G.I.-30 SEPT. 1976

GEOCRES No. 31F-113

DIST. 9 REGION

W.P. No. 106-90-01

CONT. No.

W. O. No.

STR. SITE No. 3-598

HWY. No. 17

LOCATION Hwy 17 & Vaughan Sideroad

No of PAGES - —

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ontario

Ministry of
Transportation and
Communications

* THIS PROJECT
WAS DONE TOGETHER
WITH 4 OTHERS.
WP 107-90-01
WP 451-90-02
WP 451-90-06
WP 451-90-05

FILE No. _____ **DATE** _____

REMARKS _____

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Ontario

FOUNDATION DESIGN SECTION

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 106-90-01 DIST 9

HWY 17 STR SITE 3-598

Proposed Underpass at
Highway 17 and Vaughan Sideroad

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GEOCRES 31F-113 DATE MAR 03 1993

FOUNDATION INVESTIGATION REPORT
For
Proposed Underpass at
Highway 17 and Vaughan Sideroad
W.P. 106-90-01, Site 3-598
District 9, Ottawa

INTRODUCTION

This report summaries the results of the foundation investigations conducted at Highway 17 and Vaughan sideroad. 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 17 and 91 10 18 and consisted of four (4) sampled boreholes. 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 16 and 92 12 18 and consisted of four (4) sampled boreholes and three (3) probe holes advanced at abutment and pier locations.

SITE DESCRIPTION

The site is located at the intersection of Highway 17 and Vaughan Sideroad 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. 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 17 and 91 10 18 and consisted of four sampled boreholes which were advanced to a maximum depth of 5.8 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, BH1-A)

The field work for the final investigation was carried out between 92 12 16 and 92 12 18 and consisted of four (4) sampled boreholes and three (3) probe-holes advanced to a maximum depth of 5.7 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 tests were carried out at three (3) locations (BH7, BH9 and BH10). 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 BH5 and BH6.

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

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. 1069001-A.

The predominant soil strata encountered in the boreholes consisted of cohesive/non-cohesive glacial till overlying bedrock. Surficial layers of topsoil were found in the low-lying areas and where the boreholes were advanced through the existing pavement, a layer of granular fill was contacted. At BH 3 location, a minor layer of clay was encountered at the surface.

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

Silty Sand with Gravel, Trace Clay (Granular Fill)

The granular fill layer is encountered at the surface of BH6, BH7 and BH9 to a maximum depth of 1.7 m. It forms the pavement structure of the road.

Clay

This cohesive material is only contacted in BH3 to a depth of 1.4 m

The result of an Atterberg Limited test performed on this sample showed a moisture content of 31.5% and plastic and liquid limits of 26% and 55% respectively. The plasticity index is 29%, indicating a highly plastic material.

The Standard Penetration resistance "N" Value is 20 blows/0.3m indicating a very stiff state of consistency.

Clayey Silt/Sandy Silt with Organics, Trace Rootlets (Topsoil)

This organic layer is encountered in BH4, BH5, BH8 and BH10. The material is cohesive in BH4 but non-cohesive in the other boreholes.

The result of a moisture content test performed on one sample showed high moisture content of 30.5%.

The Standard Penetration resistance "N" values range from 2 to 20 indicating loose denseness to very stiff state of consistency.

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

This cohesive stratum is contacted in BH1, BH1A, BH2 and BH3. The thickness of this layer varies from 1.5 m to 2.9 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:

Property	Range	No. of Tests
Natural Moisture Content (W%)	8.0 - 13.0	5
Liquid Limit (W_L%)	12.0 - 17.0	2
Plastic Limit (W_P%)	12.0	2
Unit Weight (kN/m^3)	23.0	1
Grain Size Distribution (%)		
Gravel	4 - 18	
Sand	40 - 50	
Silt and Clay	42 - 46	

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 15 to over 120 blows/0.3m. The material has a stiff to hard consistency, but typically hard.

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

This non-cohesive layer is contacted in BH2 and BH3 below the above-mentioned cohesive glacial till stratum, and also in BH7 and BH8. Thickness of this layer ranges from 1.3 to 5.2 m. The material is described as a heterogeneous mixture of silt, sand and gravel, trace clay. There are occasional sand layers and boulders within the deposit.

Typical properties of the material as determined by laboratory tests on representative samples are summarized as follows:

Property	Range	No. of Tests
Natural Moisture Content (w %)	9.5 - 15.5	6
Grain Size Distribution (%)		4
Gravel	1 - 19	
Sand	43 - 68	
Silt and Clay	26 - 55	

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

The Standard Penetration Resistance "N" values obtained range from 16 to over 100 blows/0.3m, indicating compact to very dense denseness.

Bedrock

Bedrock was encountered at shallow depths on the north side, typically between El. 118.1 m and 118.9 m but seated deeper on the south side at El.113.8 to El. 115.9 m. Bedrock was cored in BH1, BH2, BH5 and BH6. 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 form 75 to 100% and 0 to 79% respectively. The rock is considered medium strong.

GROUNDWATER

Groundwater levels were measured in boreholes during the course of the investigation. The water table ranged in elevation from 117.4 to 119.0 m, about 1.0 to 2.8 m depths.

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 Vaughan Sideroad is required due to widening of Highway 17. The proposed structure is a two span bridge with equal span lengths of 49 m. The width of the structure is 9.96 m. The height of the approach fills is about 8± 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, bedrock is overlain by a 1 ± m thick layer of top topsoil. It is recommended to remove the overburden by sub-excavating down to El. 118.6 - 118.9 ± m and backfill the excavation with granular material to form a pad for placement of footings, as illustrated in Figure 4. 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

Alternative, footings may be placed directly on bedrock at about El. 118.6 ± 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"

Pier -

It is recommended to place the footings directly on bedrock at about El. 118.6 to 118.9 ± m

Factored capacity at U.L.S. = 900 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 overlain by a surficial layer of topsoil or pavement structure and a major deposit of glacial till material. It is recommended to remove the surficial organic or fill material to El. 119.4 ± m 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

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.

Material	ϕ	γ	Ko	Ka
Granular "A"	35°	22.8 kN/m3	0.43	0.27
Granular "B"	30°	21.2 kN/m3	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 $\pm$ m. It is recommended that fill slopes be formed to a gradient of 2H:IV. Normal slope vegetation should be established as soon as possible after completion of the fill operation in order to control surficial erosion.

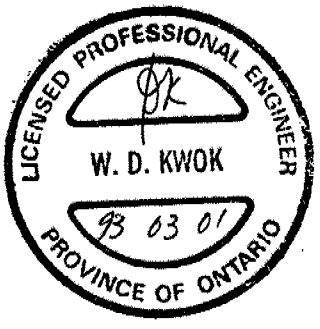
Construction Considerations

Temporary excavations of up to 2 ± m is required for footing construction. Cut slopes can be formed at a gradient of 1H:1V. Some dewatering may be required for footing construction. It 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.

