

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 258-66-02

DIST 1

HWY E.C.R.

STR SITE 6-283

Windsor - Hwy. 3 Overpass

CONTRACT 87-23

DISTRIBUTION

A.P. Watt (2)
J. R. Roy
A. Wittenberg
J.H. Blevins (2)

A.E. McKim
G.A. Wrong
B.J. Giroux
R.S. Pillar

R. Hore

A. Crowley)
J. Anderson) cover only
G. Sloan)

Files ✓

SAMPLE DISPOSITION NOTICE

TYPE	DISCARD AFTER	RECOMM. BY
JARS	78-07-04	1445
TUBES	78-07-04	1488
ROCK CORES	78-07-04	1485

FOUNDATION INVESTIGATION REPORT

For

Windsor - Hwy. 3 Overpass
Hwy. E.C.R., District 1, Chatham
W.P. 258-66-02, Site 6-283

INTRODUCTION

This report contains the results of a foundation investigation carried out for the proposed overpass structure during the period from March 6 to 11, 1978. A muskeg vehicle mounted power auger machine equipped with solid augers was used to advance four boreholes to depths ranging from 53 to 119 feet in depth. Bedrock was proven in one borehole by obtaining AXT size rock core. Dynamic Cone Penetration Tests were carried out adjacent to each borehole. The report also contains recommendations relating to the design and construction of the proposed structure and approaches.

SITE DESCRIPTION

The site is located 1.6 miles east of Hwy. 18 along the proposed E.C. Row Expressway alignment within the City of Windsor. The surrounding terrain is flat.

Physiographically, the site is located in the region referred to as the "St. Clair Clay Plain".

SUBSURFACE CONDITIONS

General

Generally, uniform subsoil conditions were found to prevail over the site area. The subsoil consists of a shallow layer of silty sand, underlain by a deep deposit of clayey silt containing some sand and a trace of gravel, followed by a sandy silt, some gravel stratum which is in turn underlain by sound limestone bedrock. The boundaries of the different deposits are shown on the Record of Borehole Sheets attached to the Appendix. The estimated stratigraphical profiles of Drawing No. 2586602-A are based upon this information. A summary plot of the engineering properties is shown on Figure 1. Soil types encountered from ground level downward are described in some detail as follows.

Silty Sand

This deposit was intersected in all borings from immediately below the ground surface to a depth of about 4 feet. The material consists of silty sand. The relative density is estimated to range from loose to compact.

Clayey Silt, Some Sand, Traces of Gravel

The surficial silty sand stratum is underlain by an extensive cohesive type of deposit at each boring location. The lower boundary was found to be at elevation 498+. It was penetrated fully only in B.H. #1 and #4. The material in the deposit consists of clayey silt containing some sand and a trace of gravel. Occasional silty clay layers and seams of silt were also encountered. A plot of plasticity index versus liquid limit shows the greater majority of points to fall within the CL zone indicating a low to medium plasticity (Figure 2). Physical properties of the overall deposit as determined from field and laboratory tests are as follows.

		<u>Range</u>
Natural Moisture Content	(W) %	13-28
Liquid Limit	(W _L) %	13-35
Plastic Limit	(W _p) %	12-19
Bulk Density	(γ) PCF	126-134
Undrained Shear Strength	(Su) PSF	
Unconfined		744-3630
Field Vane		920-2000+
Sensitivity		2-3

The results of complete mechanical analyses are shown in an envelope form on Figure 3 of the Appendix.

A desiccated zone with a thickness ranging from 10 feet to 12 feet was found in all the boreholes to extend from the upper surface of the stratum. This zone is brown in colour due to oxidation and apart from the upper 2-3 feet (water affected zone), has a very stiff consistency. Standard Penetration 'N' values ranged from 16 to 30 blows per foot. Below the desiccated layer the colour of the soil is grey and the consistency ranges somewhat randomly from firm to very stiff. For design purposes the following undrained shear strength values are suggested.

Above Elev. 583:	Su = 2500 PSF
Elev. 560 - Elev. 583:	1450
Elev. 530 - Elev. 560:	900
Elev. 498 - Elev. 530:	1500

No consolidation tests were carried out at this site but it is estimated that apart from the desiccated zone the deposit is over-consolidated by about 1.5 T.S.F. This estimation is based on tests carried out on samples obtained at the junction of E.C. Row Expressway and Hwy. 3 located about 1.6 miles east (W.P. 257-66-02). Similar subsoil conditions were encountered at both locations.

Sandy Silt, Some Gravel

An approximate 4-8 foot thick sandy silt containing some gravel zone was found to underlie the cohesive deposit. The relative density is estimated to vary from compact to dense.

Limestone Bedrock

The bedrock was proven at one borehole location (B.H. #1) by obtaining AXT size core. The rock was found to be sound limestone, the surface being at elevation 489.6.

Groundwater Conditions

Groundwater level observations have been carried out during the course of the fieldwork by recording the water levels in the open boreholes. The following levels were observed:

B.H. #1	Elev.597
B.H. #2	Elev.597
B.H. #3	Elev.598
B.H. #4	Elev.599

These figures indicate that the groundwater level is located some 2-3 feet below the existing ground level. It is assumed that the groundwater levels are subjected to seasonal variation.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to build a two span (103'-103') twin overpass structure at this location. The profile grade of E.C. Row Expressway is set at elevation 621 \pm , some 21 feet above the surface of Hwy. 3. The existing ground surface adjacent to the proposed structure site is at about elevation 600 \pm .

Structure Foundations

Piled Foundations: It is recommended that the entire structure (abutments and piers) be founded on end bearing piles driven to bedrock. The bedrock surface is located some 109 feet below ground level. These piles could be either steel 'H' piles or concrete filled steel tube piles. Design loads could be as high as 130 tons/pile for either 12 3/4" x 1/4" steel tubes or 12BP@74 steel 'H' sections. The tips of steel 'H' piles should be reinforced. If tube piling is selected the driving energy should not exceed 30,000 ft. lbs. per blow below elevation 500 to avoid damage to the piles when contact with bedrock is made. These recommendations are based on the obtained load test results and problems encountered during a pile load test in the same general area.

Spread Footings: The entire structure may be supported on spread footings placed within the very stiff desiccated zone of the subsoil between elevation 590 and elevation 595. A safe net pressure of 2.5 T.S.F. may be assumed for design purposes.

The desiccated zone is susceptible to softening on contact with water, therefore, it is recommended that the base of the footing excavations be protected by pouring lean concrete on exposure.

As an alternative, the abutments may be constructed within the approach fills and supported on spread footings placed on well compacted, suitable granular material. A safe design load of 2.5 T.S.F. may be assumed. A construction scheme is outlined on Figure 4 of the Appendix. Settlement considerations are discussed in another paragraph.

Approach Embankments

The shear strength of the subsoil is such that it will be able to support the 21 foot high approach embankments constructed with 2:1 slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven. It is recommended that this portion of the fill contain no larger grain size than 2 inches if steel tube piles are considered or larger than 3 inches in the case of steel 'H' piles.

Settlement Considerations

Due to the compressible nature of the predominant subsoil (clayey silt), it is inevitable that consolidation settlements will occur over a longterm period due to the imposed loads of structure abutments on spread footings and embankments. It is estimated that a maximum settlement of 4-5 inches will take place over a long period of time under the 21 foot high fill. Based on the experiences with similar structures under similar subsoil conditions, it can be concluded that 50% of the total settlement will be completed in about 6 months' time.

For the piers, it is estimated that settlements of spread footings will be in the order of 1½ to 2 inches. Thus, differential settlements up to 3½ inches between the piers and abutments if supported on spread footings are anticipated. Regardless of whether the structure is wholly or partly on spread footings, it would be advantageous to construct the embankments well in advance of the structures in order to minimize future differential settlements. Consideration should also be given to surcharging at the abutments' location if spread footing type support is used. The aforementioned granular core should be placed first and earth fill could be placed up to the grade of surcharge level.

Other Considerations

The pile caps and/or the underside of the spread footings should be protected against frost protection.

The topsoil stripping should be in accordance with current MTC standards.

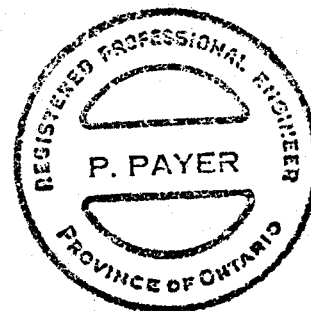
No major dewatering problems are anticipated.

MISCELLANEOUS

The boring programme was carried out during the period of March 6 to 11, 1968 under the supervision of Mr. A.M. Seppalla, Project Engineer.

This report was prepared by Mr. P. Payer, Senior Engineer, and reviewed by Mr. K.G. Selby, Supervising Engineer.

