

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31F-97

DIST. 10 REGION

W.P. No. 68-76-02

CONT. No. 82-17

W. O. No.

STR. SITE No. 29-108

HWY. No. 500

LOCATION Snake Creek Bridge

No of PAGES -

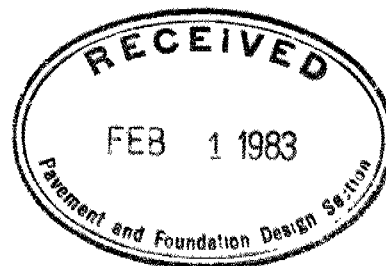
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 82 - 17



Ministry of
Transportation and
Communications

INDEX

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

EXPLANATION OF TERMS USED IN REPORT

2

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
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
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						

FOUNDATION INVESTIGATION REPORT

For

Snake Creek Bridge
4.5 km E. of Hwy. 514
W.P. 68-76-02, Site: 29-108
Hwy. 500, District 10, Bancroft

INTRODUCTION

The results of a foundation investigation program carried out for the replacement of the existing structure at the above-mentioned site are summarized in this report. The fieldwork for the proposed replacement structure was carried out from 79 10 30 to 79 11 01 and consisted of three sampled boreholes, one accompanied by a dynamic cone penetration test. Borings were achieved by means of power auger equipment capable of obtaining BXL rock core. The boring depths ranged from 3.0 to 5.5 metres with rock being cored in two of these holes to a maximum depth of 3.5 metres.

In addition, one hand auger hole and seven shallow probe holes were advanced to bedrock to verify bedrock elevations. These manual borings ranged in depth from 0.2 to 2.1 metres.

SITE DESCRIPTION

The site is located approximately 14.2 km W. of Hwy. 41 and 4.5 km E. of Hwy. 514 on Hwy. 500 in the Township of Raglan, County of Renfrew.

The Snake Creek water course through this area is structurally controlled by bedrock topography. The creek itself, at the time of the site visit, was shallow and moderately slow flowing with a water depth of approximately 0.9 metres immediately north of the existing structure.

Topography in the area is extremely varied and rough with exposed bedrock beyond the west bank dipping steeply to the south-east and bedrock on the east bank dipping at a shallow angle to the north-west. Low-lying marshy areas predominate between the exposed bedrock and creek channel transition area.

The existing structure is an approximate 12 x 7 metre single span simply supported steel girder structure. The structure is presently in good condition, showing no signs of foundation distress.

Generally, the area is underlain by a shallow till veneer and/or rock ridges. The rock knobs and ridges are irregular in outline but show rounded and smoothed surfaces as a result of glacial action. Physiographically, the site is within the Grenville Province of the Precambrian Shield Region which is distinguished by the presence of metasedimentary and meta-volcanic rocks.

SUBSURFACE CONDITIONS

The site is covered by a loose shallow alluvial deposit consisting of sandy silt to sand, ranging in depths from 0.3 metres to 2.9 metres. Competent bedrock underlying the surficial deposit was proven by coring to depths of 3.5 metres.

The boundaries between the various soil types are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, is shown on Drawing No. 2 and should be read in conjunction with the borehole sheets and this report.

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

Sandy Silt to Sand

The surficial deposit encountered over the site consists of an alluvial sandy silt to sand with some gravel. At the east abutment location, a shallow veneer of silty sand with organics was found to extend for depths of 0.2 to 1.1 metres. At the west abutment location, this deposit was found to extend for depths ranging from 2.5 to 2.9 metres with organics present to maximum depths of 1.0 metres. In addition, gradation of this material was found to become coarser with depth. Typical grain size distribution curves for this deposit are shown on Figure 1. A surficial boulder pile extending north from the existing west abutment to the old timber structure and approximately 3 metres wide was evident and may have been placed for erosion control.

Representation 'N' values obtained from the Standard Penetration Test ranged from 5 to 13 blows/.3 metres indicating a denseness for this deposit ranging from loose to compact but generally loose throughout.

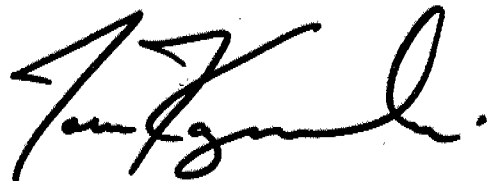
Bedrock

Competent bedrock was encountered immediately below the surficial alluvial deposit and was cored for depths ranging from 3.1 to 3.5 metres. Bedrock was identified as a hard black biotite-amphibolite gneiss of fine texture. BXL rock core recovery within this rock type ranged from 95% to 100%, indicating a very good to excellent rock quality.

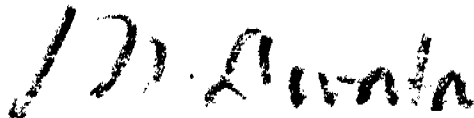
The bedrock was found to range from elevation 293.4 to 294.0 along the east bank and from elevation 291.6 to 291.9 along the west bank, generally dipping at a shallow angle towards creek centreline.

Groundwater

In consideration of the granular nature of the surficial deposit and proximity of bedrock to ground surface, groundwater levels over the site can be assumed to reflect the prevailing creek water levels at the time. Creek water level at the time of investigation was at elevation 294.55.