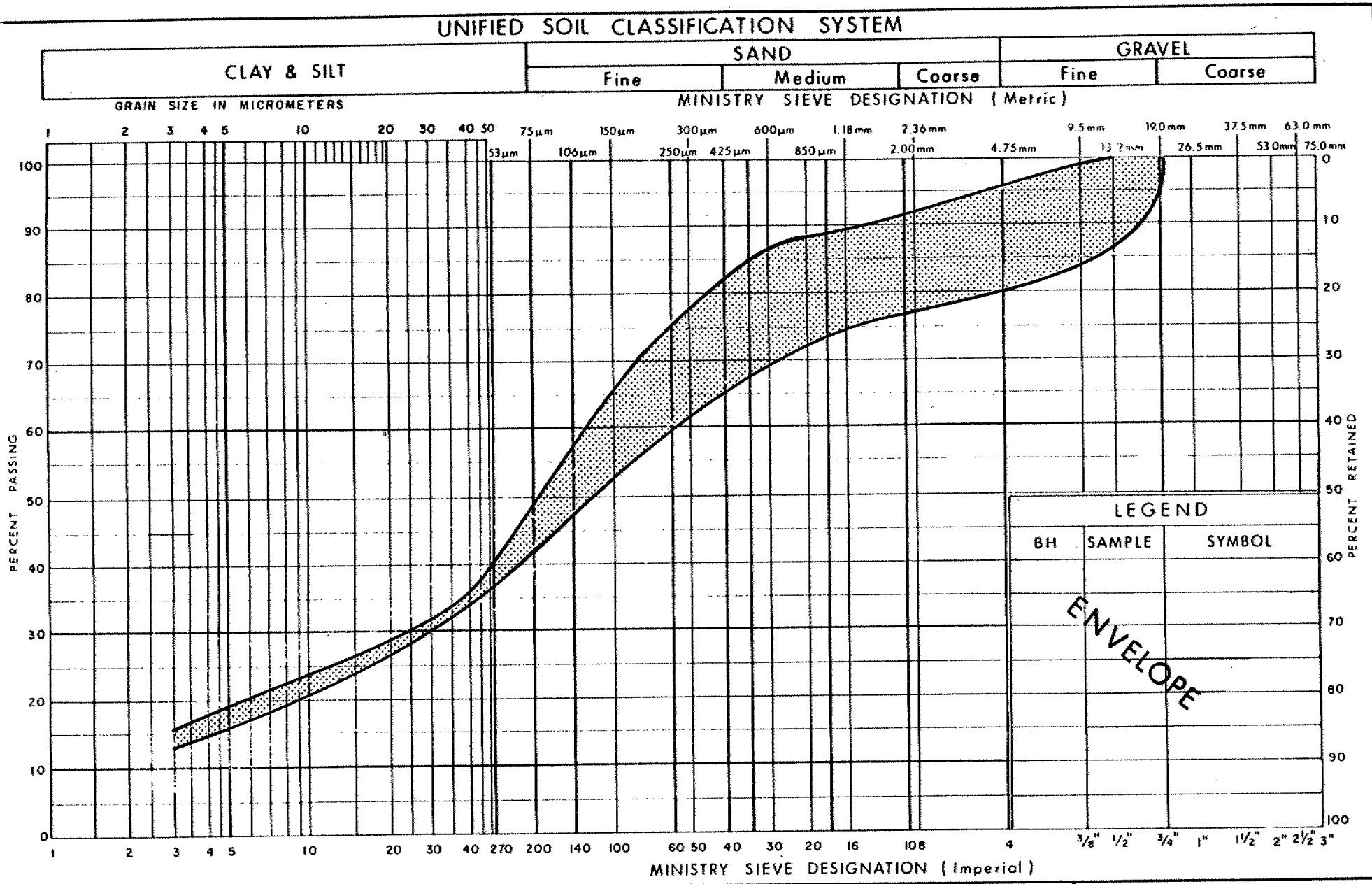
The project was carried out by D. Kwok under the supervision of B. Iyer, Senior Foundation Engineer. This report was prepared by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.



D. Kwok, P.Eng
Project Foundation Engineer

M. Devata, P. Eng.
Chief Foundation Engineer

APPENDIX



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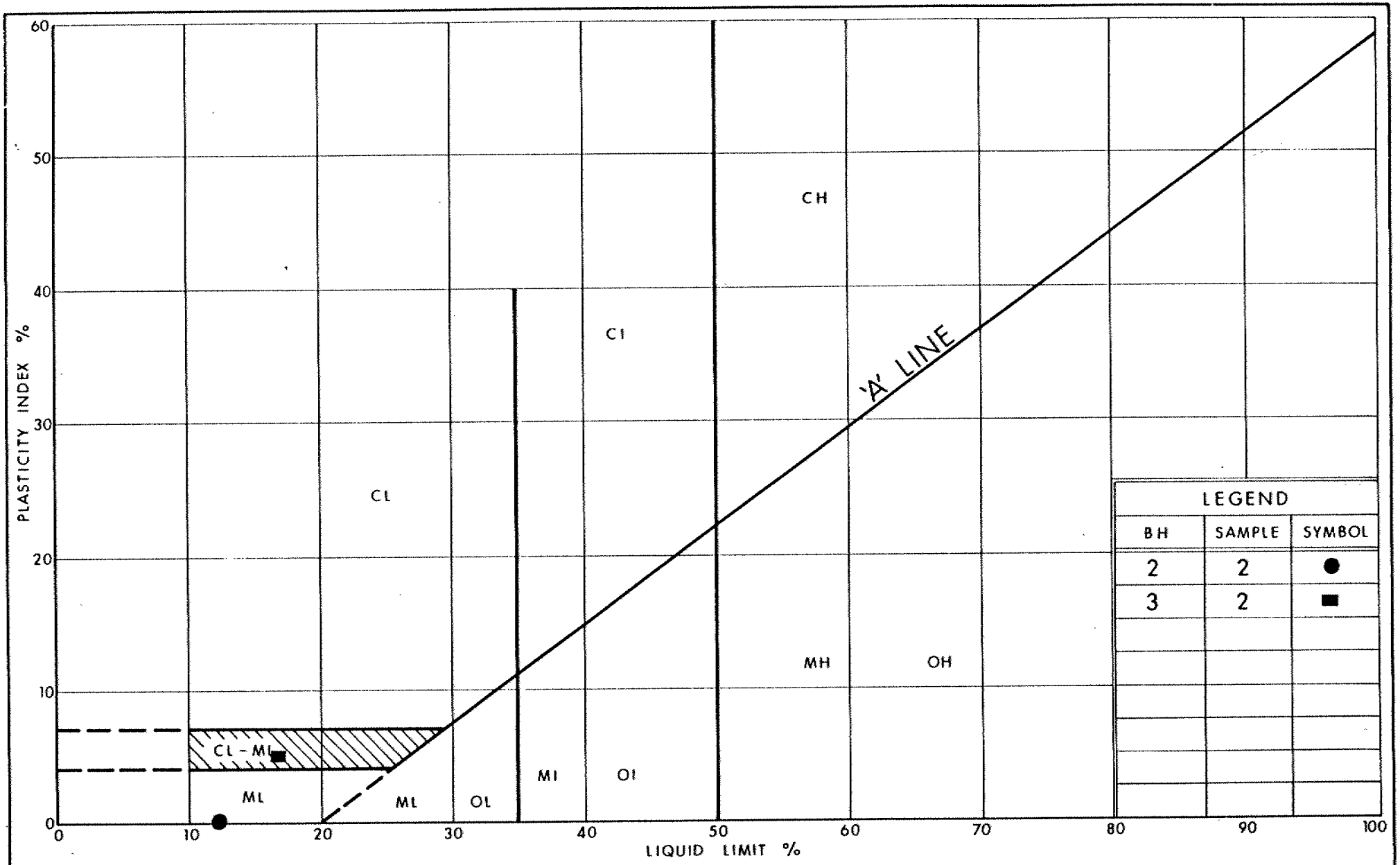
GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(GLACIAL TILL)

