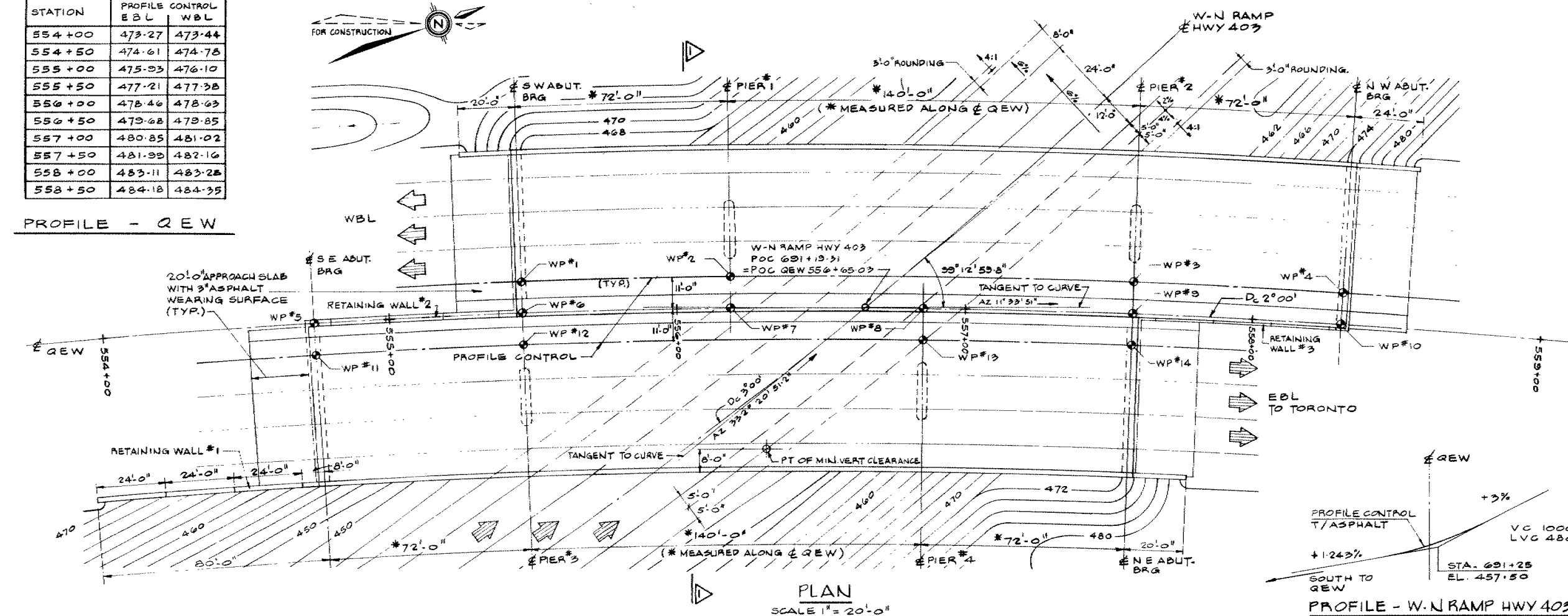


G.I.-30 SEPT. 1976

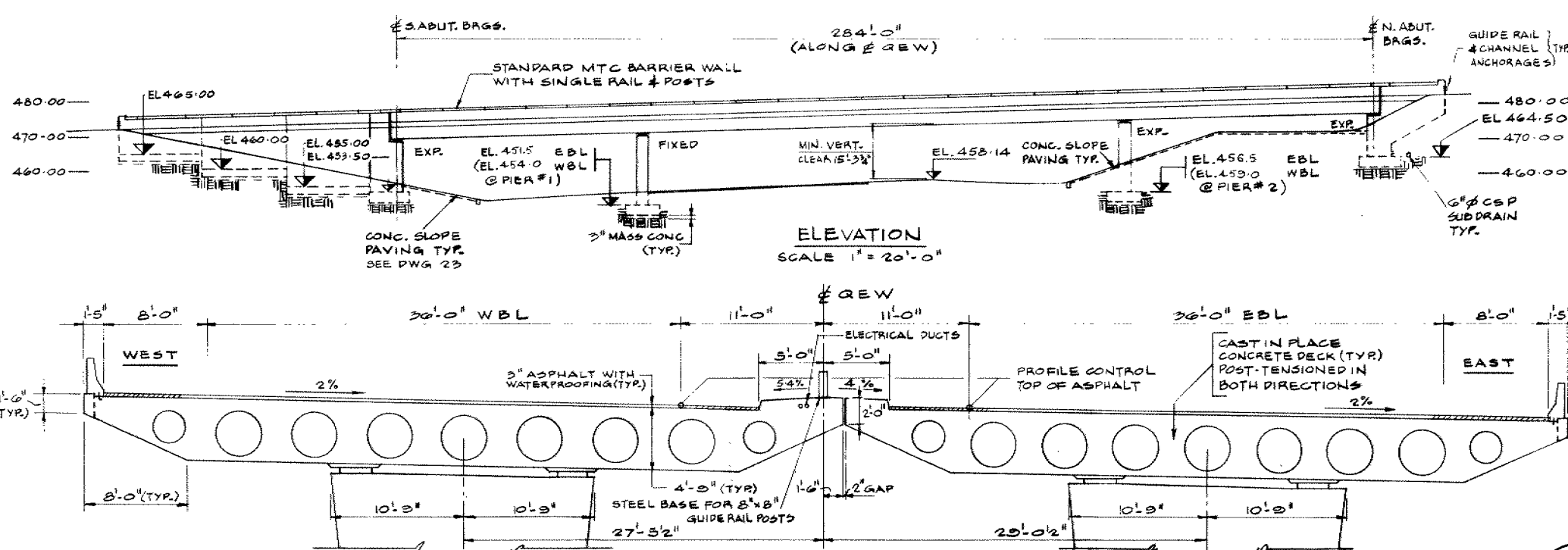
GEOCRES No. 30M5-117DIST. 4 REGION           W.P. No. 159-75-06CONT. No. 79-80W. O. No.           STR. SITE No. 10-284HWY. No. 403LOCATION W-N Ramp, Hwy 403  
Under Q.E.W.No of PAGES -           =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.           REMARKS:

STATION	PROFILE CONTROL EBL	WBL
554+00	473.27	473.44
554+50	474.61	474.78
555+00	475.93	476.10
555+50	477.21	477.38
556+00	478.46	478.63
556+50	479.68	479.85
557+00	480.85	481.02
557+50	481.99	482.16
558+00	483.11	483.28
558+50	484.18	484.35

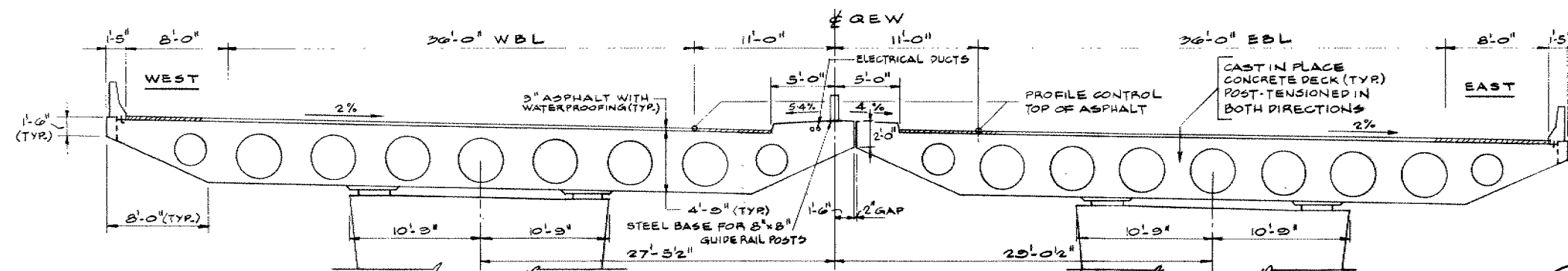
PROFILE - QEW



PLAN  
SCALE 1" = 20'-0"



ELEVATION  
SCALE 1" = 20'-0"



TYPICAL SECTION  
SCALE 3/16" = 1'-0"

DIST 4		
CONT No		
WP No 159-75-06		
W-N RAMP HWY 403		SHEET
UNDER Q E W		
GENERAL PLAN		
Giffels Consulting Engineers		

GENERAL NOTES

CLASS OF CONCRETE

DECK . . . . . 5000 PSI  
BARRIER WALLS, PIER COLUMNS . . . . . 4000 PSI  
REMAINDER . . . . . 3000 PSI

REINF. STEEL GRADE

ALL REINF. STEEL TO BE GRADE 400  
REINF. BARS WITH THE DESIGNATION "C" AT THE END OF BAR MARKS SHALL BE COATED BARS.

CLEAR COVER TO REINF. STEEL  
FTGS, ABUTMENTS, WINGWALLS, RETAIN. WALLS, 3"  
PIER COLUMNS . . . . . 2"  
DECK . . . . . TOP . . . . . 2", BOT. . . . . 1 1/2"  
CURBS & APPROACH SLABS . . . . . 2"  
BARRIER WALLS . . . . . 1 1/2"  
AND/OR AS NOTED ON DRAWINGS.

CONSTRUCTION NOTES

- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm 1/8"$
- NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE DECK CONCRETE HAS BEEN PLACED, STRESSED, & GROUTED.
- THREE MONTHS AFTER STRESSING OPERATIONS HAVE BEEN COMPLETED OR EARLIER, DEFORMATION OF THE ELASTOMERIC BEARINGS REACHES THE ALLOWABLE VALUE SPECIFIED BY THE MANUFACTURER, THE DECK SHALL BE JACKED UP AT THE ABUTMENTS TO PERMIT BEARINGS TO RETURN TO THE VERTICAL POSITION.
- JACKING PROCEDURE SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL BEFORE EXECUTION.
- TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER OF DECK REINF. SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF  $2 1/2" \pm 1/2"$  TOLERANCE.

CONCRETE QUANTITIES

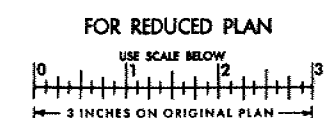
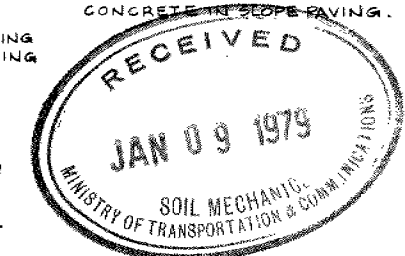
CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS.

CONCRETE IN PIERS, ABUTMENTS & WING WALLS	
4000 PSI . . . . .	204 cy
3000 PSI . . . . .	516 cy
PRESTRESSED CONG. BRIDGE DECK	
CONCRETE IN RETAINING WALLS . . . . .	200 cy
CONCRETE IN BARRIER WALLS . . . . .	59 cy
CONCRETE IN APPROACH SLABS . . . . .	137 cy
CONCRETE IN SLOPE PAVING . . . . .	232 cy

B.M. ELEV. 472.83  
TOP OF NE CORNER OF CONG PORCH ON N. FACE OF HOUSE  
520 FT. LT. STA. 551+90 QEW

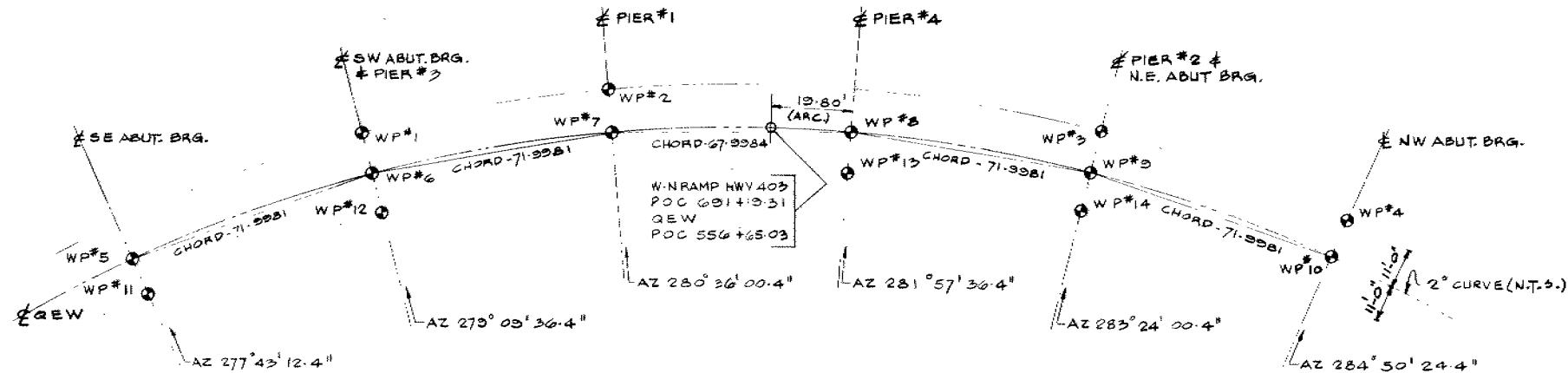
LIST OF DRAWINGS

- GENERAL PLAN
- BOREHOLE LOCATIONS & SOIL STRATA
- FOUNDATION LAYOUT
- FOOTING REINFORCEMENT
- S.W. ABUTMENT & BRGS
- N.W. ABUTMENT & BRGS
- S.E. ABUTMENT & BRGS
- N.E. ABUTMENT & BRGS
- ABUTMENT DETAILS
- RETAINING WALL #1
- RETAINING WALLS #2 & #3
- PIERS & PIER BRGS.
- DECK LAYOUT & DETAILS
- LONGITUDINAL POST-TENSIONING
- TRANSVERSE POST-TENSIONING
- DECK REINFORCING I
- DECK REINFORCING II
- DECK REINFORCING III
- BARRIER WALL (WEST)
- BARRIER WALL (EAST)
- STEEL RAILING (SINGLE TUBE)
- 20 FT. APPROACH SLABS
- SLOPE PAVING DETAILS
- AS CONSTRUCTED ELEV. & DIM.
- STANDARD DETAILS I
- STANDARD DETAILS II
- STANDARD DETAILS III

