

G.I.F-30 SEPT. 1976

GEOCRES No. 40I13-47DIST. 2 REGION                     W.P. No. 40-66-13/14CONT. No. 79-51W. O. No.                     STR. SITE No. 19-527HWY. No. 402LOCATION C.N.R Overhead StructuresNo of PAGES -=====  
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     REMARKS:

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 79-51



Ministry of  
Transportation and  
Communications



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

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

FIELD SAMPLING

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

EARTH PRESSURE TERMS

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

INDEX PROPERTIES

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

STRENGTH PARAMETERS

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

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'_1$  = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

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

## FOUNDATION INVESTIGATION REPORT

For

C.N.R. Overhead E.B.L. and W.B.L.  
W.P.s 40-66-13/14, Site Nos. 19-527 A/B  
Hwy. 402, District 2, London

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### INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned projects. Fieldwork was done during the period of February 16 to 26, 1976 utilizing a continuous flight auger machine equipped with 3½ inch I.D. hollow stem augers. The subsoil information is based on ten sampled boreholes and eight dynamic cone penetration tests. The boring operation was carried out using hollow stem augers which were advanced into the soil without the use of a plug. A split-spoon from which the ball had been removed was then washed down to just below the bottom of the augers where it was driven in the conventional manner. In this way the disturbance of the soil layer to be sampled is minimized as it is not subjected to an unbalanced hydrostatic head during the removal of the rods from the hollow stem augers.

### SITE DESCRIPTION

The site is located in the sixth concession of the Township of Caradoc approximately 800 feet west of the 20th Sideroad. The railway, which has twin sets of tracks, runs on a low embankment approximately three feet above the surrounding land. The area is gently rolling and exhibits a poorly developed pattern of drainage. The surrounding fields are engaged in a cash crop type of agriculture.

Physiographically, the area in which the site is located is referred to as the 'Caradoc Sand Plain'.

### SUBSURFACE CONDITIONS

#### General

The subsoil consists of alternating layers of cohesive and noncohesive material. The first of these is ten to fifteen feet in thickness

and consists primarily of silt with some clayey silt in the upper portion. Beneath this is a layer of approximately five feet of clayey silt which disappears in the area south of the railway tracks. Next a layer of five to fifteen feet of fine sand is found which is underlain by five to seven feet of clayey silt. This layer is in turn underlain by approximately 30 feet of fine sand. Beneath this and extending to a depth of over 125 feet is found another clayey silt layer. Reference should be made to the Record of Borehole Sheets contained in the report Appendix. Locations of boreholes and the inferred subsoil stratigraphy are shown on Drawing 19-527A-2 and 19-527B-2 of the Contract Drawings.

#### Silt

This layer is from ten to fifteen feet in depth. Its upper portion contains enough clay to make it slightly cohesive in places. Relative density generally increases with depth. The upper portion has a loose relative density with Standard Penetration 'N' values as low as five. In contrast, the relative density of the lower portion varies from compact to very dense with Standard Penetration 'N' values ranging to in excess of 100 blows per foot. Moisture content ranges from 18 to 20 percent.

#### Clayey Silt

The soil profile contains three distinct layers of clayey silt. The upper clayey silt layer, which is found between layers of silt and sand, is approximately five feet in thickness over most of the site. It was not, however, encountered in boreholes, 1, 2 or 3 located on the south side of the railway tracks. This layer exhibits a very stiff consistency with shear strengths estimated to be between 2000 and 3000 p.s.f. Moisture content was found to be approximately 20 percent. The second clayey silt layer consists of five to ten feet of material sandwiched between two fine sand layers. Moisture content varies from 17 to 21 percent. Standard Penetration 'N' values are generally between 14 and 30 indicating a stiff to very stiff consistency.

The third clayey silt layer extends from a depth of approximately 60 feet to in excess of 125 feet where the deepest borehole was terminated. It may be subdivided into two portions. Between the



depths of 60 and 105 feet Standard Penetration 'N' values range from 16 to 60 and moisture content is 20 percent or above. Below 105 feet Standard Penetration Test 'N' values are well in excess of 100 blows per foot and the moisture content ranges from 13 to 19 percent.

#### Fine Sand

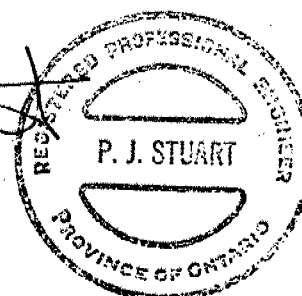
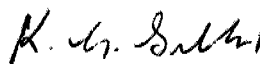
There are two distinct fine sand layers, both of which are sandwiched between layers of clayey silt. The upper layer varies in thickness from five to fifteen feet, while the lower layer ranges from 25 to 30 feet. Silt content for both layers generally ranges from 10 to 25 percent but is higher in isolated pockets and along the layer boundaries. Grain size distribution for the fine sand is shown as an envelope in Figure 1. Standard Penetration 'N' values range from 15 to in excess of 100 blows per foot but are generally in excess of 30. This would indicate a dense to very dense relative density with occasional compact pockets. Laboratory tests indicate a moisture content of approximately 20 percent.

#### Groundwater

Fieldwork was carried out during a prolonged thaw in February which produced extensive ponding in surface depressions. Water levels in the boreholes throughout this period remained within a foot of the ground surface. It may be assumed that this water level would be somewhat lower during other seasons of the year.



P. Stuart, P. Eng.  
Project Engineer

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

January, 1979

## APPENDIX



## RECORD OF BOREHOLE NO 1

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,624 N; 1,261,084 E. ORIGINATED BY PJS  
 DIST 2 HWY 402 BORING DATE February 23, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
794.3	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	17											
			2	SS	37											
			3	SS	41											
	Compact to Dense		4	SS	27											
779.3			5	SS	53											
15.0	Fine sand, some silt		6	SS	61											
			7	SS	38											
	Dense to Very Dense															
767.8			8	SS	49											
26.5	End of Borehole															

## RECORD OF BOREHOLE NO 2

WP 40-66-13 &amp; 14

LOCATION Co-ords. 15,606,638 N; 1,260,960 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 23, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Cone Test

CHECKED BY et

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W W <sub>P</sub> — W — W <sub>L</sub> WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
793.5	Ground Level									
0.0	Silt, some clayey silt layers		1	SS	30	790				
	Dense		2	SS	31					
778.5			3	SS	47	780				
15.0	Fine sand, some silt		4	SS	100	77"				
	Very Dense		5	SS	152					
767.0			6	SS	78	770				
26.5	End of Borehole									

## RECORD OF BOREHOLE NO 3

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,678 N; 1,261,024 E.  
 DIST 2 HWY 402 BORING DATE February 24, 1976  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY PJS  
 COMPILED BY MK  
 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W <sub>P</sub> — W — W <sub>L</sub>		UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W <sub>P</sub> — W — W <sub>L</sub>		
794.1	Ground Level													
0.0	Silt, some clayey silt layers		1	SS	5									
			2	SS	21									
			3	SS	20									
	Loose to Dense		4	SS	33									
779.1			5	SS	81									
15.0	Fine sand, some silt		6	SS	100.8"									
	Compact to Very Dense		7	SS	15									
			8	SS	65									
763.1														
31.0	Clayey Silt		9	SS	85									
	Very Stiff to Hard		10	SS	30									
753.1														
41.0	Fine sand, some silt		11	SS	73									
	with silt pockets		12	SS	60									
	Very Dense		13	SS	51									
			14	SS	61									
732.1														
42.0	Clayey silt													
727.6	Hard		15	SS	57									
66.5	End of Borehole													

## RECORD OF BOREHOLE NO 4

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,692 N; 1,260,901 E.  
 DIST 2 HWY 402 BORING DATE February 25, 1976  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY PJS  
 COMPILED BY MK  
 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$	
794.0	Ground Level														
0.0	Silt, some clayey silt layers		1	SS	9	790									
784.0	Loose to Dense		2	SS	46										0 7 87 6
10.0	Clayey Silt		3	SS	23										
779.0	Very Stiff		4	SS	15	780									0 88 (12)
15.0	Fine sand, some silt		5	SS	48										
	Dense to Very Dense		6	SS	100/9"										
768.0			7	SS	38	770									
26.0	Clayey Silt		8	SS	16										
761.0	Very Stiff		9	SS	59	760									
33.0	Fine sand, some silt with silt pockets		10	SS	55										0 34 62 4
	Dense to Very Dense		11	SS	28	750									
			12	SS	56										0 88 (12)
			13	SS	74	740									
728.0			14	SS	57	730									
66.0	Clayey Silt		15	SS	16	720									
	Very Stiff to Hard		16	SS	34	710									
			17	SS	100/7"	700									
690.0															
104.0															

20  
 15 0-5 % STRAIN AT FAILURE  
 10

Continued

RECORD OF BOREHOLE No 4 Continued

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,692 N; 1,260,901 E. ORIGINATED BY RJS  
 DIST 2 HWY 402 BORING DATE February 25, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ $w$ $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
690.0	continued													
104.0	Clayey Silt		18	SS	150	6"								
	Very Stiff to Hard					680								
			19	SS	120	6"								
668.5			20	SS	100	6"								
125.5	End of Borehole													

## RECORD OF BOREHOLE NO 5

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,776 N; 1,260,996 E.  
 DIST 2 HWY 402 BORING DATE February 20, 1976  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY PJS  
 COMPILED BY MK  
 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
794.3	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	15	790										
	Compact to Very Dense		2	SS	116											
782.3			3	SS	63											
12.0	Clayey Silt		4	TW	PH	780										0 6 88 6
776.3	Very Stiff		5	TW	PH											
18.0	Fine sand, some silt		6	SS	87											0 77 (23)
	Very Dense		7	SS	161	770										
766.3																
28.0	Clayey Silt		8	SS	17											
761.3	Very Stiff					760										
33.0	Fine sand, some silt with silt pockets		9	SS	72											
	Very Dense		10	SS	78											0 83 (17)
			11	SS	37	750										
			12	SS	61											
			13	SS	87	740										
732.8			14	SS	117											
61.5	End of Borehole															

## RECORD OF BOREHOLE NO 6

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,778 N; 1,260,876 E.  
 DIST 2 HWY 402 BORING DATE February 26, 1976  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger

ORIGINATED BY PJS  
 COMPILED BY MK  
 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
792.7	Ground Level															
0.0	Silt, some clayey silt layers.					790										
			1	SS	10											
			2	SS	30											
780.7	Compact to Very Dense		3	SS	52											
12.0	Clayey Silt		4	SS	18	780										
775.7	Very Stiff		5	SS	25											
17.0	Fine sand, some silt		6	SS	100/8"											
770.7	Very Dense					770										
22.0	Clayey Silt		7	SS	14											
765.7	Stiff															
27.0			8	SS	31											
	Fine sand, some silt		9	SS	100/10"	760										
	with silt pockets		10	SS	100/10"											
			11	SS	112	750										
	Dense to Very Dense		12	SS	76											
			13	SS	63	740										
			14	SS	76											
						730										
726.2			15	SS	106											
66.5	End of Borehole															



## RECORD OF BOREHOLE NO 7

WP 40-66-13 &amp; 14

LOCATION Co-ords. 15,606,830 N; 1,260,937 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 19, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
793.8	Ground Level															
0.0	Silt, some clayey silt layers.															
	Loose to Very Dense		1	SS	6											
			2	SS	45											
781.8			3	SS	54											
12.0	Clayey Silt		4	SS	12											
775.8	Stiff to Very Stiff		5	SS	17											
18.0	Fine Sand Some Silt		6	SS	90											
765.8	Very Dense		7	SS	130											
28.0	Clayey Silt		8	SS	21											
760.8	Very Stiff															
33.0	Fine sand, some silt		9	SS	48											
	with silt pockets		10	SS	69											
	Dense to Very Dense		11	SS	40											
	sand with gravel		12	SS	85											
728.8																
65.0	Clayey Silt		13	SS	49											
	Very Stiff to Hard		14	SS	16											
			15	SS	100/46"											
689.8																
104.0																

 20  
15 5 % STRAIN AT FAILURE  
10

Continued

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,830 N; 1,260,937 E. ORIGINATED BY PJS  
DIST 2 HWY 402 BORING DATE February 19, 1976 COMPILED BY JK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT	LIQUID LIMIT ——— w <sub>L</sub>	PLASTIC LIMIT ——— w <sub>p</sub>	UNIT WEIGHT  γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	WATER CONTENT — w	w <sub>p</sub> — w — w <sub>L</sub>		
							SHEAR STRENGTH	WATER CONTENT %			
						○ UNCONFINED + FIELD VANE					%
						● QUICK TRIAXIAL x LAB VANE					GR SA SI CL
689.8	continued										
104.0	Clayey Silt		16	SS	112	6"					0 1 80 19
	Very Stiff to Hard										
677.8							680				
116.0	End of Borehole		17	SS	117	6"					

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

## RECORD OF BOREHOLE NO 8

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,839 N; 1,260,843 E.  
 DIST 2 HWY 402 BORING DATE February 16, 1976  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY PJS  
 COMPILED BY MK  
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ $w$ $w_L$ WATER CONTENT %	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
794.0	Ground Level													
0.0	Silt, some clayey silt layers.		1	SS	29									
	Compact to Very Dense		2	SS	104									
782.0			3	SS	35									
12.0	Clayey Silt		4	SS	16									
776.0	Stiff		5	SS	12									
18.0	Fine sand, some silt		6	SS	32									
	Dense to Very Dense		7	SS	100/9"									
766.0			8	SS	18									
28.0	Clayey Silt		9	SS	73									
760.0	Very Stiff		10	SS	61									
34.0	Fine sand, some silt with silt pockets.		11	SS	19									
	Compact to Very Dense		12	SS	59									
			13	SS	53									
728.0														
66.0	Clayey silt													
722.5	Very Stiff		14	SS	20									
71.5	End of Borehole													

# RECORD OF BOREHOLE NO 9

WP 40-66-13 & 14

LOCATION Co-ords. 15,606,874 N; 1,260,935 E.

DIST 2 HWY 402

BORING DATE February 18, 1976

ORIGINATED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

COMPILED BY MK

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
793.7	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	6	790										
	Loose to Very Dense		2	SS	107											
781.7			3	SS	51											
12.0	Clayey Silt		4	SS	13	780										
775.7	Stiff		5	SS	12											
18.0	Fine sand, some silt		6	SS	59											
	Dense to Very Dense		7	SS	45	770										
766.7																
27.0	Clayey Silt		8	SS	20											
	Very Stiff															
760.7			9	SS	26	760										
33.0	Fine sand, some silt with silt pockets		10	SS	55											
			11	SS	22	750										
			12	SS	59											
	Compact to Very Dense		13	SS	69	740										
731.7																
62.0	Clayey Silt		14	SS	49	730										
727.2	Hard															
66.5	End of Borehole															

# RECORD OF BOREHOLE No 10

WP 40-66-13&14

LOCATION Co-ords. 15,606,894 N; 1,260,788 E.

