

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 149-87-00(B)

DIST 6

HWY 400

STR SITE

Retaining Walls Along Highway 400

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FOUNDATION INVESTIGATION REPORT  
For  
Retaining Walls Along Highway 400  
Between Hwy 401 and Finch Avenue  
W.P. 149-87-00(B)  
District 6, Toronto

INTRODUCTION

The subsoil information contained in this report was obtained from various foundation investigations carried out for existing structures in the area under W.P. 233-60, W.P. 131-85-02, W.P. 105-70-01. No additional borings were carried out in the area where the retaining walls are proposed to be constructed.

SITE DESCRIPTION

The sites for the proposed retaining walls are located along Hwy 400 between Hwy 401/Hwy. 400 and Finch Avenue and Hwy. 400 in the City of North York.

These sites are located within the physiographic region known as the "Peel Plain". The underlying geological material of this plain is a till or boulder clay containing large amounts of Palaeozoic shale and limestone.

SUBSURFACE CONDITIONS

The underlying subsoil in the area proposed for retaining walls consists mainly of cohesive material. The subsoil in the area between Hwy 401 and Hwy 400 and Hwy 400 and Sheppard Avenue consists of very stiff to firm clayey silt to silty clay. However, the area north of Hwy 400 and Sheppard Avenue consists of very stiff to hard heterogeneous mixture of clayey silt, sand and gravel (glacial till). In addition, compacted fills were observed in the area where there are approach embankments. Considering the extent of the area involved, it is not practical to give detail description for the individual strata. Reference should be made to the Record of Borehole sheets where details of the stratification at a particular boring location are given. However, for classification purposes,

the soils encountered in the project area can be divided into six different zones.

- a) Clayey Silt (Fill Material)
- b) Clayey Silt
- c) Clayey Silt to Silty Clay
- d) Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)
- e) Silty Sand
- f) Shale Bedrock

The subsurface conditions that may be expected in the proposed area of the retaining walls, together with the field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix of this report. The results of the Atterberg Limit Test are shown on Figures 1 and 2. The location of the boreholes are shown on the Drawing No. 1498700-B.

As indicated before, no borings were carried out in the area where the retaining walls are proposed to be constructed. However, a table indicating the borehole related to each retaining wall location is provided below for reference purposes.

<u>Location</u>	<u>Station</u>	<u>Related Borehole</u>
1	Stn. 11 + 350 to Stn. 14 + 150	BH #1, 2, 3 and 4
2	Stn. 14 + 215 to Stn. 14 + 530	BH #1, 2, 3 and 4
3	Stn. 10 + 835 to Stn. 14 + 175	BH #1, 2, 3 and 4
4	Stn. 15 + 646 to Stn. 16 + 402	BH #5, 6, and 7

#### Groundwater Conditions

It appears that the groundwater was encountered in all the boreholes, with the exception of borehole 6. The groundwater level in boreholes is as follows.

<u>Borehole No.</u>	<u>Elevation</u>	<u>Remarks</u>
1	122.6	
2	114.7	
3	123.2	
4	120.6	
5	138.8	Not stabilized
6	-	Not observed
7	143.5	

Since these boreholes were not advanced at the locations where the retaining walls are proposed, the groundwater conditions may vary from those given in the Record of Borehole Sheets.

## DISCUSSION AND RECOMMENDATIONS

### General

In order to accommodate the upgrading of Hwy. 400, it is proposed to construct retaining walls at four locations. The proposed structures will consist of either reinforced earth or segmental retaining walls. In addition, we were made to understand that adequate clear space between the face of the existing retaining walls and the proposed walls will be available for construction of reinforced earth wall. The location of retaining walls is as follows:

<u>Location No.</u>	<u>Station</u>
1	Stn. 11 + 350 to Stn. 14 + 150
2	Stn. 14 + 215 to Stn. 14 + 530
3	Stn. 10 + 835 to Stn. 14 + 175
4	Stn. 15 + 646 to Stn. 16 + 402

### Structure Foundation

#### Location 1 (Stn. 11 + 350 to Stn. 14 + 150)

The existing ground level along the proposed wall varies from a minimum of El. 130.8 to a maximum of El. 137.6. The height of soil to be retained varies from a minimum of 0.5 m to a maximum of 4.2 m. The following bearing capacity values are recommended for the design.

Factored Bearing Capacity at U.L.S. = 225 kPa

Bearing Capacity at S.L.S. = 150 kPa

#### Location 2 (Stn. 14 + 215 to Stn. 14 + 530)

In this area, the ground level varies from El. 138.8 to El. 142.4 and the height of soil to be retained varies from a minimum of 0.5 m to a maximum of 2.8 m. The wall may be designed assuming the following bearing capacity values.

