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DIST. 6 REGION

W.P. No. 89-78-04

CONT. No. 85-52

W. O. No.

STR. SITE No. 37-73-1127

HWY. No. 7N

LOCATION West Don River

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. 6
CONT No
WP No 89-78-04
HIGHWAY 7N BRIDGE
OVER THE WEST DON RIVER
GENERAL ARRANGEMENT



SHEET

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BORE HOLE LOCATIONS & SOIL STRATA
3. FOOTINGS
4. EAST ABUTMENT
5. WEST ABUTMENT
6. STRUCTURAL STEEL DETAILS I
7. STRUCTURAL STEEL DETAILS II
8. DECK DETAILS
9. DECK REINFORCING
10. BEARING DETAILS
11. BARRIER WALL ON SIDEWALK
12. RAILING FOR BARRIER WALL
13. 6000mm APPROACH SLAB
14. STANDARD DETAILS
15. AS CONSTRUCTED ELEV. & D.M.
16. BRIDGE DATE & SITE NUMBER DATA
17. ELECTRICAL EMBEDDED WORK-I
18. ELECTRICAL EMBEDDED WORK-II
19. QUANTITIES
20. QUANTITIES

GENERAL NOTES

CLASS OF CONCRETE

- DECK, BARRIER WALLS, ABUTMENTS, WING WALLS
FOOTINGS - 30 MPa
- REMAINDER - 20 MPa
- CLEAR COVER TO REINFORCING STEEL
- FOOTINGS - 100 ± 25 mm
- ABUTMENTS - FRONT FACE 80 ± 20 mm; BACK FACE - 70 ± 20 mm
- DECK - TOP 70 ± 20 mm; BOTTOM - 40 ± 10 mm
- REMAINDER UNLESS OTHERWISE STATED - 70 ± 20 mm

REINFORCING STEEL

- REINFORCING STEEL SHALL BE GRADE 400, UNLESS OTHERWISE SPECIFIED. BARS MARKED WITH SUFFIX 'C' SHALL BE COATED BARS.

CONSTRUCTION NOTES

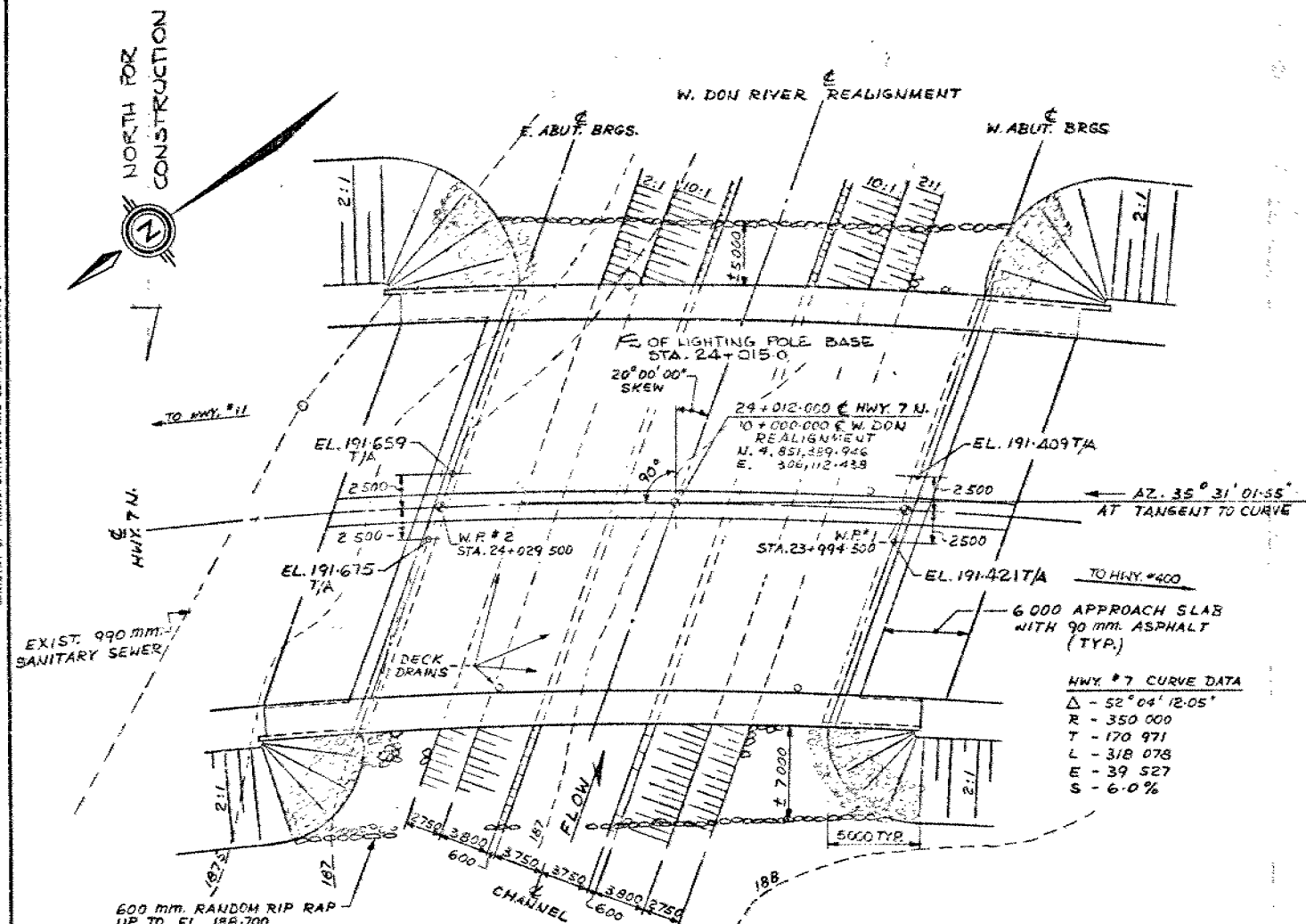
- THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.

NOTES:

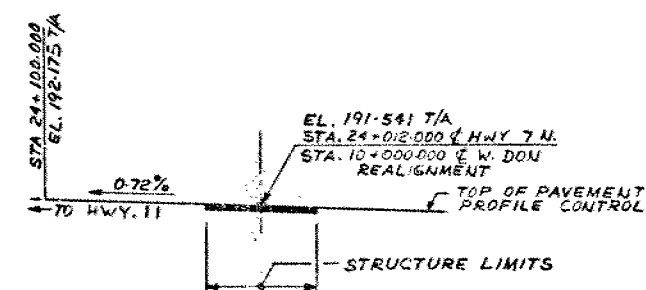
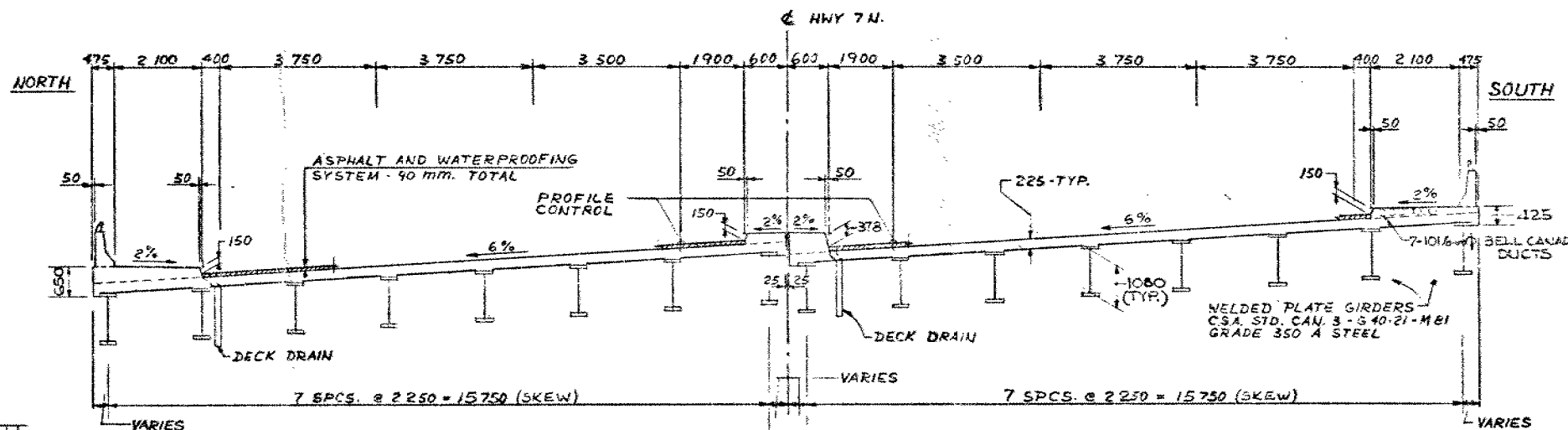
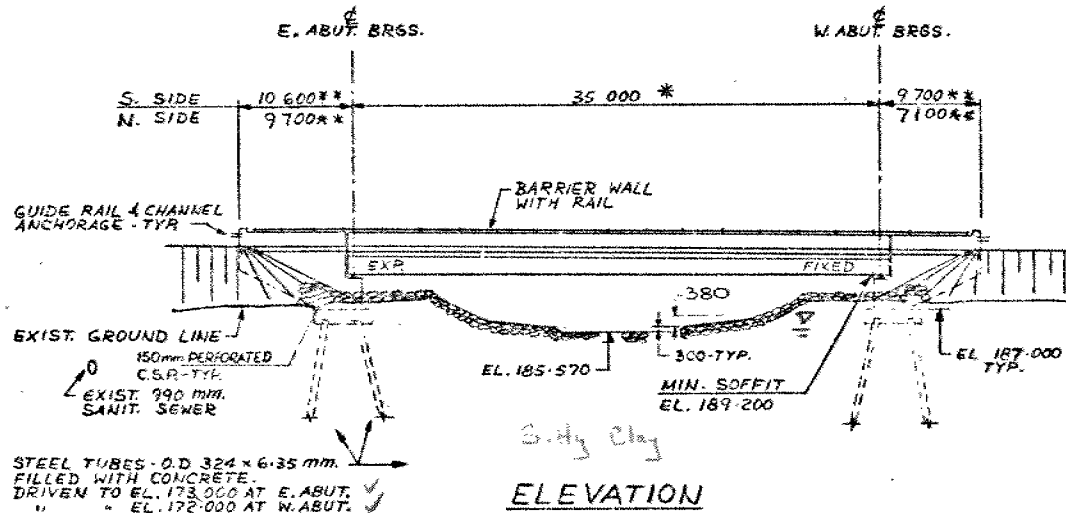
- DIMENSIONS WITH * MEASURED ALONG & HWY. 7N.
- DIMENSIONS WITH ** MEASURED ALONG OUTSIDE FACE OF WINGWALL.

