	APPROVED		DWG 1318502-A



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

CONT No
WP No 131-85-03

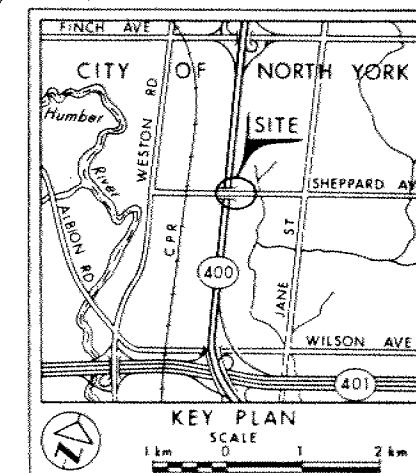
HWY 400 & SHEPPARD AVE
SOUTH-EAST RETAINING WALL
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



STRATA ENGINEERING CORP.
CONSULTING ENGINEERS & GEOTECHNICAL SPECIALISTS



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 89.02

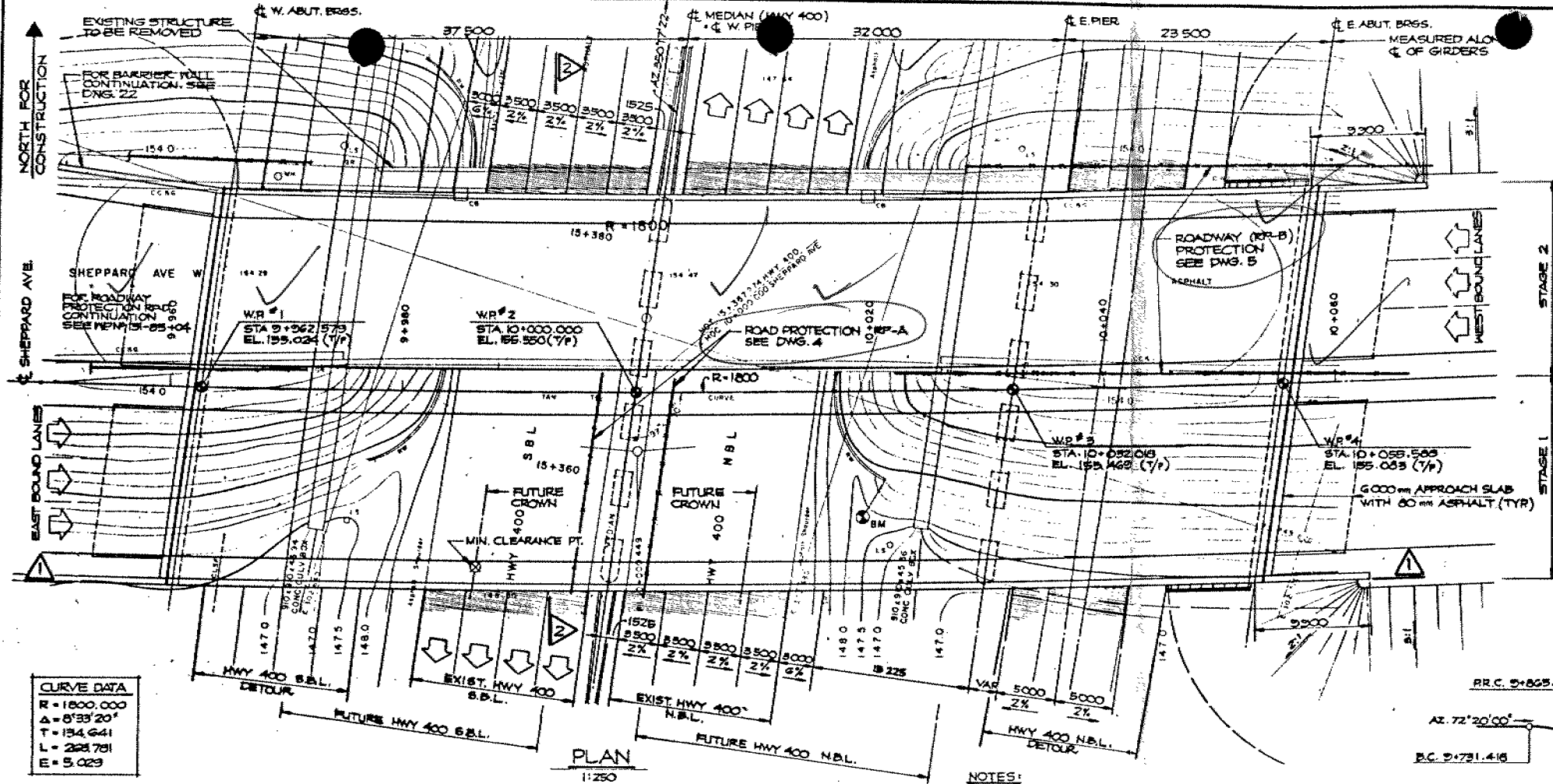
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
7	146.5	4843808.3	302697.6
10	147.7	4843817.0	302717.7
11	147.5	4843825.5	302745.0
12	147.2	4843838.7	302777.7
13	148.5	4843868.6	302836.5

NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office. Downview information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.


