

G.I.-30 SEPT. 1976

GEOCRES No. 317-96DIST. 10 REGION W.P. No. 69-78-02CONT. No. 80-86W. O. No. STR. SITE No. 29-43HWY. No. 62LOCATION Byers Creek Bridge
At Round Lake CentreNo of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

METRIC

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

NOTES

CLASS OF CONCRETE

DECK & BARRIER WALLS	30 MPa
PRESTRESSED CONC. GIRDERS	35 MPa
REMAINDER	20 MPa

REINFORCING STEEL

GRADE 400
EPE MARKS WITH SUFFIX C
DENOTE COATED BARS

CLEGG COVES TO REIN. STEEL

FOOTINGS & REINFORCEMENTS - 75 MM
DECK TOP - 50 MM
DECK BOTTOM - 35 MM
OR AS NOTED ON DETAILS

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 M.M. NO CONCRETE SHALL BE PLACED ABOVE THE REINFORCEMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

TO ACHIEVE THE MINIMUM CLEAR COVER OF 50 MM SPECIFIED AT TOP OF DECK, THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED PRIOR TO CONCRETING, WITH A CLEAR COVER OF 55 ± 15 MM TOLERANCE.

LIST OF DRAWINGS

1. GENERAL PLAN
2. BORE HOLE LOCATIONS & SOIL STRATA
3. FOUNDATIONS
4. ABUTMENTS
5. PRESTRESSED GIRDERS & BEARINGS
6. DECK
7. BARRIER WALL
8. 6 M. APPROACH SLAB
9. STANDARD DETAILS I
10. STANDARD DETAILS II
11. STANDARD DETAILS III
12. AS CONSTRUCTED ELEV. & DIM.
13. BRIDGE DATE AND SITE NUMBER DATA

