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W.P. No. 270-87-03

CONT. No. 95-34

W. O. No.

STR. SITE No. 22-162

HWY. No. 401

LOCATION Rougemount Dr. Underpass

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ministry
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REMARKS _____ 509 2346

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OVERSIZE DRAWING

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 95-34



Ministry of
Transportation

INDEX

<u>Page No:</u>	<u>DESCRIPTION</u>
1	Index
2	Abbreviations & Symbols
	Foundation Investigation Report for
3 - 26	Rougemount Drive Overpass W.P. 270-87-03, Site 22-162 Hwy. 401, District 6, Toronto
27 - 50	Rouge River Northwest Area W.P. 87-87-00 (A), Site N/A Hwy. 401 District 6, Toronto
51 - 81	Rouge River & Rougemount Drive Cut Slope Stability W.P. 87-87-00 (C), Site N/A Hwy. 401, District 6, Toronto
82 - 114	High Mast Lighting Hwy. 2 to Fairport Road W.P. 270-87-00 Hwy. 401, District 6, Toronto
115 - 122	High Mast Lighting Hwy. 2 to Fairport Rd. (Addendum) W.P. 271-87-00 Hwy. 401, District 6, Toronto
123 - 237	Retaining Walls Hwy. 2 to Fairport Road W.P. 270-87-00 Hwy. 401, District 6, Toronto
238 - 252	Retaining Walls (Addendum) Meadowvale Road to CNR Structure W.P. 271-87-00 Hwy. 401, 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 mentioned projects.

EXPLANATION OF TERMS USED IN REPORT

2

N VALUE - THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 1.3m 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 1" 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 UNGRAINED 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	C.S. OSTERBERG SAMPLE
S.T. SLOTTED TUBE SAMPLE	R.C. ROCK CORE
B.S. BLOCK SAMPLE	P.H. T.W. ADVANCED HYDRAULICALLY
C.S. CHUNK SAMPLE	P.M. T.W. ADVANCED MANUALLY
T.W. THINWALL OPEN	F.S. FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	-	COMPRESSION INDEX
C_s	-	SWELLING INDEX
C_α	-	RATE OF SECONDARY CONSOLIDATION
C_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	-	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_i	-	SENSITIVITY $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u_r	-	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	-	COEFFICIENT OF FRICTION

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	-	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	-	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	-	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$	i	-	HYDRAULIC GRADIENT
γ_{sat}	kn/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	-	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

Rougemount Drive Overpass at Highway 401

W.P. 270-87-03, Site 22-162

District 6, TorontoINTRODUCTION

This report summarizes the results of the foundation investigation conducted at Rougemount Drive Underpass at Highway 401. The investigation was carried out upon the request of the Central Region Structural Section for the proposed reconstruction of Rougemount Drive due to widening of Highway 401. The field work for the investigation was carried out between 92 09 21 and 92 09 29 and consisted of ten (10) sampled boreholes.

SITE DESCRIPTION

The site is located on Highway 401 at Rougemount Drive, in the town of Pickering, Regional Municipality of Durham. It is situated just east of the Rouge River as illustrated in Drawing No. 2708703-A.*

Physiographically, the site lies in a region known as the Iroquois Plain (after Chapman and Putnam, 1984). This region is basically a sand plain overlying glacial till with areas of silt and clay deposits.

The existing Highway 401 at this location is in a cut of about 6 m deep. The side slopes are approximately 2H:1V. The existing Rougemount Drive is supported by a two span concrete bridge. The pier and abutments are on shallow footings. The bridge is generally in fair conditions although some concrete spalling is noted.

Land use outside the transportation corridor comprises a public library to the north and private residences to the south.

* Dwg. No 2, (Sheet 1062) of the Contract Drawings.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out between 92 09 21 and 92 09 29 and consisted of ten (10) sampled boreholes which were advanced to depths of 3.2 to 15.4 m.

The boreholes were advanced using conventional hollow and solid stem augering techniques supplemented by wash-boring in the hard and bouldery stratum at depth. Boreholes BH 4, BH 6, and BH 8 were sunk by a track-mounted continuous flight auger drill rig whereas a truck-mounted machine was employed for the other boreholes. The sampling program consisted of split spoon samples collected in the overburden. Disturbed subsoil samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). They provided Standard Penetration Resistance ('N') values for assessment of the denseness of the non-cohesive material. All the samples collected were used for identification and laboratory testing purposes. Dynamic cone penetration test was carried out in BH 2. An in situ vane shear test was carried out in the cohesive stratum in BH 6 to determine the undrained shear strength of soil. The test was conducted employing the Standard MTO 'N' vane.

All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

The groundwater condition was monitored in open-boreholes and in piezometers installed in BH 4 and BH 6. All the boreholes were backfilled upon completion of the field work.

Survey information related to the location and elevation of boreholes was provided by the Central Region, Surveys and Plans Section.

Laboratory

The laboratory testing program for selected soil samples consisted of:

- Atterberg Limit Test
- Grain Size Distribution
- Unit Weight Determinations
- Natural Moisture Content Determinations

Laboratory test results are given in the following section of this report and are illustrated on figures and Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown on Drawing No. 2708703-A.*

The predominant soil strata encountered in the boreholes consisted of a deposit of cohesive glacial till material overlain by silt, clayey silt and silty clay layers. Pavement structure consisting of asphalt and/or granular subbase were contacted in BH 1 and BH 3, BH 5, BH 9 and BH 10. A minor layer of topsoil was found at the surface in BH 2, BH 6, and BH 8. Bedrock was not encountered at the termination depths of the boreholes.

Following are the specific descriptions of the material encountered in the investigation:

Silt, trace to some Sand

This non-cohesive stratum is contacted near the surface in BH 1 to BH 4 with thickness ranging from 1.3 to 3.2 m. In BH 5, BH 7 and BH 10, it is encountered below the surficial fill material with thickness of 0.6 to 1.5 m. The material contains higher sand content in BH 10. Typical properties of the material, as

* Dwg No 2, (Sheet 1062) of the Contract Drawings.

determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	13.0-20.5	6
Liquid Limit (w_L)	16	1
Plastic Limit (w_p)	15	1
Grain Size Distribution (%)		16
- Gravel	0	
- Sand	6-15	
- Silt and Clay	85-94	

Figure 1 illustrates a typical grain size distribution envelope for this material, based on representative samples from the entire site.

Based on Standard Penetration Resistance 'N' values which ranged from 13 to >100 blows/0.3 m, but typically greater than 40 blows/0.3 m, the denseness of this stratum is dense to very dense.

Clayey Silt, trace Sand

This cohesive layer is only encountered in BH 5, BH 6, and BH 8 with thickness ranging from 0.9 to 3.0 m. The material is typically described as clayey silt, trace sand, numerous stained joints. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	11-15.5	2
Liquid Limit (w_L)	17-18	2
Plastic Limit (w_p)	15-16	2
Unit Weight (kN/m^3)	24.0	1
Grain Size Distribution (%)		2
- Gravel	0	
- Sand	3-7	
- Silt and Clay	93-97	

Based on Standard Penetration Resistance 'N' values which ranged from 18 to >100 blows/0.3 m, but typically greater than 30 blows/0.3 m, the consistency of this layer is hard.

Silty Clay

This cohesive layer is encountered in all the boreholes to the south of Highway 401 (BH 5 to BH 8, and BH 10) underlying the silt or clayey silt stratum. It is 2.2 to 3.5 m in thickness. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	12.0-25.5	6
Liquid Limit (w_L)	22-30	6
Plastic Limit (w_p)	13-16	6
Unit Weight (kN/m^3)	20.0-22.0	2
Grain Size Distribution (%)		5
- Gravel	0	
- Sand	0-4	
- Silt and Clay	96-100	

Figure 2 illustrates a typical grain size distribution envelope for this material. Figure 3 illustrates a typical plasticity chart for this material. Based on this, the material is described as silty clay with low plasticity.

An attempt was made in BH 6 to determine the undrained shear strength of the material by insitu vane shear test. The vane could not be turned even at the maximum force applied by the spring of the scales. It is envisaged that the vane had been pushed into the underlying hard glacial till stratum. Based on Standard Penetration Resistance 'N' values which range from 5 to 92 blows/0.3 m, the consistency of this layer varies from soft to hard, but typically very stiff.

Heterogeneous Mixture of Clayey Silt, some Sand, trace Gravel, occasional Cobbles and Boulders (Glacial Till)

Underlying all the above layers is a major deposit of cohesive glacial till. The maximum thickness of this stratum drilled was 12.7 m. This deposit was not fully penetrated at the maximum termination depth of the boreholes (15.4 m depth, El. 89.4 m). It is typically described as a heterogeneous mixture of clayey silt, some sand, trace gravel with occasional cobbles and boulders. The size of boulders was found to be quite large at times and could not be penetrated or displaced by conventional augering techniques. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	6-9	17
Liquid Limit (w_L)	12-16.5	17
Plastic Limit (w_p)	9-14	17
Unit Weight (kN/m^3)	21.5-25.1	9
Grain Size Distribution (%)		15
- Gravel	3-34	
- Sand	23-40	
- Silt and Clay	37-73	

Figure 4 illustrates a typical grain size distribution envelope for this material, based on representative samples from the entire site. Figure 5 illustrates a typical plasticity chart for this material, based on representative samples from the entire site.

Groundwater

Groundwater level was monitored in the open boreholes during the investigation and in the two piezometers installed in BH 4 and BH 6. The base groundwater table as measured in the piezometers is at around El. 94 ± m, about 10.2 to 11.7 m below existing ground surface. Perched water table in the surficial silt layer was noted upon completion of drilling at BH 1. Groundwater level was not

established in BH 2 and BH 8 as the holes were filled with drilling water upon completion. However, all the soil samples retrieved from these boreholes were dry. The other boreholes were generally dry upon completion except some minor seepage from wet sand seams in the glacial till layer.

Groundwater level is however subject to seasonal fluctuations and may vary from the values given in this report.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer. The equipment was owned and operated by Dominion Soil Investigation Inc.

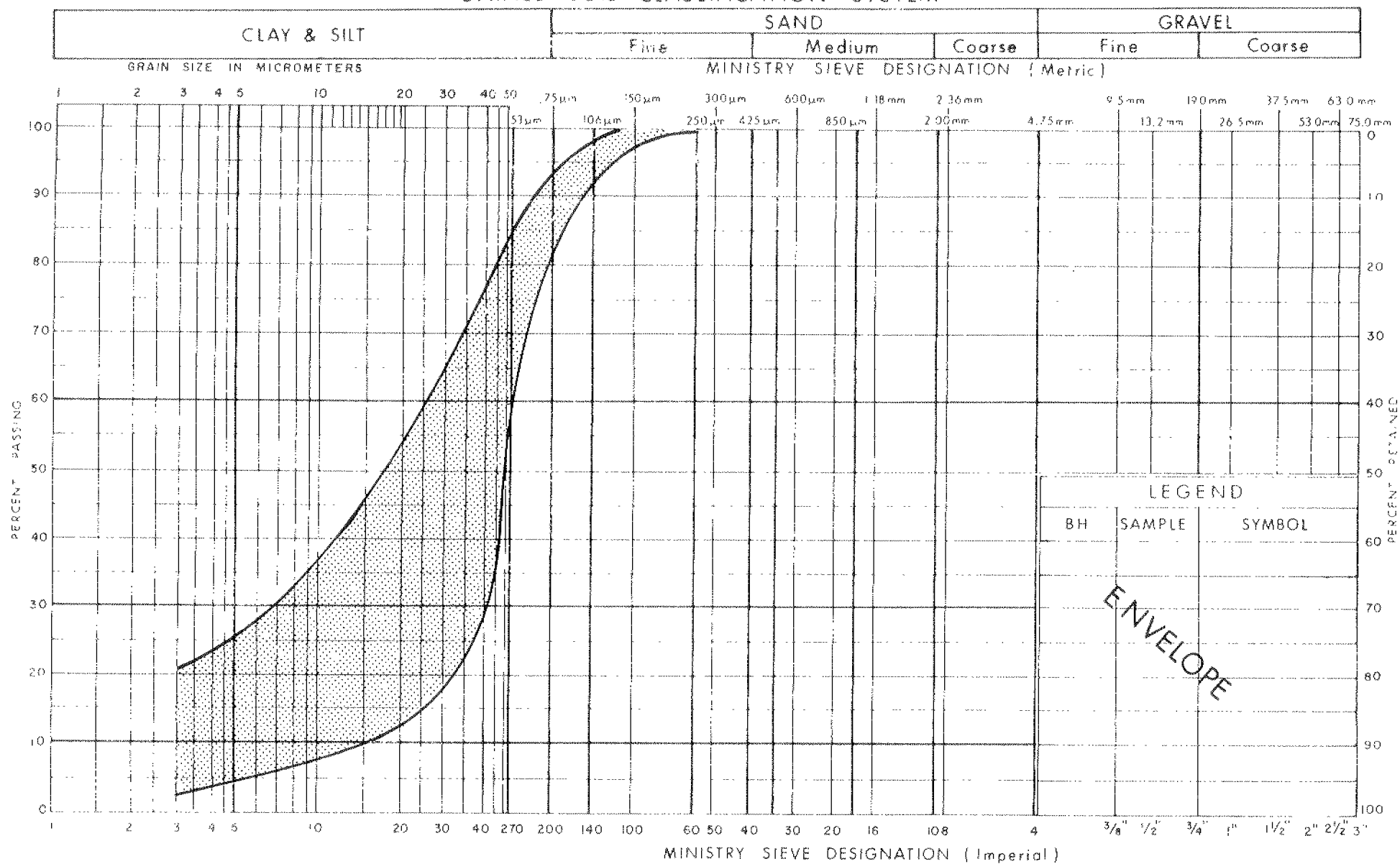
The project was carried out by D. Kwok under the supervision of B. Iyer, Senior Foundation Engineer. The report was written by D. Kwok, reviewed by B. Iyer and approved by M. Devata, Chief Foundation Engineer.



D. Dundas
D. Dundas, P. Eng.
Senior Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
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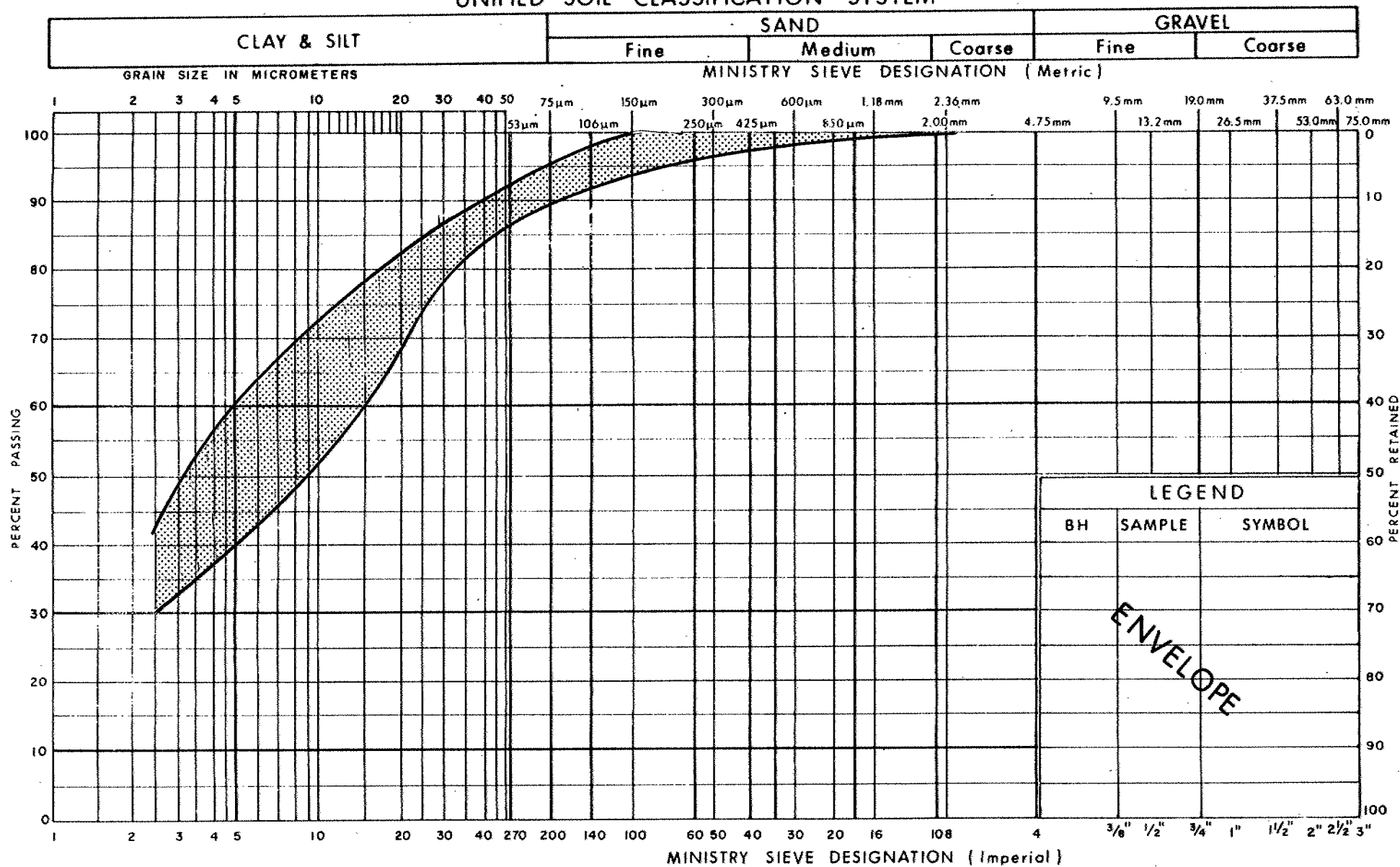
GRAIN SIZE DISTRIBUTION

SILT
TRACE / SOME SAND

FIG No 1

W P 270-87-03

UNIFIED SOIL CLASSIFICATION SYSTEM

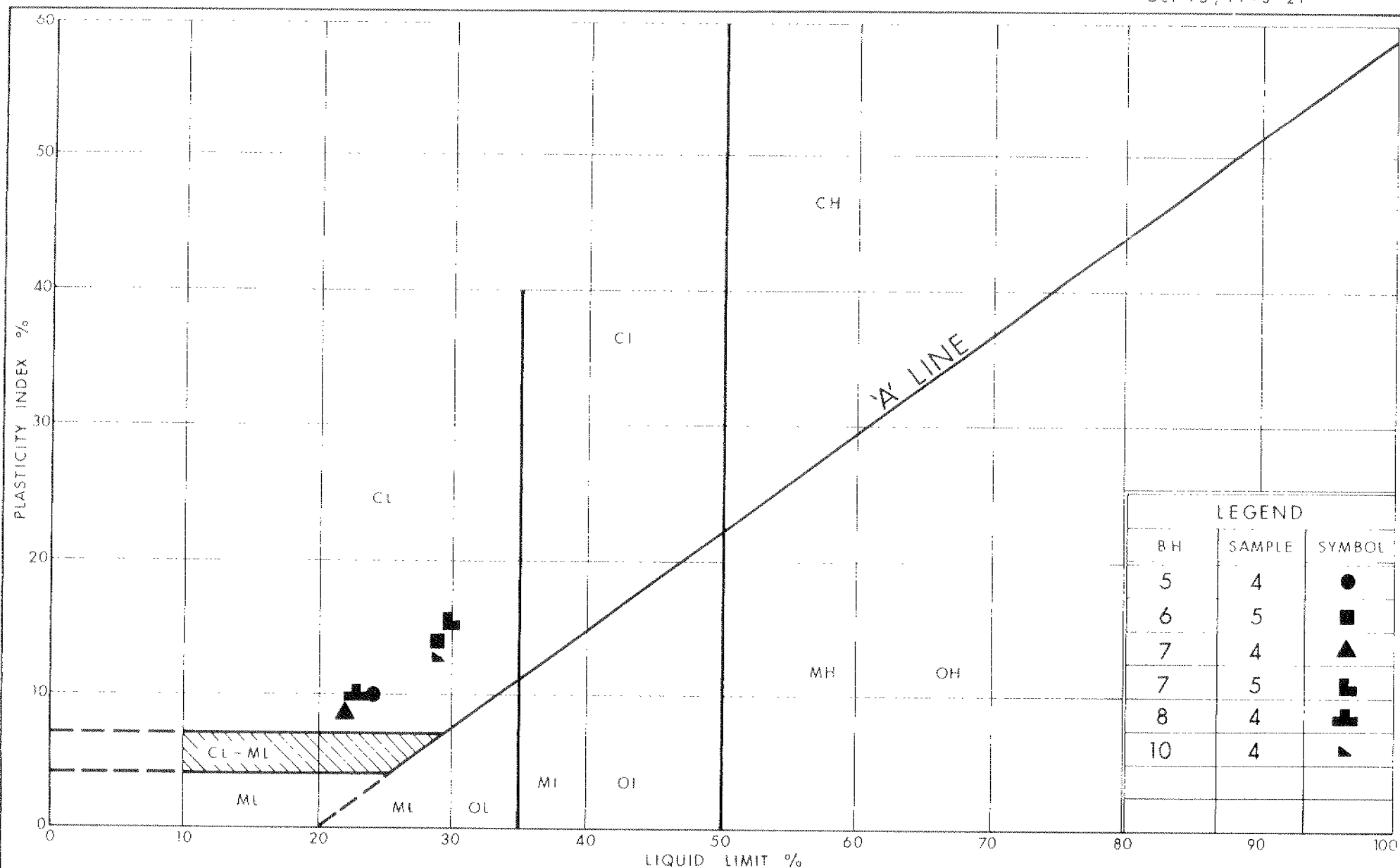


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GRAIN SIZE DISTRIBUTION SILTY CLAY

FIG No 2

W P 270-87-03



Ministry of
Transportation

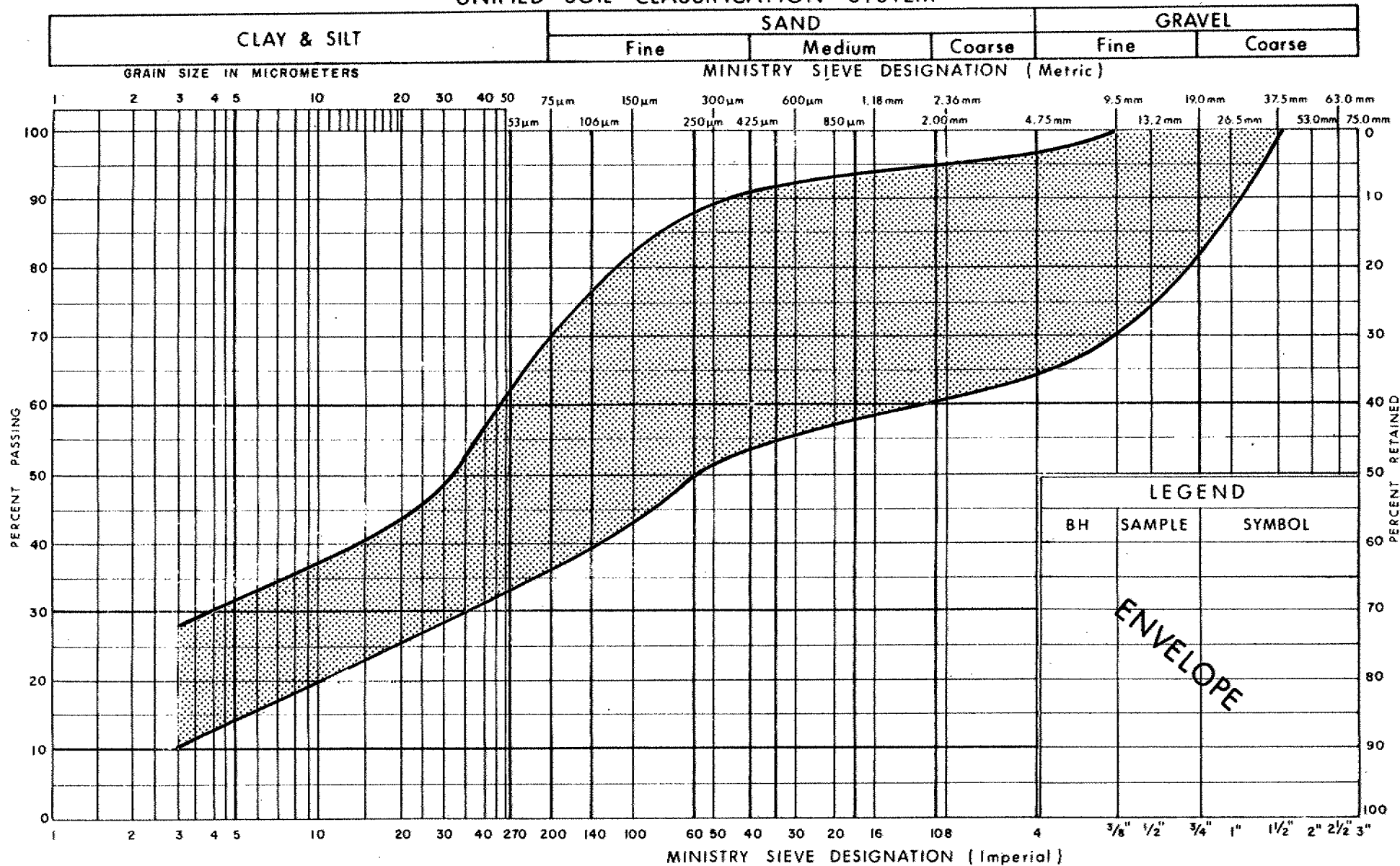
Ontario

PLASTICITY CHART SILTY CLAY

FIG No 3

W P 270-87-03

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF CLAYEY SILT,
SOME SAND, TRACE GRAVEL (GLACIAL TILL)

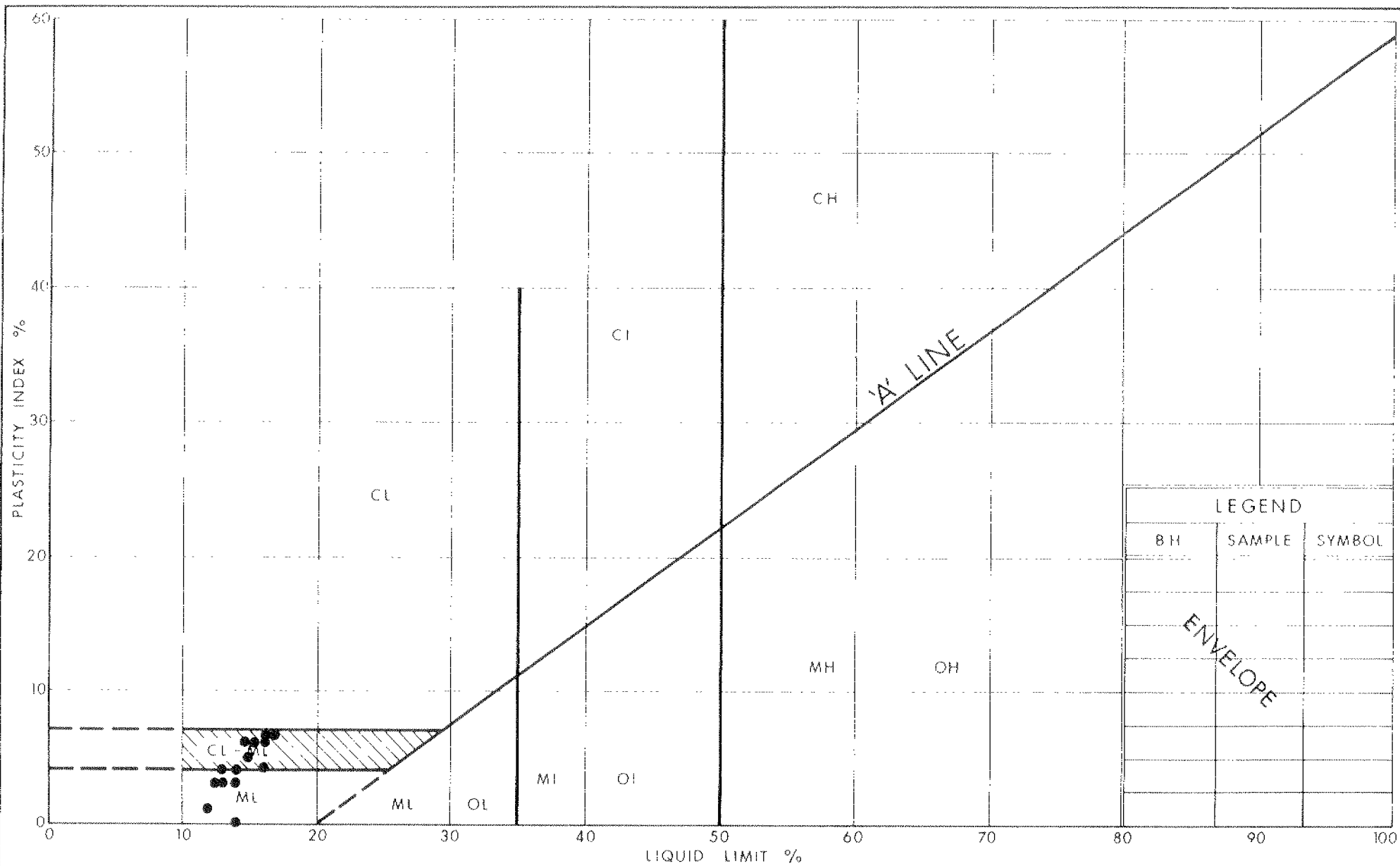
FIG No 4

W P 270-87-03



Ontario

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PLASTICITY CHART
HETEROGENEOUS MIXTURE OF CLAYEY SILT,
SOME SAND, TRACE GRAVEL (GLACIAL TILL)

FIG No 5

W P 270 - 87 - 03

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

WP 270-87-03 LOCATION Co-ords: N 4 851 885.0, E 334 649.2 ORIGINATED BY OK
 DIST 6 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 22 CHECKED BY BI

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
105.9	Ground Surface																
0.0	Pavement Structure																
103.7	Silt, trace Sand Brown, Dense		1	SS	36												0 9 84 7
			2	SS	46												
2.1	Brown		3	SS	101												
	Grey		4	SS	103												5 34 50 11
			5	SS	100	/27cm											
			6	SS	100	/18cm											
			7	SS	105	/24cm											
			8	SS	101	/24cm											4 30 40 26
			9	SS	100	/10cm											
			10	SS	101	/15cm											
			11	SS	100	/13cm											
92.1			12	SS	101	/15cm											
13.8	End of Borehole																
	• Perched water table in the Silt layer noted upon completion of drilling																

ORIGINATED BY DK

COMPILED BY DT

CHECKED BY BI

Fig. 3. Numbers refer to Sensitivity

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 855.0; E 334 658.5 ORIGINATED BY DK
DIST 6 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
DATUM Geodetic DATE 92 09 23 CHECKED BY BI

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
106.1	Ground Surface																
0.0	Pavement Structure																
105.2			1	SS	43												
0.8	Silt, trace sand, occasional sand seams Very Dense Light Brown and Grey		2	SS	99												
			3	SS	100	/28cm	104										0 14 81 5
			4	SS	100	/28cm											
102.0							102										
4.1	Heterogeneous Mixture of Clayey Silt, some sand trace gravel Occasional Silt layers Occasional Cobbles & Boulders Grey Hard (Glacial Till)		5	SS	70												
			6	SS	65		100										27 24 40 9
			7	SS	100	/28cm											
			8	SS	102		98									21.5	3 24 56 17
97.4																	
8.7	End of Borehole	**															
	<ul style="list-style-type: none"> Upon completion of drilling, trace of water at the bottom of the hole probably originated from the wet sand seams above. Drilling terminated on a big boulder 																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 848.5 E 334 645.9 ORIGINATED BY DK
DIST 5 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
DATUM Geodetic DATE 92 09 29 CHECKED BY BL

SOIL PROFILE			SAMPLES			GROUND WATER CONDI-TIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	IN VALUES			20	40	60	80	100					
105.5	Ground Surface																
0.0																	
	Clayey Silt trace organics		1	SS	29												0 6 82 12
	Silt, trace sand occasional sand seams Light Brown, Very Dense		2	SS	81		104										0 15 81 4
102.8			3	SS	100	/70cm											
2.7			4	SS	49		102										
			5	SS	71		100										
			6	SS	35		100										
			7	SS	103		100										
	Heterogeneous mixture of Clayey Silt, trace sand and gravel. Occasional wet sand seams. Occasional cobbles and boulders Grey, Hard (Glacial Till)		8	SS	100	/29cm	98									22.1	16 33 39 13
			9	SS	100	/11cm	96										
			10	SS	100	/15cm	94										
			11	SS	100	/11cm	92										
			12	SS	100	/11cm											
90.1			13	SS	100	/20cm										22.3	
15.4	End of Borehole																
	** Hole dry upon completion of drilling																
92 10 08 * GROUND WATER CONDITIONS																	
PIEZO. NO.			GROUND WATER ELEVATION (Metres)														
1			93.8														

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 798.0, E 334 672.0 ORIGINATED BY DK
DIST 6 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
DATUM Geodetic DATE 92 09 23 - 92 09 24 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT 7 kN/m ³	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
105.5	Ground Surface													
0.0	50mm Asphalt over Clayey Silt (Fill)					DRY *								
104.3			1	SS	6									
1.2	Silt, occasional wet sand seams, Brown, Very Dense		2	SS	62		104							
103.4			3	SS	74									
2.1	Clayey Silt, trace sand Grey and brown, Hard		4	SS	26		102						22.0	0 0 66 34
102.5			5	SS	21									
3.0	Silty Clay, trace sand and gravel, Grey Very Stiff		6	SS	33		100						25.1	26 34 31 9
100.1			7	SS	80									
5.5	Heterogeneous Mixture of Clayey Silt, trace gravel some sand Occasional wet sand pockets Occasional cobbles and boulders Grey, Hard (Glacial Till)		8	SS	46		98							9 38 39 14
			9	SS	100	/20cm	96							
			10	SS	100	/8cm	94							
			11	SS	110	/15cm	92							
90.2			12	SS	100	/13cm								
15.3	End of Borehole													
	* Hole dry upon completion of drilling													

+4, x5. Numbers refer to Sensitivity

RECORD OF BOREHOLE No 7

1 OF 1 METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 768.5; E 334 685.5 ORIGINATED BY DK
DIST 6 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
DATUM Geodetic DATE 92 09 24 CHECKED BY BI

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
104.9	Ground Surface																
0.0	Clayey Silt, some sand trace gravel, some organics (Fill)		1	SS	3	DRY *	104										
103.2			2	SS	13												
102.6	Silt, trace sand, Brown, Compact		3	SS	92												
2.3	Silty Clay Occasional stained joints Brown, Hard (Locustrine) Grey Stiff		4	SS	87		102									20.0	0 1 69 30
			5	SS	14		100										
99.1			6	SS	36												
5.8	Heterogeneous Mixture of Clayey Silt some Sand, trace gravel Occasional cobbles and boulders Grey, Hard (Glacial Till)		7	SS	32		98									23.7	34 29 22 15
			8	SS	50												
			9	SS	100	/25cm	96										
	Boulder		10	SS	100	/14cm	94										
			11	SS	101	/14cm	92										
91.1			12	SS	100	/13cm											
13.8	End of Borehole																
	* Hole dry upon completion of drilling																

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 761.5; E 334 675.5
DIST 5 HWY 401 BOREHOLE TYPE H.S./S.S. Augers, Tricone
DATUM Geodetic DATE 92 09 28
ORIGINATED BY DK
COMPILED BY DT
CHECKED BY BI

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 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA S CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
104.7	Ground Surface															
104.6	Topsoil															
0.3	Clayey Silt, trace sand with stained joints Brown, Hard (lacustrine)		1	SS	45	104										0 7 70 15
102.6			2	SS	100											
2.1	Silty Clay, Grey Very Stiff		3	SS	25	102										0 1 64 33
100.5			4	SS	22											
4.3			5	SS	22	100										
	Heterogeneous Mixture of Clayey Silt, trace sand and gravel Occasional cobbles and boulders Grey, Very Stiff to Hard (Glacial Till)		6	SS	64	98										17 36 31 12
			7	SS	53											
			8	SS	37	96										
			9	SS	101											
94.2			10	SS	100											
10.5	End of Borehole															
	* Upon completion, hole filled with drilling fluid. Water Level not established															

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 910.0; E 334 641.2 ORIGINATED BY DK
DIST 5 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
DATUM Geodtic DATE 92 09 22 CHECKED BY BI

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
106.1	Ground Surface															
108.9	Pavement Structure															
0.6	Heterogeneous Mixture of Clayey Silt some sand, trace gravel Hard, Brown (Glacial Till)		1	SS	52											
			2	SS	100	/28cm										
102.9			3	SS	101	/17cm										
3.2	End of Borehole															
	* Hole Dry upon completion with trace of seepage from Fill / Native soil interface															

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 747.5; E 334 692.2 ORIGINATED BY DK
 DIST 5 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 22 CHECKED BY BJ

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 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
104.5	Ground Surface																
0.0	50mm Asphalt over Silty Sand (Fill)		1	SS	16		104										
103.1			2	SS	48												0 7 86 5
1.5	Sandy Silt to Silt, some Clayey Silt layers. Brown and Grey Very Dense		3	SS	74		102										
101.6			4	SS	37												0 0 60 40
3.0	Silty Clay Occasional wet sand pockets. Grey Hard to Firm		5	SS	7		100										
99.5																	
5.2	Heterogeneous Mixture of Clayey Silt, some sand, trace gravel, Grey, Very Stiff (Glacial Till)		6	SS	27												31 27 31 10
98.0																	
6.8	End of Borehole																
	* Upon completion, trace of water at the bottom of the hole; probably seepage from sand seams																

FOUNDATION INVESTIGATION REPORT
For
Rouge River NW Area
W.P. 87-87-00 (A), Site N/A
Highway 401, District 6, Toronto

INTRODUCTION

The report is applicable to the area west of the Rouge River between Hwy 401 and Hwy 2 from Sta. 23+200 to Sta. 23+550 (Hwy 401 chainage).

SITE DESCRIPTION

The site is located at the NW quadrant of Hwy. 401 and the Rouge River as illustrated in Drawing No. 878700-A.

This area is a basically a sand plain overlying glacial till. Some of the sand is alluvial, but most is considered to be lacustrine in origin due to its extensive thickness. Silt and clay deposits immediately overlie the till, and their contact with the overlying sand is gradational. The deposits in the channel of the Rouge River are being drowned and buried with younger alluvial sediments because of the gradual rise of lake level.

The site is an area of high ground between Hwy. 2 and Hwy. 401, rising over 20 m above the floor of the Rouge River channel. The natural ground surface varies from elev. 113 m at the crest of the embankment to elev. 89 m at the base of the valley. Overall slopes are approximately 2.5H:1V or flatter.

INVESTIGATION PROCEDURES

A foundation investigation was conducted between 87 12 09 and 87 12 29, utilizing a continuous-flight auger machine equipped with 82 mm I.D. hollow-stem augers.

The investigation consisted of 9 sampled boreholes, accompanied by dynamic cone penetration tests. These boreholes are identified as BH #1 to BH #9. They extended for depths ranging from 9.6 m to 24 m. All boreholes were terminated in overburden. A total of 6 standpipe piezometers were installed.

Survey details were provided by the Central Region Surveys and Plans Section.

A total of 102 split spoon samples were collected. They provided Standard Penetration Test (N) values for assessment of the insitu state of compaction of the non-cohesive materials, and for an indication of shear strengths of cohesive materials. These samples also provided material for identification purposes. In addition representative samples were collected for Proctor compaction tests.

The laboratory testing consisted of:

- 42 grain size analyses
- 48 natural moisture content determinations
- 11 Atterberg Limit determinations
- 4 Proctor compaction tests

SUBSURFACE CONDITIONS

The Record of Borehole Sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations of the boreholes and a stratigraphical profile based on the borehole data are illustrated in Drawing No. 878700-A.

The overburden consists of the following generalized layers, in sequence, from the surface down:

<u>Thickness</u>	<u>Material</u>
7 m	Silty Sand to Sandy Silt (Lacustrine)
4 m	Silt (Lacustrine)
2 m	Silty Clay (Lacustrine)
7 m	Silt/Clayey Silt (Glacial Till)
Undetermined	Silty Sand (Lacustrine)

The eastern edge of this deposit has been eroded by the Rouge River. The surficial deposits below the floor of this area consist essentially of sandy silt.

Silty Sand to Sandy Silt (Lacustrine)

This non-cohesive material has been described as silty sand to sandy silt, trace clay.

The material was encountered at all boreholes except BH #8 and BH #9. At BH #1 to BH #7, it extends from the surface for thicknesses ranging from 2.1 m to 7.9 m.

Based on the results of Standard Penetration Tests ($N = 7$ to $100+$), the material is considered to be in a loose to very dense, but generally dense to very dense state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Moisture Content (w)	4.5-22%	10.6%	10.3%

The results of Proctor Compaction tests on representative samples of this material are:

	<u>Range</u>	<u>Average</u>
Unit Weight (γ)	19.0-19.8 kN/m ³	19.4 kN/m ³
Dry Unit Weight (γ_d)	16.8-17.6 kN/m ³	17.2 kN/m ³
Optimum Moisture Content	12.3-12.8%	12.6%

Figure 1 illustrates a typical grain size distribution for this material.

Silt (Lacustrine)

This non-cohesive material has been described as silt, some sand, trace clay. It contains occasional silty clay zones.

The material was encountered at all boreholes except BH #8 and BH #9. At BH #1 to BH #7 it extends for thicknesses ranging from 1.8 m to 4.6 m.

Based on the results of Standard Penetration Tests (N = 28 to 100+) the material is in a compact to very dense, but generally very dense state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Moisture Content (w)	14.0-20.5%	16.5%	16.3%

Figure 2 illustrates a typical grain size distribution for this material.

Silty Clay (Lacustrine)

This cohesive material has been described as silty clay.

This deposit was encountered immediately below the silt deposit at all boreholes except BH #7, #8, and #9. At BH #1 to #6, its thickness ranged from 0.6 m to 1.8 m.

Based on the results of Standard Penetration Tests ($N = 6$ to 40), the consistency of this deposit varies from firm to hard but is generally stiff to very stiff.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Moisture Content (w)	21.5-31.0%	24.7%	21.5%
Liquid Limit (w_L)	33.5-45.0%	42.0%	40.2%
Plastic Limit (w_p)	15.5-18.5%	16.0%	16.7%

Figure 3 illustrates a typical grain size distribution for this material.

Heterogeneous Mixture: Silt/Clayey Silt (Glacial Till)

This non-cohesive to slightly cohesive material has been described as silt/clayey silt, with sand, trace gravel, occasional boulders.

This deposit was encountered at all boreholes except BH #8 and BH #9. At BH #1, #3, #5 and #7, where the extent of the deposit was fully explored, its thickness ranged from 5.5 m to 9.7 m.

Based on the results of Standard Penetration Tests ($N = 15$ to $100+$) the non-cohesive portion is compact to very dense, but generally very dense, while the cohesive portion is stiff to hard, but generally hard.

Typical properties of the material, as determined by laboratory tests are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Moisture Content (w)	5.0-10.0%	7.4%	7.0%
Liquid Limit (w_L)	15.0-18.0%	16.2%	16.0%
Plastic Limit (w_P)	10.0-11.5%	10.5%	10.5%

The results of one Proctor Compaction test on a representative sample of this material are:

Unit Weight (γ)	22.3 kN/m ³
Dry Unit Weight (γ_d)	20.8 kN/m ³
Optimum Moisture Content	7.3%

Figure 4 illustrates a typical grain size distribution for this material.

Silty Sand (Lacustrine)

This non-cohesive material has been described as silty sand. It contains occasional zones of silt, gravel and very occasionally, silty clay.

This deposit was encountered at BH #1, #3, #5, and #7, where it underlies the glacial till deposit. Its thickness was not determined but is expected to be over 4 m.

Based on the results of Standard Penetration Tests ($N = 100+$) the material is very dense.

The natural moisture content (w) varies from 1.5 to 8% with an average of 3.8%.

The results of Proctor Compaction test on a representative sample of this material are:

Unit Weight (γ)	21.0 kN/m ³
Dry Unit Weight (γ_d)	19.0 kN/m ³
Optimum Moisture Content	10.5%

A typical grain size distribution is presented below:

Gravel	0-3%
Sand	55-87%
Silt	11%
Clay	3%

Sandy Silt (Lacustrine)

This non-cohesive to slightly cohesive material been described as sandy silt, some clay, trace gravel, occasional silty clay zones, occasional organics. Portions of this material may be fill.

The deposit was encountered at BH #8 and BH #9 where it extends from the surface for thicknesses of at least 9.6 m.

Based on the results of Standard Penetration Tests ($N = 9$ to $100+$) the material is in a compact to very dense/stiff to hard state.

Typical properties of the material, as determined by laboratory tests are summarized as follows:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Moisture Content (w)	10.0-19.0%	13.6%	12.5%
Liquid Limit (w_L)	16.5-24.0%	20.2%	20.0%
Plastic Limit (w_p)	13.0-16.5%	14.3%	13.5%

A typical grain size distribution is presented below:

Gravel	0-10%
Sand	11-38%
Silt	37-57%
Clay	10-31%

Groundwater

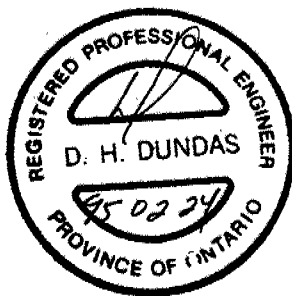
The groundwater was measured in open boreholes and also in piezometer installations at BH #1, #2, #4, #6, #7 and #8. Based on these measurements, there is a perched groundwater table, 5 to 6 m above the cohesive silty clay layer (elev. 102-107m±) as shown on Drawing No. 878700-A. The actual groundwater elevation is interpreted to be same level as the Rouge River (below elev. 86 m).

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of M. Schnarr, EGINEERING Student, and Mr. D. Green, Engineering Trainee.

The equipment used was owned and operated by Master Soil Investigation Ltd.

The report was written by D. Green, Engineering Trainee and D. Dundas, Senior Foundation Engineer.



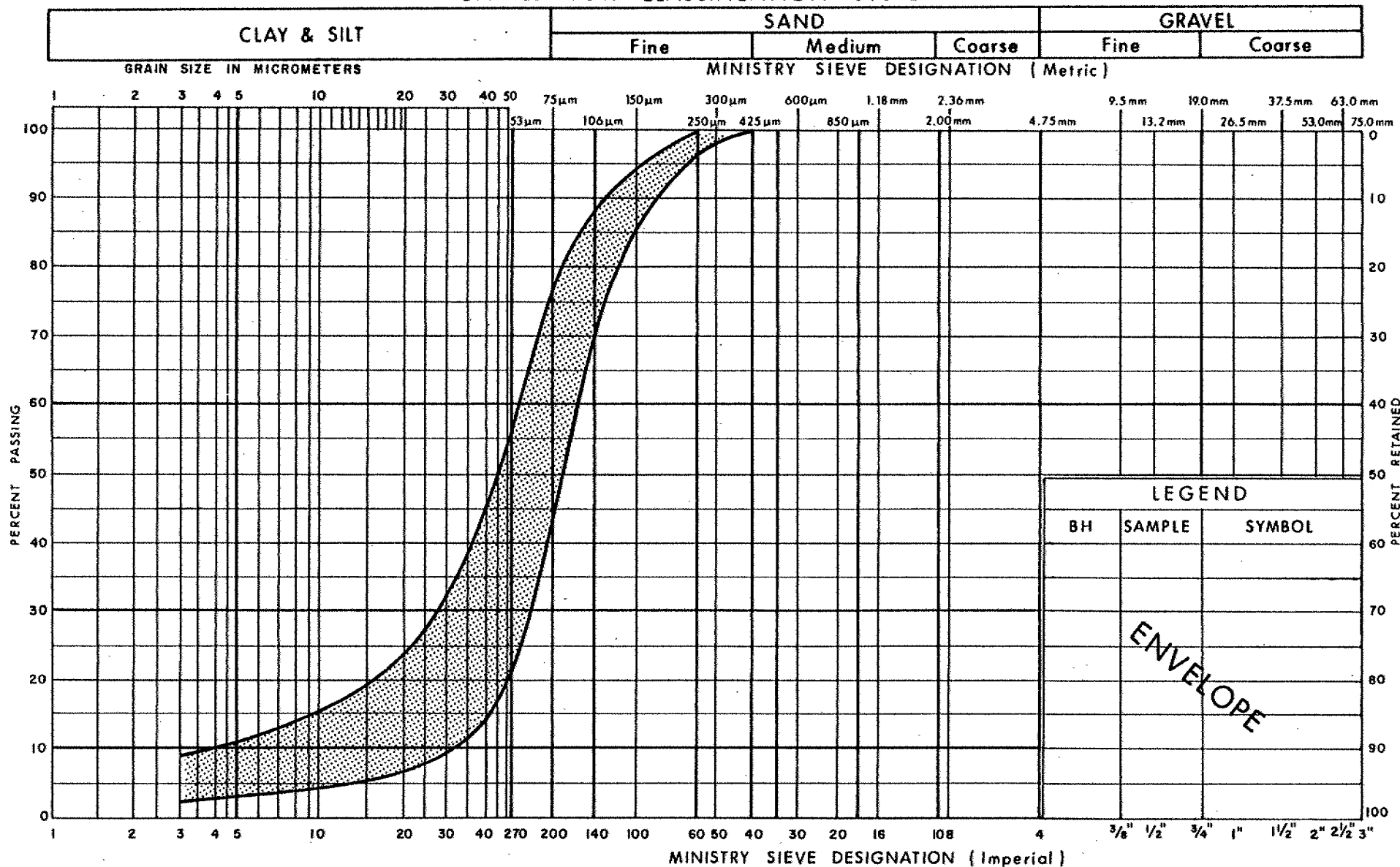
D. Dundas

D.H. Dundas, P. Eng.