REV	DATE	BY	DESCRIPTION
Geocres No			
HWY No 400		DIST 6	
SUBMDEN		SITE	
DRAWN SS		DWG 1318503-A	



METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST 6 - TORONTO CONT No WP No 131-85-02	SHEPPARD AVENUE UNDERPASS AT HWY 400 GENERAL ARRANGEMENT
--	--



UMA Engineering Ltd.
Engineers & Planners

GENERAL NOTES

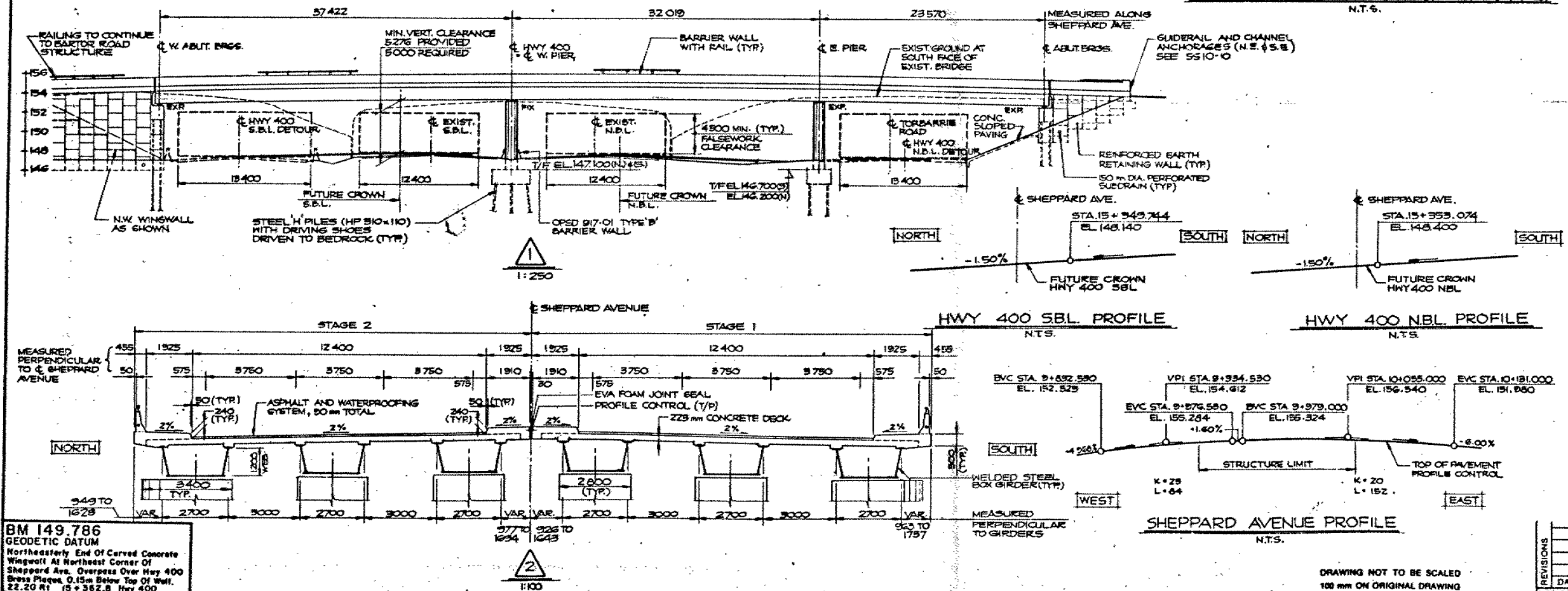
- | | | |
|----|--|-------------|
| 1. | CLASS OF CONCRETE | |
| | ALL CONCRETE | 30 MPa |
| 2. | CLEAR COVER TO REINFORCING STEEL | |
| | FOOTINGS | 100 ± 25 mm |
| | ABUTMENTS | |
| | FRONT FACE | 20 ± 20 mm |
| | BACK FACE | 70 ± 20 mm |
| | PIERS | 20 ± 20 mm |
| | DECK AND SIDEWALK | |
| | TOP | 70 ± 20 mm |
| | BOTTOM | 40 ± 10 mm |
| | APPROACH SLABS | 70 ± 20 mm |
| | REMAINDER
(UNLESS OTHERWISE SPECIFIED) | 70 ± 20 mm |
| 3. | REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH THE SUFFIC 'C' DENOTE COATED BARS. | |
| 4. | CONSTRUCTION NOTE | |
| | IF THE ACTUAL BEARING HEIGHTS ARE DIFFERENT FROM THE ASSUMED BEARING HEIGHTS GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND THE REINFORCING STEEL TO SUIT THE ACTUAL HEIGHTS. | |