FIG No 1
W P 106-90-01



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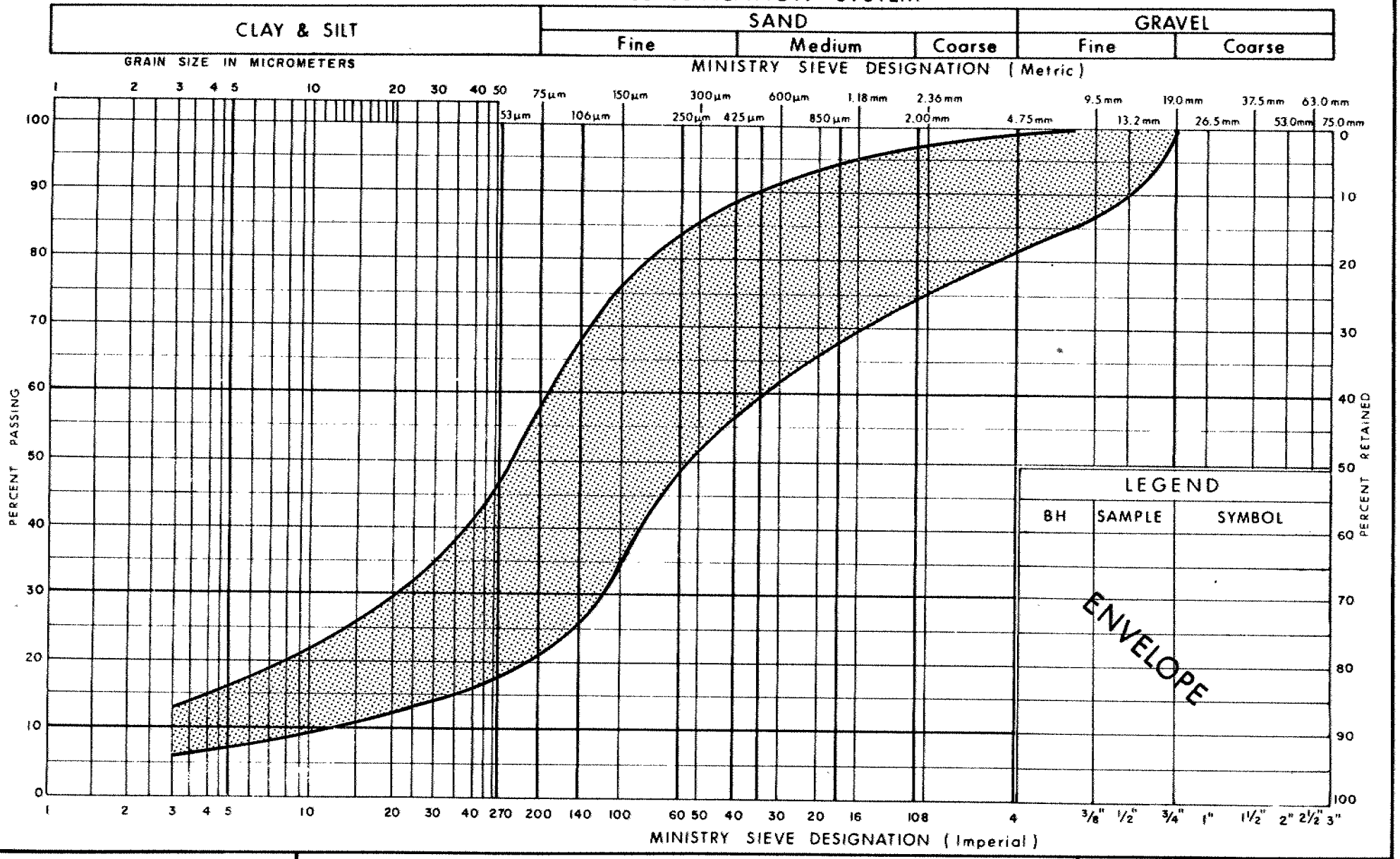
PLASTICITY CHART
HETEROGENEOUS MIXTURE OF CLAYEY SILT, SAND & GRAVEL
OCCASIONAL COBBLES (GLACIAL TILL)

FIG No 2
W P 106-90-01

UNIFIED SOIL CLASSIFICATION SYSTEM



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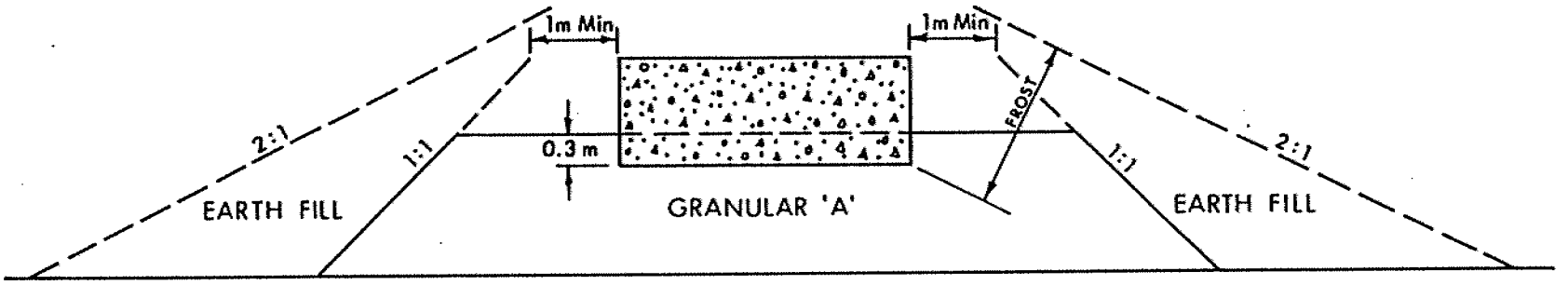
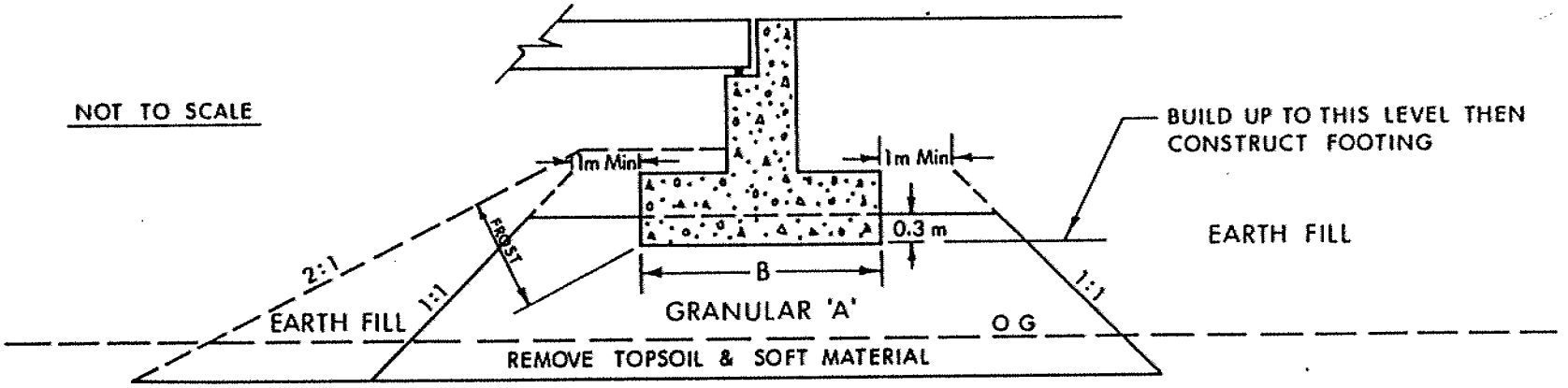
GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF **SILT, SAND & GRAVEL**
TRACE CLAY (GLACIAL TILL)