Tom Kazmierowski, P. Eng.
Foundations Engineer



M. Devata, P. Eng.
Senior Foundations Engineer

APPENDIX

RECORD OF BOREHOLE No 1

METRIC 8

W P 68-76-02 LOCATION Sta. 27+035.5 o/s 2.7 Lt. ORIGINATED BY TJK
 DIST 10 HWY 500 BOREHOLE TYPE Hollow Stem Augers - BW Casing COMPILED BY TJK
 DATUM Geodetic DATE 1979 10 30 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
294.5	Ground Surface							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE					
0.0	Organics						294							
	Sandy silt to coarse sand, some gravel		1	SS	5									13 29 49 9
	Loose to compact		2	SS	13									30 60 9 1
291.9			3	SS	66	175 mm	292							
2.59	Bedrock													
	Biotite - Amphibolite gneiss		4	BXL RC	REC 95%									
	Fine textured													
	Hard		5	BXL REC	REC 98%		290							
289.0														
5.49	End of Borehole						288							

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC 9

W P 68-72-02 LOCATION Sta. 27+042 o/s 7.9 Lt. ORIGINATED BY TJK
 DIST 10 HWY 500 BOREHOLE TYPE Hollow Stem Augers COMPILED BY TJK
 DATUM Geodetic DATE 1979 10 31 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
294.6	Ground Surface													
0.0	Silty Org. Coarse sand Trace gravel Loose		1	SS	7		294							15 74 10 1
			2	SS	8									
			3	SS	66									50 40 8 2
291.7	Gravel and rock fragments Bedrock @ 2.9		4	SS	88/230 mm		292							
3.0	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

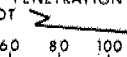


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RECORD OF BOREHOLE No 3

METRIC 10

W P 68-76-02 LOCATION Sta. 27+071.5 o/s 4.6 Lt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE BW Casing COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
294.6	Ground Surface							○ UNCONFINED	+	FIELD VANE							
0.0	Silty sand with organics						294	● QUICK TRIAXIAL	x	LAB VANE							
294.0																	
0.61	Bedrock		1	BW RC	95% REC												
	Biotite - Amphibolite gneiss		2	BXL RC	100% REC												
	Fine textured		3	BXL RC	100% REC												
	Hard		4	BXL RC	100% REC		292										
290.5																	
4.1	End of Borehole																
	WL Not Established																

+3, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF HANDAUGER HOLE No 4

METRIC 11

W P 68-76-02 LOCATION Sta. 27+037.0 o/s 4.4 Rt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Hand Augers COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
294.7	Ground Surface																
0.0	Organics						294										
	Silty sand to sandy silt																
	Loose																
292.6																	
2.1	Refusal to hand augers																

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF PROBE HOLE A

METRIC 12

W P 68-76-02 LOCATION Sta. 27+070.1 Ø ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Probe Hole COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
294.5	Water Level																
293.9	Silty sand with Organics						294										
0.6	Bedrock																
294.5	Water Level																
293.9	Organics Silty sand																
0.6	Bedrock																
294.5	Water Level																
293.4	Silty sand with organics						294										
1.1	Bedrock																
294.5	Water Level																
294.1	Water																
0.4	Silty sand with organics						294										
293.4	Bedrock																
1.1	Bedrock																

PROBE HOLE B Sta. 27+070.0 4.6 m Lt.

PROBE HOLE C Sta. 27+066.2 6.2 m Lt.

