

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 282-85-01 DIST 18  
HWY 17 STR SITE 38S-89

Garden River Bridge

DISTRIBUTION

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The existing structure is showing signs of distress. The abutments are settling and rotating, and the approach fills are settling.

### SUBSURFACE CONDITIONS

#### General

The surficial deposit at the borehole locations consists of 1.3 to 2.9 m thick granular roadway fill in a poor to moderate degree of compaction. Underlying this material is a very loose to compact silty sand some 1.3 to 5.2 m thick. Directly below this silty sand layer is an 8.8 to 12.7 m thick deposit of soft to stiff silty clay of low plasticity. This cohesive stratum is in turn underlain by a deposit of compact to very dense sand some 4.0 to 10.0 m thick. Underlying this sand is a firm to very stiff silty clay of intermediate plasticity. The lower boundary of this cohesive deposit was not established but was confirmed to a thickness of 45.9 m in the vicinity of BH 6.

The boundaries between the various deposits as determined at the boring locations are shown on the accompanying Record of Borehole sheets. The stratigraphical sections inferred from this data are shown on Drawings 2828501-A and 2828501-B.

From the ground surface downwards the various soil types encountered are described as follows:

#### Fill: Gravelly Sand to Medium Sand

This 1.3 to 2.9 m thick roadway fill was encountered in all boreholes except BH 3 and BH 6 which were located in the river. The material is primarily composed of brown to dark brown gravelly sand, trace of silt. There is no appreciable amounts of topsoil, however traces of root hairs were found in the upper 1 to 2 m of the fill material. The amounts of gravel, silt and organics varies randomly within this material.

No laboratory testing was carried out in this layer, however visual identification was carried out on all samples.

Based on N values, which range in a random fashion from 3 to 22 blows/0.3 m it is estimated that this non-cohesive fill material is in a poor to moderate state of compaction, being generally in the poor state.

#### Sandy Silt to Sand

The fill material previously described is underlain by a deposit of brown silty sand some 1.3 to 5.5 m thick. The amount of silt and sand varies significantly in this deposit. This stratum contains traces of gravel with minor intrusions of organics. This deposit includes occasional cohesive zones but essentially the overall character of the deposit is described as non-plastic.

Three grain size distribution tests were carried out on samples of this material. The results are shown on Figure 1 in the Appendix. As evidenced by the results of these tests, the composition of this non-cohesive deposit ranges from a sandy silt to a sand. Traces of clay and gravel are also present.

Based on N values which range in a random fashion from a low of 1 to a high of 14 blows/0.3 m, it is estimated that the relative denseness of this granular deposit is very loose to compact, being typically in the loose range. Generally the high N values correspond to gravelly zones encountered within the deposit.

#### Silty Clay, Low Plasticity

Underlying the silty sand is a deposit consisting generally of brown silty clay of low plasticity some 8.8 to 12.7 m thick. Variations with depth are evident. The upper 6 m of this deposit includes layers of grey silt of slight plasticity up to 0.5 m in thickness. Minor traces of organics are found in the top zone of this stratum.

The lower zone of this deposit includes imbedded nodules of reddish brown silty clay of intermediate plasticity, trace gravel. Also, air voids up to 1 cubic centimetre were found throughout this stratum.

In addition, thin silty sand seams, which were encountered randomly throughout the entire deposit, become much thicker (20 mm to 40 mm) in the lower 1 to 2 m of the stratum.

The results of 9 Atterberg Limits tests carried out on samples of this material are shown on Figure 2 in the Appendix. The results indicate the following:

	<u>Range</u>
Moisture Content (W)%	28-45.5
Liquid Limit ( $W_L$ )%	24.5-41
Plastic Limit ( $W_p$ )%	17-22.5
Plasticity Index ( $I_p$ )%	4-20

Based on these results, as shown on Figure 2, this material can be considered to be primarily a silty clay of low plasticity. Seams of slightly plastic material are also present.

Figure 3 in the Appendix shows, in envelope form, the results of gradation tests carried out on 8 samples of this material. The results are summarized as follows:

	<u>Range (%)</u>
Gravel	0
Sand	0-27
Silt	64-85
Clay	8-25

Unit weight measurements were made on 6 samples of this material resulting in a range between 17.9 and 19.3 kN/m<sup>3</sup>.

Consolidation tests carried out on two undisturbed samples indicate that this layer is very compressible. The following results were obtained:

<u>BH</u>	<u>DEPTH</u> <u>(m)</u>	<u>P<sub>c</sub></u> <u>(kPa)</u>	<u>C<sub>c</sub></u>	<u>e<sub>o</sub></u>
2	11	131	0.330	1.32
4	14	49	0.250	1.19

Based on the interpretation of undrained shear strength measurements together with the N values, this cohesive material is considered to have a very soft consistency. It should be noted that some high N values (up to 22) were obtained, however these were attributed to the presence of non-cohesive silty sand seams.

#### Sand

The silty clay previously described is underlain by a deposit of light brown sand some 4.0 to 10.0 m thick. In BH 3 the sand contains some silt. This granular material is poorly graded, generally becoming finer with increasing depth.

Based on N values ranging from 10 to over 102 blows/0.3 m it is estimated that the denseness of this material is compact to very dense. Typically this stratum becomes denser with depth.

Figure 4 in the Appendix shows the results of grain size distribution tests carried out on 2 samples of this material.

#### Silty Clay, Intermediate Plasticity

Underlying this sand is a deposit of reddish brown silty clay of intermediate plasticity (CH group). Figure 5 in the Appendix shows the results of Atterberg Limits tests carried out on 2 samples of this cohesive material. The extent of this stratum was not established, but was confirmed to a thickness of 23.4 m and 45.9 in BH 5 and 6 respectively.

Based on interpretation of undrained shear strength measurements together with N values in the range of 4 to 21 blows/0.3 m, the consistency of this material is considered to be firm to very stiff.

GROUNDWATER CONDITIONS

Groundwater observations carried out during the investigation indicate that the ground watertable is governed by the water level of the river. At the time of the investigation the top of ice in the river was at Elev. 177.4. The groundwater level in the vicinity of the site can be assumed to be at the same elevation as the water level in the river, and therefore can be assumed to vary seasonally.

## DISCUSSION AND RECOMMENDATIONS

### General

A bridge condition survey was carried out in September 1984 by the Engineering and Right-of-Way Office, Northwestern Region. The results can be found in the Preliminary Design report for this site. As a result of the condition survey, Garden River bridge was put on a five year construction program. Four alternatives were proposed in the report. The alternatives were:

- ALT. #1. Complete bridge replacement
- ALT. #2. Deck rehabilitation and foundation stabilization
- ALT. #3. Deck rehabilitation
- ALT. #4. No action

This report contains recommendations regarding Alternatives #1 and #2. Alternative #1 includes foundation design for the new bridge abutments, piers and approaches. Alternative #2 concerns itself with the rehabilitation of the existing structure.

Both alternatives require two temporary Bailey bridges. The recommendations for the Bailey bridges are included at the end of this section.

The recommendations that follow utilize timber piles driven to a pre-determined elevation. Prior to finalizing the structural design this Section would like to carry out a full scale pile load test at this site so that the loadings presented in this report can be confirmed. This Section should be made aware of the project program so that the test can be scheduled.

### ALT. #1: COMPLETE BRIDGE REPLACEMENT

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Alternative #1 proposes to construct a new three span (25 m-30 m-25 m) continuous bridge. The alignment and profile will be the same as the existing structure. The following are our recommendations for the proposed structure.

The abutments and piers could be supported on Size 36 treated timber piles driven to a predetermined pile tip elevation.

Table #1 indicates the location, station, factored axial capacity at U.L.S., axial capacity at the S.L.S. Type II and pile tip elevation. If significant deviations from the assumed stations occur this section should be contacted for a review of these recommendations. It should be noted that piles should not be driven deeper than the elevations given.