DIST 2 HWY 402

BORING DATE February 17, 1976

ORIGINATED BY PJS

DATUM Geodetic

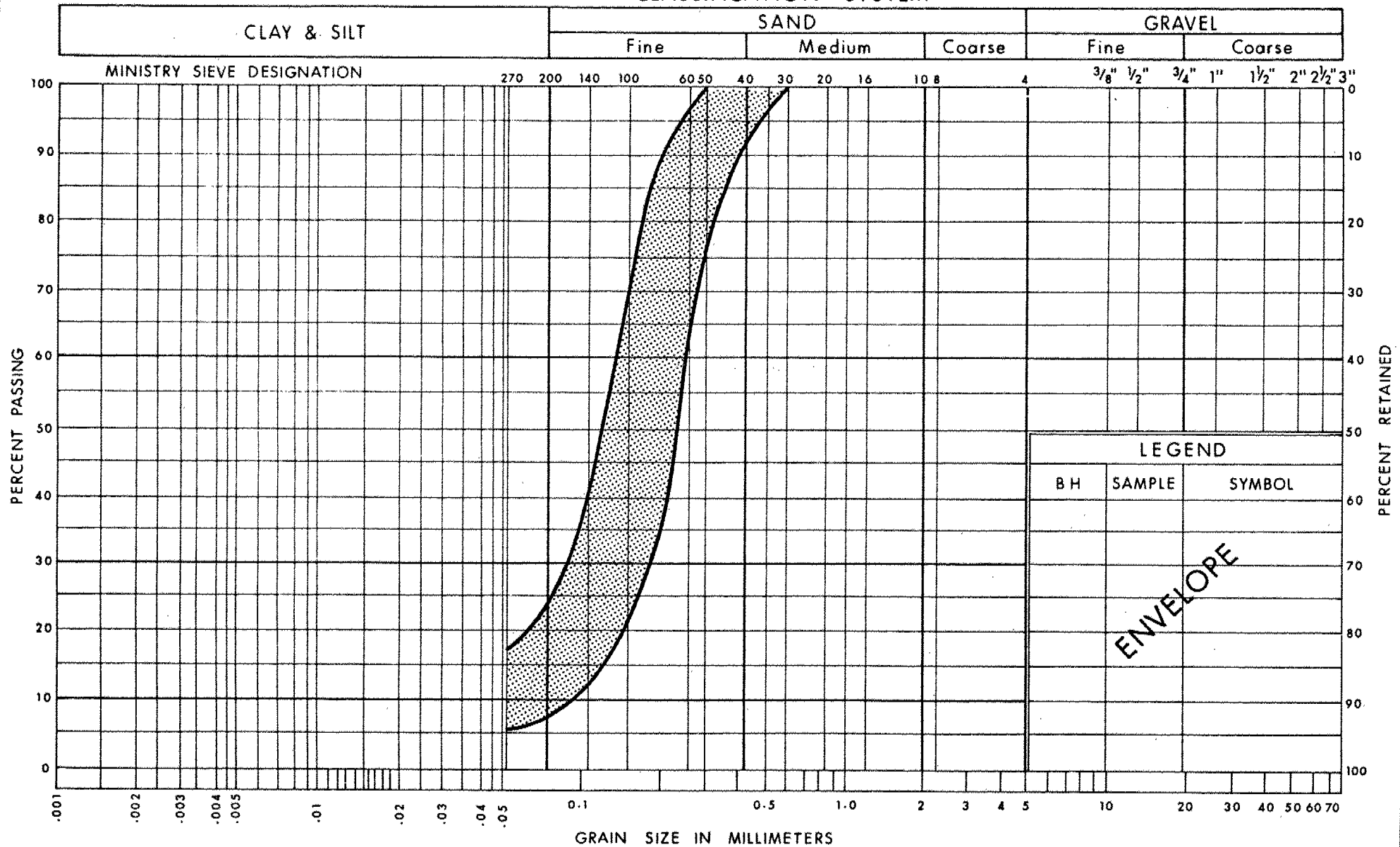
BOREHOLE TYPE Hollow Stem Auger & Cone Test

COMPILED BY MK

CHECKED BY *ep*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
794.0	Ground Level															
0.0	Silt, some clayey silt layers.		1	SS	6	790										
			2	SS	61											
782.0	Loose to Very Dense		3	SS	47											
12.0	Clayey Silt		4	SS	15	780										0 5 93 2
776.0	Very Stiff		5	SS	33											
18.0	Fine Sand Some Silt		6	SS	29											
766.0	Dense to Very Dense		7	SS	112	770										0 89 ( 11 )
28.0	Clayey Silt		8	SS	22											
761.0	Very Stiff		9	SS	27	760										
33.0	Fine Sand, trace of silt with silt pockets		10	SS	50											
752.5	Compact to Dense															
41.5	End of Borehole															0 92 ( 8 )

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
FINE SAND, SOME SILT  
(UPPER & LOWER LAYERS)

FIG No 1

W P 40-66-13 & 14

## FOUNDATION INVESTIGATION REPORT

For

Concession Road 8 Underpass  
W.P. 40-66-15, Site No. 19-526  
Hwy. 402, District 2, London

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INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project. Fieldwork was done during the period August 20-25, 1975, utilizing a continuous flight auger machine equipped with 3½ inch I.D. hollow stem augers.

SITE DESCRIPTION

The proposed site is located in the Township of Caradoc some five miles east of the Town of Strathroy. It is just west of the intersection of Concession Road 8 and the 20th Sideroad. The general area is a flat sand plain with occasional low ridges and is engaged in mixed agricultural production. The immediate area of the site is higher than much of the surrounding area and forms part of a complex of stationary sand dunes.

Physiographically, this site is located in an area referred to as the 'Caradoc Sand Plain'.

SUBSURFACE CONDITIONSGeneral

Subsoil in the area consists predominantly of a deep deposit of fine uniform sand which was laid down as a delta at an early outlet of the Thames River. A subsoil profile at this site shows a layer of 10 to 14 feet of fine sand, some silt overlying 5 to 7 feet of silt to clayey silt. Underlying this is approximately 35 feet of fine sand with a trace of silt overlying silt with fine sand. Reference should be made to the Record of Borehole Sheets contained in the Report Appendix and to Drawing 19-526-2 of the Contract Drawings. Detailed descriptions of the different soil types are given as follows.



### Fine Sand

This deposit is split into an upper and lower portion by the layer of silt to clayey silt. The upper portion (10 to 14 feet in thickness) contains considerable silt with percentages ranging up to 40%. It has a compact relative density with Standard Penetration 'N' values ranging from 10 to 27 blows per foot.

The portion of the fine sand deposit (35 feet in thickness) below the silt to clayey silt layer generally contains less than 10% silt. Standard Penetration 'N' values range from 13 to in excess of 100, indicating a relative density ranging from compact to very dense. Grain size distribution plots of this fine sand deposit are shown as an envelope in Figure 1 of the Appendix. Laboratory tests show moisture contents of approximately 20% for samples taken below the water table.

### Silt to Clayey Silt

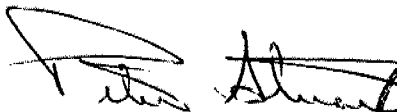
This stratum, found sandwiched between layers of fine sand, is from 5 to 7 feet in thickness. It is primarily silt but contains up to 27% clay giving it a low degree of plasticity. Its consistency ranges from very stiff to hard with Standard Penetration 'N' values varying from 18 to 74.

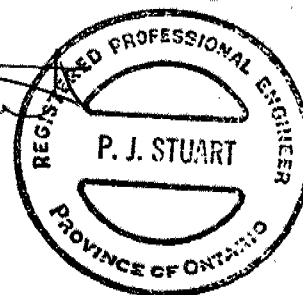
### Silt With Fine Sand

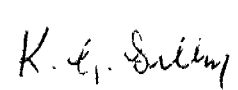
This stratum was penetrated to a shallow depth by the deepest borehole. It contains approximately 40% sand and 60% silt and is very dense.

### Groundwater

Groundwater was encountered in the fine sand at approximate elevation 779. It should be noted that this water level was recorded in August which probably represents its lowest level during the year.

  
P. Stuart, P. Eng.  
Project Engineer



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

January, 1979

## APPENDIX

# RECORD OF BOREHOLE NO 1

WP 40-66-15

DIST 2 HWY 402

DATUM Geodetic

LOCATION Co-ords. 15,611,425 N; 1,256,551 E.

BORING DATE August 25, 1975

BOREHOLE TYPE Hollow Stem Augers

ORIGINATED BY RD

COMPILED BY RD

CHECKED BY *SP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
797.6	Ground Level															
0.0	Fine sand with silt		1	SS	20											
	Compact		2	SS	15											
783.6			3	SS	17											
14.0	Clayey silt		4	SS	18											
777.6	Very Stiff to Hard		5	SS	35											
20.0	Fine sand, trace of silt.		6	SS	38											
	Dense to Very Dense		7	SS	31											
			8	SS	32											
			9	SS	41											
			10	SS	76											
			11	SS	50											
756.1			12	SS	56											
41.5	End of Borehole															
	Note: W.L. not established															

## RECORD OF BOREHOLE NO 2

WP 40-66-15 LOCATION Co-ords. 15,611,516 N; 1,256,640 E.  
 DIST 2 HWY 402 BORING DATE August 20, 1975  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Augers

ORIGINATED BY RD  
 COMPILED BY RD  
 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
798.6	Ground Level															
0.0	Fine sand, some silt															
	Compact		1	SS	19											
			2	SS	27											
784.6			3	SS	25											
14.0	Silt to clayey silt		4	SS	20											
779.6	Very Stiff to Hard		5	SS	74											
19.0			6	SS	68											
	Fine sand, trace of silt.		7	SS	24											
			8	SS	37											
			9	SS	50											
			10	SS	39											
	Compact to Very Dense		11	SS	146											
			12	SS	82											
			13	SS	34											
742.6																
56.0	Silt with fine sand.															
737.1	Very Dense		14	SS	58											
61.5	End of Borehole															

# RECORD OF BOREHOLE NO 3

WP 40-66-15 LOCATION Co-ords. 15,611,606 N; 1,256,728 E.  
 DIST 2 HWY 402 BORING DATE August 21 - 22, 1975  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Augers

ORIGINATED BY RD  
 COMPILED BY RD  
 CHECKED BY *RD*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	100	$w_p$	$w$	$w_L$		
795.2	Ground Level														
0.0	Fine sand, some silt														
	Compact		1	SS	10	790									0 83 (17)
785.2															
10.0	Silt to clayey silt.		2	SS	20										
	Very Stiff		3	SS	27										
778.2			4	SS	24	780									0 0 89 11
17.0			5	SS	16										
	Fine sand, trace of silt.		6	SS	36										
			7	SS	25										
			8	SS	37	770									
			9	SS	13										
	Compact to Very Dense		10	SS	169										
			11	SS	22	760									
753.7			12	SS	26										0 94 ( 6 )
41.5	End of Borehole														

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

Coarse

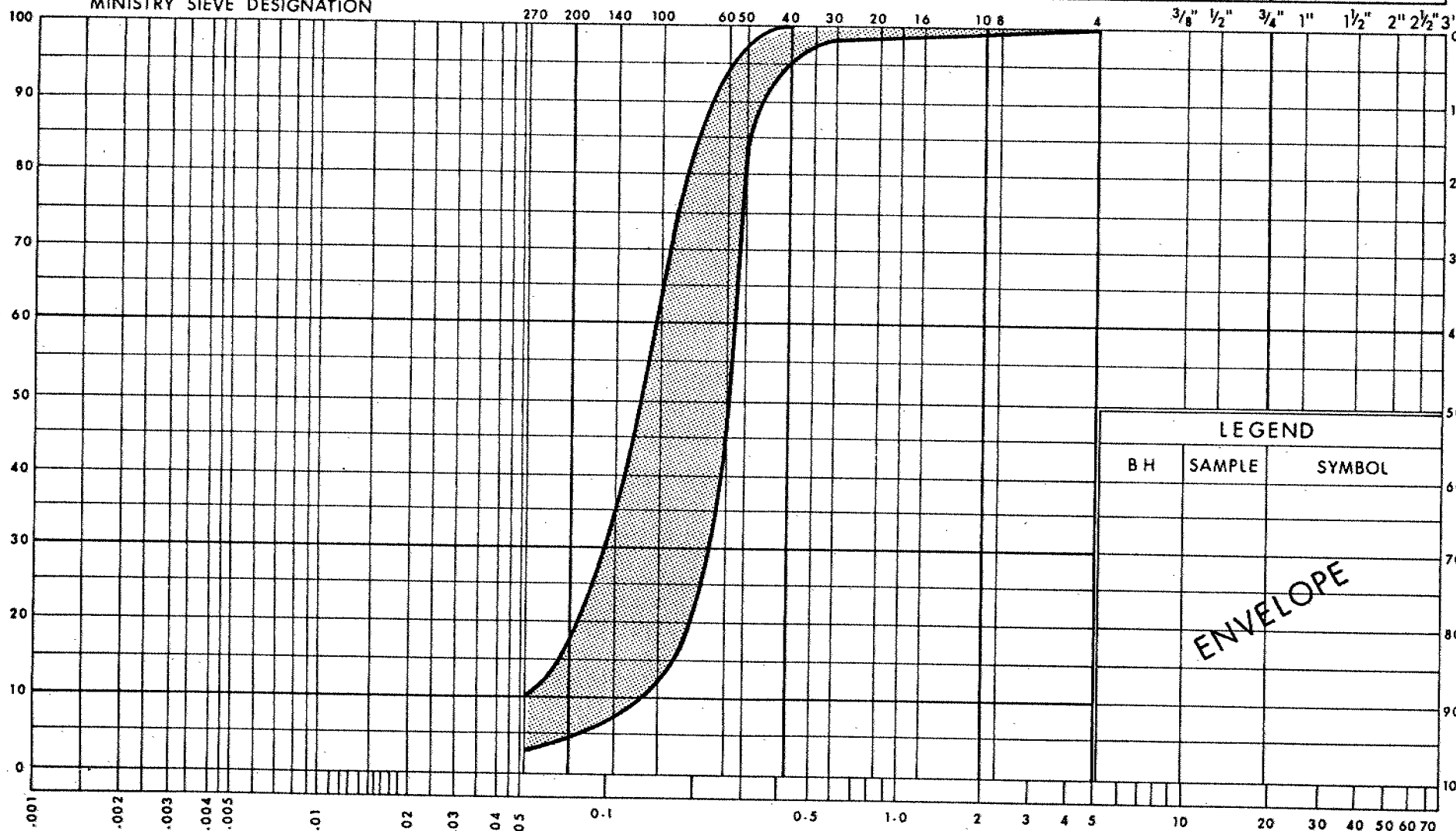
Fine

Coarse

MINISTRY SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 3/8" 1/2" 3/4" 1" 1 1/2" 2" 2 1/2" 3"

PERCENT PASSING



PERCENT RETAINED

## LEGEND

BH SAMPLE SYMBOL

ENVELOPE

GRAIN SIZE IN MILLIMETERS

GRAIN SIZE DISTRIBUTION  
FINE SAND  
TRACE OF SILT

FIG No 1

W P 40-66-15



Ministry of  
Transportation and  
Communications

## FOUNDATION INVESTIGATION REPORT

For

Concession Road 10 Underpass  
W.P. 40-66-16, Site No. 19-525  
Hwy. 402, District 2, London

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INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project. Field-work was done during the period August 25-27, 1975, utilizing a continuous flight auger machine equipped with 3½ inch I.D. hollow stem augers.

SITE DESCRIPTION

The proposed site is located in the Township of Caradoc, some 3 miles northeast of the Town of Strathroy. It is located one-half mile west of the junction of Concession Road 10 and the 20th Sideroad.

The general area is a flat sand plain with occasional low ridges and is engaged in mixed agricultural production. Physiographically, this site is located in an area referred to as the Caradoc Sand Plain.

SUBSURFACE CONDITIONSSubsoil

Reference should be made to the Record of Borehole Sheets contained in the report Appendix and to Drawing 19-525-2 of the Contract Drawings. Subsoil consists of a deep deposit of 60 feet of uniform fine sand which was laid down as a delta at an early outlet of the Thames River. Beneath this is a deposit of very dense silt some clay and a trace of sand.

The fine sand (typical grain size distribution shown as an envelope in Figure 1) may be divided into 2 portions. The upper portion, about 7 feet in thickness, is very loose to compact with Standard

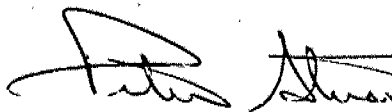


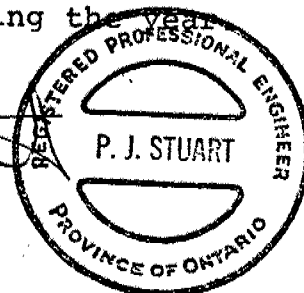
Penetration 'N' values ranging from 1 to 13 blows per foot. The silt content is relatively high in this zone ranging up to 30%.

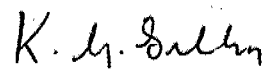
The lower portion of the deposit has a lower silt content, generally being less than 10%. The relative density is much higher ranging from compact to very dense with Standard Penetration 'N' values ranging from 25 to in excess of 100 blows per foot. Laboratory tests indicate moisture contents of approximately 20%.

#### Groundwater

Groundwater was encountered in the fine sand at approximate elevation 760. It should be noted that this water level was recorded in August and probably represents its lowest level during the year.

  
P. Stuart, P. Eng.  
Project Engineer



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

January, 1979

## APPENDIX

# RECORD OF BOREHOLE NO 1

WP 40-66-16 LOCATION Co-ords. 15,616,387 N; 1,248,881 E. ORIGINATED BY RD  
 DIST 2 HWY 402 BORING DATE August 26, 1975 COMPILED BY RD  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Augers & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p \quad w \quad w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS  % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	N' VALUES		20	40	60	80	100			
767.4	Ground Level													
0.0	Fine Sand, Some Silt Compact to Loose		1	SS	12									0 87 (13)
			2	SS	4									
			3	SS	54									
	Fine sand, trace of silt.		4	SS	111									0 92 (8)
			5	SS	110									
			6	SS	68									
	Dense to Very Dense		7	SS	66									
			8	SS	45									
			9	SS	100									
725.9			10	SS	100									0 92 (8)
41.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE NO 2

WP 40-66-16

LOCATION Co-ords. 15,616,477 N; 1,248,960 E.