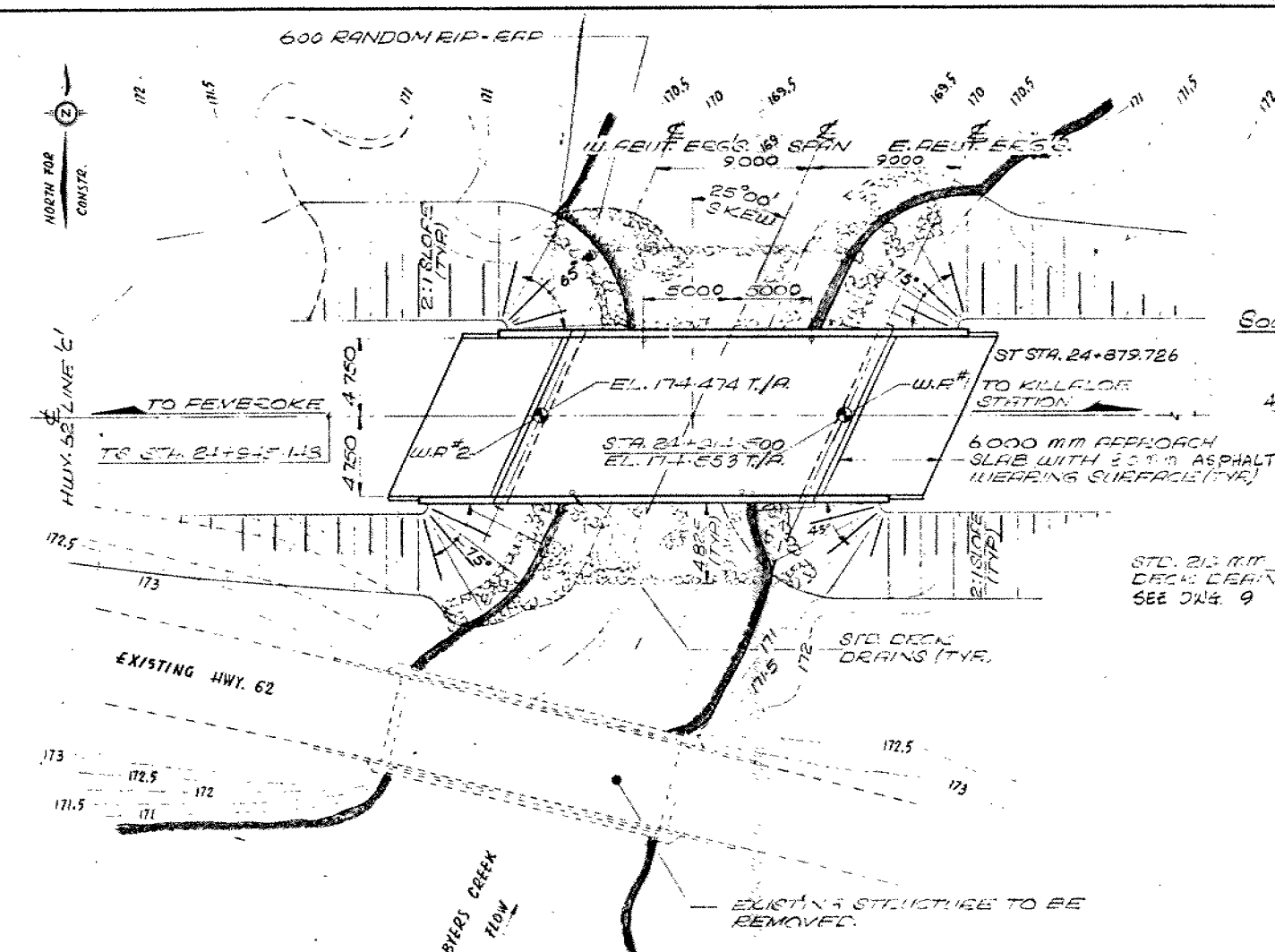
CONCRETE QUANTITIES

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

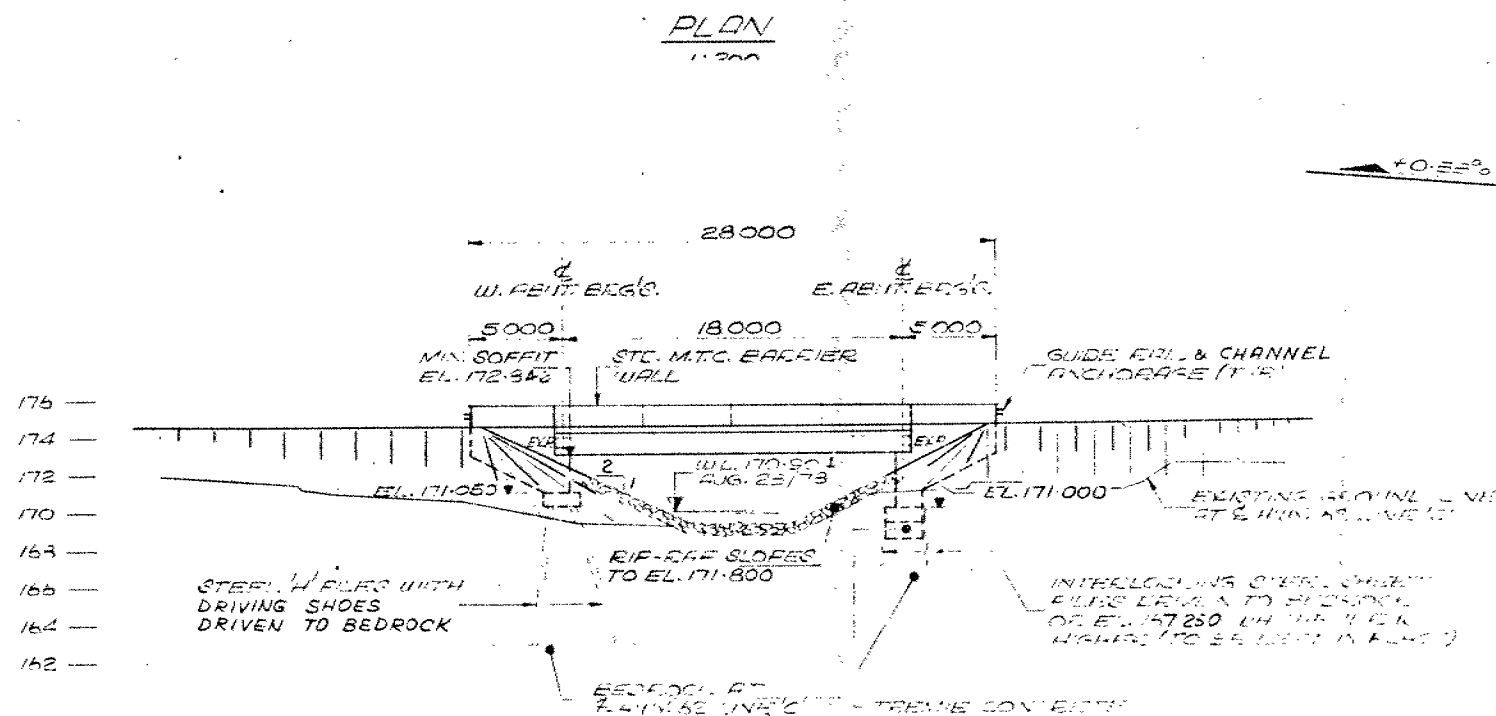
- CONCRETE IN ABUTMENTS & WINGWALLS ——— 84 m³
- CONCRETE IN DECK AND DIAPHRAGMS ——— 50 m³
- CONCRETE IN BARRIER WALLS ——— 14 m³
- CONCRETE IN APPROACH SLABS ——— 30 m³

NOTES

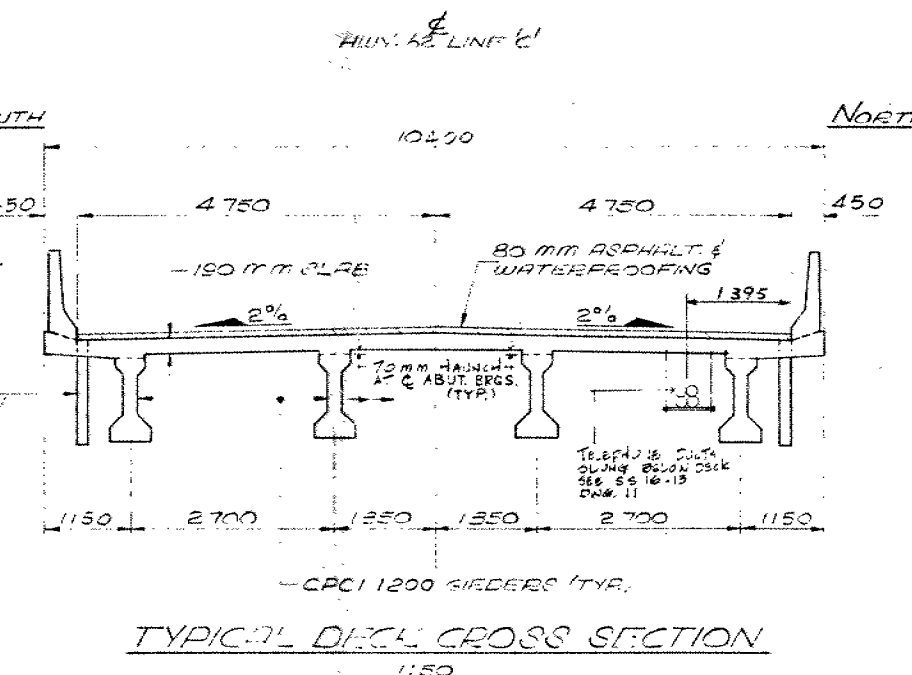
U.F. DENOTES WORKING POINT
T/F DENOTES TOE OF HSP-HST



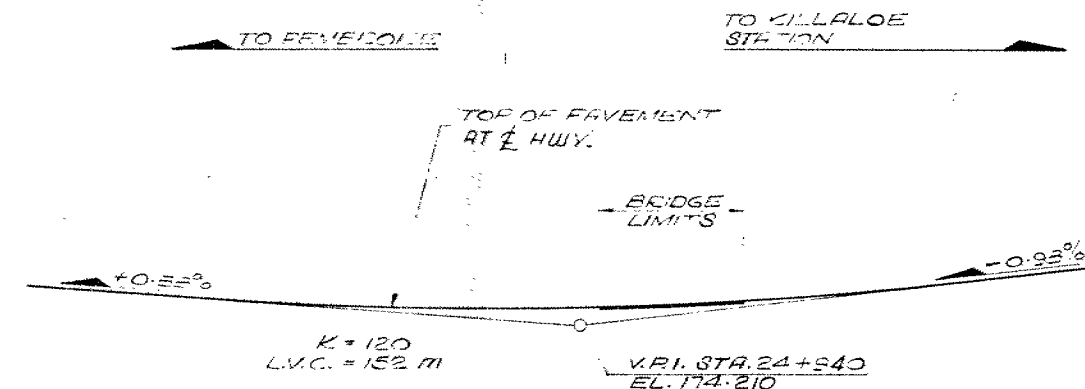
PLAN



TYPICAL DECK CROSS SECTION



PROFILE OF HWY. 62 LINE 'C'



REFERENCE B.M.

