

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40 P8-87

DIST. 3 REGION

W.P. No. 31-76-03

CONT. No. 85-35

W. O. No.

STR. SITE No. 33-298

HWY. No. 401 / 8N

LOCATION Hwy 8N SB Ramp to  
401 EB Underpass

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

# METRIC

DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES.

## NOTES:

### CLASS OF CONCRETE

DECK & PIER COLUMNS	35 MPa
ABUTMENTS, RETAINING WALLS, WING WALLS	30 MPa
PIER FOOTINGS	30 MPa
REMAINDER	20 MPa

### REINFORCING STEEL

GRADE 400  
BAR MARK WITH SUFFIX 'C' DENOTES COATED BAR.

### CLEAR COVER TO REINFORCING STEEL

	mm
FOOTINGS	100 ± 25
ABUTMENTS AND RETAINING WALLS	80 ± 20
PIER COLUMNS	70 ± 20
DECK TOP	80 ± 20
DECK BOTTOM AND SIDES	50 ± 10
REMAINDER UNLESS OTHERWISE NOTED	70 ± 20

### CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 mm.  
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL AFTER THE CONCRETE IN THE DECK HAS BEEN PLACED, STRESSED & GROUTED.

## LIST OF ABBREVIATIONS

W.P. = WORKING POINT  
T/A = TOP OF ASPHALT  
T/F = TOP OF FOOTING  
F.F. = FRONT FACE  
B.F. = BACK FACE  
E.F. = EACH FACE

## PLAN

1:500

## FALSEWORK CLEARANCES

2 LANE FACILITY

NOTE: ALL HORIZONTAL DIMENSIONS ARE MINIMUM DIM. REQUIRED AND MEASURED PERPENDICULAR TO PAVEMENT

## EAST

GUIDERAIL & CHANNEL ANCHORAGES (TYP.)

## ELEVATION

1:500

## PROFILE HWY. 8 NEW - EB RAMP

N.T.S.

## PROFILE NS-E RAMP HWY. 8

N.T.S.

## LIST OF DRAWINGS

33-164-298-1	GENERAL ARRANGEMENT
2	BORE HOLE LOCATION & SOIL STRATA
3	FOOTING LAYOUT & PILE ARRANGEMENT
4	WEST & EAST ABUTMENT FOOTING REINFORCING
5	PIER FOOTING REINFORCING
6	WEST ABUTMENT
7	EAST ABUTMENT
8	WEST & EAST ABUTMENT WINGWALLS
9	SW. RETAINING WALL
10	NE & SE RETAINING WALLS
11	DETAILS OF PILE MATERIAL
12	COLUMNS & BEARINGS
13	DECK DETAILS & ABUT. BEARINGS
14	LONGITUDINAL TENDON DETAILS
15	LONGITUDINAL TENDON DETAILS
16	TRANSVERSE TENDON DETAILS
17	TRANSVERSE TENDON DETAILS
18	TRANSVERSE TENDON DETAILS
19	DECK REINFORCING
20	DECK REINFORCING
21	DECK REINFORCING
22	BARRIER WALL - NORTH
23	BARRIER WALL - SOUTH
24	6000 mm APPRSL. SLAB
25	DETAILS OF CONC. SLOPE PAVING
26	AS CONSTRUCTED ELEV. & DIM.
27	BRIDGE DATA & SITE NUMBER DATA
28	EXPANSION JOINTS
29	STANDARD DETAILS
30	ELECTRICAL ENBEDDED WORK
31	ELECTRICAL STANDARD DETAILS
32	PILE DRIVING - STEAM / DIESEL HAMMERS
33	QUANTITIES
34	QUANTITIES



## NOTE

ELEVATIONS AT \* NORTH WEST E/P  
\*\* SOUTH EAST E/P  
\*\*\* FUTURE NORTH WEST E/P

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
DESIGN	X.Z.S.	CHECK
DRAWING	P.K.	CHECK



# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 85 - 35



Ministry of  
Transportation and  
Communications

I N D E X

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W.P. 31-76-03, Site: 33-298  
Hwy. 8 New E.B. Ramp to  
Hwy. 401 E.B. Underpass

Note: For purposes of the contract, these reports supersede all other foundation reports prepared by or for the Ministry in connection with the above-noted projects.



## EXPLANATION OF TERMS USED IN REPORT

2

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_f$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### STRESS AND STRAIN

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

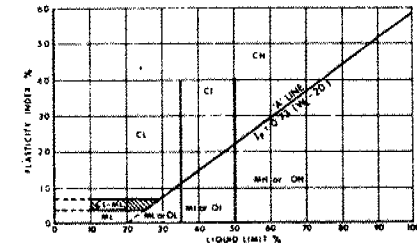
### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

# EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 75 μm AND BASING FRACTIONS ON ESTIMATED MASS)					GRP SYMB	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA					
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN 75 μm 1.75 μm IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN 4.75 mm	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZE			GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX. % OF SAND & GRAVEL; MAX. SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION; & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS.	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SW, SP MORE THAN 12% GM, GC, SM, SC 5% TO 12% <u>BORDERLINE</u> CASES REQ. USE OF DUAL SYMBOLS				
		GRAVEL WITH FINES (APPRECIABLE AMOUNT OF FINES)	PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES			NOT MEETING ALL GRADATION REQUIREMENTS FOR GW  ATTERBERG LIMITS BELOW A-LINE, OR $I_p$ LESS THAN 4  ATTERBERG LIMITS ABOVE A-LINE WITH $I_p$ GREATER THAN 7	ABOVE A-LINE WITH $I_p$ BETWEEN 4 AND 7 ARE <u>BORDERLINE</u> CASES REQUIRING USE OF DUAL SYMBOLS		
			NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES						
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN 4.75 mm	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZES & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES			SW	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES			FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS.	C <sub>u</sub> = $\frac{D_{60}}{D_{10}}$ GREATER THAN 4 C <sub>c</sub> = $\frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ BETWEEN ONE AND 3  NOT MEETING ALL GRADATION REQUIREMENTS FOR GW  ATTERBERG LIMITS BELOW A-LINE, OR $I_p$ LESS THAN 4  ATTERBERG LIMITS ABOVE A-LINE WITH $I_p$ GREATER THAN 7		
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES						
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES					C <sub>u</sub> = $\frac{D_{60}}{D_{10}}$ GREATER THAN 6 C <sub>c</sub> = $\frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ BETWEEN ONE AND 3  NOT MEETING ALL GRADATION REQUIREMENTS FOR SW  ATTERBERG LIMITS BELOW A-LINE OR $I_p$ LESS THAN 4  ATTERBERG LIMITS ABOVE A-LINE WITH $I_p$ GREATER THAN 7	ABOVE A-LINE WITH $I_p$ BETWEEN 4 AND 7 ARE <u>BORDERLINE</u> CASES REQUIRING USE OF DUAL SYMBOLS
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES						
IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN 425 μm													
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN 75 μm 175 μm IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 35%	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML	INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS.					
			NONE	QUICK	NONE								
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	CL							
			SLIGHT TO MEDIUM	SLOW	SLIGHT	OL							
			NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	ML							
			HIGH	NONE	MEDIUM TO HIGH	CL							
		LIQUID LIMIT BETWEEN 35% AND 50%	SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OL							
			SLIGHT TO MEDIUM	SLOW TO QUICK	SLIGHT	ML							
			HIGH	NONE	MEDIUM TO HIGH	CL							
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OL							
			SLIGHT TO MEDIUM	SLOW TO MORE	MEDIUM	ML							
			HIGH TO VERY HIGH	NONE	HIGH	CH							
		LIQUID LIMIT GREATER THAN 50%	MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OL							
HIGHLY ORGANIC SOILS						PL	PEAT & OTHER HIGHLY ORGANIC SOILS						

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



PLASTICITY CHART  
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

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

## Foundation Investigation Report

For

Hwy. 8 New E.B. Ramp to Hwy. 401 E.B. U'Pass

W.P. 31-76-03 Site: 33-298

Hwy. #8N, District #3, Stratford

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### INTRODUCTION

This report contains the results of a foundation investigation carried out at this location during the period of February 5-11, 1980. The fieldwork was carried out with a continuous flight auger machine mounted on an All-Terrain vehicle. The borings were advanced by employing 83 mm I.D. hollow stem augers. Dynamic penetration tests were performed adjacent to all but one borehole.

### SITE DESCRIPTION

The site is located just east of the existing Hwy. #8 and Hwy. #401 interchange complex. Apart from the road network, the surrounding terrain is flat, cultivated farmland.

Physiographically this area is situated in the region known as the 'Waterloo Hills'.

### SUBSURFACE CONDITIONS

#### General

Apart from the approximately 1.5 m of roadway fill, (generally sand) the subsoil at this location was found to be uniform and consists of a stiff to hard heterogeneous mixture of clayey silt, sand and gravel. The results of the field and laboratory tests are plotted on the accompanying Record of Borehole sheets. A stratigraphical profile across the site is shown on Drawing No. 2 of the contract documents. A description of the encountered parent soil type is as follows.



## Heterogeneous Mixture of Clayey Silt, Sand and Gravel

(Glacial Till)

Immediately below the ground level or the roadway fill material, is a glacial till stratum composed of heterogeneous mixture of clayey silt, sand and gravel. The overall thickness was not determined since the borings were terminated within this deposit. The deepest penetration was achieved in BH #5, some 22 m below ground level. The matrix of this till is basically cohesive in nature, clayey silt binding coarser sized particles. In addition, random layers (up to 30 mm in thickness) were also encountered. Laboratory tests indicate the following physical properties:

	<u>Range</u>
Liquid Limit ( $w_L$ ) %	13-30
Plastic Limit ( $w_p$ ) %	10-14
Natural Moisture Content ( $w$ ) %	5-33

Grain size distribution test results are shown in an envelope form on Figure 1 of the appendix.