Factored Bearing Capacity at U.L.S. = 225 kPa

Bearing Capacity at S.L.S. = 150 kPa

Location 3 (Stn. 10 + 835 to Stn. 14 + 175)

The existing ground level along the proposed retaining wall varies from a minimum of El. 131.3 to a maximum of El. 138.0. The height of soil to be retained varies from a minimum of 1.0 m to a maximum of 3.6 m. The recommended bearing capacity values for the design are as follows:

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. = 150 kPa

Location 4 (Stn. 15 + 646 to Stn. 16 + 402)

The existing ground level at this location varies from El. 143.8 to El. 151 and the height of soil to be retained varies from a minimum of 0.8 m to a maximum of 1.9 m. The following bearing capacity values are recommended for the design of the walls.

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. = 150 kPa

The sliding resistance for all four locations may be estimated based on effective angle of internal friction neglecting the effective shear strength of the founding soil. An unfactored coefficient of friction value of  $\tan 26$  may be assumed for the estimate.

Shallow footings in this area require a minimum of 1.2 m earth cover for frost protection.

Other Considerations

Considering the presence of ditches in the area and the susceptibility of the soil at the founding level for frost heave, it is advisable to subexcavate and backfill with granular material, if the foundations of the walls are proposed to be placed within the frost penetration depth (i.e. 1.2 m).

A Non-Standard Special Provision outlining items such as foundation preparation, reinforcing strip, backfill material and installation should be reviewed by

Foundation Design Section and included in the contract documents, if reinforced earth wall is proposed to be constructed.

MISCELLANEOUS

This report was prepared by M. Vasavithasan, Foundation Engineer, reviewed by T.C. Kim, Senior Foundation Engineer and approved by D. Dundas, Chief Foundation Engineer (Acting).