FIG No 3
W P 106-90-01



X SECTION



LONGITUDINAL 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 106-90-01

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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE
e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE No 1 — 1 OF 1 — METRIC

W.P. 106-90-01 LOCATION Coords: N 5 020 043.6; E 336 111.1 ORIGINATED BY A.H.

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.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × 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 γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
119.7	Ground Surface										
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard Occasional Cobbles and Boulders		1	SS	60 /8cm		119				
118.1			2	SS	60	▼	118				
1.6	Limestone Bedrock With Interbedded Shale		3	RC BXL	REC 92%		117				RQD 0%
115.0			4	RC BXL	REC 75%		116				RQD 7%
4.7	End of Borehole										

+³, ×⁵ : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 1-A 1 OF 1 METRIC

W.P. 106-90-01 LOCATION Coords: N 5 020 046.4; E 336 103.6 ORIGINATED BY A.H.

DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger 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 (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, x 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 γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
119.7	Ground Surface										
0.0	Trace Organics										
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard Occasional Cobbles and Boulders		1	SS	90 /23cm		119		o		
118.2											
1.5	End of Borehole Probable Bedrock										

+3, x5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 2 1 OF 1 METRIC

W.P. 106-90-01 LOCATION Coords: N 5 019 959.1; E 336 019.8 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.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o 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 γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
120.2	Ground Surface										
0.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard		1	SS	52		120				
			2	SS	127		119			23.0	4 50 34 12
			3	SS	102	▼	118				
	Brown / Grey										
	Heterogeneous Mixture of Silt, Sand and Gravel Trace Clay (Glacial Till) Very Dense		4	SS	66		117				
115.9	Boulders		5	SS	102 /28cm		116				6 68 15 11
4.3	Limestone Bedrock With Interbedded Shale		6	RC BXL	REC 92%		115				RQD 0%
114.4											
5.8	End of Borehole										

$+^3$, $\times^5$: Numbers refer to Sensitivity

$^{20}_{15}\!\diamond^{5}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3 1 OF 1 METRIC

W.P. 106-90-01 LOCATION Coords: N 5 019 979.6; E 336 050.6 ORIGINATED BY M.M.

DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.

DATUM Geodetic DATE 15/10/91 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o UNCONFINED + FIELD VANE • QUICK TRIAXIAL x 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 γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
119.5	Ground Surface										
0.0	Clay Very Stiff		1	SS	20	*	119		55		
118.1											
1.4	Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till) Occational Cobbles Stiff to Very Stiff		2	SS	31		118				18 40 26 16
			3	SS	15		117				
	Heterogeneous Mixture of Silt, Sand and Gravel Trace Clay (Glacial Till) Occasional Cobbles Compact to Very Dense		4	SS	28		116				
			5	SS	96		115				
			6	SS	106	/23cm					19 62 12 7
113.8	Boulders						114				
5.6	End of Borehole Probable Bedrock * Water level not established due to caving of the hole at a depth of 3.1 m.										

$+^3$, $\times^5$: Numbers refer to Sensitivity

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

RECORD OF BOREHOLE No 4 1 OF 1 METRIC

W.P. 106-90-01 LOCATION N 5 020032.2 E 336095.2 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger COMPILED BY DK

DATUM Geodetic DATE 92 12 17 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE 10 20 30 40 50	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
119.5	Ground Surface										
0.0	Clayey Silt with Organics Some Sand, Occasional Rootlets (Topsoil)		1	SS	20	DRY *	119				
118.6											
0.9	End of Borehole **										

* 92 12 17

** Auger refusal on probable bedrock

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5 1 OF 1 METRIC

W.P. 106-90-01 LOCATION N 5 020039.2 E 336089.4 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE H.S. Augers, BW Core Barrel COMPILED BY DK

DATUM Geodetic DATE 92 12 17 - 92 12 18 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE) (10 20 30 40 50)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
119.7 / 0.0	Ground Surface										
118.9 / 0.8	Sandy Silt with Organics Trace Rootlets (Topsoil)		1	SS	4	DRY	119		o		6 52 39 3
	Weathered		2	SS	102	/23cm					
			3	RC	REC	87%	118				RQD 0%
	Limestone Bedrock		4	RC	REC	100%	117				RQD 28%
			5	RC	REC	98%	116				RQD 55%
115.5 / 4.2	End of Borehole										

+³, ×⁵ : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 6 — 1 OF 1 — METRIC

W.P. 106-90-01 LOCATION N 5 020003.5 E 336055.1 ORIGINATED BY DK
DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger, BW Core Barrel COMPILED BY DK
DATUM Geodetic DATE 92 12 17 CHECKED BY BI

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE; 10 20 30 40 50)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
120.4	Ground Surface										
0.0	Silty Sand with Gravel Trace Clay, Brown (Granular Fill)		1	AS	–	*	120				
118.7			2	SS	103	/8cm	119				
1.7	Limestone Bedrock		3	RC	REC	100%	118				RQD 29%
			4	RC	REC	98%	117				RQD 40%
115.5			5	RC	REC	100%	116				RQD 79%
4.9	End of Borehole										

* Ground Water Level not determined

** Weathered Bedrock

$+^3$, $\times^5$: Numbers refer to Sensitivity

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

RECORD OF BOREHOLE No 7 — 1 OF 1 — METRIC

W.P. 106-90-01 LOCATION N 5 019968.4 E 336020.6 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE Cone COMPILED BY DK