Standard penetration tests were carried out within the deposit. This testing gave 'N' values to range from 10 to over 100 blows per 0.3 m. It is estimated that the consistency ranges from stiff to hard. In general, the consistency is hard below elevation 302<sup>±</sup>.

### Groundwater Conditions

The groundwater level was found to be at elevation 299<sup>±</sup> during the field investigation.



*P. Payer*  
 P. Payer, P. Eng.  
 Foundations Engineer

*K.G. Selby*  
 K.G. Selby, P. Eng.  
 Senior Foundations Engineer

RECORD OF BOREHOLE No 1												METRIC					
W.P. 31-76-03		LOCATION Co-ords. N 4 807 213.0; E 233 645.0						ORIGINATED BY BL									
DIST 3 HWY 8N		BOREHOLE TYPE Hollow Stem Augers						COMPILED BY BL									
DATUM Geodetic		DATE 80-02-05						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					
304.4	Ground Level																
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	10												
			2	SS	32												
	Stiff to Hard		3	SS	37												
			4	SS	72												
296.3	(Glacial Till)		5	SS	59												
8.1	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 31-76-03 LOCATION Co-ords. N 4 807 291.0; E 233 705.5 ORIGINATED BY BL  
DIST 3 HWY 8K BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
DATUM Geodetic DATE 80-02-06 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					
304.8	Ground Level											
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	13							5 39 44 12
			2	SS	11							
			3	SS	25							28 31 31 10
			4	SS	39							
	Stiff to Hard		5	SS	57							8 28 49 15
			6	SS	34							
			7	SS	70							
			8	SS	67							
	(Glacial Till)		9	SS	172/	280 mm						
			10	SS	102/	102 mm						
			11	SS	67/	88 mm						
			12	SS	116/	152 mm						
			13	SS	92							0 17 62 21
			14	SS	170/	280 mm						
289.1			15	SS	119/	280 mm						
15.7	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

METRIC

W P 31-76-03 LOCATION Co-ords. N 4 807 182.5; E 233 747.0 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-07 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			20 40 60 80 100						
306.7	Ground Level												
0.0	Roadway Fill		1	SS	33	306	Auger to 1.0 m						
305.2			2	SS	28								
1.5	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		3	SS	18	304							31 48 15 6
			4	SS	10								
			5	SS	84								
	Stiff to Hard		6	SS	24	302							
			7	SS	46								28 32 36 4
			8	SS	64								
			9	SS	78	300							
	(Glacial Till)		10	SS	76								
			11	SS	110/	228 mm							
			12	SS	70/	102 mm							
			13	SS	152/	228 mm							0 60 35 5
			14	SS	86								
			15	SS	66	292							
			16	SS	142/	228 mm							0 86 (14)
288.4			17	SS	100/	102 mm							
18.3	End of Borehole					288							

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 4

W.P. 31-76-03 LOCATION Co-ords. N 4 807 178.0; E 233 830.5 ORIGINATED BY BL  
DIST 3 HWY 8E BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
DATUM Geodetic DATE 80-02-07 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	SHEAR STRENGTH ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE	WATER CONTENT (%) 10 20 30	GR SA SI CL

305.7	Ground Level											
0.0												
	Heterogeneous		1	SS	47		Auger to 1.0 m					40 33 33 5
	Mixture of Clayey		2	SS	15							
	Silt, Sand and		3	SS	19							0 1 86 13
	Gravel		4	SS	33							
			5	SS	45							
	Stiff		6	SS	38							0 8 85 6
	to		7	SS	28							
	Hard		8	SS	52							
			9	SS	23							
			10	SS	59							35 25 29 11
	(Glacial Till)		11	SS	74/	152 mm						
			12	SS	79/	152 mm						
			13	SS	91							
			14	SS	143/	280 mm						0 65 33 2
			15	SS	79/	152 mm						
			16	SS	131							
			17	SS	159							
265.8			18	SS	100/	102 mm						37 38 18 7
19.9	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 5