*M. Vasavithasan*

M. Vasavithasan, P. Eng.  
Foundation Engineer

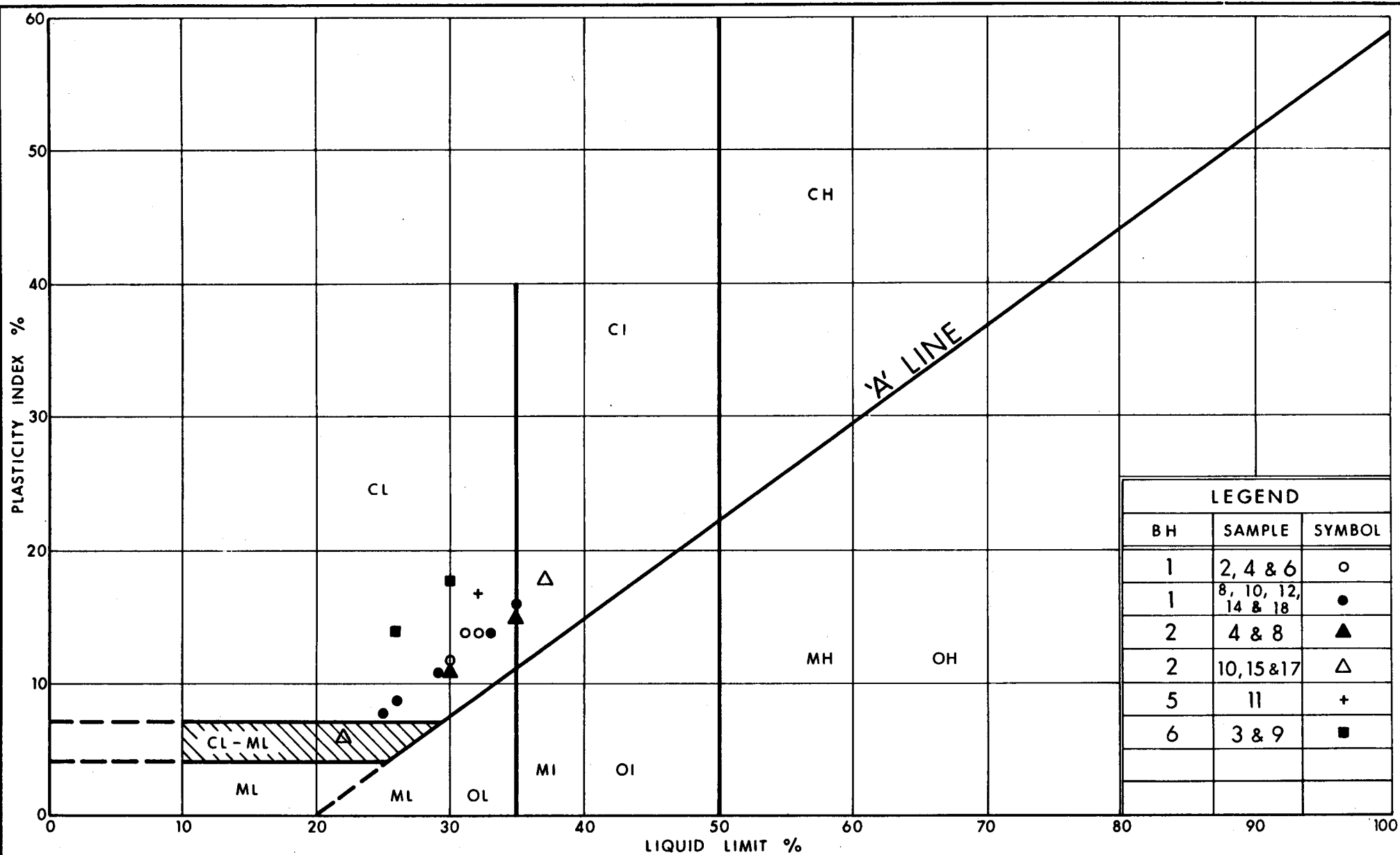


*D. Dundas*

D. Dundas, P. Eng.  
Chief Foundation Engineer  
(Acting)

## APPENDIX



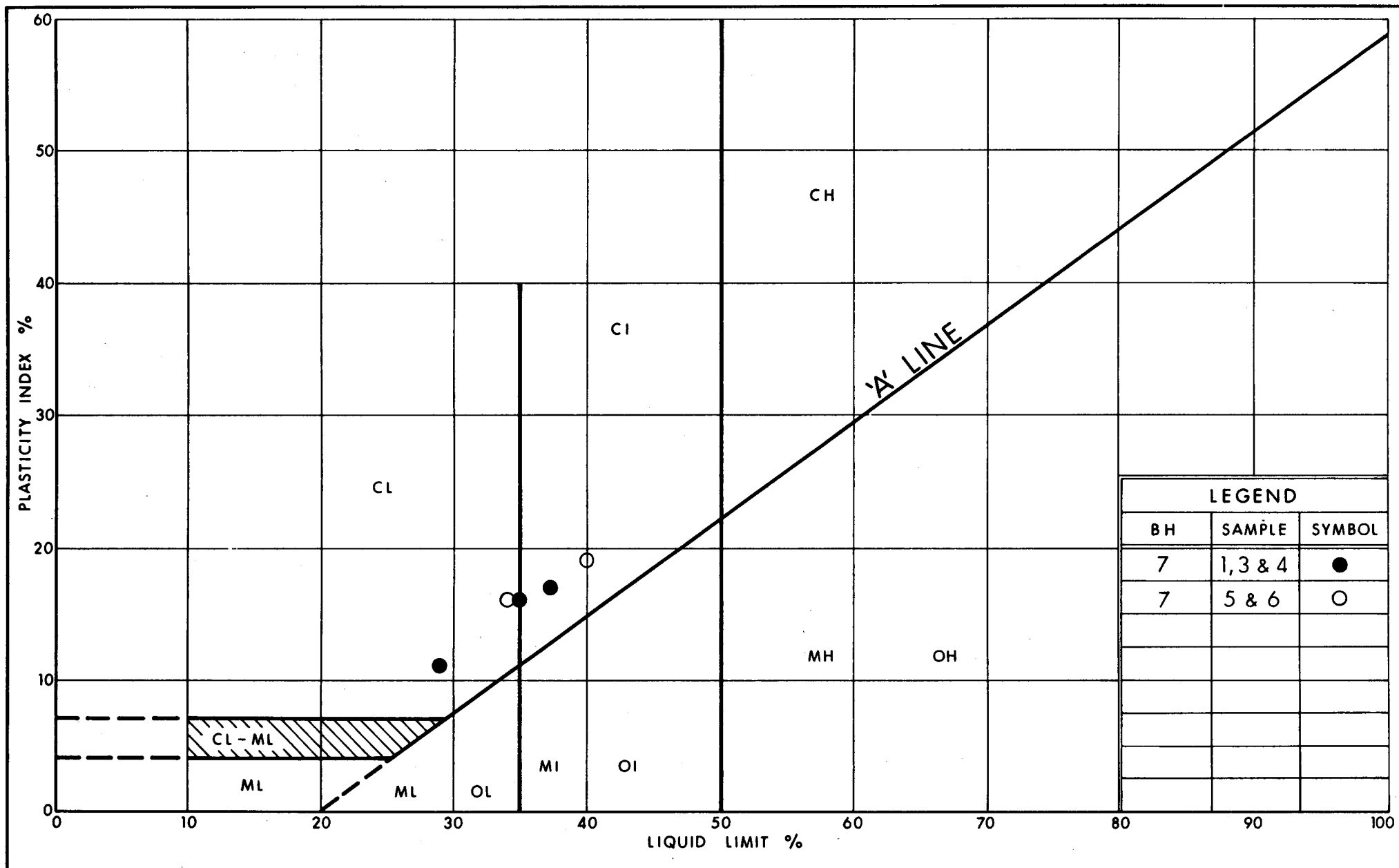


Ministry of  
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# PLASTICITY CHART CLAYEY SILT

FIG No 1

W P 149 - 87 - 00 (B)



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Ontario

# PLASTICITY CHART SILTY CLAY TO CLAYEY SILT

FIG No 2

W P 149-87-00(B)