LEGEND:

- W.P. DENOTE WORKING POINT
- T/A DENOTE TOP OF ASPHALT



- NOTES -
- DIMENSION WITH * MEASURED ALONG & HWY. 7 N.
 - DIMENSIONS WITH ** MEASURED ALONG OUTSIDE FACE OF WING WALL.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

PILE DATA (STEEL TUBE-324 x 6.35 mm)				
LOCATION	BATTER NO.	REQ'D	LENGTH	CUT-OFF EL.
EAST ABUTMENT	1	3	14.500	186.30
	6	17	13.500	186.30
	7	4	13.250	186.30
WEST ABUTMENT	1	3	15.000	186.30
	16	17	14.500	186.30
	2	2	14.250	186.30

PILE DESIGN DATA:

- DESIGN LOAD AT S.L.S. TYPE II - 540 KN.
- FACTORED CAPACITY AT U.L.S. - 800 KN.

PILE CONSTRUCTION DATA:

- SPACING OF PILES TO BE MEASURED AT UNDERSIDE OF ABUTMENT FOOTINGS.
- DRIVING SHOES SHALL BE INSTALLED ON ALL PILE TIPS IN ACCORDANCE WITH STD. DD-3302.
- PILES MUST BE DRIVEN TO:
 - EL. 173.00 FOR EAST ABUTMENT
 - EL. 172.00 FOR WEST ABUTMENT

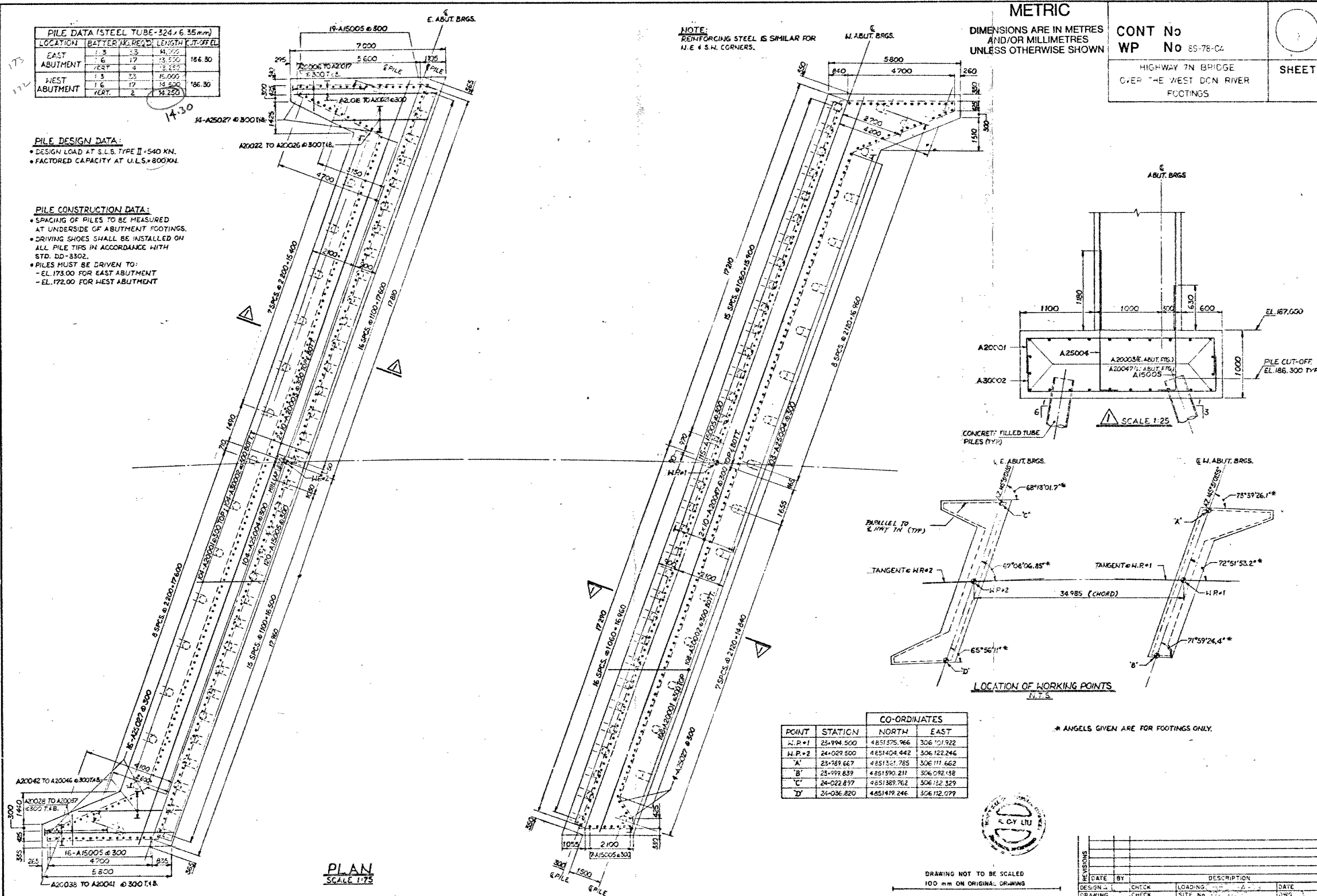
NOTE:
REINFORCING STEEL IS SIMILAR FOR
N.E. & S.W. CORNERS.

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 65-78-C4

HIGHWAY 7N BRIDGE
OVER THE WEST DON RIVER
FOOTINGS

SHEET



FOUNDATION INVESTIGATION REPORT

CONTRACT NO 85 - 52



Ministry of
Transportation and
Communications

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2	Abbreviations and Symbols
3 - 16	Foundation Investigation Report for Hwy. 7N over West Don River Bridge W.P. 89-78-04, Site 37-73-1127 Hwy. 7, District 6, Toronto

Note: For purposes of the contract, this report supersedes all other foundation reports prepared by or for the Ministry in connection with the above-noted project.



EXPLANATION OF TERMS USED IN REPORT

2

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	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
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{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
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT

For

Hwy. 7N Over West Don River Bridge
W.P. 89-78-04, Site 37-73-1127
Hwy. 7, District 6, Toronto

INTRODUCTION

This report summarizes the results of a foundation investigation completed at the above-mentioned site, providing a detailed description of subsurface conditions encountered and recommendations in accordance with appropriate structural design and related construction practices. The investigation commenced on 82 11 01 and was completed by 82 11 05. Four sampled boreholes were carried out, each accompanied by a dynamic cone penetration test. Hollow stem continuous flight augers were utilized to advance borings for depths ranging from 12.6 to 35.5 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located some 60 metres north of the existing Hwy. 7 over the West Don River structure in the township of Vaughan.

The topography is basically flat and level with the West Don River meandering in a shallow valley. Currently, the land is not in use for any commercial purpose.

Physiographically, the site is located in the Peel Plain Region which is East of the Niagara Escarpment and North of the Lake Iroquois Shoreline. It consists of bevelled till plain with gently undulating rolling surface and limited relief. Till sheets encountered are usually separated from one another by a bed of stratified silt or sand of variable thickness. Bedrock has been found in the area at depths in excess of 30 metres below ground surface and consists of shale and limestone of the Dundas Formation Ordovician Period.

SUBSURFACE CONDITIONS

General

Reasonably competent subsurface conditions were encountered across the site. The predominate surficial deposit consists of a stiff to hard cohesive glacial till extending to a depth of 16.2 metres and is composed of silty clay, sand and gravel. Underlying the surficial deposit and extending for a maximum thickness of 17.1 metres is a hard glaciolacustrine deposit of stratified silty clays and silts. Borings were terminated in a very dense stratum of sandy silt to silty sand.

The attached Record of Borehole Sheets summarizes the boundaries between the various soil types, laboratory test results, stabilized groundwater levels and the dynamic cone penetration results. The location and elevation of the borings, along with a profile showing a simplified stratigraphical summary and 2 detailed stratigraphical sections are shown on Drawing No. 2 of the Contract Drawings.

The various soil types encountered are briefly described in the following paragraphs.

Silty Clay, Sand and Gravel (Glacial Till)

The surficial deposit encountered across the site consists of a cohesive glacial till composed of silty clay with varying amounts of sand and a trace of gravel. Occasional layers of silty sand, sand and gravel were encountered within this deposit. Typical gradation curves for this till stratum are plotted in envelope form on Figure No. 1 in the Appendix. In addition, typical gradation curves for the inter-bedded coarser granular layers are shown on Figure 2. This cohesive till ranged in thickness from 11.9 to 16.2 metres. Recent alluvium, consisting of silty sand and gravel, was encountered in the upper 2 metres of this deposit.

Results of laboratory index testing performed on representative samples from this deposit are plotted on the Plasticity Chart, Figure #3 and summarized as follows:

Index Test		Range	Average
Water Content	(w)%	6-16.5	12.7
Liquid Limit	(W _L)%	18.5-28	23.6
Plastic Limit	(W _p)%	11-15.5	13.6
Plasticity Index	(I _p)%	7-14	10.1

These results indicate the matrix of this glacial till to consist of an inorganic silty clay of low plasticity (CL).

Based on interpretation of Standard Penetration Test 'N' values and augering operations, the consistency for this deposit is assessed as ranging from stiff to hard throughout except for the upper two metres where surficial softening has occurred.

Silty Clays and Silts

Underlying the surficial till and extending for thicknesses of 13.4 to 17.1 metres is a glaciolacustrine deposit consisting of stratified silty clays and silts. Layers and inclusions of sandy silt were encountered throughout this deposit. Two typical grain size distribution curves for the silty clay deposit are shown on Figure 4.

Results of index testing indicate the predominate fabric of this deposit to consist of inorganic silty clay of low to intermediate plasticity (CL-CI) with stratified bands of nonplastic to slightly plastic silts (ML).

Based on 'N' values ranging from 36 to in excess of 100 blows per 0.3 metres, the consistency of this deposit is described as hard.

Sandy Silt to Silty Sand

The basal deposit encountered at this site and explored to a maximum depth of 5.7 metres is a fine granular stratum consisting of sandy silt to silty sand.

Interpretation of 'N' values all well in excess of 100 blows per 0.3 metres suggests a denseness for this stratum of very dense throughout.