P. Payer
P. Payer, P. Eng.
Senior Engineer



K. G. Selby
K.G. Selby, P. Eng.
Supervising Engineer

June, 1978

APPENDIX



RECORD OF BOREHOLE No 1 (Formerly BH #14, W.O. 65-F-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,234; E 851,615 ORIGINATED BY A.M.S.
DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P.
DATUM Geodetic DATE March 6,7, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)				
								20 40 60 80 100											
598.6	Ground Level																		
0.0	Silty Sand																		
594.6	Loose to Compact																		
4.0			1	SS	20														
			2	SS	30									2 20 43 35					
			3A	SS	-														
			4	TW	PH								126						
	Clayey Silt Some Sand Traces of Gravel		5	TW	PH														
			6	TW	PH								127.5						
			7	TW	PH														
	Firm to Very Stiff		8	TW	PH								131.5	5 23 41 31					
			9	TW	PH														
			10	TW	PH								133						
			11	TW	PH														
			12	TW	PH								126						
			13	TW	PH														
			14	TW	PH								128	3 15 49 33					
497.6			15	SS	20														
101.0	Sandy Silt Some Gravel Compact to Dense																		
489.6			16	AXT RC	REC 100%														
109.0	Limestone Bedrock Sound		17	AXT RC	REC 100%														
479.6																			

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2 (Formerly BH. #15. W.O. 68-F-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,109; E 851,694 ORIGINATED BY A.M.S.
DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P.
DATUM Geodetic DATE March 7, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
599.3	Ground Level																
595.3	Silty Sand Loose to Compact																
4.0			1	SS	18		590										2 16 41 41
	Clayey Silt Some Sand Traces of Gravel		2	SS	22											132	
			3	TW	PH		580										
	Occasional Silty Clay Layers		4	TW	PH												
			5	TW	PH		570									127	
	Stiff to Very Stiff		6	TW	PH												
			7	TW	PH		560									132	2 25 41 32
			8	TW	PH												
							550									133	
546.3			9	TW	PH												
53.0	End of Borehole																

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 3 (Formerly BH. #16, W.O. 68-F-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,244; E 851,784 ORIGINATED BY A.M.S.
DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger COMPILED BY P.P.
DATUM Geodetic DATE March 7,8, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
600.0	Ground Level							20 40 60 80 100							
0.0	Silty Sand	..													
596.0	Loose to Compact	..													
4.0	Clayey Silt Some Sand Traces of Gravel Stiff to Very Stiff		1	SS	10										
			2	SS	30										
			3	SS	22										
			4	TW	PH										
			5	SS	13										
			6	TW	PH										
			7	SS	13										
			8	TW	PH										
			9	TW	PH										
547.0															
53.0	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

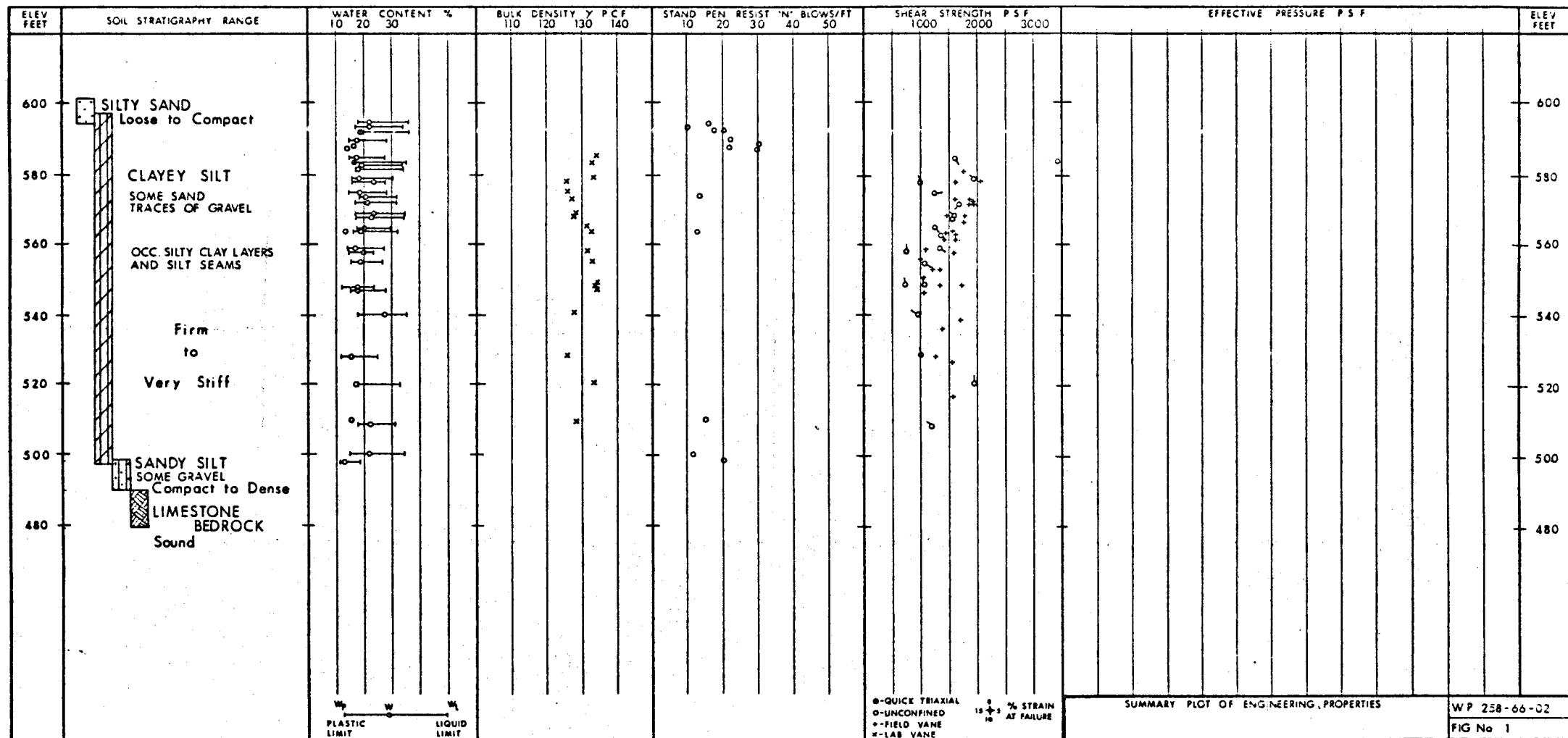
RECORD OF BOREHOLE No 4 (Formerly BH. #17, W.O. 68-F-15-1)

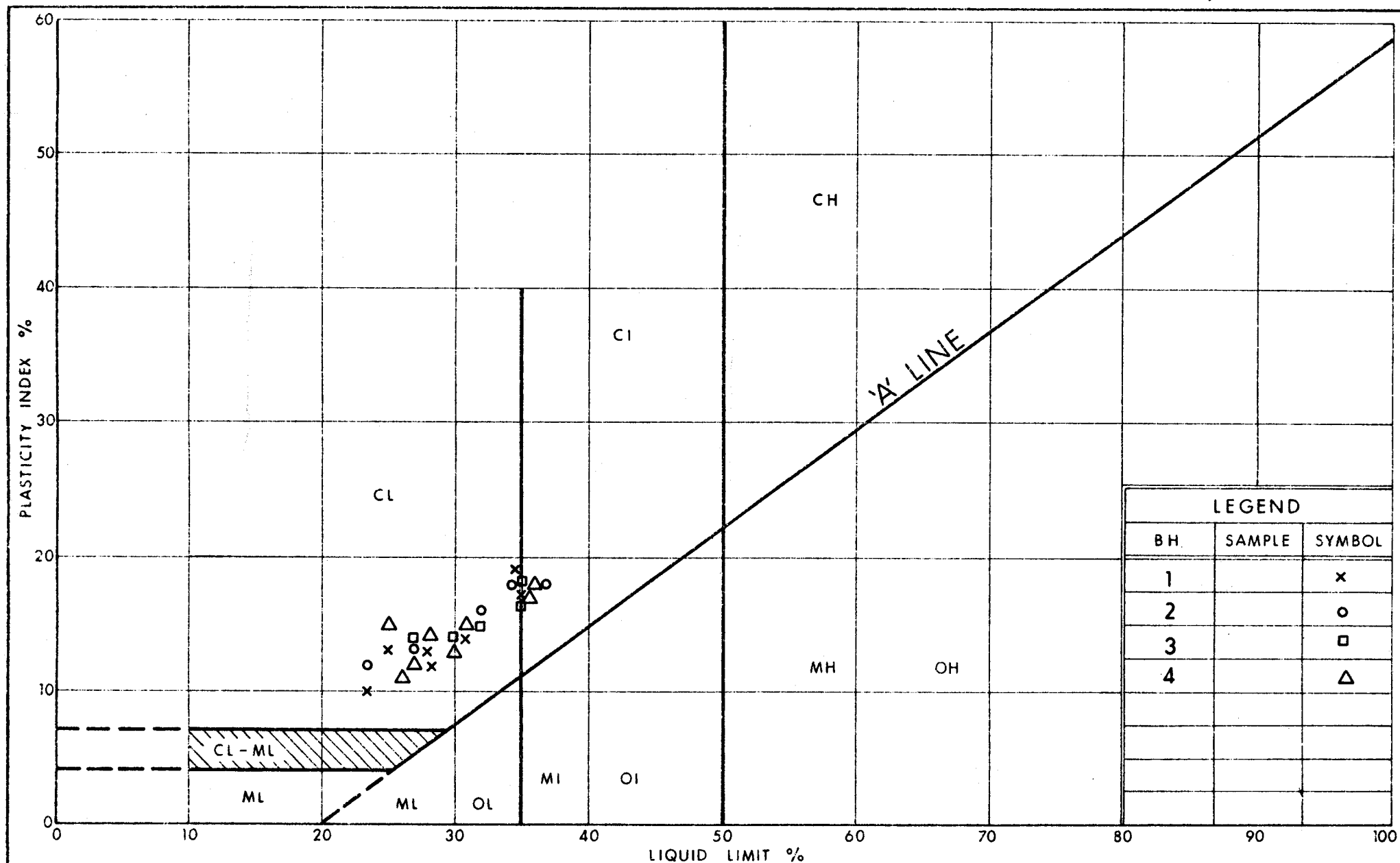
W P 258-66-02 LOCATION Coords. N 15,358,191; E 851,886 ORIGINATED BY A.M.S.
DIST 1 HWY E.C. Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P
DATUM Geodetic DATE March 8 & 11, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
601.0	Ground Level																
0.0	Silty Sand																
597.0	Loose to Compact																
4.0			1	SS	16												
			2	SS	22												
			3	TW	PH												
			4	TW	PH												
			5	TW	PH												
			6	TW	PH												
			7	TW	PH												
			8	TW	PH												
			9	TW	PH												
			10	TW	PH												
			11	TW	PH												
			12	TW	PH												
			13	TW	PH												
			14	SS	15												
			15	SS	12												
498.0	Sandy Silt																
103.0	Some Gravel, Compact																
494.5	Refusal																
106.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10