Sr. Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM


 Ministry of
Transportation

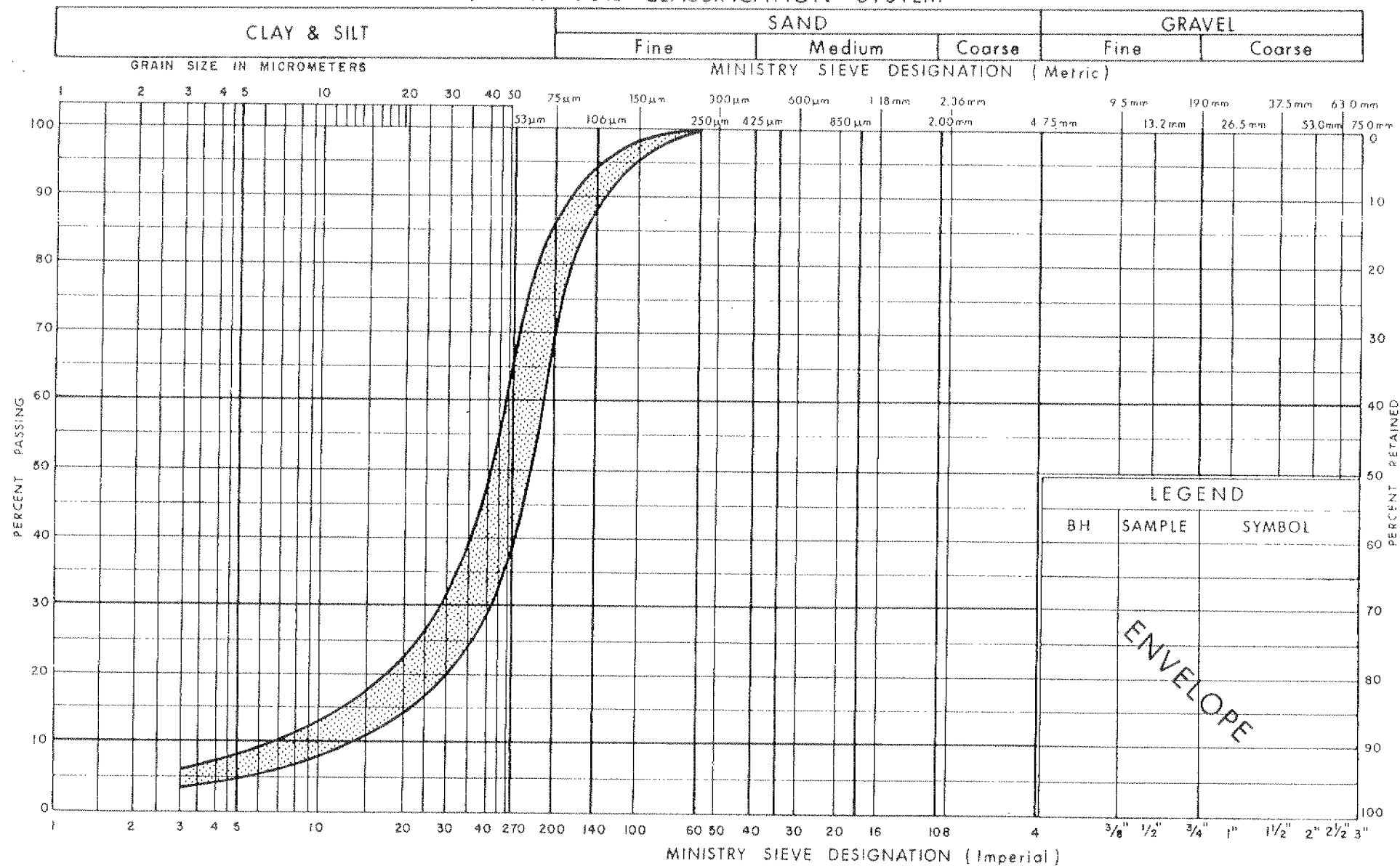
GRAIN SIZE DISTRIBUTION

SILTY SAND TO SANDY SILT (LACUSTRINE)

FIG No 1

W P 87-87-00 (A)

UNIFIED SOIL CLASSIFICATION SYSTEM


 Ministry of
Transportation

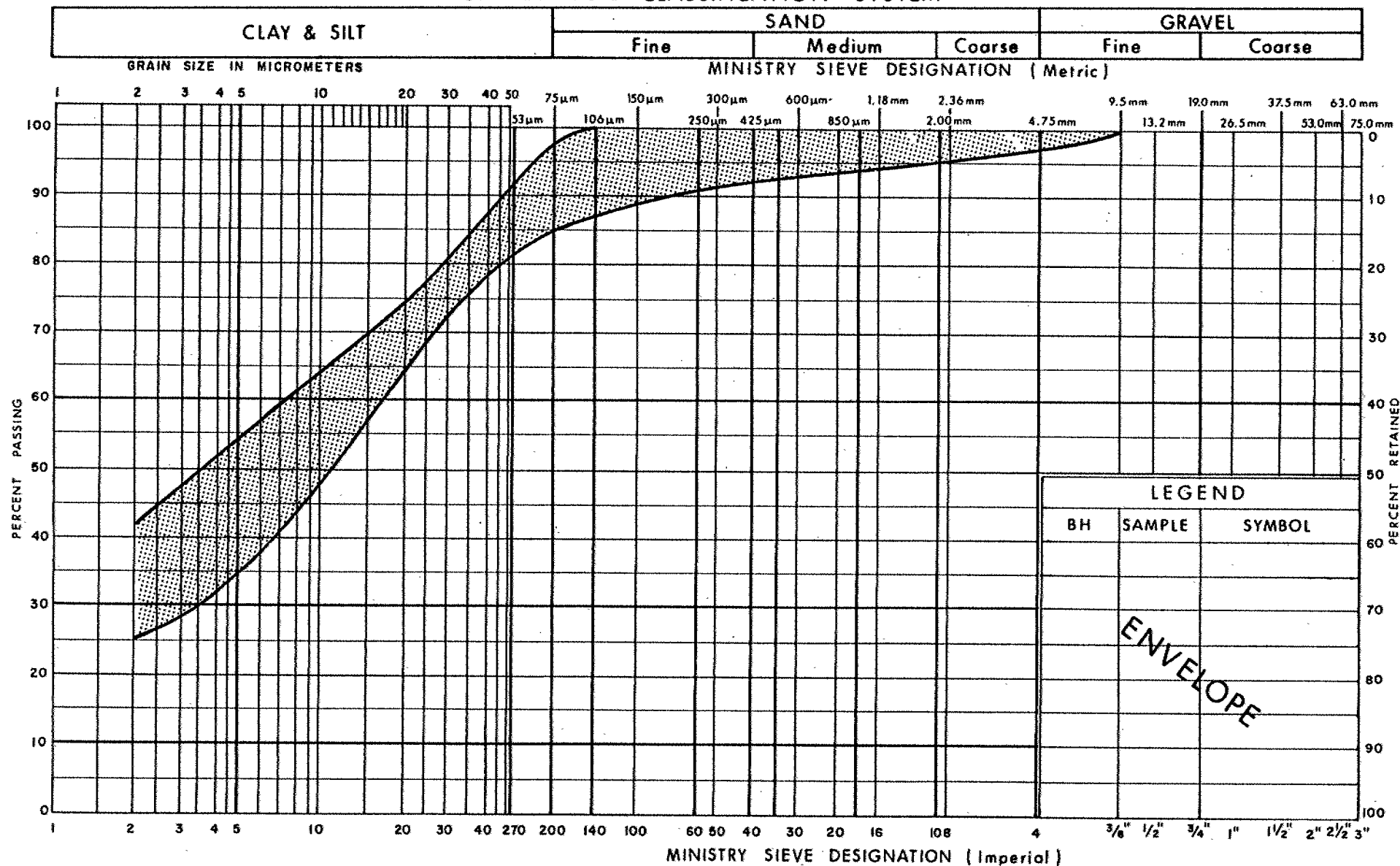
GRAIN SIZE DISTRIBUTION

SILT (LACUSTRINE)

FIG No 2

WP 87-87-00 (A)

UNIFIED SOIL CLASSIFICATION SYSTEM



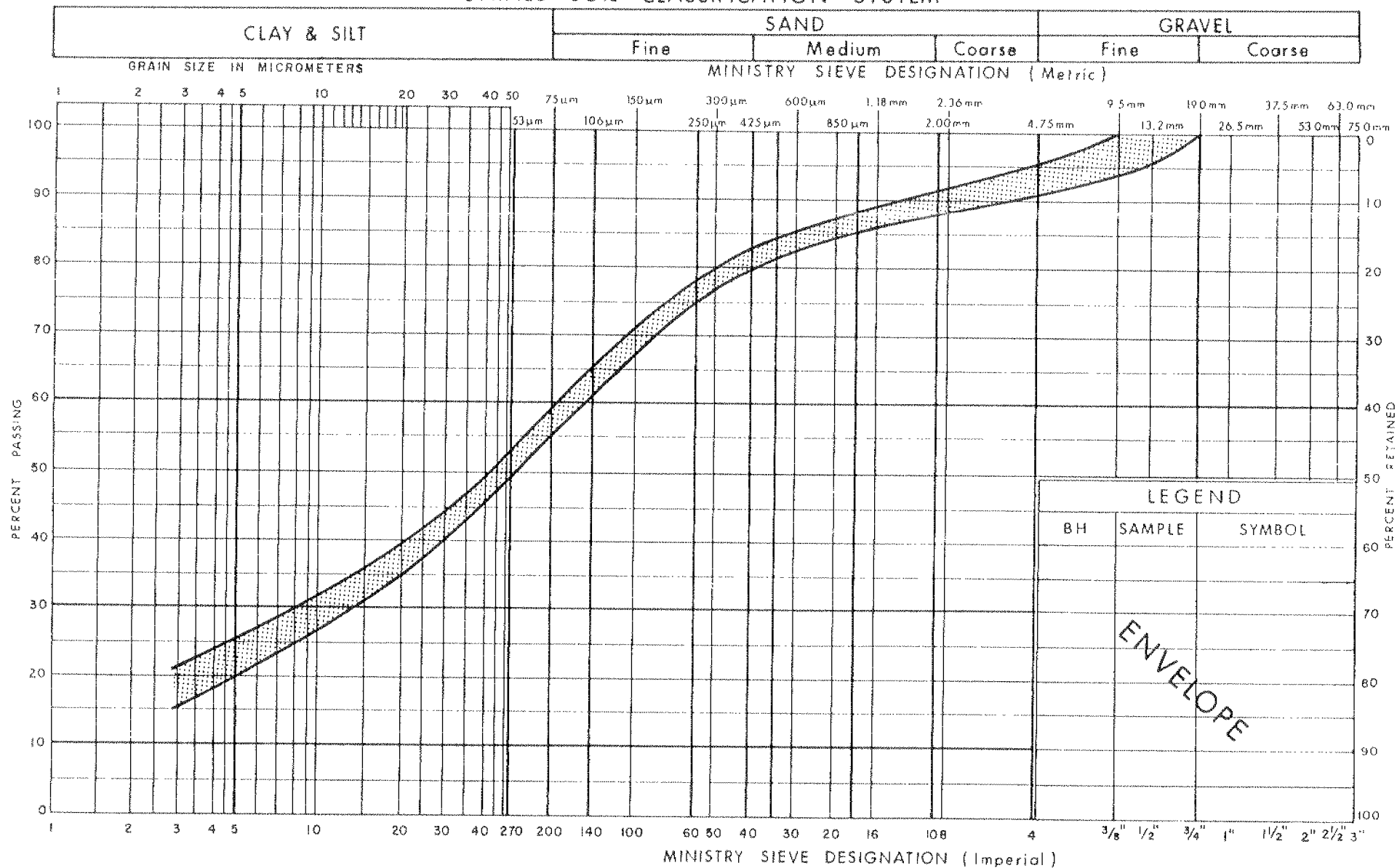
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY (LACUSTRINE)

FIG No 3

W P 87-87-00 (A)

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILT / CLAYEY SILT (Glacial Till)

FIG No 4

W P 87-87-00 (A)

RECORD OF BOREHOLE No 1

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 240.2; E 333 783.8
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H-S Auger
 DATUM Geodetic DATE 87 12 14

ORIGINATED BY MS
 COMPILED BY MS
 CHECKED BY DD

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	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
113.3	Ground Surface					Dry									GR SA SI CL
0.0															
	Silty Sand to Sandy Silt		1	SS	100/25		112								0 26 (74)
	Trace Clay		2	SS	60/15		110								
	Very Dense (Lacustrine)		3	SS	75/15		108								0 47 (53)
			4	SS	75		106								
105.4			5	SS	90		104								0 27 (73)
7.9	Silt Some Sand Trace Clay Occ. Silty Clay Zones Compact to Very Dense (Lacustrine)		6	SS	29		102								
			7	SS	70		100								0 25 72 3
101.1			8	SS	11		98								
12.2	Silty Clay Firm to Stiff (Lacustrine)		9	SS	6		96								
99.3			10	SS	120		94								
14.0	Heterogeneous Mixture Silt/Clayey Silt with Sand Trace Gravel Occ. Boulders Very Dense/Hard (Glacial Till)		11	SS	90/13		92								4 37 41 18
			12	SS	111/23										
93.8			13	SS	90/13										
19.5	Gravel		14	SS	100/8										
	Silty Sand Very Dense (Lacustrine)		15	SS	100/10										
90.3															
23.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2										METRIC		
W P 87-87-00 (A)		LOCATION Co-ords. N 4 851 223.4; E 333 804.3		ORIGINATED BY DG								
DIST 6 HWY 431		BOREHOLE TYPE Cone Test, H-S Auger		COMPILED BY DG								
DATUM Geodetic		DATE 87 12 23		CHECKED BY DD								
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									
113.1	Ground Surface											
0.0												
	Silty Sand to Sandy Silt Trace Clay Loose to Very Dense (Lacustrine)		1	SS	7							
			2	SS	100	25 cm						
			3	SS	120							0 38 61 1
			4	SS	90	15 cm						0 38 56 6
105.5												
7.6	Silt Some Sand Trace Clay Occ. Silty Clay Zones Very Dense (Lacustrine)		5	CS	-							0 17 77 6
			6	SS	57							
			7	SS	71							
			8	SS	80							0 11 84 5
			9	SS	120							
			10	SS	90	20 cm						
100.9												
12.2	Silty Clay Stiff (Lacustrine)		11	SS	8							
99.1												
14.0	Heterogeneous Mixture Silt/Clayey silt *		12	SS	14							
97.6												
15.5	End of Borehole		13	SS	120							
	* With Sand Trace Gravel Occ. Boulders Very Dense/Hard (Glacial Till)											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3										METRIC			
W P 87-87-00 (A)		LOCATION Co-ords. N 4 851 268.3; E 333 825.0		ORIGINATED BY MS									
DIST 6 HWY 401		BOREHOLE TYPE Cone Test, H-S Auger		COMPILED BY MS									
DATUM Geodetic		DATE 87 12 17 - 18		CHECKED BY DD									
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	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
113.1 0.0	Ground Surface												
	Silty Sand to Sandy Silt Trace Clay Dense to Very Dense (Lacustrine)		1	SS	42								0 20 (80)
			2	SS	100								
			3	SS	90								0 63 (37)
			4	SS	48								
105.8 7.3	Silt Some Sand, Trace Clay Occ. Silty Clay Zones		5	SS	60								0 15 80 5
	Silty Clay Firm to Stiff		6	SS	70								
			7	SS	8								4 11 44 41
102.7	Very Dense (Lacustrine)		8	SS	70	15 cm							
10.4	Silty Clay *		9	SS	15								
102.1	Stiff (Lacustrine)		10	SS	15								
11.0			11	SS	32								5 35 45 15
	Heterogeneous Mixture Silt/Clayey Silt With Sand Trace Gravel Occ. Boulders Compact to Very Dense/ Stiff to Hard (Glacial Till)		12	SS	83								
			13	SS	100	15 cm							
			14	SS	60	10 cm							6 37 44 13
			15	SS	60	10 cm							
			16	SS	61	15 cm							
92.4 20.7	Silty Sand Very Dense (Lacustrine)		17	SS	60	8 cm							0 81 (19)
			18	SS	60	8 cm							
89.1 24.0	End of Borehole		19	SS	120	3 cm							
	* Groundwater Elevation Not Determined												

RECORD OF BOREHOLE No 4										METRIC			
W P 87-87-00 (A)		LOCATION Co-ords. N 4 851 255.2; E 333 836.5		ORIGINATED BY DG									
DIST b HWY 401		BOREHOLE TYPE Cone Test, H-S Auger		COMPILED BY DG									
DATUM Geodetic		DATE 87 12 29		CHECKED BY DD									
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			VALUES	20 40 60 80 100					
112.9 0.0	Ground Surface												
	Silty Sand to Sandy Silt		1	SS	9								
	Trace Clay												
	Loose to Very Dense (Lacustrine)		2	SS	60	13 cm							0 36 60 4
			3	SS	60	15 cm							0 23 68 9
			4	SS	90	15 cm							0 43 56 1
105.9 7.0	Silt Some Sand Trace Clay Occ Silty Clay Zones Very Dense (Lacustrine)		5	SS	87								
			6	SS	110	20 cm							
102.5 10.4	Silty Clay Very Stiff (Lacustrine)		7	SS	28								
101.0 11.9	Heterogeneous Mixture		8	SS	39								
100.3 12.6	End of Borehole												
	* Silt/Clayey Silt With Sand Trace Gravel Occ Boulders Dense/Hard (Glacial Till)												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 294.5; E 333 859.8 ORIGINATED BY MS
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY MS
DATUM Geodetic DATE 87 12 10 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)					
108.6	Ground Surface									20 40 60				GR SA SI CL	
0.0	Silty Sand to Sandy Silt Trace Clay Loose to Dense (Lacustrine)		1	SS	10		108							0 44 (56)	
			2	SS	15		106								
			3	SS	36		104								0 53 (47)
103.1	Silt Some Sand, Trace Clay Occ. Silty Clay Zones Compact (Lacustrine)		4	SS	28		102							0 14 80 6	
5.5			7.3	5	SS		26	100							0 2 73 25
99.8	Silty Clay Very Stiff (Lacustrine)		6	SS	83									7 38 43 12	
8.8			7	SS	60		15 cm								
			8	SS	100										7 38 40 15
			9	SS	70										
			10	SS	38										
92.4			Heterogeneous Mixture Silt/Clayey Silt With Sand Trace Gravel Occ. Boulders Dense to Very Dense/ Hard (Glacial Till)		11		SS	90	13 cm	92					
16.2	12	SS			90		3 cm	90							
	13	SS			60		13 cm								0 66 (34)
87.1	Silt		14	SS	90		13 cm	88							
21.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 323.0; E 333 908.0 ORIGINATED BY MS
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY MS
DATUM Geodetic DATE 87 12 21 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			70 40 60 80 100	W _p W W _L	WATER CONTENT (%)				
110.2	Ground Surface													GR SA SI C.
0.0	Silty Sand to Sandy Silt Trace Clay Compact to Very Dense (Lacustrine)		1	SS	45									0 41 56
			2	SS	30									
			3	SS	84									
			4	SS	100/25	cm								0 53 46
103.2	Silt Some Sand Trace Clay Occ. Silty Clay Zones Compact to Very Dense (Lacustrine)		5	SS	100/25	cm								0 16 80
7.0			6	SS	60/7	7.8 cm								
			7	SS	28									0 20 (80)
			8	SS	40									0 2 (98)
98.6	Silty Clay Hard (Lacustrine)													
11.6														
97.1	Heterogeneous Mixture													
13.1			9	SS	100/23	cm								
96.1														
14.1	End of Borehole													
	+ Silty/Clayey Silt With Sand Trace Gravel Occ. Boulders Very Dense/Hard (Glacial Till)													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 358.6; E 333 955.9 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow-Stem Auger COMPILED BY DG
 DATUM Geodetic DATE 87 12 22 CHECKED BY DD

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	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
102.3	Ground Surface							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						GR SA SI CL
0.0	Silty Sand to Sandy Silt Trace Clay Very Dense (Lacustrine)		1	SS	57		102							0 43 (57)
100.2							100							0 26 68 6
2.1	Silt Some Sand Trace Clay Occ. Silty Clay Zones Dense to Very Dense (Lacustrine)		2	SS	48		98							0 30 66 4
			3	SS	100									
96.5			4	SS	84		96							
5.8			5	SS	36		94							
	Heterogeneous Mixture Silt/Clayey Silt With Sand Trace Gravel Occ. Boulders Dense to Very Dense/ Hard (Glacial Till)		6	SS	90	15 cm	92							
90.7			7	SS	90	13 cm	90							
11.6	Silt		8	SS	90	10 cm	88							0 12 82 6
			9	SS	90	15 cm								
	Silty Sand Very Dense (Lacustrine)		10	SS	90	15 cm								0 86 11 3
			11	SS	90	17 cm								
	Silt		12	SS	90	10 cm								
83.9	Silty Clay		13	SS	102	23 cm	84							
18.4	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 401.7; E 334 044.8 ORIGINATED BY MS
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY MS
 DATUM Geodetic DATE 87 12 10 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED 4 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									
89.6	Ground Surface													
0.0														
	Sandy Silt Some Clay Trace Gravel Occ. Silty Clay Zones Occ. Organics Compact to Dense/ Stiff to Hard (Lacustrine)		1	SS	22		88							14 38 38 10
			2	SS	37		86							1 34 52 13
			3	SS	13		84							0 71 23 6
			4	SS	100									
	Silty Sand		5	SS	9		82							
80.0			6	SS	41									
9.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

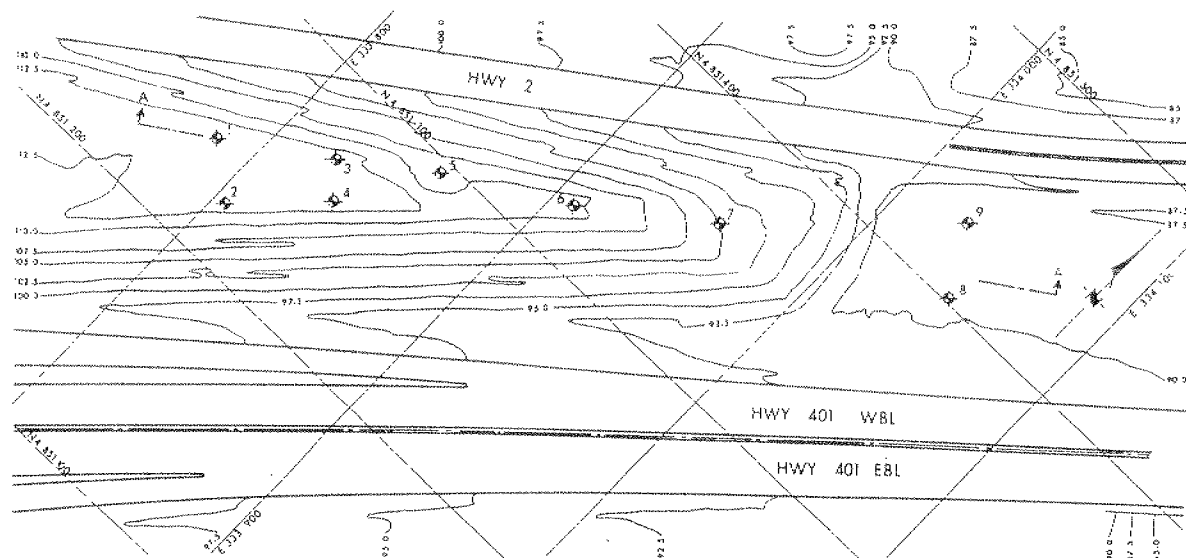
RECORD OF BOREHOLE No 9

METRIC

W P 87-87-00 (A) LOCATION Co-ords. N 4 851 428.9; E 334 028.9 ORIGINATED BY MS
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY MS
 DATUM Geodetic DATE 87 12 09 CHECKED BY DD

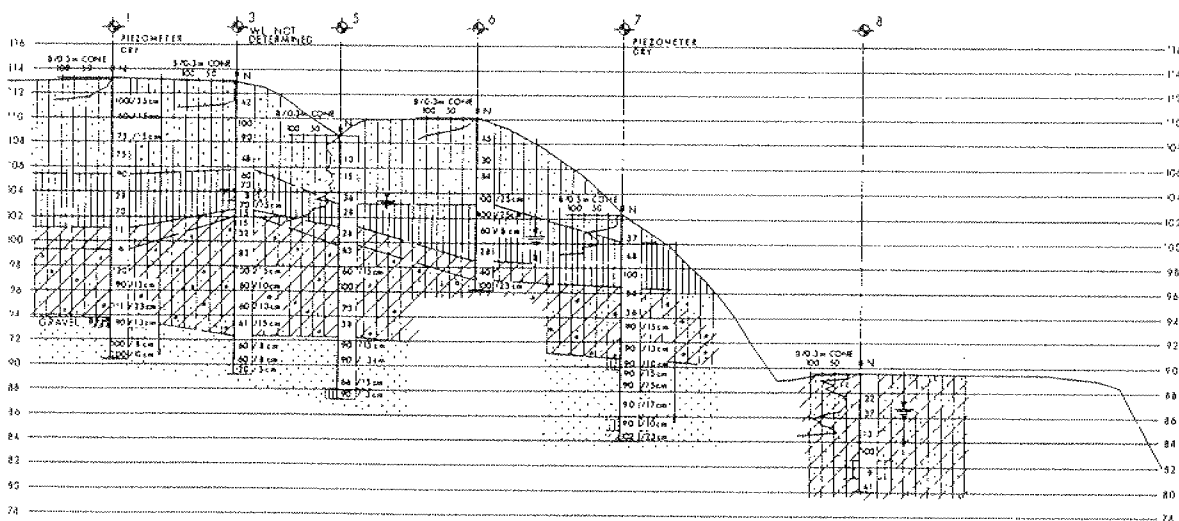
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
88.4	Ground Surface											
0.0	Sandy Silt Some Clay Trace Gravel Occ. Silty Clay Zones Occ. Organics Compact to Dense/ Very Stiff to Hard (Lacustrine)		1	SS	21	*	88					1 11 57 31
			2	SS	34		86					
			3	SS	18		84					1 31 57 11
			4	SS	25		82					
	Silty Sand		5	SS	17		80					
78.8	Silty Clay		6	SS	65							
9.6	End of Borehole											
	* Groundwater Elevation Not Determined											

OFFICE REPORT ON SOIL EXPLORATION



PLAN

SCALE
20m 10 0 10m 20m



SECTION A-A

SCALE
20m 10 0 10m 20m
1m 2 0 4m Var

METRIC
DIMENSIONS ARE IN METRES
AND/OR KILOMETRES UNLESS
OTHERWISE SHOWN. 5 METRES
IN FACTURES - METRES

CONT No 95-34
WP No 87-87-00(A)

ROUGE RIVER
(NORTHWEST AREA)
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

SOIL STRATIGRAPHY LEGEND

SILTY SAND TO SANDY SILT
TRACE CLAY
LOOSE TO Very Dense
(LACUSTRINE)

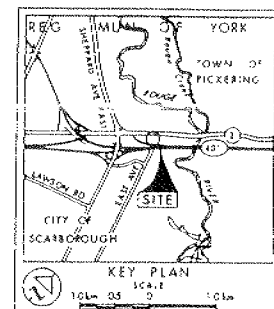
SILT
SOME SAND, TRACE CLAY
LOC SILTY CLAY ZONES
Compact to Very Dense
(LACUSTRINE)

SILTY CLAY
Firm to Hard
(LACUSTRINE)

HETEROGENEOUS MIXTURE
SILT / CLAYEY SILT
WITH SAND, TRACE GRAVEL
OCCASIONAL BODDERS
Compact to Very Dense /
SHH to Hard
(GLACIAL TILL)

SILTY SAND
Very Dense
(LACUSTRINE)

SANDY SILT
SOME CLAY, TRACE GRAVEL
OCCASIONAL SILTY CLAY ZONES
OCCASIONAL ORGANICS
Compact to Dense /
SHH to Hard
(LACUSTRINE)



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Borehole 10m (Site) Pen Test 475 (2/3) (10m)
- Cone 10m (10m) Cone 475 (2/3) (10m)
- WL at time of install pen test 57.12
- WL in Piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	113.2	4 851 240.2	333 783.8
2	113.1	4 851 223.4	333 804.3
3	113.1	4 851 268.3	333 823.0
4	112.9	4 851 255.2	333 836.3
5	112.6	4 851 294.5	333 859.8
6	110.2	4 851 323.0	333 908.0
7	102.3	4 851 358.6	333 953.9
8	89.6	4 851 401.7	334 044.4
9	88.4	4 851 426.9	334 028.9

NOTE

Soil information for BH 2,4 and 9
refer to Record of Borehole Sheets

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 accessed at the Engineering Materials Office, Downsview. Information contained in this report and related documents is confidentially excluded in accordance with the conditions of Section 2.0 of OPS-Can Code.

DATE	BY	DESCRIPTION
1995-03-14	189	Geotechnical
1995-03-14	201	15-01-6
1995-03-14	201	15-01-6
1995-03-14	201	15-01-6

FOUNDATION INVESTIGATION REPORT

51

For

Cut Slope Stability Between Rouge River and Rougemount Drive

W.P. 87-87-00 (C), Site N/A

Hwy. 401, District 6, Toronto

INTRODUCTION

This report summarizes the foundation investigation to assess quality of materials and to provide recommendations for slope stability at this location. The report is applicable to the area east and west of Rougemount Drive on the north and south sides of existing Hwy. 401 from Sta. 23+875 to Sta. 24+425 (Hwy. 401 chainage).

SITE DESCRIPTION

The site is approximately 550 m long and is located on the north and south sides of Hwy. 401 near Rougemount Drive just east of the Rouge River as illustrated in Drawing No. 878700(C)-A.

The site is located in the physiographic region known as the Iroquois Plain as described by Chapman and Putnam in "The Physiography of Southern Ontario". This region is basically a sand plain overlying glacial till with areas of silt and clay deposits.

At this location, existing Hwy. 401 is in a cut ranging from 3.8 to 13.6 m deep. The existing side slopes are approximately 2H:1V.

Land use outside the transportation corridor is primarily residential.

INVESTIGATION PROCEDURES

A foundation investigation was conducted between 88 03 14 and 88 03 23 using a continuous flight auger machine equipped with solid stem augers.

The investigation consisted of 16 sampled boreholes, 15 of which were accompanied by dynamic cone penetration tests. All boreholes were terminated within the overburden. Depths of borings ranged from 8.0 to 16.3 m. A total of 6 standpipe piezometers were installed.

Survey details were provided by the Central Region Surveys and Plans Section.

A total of 98 samples were collected consisting of 1 shelly tube sample and 97 split spoon samples. The shelly tube sample provided relatively undisturbed material for detailed laboratory evaluation of the cohesive overburden. The split spoon samples provided Standard Penetration Test values for assessment of the in situ state of compaction of the non-cohesive materials and for an indication of shear strength of the cohesive materials. The shelly tube and split spoon samples also provided material for identification purposes. The field work program also included 3 field vane tests to determine in-situ shear strengths and sensitivity values of the cohesive material. Groundwater elevation measurements were attempted at open boreholes. However, stabilized levels were difficult to achieve because of the requirements to backfill boreholes each day. The 6 piezometers installations facilitated measurement of the groundwater elevation across the site.

The laboratory testing consisted of:

- 37 grain size tests
- 35 natural moisture content determinations
- 28 Atterberg Limit determinations
- 1 unconfined compression test
- 1 unit weight determination
- 3 Proctor Compaction tests

SUBSURFACE CONDITIONS

The Record of Borehole sheets (BH #1 to #7, and #9 to #17) in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes, along with stratigraphical profiles based on the borehole data are shown on Drawing No. 878700(C)-A.

The site is underlain by an extensive deposit of competent glacial till which varies randomly from cohesive clayey silt to non-cohesive or slightly cohesive silt. However due to its generally hard or very dense nature, the in-situ behaviour is essentially cohesive. The surface of the glacial till is basin shaped. At the eastern and western extremes of the site, it is the surficial

material, while across the central portion, the glacial till is overlain by lacustrine material that has been deposited in this 6 m deep 200 m long basin. The lacustrine deposits vary from silty clay and clayey silt at the base of the basin and at its eastern extent to silt at the surface grading to sand towards the western extent. The groundwater in the glacial till was encountered approximately 6 m below ground surface at the eastern extent of the site. The depth to groundwater increases towards the west. Within the basin containing lacustrine deposits, perched groundwater was encountered approximately 3 m below ground surface.

Following are detailed descriptions of the strata encountered.

Silt (Lacustrine)

This non-cohesive material has been described as silt, trace sand, trace clay. It is relatively homogeneous and is interpreted to be lacustrine in origin.

It was encountered at the surface of the central and east portions of the basin described above (BH #4, #5, #6, #13). At these locations its thickness ranged from 2.4 to 3.4 m.

Based on the results of Standard Penetration Tests ($N = 32$ to $100+$), the density of this material can be described as dense to very dense.

The results of natural water content (w) tests indicate a range of 13.0 to 15.5%.

Figure 1 illustrates a typical grain size distribution for this material.

Sand (Lacustrine)

This non-cohesive material has been described as sand, some silt, trace gravel. It is relatively homogeneous and is interpreted to be lacustrine in origin.

It was encountered at the surface at the west portion of the basin described above (BH #3, #11, #12). At these locations its thickness ranged from 2.3 to 2.4 m.

Based on the results of Standard Penetration Tests (N = 22 to 44), the density of this material can be described as compact to dense.

The results of natural water content (w) tests indicate a range of 19.5 to 21.0%.

Figure 2 illustrates a typical grain size distribution for this material.

Clayey Silt (Lacustrine)

This cohesive material has been described as clayey silt containing occasional silt and sand seams. It is relatively homogeneous and is interpreted to be lacustrine in origin.

Although it was encountered at the surface at one location near the western extent of the basin described above, it generally underlies the silt and sand deposits and immediately overlies the glacial till deposits within the basin. Exceptions occur at the southwestern extent of the basin, which is entirely filled with sand, and at the southeastern extent of the basin at which the material grades into silty clay.

Based on the results of Standard Penetration Tests (N = 4 to 69) the consistency of this material can be described as firm to hard.

Typical natural water contents and Atterberg Limits are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Water Content (w)	10.5-17.0%	18.8%	18.8%
Liquid Limit (w _L)	16.4-34.0%	25.9%	25.3%
Plastic Limit (w _p)	12.0-16.0%	13.8%	13.5%

Figure 4 illustrates typical plasticity characteristics for this material. Based on this data it can be classified as clayey silt (CL).

Figure 3 illustrates a typical grain size distribution for this material.

A zone of silty clay (CI) was encountered towards the east extent of the basin at BH #6.

Heterogeneous Mixture: Clayey Silt/Silt (Glacial Till)

This deposit has been described as clayey silt/silt, with sand, trace gravel, occasional boulders and silt and sand seams. It varies randomly from cohesive clayey silt to non-cohesive or slightly cohesive silt, but its in-situ behaviour is essentially cohesive due to its hard or very dense nature. However, if disturbed, the silt zones would have a tendency to behave as a non-cohesive material. It is a heterogeneous deposit and is interpreted to be a glacial till.

It underlays the entire site and was encountered at all borehole locations except BH #5 which was terminated above this deposit. The surface of the glacial till is basin shaped. At the eastern and western extremes of the site, it is the surficial material, while across the central portion it is overlain by lacustrine deposits.

Based on the results of Standard Penetration Tests (N = 9 to 100+) the non-cohesive portion is loose to very dense but generally very dense, while the cohesive portion is stiff to hard but generally hard.

Typical natural water contents and Atterberg Limits are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Water Content (w)	5.5-9.0%	6.8%	7.0%
Liquid Limit (w _L)	14.0-20.5%	15.5%	14.8%
Plastic Limit (w _p)	9.0-11.5%	9.9%	10.0%

Figure 6 illustrates typical plasticity characteristics for this material. Based on this data it can be classified as silt (ML) to plastic silt (CL-ML) to clayey silt (CL).

Figure 5 illustrates a typical grain size distribution for this material.

The results of three Proctor Compaction Tests on representative composite samples of this material are:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Unit Weight	22.9 kN/m ³	22.9 kN/m ³	22.9 kN/m ³
Dry Unit Weight	21.0-21.1 kN/m ³	21.0 kN/m ³	21.2 kN/m ³
Optimum Moisture Content	8.0-9.0%	8.4%	8.25%

Groundwater

Groundwater was measured only in piezometers which were installed in BH #1, #5, #7, #10, #12 and #15. At the time of the field investigation the level was found to range between elevation 103.5 to elevation 98.7 m, about 2.5 to 6.7 m below existing ground.

The groundwater in the glacial till was encountered approximately 6 m below ground surface (at elev. 100± m) at the eastern extent of the site. Towards the west, which is also towards the Rouge River valley, the depths below the surface to groundwater increases to over 12 m (elev. 95). Within the basin containing lacustrine deposits, perched groundwater was encountered approximately 3 m below the surface (at elev. 102 to 104 m).

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of D. Green, Engineering Trainee.

The equipment used was owned and operated by Master Soil Investigation Ltd.

The report was written by Mr. Green and D. Dundas, Senior Foundation Engineer and reviewed by M. Devata, Chief Foundation Engineer.



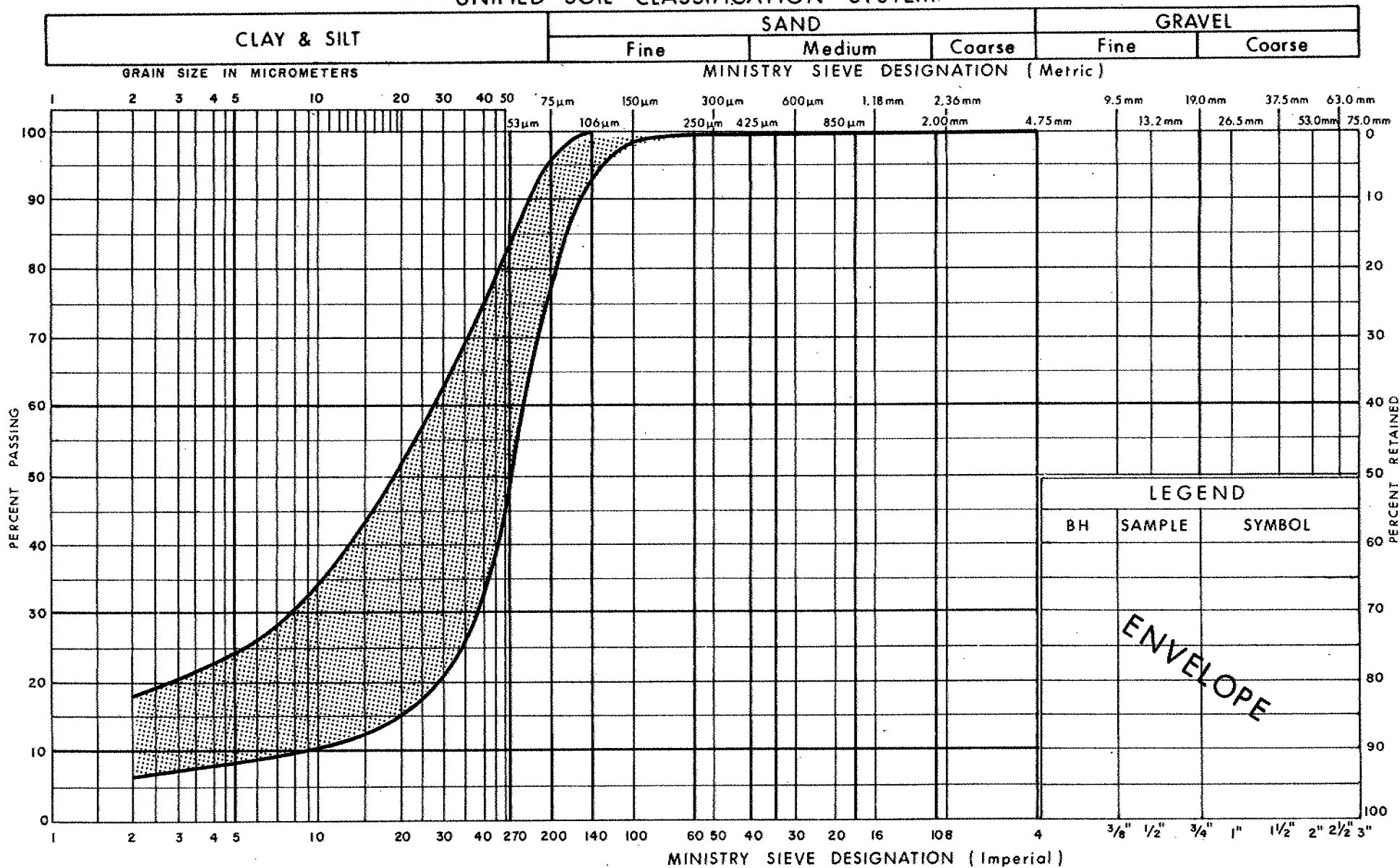
D. Dundas

D.H. Dundas, P. Eng.

Sr. Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



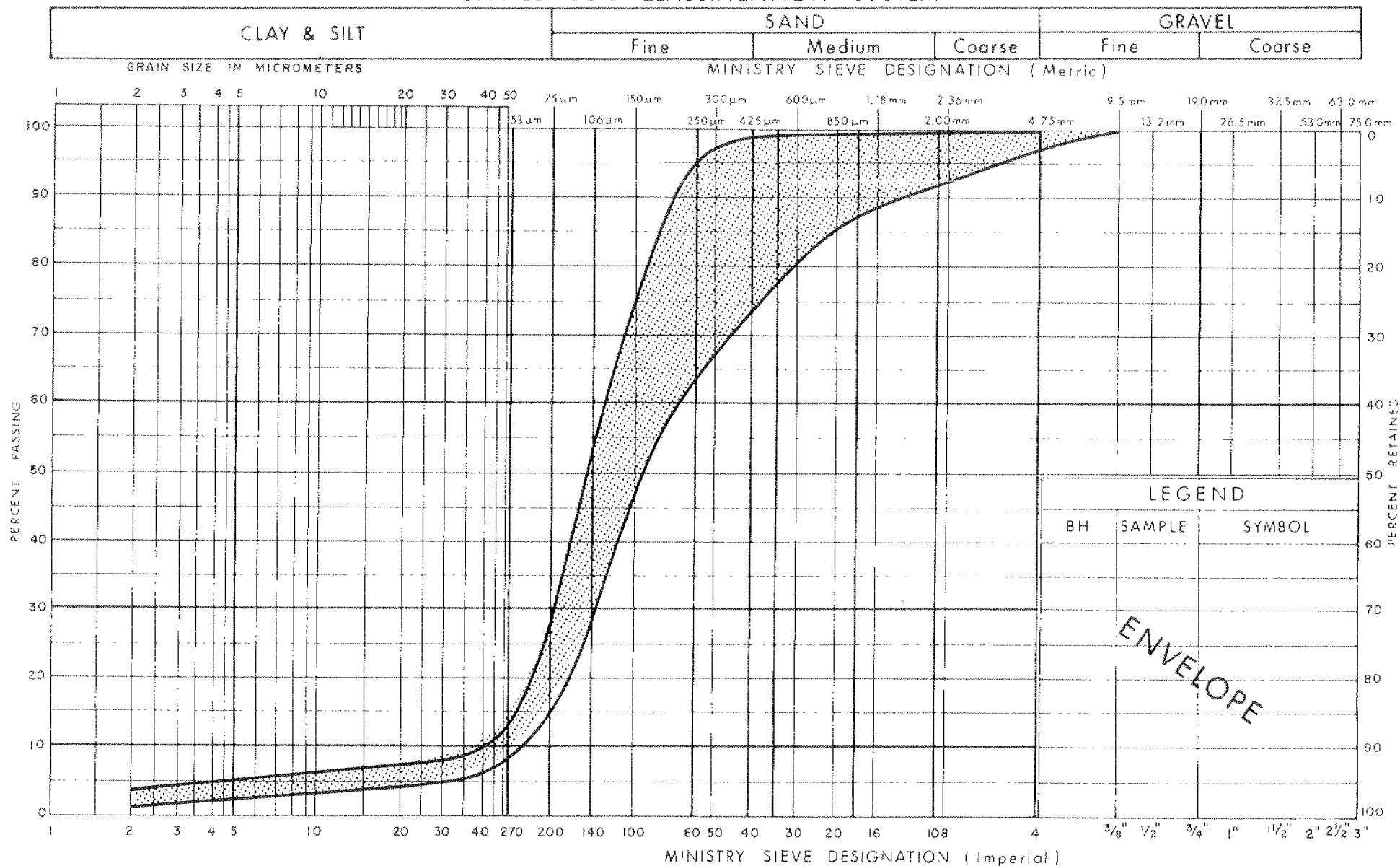
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILT (LACUSTRINE)

FIG No 1

W P 87-87-00 (C)

UNIFIED SOIL CLASSIFICATION SYSTEM


 Ministry of
Transportation

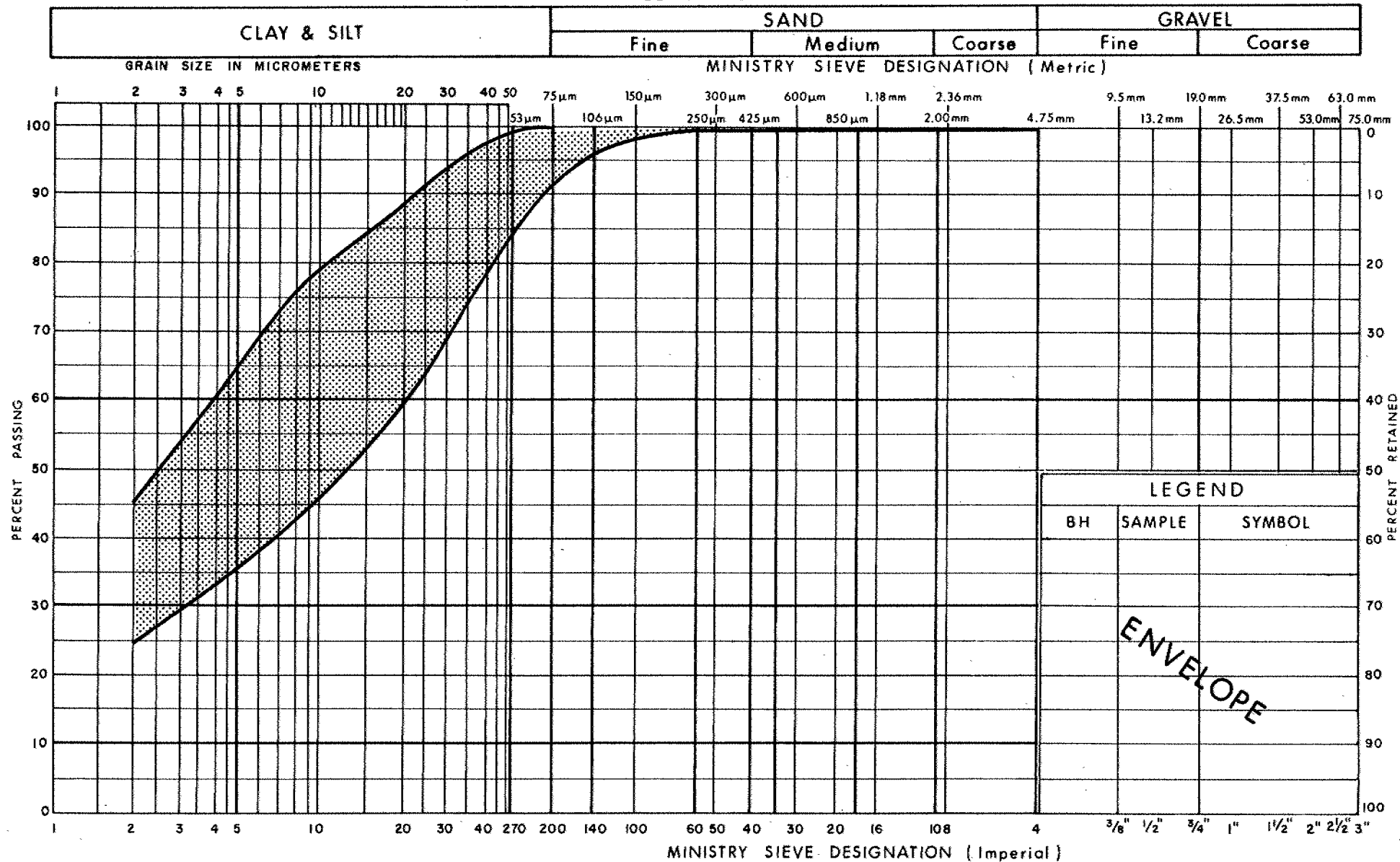
Ontario

 GRAIN SIZE DISTRIBUTION
SAND (LACUSTRINE)

FIG No 2

WP 87-87-00 (C)

09



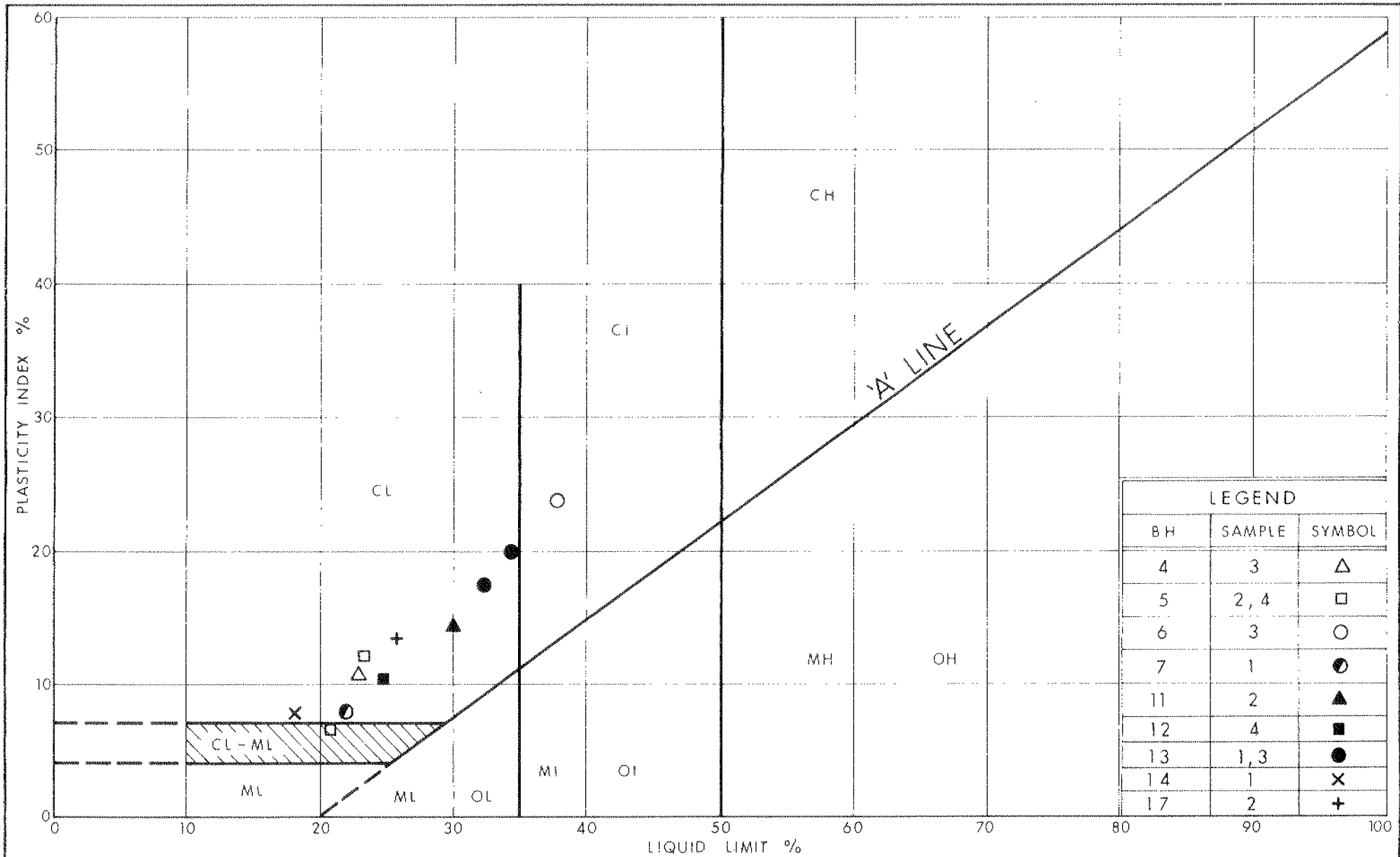
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT (LACUSTRINE)

FIG No 3

W P 87-87-00 (C)



Ministry of
Transportation

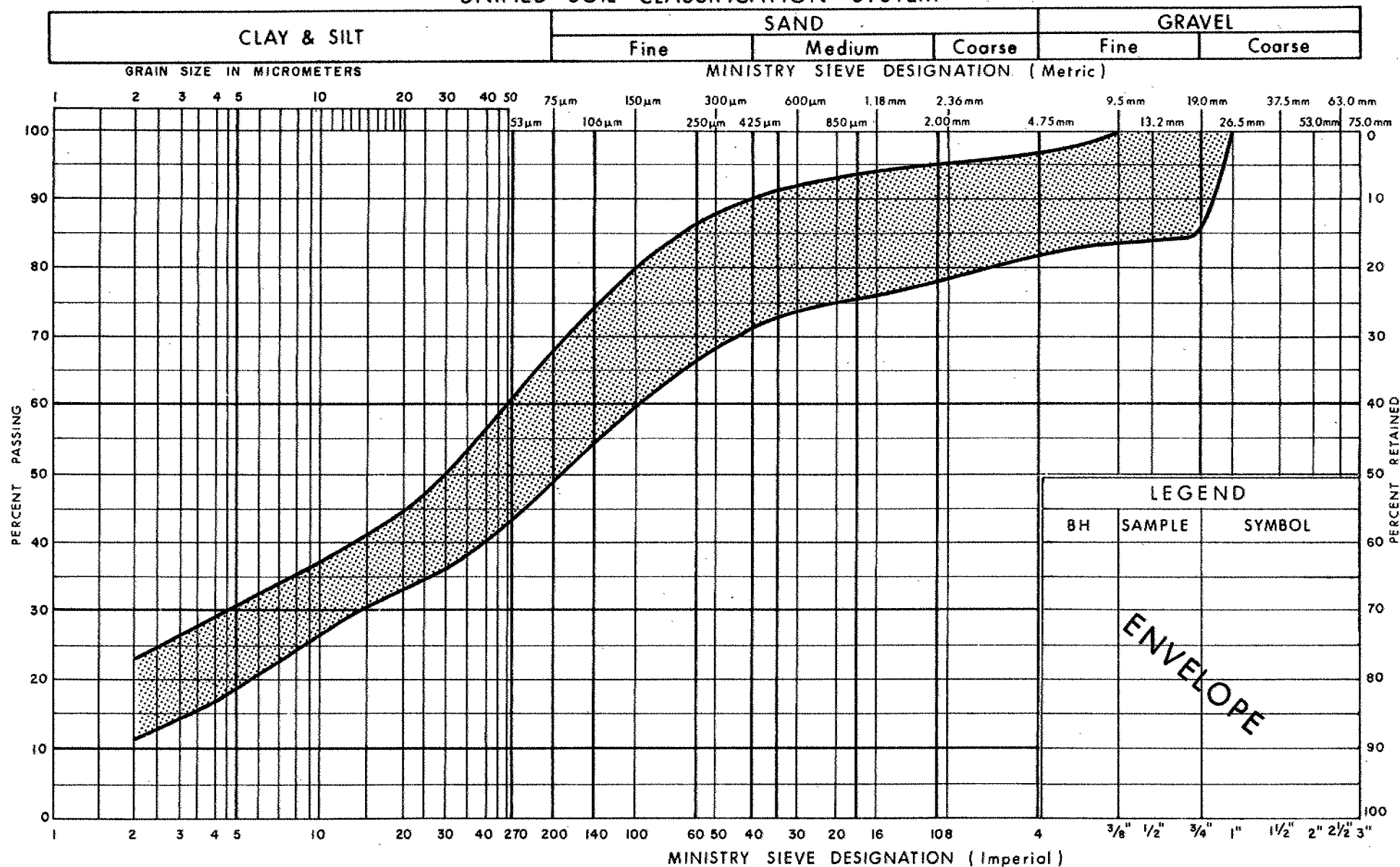
Ontario

PLASTICITY CHART CLAYEY SILT (LACUSTRINE)

FIG No 4

W P 87-87-00 (C)

UNIFIED SOIL CLASSIFICATION SYSTEM



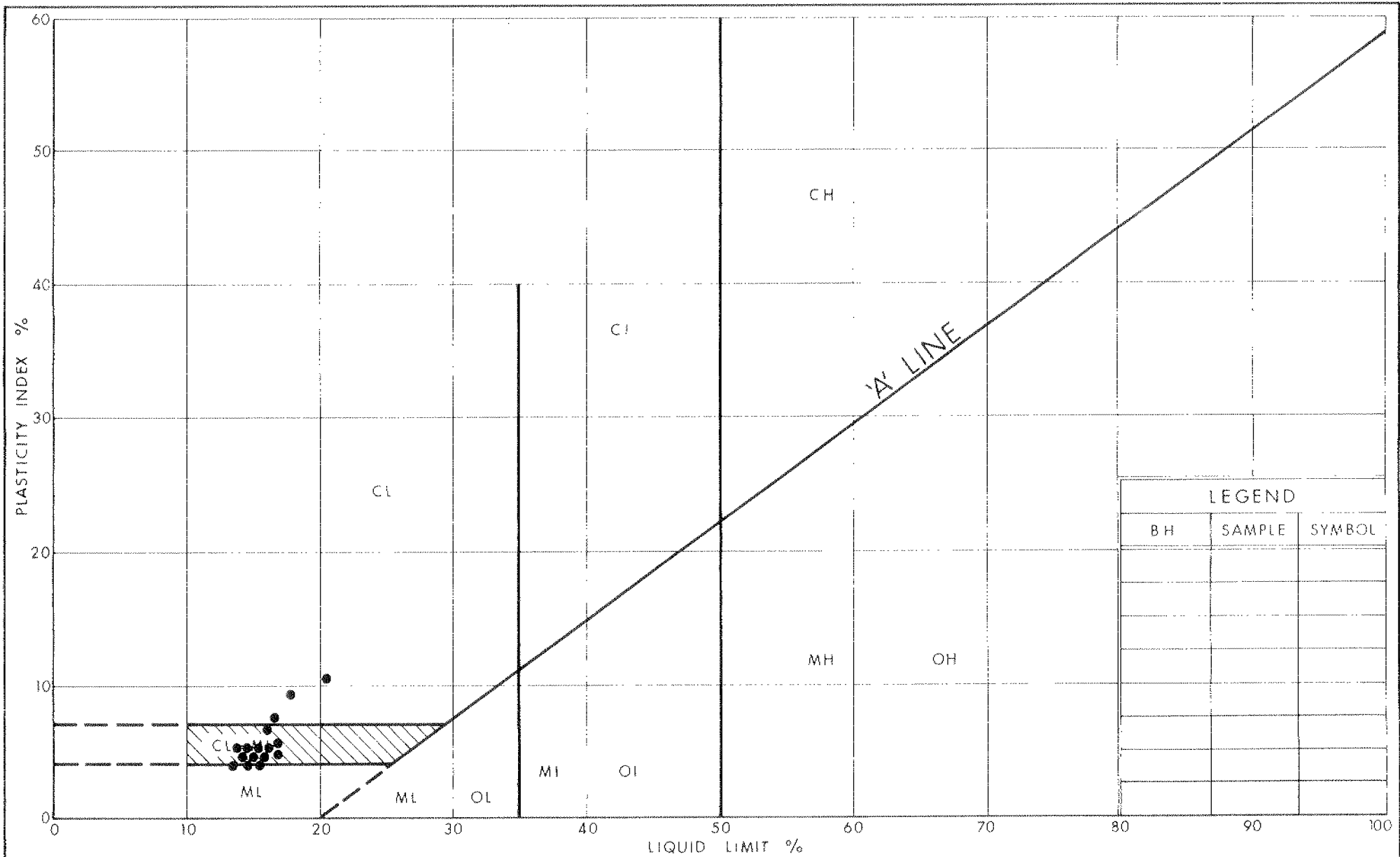
GRAIN SIZE DISTRIBUTION
CLAYEY SILT / SILT (Glacial Till)
 (WITH SAND, TRACE GRAVEL)

FIG No 5

WP 87-87-00 (C)



Ministry of
 Transportation
 Ontario



RECORD OF BOREHOLE No 1

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 534.2; E 334 405.0 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 17 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	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH kPa					
109.4	Ground Level													GR SA SI CL
0.0						Dry	29							
	Het. Mixture Clayey Silt/Silt with Sand		1	SS	120	Seal	108		120/5 cm					
	Trace Gravel		2	SS	90/	18 cm	106							
	Occ. Boulders		3	SS	120	25 cm	104							18 30 31 21
	Occ. Silt and Sand Seams		4	SS	90/	18 cm	102							
	Hard/ Very Dense (Glacial Till)		5	SS	120		100							
	Sand with Silt		6	SS	90/	18 cm	98							
	Very Dense		7	SS	90/	23 cm	96							4 37 43 17
			8	SS	90/	20 cm	94							
			9	SS	70/	13 cm								
			10	SS	90/	18 cm								
93.1			11	SS	70/									
16.3	End of Borehole					Piezometer								

OFFICE REPORT ON SOIL EXPLORATION

METRIC

OFFICE REPORT ON SOIL EXPLORATION

[illegible]

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 3

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 598.4; E 334 473.4 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY DG
 DATUM Geodetic DATE 88 03 15 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH kPa						
106.0	Ground Level													
0.0	Sand Some Silt Trace Gravel Compact (Lacustrine)		1	SS	29	*								2 81 15 2
103.7			2	SS	90/	18 cm								
2.3	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Very Dense (Glacial Till)		3	SS	90/	13 cm								6 38 40 16
			4	SS	90/	15 cm								
	Sand with Gravel Silty Sand		5	SS	90/	20 cm								
			6	SS	90/	13 cm								
95.2			7	SS	90/	18 cm								5 39 36 20
10.8	End of Borehole													
	* Water Level not Established													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 666.8; E 334 546.6 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Conc Test COMPILED BY DG
DATUM Geodetic DATE 88 03 14 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONFINED 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	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
105.4	Ground Level												GR SA SI CL
0.0	Silt Some Sand Trace Clay Very Dense (Lacustrine)	1	SS	100/	25 cm	104							0 23 71 6
2.4	Clayey Silt Occ. Silt & Sand Seams Stiff to Very Stiff (Lacustrine)	2	SS	14		102							0 1 60 39
99.0	Het. Mixture Clayey Silt/Silt	4	SS	21		100							
97.3	**	5	SS	100/	23 cm	98							
8.1	End of Borehole												
	** with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Very Dense (Glacial Till)												
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 701.0; E 334 582.7 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY DG
 DATUM Geodetic DATE 88 03 15 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	'N' VALUES			SHEAR STRENGTH kPa						
105.2	Ground Level							20 40 60 80 100						GR SA SI CL
0.0	Silt Trace Sand Trace Clay Very Dense (Lacustrine)		1	SS	90/	Seal 18 cm								0 9 82 9
102.8			2	SS	22									0 1 62 37
2.4	Clayey Silt Occ. Silt & Sand Seams Firm to Very Stiff (Lacustrine)		3	SS	5									0 8 55 37
			4	SS	7									
97.1			5	SS	10	Piezometer								
8.1	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 733.6; E 334 619.6 ORIGINATED BY DC
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DC
DATUM Geodetic DATE 88 03 14 CHECKED BY _____

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵. Numbers refer to Sensitivity

RECORD OF BOREHOLE No 7										METRIC			
W P 87-87-00 (C)		LOCATION Co-ords. N 4 851 801.9; E 334 695.2		ORIGINATED BY DG									
DIST 6 HWY 401		BOREHOLE TYPE Solid Stem Auger & Cone Test		COMPILED BY DG									
DATUM Geodetic		DATE 88 03 18		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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
105.4	Ground Level												
0.0	Clayey Silt Occ. Silt and Sand Seams Hard (Lacustrine)		1	SS	65	Seal							0 4 72 24
			2	SS	69								
101.4													
4.0	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/Very Dense (Glacial Till)		3	SS	89	Seal							
			4	SS	57								7 37 41 15
97.3			5	SS	68	Piezometer							
8.1	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

METRIC

W P 8/-87-00 (C) LOCATION Co-ords. N 4 851 867.3; E 334 769.7 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 18 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						
105.8 0.0	Ground Level				*								GR SA SI CL
	Hor. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Very Dense (Glacial Till)		1	SS	70 ⁺	15 cm		120/25cm					6 36 47 11
			2	SS	70 ⁺	13 cm							
			3	SS	54								
			4	SS	38								
97.7 8.1	End of Borehole		5	SS	74								4 38 43 15
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 688.4; E 334 404.0 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 23 CHECKED BY

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 _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								
107.6	Ground Level											
0.0												
	Het. Mixture											
	Clayey Silt/Silt		1	SS	36							
	with Sand											
	Trace Gravel											
	Sand		2	SS	98							
	Occ. Boulders											
	Occ. Silt and Sand		3	SS	93							
	Seams											
	Hard/		4	SS	90	10 cm						10 40 34 16
	Dense to Very Dense											
	(Glacial Till)		5	SS	90	20 cm						
			6	SS	60	10 cm						4 30 50 16
			7	SS	90	15 cm						
95.3			8	SS	90	15 cm						
12.3	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 715.7; E 334 446.4 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
DATUM Geodetic DATE 88 03 22 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kP_n ○ 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N VALUES								
106.9	Ground Level												GR SA SI CL
0.0	Sand Some Silt Trace Gravel Compact (Lacustrine)		1	SS	22		106						0 75 24 1
104.5	Clayey Silt Occ. Silt & sand Seams V. Stiff (Lacustrine)		2	SS	29		104						0 1 65 34
102.9	Hor. Mixture Clayey Silt/Silt		3	SS	42		102						
4.0	Silty Sand		4	SS	60/12 cm		100						
	with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Dense to Very Dense (Glacial Till)		5	SS	112		98						7 25 51 17
95.9			6	SS	113/25 cm								
11.0	End of Borehole		7	SS	90/15 cm		96						
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

+3, κ^5 : Numbers refer to
Sensitivity

20
15 $\frac{1}{2}$ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 12

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 756.3; E 334 509.0 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 22 CHECKED BY _____