B. M. 173.004

N. $\frac{1}{2}$ W. IN W. ROOT PINE
37.7 LT. 24+911

ELEVATION

1:200

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		DESCRIPTION
DESIGN	5	CHECK
DRAWING	5	CHECK
		LOADING - 800, 875 GALLONS
		5" R No. 3 - 2
		ONG 1

LEGEND -
E.S. DENOTES EQUALLY SPACED

METRIC

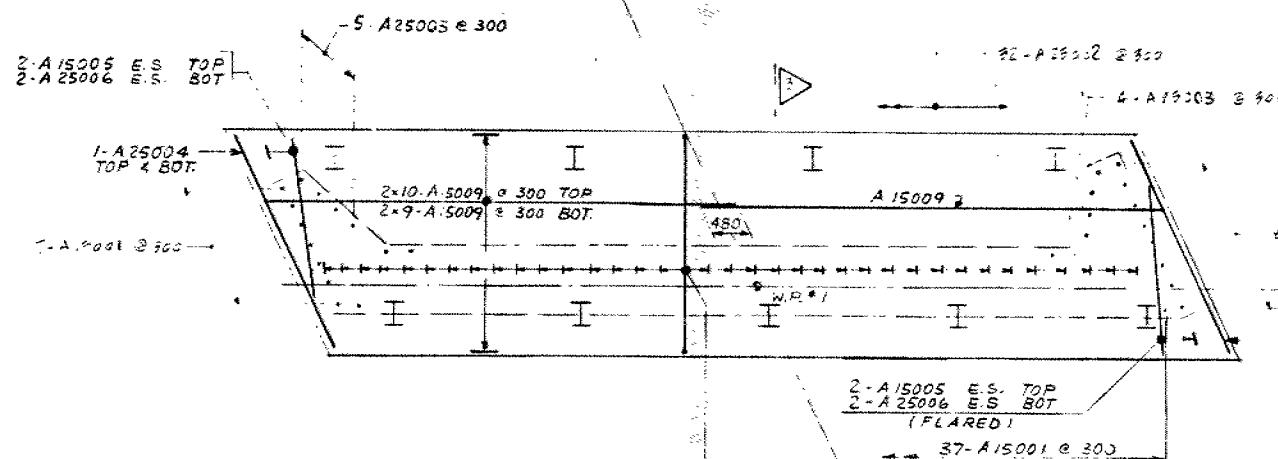
DIMENSIONS ARE IN MILLIMETRES
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AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

CONT No
WP No 69-78-02

BYERS CREEK BRIDGE
12.3 km North of ...
FOOTING

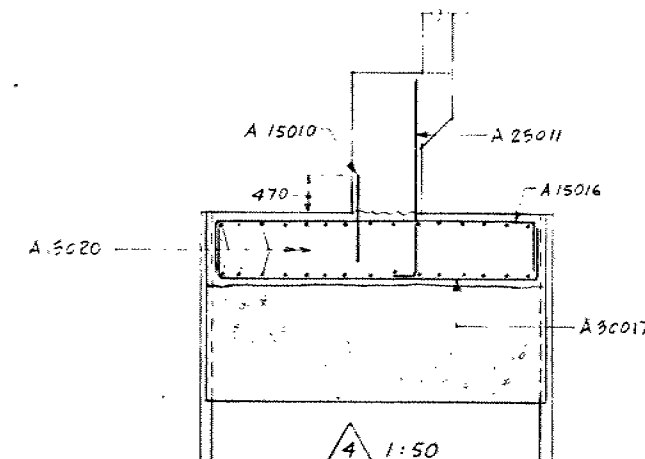
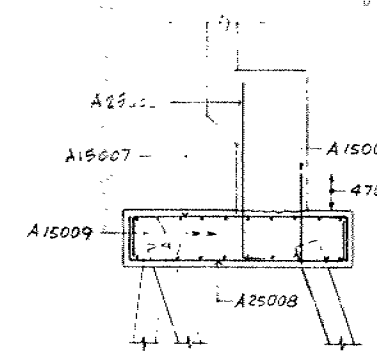
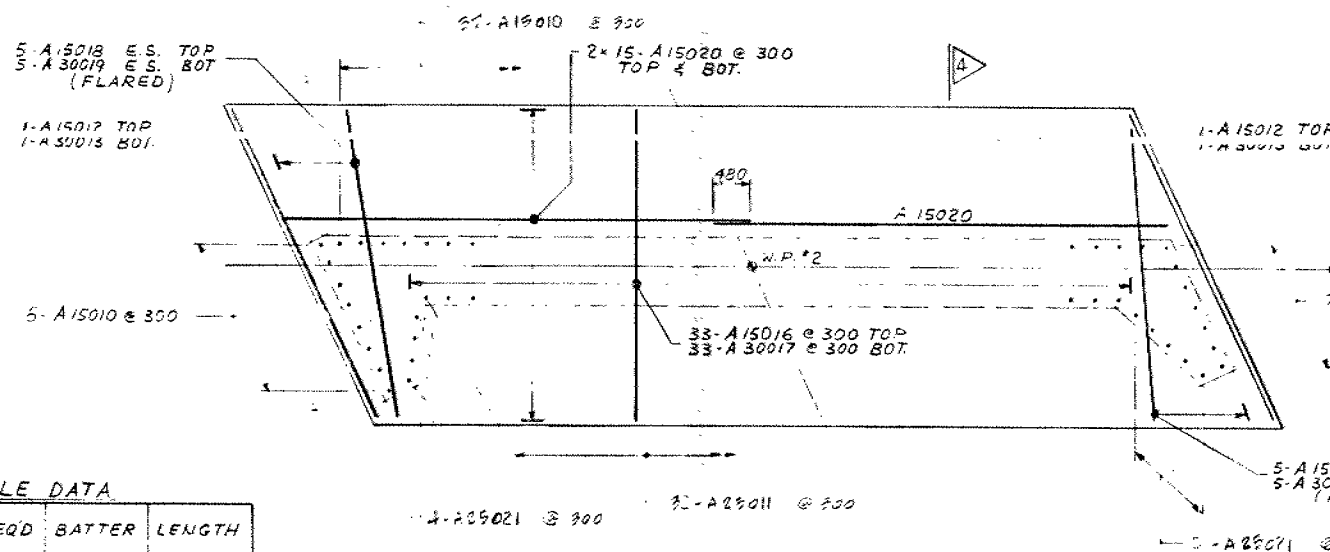
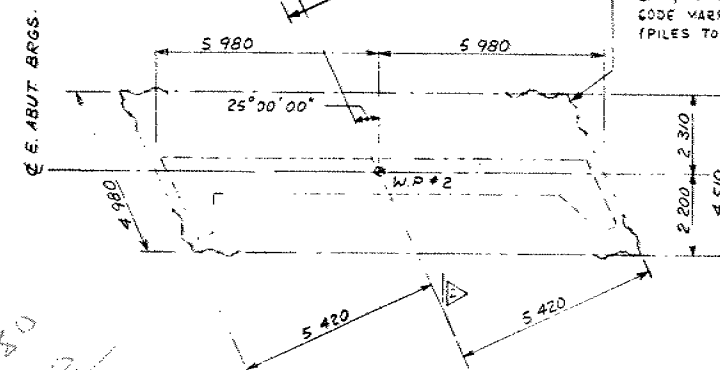
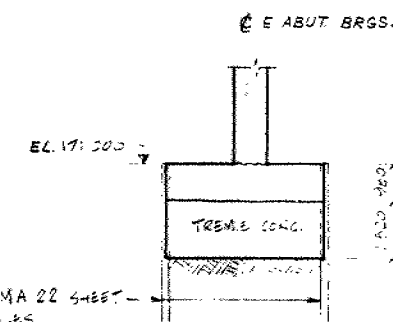
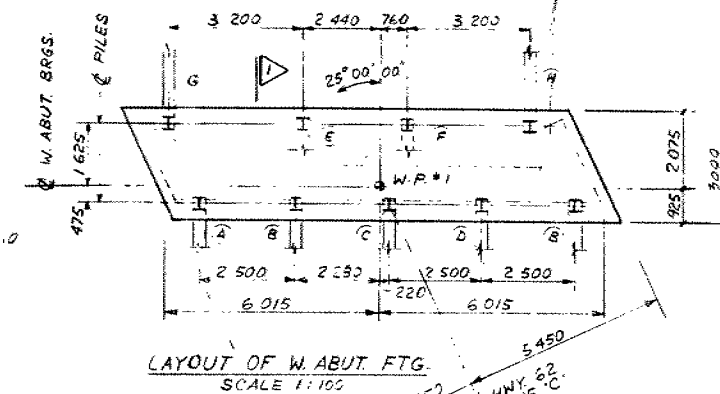
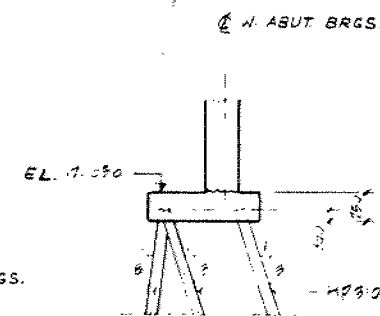