GROUNDWATER CONDITIONS

Stabilized piezometer water level readings indicate the water table corresponds to elevation 186, reflecting the river water levels at the time of investigation. Rapid fluctuations in the water table are anticipated as a result of weather conditions.



D. H. Dundas

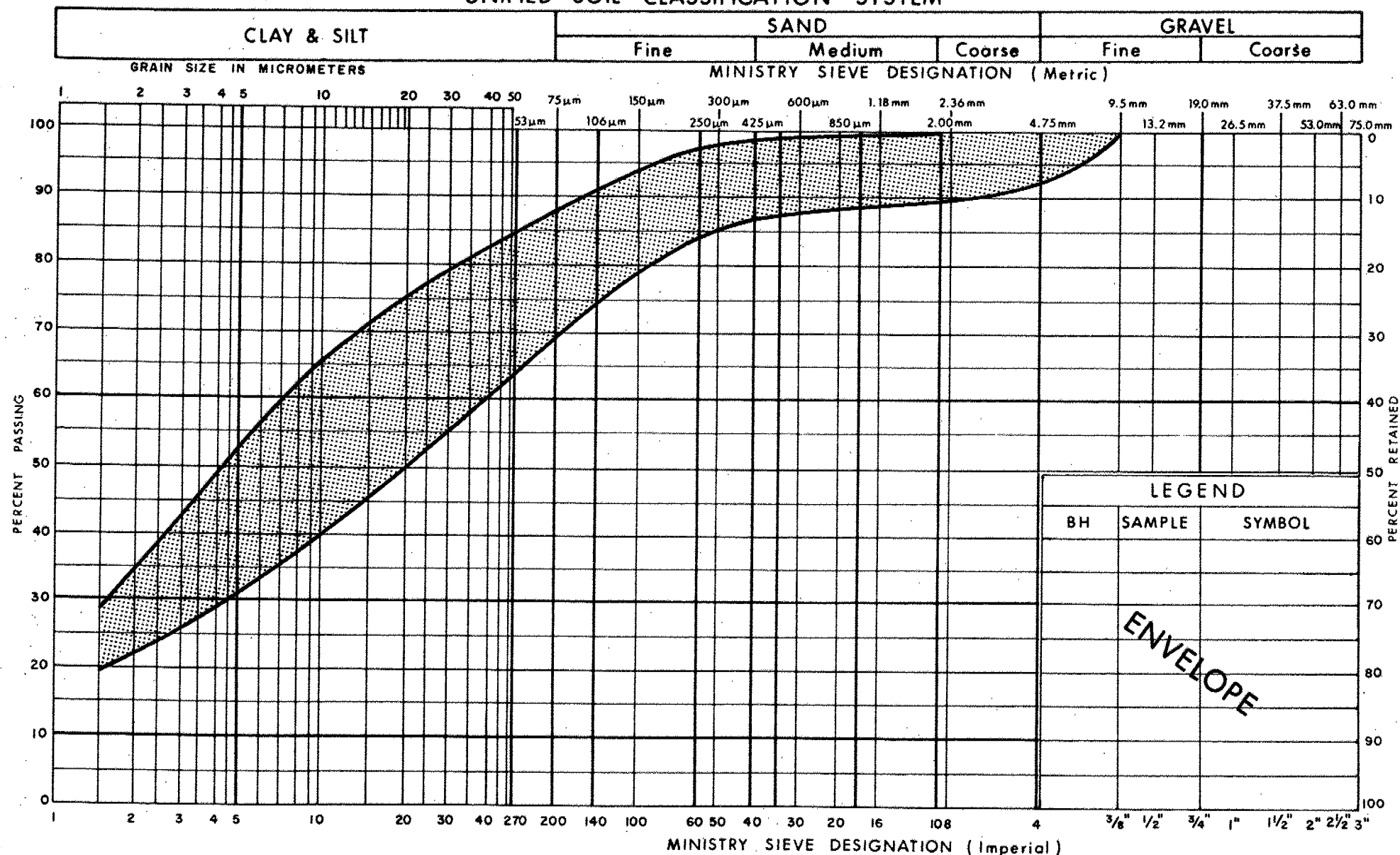
D.H. Dundas, P. Eng.
Foundations Engineer

M. Devata

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

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



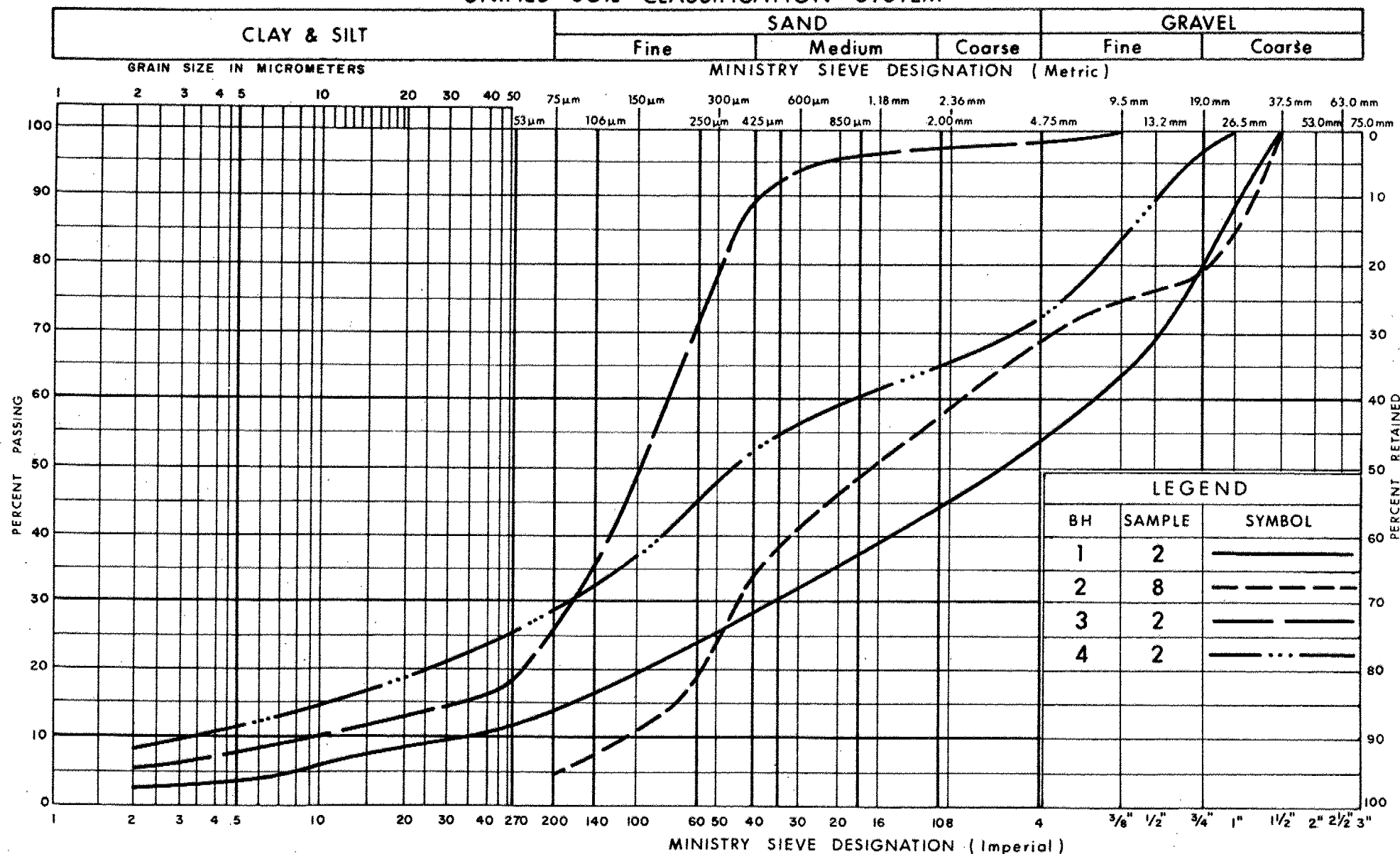
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GRAIN SIZE DISTRIBUTION
(Glacial Till) SILTY CLAY
WITH VARYING AMOUNTS OF SAND, TRACE OF GRAVEL