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 _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							
106.0	Ground Level											
0.0	Sand Some Silt Trace Gravel Dense (Lacustrine)		1	SS	44							
103.6			2	SS	30							
2.4	Clayey Silt Occ. Silt and Sand Seams Stiff to Very Stiff (Lacustrine)		3	SS	18							
			4	SS	9							
98.1			5	SS	42							
7.9	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt & Sand Seams Hard/ Very Dense (Glacial Till)		6	SS	90/							
94.9			7	SS	137							
11.1	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 796.4, E 334 571.9 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
DATUM Geodetic DATE 85 03 21 CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE			20 40 60 80 100	20 40 60 80 100					
105.1	Ground Level												
0.0	Silt Trace Sand Trace Clay Compact to Dense (Lacustrine)		1	SS	32								0 4 78 18
101.7			2	SS	17								
3.4	Clayey Silt Occ. Silt & Sand Seams Firm (Lacustrine)		3	TW	PH							20.0	0 3 52 45
99.6			4	SS	9								
5.3	Rel. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders **		5	SS	33								
97.0	Occ. Silt & Sand Seams												
8.1	End of Borehole												
	** Stiff to Hard/ Loose to Dense (Glacial Till)												
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 14

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 824.5; E 334 612.5 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
DATUM Geodetic DATE 88 03 21 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						
104.5	Ground Level												GR SA SI CL
0.0	Clayey Silt Occ. Silt & Sand Seams Very Stiff (Lacustrine)		1	SS	20	*							8 36 37 19
101.1			2	SS	17								
3.4	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt & Sand Seams Very Stiff to Hard/ Compact to Very Dense (Glacial Till)		3	SS	20								
			4	SS	22								
96.4			5	SS	108/25cm								16 33 36 15
8.1	End of Borehole												
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15

METRIC

W.P. 87-87-00 (C) LOCATION Co-ords. N 4 851 857.7; E 334 649.2 ORIGINATED BY DG
 DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 27 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								
105.5	Ground Level										
0.0											
	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Dense to Very Dense (Glacial Till)		1	SS	68						
			2	SS	54						
			3	SS	39						
			4	SS	55						
97.5			5	SS	94						
8.1	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 16

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 923.0; E 334 725.2 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 21 CHECKED BY

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	W _p W W _L	WATER CONTENT (%)	10 20 30		
104.7 0.0	Ground Level												GR SA SI CL
	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Very Dense (Glacial Till)		1	SS	90	10cm							
			2	SS	90	12cm							9 36 43 12
			3	SS	71								
			4	SS	93								
96.7 8.0	End of Borehole		5	SS	60	12cm							
	* Water Level not Established												

OFFICE REPORT ON SOIL EXPLORATION

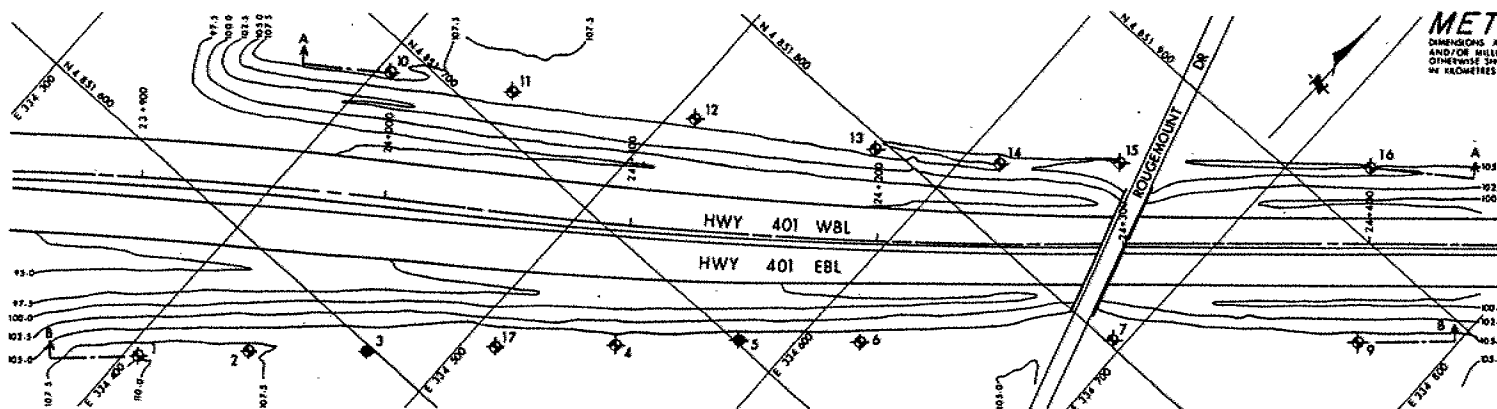
RECORD OF BOREHOLE No 17

METRIC

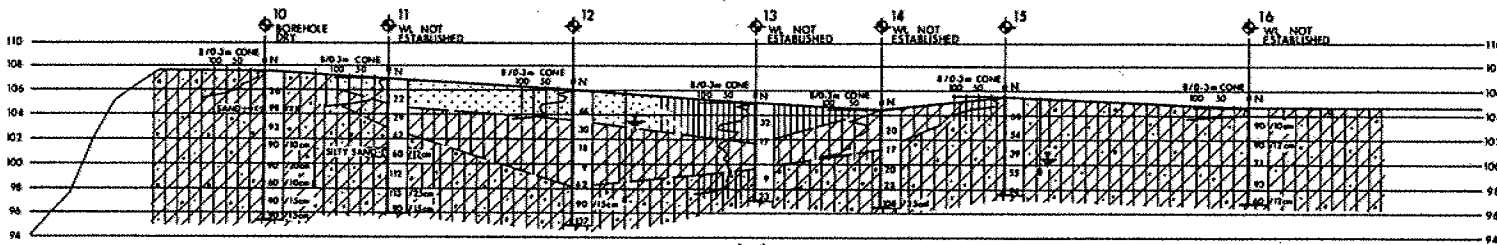
W P 87-87-00 (C) LOCATION Records N 4 851 634.0; E 334 311.5 ORIGINATED BY DG
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
 DATUM Geodetic DATE 88 03 18 CHECKED BY

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	'N' VALUES		20 40 60 80 100						
105.7	Ground Level												GR SA SI CL
0.0	Clayey Silt Occ. Silt and Sand Seams Stiff to Very Stiff (Lacustrine)		1	SS	23	*							0 3 65 32
			2	SS	17								
100.2			3	SS	8								
5.5	Het. Mixture Clayey Silt/Sand with Sand Trace Gravel Occ. Boulders Occ. Silt & Sand Seams Hard/Very Dense (Glacial Till)		4	SS	90/18cm								3 39 40 18
			5	SS	60/18cm								
96.4			6	SS	70/10cm								
9.3	End of Borehole												
	* Water Level not Established												

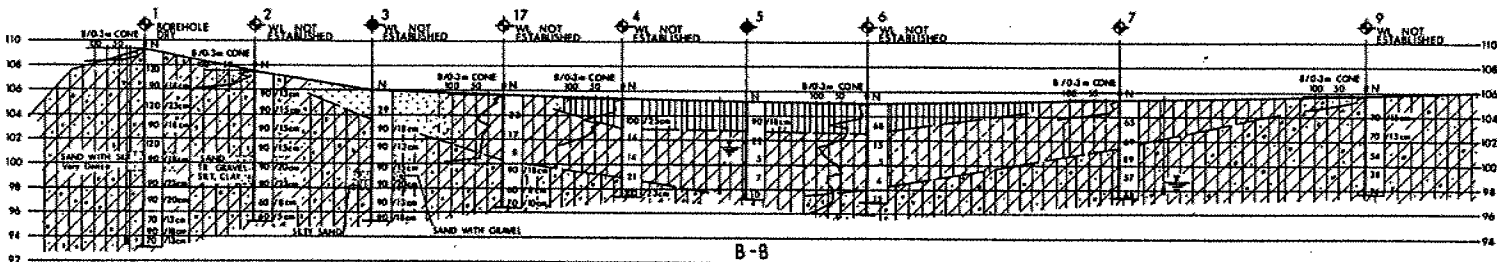
OFFICE REPORT ON SOIL EXPLORATION



PLAN
SCALE
20m 0 20m

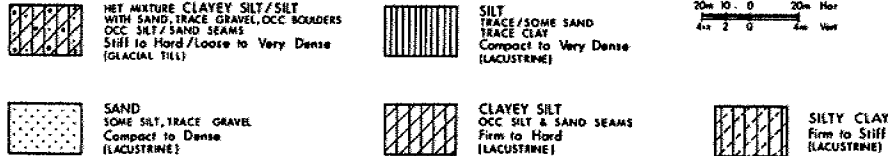


A-A

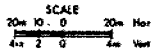


B-B

SOIL STRATIGRAPHY LEGEND

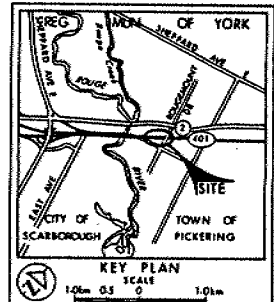


SECTIONS



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

CONT No 95-34
WP No 87-87-00(C)
ROUGE RIVER TO ROUGHMOUNT DR
BORE HOLE LOCATIONS & SOIL STRATA
SHEET



LEGEND			
◆	Bore Hole		
⊕	Dynamic Cone Penetration Test (Cone)		
◆	Bore Hole & Cone		
N	Blows/0.3m (Std Pen Test, 475 J/blow)		
COM	Blows/0.3m (60° Cone, 475 J/blow)		
+	Wt at time of investigation 88 03		
+	Wt in Piezometer		
+	Piezometer		
CO-ORDINATES			
No	ELEVATION	NORTH	EAST
1	109.4	4 851 324.2	334 403.0
2	107.5	4 851 566.5	334 437.3
3	106.0	4 851 598.4	334 473.4
4	105.4	4 851 666.8	334 546.6
5	105.2	4 851 701.0	334 582.7
6	105.0	4 851 733.6	334 619.6
7	105.4	4 851 801.9	334 695.2
8	105.8	4 851 867.3	334 769.7
9	107.6	4 851 688.4	334 404.0
10	106.9	4 851 715.7	334 446.4
11	106.0	4 851 750.3	334 509.0
12	105.1	4 851 796.4	334 571.9
13	104.5	4 851 824.5	334 612.5
14	105.6	4 851 857.7	334 649.2
15	104.7	4 851 923.0	334 725.2
16	103.7	4 851 634.0	334 511.5

-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 the project and other related documents may be examined at the Engineering Materials Office, Downtown. Information contained in this report and related documents is confidentially included in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

DATE	BY	DESCRIPTION
1987	10/10	10/10
Geotechnical No 30M14-190		
DESIGNED BY	CHECKED	DATE 88 08 19
DRAWN BY	CHECKED	DATE 87 08 01

Foundation Investigation Report
For
High Mast Lights
Hwy 2 to Fairport Road
WP 270-87-00, Site N/A
Hwy 401, Toronto

The detailed soil stratigraphy encountered at each borehole location is shown on the specific Record of Borehole Sheet included in the Appendix. The borehole locations are shown on Drawing No 2708700-A.

The groundwater level recorded at each borehole location is shown on the specific Record of Borehole Sheet. Groundwater is generally subject to seasonal fluctuations and hence may differ from the elevation given in this report.

The subsurface information at high mast light locations may be inferred from the closest borehole.

MISCELLANEOUS

The report was prepared by J. Beckett, Engineering Student, reviewed by Balu Iyer, Senior Foundation Engineer and approved by Murty Devata, Chief Foundation Engineer.



D. Dundas

D. Dundas, P.Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 93-1

1 OF 1

METRIC

W.P. 170-87-00 LOCATION Co-ords. N 4 850 340 E 332821.5 ORIGINATED BY JH
 DIST E HWY 401 BOREHOLE TYPE Solid Stem Auger, Comp. Test COMPILED BY JH
 DATUM Geodetic DATE 29/06/93 CHECKED BY 91

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 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
114.8	Ground Surface													
0.0														
	Silty Sand - Sand Some Gravel Brown Dense-Compact		1	SS	13									
			2	SS	11									
112.2			3	SS	48									
2.6			4	SS	100	/15cm								
			5	SS	100									
	Silty Sand - Sandy Silt Some Gravel Grey Very Dense		6	SS	100									
			7	SS	100									
			8	SS	20									
105.0														
9.8	End of Borehole													
	Hole caved in.													
114.8														
0.0	End of Borehole													

3, 5: Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

WP 270-87-00

RECORD OF BOREHOLE No 17

1 OF 1

METRIC

W.P. 287-87-03/04 LOCATION Co-ords. N 4 850 437.8 ; E 333 001.1

ORIGINATED BY SMH

DIST 6 HWY 401 BOREHOLE TYPE SS Auger, Cone Test

COMPILED BY SMH

DATUM Geodetic DATE 89 09 12

CHECKED BY DD

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPo							WATER CONTENT (%)				
								20 40 60 80 100							10 20 30				
117.2	Ground Surface																		
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Hard / Dense (Fill) 																		

WP 270-87-00			RECORD OF BOREHOLE No 20			1 OF 1 METRIC				
W.P. 257-87-03/04		LOCATION Co-ords. N 4 850 560.8 ; E 333 088.4		ORIGINATED BY SMH						
DIST 6 HWY 401		BOREHOLE TYPE SS Auger, Cone Test		COMPILED BY SMH						
DATUM Geodetic		DATE 89 09 12-13		CHECKED BY DD						
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 × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE						
109.2	Ground Surface									
0.0	Silty Sand, Some Gravel Compact (Fill)		1	SS	43	* DRY				
108.1			2	SS	100	/15cm	108			
1.1			3	SS	160	/26cm	107			
	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel occ. Cobbles and Boulders occ. Silty Sand Zones Hard (Glacial Till)		4	SS	150	/23cm	106			
			5	SS	100	/15cm	105			
104.5			6	SS	100	/13cm				
4.7	End of Borehole									

* 89 09 13

WP 270-87-00			RECORD OF BOREHOLE No 3			1 OF 1			METRIC				
W.P. 28-67-04			LOCATION Co-ords. N 4 850 712; E 333 356			ORIGINATED BY HS							
DIST 6 HWY 401			BOREHOLE TYPE Washboring - NX & BX Casing			COMPILED BY HD							
DATUM Geodetic			DATE 69 08 11			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 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
115.8	Ground Surface												
0.0	Fill Material Clayey silt, occ. sand seams, trace gravel. Stiff to very stiff		1	SS	25								
			2	SS	14								
112.8			3	SS	56								
3.0			4	SS	53								
			5	SS	100	/15cm							
			6	SS	100	/15cm							
			7	SS	100	/15cm							
			8	SS	166								
			9	SS	119								
			10	SS	100	/15cm							
			11	SS	105	/15cm							
			12	SS	100	/15cm							
			13	SS	100	/15cm							
			14	SS	100	/15cm							
			15	SS	100	/15cm							
96.3													
19.5	End of Borehole												

RECORD OF BOREHOLE No 93-3 1 OF 1 METRIC

W.P. 270-87-QC LOCATION Co-ords. N 4 850 558.5 E 333 393.2 ORIGINATED BY JB
 DIST E HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JB
 DATUM Geodetic DATE 28/06/93 CHECKED BY BL

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 KN/m ³	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					
114.7														
3.0	Clayey Silt Some Sandy Silt Zones Some Gravel Brown Stiff - hard		1	SS	32		114							
			2	SS	27		113							
			3	SS	29		112							
111.5	Trace Organics -		4	SS	12		111							
3.2														
			5	SS	100	/13cm	110							
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel Some Silty Sand Zones Occ. Boulder Hard, Grey (Glacial Till)		6	SS	100	/0cm	109							
			7	SS	100	/15cm	107							
							106							
105.4			8	SS	100	/15cm								
5.3	End of Borehole													

WP 270-87-00

RECORD OF BOREHOLE No 21

1 OF 1

METRIC

W.P. 28-67-01

LOCATION Co-ords. N 4 850 785; E 333 378

ORIGINATED BY SA

DIST 6

HWY 401

BOREHOLE TYPE Cont. Flight Auger

COMPILED BY SA

DATUM Geodetic

DATE 70 08 09

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLDT					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	'N' VALUES			20	40	60	80	100					
115.5	Ground Surface																
0.0																	
	Fine sand with silt and trace of gravel		1	SS	11		114										
			2	SS	11												
	Brown - Grey		3	SS	60	/10cm	112										
			4	SS	60	/5cm											
	Compact to Very Dense		5	SS	60	/5cm	110										
			6	SS	116												
			7	SS	150	/10cm	108										
107.4			8	SS	120	/15cm	106										
8.1	Het. mix. of silt, sand clay and trace of gravel		9	SS	60	/10cm	104										4 40 40 15
	V. Dense Grey		10	SS	60	/15cm	102										10 35 46 9
	Clayey silt with sand & occ. gravel, Hard, Grey		11	SS	89		100										
			12	SS	90	/15cm	98										
	Heterogeneous mixture of silt, sand, clay and gravel		13	SS	123	/23cm											
	Grey		14	SS	95	/15cm	96										5 41 44 10
	Very Dense		15	SS	81	/15cm											
95.5	(Glacial Till)		16	SS	200	/10cm											
20.0	End of Borehole																

WP 270-81-00		RECORD OF BOREHOLE No 6		1 OF 1		METRIC	
W.P. 28-67-04		LOCATION Co-ords N 4 850 687 E 333 420		ORIGINATED BY HS			
DIST 5 HWY 401		BOREHOLE TYPE Washboring, NX Casing; Cone Test		COMPILED BY HD			
DATUM Geodetic		DATE 18/07/68		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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE "N" VALUES			20 40 60 80 100	20 40 60 80 100					
115.5	Ground Surface											
0.0	Fill Material											
	Silty sand, some gravel trace clay		1 SS 12		115							
	Compact		2 SS 19		114							
			3 SS 21		113							
112.1					112							
3.4			4 SS 51									
			5 SS 100	/10cm	111							
	Heterogeneous mixture of Clayey silt, sand and gravel				110							
	Hard		6 SS 100	/13cm	109							3 39 46 12
	Brown to Grey				108							
	(Glacial till)		7 SS 100	/8cm	107							
					106							
			8 SS 100	/10cm	105							
104.7			9 SS 100	/13cm								
10.8	End of Borehole											

RECORD OF BOREHOLE No 93-5

1 OF 1

METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 850 970 E 333 743.1 ORIGINATED BY JB
 DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JB
 DATUM Geodetic DATE 21/06/93 CHECKED BY BI

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 × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
102.7	Ground Surface												
0.0	Topsoil		1	SS	102	8cm							
	Occ. Boulder												
	Heterogeneous mixture Clayey silt, sand and gravel, occ. boulder Grey Hard (Glacial Till)		2	SS	39								
			3	SS	38								
			4	SS	43								
			5	SS	91	23cm							
93.4			6	SS	100	15cm							
9.3	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

WP 270-87-00										RECORD OF BOREHOLE No 1										METRIC									
W.P. 87-87-00 (A)										LOCATION Co-ords. N 4 851 240.2; E 333 783.8										ORIGINATED BY MS									
DIST 6 HWY 401										BOREHOLE TYPE Cone Test, H-S Auger										COMPILED BY MS									
DATUM Geodetic										DATE 87 12 14										CHECKED BY DD									
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	'N' VALUES			20	40						60	80	100	WATER CONTENT (%)											
113.3	Ground Surface																												
0.0																													
	Silty Sand to Sandy Silt		1	SS	100/25	cm							0 26 (74)																
	Trace Clay		2	SS	60/15	cm																							
	Very Dense (Lacustrine)		3	SS	75/15	cm							0 47 (53)																
			4	SS	75																								
105.4			5	SS	90								0 27 (73)																
7.9			6	SS	29																								
	Silt Some Sand Trace Clay Occ. Silty Clay Zones Compact to Very Dense (Lacustrine)		7	SS	70								0 25 72																
101.1			8	SS	11																								
12.2	Silty Clay Firm to Stiff (Lacustrine)		9	SS																									
99.3			10	SS	120																								
14.0			11	SS	90/13	cm							4 37 41 18																
	Heterogeneous Mixture Silt/Clayey Silt with Sand Trace Gravel Occ. Boulders Very Dense/Hard (Glacial Till)		12	SS	111/23	cm																							
93.8			13	SS	90/13	cm																							
19.5	Gravel		14	SS	100/8	cm																							
	Silty Sand Very Dense (Lacustrine)		15	SS	100/10	cm																							
90.3																													
23.0	End of Borehole																												

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00			RECORD OF BOREHOLE No 7			METRIC						
W P 87-87-00 (A)			LOCATION Co-ords. N 4 851 358.6; E 333 955.9			ORIGINATED BY DG						
DIST 6 HWY 401			BOREHOLE TYPE Cone Test, Hollow-Stem Auger			COMPILED BY DG						
DATUM Geodetic			DATE 87 12 22			CHECKED BY DD						
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	NUMBER	TYPE			VALUES	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
102.3	Ground Surface											
0.0	Silty Sand to Sandy Silt Trace Clay Very Dense (Lacustrine)	1	SS	57								0 43 (57)
100.2		2	SS	48								0 26 68 6
2.1	Silt Some Sand Trace Clay Occ. Silty Clay Zones Dense to Very Dense (Lacustrine)	3	SS	100								0 30 66 4
96.5		4	SS	84								
5.8		5	SS	36								
	Heterogeneous Mixture Silt/Clayey Silt With Sand Trace Gravel Occ. Boulders Dense to Very Dense/ Hard (Glacial Till)	6	SS	90	15 cm							
		7	SS	90	13 cm							
90.7		8	SS	90	10 cm							0 12 82 6
11.6	Silt	9	SS	90	15 cm							
	Silty Sand Very Dense (Lacustrine)	10	SS	90	15 cm							0 86 11 3
		11	SS	90	17 cm							
	Silt	12	SS	90	10 cm							
83.9	Silty Clay	13	SS	102	23 cm							
18.4	End of Borehole											

WP 270-87-00

RECORD OF BOREHOLE No 1

METRIC

W P 268-87-01/02 LOCATION N 4 851 444.8, E 334 130.1 ORIGINATED BY BB/BS
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H S Auger, BQ Rock Core COMPILED BY BR
DATUM Geodetic DATE 89 06 26/27 CHECKED BY DD 4

OFFICE REPORT ON SOIL EXPLORATION

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60					
89.7	Ground Surface													
0.0			1	SS	30									
	Sandy Silt to Silty Sand		2	SS	15									
			3	SS	20									
	Occasional Cohesive Pockets		4	SS	12									
			5	SS	18									
	Trace Gravel		6	SS	13									
			7	SS	20									
	Compact to Dense		8	SS	43									
			9	SS	40									
			10	SS	30									
			11	SS	17									
77.5	(Fill Material)													3 32 57 8
12.2	Organic Silt to Silt With Sand		12	SS	26								20.0	2 41 45 13
	Trace Gravel													
	Trace Clay		13	SS	15									
	Very Stiff													
74.2														
15.5	***		14	SS	25									
73.5														
16.2	Bedrock		15	SS	60/15cm									
	Shale With Occasional Clay Seams		16	RC	100%									
			17	RC	100% REC									
			18	RC	100% REC									0% RQD
	Highly Weathered Moderately Weathered		19	RC	100% REC									
68.3														
21.4	End of Borehole													
** Piezometer Reading 89 09 28 *** Het. Mixture of Gravel, Sand, Silt Trace Clay, Compact Probable Cobbles/Boulders (Glacial Till)														

WP 270-87-00

RECORD OF BOREHOLE No 7

METRIC

W P 268-87-01/02

LOCATION N 4 851 374.3, E 334 156.9

ORIGINATED BY BB

DIST 6 HWY 401

BOREHOLE TYPE Cone Test, H.S. Auger, BW Casing, BQ Rock Core

COMPILED BY BB

DATUM Geodetic

DATE 89 06 28 - 30

CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	Wp	W	WL	WATER CONTENT (%)		
90.8	Ground Surface													
0.0	Sandy Silt to Silty Sand		1	SS	48									
	Trace Organics		2	SS	39									
	Occasional Cohesive Pockets		3	SS	22	Seal								
	Trace Gravel		4	SS	22									
	Compact to Dense		5	SS	23									
85.6	(Fill Material)		6	SS	13									
5.2			7	SS	10									
	Clayey Silt to Silt		8	SS	10									
	Some/With Sand		9	SS	11									
	Trace Gravel		10	SS	11									
	Occ. Sandy Silt Zones		11	SS	14									
	Stiff		12	SS	18									
79.4	(Fill Material)		13	SS	46									
11.4			14	SS	18									
	Sandy Silt to Silty Sand		15	SS	14									
	Trace Gravel		16	SS	12									
	Occ. Clayey Silt/ Organic Silt Seams		17	SS	18									
	Compact to Dense		18	SS	36									
70.2			19	SS	41									
20.6			20	SS	19									
	Organic Silt to Silt		21	SS	30									
	With Sand		22	SS	17									
	Trace Clay													
	Very Stiff to Hard													
62.6														
28.2	Sand													
	Trace/Some Gravel													
	Occ. Organic Silt to Silt Seams													
60.6	Compact to V. Dense													
30.2														

Cont

+3, x5: Numbers refer to Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10

Cont

WP 270-87-00

RECORD OF BOREHOLE No 7 Continued

METRIC

WP 268-87-01/02 LOCATION N 4 851 374.3, E 334 156.9
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, H.S. Auger, BW Casing, BQ Rock Core
DATUM Geodetic DATE 89 06 28 - 30
ORIGINATED BY BR
COMPILED BY BR
CHECKED BY DD

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH kPa					
60.6	Cont'd							○ UNCONFINED + FIELD VANE						GR SA SI C
30.2	Sand		23	SS	198	28 cm	60	● QUICK TRIAXIAL x LAB VANE						
59.1	Trace/Some Gravel													
31.7	Occ. Organic Silt to Compact to V. Dense		24	SS	100	2 cm								
	Bedrock													
	Shale		25	RC	93% REC		58							OZ RQD
56.3	Highly to Moderately Weathered		26	RC	100% REC									
34.5	End of Borehole													
	* Piezometer Reading 89 09 28													

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00

RECORD OF BOREHOLE No 1

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 534.2; E 334 405.0 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
DATUM Geodetic DATE 88 03 17 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	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
109.4	Ground Level												GR SA SI CL
0.0					Dry	88 03 29							
	Ret. Mixture Clayey Silt/Silt with Sand	1	SS	120	Seal	108		120/5 cm					
	Trace Gravel	2	SS	90/	18 cm	106							
	Occ. Boulders												
	Occ. Silt and Sand Seams	3	SS	120	25 cm	104						18 30 31 21	
	Hard/ Very Dense (Glacial Till)	4	SS	90/	18 cm	102							
		5	SS	120		100							
	Sand with Silt	6	SS	90/	18 cm	98							
	Very Dense	7	SS	90/	23 cm	96							
		8	SS	90/	20 cm	94							
		9	SS	70/	13 cm	92							4 37 43 17
		10	SS	90/	18 cm	90							
93.1		11	SS	70/	13 cm	88							
16.3	End of Borehole				Piezometer								

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00		RECORD OF BOREHOLE No 10				METRIC						
W P 87-87-00 (C)		LOCATION		Co-ords. N 4 851 688.4; E 334 404.0		ORIGINATED BY DC						
DIST 6 HWY 401		BOREHOLE TYPE		Solid Stem Auger & Cone Test		COMPILED BY DC						
DATUM Geodetic		DATE		88.03.23		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 (%)
FLYV DEPTH	DESCRIPTION	NUMBER	TYPE			VALUES	20 40 60 80 100					
107.6	Ground Level											GR SA SI CL
0.0												
	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel	1	SS	36								
	Sand	2	SS	93								
	Occ. Boulders											
	Occ. Silt and Sand Seams Hard	3	SS	93								
	Dense to Very Dense (Glacial Till)	4	SS	90	10 cm							10 40 34 16
		5	SS	90	20 cm							
		6	SS	60	10 cm							4 30 50 16
		7	SS	90	15 cm							
95.3		8	SS	90	15 cm							
12.3	End of Borehole											

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00

RECORD OF BOREHOLE No 13

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 796.4; E 334 571.9 ORIGINATED BY DG
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG
DATUM Geodetic DATE 88 03 21 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	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
105.1	Ground Level													
0.0	Silt Trace Sand Trace Clay Compact to Dense (Lacustrine)		1	SS	32	*	104							0 4 78 18
101.7			2	SS	17		102							
3.4	Clayey Silt Occ. Silt & Sand Seams Firm (Lacustrine)		3	TW	PH		100						20.0	0 3 52 45
99.6			4	SS	9		98							
5.5	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders **													
97.0	Occ. Silt & Sand Seams		5	SS	33									
8.1	End of Borehole													
	** Stiff to Hard/ Loose to Dense (Glacial Till)													
	* Water Level not Established													

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00			RECORD OF BOREHOLE No 14				METRIC				
W P 87-87-00 (C)			LOCATION Co-ords. N 4 831 824.5; E 334 612.5				ORIGINATED BY DG				
DIST 5 HWY 401			BOREHOLE TYPE Solid Stem Auger & Cone Test				COMPILED BY DG				
DATUM Geodetic			DATE 88 03 21				CHECKED BY				
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 _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								
104.5 0.0	Ground Level										
	Clayey Silt Occ. Silt & Sand Seams Very Stiff (Lacustrine)		1	SS	20						8 36 37 19
101.1 2.4	Hor. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt & Sand Seams Very Stiff to Hard/ Compact to Very Dense (Glacial Till)		2	SS	17						
			3	SS	20						
			4	SS	22						16 33 36 15
96.4 8.1	End of Borehole		5	SS	108/25cm						
	* Water Level not Established										

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00		RECORD OF BOREHOLE No 5		1 OF 1 METRIC							
W.P. 270-87-03		LOCATION Co-ords: N 4 851 798.0, E 334 672.0		ORIGINATED BY DK							
DIST 5 HWY 401		BOREHOLE TYPE H.S. Augers		COMPILED BY DT							
DATUM Geodetic		DATE 92 09 23 - 92 09 24		CHECKED BY BI							
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 ³	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	W _P W W _L			
105.5	Ground Surface										
0.0	50mm Asphalt over Clayey Silt (Fill)		1 SS 6	DRY *							
104.3			2 SS 52		104						
1.2	Silt, occasional wet sand seams, Brown, Very Dense		3 SS 74								
103.4			4 SS 26		102					22.0	0 0 66 34
2.1	Clayey Silt, trace sand Grey and brown, Hard		5 SS 21								
102.5			6 SS 33		100						
3.0	Silty Clay, trace sand and gravel, Grey Very SUH		7 SS 80							25.1	26 34 31 9
			8 SS 46		98						9 38 39 14
			9 SS 100	/20cm	96						
			10 SS 100	/8cm	94						
			11 SS 110	/15cm	92						
			12 SS 100	/13cm							
90.2											
15.3	End of Borehole										
	• Hole dry upon completion of drilling										

RECORD OF BOREHOLE No 93-6

1 of 1

METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 852 203.8 E 335 148.8 ORIGINATED BY JE
DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JB
DATUM Geodetic DATE 22/06/93 CHECKED BY BJ

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
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
97.1	Ground Surface													
97.0	Topsoil		1	SS	17									
	Clayey Silt to Silty Clay		2	SS	10									
	Some Gravel													
	Some Sand		3	SS	33									
	Brown													
	Occasional Boulder		4	SS	100	/8cm								
94.1			5	SS	100	/8cm								
93.0			6	SS	100	/8cm								
	Heterogeneous mixture of													
	Clayey Silt, Sand and													
	Gravel													
	Grey		7	SS	100	/10cm								
	hard													
	(Glacial Till)													
			8	SS	100	/15cm								
87.7			9	SS	100	/10cm								
9.4	End of Borehole													

RECORD OF BOREHOLE No 93-8

1 OF 1

METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 852 300.4 E 335 257.9 ORIGINATED BY JB
DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY DT
DATUM Geodetic DATE 93 06 21 CHECKED BY BI

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 * LAB VANE 20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
98.2	Ground Surface												
0.0	Topsoil		1	SS	7	*	98						
			2	SS	13		97						
	Clayey silt with gravel, occ. silty sand zones		3	SS	20		96						
	Brown - Grey						95						
	Hard - Firm		4	SS	40		94						
93.3			5	SS	16		93						
4.9			6	SS	15		92						
	Heterogeneous mixture of clayey silt, sand and gravel		7	SS	17		91						
	Grey						90						
	Hard - Stiff						89						
	(Glacial Till)		8	SS	46								
88.6													
9.6	End of Borehole												
	• WL Not Established												

RECORD OF BOREHOLE No 93-9

1 OF 1

METRIC

W.P. 270-87-00

LOCATION Co-ords. N 4 852 E20.8 E 335 815.0

ORIGINATED BY JR

DIST 6 HWY 401

BOREHOLE TYPE Solid Stem Auger, Cone Test

COMPILED BY JS

DATUM Genetic

DATE 22/06/93

CHECKED BY BI

[illegible]

+3, x5, Numbers refer to Sensitivity

WP 270-87-00

RECORD OF BOREHOLE No 5

W P 137-78-02 LOCATION Co-ords N 4 852 806.5 E 335 814.0 ORIGINATED BY A.C.
 DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger Cone Test COMPILED BY E.B.
 DATUM Geodetic DATE 80-08-14 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 _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 IN' VALUES								
105.0	Ground Surface										
0.0											
	Silty Clay Brown of Hard Low Plasticity Some Gravel and Sand (Glacial Till) Grey Hard		1 SS 94		104	N>150 @1.5m					4 31 48 17
			2 SS 50/10 cm.								
			3 SS 50/10 cm.								
			4 SS 50/10 cm.								
			5 SS 69/25 cm.								
			6 SS 30/8 cm.								
97.1				7 SS 50/8 cm.							
7.9	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00

RECORD OF BOREHOLE No 7

W P 137-78-02 LOCATION Co-ords N 4 852 746.0 E 335 794.0 ORIGINATED BY A.L.
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.B.
DATUM Geodetic DATE 80-08-13 CHECKED BY

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L		
104.1	Ground Level						104							
	Brown		1	SS	21									
	Very		2	SS	26									
	Stiff		3	SS	52		102							
	to		4	SS	12									
	Hard		5	SS	23		100							13 30 43 14
	Silty Clay		6	SS	16									
	of		7	SS	13		98							
	Grey		8	SS	PH		96							
	Low Plasticity		9	SS	59		94							
	with Sand		10	SS	57/15 cm.		92							32 53 10 5
	Some Gravel		11	SS	100/20 cm.		90							
	(Glacial Till)		12	SS	97		88							
	Stiff		13	SS	105		86							2 80 13 5
	Very Dense		14	SS	100/25 cm.									
94.0	Hard		15	SS	100/23 cm.									
10.1	Dark Grey													
	Fine to Medium Sand													
	with Varying													
	Amounts of Gravel													
	Some Silt													
	Trace of Clay													
85.6	End of Borehole													

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

RECORD OF BOREHOLE No 8

ORIGINATED BY A.L.

COMPILED BY R.B.

CHECKED BY

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 93-10 1 OF 1 METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 852 940.0 E 335 972.3 ORIGINATED BY JB
DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JB
DATUM Geocentric DATE 22/05/93 CHECKED BY BI

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	20 40 60 80 100					
100.8	Ground Surface													
0.0	Sandy Silt with occ. Clay layers Trace Gravel		1	SS	37									
98.7			2	SS	103									
2.1			3	SS	104	/25cm								
			4	SS	100	/25cm								
	Boulders		5	SS	100	/15cm								
	Heterogeneous mixture of Clayey Silt, Sand and Gravel, occ. Boulder Hard (Glacial Till)		6	SS	100	/10cm								
			7	SS	100	/10cm								
91.4			8	SS	100	/13cm								
9.4	End of Borehole * Water level not established													

RECORD OF BOREHOLE No 93-11 1 OF 1 METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 853 160.9 E 336 185.1 ORIGINATED BY JB
 DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY DT
 DATUM Ceodetic DATE 93.06.23 CHECKED BY BI

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
95.3	Ground Surface													
0.0	Topsoil		1	SS	11									
	Clayey Silt		2	SS	30									
	Trace gravel													
	Trace sand													
	Brown - Grey		3	SS	41									
	Hard - Stiff		4	SS	70									
91.0														
4.3			5	SS	100	/13cm								
	Heterogeneous mixture of													
	Clayey Silt, Sand and													
	Gravel		6	SS	100	/13cm								
	Grey													
	Hard		7	SS	69									
	(Glacial Till)													
85.7			8	SS	65									
9.6	End of Borehole													
	• WL Not Established													

RECORD OF BOREHOLE No 93-12 1 OF 1 METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 853 220.0 E 336 158.0 ORIGINATED BY JE
 DIST 5 HWY 40 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JE
 DATUM Geodetic DATE 25/08/93 CHECKED BY BL

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 7	REMARKS δ: GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
94.9	Ground Surface													
0.0														
			1	SS	18									
			2	SS	29									
	Occasional Sand Layers		3	SS	100	/15cm								
			4	SS	100	/15cm								
	Heterogeneous mixture of Clayey Silt, Sand and Gravel, Occ. Boulder Very Stiff - Hard (Glacial Till)		5	SS	100	/15cm								
			6	SS	100	/15cm								
			7	SS	100									
85.3			8	SS	100									
9.6	End of Borehole													

RECORD OF BOREHOLE No 93-13 1 OF 1 METRIC

W.P. 270-87-00 LOCATION Co-ords. N 4 853 456.7 E 336 501.3 ORIGINATED BY JB
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY DT
 DATUM Geodetic DATE 93 06 23 CHECKED BY BI

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	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
90.6	Ground Surface													
0.0	Topsoil		1	SS	4									
	Tr. Organics		2	SS	6									
			3	SS	5									
			4	SS	11									
	Heterogeneous mixture of Clayey Silt, Sand and Gravel Occ. Boulder Brown - Grey Firm - Stiff (Glacial Till)		5	SS	7									
			6	SS	3									
			7	SS	7									
			8	SS	2									
79.5			9	SS	25									
11.1	End of Borehole													

RECORD OF BOREHOLE No 93-14 1 of 1 METRIC

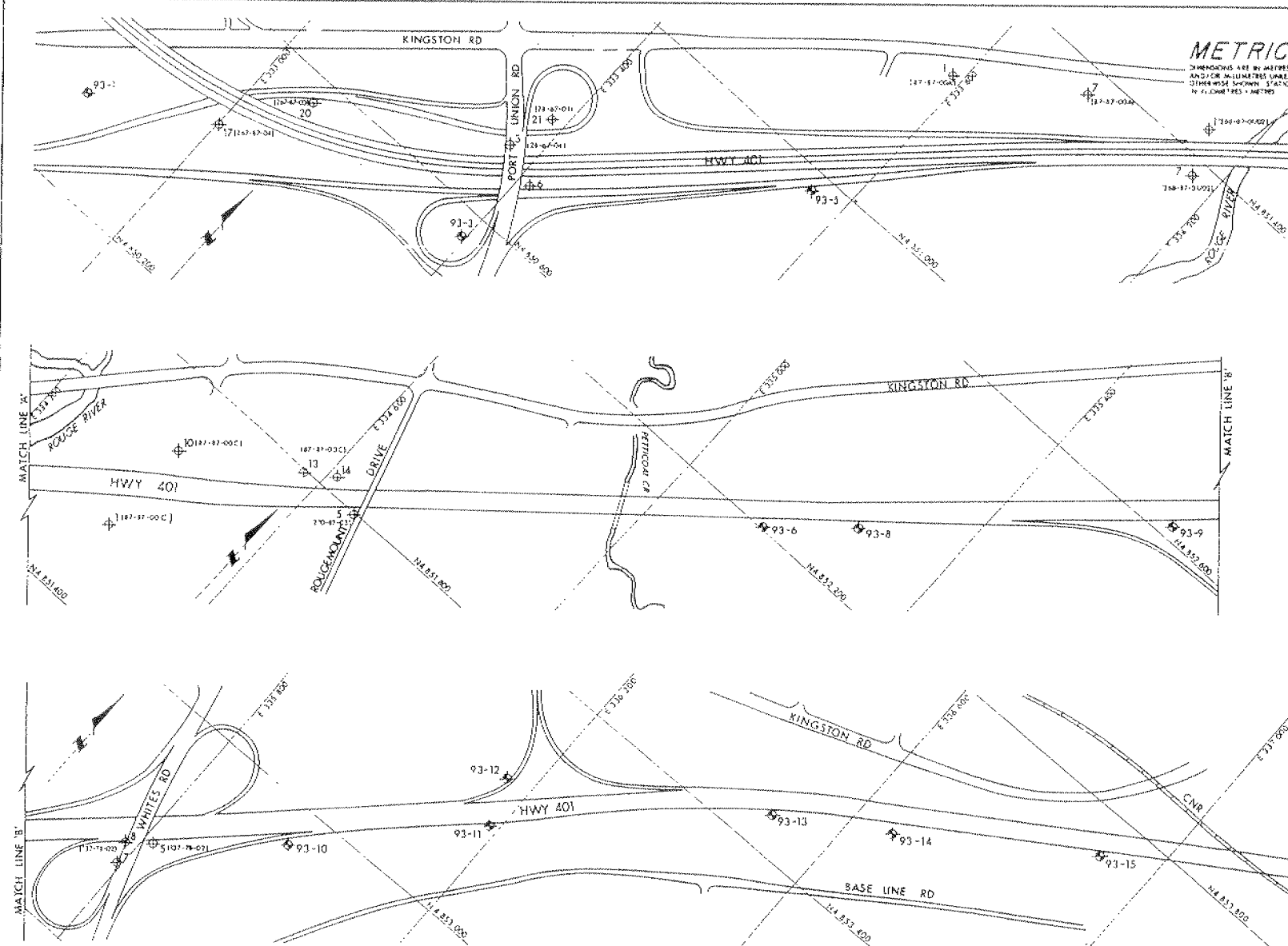
W.P. 270-87-00 LOCATION Co-ords. N 4 853 567.7 E 336 661.1 ORIGINATED BY JE
 DIST E HWY 401 BOREHOLE TYPE Solid Stem Auger Cone Test COMPILED BY JE
 DATUM Geodetic DATE 23/06/93 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kP_0 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_p NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
58.2	Ground Surface										
0.0						DRY	88				
							87				
			2	SS	78		86				
			3	SS	100		85				
			4	SS	45		84				
			5	SS	100		83				
			6	SS	71		82				
							81				
80.5	Probable Bedrock		7	SS	100						
7.7	End of Borehole										

RECORD OF BOREHOLE No 93-15 1 OF 1 METRIC

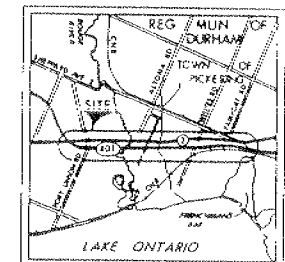
W.P. 270-87-00 LOCATION Co-ords. N 4 853 735.5 E 336 922.6 ORIGINATED BY JB
 DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger, Cone Test COMPILED BY JB
 DATUM Geodetic DATE 24/05/93 CHECKED BY BJ

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			'N' VALUES	20						40	60	80	100	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	20	40	60



METRIC
DIMENSIONS ARE IN METRES
UNLESS OTHERWISE SHOWN
STATIONS
IN 2.00M TIES - METRIC

CONT No 95-34
WP No 270-87-00
HIGH MAST LIGHTING POLES
HWY 2 TO FAIRPORT RD
BORE HOLE LOCATIONS



KEY PLAN
SCALE
1:50,000

LEGEND

- ◆ Bore Hole
- ⊕ Bore Hole of Previous Investigation
- ⊙ Bore Hole & Cone
- N Bore Hole 3m (15d Pen Test), 475 J (below)
- CONC Bore Hole 3m (15d Pen Test), 475 J (below)
- ⊕ WL at time of investigation

No.	ELEVATION	CO-ORDINATES NORTH	EAST
93-1	114.5	4 850 346.0	333 821.5
93-3	114.7	4 850 358.5	333 393.2
93-5	102.7	4 850 370.0	333 743.1
93-6	97.1	4 852 203.8	335 148.6
93-8	98.2	4 852 300.4	335 237.9
93-9	104.5	4 852 620.8	335 815.0
93-10	100.8	4 852 940.0	335 972.3
93-11	95.3	4 853 160.91	336 165.1
93-12	94.9	4 853 232.3	336 159.0
93-13	90.6	4 853 456.7	336 501.3
93-14	88.2	4 853 552.7	336 651.1
93-15	85.2	4 853 735.5	336 922.5

Note:
For location of Boreholes of Previous Investigation
Refer to Record of Borehole sheets

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 Associates Office, Downsview. Information contained in this report and related documents is specifically intended in accordance with the conditions of Section GC 2.01 of OPS Gen Cond.

REV	DATE	BY	DISCUSSION
1			
Geocres No. 30414-225			
PROJECT No. 401		DIST. 5	
SUBMITTAL No. 16		DATE 12/93	
DRAWN BY: CHICCO		CHECKED BY: CHICCO	

PLANS
SCALE
50m 0 50m

Note:
For Subsoil information Refer to
Record of Borehole sheets

Foundation Investigation Report
For
High Mast Lights
Hwy 2 to Fairport Road
WP 271-87-00, Site N/A
Hwy 401, Toronto

This is an addendum to the original High Mast Light report for WP 270-87-00 to include additional High Mast Lights within the same area encompassed by the original report. The purpose of this report is to provide additional subsurface information for the added HML locations. The detailed soil stratigraphy encountered at each borehole location is shown on the specific Record of Borehole Sheet included in the Appendix. The borehole locations are not shown on a drawing due to the addendum nature of these HML locations but the borehole locations are indicated by coordinates on the Record of Borehole Sheets.

The groundwater level recorded at each borehole location is shown on the specific Record of Borehole Sheet. Groundwater is generally subject to seasonal fluctuations and hence may differ from the elevation given in this report.

The subsurface information at high mast light locations may be inferred from the closest borehole.

MISCELLANEOUS

The report was prepared by K. Ahmad, Foundation Engineer and reviewed by D.Dundas, Senior Foundation Engineer.



D. Dundas
D. Dundas, P.Eng.
Senior Foundation Engineer

APPENDIX

WP 271-87-00

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 267-87-01/02

LOCATION Co-ords. N 4 850 498.6 ; E 332 872.6

ORIGINATED BY SMH

DIST 6

HWY 401

BOREHOLE TYPE HS Auger, SS Auger, Cone Test

COMPILED BY SMH

DATUM Geodetic

DATE 89 09 05

CHECKED BY DD

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 7 KN/m ³	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					
114.3	Top of Median													
0.0	Silty Sand, Some Gravel Compact to Dense (Fill)					*	114							
113.4							113							
0.9			1	SS	52									
			2	SS	120									4 47 39 10
			3	SS	197									
	Silty Sand Zones		4	SS	190	/28cm								
			5	SS	196	/23cm								15 31 43 11
			6	SS	140									
			7	SS	150									
	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel, occ. Cobbles and Boulders, occ. Silty Sand Zones. Hard. (Glacial Till)		8	SS	160									6 34 47 13
			9	SS	192									0 35 48 17
			10	SS	132	/26cm								4 36 35 25
			11	SS	120	/15cm								
			12	SS	127									9 37 43 11
100.3														
14.0	End of Borehole													
	* Water Level Not Established													

WP 271-87-00

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 257-87-03/04

LOCATION Co-ords. N 4 850 532.7 ; E 332 994.8

ORIGINATED BY SMH

DIST 6 HWY 401

BOREHOLE TYPE SS Auger, Cone Test

COMPILED BY SMH

DATUM Geodetic

DATE 89 09 08

CHECKED BY DD

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	'N' VALUES			20	40	60	80	100				
116.1	Ground Surface															
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Hard to Firm (Fill)		1	SS	49											10 43 37 10
			2	SS	18											3 43 42 12
			3	SS	9											22 34 34 10
113.1			4	SS	11											6 41 39 14
3.0	Trace Organics Silty Sand Zones Stiff		5	SS	17											
			6	SS	34											
			7	SS	117											
	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel, occ. Cobbles and Boulders, occ. Silty Sand Zones. Stiff to Hard (Glacial Till)		8	SS	100	/10cm										
			9	SS	100	/13cm										
106.8			10	SS	100	/15cm										
9.3	End of Borehole															
	*Hole caved in - probable water level															

WP 271-87-00

RECORD OF BOREHOLE No 1

METRIC

W P 87-87-00 (C) LOCATION Co-ords. N 4 851 534.2; E 334 405.0 ORIGINATED BY DG

DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger & Cone Test COMPILED BY DG

DATUM Geodetic DATE 88 03 17 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	N' VALUES			20 40 60 80 100					
109.4 0.0	Ground Level												
						Dry 88 03	29						
	Het. Mixture Clayey Silt/Silt with Sand Trace Gravel Occ. Boulders Occ. Silt and Sand Seams Hard/ Very Dense (Glacial Till)		1	SS	120	Seal	108	120/5 cm					
			2	SS	90/	18 cm	106						
			3	SS	120	25 cm	104						18 30 31 21
			4	SS	90/	18 cm	102						
			5	SS	120		100						
	Sand with Silt Very Dense		6	SS	90/	18 cm	98						
			7	SS	90/	23 cm	96						
			8	SS	90/	20 cm	94						
			9	SS	70/	Seal /13 cm							4 37 43 17
			10	SS	90/	18 cm							
93.1 16.3	End of Borehole		11	SS	70/	/13 cm							
						Piezometer							

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

WP 271-87-00

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

WP 270-87-03 LOCATION Co-ords: N 4 851 825.0, E 334 649.2

ORIGINATED BY DK

DIST 6 HWY 401 BOREHOLE TYPE S.S. Augers

COMPILED BY BT

DATUM Geodetic DATE 92 09 22

CHECKED BY BI

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	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
105.9	Ground Surface													
9.0	Pavement Structure													
103.7	Silt, trace Sand Brown, Dense		1	SS	36		104						22.3	0 9 84 7
2.1	Brown Grey		2	SS	46		102							5 34 50 11
			3	SS	101		100							
			4	SS	103		98							4 30 40 26
			5	SS	100	/27cm								
			6	SS	100	/18cm	100							
			7	SS	105	/24cm								
			8	SS	101	/24cm	98							
			9	SS	100	/10cm	96							
			10	SS	101	/15cm	94							
			11	SS	100	/13cm								
92.1			12	SS	101	/15cm								
13.8	End of Borehole													
	* Perched water table in the Silt layer noted upon completion of drilling													

WP 271-87-00

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 28-67-04 LOCATION Co-ords. N 4 850 712; E 333 356 ORIGINATED BY HS
DIST 5 HWY 401 BOREHOLE TYPE Washboring - NX & BX Casing COMPILED BY HD
DATUM Geodetic DATE 69 08 11 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 7 kN/m ³	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					
115.8	Ground Surface												
0.0	Fill Material Clayey silt, occ. sand seams, trace gravel. Stiff to very stiff		1	SS	25								
			2	SS	14								
112.8			3	SS	56								
3.0			4	SS	53								
			5	SS	100	/15cm							
			6	SS	100	/15cm							
			7	SS	100	/15cm							
			8	SS	166								
			9	SS	119								
	Heterogeneous mixture of clayey silt, sand and gravel, occ. boulder Hard (Glacial Till)		10	SS	100	/15cm							
			11	SS	105	/15cm							
			12	SS	100	/15cm							
			13	SS	100	/15cm							
			14	SS	100	/15cm							
			15	SS	100	/13cm							
96.3													
19.5	End of Borehole												

WP 271-87-00

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 269-87-01 LOCATION Co-ords: N 4 853 853.8 E 337 004.3 ORIGINATED BY GD
DIST 5 HWY 401 BOREHOLE TYPE HS Auger, Cone Test, BQ Core COMPILED BY GD
DATUM Geodetic DATE 1991 01 21,22 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		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 _p	W		
84.2	Ground Surface												
0.0			1	SS	25		84						
			2	SS	35		83						
	Silty Sand Some Clay, Some Gravel		3	SS	28		82						16 38 33 12
			4	SS	61		81						
			5	SS	66		80						4 33 41 22
	Cloey Silt, some Sand Occ. Silty Clay Zone Occ. Silt Zones Occ. Cobbles and Boulders Trace Gravel, Brown V. Stiff to Hard (Glacial Till)		6	SS	67		79						
			7	SS	93		78						
			8	SS	81		77						
			9	SS	59		76						
75.0	Silty Clay to Clayey Silt		10	SS	150	/8cm	75						
9.2	Highly Weathered		11	RC	REC	93%	74						RQD 20%
	SHALE BEDROCK (Slightly Weathered)		12	RC	REC	63%	73						RQD 33%
71.9							72						
12.3	End of Borehole												

**FOUNDATION INVESTIGATION REPORT
FOR
RETAINING WALLS**

**HWY. 2 TO FAIRPORT ROAD
WP 270-87-00 SITE N/A
HWY. 401, CENTRAL REGION**

INTRODUCTION

This report presents the results of a geotechnical investigation at the site of 17 retaining walls along the proposed Highway 401 widening from Highway 2 to Fairport Road.

SITE AND GEOLOGY

The proposed retaining walls are to be located along proposed Highway 401 westbound and eastbound collector lanes between Highway 2 and Fairport Road in Pickering.

The site is in the physiographic region known as the Iroquois Plain. In this area the soils consist of surface sand and clay deposited during Lake Iroquois period underlain by till deposits. The site is generally flat with the Rouge River crossing Highway 401 along part of the site.

FIELD AND LABORATORY WORK

Thirty-six borings were drilled at the retaining walls. In addition, we have utilized the data from existing MTO borings. The boreholes and the retaining walls are given on the following page. The number of the present borings shows the retaining wall followed by the individual boring number.

NOTE: Refer to Table II (Appendix) for co-ordinates and elevations of Boreholes.

Retaining Wall	Present Borehole	Previous MTO Boring
1	1-1 1-2	BH 9, 69-F-48
2		BH 26, 267-87-01/02 BH 6, 267-87-01/02 BH 1, 69-F-48
3	3-1 3-2 3-3 3-4 3-5	BH 4, 69-F-48 BH 7, 69-F-48
4	4-1	BH 20, 267-87-03/04
5	5-1 5-2 5-3 5-4 5-5	BH 8, 267-87-03/04
6	No borings	
7		BH 1, 69-F-49
8	8-1 8-2 8-3	
8A	8A-1 8A-2 8A-3 8A-4	
9	9-1 9-2 9-3	
10	10-1 10-2 10-3	
11	11-1 11-2	
13	13-1 13-3 13-4	
14		BH 2, 137-78-02 BH 104, 137-78-02 BH 1, 137-78-02
15	15-1 15-2 15-3 15-4	
17		BH 22, 267-87-01/02 BH 7, 267-87-01/02
18	18-1	BH 5, 267-87-01/02

The boreholes were drilled during the period March 14 to April 4, 1994, using a truck-mounted as well as a bombardier-mounted drill rig. Borings were made using hollow stem and solid stem augers.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler in conjunction with standard penetration tests. Dynamic cone penetration tests were carried out at many of the borings. The groundwater conditions in the borings were monitored during and at the completion of drilling.

The clearance of underground service utilities at the boreholes was carried out by Peto MacCallum staff. The borehole locations, co-ordinates and elevations of the borings were provided by Ministry of Transportation staff. Where boreholes had to be relocated the new co-ordinates and elevations were obtained by Peto MacCallum staff. All boreholes were backfilled with granular soil. Cold patching was placed at the top of borings located on shoulders.

The samples were brought back to our laboratory where they were examined by a geotechnical engineer. For approximately 15% of the samples the following laboratory tests were carried out:

- Moisture Content
- Atterburg Limits
- Grain Size Distribution

The laboratory results are plotted on the borehole logs as well as in the following figures:

Grain Size Distribution: Figures 1 to 6

Plasticity Charts: Figures 7 to 9

The borehole locations are prepared on the borehole locations plans.

Stratigraphic sections have been shown for each retaining wall. **

SUBSURFACE CONDITIONS

The subsurface conditions for each retaining wall are described in detail below based on the present boreholes and the previous MTO borings.

Retaining Wall No. 1

The following subsoil description is based on boreholes 1-1 and 1-2 and MTO borehole 9.

Topsoil

Topsoil occurred at each boring. The depth varied from 15 to 20 cm.

Fill

Fill was encountered at boreholes 1-1 and 1-2 from immediately beneath the topsoil to depths varying from 1.5 to 3.9 m. The fill consisted of brown sandy silt mixed with gravel and brick fragments. Occasional zones of grey clay and gravel with scattered

** NOTE: Stratigraphic sections are for illustration only. Refer to appropriate portion of the Contract for Structural Details.

The retaining wall details shown are for illustration only.

topsoil zones occurred at borehole 1-1. Most of the fill was non-cohesive. However, the lower depth of the fill at borehole 1-1 was of low plasticity. The "N" value of the fill varied from 10 to 80.

Silt and Sand

A deposit of silt and sand occurred beneath the fill at a depth of 1.5 m at borehole 1-2 and continued to a depth of 4.7 m. This deposit contained some sand. It was a low plasticity soil with "N" values varying from 30 to 38.

Silty Clay

Silty clay occurred at borehole 1-2 from a depth of 4.7 to 5.6 m. This is a soil of low to medium plasticity with an "N" value of 22.

Glacial Till

A deposit consisting of a heterogeneous mixture of sand and silt, some clay, trace gravel occurred at each borehole from below the topsoil at borehole 9 to a depth of 5.6 m at borehole 1-2. The till deposit continued to the maximum depth of the boreholes. The till is non-plastic or of low plasticity with "N" values varying from 24 to more than 50/10 cm.

Groundwater

The water level data is given in the borehole logs. A potential perched water condition could occur in the fill and silt and sand depending on the season of the year. A stabilized water table at borehole 9 exists at a depth of 1.77 m (July 1969).

Retaining Wall No. 2

Previous MTO borings 26, 6 and 1 are located at retaining wall No. 2.

Topsoil

Topsoil occurred at borehole 1 only to a depth of 60 cm.

Fill

Fill was encountered at all three boreholes to depths varying from 0.6 to 1.2 m. The fill was made up of silty sand, some gravel to clayey silt to silt. The "N" values varied from 31 to 56. The fill is estimated to be of low plasticity to non-plastic.

Glacial Till

Glacial till occurred from a depth of 0.6 to 1.2 m and continued to the maximum depths of the borings. This soil consisted of a heterogeneous mixture of silt, sand, trace gravel. It was non-plastic to low plasticity with "N" values varying from 51 to more than 100.