SHEET



NOTES

- PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING.
- PILES TO BE DRIVEN TO BEDROCK.



PILE DATA			
PILE	N° REQD	BATTER	LENGTH
(A)	1	3:1	6 900
(B)	2		7 600
(C)	1		8 200
(D)	1		7 900
(E)	1	8:1	7 700
(F)	1		8 100
(G)	1		8 600
(H)	1		7 400

ALL PILES TO BE HP 310 x 110

PLAN
SCALE 1:50

DRAWING NOT TO BE SCALED
COPY ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN			
CHECK			
DRAWING			

Found

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 80-86



Ministry of
Transportation and
Communications



1

INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3-14	Foundation Investigation Report Byers Creek Bridge W.P. 69-78-02

NOTE: For purposes of the contract this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
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
P	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

Byers Creek Bridge
12.8 km Northwest of
Hwys. 60/512 (Killaloe Sta.)
W.P. 69-78-02, Site 29-43
Hwy. 62, District 10, Bancroft

INTRODUCTION

This report contains the results of our investigation of the sub-surface conditions at this site. Fieldwork was carried out during the period of March 20 to March 22, 1979, and consisted of four sampled boreholes, five augered holes and three probe holes. Boreholes were advanced by means of a bombardier mounted hollow stem auger machine and the depth of boring ranged from 3 m to 10 m approximately. The probe holes were hand dug to a depth of up to 1 m below ground surface. Samples of the overburden were recovered by means of a split spoon sampler driven into the ground in accordance with the specifications for the Standard Penetration Test. Bedrock was proven by obtaining BX size rock core samples.

SITE AND GEOLOGY

The site is about 17 m north of the existing crossing of Hwy. 62 and Byers Creek on Con. 13, Lot 17, in the Township of Hagarty, County of Renfrew. The Village of Round Lake Centre is approximately 1 km west of the site.

Byers Creek originates some 17 km south of the site in the Haliburton Highlands and drains into Round Lake about 70 m north of the site. At this location Byers Creek follows a winding course with a minimum width of about 16 m at the existing bridge and a maximum depth of about 2 m. The existing structure is a single lane steel truss bridge with a clear span of 16.75 m. The existing Hwy. 62 is constructed on an earth embankment about 2.5 m high. Both the bridge and the approaches are in a good working condition.

The surrounding terrain is rolling, covered mostly with coniferous trees. A rock outcrop about 4 to 5 m high is visible some 200 m northeast of the site. The east bank of the creek is sandy and relatively steep, whereas the west bank is very gentle and has a thick growth of bulrush.

Round Lake is a popular resort centre. In this area Hwy. 62 is lined with cottages and camp grounds.

Geologically, the area is part of the Canadian Shield. The Shield has been subjected to extensive glacial erosion with most or all of the pre-glacial deposits eroded away. The underlying bedrock in this area is a granitic gneiss.

SUBSURFACE CONDITIONS

General

The overburden was found to be about 3.2 m to 7.5 m thick increasing from east to west and generally consists of a well graded sand. The lower portion of this sand stratum contains numerous cobbles and boulders. In the western portion of the creek a layer of organic silt up to 1.5 m thick was encountered immediately below the creek bed. The organic soil is generally underlain by the above mentioned well graded sand except in one particular location where it is underlain by a layer of uniform fine sand which is about 3.8 m thick. The uniform fine sand in turn is followed by the well graded sand. Across the site the overburden is underlain by gneiss bedrock.

Location and elevation of the boring and probe holes are shown in Structural Drawing No.2. Factual field data and laboratory test results are contained in the Record of Borehole Sheets. A profile and two sections of the subsoil stratigraphy estimated from the above information are also included on Structural Drawing No. 2. A description of the subsoil types, bedrock and groundwater conditions is as follows.

Organic Silt

This organic soil was encountered only in the western portion of the creek. It has a thickness of up to 1.5 m and appears to be confined to an area below contour 170.0 m. The organic silt was found to have an organic content of 2.8% to 4.1% by weight and a moisture content of 52% to 70%. Based on the very low N values of less than 1 blow per 0.3 m, it is concluded that the organic silt has a very soft consistency.

Uniform Fine Sand

In the western portion of the creek at one location a layer of uniform fine sand about 3.8 m thick was found underneath the organic silt. A typical grain size distribution curve for the uniform fine sand is shown in Figure 1. The N values from Standard Penetration Tests of less than 1 blow to 7 blows per 0.3 m indicates that the uniform fine sand has a very loose to loose relative density.

Well Graded Sand With Gravel

This is the predominant subsoil at the site. It was found immediately below ground surface in the east bank and beneath the organic silt or the uniform fine sand in the western portion of the creek. The thickness of this granular deposit was found to range from 3.2 m to 5.5 m approximately. The material generally consists of a well graded sand with gravel. However, the lower portion contains numerous cobbles and boulders. Grain size distribution curves from 50 mm split spoon samples are summarized in an envelope form in Figure 2. The N values from Standard Penetration Tests carried out in this deposit vary from 1 to 30 blows per 0.3 m, generally increasing with depth. It is estimated from this that the relative density of the granular subsoil is very loose to dense, but generally being compact.

Bedrock

Bedrock surface varies from elevation 168+ m to elevation 163+ m, generally dipping towards the north and the west.

Bedrock is a granitic gneiss with micaceous bands. Except for occasional fractures, bedrock is hard and sound as evidenced by the generally high recovery ratios and RQD values of in excess of 90%.