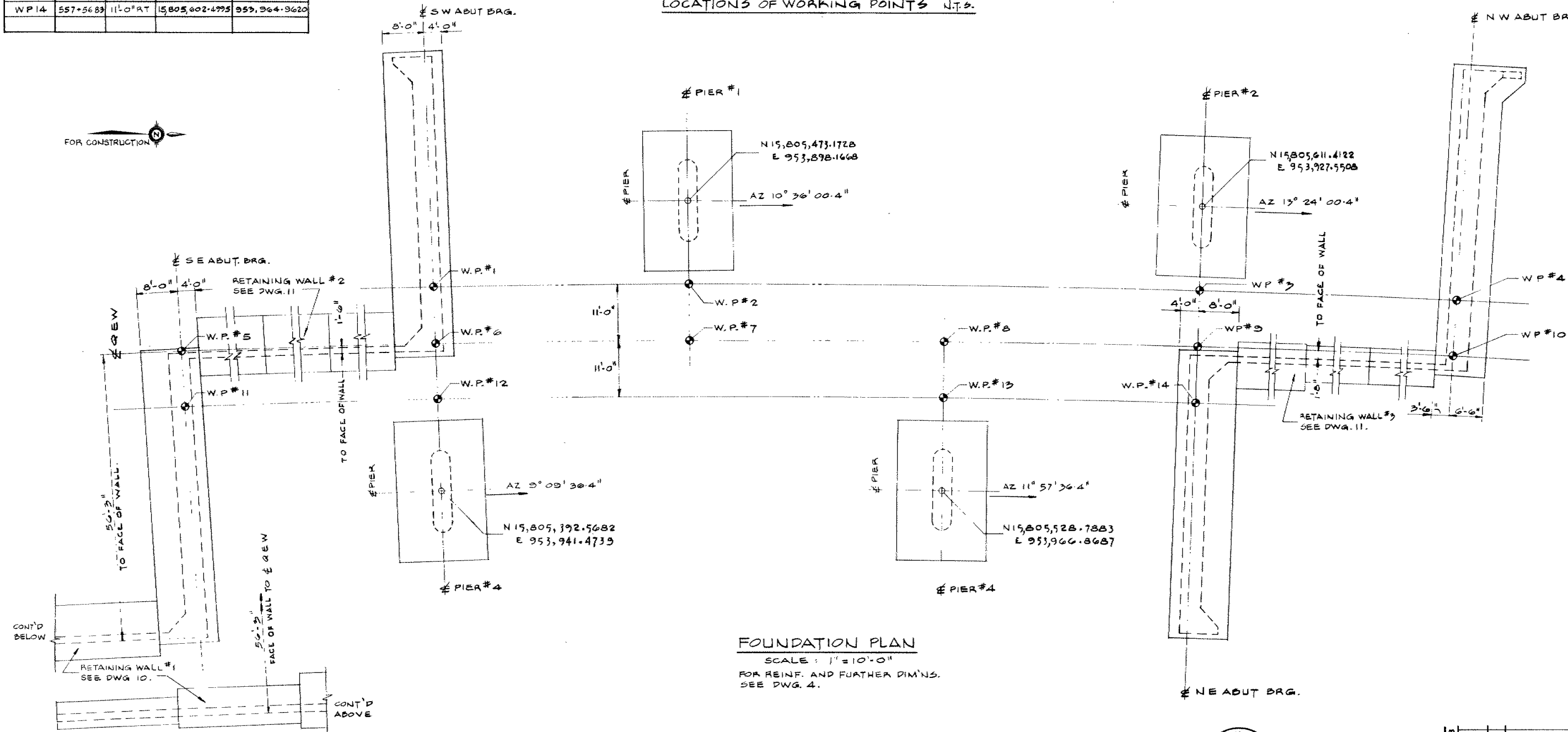


REVISIONS	DATE BY	DESCRIPTION
DESIGN EPB	CHECK	LOADING HS20-44
DRAWING BW	CHECK	SITE No 10-284 DWG 1
		DATE DEC.78

WORKING POINT DATA				
POINT	STATION ON Q.E.W.	OFFSET FROM Q.E.W.	PROVINCIAL CO-ORDINATES	
			NORTH	EAST
WP 1	555+44.83	11'-0" LT	15,805,238.9426	953,901.9429
WP 2	556+16.83	11'-0" LT	15,805,470.1453	953,914.3442
WP 3	557+56.83	11'-0" LT	15,805,607.5380	953,943.5610
WP 4	558+28.83	11'-0" LT	15,805,677.6889	953,961.1827
WP 5	554+72.83	-	15,805,325.9731	953,902.2350
WP 6	555+44.83	-	15,805,297.1915	953,912.8026
WP 7	556+16.83	-	15,805,468.1218	953,925.1565
WP 8	556+84.83	-	15,805,534.8066	953,938.4574
WP 9	557+56.83	-	15,805,605.0487	953,954.2615
WP 10	558+28.83	-	15,805,674.8715	953,971.8258
WP 11	554+72.83	11'-0" RT	15,805,324.4954	953,913.1353
WP 12	555+44.83	11'-0" RT	15,805,395.4403	953,922.6623
WP 13	556+84.83	11'-0" RT	15,805,522.5271	953,949.2186
WP 14	557+56.83	11'-0" RT	15,805,602.4993	953,964.9620



LOCATIONS OF WORKING POINTS N.T.S.



FOUNDATION PLAN

SCALE: 1" = 10'-0"  
FOR REINF. AND FURTHER DIM'S.  
SEE DWG. 4.

CONT No  
WP No 159-75-06

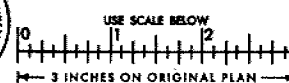
W-N RAMP HWY 403  
UNDER Q.E.W.  
FOUNDATION LAYOUT

Giffels  
Giffels, Davis & Jorgensen  
Consulting Engineers

SHEET



FOR REDUCED PLAN



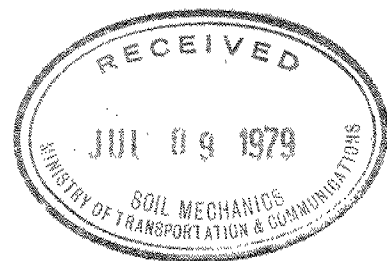
REVISIONS	DATE	BY	DESCRIPTION
DESIGN E.P.D.	CHECK W.K.	LOADING HS20-44	DATE JAN 79
DRAWING B.G.W.	CHECK E.P.D.	SITE No 10-284	DWG 3

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 79-80



Ministry of  
Transportation and  
Communications



# INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3- 61	Foundation Investigation Reports For
	W.P. 159-75-06 W-N Ramp Hwy. 403 Under QEW
	W.P. 159-75-09 Ramp N-W Over Ramp E-NS
	W.P. 159-75-10 Upper Middle Road Bridge Over Joshua Creek
	W.P. 125-66-17 QEW Over Ford Drive
	W.P. 125-66-19 South Service Road to Ford Motor Co. Over Joshua Creek
	W.P. 125-66-23 W-N, S Ramp Over Joshua Creek
	W.P. 125-66-24 N-W Ramp Over Joshua Creek

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. CIU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

#### FIELD SAMPLING

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

#### EARTH PRESSURE TERMS

$\mu$  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  
 $N_y, N_q, N_c$  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 =  $w_L - w_P$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_P}{I_P}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{I_P}$   
 $A_c$  ACTIVITY =  $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ Soil Fraction}}$   
 $Om$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

#### STRENGTH PARAMETERS

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

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

#### HYDRAULIC TERMS

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

## FOUNDATION INVESTIGATION REPORT

For

W-N Ramp Hwy. 403 Under QEW  
W.P. 159-75-06, Site 10-284  
QEW, District 4, Hamilton

---

### INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. It is based on 8 sampled boreholes advanced with a truck mounted CME55 auger during the period December 14 to 22, 1977. Solid stem augers (4 inch diameter) were employed to auger through the overburden and into the shale bedrock. In the 4 boreholes adjacent to the planned pier locations casing was set in the rock and BXL or NXL size rock core samples were obtained.

### SITE DESCRIPTION

The site is located on the QEW some 900 feet north of the existing Ford Drive underpass structure. At this location the QEW has 2 degrees of curvature and consists of 6 traffic lanes plus paved median and shoulders. This general area has a gentle slope to the south and west toward Joshua Creek. Land use is in transition from being predominantly agricultural to being residential and industrial.

### SUBSURFACE CONDITIONS

#### GENERAL

Generally uniform subsoil conditions were found to prevail over the site. The subsoil consists of a 7-8 foot deep deposit of silty clay followed by shale bedrock. The boundary between the overburden and bedrock, together with the obtained field and laboratory test results are shown on the record of borehole sheets attached to the appendix. The estimated stratigraphical profile shown on Drawing No. 10-284-2 of the contract drawing is based upon this information.

A description of the encountered overburden and bedrock type is given below.

### Silty Clay

Overburden consists of a 7 to 8 foot layer of silty clay, and trace of sand. It has a very stiff to hard consistency with Standard Penetration 'N' values ranging from 14 to in excess of 40 blows per foot. Moisture content decreases from about 24 percent near the surface to less than 15 percent at the contact with the shale.

Atterberg Limit tests performed on samples obtained within this deposit gave the following ranges:

Liquid Limit	( $W_L$ ):	27-42%
Plastic Limit	( $W_p$ ):	18-20%

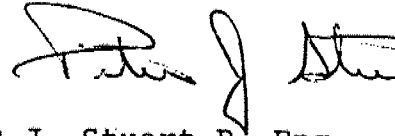
### Bedrock

The silty clay overburden is underlain by shale bedrock of the Queenston formation. It is generally red to greyish red in colour but does contain grey green bands of shaley limestone which are usually less than a foot in thickness. The upper 10 to 15 feet of shale is soft and weathered with occasional hard bands consisting chiefly of the green shaley limestone. In particular the upper 5 to 7 feet has an altered texture which is less fissile than the lower layers. The shale below this upper weathered zone (shale more than 22 feet from the ground surface) is generally hard and fissile but does contain soft and weathered zones. More detailed descriptions, as well as recovery percentages and RQD values are included on the record of borehole sheets.

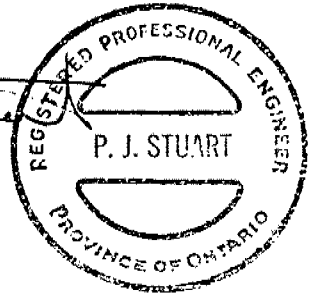


Groundwater

Groundwater levels were recorded in some of the open boreholes during the period of the fieldwork. They indicate a groundwater level about seven feet below the ground surface.



P.J. Stuart P. Eng.  
Project Engineer






P. Payer, P. Eng.  
Senior Engineer

## APPENDIX



## RECORD OF BOREHOLE No 1

W P 159-75-06 LOCATION N 15 805 696 E 953 919 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) 10 20 30					
484.1	Ground Level																
0.0	SILTY CLAY TRACE OF SAND Very Stiff To Hard						480										
477.1			1	SS	15												
7.0	QUEENSTON SHALE BEDROCK		2	SS	60												
			3	SS	100	12"											
			4	SS	100	9"											
	Red To Grey Red		5	SS	100	5"											
468.9			6	SS	50	13"	470										
15.2	End Of Borehole																
	Note: W.L. Not Established																

## RECORD OF BOREHOLE No 2

W P 159-75-06 LOCATION N 15 805 618 E 953 900 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Augers, NX Casing and NXL Core COMPILED BY P.J.S.  
DATUM Geodetic DATE December 15, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
								SHEAR STRENGTH										WATER CONTENT (%)	
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE													
482.2	Ground Level					14"	480											GR SA SI CL	
0.0	SILTY CLAY TRACE OF SAND Very Stiff To Hard		1	SS	14														
475.2			2	SS	47														
7.0	QUEENSTON SHAILE BEDROCK		3	SS	100														
	Red To Grey Red		4	NXL	80% Rec														RQD = 33
	Fine Texture		5	NXL	41% Rec			470											RQD = 13
	Soft And Fissile		6	NXL	81% Rec														RQD = 29
	With Thin Bedding		7	NXL	81% Rec			460											RQD = 38
	Including A Few Thin		8	NXL	85% Rec														RQD = 30
	Shaly Limestone Beds		9	NXL	97% Rec														RQD = 73
			10	NXL	87% Rec			450											RQD = 73
			11	NXL	100% Rec													RQD = 75	
440.3	End Of Borehole																		
41.9	Note: W.L. Not Established																		

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10



## RECORD OF BOREHOLE No 3

W P 159-75-06 LOCATION N 15 805 486 E 953 872 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, B Casing and BXL Core COMPILED BY P.J.S.  
DATUM Geodetic DATE December 14, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
478.8	Ground Level																
0.0	SILTY CLAY TRACE OF SAND Very Stiff		1	SS	15												
471.8	To Hard		2	SS	38												
7.0	QUEENSTON SHALE BEDROCK		3	SS	100/10"		470										
	Red To Grey Red Fine Texture Soft And Fissile With Thin Bedding Including A Few Thin Shaly Limestone Beds		4	BXL Core	97% Rec		460										RQD = 30
			5	BXL Core	70% Rec		450										RQD = 46
			6	BXL Core	100% Rec		440										
	Limestone Bed 21'-21'7"																
	Shaly Limestone 33'-34'		7	BXL Core	100% Rec												RQD = 65
436.5	End Of Borehole																
42.3	Note: W.L. Not Established																

