

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-124DIST. 2 REGION           W.P. No. 478-89-00CONT. No.           W. O. No.           STR. SITE No.           HWY. No. 401

LOCATION Hwy 401 from 0.5 km E of  
Interchge 199 Easterly to 2.1 km E of  
No == PAGES -                      Hwy 73

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.           

REMARKS:



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FILE No. \_\_\_\_\_ DATE \_\_\_\_\_

REMARKS \_\_\_\_\_

Wednesday @ 10:00 - Sheriff Sidky

Meet e Hwy 73/401 - Top of interchange  
on Hwy 401 if not

Arthur Watt (519) 649-3015 (Structural)

Bernie Cardyle (519) 649-3020 (Surveys & Plan)

Bob Harder (519) 878-0240 (Surveys & Plan)

#13 227 4740

Sheriff Sidky (519) 681-1441 Ext 3374

*FILE*



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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 478-89-00 DIST 3  
HWY 401 STR SITE N/A

Breakaway Sign Footings  
From 0.5 km East of Interchange 199  
Easterly to 2.1 km East of Highway 73

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# FOUNDATION INVESTIGATION REPORT

For

Breakaway Sign Footings

From 0.5 km East of Interchange 199

Easterly to 2.1 km East of Highway 73

W.P. 478-89-00, Site N/ A

Highway 401, District 3, Stratford

## **INTRODUCTION**

This report summarizes the results of a foundation investigation conducted in conjunction with proposed breakaway signs along the Highway 401 widening within the limits as mentioned above. A total of six(6) signs have been proposed between Stations 15+150 and 18+800 in areas characterized by previous swamp conditions. Some swamp subexcavation has been carried in the area under Contract 91-29, but investigation of the conditions at the specific breakaway sign locations is required to facilitate the foundation design.

## **SITE DESCRIPTION AND GEOLOGY**

The site is located on Highway 401 from 0.5 km east of interchange 199, easterly to 2.1 km east of Highway 73, in the Township of North Dorchester, County of Middlesex. The locations of the six separate breakaway signs are all on the gravel shoulder of Highway 401, or just beyond the gravel shoulder in a grassy area that is slightly sloping away from the road. In this area Highway 401 contains two(2) lanes in each direction with a 8 m-12 m gravel shoulder in each direction. As mentioned above, this area was once a swamp which was excavated when Highway 401 was constructed. Therefore, beyond the gravel shoulder and the grassy slope there is swamp area approximately 20-25 m from edge of pavement. Beyond the swamps, a heavily wooded area exists on either side of the Highway 401.

Physiographically, the site is located within the geological domain known as the Caradoc Sand Plains. The Caradoc Sand Plains, as the name implies, contain silts, sands and gravels deposited by glacial spillways during the retreat of the Wisconsin glacier that covered the area approximately 12,000 years ago. During the post glaciation period, the early Thames River cut through gravel terraces and formed deltas which covers most of Caradoc Township. The sands of Caradoc thin out toward the west until eventually the underlying clay appears on the surface.

The shallow silts and fine sands of the basin are not freely drained and as a result free standing water and swampy conditions are evident in the area. Thicknesses of peat are found in many instances overlying the sands and silts.

## **INVESTIGATION PROCEDURE**

### **General**

Soil data and inherent properties were obtained by conducting both an in situ field investigation and laboratory analyses. Details of the field investigation and the laboratory testing program are discussed below.

### **Field Investigation**

The fieldwork for this project was carried out between 93 06 08 and 93 06 09 and consisted of six(6) sampled boreholes advanced to depths ranging from 6.6 m to 9.6 m below the ground surface. The boreholes were advanced using a Canterra CT150 track-mounted drilling unit employing conventional continuous flight hollow stem augering techniques.

Subsoil samples were generally retrieved at 1.5 m intervals with auger samples taken within the surficial 1.5 metres. Disturbed subsoil samples were retrieved in accordance with the Standard Penetration Test (ASTM D1586) using a split spoon sampler driven into the soil.