Groundwater Conditions

Because the granular subsoil is highly permeable, the groundwater level is found to be closely related to the creek water level. For practical purposes, the groundwater level can be assumed equal to the prevailing creek water level. During the course of investigation, the creek water level was found to be at elevation 170.2+.



P.J. Stuart, P. Eng.
Foundations Engineer

A handwritten signature in cursive script that reads "M. Devata".

M. Devata, P. Eng.
Senior Foundations Engineer



RECORD OF BOREHOLE No 1

METRIC

7

W P 69-78-02 LOCATION Sta. 24+942.0; E Hwy. 62 Line 'C' ORIGINATED BY BL
 DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
 DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH					WATER CONTENT (%) 		
								UNCONFINED ● QUICK TRIAXIAL	FIELD VANE + FIELD VANE x LAB VANE	PLASTIC LIMIT W _p				NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L
170.6	Ground Level														
0.0	Organic Silt						170					0m 2.5%	0 80 (20)		
169.8			1	SS	1										
0.8	Uniform Very Fine to Fine Sand Very Loose to Loose														
			2	SS	4										
			3	SS	7										
166.0							168								
						166									
4.6	Well Graded Sand With Gravel Dense		4	SS	30		164					17 70 (13)			
			5	SS	N/A										
163.2															
7.4	Gneiss Bedrock With Micaceous Bands Hard and Sound		6	RC	Rec 100%		162						RQD 95%		
161.7															
8.9	End of Borehole														

RECORD OF BOREHOLE No 2

METRIC

W P 69-78-02 LOCATION Sta. 24+936.2; E Hwy. 62 Line 'C' ORIGINATED BY BL
 DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
 DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										20 40 60		
170.2	Ice Level																			
169.8	Bottom of Creek						170													
0.4	Organic Silt																			
168.4			1	SS	1		168													
1.8	Well Graded Sand With Gravel		2	SS	20															
	Compact		3	SS	26		166													
	Cobbles and Boulders		4	RC	Rec 20%		164													
162.9																				
7.3	Fractured		5	RC	Rec 90%		162													
	Gneiss Bedrock Hard and Sound		6	RC	Rec 98%															
160.3																				
9.9	End of Borehole																			

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF AUGER HOLE No 2A

METRIC

8

W P 69-78-02 LOCATION Sta. 24+937.5 o/s 5.0 m Lt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.3	Ground Level (Creek Bottom)																
0.0	Organic Silt						170										
	Sand (Inferred)						168										
	Cobbles and Boulders (Inferred)						166										
164.2																	
6.1	End of Auger Hole Refusal to Augering																

RECORD OF AUGER HOLE No 2B

METRIC

W P 69-78-02 LOCATION Sta. 24+935.0 o/s 4.9 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.2	Ice Level																
0.0	Organic Silt						170										
	Sand (Inferred)						168										
	Cobbles and Boulders (Inferred)						166										
							164										
163.5																	
6.7	End of Auger Hole Refusal to Augering																

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC 9

W P 69-78-02 LOCATION Sta. 24+917.0; @ Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
DATUM Geodetic DATE 1979 03 21 CHECKED BY *CP*

DATUM

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							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
170.9	Ground Level														
0.0	Well Graded Sand With Gravel Very Loose to Compact						170							33 50 (17)	
			1	SS	2										
			2	SS	22			168							
166.7	Cobbles and Boulders		3	RC	100%									RQD 30%	
4.2	Gneiss Bedrock, Hard Moderately Sound Steeply Fractured		4	RC	Rec 100%		166							RQD 70%	
165.1															
5.8	End of Borehole														

RECORD OF AUGER HOLE No 3A

METRIC

W P 69-78-02 LOCATION Sta. 24+918.2 o/s 5.1 m Lt. @ Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
								○ UNCONFINED	+ FIELD VANE								
						● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)									
170.9	Ground Level																
0.0	Sand With Cobbles and Boulders (Inferred)						170										
167.7							168										
3.2	End of Auger Hole Refusal to Augering																

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF AUGER HOLE No 3B

METRIC 10

W P 69-78-02 LOCATION Sta. 24+913.5 o/s 4.8 m Rt. of Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE						
170.9	Ground Level																
0.0	Sand, Some Cobbles and Boulders (Inferred)						170										
							168										
165.6							166										
5.3	End of Auger Hole Refusal to Augering																

RECORD OF AUGER HOLE No 3C

METRIC

W P 69-78-02 LOCATION Sta. 24+912.0 o/s 10.6 m Rt. of Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)					
170.2	Ground Level (Creek Bottom)						170										
0.0	Sand, Some Cobbles and Boulders (Inferred)						168										
							166										
165.0																	
5.2	End of Auger Hole Refusal to Augering																

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No. 4										METRIC		11					
W P 69-78-02		LOCATION Sta. 24+915.0 o/s 5.1 m Lt. of Hwy. 62 Line 'C'		ORIGINATED BY BL													
DIST 10 HWY 62 Line 'C'		BOREHOLE TYPE 82.55 mm Hollow Stem Augers		COMPILED BY BL													
DATUM Geodetic		DATE 1979 03 22		CHECKED BY													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	Wp	W	Wl	WATER CONTENT (%)					
171.2	Ground Level																
0.0	Well Graded Sand Loose to Compact		1	SS	15		170										
168.2	Cobbles and Boulders		2	SS	207	0.18 m	168								19 55 (26)		
3.0	Gneiss Bedrock Hard and Sound		3	RC	Rec 100%		166								RQD 97%		
165.1			4	RC	Rec 100%										RQD 100%		
6.1	End of Borehole																

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF PROBE HOLE No 5

METRIC 12

W P 69-78-02 LOCATION Sta. 24+947.8; & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
171.1	Ground Level																
170.8	Topsoil																
0.3	Fine Sand																
170.1																	
1.0	End of Hole																

RECORD OF PROBE HOLE No 6

METRIC

W P 69-78-02 LOCATION Sta. 24+933.9 o/s 9.1 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.5	Ground Level																
0.0	Organic Silt																
169.8																	
169.3	Sand																
1.0	End of Hole																