Water Table

The water level readings are given in the borehole logs. A stabilized water table was measured at a depth of 1.8 m at borehole 1 (July 1969). A perched water table is possible in the fill depending on the season of the year and weather conditions.

Retaining Wall No. 3

MTO borings 4 and 7 as well as the present boreholes 3-1 to 3-5 were carried out at retaining wall No. 3.

Topsoil

Topsoil occurred at boreholes 4, 7, 3-2 and 3-3 to depths varying from 20 to 60 cm.

Fill

Fill occurred at all borehole locations except boreholes 4 and 7 to depths varying from 0.8 to 2.6 m. The fill was generally made up of silty sand trace gravel with scattered organics and occasional wood fragments.

The fill was generally non-plastic with "N" values varying from 5 to 37.

Sand

Sand was encountered only at borehole 3-2. It was silty, fine to medium and non-plastic. The "N" values varied from 32 to 41.

Sand and Silt, Some Clay, Trace Gravel

This soil occurred at only borehole 3-3 from a depth of 3.0 m to the maximum depth of the boring. This soil has low plasticity with "N" values varying from 6 to 27.

Glacial Till

A heterogeneous mixture of sand and silt, some clay, and trace gravel occurred at each borehole location, except 3-3 from a depth of 0.6 to 4.1 m, and continued to the maximum depths of the borings. This soil is non-plastic to low plasticity with "N" values varying from 32 to more than 100.

Water Table

The water level readings are given in the borehole logs. A stabilized water table was measured at a depth 1.5 to 2.1 m. A perched water table is possible in the fill and sand depending on the time of year and weather conditions.

Retaining Wall No. 4

MTO borehole 20 and present borehole 4-1 are located at retaining wall No. 4.

Topsoil

Ten centimetres of topsoil was encountered at borehole 4-1.

Fill

Fill occurred to depths varying from 0.9 to 1.1 m. The fill was made up of silty sand, some gravel with occasional topsoil seams. The fill is non-plastic with "N" values varying from 35 to 43.

Clayey Silt

Clayey silt occurred at borehole 4-1. This deposit is of low plasticity with an "N" value of 20. It occurred from a depth of 0.9 to 1.6 m.

Glacial Till

A heterogeneous mixture of sand and silt, some clay, trace to some gravel occurred at both borings at depths from 1.1 to 1.6 m. This soil is non-plastic or of low plasticity and has "N" values varying from 24 to more than 100. The glacial till continues to the maximum depth of the borings.

Water Table

The water level readings are given in the borehole logs. A perched water table may occur in the overlying fill depending on the weather conditions and the season of the year. We believe the stabilized water table in the till occurs at a depth of about 4.0 m.

Retaining Wall No. 5

MTO boring 8 as well as present borings 5-1 to 5-5 occur at this retaining wall.

Topsoil

Topsoil occurred at boreholes 5-1, 5-2 and 5-3 to depths of from 15 to 25 cm.

Asphalt

At borehole 5-4, 12.5 cm asphalt occurred at present ground level.

Fill

Fill was encountered at boreholes 8, 5-1, 5-4 and 5-5 to depths from 0.9 to 3.0 m. The fill consisted of either clean sand and gravel or sandy silt, trace gravel with zones of clayey silt and topsoil. The fill was generally non-plastic with occasional zones of soil with low plasticity. The "N" values varied from 4 to 32.

Clayey Silt

Clayey silt occurred at borehole 5-3 from immediately below the topsoil to a depth of 1.2 m. This deposit is of low plasticity with "N" values varying from 12 to 50/8 cm.

Silt

Silt was encountered at borehole 5-5 from a depth of 3.0 to 3.6 m. The silt was layered with organic lenses. The "N" value was 20.

Sand

A deposit of wet sand occurred at borehole 5-5 from a depth of 1.2 to 2.1 m. The sand is non-plastic with an "N" value of 50/10 cm.

Clay and Silt, Some Sand, Trace Gravel

This deposit occurred at boreholes 5-4 and 5-5 from depths varying from 0.9 to 3.6 m. The deposit continued to a depth of 4.5 m. This soil has low to medium plasticity with "N" values varying from 4 to 40.

Glacial Till

A heterogeneous mixture of sand and silt, some to trace clay, and trace gravel occurred at each borehole. This till deposit is of low plasticity to non-plastic with "N" values varying from 11 to more than 100. It continued to the maximum depths of the borings.

Water Table

The water level readings are given in the borehole logs. We believe a stabilized water table occurs at a depth of approximately 1.0 m. This condition in the sand represents a perched water table. A perched water table may also occur in the fill depending on the weather conditions and the season of the year.

Retaining Wall No. 6

The subsoil conditions at retaining wall No. 6 are described by the borings carried out for wall No. 5.

Retaining Wall No. 7

MTO borehole 1 occurs at retaining wall No. 7.

Fill

Fill occurs from present ground level to a depth of 2.7 m. The fills consist of sandy silt, trace clay and gravel. The fill is non-plastic to low plasticity. "N" values varied from 19 to 33.

Glacial Till

A heterogeneous mixture of clayey silt, sand and occasional gravel occurs from a depth of 2.7 m to the maximum depth of the boring. The till is of low plasticity with "N" values varying from 31 to more than 100.

Water Table

The water level readings are given in the borehole logs. We believe a stabilized water table occurs at a depth of 2.9 m. A perched water table may occur at a shallower depth in the fill depending on the weather conditions and season of the year.

Retaining Wall No. 8

Boreholes 8-1 to 8-3 were carried out at retaining wall No. 8.

Topsoil

The topsoil depth varied from 2.0 to 45.0 cm. Topsoil occurred at each boring.

Fill

Fill was encountered at borehole 8-3 to a depth of 0.7 m. The fill consisted of gravelly sand. The fill is non-plastic with an "N" value of 15.

Sand

Sand was encountered at boreholes 8-2 to 8-3 to depths varying from 1.1 to 3.0 m. The sand was silty and fine with "N" values varying from 30 to 50/13 cm.

Sandy Silt Trace Clay

This soil was found at borehole 8-1 from surface to a depth of 2.7 m. This deposit is non-plastic with an "N" value of 40.

Glacial Till

A heterogeneous mixture of sand and silt, trace clay, trace to some gravel occurred from a depth of 1.1 to 3.0 m. It continued to the maximum depths of the borings. This soil is non-plastic to low plasticity with "N" values varying from 22 to more than 100.

Water Table

The water level readings are given in the borehole logs. We believe the stabilized water table in the glacial till occurs at approximately elevation 107. In addition, a perched water table is believed to exist in the upper sand and sandy silt deposit. At the present time, it occurs at a depth of about 1.0 m.

Retaining Wall No. 8A

Present boreholes 8A-1 to 8A-4 were carried out at this retaining wall.

Topsoil

Topsoil occurred at each borehole to depths varying from 5 to 60 cm.

Fill

Fill occurred at boreholes 8A-1, 8A-2 and 8A-4 to depths from 0.4 to 1.8 m. The fill consisted of silty sand and gravel, trace organics. "N" values varied from 3 to 9. The fill is non-plastic.

Sandy Silt, Trace Clay

This deposit occurred at borehole 8A-3 from beneath the topsoil to a depth of 6.3 m. The soil is non-plastic with "N" values varying from 28 to 94.

Sandy Silt

Sandy silt occurred at borehole 8A-4 from a depth of 1.8 m and continued to 6.8 m. This soil is non-plastic with "N" values varying from 31 to 88.

Clayey Silt

Clayey silt was encountered at boreholes 8A-3 and 8A-4 at depths of 6.3 to 6.8 m. It continued to the maximum depths of the borings. This soil has low to medium plasticity with "N" values varying from 5 to 10.

Glacial Till

A heterogeneous mixture of sand and silt, trace clay, trace gravel occurred at boreholes 8A-1 and 8A-2 from depths of 0.4 and 1.5 m. This deposit continued to the maximum depths of the borings. This soil is non-plastic with "N" values varying from 18 to 50/10 cm.

Water Table

The water level readings are given in the borehole logs. A stabilized water table is considered to act at a depth of about 2.0 m. A higher perched water condition could occur in the fill depending on the season and weather conditions.

Retaining Wall No. 9

Boreholes 9-1 to 9-3 were carried out at this retaining wall.

Topsoil

Topsoil occurred at each borehole to depths from 10 to 30 cm.

Fill

Fill was only encountered at borehole 9-2. It continued to a depth of 0.6 m and consisted of sand and gravel. The "N" value was 15.

Sand

Sand was encountered at all three boreholes from surface. This deposit continued to depths from 2.7 to 3.0 m. This soil is non-plastic with "N" values varying from 4 to 56/15 cm.

Silt

Silt was encountered at boreholes 9-2 and 9-3 from depths of 2.7 and 3.0 m and continued to depths of 4.5 and 4.6 m. This deposit is non-plastic with "N" values varying from 26 to 81.

Clayey Silt

This deposit was encountered at boreholes 9-1 and 9-3. At borehole 9-1 the deposit occurred from a depth of 1.5 m to a depth of 2.3 m, while at borehole 9-3 the deposit occurred from a depth of 4.5 m to a depth of 6.0 m. The clayey silt is of low plasticity with "N" values varying from 11 to 28.

Glacial Till

Glacial till consisting of a heterogeneous mixture of sand and silt, some clay, and trace gravel occurred at each borehole. This soil is either non-plastic or of low plasticity with "N" values varying from 90 to 66/15 cm.

Water Table

The factual water level readings are given in the borehole logs. We believe a stabilized water table occurs at a depth of about 1.5 m.

Retaining Wall No. 10

Boreholes 10-1 to 10-3 were carried out at this retaining wall.

Topsoil

The topsoil depth varied from 17 to 25 cm. It was only encountered at boreholes 10-2 and 10-3.

Fill

Fill occurred at boreholes 10-1 and 10-2 to depths from 0.6 to 1.2 m. The fill consisted of sand and gravel, and trace organics at some locations. The fill is non-plastic with "N" values varying from 15 to 48.

Sand

Sand occurred at boreholes 10-2 and 10-3 from surface to 0.6 m and continued to depths from 1.6 to 2.1 m. The sand is silty and fine with "N" values varying from 12 to 79. The sand deposit was non-plastic.

Glacial Till

This deposit was encountered at all three borings at depths from 1.2 to 2.1 m. It consists of a heterogeneous mixture of silty sand, some gravel, and trace to some clay. This deposit is non-plastic with "N" values varying from 13 to 70/15 cm. It continued to the maximum depths of the borings.

Water Table

The factual water level readings are shown in the borehole logs. We believe the stabilized water level occurs at a depth of approximately 1.3 m.

Retaining Wall No. 11

Boreholes 11-1 and 11-2 were carried out at this retaining wall.

Topsoil

Topsoil occurred at both borings to depths from 30 to 60 cm.

Sand

Sand was encountered at borehole 11-1 from beneath the topsoil to a depth of 1.8 m. The sand is silty, fine and non-plastic. The "N" values range from 25 to 38.

Silt

Silt was encountered at borehole 11-2 from beneath the topsoil to a depth of 3.0 m. The silt contained some clay, and some sand, but was non-plastic. The "N" value varied from 17 to 66.

Clayey Silt

This deposit occurred at both borings at depths from 1.8 to 3.0 m and continued to depths from 6.3 to 6.6 m. The soil has low plasticity with "N" values varying from 3 to 23.

Silt and Sand, Some Clay, Trace Gravel

This soil occurred at borehole 11-2 from a depth of 6.6 to 8.6 m. It was a low plasticity soil with "N" values varying from 4 to 15.

Glacial Till

A heterogeneous mixture of sandy silt, some clay, and trace gravel was encountered at borehole 11-1. This soil is non-plastic to low plasticity with "N" values varying from 8 to 50/13 cm.

Water Table

The factual water level readings are given in the borehole logs. We believe the stabilized water table occurs at a depth of approximately 3.0 m. Perched water at borehole 11-1 could occur in the sand depending on the season and weather conditions.

Retaining Wall No. 13

Boreholes 13-1, 13-3 and 13-4 were carried out at retaining wall No. 13.

Topsoil

Topsoil was encountered at boreholes 13-3 and 13-4 to depths from 20 to 40 cm.

Fill

Fill was found at borehole 13-1 from ground level to a depth of 4.2 m. The fill consists of a mixture of silt, sand gravel and clay with scattered organics. Topsoil zones occurred at various depths in the fill. The fill is non-plastic to low plasticity. "N" values ranged from 2 to 13.

Glacial Till

This deposit occurred at all three borings from directly beneath the topsoil to a depth of 4.2 m. It continued to the maximum depths of the borings. The deposit consists of a heterogeneous mixture of sand and silt, some clay, and trace gravel. It is of low plasticity with "N" values varying from 14 to 50/10 cm.

Water Table

The water level readings are given in the borehole logs. We believe the stabilized water level occurs at a depth of about 3.0 m. A perched water table in the fill could occur at a shallower depth depending on the weather conditions and season of the year.

Retaining Wall No. 14

MTO borings 1, 2 and 104 are located near retaining wall No. 14.

Topsoil

Topsoil occurred only at borehole 2 to a depth of 50 cm.

Fill

Fill was encountered at boreholes 1 and 104 to depths from 6.4 to 6.7 m. The fill consisted of silty clay of low plasticity, some sand, and trace gravel. "N" values varied from 6 to 41.

Glacial Till

This deposit occurred at borehole 2 from beneath the topsoil, while at the other borings the till occurred at depths from 6.4 to 6.7 m. The till consisted of silty clay with sand and trace gravel. It is of low plasticity with "N" values varying from 2 to more than 100.

Water Table

The water level readings are given in the boreholes. We believe the stabilized water table is below the depths of the borings. A perched water table could occur in the fill depending on the weather conditions and season of the year.

Retaining Wall No. 15

Boreholes 15-1 to 15-4 were carried out at retaining wall No. 15.

Topsoil

Topsoil occurred at each borehole to depths from 30 to 90 cm.

Fill

Fill was encountered at borings 15-2, 15-3 and 15-4 to depths from 1.2 to 2.3 m. The fill consists of clayey silt, some gravel and topsoil zones and is a low plasticity soil. The "N" values varied from 13 to 35.

Silty Sand

This deposit occurred only at borehole 15-1 to a depth of 3.0 m. The silty sand contained trace gravel and trace clay and is a low plasticity soil. The "N" values varied from 17 to 87/25 cm.

Glacial Till

Glacial till was encountered at each borehole location from depths of 1.2 to 3.0 m and continued to the maximum depths of the borings. The till consisted of a heterogeneous mixture of sand, silt and gravel with some clay. It is a low plasticity soil with "N" values varying from 32 to 70/15 cm.

Water Table

The water level readings are given in the borehole logs. We believe the stabilized water table occurs at a depth of about 6.0 m. A perched water table could occur in the silty sand and fill depending on the weather conditions and season of the year.

Retaining Wall No. 17

MTO borings 7 and 22 occurred at retaining wall No. 17.

Fill

Fill was encountered at both borings from the surface to depths from 0.9 to 2.9 m. The fill consists of clayey silt to silt with frequent silty sand zones. The fill is non-plastic with "N" values varying from 20 to 30.

Glacial Till

Glacial till occurred at both borings below depths from 0.9 to 2.9 m. It continued to the maximum depths of the borings. This soil consists of a heterogeneous mixture of clayey silt to silt with sand, trace gravel, occasional cobbles and boulders. The soil is of low plasticity with "N" values varying from 127 to 177/23 cm.

Water Table

The water level data is given on the borehole logs. We believe a stabilized water table occurs at a depth of about 1.8 m. A higher perched water table in the fill could occur depending on the weather conditions and season of the year.

Retaining Wall No. 18

Borehole 18-1 and MTO boring 5 occurred at this retaining wall.

Fill

Fill occurs from present ground level to depths from 1.5 to 4.2 m. The fill consists of clayey silt to sandy silt, and trace gravel with occasional topsoil layers. The fill is mostly non-plastic with "N" values ranging from 12 to 75.

Sandy Silt

Sandy silt was encountered at borehole 18-1 from a depth of 4.2 m to a depth of 5.4 m. The sandy silt contains trace clay and is non-plastic. The "N" value was 91/25 cm.

Glacial Till

Glacial till occurred at both borings at depths from 1.5 to 5.4 m. The till consists of a heterogenous mixture of sand and silt with sand, and trace gravel. The soil is non-plastic with "N" values varying from 124 to 151/23 cm.

Water Table

The water level readings are given in the borehole logs. We believe a stabilized water table occurs at a depth of about 3.0 m. A perched water table in the fill could occur depending on the weather conditions and season of the year.

NOTE: The preceding report is a copy of the factual information from the Foundation Investigation and Design Report prepared by Peto MacCallum Ltd. (consulting geotechnical engineers for this project), under the technical supervision of the MTO Foundation Design Section.



D. Dundas
D.H. Dundas, P. Eng.
Sr. Foundation Engineer

APPENDIX

TABLE II
BOREHOLE LOCATION AND ELEVATION DATA

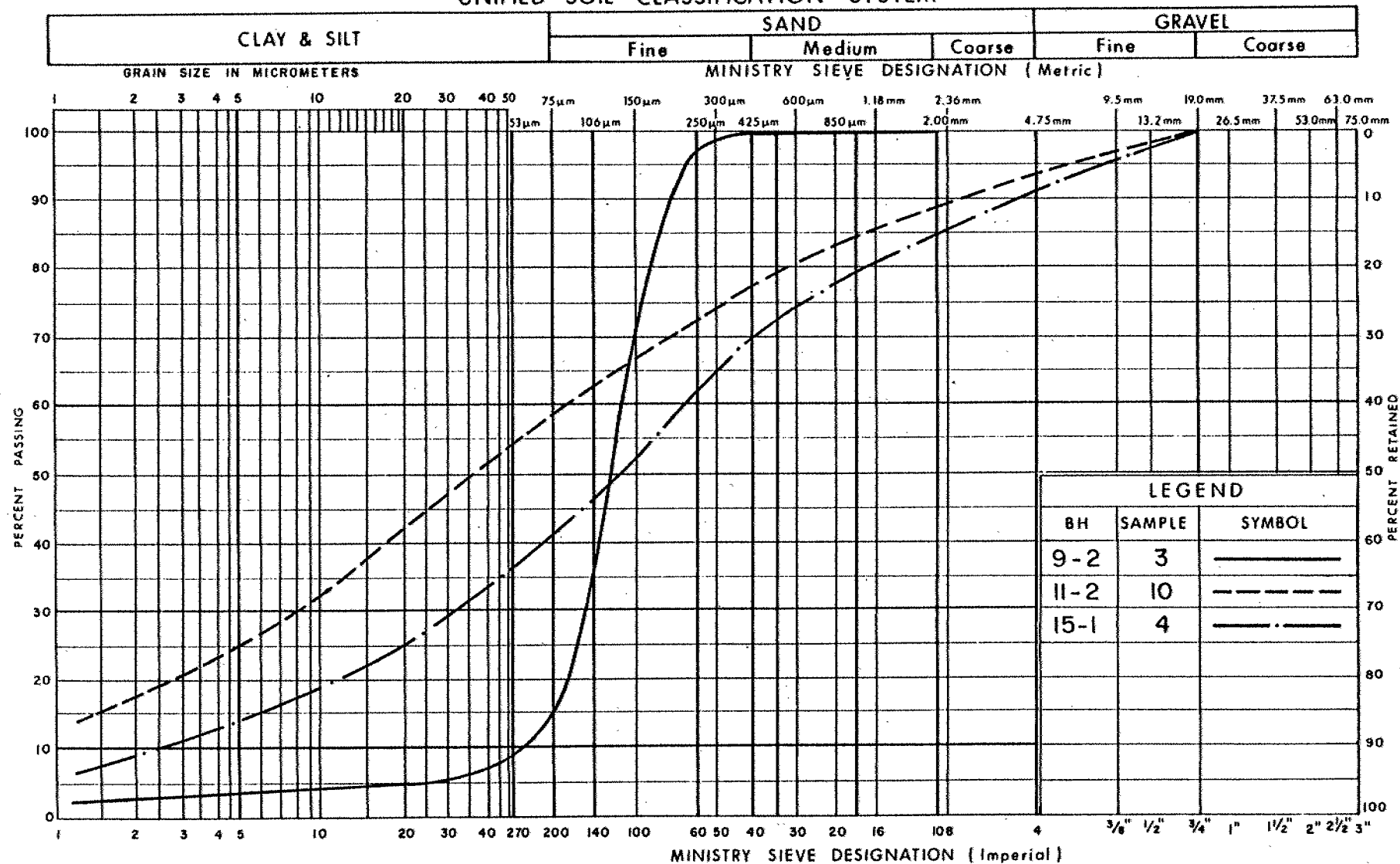
Borehole No.	Northing	Easting	Elevation
1-1	4,850,481	332,676	123.4 m
1-2	4,850,475	332,741	123.3 m
9, 69-F-48	15,913,625	1,091,930	390.8 ft
26, 267-87-01/02	4,850,479.7	332,853	114.5 m
6, 267-87-01/02	4,850,496.8	332,838.6	119.5 m
1, 69-F-48	15,913,718	1,092,454	376.1 ft
4, 69-F-48	15,913,796	1,092,713	375.9 ft
7, 69-F-48	15,913,814	1,092,833	375.2 ft
3-1	4,850,546	333,111	115.5 m
3-2	4,850,563	333,159	114.8 m
3-3	4,850,586	333,204	113.5 m
3-4	4,850,613	333,246	112.4 m
3-5	4,850,641	333,289	111.3 m
20, 287-87-03/04	4,850,560.8	333,088.4	109.2 m
4-1	4,850,577	333,151	114.3 m
8, 287-87-03/04	4,850,532.7	332,994.8	116.1 m
5-1	4,850,558	333,023	115.1 m
5-2	4,850,585	333,075	111.1 m
5-3	4,850,614	333,109	111.6 m
5-4	4,850,633	333,162	111.5 m
5-5	4,850,541	333,005	115.9 m
1, 69-F-49	15,914,558	1,093,705	378.8 ft
8-1	4,850,914	333,492	111.0 m
8-2	4,850,946	333,530	114.7 m
8-3	4,850,973	333,672	111.2 m
8A-1	4,851,103	333,710	107.9 m
8A-2	4,851,138	333,746	107.1 m

TABLE II

BOREHOLE LOCATION AND ELEVATION DATA

Borehole No.	Northing	Easting	Elevation
8A-3	4,851,176	333,780	107.9 m
8A-4	4,852,209	333,815	107.4 m
9-1	4,851,692	334,421	107.4 m
9-2	4,851,714	334,445	107.0 m
9-3	4,851,738	334,482	106.5 m
10-1	4,851,587	334,404	95.8 m
10-2	4,851,586	334,456	106.7 m
10-3	4,851,613	334,484	106.1 m
11-1	4,851,663	334,539	105.4 m
11-2	4,851,694	334,574	105.2 m
13-1	4,851,935	334,717	108.6 m
13-3	4,852,002	334,787	102.2 m
13-4	4,852,230	334,818	100.1 m
2, 137-78-02	4,852,849.5	334,758	104.5 m
104, 137-78-02	4,852,869	335,774	111.9 m
1, 137-78-02	4,852,872.5	335,782	111.9 m
15-1	4,853,676	336,718	93.2 m
15-2	4,853,699	336,751	92.0 m
15-3	4,853,719	336,790	88.9 m
15-4	4,853,738	336,819	87.1 m
22, 267-87-01/02	850,508.1	332,838.0	118.5 m
7, 267-87-01/02	850,506.1	332,850.9	116.1 m
5, 267-87-01/02	850,515.8	332,922.8	115.1 m
18-1	850,525	332,955	118.0 m

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

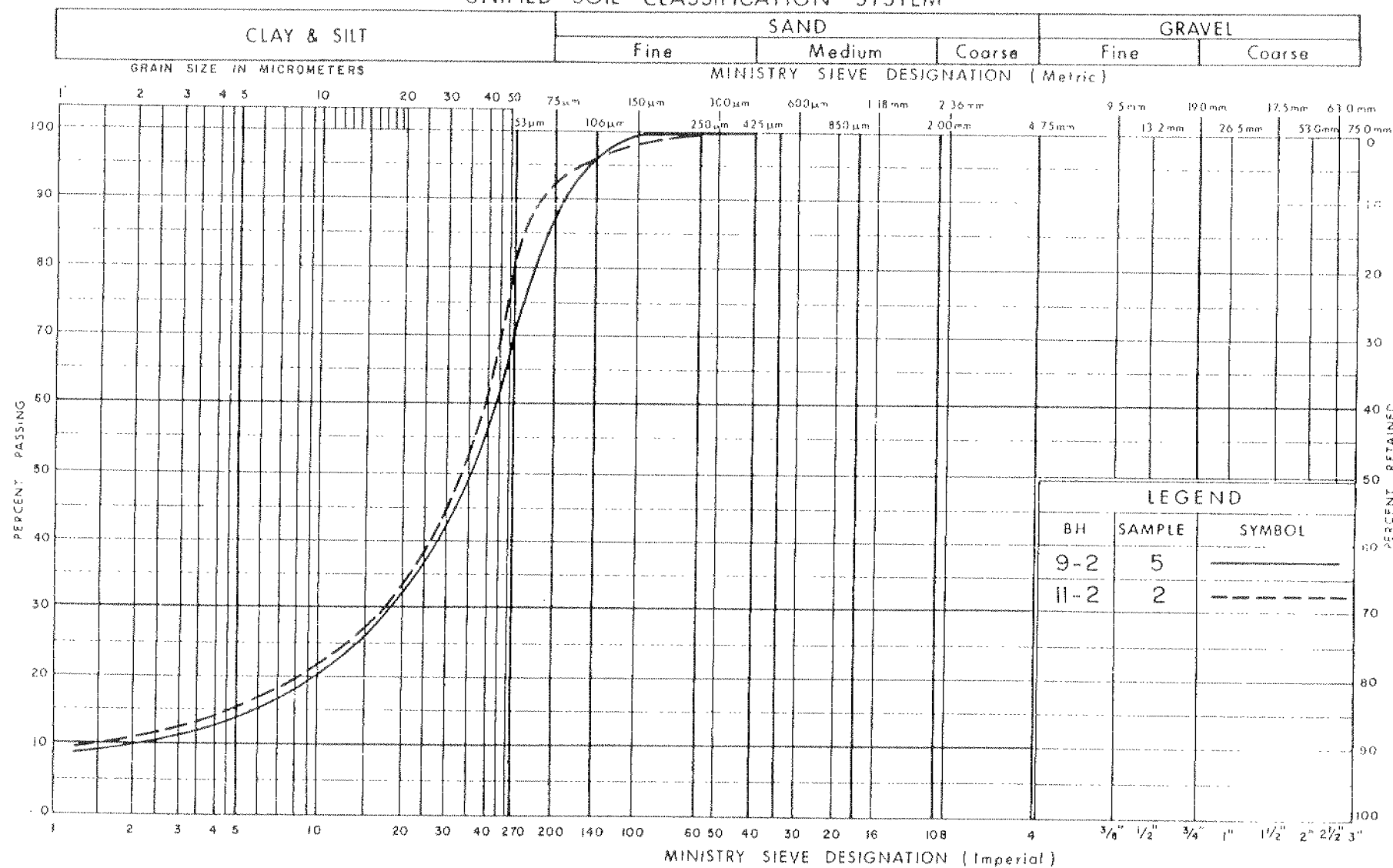
GRAIN SIZE DISTRIBUTION

SAND , SILTY SAND

FIG No 1

W P 270-87-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation

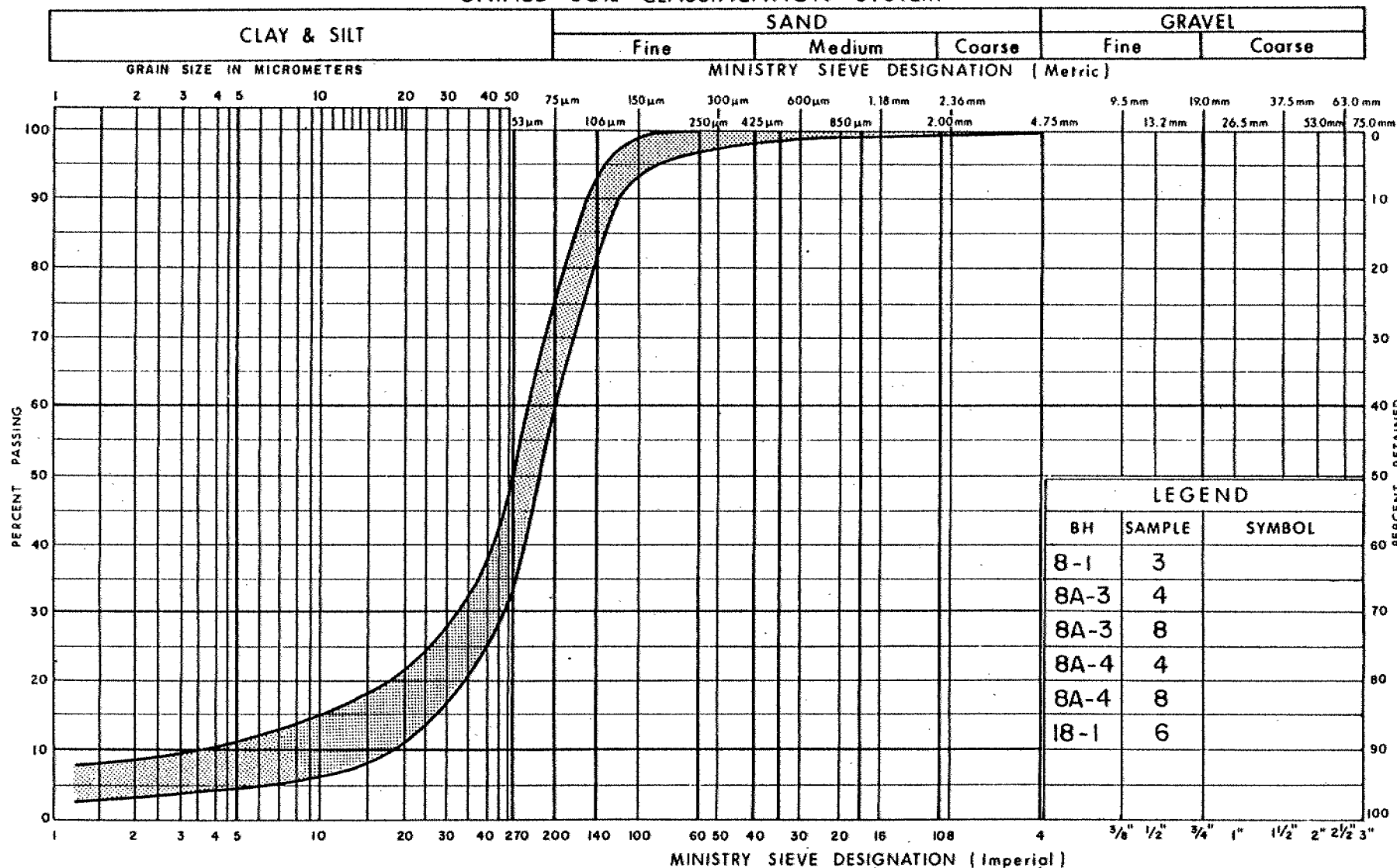
GRAIN SIZE DISTRIBUTION

SILT

FIG No 2

WP 270-87-00

UNIFIED SOIL CLASSIFICATION SYSTEM



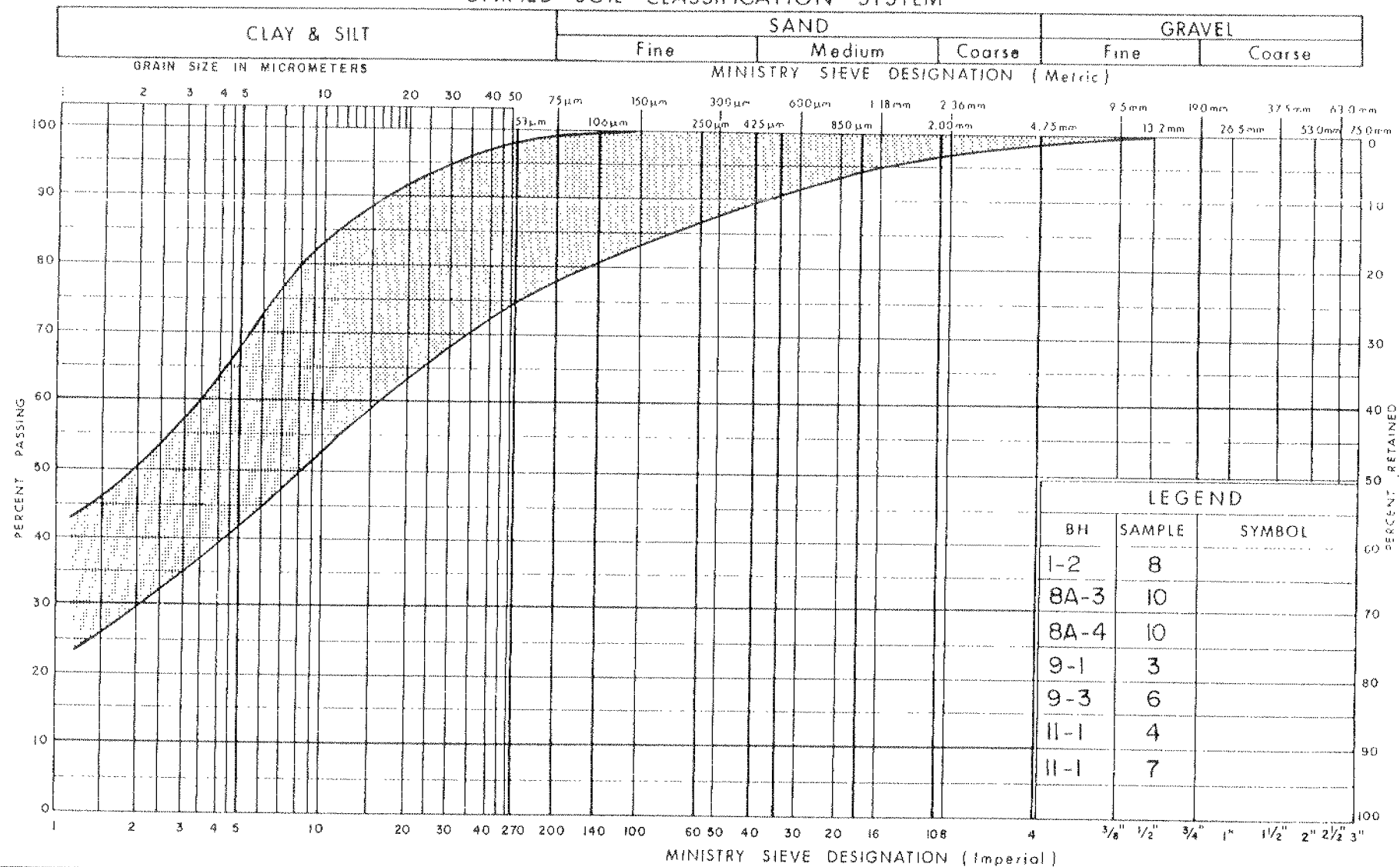
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Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT, TRACE CLAY

FIG No 3

W P 270-87-00

UNIFIED SOIL CLASSIFICATION SYSTEM



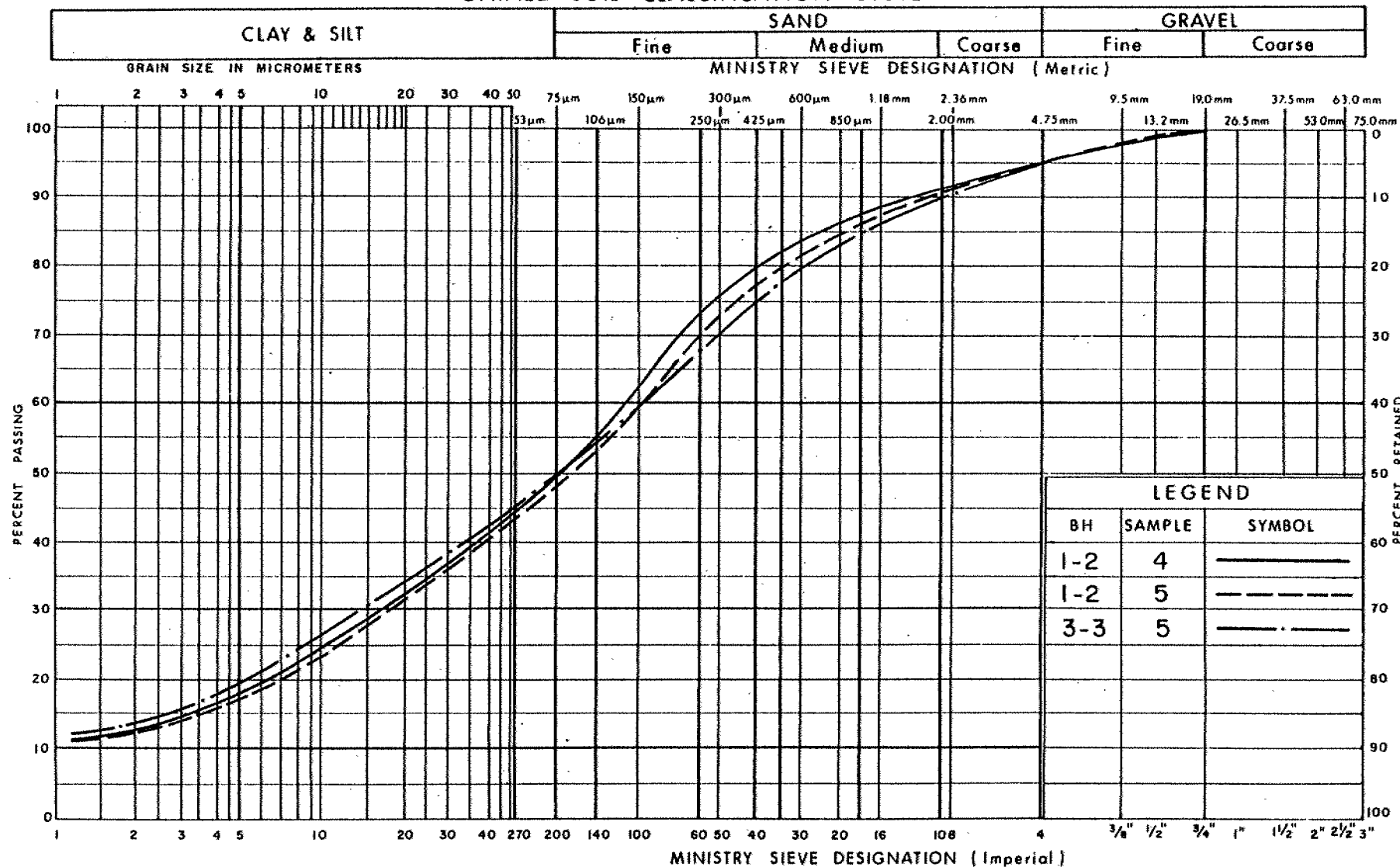
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, SILTY CLAY

FIG No 4

W P 270-87-00

UNIFIED SOIL CLASSIFICATION SYSTEM



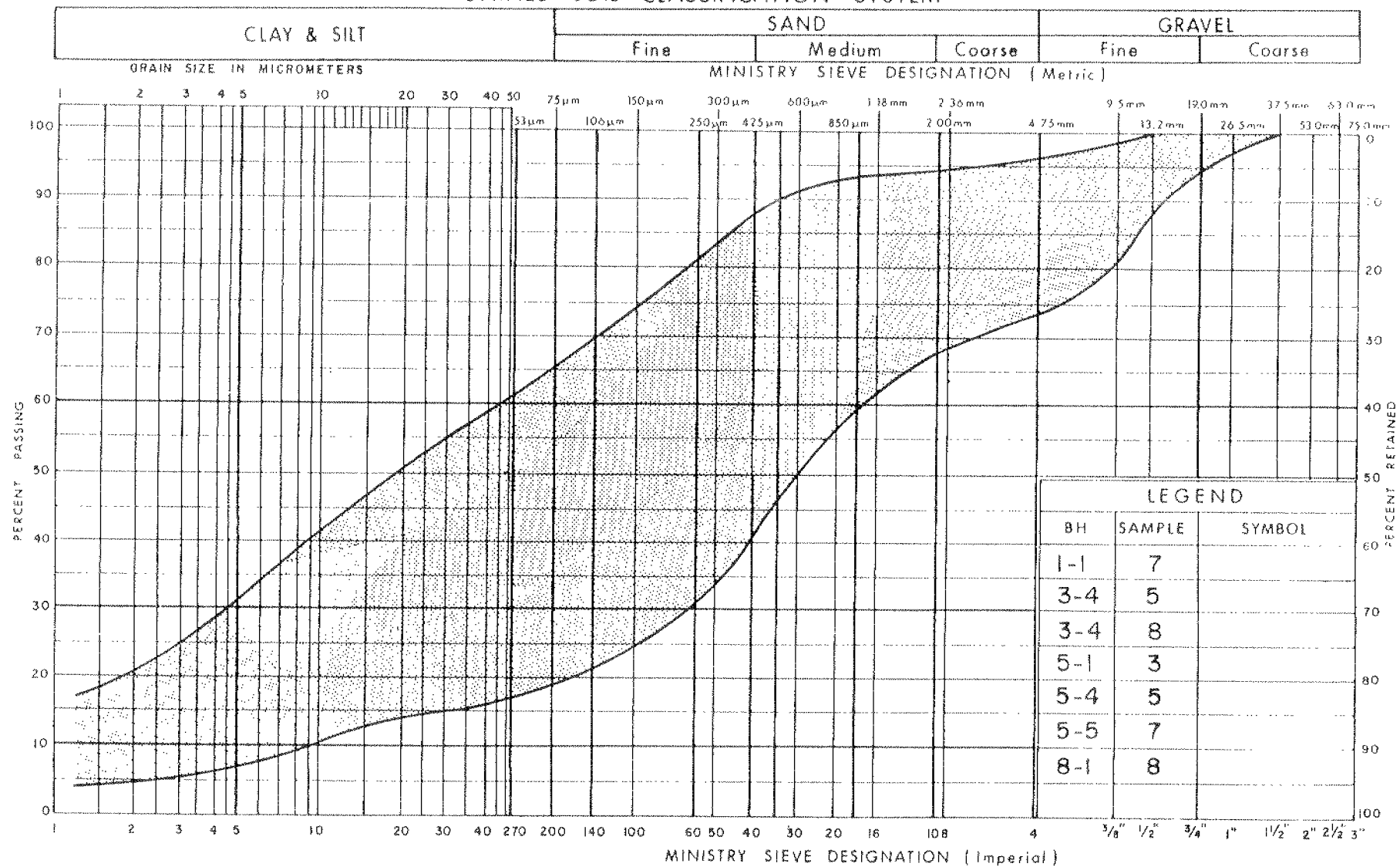
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILT AND SAND, SOME CLAY, TRACE GRAVEL

FIG No 5

W P 270-87-00

UNIFIED SOIL CLASSIFICATION SYSTEM



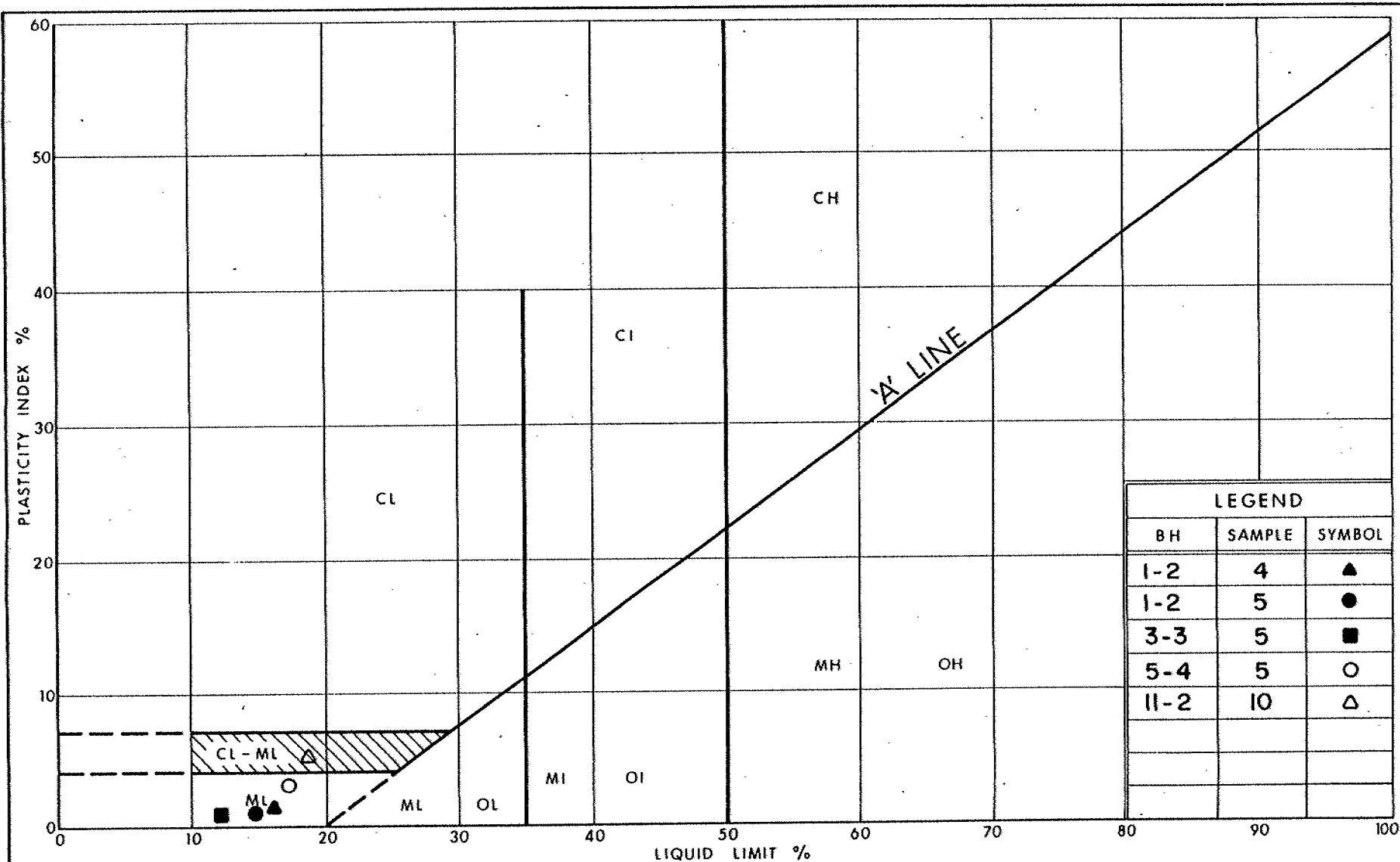
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Transportation

GRAIN SIZE DISTRIBUTION

GLACIAL TILL

FIG No 6

WP 270-87-00



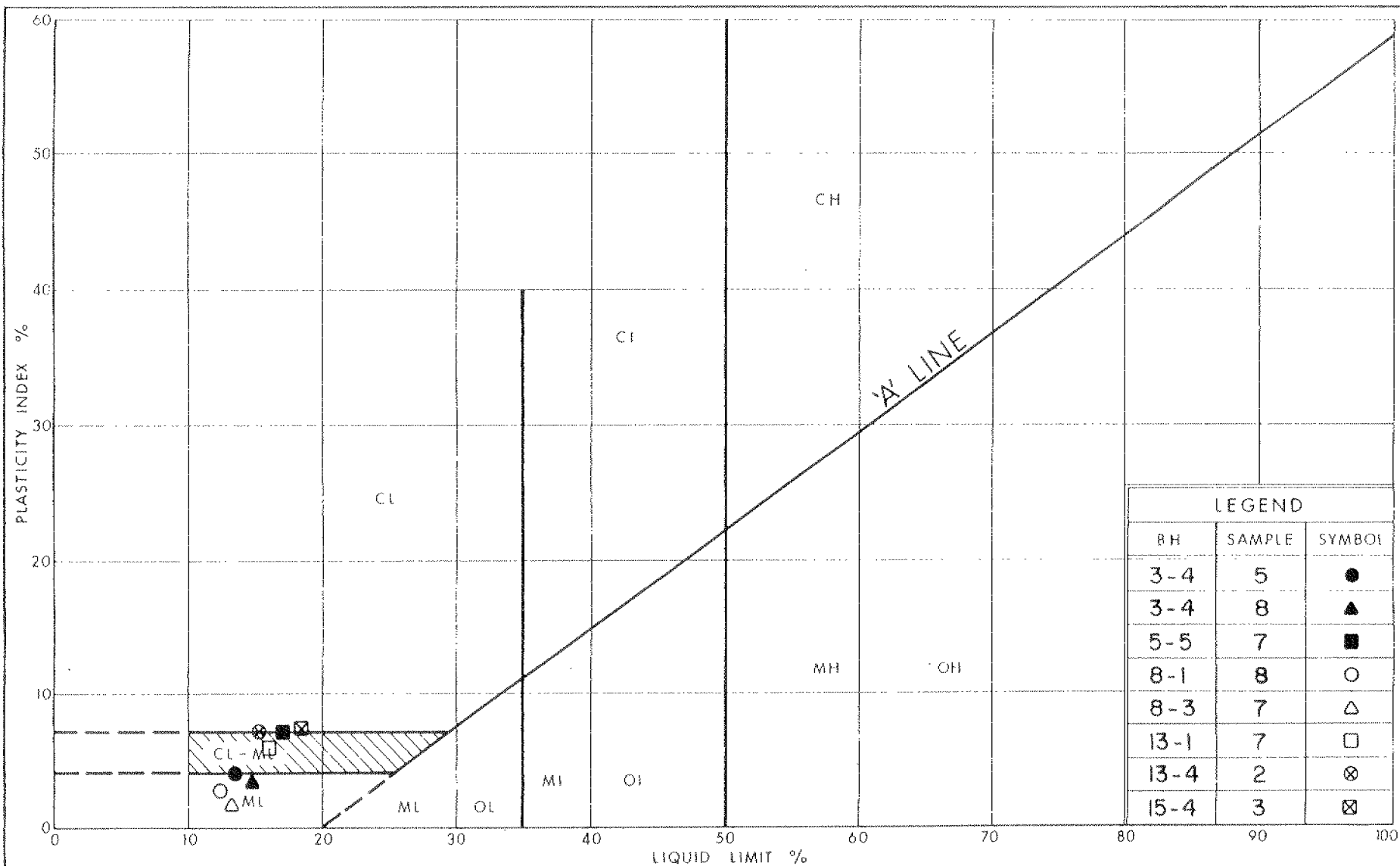
Ministry of
Transportation

Ontario

PLASTICITY CHART SILT AND SAND, SOME CLAY, TRACE GRAVEL (TILL)

FIG No 7

W P 270-87-00



Ministry of
Transportation

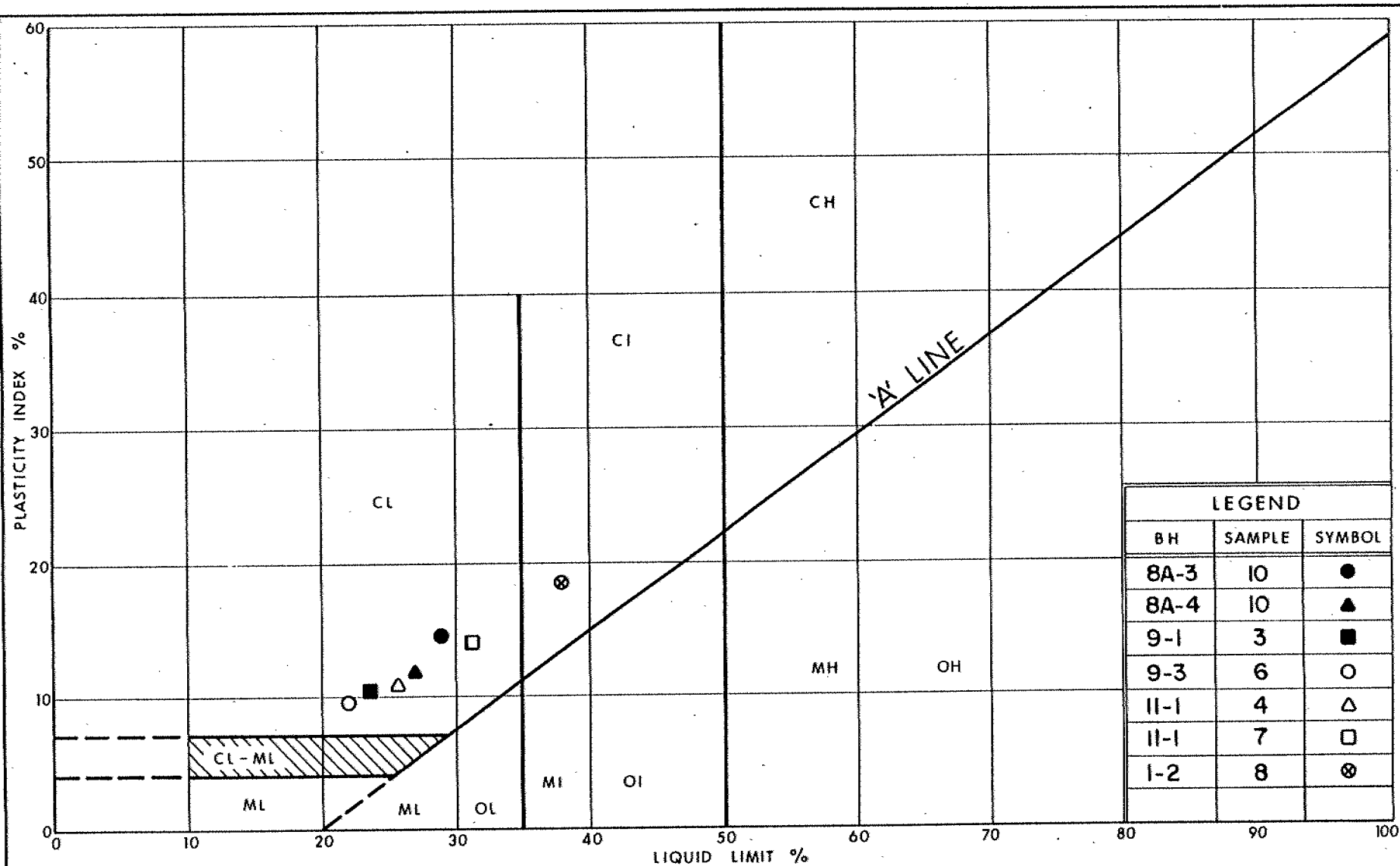
Ontario

PLASTICITY CHART

GLACIAL TILL, HETEROGENEOUS MIXTURE OF
SAND AND SILT, SOME CLAY, TRACE GRAVEL

FIG No 8

W P 270-87-00



Ministry of
Transportation

Ontario

PLASTICITY CHART CLAYEY SILT / SILTY CLAY

FIG No 9

WP 270-87-00

RECORD OF BOREHOLE No. 1-1

METRIC

W.P. 270/87-00 LOCATION Co-ords. 4,850,481 N; 332,576 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Conc Test COMPILED BY CN
DATUM Canadian DATE March 18, 1994 CHECKED BY BPW

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						
123.4	GROUND LEVEL												
0.0	15 cm Topsoil		1	SS	16								
	FILL: brown sandy silt mixed with gravel, brick fragments		2	SS	80								
121.9			3	SS	37								
1.5	FILL: sand, sandy silt, grey clay and gravel with scattered organic topsoil layers		4	SS	60								
			5	SS	37								
119.5			6	SS	68								
3.9	GLACIAL FILL: Het. mixture of sand and silt, some clay trace gravel, very dense brown/grey damp to moist non plastic		7	SS	94								
			8	SS	50/10	cm							
			9	SS	50/8	cm							
			10	SS	50/10	cm							
115.8			11	SS	30/8	cm							
7.6	End of Borehole												
	*Borehole dry on completion. Borehole moved due to obstruction at 0.5 m												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1-2

METRIC

W P 270/87-00 LOCATION Co-ords. 4,850,475 N; 332,741 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 21, 1994 CHECKED BY BPW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
123.3	GROUND LEVEL												
0.0	20 cm Topsoil		1	SS	10								
	FILL: mixed silty sand with brick fragments compact to dense		2	SS	42								
121.8						122.0							
1.5	SILT AND SAND: some clay, trace gravel, dense, brown, moist		3	SS	35								
			4	SS	38								5 45 38 12
120.3													
3.0	sandier with scattered organic stained seams, (possible alluvium)		5	SS	32	120.0							5 47 36 12
			6	SS	30								
118.6													
4.7	SILTY CLAY: very stiff to hard brown		7	SS	22	118.0							
117.7			8	SS	57								
5.6	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, very dense, dry to damp		9	SS	84/28 cm								- 4 42 54
			10	SS	47	116.0							
115.8													
7.5	Compact, wet												
115.2			11	SS	24								
8.1	End of Borehole *Borehole dry on completion												

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00

WALL I

IMPERIAL

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 62-F-18 LOCATION Co-ords. 15,913,625 N; 1,091,930 E.