PROBE HOLE D Sta. 27+062.1 Ø

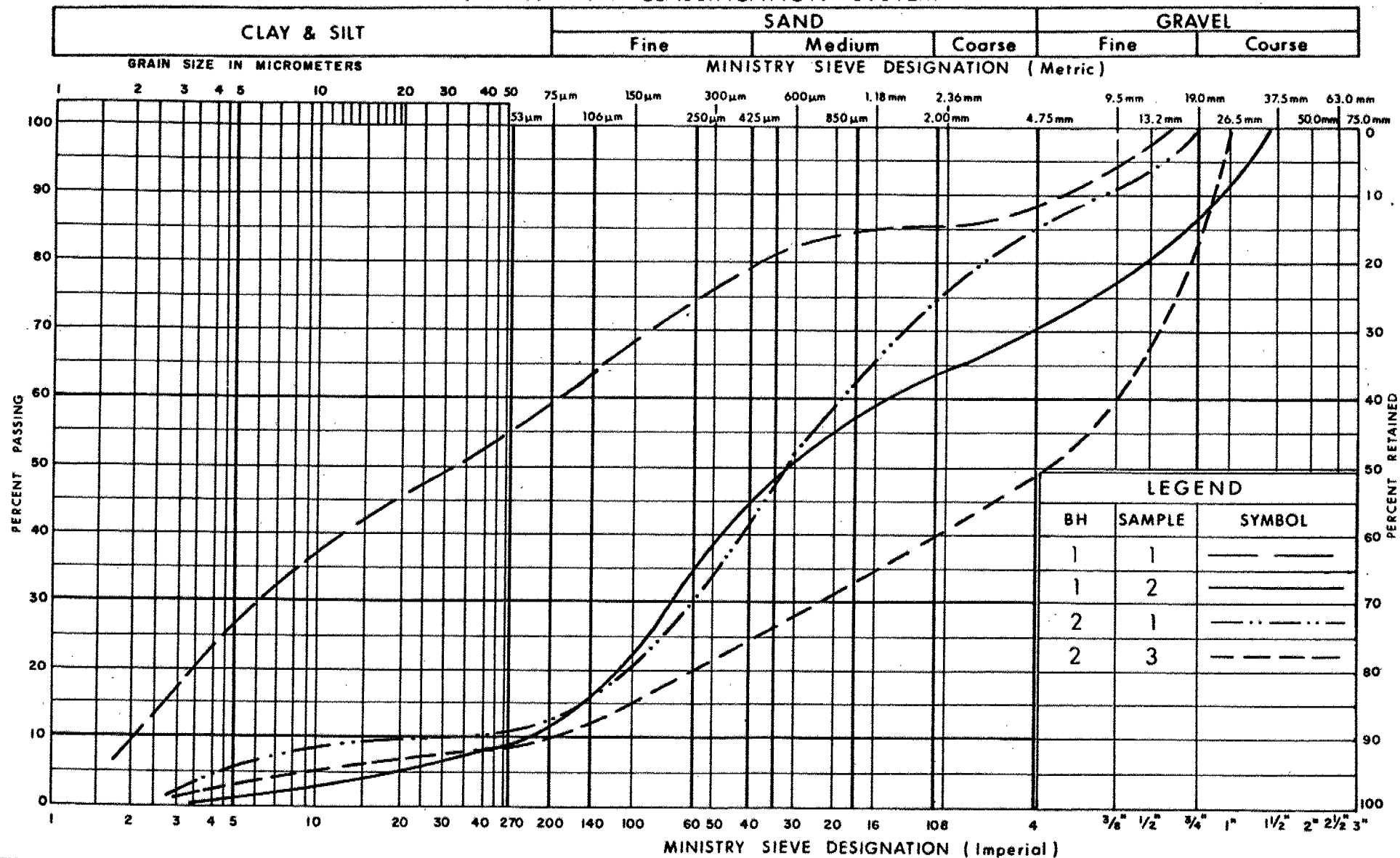
+3, x⁵ : Numbers refer to 20
Sensitivity 15 ± 5 (%) STRAIN AT FAILURE
10

W P 68-76-02 LOCATION Sta. 27+063.1 4.6 m Rt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Probe Hole COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

[illegible]

+3, x5: Numbers refer to Sensitivity

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SANDY SILT TO SAND
WITH SOME GRAVEL

FIG No 1

W P 68-76-02

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	80 02 20	M.A.
TUBES	—	—
ROCK CORES	the amount of cont	M.A.

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 68-76-02 DIST 10
HWY 500 STR SITE 29-108
Snake River Bridge
4.5 km E. of Hwy. 514

DISTRIBUTION

T. C. Kingsland
W. E. Blum
C. E. Pritchard
R. W. Franks (2)

K. G. Bassi
B. J. Giroux

R. Hore

L. Saulnier)
J. Anderson) Cover only
T. J. Kovich)

✓Files

FOUNDATION INVESTIGATION REPORT

For

Snake River Bridge
4.5 km E. of Hwy. 514
W.P. 68-76-02, Site: 29-108
Hwy. 500, District 10, Bancroft

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Topography in the area is extremely varied and rough with

exposed bedrock beyond the west bank dipping steeply to the south-east and bedrock on the east bank dipping at a shallow angle to the north-west. Lowlying marshy areas predominate between the exposed bedrock and creek channel transition area.

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Generally, the area is underlain by a shallow till veneer and/or rock ridges. The rock knobs and ridges are irregular in outline but show rounded and smoothed surfaces as a result of glacial action. Physiographically, the site is within the Grenville Province of the Precambrian Shield Region which is distinguished by the presence of metasedimentary and meta-volcanic rocks.

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The boundaries between the various soil types are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, is shown on Drawing No. 687602-A.

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

Sandy Silt to Sand

The surficial deposit encountered over the site consists of an

alluvial sandy silt to sand with some gravel. At the east abutment location, a shallow veneer of silty sand with organics was found to extend for depths of 0.2 to 1.1 metres. At the west abutment location, this deposit was found to extend for depths ranging from 2.5 to 2.9 metres with organics present to maximum depths of 1.0 metres. In addition, gradation of this material was found to become coarser with depth. Typical grain size distribution curves for this deposit are shown on Figure 1. A surficial boulder pile extending north from the existing west abutment to the old timber structure and approximately 3 metres wide was evident and may have been placed for erosion control.

Representation 'N' values obtained from the Standard Penetration Test ranged from 5 to 13 blows/.3 metres indicating a denseness for this deposit ranging from loose to compact but generally loose throughout.

Bedrock

Competent bedrock was encountered immediately below the surficial alluvial deposit and was cored for depths ranging from 3.1 to 3.5 metres. Bedrock was identified as a hard black biotite-amphibolite gneiss of fine texture. BXL rock core recovery within this rock type ranged from 95% to 100%, indicating a very good to excellent rock quality.