RECORD OF PROBE HOLE No 7

METRIC

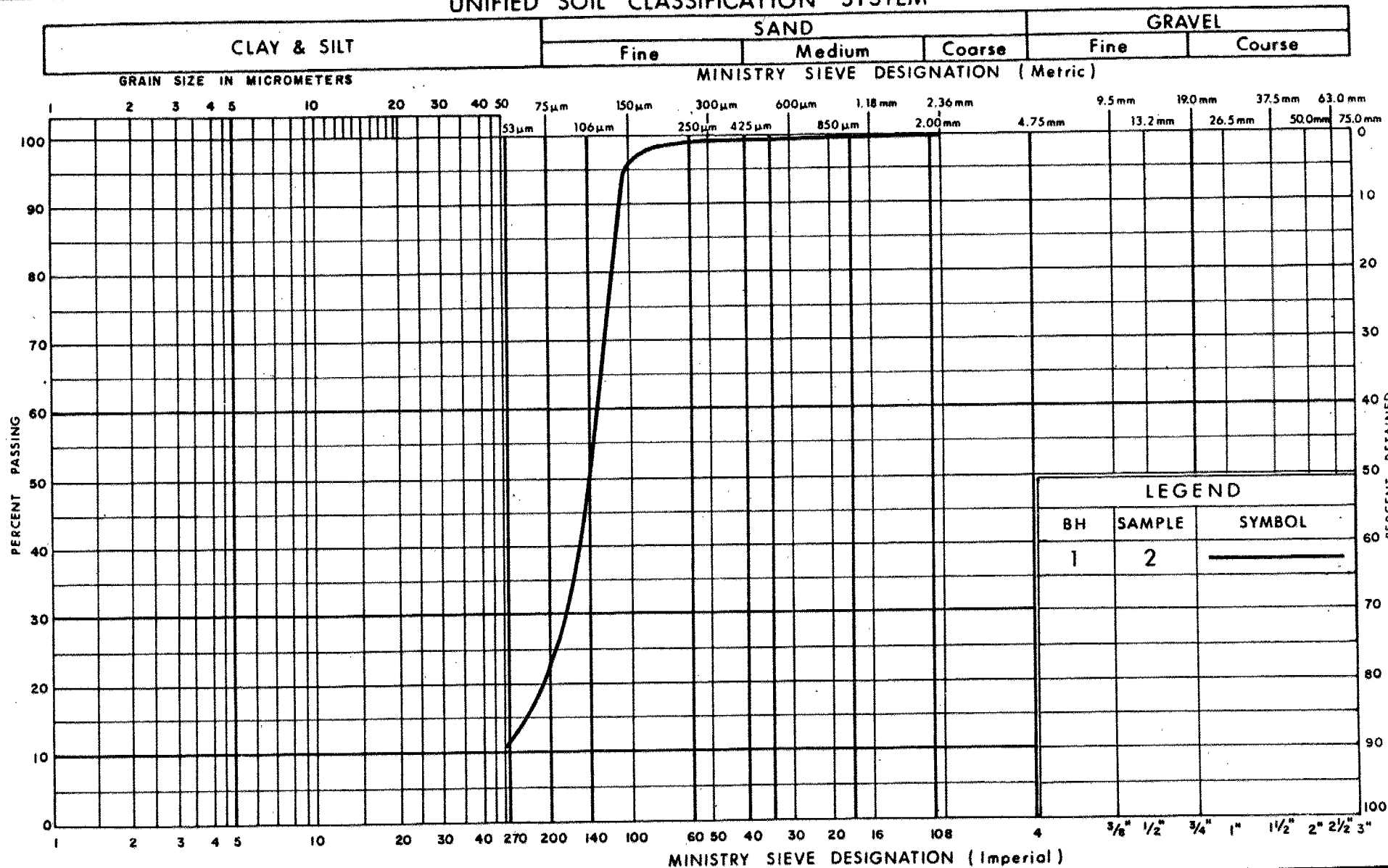
W P 69-78-02 LOCATION Sta. 24+944.2 o/s 5.4 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.7	Ground Level																
0.0	Organic Silt																
169.9																	
169.7	Sand																
1.0	End of Hole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

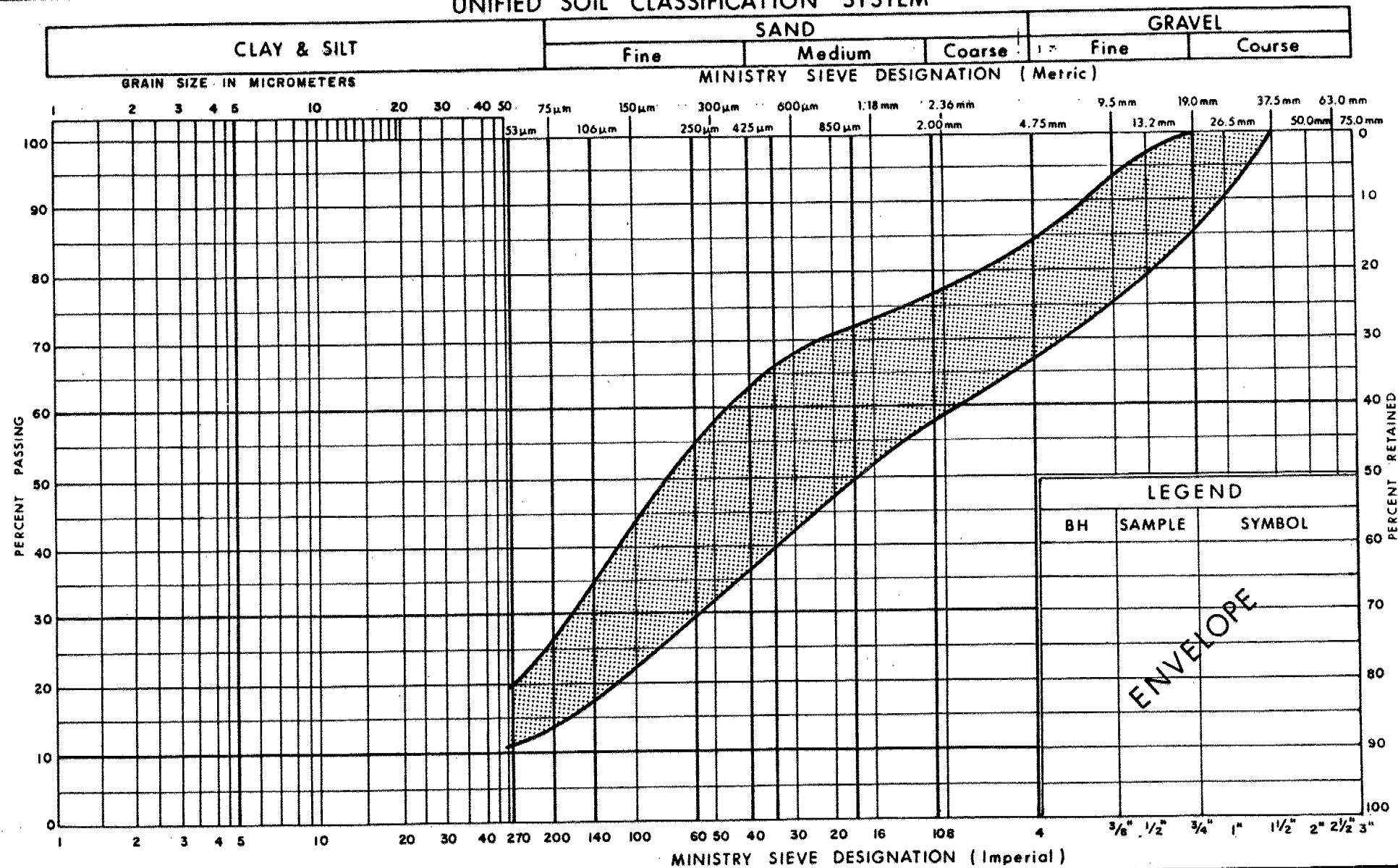
GRAIN SIZE DISTRIBUTION

UNIFORM FINE SAND

FIG No 1

W P 69-78-02

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
WELL GRADED SAND, WITH GRAVEL

FIG No 2
W P 69-78-02

ENGINEERING MATERIALS OFFICE SOIL MECHANICS SECTION

WP 69-78-02

DIST 10

HWY 62

STR SITE 29-43

Byers Creek Bridge
12.8 km Northwest of
Hwys. 60/512 (Killaloe Sta.)