## RECORD OF BOREHOLE No 4

W P 159-75-06 LOCATION N 15 805 407 E 953 858 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
477.7	Ground Level																
0.0	SILTY CLAY TRACE OF SAND Very Stiff To Hard		1	SS	15		470										0 8 65 27
469.7			2	SS	58												
8.0	QUEENSTON SHALES BEDROCK		3	SS	100/9"												0 2 68 30
	Red To Grey Red		4	SS	100/6"												
			5	SS	75/4"		460										
457.5			6	SS	75/3"												
20.2	End Of Borehole																
	Note: W.L. Not Established																

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10

5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 5

W P 159-73-06 LOCATION N 15 805 318 E 953 954 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
474.0	Ground Level															
0.0	SILTY CLAY TRACE OF SAND Very Stiff															
	To Hard		1	SS	30		470									
466.0			2	SS	87											
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/13"											
			4	SS	50/1"		460									
	Red To Grey Red		5	SS	100/11"											
453.8			6	SS	75/13"											
20.0	End Of Borehole															

# RECORD OF BOREHOLE No 6

W P 159-75-06 LOCATION N 15 805 395 E 953 965 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, BX Casing, BXL Core COMPILED BY P.J.S.  
DATUM Geodetic DATE December 20, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
476.2	Ground Level															
0.0	SILTY CLAY TRACE OF SAND Very Stiff															
	To Hard		1	SS	21		470									
468.2			2	SS	53											
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/6"											
	Red To Grey Red						460									
	Fine Texture		4	BXL	95%											
	Soft And Fissile			Core	Rec											RQD = 38
	With Thin Bedding						450									
	Including A Few Thin		5	BXL	100%											
	Beds Of Shaly Limestone			Core	Rec											RQD = 75
	Limestone Bed 31'9"- 32'2"						440									
	Limestone Bed 40'6"- 41'4"		6	BXL	95%											RQD = 33
				Core	Rec											
431.9																
44.3	End Of Borehole															
	Note: W.L. Not Established															

# RECORD OF BOREHOLE No 7

W P 159-75-06 LOCATION N 15 805 525 E 953 990 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, BX Casing, BXL Core COMPILED BY P.J.S.  
DATUM Geodetic DATE December 20, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
479.4	Ground Level																
0.0	SILTY CLAY TRACE OF SAND Very Stiff		1	SS	21												GR SA SI CL
471.4	To Hard		2	SS	116/15"												0 4 45 51
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/12"		470										0 7 63 30
	Red To Grey Red Fine Texture Soft And Fissile With Thin Bedding Including A Few Shaly Limestone Beds Shaly Limestone 15'8"-16'0" Shaly Limestone 40'8"-41'0" Shaly Limestone 43'5"-44'5"		4	BXL Core	98% Rec		460										RQD = 50
			5	BXL Core	100% Rec		450										RQD = 67
			6	BXL Core	100% Rec		440										RQD = 54
434.4	End Of Borehole																
45.0	Note: W.L. Not Established																

# RECORD OF BOREHOLE No 8

W P 159-75-06 LOCATION N 15 805 601 E 954 015 Co-ords. ORIGINATED BY P.J.S.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
DATUM Geodetic DATE December 21, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
481.3	Ground Level																
0.0	SILTY CLAY TRACE OF SAND Very Stiff		1	SS	16		480										
473.3	To Hard		2	SS	56												
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/7"		470										
	Red To Grey Red		4	SS	100/5"												
463.6			5	SS	75/3"												
17.7	End Of Borehole		6	SS	75/3"												

## FOUNDATION INVESTIGATION REPORT

For

Ramp N-W Over Ramp E-NS  
QEW/Ford Drive/Hwy. 403 Link Interchange  
W.P. 159-75-09, Site 10-283  
Hwy. 403, District 4, Hamilton

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INTRODUCTION

This report contains the results of our investigation of the sub-surface conditions at this site. Fieldwork was carried out from November 9 to November 10, 1977 and also from October 16 to October 17, 1978. The initial investigation consisted of seven sampled boreholes and the subsequent one consisted of five additional boreholes. In both investigations, the borings were advanced by means of a bombardier mounted auger machine equipped with 3½" I.D. hollow stem augers and their depths ranged approximately from 10 to 20 feet below ground surface. Disturbed samples of the overburden were obtained by means of a split spoon sampler driven into the ground in accordance with the specifications for Standard Penetration Test. Bedrock was proven by recovering up to 10 feet of BXL size rock core samples.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately 500 feet north of the existing Queen Elizabeth Way underpass at Ford Drive in the Town of Oakville, Regional Municipality of Halton. The land immediately adjacent to the site has a gentle rolling topography sloping down to the south. Drainage ditches excavated within the area have exposed the underlying red Queenston shale. The land is developed for farming purposes.

Physiographically, the site lies on the southern edge of the region referred to as the "South Slope". This region is a strip of land bounded by the Iroquois Plains on the south and the Peel Plains on the north. The region is characterized by glacial till overburden underlain by shale bedrock of Queenston and Dundas Formation of the Upper Ordovician age.

## SUBSURFACE CONDITIONS

### General

The predominant subsoil at this site is a very stiff to hard clayey silt which has a thickness of about 2.5 feet to 10 feet. In the southern portion of the site, the clayey silt is overlain by a layer of earthfill up to approximately 8.5 feet thick. Across the site the overburden is underlain by shale bedrock.

Factual field data and laboratory test results about the subsoil and bedrock are given in the Record of Borehole Sheets. A profile and four sections of the subsoil stratigraphy inferred from the above information are shown in Drawing No. 10-283-2 which also includes the location and elevation of the boreholes. A description of the subsoil, bedrock and groundwater conditions is as follows.

### Fill Material

In the southern portion of the site a layer of earthfill was encountered immediately below ground surface. The fill has a thickness ranging from 1.5 feet to 8.5 feet and is composed of clayey silt from the adjacent area. Based on the 'N' values of seven blows/foot to 19 blows/foot, it is inferred that the fill was relatively uniformly compacted.

### Clayey Silt, Some Sand and Occasional Gravel

Underneath the fill material or below a 12 inch thick layer of topsoil elsewhere is a 2.5 foot to 10 foot thick cohesive stratum of clayey silt with some sand and occasional gravel. Grain size distribution of the cohesive subsoil is summarized in an envelope form in Figure 1. The index properties of the clayey silt as determined from laboratory testing are summarized below.

		<u>Range</u>
Liquid Limit	(W <sub>L</sub> ) %	27-33
Plastic Limit	(W <sub>p</sub> ) %	17-19
Moisture Content	(W) %	10-16

The results of the Atterberg Limit tests are also plotted on the Plasticity Chart on Figure 2. The Atterberg Limits indicate that the cohesive stratum is generally inorganic and of low plasticity.



The Standard Penetration Tests gave 'N' values in the range of 12 to over 100 blows per foot generally increasing with depth. Based on these 'N' values the consistency of this cohesive stratum is estimated to be very stiff to hard.

#### Bedrock - Shale

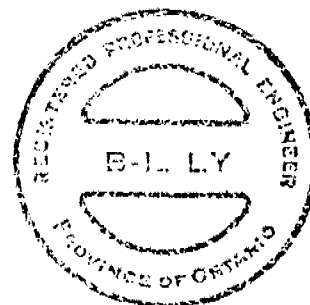
Underlying the cohesive deposit is shale bedrock which was proven to a maximum depth of 10 feet. The bedrock may be described as soft, red in colour and fissile, having thin horizontal bedding planes with seams of limestone up to 8 inches thick. Generally, the upper 6 to 12 inches of the shale bedrock is weathered but in certain locations the weathered zone was as deep as four feet. A detailed description of the bedrock is given on the Record of Borehole Sheets. Although the recovery ratios are high, the rock quality designation (RQD) for the cored shale bedrock varies from 0% to 50%, indicating a rock quality ranging from very poor to fair.

#### Groundwater

The groundwater level conditions were observed by measuring the water level in the open boreholes during and after the completion of the foundation investigation. In the early fieldwork this groundwater level was found to vary between elevation 468.3 and 480.7 which corresponds to 2.0 to 3.5 feet below the existing ground surface. In the subsequent fieldwork some of the boreholes were dry and open to the full depth but in the others the groundwater level was not established due to the presence of drilling water from the rock coring operation.

*B. Ly*  
B. Ly, P. Eng.  
Senior Engineer

*M. Devata*  
M. Devata, P. Eng.  
Supervising Engineer




## APPENDIX



# RECORD OF BOREHOLE No 1

W P 159-75-09 LOCATION Co-ords N 15 805 666; E 953 420 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger BXL Core COMPILED BY *u.f.*  
DATUM Geodetic DATE November 9th, 1977 CHECKED BY *u.f.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
483.7	Ground Level							○ UNCONFINED	+ FIELD VANE					
0.0	Topsoil		1	SS	46				● QUICK TRIAXIAL	x LAB VANE				
478.7	Clayey silt with traces of sand													
5.0	Shale		2	BXL	100% Rec.									
473.7	Bedrock													
10.0	End of Borehole													
	Bedrock: Shale, Brown red colour, fine texture, soft, friable - R.Q.D. 0%													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

W P 159-75-09 LOCATION Co-ords N 15 805 696; E 953 468 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger BXL Core COMPILED BY w.f.  
DATUM Geodetic DATE November 10th, 1977 CHECKED BY w.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
483.1	Ground Level												
0.0	Topsoil												
478.1	Clayey silt with trace of sand		1	SS	50		480						0 2 74 24
5.0	Hard Shale		2	BXL	100% Rec.								
473.1	Bedrock												
10.0	End of Borehole						470						
	Bedrock: Shale, brown red colour, fine texture, soft and fissile R.Q.D. 0%												

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

W P 159-75-09 LOCATION Co-ords N 15 805 604; E 953 491 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3½" Hollow Stem Auger BXL Core COMPILED BY *cl.*  
 DATUM Geodetic DATE November 9th, 1977 CHECKED BY *cl.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT $\Sigma$					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
481.1	Ground Level													
0.0	Topsoil													
476.1	Clayey Silt with traces of sand Hard		1	SS	44		480							GR SA SI CL
5.0	Shale		2	BXL	100% Rec.									0 9 71 20
	Bedrock						470							
466.1														
15.0	End of Borehole													
	Bedrock: Shale, brown red colour, with few thin beds of grey shale, fine texture, soft and fissile -R.Q.D. 0%													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

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



## RECORD OF BOREHOLE No 4

W P 159-75-09 LOCATION Co-ords N 15 805 464; E 953 561 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3½" Hollow Stem Auger BXL Core COMPILED BY *el*  
 DATUM Geodetic DATE November 10th, 1977 CHECKED BY *el*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
476.9	Ground Level																
0.0	Topsoil																
469.9	Clayey silt with traces of sand		1	SS	32												
7.0	Hard		2		95												
459.9	Shale with seams of shaly limestone		3	BXL	100% Rec.												
17.0	Bedrock																
	End of Borehole																
	Bedrock: Shale, brown red colour, fine texture, soft and fissile. Shaly Limestone, light grey colour, fine texture medium hard to soft. R.Q.D. 0%																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 5

W P 159-75-09 LOCATION Co-ords N 15 805 333; E 953 616  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger BXL Core  
DATUM Geodetic DATE November 10th, 1977  
ORIGINATED BY V.K.  
COMPILED BY *W.J.*  
CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
474.8	Ground Level																
0.0	Topsoil																
	Clayey Silt With Traces of Sand Very Stiff		1	SS	21		470										0 8 52 40
464.3			2	SS	29												
			3	SS	100												
10.5	Shale With Seams of Shaly Limestone																0 2 67 31
454.3	Bedrock		4	BXL	100% Rec.		460										
20.5	End of Borehole																
	Bedrock:  Shale, brown red colour, fine texture, soft and fissile. Shaly limestone, light grey colour, medium hard to soft, medium texture  R.Q.D.0%																

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

RECORD OF BOREHOLE No 6

W P 159-75-09 LOCATION Co-ords N 15 805 241; E 953 615 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger BXL Core COMPILED BY V.K.  
DATUM Geodetic DATE November 10th, 1977 CHECKED BY V.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
472.5	Ground Level																
0.0	Topsoil																
	Clayey Silt With Some Sand and Gravel		1	SS	24		470										
463.0	Very Stiff to Hard		2		58												
9.5	Weathered		3	SS	667	9"											
457.5	Shale With Seams of Shaly Limestone Bedrock		4	BXL	100% Rec.		460										
15.0	End of Borehole																
	Bedrock:  Shale, brown red colour, fine texture, soft and fissile. Shaly limestone, light grey colour, medium hard to soft, medium texture  R.Q.D.0%																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15-0.5 (%) STRAIN AT FAILURE  
10





# RECORD OF BOREHOLE No 7

W P 159-75-09 LOCATION Co-ords N 15 805 259; E 953 669 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger BXL Core COMPILED BY R.  
DATUM Geodetic DATE November 9th, 1977 CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
471.8	Ground Level																
0.0	Topsoil																
462.8	Clayey Silt With Traces of Sand Hard		1	SS	32		470										
9.0	Weathered Shale With Seams of Shaly Limestone		2	SS	40												
457.3	Bedrock		3	SS	50/	5"											
14.5	End of Borehole		4	BXL	100% Rec.		460										
	Bedrock:  Shale, brown red colour, fine texture, soft and fissile. Shaly limestone, light grey colour, fine texture, medium hard to soft, shale R.Q.D.0% limestone R.Q.D.50%																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 10

W P 159-75-09 LOCATION Coords. N 805 203; E 953 635 ORIGINATED BY B.L.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/4" Hollow Stem Augers COMPILED BY B.L.  
DATUM Geodetic DATE October 17, 1978 CHECKED BY \_\_\_\_\_

[illegible]

## RECORD OF BOREHOLE No 11

W P 159-75-09 LOCATION Coor'ds. N 805 221; E 959 671 ORIGINATED BY B.L.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2"  $\phi$  Hollow Stem Augers and BXL Rock Core COMPILED BY B.L.  
DATUM Geodetic DATE October 16, 1978 CHECKED BY \_\_\_\_\_

