

GEOCRES No. 31F-112DIST. 9 REGION W.P. No. 107-90-01CONT. No. W. O. No. STR. SITE No. 3-597HWY. No. 17LOCATION Hwy 17 & Panunze Dr.No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

SHEET

MP

3. **REINFORCING STEEL**

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH SUFFIX "C" DENOTE COATED BARS.

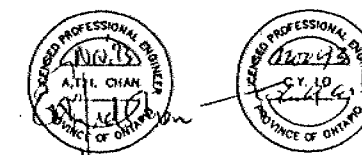
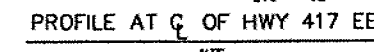
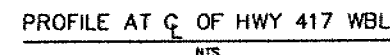
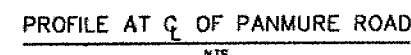
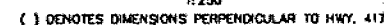
4. **CONSTRUCTION NOTES**

THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.

1. GENERAL ARRANGEMENT
2. BATH HOLE LOCATIONS & SOIL STRATA
3. FOUNDATION LAYOUT
4. FOOTING REINFORCING
5. ABUTMENTS
6. WINGWALLS I
7. WINGWALLS II
8. PIER AND BEARING DETAILS
9. DECK DETAILS
10. LONGITUDINAL TENDONS
11. TRANSVERSE TENDONS
12. DECK REINFORCING - I
13. DECK REINFORCING - II
14. DECK REINFORCING - III
15. BARRIER WALL W/O RAILING
16. JOINT ANCHORAGE AND ARMOURING
17. 6000 MM APPROX SLAB
18. DETAILS OF CONC. SLOPE PAVING
19. STANDARD DETAILS
20. QUANTITIES - STRUCTURE

T/F	TOP OF FOOTING
T/C	TOP OF CONCRETE
T/P	TOP OF PAVEMENT (OR TOP OF CONC. DAM)
WP	WORKING POINT

OPSD-3501.00	GRANULAR BACKFILL REQUIREMENTS, ABUTMENTS
OPSD-3906.02	BRIDGE DECK WATERPROOFING
OPSD-4010.00	GUIDE RAIL AND CHANNEL ANCHORAGE
OPSD-4602.00	FALSEWORK CLEARANCES



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

QUAD 45076SE LINE 354
CULV. UNDER HWY 17 AT JCT WITH FITZROY-
HUNTLEY TWP LINE, TABLET IN TOP OF NE END
OF CULV. 11.4LT 9+886.3 WBL

[illegible]



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Transportation and
Communications

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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 107-90-01 DIST 9
HWY 17 STR SITE 3-597

Proposed Underpass at
Highway 17 and Panmure Drive

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FOUNDATION INVESTIGATION REPORT

For

Proposed Underpass at

Highway 17 and Panmure Drive

W.P. 107-90-01, Site 3-597

District 9, Ottawa

INTRODUCTION

This report summarizes the results of the foundation investigations conducted at Highway 17 and Panmure Drive. The investigations were carried out upon the request of Eastern Region Structural Section for the proposed underpass due to widening of Highway 17. The preliminary investigation was conducted between 91 10 16 and 91 10 17 and consisted of two (2) sampled boreholes and one hand dug hole. Subsequent to the preliminary investigation, an "E" plan was produced for the structure. It was considered necessary to supplement the preliminary data with additional boreholes at the locations of the footing elements. The field work for the final investigation was carried out between 92 12 15 and 92 12 18 and consisted of seven (7) sampled boreholes and one (1) probe hole advanced at abutment and pier locations.

SITE DESCRIPTION

The site is located at the intersection of Highway 17 and Panmure Drive in the Township of West Carleton, District of Ottawa.

The topography of the area is generally flat with 1 to 2 m high road embankments. The low lying areas are generally grassed. The ditches north of Highway 17 on both sides of Panmure Drive are swampy. Land-use around the structure location is mainly a traffic corridor.

Physiographically, the site lies in a region known as Smith Falls limestone plain (after Chapman and Putnam, 1984). This region is characterized by shallow soil over limestone. The bedrock in the area belongs to the Beckmantown Group and includes grey limestone, magnesian limestone, etc. There are scattered small

patches of till at places.

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 preliminary investigation was carried out between 91 10 16 and 91 10 17 and consisted of two sampled boreholes and a hand-dug hole which were advanced to a maximum depth of 7.6 m. Details of the investigation procedures are included in the preliminary foundation investigation report dated 92 03 09. The record of borehole sheets were extracted and attached in the Appendix of this report (BH1-BH3)

The field work for the final investigation was carried out between 92 12 15 and 92 12 18 and consisted of seven (7) sampled boreholes and one (1) probe-hole advanced to a maximum depth of 5.5 m.

The boreholes were advanced using conventional hollow stem augering techniques supplemented by wash-boring and coring in the bedrock. A track mounted continuous flight auger drill rig was employed for the operation. 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 (N) values for assessment of the denseness of the non-cohesive material. The samples collected were used for identification and laboratory testing purposes. Dynamic cone penetration test was carried out at BH4 location. Conventional rock coring techniques were applied in retrieving rock core samples in the bedrock for rock quality determinations and classification purposes. Standard "B" size casing and core barrels were utilized. Rock coring was carried out in BH6 and BH8. Hand probing was done in BH4 with a bar to determine the thickness of the soft organic layer.

Ground water levels were monitored throughout the duration of the investigation in open boreholes. 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 Eastern Region, Surveys and Plans Section.

Laboratory

The laboratory testing program for select soil samples consisted of:

- Atterberg Limits
- Grain Size Distribution
- Unit Weight Determinations
- Natural Moisture Content
- Organic Content Determinations

Laboratory test results on samples from the preliminary and final investigations are summarized in the following section of this report. They are also illustrated on the Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

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 in Dwg. No. 1079001-A.

The predominant soil strata encountered in the boreholes consisted of cohesive/non-cohesive glacial till overlying bedrock. Surficial layers of topsoil or peat were found in the low-lying areas and where the boreholes were advanced through the existing pavement, a layer of granular fill was contacted.

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

Silty Sand with Gravel (Granular Fill)

The granular fill layer is encountered at the surface of BH4 and BH7 to a maximum depth of 1.6 m. It forms the pavement structure of the road. Laboratory tests carried out on a sample indicated moisture content of 7% and grain size distribution of 59% gravel, 32% sand and 9% silt and clay.