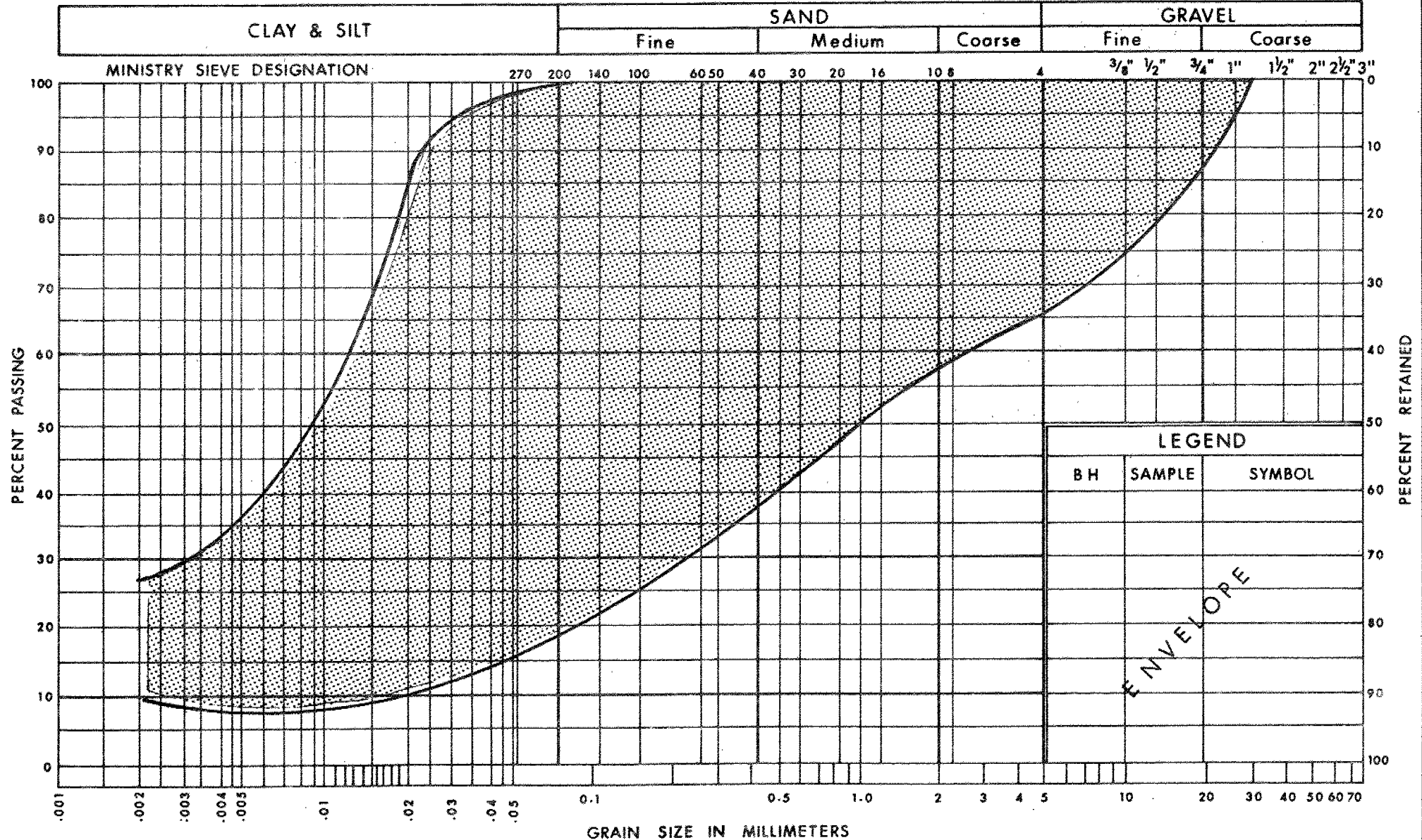
W P 31-76-03 LOCATION Co-ords. N 4 807 181.5; E 233 865.5 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-11 CHECKED BY \_\_\_\_\_

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 * 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								
305.9 0.0	Ground Level											
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	19							
			2	SS	12							
			3	SS	26							
			4	SS	50							
			5	SS	51							
			6	SS	25							
			7	SS	25							
			8	SS	20							
	Stiff to Hard		9	SS	56/	102 mm						
			10	SS	50/	102 mm						
	(Glacial Till)		11	SS	82/	152 mm						
			12	SS	66/	152 mm						
			13	SS	82							
			14	SS	95/	127 mm						
			15	SS	112							
			16	SS	150							
			17	SS	132/	254 mm						
			18	SS	110/	127 mm						
284.3 21.6	End of Borehole		19	GS	50/	12 mm						

OFFICE REPORT ON SOIL EXPLORATION



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
HETEROGENEOUS MIXTURE OF CLAYEY SILT SAND  
& GRAVEL (GLACIAL TILL)

FIG No 1  
W P 31-76-03

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 31-76-03 DIST #3  
HWY #8N STR SITE 33-298  
Hwy. #8 SB Ramp to Hwy. #401  
EB Underpass

DISTRIBUTION

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A. Crowley )  
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Files

# FOUNDATION INVESTIGATION REPORT

For

Hwy. #8 SB Ramp to Hwy. #401 EB Underpass  
W.P. 31-76-03 Site: 33-298  
Hwy. #8N, District #3, Stratford

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## INTRODUCTION

This report contains the results of a foundation investigation carried out at this location during the period of February 5-11, 1980. The fieldwork was carried out with a continuous flight auger machine mounted on an All-Terrain vehicle. The borings were advanced by employing 82 mm I.D. hollow stem augers. Dynamic penetration tests were performed adjacent to all but one borehole.

## SITE DESCRIPTION

The site is located just east of the existing Hwy. #8 and Hwy. #401 interchange complex. Apart from the road network, the surrounding terrain is flat, cultivated farmland.

Physiographically this area is situated in the region known as the 'Waterloo Hills'.

## SUBSURFACE CONDITIONS

### General

Apart from the approximately 1.5 m. of roadway fill, (generally sand) the subsoil at this location was found to

be uniform and consists of a stiff to hard heterogeneous mixture of clayey silt, sand and gravel. The results of the field and laboratory tests are plotted on the accompanying Record of Borehole sheets. A stratigraphical profile across the site is shown on Drawing No. 317603-A. A description of the encountered parent soil type is as follows.