DATUM Geodetic DATE 92 12 17 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
120.3	Ground Surface										
0.0 / 119.4	Probable Granular Fill (Pavement Structure)					*	120	** 245			
0.9 / 114.6	Probable Heterogeneous Mixture of Silt, Sand and Gravel, Trace Clay Occasional Sand layers and Silt Zones (Glacial Till)						119 118 117 116 115				
5.7	End of Borehole Probable Bedrock							120/ 23cm			

* Groundwater level not determined

** High Blowcounts due to frozen ground

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: o UNCONFINED + FIELD VANE; • QUICK TRIAXIAL × LAB VANE; 10 20 30 40 50

WATER CONTENT (%): PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; 20 40 60

UNIT WEIGHT 7 kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8 1 OF 1 METRIC

W.P. 106-90-01 LOCATION N 5 019076.0 E 336014.2 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE H.S. Auger 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 (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE) (10 20 30 40 50)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
120.0	Ground Surface										
0.0 119.5	Sandy Silt with Organics Dark Brown (Topsoil)		1	SS	2						
0.5	Heterogeneous Mixture of Silt, Sand and Gravel, Trace Clay Occasional Sand layers Compact to Dense (Glacial Till)		2	SS	16	▼*	119		o		2 42 44 12
	Brown		3	SS	18		118				
			4	SS	16		117				
	Grey		5	SS	22				o		1 45 48 6
							116				
			6	SS	38		115				
114.3											
5.7	End of Borehole **										

* Unstabilized Water Level measured upon completion of drilling

** Auger Refusal on Probable Bedrock

+³, ×⁵ : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 9 1 OF 1 METRIC

W.P. 106-90-01 LOCATION N 5 020000.4 E 336057.8 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE Cone COMPILED BY DK

DATUM Geodetic DATE 92 12 17 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 10 20 30 40 50	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
120.3	Ground Surface										
0.0	Probable Granular Fill					*	120				
118.8							119				
1.5	End of Borehole Probable Bedrock							120/4cm			

* Groundwater level not determined

+³, ×⁵ : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10 1 OF 1 METRIC

W.P. 106-90-01 LOCATION N 5 020007.2 E 336052.0 ORIGINATED BY DK

DIST 9 HWY 17 BOREHOLE TYPE Cone COMPILED BY DK

DATUM Geodetic DATE 92 12 17 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa: o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	WATER CONTENT (%)		
119.5 Ground Surface								20 40 60 80 100 / 10 20 30 40 50	20 40 60	kN/m³	GR SA SI CL
0.0 / 118.8	Probable Topsoil					*	119				
0.6	End of Borehole Probable Bedrock							120/25cm			

* Groundwater level not determined

+³, ×⁵ ; Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

ROCK CORE DESCRIPTION
WP 106-90-01

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	3	1.62-3.15	92	0	1.62-2.67	**LIMESTONE** (nodular in places), light grey to dark grey, with greyish black fossiliferous (bryozoa, brachiopods, crinoids) **SHALE** interbeds up to 10 cm thick (45%); fine to medium grained; medium strong to weak; unweathered to slightly weathered; fractures close to extremely close spaced, flat, undulating to planar, smooth.
	4	3.15-4.67	75	7	2.67-4.42	**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.
					4.42-4.67	**LIMESTONE** (nodular), light grey to dark grey, with greyish black undulating **SHALE** partings and interbeds up to 2 cm thick (15%); fine to medium grained; medium strong to weak; unweathered to slightly weathered; fractures close to extremely close spaced, flat, undulating to planar, smooth to rough.
2	6	4.27-5.79	92	0	4.27-5.79	**LIMESTONE** (nodular), light grey to dark grey, with greyish black undulating **SHALE** partings and interbeds up to 3 cm thick (13%); fine to medium grained; medium strong to weak; unweathered to slightly weathered; fractures close to extremely close spaced, flat to dipping, undulating to planar, smooth to rough.

***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 106-90-01

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
5	3	1.07-2.03	87	0	1.07-4.24	**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 near vertical, undulating to planar, smooth to rough.
	4	2.03-2.77	100	28		
	5	2.77-4.24	98	55		
6	3	1.80-2.72	100	29	1.80-4.85	**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; fractures moderate to extremely close spaced, flat to dipping, undulating to planar, smooth to rough.
	4	2.72-4.24	98	40		
	5	4.24-4.85	100	79		

***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

MINISTRY OF TRANSPORTATION, ONTARIO PH-D-207 88 10

METRIC

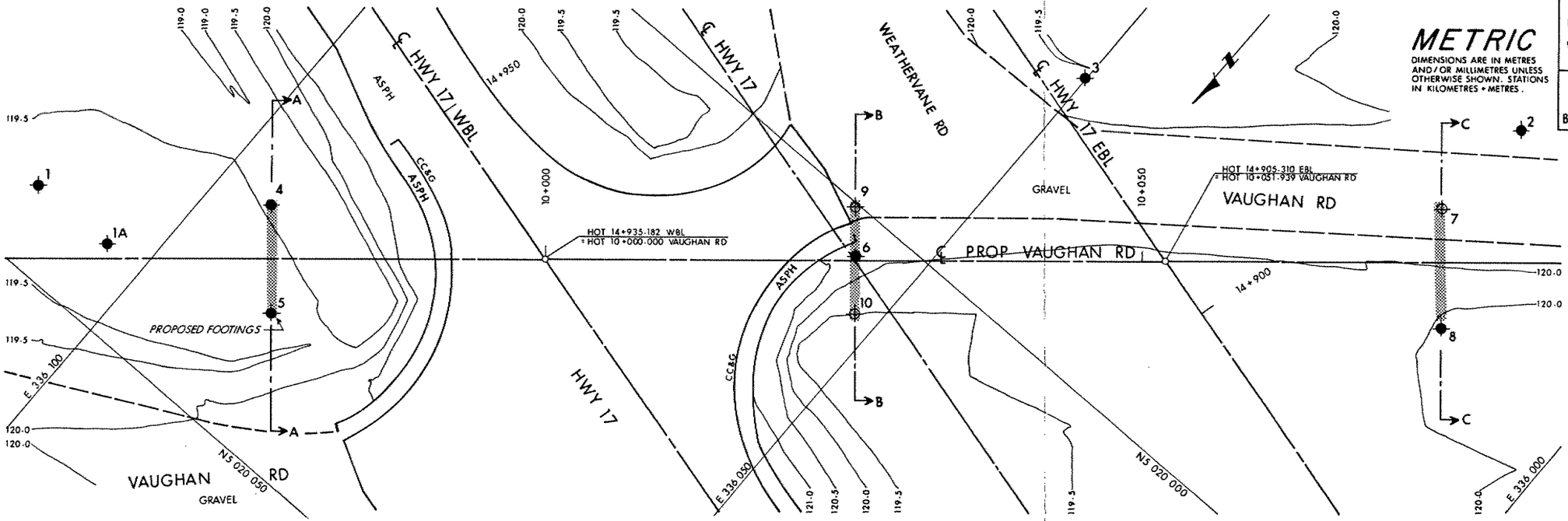
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No
WP No 106-90-01