[illegible]

## RECORD OF BOREHOLE No 12

W P 159-75-09 LOCATION Coords. N 805 291; E 353 612 ORIGINATED BY B.L.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Augers and BXL Rock Core COMPILED BY B.L.  
DATUM Geodetic DATE October 16, 1978 CHECKED BY \_\_\_\_\_

[illegible]



## RECORD OF BOREHOLE No 13

W P 159-75-09 LOCATION Coords. N 805 302; E 953 640 ORIGINATED BY B.L.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Augers COMPILED BY B.L.  
DATUM Geodetic DATE October 17, 1978 CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
							○ UNCONFINED	+ FIELD VANE					
							● QUICK TRIAXIAL	x LAB VANE	WATER CONTENT (%)				
473.9	Ground Surface												
0.0	Fill												
1.5	Clayey Silt: Reddish Very Stiff to Hard, Some Sand and Shale Fragments		1	SS	12	470							
			2	SS	19								
			3	SS	41								
464.9													
9.0	Shale Bedrock: Weathered		4	SS	60/	1"							
10.5	End of Borehole Note: Bottom of Hole Was Moist Upon Completion												

## RECORD OF BOREHOLE No 14

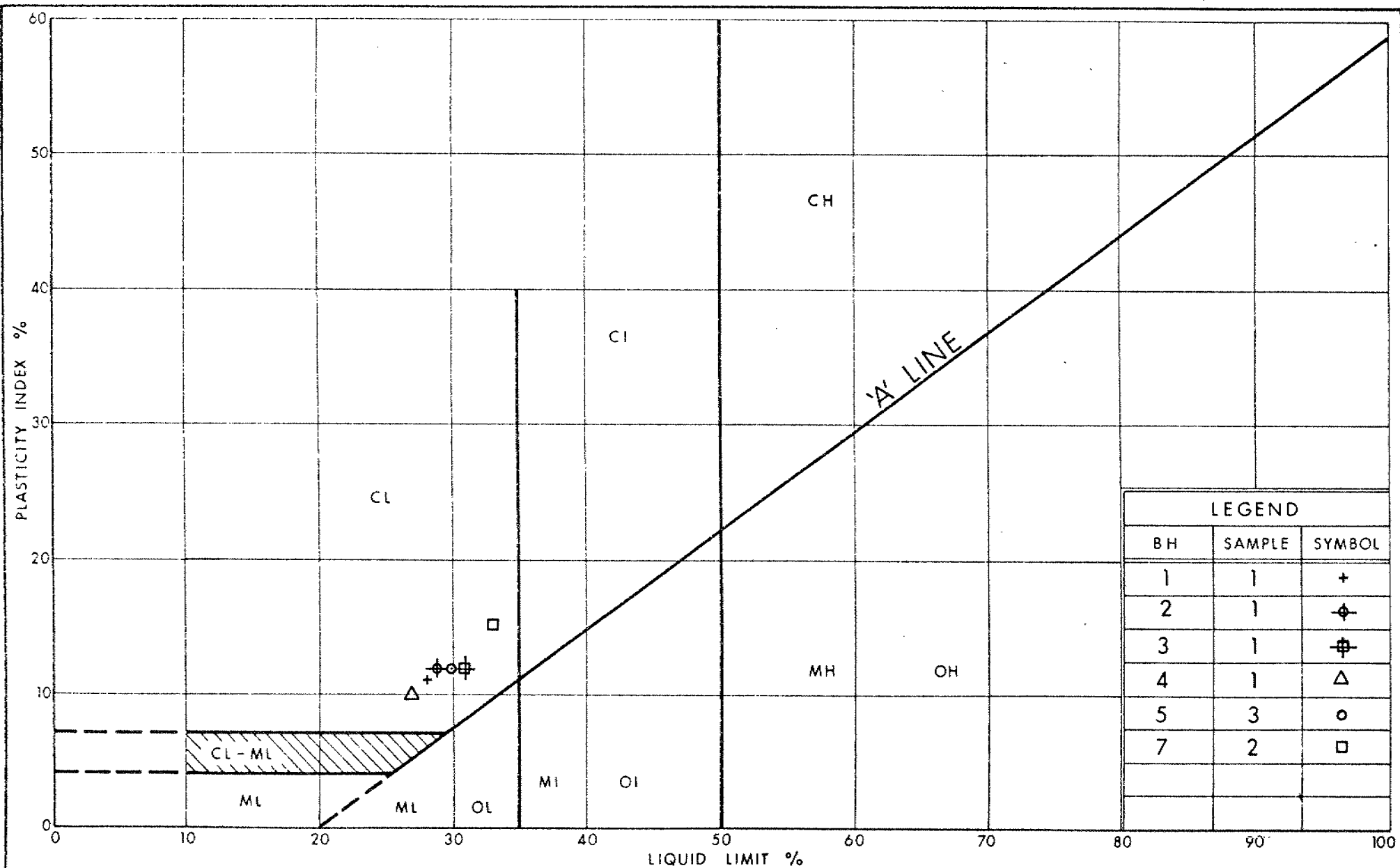
W P 159-75-09 LOCATION Coords. N 805 165; E 953 634 ORIGINATED BY B.L.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Augers COMPILED BY B.L.  
DATUM Geodetic DATE October 17, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
476.0	Ground Surface																	
0.0	Fill: Clayey Silt Some Shale Flakes and Gravel		1	SS	11	2"	470											
469.0			2	SS	60/													
7.0	Clayey Silt: Very Stiff, Some Shale Fragments		3	SS	16													
464.5			4	SS	27													
11.5	Shale: Weathered		5	SS	60/	2"												
460.5			6	SS	60/	4"												
15.5	End of Borehole  Note: A Pocket of Water was Encountered in the Fill at a Depth Between 6 and 7 feet.																	



# GRAIN SIZE DISTRIBUTION CLAYEY SILT WITH TRACES OF SAND

W P 159-75-09



Ontario

Ministry of  
Transportation and  
Communications

PLASTICITY CHART  
CLAYEY SILT  
WITH TRACES OF SAND

FIG No 2

W P 159-75-09

## FOUNDATION INVESTIGATION REPORT

For

Upper Middle Road Bridge Over Joshua Creek

W.P. 159-75-10, Site 10-120

QEW/403, District 4, Hamilton

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INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. The fieldwork consisted of two boreholes advanced on August 14, 1978 employing a CME auger mounted on a tracked vehicle. Hollow stem augers were employed to auger through the overburden after which BX diamonds and core-barrel were used to obtain samples of the underlying bedrock.

SITE DESCRIPTION

The site is located on Upper Middle Road half a mile west of the existing Ford Drive-QEW interchange. Here Upper Middle Road crosses Joshua Creek on a two lane rigid frame structure having a span of 45 feet. The channel bed consists of loose slabs of limestone and shale alternating with areas of exposed bedrock. At the time of the investigation there was no apparent flow in the stream with only isolated pools of water in the channel. The valley slopes are relatively gentle and are covered with patches of trees and undergrowth. Land use in the general area is undergoing a change from agricultural to urban and industrial.

SUBSURFACE CONDITIONSGeneral

The encountered subsurface conditions are shown on the Record of Borehole Sheets in the Appendix. The locations and elevations of the borings, together with the stratigraphy, are presented on Drawing No. 10-120-2 of the Contract Drawing. A description of the overburden and bedrock type is given below.


### Clayey Silt

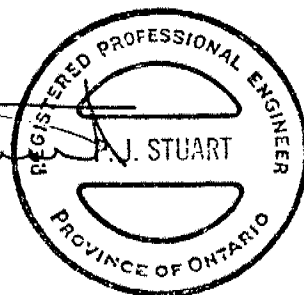
The overburden on the valley slopes consists of a shallow deposit of clayey silt containing some sand and gravel, as well as larger fragments of the underlying bedrock. It has a hard consistency as shown by a Standard Penetration 'N' value of 41.


The bedrock is part of the Meaford-Dundas formation and consists of interbedded layers of limestone and shale with occasional thin seams of clay. The percent of the rock core recovered was low but may at least partly be explained by the use of a BX corebit. The core recovered did show that the limestone beds occasionally exceed one foot in thickness.

### Groundwater

Groundwater was encountered in the bedrock at levels approximately equal to the stream bed level.

  
P.J. Stuart, P. Eng.  
Project Engineer



  
P. Payer, P. Eng.  
Senior Engineer

## APPENDIX





# RECORD OF BOREHOLE No 1

W P 159-75-10 LOCATION Coords. N 15,803,811; E 952,131 ORIGINATED BY P.J.S.  
DIST 4 HWY QEW/403 BOREHOLE TYPE Hollow Stem Auger and BX Core COMPILED BY P.J.S.  
DATUM Geodetic DATE August 14, 1978 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
423.3	Ground Level												
0.0	Clayey Silt, Some Sand and Gravel		1	SS	41	*	420						
417.6	Hard		2	SS									
5.7	Bedrock Interbedded Layers of Shale and Limestone		3	BX RC	35% Rec			Spoon Bouncing					
408.4			4	BX RC	50% Rec		410						
14.9	End of Borehole  *Note: Water Level Not Established												

OFFICE REPORT ON SOIL EXPLORATION

## RECORD OF BOREHOLE No 2

W P 159-75-10 LOCATION Coords. N 15,803,774; E 952,111 ORIGINATED BY P.J.S.  
DIST 4 HWY QEW/403 BOREHOLE TYPE BX Core COMPILED BY P.J.S.  
DATUM Geodetic DATE August 14, 1978 CHECKED BY RS

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

\*3, x5: Numbers refer to Sensitivity

20  
15  $\phi$  5. (%) STRAIN AT FAILURE

## FOUNDATION INVESTIGATION REPORT

For

QEW Over Ford Drive  
W.P. 125-66-17, Site 10-286  
QEW, District 4, Hamilton

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INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Field work was carried out during the period of March 21 to 23, 1977. Four boreholes were advanced into the shale bedrock employing 4 inch diameter solid stem augers, and then BXL core samples were obtained from each borehole.

SITE DESCRIPTION

This site is located on the QEW approximately 900 feet south of the existing Ford Drive underpass structure. At this location the QEW consists of 6 traffic lanes plus paved shoulders and median. The ground surface in this area slopes gently towards Joshua Creek which is located some 500 feet to the south. Land use in the area is in transition from being predominantly agricultural to being industrial and residential.

SUBSURFACE CONDITIONSGENERAL

Subsoil at the site was found to consist of a relatively shallow (7'-8'), very stiff to hard clayey silt to silty clay, underlain by shale bedrock. Reference should be made to the record of borehole sheets which are contained in the appendix of this report. These sheets contain the extent and the descriptions of the soil and bedrock types encountered and also in summarized form, the results of all field and laboratory tests performed. Reference should also be made to Drawing No. 10-268-2 of the contract drawings which also shows the locations and elevations of borings, together with

the inferred soil stratigraphy. Detailed descriptions of the encountered subsurface conditions are given below.

### Clayey Silt to Silty Clay

The overburden in the area consists of a 7 to 8 foot layer of clayey silt to silty clay. It has a very stiff to hard consistency with Standard Penetration 'N' values ranging from 16 to 50 blows per foot. Moisture content varies between 10 and 20 percent with an average of about 15 percent.

Atterberg Limit tests performed on samples obtained within this deposit indicate the following ranges:

Liquid Limit	( $W_L$ ):	27-38%
Plastic Limit	( $W_P$ ):	18-22%

### Bedrock

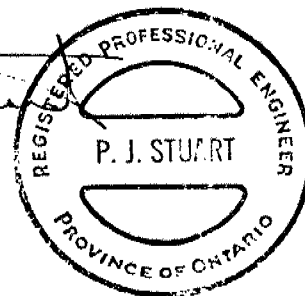
The clayey silt to silty clay overburden is underlain by shale bedrock of the Meaford Dundas Formation. It is interbedded with layers of shaley limestone and limestone up to 1.5 feet in thickness. The shale is grey and fissile exhibiting thin horizontal bedding. An upper zone up to 7 feet in thickness shows considerable deterioration and is shown on the sections and logsheets as weathered. Detailed descriptions of the cores recovered are given on the record of borehole sheets located in the appendix of this report.

### Groundwater

Groundwater levels in the open boreholes were recorded during the period of the field work. They indicate the groundwater level was from 4 to 6 feet below the ground surface.