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	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

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /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

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

# RECORD OF BOREHOLE No 1

1 OF 2 METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 841 851.0; E 303 162.0 ORIGINATED BY G&ASSO.  
 DIST 6 HWY 400 BOREHOLE TYPE POWER AUGER & CONE TEST COMPILED BY M V  
 DATUM GEODETIC DATE 1962 09 20 & 21 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
132.8	Ground Surface												
0.0	CLAYEY SILT, Some Sand, Some Gravel, Very Stiff ( FILL )		1	SS	21								
			2	SS	19								
			3	SS	20								
			4	SS	23								
			5	SS	19								
			6	SS	17								
			7	SS	21								
125.5	Some Sand		8	SS	29								
7.3			9	SS	14								
			10	TW	PH							18.9	
			11	TW	PH							20.1	
			12	TW	PH							20.3	
			13	TW	PH								
			14	TW	PH								
			15	SS	5							21.0	
			16	TW	PH								
			17	SS	11								
			18	SS	9								
102.3	CLAYEY SILT, Some Sand, Some Gravel, Stiff to Very Stiff		19	SS	13								
30.5													

Continued

Continued

+3, +5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 1

2 OF 2

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 841 851.0; E 303 162.0 ORIGINATED BY G&ASSO.

DIST 6 HWY 400 BOREHOLE TYPE POWER AUGER & CONE TEST COMPILED BY M V

DATUM GEODETIC DATE 1962 09 20 & 21 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
102.2	Continued																
30.6	End of Borehole																
	• Note: Formerly BH #5 of W. P. 233 - 60																

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 841 861.0; E 303 230.0 ORIGINATED BY GASSO.

DIST 6 HWY 400 BOREHOLE TYPE POWER AUGER COMPILED BY M V

DATUM GEODETTIC DATE 1962 09 26 & 27 CHECKED BY TCK

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 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
128.1	Ground Surface													
0.0	SILTY SAND, Loose ( Fill )													
0.7			1	SS	15									
			2	SS	29									
	Occasional Sand Seams		3	SS	25		126						20.1	
			4	TW	PH									
			5	SS	12		124						21.2	
			6	TW	PH									
			7	SS	9		122							
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Stiff		8	TW	PH		120						20.3	
			9	SS	10									
			10	TW	PH		118						19.8	
			11	SS	11									
			12	TW	PH		116							
			13	SS	27									
111.6							114							
18.5	SILTY SAND, Loose to Compact		14	TW	PH		112							
110.1														
18.0	CLAYEY SILT, Trace of Sand, Trace of Gravel, Pockets of Sand Layers, Stiff to Hard		15	SS	14		110							
			16	SS	14		108							
			17	SS	24		106							
104.9			18	SS	35									
23.2	End of Borehole													
	• Note: Formerly BH #7 of W. P. 233 - 80													

# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 841 833.0; E 303 147.0 ORIGINATED BY G&ASSO.  
DIST 6 HWY 400 BOREHOLE TYPE POWER AUGER & CONE TEST COMPILED BY M V  
DATUM GEODETIC DATE 1962 09 27 TO 1962 10 01 CHECKED BY TCK

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 KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
127.3	Ground Surface													
0.0	CLAYEY SILT, Some Sand, Very Stiff to Stiff ( Fill )		1	SS	17									
125.2			2	SS	8									
2.1			3	SS	6									
			4	SS	8									
			5	SS	17									
			6	SS	19									
			7	TW	PH									
			8	SS	13									
			9	TW	PH									
			10	SS	10									
			11	TW	PH									
			12	SS	13									
			13	TW	PH									
			14	SS	8									
			15	TW	PH									
			16	SS	6									
			17	SS	8									
105.0														
22.3	End of Borehole													
	• Note: Formerly BH #8 of W. P. 233 - 60													

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 841 802.0; E 303 101.0 ORIGINATED BY G&ASSO.  
DIST 6 HWY 400 BOREHOLE TYPE POWER AUGER COMPILED BY M V  
DATUM GEODETIC DATE 1962 10 02 & 03 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60
127.0	Ground Surface														
0.0	SAND and GRAVEL (Fill)														
0.6	CLAYEY SILT, Trace of Sand, Trace of Gravel, Occasional Sand Seams, Very Stiff		1	SS	6										
			2	SS	13										
			3	SS	17										
			4	SS	18										
			5	SS	19										
			6	TW	PH										
			7	SS	12										
			8	SS	15										
			9	TW	PH										
			10	SS	22										
			11	TW	PH										
			12	TW	PH										
			13	SS	16										
			14	TW	PH										
106.7			15	SS	12										
20.3	End of Borehole														
	* Note: Formerly BH #9 of W. P. 233 - 60														



# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS N 4 843 819.8; E 302 824.6 ORIGINATED BY STRATA  
DIST 6 HWY 400 BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY M V  
DATUM GEODETIC DATE 1989 01 31 & 1989 02 01 CHECKED BY TCK