ORIGINATED BY HD

W.P. 28-67-02 BORING DATE July 24, 1969

COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Washboring-NX & BX Casing; Cone

CHECKED BY J/C

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	W _P	W	W _L		
390.8	Ground Level															
389.3	Topsoil	X				390										
1.5			1	SS	58											
	Mottled Brown		2	SS	85											
381.8			3	SS	45	380										
9.0	Glacial Till		4	SS	24											
	Het. mix. of silt, sand & occ. gravel		5	SS	82											
	Compact - Very dense		6	SS	100/3"	370										
	with zones of cohesive mix. of clayey silt, sand and occasional gravel		7	SS	100/3"											
	Very stiff - Hard		8	SS	100/3"	360										
350.0	Grey															
30.8	End of Borehole															
						350										

WALL 2

WP 270-87-00		RECORD OF BOREHOLE No 26		1 OF 1		METRIC							
W.P. 267-87-01/02		LOCATION Co-ords. N 4 850 479.7 ; E 332 853.0		ORIGINATED BY CC									
DIST 6 HWY 401		BOREHOLE TYPE S.S. Auger, Cone test		COMPILED BY CC									
DATUM Geodetic		DATE 89 11 29		CHECKED BY DD									
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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
114.5	Top of Median												
0.0	Silty Sand, Some Gravel Compact to Dense (Fill)		1	SS	31								
113.3			2	SS	118								
1.2			3	SS	100	/13cm							
			4	SS	170								
			5	SS	152								
	Hel. Mixture of Clayey Silt to Silt with Sand, Trace Gravel occ. Cobbles and Boulders occ. Silty Sand Zones Hard (Glacial Till)		6	SS	175	/26cm							
			7	SS	105								
			8	SS	98								
			9	SS	126								
105.1			10	SS	131								
9.4	End of Borehole												

SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE

• QUICK TRIAXIAL * LAB VANE

20 40 60 80 100

WATER CONTENT (%)

10 20 30

* Water Level Not Established

WALL 2

164

WP 270-87-00		RECORD OF BOREHOLE No 6		1 OF 1		METRIC						
W.P. 257-87-01/02		LOCATION Co-ords. N 4 850 496.8 ; E 332 938.6		ORIGINATED BY SMH								
DIST 6 HWY 401		BOREHOLE TYPE SS Auger, Cone Test		COMPILED BY SMH								
DATUM Geodetic		DATE 89 09 06		CHECKED BY DD								
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	'N' VALUES					
119.5	Ground Surface											
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Firm to Stiff/Loose to Compact (Fill)		1	SS	56							
118.4			2	SS	51							
1.1	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel, occ. Cobbles and Boulders, occ. Silty Sand Zones. Hard. (Glacial Till)		3	SS	96							
			4	SS	74							
			5	SS	89							
	Silty Sand Zones		6	SS	112							
114.5												
5.0	End of Borehole											

89 09 13

WP 270-87-00

WALL 2

IMPERIAL

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-118 LOCATION Co-ords. 15,913,718 N; 1,092,451 E.
 W.P. 28-67-03 BORING DATE July 25, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone

ORIGINATED BY HISCOMPILED BY CHCHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %		
							20	40	60	80	100	O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					w_p — w — w_L 10 20 30		
376.1	Ground Level																		
374.1	Topsoil & Fill Material																		
2.0	Compact - Very Dense or V. Stiff - Hard Mottled Brown		1	SS	24	370										10 33 42 15 370.1			
368.1	Glacial Till		2	SS	115											7 39 47 2			
8.0	Het. mix. of silt, sand & occ. gravel.		3	SS	160/4"														
			4	SS	100/4"											1 40 49 10			
			5	SS	100/5"	360													
	Very dense with zones of cohesive mixture of clayey silt, sand & occ. gravel.		6	SS	100/5"														
			7	SS	165/3"	350										3 45 43 9			
345.8	Hard Grey		8	SS	162/4"														
30.3	End of hole					340													

RECORD OF BOREHOLE No 3-1

METRIC

W.P. 220/87-00 LOCATION Co-ords. 4,830,546 N; 333,111 E ORIGINATED BY CB
 DIST. 4 HWY. 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
 DATUM Meadeville DATE March 21, 1994 CHECKED BY HPW

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	
ELV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						SHEAR STRENGTH kPa □ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE
115.5	GROUND LEVEL																
0.0	FILL: mixed brown silty sand, gravel, some organics in top 20/cm, scattered topsoil layers, compact	1	SS	14	*	114.0											
		2	SS	-													
		3	SS	16													
112.9		4	SS	26													
3.6		5	SS	57/15			cm										
	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace to some gravel, brown/gray, damp, very dense	6	SS	60/8	cm	112.0											
		7	SS	60/10	cm												
		8	SS	60/3	cm	110.0											
108.0						108.0											
7.5	End of Borehole *Borehole dry on completion																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3-2

METRIC

W P 270/1-87-00 LOCATION Co-ords, 4,850,563 N; 333,159 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 24, 1994 CHECKED BY BPW

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	'N' VALUES		20	40	60	80	100					
114.8	GROUND LEVEL															
0.0	20 cm Topsoil		1	SS	11	*										
	FILL: brown, sand trace gravel															
113.9	0.9		2	SS	47											
	SAND: (Possibly Fill) brown silty sand, trace gravel, scattered silt seams, dense															
112.8			3	SS	44											
	2.0		4	SS	32											
	SAND: dense grey, silty fine, moist to wet															
			5	SS	41											
110.7																
	4.1		6	SS	60/13	cm										
	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace to some gravel, very dense															
			7	SS	60/10	cm										
108.0																
107.2			8	SS	50/10	cm										
	7.6															
	End of Borehole *Water level not established															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3-3

METRIC

W.P. 270/67-00 LOCATION Co-ords. 4,850,586 N; 333,204 E ORIGINATED BY CB
 DIST 8 HWY 401 BOREHOLE TYPE Solid Stem Augers and Conc Test COMPILED BY CB
 DATUM Geodetic DATE March 24, 1994 CHECKED BY BPW

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 (%)
FIELD DEPTH	DESCRIPTION	NUMBER	TYPE	N _v VALUES			20 40 60 80 100						
113.3	GROUND LEVEL												GR SA SI CL
0.0	60 cm Topsoil	1	SS	8									
	TILL: silty sand, trace gravel, scattered wood fragments, loose	2	SS	26									
		3	SS	18									
		4	SS	4									
110.5													
3.0	SAND AND SILT: some CLAY, trace GRAVEL, (TILL)- damp to wet, compact	5	SS	10	*								5 45 37 13
		6	SS	9									
		7	SS	7									
108.1													
5.4	clayey, firm to stiff	8	SS	8									
		9	SS	6									
106.9													
6.6	stiff to very stiff	10	SS	27									
		11	SS	14									
104.3													
9.2	End of Dynamic Cone * on completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3-4

METRIC

W P 270/87-00 LOCATION Co-ords. 4,850,613 N; 333,246 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 23, 1994 CHECKED BY BFW

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 kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)
112.4	GROUND LEVEL															
0.0	FILL: grey sand, trace gravel with organics		1	SS	5	*	112.0									
111.6			2	SS	32											
0.8	GLACIAL TILL: Ret. mixture of sand and silt, some clay, trace gravel, dense, damp to moist		3	SS	43											
			4	SS	49		110.0									
			5	SS	39											
			6	SS	32		108.0									
106.4			7	SS	60/10	cm	106.0									
6.0	very dense, damp															
104.8			8	SS	50/8	cm										
7.6	End of Borehole *Borehole dry on completion															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3-5

METRIC

W.P. 270/87-00 LOCATION Co-ords. 4,850,641 N; 333,289 E ORIGINATED BY CB
 DIST 9 HWY. 201 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
 DATUM Canadian DATE Mark 23, 1994 CHECKED BY BPW

SOIL PROFILE		STRAT. PLOT	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		NUMBER	TYPE			20	40	60	80	100					
111.3	GROUND LEVEL															GR SA SI CL
0.0	FILL: dark, brown sand, with organics, dense		1	SS	37	*										
110.5	GLACIAL TILL: Hgt. mixture of sand and silt, some clay, trace to some clay, brown grey, moist to damp, dense		2	SS	51											
0.8			3	SS	74											
			4	SS	90											
			5	SS	82											
107.3			6	SS	55/13	cm										
4.0	very dense		7	SS	60/5	cm										
			8	SS	60/8	cm										
103.8			9	SS	50/3	cm										
7.5	End of Borehole															
	*Borehole dry on completion															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5. Numbers refer to
Sensitivity

20
15 S [%] STRAIN AT FAILURE
10

WP 270-87-00

WALL 3

IMPERIAL

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 59-F-48 LOCATION Co-ords. 15,913,796 N; 1,092,713 E. ORIGINATED BY HS
 W.P. 28-67-03 BORING DATE July 22, 1969 COMPILED BY CM
 DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone CHECKED BY Q/E

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION . RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					WATER CONTENT % w_p — w — w_L 10 20 30		
375.9	Ground Level																		
373.9	Topsoil	X																	
2.0	Dense - Very Dense or Hard		1	SS	37														
	Mottled Brown		2	SS	112	370													
	Glacial Till		3	SS	100.5"														
363.1	Het. mix. of silt, sand & occasional gravel		4	SS	100.5"														
12.5	Very dense with zones of cohesive mixture of clayey silt sand & occ. gravel		5	SS	100.2"	360													
	Hard		6	SS	136.4"														
	Gray		7	SS	100.5"	350													
345.7	End of Borehole		8	SS	100.5"	340													
30.2																			

171

WP 270-87-00

WALL 3

IMPERIAL

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-48 LOCATION Co-ords. 15,913,814 N; E 1,092,833


ORIGINATED BY VK

W.P. 28-67-03 BORING DATE June 10, 1969

COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone

CHECKED BY *AK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED		+ FIELD VANE			● QUICK TRIAXIAL		x LAB. VANE		
375.2	Ground Level															
373.2	Topsoil	2														
2.0	(mottled brown)		1	SS	57											
	Glacial Till		2	SS	53	370										
	Het. mix. of silt, sand &		3	SS	317 10"											
	occ. gravel		4	SS	100 6"											
	Very dense		5	SS	100 4"	360										
357.2	With		6	SS	100 3"											
1.0	zones of cohesive															
	mixture of clayey															
	silt; sand & occ. grav															
350.0	Hard Grey		7	SS	106 3"	350										
25.2	End of Borehole															

RECORD OF BOREHOLE No 4-1

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4,850,577 N; 333,151 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 25, 1994 CHECKED BY BPW

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					
114.3	GROUND LEVEL													
0.0	10 cm Topsoil		1	SS	35	*	114.0							
113.4	FILL: sand, sandy silt, topsoil seams, compact		2	SS	20									
0.9	CLAYEY SILT: very stiff brown, trace gravel		3	SS	24									
112.7	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace to some gravel, very dense, dry to damp		4	SS	50/15	cm	112.0							
			5	SS	60/5	cm								
			6	SS	50/3	cm	110.0							
			7	SS	60/8	cm	108.0							
106.8			8	SS	50/No	penetration								
7.5	End of Borehole *Water level not established													

OFFICE REPORT ON SOIL EXPLORATION

WALL 4

WP 270-87-00

RECORD OF BOREHOLE No 20

1 OF 1

METRIC

W.P. 257-87-03/04 LOCATION Co-ords. N 4 850 560.8 ; E 333 088.4 ORIGINATED BY SMH
DIST 6 HWY 401 BOREHOLE TYPE SS Auger, Cone Test COMPILED BY SMH
DATUM Geodetic DATE 89 09 12-13 CHECKED BY DD

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 7 kN/m ³	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					
109.2	Ground Surface											
0.0	Silty Sand, Some Gravel Compact (Fill)											
109.1			1	SS	43							31 58 9 2
1.1			2	SS	100	/15cm						
	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel occ. Cobbles and Boulders occ. Silty Sand Zones Hard (Glacial Till)		3	SS	160	/26cm						
			4	SS	150	/23cm						
			5	SS	100	/15cm						
104.5			6	SS	100	/13cm						
4.7	End of Borehole											

* 89 09 13

RECORD OF BOREHOLE No 5-1

METRIC

W P 270/87-00 LOCATION Co-ords. 4,850,558 N; 333,023 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 30-31, 1994 CHECKED BY BPW

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					
115.1	GROUND LEVEL															
0.0	15 cm Topsoil		1	SS	4											
114.2	FILL: sand, topsoil, some straw, loose to compact															
0.9	GLACIAL TILL: Het. mixture of silty sand trace to some clay, trace to some gravel, dense to very dense, some sand seams, damp		2	SS	18	114.0										
			3	SS	47											
			4	SS	65											
			5	SS	81	112.0										
			6	SS	92/25	110.0										
			7	SS	51/10											
108.1																
7.0	silt, trace sand, trace					108.0										
107.5	gravel, damp		8	SS	50/5											
7.6	End of Borehole *On completion															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5-2

METRIC

W.F. 270/88-8700 LOCATION Co-ords. 4,850,585 N; 333,075 E ORIGINATED BY CB
DIST. 7 HWY. 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Meadeville DATE April 4, 1994 CHECKED BY BPW

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	VALUES	20	40	60	80	100					
111.1	GROUND LEVEL														
0.0	75 cm Topsoil		1	SS	43										
	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace to some gravel, very dense		2	SS	50/10										
			3	SS	50/8										
			4	SS	62/5										
			5	SS	50/8										
106.3	4.6 End of Borehole *Borehole dry on completion		6	SS	65/8										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5-3

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4.850.614 N: 33.109 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE April 4, 1994 CHECKED BY BPW

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					
111.6	GROUND LEVEL																
0.0	20 cm Topsoil		1	SS	12												
	CLAYEY SILT: layered, trace sand, hard, dry		2	SS	50/8	cm											
110.4																	
1.2	SAND: very dense, silty, fine, wet		3	SS	50/10	cm	110.0										
109.5																	
2.1	GLACIAL TILL: Het. mixture of silty sand, some gravel, trace to some clay, dry to damp, very dense		4	SS	50/10	cm											
			5	SS	60/15	cm											
							108.0										
107.0			6	SS	53/8	cm											
4.6	End of Borehole *On completion																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5-4

METRIC

W P 7/0/8700 LOCATION Co-ords. 4,850,633 N; 333,162 E ORIGINATED BY CB
DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Meadville DATE April 4, 1994 CHECKED BY BFW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
111.5	GROUND LEVEL												
0.0	11.5 cm Asphalt												
	FILL: sand and gravel												
110.6													
0.9	CLAY AND SILT: some SAND, trace gravel (TILL) - stiff to hard, low to medium plasticity, moist to wet		1	SS	10								
			2	SS	40								
			3	SS	16								
			4	SS	4								
107.0													
4.5	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, compact		5	SS	11								9 35 41 15
105.5													
6.0	very dense		6	SS	60/10	cm							
103.9													
			7	SS	50/10	cm							
7.6	End of Borehole												
	*On completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5-5

METRIC

W P 270/87-00 LOCATION Co-ords. 4,850,541 N; 333,005 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 31, 1994 CHECKED BY BPW

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	'N' VALUES			20	40	60	80	100					
115.9	GROUND LEVEL																
0.0	20 cm sand and gravel FILL: sandy silt, trace gravel, zones of clayey silt, moist to wet, compact to dense.		1	SS	57	*											
			2	SS	32												
			3	SS	14		114.0										
			4	SS	12												
112.9																	
3.0	SILT: layered, moist, organic lenses		5	SS	20												
112.3																	
3.6	CLAYEY SILT: trace sand, (TILL) very stiff						112.0										
111.4																	
4.5	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, very dense, damp to moist		6	SS	53/15	cm											
			7	SS	63/15	cm	110.0						0				5 30 47 18
108.4																	
			8	SS	50/3	cm											
7.5	End of Borehole *Borehole dry on completion																

OFFICE REPORT ON SOIL EXPLORATION

*³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

WP 270-87-00			RECORD OF BOREHOLE No 8			1 OF 1			METRIC								
W.P. 287-87-03/04			LOCATION Co-ords. N 4 850 532.7 ; E 332 994.8			ORIGINATED BY SMH											
DIST 6 HWY 401			BOREHOLE TYPE SS Auger, Cone Test			COMPILED BY SMH											
DATUM Geodetic			DATE 89 09 08			CHECKED BY DD											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	7	GR SA SI CL			
115.1	Ground Surface																
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Hard to Firm (Fill)		1	SS	49		115	120/2.3cm						10 43 37 10			
			2	SS	18		114							3 43 42 10			
			3	SS	9		113							22 34 34 10			
113.1	Trace Organics Silty Sand Zones Stiff		4	SS	11		112							6 41 39 10			
3.0			5	SS	17		111										
			6	SS	34		110										
			7	SS	117		109										
	Hel. Mixture of Clayey Silt to Silt with Sand. Trace Gravel, occ. Cobbles and Boulders, occ. Silty Sand Zones. Stiff to Hard (Glacial Till)		8	SS	100	/10cm	108										
			9	SS	100	/13cm	107										
106.8			10	SS	100	/15cm											
9.3	End of Borehole																
	*Hole caved in ~ probable water level																

WP 270-87-00

WALL 7

IMPERIAL

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.1

FOUNDATION SECTION

JOB 69-F-49

LOCATION Co-ords. 15,914,558 N; 1,093,705 E.

ORIGINATED BY HD

W.P. 28-67-04

BORING DATE July 14, 1969

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring-WX & BX Casings; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
							20	40	60	80	100	○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE				
378.8	Ground Level																
0.0	Fill Material		1	SS	33												
	Sandy silt, trace clay and gravel		2	SS	31											6 30 55 9	
	Compact - Dense		3	SS	19												
370.0			4	SS	31	370										369.4	
8.8	Glacial Till		5	SS	169											4 33 51 12	
	Not mix. clayey silt, sand and occ. gravel		6	SS	100.4"												
			7	SS	133.4"	360										7 46 39 8	
	Hard		8	SS	165	8"											
			9	SS	115	350										20 48 24 8	
342.8	(342.8)		10	SS	160												
36.0	End of Borehole				340												

RECORD OF BOREHOLE No 8-1

METRIC

W.P. 070/000-87-00 LOCATION Co-ords. 4,850,914 N; 333,492 E ORIGINATED BY CR
DIST P. HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 16, 1994 CHECKED BY BPW

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. PLT	NUMBER	TYPE			20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
111.0	GROUND LEVEL												
0.0	-5 cm Topsoil		1	SS									
	SANDY SILT: trace clay, wet, dense, grey, trace organics		2	SS	40								
			3	SS	39								
			4	SS	39								
			5	SS	36								
108.2	GLACIAL TILL: Wet mixture of silty sand, some clay, some gravel, dense to very dense		6	SS	53/15 cm								
2.7			7	SS	62								
			8	SS	103								
			9	SS	50/10 cm								
			10	SS	54/15 cm								
			11	SS	97								
102.9	8.1 End of Borehole *On completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8-2

METRIC

W P 270/87-00 LOCATION Co-ords 4,850,946 N; 333,530 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 16, 1994 CHECKED BY BPW

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 _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								
114.7	GROUND LEVEL										
0.0	30 cm Topsoil SAND: silty, fine, moist to wet, dense to very dense		1 SS 1	*	114.0						
			2 SS 30								
			3 SS 52								
			4 SS 50/13	cm	112.0						
111.7	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, very dense		5 SS 50/10	cm							
			6 SS 63/15	cm							
			7 SS 64		110.0						
			8 SS 57/15	cm							
			9 SS 59/8	cm							
			10 SS 60/10	cm	108.0						
107.0			11 SS 74/15	cm							
7.7	End of Borehole *Borehole dry on completion										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8-3

METRIC

W.P. 770/88-87-00 LOCATION CO-ords. 4,850,973 N; 333,672 E ORIGINATED BY CB
DIST 8 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 17, 1994 CHECKED BY BPW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PILOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION [%]			
FIELD DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			20	40						60	80	100
							SHEAR STRENGTH kPa							WATER CONTENT (%)		
						○ UNCONFINED + FIELD VANE										
						● QUICK TRIAXIAL x LAB VANE										
111.2	GROUND LEVEL															
0.0	7 cm Topsoil		1	SS	15											
110.5	FILL: gravelly sand, compact															
0.7	SAND: very dense brown, silty, moist		2	SS	56											
110.1	GLACIAL TILL: Het. mixture of sand and silt, trace clay, trace to some gravel, dense dry to moist		3	SS	74											
			4	SS	82											
			5	SS	84											
107.2			6	SS	36											
1.0	wet with wet sand scams, compact to dense		7	SS	32											
			8	SS	27											
			9	SS	25											
			10	SS	30											
103.1			11	SS	35											
8.1	End of Borehole															
	*On completion															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8A-1

METRIC

W P 270-87-00 LOCATION Co-ords. 4,851,103 N; 333,710 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE Marsh 17, 1994 CHECKED BY BPW

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					
107.9	GROUND LEVEL												
0.0	5 cm Topsoil												
107.5	FILL: sand and gravel		1	SS	17								
0.4	GLACIAL TILL: Het. mixture of sand and silt, trace to some clay, trace to some gravel, dense to very dense		2	SS	34								
			3	SS	29								
			4	SS	46								
			5	SS	57/15	cm							
			6	SS	50/13	cm							
			7	SS	50								
			8	SS	53/15	cm							
			9	SS	83								
			10	SS	80								
100.2			11	SS	52/15	cm							
7.7	End of Borehole *Water level not established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8A-2

METRIC

W F 270/1-87-00 LOCATION Co-ords. 4,851,138 N; 333,746 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CNL
DATUM Canadian DATE March 22, 1994 CHECKED BY BPW

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			VALUES	20 40 60 80 100					
107.1	GROUND LEVEL												
0.0	(20 cm Topsoil)		1	SS	9								GR SA SI CL
	FILL: mixed sand and gravel, trace organics		2	SS	4								
105.6						106.0							
1.5	GLACIAL TILL: Het. mixture of sand and silt, trace clay, trace gravel, compact to very dense, occasional wet sand seams		3	SS	18								9 52 32 7
			4	SS	49								
			5	SS	61/15	cm							
			6	SS	50/10	cm							
			7	SS	63								9 44 40 7
			8	SS	72								
			9	SS	50/13	cm							
			10	SS	54/15	cm							
99.5			11	SS	50/5	cm	100.0						
7.6	End of Borehole												
	*Water level not established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8A-3

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4,851,176 N: 333,780 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 22, 1994 CHECKED BY BPW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
107.9	GROUND LEVEL												
0.0	60 cm Topsoil		1	SS	17								
	SANDY SILT: trace clay, dense, dry		2	SS	49								
			3	SS	42								
105.8			4	SS	87								
2.1	wet		5	SS	28								
			6	SS	31								
			7	SS	94								
			8	SS	40								
101.6			9	SS	43								
6.3	CLAYEY SILT: grey, layered, some sand seams, stiff to very stiff		10	SS	8								
			11	SS	10								
99.8													
8.1	End of Borehole *30 minutes after completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8A-4

METRIC

W.F. 270-67-00 LOCATION Co-ords. 4,852,209 N; 333,815 E ORIGINATED BY CB
 DIST. 5 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
 DATUM Geodetic DATE March 22, 1994 CHECKED BY BPW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
FIELD DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			70 40 60 80 100		W _p	W	W _L		
107.4	GROUND LEVEL												
0.0	30 cm Topsoil		1	SS	7								
	FILL: silty sand, trace organics		2	SS	3								
105.6	1.8 SANDY SILT: wet, dense		3	SS	9								
			4	SS	B2								
			5	SS	31								
			6	SS	32								
			7	SS	50								
			8	SS	88								
			9	SS	45								
100.6	6.8 CLAYEY SILT: still, layered, grey		10	SS	6								
99.3			11	SS	5								
8.1	End of Borehole *On completion												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9-1

METRIC

W P 270/87-00 LOCATION Co-ords. 4,851,692 N; 334,421 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 29, 1994 CHECKED BY BPW

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 9-2

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4,851,714 N; 334,445 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 22, 1994 CHECKED BY BPW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PILOT					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	VALUES		20	40	60	80	100					
107.0	GROUND LEVEL															
0.0	10 cm Topsoil		1	SS	15											
106.4	FILL: sand and gravel															
0.6	SAND: some silt, brown, damp, compact, brown/ grey		2	SS	15											
			3	SS	22											
104.3			4	SS	25											
2.7	SILT: some sand, clayey to some clay, dense		5	SS	181											
102.4																
4.8	GLACIAL TILL: Het. mixture of sand and silt, some to trace clay, trace gravel, very dense		6	SS	75/23 cm											
			7	SS	50/10 cm											
99.2			8	SS	50/13 cm											
7.8	End of Borehole *Borehole dry on completion															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9-3

METRIC

W P 270/88-8700 LOCATION Co-ords. 4,851,738 N; 334,482 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 29, 1994 CHECKED BY BPW

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	W _p	W		
106.5	GROUND LEVEL															
0.0	15 cm Topsoil		1	SS	4											
	SAND: brown silty fine sand, damp, dense		2	SS	42											
105.0																
1.5	grey, moist to wet		3	SS	58											
			4	SS	56/15	cm										
103.5																
3.0	SILT: compact grey sandy silt, trace clay, moist to wet		5	SS	26											
102.0																
4.5	CLAYEY SILT: stiff, grey layered		6	SS	11											
100.5																
6.0	CLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, damp, very dense		7	SS	62/15	cm										
98.7																
7.8	End of Borehole *On completion		8	SS	59/15	cm										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10-1

METRIC

W.P. 270/87-00 LOCATION Co-ords. 4,851,587 N; 334,404 E ORIGINATED BY CB
DIST 6 HWY 402 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Goodell DATE April 4, 1994 CHECKED BY BPW

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 (%)
FLYV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE			'N' VALUES	20 40 60 80 100					
95.8	GROUND LEVEL						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					GR SA SI CL
0.0	FILL: mixed brown sand and gravel, trace organics, damp, compact		1 SS 15									
94.6			2 SS 30									
1.2	GLACIAL TILL: Het. mixture of sand and silt, trace to some clay, trace to some gravel, very dense, occasional sand layers		3 SS 58/15	cm	94.0							
			4 SS 65/13	cm								
			5 SS 50/10	cm	92.0							
			6 SS 50/13	cm								
			7 SS 63/15	cm	90.0							
88.3			8 SS 50/No	penetration								
7.5	End of borehole *Borehole dry on completion											

OFFICE REPORT ON SOIL EXPLORATION

+3, x5. Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-2

METRIC

W P 270/87-00 LOCATION Co-Ords. 4,851,586 N; 334,456 E ORIGINATED BY CB
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
 DATUM Geodetic DATE March 25, 1994 CHECKED BY BPW

OFFICE REPORT ON SOIL EXPLORATION

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					
106.7	GROUND LEVEL															
0.0	17 cm Topsoil		1	SS	48											
106.1	FILL: sand and gravel															
0.6	SAND: compact brown silty fine, damp		2	SS	19											
105.2																
1.5	very dense, gravelly		3	SS	79											
104.6																
2.1	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace to some gravel, very dense		4	SS	60/5	cm										
			5	SS	60/13	cm										
			6	SS	60/8	cm										
			7	SS	76/15	cm										
99.2																
7.5	dense, fine sand		8	SS	70/15	cm										
7.7	End of Borehole *On completion															

RECORD OF BOREHOLE No 10-3

METRIC

W.P. 270/██-87-00 LOCATION Co-ords. 4,851,613 N; 344,484 E ORIGINATED BY CB
DIST 0 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Woodroffe DATE March 28, 1994 CHECKED BY BPW

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	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED * FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
106.1	GROUND LEVEL													GR SA SI CL
106.0	25 cm Topsoil		1	SS	14									
	SAND: compact, brown, silty, fine, damp		2	SS	12									
104.5														
104.0	1.6 GLACIAL TILL: Het. mixture of silty sand, some gravel, trace to some clay, compact to very dense, damp with occasional wet zones		3	SS	13									
			4	SS	93									17 65 13 5
			5	SS	50/10	cm								
			6	SS	65/13	cm								
			7	SS	66/13	cm								
98.5			8	SS	60/10	cm								
7.6	End of Borehole													
	*On completion													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11-1

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4,851,663 N; 334,539 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE Marsh 28, 1994 CHECKED BY BPW

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 _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								
105.4	GROUND LEVEL										
0.0	60 cm Topsoil		1	SS	20						
	SAND: compact brown, silty, fine, damp		2	SS	25						
103.6			3	SS	38						
1.8	CLAYEY SILT: firm to very stiff, brown, layered, some sand seams		4	SS	23						
			5	SS	17						
			6	SS	14						
			7	SS	5						
			8	SS	13						
99.1			9	SS	8						
6.3	GLACIAL TILL: Het. mixture of sand silt, some clay, trace gravel, very dense		10	SS	50/13	cm					
97.8			11	SS	50/10	cm					
7.6	End of Borehole *Borehole dry on completion										

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11-2

METRIC

W.P. 270/87-00 LOCATION Co-ords. 4.851,694 N; 334,574 E ORIGINATED BY CB
DIST 5 HWY 40 BOREHOLE TYPE Solid Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 28, 1994 CHECKED BY BPW

SOIL PROFILE		STRAT. PLT	SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PILOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
105.0	GROUND LEVEL															
0.0	30 cm Topsoil		1	SS	17											
	SILT: some clay, some sand, dense, damp to moist		2	SS	30											
			3	SS	56											
			4	SS	31											
102.2																
2.0	CLAYEY SILT: firm to stiff, prev. layered, occasional wet sand and silt layers		5	SS	10											
			6	SS	14											
			7	SS	4											
			8	SS	6											
98.6			9	SS	6											
6.6	SILT AND SAND: some clay, trace gravel (TILL) firm to stiff, damp to wet		10	SS	4											
			11	SS	15											
90.6																
8.6	End of Dynamic Cone															
	*Borehole drv on completion															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13-1

METRIC

W P 270/87-00 LOCATION Co-ords. 4,851,935 N; 334,717 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 30, 1994 CHECKED BY BPW

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					
108.6	GROUND LEVEL																
0.0	FILL: brown to dark brown mixed silt, sand, gravel and clay with scattered organics, very loose to loose		1	SS	13		108.0										
			2	SS	7												
			3	SS	2												
			4	SS	5		106.0										
	30 cm Topsoil ----- organic stained ----- gravel and silt		5	SS	5												
104.4			6	SS	9												
4.2	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, very dense, damp to moist		7	SS	50/10	cm	104.0										5 40 38 15
			8	SS	50/10	cm											
							102.0										
100.5			9	SS	92												
8.1	End of Borehole *On completion																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13-3

METRIC

W.P. 270/87-00 LOCATION Co-ords. 4,852,002 N; 334,787 E ORIGINATED BY CH
DIST. 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM GGDnetic DATE March 30, 1994 CHECKED BY KPW

SOIL PROFILE		SAMPLES		GROUND WATER	ELEVATION	DYNAMIC CONE PENETRATION		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	CONDIT-ONS	SCALE	RESISTANCE PLOT	W _p	W	W _L	Y	
102.2	GROUND LEVEL						20 40 60 80 100					GR SA SI CL
0.0	20 cm Topsoil		1	SS	14							
	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel, dense to very dense, damp to moist, brown		2	SS	44							
			3	SS	50/10 cm							
			4	SS	51/10 cm							
			5	SS	64/15 cm							
97.6			6	SS	50/10 cm							
4.6	End of Borehole *Borehole dry on completion											

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵ Numbers refer to Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-4

METRIC

W P 270/88-87-00 LOCATION Co-ords. 4,852,230 N; 334,818 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY CN
DATUM Geodetic DATE March 30, 1994 CHECKED BY BPW

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)					
100.1	GROUND LEVEL																
0.0	40 cm Topsoil		1	SS	3	*	100.0										
	GLACIAL TILL: Het- mixture of sand and silt, some clay, trace gravel, dense to very dense, brown to grey, damp to moist		2	SS	53											7 38 37 18	
			3	SS	61/15	cm											
			4	SS	50/10	cm	98.0										
			5	SS	50/8	cm											
			6	SS	50/10	cm	96.0										
			7	SS	55/13	cm	94.0										
92.4	sand seams		8	SS	51/10	cm											
7.7	End of Borehole *Borehole dry on completion																

OFFICE REPORT ON SOIL EXPLORATION

WP 270-B1-00

RECORD OF BOREHOLE No 2

W P 137-78-02 LOCATION N 4 852 849.5 E 335 758.0 ORIGINATED BY A.C.
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger Cone Test COMPILED BY R.B.
DATUM Geodetic DATE 80-08-14 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	VALUES			20 40 60 80 100						
104.5	Ground Level													
104.0	Top Soil													
	Brown		1	SS	2		104							
	Soft		2	SS	6									
	Silty Clay		3	SS	55		102							
	of		4	SS	23									
	Low Plasticity		5	SS	16		100							4 35 41 20
	with sand		6	SS	20									
	Trace of													
	gravel													
	(Glacial Till)													
	Firm to Stiff													
	with gravel		7	SS	100/30 cm.		98							32 30 23 15
	Hard													
95.0	End of Borehole		8	SS	100/18 cm.		96							
9.5	Water level not established						94							

WP 270-87-00

RECORD OF BOREHOLE No 104

W P 137-78-02 LOCATION Co-ords N 4 852 869 E 335 774 ORIGINATED BY Z. M.
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY Z. M.
DATUM Geodetic DATE 81 06 25 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
111.9	Pavement Shoulder																GR SA SI CL
0.0	Fill		1	SS	10	*											6 32 49 13
	Brown silty clay of low plasticity and sand trace of gravel		2	SS	14		110										
			3	SS	23												
			4	SS	11		108										
			5	SS	12												
	Stiff to very stiff		6	SS	26												
			7	SS	41		106										
105.5			8	SS	16												
6.4	Silty clay of low plasticity with sand trace of gravel		9	SS	44		104										6 30 48 16
	(Till) Hard																
102.1			10	SS	106		102										
9.8	End of Borehole Refusal to augering possible boulder *Water level not established																

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

5 (% STRAIN AT FAILURE

WP 270-87-00

RECORD OF BOREHOLE No 1

W P 137-78-02 LOCATION Co-ords N 4 852 972.5 E 325 782.0 ORIGINATED BY AC.
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.B.
DATUM Geodetic DATE 80-08-13 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
111.9	Ground Level													
0.0	Fill		1	SS	12									
	Brown silty clay of low Plasticity, Some sand, Trace of gravel, Firm to V. Stiff		2	SS	15		110							
			3	SS	17									
			4	SS	6									
			5	SS	6		108							
			6	SS	30									
105.2			7	SS	9		106							
6.7	Silty clay Low plasticity Some sand and gravel (Fill) Hard		8	SS	100/10 cm.		104							
102.7			9	SS	50/3 cm.									
9.2	End of Borehole						102							
	Note: Water level not established													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15-1

METRIC

W P 270/87-00 LOCATION Co-ords. 4,853,676 N; 336,718 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 14, 1994 CHECKED BY BPW

OFFICE REPORT ON SOIL EXPLORATION

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			20 40 60 80 100						
93.2	GROUND LEVEL												
0.0	80 cm Topsoil		1	SS	20								
	SILTY SAND: trace gravel, trace clay, compact to very dense, damp		2	SS	17								
			3	SS	65								
			4	SS	87/25	cm							8 58 27 7
90.2			5	SS	65								
3.0	GLACIAL TILL: Het. mixture of silty sand, some clay, trace gravel, dense to very dense, damp to moist		6	SS	84								7 50 33 10
			7	SS	74								
			8	SS	81/15	cm							
87.2			9	SS	91/23	cm							
6.0	wet silt layers		10	SS	-								
			11	SS	-								*Sampler bouncing on cobble
85.7													
7.5	End of Borehole *Water level not established												

RECORD OF BOREHOLE No 15-2										METRIC		
W F 270/88-87-00		LOCATION Co-ords. 4,853,699 N; 336,751 E		ORIGINATED BY CR								
DIST 0 HWY 401		BOREHOLE TYPE Hollow Stem Augers and Cone Test		COMPILED BY CN								
DATUM Geodetic		DATE March 14, 1994		CHECKED BY BJW								
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 (%)
DEPTH	DESCRIPTION	NUMBER	TYPE			N' VALUES	20					
92.0	GROUND LEVEL											
0.0	90 cm Topsoil	1	SS	21	*	92.0						
	FILL: clayey silt, trace gravel, topsoil layers	2	SS	13								
		3	SS	35								
89.7	20 cm Topsoil					90.0						
2.3	GLACIAL TILL: Het. mixture of silty sand, some gravel, trace clay, dense to very dense, damp to moist, occasional black shale fragments	4	SS	52								
		5	SS	92								
		6	SS	71/15	cm	88.0						
		7	SS	65/13	cm							
		8	SS	70/15	cm							
		9	SS	58/15	cm	86.0						
85.4	End of Borehole Auger refusal *Borehole dry on completion											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15-3

METRIC

W P 270/89-00 LOCATION Co-ords. 4,853,719 N; 336,790 E ORIGINATED BY CB
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY CN
DATUM Geodetic DATE March 14 - 15, 1994 CHECKED BY BPW

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 kPa					
88.9	GROUND LEVEL													
0.0	30 cm Topsoil		1	SS	10	*								
	FILL: clayey silt, trace gravel, topsoil zones, stiff		2	SS	16									
87.4														
1.5	GLACIAL TILL: Het. mixture of sand and silt, trace clay, trace gravel		3	SS	43									
86.8														
2.1	End of Borehole Auger refusal *Borehole dry on completion													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15-4

METRIC

W.P. 270/66-67-00 LOCATION Co-ords. 4,823,738 N; 336,819 E ORIGINATED BY CB
DIST 5 HWY 401 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY CW
DATUM Geodetic DATE March 15, 1994 CHECKED BY BPW

OFFICE REPORT ON SOIL EXPLORATION

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 kPo					
87.1	GROUND LEVEL						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	10 20 30					GR SA SI CL
86.0	60 cm Topsoil		1	SS	26								Ground frozen
85.8	FILL: clayey silt -- some gravel, topsoil very stiff		2	SS	25								
84.0	GLACIAL TILL: Med. mixture of sand, silt and gravel, some clay, dense to very dense, damp to moist		3	SS	36								25 37 26 12
			4	SS	50/8	cm							
			5	SS	60/13	cm							
			6	SS	51								
			7	SS	32								
			8	SS	33								
81.1			9	SS	40								
80.0	6.0 wet		10	SS	-			100/25 cm					Split spoon bouncing on probable cobble
79.9													
78.0	End of Borehole Auger refusal *Water level not established												

*3, *5: Numbers refer to
Sensitivity

20
10-50 (%) STRAIN AT FAILURE
10

WALL 17

WP 270-87-00

RECORD OF BOREHOLE No 22

1 OF 1

METRIC

W.P. 267-87-01/02 LOCATION Co-ords. N 4 850 508.1 ; E 332 838.0 ORIGINATED BY SMH
DIST 5 HWY 401 BOREHOLE TYPE SS Auger, COMPILED BY SMH
DATUM Geodetic DATE 89 09 13 CHECKED BY DD

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			20	40	60	80	100					
118.5	Ground Surface																
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Firm to Stiff/Loose to Compact (Fill)		1	SS	30		118										
			2	SS	20		117										4 43 43 10
	Silty Sand		3	SS	23		116										24 40 31 5
115.6			4	SS	100	/15cm	115										
2.9	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel occ. Cobbles and Boulders occ. Silty Sand Zones Hard (Glacial Till)		5	SS	100	/10cm	114										
113.8																	
4.7	End of Borehole * Water Level Not Established																

WP 270-87-00		RECORD OF BOREHOLE No 7		1 OF 1		METRIC										
W.P. 257-87-01/02		LOCATION Co-ords. N 4 850 506.1 ; E 332 850.9		ORIGINATED BY SMH												
DIST 5 HWY 401		BOREHOLE TYPE SS Auger, Cone Test		COMPILED BY SMH												
DATUM Geodetic		DATE 89 09 09		CHECKED BY DD												
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 7 kN/m ³	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		
115.1	Ground Surface															
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Firm to Stiff/Loose to Compact (Fill)															
115.2																
0.9			1	SS	127											
			2	SS	100	/15cm										
			3	SS	100	/15cm										
			4	SS	110	/15cm										
			5	SS	128	/23cm										
			6	SS	100	/15cm										
			7	SS	93											
			8	SS	100	/10cm										
			9	SS	100	/15cm										
			10	SS	177	/23cm										
			11	SS	183	/26cm										
105.2																
10.9	End of Borehole															
<p>89 09 28</p> <p>* GROUND WATER CONDITIONS</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>PIEZO. NO.</th> <th>GROUND WATER ELEVATION (Metres)</th> </tr> <tr> <td>1</td> <td>114.2</td> </tr> </table>													PIEZO. NO.	GROUND WATER ELEVATION (Metres)	1	114.2
PIEZO. NO.	GROUND WATER ELEVATION (Metres)															
1	114.2															

WP 270-87-00			RECORD OF BOREHOLE No 18-1				METRIC										
W P 270/87-00			LOCATION Co-ords. 4,850,520,N; 332,959 E				ORIGINATED BY CB										
DIST 6 HWY 401			BOREHOLE TYPE Solid Stem Augers				COMPILED BY CN										
DATUM Geodetic			DATE March 13, 1994				CHECKED BY BPW										
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					
118.0	GROUND LEVEL																
0.0	FILL: sandy silt, trace gravel, occasional clayey zones, occasional topsoil layers, compact, damp to moist		1	SS	17												
			2	SS	35												
			3	SS	23												
			4	SS	36												
			5	SS	75												
113.8																	
4.2	SANDY SILT: trace clay, wet, very dense		6	SS	91/25	cm											- 40 57 3
112.6																	
5.4	GLACIAL TILL: Het. mixture of sand and silt, some clay, trace gravel		7	SS	50/10	cm											
111.9																	
6.1	End of Borehole *Water level not established																

OFFICE REPORT ON SOIL EXPLORATION

WP 270-87-00

RECORD OF BOREHOLE No 5

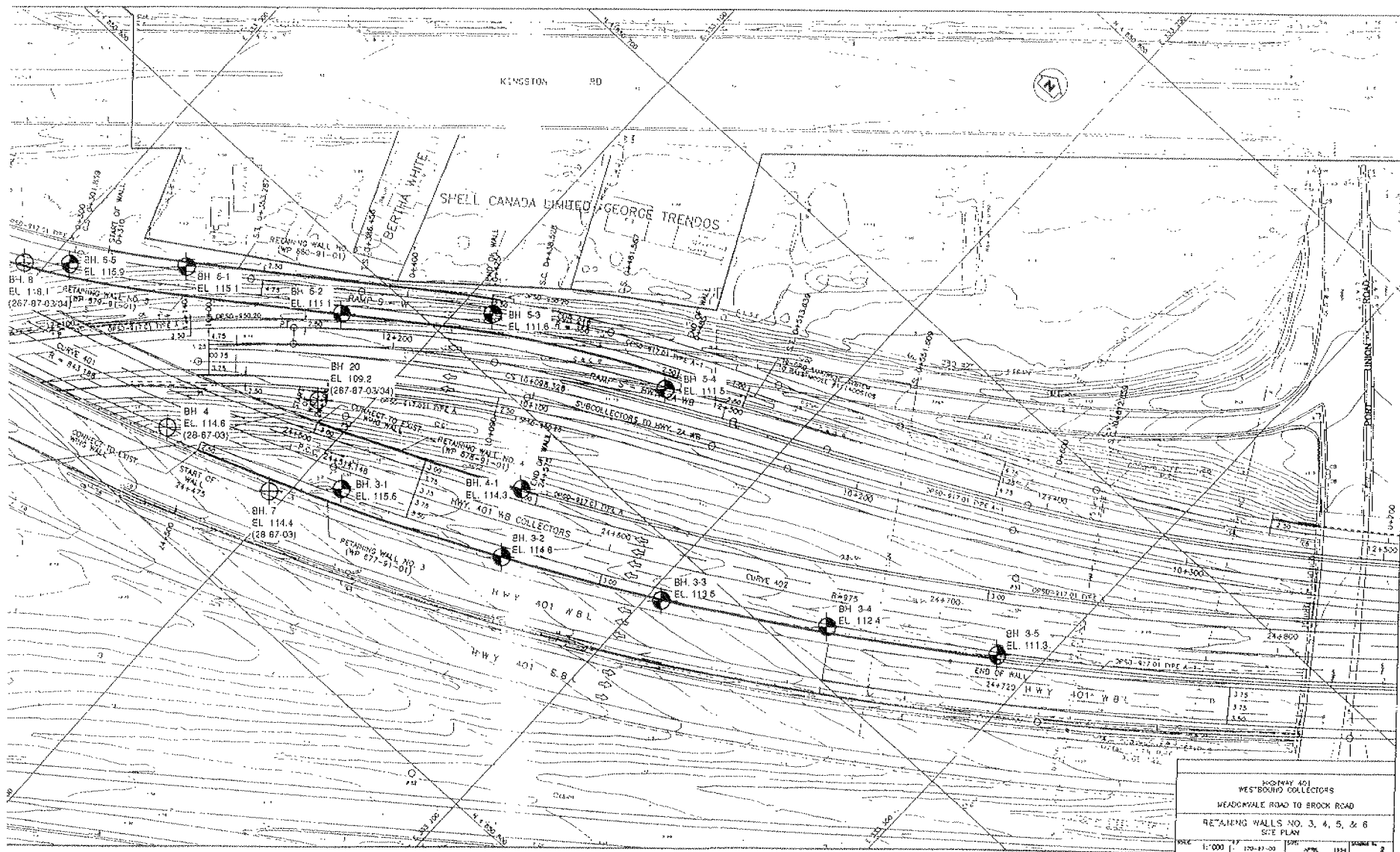
1 OF 1

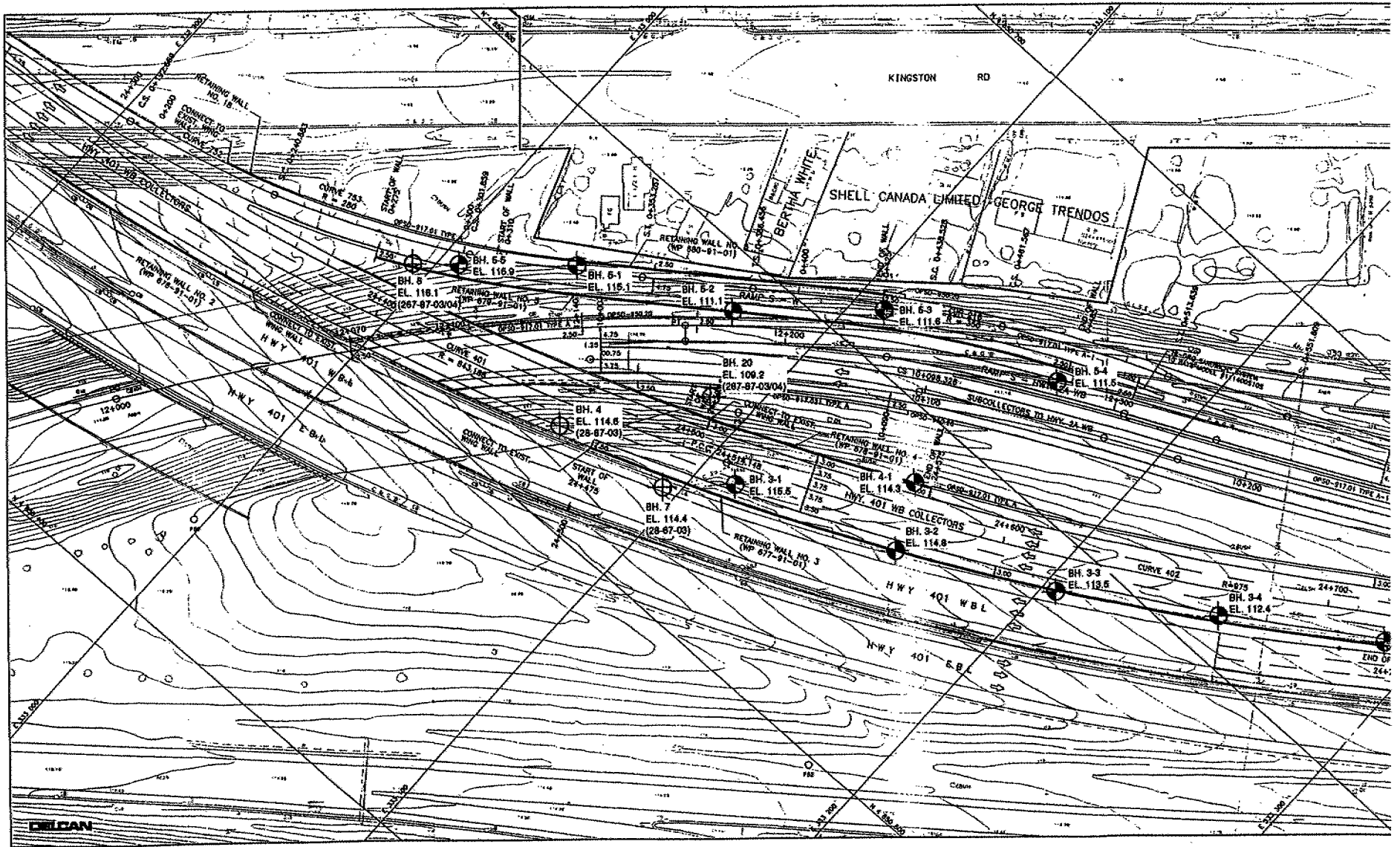
METRIC

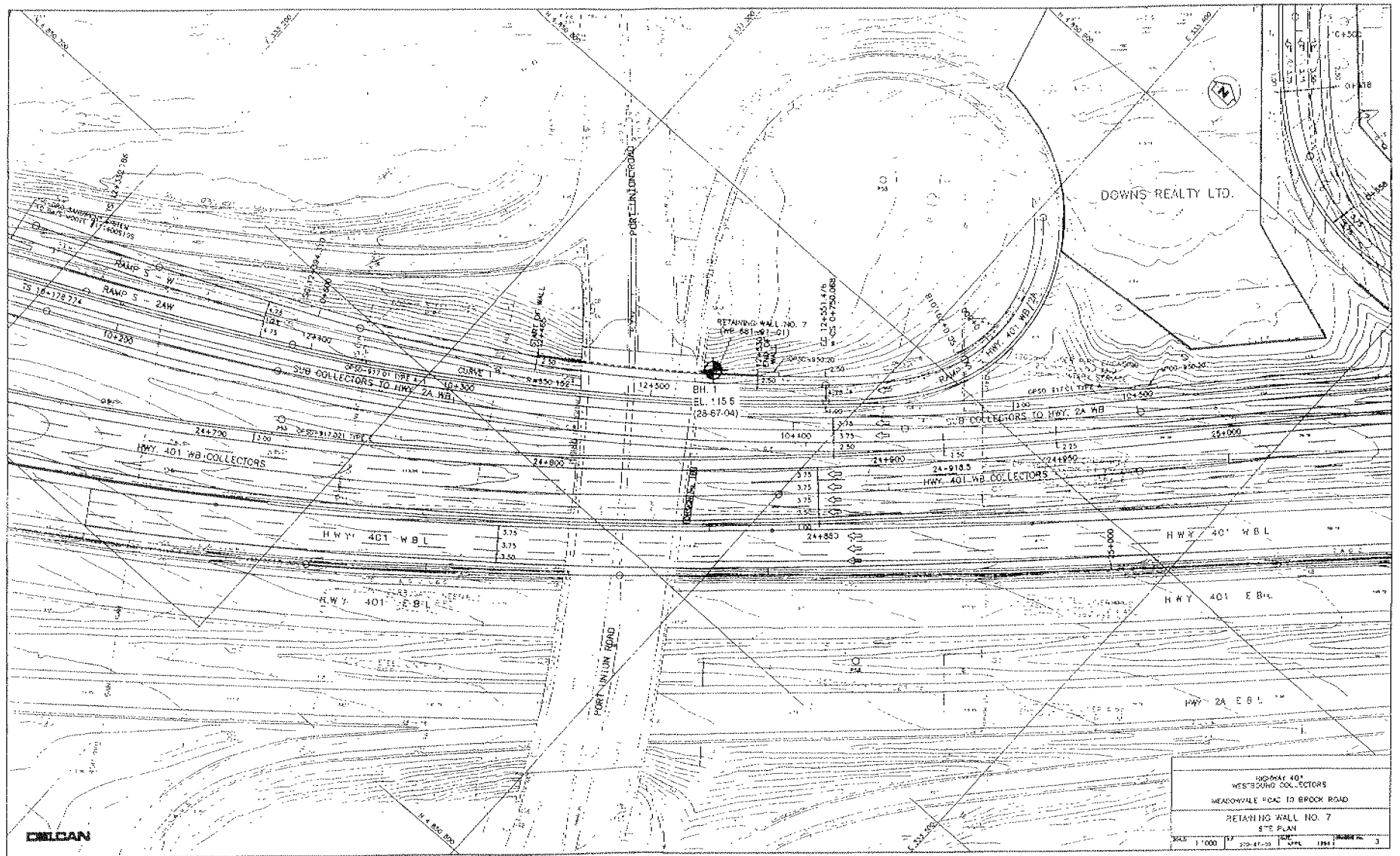
W.P. 257-87-01/02 LOCATION Co-ords. N 4 850 515.8 ; E 332 922.8 ORIGINATED BY SMH
DIST 5 HWY 401 BOREHOLE TYPE SS Auger, Cone Test COMPILED BY SMH
DATUM Geodetic DATE 89 09 05 CHECKED BY DD

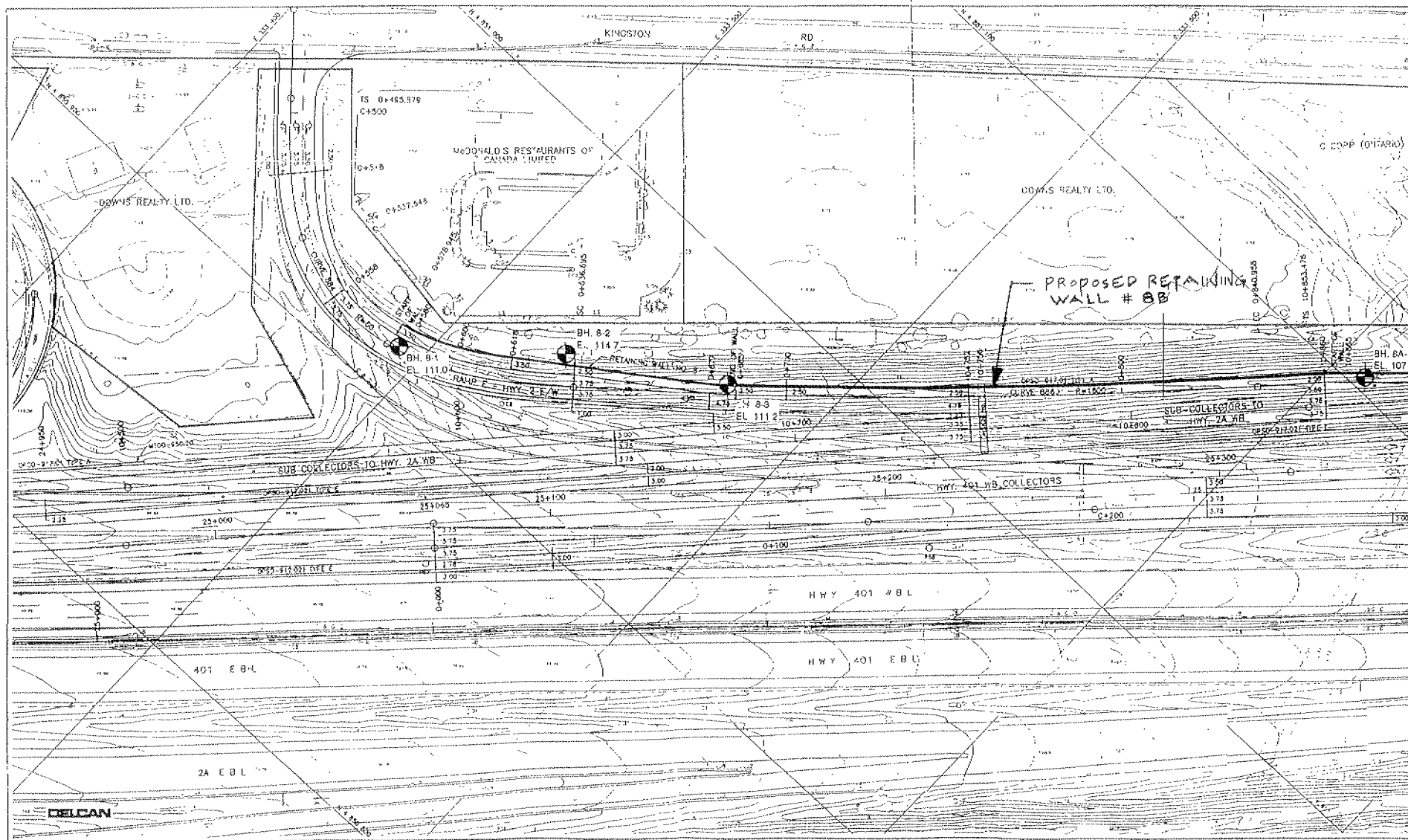
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
115.1	Ground Surface														
0.0	Clayey Silt to Silt With Frequent Silty Sand Zones Some Gravel Firm to Stiff/Loose to Compact (Fill)		1	SS	12		115								
113.6			2	SS	124		114								3 38 44 15
1.5			3	SS	170	/25cm	113								10 53 34 3
	Silty Sand Zones		4	SS	120		112								0 57 42 1
			5	SS	115		111								
			6	SS	171	/18cm	110								
			7	SS	110	/15cm	109								
	Het. Mixture of Clayey Silt to Silt with Sand, Trace Gravel, occ. Cobbles and Boulders, occ. Silty Sand Zones. Hard. (Glacial Till)		8	SS	130	/13cm	108								
			9	SS	120	/5cm	107								
			10	SS	100	/10cm	106								
104.2			11	SS	151	/23cm	105								
10.9	End of Borehole														