Ontario

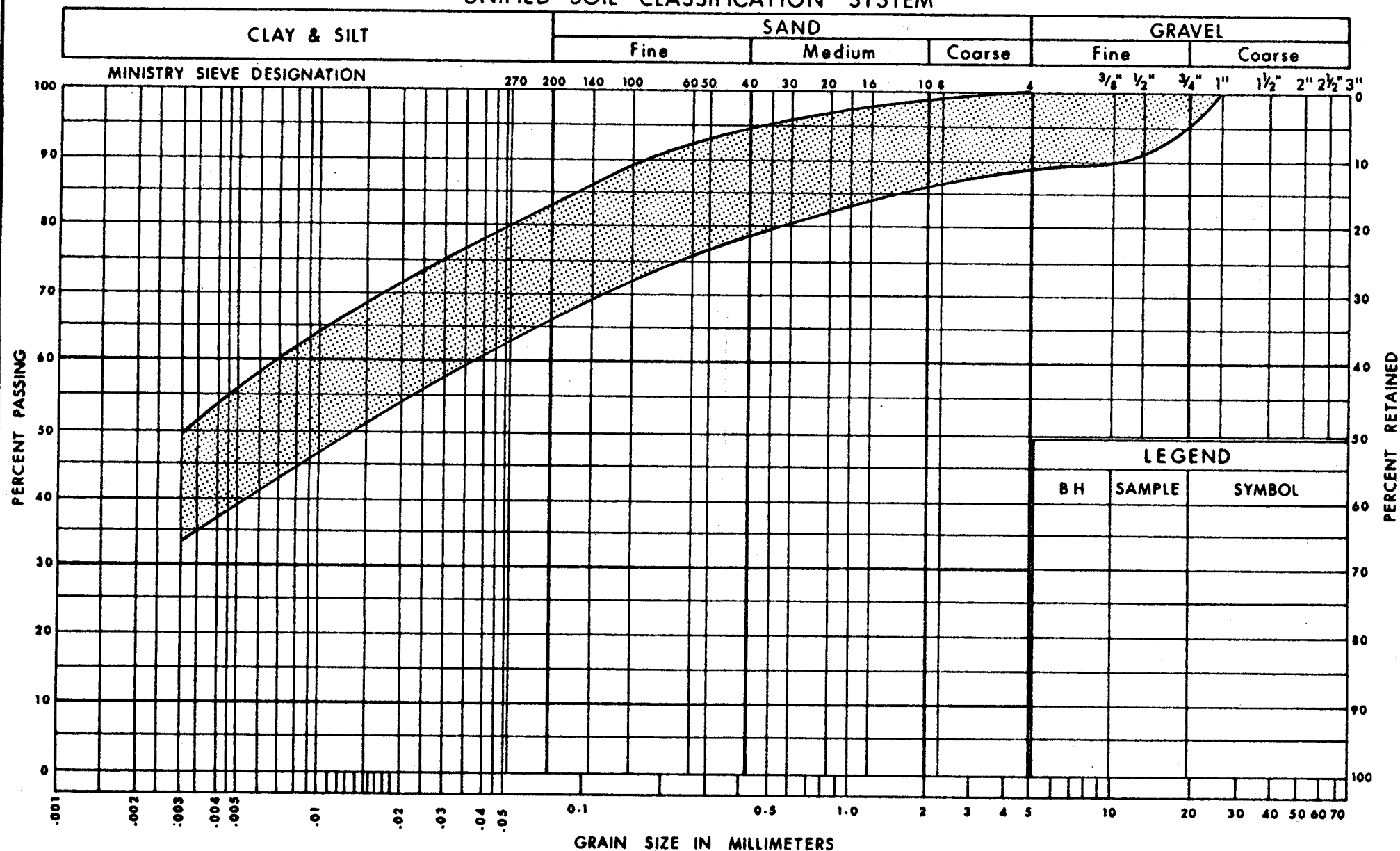
 Ministry of
Transportation and
Communications

PLASTICITY CHART
CLAYEY SILT, SOME SAND, TRACES OF GRAVEL
OCC. SILTY CLAY LAYERS
AND SILT SEAMS

FIG No 2

W P 258-66-02

UNIFIED SOIL CLASSIFICATION SYSTEM



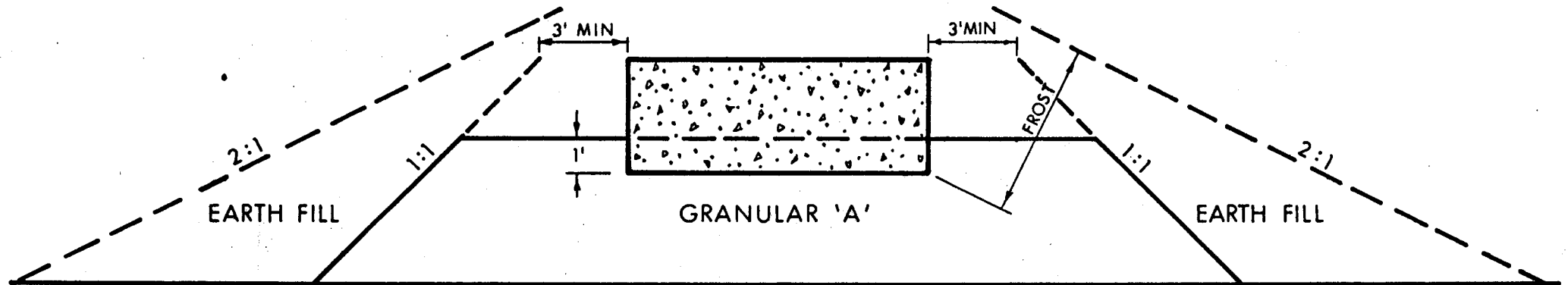
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
 CLAYEY SILT, SOME SAND, TRACES OF GRAVEL
 OCC. SILTY CLAY LAYERS
 AND SILT SEAMS

FIG No 3

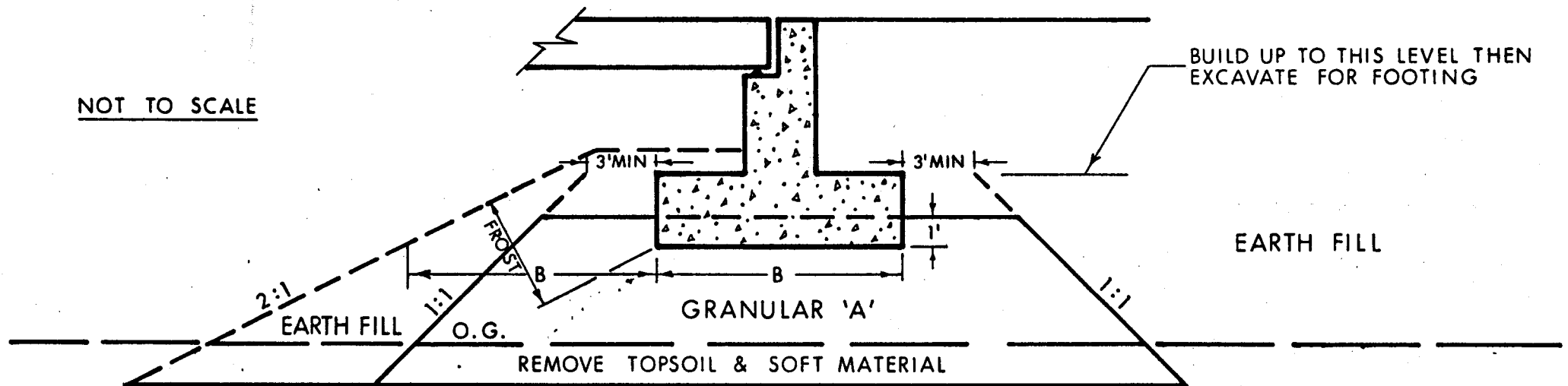
W P 258-66-02

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' & EARTH FILL FOR FOOTING.