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 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
154.1	Road Surface																			
0.0	Asphalt																			
153.0	SAND and GRAVEL ( Granular Base )																			
1.1	CLAYEY SILT, Some Sand, Stiff to Very Stiff ( Fill )		1	SS	8															
			2	SS	8															
			3	SS	17															
			4	SS	10															
			5	SS	28															
148.2	Occasional Cobbles		6	SS	50	/8cm														
7.9	Some Sand  Very Stiff to Hard		7	SS	21															
			8	SS	33															
			9	SS	38															
			10	SS	11															
			11	SS	8															
139.5	CLAYEY SILT, Stiff  Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till )		12	TW	PH															
14.6			13	SS	36															
			14	SS	48															
			15	SS	99															
			16	SS	128															
			17	SS	61															
			18	SS	70	/1cm														
130.2	SHALE BEDROCK		19	RC BX	REC 80%															
23.9																				
128.1	End of Borehole • Note: Formerly BH #1 of W. P. 131 - 85 - 02  Water Level Not Stabilized																			
26.0																				

# RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS N 4 843 840.2; E 302 891.0 ORIGINATED BY STRATA  
DIST 6 HWY 400 BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY M V  
DATUM GEODETIC DATE 1989 01 25 CHECKED BY TCK

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 kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100												
								SHEAR STRENGTH kPa							WATER CONTENT (%)					
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE											
154.1	Road Surface																			
0.0	Asphalt																			
0.8	SAND and GRAVEL																			
			1	SS	9															
			2	SS	17															
	CLAYEY SILT, Some Sand, Stiff to Very Stiff ( Fill )		3	SS	23															
			4	SS	19															
148.2			5	SS	29															
7.9	Very Stiff to Hard		6	SS	52															
	Some Sand, Trace of Gravel		7	SS	19															
	CLAYEY SILT, Trace of Sand, Firm		8	SS	6															
			9	TW	PM															
139.2			10	TW	PM															
14.9	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Very Stiff to hard ( Glacial Till )		11	SS	15															
			12	SS	39															
134.6			13	SS	72															
18.5	SHALE BEDROCK		14	SS	85															
132.8																				
21.3	End of Borehole • Note: Formerly BH # 6 of W. P. 131 - 85 - 02  Water Level Not Observed																			

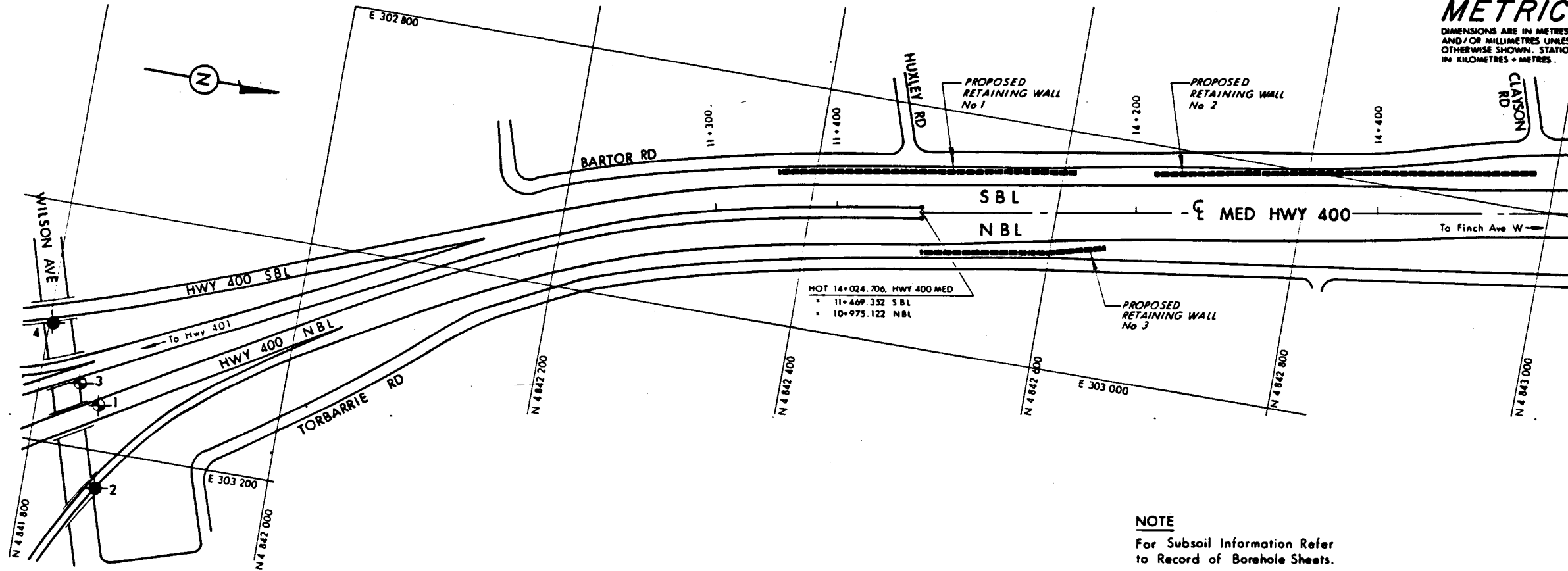
# RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 149 - 87 - 00 ( B ) LOCATION CO - ORDS. N 4 844 040.0; E 302 577.0 ORIGINATED BY V K  
 DIST 6 HWY 400 BOREHOLE TYPE PENDRILL & CONE TEST COMPILED BY M V  
 DATUM GEODETIC DATE 1971 02 09 CHECKED BY TCK