The bedrock was found to range from elevation 293.4 to 294.0 along the east bank and from elevation 291.6 to 291.9 along the west bank, generally dipping at a shallow angle towards creek centreline.

Groundwater

In consideration of the granular nature of the surficial deposit and proximity of bedrock to ground surface, groundwater levels over the site can be assumed to reflect the prevailing creek water levels at the time. Creek water level at the time of investigation was at elevation 294.55.

DISCUSSION AND RECOMMENDATIONS

Present planning for the upgrading of the existing Hwy. 500 calls for the realignment of the highway centreline at Snake Creek and will require the replacement of the existing single lane structure at Snake Creek with a 21 x 8.5 metre single span simply supported concrete structure. A proposed profile grade elevation of 298 ± will require fill heights in the order of 3.5 metres.

In view of the relatively shallow surficial deposits overlying competent bedrock in the area, our recommendations pertaining to the foundations and earthworks for the replacement structure are as follows.

Structure Foundations

The proposed replacement structure should be supported on spread footings founded on competent bedrock. Footings so founded can be designed for a safe bearing pressure of 950 kPa, which should be sufficient for this type of structure provided all weathered or loosen material is completely removed from the rock surface. For design purposes, the bottom of footings elevation founded on competent bedrock are approximately:

<u>Footing Location</u>	<u>Bottom of Footing Elevation</u>
West Abutment Footing	291.9 ±
East Abutment Footing	293.3 ±

In consideration of the highly permeable nature of the surficial deposit and the proximity of creek water levels, provisions should include an approximately designed dewatering system for the west abutment location possibly incorporating steel sheeting to facilitate construction of footings in the dry. Prior excavation of the existing boulder pile mentioned

previously will be required before placement of steel sheeting. Alternatively, tremie concrete can be utilized as a tremie seal to effectively prevent water inflow at the base of the sheeting.

In order to resist lateral forces acting on the abutment wall and foundations, frictional forces between the footing base and horizontal bedrock surface can be calculated assuming a coefficient of friction of 0.75 against sliding. Greater lateral resistance can be achieved by keying or dowelling the footing into competent rock. Backfill behind the abutments should be composed of well compacted free-draining granular material with provision made for adequate drainage. The lateral earth pressure exerted on the abutment walls by the granular backfill can be computed assuming a unit weight of 20.4 kN/m^3 for the backfill and an "at rest" lateral earth pressure coefficient of 0.5 with due allowance for surcharge and traffic loads.

Construction Considerations

All rock surfaces within the planned limits of the foundations should be clean, free from any muck and loose rock fragments, before placement of the footings.

Any variations in bedrock surface along the full length of the abutment can be levelled out through the use of mass concrete placed between the bedrock surface and the established abutment footing elevation.

Approaches

No stability problems are anticipated for embankment slopes provided they are constructed not steeper than 2:1. All organics and deleterious material within the plan limits of the approach embankments should be subexcavated for their full depth and backfilled with well compacted granular material.

Adequate precautions should be taken to protect the approach embankments from creek scour action. This may be achieved by a suitably placed rip-rap scheme.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. T. J. Kazmierowski, Project Foundations Engineer. The equipment was owned and operated by Dominion Soil Investigation, Inc., Kitchener.

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



A handwritten signature in cursive script, reading 'Tom Kazmierowski', written over the right side of the professional seal.

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

A handwritten signature in cursive script, reading 'M. Devata', written above the name and title.

M. Devata, P. Eng.
Senior Foundations Engineer.

February, 1980.

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

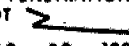
W P 68-76-02 LOCATION Sta. 27+035.5 o/s 2.7 Lt. ORIGINATED BY TJK
 DIST 10 HWY 300 BOREHOLE TYPE Hollow Stem Augers - BW Casing COMPILED BY TJK
 DATUM Geodetic DATE 1979 10 30 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							SHEAR STRENGTH	WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE							
294.5	Ground Surface													GR SA SI CL		
0.0	Organics						294							13 29 49 9		
	Sandy silt to coarse sand, some gravel		1	SS	5									30 60 9 1		
	Loose to compact		2	SS	13											
291.9			3	SS	66/	175 mm	292									
2.59	Bedrock															
	Biotite - Amphibolite gneiss		4	BXL EC	REC 95%											
	Fine textured															
	Hard		5	BXL REC	REC 98%		290									
289.0																
5.49	End of Borehole						288									

RECORD OF BOREHOLE No 2

METRIC

W P 68-72-02 LOCATION Sta. 27+042 o/s 7.9 Lt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Hollow Stem Augers COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
							20	40	60	80	100						
294.6	Ground Surface																
0.0	Silty Org. Coarse sand Trace gravel Loose		1	SS	7											15 74 10 1	
			2	SS	8												
			3	ES	66											50 40 8 2	
291.7	Gravel fragments and rock fragments Bedrock @ 2.9		4	SS	88/230 mm												
3.0	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 3

METRIC

W P 68-76-02 LOCATION Sta. 27+071.5 o/s 4.6 Lt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE BW Casing COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)						
294.6	Ground Surface																
0.0	Silty sand with organics																
294.0																	
0.61	Bedrock		1	BW RC	95% REC												
	Biotite - Amphibolite gneiss		2	BXL RC	100% REC												
	Fine textured		3	BXL RC	100% REC												
	Hard		4	BXL RC	100% REC												
290.5																	
4.1	End of Borehole																