All subsoil samples were identified in the field and then properly placed and sealed in plastic containers to preserve the natural moisture contents in the soil. The samples were then transported to the laboratory where further visual examination and laboratory testing was conducted as described in the next section below.

Groundwater levels were determined by monitoring the water levels in the open boreholes throughout the duration of the field investigation. All boreholes were backfilled upon completion of the fieldwork.

The survey related to the location and elevation of the individual boreholes was provided by the Southwestern Region Surveys and Plans.

### **Laboratory Analyses**

All subsoil samples were carefully visually examined in the laboratory in accordance with the procedures outlined in the Visual Method described in Chapter 2 of the MTO Soil Classification Manual. Laboratory testing consisted of Grain Size Distribution determination and Natural Moisture Content determination. Sample preparation and testing were conducted in accordance with the MTO Laboratory Testing Manual.

Laboratory test results have been summarized below in the subsequent section of this report entitled "Subsurface Conditions" and are illustrated on the corresponding Record of Borehole sheets and figures included in the Appendix to this report.

## **SUBSURFACE CONDITIONS**

### **General**

Although the borehole locations are widely scattered over an extensive area, the subsurface conditions are generally similar across the investigated area. The predominant native

deposit is poorly graded fine to medium sand with minor traces of silt that contains traces to some gravel at lower depths at various locations. The thickness of this cohesionless deposit investigated ranged from 5.4 m to 9.6 m. Traces of organics were found within the surficial 1.5 metres of the deposit at BH's 5 and 6.

At some locations, the native sand deposit is overlain by either minor thicknesses of fill material, also consisting of sand or shallow thicknesses of peat. The sand fill material was encountered at BH 2 for a thickness of 1.8 metres. At BH's 3 and 4, 0.3 and 1.2 metres of dark brown peat that consisted of decayed vegetative matter and also silt and sand percentages were encountered respectively.

Soil descriptions, boundaries between the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of the investigation are shown on the individual Record of Borehole sheets in the Appendix. Subsoil and groundwater conditions are also described below.

## **SUBSOIL CONDITIONS**

### **Sand (Fill Material)**

A brown, compact sand of approximately 1.8 metre thickness was encountered at BH 2. It appears that this material was fill placed as part of the swamp subexcavation conducted in conjunction with the highway widening in the area.

### **Peat**

A very soft to soft dark brown peat material, typical of swampy conditions was encountered at BH's 3 and 4 for thicknesses of 0.3 m to 1.2 m respectively. This material consisted of decayed vegetative matter combined with silt percentages with some sand. As expected, moisture contents were extremely large (up to 241%).



**Sand, trace Silt to Sand, with Gravel**

The predominant native deposit at the site consists of a cohesionless, saturated sand that varies in silt and gravel percentages. The sand is a poorly graded fine to medium sand and silt percentages ranged from traces (<10%) to some silt (17%). Gravel percentages ranged from zero to some percentages (23%). A Grain Size Distribution envelope and gradation curves as determined by mechanical sieve analyses are illustrated on Figure 1 in the Appendix. The deposit was explored for thicknesses ranging from 5.4 m to 9.6 m.

In view of the high water table across the entire site, most of the deposit is submerged beneath the groundwater table. As a result, the cohesionless soil is susceptible to a "boiling condition" if subjected to unbalanced hydrostatic head. This condition developed during the borehole advancement and as a result, borehole cave-in and sloughing was observed throughout the borehole penetration in this material at the base of the borehole below the groundwater table.

The 'N' values as derived from the Standard Penetration Test revealed values ranging from 1 blow/0.3 m to 97 blows/0.3 m suggesting a very loose to very dense state of dense. The lower 'N' values may be attributable to soil disturbance created by the "boiling" condition described above whereas the larger 'N' values may be attributable to the coarser gravel sizes. In general, 'N' values were in the 10 blows/0.3 m to 30 blows/0.3 m range indicating a compact state of denseness.