Peat

This organic material is contacted in a swampy area where BH6, BH9 and BH10 are located. It is up to 1.5 m in thickness and has been described as organics, some sandy silt, trace gravel, occasional woodchips.

The result of laboratory testing performed on a sample showed an organic content of 10.7%. The material is typically in a very loose to loose state of denseness.

Silty Sand with Organics (Topsoil)

This organic layer is encountered in BH1 to BH5 to a maximum depth of 1.8 m.

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%)	37 - 40.5	2
Grain Size Distribution (%)		1
Gravel	32	
Sand	30	
Silt and Clay	38	
Organic Content (%)	12.9	1

The Standard Penetration resistance "N" values range from 1 to 3 indicating very loose state of denseness.

Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)

This cohesive stratum is contacted in BH1 and BH4. The thickness of this layer varies from 0.2 m to 2.8 m. The material is described as a heterogeneous mixture of clayey silt, sand and gravel.

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%)	15.0 - 19.0	2
Liquid Limit (W_L %)	17.0 - 34.0	2
Plastic Limit (W_p %)	12.0 - 16.5	2
Unit Weight (kN/m^3)	19.7	1
Grain Size Distribution (%)		
Gravel	6 - 21	
Sand	18 - 40	
Silt and Clay	54 - 61	

Figure 1 illustrates a grain size distribution envelope for this material. Figure 2 illustrates a plasticity chart for this material. Based on it, the material can be classified as being slightly plastic.

The Standard Penetration Resistance "N" values obtained range from 20 to 71 blows/0.23 m. The material has a very stiff to hard consistency.

Heterogeneous Mixture of Silty, Sand, Clay and Gravel (Glacial Till)

This non-cohesive layer is contacted in BH5, BH8, BH9 and BH10. The material is typically described as a heterogeneous mixture of silty sand, clay and gravel.

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%)	6.5 - 20.5	3
Liquid Limit (W_L %)	13.5 - 18.0	2
Plastic Limit (W_p %)	9.5 - 14.5	2
Grain Size Distribution (%)		3
Gravel	15 - 31	
Sand	14 - 42	
Silt and Clay	27 - 71	

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

The Standard Penetration Resistance "N" Values obtained range widely from 3 to over 59 blows/0.26 m, indicating very loose to very dense denseness but typically compact to dense.

Bedrock

Bedrock was generally encountered at shallow depths throughout the site. It dips gently from El. 136.0 \pm m at the north abutment location to El. 137.6 \pm m at the south abutment location. Bedrock was cored in BH1, BH2, BH6 and BH8. The rock cores obtained are used for rock quality determination and classification. Detailed description of the rock are attached in the Appendix.

Bedrock is a limestone of the Bobcaygeon formation. Core recoveries and Rock Quality Designations range from 44 to 100% and 0 to 24% respectively. The rock is considered medium strong.

GROUNDWATER

Groundwater levels were measured in boreholes during the course of the investigation. The water table encountered was typically close to the ground surface, with elevations generally between 137.5 to 138.5 \pm m.

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

DISCUSSION AND RECOMMENDATIONS

General

The proposed underpass at Panmure Drive is required due to widening of Highway 17. The proposed structure is a two span bridge with equal span lengths of $51\pm$ m. The width of the structure is 17 m. The height of the approach fills is about $8\pm$ m.

A preliminary investigation was conducted in October, 1991 and preliminary recommendations were provided to allow design to proceed. Subsequently, an "E" plan was produced for the structure and it was considered necessary to supplement the preliminary information with additional investigation at footing locations. The following recommendations have taken into account the results of the final investigation and the preliminary information.

Foundation

According to the investigation results, competent subsoil or bedrock exists at relatively shallow depths. The foundation for the structure may therefore be founded on conventional spread footings to achieve a cost effective design.

North Abutment -

At this abutment location, the glacial till stratum and bedrock is overlain by a $1.5 \pm$ m thick layer of granular fill and topsoil. It is recommended to remove the granular fill and topsoil and backfill the excavation with granular material to form a pad for placement of footings, as illustrated in Figure 4. Footings should be perched as high as possible within the fill on a minimum 3 m thick granular pad. 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). 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

Pier -

It is recommended to place the footings directly on bedrock at about El. 136.6 to 137.1 \pm m

Factored capacity at U.L.S. = 3000 kPa

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

South Abutment -

At this abutment location, bedrock is encountered at shallow depths and overlain by a surficial layer of glacial deposit or pavement structure. It is recommended to remove the surficial organic or unsuitable and place footing perched as high as possible within the fill on a minimum 3 m thick 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

Alternatively, footings may be placed directly on bedrock at about El. 137.6 \pm m.

Factored capacity at U.L.S. = 3000 kPa

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

General

All footings should be provided with 1.8 m earth cover 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. An unfactored coefficient of friction of 0.58 may be used between concrete and bedrock and 0.70 between concrete and granular pad.

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 purpose, the following properties for backfill are recommended.

<u>Material</u>	ϕ	γ	<u>Ko</u>	<u>Ka</u>
Granular "A"	35°	22.8 kN/m ³	0.43	0.27
Granular "B"	30°	21.2 kN/m ³	0.43	0.33

These earth pressure coefficients apply to horizontal backfill surfaces only. The appropriate consideration shall be given to account for sloping surfaces.

Slope Stability

The height of the approach fills is about 8 ± m. It is recommended that fill slopes be formed to a gradient of 2H:1V. Normal slope vegetation should be established as soon as possible after completion of the fill operation in order

to control surficial erosion.

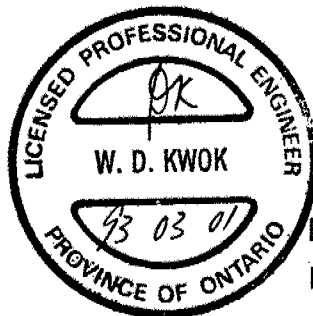
Construction Considerations

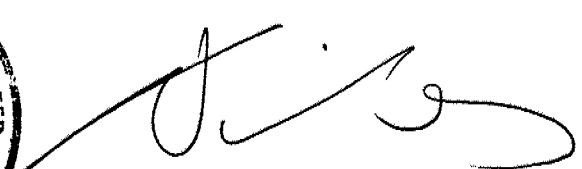
Temporary excavations of up to $2 \pm m$ is required for footing construction. Cut slopes can be formed at a gradient of 1H:1V. Some dewatering system is required for the excavations. Unwatering the footing area can be handled by sump pumping in perimeter ditches.