FIG No 1

W P 89-78-04

UNIFIED SOIL CLASSIFICATION SYSTEM

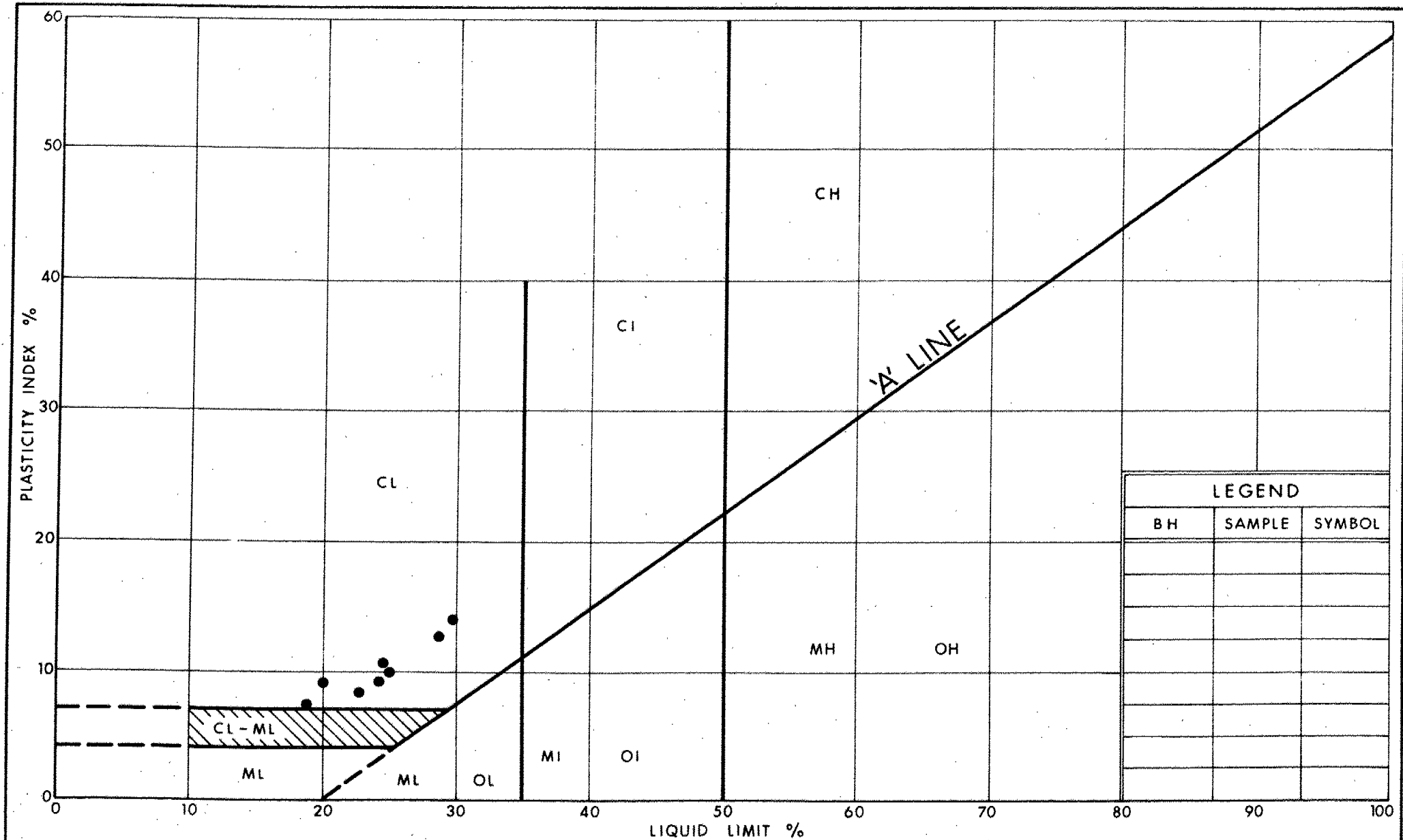


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GRAIN SIZE DISTRIBUTION
INTERBEDDED SILTY SAND & GRAVELLY SAND
(Glacial Till)

FIG No 2

W P 89-78-04



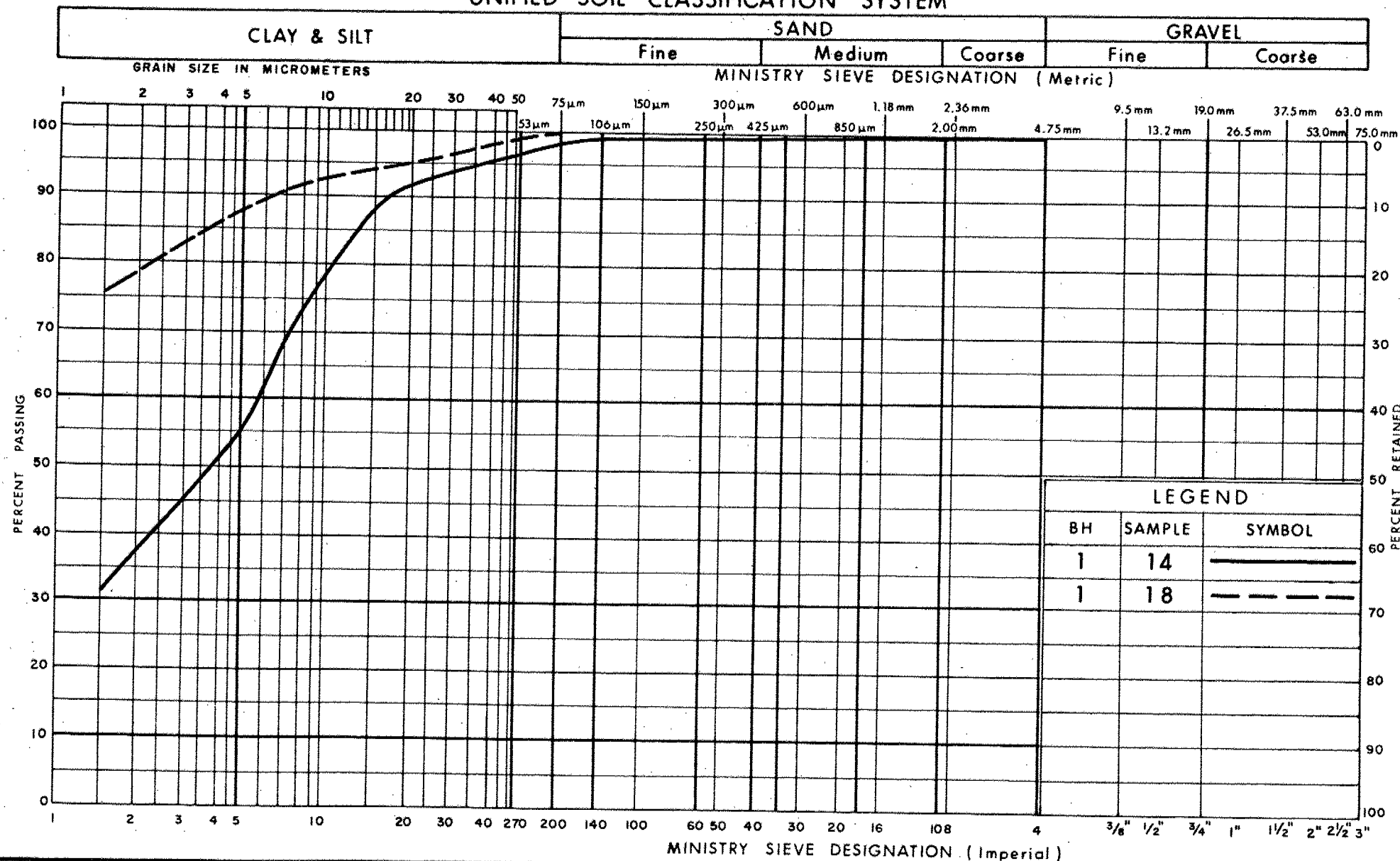
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PLASTICITY CHART
(Glacial Till Matrix)
SILTY CLAY OF LOW PLASTICITY

FIG No 3

W P 89-78-04

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

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GRAIN SIZE DISTRIBUTION
STRATIFIED SILTY CLAYS

FIG No 4

W P 89-78-04

RECORD OF BOREHOLE No 1

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 423.8; E 306 114.1 ORIGINATED BY AR
 DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
 DATUM Geodetic DATE 82 11 01 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
187.0	Ground Surface								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
0.0			1	SS	5		186							
	Silty Sand and Gravel		2	SS	26									47 40 11 2
	Brown Gray		3	SS	23									1 13 53 33
	(Glacial Till)		4	SS	13									
	Silty Clay with Varying amounts of Sand, Trace of Gravel		5	SS	16									9 16 44 31
			6	SS	23									
			7	SS	23									
			8	SS	16									3 30 44 23
	Sandy Silt		9	SS	45									0 21 74 5
	Stiff to Hard		10	SS	43									
			11	SS	56									
175.1			12	SS	168/20 cm									
11.9			13	SS	181/20 cm									
	Gray Stratified Silty Clays and Silts Occ. Layers of Sandy Silt		14	SS	57									
			15	SS	58									
	Hard		16	SS	46									
			17	SS	49									
			18	SS	135/23 cm									
158.0			19	SS	190/18 cm									
29.0	Gray Sandy Silt to Silty Sand Very Dense		20	SS	180/23 cm									
154.8														
32.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to
Sensitivity

20
15
10
+ 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2										METRIC				
W P 89-78-04		LOCATION Co-ords. N 4 851 384.4; E 306 129.3				ORIGINATED BY AR								
DIST 6 HWY 7N		BOREHOLE TYPE Hollow Stem Auger & Cone Test				COMPILED BY TJK								
DATUM Geodetic		DATE 82 11 02				CHECKED BY <i>[Signature]</i>								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	WATER CONTENT (%) 10 20 30					
186.9	Ground Surface													
0.0	Trace of Organics		1	SS	37									2 14 60 24
	Gray (Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt & Sand Layers		2	SS	44									
			3	SS	45									
			4	SS	23									
			5	SS	28									
			6	SS	37									1 14 76 9
	Silty Sand		7	SS	53									
	Layers of Sand & Gravel		8	SS	29									31 63 (6)
	Very Stiff to Hard													
174.3			9	SS	158	23 cm								
12.6	End of Borehole													
	* Note: Water Level not established													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 356.9; E 306 109.7 ORIGINATED BY AR
 DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
 DATUM Geodetic DATE 82 11 03 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	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					
187.7	Ground Surface												
0.0	Soft		1	SS	2								
	Brown Silty Sand		2	SS	5								2 72 22 4
	Grey		3	SS	67								0 12 63 25
			4	SS	63								
			5	SS	38								
	(Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt and Sand Layers		6	SS	39								
			7	SS	36								
	Very Stiff to Hard		8	SS	20								
			9	SS	30								
			10	SS	100/23 cm								13 33 40 14
171.5													
16.2			11	SS	158/23 cm								
	Grey Stratified Silty Clays and Silts Occ. Layers of Sandy Silt		12	SS	43								
			13	SS	36								
	Hard												
			14	SS	39								
158.1													
29.6	Sandy Silt to Silty Sand												

Continued

2, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 3 Continued

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 356.9; E 306 109.7 ORIGINATED BY AR
 DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
 DATUM Geodetic DATE 82 11 03 CHECKED BY ef

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
	Continued															
	Gray Sandy Silt to Silty Sand		15	SS	200/20 cm	156										
	Very Dense					154										
152.4			16	SS	100/10 cm											
35.3	End of Borehole															
	* Note: Piezometer damaged, W.L. not established															

OFFICE REPORT ON SOIL EXPLORATION

*3, *5 : Numbers refer to
Sensitivity

20
15
10
*5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 396.3; W 306 094.5 ORIGINATED BY AR
DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY IJK
DATUM Geodetic DATE 82 11 05 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
187.8	Ground Surface													
0.0	Firm Brown Grey Silty Sand and Gravel		1	SS	5									29 43 21 7
			2	SS	29									3 12 55 30
			3	SS	39									
			4	SS	31									
	(Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt and Sand Layers		5	SS	27									
			6	SS	24									1 21 50 28
	Very Stiff to Hard		7	SS	27									
			8	SS	25									
175.2			9	SS	42									
12.6	End of Borehole													
	* Note: Water Level not established													

OFFICE REPORT ON SOIL EXPLORATION

*³, *⁸: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



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foundation investigation and design report

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 89-78-04

DIST 6

HWY 7

STR SITE 37-73-1127

Hwy. 7N Over West Don River Bridge

CONT. 85-52

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FOUNDATION INVESTIGATION REPORT

For

Hwy. 7N Over West Don River Bridge
W.P. 89-78-04, Site 37-73-1127
Hwy. 7, District 6, Toronto

INTRODUCTION

This report summarizes the results of a foundation investigation completed at the above-mentioned site, providing a detailed description of subsurface conditions encountered and recommendations in accordance with appropriate structural design and related construction practices. The investigation commenced on 82 11 01 and was completed by 82 11 05. Four sampled boreholes were carried out, each accompanied by a dynamic cone penetration test. Hollow stem continuous flight augers were utilized to advance borings for depths ranging from 12.6 to 35.5 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located some 60 metres north of the existing Hwy. 7 over the West Don River structure in the township of Vaughan.