Heterogeneous Mixture of Clayey Silt, Sand and Gravel

(Glacial Till)

Immediately below the groundlevel or the roadway fill material, is a glacial till stratum composed of heterogeneous mixture of clayey silt, sand and gravel. The overall thickness was not determined since the borings were terminated within this deposit. The deepest penetration was achieved in BH #5, some 22 m below ground level. The matrix of this till is basically cohesive in nature, clayey silt binding coarser sized particles. In addition, random layers (up to 30 mm in thickness) were also encountered. Laboratory tests indicate the following physical properties:

	<u>Range</u>
Liquid Limit ( $w_L$ ) %	13-30
Plastic Limit ( $w_p$ ) %	10-14
Natural Moisture Content ( $w$ ) %	5-33

Grain size distribution test results are shown in an envelope form on Figure 1 of the appendix.

Standard penetration tests were carried out within the

deposit. This testing gave 'N' values to range from 10 to over 100 blows per 0.3 m. It is estimated that the consistency ranges from stiff to hard. In general, the consistency is hard below elevation 302<sub>±</sub>.

Groundwater Conditions

The groundwater level was found to be at elevation 299<sub>±</sub> during the field investigation.

## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to construct a six-span (16-35-30-35-26-20) structure at this location to provide access from Hwy. #8N to Hwy. #401 east bound lanes. The profile grade of the proposed new ramp structure is not available at this time, but assumed to be at elevation 313± some 6.5 m over the median of existing Hwy. #401.

Apart from the roadway fill material the subsoil was found to consist of a stiff to hard heterogeneous mixture of clayey silt, sand and gravel.

### Structure Foundations

The following alternatives should be considered for the structure support.

#### a) Spread Footings in Original Ground

The entire structure may be founded on spread footings placed at or below elevation 302±. A safe net pressure of 360 kPa may be assumed for design purposes.

The cohesive glacial till deposit is susceptible to softening on contact with water therefore, it is recommended that an approximate 150 mm thick lean concrete be poured on the footing bases immediately on exposure.

A frictional resistance value of 90 kPa is recommended to prevent the sliding of the footings. Settlement of the foundation subsoil



due to the surcharge loading of the footings will be negligible in magnitude.

b) Spread Footing on Compacted Fill

As an alternative, the abutments may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of 335 kPa may be assumed. A detailed construction scheme is outlined on Figure 2 of the Appendix.

c) Perched Abutments on Short Piles

As a second alternative, the abutments may be constructed within the approach fills and supported on short piles driven through the fill some 4 m into the original ground. In the case of 323.9 mm O.D. @ 49.73 Kg/m steel tube piles or HP 310x110 steel 'H' piles, the maximum permissible load is 250 kN. For longer piles, (driven to elevation 296<sub>+</sub>) the design load may be increased to about 500 kN.

Approaches Embankments

It is assumed that up to 8 m high approach fills will be required at this location. No stability problems are anticipated for the approaches of this magnitude, constructed with 2:1 forward and side slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than

50 mm. Settlement of the glacial till material induced by the construction of approach fills is estimated to be in the range of 25-50 mm and will take place over a long term period.

### Other Considerations

The frost protection requirements in this area is about 1.3 m.

No major dewatering problems are anticipated.

Topsoil and/or soft surficial material should be removed in accordance with current M.T.C. practices.

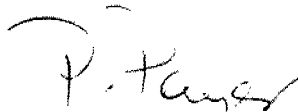
In order to estimate the earth pressures on the abutment walls the following values are recommended:

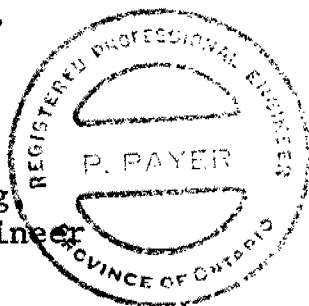
Unit weight of granular backfill =  $21 \text{ kN/m}^3$   
Coefficient of active earth pressure =  $K_a = 0.35$   
Coefficient of earth pressure at rest =  $K_o = 0.5$

A suitable drainage system should be provided to relieve the build-up of excess hydrostatic pressure behind the abutment walls. Some roadway protection may be required.

### Miscellaneous

The fieldwork for this project was carried out by Mr. B. Little, Student Technician. This report was written by Mr. P. Payer, and reviewed by Mr. K.G. Selby. The equipment used was owned and operated by Dominion Soil Investigation (Kitchener) Ltd.