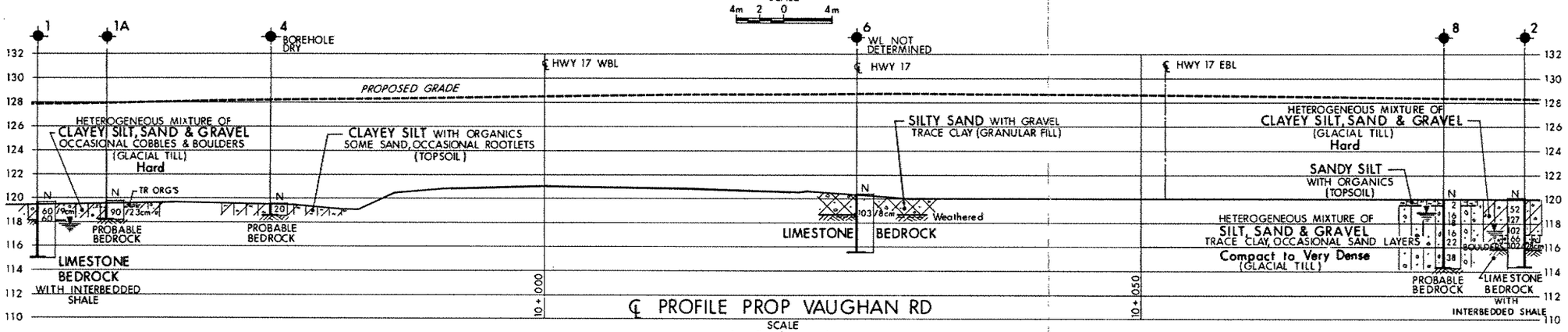
VAUGHAN RD

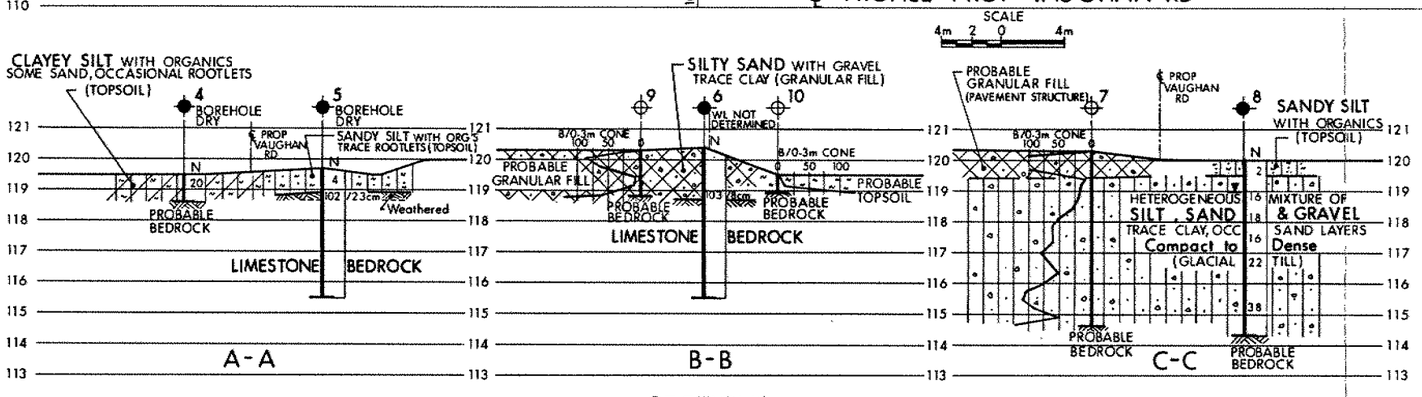
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

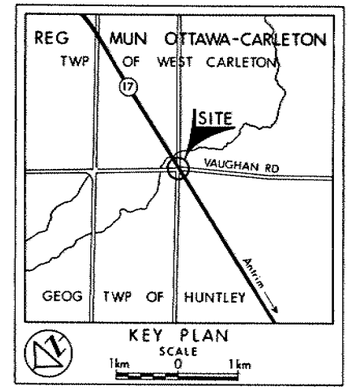


PLAN
SCALE 4m 2 0 4m





SECTIONS
SCALE 4m 0 4m Hor
2m 0 2m Vert



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 1991 10 and 1992 12

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	119.7	5 020 043.6	336 111.1
1A	119.7	5 020 046.4	336 103.6
2	120.2	5 019 959.1	336 019.8
3	119.5	5 019 979.6	336 050.6
4	119.5	5 020 032.2	336 095.2
5	119.7	5 020 039.2	336 089.4
6	120.4	5 020 003.5	336 055.1
7	120.3	5 019 968.4	336 020.6
8	120.0	5 019 976.0	336 014.2
9	120.3	5 020 000.4	336 057.8
10	119.5	5 020 007.2	336 052.0

91-10

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
For Subsoil information of BH-3 Refer to Record of Borehole sheets