**GROUNDWATER CONDITIONS**

Observation of the groundwater level was carried out by measuring the water levels in the open boreholes throughout the duration of the field investigation. Groundwater levels determined at the time of the investigation are summarized in Table 1 below:

Table 1 - Groundwater Levels		
BH No.	Depth (m)	Elevation (m)
1	0.5	260.3
2	0.5	260.5
3	0.3	260.3
4	0.9	261
5	1.8	261.6
6	1.5	262

Groundwater levels are subject to seasonal fluctuations and hence can vary from the values given in this report.

## **DISCUSSION AND RECOMMENDATIONS**

A total of six(6) breakaway signs have been proposed as part of the Highway 401 widening at locations from approximately 0.5 km east of interchange 199 easterly to 2.1 km east of Highway 73. Table 2 in the Appendix summarizes the location and size of the proposed signs.

Figure 5.4.3. (page 5-31 of the Sign Support Manual) illustrates a typical and conventional footing used to support breakaway signs. The footing consists of a steel column stub embedded to a certain depth in a 450 mm diameter augered hole. The annular space between the shaft of the hole and the column stub is concrete infilled.

The request for the foundation investigation for the breakaway signs was based on the possibility that the subsoil conditions at the sign locations were swamp-like in nature rendering the conventional footing design described above unsuitable. The scope of the investigation was therefore defined to determine the subsoil conditions at each specific breakaway sign and to develop a contingency design should the conditions prove to be unfavourable for the conventional design.

Recommendations pertaining to the design and construction of the breakaway sign foundations are contained in this report.

### **Design Considerations/Parameters**

As discussed in the factual component of this report, subsoil conditions determined at the proposed breakaway sign locations are such that peat material was found at only sign numbers 3 and 4 with traces of organics present at sign numbers 5 and 6 for thicknesses up to approximately 1.5 metres. Sign areas range from 8.8 m<sup>2</sup> to 12.6 m<sup>2</sup> and based on the sign area - footing depth table given in Figure 5.4.3 of the Sign Support Manual, a footing depth of 1.7 m to 2 m is required. The acceptability of the conventional footing must be examined

based on the applied loads and the horizontal capacities of the soil. The footing design must satisfy the conditions of limit states design as specified in the O.H.B.D.C. The footing design is a function of the horizontal subgrade reaction, pile length and size and pile stiffness. In view of the similarities with the design of high mast pole foundations, the designer can reference the MTO design manual entitled "Procedures for the Design for High Mast Pole Foundations" available at the Structural Office in determining the adequacy of the conventional design or whether a modification is necessary. A standard high mast pole concrete caisson can be used as an alternative design.

The computation of the horizontal capacity of the foundation must incorporate the following guidelines.

- (1) lateral resistance be neglected within the frost penetration depth equivalent to 1.2 m at the site. Lateral loads within the frost penetration depth should however still be applied in the calculations.
- (2) lateral resistance be neglected within the peat material.
- (3) lateral resistance be neglected within the fill material.

Table 3 in the Appendix provides soil parameters to facilitate the design of the sign support foundations. The soil design parameters include:

- (1) the angle of internal friction ( $\phi$ ) for cohesionless soils. This parameter is given in unfactored form and hence should be factored in accordance with Section 6-5.2 of the O.H.B.D.C.
- (2) saturated unit weight of soil ( $\gamma$ ). The buoyant unit weight of soil ( $\gamma'$ ) shall be applied for soils submerged beneath the groundwater table.

- (3) the groundwater table elevation.

### **CONSTRUCTION CONSIDERATIONS**

The cohesionless submerged native sand deposit with the silt and gravel percentages present at all breakaway sign locations will slough into an open hole produced in the advancement of an unprotected drilled shaft. This condition is the result of unbalanced hydrostatic head as described earlier in this report. It is recommended that the contractor be advised of this potential condition and instructed to render the bored pile stable without any soil cave-in throughout the installation of the footing. This information should be supplied to the contractor via a Non Standard Special Provision (NSSP) included in the contract documents.