DIST 2 HWY 402

BORING DATE August 25 - 26, 1975

ORIGINATED BY RD

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Augers & Cone Test

COMPILED BY RD

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
766.8	Ground Level															
0.0	Fine sand with silt Loose to Very Loose		1	SS	11											
			2	SS	1	760										0 69 (31)
			3	SS	35											
			4	SS	105											
	Fine sand, trace of silt.		5	SS	94											
			6	SS	109											
			7	SS	45	750										
			8	SS	39											
	Dense to Very Dense		9	SS	93	740										0 96 (4)
			10	SS	149											
			11	SS	34	720										
			12	SS	82	710										
705.8																
61.0	Silt, some clay, trace of sand.															
700.3	Very Dense		13	SS	62											
66.5	End of Borehole															0 5 84 11

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE NO 3

WP 40-66-16

LOCATION Co-ords. 15,616,564 N; 1,249,056 E.

DIST 2 HWY 402

BORING DATE August 27, 1975

ORIGINATED BY RD

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Augers & Cone Test

COMPILED BY RD

CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS  % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
768.3	Ground Level															
0.0	Fine sand, trace of silt.  Compact to Very Dense		1	SS	13	760										0 88 (12)
			2	SS	13											
			3	SS	81											
			4	SS	98											
			5	SS	117											
			6	SS	86/8"											
			7	SS	29											
			8	SS	25											
			9	SS	38											
727.3						750										0 95 ( 5 )
						740										0 97 ( 3 )
						730										
41.0	End of Borehole		10	SS	100 5"											

# GRAIN SIZE DISTRIBUTION

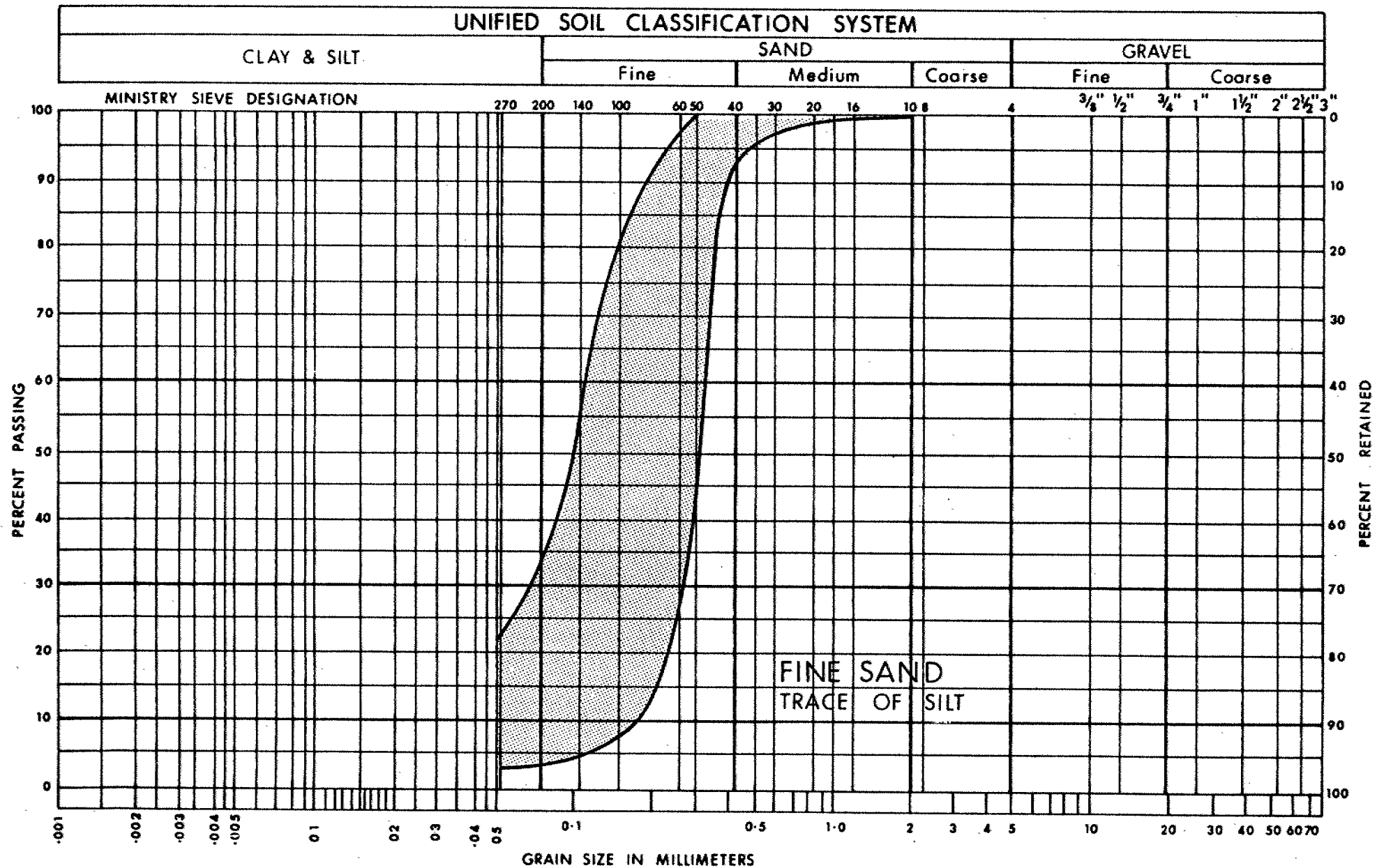


FIG. 1

## FOUNDATION INVESTIGATION REPORT

For

Sydenham River Bridges, E.B.L. and W.B.L.  
W.P.s 40-66-17/18, Site Nos. 19-524 A/B  
Hwy. 402, District 2, London

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INTRODUCTION

This report contains the results of a foundation investigation carried out at the above described location. Fieldwork was done during the period of November 7-20, 1975, utilizing a continuous flight auger machine equipped with 3¼ inch I.D. hollow stem augers. The factual and interpreted soil data are presented in the report.

SITE DESCRIPTION

The site of the proposed twin structures is located at the crossing of the proposed Hwy. #402 and Sydenham River, Lot 20, Con. X, Township of Caradox, County of Middlesex.

Sydenham River at this location flows in a general northeast to southwest direction. The river follows a somewhat meandering course through a self-eroded valley which is about 0.5 miles wide. The existing river channel is about 25 feet wide and 10 feet deep.

The land surface rises sharply towards the east. Physiographically, the site is located in the region referred to as the Caradoc Sand Plains. Sands and other light textured waterlaid deposits are characteristics for this region.

SUBSURFACE CONDITIONSGeneral

Generally, a zone of silty sand to sandy silt, traces of clay occurs in the upper stratum of all boreholes. Below the granular there is a very stiff to hard clayey silt with traces to some sand. The cohesive deposit is followed by a very dense deposit of sand and gravel with trace of silt and clay. The boundaries of the various deposits are shown on the accompanying Record of Borehole Sheets.



The stratigraphical sections plotted on Drawing Nos. 19-524A-2 and 19-524B-2 have been inferred from this data. From ground level downward the various soil types encountered are described in some detail below.

#### Silty Sand to Sandy Silt, Traces of Clay

This deposit was intersected at every boring location immediately below ground surface but was not penetrated to its full extent in each borehole. The thickness was found to range from 52 to 81 feet in Borehole #4 and #2 respectively.

The material in the stratum consists of sands and silts with varying proportions. The chief constituent is sand in the upper segment, while the lower part of the deposit contains a larger percentage of silt. Traces of clay were also found within this zone. Grain size distribution testing was carried out on selected samples from the deposit. The results are plotted in envelope form on Figure 1.

Standard Penetration Testing was carried out within this granular deposit and the results are plotted on the Record of Borehole Sheets. The obtained 'N' values ranged from 1 blows/18 inches to 196 blows/11 inches. Based on these results it is estimated that the relative density of this deposit varies from loose to very dense. The natural moisture content ranges from 5% to 23%.

#### Clayey Silt, Some to Traces of Sand

The granular deposit is underlain by a cohesive stratum in Boreholes #1, 2, 4 and 6 at approximate elevation 697. At the other borehole locations, the borings were terminated in the silty sand to sandy silt deposit. The stratum also contains some to traces of clay.

A limited number of laboratory tests carried out on selected samples indicate the following physical properties.

		<u>Range</u>
Liquid Limit	(%)	17-32
Plastic Limit	(%)	11-16
Natural Moisture Content	(%)	16-22

The results of grain size distribution tests are plotted on Figure 2 of the Appendix.

The consistency of the stratum varies from very stiff to hard.


Sand and Gravel, Traces of Silt and Clay

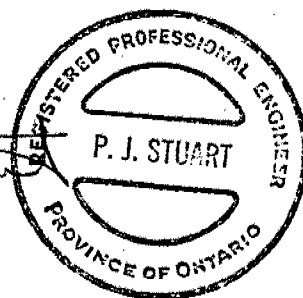
In Borehole #2 a very dense deposit of sand and gravel with traces of silt and clay was encountered below the cohesive deposit. The lower boundary was not determined.


Groundwater Conditions

The following groundwater levels were observed during the field investigation:

Borehole #1	Elevation 758.5
2	748.5
3	746.0
4	745.0
5	745.0
6	Not Established

  
P. Stuart, P. Eng.  
Project Engineer



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

January, 1979

## APPENDIX

## RECORD OF BOREHOLE NO 1

WP 40-66-17/18

LOCATION Co-ords. 15,618,163 N; 1,247,288 E.

ORIGINATED BY PP

DIST 2 HWY 402

BORING DATE November 7, 1975

COMPILED BY OJ

DATUM Geodetic

BOREHOLE TYPE Washbore-NX &amp; BX Casing &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	WATER CONTENT % 10 20 30				
774.7	Ground Level															
0.0	Silty sand to sandy silt, traces of clay		1	SS	12	770									0 47 (53)	
			2	SS	18											
			3	SS	37										0 5 92 3	
			4	SS	43											
			5	SS	64											
			6	SS	100	4"									0 87 (13)	
			7	SS	100	5"										
			8	SS	100	5"										
	Compact to		9	SS	61										0 90 (10)	
	Very Dense		10	SS	39											
			11	SS	44											
			12	SS	53										0 87 (13)	
			13	SS	56											
			14	SS	137											
			15	SS	85											
			16	SS	70											
696.7						740										
78.0	Clayey silt					730										
693.2	Hard		17	SS	52	720										
81.5	End of Borehole					710										
						700										

# RECORD OF BOREHOLE NO 2

WP 40-66-17/18

LOCATION Co-ords. 15,618,265 N; 1,247,352 E.

DIST 2 HWY 402

BORING DATE November 12-17, 1975

ORIGINATED BY PP

DATUM Geodetic

BOREHOLE TYPE Washbore - NX & BX Casing & Cone Test

COMPILED BY OJ

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 25 50 75 100 125 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W W <sub>P</sub> — W — W <sub>L</sub> WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
751.8	Ground Level									
0.0	Silty sand to sandy silt, traces of clay		1	SS	10	750				
			2	SS	8					
			3	SS	20					
			4	SS	52	740				
			5	SS	27					
			6	SS	69					
			7	SS	32	730				
	Loose to		8	SS	196	11"				0 60 (40)
	Very Dense		9	SS	78					
			10	SS	88					
			11	SS	60					
			12	SS	23					
			13	SS	52					
			14	SS	18					
696.8						720				
55.0						710				
						700				
						690				0 0 75 25
	Clayey silt, some sand.		15	SS	19					
			16	SS	66					
						680				
						670				0 15 67 18
	Very Stiff to Hard		17	SS	29					
			18	SS	16					
						660				
			19	SS	25					
						650				

cont.

RECORD OF BOREHOLE No 2 cont.

WP 40-66-17/18 LOCATION Co-ords. 15,618,256 N; 1,247,352 E. ORIGINATED BY PP  
 DIST 2 HWY 402 BORING DATE November 12-17, 1975 COMPILED BY OJ  
 DATUM Geodetic BOREHOLE TYPE Washbore-NX & BX Casing & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
	continued															
			20	SS	35	640										
634.8																
117.0	Sand & gravel, traces															
631.3	of silt & clay															
120.5	End of Borehole		21	SS	59											40 48 (12)

## RECORD OF BOREHOLE NO 3

WP 40-66-17/18

LOCATION Co-ords. 15,618,298 N; 1,247,316 E.

ORIGINATED BY MK

DIST 2 HWY 402

BORING DATE Nov. 18, 1975

COMPILED BY OJ

DATUM Geodetic

BOREHOLE TYPE Washbore-NX Casing &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 25 50 75 100 125 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
749.8	Ground Level									
0.0	Silty sand to sandy silt, traces of clay		1	SS	9					
			2	SS	8					
			3	SS	24					
			4	SS	57					
			5	SS	21					
			6	SS	34					
	Loose to Very Dense		7	SS	27					
			8	SS	134					
			9	SS	36					
			10	SS	52					
			11	SS	57					
			12	SS	33					
			13	SS	44					
698.3			14	SS	38					
51.5	End of Borehole									

# RECORD OF BOREHOLE NO 4

WP 40-66-17/18

LOCATION Co-ords. 15,618,390 N; 1,247,223 E.

ORIGINATED BY MK

DIST 2 HWY 402

BORING DATE November 17-18, 1975

COMPILED BY OJ

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
748.2	Ground Level															
0.0	Silty sand to sandy silt.  Very Loose to  Very Dense		1	SS	4											
			2	SS	1/18"											
			3	SS	3											
			4	SS	1/6"											
			5	SS	38											
			6	SS	36											
			7	SS	9											
			8	SS	8											
			9	SS	18											
			10	SS	56											
			11	SS	13											
			12	SS	17											
			13	SS	22											
			14	SS	11											
			15	SS	17											
697.2			16	SS	40											
51.0	Clayey silt, trace of sand.		17	SS	52											
691.7	Very Stiff to Hard		18	SS	18											
56.5	End of Borehole															



## RECORD OF BOREHOLE NO 5

WP 40-66-17/18

LOCATION Co-ords. 15,618,271 N; 1,247,184 E.

ORIGINATED BY MK

DIST 2 HWY 402

BORING DATE November 18 - 19, 1975

COMPILED BY OJ

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
749.6	Ground Level															
0.0	Silty sand to sandy silt, traces of clay  Very Loose to  Very Dense		1	SS	5											
			2	SS	1/12"											
			3	SS	1/18"											
			4	SS	1/12"											
			5	SS	1/18"											
			6	SS	46											
			7	SS	22											
			8	SS	16											
			9	SS	11											
			10	SS	76											
			11	SS	107											
			12	SS	10											
			13	SS	21											
			14	SS	15											
			15	SS	24											
698.1			16	SS	19											
51.5	End of Borehole															

## RECORD OF BOREHOLE NO 6

WP 40-66-17/18 LOCATION Co-ords. 15,618,315 N; 1,247,143 E. ORIGINATED BY MK  
 DIST 2 HWY 402 BORING DATE November 19-20, 1975 COMPILED BY OJ  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT			LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30			
							SHEAR STRENGTH								
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
748.0	Ground Level														
0.0	Silty sand to sandy  silt, traces of clay         Very Loose to Very  Dense	•	1	SS	4										
			2	SS	1/12"										
			3	SS	3										
			4	SS	62										
			5	SS	15										
			6	SS	15										
			7	SS	14										
			8	SS	33										
			9	SS	10										
			10	SS	66										
			11	SS	17										
			12	SS	25										
			13	SS	22										
			14	SS	18										
			15	SS	25										
697.0			16	SS	61									0 7 92 1	
51.0	Clayey silt, traces  of sand.    Very Stiff to Hard	▨												0 16 78 6 0 1 77 22	
			17	SS	22										0 0 71 29
			18	SS	20										
			19	SS	20										
			20	SS	64										0 5 69 26
			21	SS	26										0 0 79 21
cont.															

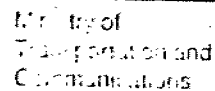
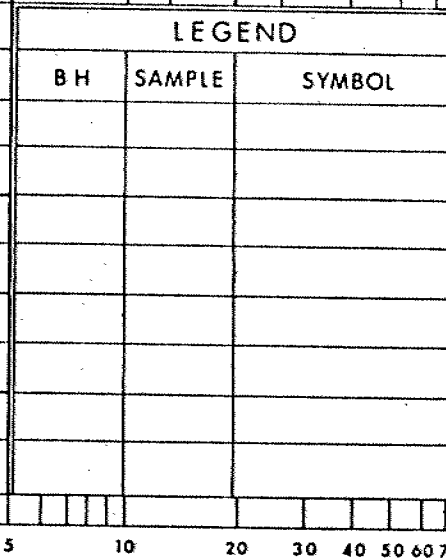
cont.

RECORD OF BOREHOLE No 6 cont.