*P.J. Stuart*  
P.J. Stuart, P. Eng.  
Project Engineer

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

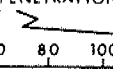








## APPENDIX



# RECORD OF BOREHOLE No 3

W P 125-66-17 LOCATION Co-ords N 15 803 724; E 954 012 ORIGINATED BY CTJ  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY CTJ  
DATUM Geodetic DATE March 23, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								20	40	60	80	100						
								○ UNCONFINED      + FIELD VANE					WATER CONTENT (%)					
								● QUICK TRIAXIAL      x LAB VANE										
422.0	Ground Level																	
0.0	Clayey Silt To Silty Clay, Some Sand, Trace Of Gravel		1	SS	46		420											
414.5	Hard		2	SS	32													
412.5	(Weathered)		3	SS	112													
9.5	(Sound)																	
	Shale Bedrock (See Below)*		4	BXL	91% REC		410										RQD 30%	
			5	BXL	100% REC		400										RQD 63%	
392.3	End Of Borehole																	
29.7	*Intermittent shale, shaly limestone & limestone, fine tex- ture, soft to med.hard light grey, shale is fissile, thin bedding with Limestone (med. hard, fine texture, light grey, fossil- iferous) seams from 12'8" to 13'6" 19'6" to 20'2" 25'3" to 26'2"																	

+3, x5: Numbers refer to  
Sensitivity

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



# RECORD OF BOREHOLE No 4

W P 125-66-17 LOCATION Co-ords N 15 803 823; E 954 023 ORIGINATED BY CTJ  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY CTJ  
DATUM Geodetic DATE March 22, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE								● QUICK TRIAXIAL		x LAB VANE
427.1	Ground Level																			
0.0	Clayey Silt To Silty Clay, Some Sand Traces Of Gravel (Reworked) Very Stiff		1	SS	16											5 31 39 25				
420.0			2	SS	111/8"															
7.1	(Weathered)		3	SS	131/9"															
417.1			4	BXL	84% REC											RQD 25%				
10.0	Shale Bedrock (See Below)*		5	BXL	100% REC											RQD 15%				
			6	BXL	97% REC											RQD 60%				
397.9																				
29.2	End Of Borehole																			
	*Intermittent Shale, Shaly Limestone & Limestone Beds, Soft To Hard, Fine Texture, Shale Is Fissile, Light Grey Colour, Thin hori- zontal Bedding With Limestone (Hard, Fine Texture fossiliferous) seams from 11'10" to 12'4" 13' 6" to 14'2" 22' 2" to 22'6" 23' 0" to 23'10" 28'10" to 29'2"																			

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 5

W P 125-66-17 LOCATION Co-ords N 15 803 726; E 953 841 ORIGINATED BY VK  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core & Cone Test COMPILED BY VK  
DATUM Geodetic DATE March 22, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100	PASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT w <sub>L</sub>	
422.7	Ground Level												
0.0	Clayey Silt To Silty Clay, Trace Of Sand Very Stiff Brown To Hard Grey		1	SS	16		420						
414.7			2	SS	37								
8.0			3	SS	100	4"							
411.7	(Weathered)												
11.0	(Sound)		4	BXL	100% REC		410						
	Shale Bedrock* (See Below)		5	BXL	100% REC								
			6	BXL	100% REC		400						
			7	BXL	90% REC								
391.7	End Of Borehole												
31.0	*Intermittent Thin Beds Of Shale, Shaly Limestone & Limestone (Dark Grey Colour, Fine Texture, Soft To Hard, Shale Is Fissile, Thin Horizontal Bed- ding) With Limestone Seams (Light Grey, Fine Texture, Hard)												
From	14'4" to 15'4" 17'3" to 18'6" 21'0" to 21'9" 26'0" to 27'6"												

OFFICE REPORT ON SOIL EXPLORATION





RECORD OF BOREHOLE No 6

W P 125-66-17 LOCATION Co-ords N 15 803 824; E 953 833 ORIGINATED BY VK  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Stem Auger, BXL Core & Cone Test COMPILED BY VK  
DATUM Geodetic DATE March 21, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
428.5	Ground Level										
0.0	Clayey Silt To Silty Clay, Trace Of Sand Occ. Cobbles Hard, Brown		1	SS	37						
421.5			2	SS	113						
7.0	Shale Bedrock * (See Below)		3	SS	100	5"					
414.0	(Weathered)		4	SS	136	11"					
14.5	(Sound)		5	BXL	100%						
			6	BXL	75%						
			7	BXL	100%						
			8	BXL	100%						
398.5											
30.0	End Of Borehole										
	*Intermittent Shale, Shaly Limestone And Shale Beds (Soft To Med. Hard, Fine Texture Shale is Fissile, Thin Horizontal Bedding With Limestone Seams (Med. Hard, Fine Texture, Light Grey Colour, Fossiliferous, Shale Seams Present) 21'3" to 24'2" 26'3" to 27'5"										
	Note: Waterlevel not established										

## FOUNDATION INVESTIGATION REPORT

For

South Service Road to Ford Motor Co.  
Over Joshua Creek  
W.P. 125-66-19, Site 10-288  
Hwy. 403, District 4, Hamilton

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INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project on November 15, 1977.

The fieldwork consisted of one probe hole and three sampled boreholes advanced by means of a continuous flight auger machine equipped with 3¼" hollow stem augers. In addition, diamond drilling techniques were employed to obtain up to 5 feet of BXL size core of the bedrock. The sampled boreholes ranged in depth from 8.5 to 10 feet below the ground surface. The probe hole was located in the creek bed, where the bedrock is exposed below 6 to 8 inches of water.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately 1½ miles east of Q.E.W. on Joshua Creek in the Town of Oakville, Regional Municipality of Halton. The land immediately adjacent to the site has a gentle rolling topography sloping down to the south. The creek has exposed the underlying red Queenston shale. The land forms part of the green park area surrounding the Ford Motor Co. of Oakville office building.

Physiographically the site lies on the southern edge of the region referred to as the "South Slope". This region is a strip of land bounded by the Iroquois Plain on the south and Peel Plain on the north. The region is characterized by glacial till overburden underlain by shale bedrock of Queenston and Dundas Formation of the Upper Ordovician Age.

## SUBSURFACE CONDITIONS

The subsurface conditions at the site were found to be quite uniform. A 3 to 4.5 foot layer of clayey silt is underlain by shale bedrock, except in the creek bed where the bedrock is exposed. A detailed description of the various soil and rock types encountered in each borehole is given in the Record of Borehole Sheets. The estimated stratigraphical profile and sections shown on Contract Drawing No. 10-288-2 are based upon this information. From ground level downwards the various types encountered are as follows.

### Clayey Silt With Some Sand and Organics

Under a six inch thick layer of topsoil a cohesive deposit of 3 to 4.5 feet in thickness, consisting of clayey silt with some sand and intrusions of organics was encountered. The material is mainly an alluvial deposit and lies in the flood plain of the creek.

### Bedrock Shale

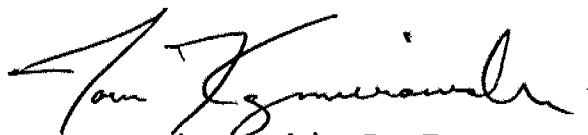
Underlying the cohesive deposit or immediately below the creek bed the bedrock was cored to a maximum depth of 5 feet. The bedrock can be described as soft, red in colour and fissile, having thin horizontal bedding planes with seams of limestone up to 15 inches thick.

The upper 6 to 12 inches of the bedrock is weathered and the rest moderately fractured. In B.H. #1 at a 9 foot depth, a vertical joint fracture of 12 inches was present. A detailed description of the bedrock is given on the Record of Borehole Sheets. The rock quality designation (R.Q.D.) for the cored bedrock is 25% to 35% indicating that the rock quality is generally poor.

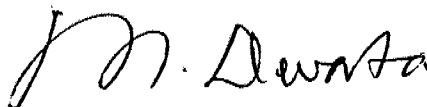
### Groundwater

The groundwater level conditions were observed by measuring in the open boreholes during and after the completion of the foundation

investigation. The groundwater level was found to be at elevation 370.0, which corresponds to the creek water elevation during the time of the investigation.



T. Kazmierowski, P. Eng.  
Project Engineer



M. Devata, P. Eng.  
Supervising Engineer



## APPENDIX



RECORD OF BOREHOLE No 1

W P 125-66-19 LOCATION Co-ords N 15 802 989 E 955 080 ORIGINATED BY V.K.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Hollow Stem Auger and BXL Core COMPILED BY V.K.  
DATUM Geodetic DATE 15 November 1977 CHECKED BY [Signature]

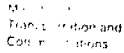
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
373.8	Ground Level																
0.0	Clayey Silt, Sand With Gravel and Organics		1	SS	3/6"		370							o			39 23 26 12
368.8																	
5.0	B																
	A (Bedrock)																R.O.D. 25%
363.8	B																
10.0	End of Borehole						360										
	Bedrock:																
	A. Shale, Dark Grey Colour Fine Texture, Soft, Fissile.																
	B. Limestone, Light Grey Colour, Med.Texture, Hard, Vertical Joint Fracture																

# RECORD OF BOREHOLE No 2

W P 125-66-19 LOCATION Co-ords N 15 803 034 E 955 074 ORIGINATED BY V.K.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Hollow Stem Auger and BXL Core COMPILED BY V.K.  
 DATUM Geodetic DATE 15 November 1977 CHECKED BY J.S./

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
374.4	Ground Level																GR 5A SI CL
0.0 370.9	Clayey Silt, Sand, Some Gravel & Organics		1	AS	-												14 31 38 17
3.5	Weathered A (Bedrock) B		2	BXL	90%												R.Q.D. 35%
365.9																	
8.5	End of Borehole																
	Bedrock: A. Shale, Dark Grey Colour, Fine Texture, soft, fissile. B. Limestone, Light Grey Colour, Med. texture, Hard. Vertical Joint Fracture 6.5' to 7'.																

OFFICE REPORT ON SOIL EXPLORATION



W P 125-66-19 LOCATION Co-ords N 15 802 986 E 955 128 ORIGINATED BY V.K.  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Probe Hole COMPILED BY V.K.  
DATUM Geodetic DATE 15 November 1977 CHECKED BY J.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT $\Sigma$					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
370.3	Water Level																
0.8	End of Borehole (Probable Bedrock)	11E1E															
							360-										
											</						

+<sup>3</sup>, x<sup>5</sup> : Numbers refer to Sensitivity

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



# RECORD OF BOREHOLE No 4

W P 125-66-19 LOCATION Co-ords N 15 803 030 E 955 122 ORIGINATED BY  
DIST 4 HWY Q.E.W. BOREHOLE TYPE Hollow Stem Auger and EXL Core COMPILED BY V.K.  
DATUM Geodetic DATE 15 November 1977 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
375.2	Ground Level																
0.0	Clayey Silt, Sand and Gravel and Some Or- ganics		1	SS	47.6		370-										GR SA SI CL
5.0	Weathered																34 38 16 12
366.2	Bedrock		2	BXL	75%												R.Q.D. 35 %
9.0	End of Borehole																
	Bedrock: A. Shale, Red Brown Colour, Fine Texture, Soft, Fissile. B. Limestone, Light Grey Colour, Med. Hard.																

## FOUNDATION INVESTIGATION REPORT

For

W-N, S Ramp Over Joshua Creek  
W.P. 125-66-23, Site 10-140C  
QEW, District 4, Hamilton

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INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of November 14 to 15, 1977. The fieldwork consisted of four sampled boreholes advanced by means of a continuous flight auger machine equipped with 3 1/4" I.D. hollow stem augers. In addition, diamond drilling techniques were employed to obtain up to five feet of BXL size core samples of the bedrock. The boreholes ranged in depth from 9 to 11 feet below the ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately half a mile east of Q.E.W. at Joshua Creek in the Town of Oakville, Regional Municipality of Halton. The land immediately adjacent to the site has a gentle rolling topography sloping down to the south. The creek has exposed the underlying red Queenston shale. The land forms part of the green park area surrounding the Ford Motor Co. of Oakville office building.

Physiographically, the site lies on the southern edge of the region referred to as the "South Slope". This region is a strip of land bounded by the Iroquois Plain on the south and Peel Plain on the north. The region is characterized by glacial till overburden underlain by shale bedrock of Queenston and Dundas Formation of the Upper Ordovician Age.

SUBSURFACE CONDITIONS

The subsurface conditions at the site were found to be quite uniform. A three to five foot layer of clayey silt is underlain by shale

bedrock. Detailed descriptions of the various soil and rock types encountered in each borehole are given in the Record of Borehole Sheets. The estimated stratigraphical profile and sections shown on Contract Drawing No. 10-140C-2 are based upon this information. From ground level downwards the various types encountered are as follows.

#### Clayey Silt With Some Sand and Occasional Gravel

Under a one foot layer of topsoil a cohesive stratum three to five feet thick consisting of clayey silt with some sand and occasional gravel was encountered.

The physical properties of the clayey silt as determined from laboratory testing are summarized below:

			<u>Range</u>
Liquid Limit	(W <sub>L</sub> )	%	30-32
Plastic Limit	(W <sub>p</sub> )	%	20-22
Moisture Content	(W)	%	10-12

The results of the Atterberg Limit Tests indicate that the cohesive layer is inorganic and of low plasticity.

The Standard Penetration Tests gave an 'N' value range of 15 to 51 blows per foot indicating that the consistency of the layer is very stiff to hard.

#### Bedrock

Underlying the cohesive clayey silt layer is the bedrock which was explored to a maximum extent of five feet. The bedrock consists of interbedded layers of shale and limestone. The shale is soft, red in colour and fissile, having thin horizontal bedding planes with seams of limestone up to one foot thick. In B.H. #2 the upper one foot of the bedrock is weathered and below this the bedrock is moderately fractured. A detailed description of the bedrock is given on the Record of Borehole Sheets. The Rock Quality Designation (RQD) for the cored samples of the bedrock is about 15% to 30% indicating that the rock quality is generally poor.

Groundwater

The groundwater level conditions were observed by measuring in the open boreholes during and after the completion of the foundation investigation. The groundwater level was found to vary between elevation 386.0 and elevation 386.5 which corresponds to 2 to 3.5 feet below the existing ground surface. The water level in the creek during the time of investigation was at elevation 385.0. The groundwater levels are shown on the Record of Borehole Sheets, as well as on Contract Drawing No. 10-140C-2.