TABLE 1

<u>LOCATION</u>	<u>STA.</u>	FACTORED	AXIAL CAP.	PILE
		AXIAL CAP.	AT S.L.S.	
		<u>AT U.L.S.</u>	<u>TYPE II</u>	<u>TIP ELEV.</u>
West Abutment	16+110	350 kN	220 kN	164
West Pier	16+135	350 kN	220 kN	162
East Pier	16+165	350 kN	220 kN	161
East Abutment	16+190	350 kN	220 kN	162

The loadings are subject to revision after a pile load test is complete. Similarly, field control measures for the pile driving will be given after the load test.

Dewatering will be required if the pile caps lie below the prevailing water table since the surficial underlying materials are of a non-cohesive nature.

In order to prevent rotational movement of the abutment the extreme end of the wing walls should also be supported on treated timber piles similar to those previously described. It is considered that this will improve the stability of the abutment in the longitudinal direction.

Particle size of fill material placed in the area where piles will be driven should not exceed 75 mm in order to facilitate pile driving. Any surficial boulders which may obstruct pile driving should also be removed.

#### Lateral Earth Pressures

Abutments should normally be designed for the active earth pressure ( $k_a$ ) condition. The at-rest ( $k_o$ ) condition should only be used in cases where the deflection of the abutment is prevented by the propping action of the deck, such as is the case with a rigid frame structure. Similarly, the at-rest ( $k_o$ ) condition can be used for abutments on spread footings founded on unyielding material unless the abutment can deflect sufficiently to mobilize the active earth pressures.



Backfill to structures should consist of granular material in accordance with M.T.C. Standard Special Provision #121 (dated October 1983). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C. For design purposes, the physical properties of the backfill are as follows:

<u>Material</u>	<u><math>\phi</math></u>	<u><math>\gamma</math></u>
Granular 'A'	35°	22.0 kN/m <sup>3</sup>
Granular 'B'	30°	21.2 kN/m <sup>3</sup>

### Approach Fills

Since the approaches will not be increased in height no stability problems are anticipated in the embankments providing standard 2H:1V slopes are maintained. However if any widening is required the new slopes should be keyed into the existing fill as per current M.T.C. Standards.

In order to minimize future settlement of the approach fills, the existing fill should be excavated to a maximum depth of 3 m, to a point 30 m back of the abutments and replaced with light-weight fill, such as air cooled slag of nominal 10 mm diameter and with a maximum in-place unit weight of 11 kN/m<sup>3</sup>. This will reduce future settlement in the immediate approaches.

*3m x 30m  
Σ 10% TAPER*

Any surficial organic material should be excavated to its full depth prior to placing any new fills in this area.

A minimum 2 m of frost cover or equivalent should be provided to the underside of pile caps.

Random rip-rap should be placed up to the high-high water table to prevent scour action by the river at the abutment locations.

### ALT. #2: DECK REHABILITATION AND FOUNDATION STABILIZATION

The existing four span steel girder bridge was constructed during the early 1940's. Accurate records of the design and construction were not kept and consequently the information available regarding the foundation of this bridge is limited. It is assumed however that the piers are supported on piles (probably timber) and that the abutments are supported on spread footings.

Maintenance records dating back to 1956 indicate that the abutments are in a state of complete failure. They are cracked through the ballast walls and rotation and settlement are continuously occurring.

The piers are experiencing serious cracking and spalling. No evidence of settlement or rotation of the piers has been documented.

The approaches are settling and thus resulting in heavy vehicle impact on the structure end spans. The approaches have been padded in the past but are presently exhibiting further settlement.

The following are our recommendations for remedial action of the existing bridge.

#### Existing Abutments

The existing abutments are in a state of complete failure. The abutment footings are founded on very loose to compact silty sand. This is a very poor foundation material and in our opinion could result in excessive settlements and potential for failure in the future. It is recommended that the existing abutments be removed and replaced with new abutments supported on Size 36 treated timber piles using the data previously given in Table 1.

Temporary support will be required while the abutments are being demolished and reconstructed. For temporary support systems at the abutment locations the bearing capacity of the ground surface can be assumed to be 50 kPa at the S.L.S. Type II.

#### Existing Piers

No history of settlement at the piers is evident. As a result the rehabilitation of the deck should not impose any detrimental effects on the piers provided that the loads acting on the piers is not increased. If an increase in loading occurs, additional Size 36 treated timber piles will be required to accommodate this new load at the existing pier locations. Any new piles should be designed as per the tip elevation and loadings given in Table 1.

### Approach Fills

The recommendations given in Alternative 1 with regards to the approach fills apply for Alternative 2.

### TEMPORARY BAILEY BRIDGES

Two Bailey bridges are required during the construction. There are two possible locations. Option #1 involves one Bailey on the north side of the existing structure and the other located on the south side. Option #2 involves both Baileys located on the south side of the existing structure.

#### OPTION #1: NORTH AND SOUTH SIDE

The two span north side temporary Bailey bridge will carry the westbound traffic. The centre pier and abutment could be supported on size 36 treated timber piles driven to a predetermined tip elevation as per Table 2. If for any reason piles are unacceptable, the Bailey bridge may be supported on rock filled timber cribs. For design purposes the bearing capacity at the S.L.S. Type II of 50 kPa can be used.

The two span south side temporary Bailey bridge will carry the eastbound traffic. The existing concrete abutments of the abandoned bridge at this site may be utilized in order to support the Bailey bridge abutments. The centre pier could be supported on timber piles as per Table #2.

#### OPTION #2: SOUTH SIDE ONLY

The two Bailey bridges could be erected, side by side, partly on the M.T.C. R.O.W. and partly on the Garden River Indian Reserve. The centre piers could again be supported by Size 36 timber piles. However, since no information exists on the substructure of the concrete remains mentioned above, and since the easterly abandoned abutment exhibits longitudinal cracking, it is assumed that they cannot support both Baileys without undue risk of serious settlement or failure. Therefore one of Baileys should have its abutments supported on Size 36 timber piles, as per Table 2.

TABLE 2

<u>LOCATION</u>	<u>STA.(±)</u>	FACTORED AXIAL CAP. <u>AT U.L.S.</u>	AXIAL CAP. AT S.L.S. <u>TYPE II</u>	PILE TIP ELEV. <u>TIP ELEV.</u>
North Bailey:				
West Abutment	16+120	350 kN	220 kN	163
Central Pier	16+150	350 kN	220 kN	162
East Abutment	16+180	350 kN	220 kN	162
South Bailey:				
West Abutment	16+110	350 kN	220 kN	166
Central Pier	16+138	350 kN	220 kN	163
East Abutment	16+165	350 kN	220 kN	160

As mentioned previously, the loadings given in this table are subject to revision after a full scale pile load test is carried out at this site.

The exact alignment of the proposed Bailey bridges were not available at this time. If significant deviations from the above assumed stations occur this section should be contacted so that the recommendations can be reviewed.

MISCELLANEOUS

The field work for this investigation was carried out during the period 86 02 26 to 86 03 27, under the supervision of Mr. J. Fellenius and Mr. D. Protulipac, Student Engineers.

The report was prepared by Mr. J. Fellenius under the supervision of Mr. L. Politano, Project Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer.

The Equipment used was owned and operated by Dominion Soil Investigation, and by Marathon Drilling.