FIG. 4

EXPLANATION OF TERMS USED IN REPORT

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

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

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

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

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

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

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

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

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

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

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

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS




LABORATORY TESTING

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

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE 
 w SLOPE ANGLE-BACKFACE OF WALL 
 β ANGLE OF SLOPE 
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{w_L - w_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{2.4 \mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

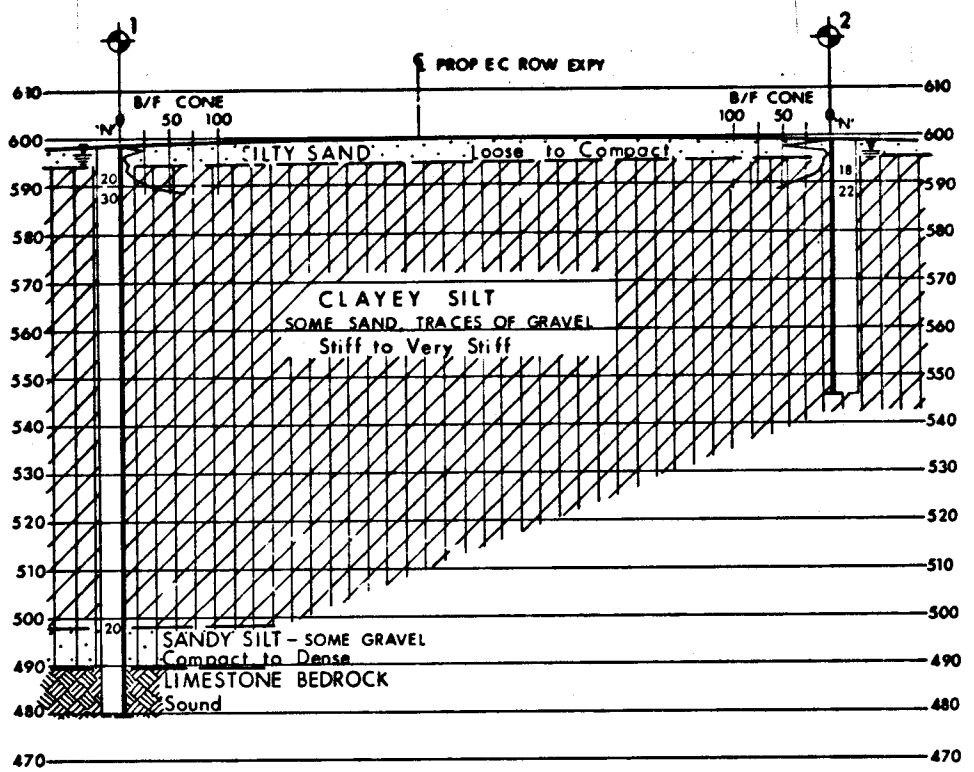
STRENGTH PARAMETERS

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

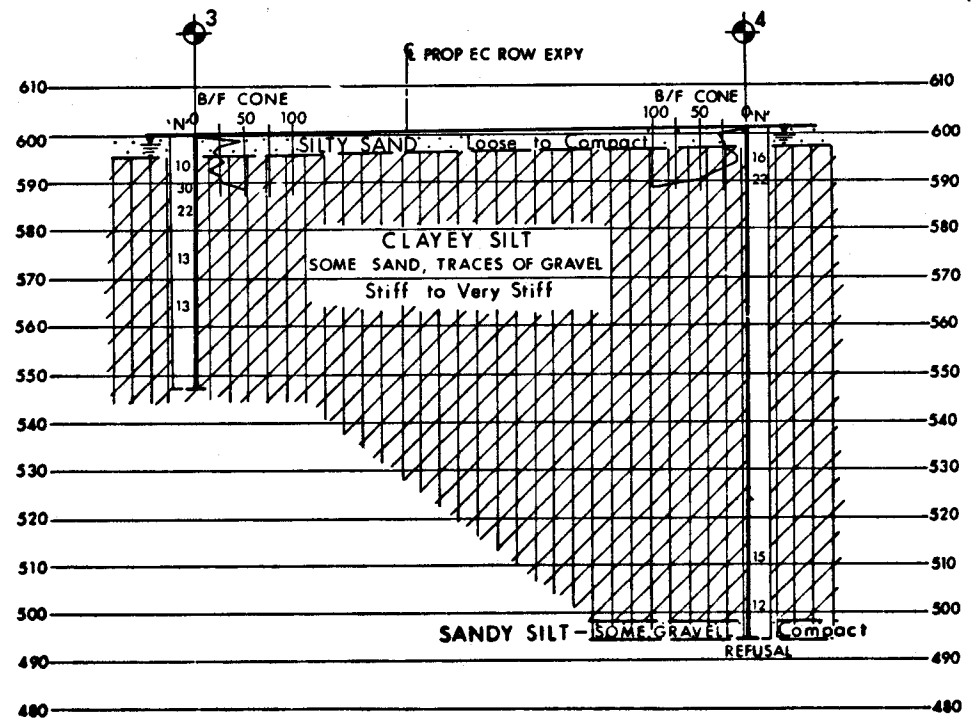
HYDRAULIC TERMS

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

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

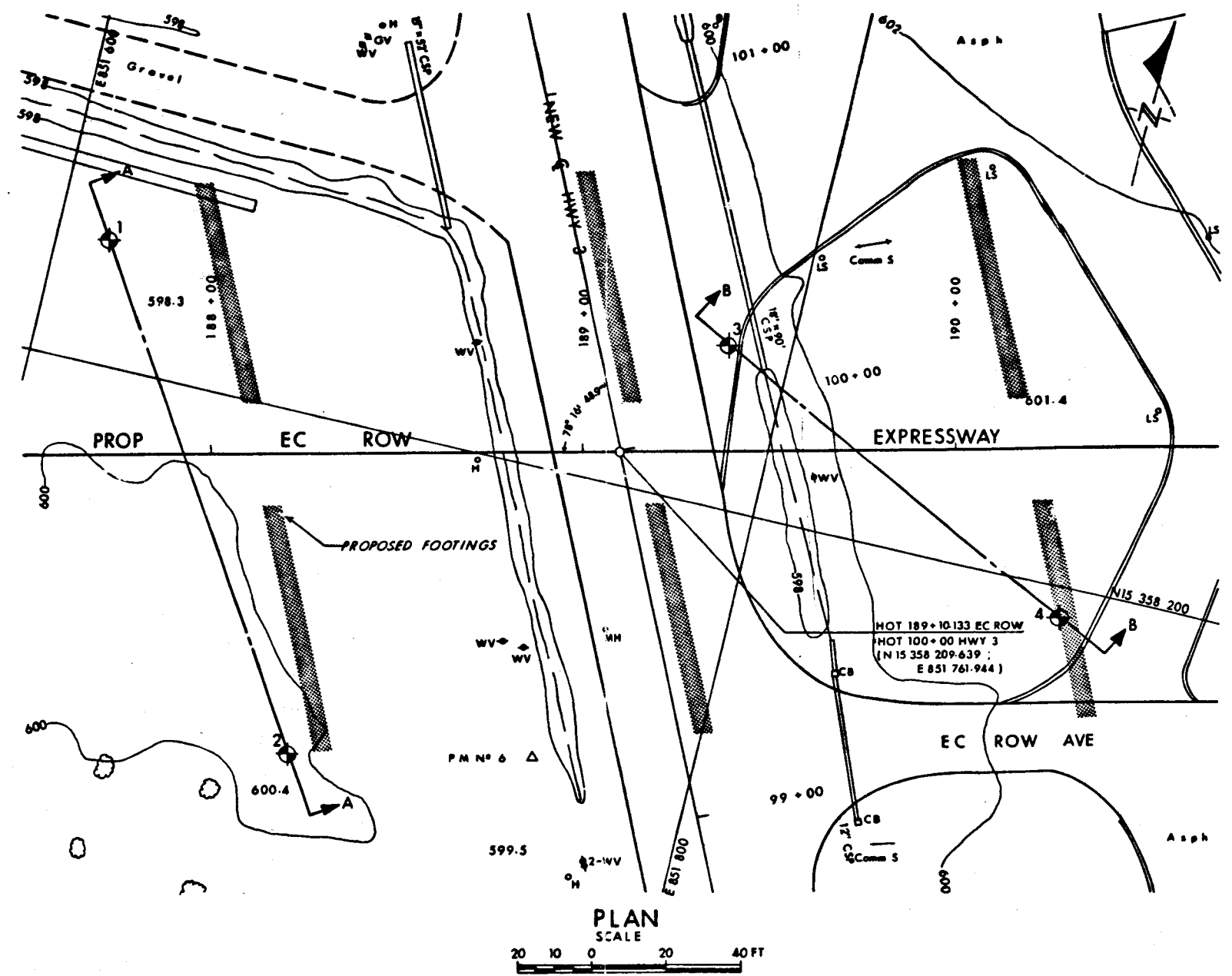


A-A

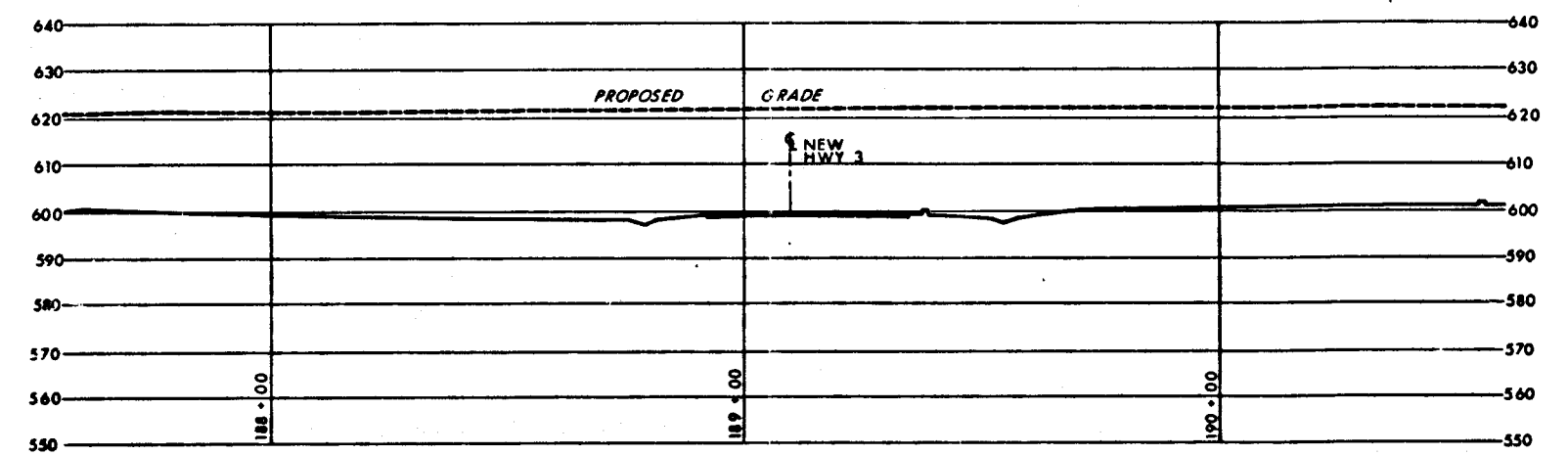


B-B

SECTIONS



PLAN

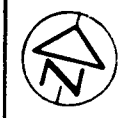


Q PROFILE PROP EC ROW EXPY

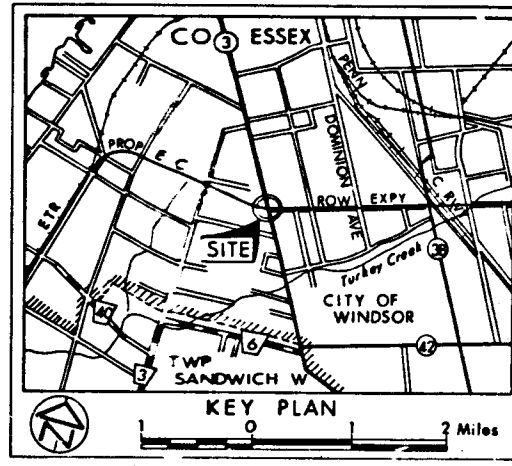


CONT No
WP No 258-66-02

HWY 3 OVERPASS
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- WL at time of investigation Mar 1968

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	598.6	15 358 234	851 615
2	599.3	15 358 109	851 694
3	600.0	15 358 244	851 784
4	601.0	15 358 191	851 886

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

GEOCRE N° 4016-10

REVISIONS	DATE	BY	DESCRIPTION

HWY No PROP EC ROW EXPY
SUBORD PP CHECKED DATE 78 06 27
DRAWN LJ CHECKED DATE 78 06 27
DIST 1
SITE 6-283
DWG 2586602-A

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 87-23



Ministry of
Transportation and
Communications

4056-10

INDEX

<u>PAGE NO.</u>	<u>DESCRIPTION</u>
1	Index
2	Abbreviations and Symbols
3	MTC Soil Classification System
4 - 14	Foundation Investigation Report Hwy. #3 Overpass E. C. Row Expressway W.P. 258-66-02; Site 6-1398-283

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

EXPLANATION OF TERMS USED IN REPORT

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

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

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

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

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

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

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

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

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

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

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

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS



LABORATORY TESTING

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

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL 
 β ANGLE OF SLOPE 
 N_q, N_c, N_{γ} BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

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

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 w, σ STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

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

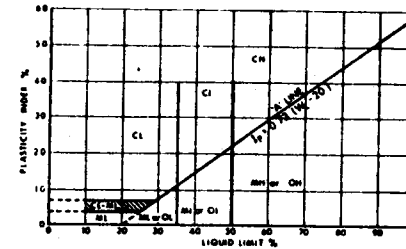
HYDRAULIC TERMS

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

EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 75 mm AND BASING FRACTIONS ON ESTIMATED MASS)					GRP. SYMB.	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN 75 μ m (MORE THAN HALF OF MATERIAL IS LARGER THAN 75 mm)	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN 4.75 mm	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZE			GM	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX. % OF SAND & GRAVEL; MAX. SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION; & SYMBOL IN PARENTHESES. FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS.	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μ m) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: LESS THAN 5% GM, GP, SW, SP MORE THAN 12% GM, GC, SM, SC 5% TO 12% BORDERLINE CASES REQ. USE OF DUAL SYMBOLS
		GRAVEL WITH FINES (APPRECIABLE AMOUNT OF FINES)	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE PL BELOW)			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES		
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES		
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN 4.75 mm	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZES & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES			SM	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES		
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES		
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE PL BELOW)			SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES		
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES		
	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN 425 μ m								
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN 75 μ m (75 μ m IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 35%	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML	INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES. FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS.	