*M Maclean*

M. MacLean, P. Eng.  
Project Engineer



*M. Devata*

M. Devata, P. Eng.  
Supervising Engineer

## APPENDIX

# RECORD OF BOREHOLE No 1

W P 125-66-23 LOCATION Co-ords N 15,803,181; E 954,335 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
389.6	Ground Level																
0.0	Topsoil																
384.6	Clayey Silt, Sand & Gravel Hard		1	SS	51									0			28 7 39 26
5.0	Shale Bedrock*																R.Q.D. 15%
379.6							380										
10.0	End of Borehole																
	* Bedrock: Shale, grey, soft, fissile, 2" limestone seams																

# RECORD OF BOREHOLE No 2

W P 125-66-23 LOCATION Co-ords N 15,803,193; E 954,297 ORIGINATED BY V.K.  
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core and Cone Test COMPILED BY V.K.  
 DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
389.6	Ground Level																
0.0	Topsoil																
383.6	Clayey Silt, Sand and Gravel Very Stiff		1	SS	15									0			50 22 14 5
5.0	Weathered																R.Q.D. 20%
378.6	Shale Bedrock*						380										
11.0	End of Borehole																
	* Bedrock: Shale, grey, soft, fissile. 4" limestone seams																

OFFICE REPORT ON SOIL EXPLORATION



## RECORD OF BOREHOLE No 3

W P 125-66-23 LOCATION Co-ords: N 15,803,229; E 954,333 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core COMPILED BY V.K.  
DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
388.1	Ground Level																
0.0	Topsoil																
384.1	Clayey Silt, sand and Gravel																
4.0																	
	A Bedrock*																R.Q.D. 30%
379.1							380										
9.0	End of Borehole																
	* Bedrock:																
	A. Shale, grey, soft fissile with 1" seams of limestone																
	B. Limestone, light grey, fine to med. grained, hard. Fossiliferous																

## RECORD OF BOREHOLE No 4

W P 125-66-23 LOCATION Co-ords: N 15,803,217; E 954,368 ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core COMPILED BY V.K.  
DATUM Geodetic DATE November 15, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
388.0	Ground Level																
0.0	Topsoil																
383.0	Clayey Silt, Sand and Gravel, Very Stiff		1	GS	18												56 21 18 5
5.0																	
	A Bedrock*						380										R.Q.D. 30%
178.0																	
10.0	End of Borehole																
	* Bedrock:																
	A. Shale, grey, soft fissile, thin seams of limestone.																
	B. Limestone, light grey, med. grained, hard, fossiliferous																

## FOUNDATION INVESTIGATION REPORT

For

N-W Ramp Over Joshua Creek  
W.P. 125-66-24, Site 10-140B  
QEWS, District 4, Hamilton

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INTRODUCTION

This report contains the results of a foundation investigation done at the site of the above mentioned structure. The fieldwork was carried out during the period of September 19 to September 21, 1978. It consisted of four sampled boreholes, two of which were accompanied by a dynamic cone penetration test. The borings were advanced by means of solid stem continuous flight augers through the overburden; thereafter by diamond drilling techniques to depths ranging from 10 to 23 feet below the ground surface. Bedrock was proven by obtaining up to 6.5 feet of BXL size rock core.

SITE AND GEOLOGY

The site is approximately 200 feet west of the existing crossing of QEWS and Joshua Creek in the Town of Oakville, Regional Municipality of Halton.

At this location Joshua Creek meanders in a 30 to 50 foot wide flood-plain valley floor. The valley is about 20 feet deep and about 200 feet wide from crest to crest. During the time of field investigation, Joshua Creek was about 10 to 15 feet wide and the water in the creek was about 1 to 2 feet deep. The area surrounding the site is covered with trees and bushes.

Physiographically, the site lies in the southern edge of the region referred to as the "South Slope". This region is a strip of land bounded by the Iroquois Plain on the south and the Peel Plain on the north. The region is characterized by glacial till overburden which is closely related to the underlying shale bedrock of Queenston and Dundas formations of the Ordovician Age.



## SUBSURFACE CONDITIONS

### General

At this site the overburden has an overall thickness of about 15 to 17 feet on the south side of the valley but it diminishes to 3 to 4 feet thick at the valley floor. The overburden generally consists of a glacial till composed of clayey silt, some sand and gravel. However, in the valley floor Joshua Creek has eroded the glacial till and redeposited a sandy gravel. Across the site the overburden is underlain by interbedded shale and limestone bedrock.

Factual data on the subsurface conditions is shown on the Record of Borehole Sheets. The locations and elevations of the borings, together with the estimated stratigraphical sections are shown on Contract Drawing No. 10-140B-2. A description of the subsoil and bedrock conditions is given below.

### Sandy Gravel

This flood plain deposit was encountered in the river valley extending from ground surface to bedrock for a thickness of 3 to 4 feet. This deposit is alluvial in origin and is composed of sandy gravel with some silt and trace of clay. Typical grain size distribution curves for material from this deposit are shown in Figure 1. The Standard Penetration Test 'N' values of 10 and 14 blows/foot indicate that this deposit has a loose to compact relative density.

### Clayey Silt, Some Sand and Gravel (Glacial Till)

This deposit encountered on the south valley side has a thickness of about 15 to 17 feet. It is a glacial till composed of clayey silt, some sand and gravel. Typical grain size distribution curves of the material from this deposit are shown in an envelope form on Figure 2. Geotechnical identity indices of the cohesive subsoil as determined from laboratory testing are summarized below.

	<u>Range</u>
Natural Moisture Content (W) %	9-12
Liquid Limit (W <sub>L</sub> ) %	29-34
Plastic Limit (W <sub>p</sub> ) %	16-18

The results of the Atterberg Limit testing are also plotted on the Plasticity Chart, Figure 3, which indicates this deposit is inorganic and cohesive with a low plasticity.

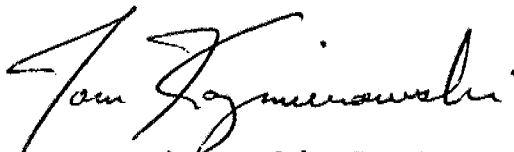
The Standard Penetration Test 'N' values ranged from 22 to 42 blows/foot, generally increasing with depth. However, at one isolated location an 'N' value in excess of 100 blows/foot was encountered. This high 'N' value is attributed to the presence of gravel. It is inferred from this that the consistency of this cohesive deposit varies from very stiff to hard.

#### Bedrock (Interbedded Shale and Limestone)

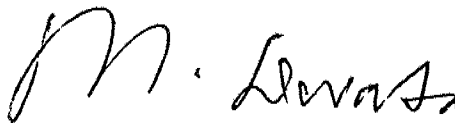
Bedrock was encountered at elevation 394 in the valley floor and at elevation 396 to elevation 398 in the vicinity of the south bank. Bedrock may be described as interbedded shale and limestone. Reference should be made to a detailed description of the rock cores which is included in the Appendix of this report.

#### Groundwater Conditions

For construction purposes the groundwater level may be assumed equal to the water level in the creek which was at elevation 397 ± during the time of investigation.



T. Kazmierowski, P. Eng.  
Project Engineer



M. Devata, P. Eng.  
Supervising Engineer



## APPENDIX



## RECORD OF BOREHOLE No 1

W P 125-66-24 LOCATION Sta. 30+11 o/s 18' Rt. Control Line N-W Ramp ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE Solid Stem Auger, BXL Core COMPILED BY V.K.  
DATUM Geodetic DATE September 21, 1978 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT $\Sigma$					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
397.8	Ground Level																
0.0	Sandy Gravel With		1	SS	10												45 29 19 7
394.3	Some Clay and Silt		2	BXL	30%												
3.5	Weathered																
	Sound, Interbedded		3	BXL	100%												
	Shale and Limestone																
387.8	Bedrock				Rec.		390										
10.0	End of Borehole																
	Note: Water Level Not Established																

## RECORD OF BOREHOLE No 2

W P 125-66-24 LOCATION Sta. 30+31 o/s 10' Lt. Control Line N-W Ramp ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE Solid Stem Auger, BXL Core Drill COMPILED BY V.K.  
DATUM Geodetic DATE September 20, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT $\Sigma$					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
397.8	Ground Level																
0.0	Sandy Gravel With		1	SS	14												68 16 13 3
394.3	Some Clay and Silt		2	BXL	100%												
3.5	Interbedded Shale and																
	Limestone Bedrock		3	BXL	100%		390										
387.8					Rec.												
10.0	End of Borehole																
	Note: Water Level Not Established																

# RECORD OF BOREHOLE No 3

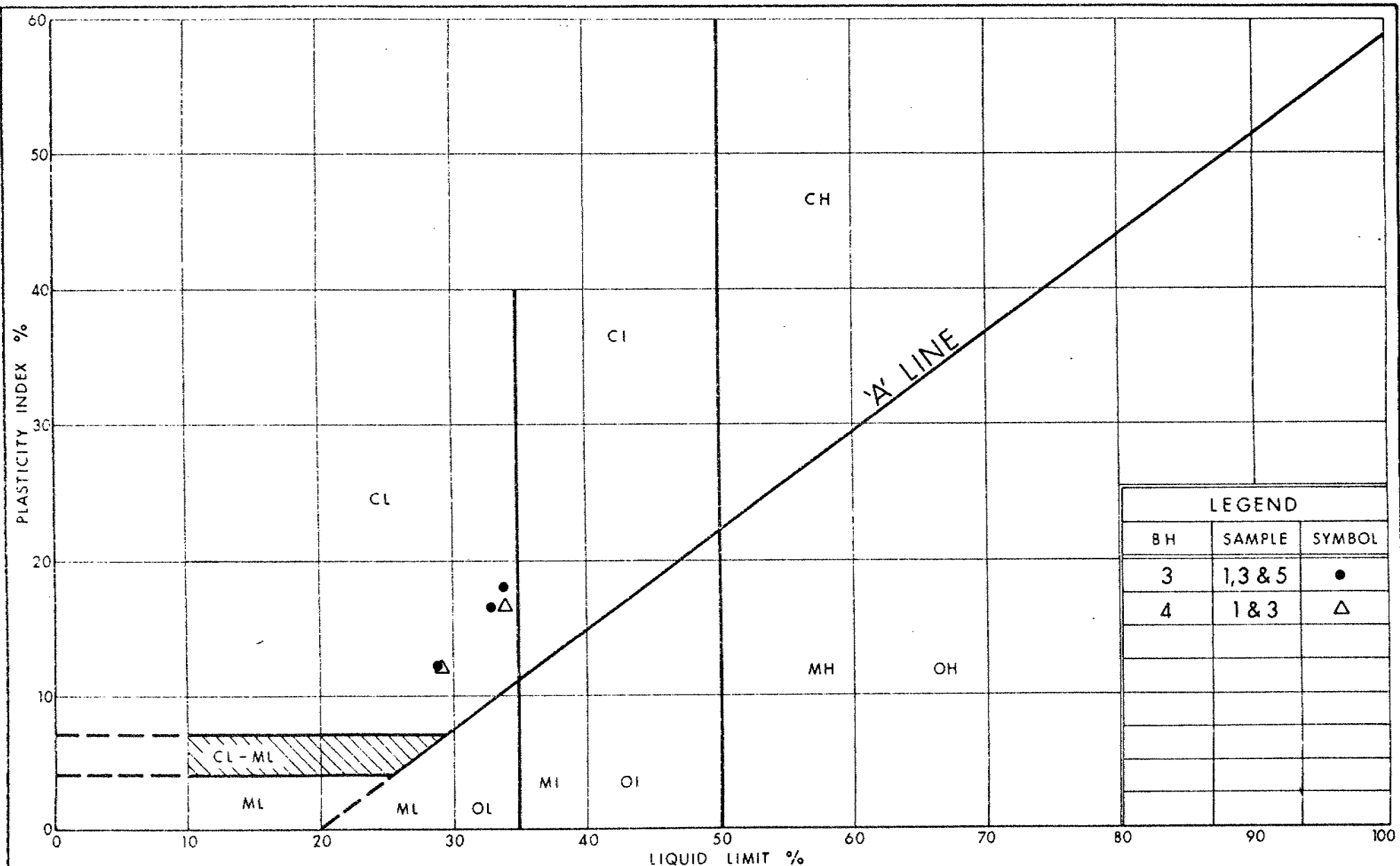
W P 125-66-24 LOCATION Sta. 29+64 o/s 10' Lt. Control Line N-W Ramp ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE Solid Stem Auger, BXL Core and Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE September 20, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
412.7	Ground Level													
0.0	Clayey Silt, Some Sand and Gravel Very Stiff to Hard		1	SS	24		410							4 10 55 31
			2	SS	1007	6"								7 13 49 31
			3	SS	29									
			4	SS	42									
395.7	Brown Grey		5	SS	36									
17.0	Weathered Interbedded Shale and Limestone Bedrock		6	BXL	100% Rec.									
389.7														
23.0	End of Borehole													
	Note: Water Level Not Established													

# RECORD OF BOREHOLE No 4

W P 125-66-24 LOCATION Sta. 29+45 o/s 13' Rt. Control Line N-W Ramp ORIGINATED BY V.K.  
DIST 4 HWY 403 BOREHOLE TYPE Solid Stem Auger, BXL Core and Cone Test COMPILED BY V.K.  
DATUM Geodetic DATE September 19, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
412.7	Ground Level													
0.0	Clayey Silt, Some Sand and Gravel Brown, Very Stiff to Hard		1	SS	22		410							4 10 48 38
			2	SS	31									8 10 49 25
			3	SS	32									
397.9			4	SS	26									
14.8	Interbedded Shale and Limestone Bedrock		5	BXL	100% Rec.									
392.9														
19.8	End of Borehole													
	Note: Water Level Not Established													