*Jan Fellenius*

J. Fellenius  
Student Engineer



*M. Devata*

M. Devata, P. Eng.  
Chief Foundations Engineer  
(East)

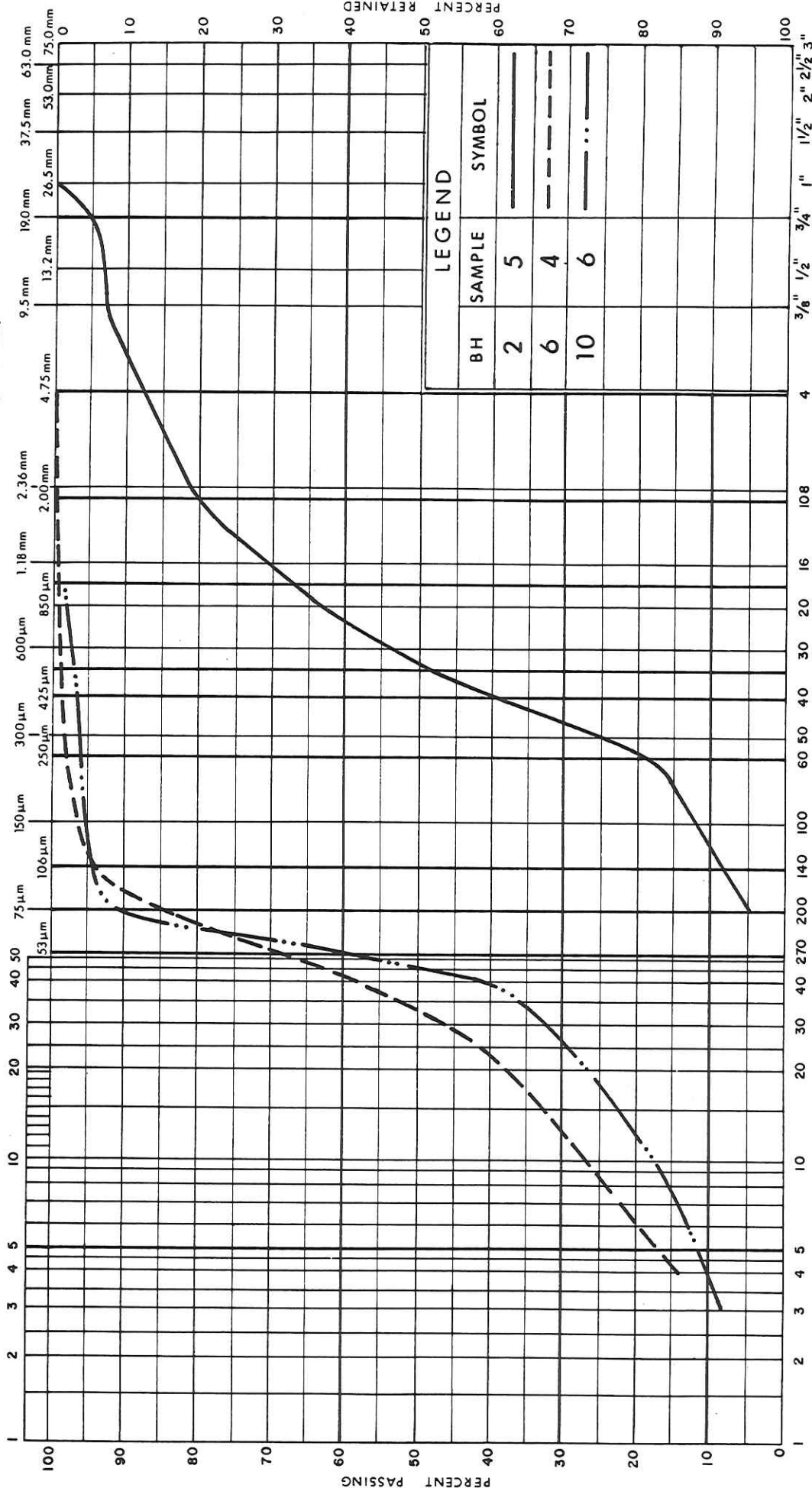
APPENDIX

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



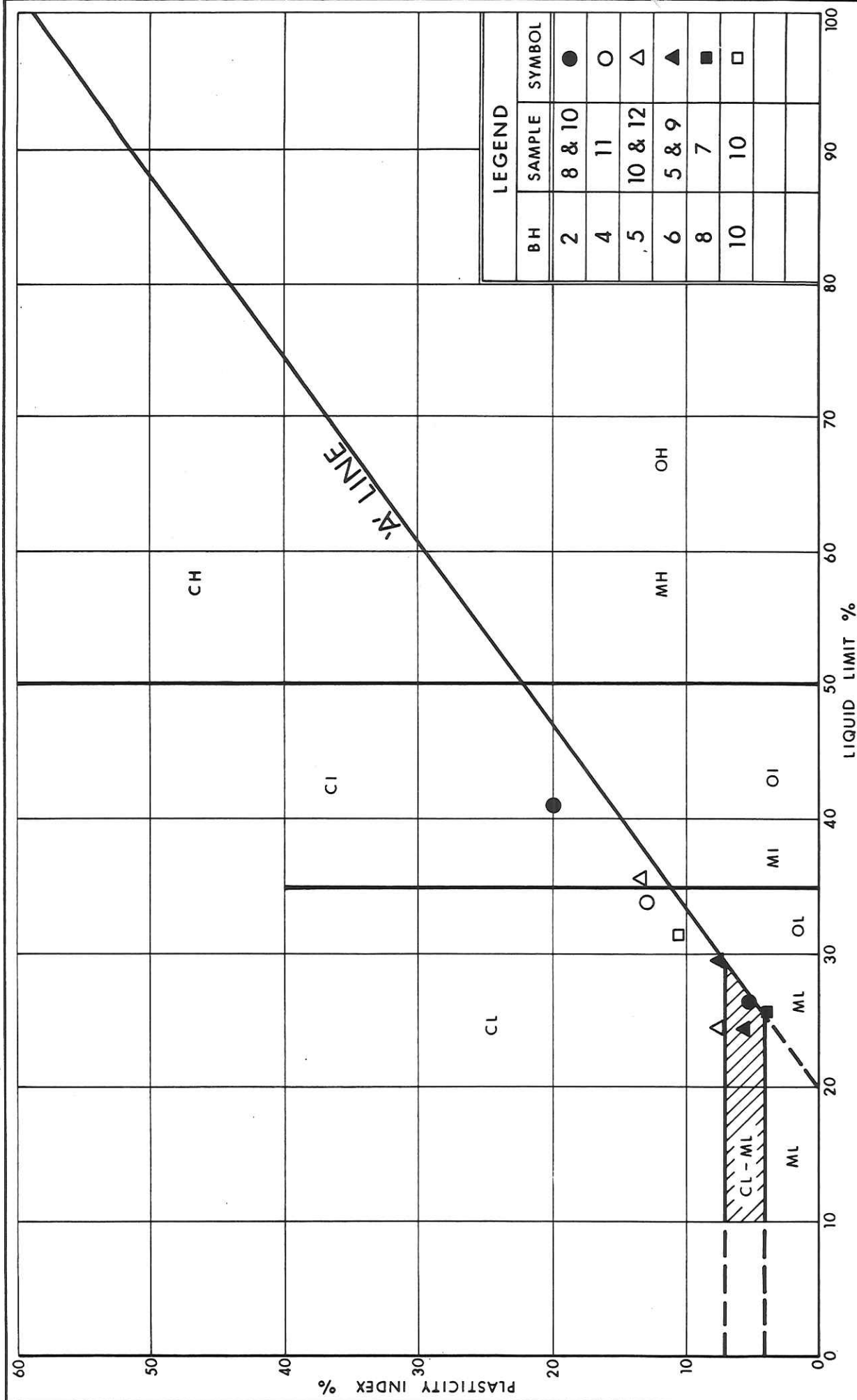
GRAIN SIZE DISTRIBUTION  
SANDY SILT TO SAND

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FIG No 1

W P 282-85-01



# PLASTICITY CHART SILTY CLAY, (LOW PLASTICITY)

FIG No 2

W P 282-85-01





GRAIN SIZE DISTRIBUTION  
SILTY CLAY (LOW PLASTICITY)