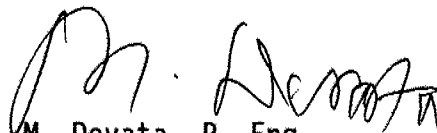
MISCELLANEOUS

The field work for the final investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer. The equipment was owned and operated by Marathon Drilling Co. Ltd. Bedrock was examined and classified by MTO petrographer, D. Williams.

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.

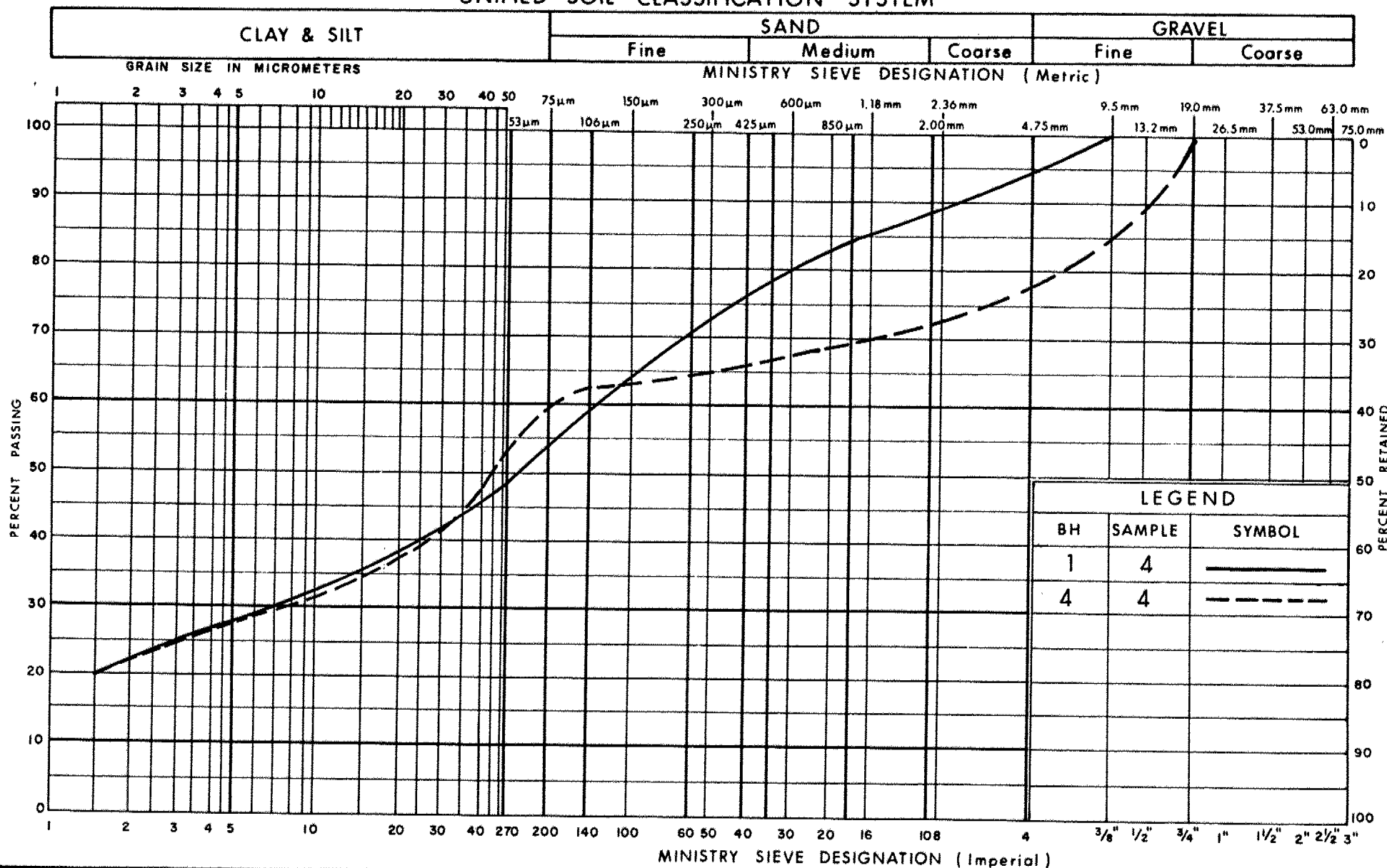



D. Kwok, P.Eng
Project Foundation Engineer


M. Devata, P. Eng.