RECORD OF HANDAUGER HOLE No 4

METRIC

W P 68-76-02 LOCATION Sta. 27+037.0 o/s 4.4 Rt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Hand Augers COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
294.7	Ground Surface																
0.0	Organics																
	Silty sand to sandy silt																
	Loose																
292.6																	
2.1	Refusal to hand augers																

RECORD OF PROBE HOLE A

METRIC

W P 68-76-02 LOCATION Sta. 27+070.1 f ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE Probe Hole COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF PROBE HOLE E

METRIC

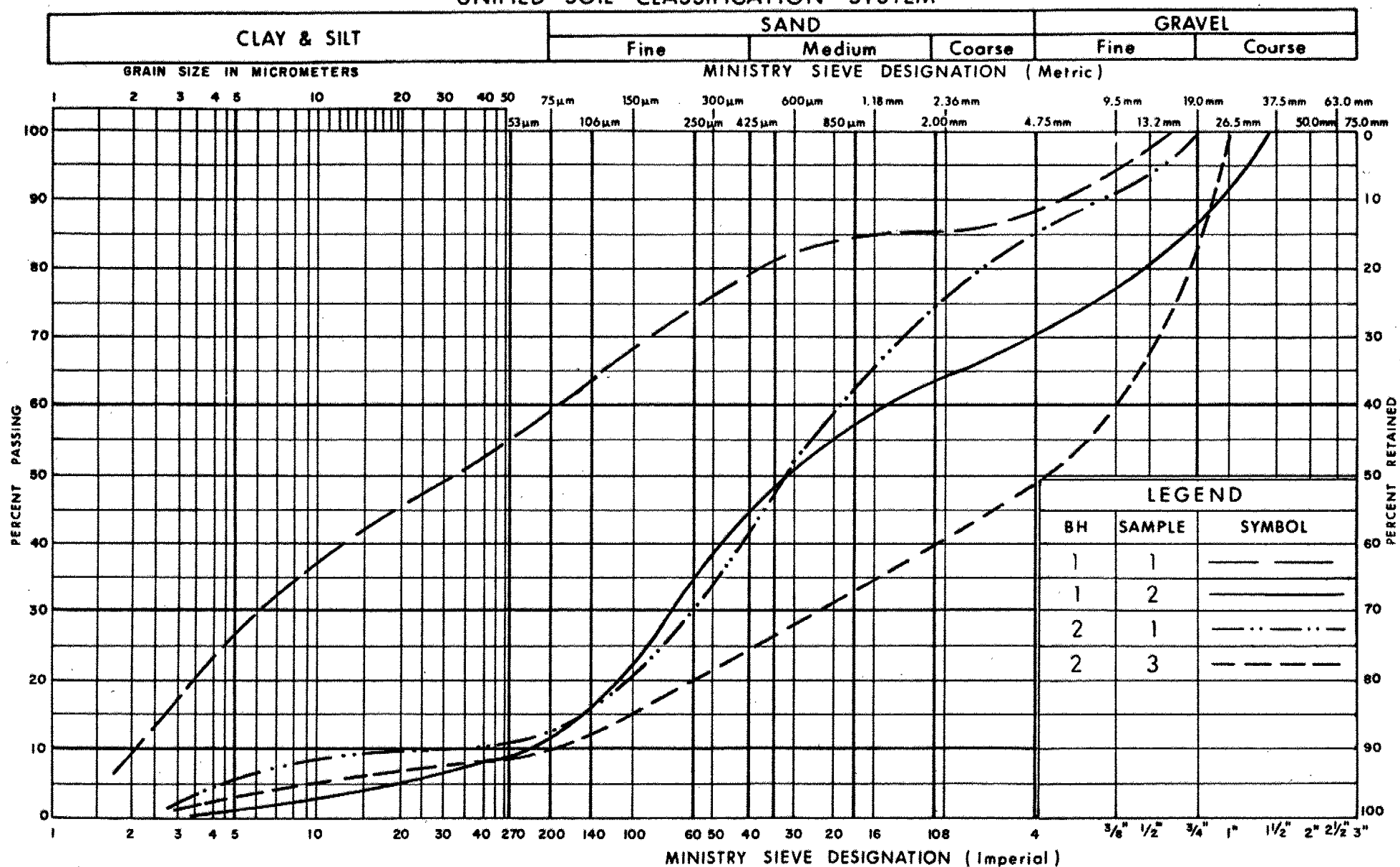
W P 68-76-02 LOCATION Sta. 27+063.1 4.6 m Rt. ORIGINATED BY TJK
DIST 10 HWY 500 BOREHOLE TYPE _____ COMPILED BY TJK
DATUM Geodetic DATE 1979 10 31 CHECKED BY _____

[illegible]

***3, *5 : Numbers refer to Sensitivity**

20
15 ϕ 5 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



**Ministry of
Transportation and
Communications**

GRAIN SIZE DISTRIBUTION

SANDY SILT TO SAND

WITH SOME GRAVEL

FIG No 1

W P 68-76-02

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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	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 = $\frac{c_u}{\tau_r}$