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

Geocres No 31F-113

REF No PLAN, 92 06

HWY No 17			DIST 9
SUBM'D DK	CHECKED	DATE 1993 02 24	SITE 3-598
DRAWN DT	CHECKED	APPROVED	DWG 1069001-A

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

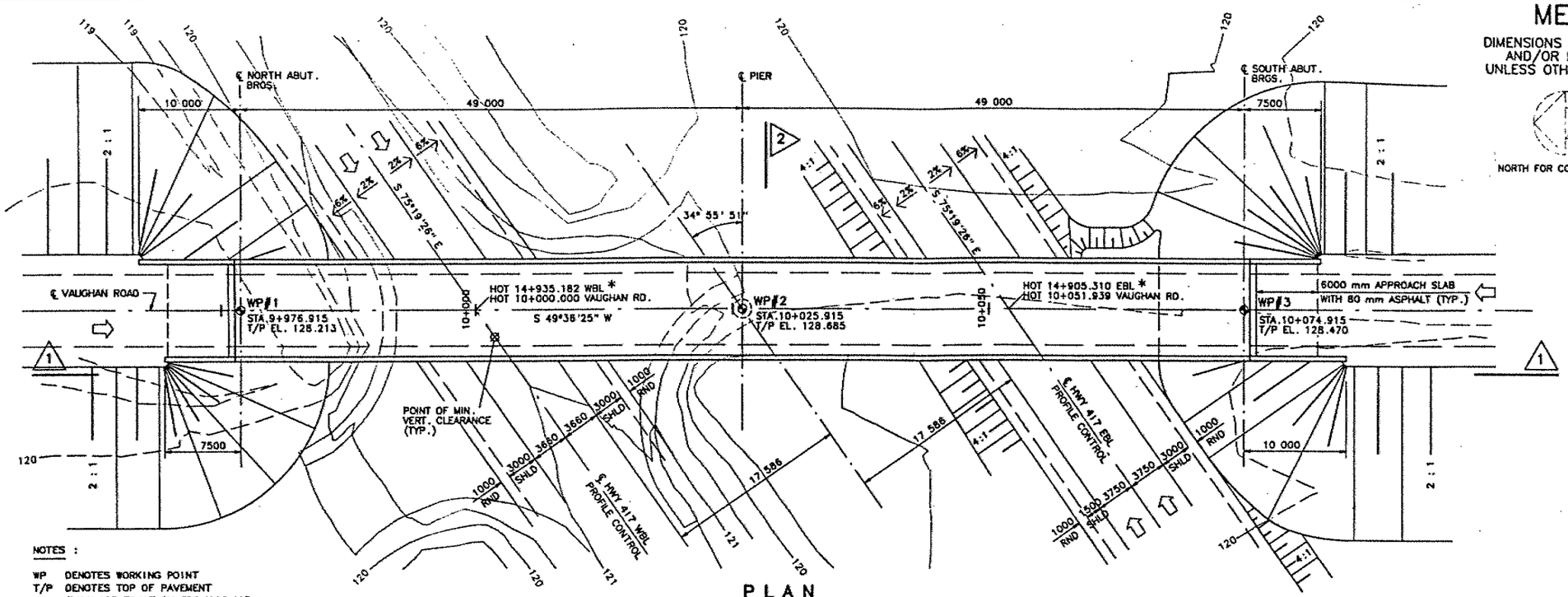
NORTH FOR CONSTRUCTION

DIST. 9
CONT No
WP No 106-90-01

HIGHWAY 417 UNDERPASS AT VAUGHAN ROAD
GENERAL ARRANGEMENT

SHEET

PROCTOR & REDFERN LIMITED
CONSULTING ENGINEERS, ARCHITECTS, SCIENTISTS AND PLANNERS
TORONTO, KINGSTON, OTTAWA – ONTARIO.
E.O. 92317

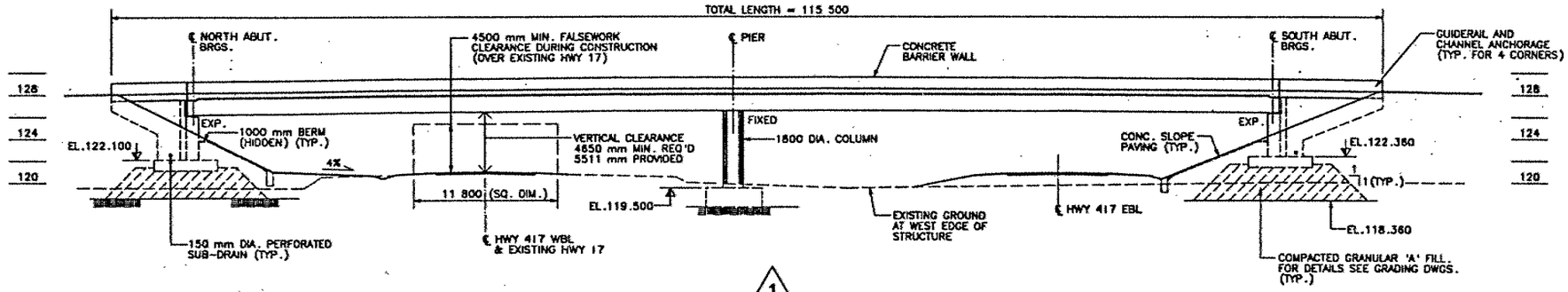


NOTES :

WP DENOTES WORKING POINT
T/P DENOTES TOP OF PAVEMENT
* CHAINAGE EQUATION FOR HWY 417 ; STATION WBL = STATION EBL +0.132

PLAN

1 : 250



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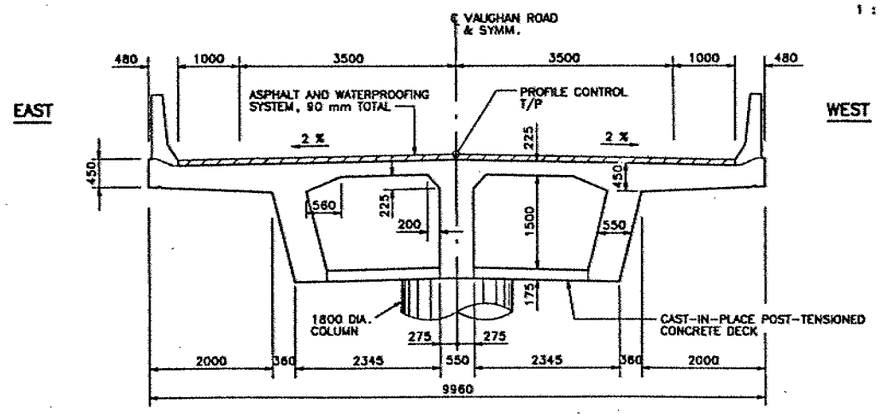
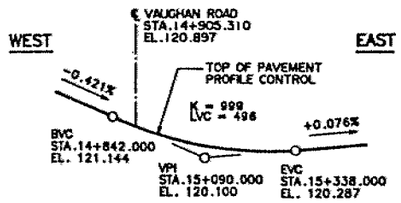


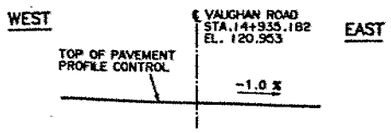
2

1 : 50



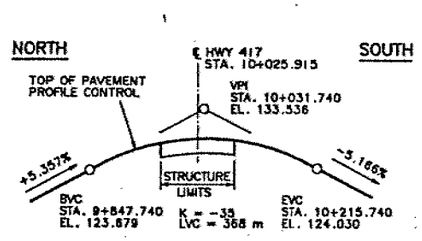
PROFILE HWY 417 EB LANES

N. T. S.



PROFILE HWY 417 WB LANES

N. T. S.



PROFILE OF VAUGHAN ROAD

N. T. S.

NOTES :

1. CLASS OF CONCRETE

DECK & PIER COLUMNS	35 MPa
REMAINDER	30 MPa

2. CLEAR COVER TO REINFORCING

FOOTINGS		100 ±25
ABUTMENTS & WINGWALLS		
FRONT FACE		80 ±20
BACK FACE		70 ±20
PIERS		80 ±20
DECK		
TOP SLAB	TOP	70 ±20
	BOT.	40 ±10
BOT. SLAB	TOP	40 ±10
	BOT.	50 ±10
WEBS		60 ±10
REMAINDER		70 ±20

UNLESS OTHERWISE SPECIFIED

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

4. CONSTRUCTION NOTE :

- 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.

LIST OF DRAWINGS

APPLICABLE STANDARD DRAWING :

OPSD-3501.00 GRANULAR BACKFILL REQUIREMENTS ABUTMENTS

BM 120.340
TOP OF HCM NCC19770904
7.5 LT. 14 + 948.300 (WBL)

REGISTERED PROFESSIONAL ENGINEER 93.03.01 T-F. WONG PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER 93.03.01 A. POPOVIC PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	A.P.	CHK	T.W.	CODE	OHBDC-1983	LOAD	CLASS A	DATE	FEB. 1993
DRAWING	C.K.	CHK	A.P.	SITE	3-598	STRUCT		SCHEME	DWG 1

MEMORANDUM

Ontario

To: Louis Tay, P. Eng.
Senior Project Engineer

June 23, 1998

From: Pavements and Foundations Section
Room 315, Central Bldg.