FIG No 3

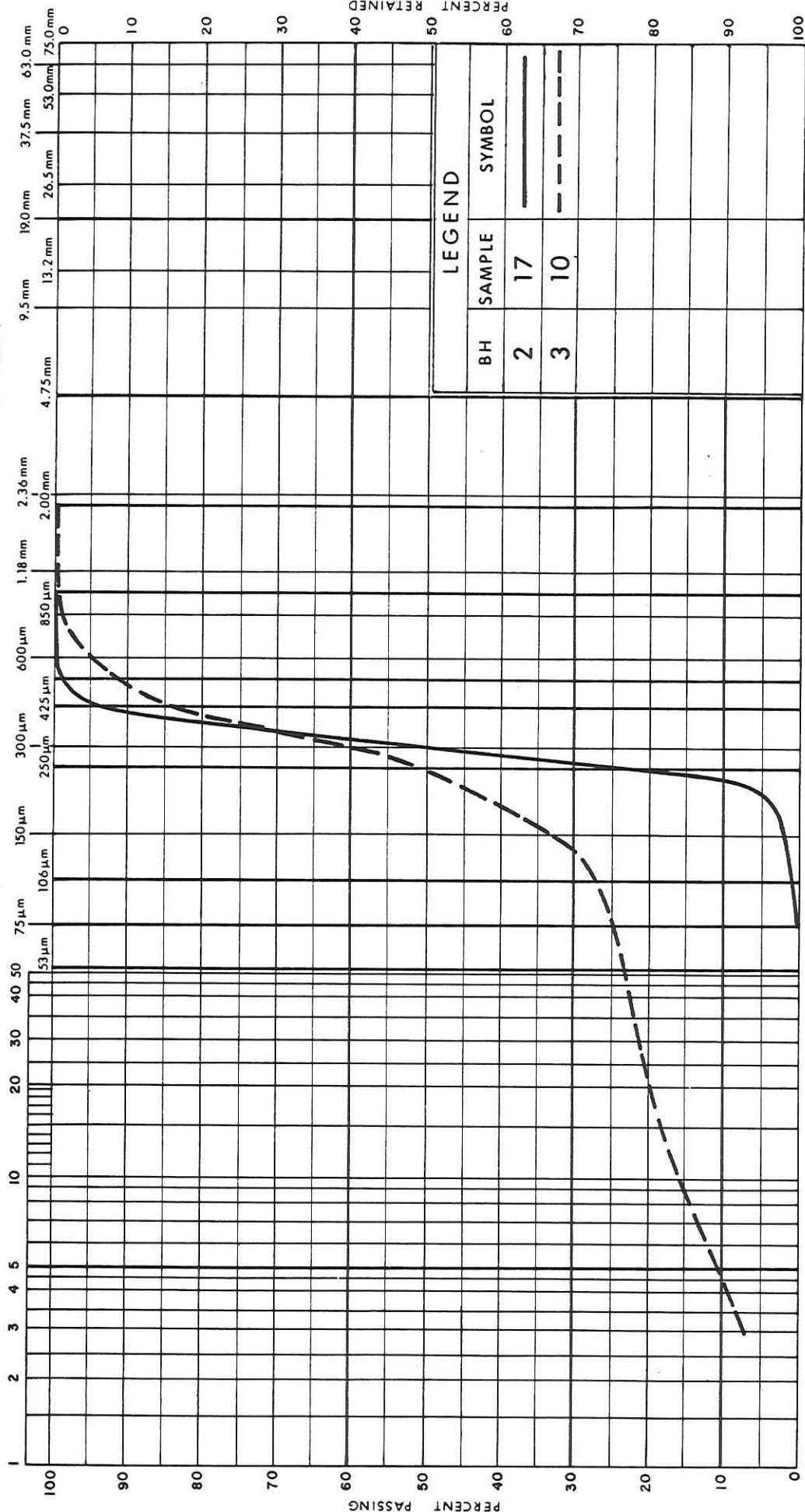
WP 282-85-01

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

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## GRAIN SIZE DISTRIBUTION

SAND

FIG No 4

W P 282-85-01

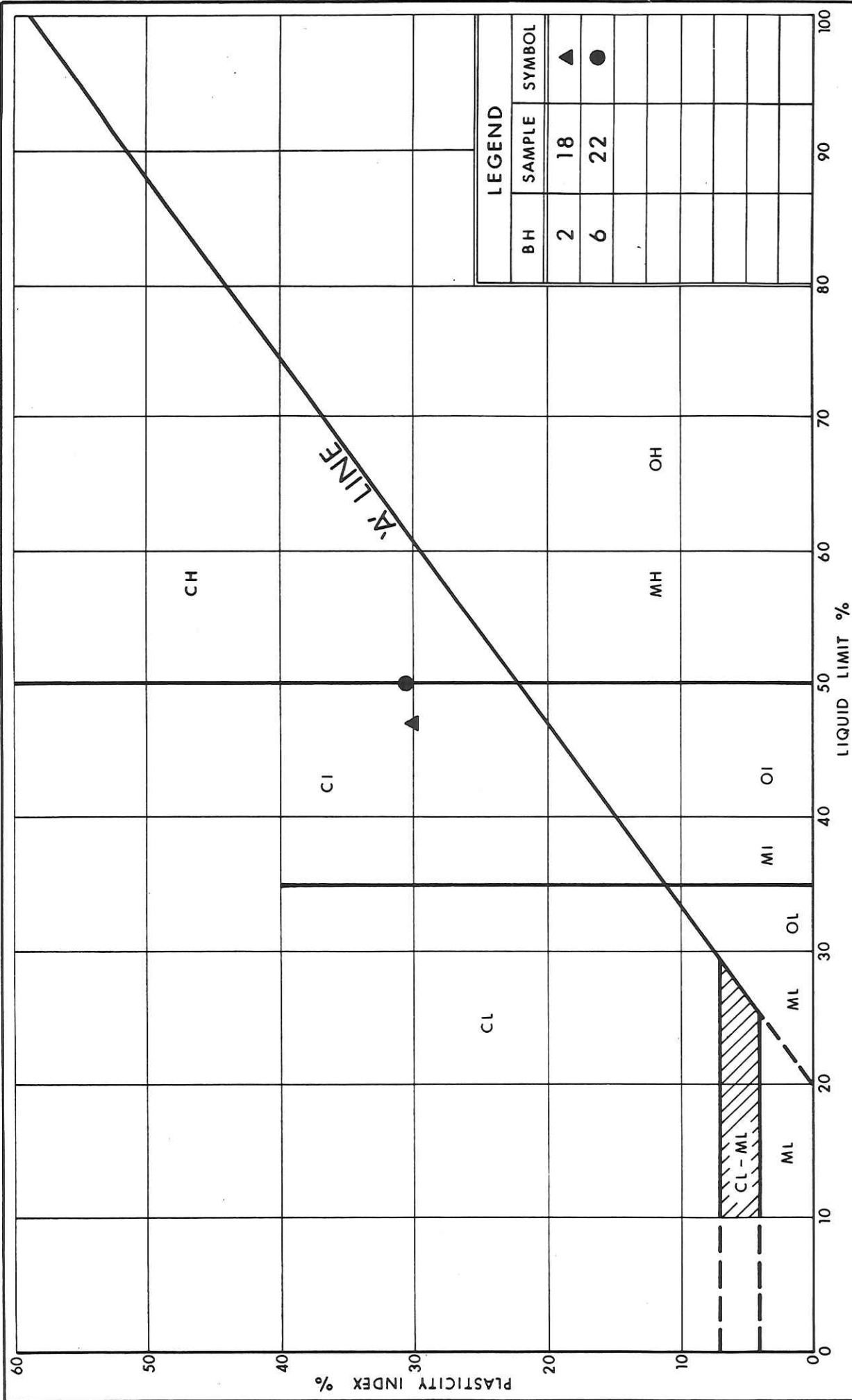


FIG No 5

# PLASTICITY CHART

W P 282 - 85 - 01

SILTY CLAY (INTERMEDIATE PLASTICITY)

## 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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	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
$\sigma'_{v0}$	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 = $\frac{c_u}{\tau_r}$

### 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 = $\frac{w_L - w_p}{I_p}$	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

METRIC

W P 282-85-01 LOCATION STA. 16 + 100.0; 0/s 8.5 m Lt. 4 Hwy. 17 ORIGINATED BY D.P.  
 DIST 18 HWY 17 BOREHOLE TYPE N Casing - Wash Boring, Cone Test COMPILED BY J.E.  
 DATUM Geodetic DATE 86 03 18 to 24 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
182.5	Ground Surface												
0.0	Gravelly Sand Trace Silt (Fill)		1	SS	22								
			2	SS	6								
179.6	Sand		3	SS	12								
2.9	Sandy Silt to Sand Very Loose to Loose		4	SS	2								
178.3			5	SS	7								
4.2	Silty Clay Low Plast. with Random Silty Organics Sand Seams		6	SS	2								
175.9	Soft		7	SS	2								
6.6	End of Borehole												
174.6													
7.9	End of Cone Test												
	* Ground water level not determined												