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BORERHOLE LOCATIONS & SOIL STRATA
3. CONSTRUCTION STAGING
4. ROADWAY PROTECTION I
5. ROADWAY PROTECTION II
6. FOOTING LAYOUT AND REINFORCEMENT
7. ABUTMENTS
8. REINFORCED EARTH WALLS - PLAN, DETAILS & SCHEDULES
9. REINFORCED EARTH WALLS - EAST ABUTMENT ELEVATION
10. REINFORCED EARTH WALLS - WEST ABUTMENT ELEVATION
11. REINFORCED EARTH WALLS - SECTIONS & DETAILS
12. REINFORCED EARTH WALLS - TYPICAL DETAILS
13. PIERS
14. BEARINGS
15. STRUCTURAL STEEL DETAILS I
16. STRUCTURAL STEEL DETAILS II
17. STRUCTURAL STEEL DETAILS III
18. STRUCTURAL STEEL DETAILS IV
19. DECK DIMENSIONS AND SCREED ELEVATIONS
20. DECK REINFORCEMENT
21. BARRIER WALL ON SIDEWALK
22. BARRIER WALL ON REINFORCED EARTH PANELS
23. RAILING FOR BARRIER WALL
24. JOINT ANCHORAGE AND ARMOURING
25. 6000 mm APPROACH SLAB
26. DETAILS OF CONCRETE SLOPE PAVING
27. STANDARD DETAILS I
28. STANDARD DETAILS II
29. AS CONSTRUCTED ELEVATIONS & DIMENSIONS
30. EMBEDDED WORK IN STRUCTURE
31. QUANTITIES - STRUCTURE I
32. QUANTITIES - STRUCTURE II

APPLICABLE STANDARD DRAWINGS

- | | |
|---------|---|
| DD-5503 | MINIMUM GRANULAR BACKFILL REQUIREMENTS (PERCHED ABUTMENT) |
| DD-4604 | FALSEWORK CLEARANCES |



BM 149.786
GEODETC DATUM
Northeasterly End Of Curved Concrete
Wingwall At Northeast Corner Of
Sheppard Ave. Overpass Over Hwy 400
Bress Plates 0.15m Below Top Of Wall.
22.20 At 15 + 362.8 Hwy 400

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS				
DATE	BY	DESCRIPTION		
DESIGN H.C.	CHK K.A.	CODE OHBDC - 83 [LOAD CLASS X] DATE FEB 1992		
UNR	CHK G.L.B.	SIZE 37' WIDE 10' TALL		

92-1115 92-4

NORTH FOR CONSTRUCTION

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 131-85-02



SHEPPARD AVENUE UNDERPASS
AT HWY 400
ROADWAY PROTECTION I

SHEET

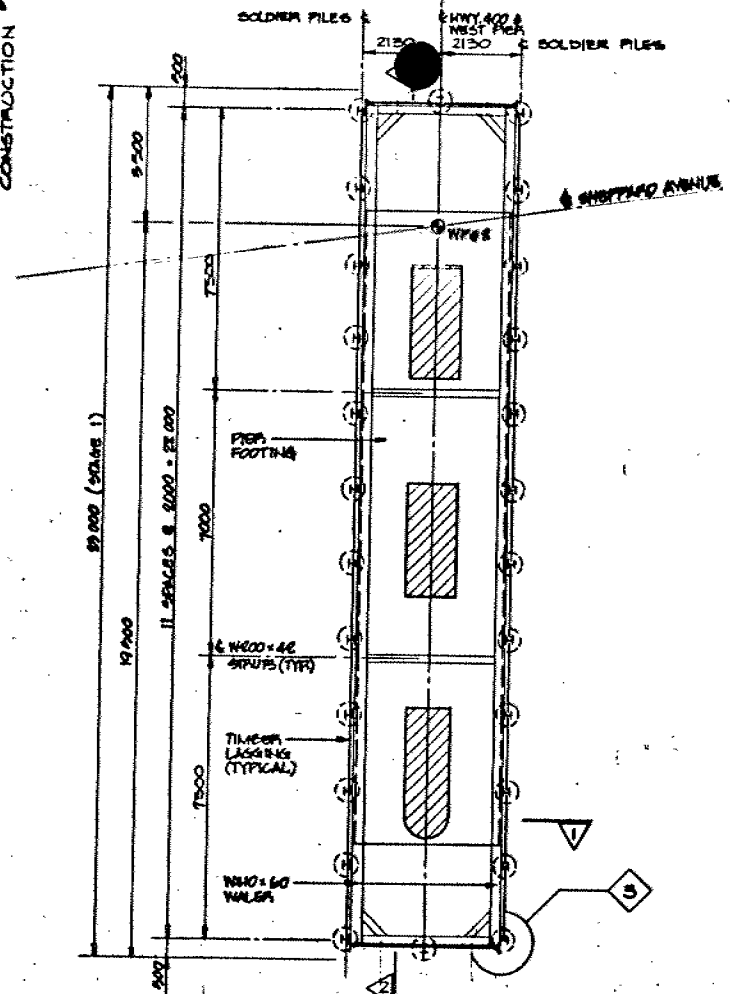
uma UMA Engineering Ltd.
Engineers & Planners