DISTRIBUTION

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

K.G. Bassi
G.A. Wrong
B.J. Giroux
R.S. Pillar

R. Hore

R. Forest)
J. Anderson) cover only
G. Sloan)

Files ✓

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	79 05 23	MD
TUBES	-	-
ROCK CORES	Are removed & sent	MD

FOUNDATION INVESTIGATION REPORT

For

Byers Creek Bridge
12.8 km Northwest of
Hwys. 60/512 (Killaloe Sta.)
W.P. 69-78-02, Site 29-43
Hwy. 62, District 10, Bancroft

INTRODUCTION

This report contains the results of our investigation of the sub-surface conditions at this site. Fieldwork was carried out during the period of March 20 to March 22, 1979, consisting of four sampled boreholes, five augered holes and three probe holes. Boreholes were advanced by means of a bombardier mounted hollow stem auger machine and the depth of boring ranged from 3 m to 10 m approximately. The probe holes were hand dug to a depth of up to 1 m below ground surface. Samples of the overburden were recovered by means of a split spoon sampler driven into the ground in accordance with the specifications for Standard Penetration Test. Bedrock was proven by obtaining BX size rock core samples.

SITE AND GEOLOGY

The site is about 17 m north of the existing crossing of Hwy. 62 and Byers Creek on Con. 13, Lot 17, in the Township of Hagarty, County of Renfrew. The Village of Round Lake Centre is approximately 1 km west of the site.

Byers Creek originates some 17 km south of the site in the Haliburton Highlands and drains into Round Lake about 70 m north of the site. At this location Byers Creek follows a winding course with a minimum width of about 16 m at the existing bridge and a maximum depth of about 2 m. The existing structure is a single lane steel truss pony bridge with a clear span of 16.75 m. The existing Hwy. 62 is constructed on an earth embankment about 2.5 m high. Both the bridge and the approaches are in a good working condition.

The surrounding terrain is rolling, covered mostly with coniferous trees. A rock outcrop about 4 to 5 m high is visible some 200 m northeast of the site. The east bank of the creek is sandy and relatively steep, whereas the west bank is very gentle and has a thick growth of bulrush.

Round Lake is a popular resort centre. In this area Hwy. 62 is lined with cottages and camp grounds.

Geologically, the area is part of the Canadian Shield. The Shield has been subjected to extensive glacial erosion with most or all of the pre-glacial deposits eroded away. The underlying bedrock in this area is a granitic gneiss.

SUBSURFACE CONDITIONS

General

The overburden was found to be about 3.2 m to 7.5 m thick increasing from east to west and generally consists of a well graded sand. The lower portion of this sand stratum contains numerous cobbles and boulders. In the western portion of the creek a layer of organic silt up to 1.5 m thick was encountered immediately below the creek bed. The organic soil is generally underlain by the above mentioned well graded sand except in one particular location where it is underlain by a layer of uniform fine sand which is about 3.8 m thick. The uniform fine sand in turn is followed by the well graded sand. Across the site the overburden is underlain by gneiss bedrock.

Location and elevation of the boring and probe holes are shown in Drawing No. 697801-A. Factual field data and laboratory test results are contained in the Record of Borehole Sheets. A profile and two sections of the subsoil stratigraphy estimated from the above information are also included in Drawing 697801-A. A description of the subsoil types, bedrock and groundwater conditions is as follows.

Organic Silt

This organic soil was encountered only in the western portion of the creek. It has a thickness of up to 1.5 m and appears to be confined to an area below contour 174.0 m. The organic silt was found to have an organic content of about 2.8% and 4.1% by weight and a moisture content of 52% and 70% approximately. Based on the very low N values of less than 1 blow per 0.3 m, it is concluded that the organic silt has a very soft consistency.

Uniform Fine Sand

In the western portion of the creek at one location a layer of uniform fine sand about 3.8 m thick was found underneath the organic silt. A typical grain size distribution curve for the uniform fine sand is shown in Figure 1. The N values from Standard Penetration Tests of less than 1 blow to 7 blows per 0.3 m indicates that the uniform fine sand has a very loose to loose relative density.

Well Graded Sand With Gravel

This is the predominant subsoil at the site. It was found immediately below ground surface in the east bank and beneath the organic silt or the uniform fine sand in the western portion of the creek. The thickness of this granular deposit was found to range from 3.2 m to 5.5 m approximately. The material in this stratum generally consists of a well graded sand with gravel. The grain size distribution curves of this sandy subsoil are summarized in an envelope form in Figure 2. In the lower portion of the well graded sand stratum, however, cobbles and boulders were frequently encountered. The N values from the Standard Penetration Test carried out in this deposit varies from 1 to 30 blows per 0.3 m, generally increasing with depth. It is estimated from this that the relative density of the granular subsoil is very loose to dense, but generally being compact.

Bedrock

Bedrock surface varies from elevation 168+ m to elevation 163+ m, generally dipping towards the north and the west.

Bedrock is a granitic gneiss with micaceous bands. Except for occasional fractures, bedrock is hard and sound as evidenced by the generally high recovery ratios and RQD values of in excess of 90%.

Groundwater Conditions

Because the granular subsoil is highly permeable, the groundwater level is found to be closely related to the creek water level. For practical purposes, the groundwater level can be assumed equal to the prevailing creek water level. During the course of investigation, the creek water level was found to be at elevation 170.2₊.

RECOMMENDATIONS

It is proposed to realign Hwy. 62 in the vicinity of Byers Creek. In conjunction with this it is also considered to construct a new bridge to accommodate two lane traffic. The new bridge, a single span structure with a clear span of 19.6 m and a width of 9.5 m, will be located some 17 m north of the existing one. The profile grade of the relocated Hwy. 62 will be at elevation 174.5 m approximately. This will require approach fills up to 4.5 m high measured from the creek bed and closed type abutments for the structure. Our recommendations for the design and construction of the structure foundations and the approaches are as follows.

Structure Foundations

The subsoil conditions are more favourable at the east abutment location than at the west abutment location. It is, therefore, recommended to support the east abutment on spread footings and to found the west abutment on end bearing piles.