WP 40-66-17/18 LOCATION Co-ords. 15,618,315 N; 1,247,143 E. ORIGINATED BY MK  
 DIST 2 HWY 402 BORING DATE November 19-20, 1975 COMPILED BY OJ  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS  % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
	continued						SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					10 20 30				
627.5			22	SS	90	640										
						630										
121.5	End of Borehole		23	SS	116											0 8 53 39

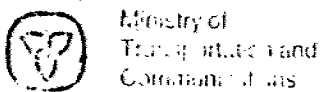
CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



## GRAIN SIZE DISTRIBUTION SILTY SAND TO SANDY SILT

FIG No 1

W P 40-66-17 & 18



W P 40-66-17 & 18 47

## FOUNDATION INVESTIGATION REPORT

For

County Road 39 Interchange  
Overpass E.B.L. and W.B.L.  
W.P.s 40-66-19/20, Site Nos. 19-523 A/B  
Hwy. 402, District 2, London

---

INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned projects. Field-work was done during the period November 5-28, 1975, utilizing a continuous flight auger machine equipped with 3½ inch I.D. hollow stem augers.

SITE DESCRIPTION

The site is located at the crossing of the existing Middlesex County Road #39 and future Hwy. #402, approximately 1.8 miles southwest of Hickory Corner which is situated at the junction of County Road #39 and Hwy. #22.

County Road #39 is the boundary line between Townships Adelaide and Caradoc. The road is located in a shallow cut (approximately 6 feet deep), the top of pavement at centreline being at elevation 778±. The depth of drainage ditches which are located on both sides of the roadway is about 3.5 feet.

In terms of topography, the immediate area of the site is relatively flat and gently sloping toward the southeast. The land is used for agricultural purposes and was plowed at the time of the field investigation.

Physiographically, the site is situated in the region referred to as the Caradoc Sand Plains. Sand and other light textured waterlaid deposits are characteristic of this region.

## SUBSURFACE CONDITIONS

### General

The soil conditions at the site, in general, were found to be uniform over the area investigated.

The surficial deposit (below original ground level) across the site is composed of a layer 3.5 to 8.5 ft. thick of very stiff silty clay with traces of sand, followed by an extensive loose to very dense cohesionless deposit of sands and silts with traces of clay to a minimum depth of 93 feet. Beneath this cohesionless deposit, a stratum of very stiff to hard clayey silt was penetrated up to 37 feet. The sandy silt to silty sand deposit was fully penetrated in Boreholes No. 2 and 5 and the borings were terminated in the clayey silt layer.

Roadway fill material (up to 3.5 feet) consisting of mixtures or layers of sand, silt, clay and organics, was encountered in Boreholes No. 3 and 4 which were put down adjacent to the existing County Road #39.

The boundaries of the various deposits are shown on the accompanying Record of Borehole Sheets. The stratigraphical sections plotted on Drawing Nos. 19-523A-2 and 19-523B-2 of the Contract Drawings are inferred from this data. Descriptions of the soil types encountered in the boreholes are given below.

### Silty Clay With Traces of Sand

This deposit occurs from the original (natural) ground surface to a maximum depth of 8.5 feet (B.H.'s #1, 2, 5 and 6). The material in the stratum consists of silty clay with traces of sand. Atterberg Limit Tests indicate that the compressibility or plasticity of this inorganic stratum is in the medium range.

Standard Penetration Tests were carried out within this deposit. The obtained 'N' values varied between 8 and 25 blows per foot from which it is estimated that the consistency ranges from firm to very stiff.

### Fill Material

This material was observed in B.H.'s No. 3 and 4 which were drilled through the existing road shoulders. The soil consists of mixtures or layers of sand, silt, clay and organics. The thickness at the borehole locations ranges from 2.5 to 3.5 feet.

### Sandy Silt to Silty Sand, Traces of Clay

This deposit was intersected at every boring location immediately beneath the silty clay or the fill material but was not penetrated to its full extent in every borehole. The thickness was found to range from 81 to 93 feet in Borehole No. 5 and 2 respectively.

The material in the stratum consists of silts and sand in varying proportions. The chief constituent is silt in the upper half of the deposit, while the lower half consists mostly of sand. Traces of clay were also found throughout the stratum. Grain size distribution tests were carried out on selected samples. The results are plotted in envelope form on Figure 1 of the Appendix.

Standard Penetration Tests were carried out within this cohesionless (granular) deposit and the results are plotted on the Record of Borehole Sheets. The obtained 'N' values varied from 5 blows/foot to 100 blows for 5 inches. Based on these results, it is estimated that the relative density of this deposit is generally loose in the upper 5 feet and ranges somewhat randomly from compact to very dense in the remainder of the deposit.

The natural moisture content varies between 5% and 21%, however, the bulk of the deposit has a moisture content close to 20%.

### Clayey Silt

Boreholes No. 2 and 5 which were drilled beyond the lower boundary of the sandy silt to silty sand deposit encountered a stratum of clayey silt at elevation 679+ and elevation 693+ respectively. The stratum was penetrated up to 37 feet.

A limited number of laboratory tests indicated that the deposit is inorganic and has a low plasticity.



The natural moisture content ranges from 20 to 23%.

Based on Standard Penetration Test 'N' values, the consistency is estimated to range from very stiff to hard.

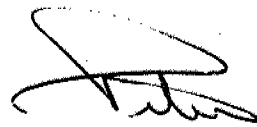
#### Groundwater Conditions

At the time of the field investigation on November 5 to 18, 1975, the following groundwater levels were recorded:

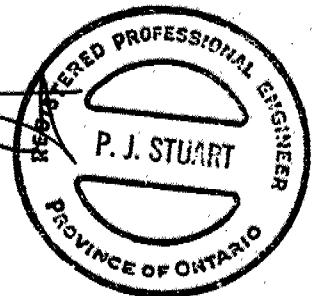
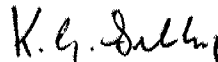
B.H. #1	Elevation 754.2
2	754.2
3	753.0
4	757.5
5	756.3
6	758.0

The average natural ground surface was at elevation 780+ in the vicinity of the site.

It is pointed out that the water level observations were carried out during a relatively dry period and that higher levels will probably prevail in the spring period.



P. Stuart, P. Eng.  
Project Engineer

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

January, 1979

## APPENDIX

## RECORD OF BOREHOLE NO 1

WP 40-66-19/20

LOCATION Co-ords. 15,619,814 N; 1,245,881 E.

ORIGINATED BY MK

DIST 2 HWY 402

BORING DATE November 5-7, 1975

COMPILED BY OJ

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 25 50 75 100 125 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ $w$ $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT Y	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
781.5	Ground Level									
0.0	Silty clay, traces of sand. Very Stiff		1	SS	23	780				0 1 49 50
773.0			2	SS	25					
8.5			3	SS	9					
	Sandy silt to silty		4	SS	21					
			5	SS	35					
			6	SS	39					
			7	SS	34					
			8	SS	95					
	sand, traces of clay		9	SS	67					
			10	SS	41					
			11	SS	31					
			12	SS	95					
			13	SS	52					
	Loose to Very Dense		14	SS	24					
			15	SS	9					
			16	SS	31					
			17	SS	83					
			18	SS	100/5"					
725.0			19	SS	76					
56.5	End of Borehole									

## RECORD OF BOREHOLE NO 2

WP 40-66-19/20

LOCATION Co-ords. 15,619,730 N; 1,245,793 E.

ORIGINATED BY MK

DIST 2 HWY 402

BORING DATE November 7-11, 1975

COMPILED BY GP

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Bi-Cone &amp; Cone Test

CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
780.8	Ground Level															
0.0	Silty clay traces of sand Very Stiff		1	SS	21	780										
			1A	TW	PH											
772.3			1B	TW	PH											
8.5			2	SS	17	770										0 27 (73)
			3	SS	32											
			4	SS	31											
			5	SS	43											
	Sandy Silt		6	SS	107	760										
			7	SS	127											
	to		8	SS	60											
	Silty Sand		9	SS	39											
			10	SS	100	750										0 83 (17)
			11	SS	15											
	Trace of Clay		12	SS	154	740										
			13	SS	90											
			14	SS	100	730										
	Compact to Very		15	SS	80	720										
	Dense		16	SS	117											
			17	SS	153	710										
			18	SS	130	700										0 54 42 4
			19	SS	58	690										
679.4			20	SS	86	680										
101.4	Clayey silt, very															
676.8	Stiff to Hard															
104.0																

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE NO 2 Continued

WP 40-66-19/20 LOCATION Co-ords. 15,619,730 N; 1,245,793 E. ORIGINATED BY mk  
 DIST 2 HWY 402 BORING DATE November 7-11, 1975 COMPILED BY GP  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Bi-Cone CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
676.8	continued															
104.0	Clayey Silt															
	Very Stiff to Hard		21	SS	41	670										
659.3																
			22	SS	24	660										
121.5	End of Borehole															

## RECORD OF BOREHOLE No 3

WP 40-66-19/20

LOCATION Co-ords. 15,619,737 N; 1,245,869 E.

DIST 2 HWY 402

BORING DATE November 12, 1975

ORIGINATED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Tri -Cone &amp; Cone Test

COMPILED BY GP

 CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$		
776.7	Ground Level														
0.0	Fill Material—layers of sand, clayey silt & organics.		1	SS	3										
773.2			2	SS	10										
3.5	Sandy Silt to Silty Sand		3	SS	33										
			4	SS	35										
	traces of clay		5	SS	31										
			6	SS	63										
			7	SS	73										
			8	SS	49										
	Loose to Very Dense		9	SS	167										
			10	SS	85										
			11	SS	160										
			12	SS	127										
			13	SS	54										
			14	SS	62										
722.7			15	SS	42										
54.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE NO 4

WP 40-66-19/20

LOCATION Co-ords. 15,619,694 N; 1,245,914 E.

DIST 2 HWY 402

BORING DATE November 20-24, 1975

ORIGINATED BY PP

DATUM Geodetic

BOREHOLE TYPE Auger BX Casing &amp; Bi-Cone &amp; Cone Test

COMPILED BY GP

CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 25 50 75 100 125 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ — $W$ — $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
775.0	Ground Level									
0.0	Fill mat'l., layers of									
772.5	sand, clayey sil. & org.									
2.5			1	SS	26					
			2	SS	47					
			3	SS	58					
	Sandy silt to silty		4	SS	63					
			5	SS	68					
	sand, traces of clay		6	SS	90/5					
			7	SS	132					
			8	SS	63					
			9	SS	139					
			10	SS	87					
	Compact to Very Dense		11	SS	33					
			12	SS	34					
			13	SS	123					
			14	SS	113					
			15	SS	63					
723.5			16	SS	68					
51.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE NO 5

WP 40-66-19/20

LOCATION Co-ords. 15,619,706 N; 1,245,981 E.

ORIGINATED BY PP; MK

DIST 2 HWY 402

BORING DATE November 25-27, 1975

COMPILED BY GP

DATUM Geodetic

BOREHOLE TYPE Auger &amp; BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	WP	WL	W		
777.8	Ground Level															
0.0	Silty clay, traces of sand. Very Stiff		1	SS	18											
773.8			2	SS	5											
4.0			3	SS	18	770										
	Sandy silt to silty		4	SS	21											
			5	SS	48											
	sand, traces of		6	SS	26	760										0 51 (49)
			7	SS	138											
	clay.		8	SS	45											
			9	SS	40											
			10	SS	170	750										
			12	SS	37											
			13	SS	66	740										0 55 (45)
	Loose to Very Dense		14	SS	89											
			15	SS	100	730										
			16	SS	74											
			17	SS	51	720										
			18	SS	87	710										
			19	SS	100	700										
			20	SS	54	690										
692.8	Clayey Silt		21	SS	80	680										
85.0	Hard															
673.8																
104.0																0 0 69 31



RECORD OF BOREHOLE NO 5 Continued

WP 40-66-19/20 LOCATION Co-ords. 15,619,706 N; 1,245,981 E. ORIGINATED BY PP;MK  
 DIST 2 HWY 402 BORING DATE November 25-27, 1975 COMPILED BY GP  
 DATUM Geodetic BOREHOLE TYPE Auger & BX Casing CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_P$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
673.8	continued															
104.0	Clayey silt					670										
	Hard		22	SS	95											
656.3						660										
121.5	End of Borehole		23	SS	34											

RECORD OF BOREHOLE No 6

60

WP 40-66-19/20

LOCATION Co-ords. 15,619,622 N; 1,245,893 E.

DIST 2 HWY 402

BORING DATE November 28, 1975

ORIGINATED BY MK

DATUM Geodetic

BOREHOLE TYPE Auger & Cone Test

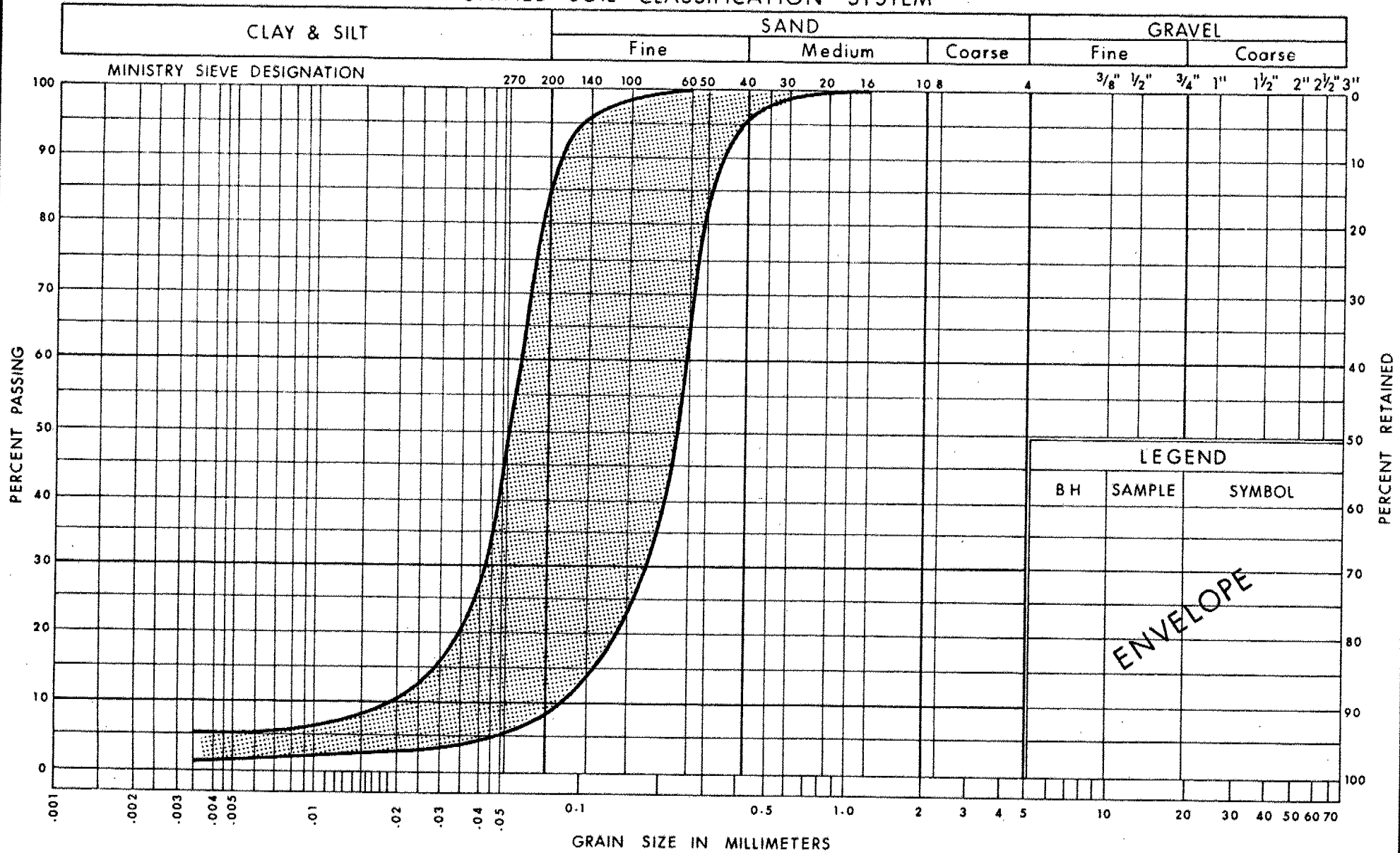
COMPILED BY GP

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 25 50 75 100 125 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
777.5	Ground Level									
0.0	Silty Clay									
774.0	Firm		1	SS	8					
3.5			2	SS	6					
			3	SS	7					
	Sandysilt to silty		4	SS	25					
			5	SS	49					
	sand, traces of		6	SS	29					
	clay.		7	SS	104					
			8	SS	52					
			9	SS	41					
			10	SS	137					
	Loose to Very Dense		11	SS	27					
			12	SS	50					
			13	SS	70					
			14	SS	55					
			15	SS	202					
726.0			16	SS	69					
51.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SANDY SILT TO SILTY SAND  
TRACES OF CLAY

FIG No 1

W P 40-66-19 & 20

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

40113-47  
GEOCRES No.

TO: A.P. Watt (2)  
Regional Structural Planning Engineer  
Southwestern Region, London

FROM: Soil Mechanics Section  
Geotechnical Office  
West Bldg.

ATTENTION:

DATE: April 30, 1976

OUR FILE REF.