NOTES

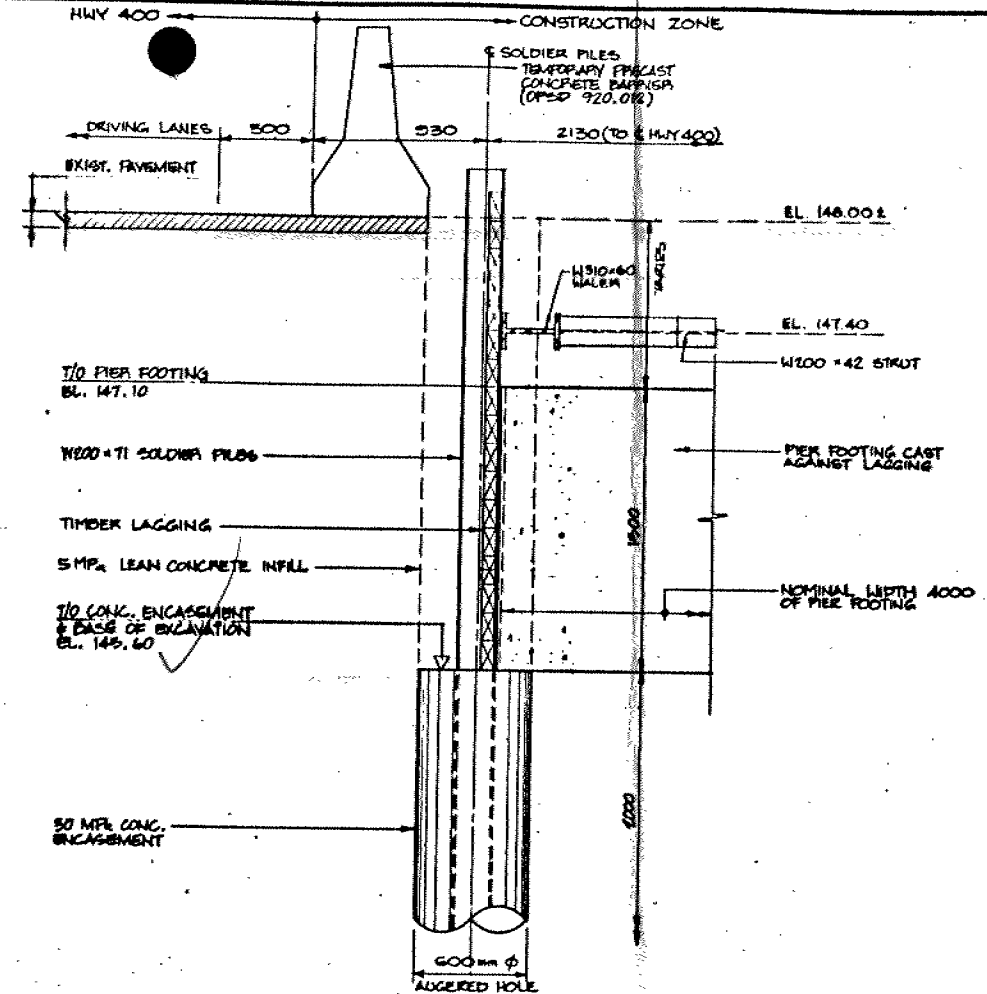
1. THE CONTRACTOR SHALL SUBMIT DETAILED CONSTRUCTION DRAWINGS SEALED & SIGNED BY A PROFESSIONAL ENGINEER FOR ANY ROADWAY PROTECTION WORK. ALTERNATIVE ROADWAY PROTECTION SCHEMES WILL BE CONSIDERED SUBJECT TO THE ENGINEER'S APPROVAL. ALTERNATIVE SCHEMES WILL NOT BE ALLOWED TO ENCROACH INTO THE PAVED PORTIONS OF HWY 400 BEYOND THE LIMITS SHOWN ON THE DRAWING.
2. STRUCTURAL STEEL FOR ROADWAY PROTECTION SHALL BE CAN/CSA G40.21-187, GRADE 300W.
3. WELDING OF STRUCTURAL STEEL SHALL FOLLOW CSA W59-M1989.
4. THE CONTRACTOR SHALL VERIFY EXISTING GRADE ELEVATIONS AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
5. UNLESS OTHERWISE NOTED, WELD SIZES FOR STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH STRUCTURAL STEEL NOTES ON DWG 15.
6. ✓ TIMBER LAGGING SHALL BE HARDWOOD LUMBER AND SHALL CONFORM TO CAN-086-M84.
7. ✓ LAGGING SHALL BE INSTALLED IN LIFTS NOT EXCEEDING 1.0 M AS EXCAVATION PROCEEDS.
8. ✓ PILES SHALL BE PLACED INTO PRE-DRILLED HOLES AND HOLES SHALL BE FILLED WITH 30 MPa CONCRETE BELOW BASE OF EXCAVATION OR AS STATED OTHERWISE AND WITH 5.0 MPa LEAN CONCRETE UP TO GRADE LEVEL.
9. ✓ TIE RODS SHALL BE 16 DYWIDAG THREAD BARS GRADE 1030 MPa CONFORMING TO THE REQUIREMENTS OF ASTM DESIGNATION A722.