  
P. Payer, P. Eng.  
Foundations Engineer



  
K.G. Selby, P. Eng.  
Senior Foundations Engineer

June 25, 1980

## APPENDIX

# RECORD OF BOREHOLE No 1

METRIC

W P 31-76-03 LOCATION Co-ords. N 4 807 213.0; E 233 645.0 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers COMPILED BY BL  
 DATUM Geodetic DATE 80-02-05 CHECKED BY \_\_\_\_\_

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		
304.4	Ground Level													
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	10		304							
			2	SS	32		302							
	Stiff to Hard		3	SS	37		300							
			4	SS	72		298							
296.3	(Glacial Till)		5	SS	59									
8.1	End of Borehole						296							

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 31-76-03 LOCATION Co-ords. N 4 807 291.0; E 233 705.5 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-06 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					
304.8	Ground Level											GR SA SI CL
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	13							5 39 44 12
			2	SS	11							28 31 31 10
			3	SS	25							
			4	SS	39							
	Stiff to Hard		5	SS	57							8 28 49 15
			6	SS	34							
			7	SS	70							
			8	SS	67							
			9	SS	172/	280 mm						
			10	SS	102/	102 mm						
	(Glacial Till)		11	SS	67/	88 mm						
			12	SS	116/	152 mm						
			13	SS	92							0 17 62 21
			14	SS	170/	280 mm						
289.1			15	SS	119/	280 mm						
15.7	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 3

METRIC

W P 31-76-03 LOCATION Co-ords. N 4 807 182.5; E 233 747.0 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-07 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						
								SHEAR STRENGTH						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					
306.7	Ground Level													
0.0	Roadway Fill						306	Auger to 1.0 m						
305.2			1	SS	33									31 48 15 6
1.5	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		2	SS	28									
			3	SS	18		304							
			4	SS	10									
			5	SS	84									
	Stiff to Hard		6	SS	24		302							
			7	SS	46									28 32 36 4
			8	SS	64									
			9	SS	78		300							
	(Glacial Till)		10	SS	76									
			11	SS	110/	228 mm	298							
			12	SS	70/	102 mm	296	PILE TIP						
			13	SS	152/	228 mm	294	PILE TIP						0 60 35 5
			14	SS	86		292							
			15	SS	66		290							0 86 (14)
288.4			16	SS	142/	228 mm								
18.3	End of Borehole		17	SS	100/	102 mm	288							

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



## RECORD OF BOREHOLE No 4

W P 31-76-03 LOCATION Co-ords. N 4 807 178.0; E 233 830.5 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-07 CHECKED BY \_\_\_\_\_

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <div>20 40 60 80 100</div>	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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE
305.7	Ground Level													
0.0														
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel		1	SS	47		Auger to 1.0 m		○				40 33 33 5	
			2	SS	15								0 1 86 13	
			3	SS	19									
			4	SS	33					○				
			5	SS	45				○	—				
	Stiff to Hard		6	SS	38								0 8 85 6	
			7	SS	28									
			8	SS	52					○				
			9	SS	23									
			10	SS	59				○	—			35 25 29 11	
	(Glacial Till)		11	SS	74/	152 mm								
			12	SS	79/	152 mm								
			13	SS	91									
			14	SS	143/	280 mm				○			0 65 33 2	
			15	SS	79/	152 mm								
			16	SS	131									
			17	SS	159									
285.8			18	SS	100/	102 mm			○				37 38 18 7	
19.9	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 ÷ 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 5

W P 31-76-03 LOCATION Co-ords. N 4 807 181.5; E 233 865.5 ORIGINATED BY BL  
 DIST 3 HWY 8N BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 80-02-11 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	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
305.9	Ground Level												
0.0													
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel	1	SS	19									
		2	SS	12									
		3	SS	26									
		4	SS	50									
		5	SS	51									
		6	SS	25									
		7	SS	25									
	Stiff to Hard	8	SS	20									
		9	SS	56/	102 mm								
		10	SS	50/	102 mm								
	(Glacial Till)	11	SS	82/	152 mm								
		12	SS	66/	152 mm								
		13	SS	82									
		14	SS	95/	127 mm								
		15	SS	112									
		16	SS	150									
		17	SS	132/	254 mm								
		18	SS	110/	127 mm								
284.3		19	SS	50/	12 mm								
21.6	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION



## GRAIN SIZE DISTRIBUTION HETEROGENEOUS MIXTURE OF CLAYEY SILT SAND & GRAVEL (GLACIAL TILL)

FIG No	1
W P	31-76-03

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### STRESS AND STRAIN

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

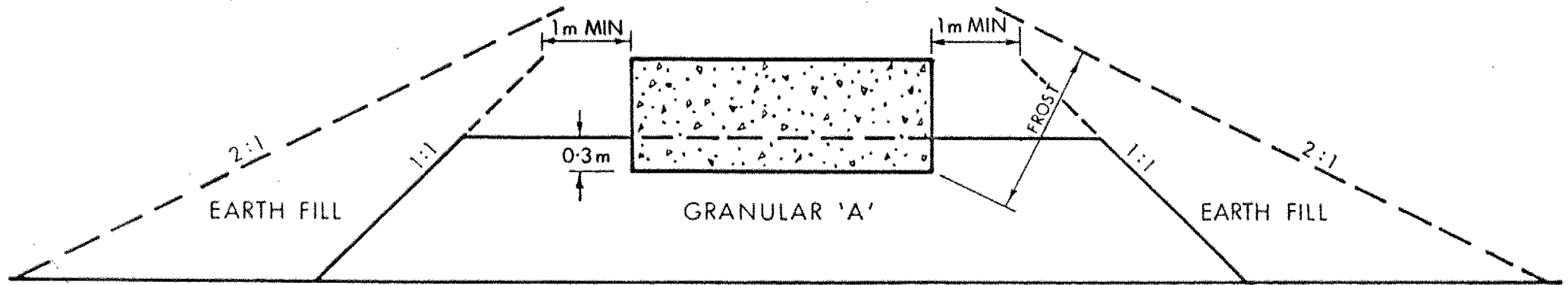
### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