			NONE	QUICK	NONE	CL	CLAYEY SILTS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS		
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS		
		LIQUID LIMIT BETWEEN 35% AND 50%	SLIGHT TO MEDIUM	SLOW	SLIGHT	MH	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS		
			HIGH	NONE	MEDIUM TO HIGH	CL	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY		
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OL	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY		
		LIQUID LIMIT GREATER THAN 50%	SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HEAVILY COMPRESSIBLE MICACEOUS OR DIATOMEACEOUS FINE SANDY SILTS, ELASTIC SILTS		
			HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS		
			MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
	HEAVILY ORGANIC SOILS HEAVILY REDUCED BY COLOUR, ODOUR, SPOONY FEEL & TENDENCY TO FORM SILT						PT	PEAT & OTHER HEAVILY ORGANIC SOILS	

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



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

REMARKS: SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE GM-GC, WELLY GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER

FOUNDATION INVESTIGATION REPORT
For
Windsor - Hwy. 3 Overpass
Hwy. E.C.R., District 1, Chatham
W.P. 258-66-02, Site 6-1398-283

4

INTRODUCTION

This report contains the results of a foundation investigation carried out for the proposed overpass structure during the period from March 6 to 11, 1978. A muskeg vehicle mounted power auger machine equipped with solid augers was used to advance four boreholes to depths ranging from 53 to 119 feet in depth. Bedrock was proven in one borehole by obtaining AXT size rock core. Dynamic Cone Penetration Tests were carried out adjacent to each borehole.

SITE DESCRIPTION

The site is located 1.6 miles east of Hwy. 18 along the proposed E.C. Row Expressway alignment within the City of Windsor. The surrounding terrain is flat.

Physiographically, the site is located in the region referred to as the "St. Clair Clay Plain".

SUBSURFACE CONDITIONS

General

Generally, uniform subsoil conditions were found to prevail over the site area. The subsoil consists of a shallow layer of silty sand, underlain by a deep deposit of clayey silt containing some sand and a trace of gravel, followed by a sandy silt, some gravel stratum which is in turn underlain by sound limestone bedrock. The boundaries of the different deposits are shown on the Record of Borehole Sheets attached to the Appendix. The estimated stratigraphical profiles of Drawing No. 2 of the Contract Drawings are based upon this information. A summary plot of the engineering properties is shown on Figure 1. Soil types encountered from ground level downward are described in some detail as follows.

Silty Sand

This deposit was intersected in all borings from immediately below the ground surface to a depth of about 4 feet. The material consists of silty sand. The relative density is estimated to range from loose to compact.

Clayey Silt, Some Sand, Traces of Gravel

The surficial silty sand stratum is underlain by an extensive cohesive type of deposit at each boring location. The lower boundary was found to be at elevation 498±. It was penetrated fully only in BH 1 and 4. The material in the deposit consists of clayey silt containing some sand and a trace of gravel. Occasional silty clay layers and seams of silt were also encountered. A plot of plasticity index versus liquid limit shows the greater majority of points to fall within the CL zone indicating a low to medium plasticity (Figure 2). Physical properties of the overall deposit as determined from field and laboratory tests are as follows:

			<u>Range</u>
Natural Moisture Content (W)	%		13-28
Liquid Limit	(W _L)	%	13-35
Plastic Limit	(W _p)	%	12-19
Bulk Density	(γ)	PCF	126-134
Undrained Shear Strength (C _u)	PSF		
Unconfined			744-3630
Field Vane			920-2000+
Sensitivity			2-3

The results of mechanical analyses are shown in an envelope form on Figure 3 of the Appendix.

A desiccated zone with a thickness ranging from 10 feet to 12 feet was found in all the boreholes to extend from the upper surface of the stratum. This zone is brown in colour due to oxidation and apart from the upper 2-3 feet (water affected zone), has a very stiff consistency. Standard Penetration 'N' values ranged from 16 to 30 blows per foot. Below the desiccated layer the colour of the soil is grey and the consistency ranges somewhat randomly from firm to very stiff. The average values of the undrained shear strength are as follows.

Above Elev. 583:	Cu = 2500 PSF
Elev. 560 - Elev. 583:	1450
Elev. 530 - Elev. 560:	900
Elev. 498 - Elev. 530:	1500

Sandy Silt, Some Gravel

An approximate 4-8 foot thick sandy silt containing some gravel zone was found to underlie the cohesive deposit. The relative density is estimated to vary from compact to dense.

Limestone Bedrock

The bedrock was proven at one borehole location (BH #1) by obtaining AXT size core. The rock was found to be sound limestone, the surface being at elevation 489.6.

Groundwater Conditions

Groundwater level observations have been carried out during the course of the fieldwork by recording the water levels in the open boreholes. The following levels were observed:

BH #1	Elev. 597
BH #2	Elev. 597
BH #3	Elev. 598
BH #4	Elev. 599

These figures indicate that the groundwater level is located some 2-3 feet below the existing ground level. It is assumed that the groundwater levels are subjected to seasonal variation.