**WEST PIER (EASTBOUND STRUCTURE)
ROADWAY PROTECTION CONSTRUCTION SEQUENCE**

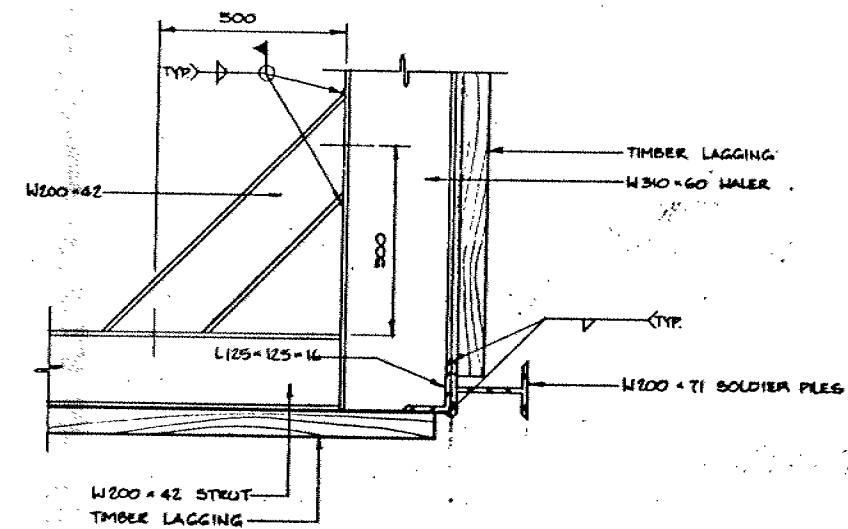
- ✓ 1. INSTALL TEMPORARY CONCRETE BARRIERS
- ✓ 2. INSTALL SOLDIER PILES
- ✓ 3. EXCAVATE AND INSTALL TIMBER LAGGING TO ELEVATION 0.5 M BELOW WALER LEVEL
- ✓ 4. INSTALL STRUTS AND WALERS
- ✓ 5. EXCAVATE TO ELEVATION AS SHOWN
- ✓ 6. DRIVE STEEL H-PILES FOR FOOTING
- ✓ 7. CONSTRUCT FOOTING, PIERS AND BACKFILL
- ✓ 8. REMOVE SHORING 1.0 M BELOW FINISHED GRADE