IN REPLY TO

MAY 05 1976

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

W.P. 40-66-13/14  
Hwy. 402, District 2, London  
CNR Overhead EBL/WBL  
5.8 Miles West of Hwy 2

*Site #19-527*

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

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

*K. G. Selby*

K.G. Selby  
Supervising Engineer

KGS/bp

cc: R.S. Pillar  
C.S. Grebski  
B.J. Giroux  
G.A. Wrong  
A. Wittenberg  
J.R. Roy  
D.P. Collins  
R. Hore  
J. Anderson )  
A. Crowley ) Memo only  
G. Sloan )  
Files

# FOUNDATION INVESTIGATION REPORT

For

W.P. 40-66-13/14  
Hwy. 402, District 2, London  
CNR Overhead EBL/WBL  
5.8 Miles West of Hwy 2

---

## 1. INTRODUCTION

This report is to provide information for the design and construction of proposed twin structures at the above site.

The subsoil information is based on ten sampled boreholes and eight dynamic cone penetration tests. The boring operation was carried out using hollow stem augers which were advanced into the soil without the use of a plug. A spilt-spoon, from which the ball had been removed, was then washed down to just below the bottom of the augers, where it was driven in the conventional manner. In this way the disturbance of the soil layer to be sampled is minimized as it is not subjected to an unbalanced hydrostatic head during the removal of the rods from the hollow stem augers.

## 2. SITE DESCRIPTION

The proposed location is in the sixth concession of the Twp. of Caradoc approx. 800 ft. west of the 20th. sideroad. The railway, which has twin sets of tracks, runs on a low embankment approx. three feet above the surrounding land. The area is gently rolling and exhibits a poorly developed pattern of drainage. The surrounding fields are engaged in a cash crop type of agriculture.

Physiographically, the area in which the site is located is referred to as the 'Caradoc Sand Plain'.

## 3. SUBSOIL

### 3.1 General

The subsoil consists of alternating layers of cohesive and non cohesive

material. The first of these is ten to fifteen feet in thickness and consists primarily of silt with some clayey silt in the upper portion. Beneath this is a layer of approx. five feet of clayey silt which disappears in the area south of the railway tracks. Next a layer of five to fifteen feet of fine sand is found which is underlain by five to seven feet of clayey silt. This layer is in turn underlain by approx. 30 ft. of fine sand. Beneath this and extending to a depth of over 125 ft. is found another clayey silt layer.

Locations of boreholes and the inferred subsoil stratigraphy are shown in Dwg. 406613 & 14-A.

### 3.2 Silt

This layer is from ten to fifteen feet in depth. Its upper portion contains enough clay to make it slightly cohesive in places. Relative density generally increases with depth. The upper portion has a loose relative density with Standard Penetration 'N' values as low as five. In contrast the relative density of the lower portion varies from compact to very dense with Standard Penetration 'N' values ranging to in excess of 100 blows per foot. Moisture content ranges from 18 to 20 percent.

### 3.3 Clayey Silt

The soil profile contains three distinct layers of clayey silt.

The upper clayey silt layer, which is found between layers of silt and sand is approx. five feet in thickness over most of the site. It was not however encountered in boreholes one, two or three located on the south side of the railway tracks. This layer exhibits a very stiff consistency with shear strengths estimated to be between 2000 and 3000 p.s.f. Moisture content was found to be approx. 20 percent.

The second clayey silt layer consists of five to ten feet of material sandwiched between two fine sand layers. Moisture content varies from 17 to 21 percent. Standard Penetration 'N' values are generally between 14 and 30 indicating a stiff to very stiff consistency.

The third clayey silt layer extends from a depth of approximately 60 ft. to in excess of 125 ft. where the deepest borehole was terminated. It may be subdivided into two portions. Between the depths of 60 and 105 ft. Standard Penetration 'N' values range from 16 to 60 and moisture content is 20 percent or above. Below 105 ft. Standard Penetration Test 'N' values are well in excess of 100 blows per foot and the moisture content ranges from 13 to 19 percent.

#### 3.4 Fine Sand

There are two distinct fine sand layers both of which are sandwiched between layers of clayey silt. The upper layer varies in thickness from five to fifteen feet while the lower layer ranges from 25 to 30 ft. Silt content for both layers generally ranges from 10 to 25 percent but is higher in isolated pockets and along the layer boundaries. Grain size distribution for the fine sand is shown as an envelope in Fig. 1. Standard Penetration 'N' values range from 15 to in excess of 100 blows per foot but are generally in excess of 30. This would indicate a dense to very dense relative density with occasional compact pockets. Laboratory tests indicate a moisture content of approx. 20 percent.

#### 3.5 Groundwater

Field work was carried out during a prolonged thaw in February which produced extensive ponding in surface depressions. Water levels in the boreholes throughout this period remained within a foot of the ground surface. It may be assumed that this water level would be somewhat lower during other seasons of the year.

### 4. DISCUSSION AND RECOMMENDATIONS

#### 4.1 Discussion

It is proposed that Hwy. 402 pass over the double CNR tracks plus a service road parallel to the railway tracks on twin four span structures. The bridges would have approach embankments approx. 33 ft. in height and would consist of spans of 58, 92, 87 and 58 ft.

#### 4.2 Perched Abutments

Perched abutments may be supported on steel tube piles (12 3/4" X 1/4"). A design load of 25 tons per pile may be used if these piles are driven to

elev. 780 for the south abutments and 785 for the north abutments.

Alternately if the driving of these piles is controlled by Hiley Formula it is estimated they will achieve a design load of 60 tons at approximate elev. 755.

#### 4.3 Piers

- (a) The piers may be supported on spread footings at elev. 786. A design load of 3 tons per sq. ft. may be used assuming a settlement of one inch.
- (b) As an alternative the piers may be supported on tube piles. The driving of these piles should be controlled by the Hiley Formula. A design load of 60 tons will be achieved at approx. elev. 755.
- (c) The piers may be supported on timber piles. These piles would, however, be unsuitable to use for perched abutments as difficulties in driving them through the approach fills could be expected. A design load of 35 tons should be used for these piles with a tip elev. of 770.

#### 4.4 H-Piles

The structure may be supported on steel H-piles with a design load equal to their allowable structural capacity. This capacity should be achieved at approx. elev. 680.

#### 4.5 Settlements

Settlements will be greatest under the approach fills. Due to the non-cohesive nature of most of the upper 60 ft. of the subsoil, settlement will occur primarily during construction. Differential settlement after the deck is placed will be less than 1 inch.

#### 4.6 Dewatering

The use of spread footings will require a dewatering scheme employing sheet piling. The sheet piling should be driven so that its depth below the



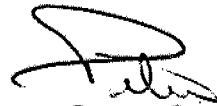
groundwater level is equal to twice the required depth of excavation below the same groundwater level.

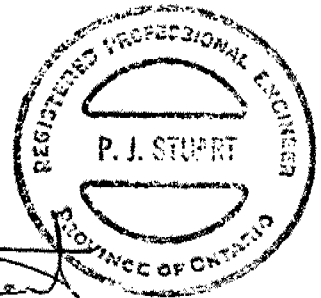
#### 4.7 Frost Protection

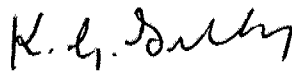
All pile caps or spread footings should be protected by a minimum four feet of cover against frost action.

#### 4.8 Approach Embankments

No stability problems are anticipated with embankment fills (33 ft.) if 2:1 slopes are employed. Cobbles exceeding a 3 inch. diameter should be removed from fill placed at locations through which piles have to be driven.

  
Peter Stuart, P. Eng.  
Project Engineer



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

KGS/bp

## APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,624 N; 1,261,084 E. ORIGINATED BY FJS  
DIST 2 HWY 402 BORING DATE February 23, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
794.3	Ground Level															GR SA SI CL
0.0	Silt, some clayey silt layers		1	SS	17											
			2	SS	37											
			3	SS	41											
	Compact to Dense		4	SS	27											
779.3			5	SS	53											
15.0	Fine sand, some silt		6	SS	61											
			7	SS	38											
	Dense to Very Dense															
767.8			8	SS	49											
26.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,638 N; 1,260,960 E.  
DIST 2 HWY 402 BORING DATE February 23, 1976  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY PJS  
COMPILED BY MK  
CHECKED BY *ep.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
793.5	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	30											
			2	SS	31											
778.5	Dense		3	SS	47											
15.0	Fine sand, some silt		4	SS	100/7"											
			5	SS	152											
767.0	Very Dense		6	SS	78											
26.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,678 N; 1,261,024 E. ORIGINATED BY PJS  
 DIST 2 HWY 402 BORING DATE February 24, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
794.1	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	5	790										
			2	SS	21											
	Loose to Dense		3	SS	20											
779.1			4	SS	33	780										
15.0	Fine sand, some silt		5	SS	81											
	Compact to Very Dense		6	SS	100/8"											
			7	SS	15	770										
			8	SS	65											
763.1	Clayey Silt		9	SS	85	760										
31.0	Very Stiff to Hard		10	SS	30											
753.1			11	SS	73	750										
41.0	Fine sand, some silt with silt pockets		12	SS	60											
	Very Dense		13	SS	51	740										
			14	SS	61											
732.1						730										
42.0	Clayey silt															
727.6	Hard		15	SS	57											
66.5	End of Borehole															

RECORD OF BOREHOLE NO 4

WP 40-66-13 & 14

LOCATION Co-ords. 15,606,692 N; 1,260,901 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 25, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
794.0	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	9	790										
784.0	Loose to Dense		2	SS	46											0 7 87 6
10.0	Clayey Silt		3	SS	23											
779.0	Very Stiff		4	SS	15	780										0 88 (12)
15.0	Fine sand, some silt		5	SS	48											
	Dense to Very Dense		6	SS	100/9"	770										
768.0			7	SS	38											
26.0	Clayey Silt		8	SS	16	760										
761.0	Very Stiff		9	SS	59											
33.0	Fine sand, some silt with silt pockets		10	SS	55	750										0 34 62 4
	Dense to Very Dense		11	SS	28											
			12	SS	56	740										0 88 (12)
			13	SS	74	730										
728.0			14	SS	57	720										
66.0	Clayey Silt		15	SS	16	710										
	Very Stiff to Hard		16	SS	34	700										
			17	SS	100/7"											
690.0																
104.0																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4 Continued

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,692 N; 1,260,901 E. ORIGINATED BY PJS  
 DIST 2 HWY 402 BORING DATE February 25, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ — $W$ — $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100			
690.0	continued													
104.0	Clayey Silt		18	SS	150	6"								
	Very Stiff to Hard					680								
			19	SS	120	6"								
668.5			20	SS	100	6"								
125.5	End of Borehole													

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,776 N; 1,260,996 E. ORIGINATED BY PJS  
 DIST 2 HWY 402 BORING DATE February 20, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	Wp	W	WL		
794.3	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	15	790										
	Compact to Very Dense		2	SS	116											
782.3			3	SS	63											0 6 88 6
12.0	Clayey Silt		4	TW	PH	780										
776.3	Very Stiff		5	TW	PH											
18.0	Fine sand, some silt		6	SS	87											0 77 (23)
	Very Dense		7	SS	161	770										
766.3			8	SS	17											
28.0	Clayey Silt		9	SS	72	760										
761.3	Very Stiff		10	SS	76											0 83 (17)
33.0	Fine sand, some silt with silt pockets		11	SS	37	750										
	Very Dense		12	SS	61											
			13	SS	87	740										
732.8			14	SS	117											
61.5	End of Borehole															



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 40-66-13 & 14

LOCATION Co-ords. 15,606,778 N; 1,260,876 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 26, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
792.7	Ground Level															GR SA SI CL
0.0	Silt, some clayey silt layers.					790										
			1	SS	10											
			2	SS	30											
	Compact to Very Dense		3	SS	52											
780.7			4	SS	18	780										
12.0	Clayey Silt		5	SS	25											
775.7	Very Stiff		6	SS	100/8"											
17.0	Fine sand, some silt															
770.7	Very Dense		7	SS	14	770										
22.0	Clayey Silt															
765.7	Stiff		8	SS	31											
27.0																
	Fine sand, some silt		9	SS	100/10"	760										
			10	SS	100/10"											
	with silt pockets		11	SS	112	750										
			12	SS	76											
	Dense to Very Dense		13	SS	63	740										
			14	SS	76											
						730										
726.2			15	SS	106											
66.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,830 N; 1,260,937 E. ORIGINATED BY PJS  
DIST 2 HWY 402 BORING DATE February 19, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY JPB

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_p$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_p$	$W$	$W_L$		
793.8	Ground Level															
0.0	Silt, some clayey silt layers.															
	Loose to Very Dense		1	SS	6											
			2	SS	45											
781.8			3	SS	54											
12.0	Clayey Silt		4	SS	12											
	Stiff to Very Stiff		5	SS	17											
775.8																
18.0	Fine Sand		6	SS	90											
	Some Silt															
765.8	Very Dense		7	SS	130											
28.0	Clayey Silt		8	SS	21											
760.8	Very Stiff															
33.0	Fine sand, some silt		9	SS	48											
	with silt pockets		10	SS	69											
	Dense to Very Dense															
			11	SS	40											
	sand with gravel		12	SS	85											
728.8																
65.0	Clayey Silt		13	SS	49											
	Very Stiff to Hard		14	SS	16											
			15	SS	100/6"											
689.8																
104.0																

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

Continued

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE No 7 Continued

WP 40-66-13 & 14      LOCATION Co-ords. 15,606,830 N; 1,260,937 E.      ORIGINATED BY PJS  
DIST 2      HWY 402      BORING DATE February 19, 1976      COMPILED BY MK  
DATUM Geodetic      BOREHOLE TYPE Hollow Stem Auger      CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS  % 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					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					10 20 30				
689.8	continued															
104.0	Clayey Silt		16	SS	112.6"								o		0 1 80 19	
	Very Stiff to Hard					680										
677.8			17	SS	111.6"								o			
116.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 8

WP 40-66-13 & 14 LOCATION Co-ords. 15,606,839 N; 1,260,843 E. ORIGINATED BY PJS  
 DIST 2 HWY 402 BORING DATE February 16, 1976 COMPILED BY MK  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
794.0	Ground Level															
0.0	Silt, some clayey silt layers.															
	Compact to Very Dense		1	SS	29											
			2	SS	104											
782.0			3	SS	35											
12.0	Clayey Silt		4	SS	16											
	Stiff		5	SS	12											
776.0																
18.0	Fine sand, some silt		6	SS	32											
	Dense to Very Dense		7	SS	100/9"											
766.0																
28.0	Clayey Silt		8	SS	18											
760.0	Very Stiff															
34.0			9	SS	73											
	Fine sand, some silt															
	with silt pockets.		10	SS	61											
			11	SS	19											
	Compact to Very Dense		12	SS	59											
			13	SS	53											
728.0																
66.0	Clayey silt															
722.5	Very Stiff		14	SS	20											
71.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

WP 40-66-13 & 14

LOCATION Co-ords. 15,606,874 N; 1,260,935 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 18, 1976

COMPILED BY NK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
793.7	Ground Level															
0.0	Silt, some clayey silt layers		1	SS	6	790										
	Loose to Very Dense		2	SS	107											
781.7			3	SS	51											
12.0	Clayey Silt		4	SS	13	780										
	Stiff		5	SS	12											
775.7																
18.0	Fine sand, some silt		6	SS	59											
	Dense to Very Dense					770										
766.7			7	SS	45											
27.0	Clayey Silt															
	Very Stiff		8	SS	20											
760.7						760										
33.0	Fine sand, some silt with silt pockets		9	SS	26											
			10	SS	55											
			11	SS	22	750										
	Compact to Very Dense		12	SS	59											
			13	SS	69	740										
731.7																
62.0	Clayey Silt					730										
727.2	Hard		14	SS	49											
66.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