Experience has shown that conventional bored caissons can be successfully advanced through cohesionless materials submerged beneath the groundwater table using one of two methods:

- (a) installing a temporary liner and constructing the caisson within the steel liner. After the liner has been cleaned out and the required reinforcing installed, the concrete should be placed in the dry or via tremie methods. A rapid withdrawal of the temporary casing should be avoided subsequent to concrete placement to prevent the intrusion of soil in the concrete (necking). Conversely, the temporary liner should not be allowed to get stuck in partial set concrete. The unbalanced head must be controlled throughout the installation process.
- (b) mud drilling and tremie techniques may be employed. The application of this method should be associated with a quality assurance program that will verify the quality of the bentonite slurry (density, viscosity, etc.).

**MISCELLANEOUS**

The field work for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer and N. Mullen, Engineering Student. utilizing equipment owned and operated by London Soil Test.

The project was carried out by T. Sangiuliano under the general supervision of P. Payer, Senior Foundation Engineer. The report was written by T. Sangiuliano, reviewed by P. Payer and approved by M. Devata, Chief Foundation Engineer.



A handwritten signature in black ink, appearing to read 'T. Sangiuliano'.

T. Sangiuliano, P.Eng.  
Foundation Engineer

A handwritten signature in black ink, appearing to read 'M. Devata'.