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

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						

METRIC

NOTE:
DIMENSIONS ARE IN METERS
AND/OR MILLIMETERS UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETERS + METERS

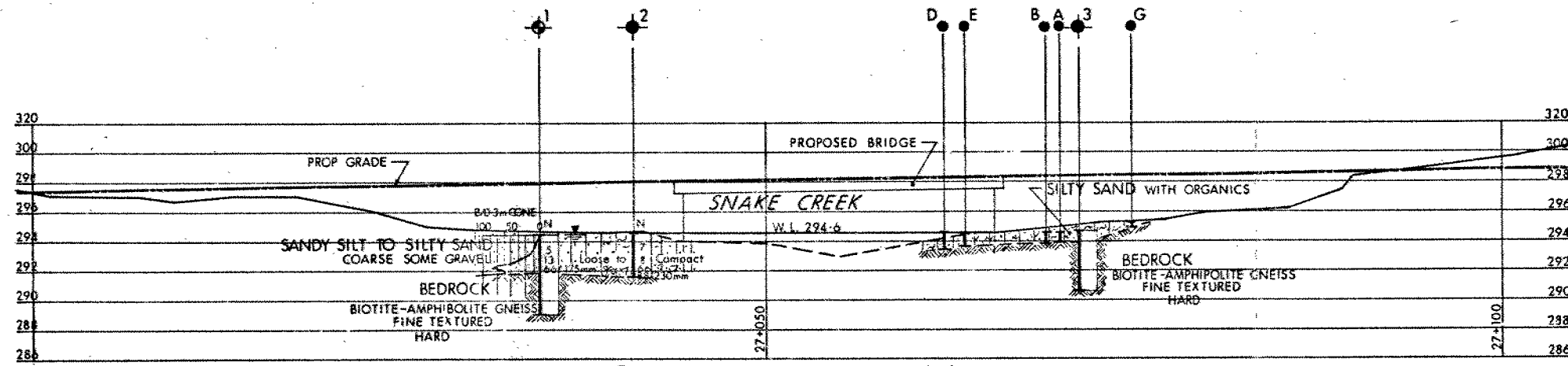
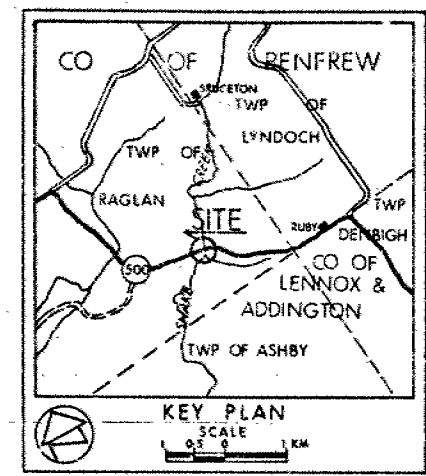
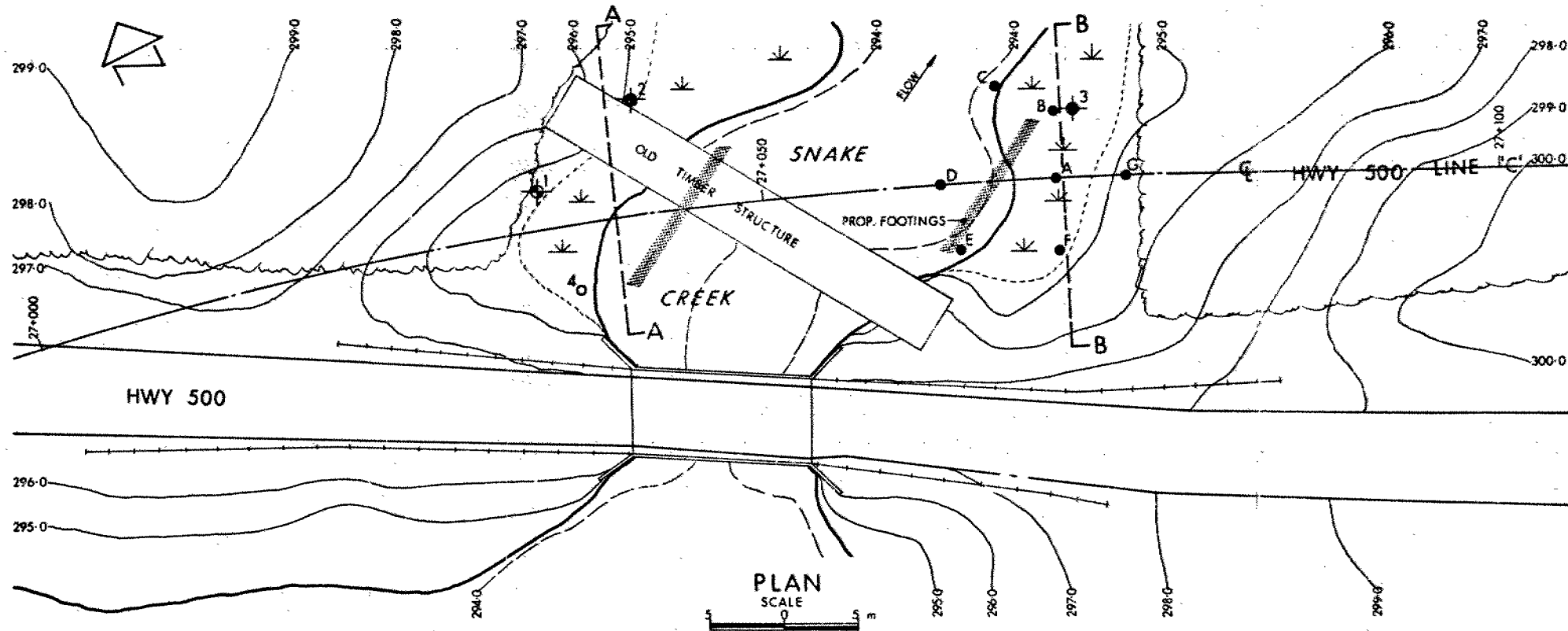
CONT No
WP No 68-76-02