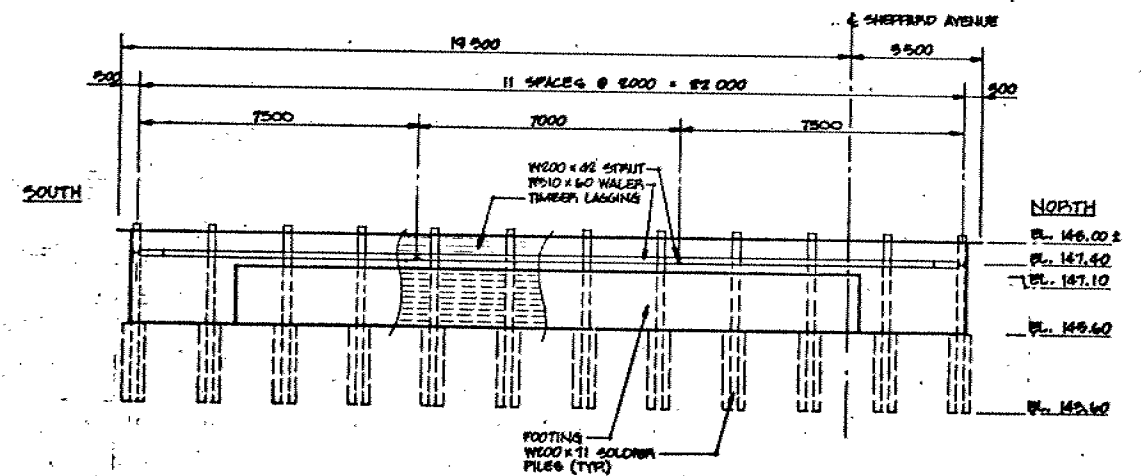
PLAN
1:100



ELEVATION
1:20



ELEVATION
1:10

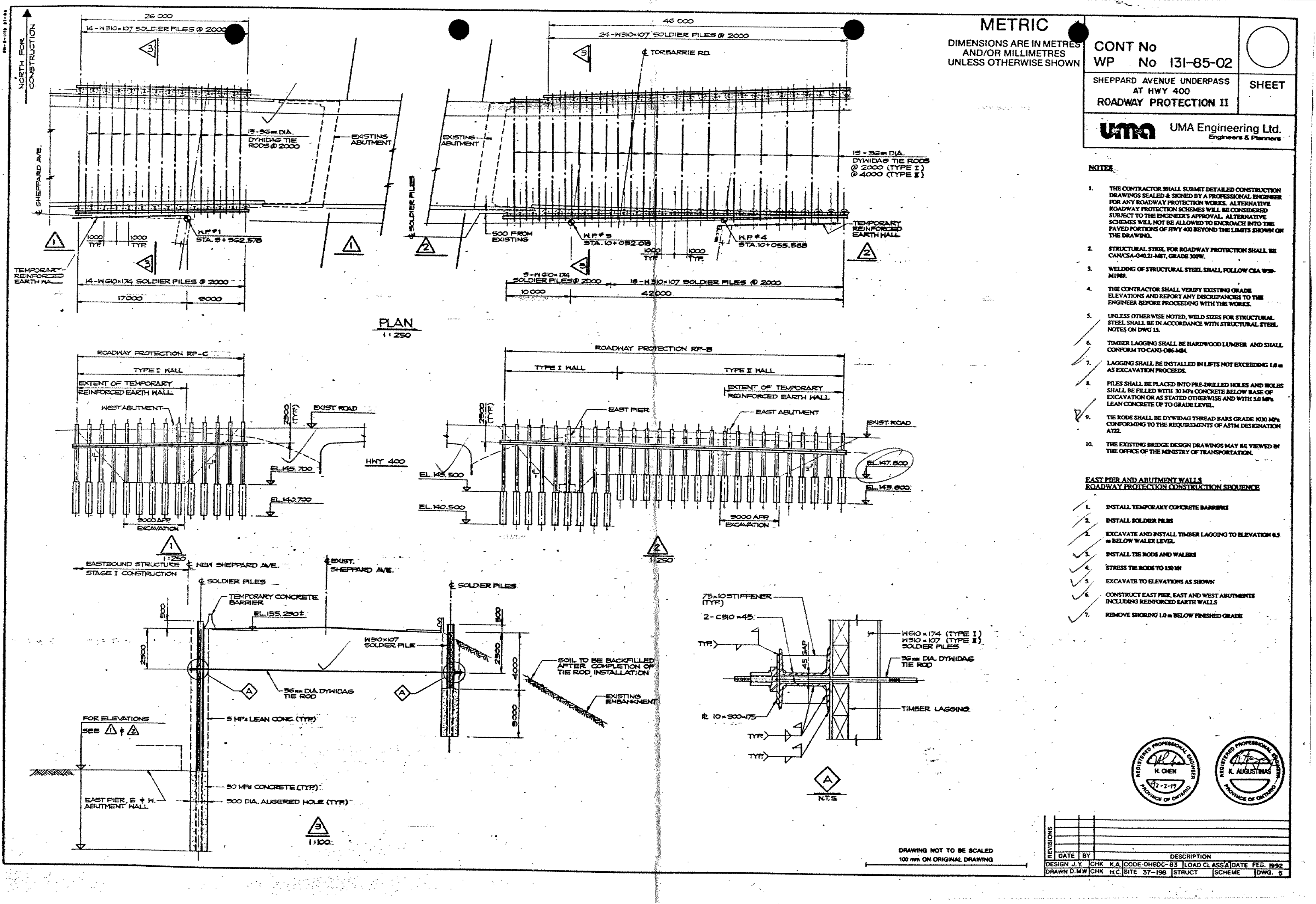


PLAN
1:100

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	J.Y.	CHK K.A.	CODE OHBC-83 (LOAD CLASS A) DATE FEB. 1992
DRAWN	L.M.	CHK H.C.	SITE 37-198 STRUCT SCHEME DWG. 4





METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 131-85-02

SHEPPARD AVENUE UNDERPASS
AT HWY 400
ROADWAY PROTECTION II

SHEET

UMA Engineering Ltd.
Engineers & Planners

NOTES

1. THE CONTRACTOR SHALL SUBMIT DETAILED CONSTRUCTION DRAWINGS SEALED & SIGNED BY A PROFESSIONAL ENGINEER FOR ANY ROADWAY PROTECTION WORKS. ALTERNATIVE ROADWAY PROTECTION SCHEMES WILL BE CONSIDERED SUBJECT TO THE ENGINEER'S APPROVAL. ALTERNATIVE SCHEMES WILL NOT BE ALLOWED TO ENCRoACH INTO THE PAVED PORTIONS OF HWY 400 BEYOND THE LIMITS SHOWN ON THE DRAWING.
2. STRUCTURAL STEEL FOR ROADWAY PROTECTION SHALL BE CANCSA-G40.21-M87, GRADE 300W.
3. WELDING OF STRUCTURAL STEEL SHALL FOLLOW CSA W59-M1989.
4. THE CONTRACTOR SHALL VERIFY EXISTING GRADE ELEVATIONS AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
5. UNLESS OTHERWISE NOTED, WELD SIZES FOR STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH STRUCTURAL STEEL NOTES ON DWG 15.