M. Devata, P.Eng.  
Chief Foundation Engineer

## **APPENDIX**

**Table 2 - Breakaway Sign Supports**

**W.P. 478-89-00**

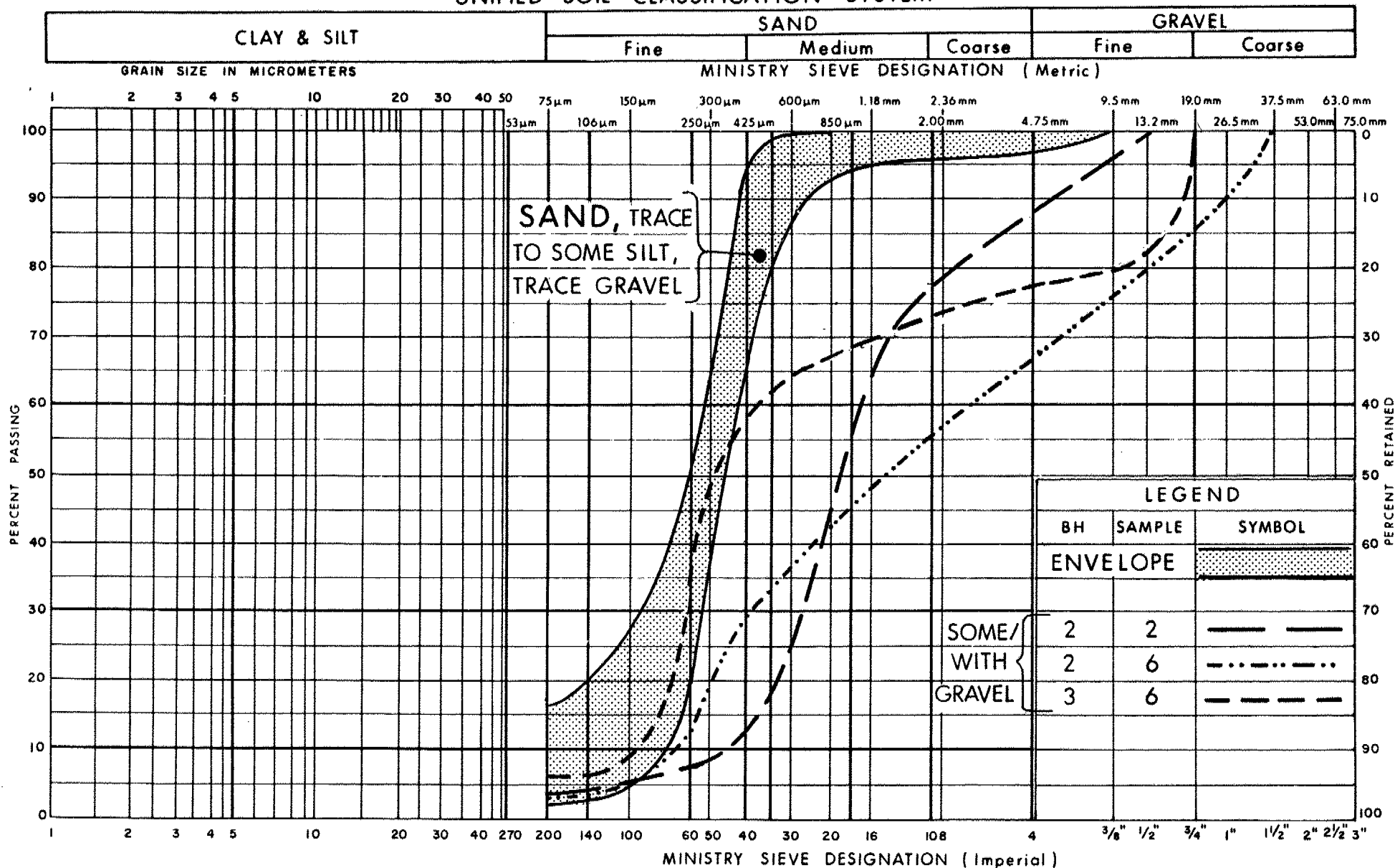
<b>Sign No.</b>	<b>Sign Size (Height x Width) (m)</b>	<b>Sign Area (m<sup>2</sup>)</b>	<b>Station</b>	<b>Offset (m) (C/L of Hwy. 401)</b>
1	2.1 x 6.0	12.6	15+150 Adv. WBL	21.6
2	2.4 x 4.2	10.1	16+070 Adv. WBL	21.6
3	2.1 x 4.2	8.8	17+070 Turn EBL	31
4	2.1 x 4.2	8.8	17+800 Turn WBL	31
5	2.4 x 4.2	10.1	18+420 Adv. WBL	21.6
6	2.1 x 4.8	10.1	18+800 Dest. EBL	21.6



**Table 3 - Breakaway Sign - Soil Design Parameters**

Sign No.	BH No.	Soil				G.W.L. Elevation (m)	Remarks
		Type	Elevation (m)	Angle of Internal Friction ( $\gamma$ ) (°)	Saturated Unit Weight ( $\gamma$ ) (kN/m <sup>3</sup> )		
1	1	Sand	261.3-254.7	30	20	260.3	None.
2	2	Fill Sand	261-259.2 259.2-251.4	30 30	20 20	260.5	No lateral resistance in fill.
3	3	Peat Sand	260.6-260.3 260.3-253 253-251	0 30 35	20 20 20	260.3	No lateral resistance in Peat.
4	4	Peat	261.9-260.7 260.7-255.3	0 30	20 20	261	No lateral resistance in Peat.
5	5	Sand	263.4-258 258-253.8	28 30	20 20	261.6	Surficial Traces Organics.
6	6	Sand	263.5-262 262-253.9	28 30	20 20	262	Surficial Traces Organics.