OFFICE REPORT ON SOIL EXPLORATION



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## RECORD OF BOREHOLE No 2

METRIC

W P 282-85-01 LOCATION STA. 16 + 113.3; 0/s 9.0 m LT. 4 Hwy. 17 ORIGINATED BY J.F.  
DIST 18 HWY 17 BOREHOLE TYPE N Casing - Wash Boring, Cone Test COMPILED BY J.F.  
DATUM Geodetic DATE 86 03 13 to 17 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	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						
182.0	Ground Surface										
0.0	Gravelly Sand Trace Organics (Fill)		1	SS	16						
180.4			2	SS	9						
1.6			3	SS	4						
	Sandy Silt to Sand Very Loose to Loose		4	SS	1						
177.6			5	SS	8						
4.4			6	SS	3						12 84 (4)
	Silty Clay Low Plasticity Random Silty Sand Seams Soft to Firm		7	SS	7						
			8	SS	4						
			9	SS	2						0 27 65 8
			10	TW	P H						0 4 71 25
	With Silty Sand Seams		11	SS	9						
167.9			12	SS	14						
14.1			13	SS	48						
	Sand Fine to Coarse Dense to Very Dense		14	SS	115						
			15	SS	38						
			16	SS	28						
			17	SS	33						0 100 0 0
157.9											
24.1			18	TW	P M						0 1 45 54
	Silty Clay Intermediate Plasticity Stiff									18.7	
154.6											
27.4	End of Borehole										

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

OFFICE REPORT ON SOIL EXPLORATION





Ministry of  
Transportation and  
Communications

# RECORD OF BOREHOLE No 3

METRIC

W P 282-85-01 LOCATION STA. 16 + 149.0; 0/s 11.0 m Lt. 4 Hwy. 17 ORIGINATED BY D.P.  
DIST 18 HWY 17 BOREHOLE TYPE Hollow Stem Augers, Cone Test COMPILED BY J.F.  
DATUM Geodetic DATE 86 02 27 and 28 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER 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						
177.4	Ice Level										
0.0	Water										
174.6	River Bottom										
2.8	Sandy Silt to Sand Very Loose		1	SS	4						
171.9			2	SS	4						
5.5	Silty Clay Low Plasticity Random Silty Sand Seams		3	SS	-						
	Firm to Stiff		4	SS	4						
			5	TW	-					19.2	
			6	TW	P H					19.2	
	Silty Sand Seams		7	SS	19						
163.1			8	SS	22						
14.3	Sand, Some Silt Fine to Coarse Compact		9	SS	14						
			10	SS	18						0 74 22 4
159.1											
18.3	Silty Clay Intermediate Plasticity Stiff		11	SS	7						
154.1			12	SS	9						
23.3	End of Borehole										
148.2											
29.2	End of Cone Test										

+3, x5: Numbers refer to Sensitivity

20  
15 10 5 (%) STRAIN AT FAILURE  
10



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# RECORD OF BOREHOLE No 4

METRIC

W P 282-85-01 LOCATION STA. 16 + 190.0; °/s 7.5 m Lt. E Hwy. 17 ORIGINATED BY J.F.  
DIST 18 HWY 17 BOREHOLE TYPE N Casing - Wash Boring, Cone Test COMPILED BY J.F.  
DATUM Geodetic DATE 86 03 21 to 23 CHECKED BY *JP*

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			SHEAR STRENGTH kPa		W <sub>p</sub>	W	W <sub>L</sub>		
182.5	Ground Surface						182	20 40 60 80 100						
0.0	Gravelly Sand		1	SS	17		180	20 40 60 80 100						
181.0	Trace Silt, Trace Organics (Fill)		2	SS	8		178	20 40 60 80 100						
1.5			3	SS	4		176	20 40 60 80 100						
	Trace Gravel		4	SS	10		174	20 40 60 80 100						
	Sandy Silt to Sand		5	SS	7		172	20 40 60 80 100						
	Loose		6	SS	3		170	20 40 60 80 100						
175.8			7	SS	4		168	20 40 60 80 100						
6.7	Silty Clay		8	SS	2		166	20 40 60 80 100						
	Low Plasticity		9	SS	2		164	20 40 60 80 100						
	Random Silty Sand Seams		10	SS	4		162	20 40 60 80 100						
	Soft to Stiff		11	TW	P M		160	20 40 60 80 100						
166.3			12	SS	2		158	20 40 60 80 100						
16.2	Sand		13	SS	34		156	20 40 60 80 100						
	Fine to Coarse		14	SS	101			20 40 60 80 100						
	Dense to Very Dense		15	SS	57			20 40 60 80 100						
			16	SS	35			20 40 60 80 100						
			17	SS	31			20 40 60 80 100						
158.2			18	TW	P M			20 40 60 80 100						
24.3	Silty Clay							20 40 60 80 100						
	Intermediate Plasticity							20 40 60 80 100						
	Stiff							20 40 60 80 100						
155.1			19	SS	-			20 40 60 80 100						
27.4	End of Borehole							20 40 60 80 100						

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 5 (1 of 2) METRIC

W P 282-85-01 LOCATION STA. 16 + 113.3; 0/s 7.6 m Rt. 4 Hwy. 17 ORIGINATED BY D.P.  
 DIST 18 HWY 17 BOREHOLE TYPE Hollowstem Augers, Cone Test COMPILED BY J.F.  
 DATUM Geodetic DATE 86 03 17 to 22 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					
182.3	Ground Surface																
0.0	Gravelly Sand Trace Silt Trace Organics (Fill)		1	SS	7		182										
180.2			2	SS	4		180										
2.1	Sandy Silt to Sand Trace Organics Very Loose to Compact		3	SS	4		180										
	Trace Gravel		4	SS	2		180										
			5	SS	14		178										
			6	SS	3		178										
176.8							176										
5.5	Silty Clay Low Plasticity Random Silty Sand Seams Soft to Stiff		7	SS	3		176										
			8	SS	4		176										
			9	SS	2		174										0 14 66 20
			10	SS	3		172										0 5 76 19
			11	SS	-		170										
			12	TW	P H		170										
			13	SS	11		168										
166.8							168										
15.5	Sand Fine to Coarse Compact		14	SS	10		166										
			15	SS	14		164										
							162										
159.5							160										
22.8	Silty Clay Intermediate Plasticity Stiff to Very Stiff		16	SS	21		158										
			17	SS	7		156										
			18	SS	9		154										
152.1							152										

Continued

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

Continued

# RECORD OF BOREHOLE No 5 (2 of 2) METRIC

W P 282-85-01 LOCATION STA. 16 + 113.3; °/s 7.6 m Rt. 4 Hwy. 17 ORIGINATED BY D.P.  
 DIST 18 HWY 17 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY J.F.  
 DATUM Geodetic DATE 86 03 17 to 22 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	20 40 60 80 100					
152.1 30.2	<b>Continued</b>  Silty Clay Intermediate Plasticity Stiff													
136.1 46.2	End of Borehole		20	SS	13									

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 6 (1 of 3) METRIC

W P 282-85-01 LOCATION STA. 16 + 165.0; °/s 7.0 m Rt. 4 Hwy. 17 ORIGINATED BY J.F.  
 DIST 18 HWY 17 BOREHOLE TYPE N Casing Wash Boring, Cone Test COMPILED BY J.F.  
 DATUM Geodetic DATE 86 02 26 to 86 03 12 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>		
177.4	Ice Level													
176.8	River Bottom													
0.6	Medium Sand Trace Gravel Loose		1	SS	5									
175.2			2	SS	4									
2.2	Sandy Silt to Sand Trace Gravel Very Loose		3	SS	2									
173.5			4	SS	3									
3.9	Silty Clay Low Plasticity Random Silty Sand Seams Soft to Stiff		5	TW	P.M.									
			6	TW	P.M.									
			7	SS	4									
			8	SS	2									
			9	SS	3									
	With Silty Sand Seams		10	SS	20									
164.0	Very Stiff													
13.4	Sand Fine to Coarse Compact to Very Dense		11	SS	28/15 cm									
			12	SS	21									
			13	SS	18									
			14	SS	38									
			15	SS	41									
156.2														
21.2	Silty Clay Intermediate Plasticity Firm to Stiff		16	SS	5									
			17	TW	P.M.									
			18	SS	P.M.									
147.2														
30.2														