The topography is basically flat and level with the West Don River meandering in a shallow valley. Currently, the land is not in use for any commercial purpose.

Physiographically, the site is located in the Peel Plain Region which is East of the Niagara Escarpment and North of the Lake Iroquois Shoreline. It consists of bevelled till plain with gently undulating rolling surface and limited relief. Till sheets encountered are usually separated from one another by a bed of stratified silt or sand of variable thickness. Bedrock has been found in the area at depths in excess of 30 metres below ground surface and consists of shale and limestone of the Dundas Formation Ordovician Period.

SUBSURFACE CONDITIONS

General

Reasonably competent subsurface conditions were encountered across the site. The predominate surficial deposit consists of a stiff to hard cohesive glacial till extending to a depth of 16.2 metres and is composed of silty clay, sand and gravel. Underlying the surficial deposit and extending for a maximum thickness of 17.1 metres is a hard glaciolacustrine deposit of stratified silty clays and silts. Borings were terminated in a very dense stratum of sandy silt to silty sand.

The attached Record of Borehole Sheets summarizes the boundaries between the various soil types, laboratory test results, stabilized groundwater levels and the dynamic cone penetration results. The location and elevation of the borings, along with a profile showing a simplified stratigraphical summary and 2 detailed stratigraphical sections are shown on Drawing No. 897804-A.

The various soil types encountered are briefly described in the following paragraphs.

Silty Clay, Sand and Gravel (Glacial Till)

The surficial deposit encountered across the site consists of a cohesive glacial till composed of silty clay with varying amounts of sand and a trace of gravel. Occasional layers of silty sand, sand and gravel were encountered within this deposit. Typical gradation curves for this till stratum are plotted in envelope form on Figure No. 1 in the Appendix. In addition, typical gradation curves for the inter-bedded coarser granular layers are shown on Figure 2. This cohesive till ranged in thickness from 11.9 to 16.2 metres. Recent alluvium, consisting of silty sand and gravel, was encountered in the upper 2 metres of this deposit.

Results of laboratory index testing performed on representative samples from this deposit are plotted on the Plasticity Chart, Figure #3 and summarized as follows:

Index Test		Range	Average
Water Content	(w)%	6-16.5	12.7
Liquid Limit	(W _L)%	18.5-28	23.6
Plastic Limit	(W _p)%	11-15.5	13.6
Plasticity Index	(I _p)%	7-14	10.1

These results indicate the matrix of this glacial till to consist of an inorganic silty clay of low plasticity (CL).

Based on interpretation of Standard Penetration Test 'N' values and augering operations, the consistency for this deposit is assessed as ranging from stiff to hard throughout except for the upper two metres where surficial softening has occurred.

Silty Clays and Silts

Underlying the surficial till and extending for thicknesses of 13.4 to 17.1 metres is a glaciolacustrine deposit consisting of stratified silty clays and silts. Layers and inclusions of sandy silt were encountered throughout this deposit. Two typical grain size distribution curves for the silty clay deposit are shown on Figure 4.

Results of index testing indicate the predominate fabric of this deposit to consist of inorganic silty clay of low to intermediate plasticity (CL-CI) with stratified bands of nonplastic to slightly plastic silts (ML).

Based on 'N' values ranging from 36 to in excess of 100 blows per 0.3 metres, the consistency of this deposit is described as hard.

Sandy Silt to Silty Sand

The basal deposit encountered at this site and explored to a maximum depth of 5.7 metres is a fine granular stratum consisting of sandy silt to silty sand.

Interpretation of 'N' values all well in excess of 100 blows per 0.3 metres suggests a denseness for this stratum of very dense throughout.

GROUNDWATER CONDITIONS

Stabilized piezometer water level readings indicate the water table corresponds to elevation 186, reflecting the river water levels at the time of investigation. Rapid fluctuations in the water table are anticipated as a result of weather conditions.

DISCUSSION AND RECOMMENDATIONS

As part of the Hwy. 7 realignment to accommodate future Hwy. 407 requirements, it is proposed to cross the West Don River with a 34 metre long by 32 metre wide single span simply supported structure. A planned Hwy. 7N profile grade of 191.5 and river bottom elevation of approximately 186 will necessitate maximum approach fill heights in the order of 6 metres. In addition, minor realignment of the West Don River will be required.

In consideration of the reasonably competent nature of the underlying glacial subsurface condition, recommendations dealing with the structure foundations and related earthworks are as follows.

Structure Foundations

Shallow spread footings founded in the glacial till deposit are considered marginally viable due to surficial softening and scourability of the bearing soils. For footings located at or below elevation 185, the following O.H.B.D.C. bearing capacities are recommended:

Factored Capacity at U.L.S. 400 kPa

Capacity at S.L.S. Type II 240 kPa

Resistance to sliding can be calculated assuming an adhesional value of 95 kPa between the base of the abutment footing and the underlying glacial till.

Full height abutments should be founded on short friction piles driven to a specified elevation. A concrete filled steel tube O.D. 324 mm x 6.3 mm @ 49.7 kg/m driven to a tip elevation of 173 for the east abutment and 172 for the west abutment can be designed for the following O.H.B.D.C. parameters:

Factored Capacity at U.L.S. $(Q_f) = 800 \text{ kN}$

Capacity at S.L.S. Type II $(Q_s) = 540 \text{ kN}$

Tube piles should be equipped with a standard plate driving shoe. Alternatively, full height abutments can be founded on longer end bearing piles driven to practical refusal into the sandy silt to silty sand stratum. For a steel 'H' section pile driven to a minimum set of 15 blows per 25 mm for the final 75 mm of pile advancement using a minimum driving energy of 48,000 joules/blow, the following O.H.B.D.C. parameters are suggested for design purposes:

<u>Pile Section</u>	<u>Factored Capacity at U.L.S. (kN)</u>	<u>Capacity at S.L.S. Type II (kN)</u>
310 HP 79	1250	890
310 HP 110	1600	1150

For design estimating purposes, theoretical pile embedment lengths can be calculated assuming an anticipated pile tip elevation 155.

Other Considerations

All softened and/or organic material within the planned limits of the immediate approaches and abutment pile caps should be subexcavated for their full depth and backfilled prior to fill placement and pile driving operations.

Fill material placed within the zone of pile penetration must be restricted to a maximum grain size of 75 mm.

Difficult driving conditions are anticipated for end bearing piles between elevations 175 and 169 and field personnel should be made aware of this concern.

The underside of the abutment footings or pile cap should be provided with a minimum 1.25 metres of earth cover for frost protection purposes.

Earth pressures against the back of the abutment wall should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. Manual, with provisions made for adequate drainage.

Abutment footing or pile cap excavations carried down below the prevailing groundwater level will require an appropriate dewatering scheme to insure placement of concrete "in-the-dry". This can be achieved with a suitable sheet piling cutoff design where interlocking piling is driven a minimum depth below the excavation of twice the water table height above the base of the excavation.

The use of heavy vibratory compaction equipment must be restricted in proximity to the abutment wall as per current M.T.C. practice.

No stability/settlement problems are anticipated for permanent embankment slopes constructed to standard 2:1 geometry provided subexcavation of all softened and/or organic material is carried out in the immediate area of the approaches.

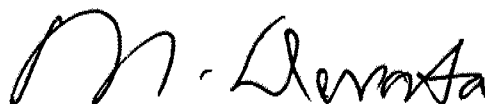
MISCELLANEOUS

The fieldwork for this investigation was performed under the supervision of Mr. A. Ragula, Student Field Technician.

This report was written by Mr. T. Kazmierowski, Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.





T.J. Kazmierowski, P. Eng.
Foundations Engineer


M. Devata, P. Eng.
Senior Foundations Engineer

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 423.8; E 306 114.1 ORIGINATED BY AR
DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
DATUM Geodetic DATE 82 11 01 CHECKED BY 

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100	SHEAR STRENGTH					
187.0	Ground Surface						○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	10 20 30				GR SA SI CL
0.0	Brown Grey (Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Sandy Silt Stiff to Hard		1	SS	9	186							47 40 11 2
			2	SS	26	184							1 13 53 33
			3	SS	23								
			4	SS	13								
			5	SS	16								9 16 44 31
			6	SS	23	182							
			7	SS	23								
			8	SS	16	180							3 30 44 23
			9	SS	43								0 21 74 5
			10	SS	43	178							
			11	SS	56	176							
175.1	Grey Stratified Silty Clays and Silts Occ. Layers of Sandy Silt Hard		12	SS	168	20 cm							
11.9			13	SS	161	20 cm							
			14	SS	57		Bentonite Seal						1 1 63 35
			15	SS	58		Piezometer Bentonite Seal						
			16	SS	46								
			17	SS	49								
			18	SS	135	23 cm							0 0 22 78
158.0	Grey Sandy Silt to Silty Sand Very Dense		19	SS	190	18 cm							
29.0			20	SS	180	23 cm							
154.8													

32.2 End of Borehole

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 384.4; E 306 129.3 ORIGINATED BY AR
DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
DATUM Geodetic DATE 82 11 02 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
186.9	Ground Surface													
0.0	Trace of Organics		1	SS	37	*	186							
			2	SS	44									2 14 60 24
	Grey (Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt & Sand Layers		3	SS	45		184							
			4	SS	23									
			5	SS	28		182							
			6	SS	37									1 14 76 9
	Silty Sand		7	SS	53		180							
	Layers of Sand & Gravel		8	SS	29		178							31 63 (6)
	Very Stiff to Hard						176							
174.3			9	SS	158/23 cm									
12.6	End of Borehole													
	* Note: Water Level not established													

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RECORD OF BOREHOLE No 3

METRIC

W P B9-78-04 LOCATION Co-ords. N 4 851 356.9; E 306 109.7 ORIGINATED BY AR
DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
DATUM Geodetic DATE 82 11 03 CHECKED BY EP