HWY 500 & SNAKE CREEK BRIDGE

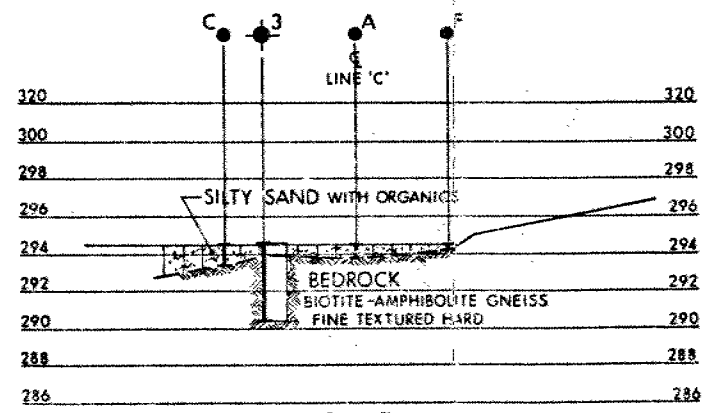
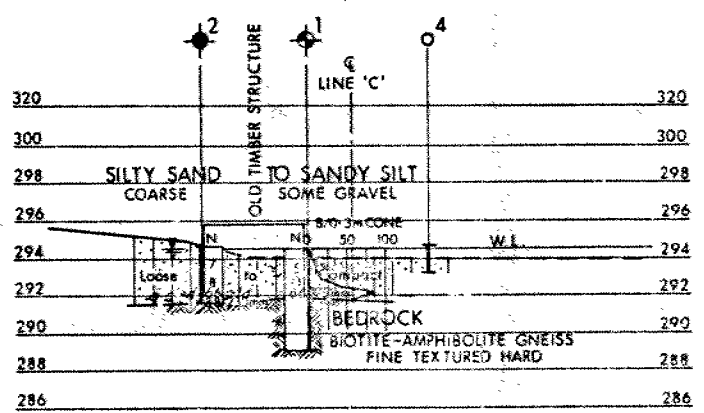
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test (Cone)		
	Bore Hole & Cone		
N	Blows/0.3m (Std Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
	W.L. at time of investigation 79 10 30		
	W.L. Not Established in BH No 3		
	HANDAUGER HOLE		
	PROBE HOLES		
No	ELEVATION	STATION	OFFSET
1	294.5	27+035.5	2.7 LT.
2	294.6	27+042.0	7.9 LT.
3	294.6	27+071.5	4.6 LT.
4	HANDAUGER HOLE	27+037.0	4.4 RT.
PROBE HOLES			
A	294.5	27+070.1	Q
B	294.5	27+070.0	4.6 LT.
C	294.5	27+066.2	6.2 LT.
D	294.5	27+062.1	Q
E	294.5	27+063.1	4.6 RT.
F	294.5	27+070.0	4.9 RT.
G	295.2	27+074.8	Q



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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 31F-97