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
144.1	Ground Surface												
0.0	Very Stiff  -----  SILTY CLAY to CLAYEY SILT, Trace of Sand, Occasional Silt Seams, Firm		1	SS	30								
			2	SS	24								
			3	SS	16								
			4	TW	PM								
			5	TW	PM								
			6	TW	PM								
136.5	7.6 End of Borehole												
	* Note: Formerly BH #4 of W. P. 105 - 70 - 01												



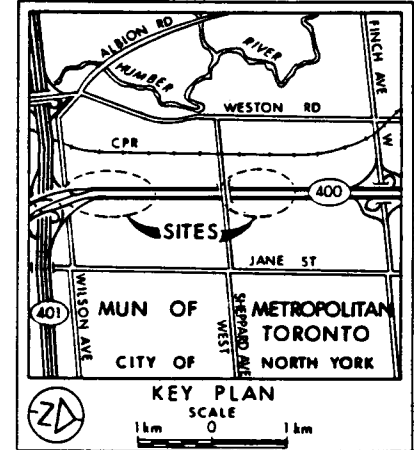
CONT No  
WP No 149-87-00(B)

PROP RETAINING WALLS HWY 400  
(Between Hwy 401 & Finch Ave W)

BORE HOLE LOCATIONS & SOIL STRATA



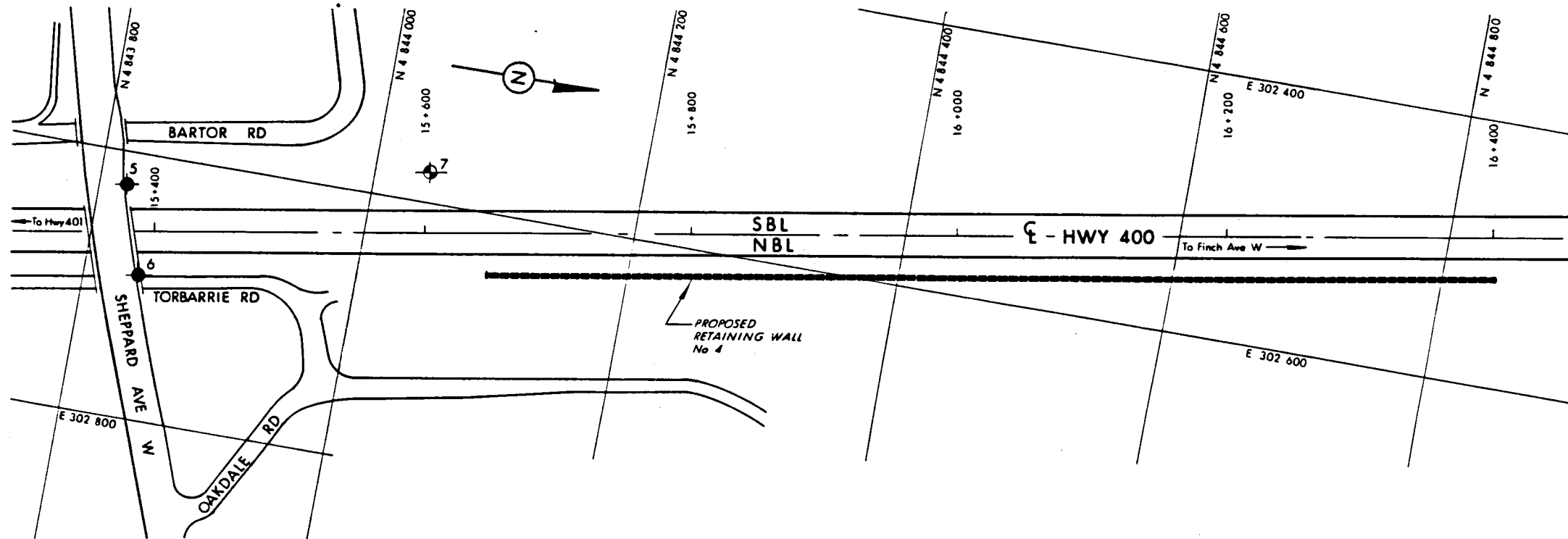
SHEET



**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)
- ⬆ WL at time of investigation  
1962 09 & 10, 1971 02, 1989 01 & 02