P. Payer
 P. Payer, P.Eng.
 Senior Foundations Engineer

K. G. Selby
 K. G. Selby, P.Eng.
 Chief Foundations Engineer (West)

APPENDIX

RECORD OF BOREHOLE No 1 (Formerly BH #14, W.O. 65-P-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,234; E 851,615 ORIGINATED BY A.M.S.
 DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P.
 DATUM Geodetic DATE March 6,7, 1968 CHECKED BY [Signature]

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					
598.6	Ground Level													
0.0	Silty Sand													
594.6	Loose to Compact													
4.0	Clayey Silt Some Sand Traces of Gravel Firm to Very Stiff		1	SS	20									2 20 43 35
			2	SS	30									
			3A	SS	-									
			4	TW	PH									126
			5	TW	PH									
			6	TW	PH									127.5
			7	TW	PH									
			8	TW	PH									131.5 5 23 41 31
			9	TW	PH									
			10	TW	PH									133
			11	TW	PH									
			12	TW	PH									126
		13	TW	PH										
		14	TW	PH									128 3 15 49 33	
497.6			15	SS	20									
101.0	Sandy Silt Some Gravel Compact to Dense													
489.6	Limestone Bedrock Sound		16	AXT RC	REC 100%									
109.0			17	AXT RC	REC 100%									
479.6														

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2 (Formerly BH. #15. W.O. 68-F-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,109; E 851,694 ORIGINATED BY A.M.S.
 DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P.
 DATUM Geodetic DATE March 7, 1968 CHECKED BY AD

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					
599.3	Ground Level															
0.0	Silty Sand															
595.3	Loose to Compact															
4.0			1	SS	18											
	Clayey Silt		2	SS	22											2 16 41 41
	Some Sand		3	TW	PH										132	
	Traces of Gravel		4	TW	PH											
	Occasional Silty		5	TW	PH										127	
	Clay Layers		6	TW	PH											
	Stiff to		7	TW	PH										132	2 25 41 32
	Very		8	TW	PH											
	Stiff		9	TW	PH										133	
546.3																
53.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3 (Formerly BH. #16, W.O. 68-F-15-1)

W P 258-66-02 LOCATION Coords. N 15,358,244; E 851,784 ORIGINATED BY A.M.S.
 DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger COMPILED BY P.P.
 DATUM Geodetic DATE March 7,8, 1968 CHECKED BY [Signature]

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				
600.0	Ground Level															
0.0	Silty Sand															
596.0	Loose to Compact															
4.0			1	SS	10											
			2	SS	30		590									3 19 48 30
	Clayey Silt		3	SS	22											
	Some Sand		4	TW	PH		580								133	
	Traces of Gravel		5	SS	13											
	Stiff to Very Stiff		6	TW	PH		570								129	
			7	SS	13											
			8	TW	PH		560								134	5 27 39 29
			9	TW	PH		550									
547.0																
53.0	End of Borehole															

RECORD OF BOREHOLE No 4 (Formerly BH. #17, W.O. 68-F-15-1)

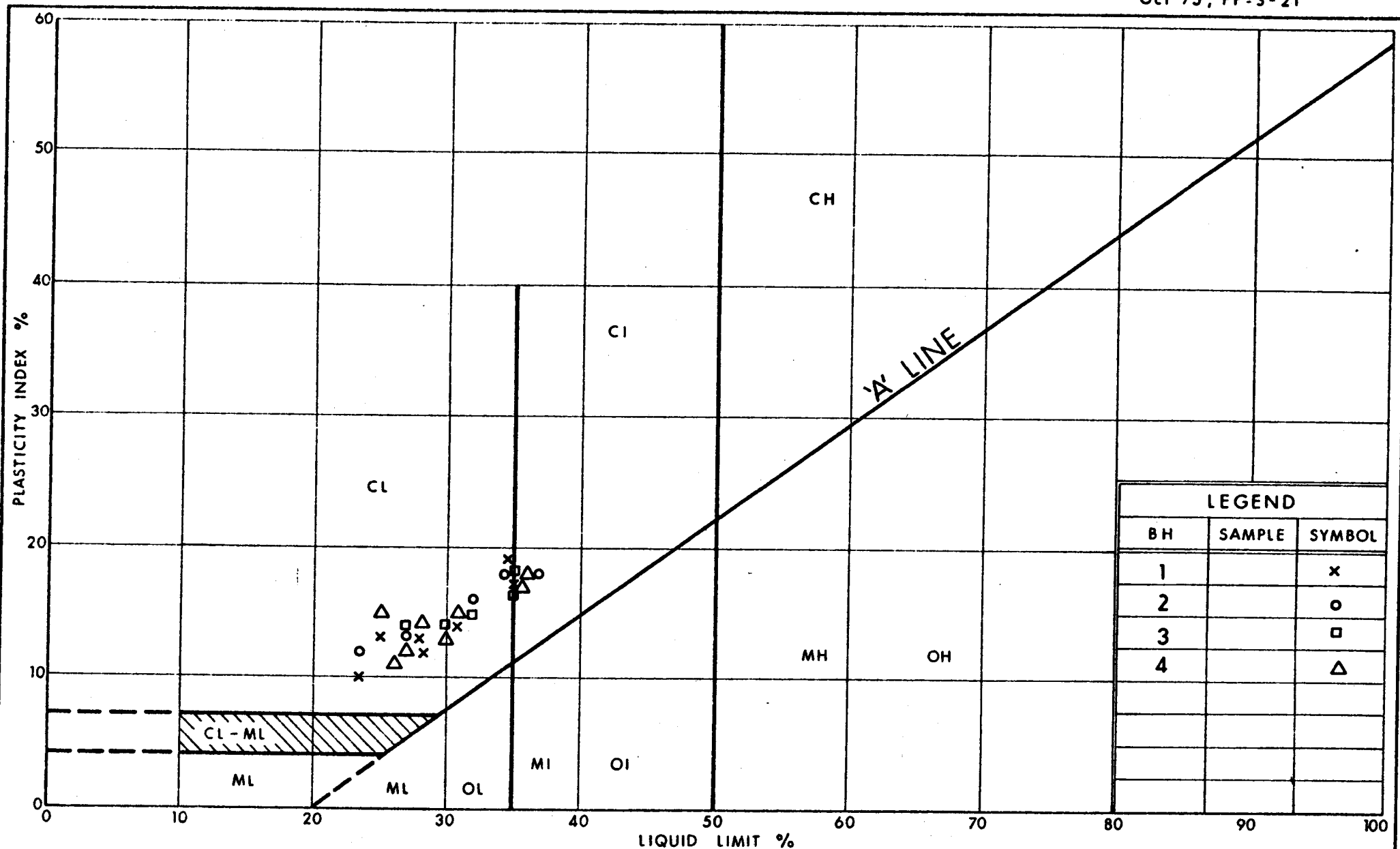
W P 258-66-02 LOCATION Coords. N 15,358,191; E 851,886 ORIGINATED BY A.M.S.
 DIST 1 HWY E.C.Row BOREHOLE TYPE Continuous Flight Auger (S.A.) COMPILED BY P.P.
 DATUM Geodetic DATE March 8 & 11, 1968 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	1000 2000					
601.0	Ground Level						600							
0.0	Silty Sand													
597.0	Loose to Compact													
4.0			1	SS	16									
			2	SS	22		590							0 19 46 35
			3	TW	PH								134	
			4	TW	PH		580							
	Clayey Silt Some Sand Traces of Gravel		5	TW	PH								126	
			6	TW	PH		570							
			7	TW	PH								131	2 22 42 34
			8	TW	PH		560							
			9	TW	PH								132	
			10	TW	PH		550							
	Stiff to Very Stiff													
			11	TW	PH		540						127.5	
	Occasional Silt Seams													
			12	TW	PH		530							
			13	TW	PH		520						133	
			14	SS	15		510							11 21 41 27
			15	SS	12		500							
498.0														
103.0	Sandy Silt Some Gravel, Compact													
494.5														
106.5	Refusal End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10