6. TIMBER LAGGING SHALL BE HARDWOOD LUMBER AND SHALL CONFORM TO CAN3-086-M84.
7. LAGGING SHALL BE INSTALLED IN LIFTS NOT EXCEEDING 1.0 m AS EXCAVATION PROCEEDS.
8. PILES SHALL BE PLACED INTO PRE-DRILLED HOLES AND HOLES SHALL BE FILLED WITH 30 MPa CONCRETE BELOW BASE OF EXCAVATION OR AS STATED OTHERWISE AND WITH 5.0 MPa LEAN CONCRETE UP TO GRADE LEVEL.
9. TIE RODS SHALL BE DYWIDAG THREAD BARS GRADE 1030 MPa CONFORMING TO THE REQUIREMENTS OF ASTM DESIGNATION A722.
10. THE EXISTING BRIDGE DESIGN DRAWINGS MAY BE VIEWED IN THE OFFICE OF THE MINISTRY OF TRANSPORTATION.

EAST PIER AND ABUTMENT WALLS
ROADWAY PROTECTION CONSTRUCTION SEQUENCE

1. INSTALL TEMPORARY CONCRETE BARRIERS
2. INSTALL SOLDIER PILES
3. EXCAVATE AND INSTALL TIMBER LAGGING TO ELEVATION 0.5 m BELOW WATER LEVEL
4. INSTALL TIE RODS AND WALLS
5. STRESS TIE RODS TO 130 MPa
6. EXCAVATE TO ELEVATIONS AS SHOWN
7. CONSTRUCT EAST PIER, EAST AND WEST ABUTMENTS INCLUDING REINFORCED EARTH WALLS
8. REMOVE SHORING 1.0 m BELOW FINISHED GRADE

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN J.Y.	CHK K.A.	CODE 0H8DC-83	LOAD CLASS A
DRAWN D.M.W.	CHK H.C.	SITE 37-198	STRUCT SCHEME DWG. 5
DATE FEB. 1992			