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 _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
187.7	Ground Surface											
0.0	Soft		1	SS	2	*						
	Brown Silty Sand		2	SS	5		186					2 72 22 4
	Grey		3	SS	67							
			4	SS	63		184	100/25 cm				0 12 63 25
			5	SS	38							
	(Glacial Till)		6	SS	39		182					
	Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt and Sand Layers		7	SS	36		180					
	Very Stiff to Hard		8	SS	20		178					
			9	SS	50		176					
			10	SS	100/13 cm		172					13 33 40 14
171.5												
16.2			11	SS	158/23 cm		170					
			12	SS	43		166					
	Grey Stratified Silty Clays and Silts Occ. Layers of Sandy Silt		13	SS	36		164					
	Hard		14	SS	39		160					
158.1												
29.6	Sandy Silt to Silty Sand						158					

Continued

+3, x5 : Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

Continued

RECORD OF BOREHOLE No 3 Continued

METRIC

W P 89-78-04 LOCATION Co-ords. N 4 851 356.9; E 306 109.7 ORIGINATED BY AR
 DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
 DATUM Geodetic DATE 82 11 03 CHECKED BY ep

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	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					
	Continued																
	Grey Sandy Silt to Silty Sand		15	SS	200/20	g	156										
	Very Dense						154										
152.4			16	SS	100/10	cm											
35.3	End of Borehole																
	* Note: Piezometer damaged, W.L. not established																

OFFICE REPORT ON SOIL EXPLORATION

*³, *⁵: Numbers refer to
Sensitivity

20
15 $\frac{1}{5}$ (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

METRIC

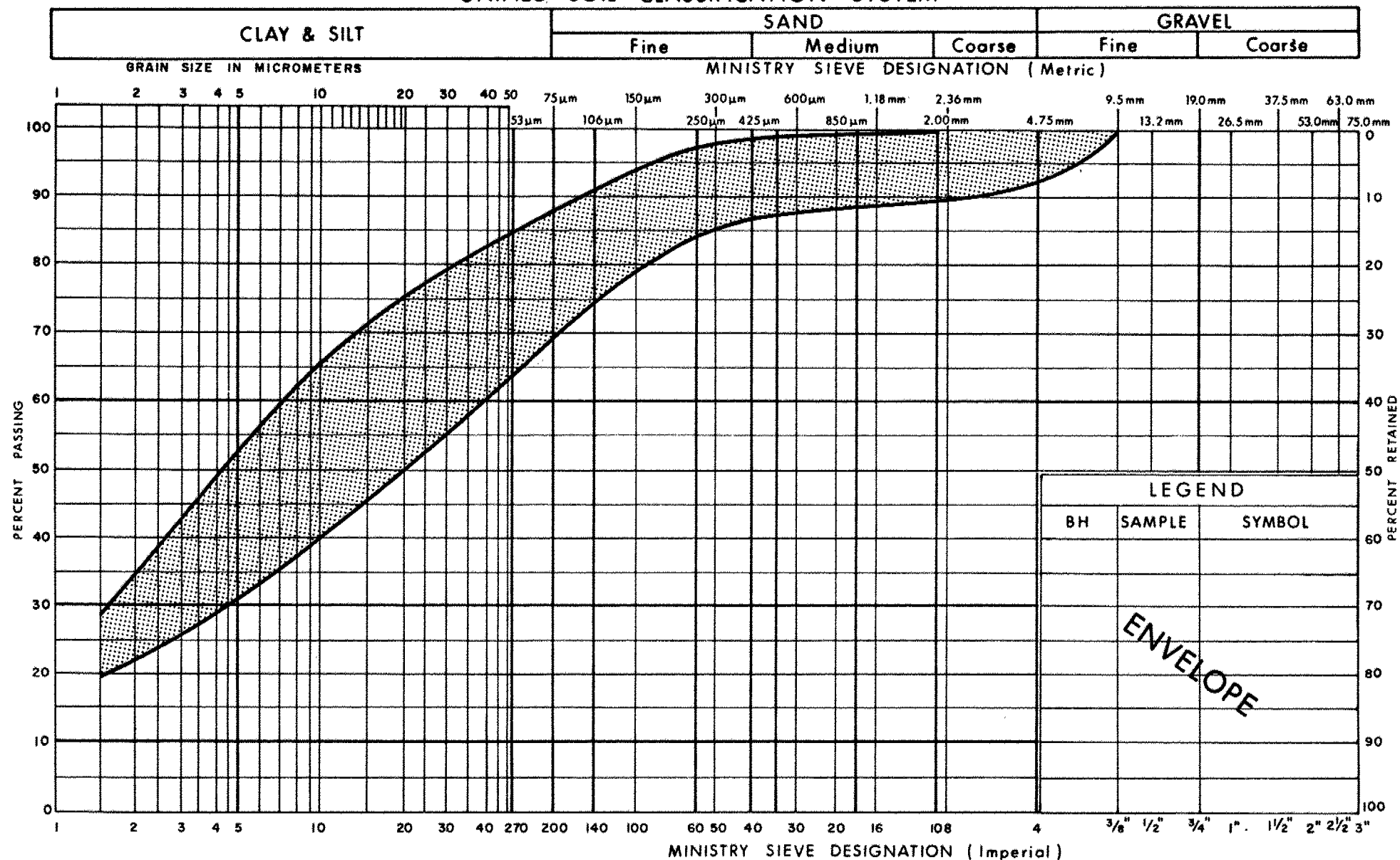
W P 89-78-04 LOCATION Co-ords. N 4 851 396.3; E 306 094.5 ORIGINATED BY AR
 DIST 6 HWY 7N BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY TJK
 DATUM Geodetic DATE 82 11 05 CHECKED BY GP

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 _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
187.8	Ground Surface													
0.0	Firm Brown Grey Silty Sand and Gravel (Glacial Till) Silty Clay with Varying amounts of Sand, Trace of Gravel Occ. Silt and Sand Layers Very Stiff to Hard		1	SS	5	*	186							29 43 21 7
			2	SS	29									3 12 55 30
			3	SS	39									
			4	SS	31									
			5	SS	27									
			6	SS	24									1 21 50 28
			7	SS	27									
			8	SS	25									
175.2			9	SS	42									
12.6	End of Borehole * Note: Water Level not established													

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



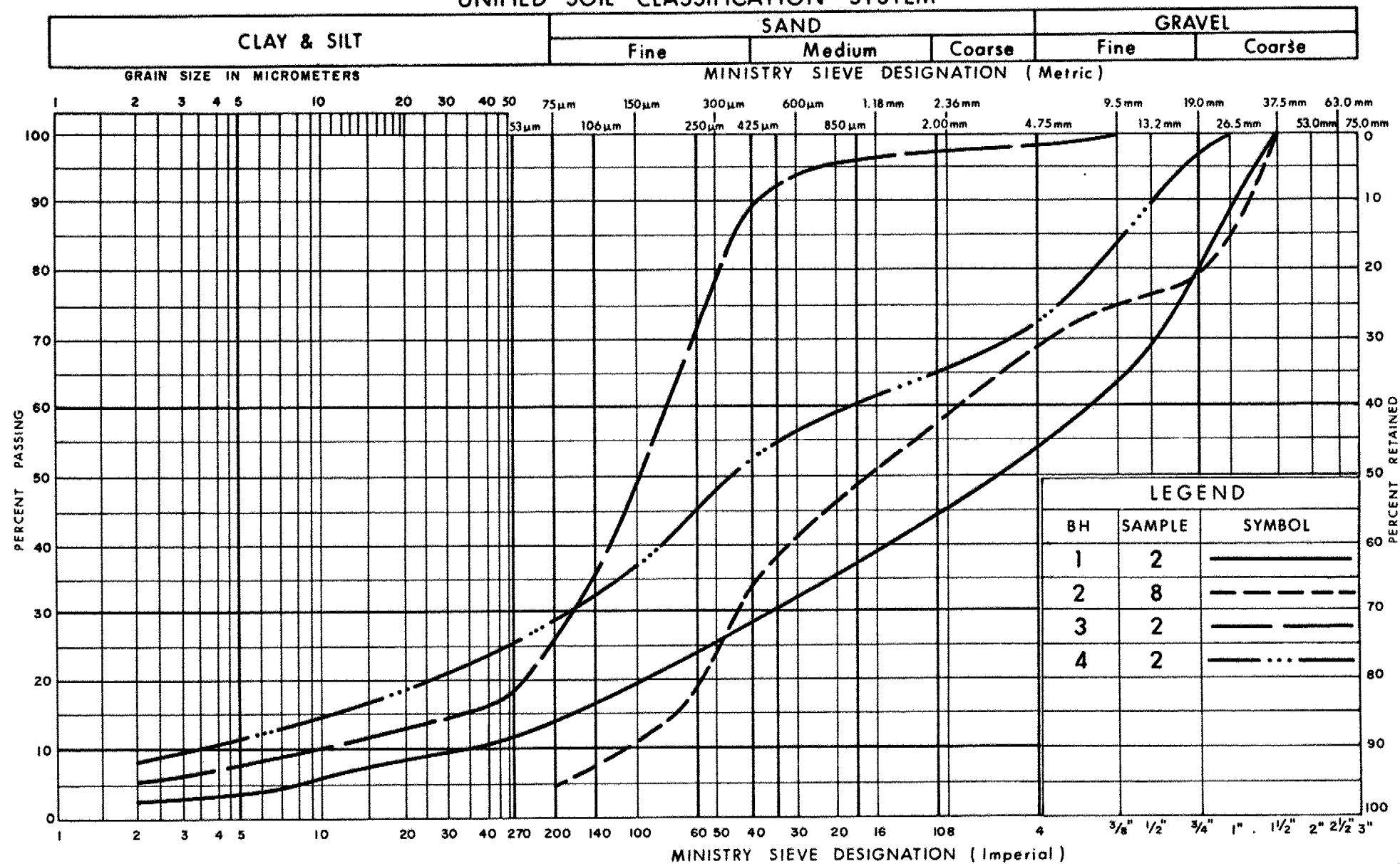
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GRAIN SIZE DISTRIBUTION
(Glacial Till) **SILTY CLAY**
WITH VARYING AMOUNTS OF SAND, TRACE OF GRAVEL