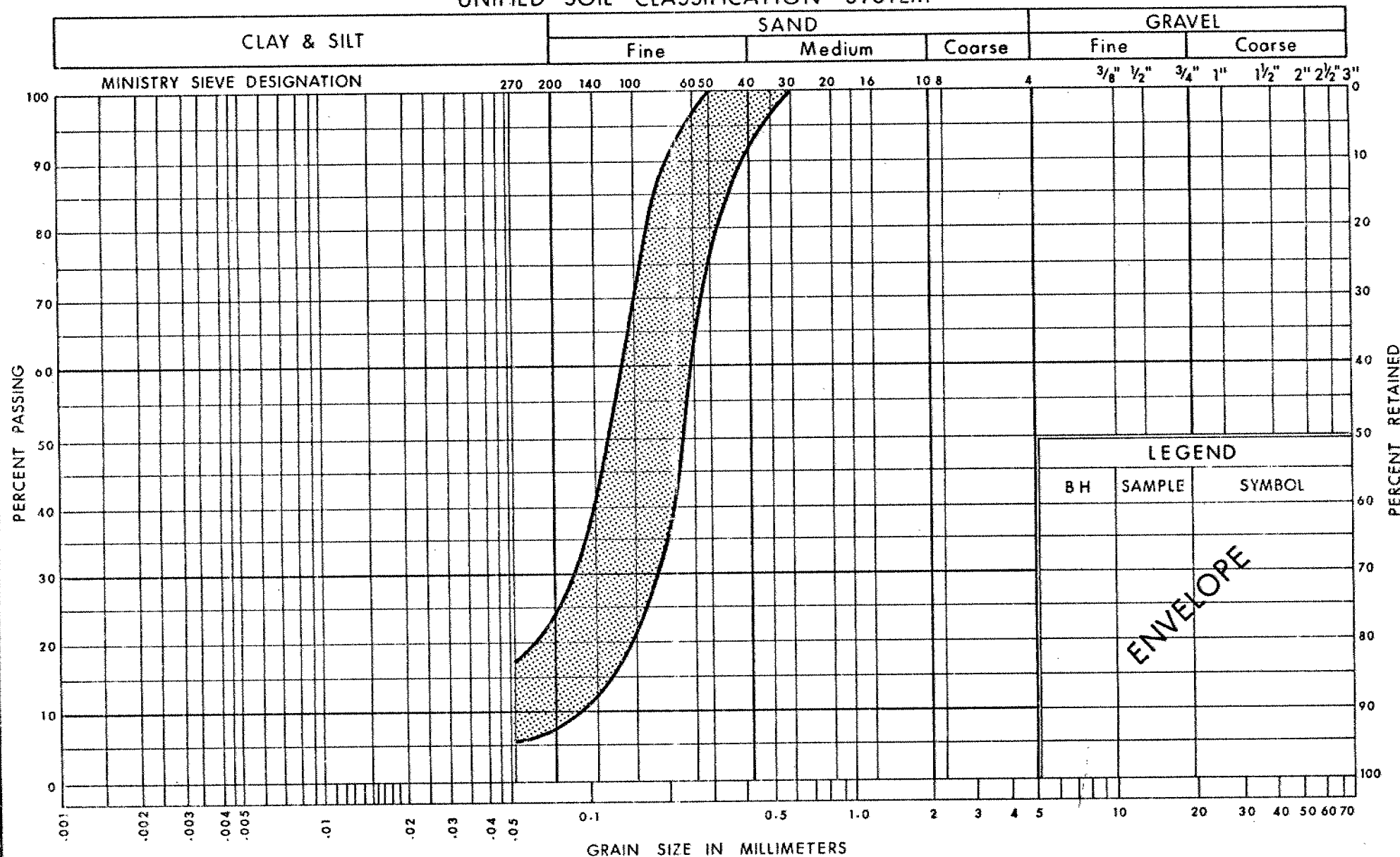
WP 40-66-13&14 LOCATION Co-ords. 15,606,894 N; 1,260,788 E. ORIGINATED BY RJS  
DIST 2 HWY 402 BORING DATE February 17, 1976 COMPILED BY MK  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY *ep.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
794.0	Ground Level															
0.0	Silt, some clayey silt layers.		1	SS	6	790										
			2	SS	61											
	Loose to Very Dense		3	SS	47											
782.0			4	SS	15	780										
12.0	Clayey Silt		5	SS	33											
776.0	Very Stiff															
18.0	Fine Sand		6	SS	29	770										
	Some Silt															
	Dense to Very Dense		7	SS	112											
766.0			8	SS	22	760										
28.0	Clayey Silt															
761.0	Very Stiff		9	SS	27											
33.0	Fine Sand, trace of silt with silt pockets															
752.5	Compact to Dense		10	SS	50											
41.5	End of Borehole															

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

OFFICE REPORT ON SOIL EXPLORATION

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of  
Transportation and  
Communications

ENGINEERING SERVICES BRANCH

# GRAIN SIZE DISTRIBUTION

## FINE SAND, SOME SILT

### (UPPER & LOWER LAYERS)

FIG No 1

W P 40-66-13 & 14

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

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

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

### DESCRIPTION OF SOIL

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

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

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		



# ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

## SOIL PROPERTIES

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

## GENERAL

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

## STRESS AND STRAIN

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

## EARTH PRESSURE

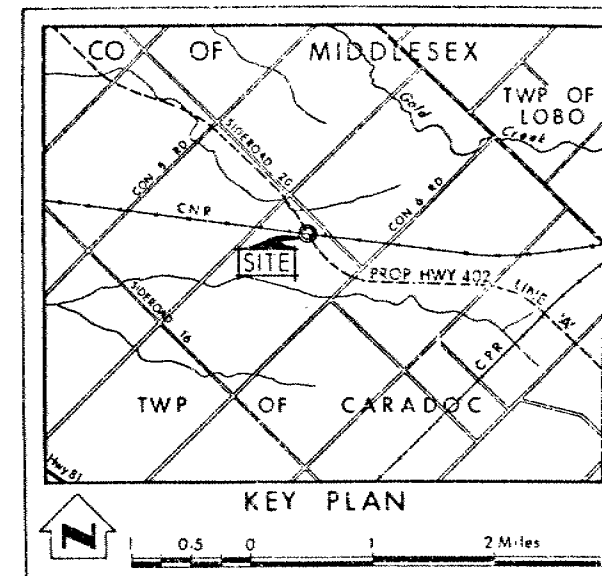
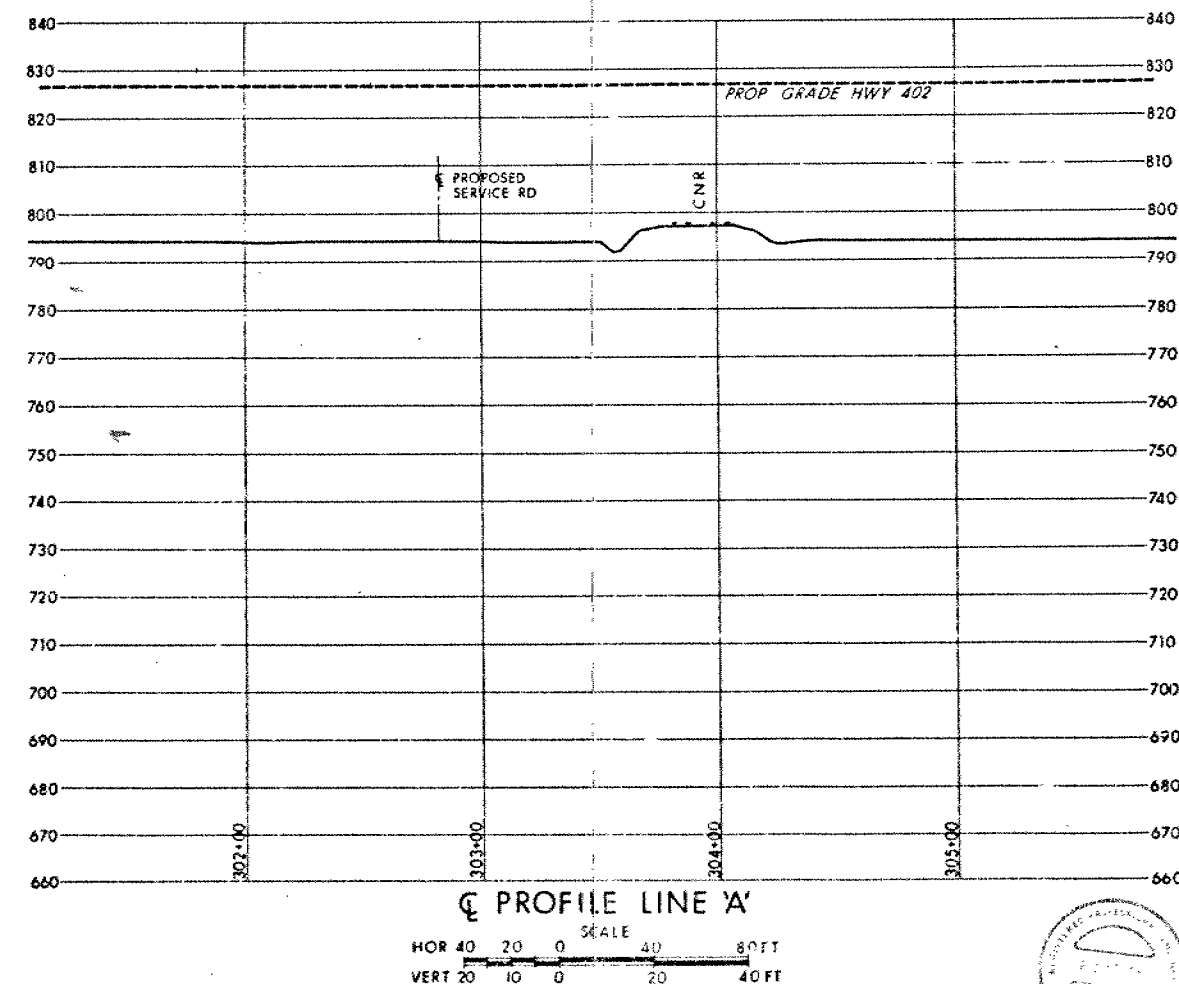
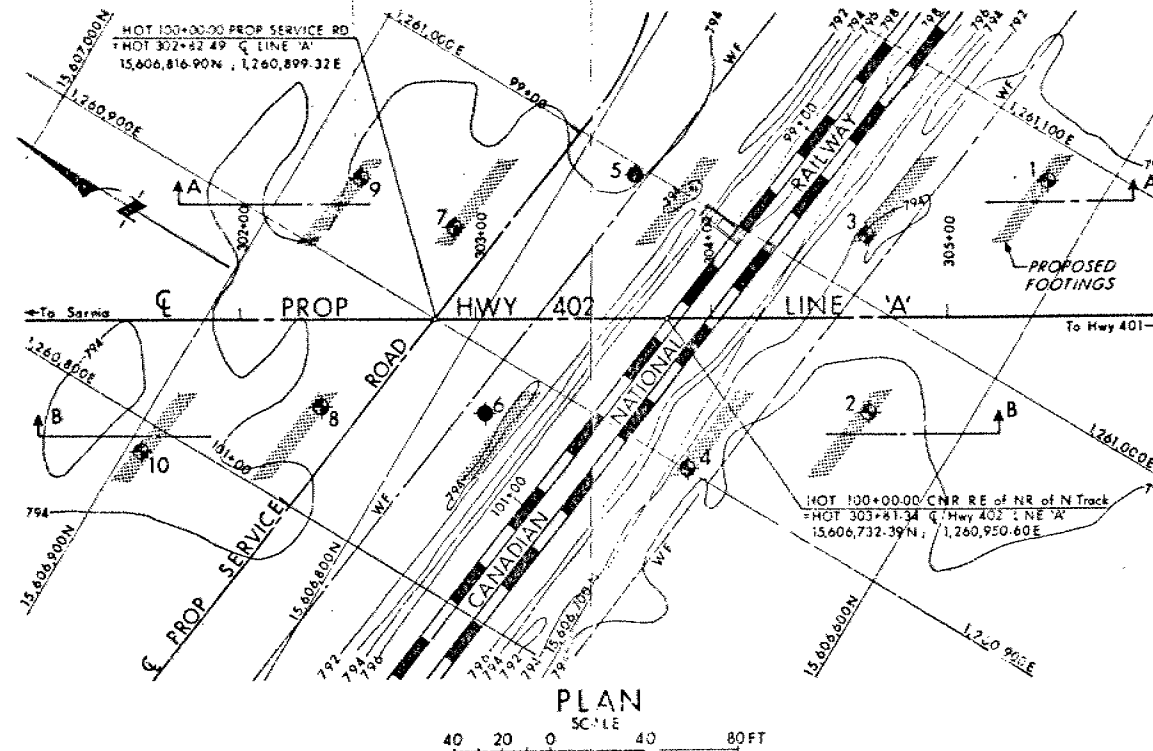
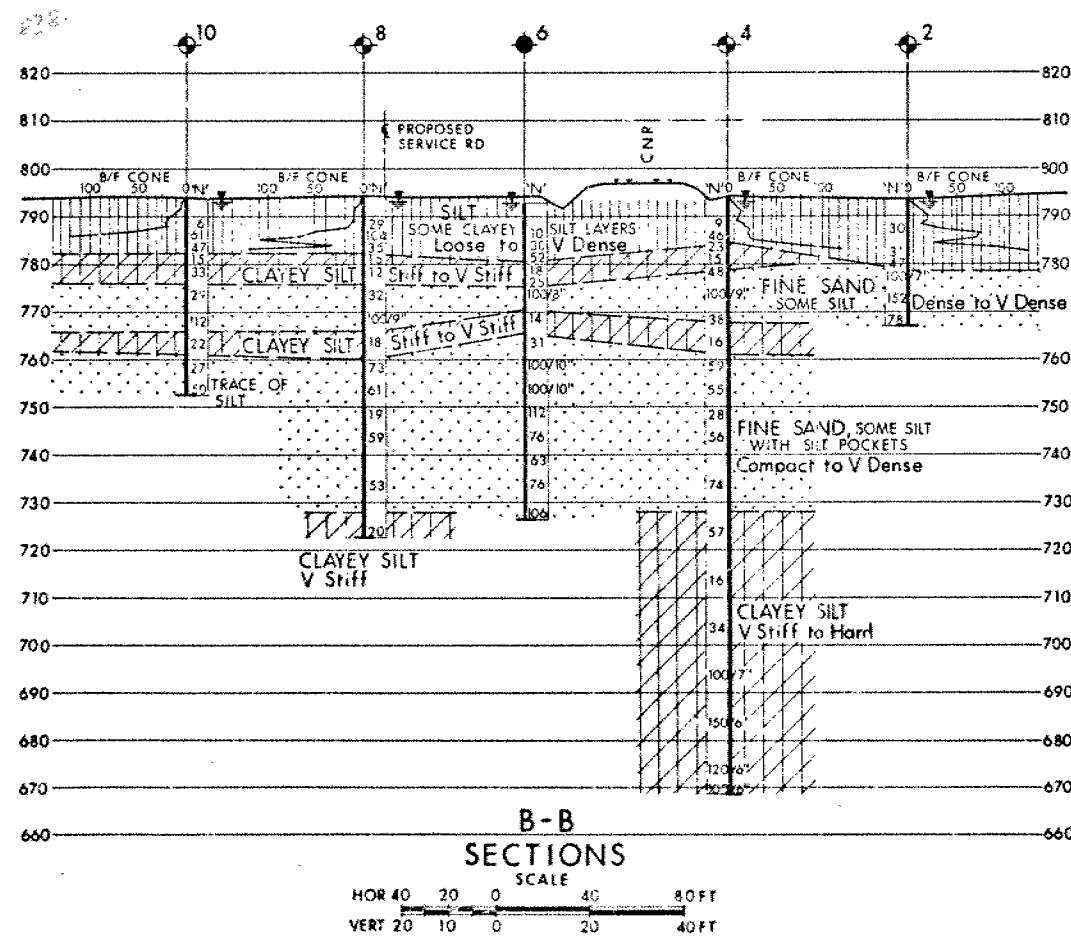
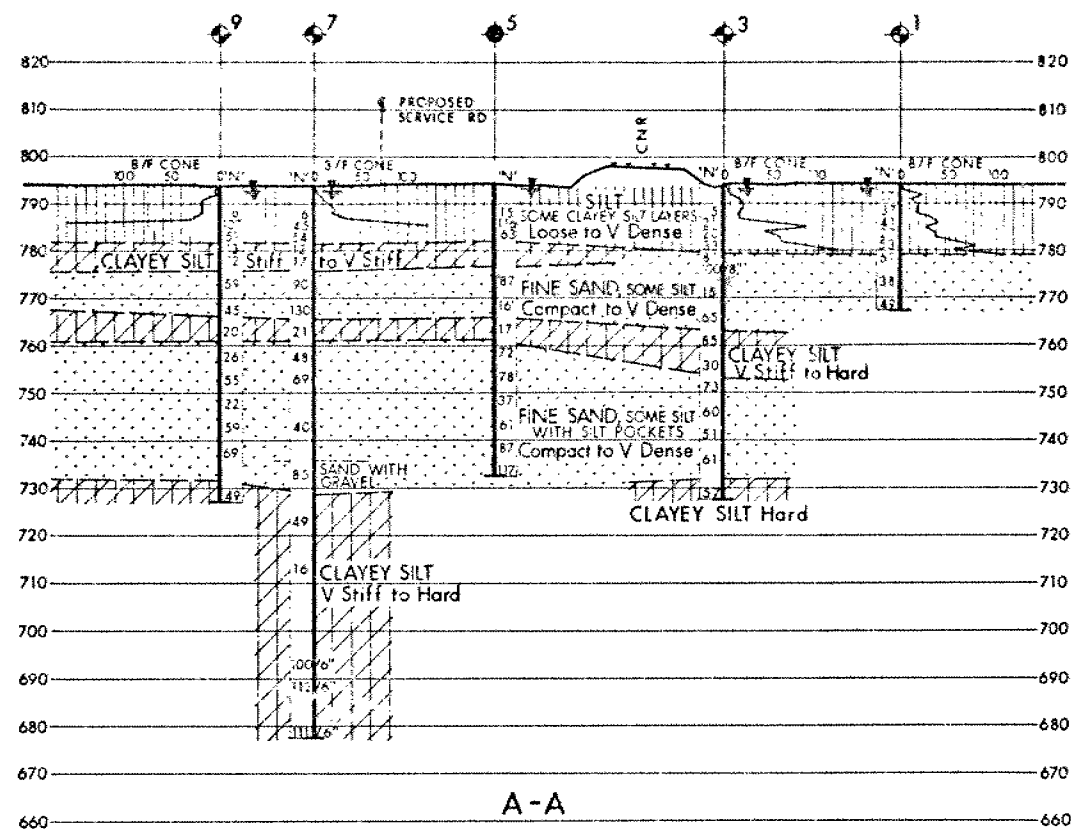
$d$	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
$K$	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

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

## SLOPES

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



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Feb. 1976		

NO.	ELEVATION	CO-ORDINATES NORTH	EAST
1	794.3	15,606,624	1,261,084
2	793.5	15,606,638	1,260,960
3	794.1	15,606,678	1,261,024
4	794.0	15,606,692	1,260,901
5	794.3	15,606,776	1,260,996
6	792.7	15,606,778	1,260,976
7	793.8	15,606,830	1,260,937
8	794.0	15,606,839	1,260,843
9	793.7	15,606,874	1,260,935
10	794.0	15,606,894	1,260,788

**NOTE**

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

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

**CANADIAN NATIONAL RAILWAY**  
(5.8 Miles West of Hwy 2)

HIGHWAY NO. Prop. 402 LINE 'A' DIST NO. 2  
CO. MIDDLESEX  
TWP. CARADOC LOT CON

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBMITTALS: CHECKED: W.P. NO. 40-66-13 & 14 DRAWING NO. 406613 & 14-A  
DRAWN: CHECKED: W.P. NO. 406613 & 14-A  
DATE: April 21, 1976 SITE NO. 19-527 BRIDGE DRAWING NO.  
APPROVED: CONT. NO.