Chief Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

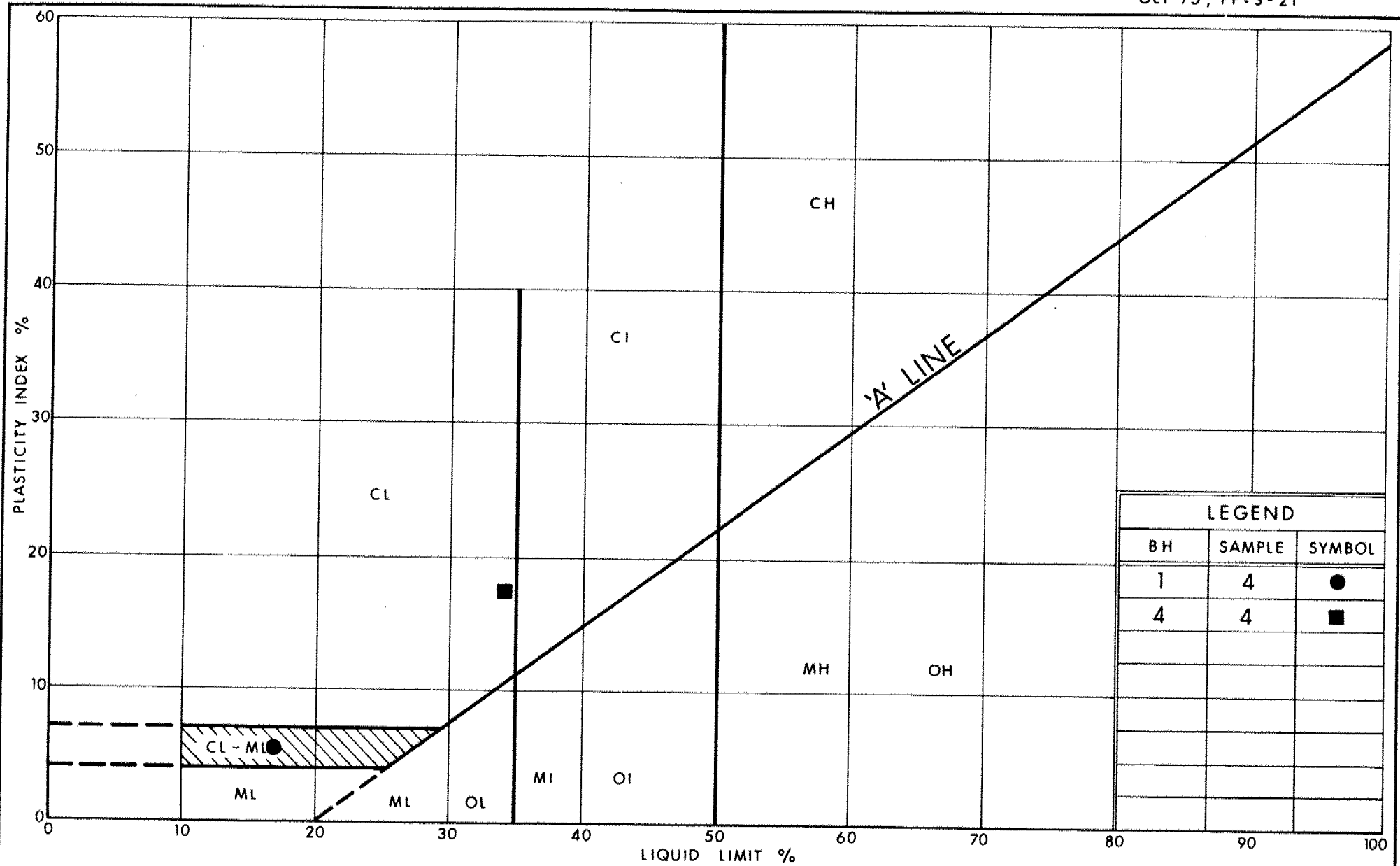


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GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF CLAYEY SILT & SAND
 TRACE GRAVEL (GLACIAL TILL)

FIG No 1

W P 107-90-01



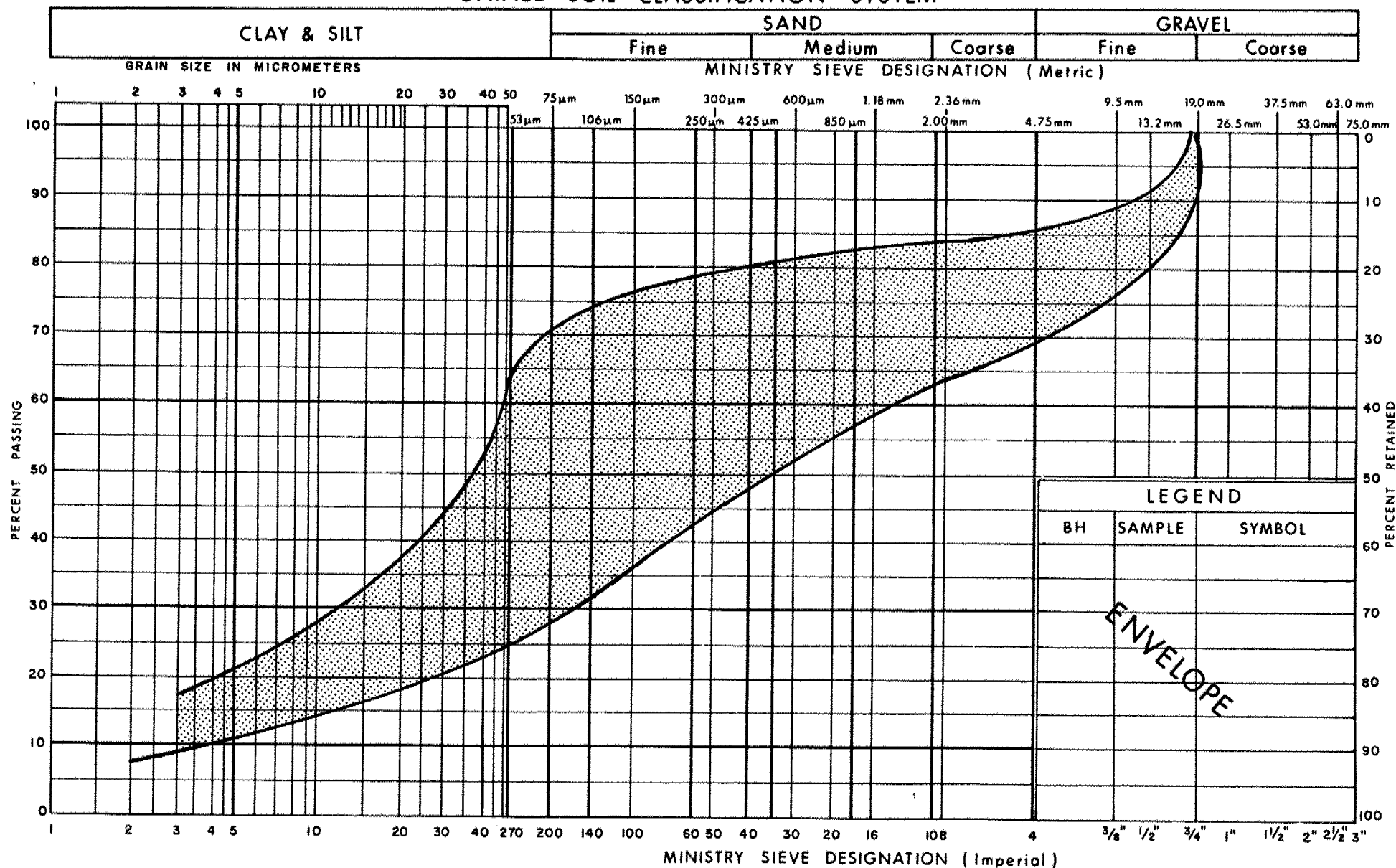
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PLASTICITY CHART
HETEROGENEOUS MIXTURE OF CLAYEY SILT & SAND
TRACE GRAVEL (GLACIAL TILL)