FIG No 1

W P 89-78-04

UNIFIED SOIL CLASSIFICATION SYSTEM

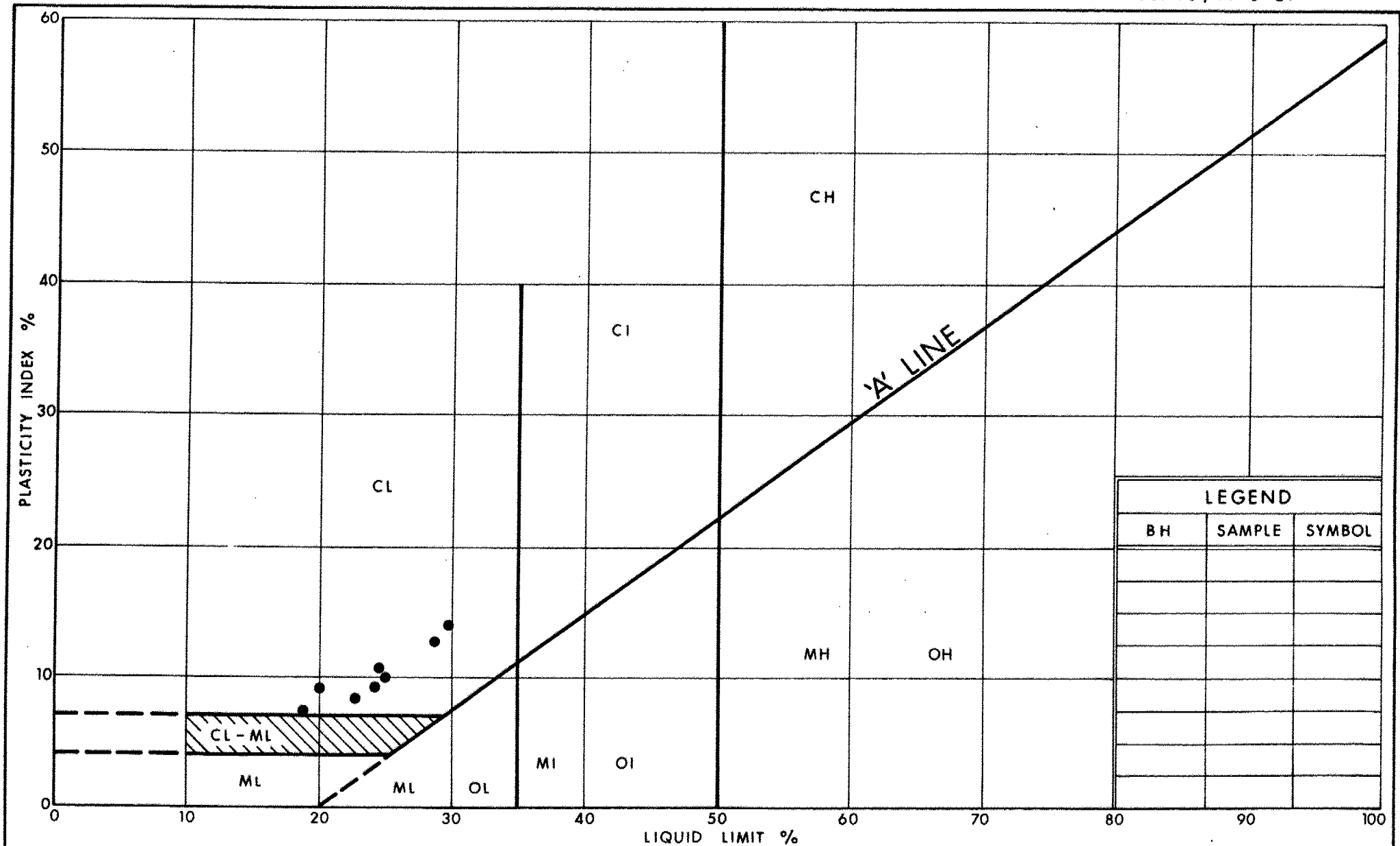


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GRAIN SIZE DISTRIBUTION
INTERBEDDED SILTY SAND & GRAVELLY SAND
(Glacial Till)

FIG No 2

W P 89-78-04

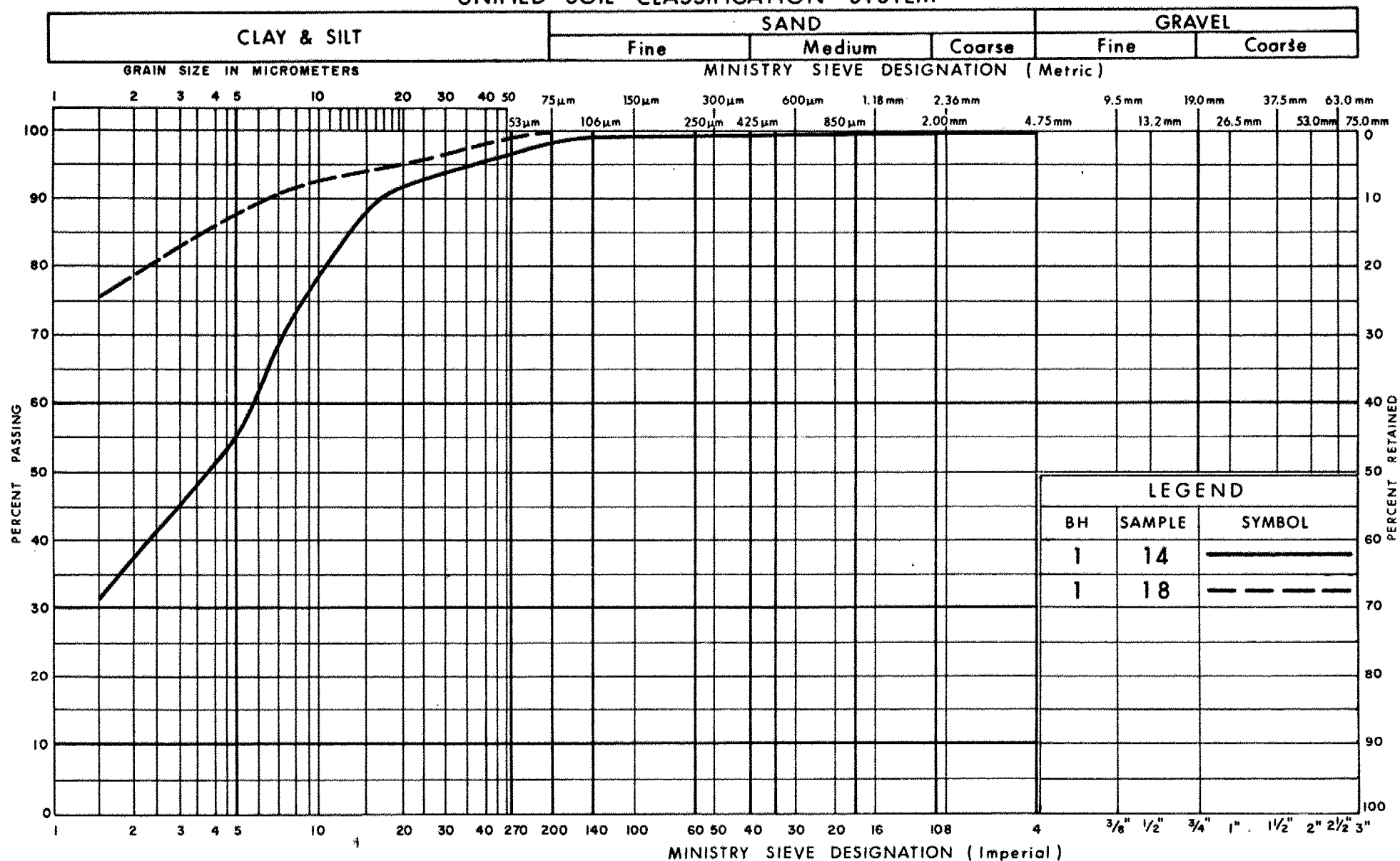
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PLASTICITY CHART
(Glacial Till Matrix)
SILTY CLAY OF LOW PLASTICITY

FIG No 3

W P 89-78-04

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION STRATIFIED SILTY CLAYS

FIG No 4

W P 89-78-04

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

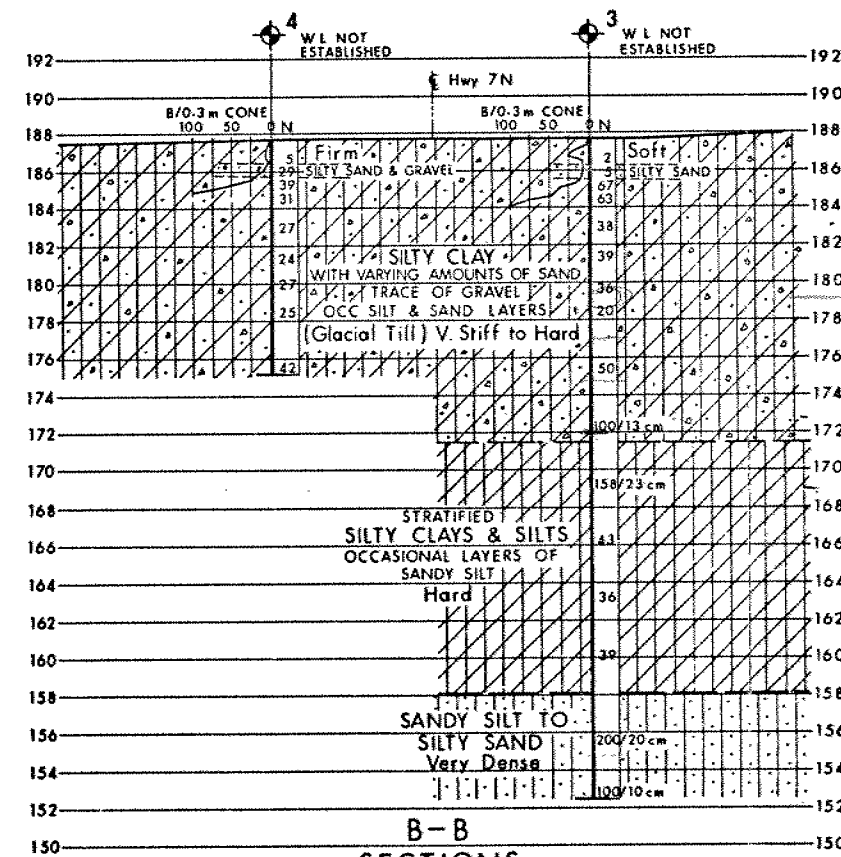
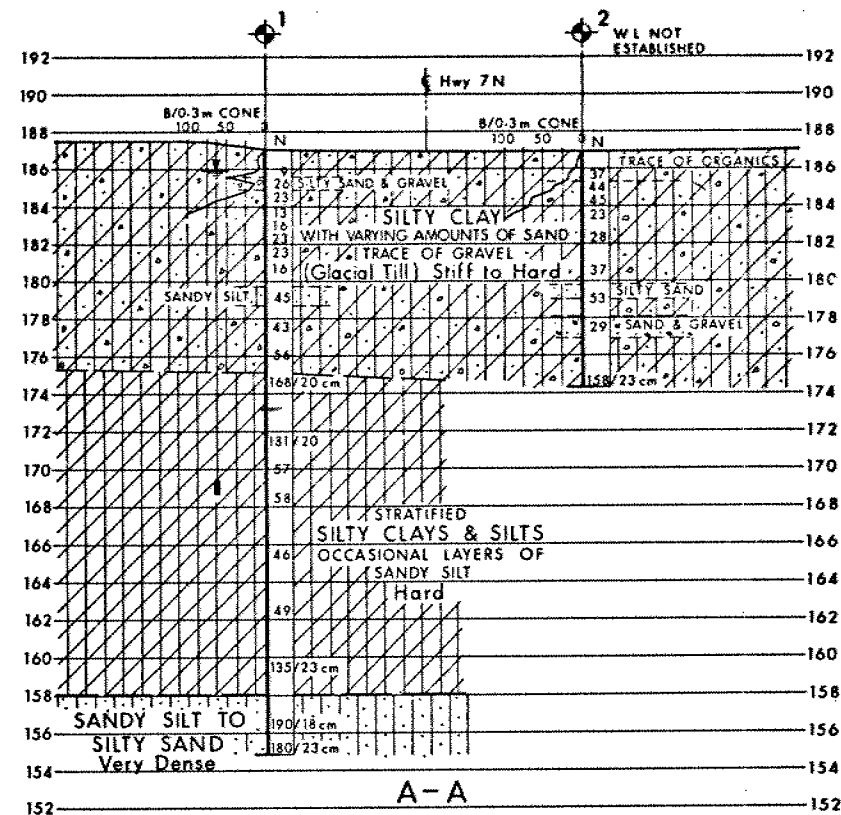
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa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