Continued

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

20  
15 5 (%) STRAIN AT FAILURE  
10

Continued



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# RECORD OF BOREHOLE No 6 (2 of 3)

METRIC

W P 282-85-01 LOCATION STA. 16 + 165.0; °/s 7.0 m Rt.  $\angle$  Hwy. 17 ORIGINATED BY J.F.  
DIST 18 HWY 17 BOREHOLE TYPE N Casing - Wash Boring, Cone Test COMPILED BY J.F.  
DATUM Geodetic DATE 86 02 26 to 86 03 12 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 $\gamma$ 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					
							20 40 60 80 100	20 40 60 80 100	10 20 30				
147.2	Continued		19	SS	P M								
30.2													
			20	SS	4								
	Silty Clay Intermediate Plasticity Firm to Stiff												
			21	TW	*								
			22	TW	*								
			23	SS	*								
117.0	Continued												
60.4													

\* RODS SANK UNDER SELF WEIGHT

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

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

Continued

# RECORD OF BOREHOLE No 6 (3 of 3) METRIC

W P 282-85-01 LOCATION STA. 16 + 165.0; °/s 7.0 m Rt. 4 Hwy. 17 ORIGINATED BY J.F.  
 DIST 18 HWY 17 BOREHOLE TYPE N Casing - Wash Boring, Cone Test COMPILED BY J.F.  
 DATUM Geodetic DATE 86 02 26 to 86 03 12 CHECKED BY *J.F.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT	LIQUID LIMIT	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	PLASTIC LIMIT W <sub>p</sub>	W		
117.0	<b>Continued</b>															
60.4	Silty Clay Intermediate Plasticity Firm to Stiff						116									
							114									
							112									
110.3																
67.1	End of Borehole															



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# RECORD OF BOREHOLE No 7

METRIC

W P 282-85-01 LOCATION STA. 16 + 189.0; °/s 9.2 m Rt. 4 Hwy. 17 ORIGINATED BY J.F.  
DIST 18 HWY 17 BOREHOLE TYPE Cone Penetration Test COMPILED BY J.F.  
DATUM Geodetic DATE 86 03 17 CHECKED BY *JP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
182.0	Ground Surface										
0.0	Probable Gravelly Sand (Fill)										
179.4											
2.6	Probable Sandy Silt to Sand										
175.8											
6.2	Probable Silty Clay										
165.8											
16.2	Probable Sand										
163.7											
18.3	End of Cone Test										

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

# RECORD OF BOREHOLE No 8

METRIC

W P 282-85-01 LOCATION STA. 16 + 194.4; 0/s 11.1 m RT 4 Hwy. 17 ORIGINATED BY D.P.  
 DIST 18 HWY 17 BOREHOLE TYPE Hollowstem Augers COMPILED BY J.F.  
 DATUM Geodetic DATE 86 03 26 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					
181.9	Ground Surface																
0.0	Gravelly Sand Trace Silt Trace Organics (Fill)		1	SS	11		180										
			2	SS	3												
179.3			3	SS	3												
2.6	Sandy Silt to Sand Very Loose to Compact		4	SS	1		178										
			5	SS	14												
			6	SS	6												
175.8						*	176										
6.1	Silty Clay Low Plasticity Random Silty Sand Seams		7	SS	2												
			8	SS	5												
173.8	Soft to Firm		9	SS	4		174										
8.1	End of Borehole																
	* Ground water level not determined																

# RECORD OF BOREHOLE No 9

METRIC

W P 282-85-01 LOCATION STA. 16 + 113.3; 0/s 14.2 m RT. 4 Hwy 17 ORIGINATED BY D.P.  
 DIST 18 HWY 17 BOREHOLE TYPE Cone Penetration Test COMPILED BY J.F.  
 DATUM Geodetic DATE 86 03 24 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 x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
182.1	Ground Surface						182				
0.0	Probable Gravelly Sand (Fill)						180				
180.3							178				
1.8	Probable Sandy Silt to Sand						176				
176.0							174				
6.1	Probable Silty Clay						172				
							170				
							168				
166.8							166				
15.3	Probable Sand						164				
							162				
							160				
159.2											
22.9	End of Cone Test										





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# RECORD OF BOREHOLE No 10

METRIC

W P 282-85-01 LOCATION STA. 16 + 167.0; 0/s 15.6 m RT. 4 Hwy 17 ORIGINATED BY D.P.  
DIST 18 HWY 17 BOREHOLE TYPE Hollowstem Augers COMPILED BY J.F.  
DATUM Geodetic DATE 86 03 24 and 25 CHECKED BY [Signature]