FIG No 2

W P 107-90-01

UNIFIED SOIL CLASSIFICATION SYSTEM

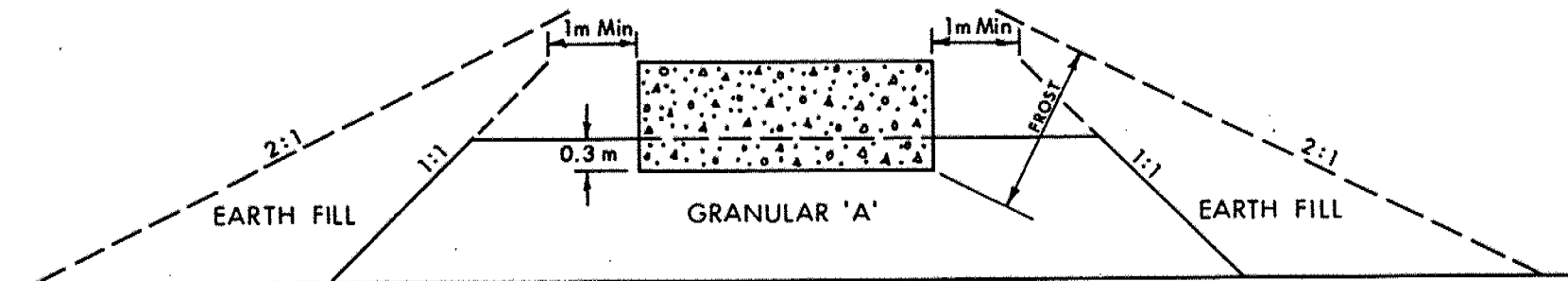


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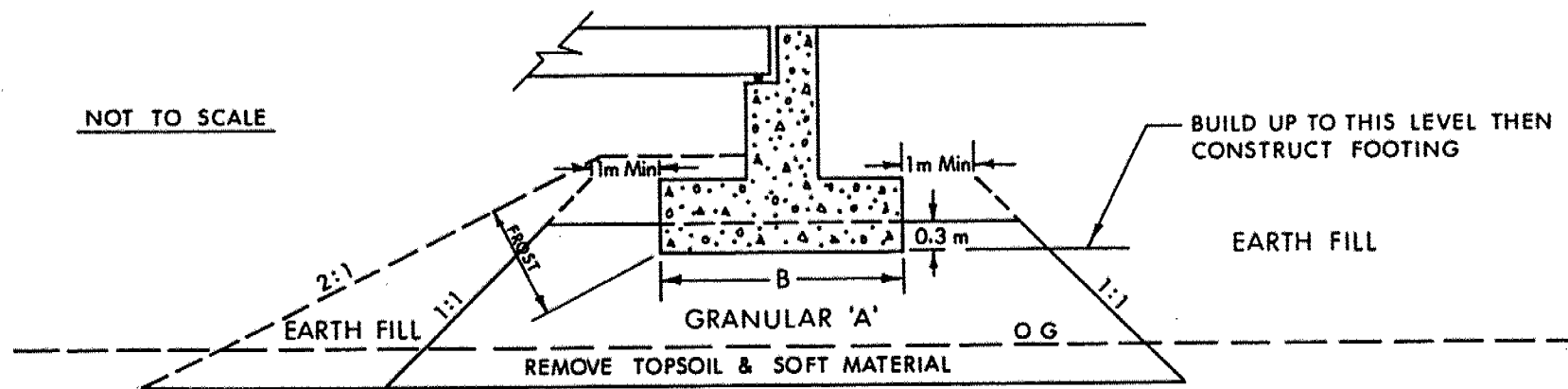
GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF SILTY SAND, CLAY & GRAVEL
 (GLACIAL TILL)

FIG No 3

W P 107-90-01



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 4

W P 107-90-01

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 107-90-01 LOCATION Coords: N 5 021 303.6; E 331 350.2 ORIGINATED BY A.H.
DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
DATUM Geodetic DATE 91/10/16 CHECKED BY B.I.

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	W _p	W	W _L					
138.8	Ground Surface																			
0.0	Silty Sand Trace Organics Topsoil Very Loose		1	SS	2															
137.0			2	SS	7															
1.8			3	SS	20															
	Heterogeneous Mixture of Clayey Silt and Sand Trace Gravel (Glacial Till) Very Stiff to Hard		4	SS	33															
			5	SS	27															
134.2																				
4.6			6	RC BXL	REC 88%															
	Limestone Bedrock Medium Strong		7	RC BXL	REC 68%															
131.2																				
7.6	End of Borehole																			
<p>• Standpipe</p> <p>91/10/19</p> <p>• GROUND WATER CONDITIONS</p> <table border="1"> <tr> <td>PIEZO. NO.</td> <td>GROUND WATER ELEVATION (Metres)</td> </tr> <tr> <td>1</td> <td>138.6</td> </tr> </table>																	PIEZO. NO.	GROUND WATER ELEVATION (Metres)	1	138.6
PIEZO. NO.	GROUND WATER ELEVATION (Metres)																			
1	138.6																			

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 107-90-01 LOCATION Coords: N 5 021 202.1; E 331 246.4 ORIGINATED BY M.M.
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, BX Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/10/16 CHECKED BY B.I.

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	w _p	w	w _L					
138.8	Ground Surface																			
0.0	Silty Sand Trace Organics																			
138.3																				
0.5			1	RC BXL	REC 83%											RQD 0%				
	Limestone Bedrock Medium Strong		2	RC BXL	REC 95%											RQD 20%				
136.2																				
2.6	End of Borehole																			
<p>• Standpipe</p> <p>91/10/19</p> <p>• GROUND WATER CONDITIONS</p> <table border="1"> <tr> <td>PIEZO. NO.</td> <td>GROUND WATER ELEVATION (Metres)</td> </tr> <tr> <td>1</td> <td>138.6</td> </tr> </table>																	PIEZO. NO.	GROUND WATER ELEVATION (Metres)	1	138.6
PIEZO. NO.	GROUND WATER ELEVATION (Metres)																			
1	138.6																			

RECORD OF BOREHOLE No 3

1 OF 1 METRIC

W.P. 107-90-01 LOCATION Coords: N 5 021 230.2; E 331 278.1 ORIGINATED BY M.M.
 DIST 9 HWY 17 BOREHOLE TYPE Hand Dug COMPILED BY A.H.
 DATUM Geodetic DATE 91/10/16 CHECKED BY B.L.