Ontario

Ministry of
Transportation and
Communications

PLASTICITY CHART
CLAYEY SILT, SOME SAND, TRACES OF GRAVEL
OCC. SILTY CLAY LAYERS
AND SILT SEAMS

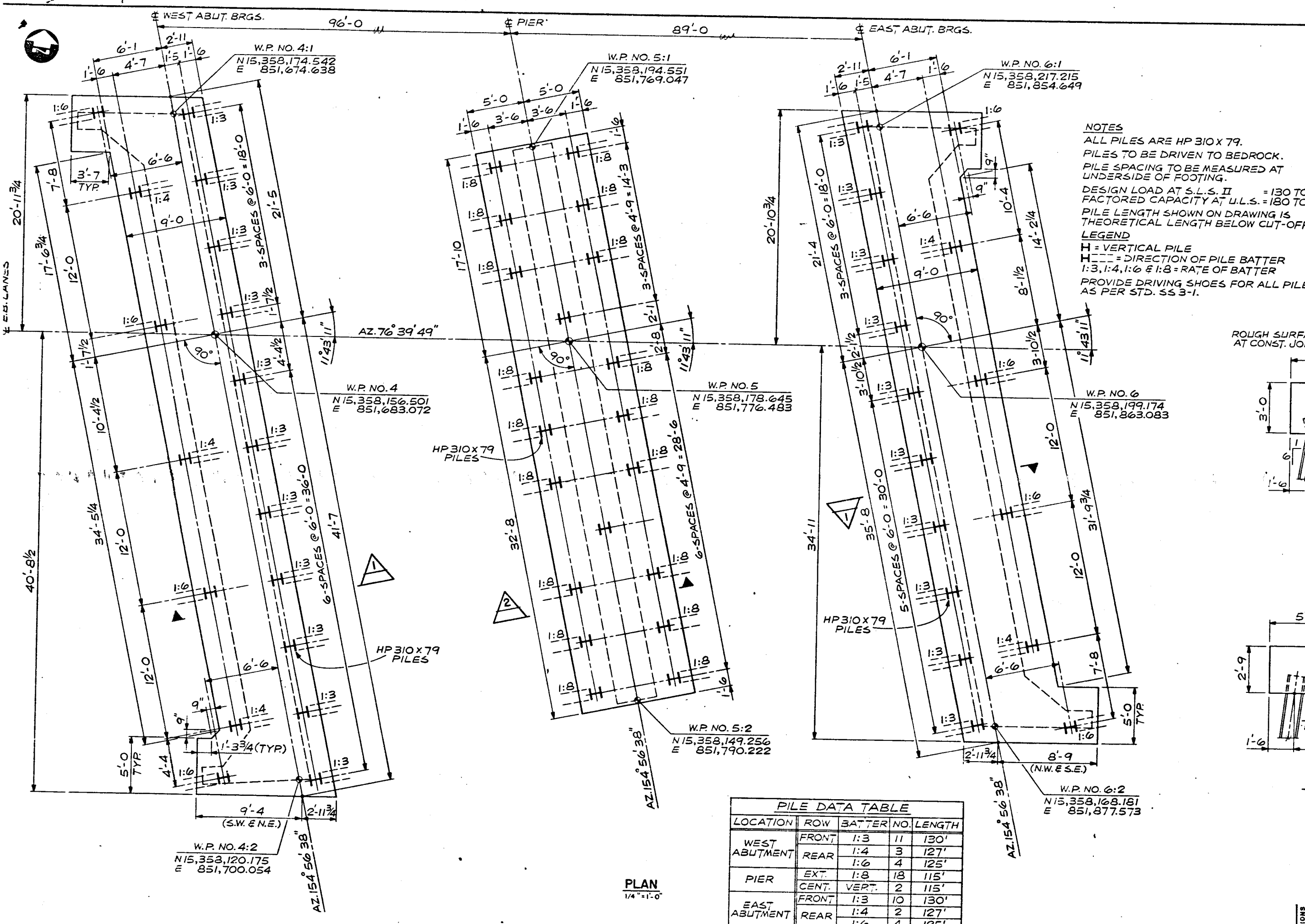
FIG No 2

W P 258-66-02



GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SOME SAND, TRACES OF GRAVEL
OCC. SILTY CLAY LAYERS
AND SILT SEAMS

WP 258-66-02



DISTRICT No. 1

CONT No

WP No 258-66-02

E.C. ROW EXPRESSWAY E.B.L. HIGHWAY 3 OVERPASS

FOUNDATION LAYOUT

DILLON

Consulting Engineers & Planners

NOTES

ALL PILES ARE HP 310 X 79.

PILES TO BE DRIVEN TO BEDROCK.

PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING.

DESIGN LOAD AT S.L.S. II = 130 TONS

FACTORED CAPACITY AT U.L.S. = 180 TONS

PILE LENGTH SHOWN ON DRAWING IS THEORETICAL LENGTH BELOW CUT-OFF.

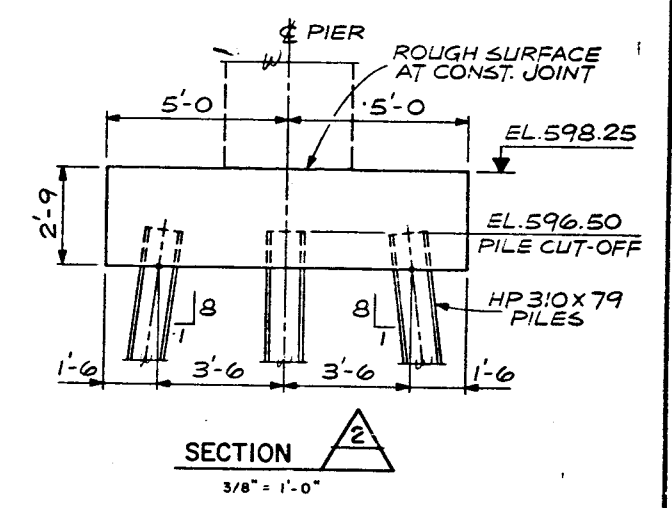
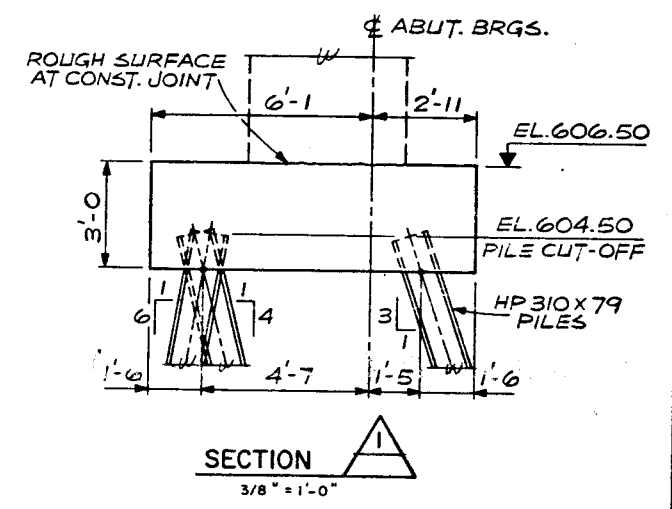
LEGEND

H = VERTICAL PILE

H = DIRECTION OF PILE BATTER

1:3, 1:4, 1:6 & 1:8 = RATE OF BATTER

PROVIDE DRIVING SHOES FOR ALL PILES AS PER STD. SS 3-1.



PILE DATA TABLE				
LOCATION	ROW	BATTER	NO.	LENGTH
WEST ABUTMENT	FRONT	1:3	11	130'
	REAR	1:4	3	127'
		1:6	4	125'
PIER	EXT.	1:8	18	115'
	CENT.	VERT.	2	115'
EAST ABUTMENT	FRONT	1:3	10	130'
	REAR	1:4	2	127'
		1:6	4	125'

DRAWING NOT TO BE SCALED

10 11 12 13

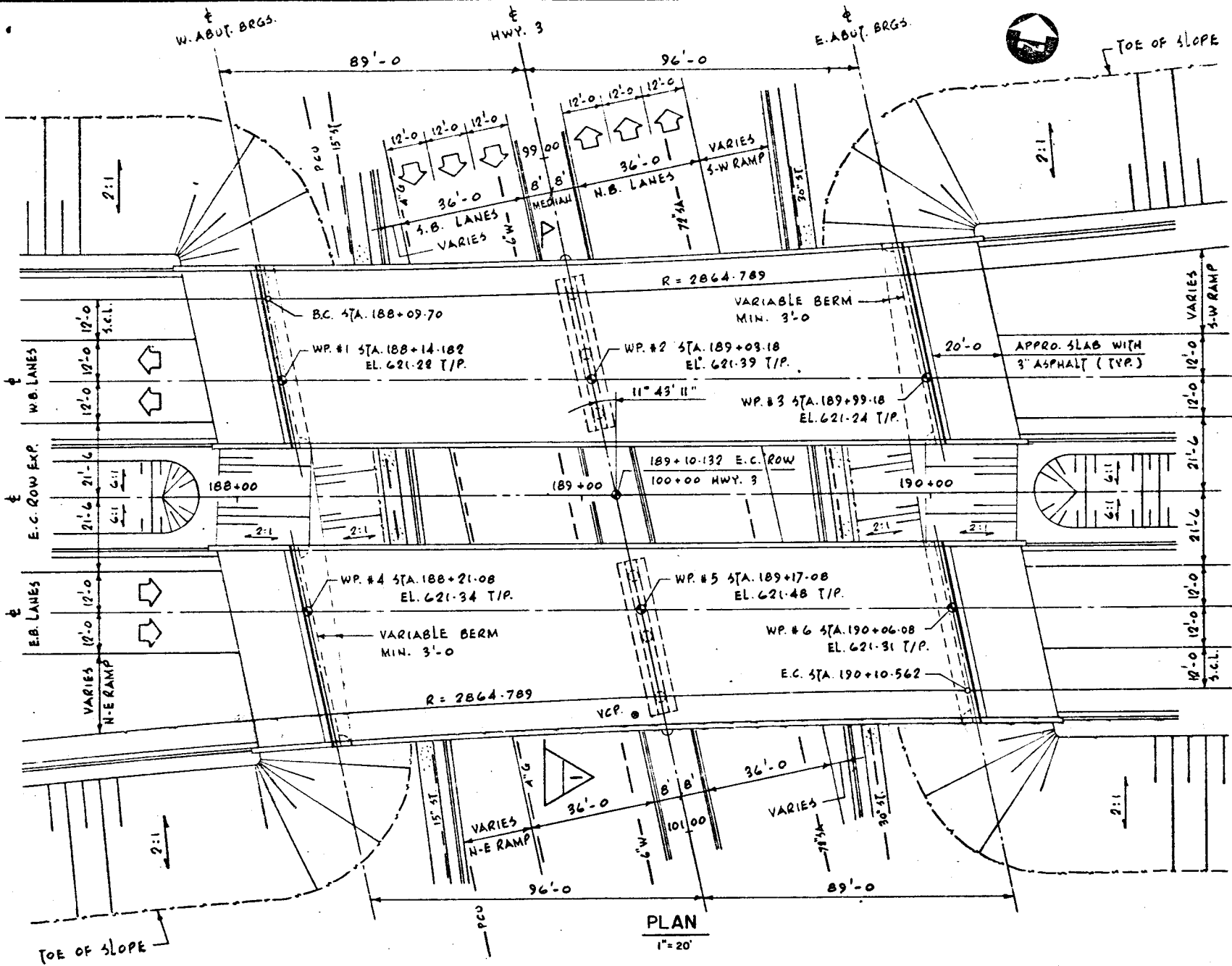
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION

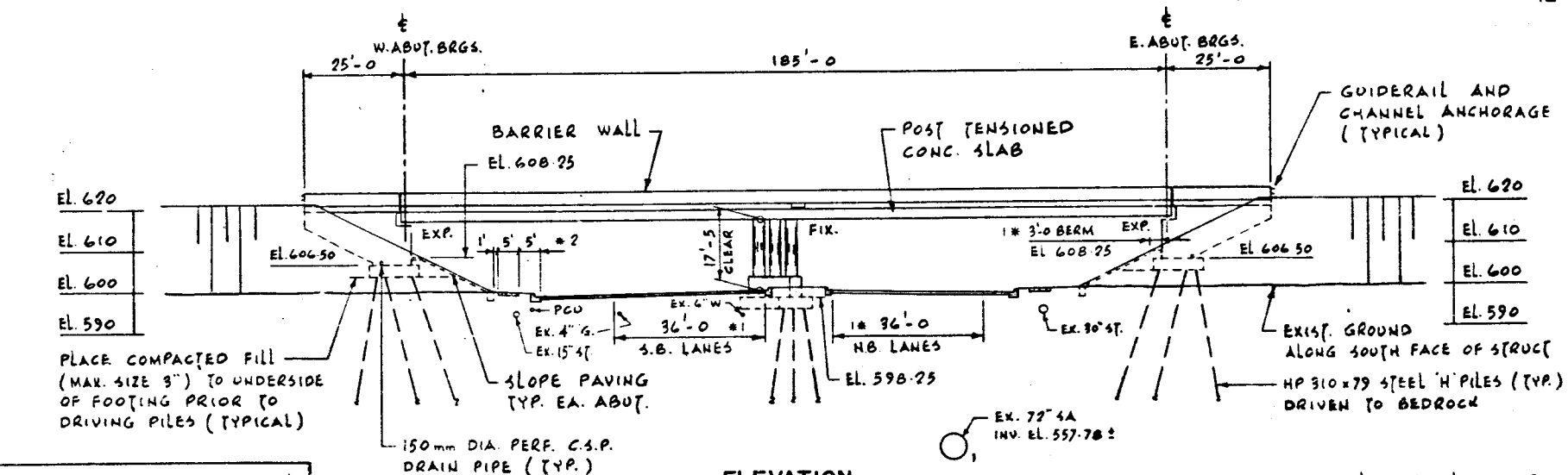
DESIGN MDP CHECK GK LOADING OHBDC-A-79 DATE MAY 83

DRAWING GLB CHECK JB SITE No 6-1398-283A/DWG 3

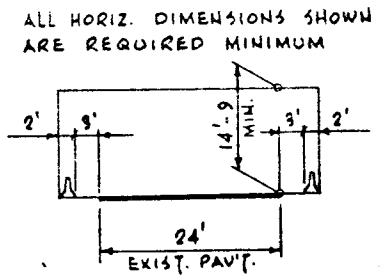




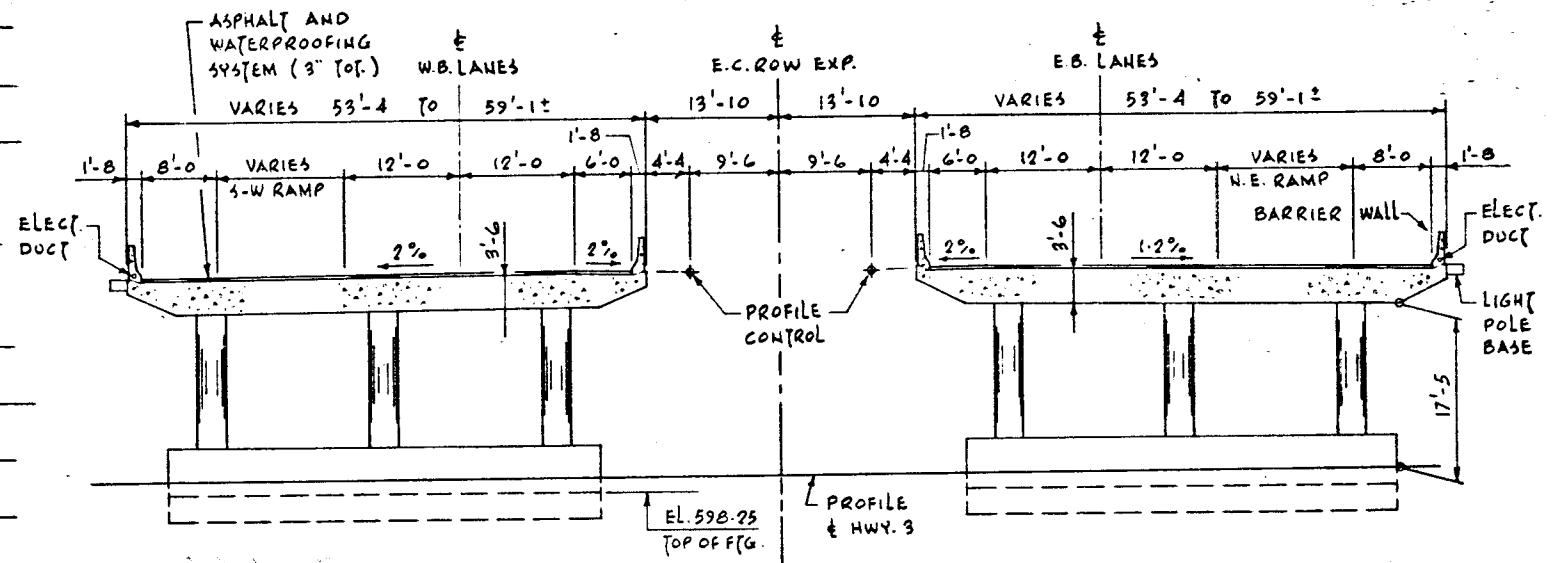
PLAN
1" = 20'



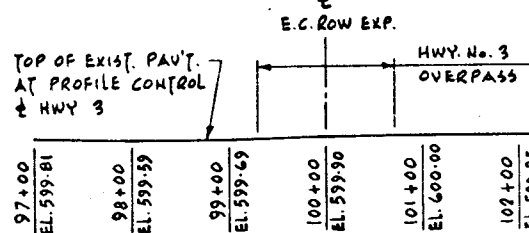
ELEVATION
1" = 20'



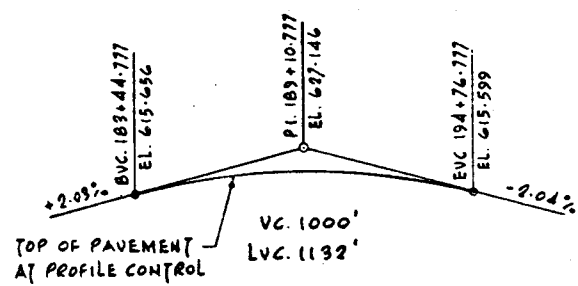
FALSEWORK CLEARANCES
TYPICAL N.B. & S.B. LANES



SECTION
1" = 10'



HIGHWAY No 3



E.C. ROW EXPRESSWAY

PROFILE DATA

LIST OF DRAWINGS

- 1 GENERAL ARRANGEMENT
- 2 BOREHOLE LOCATION AND SOIL STRATA
- 3 FOUNDATION LAYOUT
- 4 FOUNDATION REINFORCEMENT
- 5 WEST ABUTMENT LAYOUT
- 6 WEST ABUTMENT REINFORCEMENT
- 7 EAST ABUTMENT LAYOUT
- 8 EAST ABUTMENT REINFORCEMENT
- 9 PIER DETAILS
- 10 DECK LAYOUT AND SCREED ELEVATIONS
- 11 DECK CABLES LAYOUT
- 12 DECK CABLES DETAILS
- 13 DECK REINFORCEMENT I
- 14 DECK REINFORCEMENT II
- 15 EXPANSION JOINTS
- 16 BARRIER WALL
- 17 APPROACH SLABS
- 18 DETAILS OF CONC SLOPE PAVING
- 19 STANDARD DETAILS I
- 20 STANDARD DETAILS II
- 21 STANDARD DETAILS III
- 22 EMBEDDED ELECTRICAL
- 23 BRIDGE DATE AND SITE No.
- 24 AS CONSTRUCTED ELEV. & DIM.
- 25 QUANTITIES - STRUCTURE
- 26 QUANTITIES - STRUCTURE

GENERAL NOTES

CLASS OF CONCRETE
PERS. DECK 35 MPa
BARRIER WALLS, ABUTMENTS 30 MPa
REMAINDER 20 MPa

CLEAR COVER TO REINFORCING STEEL
FOOTINGS 4" x 1"
PIERS 3" x 3/4"
ABUTMENTS FRONT FACE (FF) 2 3/4" x 3/4"
BACK FACE (BF) 2 3/4" x 3/4"
DECK TOP BARS 2 3/4" x 3/4"
BOT. BARS 2" x 3/8"

REMAINDER 2 3/4" x 3/4" UNLESS SHOWN OTHERWISE

GRADE OF REINFORCING STEEL
REINFORCING STEEL SHALL BE GRADE 400
REINFORCING BARS MARKED WITH THE SUFFIX "C"
SHALL BE EPOXY COATED.

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING
THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED
ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$
NO CONCRETE SHALL BE PLACED ABOVE THE
ABUTMENT BEARING SEATS UNTIL THE CONCRETE
IN THE DECK HAS BEEN PLACED, STRESSED AND
GROUTED.