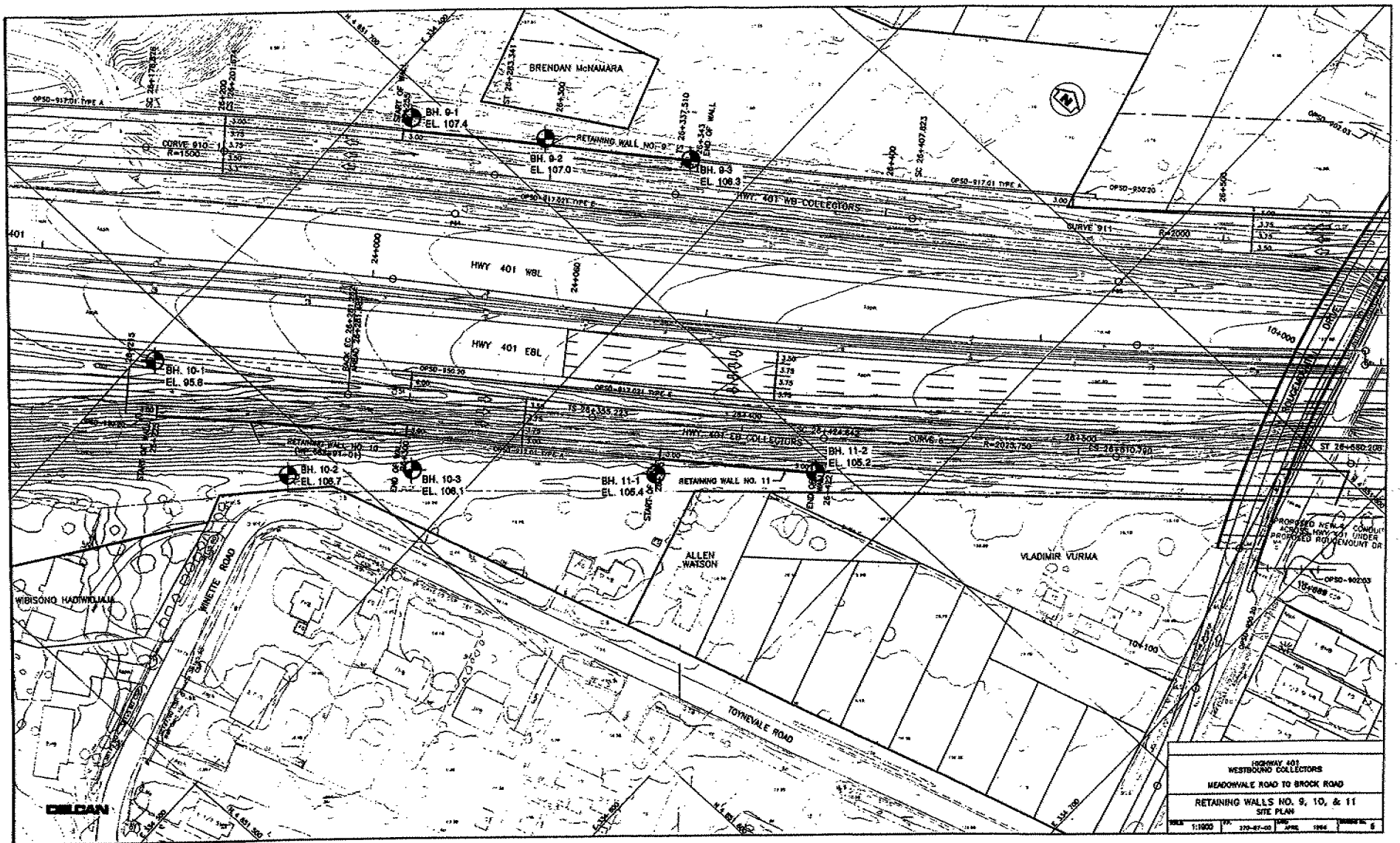
* 89 09 13

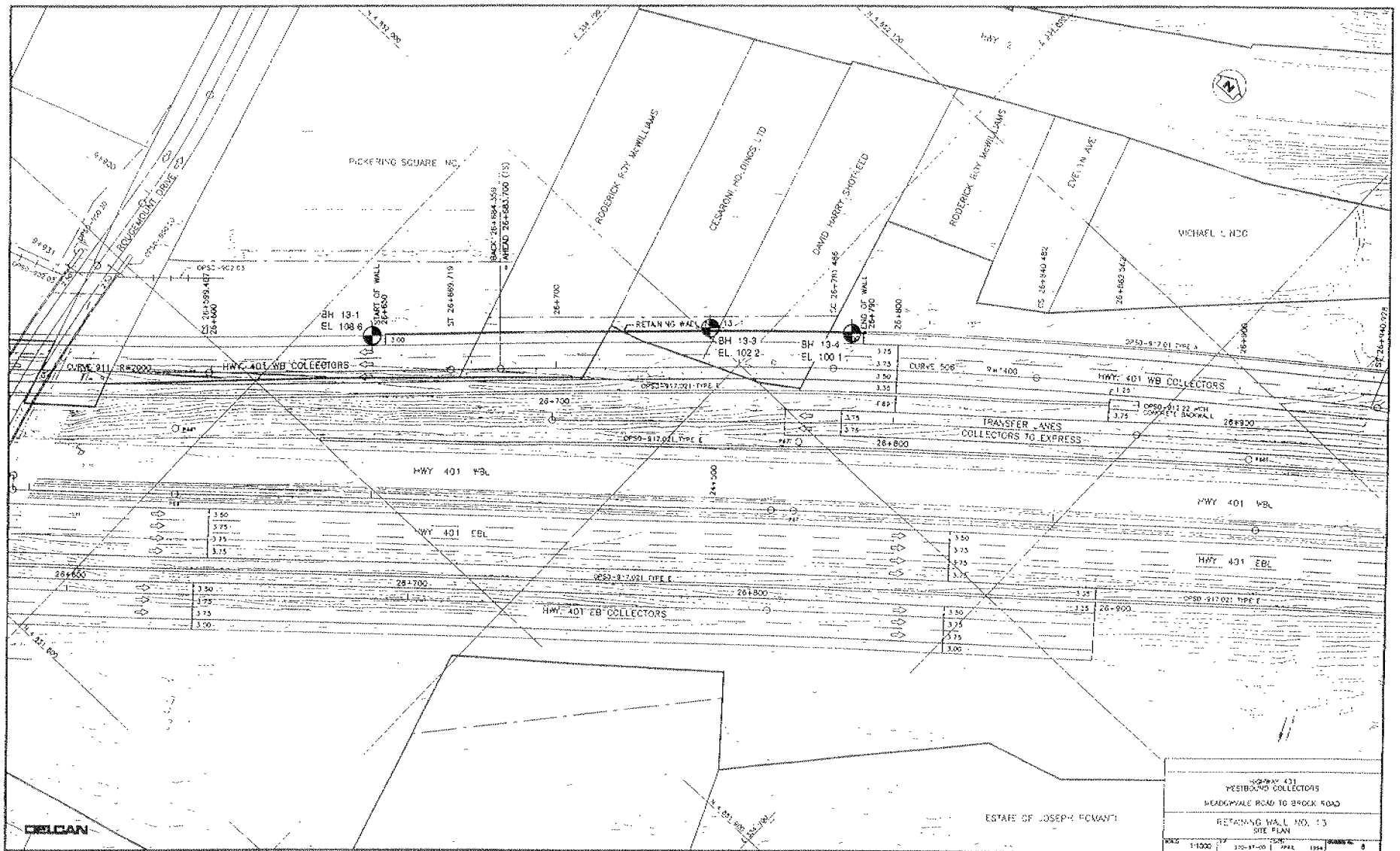


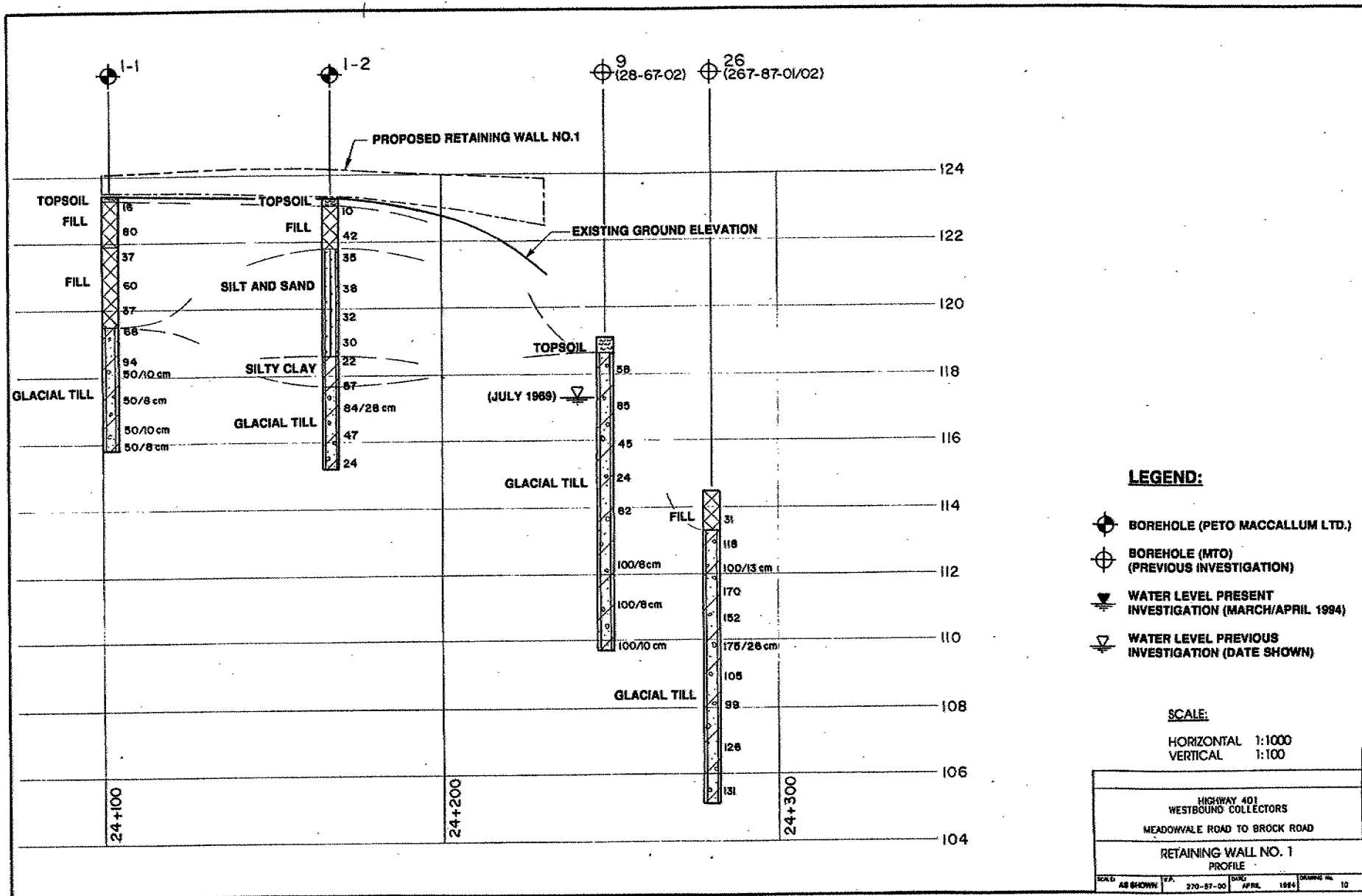


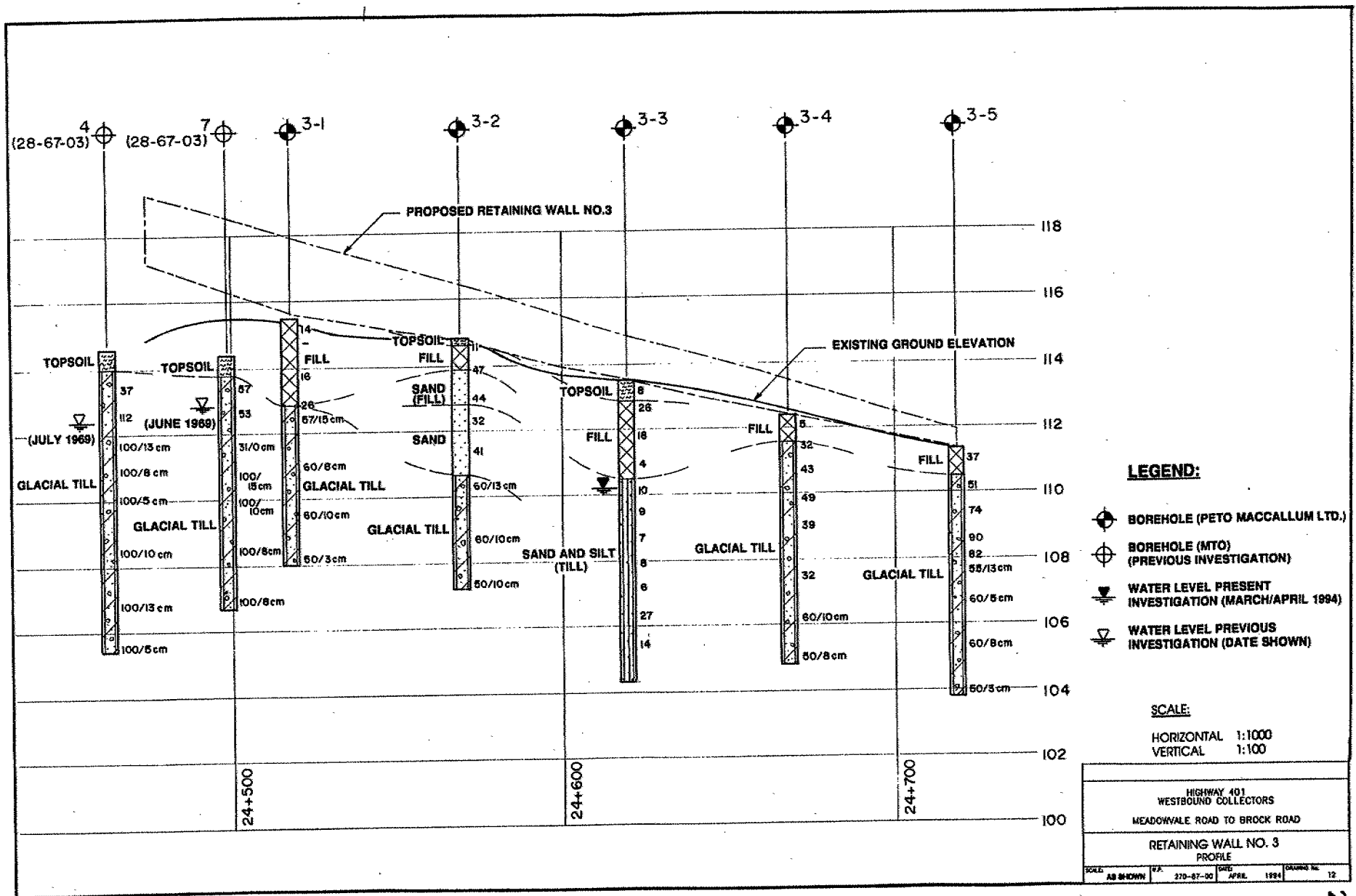


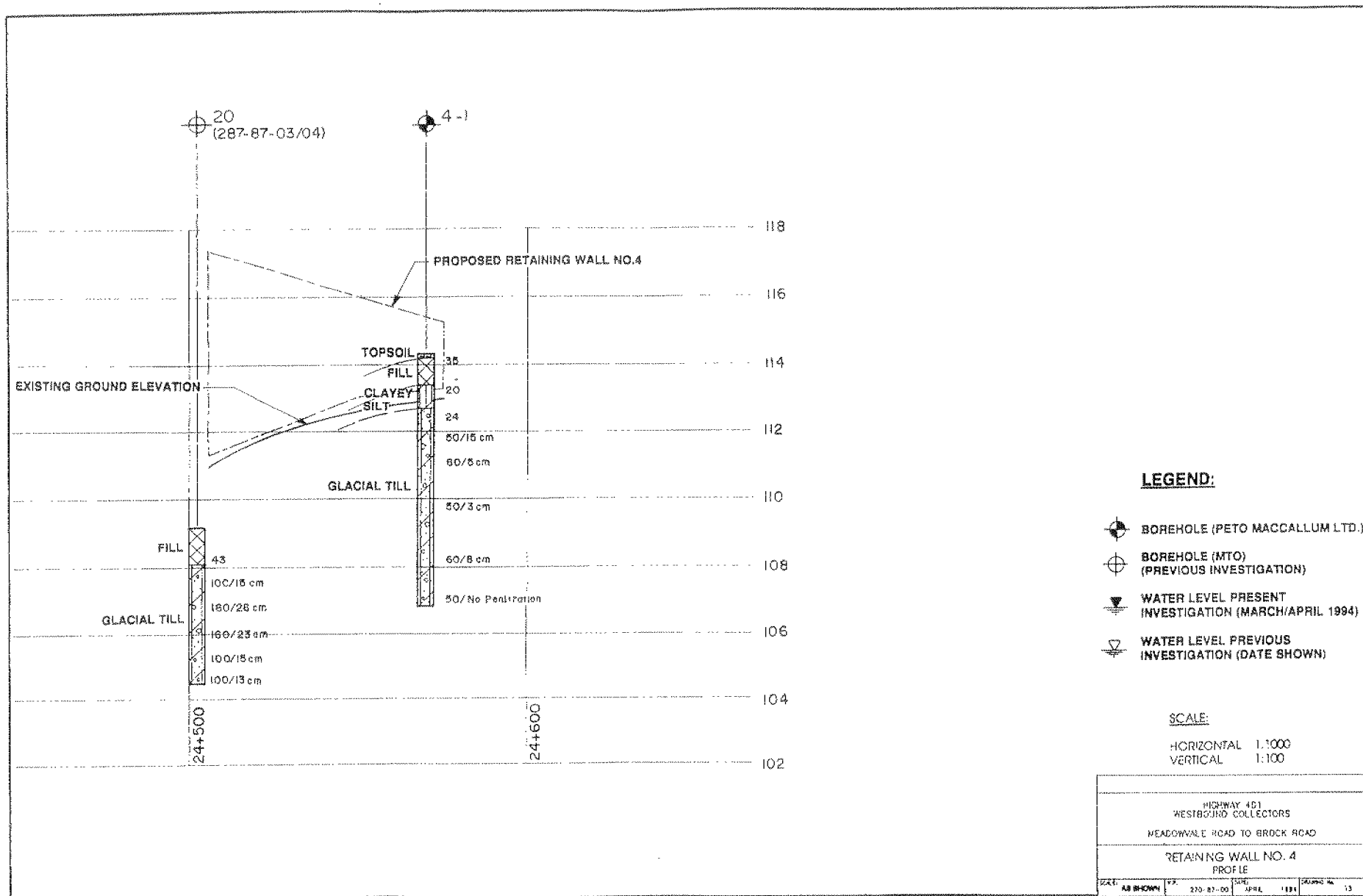


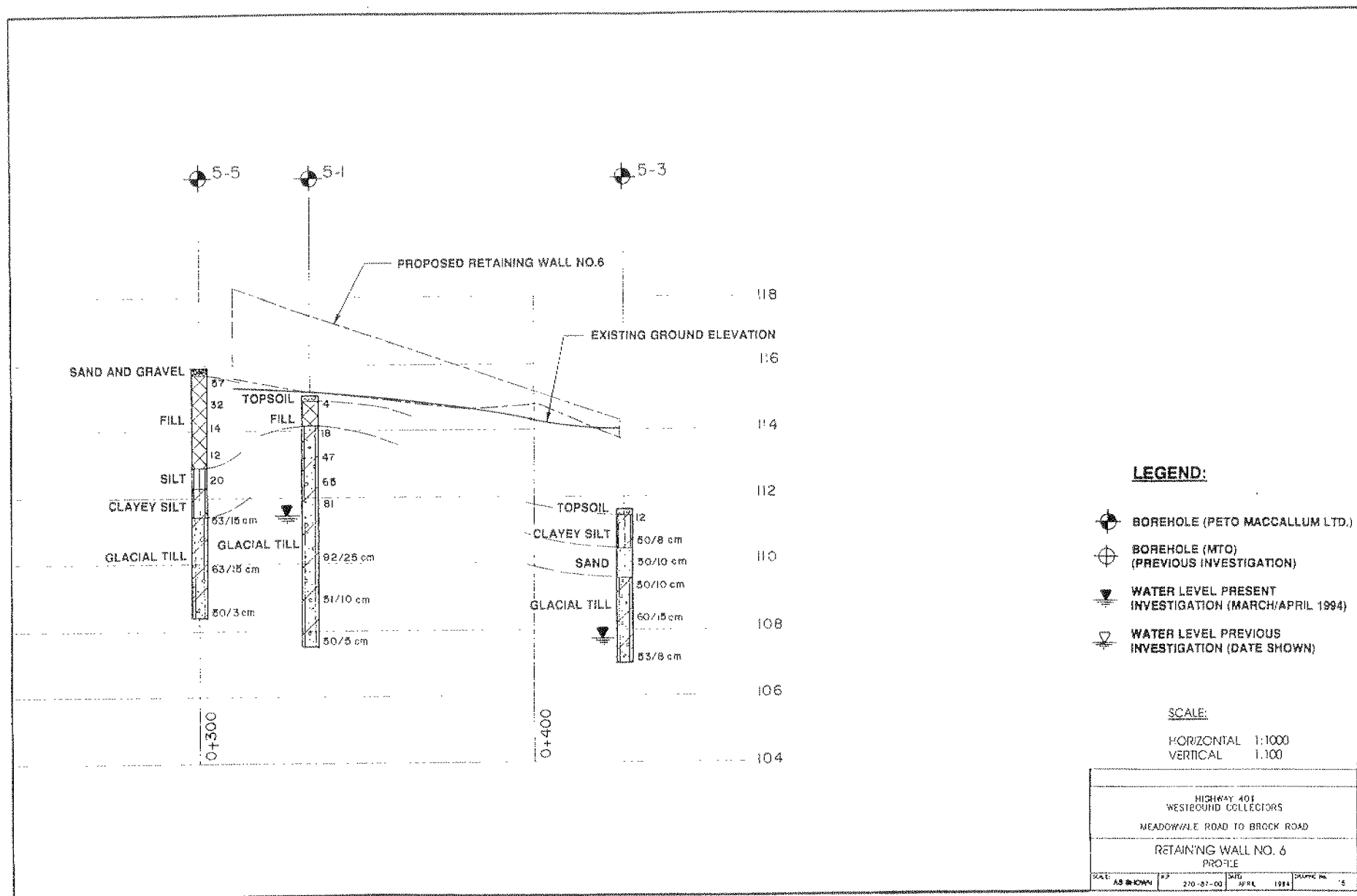


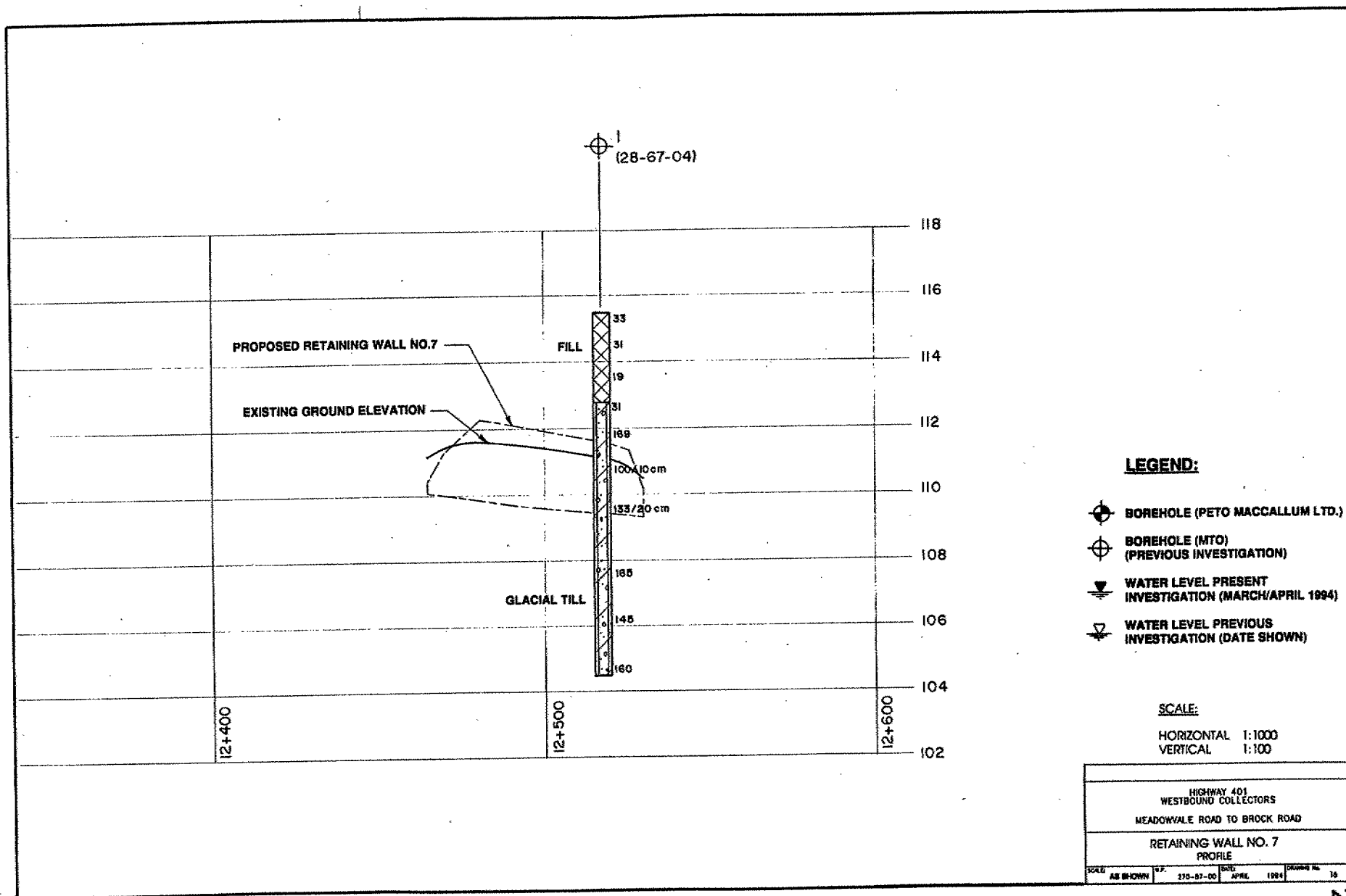


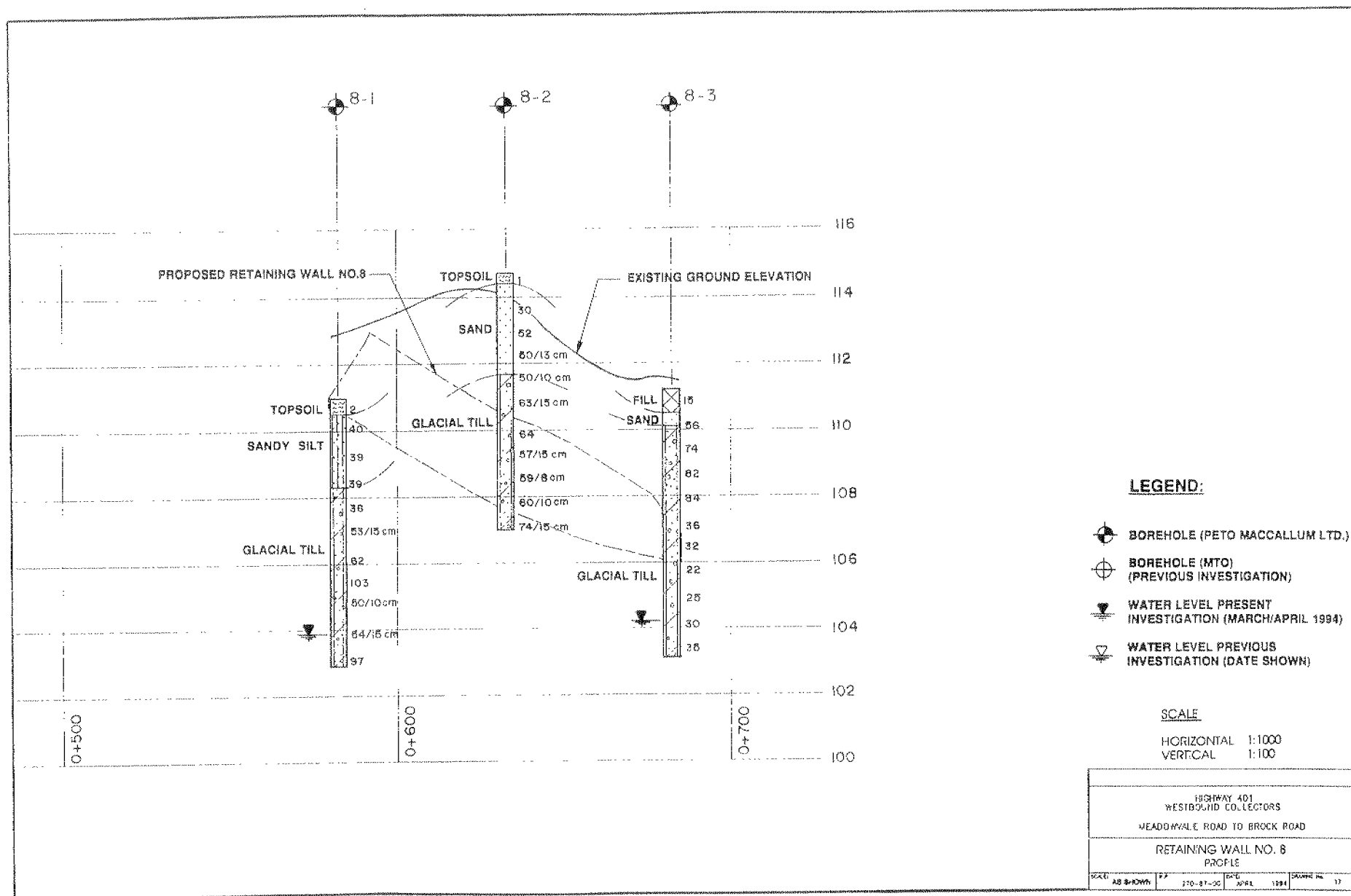


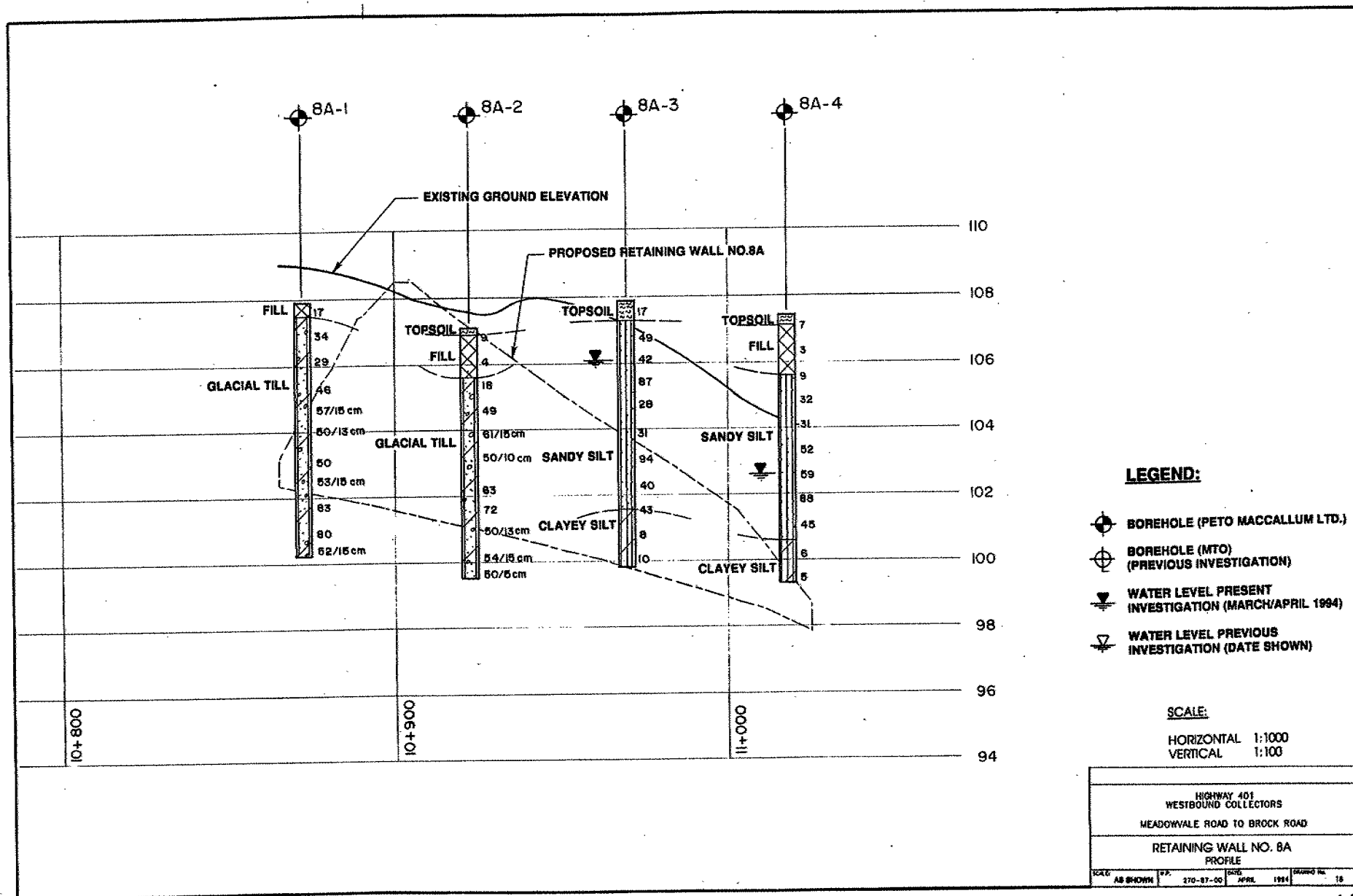


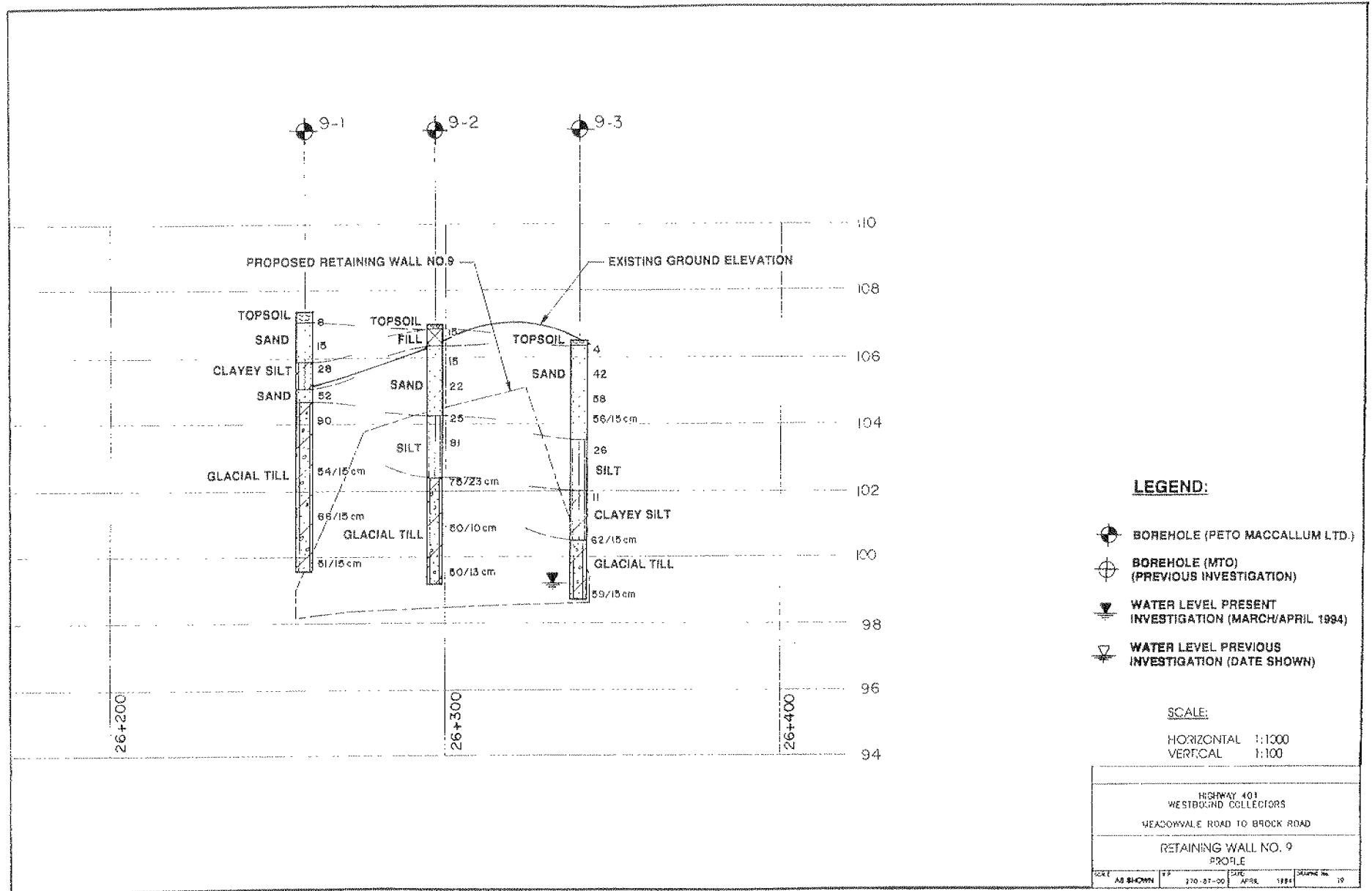


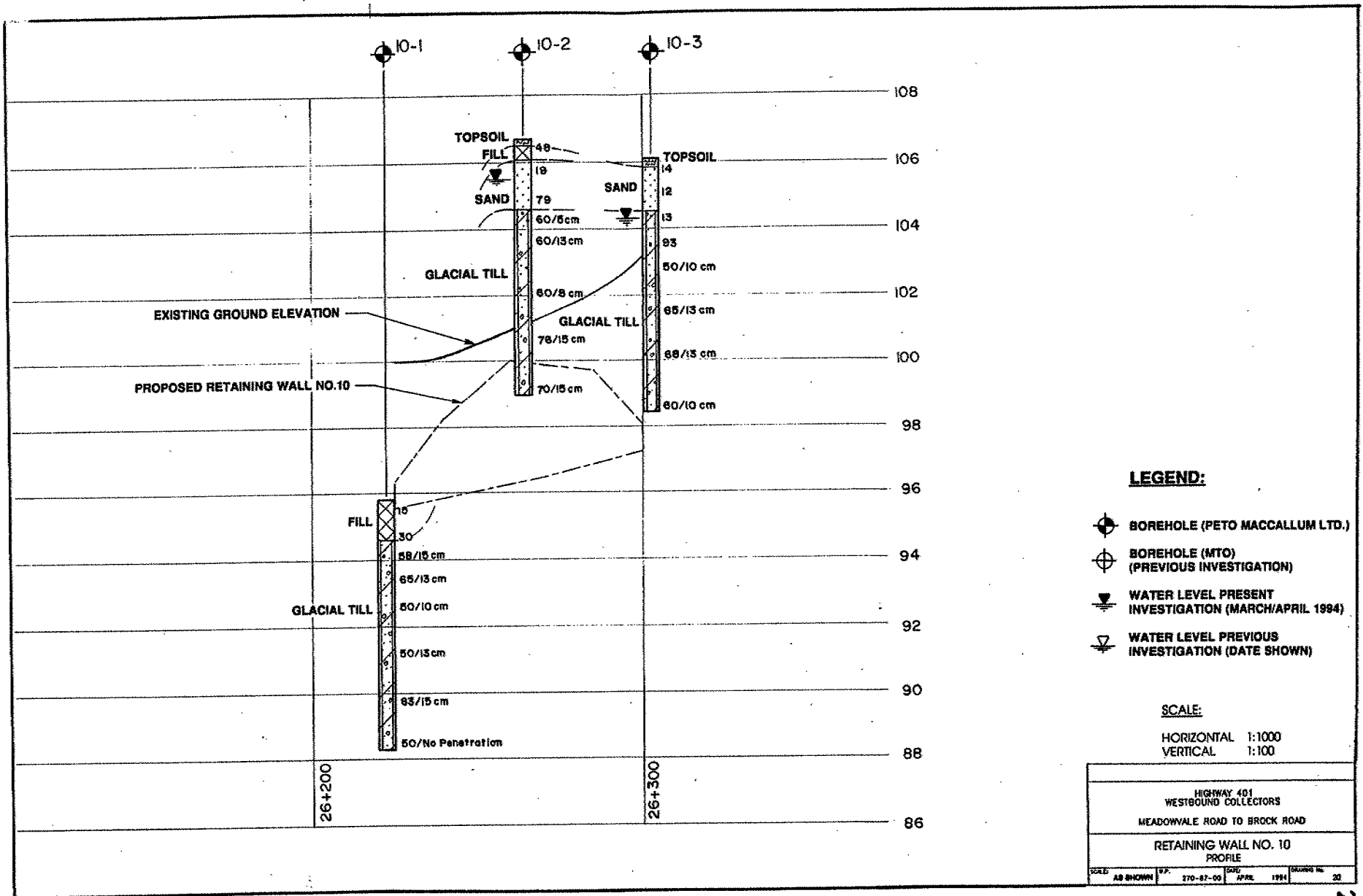


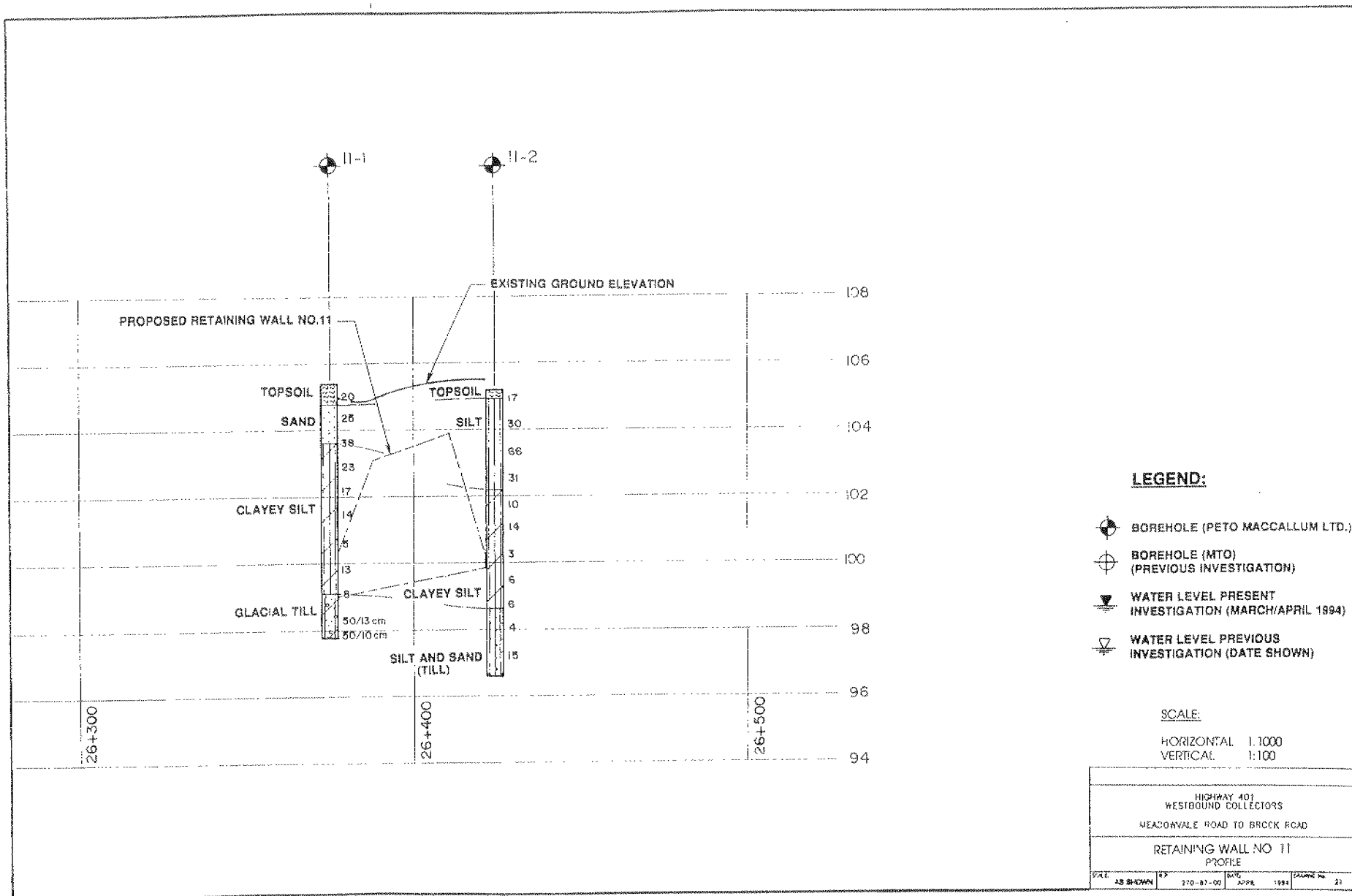




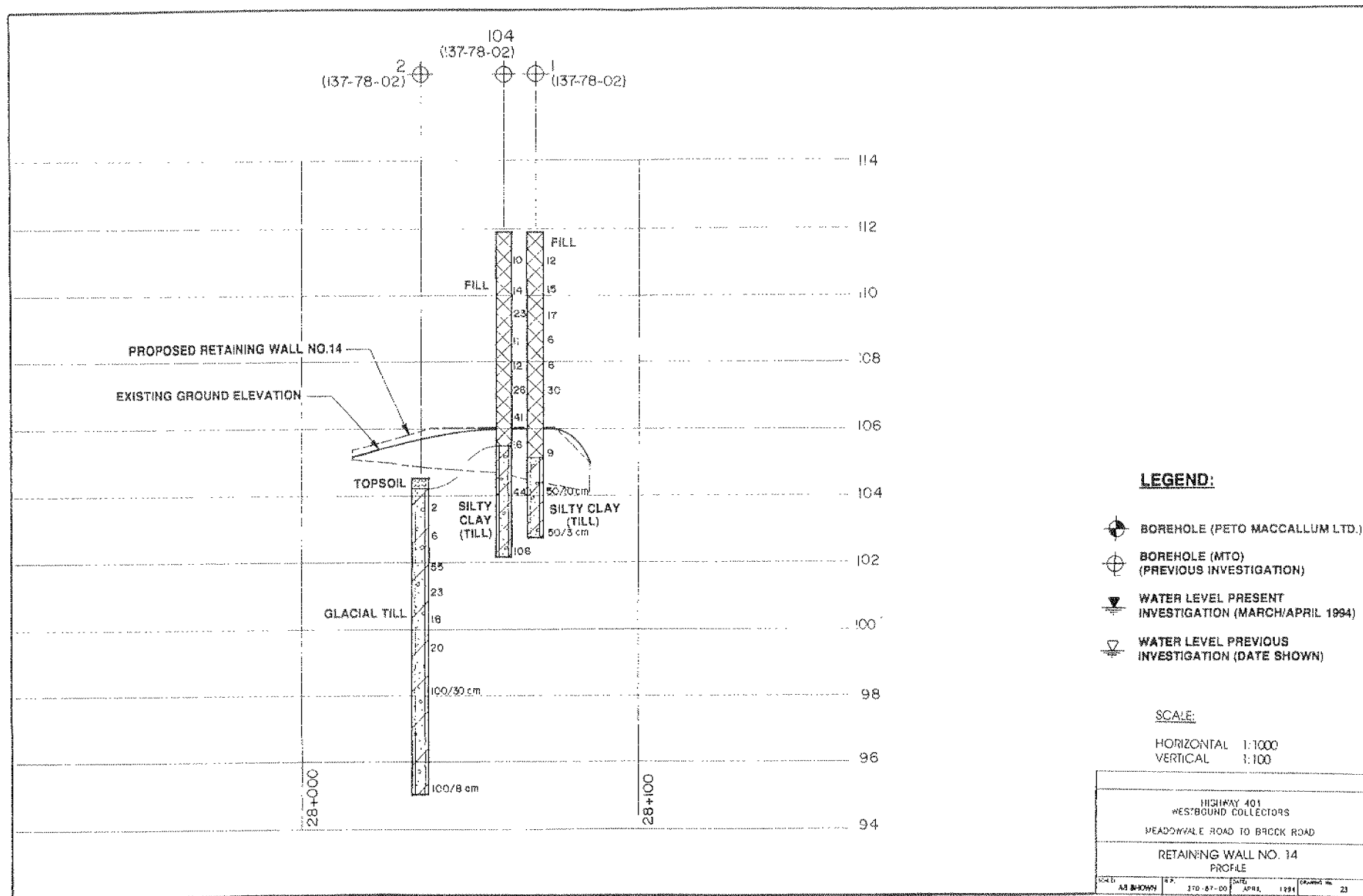


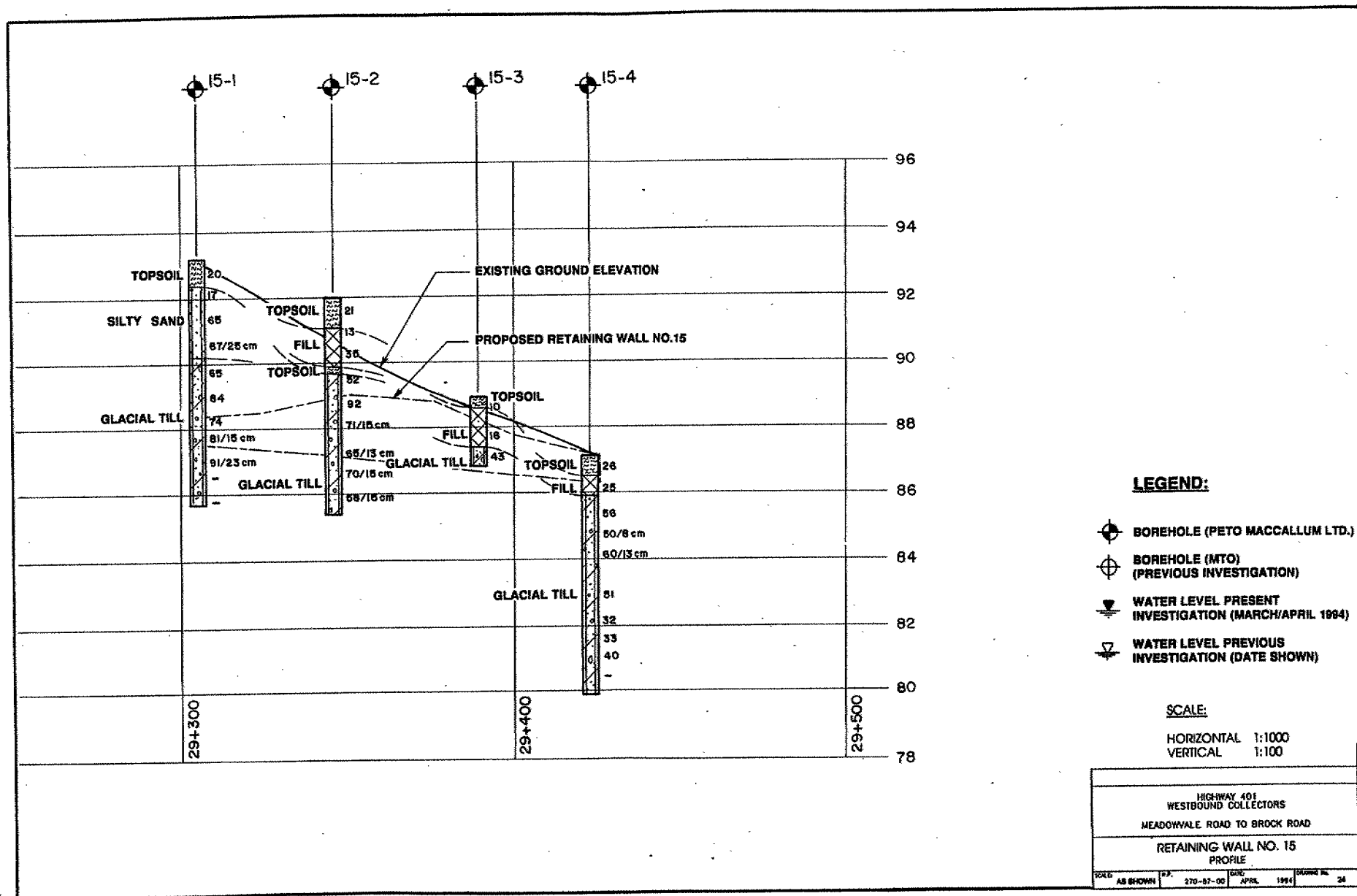


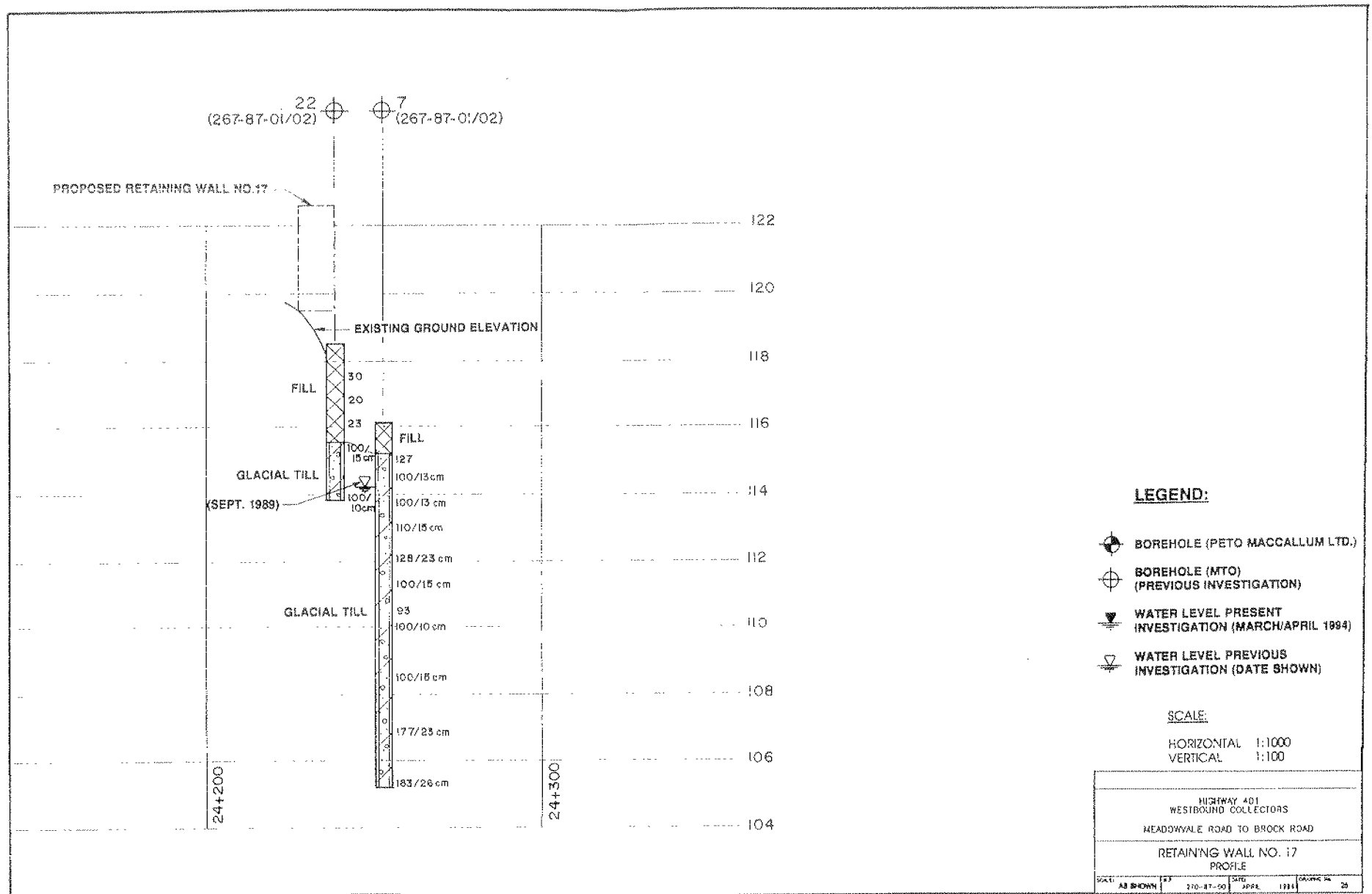


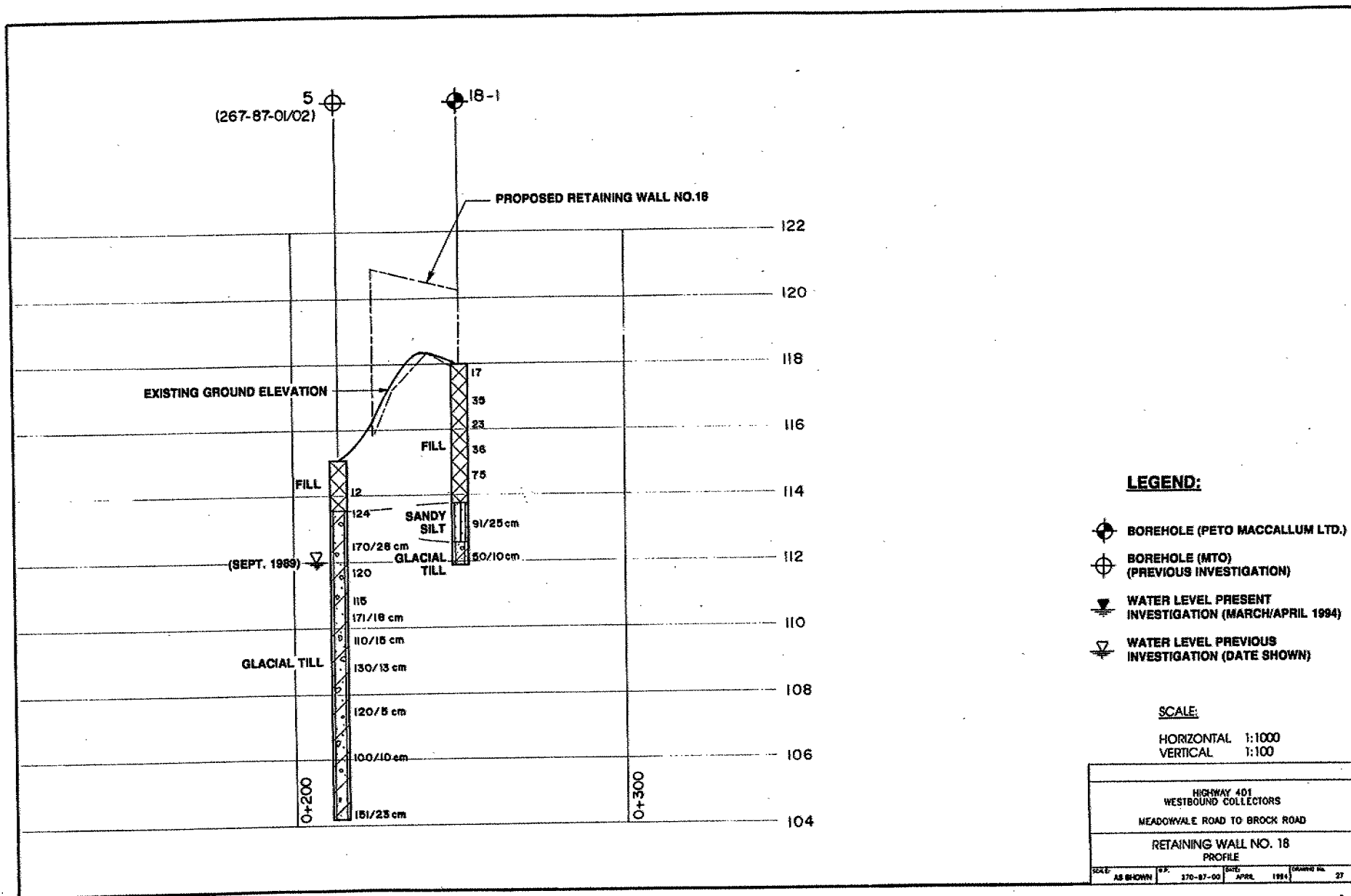












Addendum
for
Foundation Investigation Report
For
Retaining Walls
Hwy 2 to Fairport Road
WP 270/271-87-00, Site N/A
Hwy 401, Toronto

This is an addendum to the original Retaining Wall report for WP 270-87-00. The purpose of this addendum is to provide additional subsurface information for the added Retaining Wall locations (Retaining Walls #7A, #8B in WP 270-87-00, and #16-1 to #16-4 inclusive in WP 271-87-00). The detailed soil stratigraphy encountered at each addendum borehole location is shown on the specific Record of Borehole Sheet included in the Appendix. Refer to the appended plans for locations of boreholes. The layout and details illustrated on the plans are for illustration only, not for structural details. Refer to the appropriate portion of the contract documents for structural details.