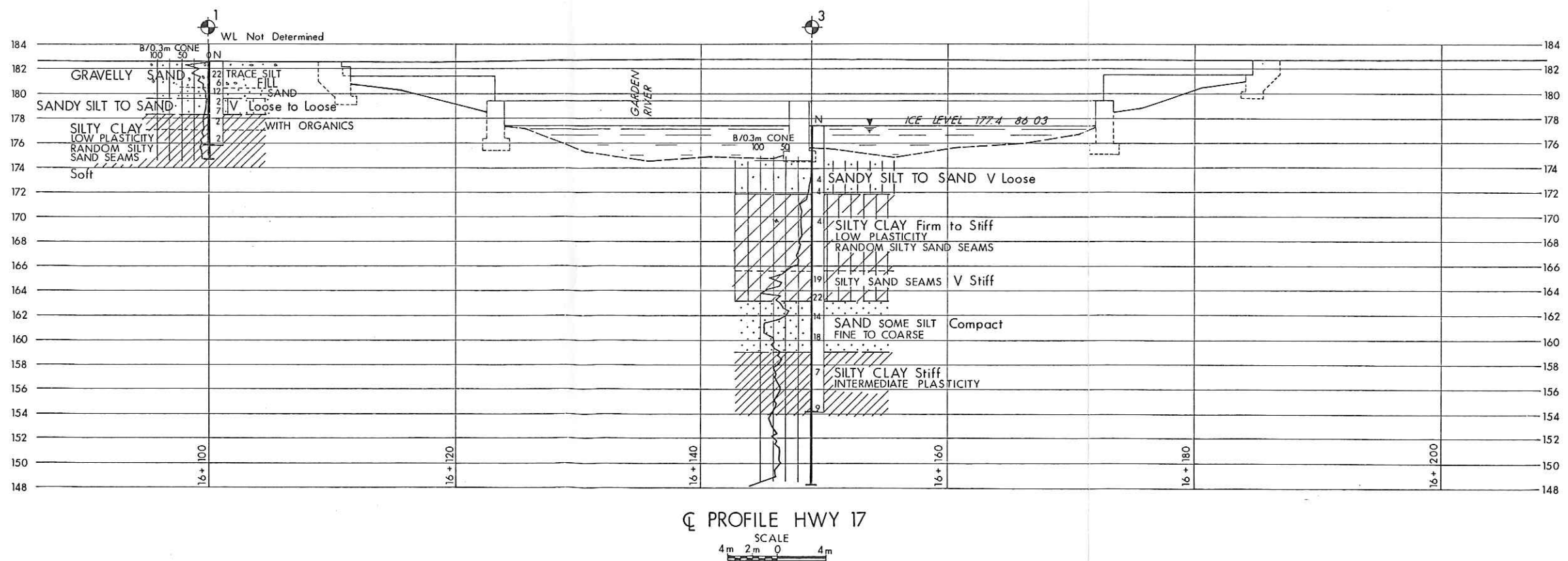
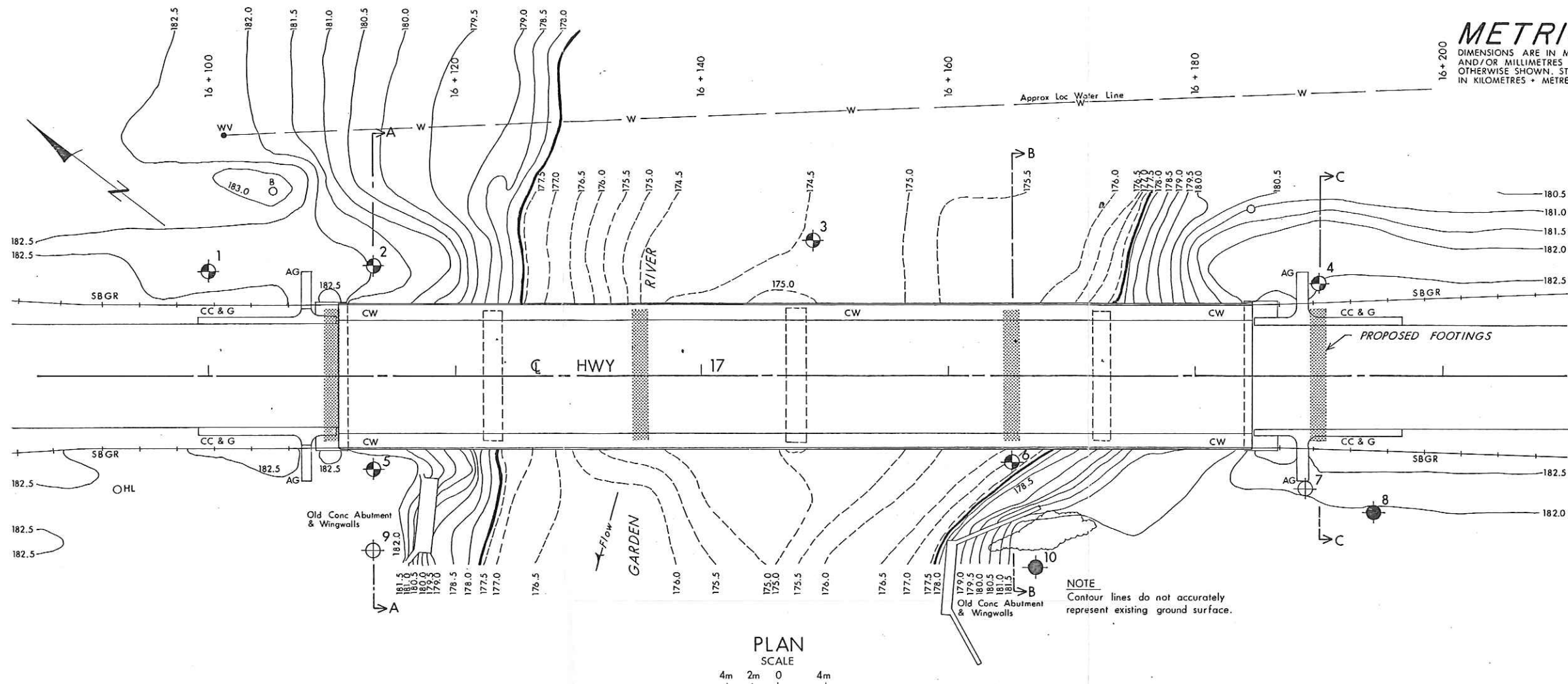
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
181.9	Ground Surface													
0.0	Medium Sand Trace Silt Trace Organics (Fill)		1	SS	5									
179.7			2	SS	6		180							
2.2	Sandy Silt to Sand Loose		3	SS	5									
			4	SS	7									
	Trace organics		5	SS	4		178							
	Silty Zone		6	SS	6									0 8 87 5
176.3						*								
5.6	Silty Clay Low Plast. Random Silty Sand Seams Soft to Stiff		7	SS	2		176							
			8	SS	3		174							
			9	SS	2									
			10	TW	-		172	p x	4 +3				17.9	0 22 68 10
							170							
			11	SS	2									
			12	SS	4		168		+4 +2					
							166							
			13	SS	6									
163.6							164							
18.3	Sand Fine to Coarse Compact to V. Dense		14	SS	102/23 cm		162							
							160							
			15	SS	20		158							
156.5							156							
25.4	Silty Clay Intermediate Plasticity Stiff		16	SS	9									
							154							
			17	TW	P H									
151.9							152		1					

30.0 End of Borehole

\*Ground Water Level  
Not Determined

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

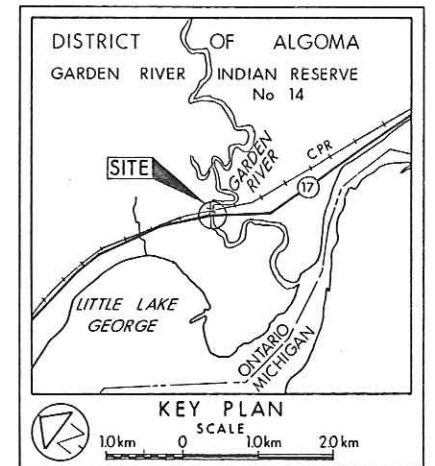
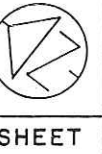
20  
15 5 (%) STRAIN AT FAILURE  
10



**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 282-85-01

GARDEN RIVER BRIDGE  
BORE HOLE LOCATIONS & SOIL STRATA



**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 86 03

No	ELEVATION	STATION	OFFSET
1	182.5	16+100.0	8.5m Lt
2	182.0	16+113.3	9.0m Lt
3	177.4	16+149.0	11.0m Lt
4	182.5	16+190.0	7.5m Lt
5	182.3	16+113.3	7.6m Rt
6	177.4	16+165.0	7.0m Rt
7	182.0	16+189.0	9.2m Rt
8	181.9	16+194.4	11.1m Rt
9	182.1	16+113.3	14.2m Rt
10	181.9	16+167.0	15.6m Rt

**=NOTE=**

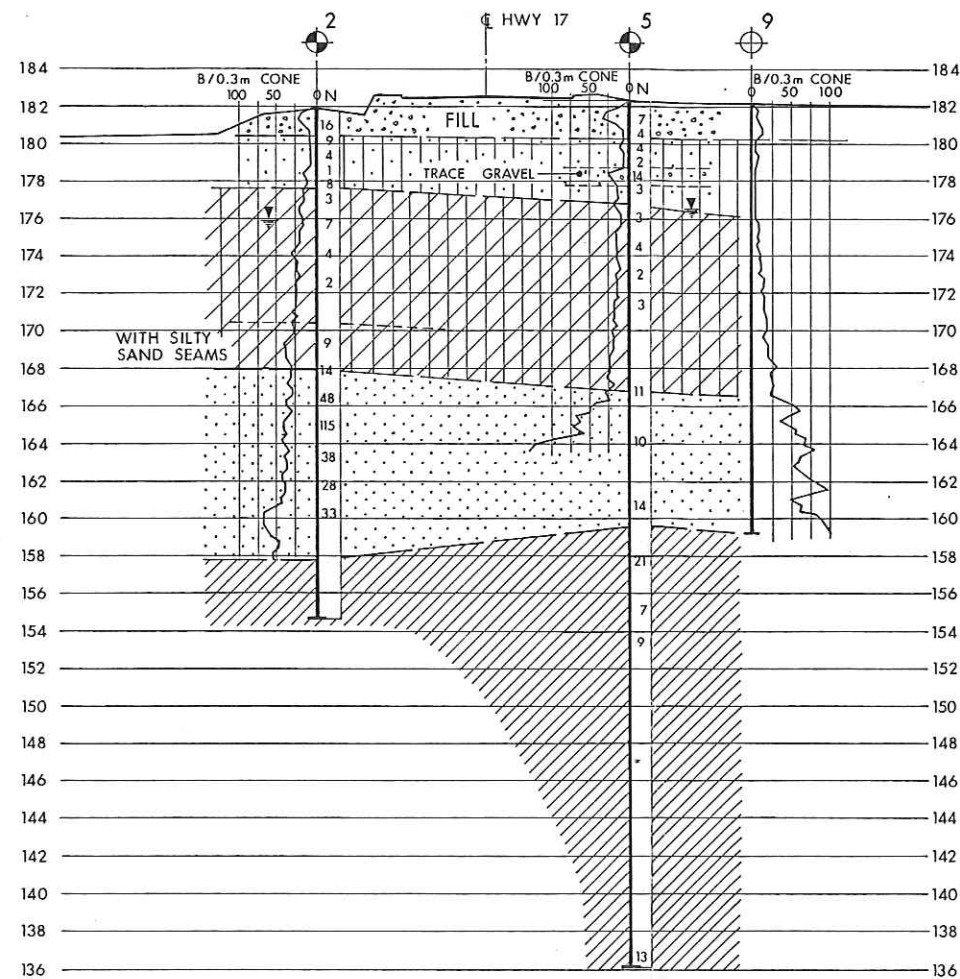
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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 excluded in accordance with the conditions of Section 102-2 of Form 100.