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					
138.4	Ground Surface																
0.0	Silty Sand																
138.0	Trace Organics																
0.4	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 4

1 OF 1 METRIC

W.P. 107-90-01 LOCATION N 5 021282.8 E 331330.2 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, Cone COMPILED BY DK
 DATUM Geodetic DATE 92 12 18 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					
139.2	Ground Surface													
0.0	Silty Sand with Gravel Brown, Loose (Granular Fill)													
138.3														
0.9	Silty Sand with Organics (Topsoil) Black and Green Very Loose to Loose		1	SS	3									
137.7														
1.5	Heterogeneous Mixture of Silty Sand, Clay and Gravel Some Wet Silt Zones Grey, Loose (Glacial Till)		2	SS	3									
			3	SS	5									
135.8	becoming Clayey, Hard Some Shale Fragments		4	SS	71	/23cm								21 18 43 18
3.4	End of Borehole													
	• Unstabilized Water Level measured upon completion of drilling													
	** Auger refusal on Probable Bedrock													

RECORD OF BOREHOLE No 4A

1 OF 1

METRIC

W.P. 107-90-01 LOCATION N 5 021281.2 E 331335.0 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE Hand Probing with a Bar COMPILED BY DK
 DATUM Geodetic DATE 92 12 18 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 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		
138.1	Ground Surface																
0.0	Probable Silty Sand with Organics (Topsoil) Black						138										
136.5							137										
1.6	End of Borehole																
	• Swampy Area - Water level at ground surface • Refusal on Probable Sandy Silt material																

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 107-90-01 LOCATION N 5 021286.7 E 331314.7 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY DK
 DATUM Geodetic DATE 92 12 18 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	W _p	W	W _L		
138.0	Ground Surface																
0.0	Silty Sand with Organics Trace Rootlets Dark Brown, Very Loose		1	SS	1		137										
1.1	Heterogeneous Mixture of Silt Clay and Gravel Some Rock Fragments Grey, Very Dense		2	SS	53	/28cm											15 14 60 11
136.0																	
2.0	End of Borehole • 92 12 18 •• Auger refusal on Probable Bedrock	**															

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 107-90-01 LOCATION N 5 021251.2 E 331285.8 ORIGINATED BY DK
DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, BW Core Barrel COMPILED BY DK
DATUM Geodetic DATE 92 12 16 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 γ 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 (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
138.7	Ground Surface							20	40	60	80	100	w _p	w	w _L		
0.0	Black Organics, Some Sandy Silt Trace Gravel Occasional Woodchips (Peat)		1	SS	6	 /10cm	138										
137.2			2	SS	5		137										
1.5	Weathered		3	SS	50		136										
			4	RC	REC 90%		135										RQD 0%
	Limestone		5	RC	REC 100%		134										RQD 7%
	Bedrock		6	RC	REC 94%												RQD 20%
133.2																	
5.5	End of Borehole																
	• Unstabilized Water Level measured upon completion of drilling																

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 107-90-01 LOCATION N 5 021216.0 E 331257.4 ORIGINATED BY DK
DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY DK
DATUM Geodetic DATE 92 12 15 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 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		
139.1																	
0.0	Crusher-run Limestone																
	Silty Sand, Some Gravel																
	Brown, Compact		1	SS	15												
	(Granular Fill)																
137.5			2	SS	57												
1.6	End of Borehole	**															
	* Trace of Water at the bottom of the hole upon completion of drilling																
	** Auger refusal on Probable Bedrock																

RECORD OF BOREHOLE No 8

1 OF 1 METRIC

W.P. 107-90-01 LOCATION N 5 021220.4 E 331240.3 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, BW Core Barrel COMPILED BY DK
 DATUM Geodetic DATE 92 12 15 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		
138.8	Ground Surface																
0.0	Trace Organics Brown Grey		1	SS	22	DRY +											
137.6	Heterogeneous Mixture of Silty Sand and Gravel, Compact (Glacial Till)		2	SS	23		138						0 H				31 42 20 7
1.2			3	RC	REC	44%	137										RQD 0%
			4	RC	REC	90%											RQD 0%
	Limestone		5	RC	REC	86%	136										RQD 0%
	Bedrock		6	RC	REC	93%	135										RQD 7%
133.9			7	RC	REC	100%											RQD 0%
4.9	End of Borehole • 92 12 15 Hole dry upon completion																

RECORD OF BOREHOLE No 9

1 OF 1 METRIC

W.P. 107-90-01 LOCATION N 5 021248.6 E 331295.8 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY DK
 DATUM Geodetic DATE 92 12 15 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT 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			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE 10 20 30 40 50					WATER CONTENT (%) W _p W W _L 20 40 60				
138.7	Ground Surface																
0.0	Black Organics, Occasional Woodchips Trace Gravel Some Sandy Silt (Peat)		1	SS	1												
137.2			2	SS	1												
1.5			3	SS	59	26cm										25 42 21 12	
136.6	Weathered Bedrock																
2.1	End of Borehole * Stabilized Water Level measured one day after completion of drilling ** Heterogeneous Mixture of Silty Sand, Clay and Gravel (Glacial Till) *** Auger refusal on Probable Sound Bedrock																

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

W.P. 107-90-01 LOCATION N 5 021254.1 E 331275.1 ORIGINATED BY DK
 DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY DK
 DATUM Geodetic DATE 92 12 15 CHECKED BY BI

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				NATURAL MOISTURE CONTENT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L	
138.6	Ground Surface														
0.0	Black Organics Occasional Woodchips Some Sandy Silt, Trace Gravel (Peat)		1	SS	2										
137.4			2	SS	1										
137.1															
1.5	End of Borehole Probable Bedrock														
	<ul style="list-style-type: none"> Unstabilized Water Level measured upon completion of drilling Heterogeneous Mixture of Silty Sand, Clay and Gravel (Glacial Till) 														

ROCK CORE DESCRIPTION

WP 107-90-01

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	6	4.57-6.30	88	24	4.57-7.62	LIMESTONE (undulating shaly partings; nodular in places; intraclastic in part), light grey to dark grey; fine to medium grained; medium strong; unweathered to slightly weathered; fractures close to extremely close spaced, flat to dipping, undulating to planar, smooth to rough.
	7	6.30-7.62	69	0		
2	1	0.51-1.12	83	0	0.51-2.64	LIMESTONE (undulating shaly partings; nodular in places), light grey to dark grey; fine to medium grained; medium strong; unweathered to slightly weathered; fractures close to extremely close spaced, flat to dipping, undulating to planar, smooth to rough.
	2	1.12-2.64	95	20		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