The groundwater level recorded at each borehole location is shown on the specific Record of Borehole Sheet. Groundwater is generally subject to seasonal fluctuations and hence may differ from the elevation given in this report.

The subsurface information at Retaining Wall locations may be inferred from the closest borehole.

MISCELLANEOUS

The report was prepared by K. Ahmad, Foundation Engineer and reviewed by D. Dundas, Senior Foundation Engineer.



D. Dundas
D. Dundas, P.Eng.
Senior Foundation Engineer

APPENDIX

WALL 16-1

240

RECORD OF BOREHOLE No 101

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 850 240.5 E 332 840.0 ORIGINATED BY SA
DIST 5 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995_02_08 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100					
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
							WATER CONTENT (%) PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L 20 40 60						
115.0	Ground Surface												
0.0													
	Silty Sand, Trace of Gravel Trace of Clay, Some Organic Brown, Moist to Wet V. Loose to Dense (Fill)		1	SS	38		114						
			2	SS	6		115						
			3	SS	4								
112.1							112						
2.9			4	SS	34								
			5	SS	75	/10cm	111						
			6	SS	65	/15cm	110						
			7	SS	80	/15cm							
	Silty Sand to Sandy Silt Brown, Wet Dense to V. Dense		8	SS	90	/15cm	109						
							108						
			9	SS	80	/15cm	107						
							106						
105.4													
9.6	End of Borehole												

RECORD OF BOREHOLE No 102

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 850 342.0, E 332 910.0 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 08 CHECKED BY KA

[illegible]

WALL 16-1

242

RECORD OF BOREHOLE No 103

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 850 425.0 E 332 960.5 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 08 CHECKED BY KA

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	'N' VALUES			20	40	60	80	100					
110.9	Ground Surface																
0.0																	
			1	SS	72	/15cm	110										
			2	SS	80	/13cm	109										
			3	SS	75	/13cm	108										
			4	SS	70	/13cm	107										
			5	SS	75		106										
			6	SS	120		105										
			7	SS	72	/15cm	104										
			8	SS	80	/15cm	103										
			9	SS	80	/15cm	102										
101.3			10	SS	70	/15cm											
9.6	End of Borehole																

Silty Sand to Silt
Trace of Clay, Trace of Gravel
Same Sand
Occasional Layers of Clayey
Silt With Sand
Brown, Damp to Wet
V Dense
(Glacial Till)

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 28-67-04 LOCATION Co-ords. N 4 850 687 E 333 420 ORIGINATED BY HS
DIST 6 HWY 401 BOREHOLE TYPE Washboring, NX Casing, Cone Test COMPILED BY HD
DATUM Geodetic DATE 18/07/69 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 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
115.5	Ground Surface																
0.0	Fill Material																
	Silty sand, some gravel trace clay		1	SS	12		115										
	Compact		2	SS	19		114										
			3	SS	21		113										
112.1							112										
3.4			4	SS	51												
			5	SS	100	/10cm	111										
	Heterogeneous mixture of Clayey silt, sand and gravel						110										
	Hard		6	SS	100	/13cm	109										
	Brown to Grey						108										
	(Glacial Till)		7	SS	100	/6cm	107										
			8	SS	100	/10cm	106										
104.7							105										
10.8	End of Borehole																

WALLS 16-2 & 16-3

24.1

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 28-67-04 LOCATION Coord.: N 4 850 655 E 333 384 ORIGINATED BY HD
DIST 6 HWY 401 BOREHOLE TYPE Washboring-NX & BX Casing Cone Test COMPILED BY HD
DATUM Geodetic DATE 17&18 07 1969 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	'N' VALUES			20	40	60	80	100					
115.8	Ground Surface																
0.0	Fill Material																
	Sandy Silt, Compact																
112.5			1	SS	14		113										0 36 61 3
1.3			2	SS	60		112						0.1				4 29 54 13
	Heterogeneous Mixture of Clayey Silt, Sand and Occasional Gravel		3	SS	115		111										
	(Glacial till)		4	SS	149		110						0				2 40 48 10
			5	SS	53		109										
			6	SS	16		108						0				
	Very Stiff		7	SS	40		107										
			8	SS	100		106						0.1				
	Hard		9	SS	100		105										
			10	SS	100		104						0				
	Grey						103						0				
							102										
101.4																	
12.4	End of Borehole																4 45 42 9

WALL 7A

RECORD OF BOREHOLE No 106

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 850 841.5, E 333 480.0 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 07 CHECKED BY KA

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					
109.0	Ground Surface															
0.0	Silt to Silty Sand Trace of Gravel Occasional Silty Clay Brown, Moist Dense to V. Dense (Glacial Till)		1	SS	20	DRY *										
			2	SS	86											
			3	SS	79											
			4	SS	122											
			5	SS	74											
			6	SS	25											
			7	SS	33											
			8	SS	81											
			9	SS	95	/15cm										
			10	SS	95											
99.4	End of Borehole															

WALL 7A

246

RECORD OF BOREHOLE No 107

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 850 856.0, E 333 502.5 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 07 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA S CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)	20 40 60			
108.5	Ground Surface															
0.0			1	SS	81											
			2	SS	66											
			3	SS	62											
			4	SS	8											
			5	SS	37											
	Sandy Silt To Silt With Trace of Sand, Trace of Clay Occasional Silty Clay Brown, Moist to Wet Dense to V. Dense (Glacial Till)		6	SS	75	/10cm										
			7	SS	128											
	Gravelly Sand		8	SS	72											
			9	SS	75	/15cm										
			10	SS	70	/15cm										
98.5	End of Borehole															

RECORD OF BOREHOLE No 104

1 OF 1

METRIC

W.P. 271-87-00 LOCATION Coord.: N 4 852 752.5, E 335 780.0 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 06 CHECKED BY KA

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 ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	w _p	w			w _L
105.0	Ground Surface																
0.0	Clayey Silt to Silt With Some Sand, Trace of Clay Brown, Moist V. Stiff to Hard (Glacial Till)					DRY *											
			1	SS	30	104											
			2	SS	23	103											
			3	SS	41	102											
			4	SS	56	101											
			5	SS	65	100											
			6	SS	29	99											
			7	SS	26	98											
			8	SS	22	97											
			9	SS	95	96											
95.4			10	SS	70	/15cm											
9.6	End of Borehole																

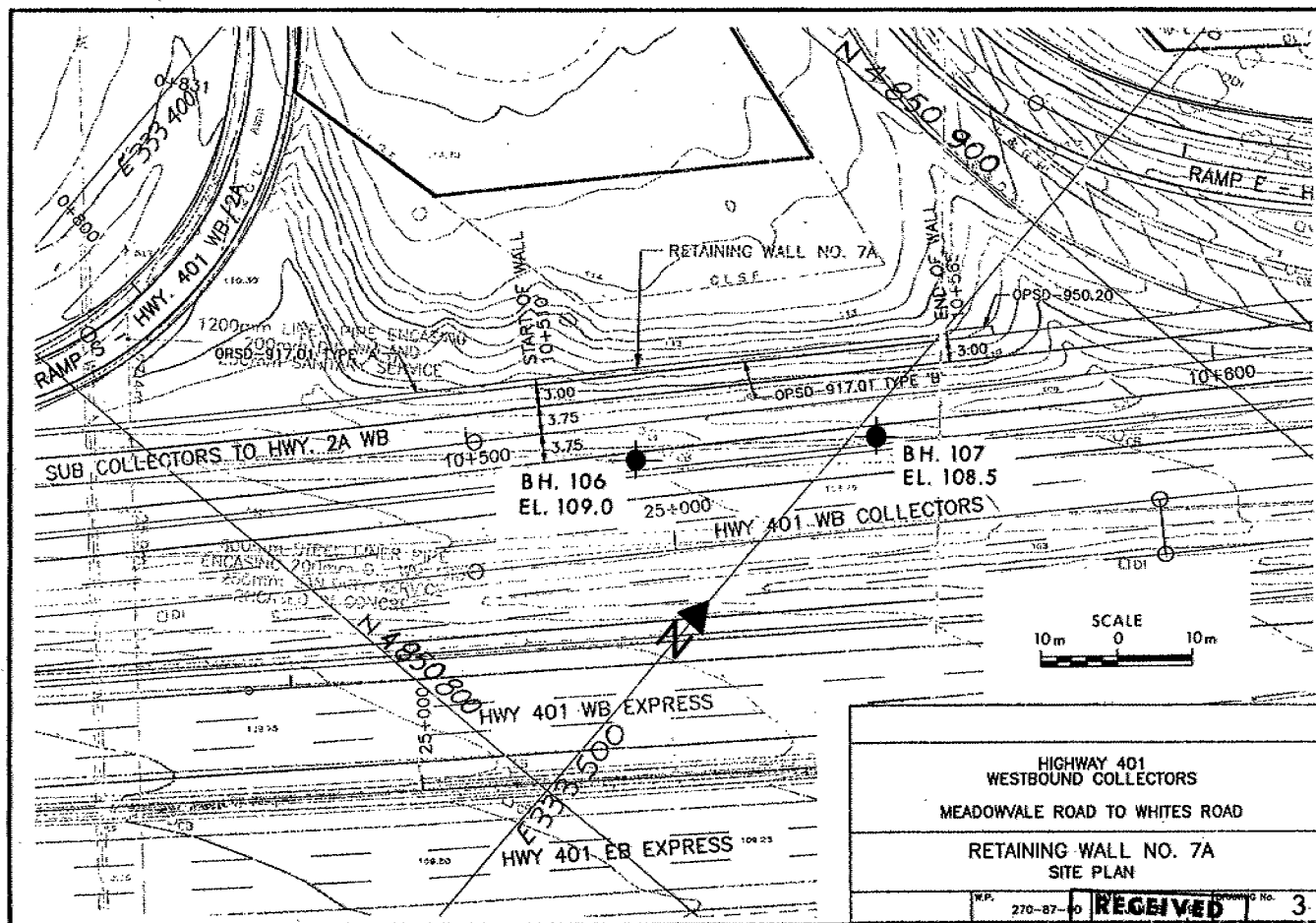
RECORD OF BOREHOLE No 105

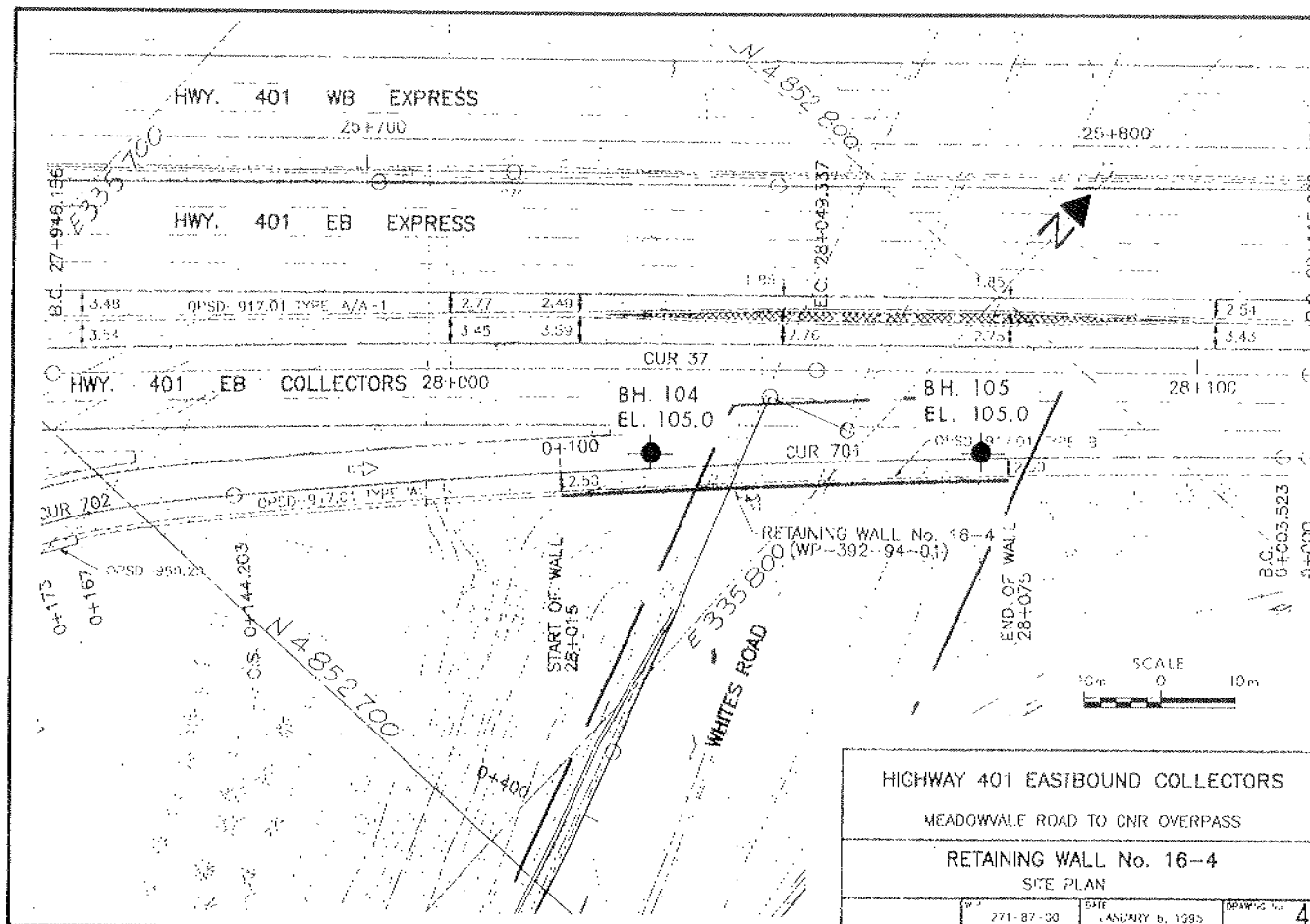
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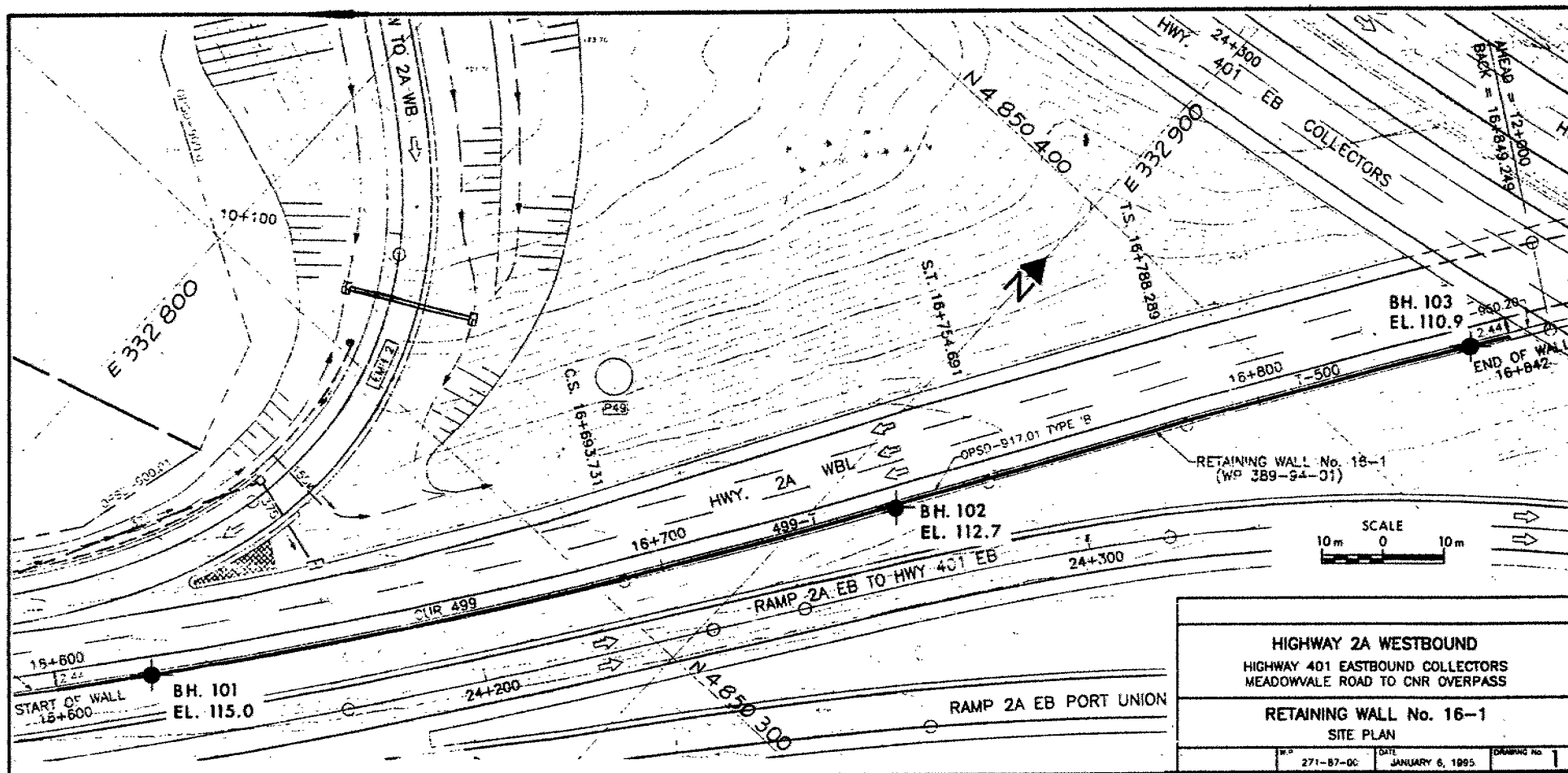
METRIC

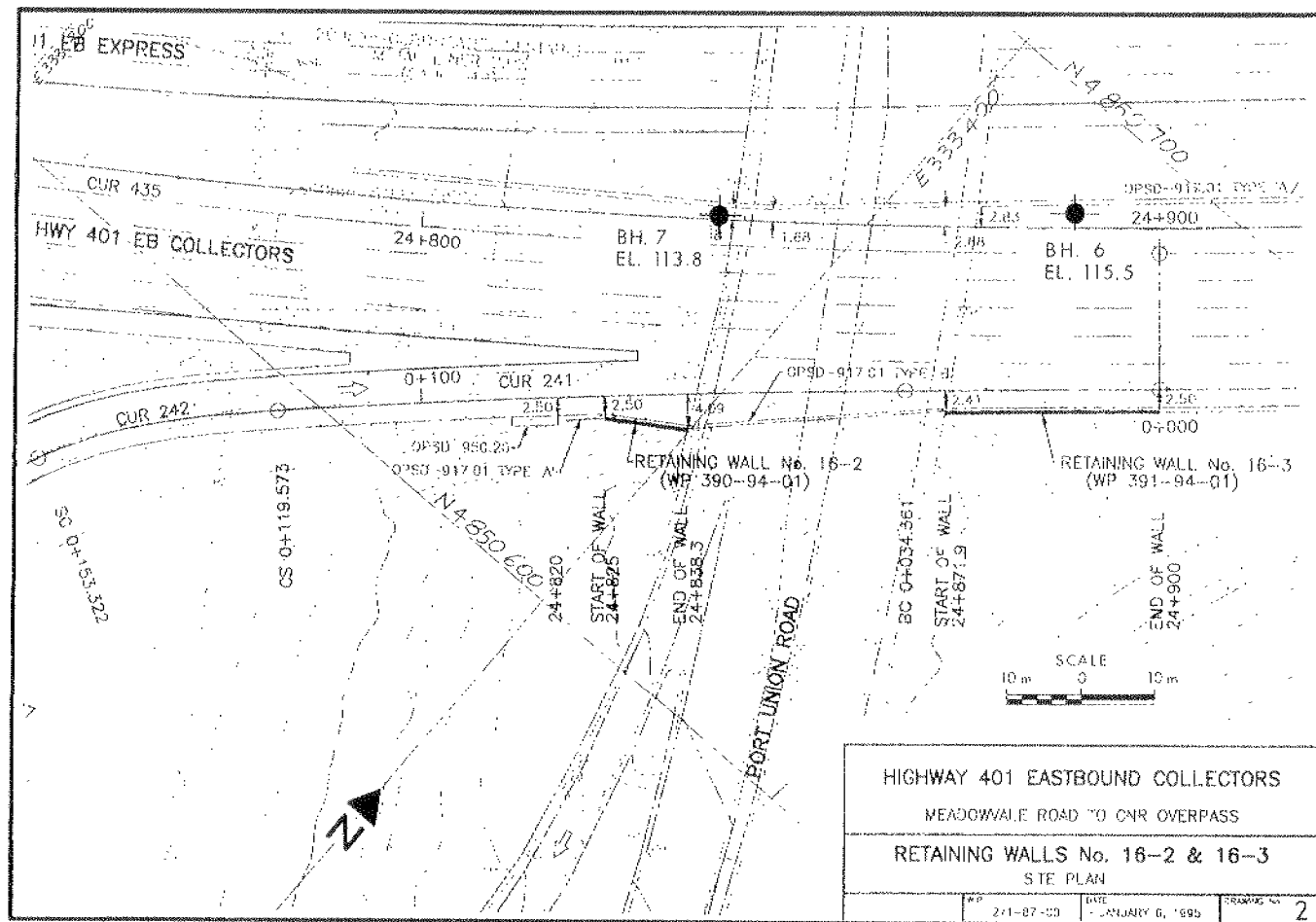
W.P. 271-87-00 LOCATION Coord. N 4 852 782.5, E 335 812.5 ORIGINATED BY SA
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY SA
DATUM Geodetic DATE 1995 02 06 CHECKED BY KA

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
105.0	Ground Surface																
0.0	Sand With Gravel Brown, Moist (Fill)		1	SS	55	DRY *	104										
103.6			2	SS	47		103										
1.4			3	SS	72		102										
			4	SS	37		101										
	Clayey Silt, Trace of Gravel Brown, Moist V. Stiff to Hard (Glacial Till)		5	SS	42		100										
			6	SS	36		99										
			7	SS	17		98										
			8	SS	16		97										
96.0			9	SS	70	/10cm	96										
7.0	Sandy Silt Brown, Damp, V. Dense (Glacial Till)		10	SS	95	/15cm	95										
95.4																	
8.6	End of Borehole																









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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONT 95-34

WP 270-87-03 DIST 6

HWY 401 STR SITE 22-162

Rougemount Drive Underpass at Hwy. 401

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FOUNDATION INVESTIGATION REPORT
For
Rougemount Drive Overpass at Highway 401
W.P. 270-87-03, Site 22-162
District 6, Toronto

INTRODUCTION

This report summarizes the results of the foundation investigation conducted at Rougemount Drive Underpass at Highway 401. The investigation was carried out upon the request of the Central Region Structural Section for the proposed reconstruction of Rougemount Drive due to widening of Highway 401. The field work for the investigation was carried out between 92 09 21 and 92 09 29 and consisted of ten (10) sampled boreholes.

SITE DESCRIPTION

The site is located on Highway 401 at Rougemount Drive, in the town of Pickering, Regional Municipality of Durham. It is situated just east of the Rouge River as illustrated in Drawing No. 2708703-A.

Physiographically, the site lies in a region known as the Iroquois Plain (after Chapman and Putnam, 1984). This region is basically a sand plain overlying glacial till with areas of silt and clay deposits.

The existing Highway 401 at this location is in a cut of about 6 m deep. The side slopes are approximately 2H:1V. The existing Rougemount Drive is supported by a two span concrete bridge. The pier and abutments are on shallow footings. The bridge is generally in fair conditions although some concrete spalling is noted.

Land use outside the transportation corridor comprises a public library to the north and private residences to the south.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out between 92 09 21 and 92 09 29 and consisted of ten (10) sampled boreholes which were advanced to depths of 3.2 to 15.4 m.

The boreholes were advanced using conventional hollow and solid stem augering techniques supplemented by wash-boring in the hard and bouldery stratum at depth. Boreholes BH 4, BH 6, and BH 8 were sunk by a track-mounted continuous flight auger drill rig whereas a truck-mounted machine was employed for the other boreholes. The sampling program consisted of split spoon samples collected in the overburden. Disturbed subsoil samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). They provided Standard Penetration Resistance ('N') values for assessment of the denseness of the non-cohesive material. All the samples collected were used for identification and laboratory testing purposes. Dynamic cone penetration test was carried out in BH 2. An in situ vane shear test was carried out in the cohesive stratum in BH 6 to determine the undrained shear strength of soil. The test was conducted employing the Standard MTO 'N' vane.

All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

The groundwater condition was monitored in open-boreholes and in piezometers installed in BH 4 and BH 6. All the boreholes were backfilled upon completion of the field work.

Survey information related to the location and elevation of boreholes was provided by the Central Region, Surveys and Plans Section.

Laboratory

The laboratory testing program for selected soil samples consisted of:

- Atterberg Limit Test
- Grain Size Distribution
- Unit Weight Determinations
- Natural Moisture Content Determinations

Laboratory test results are given in the following section of this report and are illustrated on figures and Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown on Drawing No. 2708703-A.

The predominant soil strata encountered in the boreholes consisted of a deposit of cohesive glacial till material overlain by silt, clayey silt and silty clay layers. Pavement structure consisting of asphalt and/or granular subbase were contacted in BH 1 and BH 3, BH 5, BH 9 and BH 10. A minor layer of topsoil was found at the surface in BH 2, BH 6, and BH 8. Bedrock was not encountered at the termination depths of the boreholes.

Following are the specific descriptions of the material encountered in the investigation:

Silt, trace to some Sand

This non-cohesive stratum is contacted near the surface in BH 1 to BH 4 with thickness ranging from 1.3 to 3.2 m. In BH 5, BH 7 and BH 10, it is encountered below the surficial fill material with thickness of 0.6 to 1.5 m. The material contains higher sand content in BH 10. Typical properties of the material, as

determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	13.0-20.5	6
Liquid Limit (w_L)	16	1
Plastic Limit (w_p)	15	1
Grain Size Distribution (%)		16
- Gravel	0	
- Sand	6-15	
- Silt and Clay	85-94	

Figure 1 illustrates a typical grain size distribution envelope for this material, based on representative samples from the entire site.

Based on Standard Penetration Resistance 'N' values which ranged from 13 to >100 blows/0.3 m, but typically greater than 40 blows/0.3 m, the denseness of this stratum is dense to very dense.

Clayey Silt, trace Sand

This cohesive layer is only encountered in BH 5, BH 6, and BH 8 with thickness ranging from 0.9 to 3.0 m. The material is typically described as clayey silt, trace sand, numerous stained joints. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	11-15.5	2
Liquid Limit (w_L)	17-18	2
Plastic Limit (w_p)	15-16	2
Unit Weight (kN/m^3)	24.0	1
Grain Size Distribution (%)		2
- Gravel	0	
- Sand	3-7	
- Silt and Clay	93-97	

Based on Standard Penetration Resistance 'N' values which ranged from 18 to >100 blows/0.3 m, but typically greater than 30 blows/0.3 m, the consistency of this layer is hard.

Silty Clay

This cohesive layer is encountered in all the boreholes to the south of Highway 401 (BH 5 to BH 8, and BH 10) underlying the silt or clayey silt stratum. It is 2.2 to 3.5 m in thickness. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	12.0-25.5	6
Liquid Limit (w_L)	22-30	6
Plastic Limit (w_p)	13-16	6
Unit Weight (kN/m^3)	20.0-22.0	2
Grain Size Distribution (%)		5
- Gravel	0	
- Sand	0-4	
- Silt and Clay	96-100	

Figure 2 illustrates a typical grain size distribution envelope for this material. Figure 3 illustrates a typical plasticity chart for this material. Based on this, the material is described as silty clay with low plasticity.

An attempt was made in BH 6 to determine the undrained shear strength of the material by insitu vane shear test. The vane could not be turned even at the maximum force applied by the spring of the scales. It is envisaged that the vane had been pushed into the underlying hard glacial till stratum. Based on Standard Penetration Resistance 'N' values which range from 5 to 92 blows/0.3 m, the consistency of this layer varies from soft to hard, but typically very stiff.

Heterogeneous Mixture of Clayey Silt, some Sand, trace Gravel, occasional Cobbles and Boulders (Glacial Till)

Underlying all the above layers is a major deposit of cohesive glacial till. The maximum thickness of this stratum drilled was 12.7 m. This deposit was not fully penetrated at the maximum termination depth of the boreholes (15.4 m depth, El. 89.4 m). It is typically described as a heterogeneous mixture of clayey silt, some sand, trace gravel with occasional cobbles and boulders. The size of boulders was found to be quite large at times and could not be penetrated or displaced by conventional augering techniques. Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	6-9	17
Liquid Limit (w_L)	12-16.5	17
Plastic Limit (w_p)	9-14	17
Unit Weight (kN/m^3)	21.5-25.1	9
Grain Size Distribution (%)		15
- Gravel	3-34	
- Sand	23-40	
- Silt and Clay	37-73	

Figure 4 illustrates a typical grain size distribution envelope for this material, based on representative samples from the entire site. Figure 5 illustrates a typical plasticity chart for this material, based on representative samples from the entire site.

Groundwater

Groundwater level was monitored in the open boreholes during the investigation and in the two piezometers installed in BH 4 and BH 6. The base groundwater table as measured in the piezometers is at around El. 94 ± m, about 10.2 to 11.7 m below existing ground surface. Perched water table in the surficial silt layer was noted upon completion of drilling at BH 1. Groundwater level was not

established in BH 2 and BH 8 as the holes were filled with drilling water upon completion. However, all the soil samples retrieved from these boreholes were dry. The other boreholes were generally dry upon completion except some minor seepage from wet sand seams in the glacial till layer.

Groundwater level is however subject to seasonal fluctuations and may vary from the values given in this report.

DISCUSSION AND RECOMMENDATION

General

The project comprises replacement of the existing two span structure at Rougemount Drive by a three span structure for the widening of Highway 401. The new structure consists of 56 m mid span and 34 m end spans. It is 12.5 m wide between barriers with one lane each way and sidewalks. Highway 401 will be widened to accommodate additional express lanes and three collector lanes each way. This will involve further cutting back into the existing cuts on both sides of Highway 401.

Foundation

Due to the existence of competent subsoil in this site, the foundation for the structure may be founded on conventional spread footings to achieve a cost effective design.

North Abutment -

For footings founded on cohesive glacial till material at El. 103.5 m and assuming a footing width of 4 m, the bearing capacities as per the O.H.B.D.C., are as follows. Due to the competence of the material at this level, it is considered as 'unyielding soil'.

Factored Bearing Capacity at U.L.S. = 1000 kPa

Bearing Capacity at S.L.S. Type II = does not govern in the case
of unyielding soil.

Alternatively, the footing may be founded higher in the dense to very dense silt stratum with the following bearing capacities.

Factored Bearing Capacity at U.L.S. = 860 kPa

Bearing Capacity at S.L.S. Type II = 500 kPa

Perched groundwater condition may be expected in the silt stratum and the material is susceptible to disturbance under uneven hydrostatic head. It is therefore imperative that a dewatering scheme be adopted prior to bulk excavation in the footing area to drain the water away. Dewatering may be in the form of oversized excavation with perimeter drainage ditches and sump pumps.

North Pier -

The proposed grade at this pier location is about El. 100 m. Footings may be founded as high as possible in the competent glacial till stratum, taking into account the minimum earth cover for frost protection. The design bearing capacities as per O.H.B.D.C. are as follows.

Factored Bearing Capacity at U.L.S. = 1000 kPa

Bearing Capacity at S.L.S. Type II = does not govern for unyielding soils.

South Pier -

The proposed grade at this pier location is about El. 100.5 m. Footings may be founded as high as possible in the glacial till stratum below El. 99 m. The till material at this level is slightly less competent as revealed by the Standard Penetration Test 'N' values in BH 5 and BH 6, and hence reduced bearing capacities are recommended as follows.

Factored Bearing Capacity at U.L.S. = 1000 kPa
Bearing Capacity at S.L.S. Type II = 600 kPa

South Abutment -

At this abutment location, the competent till stratum is overlain by layers of clayey silt/silty clay material. It would be uneconomical to excavate down to the till stratum for footing construction. It is therefore recommended to remove the surficial fill and unsuitable material by subexcavating down to El. 102.5 m and backfilling with granular material to form a pad for placement of footings, as

illustrated in Figure 6. The granular pad should be constructed to a minimum 1 m edge distance from the top of the footing to the crest of the pad and with 1H:1V slopes. The Granular 'A' material must be placed and compacted to achieve 100% of the Proctor maximum density as outlined in OPSS 501.08.02 (Method A). Any softened and/or unsuitable material present within the natural subgrade must be removed prior to the placement of the granular pad. For the purpose of the O.H.B.D.C., the following bearing capacities can be used in the foundation design.

Factored Capacity at U.L.S. = 900 kPa

Bearing Capacity at S.L.S. Type II = 350 kPa

General -

All footings should have a minimum earth cover of 1.2 m for frost protection.

Reduction for the inclination of loading on the shallow foundation shall be carried out in accordance with Section 6.7.3.3.5 of the O.H.B.D.C.

The computation of the sliding resistance of the foundation shall be carried out in accordance with Section 6-7.3.3.2 of the O.H.B.D.C. The following unfactored friction angles can be used between the concrete footing and the founding material.

<u>Founding Material</u>	<u>ϕ</u>
Granular 'A'	35°
Silt	32°
Cohesive Till	28°

Backfill

Backfill to abutments should consist of granular material in accordance with MTO Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6-6.1.2.1 of the O.H.B.D.C. The active condition will govern earth pressure design for the yielding condition while the at-rest

condition will govern earth pressure design for the unyielding condition. For design purposes, the following properties for backfill are recommended:

<u>Material</u>	<u>ϕ</u>	<u>γ</u>	<u>K_o</u>	<u>K_a</u>
Granular 'A'	35°	22.8 kN/m ³	0.43	0.27
Granular 'B'	30°	21.2 kN/m ³	0.50	0.33

Slope Stability

For widening of Highway 401, further cutting back into the existing slopes is required on both sides of the highway. The final slope will be in the order of 8 ± m high and be a combination of cut and fill. No deep seated slope failures are anticipated for the recommended geometry. However, surficial instabilities have been reported to have occurred after the construction of the existing Highway 401 in this general area.

It is recommended that all cut and fill slopes be formed at a gradient of 2H:1V or flatter with a 2 m wide mid-height berm for slopes higher than 6 m. Drainage blankets will be required if seepage zones are noted on the slope face. It is recommended the final slope face be inspected by an engineer from this office upon completion of the excavation to determine the extent of drainage blanket required, if any. Normal slope vegetation should be established as soon as possible after completion of the cut/fill operation in order to control surficial erosion.

Shoring

Temporary excavation for footing construction will be in the order of 2 m or less and can be carried out with 1H:1V gradient. No shoring is considered necessary unless the excavation comes very close to the footings of the existing Rougemount Drive Underpass. If shoring is required, please contact this office for soil design parameters.

Construction Considerations

The field investigation has revealed layers of boulders and cobbles in the glacial till strata. Provisions should be made in the contract document to take into account possible obstructions during excavations.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer. The equipment was owned and operated by Dominion Soil Investigation Inc.

The project was carried out by D. Kwok under the supervision of B. Iyer, Senior Foundation Engineer. This report was prepared by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.



A handwritten signature in black ink, appearing to be "D. Kwok", written over a horizontal line.

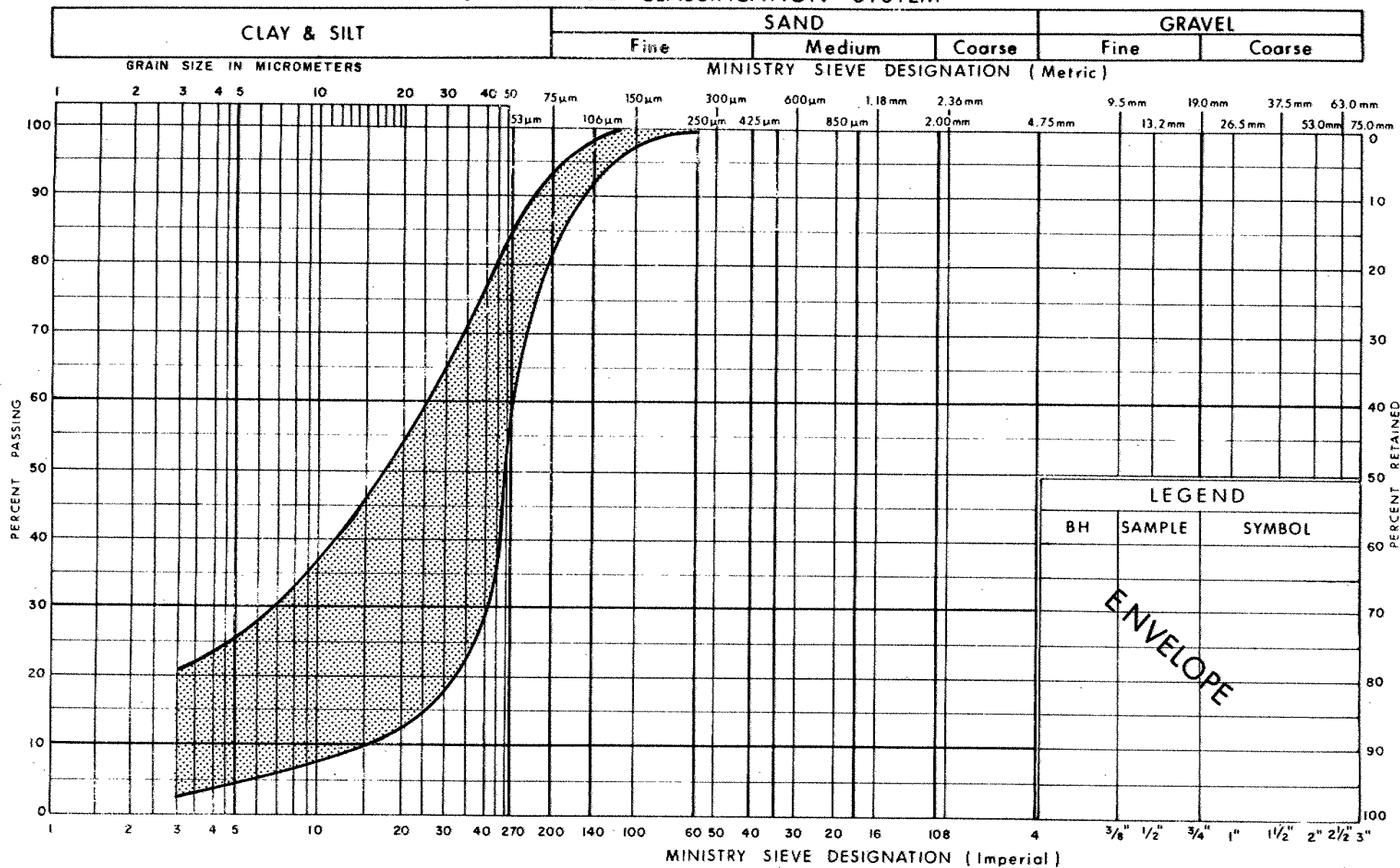
D. Kwok, P.Eng.
Project Foundation Engineer

A handwritten signature in black ink, appearing to be "M. Devata", written in a cursive style.

M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



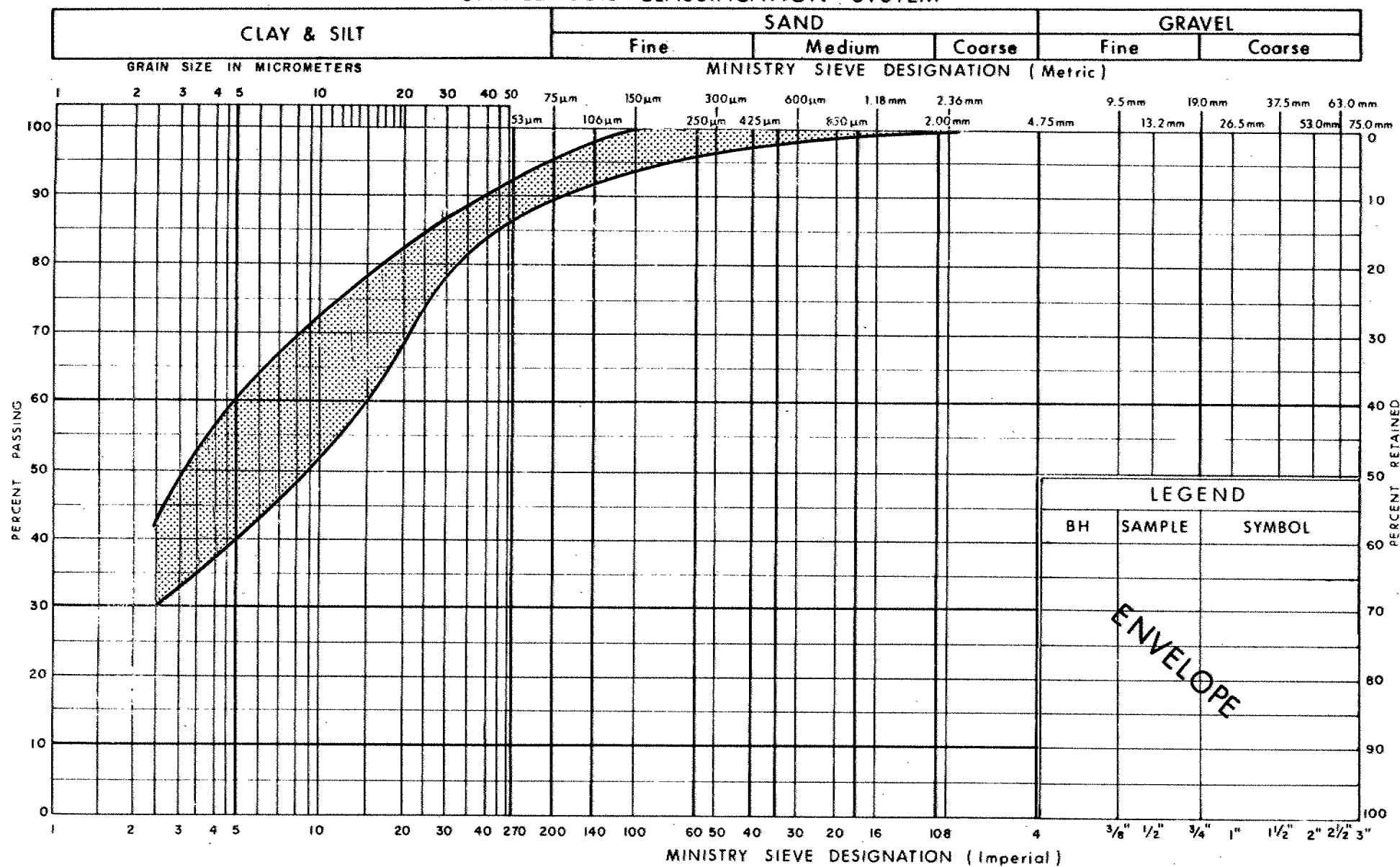
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GRAIN SIZE DISTRIBUTION
SILT
TRACE / SOME SAND

FIG No 1

W P 270-87-03

UNIFIED SOIL CLASSIFICATION SYSTEM

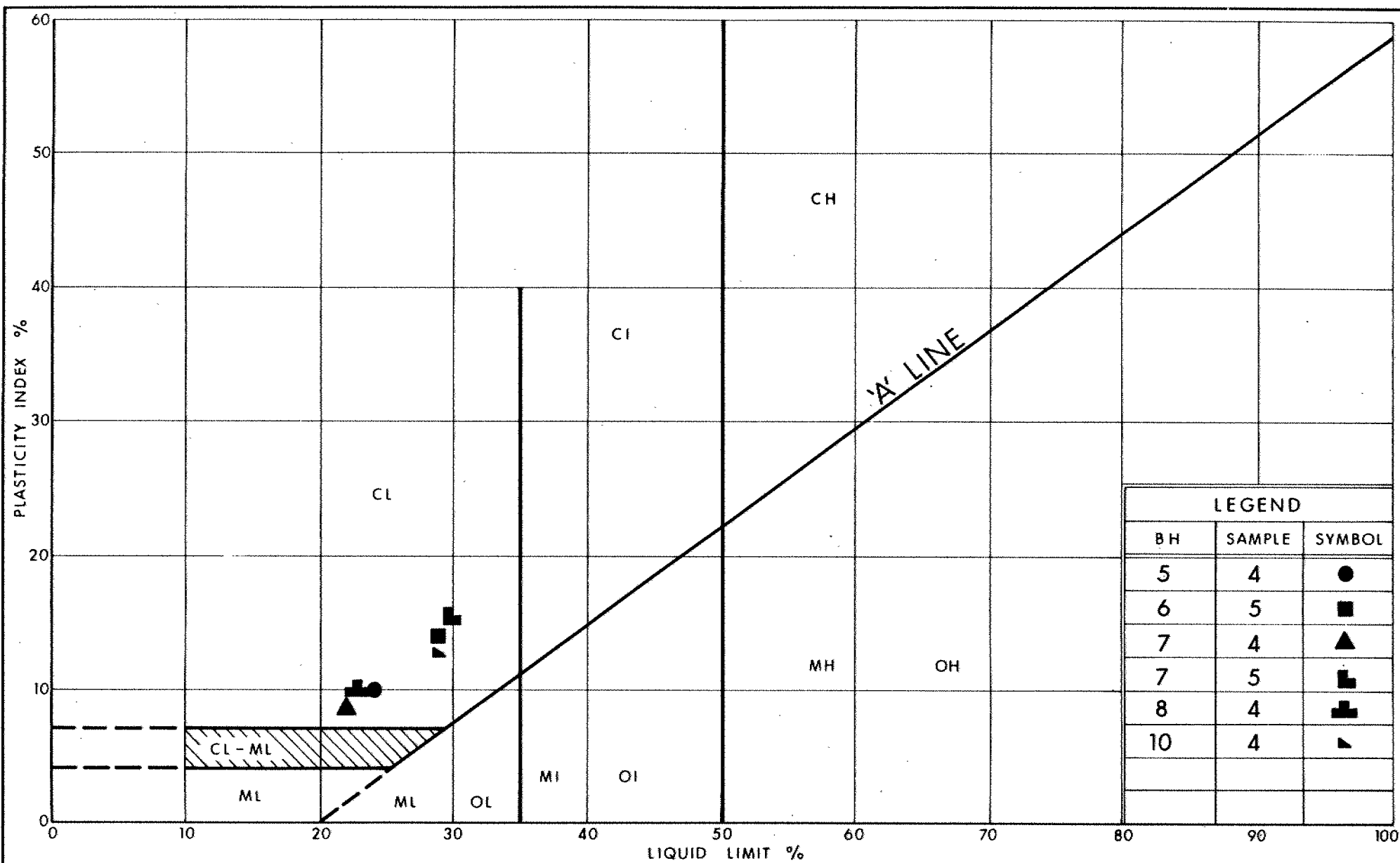
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GRAIN SIZE DISTRIBUTION SILTY CLAY

FIG No 2

W P 270-87-03



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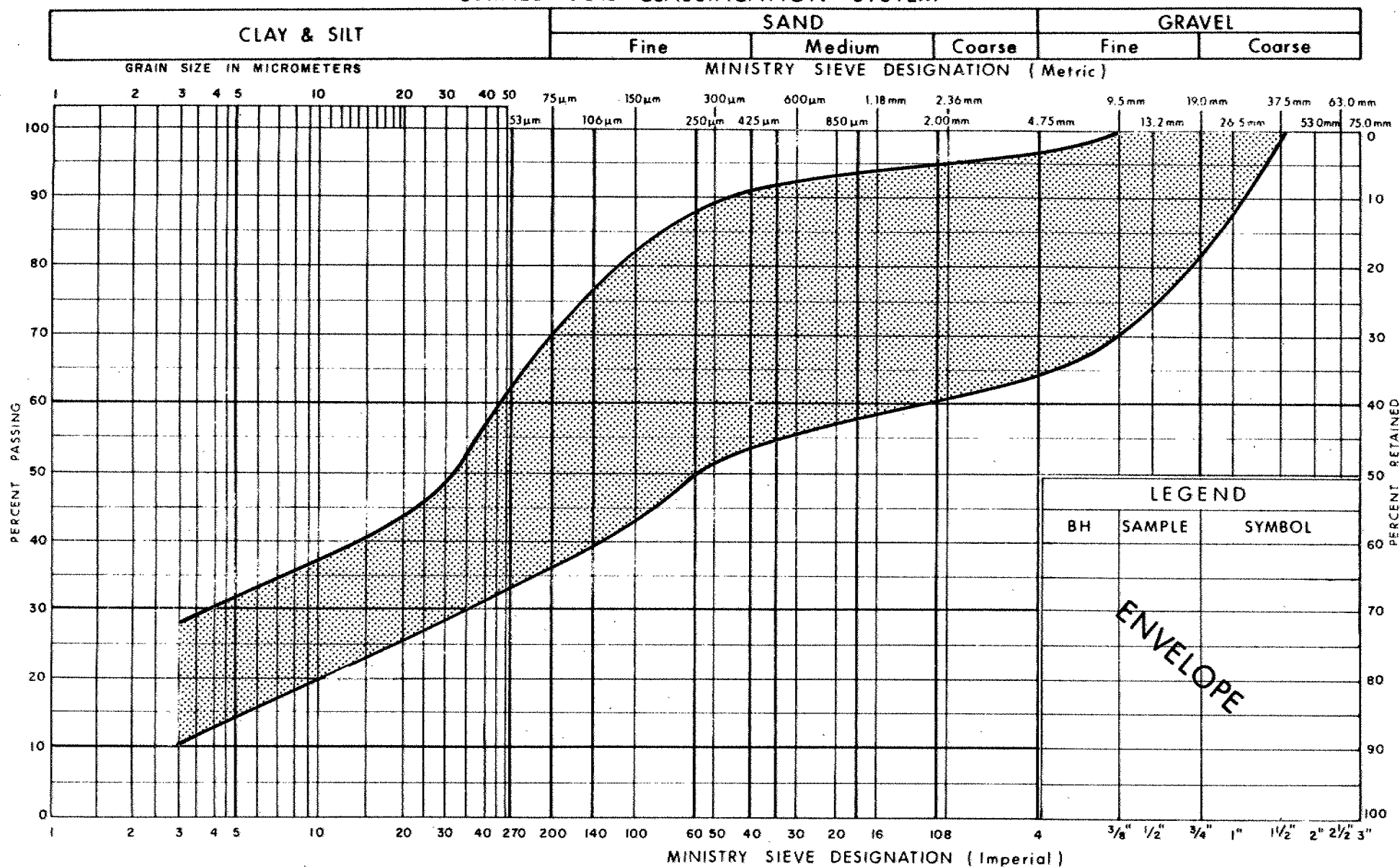
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PLASTICITY CHART SILTY CLAY

FIG No 3

W P 270-87-03

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF CLAYEY SILT,
SOME SAND, TRACE GRAVEL (GLACIAL TILL)

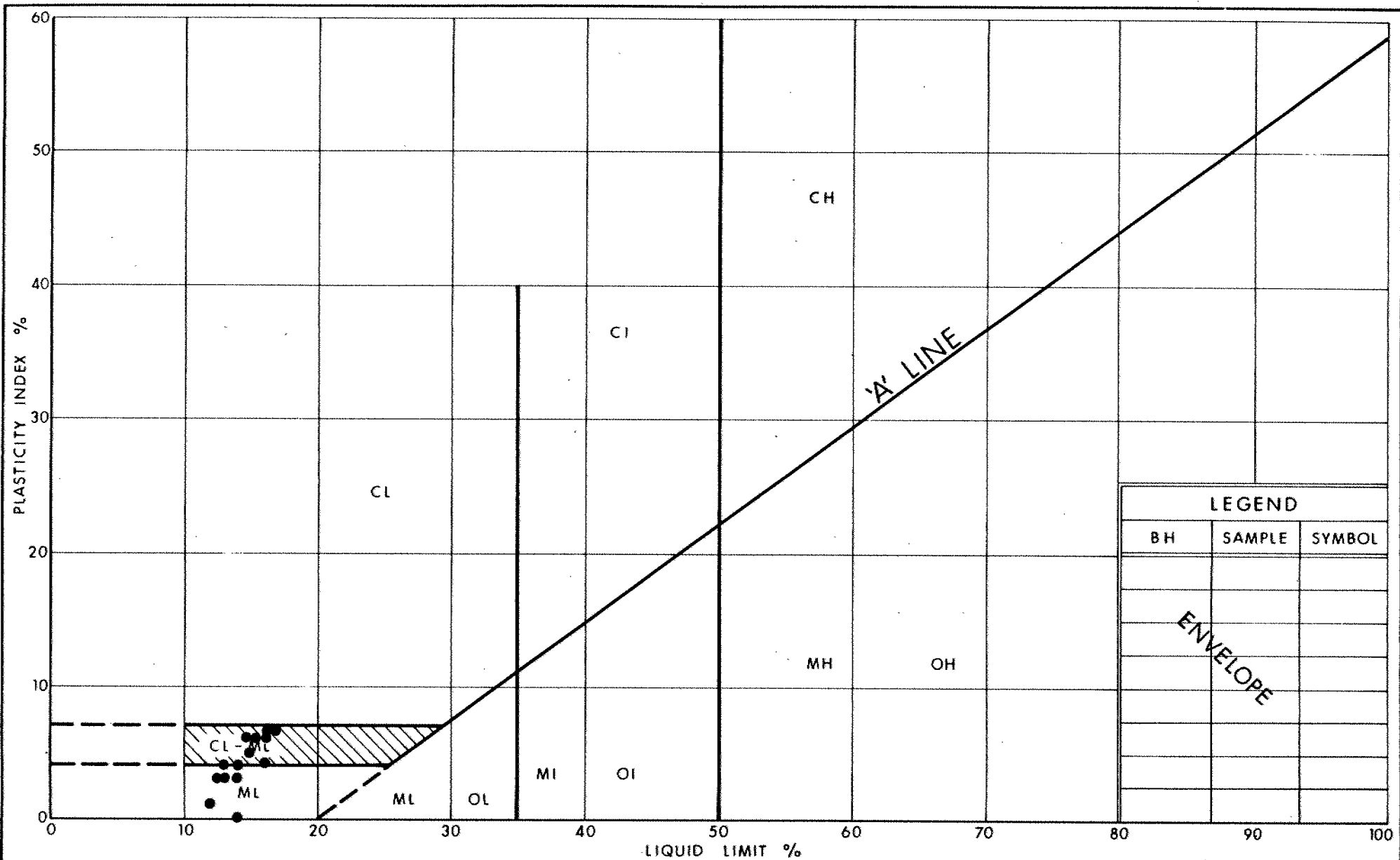
FIG No 4

W P 270-87-03



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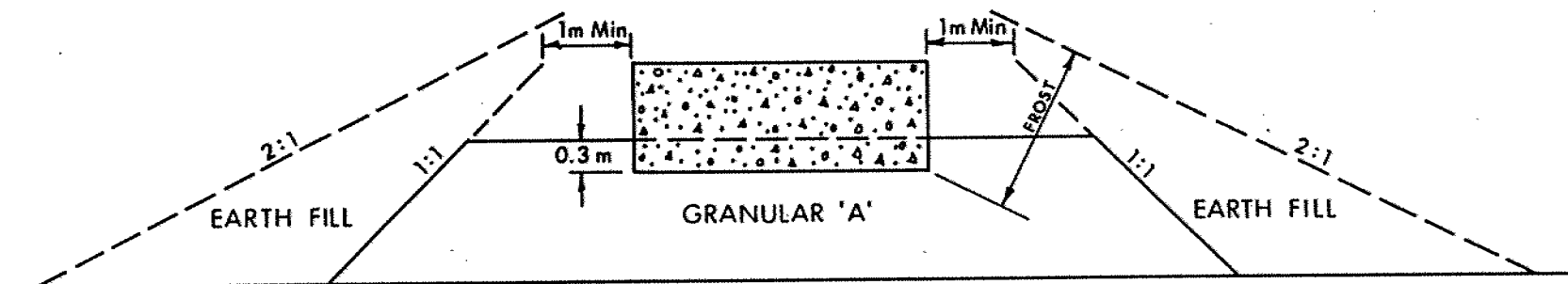