HWY No 500 DATE 80 01 15 SITE 29-108

SUBMD T. K. CHECKED DATE 80 01 15 SITE 29-108

DRAWNCL J. CHECKED DATE 80 01 15 SITE 29-108

SECTIONS

SCALE 0 5 m

DIST. 10 - BANCROFT
CONT. No
WP No 68-76-02

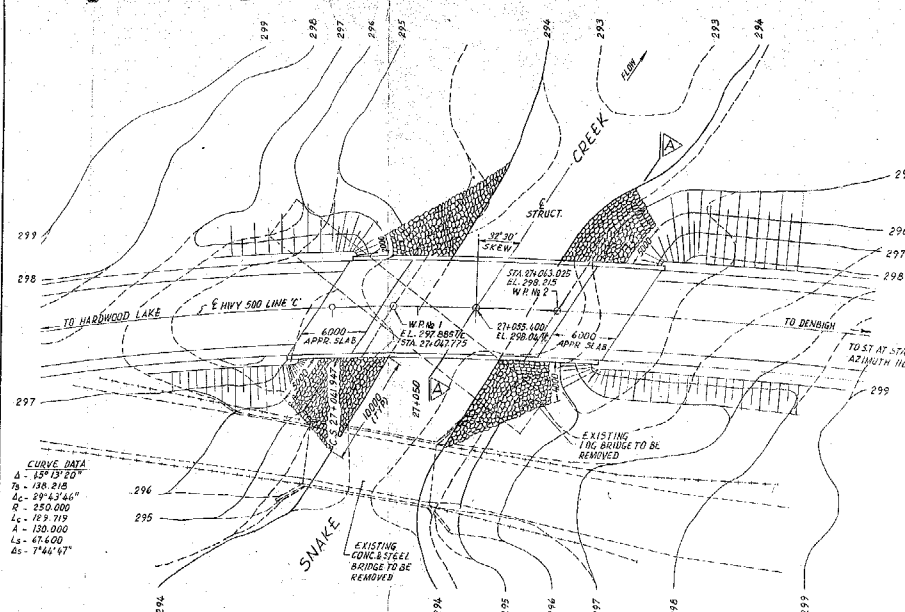


**SNAKE CREEK BRIDGE
GENERAL ARRANGEMENT**

SHEET

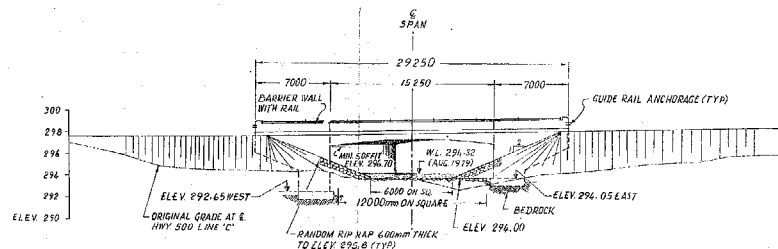
METRIC

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.



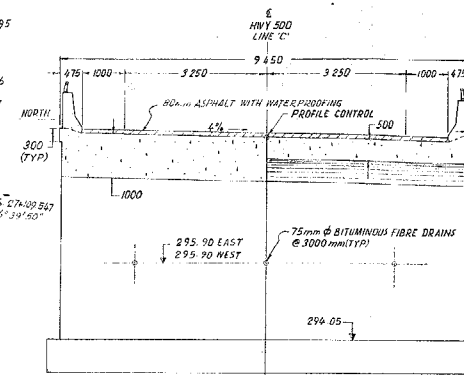
CURVE DATA
Δ - 18° 15' 00"
Ts - 138.218
Lc - 24.437
R - 250.000
Ls - 18.9.719
A - 130.000
Ls - 47.600
Δs - 7° 44' 47"

**PLAN
1:200**



**SOUTH ELEVATION
1:200**

REFERENCE: BENCH MARK
B.M. 296.096
GEODETIC DATUM
NAW IN NW CORNER OF 0.70 SPRUCE
N.E. OF 267920.5



**SECTION-AA
1:50**

NOTES:

- CLASS OF CONCRETE**
RIGID FRAME, WINGWALLS & BARRIER WALLS - 30 MPa
FOOTINGS - 20 MPa
- REINFORCING STEEL** GRADE 400
BAR MARK WITH THE SUFFIX 'C' INDICATE COATED BARS.
- CLEAR COVER TO REINFORCING STEEL**
FOOTINGS 75 ± 95 mm
ABUTMENTS AND WING WALLS 50 ± 20 mm
DECK 70 ± 10 mm
BARRIER WALLS 30 ± 10 mm
AS INDICATED

CONSTRUCTION NOTES

- FOOTINGS TO BE FOUNDED ON SOUND BEDROCK.
- BACKFILL TO BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION OF BACKFILLS AT ABUTMENT EXCEED 600 mm.
- FRAMEWORK SUPPORTING WINGWALLS NOT TO BE REMOVED UNTIL CONCRETE HAS REACHED A STRENGTH OF 20 MPa.

- T.C. DENOTES TOP OF CONCRETE
W.P. DENOTES WORKING POINT

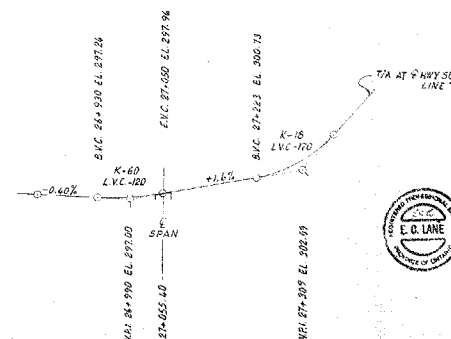
LIST OF DRAWINGS:

- 25-108-1 GENERAL ARRANGEMENT
-2 BORE HOLE LOCATION & SOIL STRATA
-3 FOOTING AND WINGWALL DETAILS
-4 RIGID FRAME DETAILS
-5 BARRIER WALL
-6 RAILING FOR BARRIER WALL
-7 APPROACH SLAB
-8 AS CONSTRUCTED ELEV & DIMENSIONS

CONCRETE QUANTITIES

CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:

CONCRETE IN BRIDGE	26.5 m³
CONCRETE IN BARRIER WALLS	15 m³
CONCRETE IN APPROACH SLABS	31 m³



**PROFILE HWY 500 LINE 'C'
N.T.S.**

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DATE	BY	CHECK	DESCRIPTION
DESIGN	ELL		LOADING QUOTE DATE FEB/02
DRAWING	AMY	CHECK W.S.	SITE NO 25-108-100