LEGEND		
BH	SAMPLE	SYMBOL
3	1,3 & 5	●
4	1 & 3	Δ



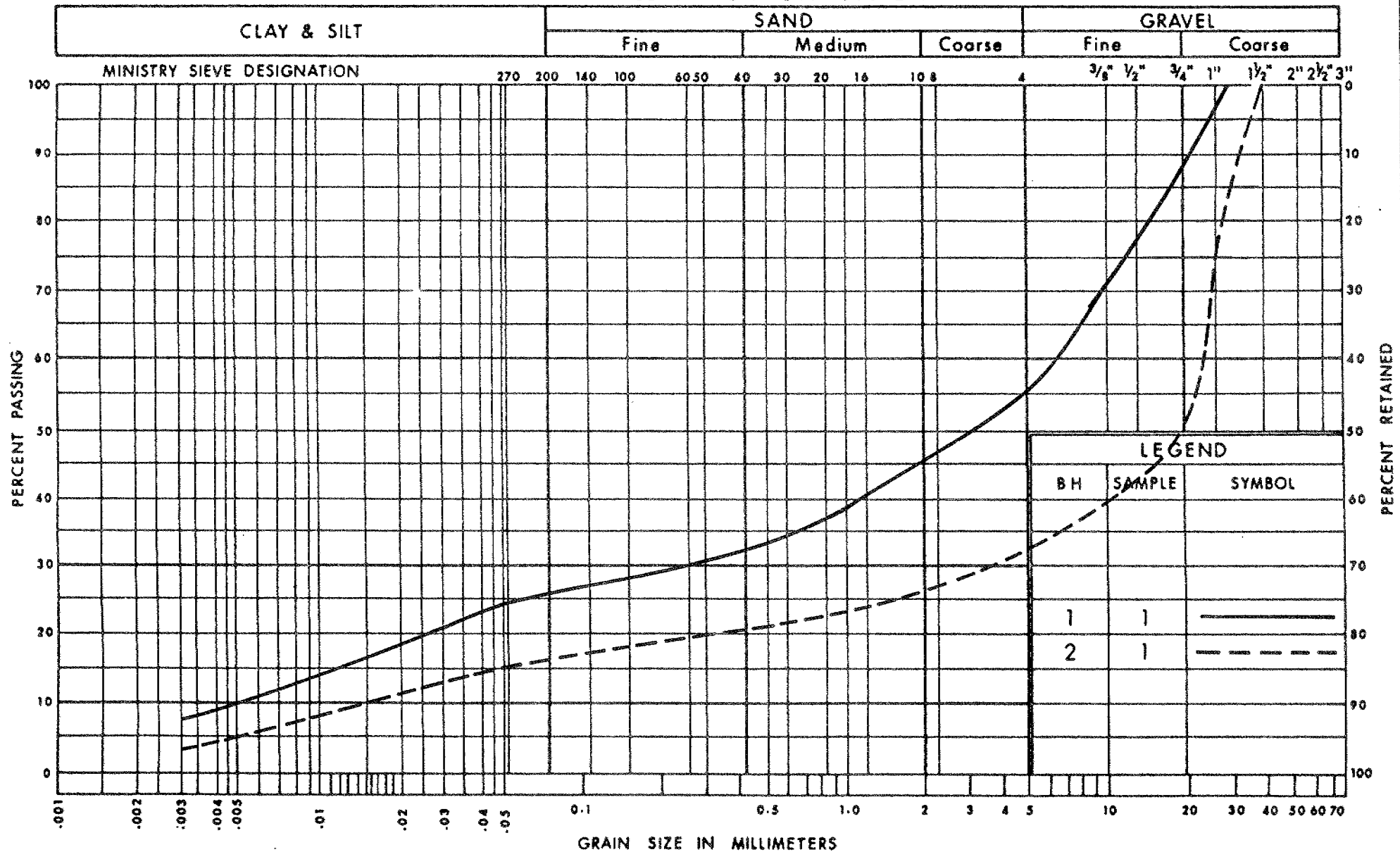
Ministry of  
Transportation and  
Communications

# PLASTICITY CHART CLAYEY SILT, SOME SAND & GRAVEL

FIG No 3

W P 125-66-24

## UNIFIED SOIL CLASSIFICATION SYSTEM



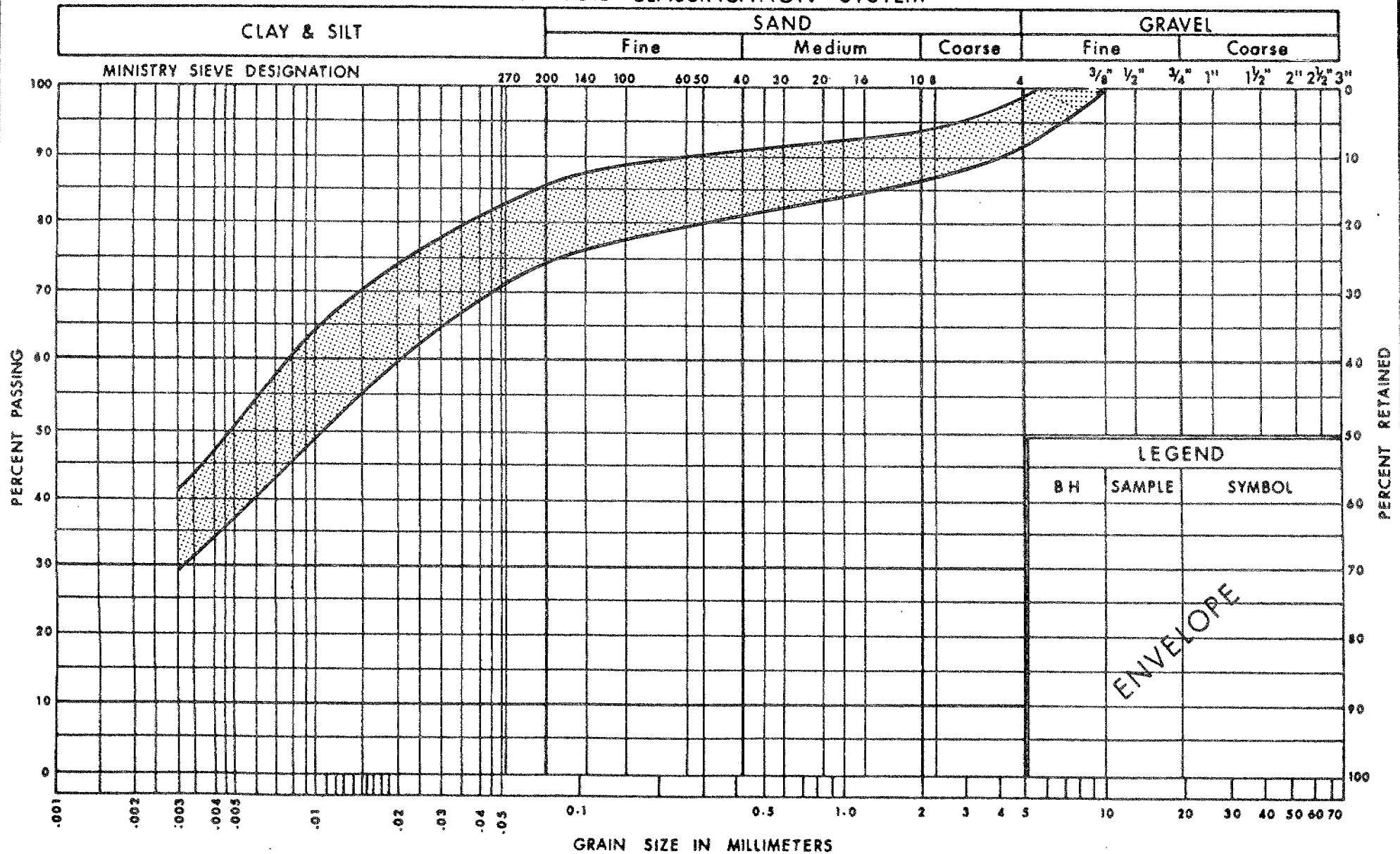
Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SANDY GRAVEL, WITH SOME SILT & CLAY

FIG No 1

WP 125-66-24

# UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT, SOME SAND & GRAVEL

FIG No 2

W P 125-66-24





Ministry of  
Transportation and  
Communications

# DIAMOND DRILL RECORD

HOLE NO. \_\_\_\_\_ SHEET NO. \_\_\_\_\_

PROPERTY \_\_\_\_\_ W.P.125-66-24  
LOCATION \_\_\_\_\_  
\_\_\_\_\_ Josuha Creek  
\_\_\_\_\_ Oakville, Ontario.  
LATITUDE \_\_\_\_\_  
DEPARTURE \_\_\_\_\_  
BEARING \_\_\_\_\_

DIP

90°

TOTAL FOOTAGE \_\_\_\_\_

ELEV. COLLAR \_\_\_\_\_  
DATUM \_\_\_\_\_  
DATE STARTED \_\_\_\_\_  
DATE COMPLETED \_\_\_\_\_  
DRILLED BY \_\_\_\_\_  
LOGGED BY \_\_\_\_\_

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		Hole #1				
3'5"	10'0"	Intermittent shale and limestone bedding throughout varying from two inches to 10" with the limestone. Limestone is hard, fine texture, light grey colour and slightly sandy. Shale is black, soft, fine texture and fissile.				ground core at top of hole, possibly shale, approximately 1.5' lost core.
		Hole #2				
3'5"	10'0"	Same as hole #1.				
		Hole #3				
18'0"	23'0"	Same as hole #1.				thickest limestone bed 8".
		Hole #4				
14'8"	19'8"	Same as hole #1.				thickest limestone 10".

DATE OF EXAMINATION \_\_\_\_\_ October 12th, 1978

\_\_\_\_\_ B.K.Glassford

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 159-75-06

DIST 4

HWY QEW

STR SITE 10-284

W-N Ramp Hwy. 403 Under QEW

DISTRIBUTION

G.C.E. Burkhardt (3)  
R.D. Gunter  
M.R. Ernseaks  
D.E. Thrasher (2)

C. Grebski  
G.A. Wrong  
B.J. Giroux  
R.S. Pillar

R. Hore

R. Fitzgibbon )  
J. Anderson ) cover only  
G. Sloan )

Files ✓

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	78-02-20	1248
TUBES	—	—
ROCK CORES	(Contract Award)	1248

# FOUNDATION INVESTIGATION REPORT

For

W-N Ramp Hwy. 403 Under QEW  
W.P. 159-75-06, Site 10-284  
QEW, District 4, Hamilton

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## INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. It is based on 8 sampled boreholes advanced with a truck mounted CME55 auger during the period December 14 to 22, 1977. Solid stem augers were employed to auger through the overburden and into the shale bedrock. In the 4 boreholes adjacent to the planned pier locations casing was set in the rock and BXL or NXL size rock core samples were obtained.

## SITE DESCRIPTION

The site is located on the QEW some 900 feet north of the existing Ford Drive underpass structure. At this location the QEW has 2 degrees of curvature and consists of 6 traffic lanes plus paved median and shoulders. This general area has a gentle slope to the south and west toward Joshua Creek. Land use is in transition from being predominantly agricultural to being residential and industrial.

## SUBSURFACE CONDITIONS

Overburden consists of a 7 to 8 foot layer of silty clay. It has a very stiff to hard consistency with Standard Penetration 'N' values ranging from 14 to in excess of 40 blows per foot. Moisture content decreases from about 24 percent near the surface to less than 15 percent at the contact with the shale.

The silty clay overburden is underlain by shale bedrock of the Queenston formation. It is generally red to greyish red in colour but does contain grey green bands of shaley limestone which are usually less than a foot in thickness. The upper 10 to 15 feet of shale is soft and weathered with occasional hard bands consisting chiefly of the green shaley limestone. In particular the upper 5 to 7 feet has an altered texture which is less fissile than the lower layers. The shale below this upper weathered zone (shale more than 22 feet from the ground surface) is generally hard and fissile but does contain soft and weathered zones. More detailed descriptions, as well as recovery percentages and RQD values are included on the log sheets.

Groundwater levels were recorded in several of the open boreholes during the period of the fieldwork. They indicate a groundwater level about 7 feet below the ground surface.

## DESIGN CONSIDERATIONS

### Proposal

The proposed scheme calls for the QEW to remain at approximately its existing grade and to pass over a depressed W-N Ramp of Hwy. 403. The twin structures carrying the QEW will have spans of 80, 135 and 80 feet.

### Recommendations

Spread footings: The proposed structures should be supported on spread footings in the shale bedrock. The pier footings will be founded approximately 30 feet below the ground surface in the relatively sound shale bedrock. They may be designed with loads of up to 10 tons per square foot. The abutment footings will be located approximately 15 to 20 feet below the ground surface in shale bedrock exhibiting considerable softening and weathering. The design load for the abutment footings should, therefore, not exceed 5 tons per square foot. To prevent deterioration of the shale bedrock on exposure to air and water the footing bases should be covered by 6 inches of mass concrete within 3 hours of the excavation reaching grade. Any soft shale encountered at the footing grade should be excavated and replaced by mass concrete.

Frost protection: The underside of the footings should be provided with 4 feet of cover to prevent deterioration of the shale due to frost action.

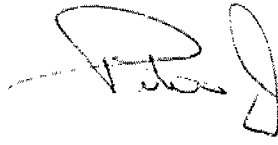
Dewatering: No serious dewatering problems are anticipated. Any seepage water should be removed by pumping from sumps.

## MISCELLANEOUS

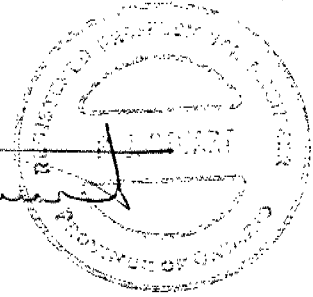
Resistance of the footing to sliding on the shale bedrock should be calculated using a coefficient of friction of 0.4. Further resistance to sliding should be achieved by placing dowels in the bedrock.

The abutment walls should be backfilled with free draining granular material with weep holes provided to prevent buildup of hydrostatic pressure.

All cut slopes in the shale bedrock should be made at 2 horizontal to 1 vertical and treated in the same manner as cut slopes in earth.