Tel: (416) 235-5267
Fax: (416) 235-5240

Re: GWP 105-90-00
Hwy 17 from 1.6 km W of Panmure Rd Easterly to 1.0 km W of Hwy 44 (WBL), Hot Mix Paving

As requested in your memorandum dated June 17, 1998, we have completed a review of the foundation related items of the tender documents and drawings. Our review comments are provided in this memorandum.

General

The Contract drawings do not include a borehole plan and stratigraphical section drawing. It is recommended that this drawing be included for the proposed structures and culverts.

Panmure Rd Underpass

Abutment Foundation Design

The abutments for the Panmure Rd Underpass are perched and founded on compacted Granular "A" pads bearing on bedrock. A note on the drawing(Sheet 156) refers to the Grading Drawings for details of the Granular "A" pad. Please ensure that the appropriate drawing is included. If required, a typical "Abutment on Compacted Fill Showing Granular 'A' Core" drawing can be obtained from our office.

Pier Construction

The pier is to be founded on spread footings bearing on the bedrock surface at Elevation 136.0 m. The existing bedrock surface is approximately at Elevation 137.2. Consequently, approximately 1.2 m of rock excavation will be required. Although item 102 covers the rock excavation for structure, it is recommended that a note be included on the drawing that denotes this rock excavation. In addition, a specification for rock excavation shall also be included in the contract package.

Embankment Slope Geometry

A two(2) metre berm is illustrated on the General Arrangement Drawing. Typically, at sites with competent native subsoils such as at this site, berms are recommended to ensure the surficial stability of slopes when embankment heights exceed 8 metres. At the site, it appears that embankment fill heights are approximately 8 metres in height. Please clarify the requirement for the berms.

Temporary Dewatering

Temporary dewatering measures will be required to facilitate the excavation of the cohesionless Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) overburden and the construction of the Granular "A" pads. A Non Standard Special Provision shall be included in the Contract that alerts the Contractor of the subsurface and groundwater conditions at the site and that the Contractor is responsible for effecting a temporary dewatering scheme.

Vaughan Rd Underpass

Abutment Foundation Design

The abutments for the Vaughan Rd Underpass are perched and founded on compacted Granular "A" pads bearing on bedrock at the north abutment and bearing on the native subsoil at the south abutment. A note on the drawing(Sheet 175) refers to the Grading Drawings for details of the Granular "A" pad. Please ensure that the appropriate drawing is included. If required, a typical "Abutment on Compacted Fill Showing Granular 'A' Core" drawing can be obtained from our office.

Pier Construction

The pier is to be founded on spread footings bearing on the bedrock surface at Elevation 117.8 m. The existing bedrock surface is approximately at Elevation 118.8. Consequently, approximately 0.9 m of rock excavation will be required. Although item 87 covers the rock excavation for structure, it is recommended that a note be included on the drawing that denotes this rock excavation. In addition, a specification for rock excavation shall also be included in the contract package.

Temporary Dewatering

Temporary dewatering measures will be required to facilitate the excavation of the Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) and the construction of the Granular "A" pads. A Non Standard Special Provision shall be included in the Contract that alerts the Contractor of the subsurface and groundwater conditions at the site and that the Contractor is responsible for effecting a temporary dewatering scheme.

Culverts

Two(2) rigid frame open footing culverts(Culverts #32 & 36) and two non-rigid frame box culverts (Culverts #26 & 33) are shown on Sheets 61 to 64 inclusive. Foundation Investigation Reports for

these structures are not available. Please confirm if foundation investigations were carried out for these structures.

We trust the above comments are sufficient for your purposes. If you require additional information, please do not hesitate to contact our office.

T. Sangiuliano, P. Eng.
Foundation Engineer

for

D. Dundas, P. Eng.
Senior Foundation Engineer

cc. T. Kazmierowski

memorandum

Ontario

To: E.C. Lane
Head, Structural Section
Eastern Region

Date: 1992 12 31

Attn: W. Kong

From: Foundation Design Section
Room 315, Central Building
Downsview

Re: Vaughan Road Underpass - Hwy. 417
W.P. 106-90-01, Site 3-598
District 9, Ottawa

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

The fieldwork was conducted between 92 12 16 and 92 12 18 and consisted of four (4) additional sampled boreholes and three (3) probe-holes advanced at abutment and pier locations.

At the north abutment location, bedrock was encountered at El. 118.6± m with about 0.8 m of topsoil overlying it. At the pier location, bedrock was contacted at El. 118.6 - 118.9± m. Overburden consisted of pavement structure and fill or topsoil. Thickness of overburden varied from 0.5 m to 1.5 m. At the south abutment location, bedrock was deeply seated at El. 114.0 to 114.4± m, overlain by 6± m of overburden. Overburden material consisted of a surface layer of topsoil (0.5± m) overlying compact to dense glacial till material with some sand and silt layers.

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

Foundation

North Abutment

- remove surficial organic or loose material, virtually to bedrock
- employ shallow footings perched as high as possible within the fill on a minimum 3 m thick granular pad

  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. 118.6± m

  Factored capacity at U.L.S. - 3000 kPa
  Bearing capacity at S.L.S. Type II does not govern.

Pier

- place footings directly on bedrock at about El. 118.6 - 118.9± m

  Factored capacity at U.L.S. - 3000 kPa
  Bearing capacity at S.L.S. Type II does not govern.

South Abutment

- remove surficial organic material (about 0.5± m)

- employ shallow footings perched as high as possible within the fill on a minimum 3 m thick granular pad

  Factored capacity at U.L.S. - 900 kPa
  Bearing capacity at S.L.S. Type II - 350 kPa

General

- All footings should be provided with 1.8 m earth cover for frost protection.

- For sliding resistance, an unfactored coefficient of friction of 0.58 may be used between concrete and bedrock surface and 0.70 between concrete and granular pad.

Lateral Earth Pressure and Slope Stability

- recommendations given in the preliminary foundation report are still valid

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

D. Kwok, P. Eng.
Project Foundation Engineer

for

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

BI/DK/jb

memorandum

Ontario

To: E.C. Lane
Head, Structural Section
Eastern Region

Date: 1992 11 03

Attn: W. Kong
Structural Engineer

From: Foundation Design Section
Room 315, Central Building
Downsview

Re: Foundation Investigation Reports
Vaughan Road U'Pass - Hwy. 417
W.P. 106-90-01
District 9, Ottawa

We reviewed the E-Plan forwarded by your office and find that the boreholes put down during the preliminary foundation investigation are not sufficient to provide final foundation recommendations for the proposed structure. Additional field investigation would be required before our report is finished.

Your present design schedule will not permit us to carry out additional field investigation at this site. Is it possible to extend your design completion date? Can you lay out the proposed structure in the field to facilitate our field operation? I would assume that property acquisition is now complete and access to the proposed structure location is available to MTO personnel.

Please respond ASAP and advise whether you want us to proceed with the additional field investigation.

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

BI/jb

cc. K.G. Bassi/I. Husain