MECHANICAL PROPERTIES OF SOIL

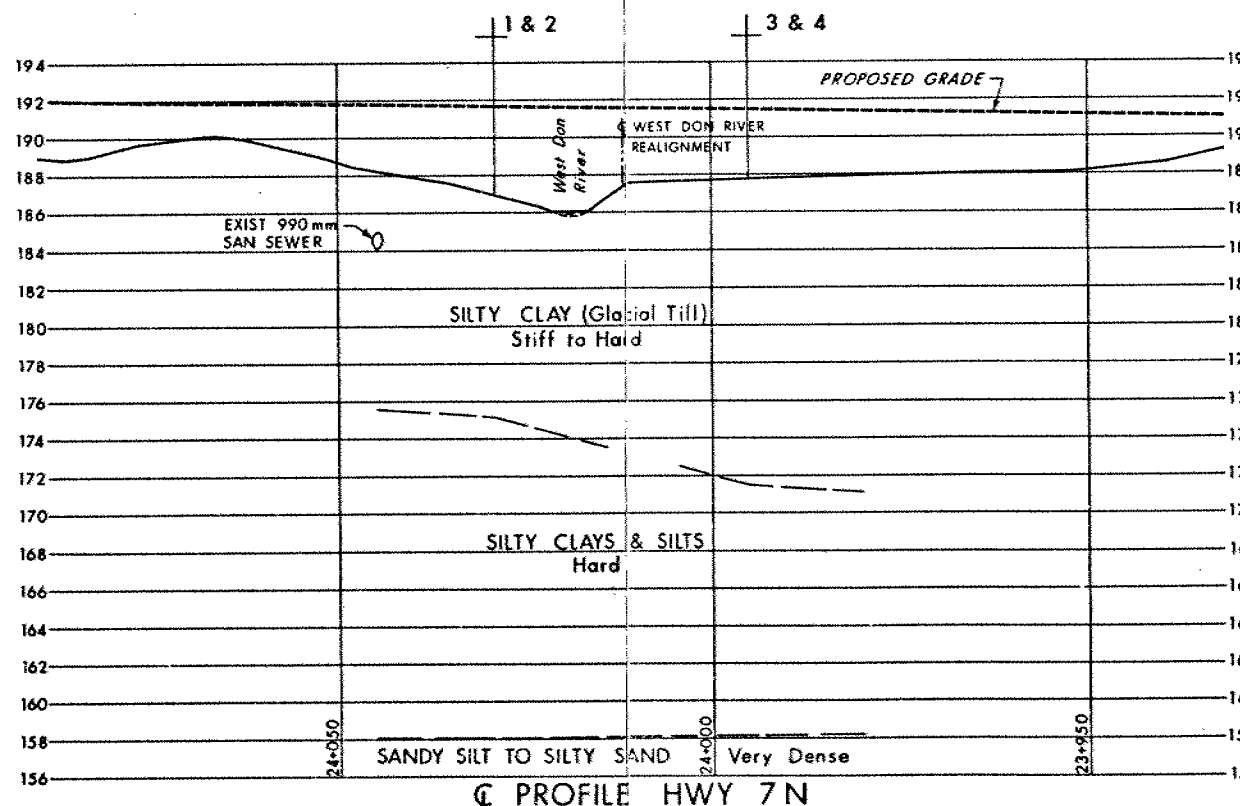
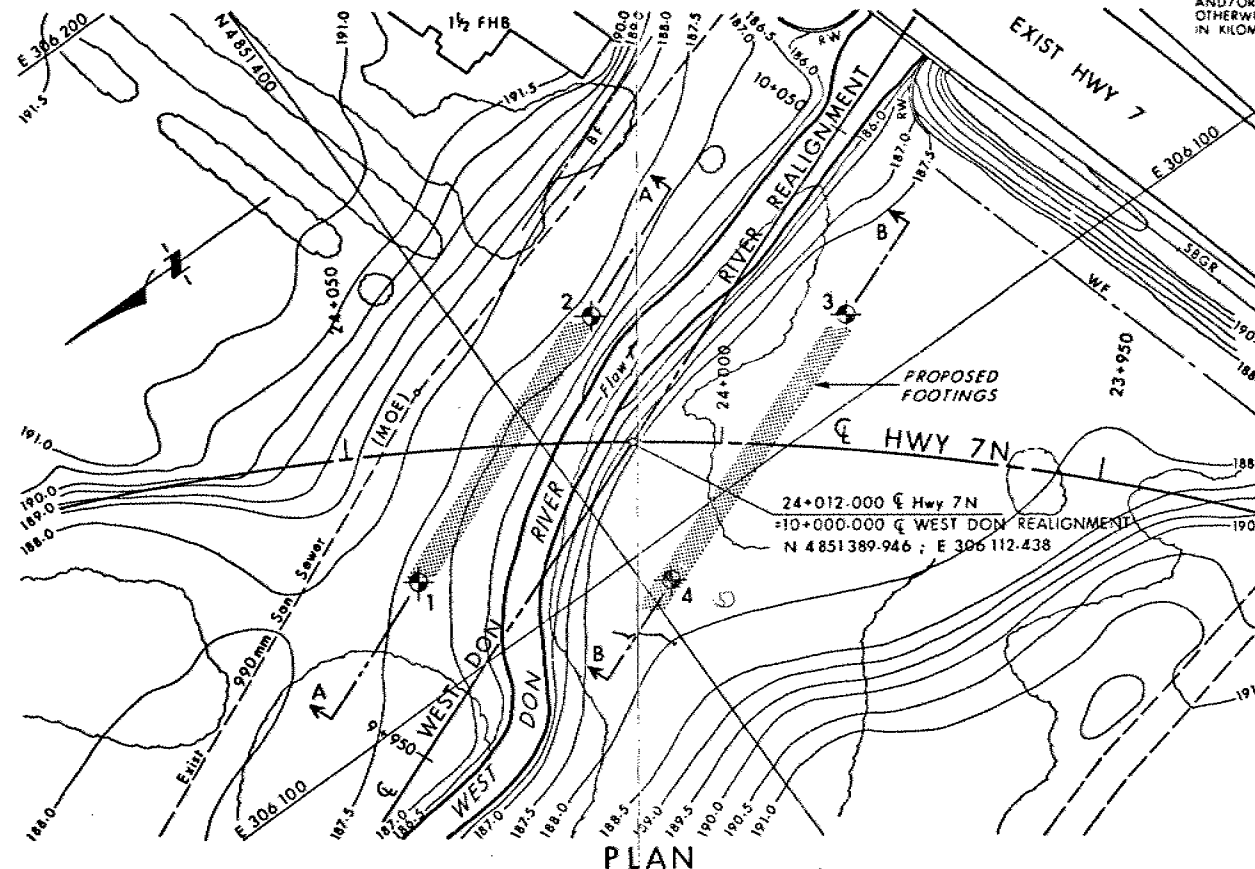
m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{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
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



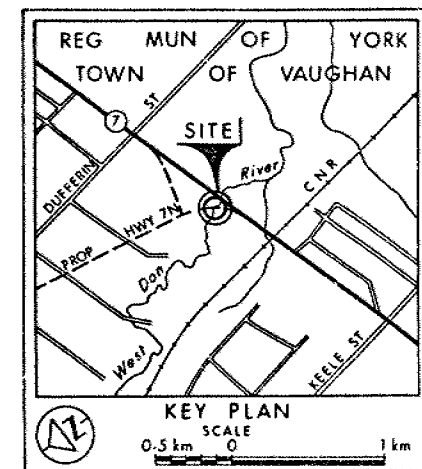
SCALE
HOR 10m 5 0 10m
VERT 4m 2 0 4m



SCALE
HOR 10m 5 0 10m
VERT 4m 2 0 4m

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

CONT No
WP No 89-78-04
HWY 7N OVER WEST DON RIVER
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 1982 11
- WL Not Established in Boreholes 2, 3 and 4
- WL in Piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	187.0	4 851 423.8	306 114.1
2	186.9	4 851 384.4	306 129.3
3	187.7	4 851 356.9	306 109.7
4	187.8	4 851 396.3	306 094.5

NOTE

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

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.

DATE	BY	DESCRIPTION
1983 02 02	DATE	1983 02 02
1983 02 02	DATE	1983 02 02
1983 02 02	DATE	1983 02 02

REF DILLON CONS ENGINEERS & PLANNERS
Project No 9209-01 Sheet D3 : 1982 09

Geacres No 30M14 - 168
HWY No 7N
SUBMITTAL CHECKED DATE 1983 02 02 SITE 37-73-1127
DRAWN BY CHECKED APPROVED DWG 897804-A