## UNIFIED SOIL CLASSIFICATION SYSTEM



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## GRAIN SIZE DISTRIBUTION

SAND, TRACE SILT TO SAND, WITH GRAVEL

FIG No 1

W P 478 - 89 - 00

## 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

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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$kPa^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	$m^2/s$	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 = $\frac{c_u}{\tau_r}$

### 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

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

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 478-89-00 LOCATION Coordinates: N 4 758 754.2 E 423 562.5 ORIGINATED BY NM  
DIST 2 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY TS  
DATUM Geodetic DATE 93 06 09 CHECKED BY PP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT 7 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		
261.3	Ground Surface															
0.0			1	AS	-											0 97 (3)
			2	SS	13											
	Sand, trace Silt															
	Brown, Compact		3	SS	22											
			4	SS	15											
254.7			5	SS	15											
6.6	End of Borehole • 93 06 09															

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 478-89-00 LOCATION Coordinates: N 4 758 927.2 E 424 469.7 ORIGINATED BY NM  
 DIST 2 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY TS  
 DATUM Geodetic DATE 93 06 08 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 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>		
261.0	Ground Surface																
0.0	Sand (Fill Material) Brown, Compact																
259.2			1	SS	24												
1.8																	
	Sand, some to with Gravel trace Silt Compact to Dense		2	SS	43												
			3	SS	14												
	Grey Brown		4	SS	32												
			5	SS	28												
251.4			6	SS	38												
9.6	End of Borehole • 93 06 08																

# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 478-89-00 LOCATION Coordinates: N 4 759 141.8 E 425 443.9 ORIGINATED BY NM  
DIST 2 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY TS  
DATUM Geodetic DATE 93 06 08 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	w <sub>p</sub>	w	w <sub>L</sub>		
260.6	Ground Surface		1	AS	-												
260.3	Peat, Dark Brown, Very Soft		2	SS	16												
0.3			3	SS	3												
	Sand, trace Silt		4	SS	14												
	Grey		5	SS	10												
	Very Loose to Compact		6	SS	49												
	Dense to Very Dense		7	SS	97												
	Some Gravel																
251.0																	
9.6	End of Borehole																
	* 93 06 08																

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 478-89-00

LOCATION Coordinates: N 4 759 592.5 E 427 115.5

ORIGINATED BY NM

DIST 2 HWY 401

BOREHOLE TYPE HS Auger

COMPILED BY TS

DATUM Geodetic

DATE 93 06 09

CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 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>		
261.9	Ground Surface																
0.0	Peat Dark Brown, Very Soft		1	AS	-											2 22 (76)	
260.7																	
1.2			2	SS	10												
	Sand, trace Silt Grey, Compact																
			3	SS	15											0 97 (3)	
			4	SS	12												
	trace Gravel																
255.3			5	SS	15												
6.6	End of Borehole * 93 06 09																

# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 478-89-00

LOCATION Coordinates: N 4 759 464.6 E 426 754.3

ORIGINATED BY NM

DIST 2 HWY 401

BOREHOLE TYPE HS Auger

COMPILED BY TS

DATUM Geodetic

DATE 93 06 08

CHECKED BY PP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT 7 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>		
263.4	Ground Surface															
0.0																
	trace Organics,		1	AS	-											
	Brown		2	SS	4											
	Grey		3	SS	1											0 83 (17)
			4	SS	8											
	Brown															
	Sand, trace to some Silt															
	and trace Gravel		5	SS	7											3 90 (7)
	Very Loose to Compact															
			6	SS	26											
			7	SS	25											
253.8			8	SS	18											
9.6	End of Borehole															
	• 93 06 08															



# RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 478-89-00 LOCATION Coordinates: N 4 759 592.5 E 427 115.5 ORIGINATED BY NM  
 DIST 2 HWY 401 BOREHOLE TYPE HS Auger COMPILED BY TS  
 DATUM Geodetic DATE 93 06 09 CHECKED BY PP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			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	w <sub>p</sub>	w		
263.5	Ground Surface															
0.0	trace Organics, Grey		1	AS	-											0 87 (13)
			2	SS	13											
	Brown Grey		3	SS	15											
	Sand, trace to some Silt Loose to Compact		4	SS	6											0 97 (3)
			5	SS	15											
			6	SS	19											
253.9			7	SS	17											
9.6	End of Borehole • 93 06 09															