ROCK CORE DESCRIPTION

WP 107-90-01

Page 1 of 1

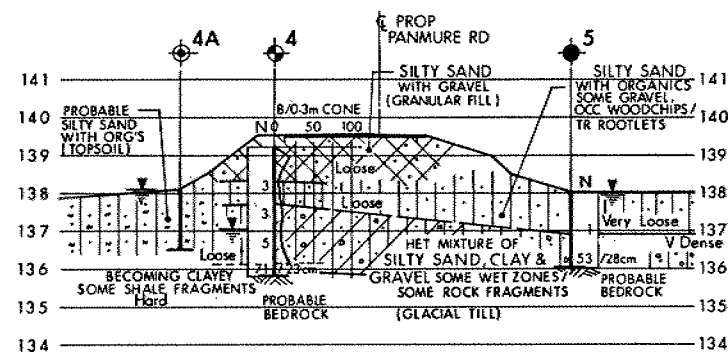
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
6	4	1.70-2.57	90	0	1.70-5.49	LIMESTONE (nodular in places) with undulating shaly partings and interbeds up to 4 cm thick, light grey to dark grey; fine to medium grained; medium strong; unweathered to slightly weathered; fractures close to extremely close spaced, flat to dipping, undulating to planar, smooth to rough.
	5	2.57-4.17	100	7		
	6	4.17-5.49	94	20		
8	3	1.24-1.70	44	0	1.24-4.85	LIMESTONE (nodular in places) with undulating shaly partings and interbeds up to 3 cm thick, light grey to dark grey; fine to medium grained; medium strong; unweathered to slightly weathered (moderately weathered, 1.24-1.70 m); fractures close to extremely close spaced, flat to near vertical, undulating to planar, smooth to rough.
	4	1.70-2.31	90	0		
	5	2.31-2.77	86	0		
	6	2.77-4.24	93	7		
	7	4.24-4.85	100	0		

*CR = CORE RECOVERY

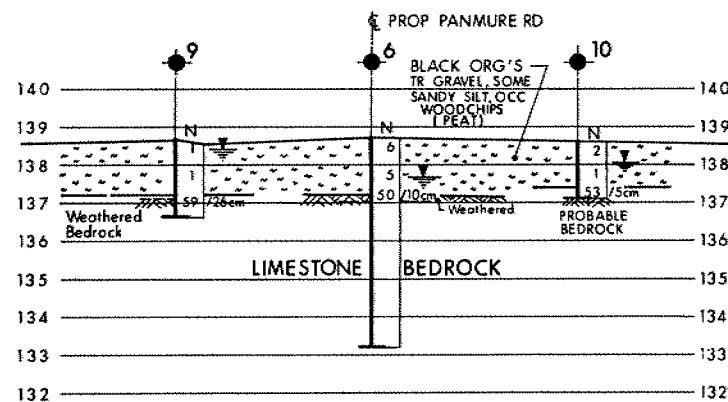
*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

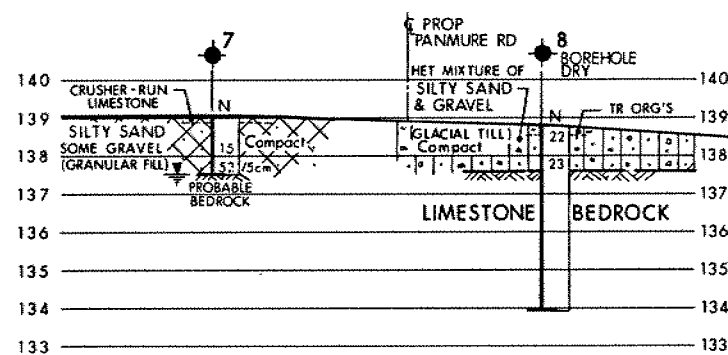
Logged by: DAW, Soils and Aggregates Section



A-A

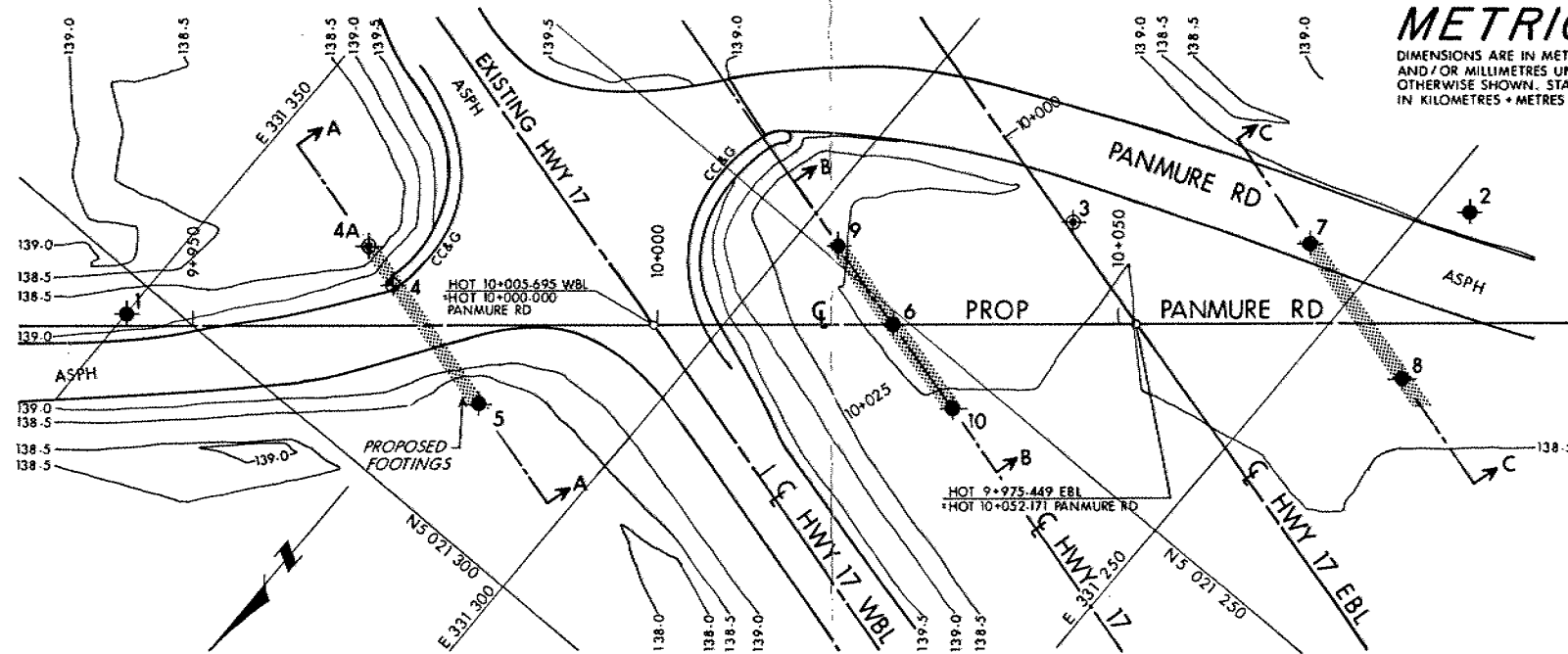
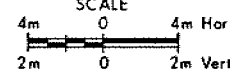