DIST. No 2		SHEET
CONT No WP No 40-66-13		
C.N.R. OVERHEAD 55' min. clear. over track GENERAL PLAN E.S.L. Bridge, Hwy. 402		

**NOTES**

**Class of Concrete**  
Deck & barrier walls - 4000 P.S.I.  
Piers - 4000 P.S.I.  
Remainder - 3000 P.S.I.  
Or as noted on drawings

**Clear Cover on Rein. Steel**  
Footings - 3"  
Abutts. - 3"  
Deck - 2" top, 1" bot.  
Barrier walls - As shown  
Or as noted on drawings

**Construction Notes**  
1. The Contractor shall be responsible for finishing the bearing seat dead level to the specified elevations with a tolerance of  $\pm 3/8"$ .  
2. No concrete shall be placed above the abutment bearing seats until concrete in the deck has been placed.

**Reinforcing Steel Grade**  
All steel - 60 U.S.I.

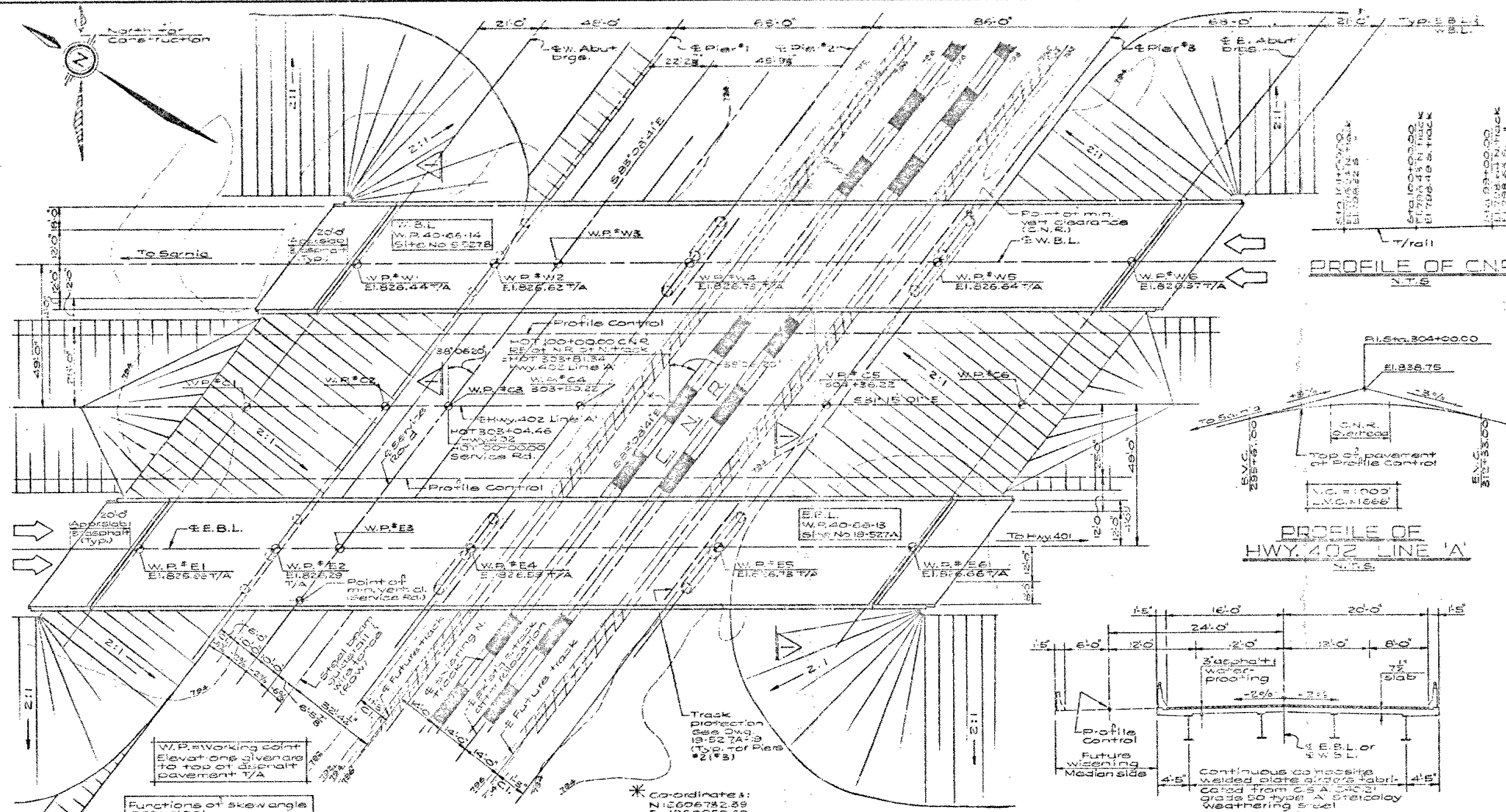
**Formwork**  
The formwork between deck and ballast walls (e.g. expanded polystyrene) shall be removed by the Contractor.

**Concrete & Structural Steel Quant.**  
Concrete & structural steel quantities are listed below for the appropriate lump sum tender items:  
Concrete in piers, abutts., & wingwalls - 2000 P.S.I. 183 Cu.yd.  
4000 P.S.I. 203 Cu.yd.  
Concrete in deck - 4000 P.S.I. 277 Cu.yd.  
Concrete in barrier walls - 47 Cu.yd.  
Concrete in approach slabs - 45 Cu.yd.  
Structural Steel - 83 Tons

- LIST OF DRAWINGS**
- |        |    |                                   |
|--------|----|-----------------------------------|
| 19-527 | 1  | General Plan                      |
|        | 2  | Bore Hole Locations & Soil Strata |
|        | 3  | Foundation Layout                 |
|        | 4  | Footings Reinforcing              |
|        | 5  | West Abutment                     |
|        | 6  | East Abutment                     |
|        | 7  | Pier #1                           |
|        | 8  | Piers #2 & #3                     |
|        | 9  | Structural Steel I                |
|        | 10 | Structural Steel II               |
|        | 11 | Structural Steel III              |
|        | 12 | Deck Details I Scribed Elevations |
|        | 13 | Deck Reinforcing                  |
|        | 14 | Barrier Walls                     |
|        | 15 | Steel Rolling                     |
|        | 16 | 20 Ft. Approach Slabs             |
|        | 17 | Standard Details I                |
|        | 18 | Standard Details II               |
|        | 19 | Standard Details III              |
|        | 20 | As Constructed Elevations         |

B.M. 784.97  
Geodetic Datum  
N.S. 1st Hwy. Right of Way Maple  
505 ft. 3 in. from line of

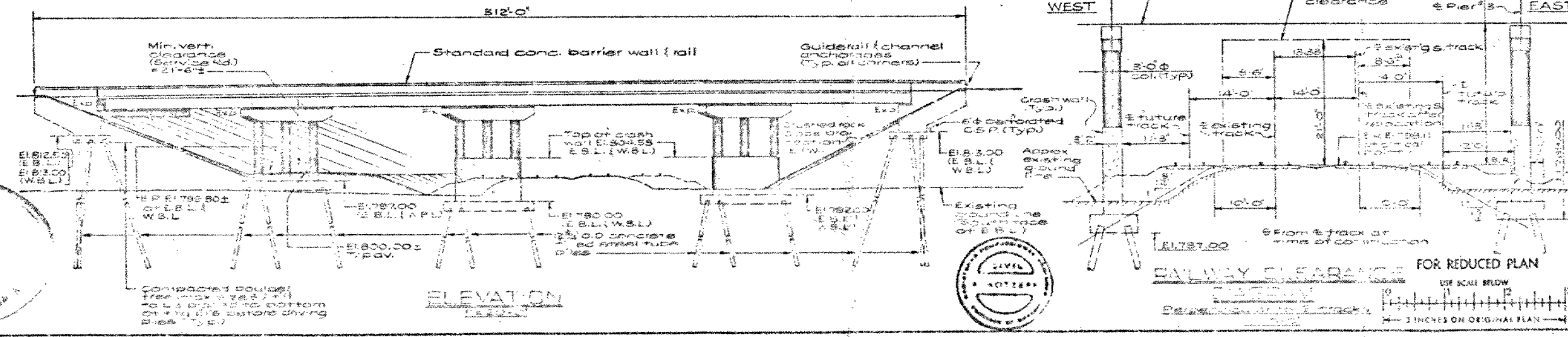
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DESIGN	CHECK	LOADING
DRAWING	CHECK	AT SITE



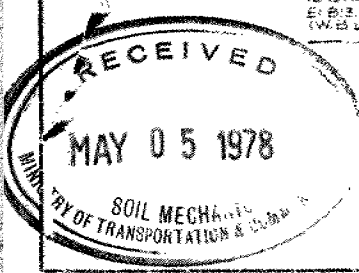
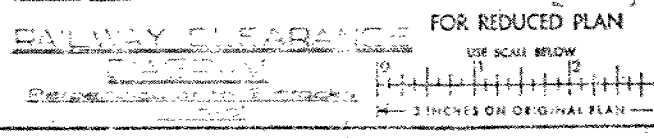
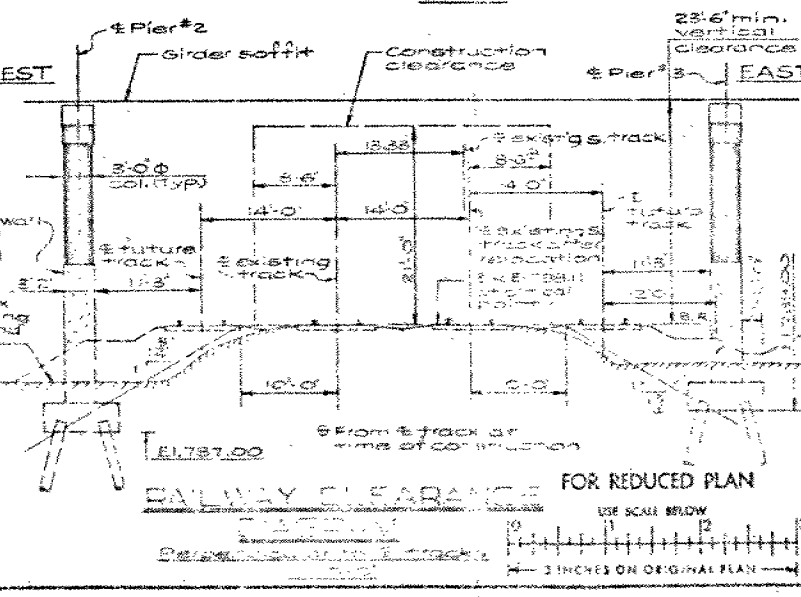
Functions of skew angle 38° 06' 20"

Sin	0.611121
Cos	0.7885751
Tan	0.7842567
Sec	1.2703437

PLAN  
1"=20'-0"



ELEVATION  
1"=20'-0"







DIST. No 2		SHEET
CONT No WP No 40-66-14		
C.N.R. OVERHEAD 5.8 miles west of Hwy. 2		GENERAL PLAN
W.B.L. Bridge, Hwy. 402		

**NOTES**

**Class of Concrete**  
 Deck (barrier walls) --- 4000 P.S.I.  
 Piers --- 4000 P.S.I.  
 Remainder --- 3000 P.S.I.  
 Or as noted on drawings

**Clear Cover on Reinf. Steel**  
 Footings --- 3"  
 Abutts. --- 3"  
 Deck --- 2" top; 1" bot  
 Barrier walls --- As shown  
 Or as noted on drawings

**Construction Notes**  
 The Contractor shall be responsible for finishing the bearing seat dead level to the specified elevations with a tolerance of  $\pm 1/8"$ .  
 No concrete shall be placed above the abutment bearing seats until concrete in the deck has been placed.

**Reinforcing Steel Grade**  
 All steel --- 60 K.S.I.

**Formwork**  
 The formwork between deck and ballast walls (e.g. expanded polystyrene) shall be removed by the Contractor.