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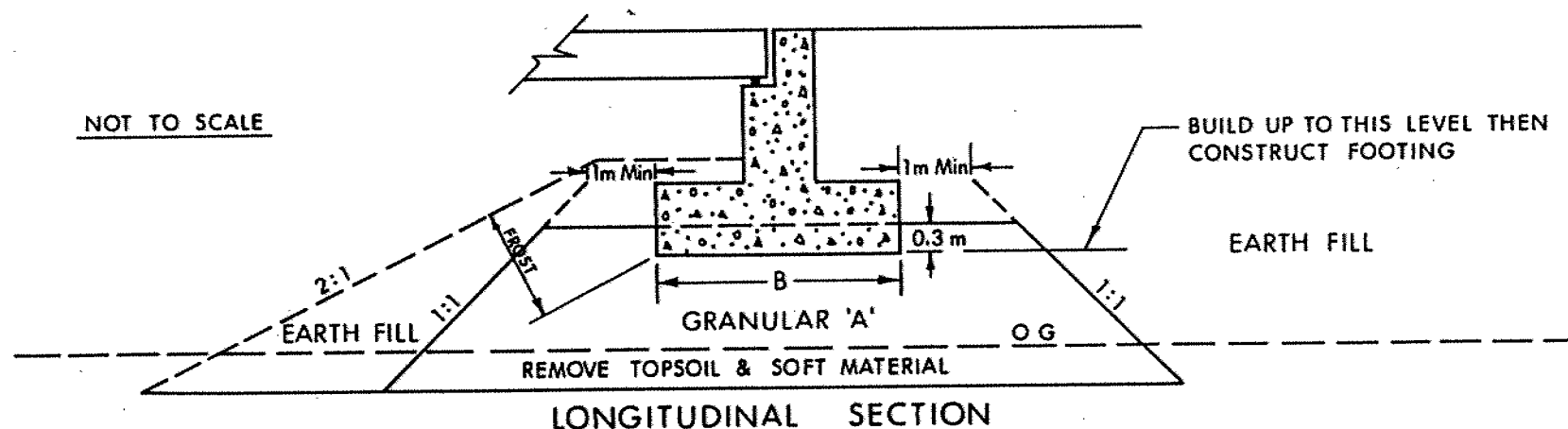
PLASTICITY CHART
HETEROGENEOUS MIXTURE OF CLAYEY SILT,
SOME SAND, TRACE GRAVEL (GLACIAL TILL)

FIG No 5

W P 270-87-03



X SECTION



NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



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ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 6

W P 270-87-03

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	T.P.	THINWALL PISTON
WS	WASH SAMPLE	O.S.	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	R.C.	ROCK CORE
BS	BLOCK SAMPLE	P.H.	T.W. ADVANCED HYDRAULICALLY
CS	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						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

WP 270-87-03 LOCATION Co-ords: N 4 851 885.0, E 334 649.2 ORIGINATED BY DK
 DIST 6 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 22 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT 7 kN/m ³	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _P	W	W _L		
105.9	Ground Surface																
0.0	Pavement Structure																
	Silt, trace Sand Brown, Dense		1	SS	36												0 9 84 7
103.7			2	SS	46		104										
2.1	Brown		3	SS	101											22.3	5 34 50 11
	Grey		4	SS	103		102										
			5	SS	100	/27cm											
			6	SS	100	/18cm	100										
			7	SS	105	/24cm											
	Heterogeneous Mixture of Clayey Silt, some sand trace gravel occasional Cobbles & Boulders Hard (Glacial Till)		8	SS	101	/24cm	98										4 30 40 26
			9	SS	100	/10cm	96										
			10	SS	101	/15cm											
	Boulders		11	SS	100	/13cm	94										
92.1			12	SS	101	/15cm											
13.8	End of Borehole																
	• Perched water table in the Silt layer noted upon completion of drilling																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 877.0; E 334 638.5 ORIGINATED BY DK
 DIST 6 HWY 401 BOREHOLE TYPE H.S. Augers, Cone COMPILED BY DT
 DATUM Geodetic DATE 92 09 21 CHECKED BY BI

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
105.9	Ground Surface													
105.4	Topsoil													
0.5	Silt, Some sand, Brown		1	SS	70									0 13 84 3
104.1	Very Dense		2	SS	61									
1.8	Clayey Silt, Brown		3	SS	102	/20cm								
			4	SS	78									
			5	SS	61									
	Heterogeneous Mixture of Clayey Silt, some sand, trace gravel, occasional cobbles and boulders, occasional sand seams Grey, Hard (Glacial Till)		6	SS	104	/18cm								
			7	SS	100									23.1 5 40 37 18
			8	SS	100	/25cm								
			9	SS	100	/10cm								
			10	SS	100	/25cm								24.1 8 36 35 21
93.6	Boulders		11	SS	100	/13cm								
12.3	End of Borehole													
	Hole filled with surface runoff and drilling fluid. Water level not determined													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 855.0; E 334 658.5 ORIGINATED BY DK
 DIST 5 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 23 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
106.1	Ground Surface																
0.0	Pavement Structure																
105.2																	
0.9	Silt, trace sand, occasional sand seams Very Dense Light Brown and Grey		1	SS	43	/28cm	104										0 14 81 5
			2	SS	99												
			3	SS	100												
			4	SS	100												
102.0																	
4.1	Heterogeneous Mixture of Clayey Silt, some sand trace gravel Occasional Silt layers Occasional Cobbles & Boulders Grey Hard (Glacial Till)		5	SS	70	/28cm	100										27 24 40 9
			6	SS	65												
			7	SS	100												
			8	SS	102												
97.4																	
8.7	End of Borehole	**															
	* Upon completion of drilling, trace of water at the bottom of the hole probably originated from the wet sand seams above. ** Drilling terminated on a big boulder																

1 OF 1

METRIC

DATUM Geodetic DATE 92 09 29 CHECKED BY Bl

DATUM Geodetic DATE 92 09 29 CHECKED BY Bl

DATUM Geodetic DATE 92 09 29 CHECKED BY Bl

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 798.0, E 334 672.0 ORIGINATED BY DK
 DIST 5 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 23 - 92 09 24 CHECKED BY BI

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	'N' VALUES			20	40	60	80	100					
105.5	Ground Surface																
0.0	50mm Asphalt over Clayey Silt (Fill)					DRY											
104.3			1	SS	6												
1.2	Silt, occasional wet sand seams, Brown, Very Dense		2	SS	62		104										
103.4																	
2.1	Clayey Silt, trace sand Grey and brown, Hard		3	SS	74												
102.5																	
3.0	Silty Clay, trace sand and gravel, Grey Very Stiff		4	SS	26		102									22.0	0 0 66 34
100.1			5	SS	21												
							100										
5.5	Heterogeneous Mixture of Clayey Silt, trace gravel some sand Occasional wet sand pockets Occasional cobbles and boulders Grey, Hard (Glacial Till)		6	SS	33												
			7	SS	80												
			8	SS	46		98										25.1 26 34 31 9
			9	SS	100	/20cm	96										9 38 39 14
							94										
			10	SS	100	/8cm											
			11	SS	110	/15cm	92										
90.2			12	SS	100	/13cm											
15.3	End of Borehole																
	* Hole dry upon completion of drilling																

METRIC

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 7

1 OF 1 METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 768.5; E 334 685.5 ORIGINATED BY DK
 DIST 5 HWY 401 BOREHOLE TYPE H.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 24 CHECKED BY BI

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
104.9	Ground Surface													
0.0	Clayey Silt, some sand trace gravel, some organics (Fill)		1	SS	3									
103.2			2	SS	13									
102.8	Silt, trace sand, Brown, Compact		3	SS	92									
2.3	Silty Clay Occasional stained joints Brown, Hard (Locustrine) Grey Stiff		4	SS	87									
			5	SS	14									
99.1			6	SS	36									
5.8	Heterogeneous Mixture of Clayey Silt some Sand, trace gravel Occasional cobbles and boulders Grey, Hard (Glacial Till)		7	SS	32									
			8	SS	50									
			9	SS	100	/25cm								
			10	SS	100	/14cm								
			11	SS	101	/14cm								
91.1			12	SS	100	/13cm								
13.8	End of Borehole													
	* Hole dry upon completion of drilling													

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 761.5; E 334 675.5 ORIGINATED BY DK
 DIST 6 HWY 401 BOREHOLE TYPE H.S./S.S. Augers, Tricone COMPILED BY OT
 DATUM Geodetic DATE 92 09 28 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT 7 kN/m ³	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _P	W	W _L		
104.7	Ground Surface																
104.3	Topsoil																
0.3	Clayey Silt, trace sand with stained joints Brown, Hard (Locustrine)		1	SS	45	/20cm	104						4				0 7 78 15
102.6			2	SS	100												
2.1	Silty Clay, Grey Very Stiff		3	SS	25		102										0 1 66 33
			4	SS	22												
100.5																	
4.3	Heterogeneous Mixture of Clayey Silt, trace sand and gravel Occasional cobbles and boulders Grey, Very Stiff to Hard (Glacial Till)		5	SS	22	/15cm	100										
			6	SS	64												
			7	SS	53		98						OH				17 36 35 12
			8	SS	37												
			9	SS	101	/10cm	96										
94.2			10	SS	100												
10.5	End of Borehole • Upon completion, hole filled with drilling fluid. Water Level not established																

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 910.0; E 334 641.2 ORIGINATED BY DK
 DIST 6 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 22 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID UNIT MOISTURE UNIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	w _p	w	w _L		
106.1	Ground Surface																
109.9	Pavement Structure																
0.6	Heterogeneous Mixture of Clayey Silt some sand, trace gravel Hard, Brown (Glacial Till)		1	SS	62												
			2	SS	100	/28cm											
102.9																	
			3	SS	101	/17cm											
3.2	End of Borehole																
	* Hole Dry upon completion with trace of seepage from Fill / Native soil interface																

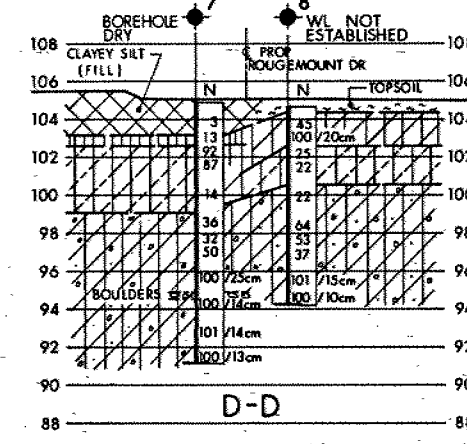
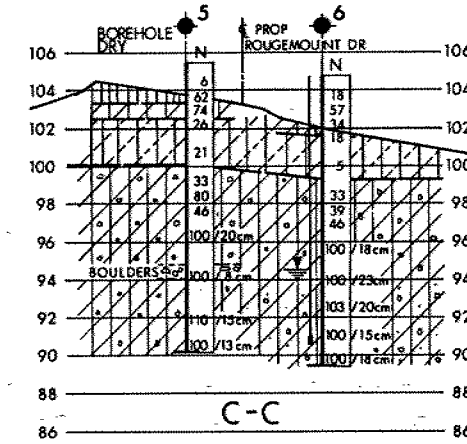
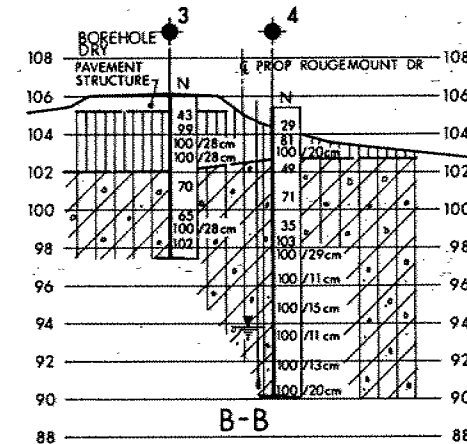
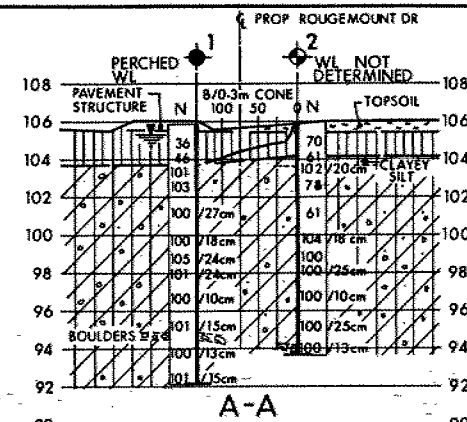
RECORD OF BOREHOLE No 10

1 OF 1

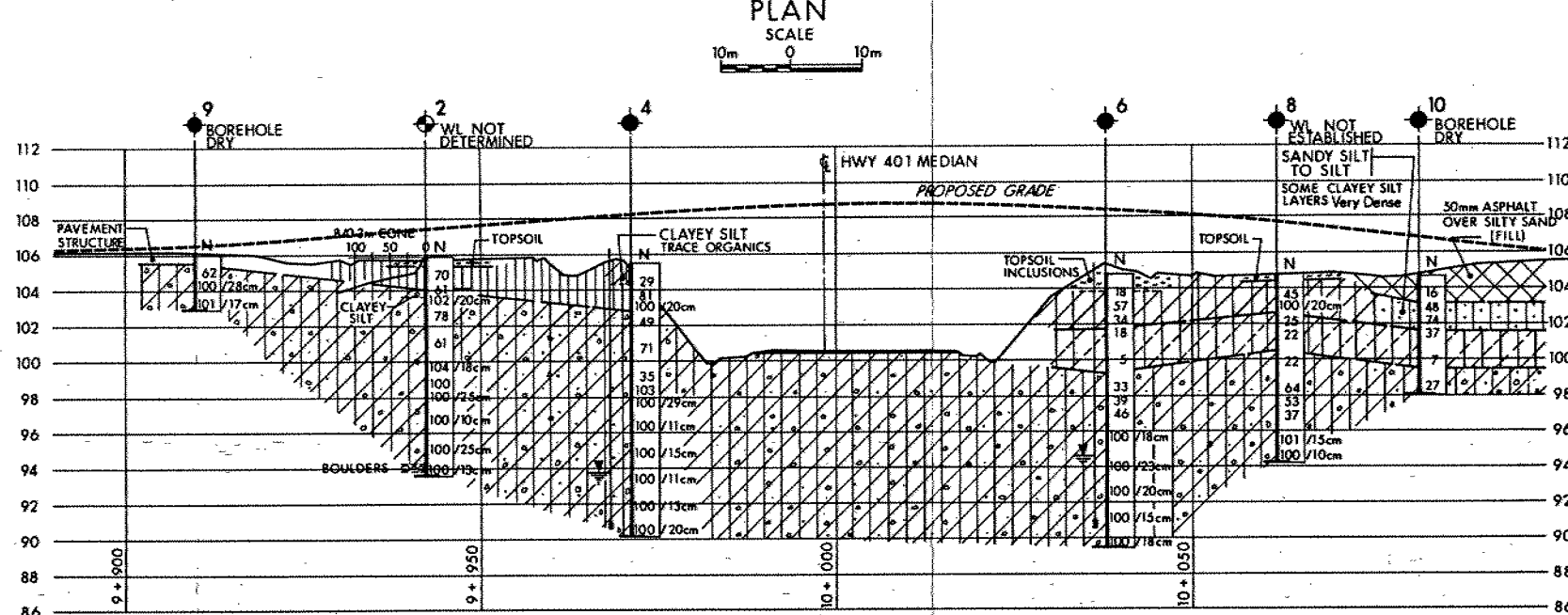
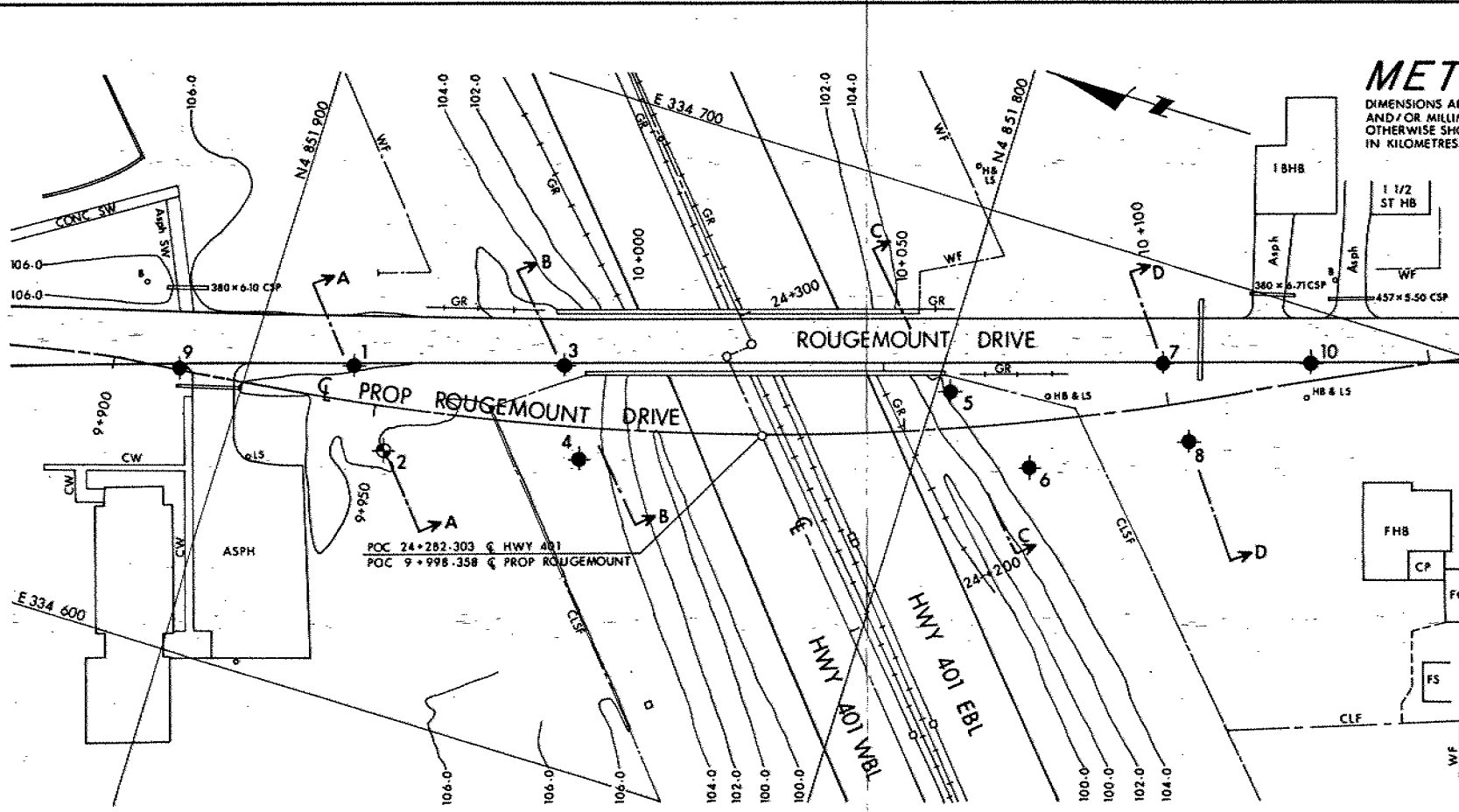
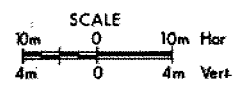
METRIC

W.P. 270-87-03 LOCATION Co-ords: N 4 851 747.5; E 334 692.2 ORIGINATED BY DK
 DIST 6 HWY 401 BOREHOLE TYPE S.S. Augers COMPILED BY DT
 DATUM Geodetic DATE 92 09 22 CHECKED BY BI

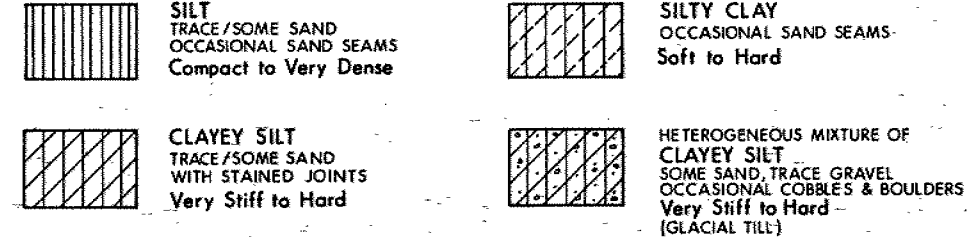
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
104.5	Ground Surface																
0.0	50mm Asphalt over Silty Sand (Fill)		1	SS	16		104										
103.1			2	SS	48												0 7 88 5
1.5	Sandy Silt to Silt, some Clayey Silt layers, Brown and Grey Very Dense		3	SS	74		102										
101.6			4	SS	37												0 0 60 40
3.0	Silty Clay Occasional wet sand packets, Grey Hard to Firm		5	SS	7		100										
99.5			6	SS	27												
5.2	Heterogeneous Mixture of Clayey Silt, some sand, trace gravel, Grey, Very Stiff (Glacial Till)																31 27 32 10
98.0																	
6.5	End of Borehole																
	• Upon completion, trace of water at the bottom of the hole; probably seepage from sand seams																



SECTIONS



SOIL STRATIGRAPHY LEGEND



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

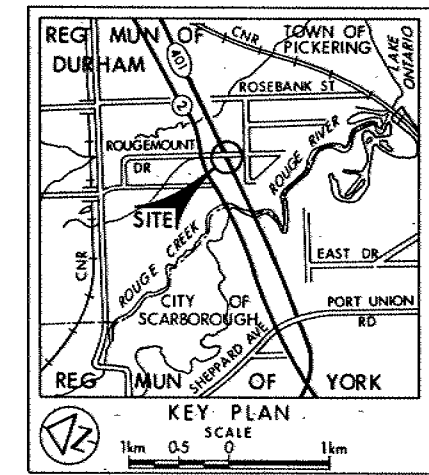
CONT No
WP No 270-87-03

ROUGEMOUNT DRIVE

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 92 09
- WL in Piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	105.9	4 851 885.0	334 649.2
2	105.9	4 851 877.0	334 638.5
3	106.1	4 851 855.0	334 658.5
4	105.5	4 851 848.5	334 645.9
5	105.5	4 851 798.0	334 672.0
6	104.8	4 851 783.1	334 664.5
7	104.9	4 851 768.5	334 685.5
8	104.7	4 851 761.5	334 675.5
9	106.1	4 851 910.0	334 641.2
10	104.6	4 851 747.5	334 692.2

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 GC 2.01 of OPS Gen. Cond.

REV	DATE	BY	DESCRIPTION
1			

Geocres No 30M14-224

HWY No 401		DIST 6
SUBMD OK	CHECKED	DATE 1992 11 24
DRAWN DT	CHECKED	APPROVED

SITE 22-162
DWG 2708703-A

MEMORANDUM

(416)235-3731

To: M.D. Billings
Head, Geotechnical Section
Central Region

Attn: K.D. Ganesh

From: Foundation Design Section
Room 315, Central Building
Downsview, Ontario

Re: Temporary Access Roads for Bridge Construction
Rougemount Drive Bridge Site
W.P. 270-87-00, Site: 22-162
District 6, Toronto

1994 07 06

We have reviewed the above mentioned proposal submitted by Delcan. We understand that temporary access roads would be constructed on either sides of Hwy 401 at the Rougemount Drive to facilitate construction of the new bridge.

The soil at the site is very competent, generally very stiff to hard silty clay to clayey silt overlying very stiff to hard glacial till and low groundwater table. Although, we were not provided the profiles of the access roads, we assume that the grade changes would be minor and therefore, we have no objection to the proposal.



K.S.Q. Ahmad, P. Eng.
Foundation Engineer

For

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

MEMORANDUM



To: G. Al-Bazi
Design Engineer
Structural Office
7th Floor, Atrium Tower

Date: December 29, 1993

From: Foundation Design Section
Room 315, Central Bldg.

Tel: 235-3731
Fax: 235-5240

Re: Design Recommendations for
Roadway Protection
Proposed Rougemount Drive Overpass
W.P. 270-87-03, Site 22-162
District 6, Toronto

This memo is to confirm the following items which were discussed at our meeting of 1993 12 10. Reference should be made to our previous memo dated 1993 11 22.

1. Passive pressures given in our previous memo are factored values.
2. For design of anchors, bond between grout and till beyond a 30° line (to vertical) shall be considered.
3. The factored skin resistance between grout and cohesive till shall be 60 kPa. With the above value, pull out tests are not needed for temporary shoring.

We trust that the above information is sufficient for your immediate needs.

A handwritten signature in cursive script, appearing to read "B. Iyer", written over a horizontal line.

B. Iyer, P. Eng.
Senior Foundation Engineer

BI/jb

memorandum



To: G. Al-Bazi, P. Eng.
Design Engineer
Structural Office
7th Floor, Atrium Tower

Date: 93 11 22

From: Foundation Design Section
Room 315, Central Building

Subject: Proposed Rougemount Drive Overpass
Hwy 401
W.P.270-87-03, Site 22-162
District 6, Toronto

Further to our recent telephone discussion (Al-Bazi/Kwok), we have received a letter from your consultant Wyllie & Ufnal dated 93 11 04 concerning the roadway protection design for the above structure. Drawing Nos. 1, 3 and 4 attached therein show the General Arrangement of the proposed structure and the Roadway Protection scheme.

Reference is made to the foundation report produced by this office for details of the subsoil conditions. In general, the subsurface stratigraphy at the north abutment and pier locations typically comprises a competent layer of silt overlying hard cohesive till material. At the south abutment and pier locations, a cohesive layer of clayey silt to silty clay is found between the silt and the till strata. Base groundwater table measured during the field investigation was at around El. $94 \pm$ m, which is generally below the caisson bottom elevations given in Drawing No. 4. However, perched water table in the silt layer and isolated wet seams in the till deposit can be expected.

Based on the above subsoil information, we have the following recommendations for the design of the temporary anchored wall for roadway protection:

- The active pressure to be used in the design should be equal to $0.3\gamma H$ and in a trapezoidal distribution as shown on the attached sketch. An average unit weight of 21 kN/m^3 may be used. Passive pressure should have a rectangular distribution with a magnitude of 150 kPa for till material and 60 kPa for silty clay material. Construction surcharge and water pressure should be accounted for in the design.
- For mobilization of pull out resistance, the entire anchorage body for the tie-backs should be located in the competent glacial till stratum. For design purpose, the factored skin resistance between grout and till material is 250 kPa. Selected pull out tests should be carried out during construction to confirm the assumed capacity.

- The overall stability of the anchorage system should be checked. Reference may be made to Canadian Foundation Engineering Manual for method of analysis and design assumptions.

- Bearing capacities for the soldier pile sockets are summarized as follows:

Founded on competent till -

Factored Bearing Capacity at ULS = 1000 kPa

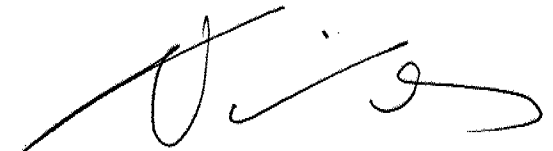
Bearing Capacity at SLS Type II does not control

Founded on Silty Clay -

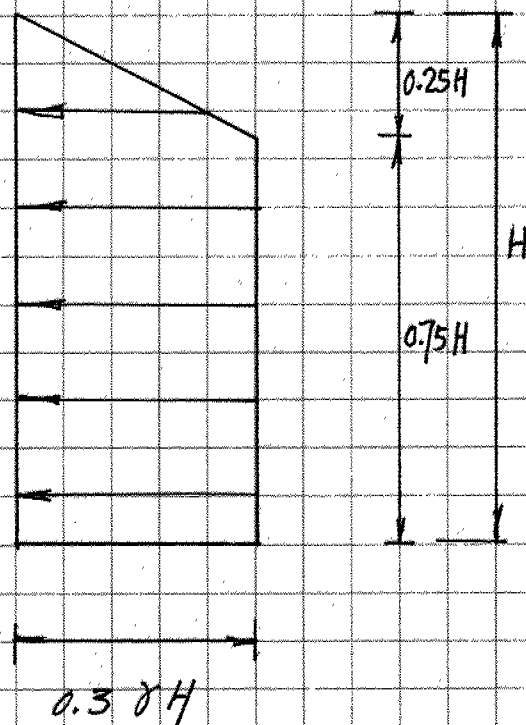
Factored Bearing Capacity at ULS = 450 kPa

Bearing Capacity at SLS Type II = 300 kPa

We believe the above is sufficient for the design. Should you require further input from our office, please call us.



David Kwok, P.Eng.
Project Foundation Engineer
for
Balu Iyer, P.Eng.
Senior Foundation Engineer



ACTIVE PRESSURE DISTRIBUTION

SEND
TOGeorge Al-Bazi
Structural Office

FROM

David Kwok

DEPT.

Foundation Design Section

DATE

93 05 28

SUBJECT

W.P. 270-87-03 Rougemount Drive Underpass

Your faxgram dated 93 05 28 refers. Based on the new footing widths and founding elevations suggested by your consultant, we have reviewed the foundation recommendations and found that the previous values are still valid, as follows:

North Abutment founding elevation - 101.7 m
 factored Bearing Capacity at U.L.S. = 1000 kPa
 Bearing Capacity at S.L.S. Type II = does not govern in
 the case of unyielding soil

REPLY

South Abutment founding elevation - 102.3 m
 factored Bearing Capacity at U.L.S. = 450 kPa
 Bearing Capacity at S.L.S. Type II = 300 kPa

REPLY FROM

REPLY DATE



Toronto, Ontario
May 27th, 1993

Ministry of Transportation, Ontario,
Structural Office,
7th Floor, Atrium Tower,
1201 Wilson Avenue,
DOWNSVIEW, Ontario.
M3M 1G8

Attention: Mr. George Al-Bazi, P. Eng.

Reference: Rougemount Drive Underpass
W.P. 27087-03, Site 22-162
District 6, Toronto
Wyllie & Ufnal Project No. 9301

Dear George:

Further to our telephone discussion on May 25th, 1993 please arrange with Foundation Section design bearing capacities for the following assumed footings:

North Abutment

- footing width - 3.00 m
- footing founded at el. 101.7 m

South Abutment

- footing width - 3.60 m
- footing founded at el. 102.3 m

Revised footing widths will enable us to achieve the maximum cost savings of the abutments.

Thank you for your help.

Yours very truly,
WYLLIE & UFNAL CONSULTANTS LTD.



T.M. Zeniuk, P. Eng.
Director, Structural Engineering

TMZ:ks

9301A

90 Birmingham Street, Toronto, Ontario M6V 3W6 (416) 252-5451
155 MacLaren Street, Ottawa, Ontario K2P 0K9 (613) 232-1107
111 Heritage Road, Suite 203, Chatham, Ontario N7M 5L3 (519) 364-4426

memorandum



To: G. Al-Bazi
Design Engineer
Structural Office
7th Floor, Atrium Tower

Date: 1993 04 07

From: Foundation Design Section
Room 315, Central Building

Re: Rougemount Drive Overpass at Hwy. 401
W.P. 270-87-03, Site 22-162
District 6, Toronto

We refer to your facsimile dated 93 04 07 and are pleased to provide the following additional foundation recommendations pertaining to the design of the captioned structure.

For the south abutment, an alternative to placing the footings on a granular pad is to found them directly on native silty clay at about El. 102.3 m. Based on an assumed footing width of 4 m, the design bearing capacities as per O.H.B.D.C. are as follows.

Factored Bearing Capacity at U.L.S. = 450 kPa
Bearing Capacity at S.L.S. Type II = 300 kPa

Please call our office should there be any questions.

A handwritten signature in black ink, appearing to be "D. Kwok", written over a horizontal line.

D. Kwok, P. Eng.
Project Foundation Engineer

for

B. Iyer, P. Eng.
Sr. Foundation Engineer

BI/DK/jb



Toronto, Ontario
April 2, 1993

Ministry of Transportation, Ontario,
Structural office,
7th Floor, Atrium Tower,
1201 Wilson Avenue,
DOWNSVIEW, Ontario.
M3M 1J8

Attention: Mr. George Al-Bazi, P. Eng.

Reference: Rougemount Drive Underpass
W.P. 270-870.3, Site 22-162
District 6, Toronto
Wyllie & Ufnal Project No. 9301

Dear George:

Please find enclosed a sketch of South Abutment for the above noted project. The bottom footing elevation is 102.30 m. The Foundation Report recommended removing the surficial fill and unsuitable material by sub-excavation down to elevation 102.650 m and backfilling with granular material to form a pad for placement of footings.

The project requirements place the footing below proposed sub-excavation level of 102.50 m within silty clay. As silty clay bearing capacity was not provided, we would appreciate it if you could arrange with the Foundation Section for this information to be made available.

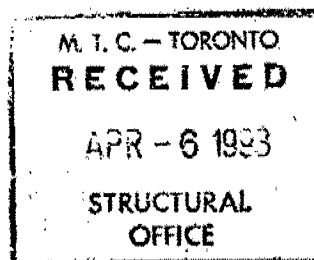
Thank you for your assistance.

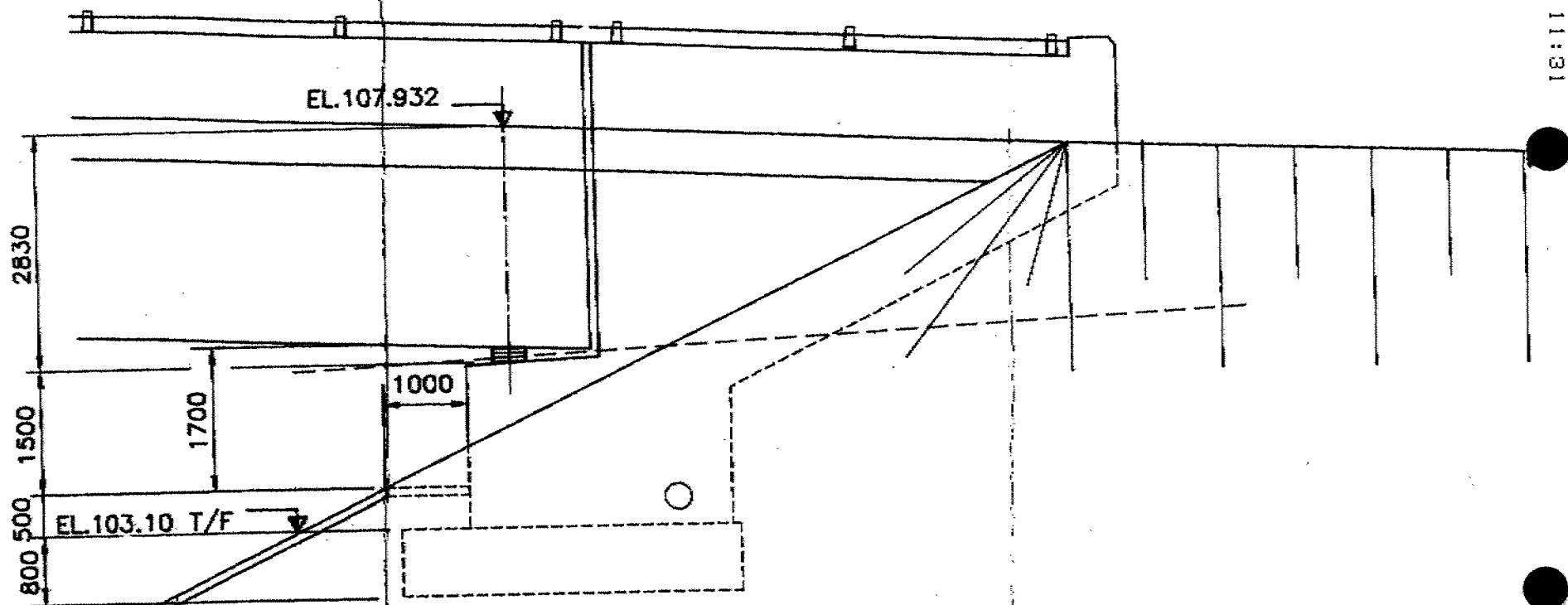
Yours truly,
WYLLIE & UFNAL CONSULTANTS LTD.

A handwritten signature in dark ink, appearing to read 'T.M. Zeniuk'.

T.M. Zeniuk, P. Eng.,
Director, Structural Engineering

TMZ:ks
Enclosure





ELEVATION SOUTH ABUT.

1:75

memorandum



To : V.F.Boehnke
Head of Structural Section
Central Region
Attention : S.A.I. Shamji

Date: 92 10 19

From : Foundation Design Section
Room 315, Central Building

Re : Highway 401, Rougemount Drive Underpass
W.P. 270-87-03, Site 22-162
District 6, Toronto

The field investigation for the above-noted project has been completed. This memorandum provides a summary of the subsurface conditions encountered at the site and engineering recommendations intended for design to proceed. The final foundation report will follow.

The site is located on Highway 401 at Rougemount Drive in the Town of Pickering, District of Toronto. There is an existing two span bridge structure supporting Rougemount Drive over Highway 401. The proposed structure is required for the reconstruction of Rougemount Drive due to widening of Highway 401 at this location.

The field work was conducted between 92 09 21 and 92 09 29 and consisted of ten (10) sampled boreholes taken down to 3.2-15.4 m depths. One copy each of the borehole location plan and preliminary record of borehole sheets is attached. The subsurface material encountered typically comprised of a surficial layer of silt/clayey silt overlying a major deposit of cohesive glacial till. A minor layer of silty clay was contacted on the south side of the highway above the glacial till stratum. Some fill and topsoil materials were found at the surface at isolated areas. The silt and clayey silt layers are typically in a dense to very dense and hard state respectively. The glacial till deposit comprises of a heterogeneous mixture of clayey silt, some sand, trace gravel. It is very competent with hard consistency. Some boulders were encountered in the till stratum during the investigation. The consistency of the silty clay layer encountered varies from soft to hard but typically in a very stiff state. The groundwater condition was monitored in the open boreholes and the piezometers installed in BH 4 and BH 6. The base groundwater table as measured in the piezometers is low-lying at around El. 94 ± m. Perched water table in the surficial silt layer was noted upon completion of drilling at BH 1. Laboratory tests are being carried out on the soil samples and the results will be included in the final report.

The project comprises replacement of the existing two span structure at

Rougemount Drive by a three span structure for the widening of Highway 401. This will involve further cutting back into the existing cuts on both sides of Highway 401.

The following are the engineering recommendations pertaining to the design and construction of the structure.

Foundation

Due to the existence of competent subsoil in this site, the foundation for the structure may be founded on conventional spread footings to achieve a cost effective design.

North Abutment -

For footings founded on cohesive glacial till material at El. 103.5 m and assuming a footing width of 4 m, the bearing capacities as per the O.H.B.D.C., are as follows. Due to the competence of the material at this level, it is considered as 'unyielding soil'.

Factored Bearing Capacity at U.L.S. = 1000 kPa

Bearing Capacity at S.L.S. Type II does not govern in the case of unyielding soil.

Alternatively, the footing may be founded higher in the dense to very dense silt stratum with the following bearing capacities.

Factored Bearing Capacity at U.L.S. = 860 kPa

Bearing Capacity at S.L.S. Type II = 500 kPa

Perched groundwater condition may be expected in the silt stratum and the material is susceptible to disturbance under uneven hydrostatic head. It is therefore imperative that a dewatering scheme be adopted prior to bulk excavation in the footing envelope to drain the water away. Dewatering may be in the form of oversized excavation with perimeter drainage ditches and sump pumps.

North Pier -

The proposed grade at this pier location is about El. 100 m. Footings may be founded as high as possible in the competent glacial till stratum, taking into account the minimum earth cover for frost protection. The design bearing

capacities as per O.H.B.D.C. are as follows.

Factored Bearing Capacity at U.L.S. = 1000 kPa

Bearing Capacity at S.L.S. Type II does not govern for unyielding soils

South Pier -

The proposed grade at this pier location is about El. 100.5 m. Footings may be founded as high as possible in the glacial till stratum below El. 99 m. The till material at this level is slightly less competent as revealed by the Standard Penetration Test 'N' values in BH 5 and BH 6, and hence reduced bearing capacities are recommended as follows.

Factored Bearing Capacity at U.L.S. = 1000 kPa

Bearing Capacity at S.L.S. Type II = 600 kPa

South Abutment -

At this abutment location, the competent till stratum is overlain by layers of clayey silt/silty clay material. It would be uneconomical to excavate down to the till stratum for footing construction. It is therefore recommended to remove the surficial fill and unsuitable material by subexcavating down to El. 102.5 m and backfilling with granular material to form a pad for placement of footings, as illustrated in Figure 1 attached. The granular pad should be constructed to a minimum 1 m edge distance from the top of the footing to the crest of the pad and with 1H:1V slopes. All footings should be protected against frost penetration and consequently a 1.2 m earth cover is required. The Granular 'A' material must be placed and compacted to achieve 100% of the Proctor maximum density as outlined in OPSS 501.08.02 (Method A). Any softened and/or unsuitable material present within the natural subgrade must be removed prior to the placement of the granular pad. For the purpose of the O.H.B.D.C., the following bearing capacities can be used in the foundation design.

Factored Capacity at U.L.S. = 900 kPa

Bearing Capacity at S.L.S. Type II = 350 kPa

General -

All footings should have a minimum earth cover of 1.2 m for frost protection.

Reduction for the inclination of loading on the shallow foundation shall be carried out in accordance with Section 6.7.3.3.5 of the O.H.B.D.C.

The computation of the sliding resistance of the foundation shall be carried out in accordance with Section 6-7.3.3.2 of the O.H.B.D.C. the following unfactored friction angles can be used between the concrete footing and the founding material.

<u>Founding Material</u>	<u>δ</u>
Granular 'A'	35°
Silt	32°
Cohesive Till	28°

Backfill

Backfill to abutments should consist of granular material in accordance with MTO Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6-6.1.2.1 of the O.H.B.D.C. The active condition will govern earth pressure design for the yielding condition while the at-rest condition will govern earth pressure design for the unyielding condition. For design purposes, the following properties for backfill are recommended :

<u>Material</u>	<u>ϕ</u>	<u>γ</u>	<u>K_o</u>	<u>K_a</u>
Granular 'A'	35 degrees	22.8kN/m ³	0.43	0.27
Granular 'B'	30 degrees	21.2kN/m ³	0.50	0.33

Slope Stability

For widening of Highway 401, further cutting back into the existing slopes is required on both sides of the highway. The final slope will be in the order of 7.5 m high and be a combination of cut and fill. No deep seated slope failures are anticipated for the recommended geometry. However, surficial instabilities have been reported to have occurred after the construction of the existing Highway 401 in this general area. A previous report from our office on the stability of the existing cuts (W.P. 87-87-00(C)) has recommended a 2 m wide mid-height berm for cuts

higher than 6 m. In addition, due to the anticipated instabilities triggered by seepage zones in the non-cohesive silt and sand seams that are randomly distributed in the overburden, a 0.6 m thick granular blanket was recommended on the lower half of all slopes higher than 4.5 m.

It is recommended that all cut and fill slopes be formed at a gradient of 2H:1V or flatter with a 2 m wide mid-height berm for slopes higher than 6 m. A drainage blanket should be provided as mentioned above. Normal slope vegetation should be established as soon as possible after completion of the cut/fill operation in order to control surficial erosion.

Shoring

Temporary excavation for footing construction will be in the order of 2 m or less and can be carried out with 1H:1V gradient. No shoring is considered necessary unless the excavation comes very close to the footings of the existing Rougemount Drive Underpass. If shoring is required, please contact this office for soil design parameters.

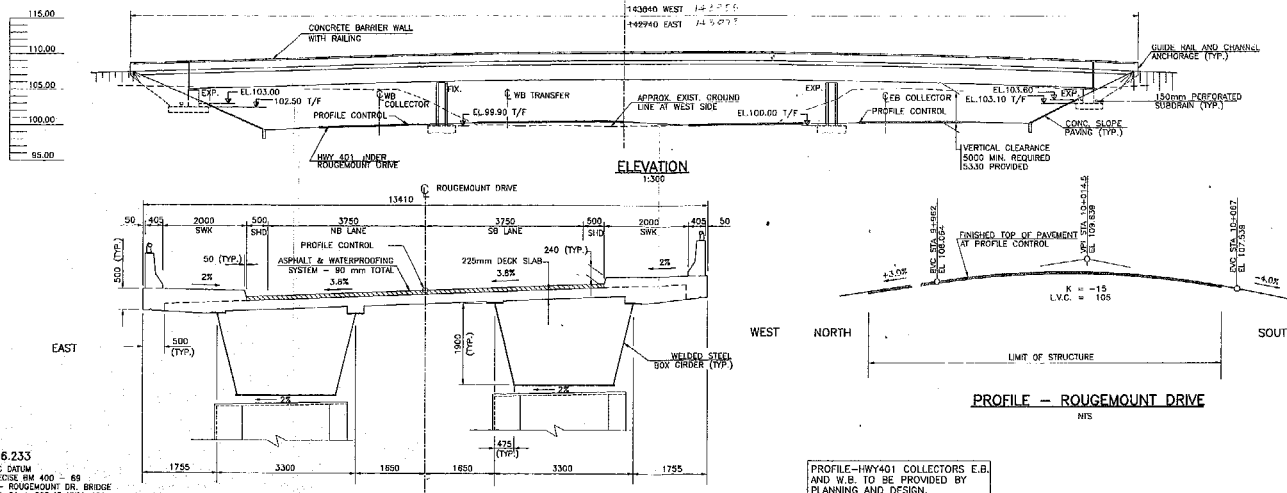
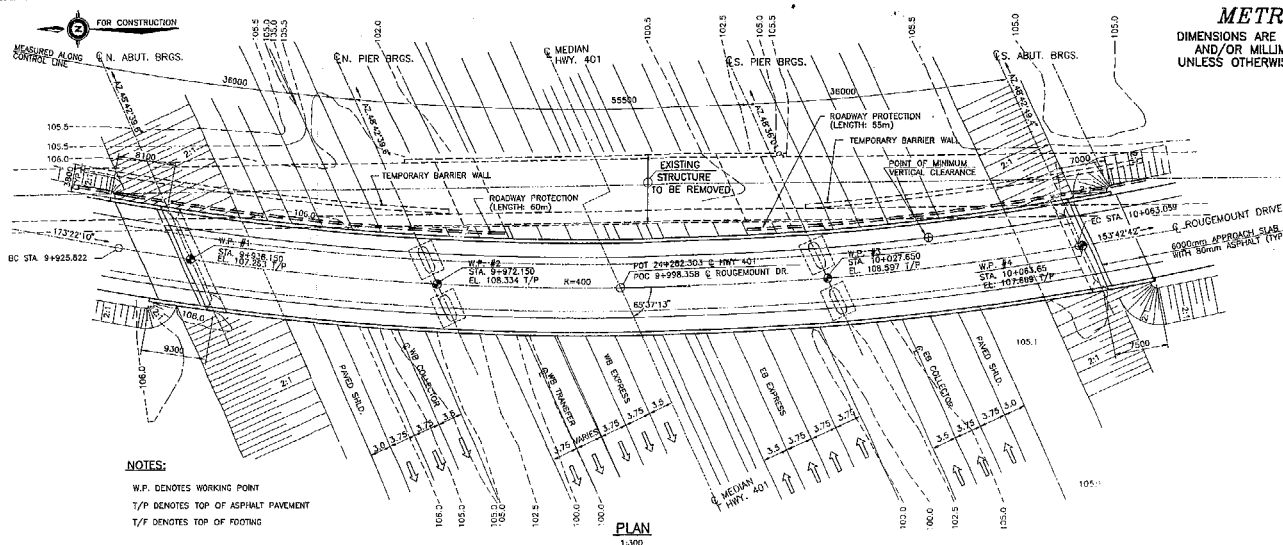
Construction Considerations

The field investigation has revealed layers of boulders and cobbles in the glacial till strata. Provisions should also be made in the contract document to take into account possible obstructions during excavations.

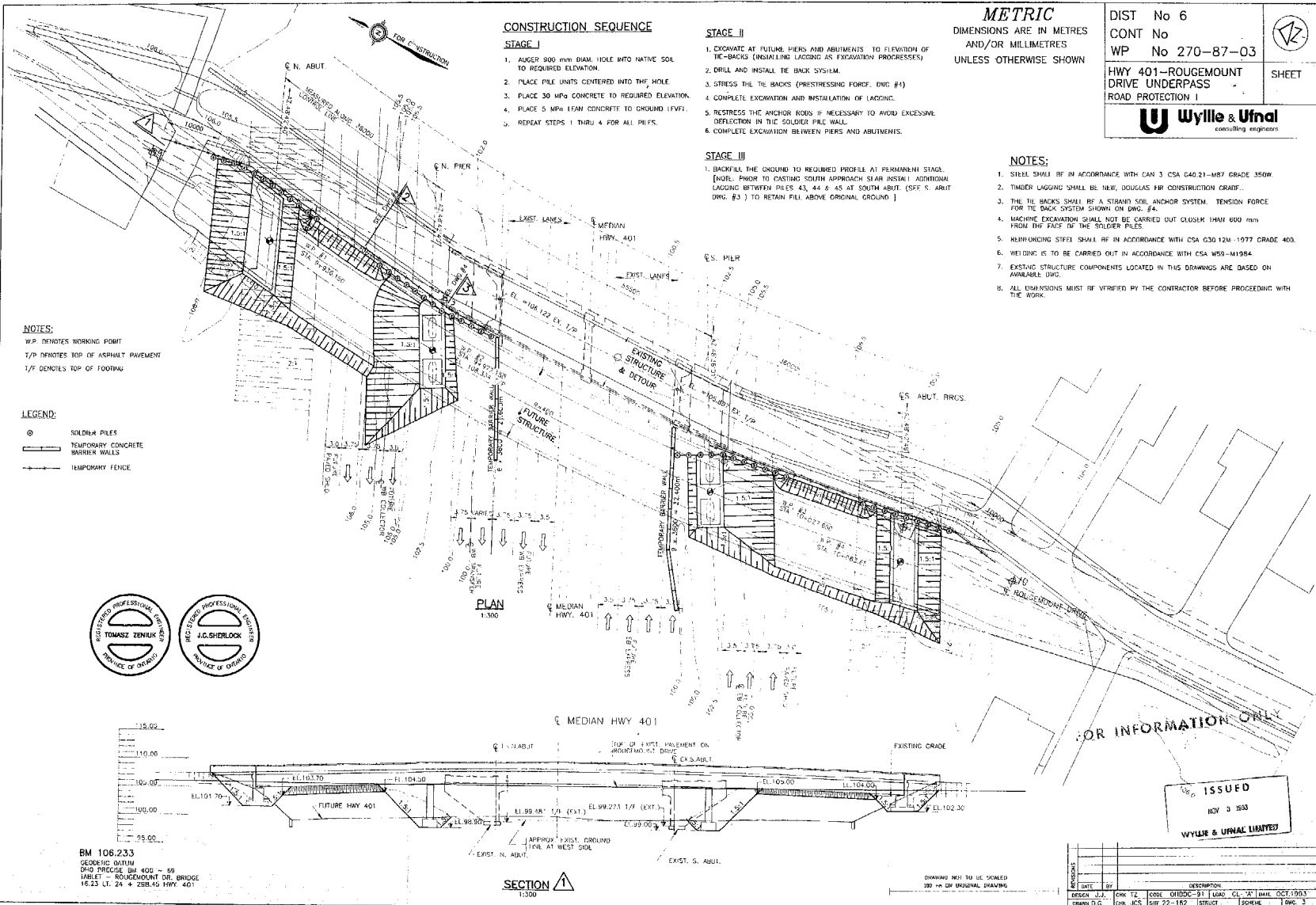
We believe that the above is sufficient for the present purpose. Should you have any question or require further information, please call us.



D. Kwok, P. Eng.
Project Foundation Engineer
for
B. Iyer, P. Eng.
Senior Foundation Engineer



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



REVISIONS										
DATE		BY		DESCRIPTION						
DESIGN	J.J.	CHK	TZ	CODE	0100C-91	LOAD	CL-A	DATE	OCT. 1993	
DRAWN	T.G.	CHK	ICS	SITE	22-182	STRUCT	SCHULE	DWG.	3	

BH9

11

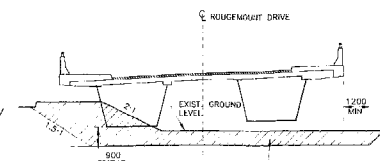
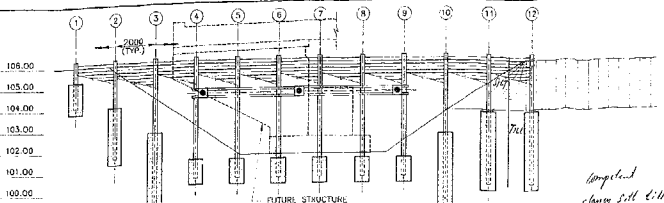
BH1

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES

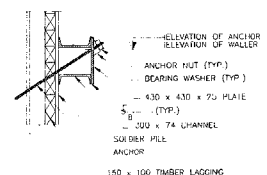
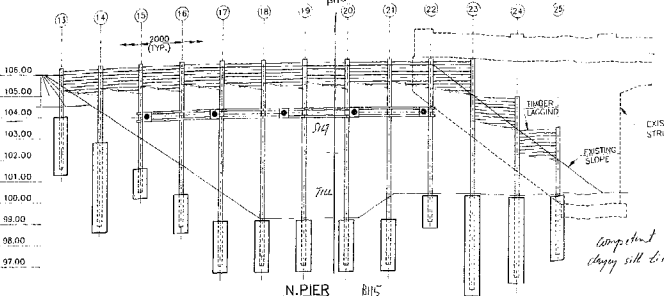
CONT No
WP No 270-87-03
HWY 401-ROUGEMOUNT
DRIVE UNDERPASS
ROAD PROTECTION II

SHEET

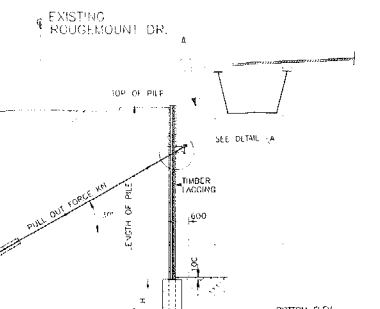
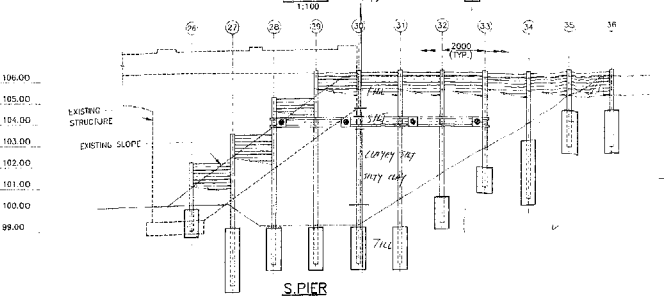
Wyllie & Wlral
consulting engineers



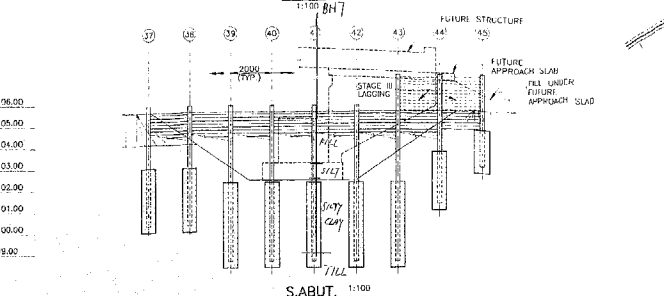
SECTION
(FROM DWG #3)
1:100



DETAIL
1:20



SECTION
(FROM DWG #3)
1:100



PILE NUMBER	BOU. EL.	II	D	DESIGNATION	TOP EL.	LENGTH	DESIGNATION	EL.	LENGTH	EL.	ANCHOR LOCATION	PULL OUT FORCE KN (LBS)	NOTES
NORTH ABUTMENT													
1	103.80	1.50	700	W310x39	106.30	2.20							
2	101.35	2.70	700	W310x39	106.30	4.65							
3	98.10	4.20	700	W310x179	106.30	7.80							
4	100.30	1.20	700	W310x39	106.30	4.70							
5	100.30	1.20	700	W310x39	106.30	4.70							
6	100.30	1.20	700	W310x39	106.30	4.70							
7	100.30	1.20	700	W310x39	106.30	4.70							
8	103.30	1.20	700	W310x39	106.30	4.70							
9	100.30	1.20	700	W310x39	106.30	4.70							
10	98.10	4.50	700	W310x39	106.30	7.80							
11	99.90	3.70	700	W310x39	106.30	7.00							
12	99.90	3.70	700	W310x39	106.30	7.00							
NORTH PIER													
13	101.30	2.70	700	W310x39	106.30	4.70							
14	98.50	4.20	700	W310x179	106.30	7.50							
15	100.00	1.40	700	W310x79	106.30	6.00							
16	98.30	1.80	700	W310x179	106.30	7.70							
17	95.40	2.40	700	W310x179	106.30	9.60							
18	96.50	2.40	700	W310x179	106.30	9.60							
19	95.40	2.40	700	W310x179	106.30	9.60							
20	96.40	2.40	700	W310x179	106.30	9.60							
21	96.40	2.40	700	W310x179	106.30	9.60							
22	98.40	1.50	700	W310x79	106.30	7.80							
23	95.20	4.70	700	W310x79	106.30	10.80							
24	95.90	4.00	700	W310x79	106.30	8.40							
25	96.90	3.00	700	W310x39	106.30	5.90							
SOUTH PIER													
26	98.50	1.30	700	W310x39	106.30	3.20							
27	90.90	3.00	700	W310x39	106.30	7.10							
28	96.90	2.00	700	W310x179	106.30	7.80							
29	96.90	2.00	700	W310x179	106.30	9.00							
30	96.90	2.00	700	W310x179	106.30	9.00							
31	96.90	2.00	700	W310x179	106.30	9.40							
32	98.90	1.50	700	W310x79	106.30	7.10							
33	100.50	1.20	700	W310x39	106.30	5.40							
34	100.00	3.00	700	W310x79	106.30	5.80							
35	100.30	2.00	700	W310x39	106.30	3.60							
36	102.30	2.00	700	W310x39	106.30	3.60							
SOUTH ABUTMENT													
37	99.90	3.00	700	W310x39	106.30	5.80							
38	99.90	3.00	700	W310x39	106.30	5.80							
39	98.20	4.00	700	W310x79	106.30	7.30							
40	98.20	4.00	700	W310x79	106.30	7.30							
41	98.20	4.00	700	W310x79	106.30	7.30							
42	98.20	4.00	700	W310x79	106.30	7.30							
43	98.20	4.00	700	W310x79	106.30	7.30							
44	100.90	2.70	700	W310x39	106.30	6.00							
45	102.80	2.00	700	W310x39	106.30	4.30							

FOR INFORMATION ONLY

(X ANCHOR FORCES SUBJECT TO CHANGE)

ISSUED
DATE 8 NOV 1993



DRAWING NOT TO BE SCALED
FOR ANY OTHER DRAWING

DATE	BY	CHK	APP	DATE	DESCRIPTION
1993	11/11	11/11	11/11	11/11	11/11
1993	11/11	11/11	11/11	11/11	11/11
1993	11/11	11/11	11/11	11/11	11/11