P. Stuart, P. Eng.  
Project Engineer



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

February, 1978

## APPENDIX

## RECORD OF BOREHOLE No 1

W P 159-75-06 LOCATION N 15 805 696 E 953 919 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
484.1	Ground Level																GR SA SI CL
0.0	SILTY CLAY						480										
	Very Stiff To Hard		1	SS	15												
477.1			2	SS	60												
7.0	QUEENSTON SHALE BEDROCK		3	SS	100/12"												
			4	SS	100/9"												
	Red To Grey Red		5	SS	100/5"												
468.9			6	SS	50/3"		470										
15.2	End Of Borehole																
	Note: W.L. Not Established																

## RECORD OF BOREHOLE No 2

W P 159-75-06 LOCATION N 15 805 618 E 953 900 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Augers, NX Casing and NXL Core COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 15, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
482.2	Ground Level																GR SA SI CL
0.0	SILTY CLAY						480										
	Very Stiff To Hard		1	SS	14												
475.2			2	SS	47												
7.0	QUEENSTON SHALE BEDROCK		3	SS	100/14"												
	Red To Grey Red		4	NXL	80% Rec												RQD = 33
	Fine Texture		5	NXL	41% Rec		470										RQD = 13
	Soft And Fissile		6	NXL	81% Rec												RQD = 29
	With Thin Bedding		7	NXL	81% Rec		460										RQD = 38
	Including A Few Thin Shaly Limestone Beds		8	NXL	85% Rec												RQD = 30
			9	NXL	97% Rec												RQD = 73
			10	NXL	87% Rec		450										RQD = 73
			11	NXL	100% Rec												RQD = 75
440.3																	
41.9	End Of Borehole																
	Note: W.L. Not Established																

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



## RECORD OF BOREHOLE No 3

W P 159-75-06 LOCATION N 15 805 486 E 953 872 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, B Casing and BXL Core COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 14, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	20 40 60 80 100	10 20 30			
478.8	Ground Level													
0.0	SILTY CLAY													
	Very Stiff		1	SS	15									
471.8	To Hard		2	SS	38									
7.0	QUEENSTON SHALE BEDROCK		3	SS	100/10"		470							
	Red To Grey Red													
	Fine Texture		4	BXL Core	97% Rec									RQD = 30
	Soft And Fissile													
	With Thin Bedding		5	BXL Core	70% Rec		460							RQD = 46
	Including A Few													
	Thin Shaly Limestone													
	Beds		6	BXL Core	100% Rec		450							
	Limestone Bed 21'-21'7"													
	Shaly Limestone 33'-34'		7	BXL Core	100% Rec		440							RQD = 65
436.5	End Of Borehole													
42.3	Note: W.L. Not Established													

## RECORD OF BOREHOLE No 4

W P 159-75-06 LOCATION N 15 805 407 E 953 858 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100						WATER CONTENT (%)				
								SHEAR STRENGTH										

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

## RECORD OF BOREHOLE No 5

W P 159-75-06 LOCATION N 15 805 318 E 953 954 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 22, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
474.0	Ground Level																
0.0	SILTY CLAY						470										
	Very Stiff		1	SS	30												
466.0	To Hard		2	SS	87												
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/13"		460										
	Red To Grey Red		4	SS	50/1"												
			5	SS	100/11"												
453.8			6	SS	75/3"												
20.2	End Of Borehole																

## RECORD OF BOREHOLE No 6

W P 159-75-06 LOCATION N 15 805 395 E 953 965 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, BX Casing, BXL Core COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 20, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
476.2	Ground Level																
0.0	SILTY CLAY						470										
	Very Stiff		1	SS	21												
468.2	To Hard		2	SS	53												
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/6"		460										
	Red To Grey Red																
	Fine Texture		4	BXL	95% Core Rec		450										RQD = 38
	Soft And Fissile																
	With Thin Bedding																
	Including A Few Thin																
	Beds Of Shaly Limestone		5	BXL	100% Core Rec		440										RQD = 75
	Limestone Bed 31'9"-32'2"																
	Limestone Bed 40'6"-41'4"		6	BXL	95% Core Rec												RQD = 33
431.9																	
44.3	End Of Borehole																
	Note: W.L. Not Established																

+3, x<sup>5</sup>: Numbers refer to 20  
 15 5 (%) STRAIN AT FAILURE  
 Sensitivity 10

## RECORD OF BOREHOLE No 7

W P 159-75-06 LOCATION N 15 805 525 E 953 990 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, BX Casing, BXL Core COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 20, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
479.4	Ground Level																GR SA SI CL
0.0	SILTY CLAY																
	Very Stiff		1	SS	21												0 4 45 51
	To Hard																
471.4			2	SS	116/15"												0 7 63 30
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/12"		470										0 3 71 26
	Red To Grey Red																
	Fine Texture		4	BXL Core	98% Rec		460										RQD = 50
	Soft And Fissile																
	With Thin Bedding																
	Including A Few																
	Shaly Limestone Beds		5	BXL Core	100% Rec		450										RQD = 67
	Shaly Limestone 15'8"-16'0"																
	Shaly Limestone 40'8"-41'0"																
	Shaly Limestone 43'5"-44'5"		6	BXL Core	100% Rec		440										RQD = 54
434.4																	
45.0	End Of Borehole																
	Note: W.L. Not Established																

## RECORD OF BOREHOLE No 8

W P 159-75-06 LOCATION N 15 805 601 E 954 015 Co-ords. ORIGINATED BY P.J.S.  
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.  
 DATUM Geodetic DATE December 21, 1977 CHECKED BY R.S.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
481.3	Ground Level																GR SA SI CL
0.0	SILTY CLAY						480										
	Very Stiff		1	SS	16												
	To Hard																
473.3			2	SS	56												
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/7"		470										
			4	SS	100/5"												
	Red To Grey Red		5	SS	75/3"												
463.6			6	SS	75/3"												
17.7	End Of Borehole																

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

# 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.  $\bar{C}\bar{U}$  = 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 POIL SAMPLE  
R C ROCK CORE  
P H T.W. ADVANCED HYDRAULICALLY  
P M T.W. ADVANCED MANUALLY

$\mu$  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  
 $\omega$  SLOPE ANGLE-BACKFACE OF WALL  
 $\beta$  ANGLE OF SLOPE  
 $N_c, N_q, N_\gamma$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
B, L FOOTING DIMENSIONS

### INDEX PROPERTIES

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

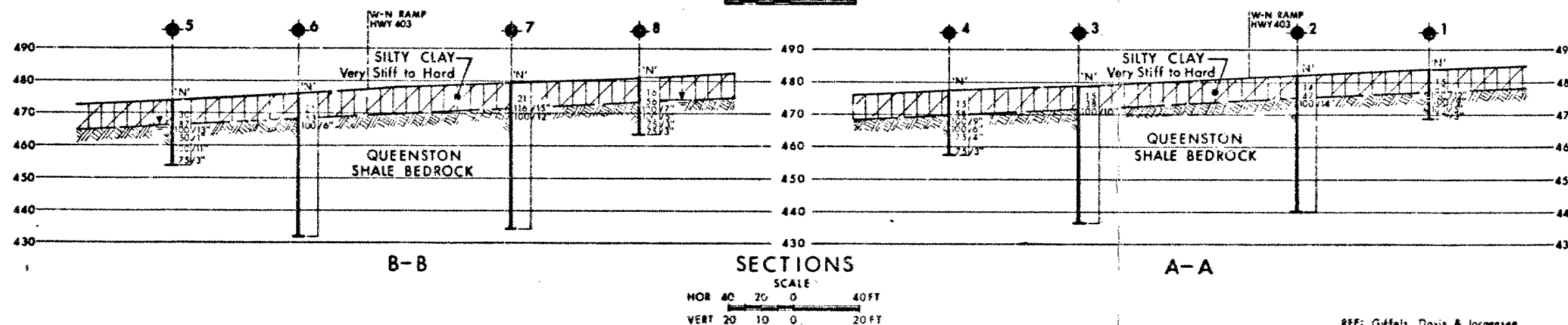
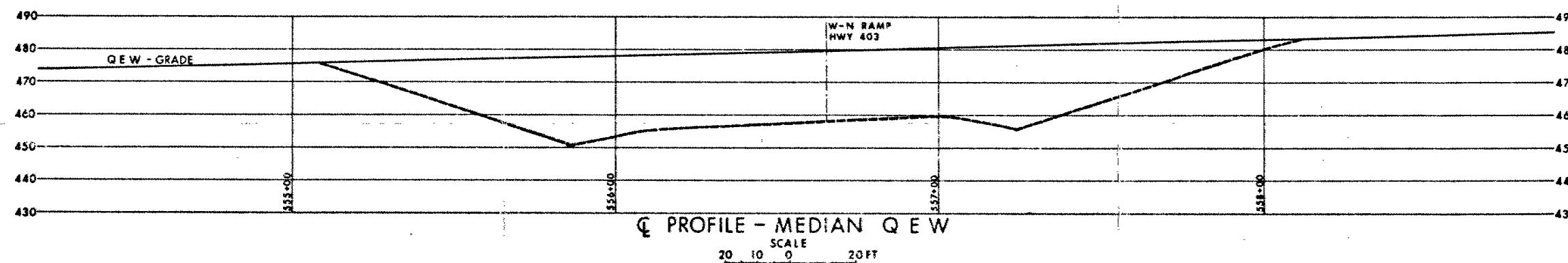
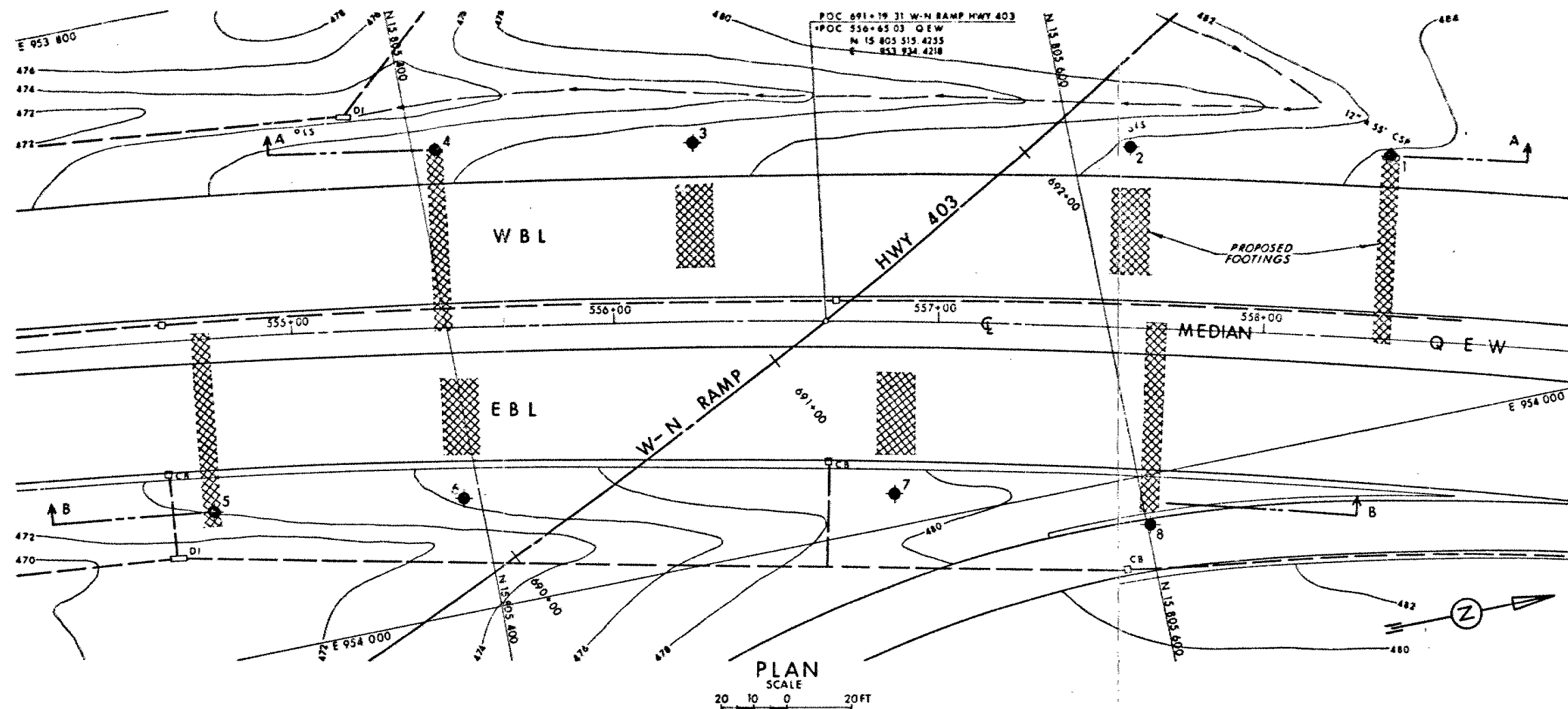
### STRENGTH PARAMETERS

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

### HYDRAULIC TERMS

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

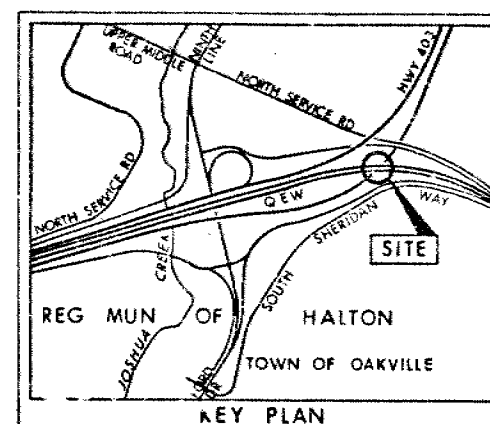
**NOTE:** EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE  
 $\sigma'_1$  = EFFECTIVE NORMAL STRESS



CONT No  
WP No 159-75-06

W-N RAMP HWY 403  
UNDER QEW  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- WL at time of investigation Dec 1977
- WL NOT Established for Bore Holes 1, 2, 3, 4, 6 & 7.

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	484.1	15 805 696	953 919
2	482.2	15 805 618	953 900
3	478.8	15 805 475	953 872
4	477.7	15 805 407	953 858
5	474.0	15 805 318	953 954
6	476.2	15 805 395	953 965
7	479.4	15 805 525	953 990
8	481.3	15 805 601	954 015

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

REF: Giffels, Davis & Jorgensen  
Consulting Engineers 20/6/77

HWY No QEW  
SLWD PJS CHECKED DATE Feb 15, 1978  
DRAWN CHECKED DATE 10-284  
1597506-A