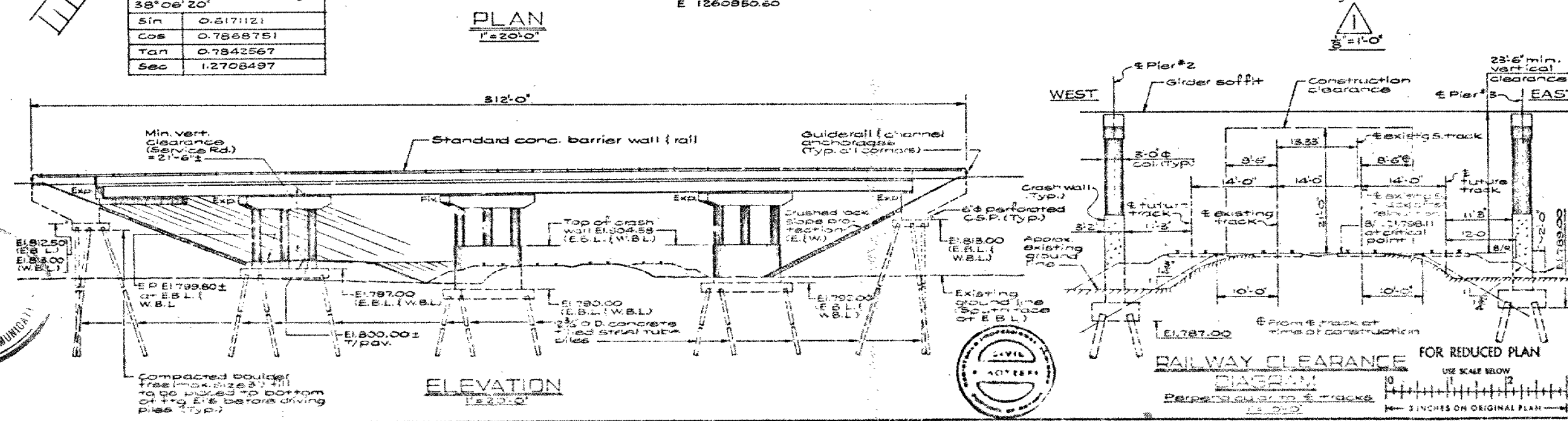
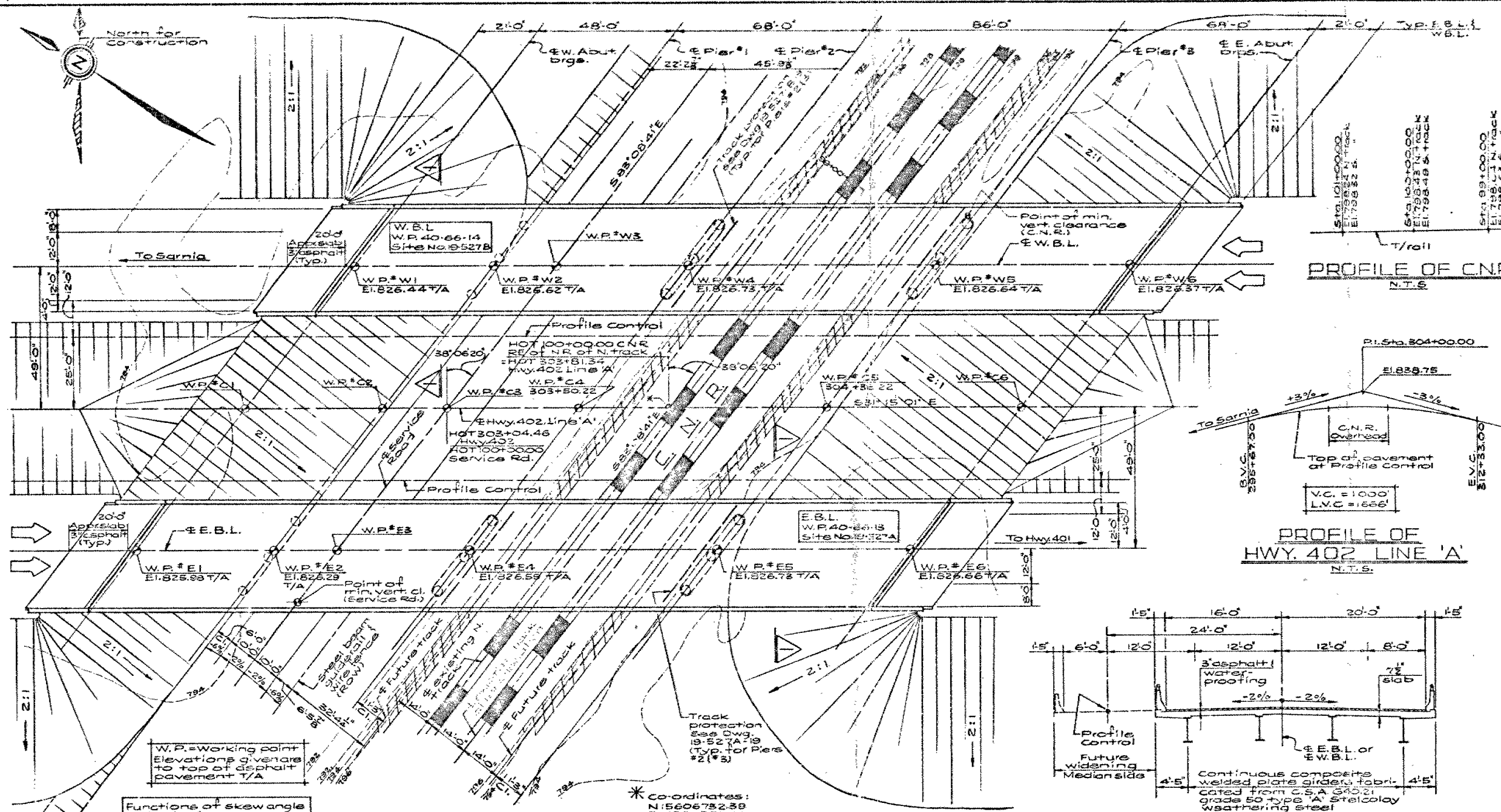
**Concrete / Structural Steel Quant.**  
 Concrete / structural steel quantities are listed below for the appropriate lump sum tender items:  
 Concrete in piers, abutts. (wingwalls) --- 3000 P.S.I. --- 161 Cuyd.  
 --- 4000 P.S.I. --- 202 Cuyd.  
 Concrete in deck --- 277 Cuyd.  
 Concrete in barrier walls --- 47 Cuyd.  
 Concrete in approach slabs --- 45 Cuyd.  
 Structural Steel --- 89 Tons

- LIST OF DRAWINGS**
- 19-527 - 1 General Plan
  - 2 Base Hole Locations / Soil Strata
  - 3 Foundation Layout
  - 4 Footing Reinforcing
  - 5 West Abutment
  - 6 East Abutment
  - 7 Pier #1
  - 8 Piers #2 & #3
  - 9 Structural Steel I
  - 10 Structural Steel II
  - 11 Structural Steel III
  - 12 Deck Details / Screed Elevations
  - 13 Deck Reinforcing
  - 14 Barrier Walls
  - 15 Steel Railing
  - 16 20 Ft. Approach Slabs
  - 17 Standard Details I
  - 18 Standard Details II
  - 19 Standard Details III
  - 20 As Constructed Elevations

B.M. 794.97  
 Geodetic Datum  
 N.W. in NW Root at 25 Maple  
 505 Lt 30110 Line A

REVISIONS	DATE BY	DESCRIPTION

DESIGN BY: J.P. CHECK BY: J.P. DATE: 1978  
 DRAWING CHECK BY: J.P. DATE: 1978



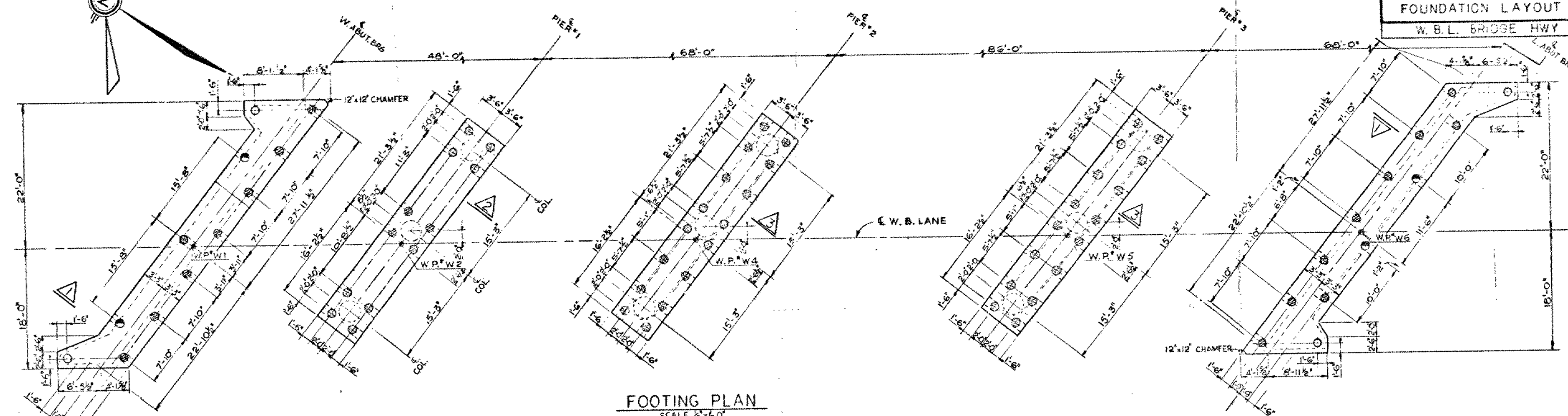
RECEIVED  
 MAY 05 1978  
 MECHANICS  
 DIVISION & COMMUNITY

DIST No 2  
CONT No  
WP No 40-66-14

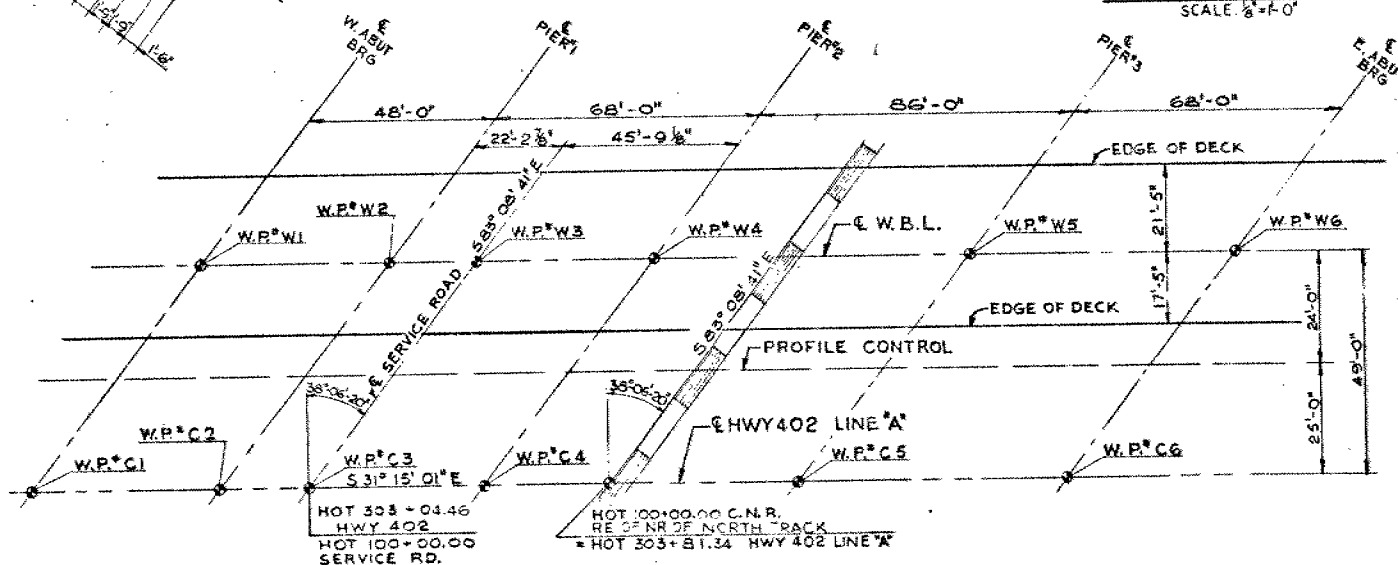
C.N.R. OVERHEAD  
FOUNDATION LAYOUT

W.B.L. BRIDGE HWY 402

SHEET



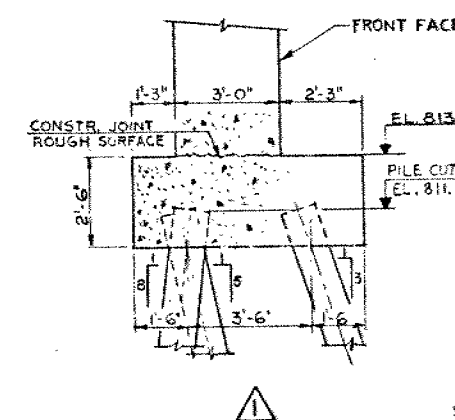
FOOTING PLAN  
SCALE 1/8\"/>



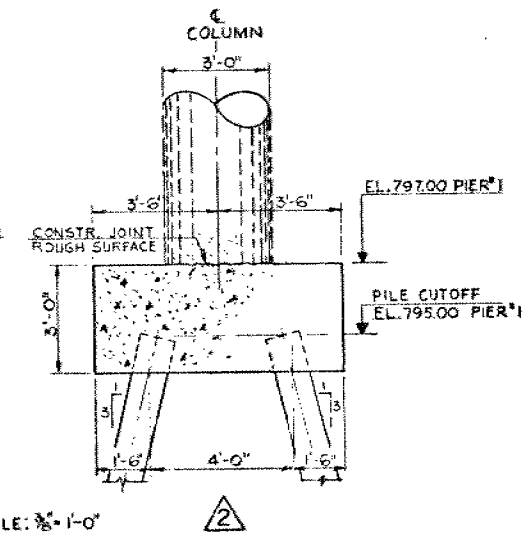
SITE LAYOUT PLAN  
N.T.S.

W.P.	STATION	CO-ORDINATES		W.P.	STATION	CO-ORDINATES	
		NORTH	EAST			NORTH	EAST
W.P.*C1	302+24.22	1560695.10	1260874.25	W.P.*W1	302+72.65	1560685.73	1260936.10
W.P.*C2	302+26.22	15606917.13	1260990.18	W.P.*W2	303+27.05	15606403.70	126096.01
W.P.*C3	303+04.40	15606795.11	1260910.72	W.P.*W3	303+42.89	15606792.05	1260972.54
W.P.*C4	303+50.22	15606755.99	1260934.46	W.P.*W4	303+88.65	1560675.56	1260995.25
W.P.*C5	304+36.22	15606695.47	1260972.07	W.P.*W5	304+74.65	15606675.04	1261040.00
W.P.*C6	305+04.22	15606627.34	1261014.35	W.P.*W6	305+42.65	15606612.51	1261076.17

PILE DATA				
LOCATION	FACE	NO. REQ'D	BATTER	LENGTH
W. ABUTMENT	FRONT	1	1:5	52'-0"
	REAR	2	VERTIC	52'-0"
	REAR	2	1:5	52'-0"
PIER NO 1	WEST	6	1:3	45'-0"
	EAST	6	1:3	44'-0"
	REAR	2	1:5	52'-0"
PIER NO 2	NORTH	2	1:3	37'-0"
	SOUTH	2	1:3	37'-0"
	WEST	6	1:5	52'-0"
PIER NO 3	NORTH	2	1:3	40'-0"
	SOUTH	2	1:3	40'-0"
	REAR	2	VERTIC	52'-0"



SCALE: 1/8\"/>



2

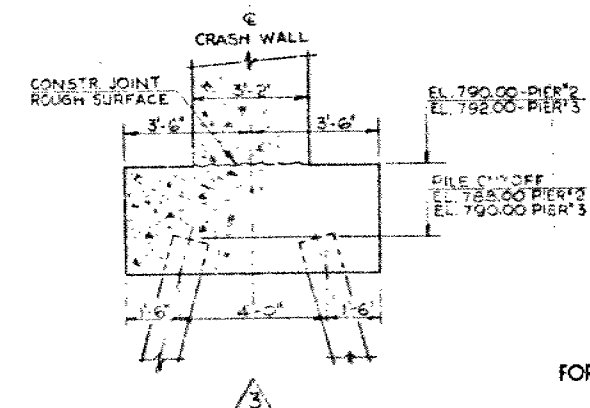
LEGEND

- PILES BATTERED 1:3
- PILES BATTERED 1:5
- PILES BATTERED 1:8
- PILES DRIVEN VERTICALLY

NOTES

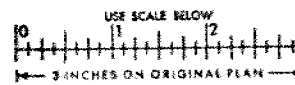
ALL PILE SPACING TO BE MEASURED AT UNDER SIDE OF FOOTING.  
ALL PILES ARE 12" O.D. x 0.25" WALL THICKNESS STEEL TUBE PILES.  
TUBE PILES TO BE FILLED WITH 3000 P.S.I. CONCRETE AFTER INSTALLATION AND INSPECTION.  
PILES TO BE DRIVEN IN ACCORDANCE WITH SS3-II USING DESIGN LOAD 60 TONS/PILE.

CONCRETE QUANTITY IN TUBE PILES-88-C.Y.



3

FOR REDUCED PLAN



REVISIONS	DATE	BY	DESCRIPTION
DESIGN A	CHECK	LOADING	10-27-74
DRAWING A	CHECK	SITE	10-27-74

# memorandum



To: M. Bond  
Head, Geotechnical Section  
Southwestern Region

Date: 1985 09 18

From: Foundation Design Section  
Room 315, Central Building

RE: C.N.R. Overhead, East Approach Embankment  
Site No. 19-527, Highway 402  
District 2, London

This memo summarizes discussions and technical recommendations formulated by yourself and the writer during our visit to the above-mentioned site on 85 06 13 and subsequently by telephone.

## Background

The embankments for the structure approaches were constructed to subgrade level under Contract 79-51. Fill material used was a silty clay. Original ground at the site consists of layers of compact to very dense silt followed by stiff to hard silty clay. The pavements were constructed under Contract 82-67 and consisted of a 1½ inch surface course of HLL, a 1½ inch upper course of HL4, a 7-inch middle course of concrete base and a 5-inch lower course of lean concrete base. Shortly after the road was opened to the public, settlements began to occur on the E.B.L.s and W.B.L.s of the east approach from the bridge to about six hundred feet easterly. Investigations carried out by the Regional Geotechnical Sections revealed the presence of up to three feet of sand saturated with water below the lean concrete base. It appears that this sandy material had been used to bring the embankment up to subgrade level prior to paving operations. Its saturated condition and apparent inability to drain is most undesirable just below the pavement. These factors are probably the major causes of the settlements which have occurred.

## Recommendations

A review of the subsurface conditions at this site indicates that it is most unlikely that the pavement settlements are due to differential settlements of the soil below the embankments. They are almost certainly due to compression of the saturated sandy material in the upper subgrade. Only removal of this material and complete rebuilding will provide a one-hundred percent solution to the problem, however, before this extreme step is taken another approach should be tried. If drainage of the sand layers can be effected and maintained it may be possible that further settlements will be substantially reduced or prevented and the pavement will require patching only. To achieve this, french drains two feet wide and five feet deep should be constructed at each side of the pavements. A six inch perforated pipe should be placed in the trench which should be backfilled with Granular 'A'. A frost free outlet must be provided for the pipes. In those areas where settlement is severe, transverse french drains connected to the side drains should also be constructed. This treatment should be applied initially as an experiment on one or two areas where the settlements are the most severe and extended if significant improvements occur.

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