10-1116 97-02

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 131-85-02



SHEPPARD AVENUE UNDERPASS
AT HWY 400
FOOTING LAYOUT AND
REINFORCEMENT

SHEET

UMA Engineering Ltd.
Engineers & Planners

STAGE 1
SHEPPARD AVENUE WEST

STAGE 2

NORTH FOR
CONSTRUCTION

FOOTING LAYOUT

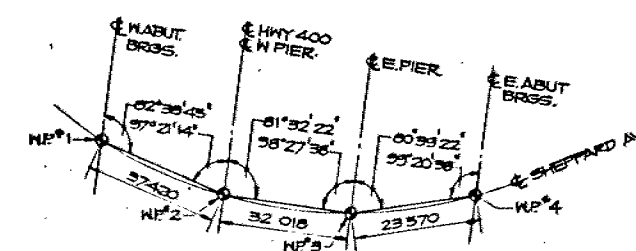
1:100

PILE DATA

LOCATION	BATTER	NO REQ'D	LENGTH (M)	PILE CUT-OFF ELEVATION
ABUTMENT	VERT.	16	22	151.800
N.W. PIER	VERT.	4	15	146.100
S.W. PIER	1:4	12	15	146.100
N.E. PIER	VERT.	10	14	145.500
S.E. PIER	1:4	4	14	145.500
E. ABUTMENT	VERT.	10	16	151.860

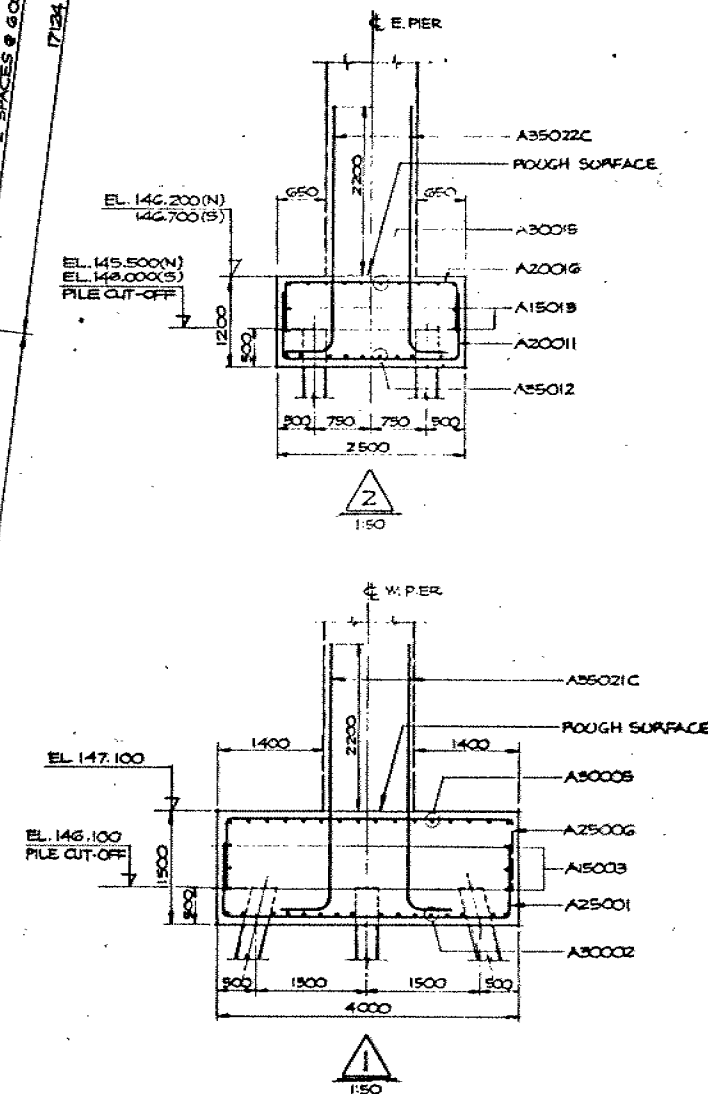
PILE NOTES:

1. PILES SHALL BE $\Phi 310 \times 110$
2. PILES SHALL HAVE DRIVING SHOES
3. PILES SHALL BE DRIVEN TO BEDROCK
4. PILE SPACING IS MEASURED AT THE UNDERSIDE OF FOOTINGS
5. PILE LENGTHS SHOWN ARE THEORETICAL LENGTH BELOW CUT-OFF
6. PILE DESIGN DATA
CAPACITY AS SLS TYPE I 1150 kN
FACTORED CAPACITY AT ULS 1600 kN



HORIZONTAL CONTROL DETAILS
N.T.S.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



APPLICABLE STANDARD DRAWINGS
DD-3301 SPICE AND DRIVING SHOE DETAILS
FOR STEEL 'H' PILES



REVISIONS	DATE	BY	DESCRIPTION

DESIGN J.Y. CHK K.A. CODE OHBDC-83 LOAD CLASS A DATE FEB. 1992
DRAWN E.M. CHK H.C. SITE 37-198 STRUCT SCHEME DWG. 6