B-B

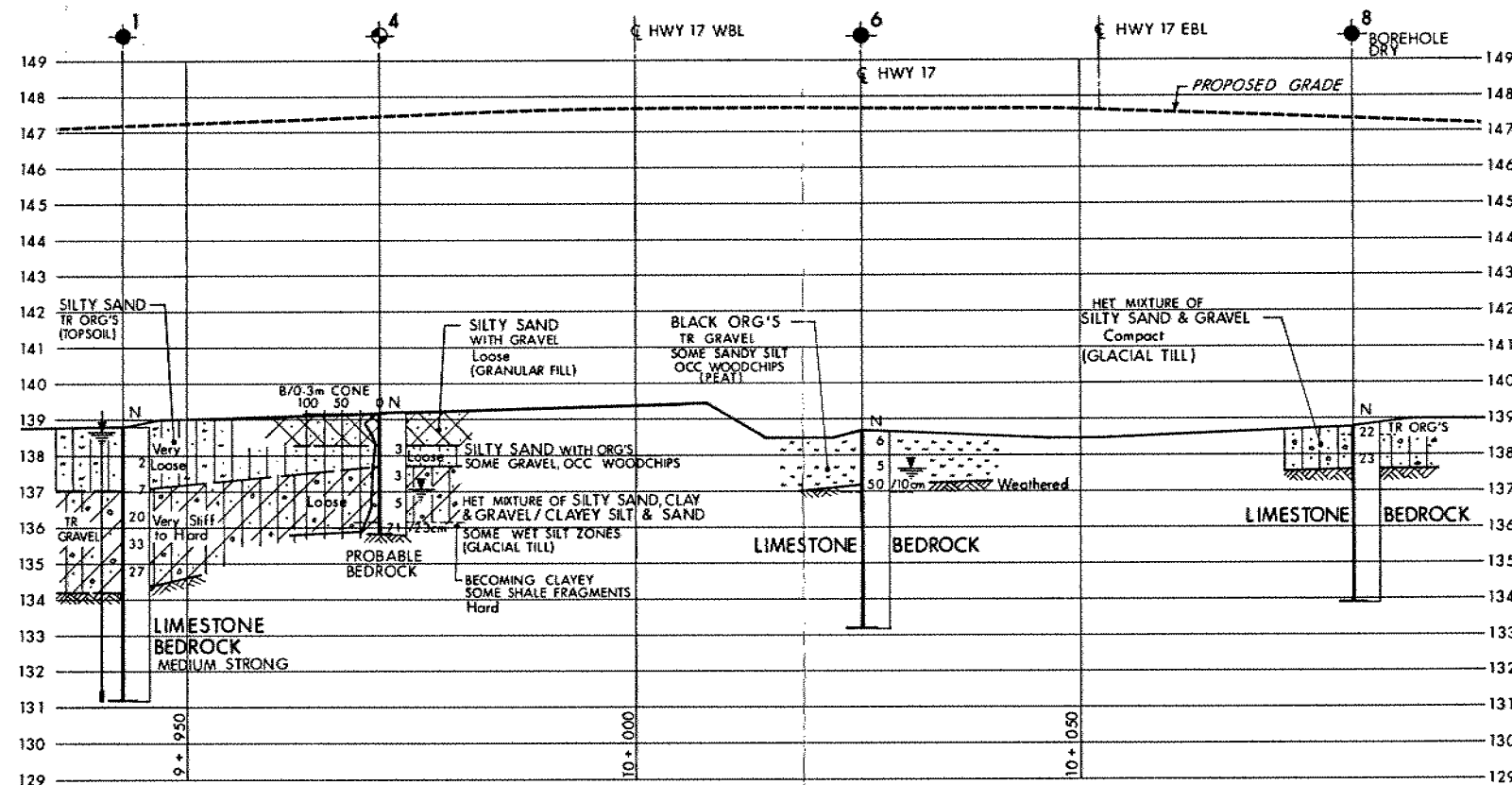


C-C

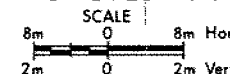
SECTIONS



PLAN



PROFILE PROPOSED PANMURE RD



METRIC

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

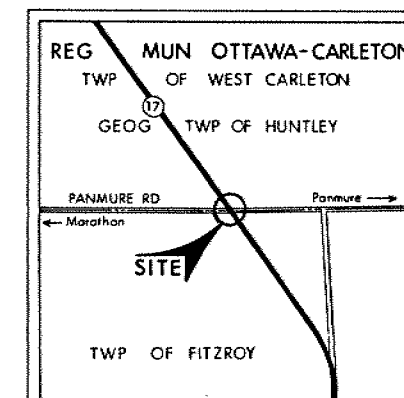
CONT No
WP No 107-90-01

PANMURE RD

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN

SCALE

1km 0 1km

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)
- W/L at time of investigation
91 10 and 92 12
- Probe Hole
- W/L in Piezometer
- Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	138.8	5 021 303.6	331 350.2
2	138.8	5 021 202.1	331 246.4
3	138.4	5 021 230.2	331 278.1
4	139.2	5 021 282.8	331 330.2
4A	138.1	5 021 281.2	331 335.0
5	138.0	5 021 286.7	331 314.7
6	138.7	5 021 251.2	331 285.8
7	139.1	5 021 216.0	331 257.4
8	138.8	5 021 220.4	331 240.3
9	138.7	5 021 248.6	331 295.8
10	138.6	5 021 254.1	331 275.1

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			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Geocres No 31F-112

HWY No 17	SUBM'D DK	CHECKED	DATE 1992 02 22	DIST 9
DRAWN DT	CHECKED	APPROVED		SITE 3-597
				DWG 1079001-A

Note

For Subsoil information of BH-2 and BH-3 refer to Record of Borehole sheets