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	132.8	4841 851.0	303 162.0
2	128.1	4841 861.0	303 230.0
3	127.3	4841 833.0	303 147.0
4	127.0	4841 802.0	303 101.0
5	154.1	4843 819.8	302 624.6
6	154.1	4843 840.2	302 691.0
7	144.1	4844 040.0	302 577.0



**PLANS**

SCALE  
40m 0 40m

**NOTE**

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically included in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV	DATE	BY	DESCRIPTION

Geocres No 30M11-192

HWY No 400	CHECKED BY	DATE 1994 04 29	DIST 6
SUBORD M V	CHECKED BY	DATE 1994 04 29	SITE
DRAWN R S	CHECKED BY	DATE 1994 04 29	DWG 1498700(B)-A





Ontario

## memorandum



MINISTRY OF TRANSPORTATION  
Structural Section  
1201 Wilson Avenue  
Atrium Tower, 4th Floor  
Downsview, Ontario, M3M 1J8  
Telephone: 235-5659 Ext. 7720

DATE: February 1, 1994

TO: D. Dundas, P. Eng.  
Acting Chief Foundation Engineer  
Foundation Design Section

RE: Foundation Investigation at the proposed locations of Reinforced Earth Retaining Walls or Equivalent Structures between Hwy. 401 and Steeles Avenue, W.P. 149-87-00, District 6, Toronto

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Please provide a Foundation Report or a Foundation Memo Report, whichever is appropriate, for the above noted retaining is appropriate, for the above noted retaining walls. Enclosed please find 2 sets of 2 drawings showing the locations of the proposed structures, as well as ground and road grade elevations.

The present project schedule requires the preliminary foundation recommendations by March 15, 1994 and the final foundation recommendations by April 15, 1994.

L. Mikhailovsky  
Sr. Structural Engineer  
for:  
V. F. Boehnke  
Head, Structural Section

LM:vn



STRUCTURE PLANNING FIELD RECONNAISSANCE  
REPORT FOR SUBSURFACE EXPLORATION

Please see instructions on back

PROJECT INFORMATION	W.P. <u>149-87-00</u> Site No. <u>—</u> Dist. <u>6</u> Region <u>CENTRAL</u>
	Location <u>HWY 400 FROM HWY 401 TO STEELES AVENUE</u>
	Prog. Yr. <u>1995</u> Work Type <u>HWY RECONSTRUCTION</u> METRIC <input checked="" type="checkbox"/> MODIMP <input type="checkbox"/>

SITE FEATURES	Description of site conditions which may assist in proper planning and execution of subsurface exploration program (e.g. terrain conditions, local restrictions, etc.) <u>VARY</u>
	Photographs of site: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Return Requested: Yes <input type="checkbox"/> <u>N/A</u> No <input type="checkbox"/>

PERMISSION AND CLEARANCE	Property owners to be contacted for permission to enter property. 1. <u>N/A</u> Tel. _____ 2. _____ Tel. _____ 3. _____ Tel. _____ 4. _____ Tel. _____  (Note: To save time it is preferable that Region obtain entrance permission in advance)  Utility companies to be contacted for clearance permits. - INTERPROVINCIAL PIPE LINE INC. 1-(905) 849-7811 1. <u>SUN-CANADIAN PIPE LINE</u> Tel. <u>1-(905) 689-6641</u> - IMPERIAL OIL 1-(905) 689-6651 2. <u>TRANS-NORTHERN PIPE LINES</u> Tel. <u>(416) 724-2253</u> - ONTARIO HYDRO (905) 946-6000 3. <u>VAUGHAN HYDRO</u> Tel. <u>(905) 832-8371</u> - NORTH YORK HYDRO (416) 222-3311 4. <u>CONSUMERS GAS</u> Tel. <u>(416) 495-6167</u> - ROGERS CABLE (416) 446-6756 - BELL CANADA (416) 484-4841 - METRO TELECOM (416) 322-6305
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SCHEDULING INFORMATION	Does final E-Plan accompany this request? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If no, when will E-Plan or similar document be supplied? <u>B-PLANS (2 sets of 2) DWG</u>  Is site <u>presently</u> properly staked? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If no, is staking necessary to locate site in field? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>  Will recommendations be required in advance of report? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If yes, what is the last acceptable date for report? <u>APRIL 15, 1994</u>
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OTHER DATA	Nearest source of water <u>BLACK CREEK</u> Distance to site <u>VARIES</u>
	Nearest accommodation <u>N/A</u> Tel. No. _____
	Nearest similar structure <u>HWY 407 (REINFORCED EARTH RET. WALLS)</u> Design Information Available? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, where? _____ Nearest MTC Patrol <u>PAT. 43, HWY 400 &amp; SHEPPARD AVENUE</u> Tel. <u>742-8811, 742-8812</u>