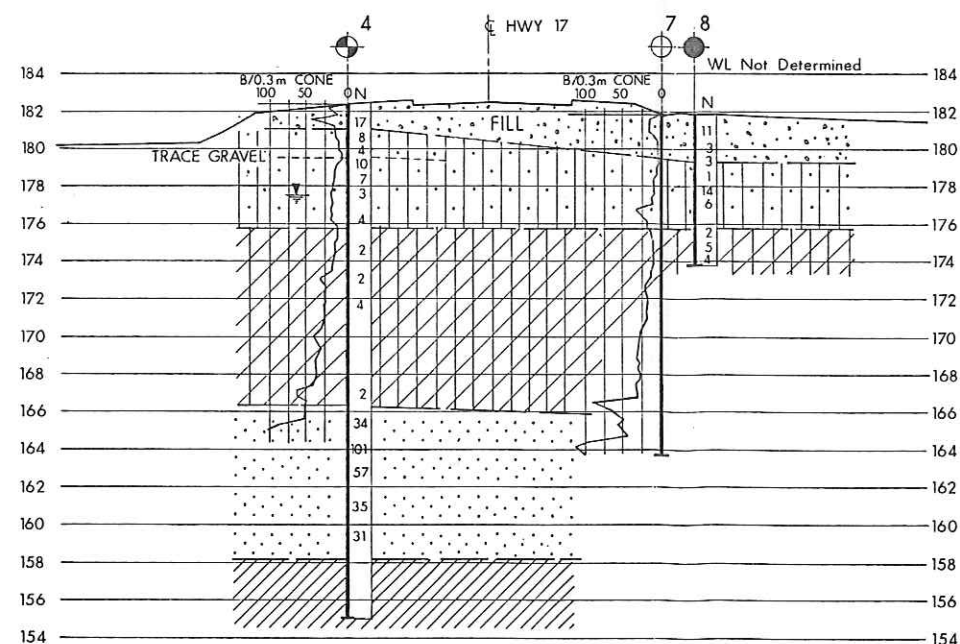
REV	DATE	BY	DESCRIPTION

Geocres No 41K-43

HWY No 17	CHECKED	DATE 86 04 28	DIST 18
SUBMD JF	CHECKED	APPROVED	SITE 385-89
DRAWN DT	CHECKED		DWG 2828501-A



SECTION A-A



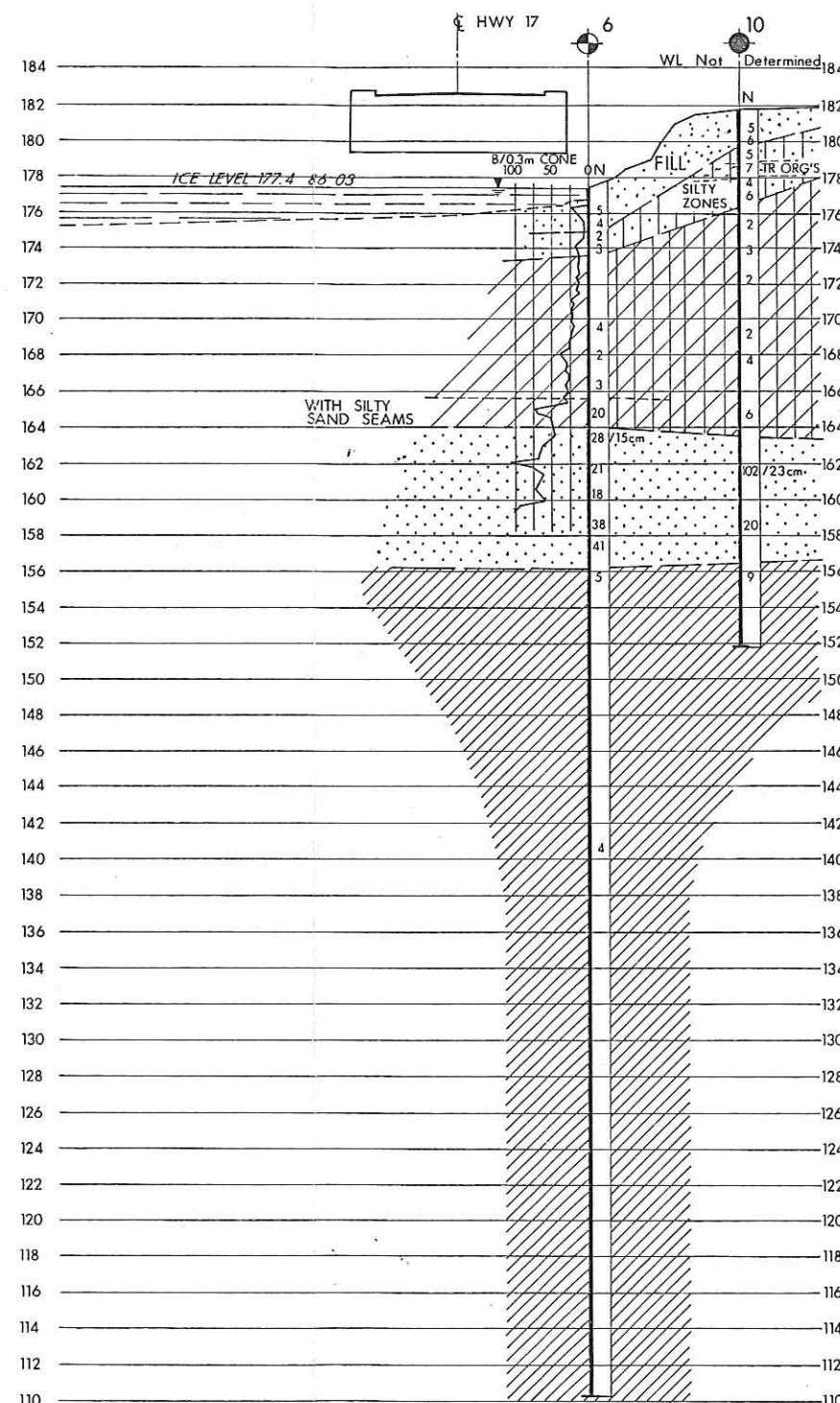
SECTION C-C

SCALE  
4m 2m 0 4m

SOIL STRATIGRAPHY LEGEND

- GRAVELLY SAND (FILL)  
TRACE SILT, ORGANICS
- MEDIUM SAND (FILL)  
TRACE SILT, ORGANICS  
Loose
- SANDY SILT TO SAND  
V Loose to Compact

- SILTY CLAY  
LOW PLASTICITY, RANDOM SILT SEAMS  
Soft to Stiff
- SAND  
FINE TO COARSE  
Compact to Very Dense
- SILTY CLAY  
INTERMEDIATE PLASTICITY  
Firm to Very Stiff



SECTION B-B

METRIC

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

CONT No  
WP No 282-85-01

GARDEN RIVER BRIDGE  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

SEE DWG 2828501-A

KEY PLAN  
SCALE

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 86 03

No	ELEVATION
2	182.0
4	182.5
5	182.3
6	177.4
7	182.0
8	181.9
9	182.1
10	181.9

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 excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
Geocres No 41K-43			
HWY No 17			DIST 18
SUBMD JF	CHECKED	DATE 86 04 28	SITE 38S-18
DRAWN DT	CHECKED	APPROVED	DWG 2828501-B