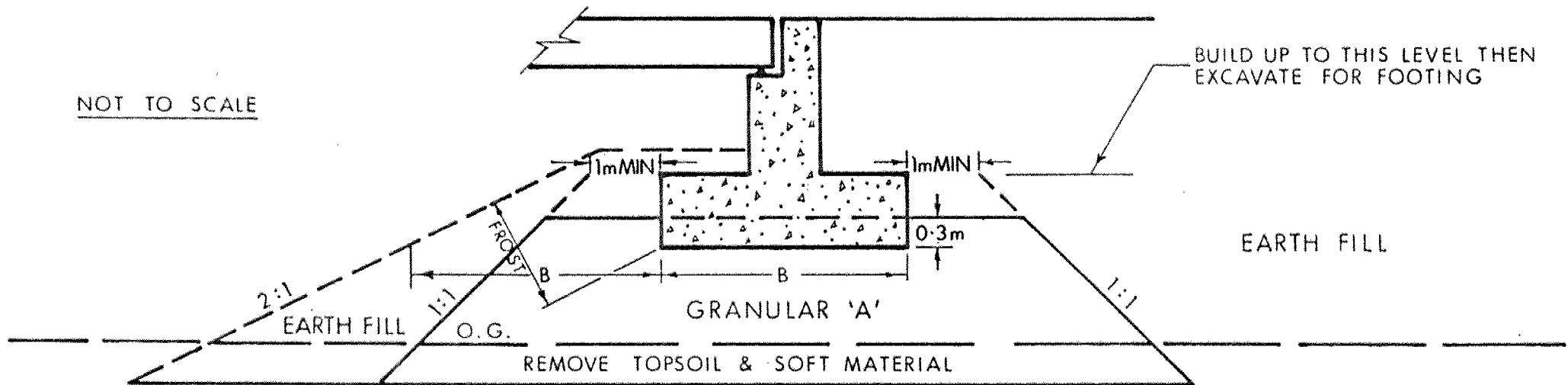
$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

# ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

## NOTES:

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

W.P. 31-76-03

FIG. 2

METRIC

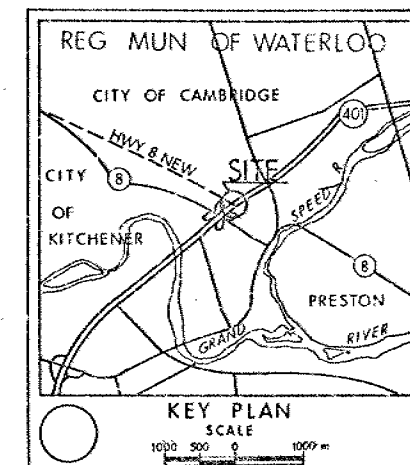
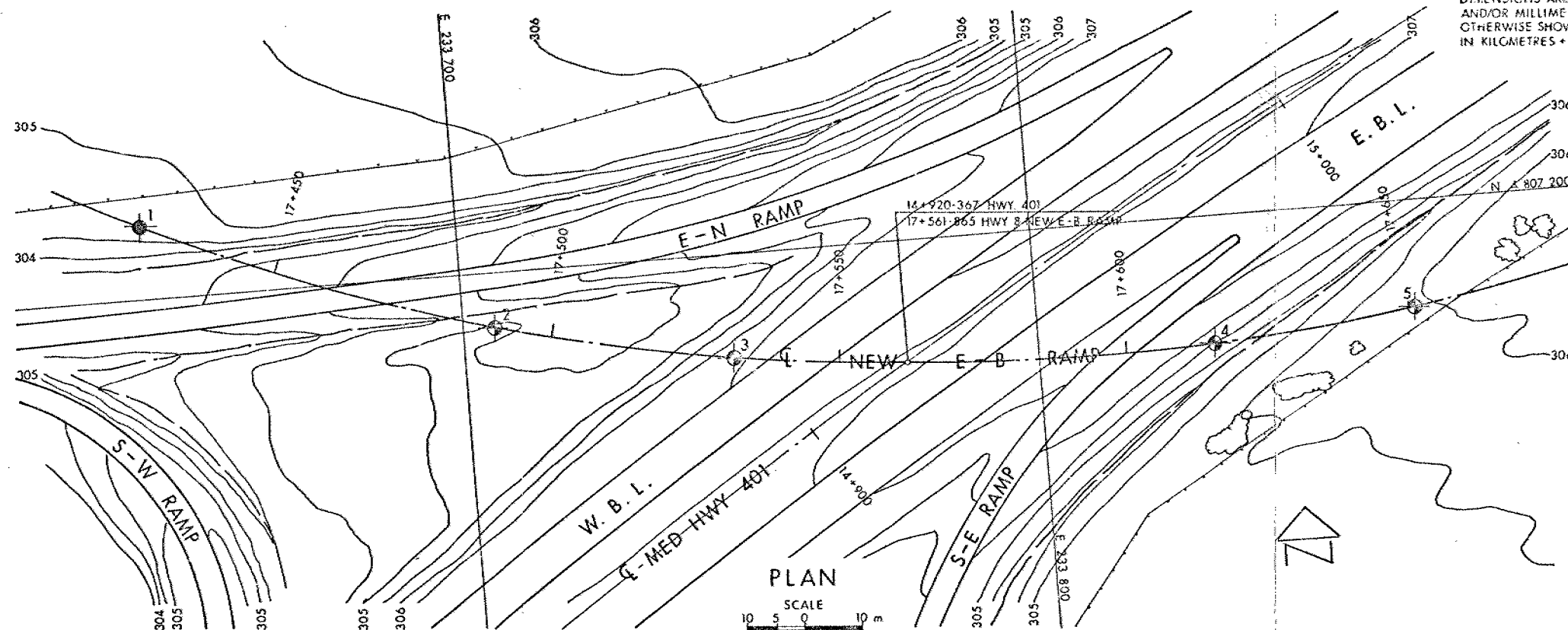
NOTE:  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