Prepared By L. MIKHAILOVSKY Title SR. STRUCTURAL ENGINEER  
Date FEBRUARY 1, 1994

INSTRUCTIONS FOR COMPLETION  
OF FIELD RECONNAISSANCE REPORTS

1. This form should be filled out as completely as possible and should accompany any request for foundation engineering services.
2. Photographs of the site will often suffice in lieu of descriptive information on topography and ground cover. The purpose of the photographs and/or written information on topography and ground cover is to help the geotechnical engineer plan the most efficient subsurface exploration program using appropriate equipment and methods.
3. Lack of information on property ownership can cause considerable delays in commencement of field work, thus affecting the project schedule for foundation engineering services. Advance information on property ownership and clearance to enter property is always appreciated.

Any information on buried utilities is helpful. It is understood, however, that the ultimate responsibility rests with the field personnel providing the geotechnical services to ascertain the presence and location of buried utilities prior to commencement of the exploration program.

4. The information requested under 'Other Data' is useful in proper planning of field investigation. Advance information on other structures in the area alerts the field personnel to make pertinent performance observations for future decision-making on proposed project.

# MEMORANDUM



To: V. Boehnke  
Head, Structural Section  
4th Floor, Atrium Tower

Date: February 28, 1994

Attn: L. Mikhailovsky

From: Foundation Design Section  
Room 315, Central Bldg.

Tel: 235-3731  
Fax: 235-5240

Re: Reinforced Earth or  
Segmental Retaining Walls Along Hwy. 400  
Between Hwy 401 and Finch Avenue  
W.P. 149-87-00(B)  
District 6, Toronto

A preliminary recommendation is provided based on the information obtained from various foundation investigations carried out for existing structures in the area under W.P. 233-60, W.P. 131-85-02 and W.P. 105-70-01. No additional borings were carried out in the area where the retaining walls are proposed to be constructed.

The information provided to us indicate that the proposed structures will consist of either reinforced earth or segmental retaining walls. In addition, we were made to understand that the clear space between the face of the existing retaining wall and the proposed wall will be at least 3.0 m.

The underlying subsoil in the area proposed for retaining walls consist mainly of cohesive material. The underlying subsoil in the area between Hwy 401 and Hwy 400 and Hwy 400 and Sheppard Avenue consists of very stiff to firm clayey silt to silty clay. However, the area north of Hwy 400 and Sheppard Avenue consists of very stiff to hard heterogeneous mixture of clayey silt, sand and gravel (glacial till). The location of the retaining walls and the recommendation for each location is as follows:

## Location 1 (Stn. 11+350 to Stn. 14+150)

The existing ground level along the proposed wall varies from a minimum of El. 130.8 to a maximum of El. 137.6. The height of soil to be retained varies from a minimum 0.5 m to a maximum of 4.2 m. The following bearing capacity values are recommended for the design.

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. Type II = 150 kPa

## Location 2 (Stn. 14+215 to Stn. 14+530)

In this area, the ground level varies from El. 138.8 to El. 142.4. The height of soil to be retained varies from a minimum of 0.5 m to a maximum of 2.8 m. The wall may be designed assuming the following bearing capacity values.

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. Type II = 150 kPa



Location 3 (Stn. 10+835 to Stn 14+175)

The ground level along the proposed retaining wall varies from El. 131.3 to El. 138.0. The height of soil to be retained varies from a minimum of 1.0 m to a maximum of 3.6 m. The recommended bearing capacity values for the design are as follows:

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. Type II = 150 kPa

Location 4 (Stn. 15+693 to Stn. 16+175)

The ground level along the proposed retaining wall varies from El. 144.8 to El. 147.6. The height of soil to be retained varies from a ~~few millimetres~~ to a maximum of 1.4 m. The following bearing capacity values are recommended for the design.

Factored Bearing Capacity at U.L.S. = 225 kPa  
Bearing Capacity at S.L.S. Type II = 150 kPa

The sliding resistance for all four locations may be estimated based on effective angle of internal friction neglecting the effective shear strength of the founding soil. An unfactored coefficient of friction value of  $\tan 26^\circ$  may be assumed for the estimate.

Shallow footings in this area require a minimum of 1.2 m earth cover for frost protection. Considering the presence of ditches in the area and the susceptibility of the founding soil for frost heave, it is advisable to subexcavate and backfill with granular material if the wall is proposed to be constructed within the frost penetration depth.

If reinforced earth wall is proposed to be constructed, a Non-Standard Special Provision outlining such items as foundation preparation, reinforcing strip, backfill material and installation should be reviewed by this Section and included in the contract documents.

We believe that this memorandum meets with your present requirements. If you have any questions, please contact this office.

*M. Vasavithasan*

M. Vasavithasan, P. Eng.  
Foundation Engineer

for

T.C. Kim, P. Eng.  
Sr. Foundation Engineer

MV/TCK/jb