CONT No  
WP No 31-76-03

HWY 8 NEW E. BOUND RAMP  
& HWY 401  
BORE HOLE LOCATIONS & SOIL STRATA

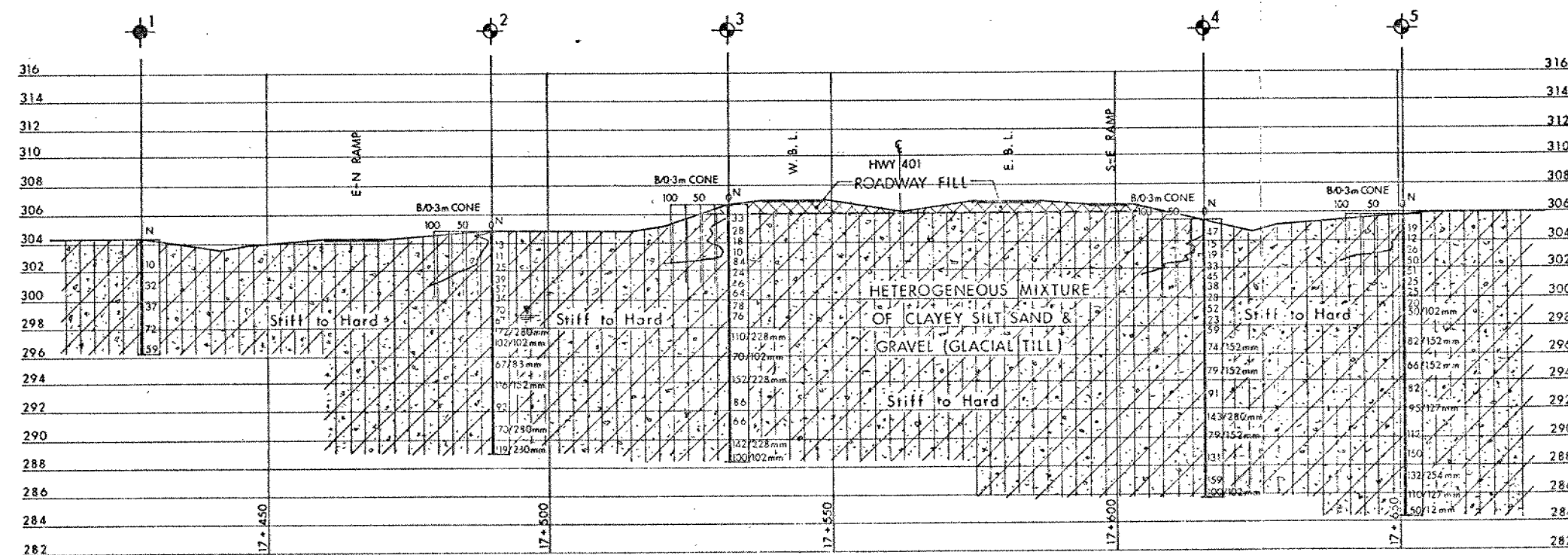


SHEET



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 80 02 06
- NO WL Established in BH No. 1, 3, 4, 5



PROFILE HWY 8 NEW EAST-BOUND RAMP

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	304.4	4 807 213.0	233 645.0
2	304.8	4 807 191.0	233 705.5
3	306.7	4 807 182.5	233 747.0
4	305.7	4 807 178.0	233 830.5
5	305.9	4 807 181.5	233 865.5

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 40P8-87

HWY No 8 NEW	DATE 80 05 14	DIST 3
SUBMD P.P. CHECKED	APPROVED	SITE 33-296
DRAWN J. CHECKED	APPROVED	DWG 317601-A