The spread footings should be placed at or below elevation 168.5 m and they can be designed for a bearing pressure of up to 200 kPa. Resistance of the footings to lateral forces can be computed by assuming a friction angle of 30° . Because the footings are situated in a granular subsoil below the groundwater level, a dewatering scheme will be required for the construction of the footings. One such method may consist of interlocking steel sheet piles. Because of the relatively shallow depth to bedrock below the proposed footing formation level, the steel sheeting may not have sufficient embedment to prevent "boiling" of the granular subsoil due to unbalanced hydrostatic head. In view of this, excavation should be carried out underwater and the method of tremie concrete should be used in conjunction with steel sheeting. The sheeting should be left in place for scour protection purposes.

The end bearing piles for the west abutment should be driven to bedrock surface and they can be designed for their maximum allowable capacity. There is a possibility that some of the piles may hang up in the bouldery zone immediately above bedrock. In such a

case, pile driving should be controlled by Hiley formula in order to ensure that these piles would attain their design bearing capacity. Because of the presence of cobbles and boulders, heavy H section piles should be used and the tip of these piles should be reinforced with a driving shoe. Lateral forces on the abutment should be resisted by batter piles. The underside of the pile cap should have a minimum 1.5 m of earth cover for frost protection purposes. If the pile cap is situated below the groundwater level, a temporary dewatering scheme will be required for the construction of the pile cap. Dewatering can be achieved by means of interlocking steel sheet piles driven below the formation level of the pile cap to a distance equal to the prevailing unbalanced hydrostatic head. If the required embedment of the sheeting cannot be attained due to obstruction caused by cobbles and boulders, the method of tremie concrete should be adopted. The sheeting should also be left in place for scour protection purposes.

Approaches

The required approach fills can be constructed with a slope angle of 2H to 1V provided the organic silt underneath the west approach fill is subexcavated and replaced with granular material. The area of subexcavation, required only in the western portion of the site, is bounded by the toe of the fill and contour 171.0 m.

Because of the granular nature of the subsoil settlements will be immediate.

Other Considerations

Backfill to the abutments should be composed of free draining granular material placed and compacted as per current MTC practice. It should be noted that the use of heavy vibratory equipment should be restricted as outlined in the recent MTC "Operational Constraints". The backfill should be provided with adequate drainage in order to relieve any build-up of hydrostatic water pressure behind the abutment walls.

To estimate the earth pressure exerted by the granular backfill, the following parameters can be used:

Lateral earth pressure coefficient

$$K = 0.35$$

Unit weight by backfill

$$\gamma = 21.5 \text{ kN/m}^3$$

Differential settlements between the abutments founded as recommended in the previous section will be less than 15 mm and will take place almost immediately.

B. Ly

B. Ly, P. Eng.
Senior Engineer



M. Devata

M. Devata, P. Eng.
Supervising Engineer

April, 1979

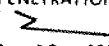
APPENDIX



RECORD OF BOREHOLE No 1

METRIC

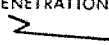
W P 69-78-02 LOCATION Sta. 24+942.0; @ Hwy. 62 Line 'C' ORIGINATED BY BL
 DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
 DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.6	Ground Level																
0.0	Organic Silt						170									0m	
169.8			1	SS	1											2.5%	
0.8	Uniform Very Fine to Fine Sand Very Loose to Loose		2	SS	4		168										0 80 (20)
			3	SS	7												
166.0							166										
4.6	Well Graded Sand With Gravel Dense		4	SS	30												
			5	SS	N/A		164										17 70 (13)
163.2																	
7.4	Gneiss Bedrock With Micaceous Bands Hard and Sound		6	RC	Rec 100%		162										RQD 95%
161.7																	
8.9	End of Borehole																

RECORD OF BOREHOLE No 2

METRIC

W P 69-78-02 LOCATION Sta. 24+936.2; @ Hwy. 62 Line 'C' ORIGINATED BY BL
 DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
 DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.2	Ice Level																
169.8	Bottom of Creek						170										
0.4	Organic Silt															0m	
168.4			1	SS	1											4.1%	
1.8	Well Graded Sand With Gravel Compact		2	SS	20		168										30 51 (19)
			3	SS	26		166										35 50 (15)
	Cobbles and Boulders		4	RC	Rec 20%		164										RQD 15%
162.9																	
7.3	Fractured Gneiss Bedrock Hard and Sound		5	RC	Rec 90%		162										RQD 70%
			6	RC	Rec 98%												RQD 95%
160.3																	
9.9	End of Borehole																

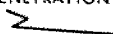



+3, x5 : Numbers refer to 20
Sensitivity 15-5 (%) STRAIN AT FAILURE
16



RECORD OF AUGER HOLE No 2A

METRIC

W P 69-78-02 LOCATION Sta. 24+937.5 o/s 5.0 m Lt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY OP

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										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
170.3	Ground Level (Creek Bottom)																	
0.0	Organic Silt						170											
	Sand (Inferred)						168											
	Cobbles and Boulders (Inferred)						166											
164.2																		
6.1	End of Auger Hole Refusal to Augering																	

RECORD OF AUGER HOLE No 2B

METRIC

W P 69-78-02 LOCATION Sta. 24+935.0 o/s 4.9 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY OP

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										WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										-----○-----	
170.2	Ice Level																		
0.0	Organic Silt						170												
	Sand (Inferred)						168												
	Cobbles and Boulders (Inferred)						166												
163.5							164												
6.7	End of Auger Hole Refusal to Augering																		

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

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:

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

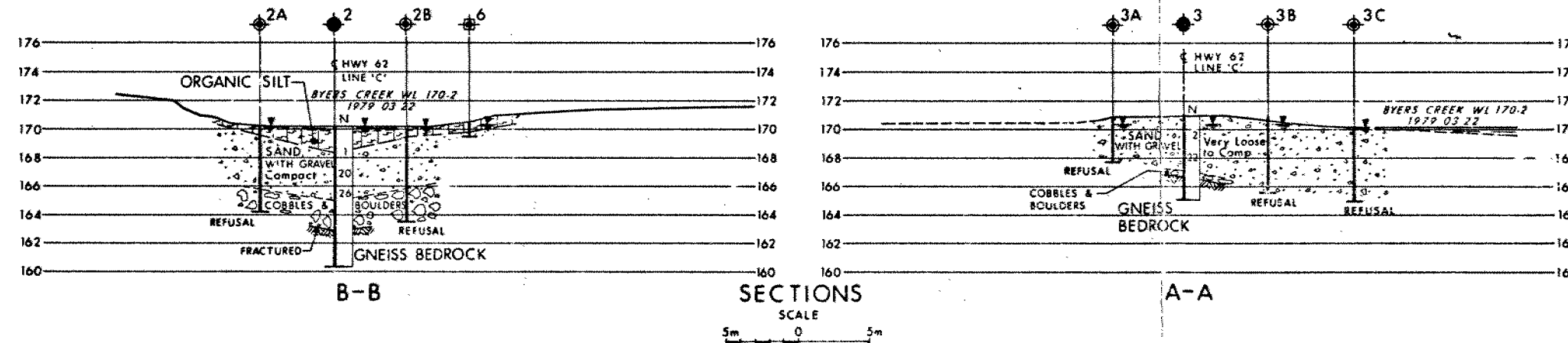
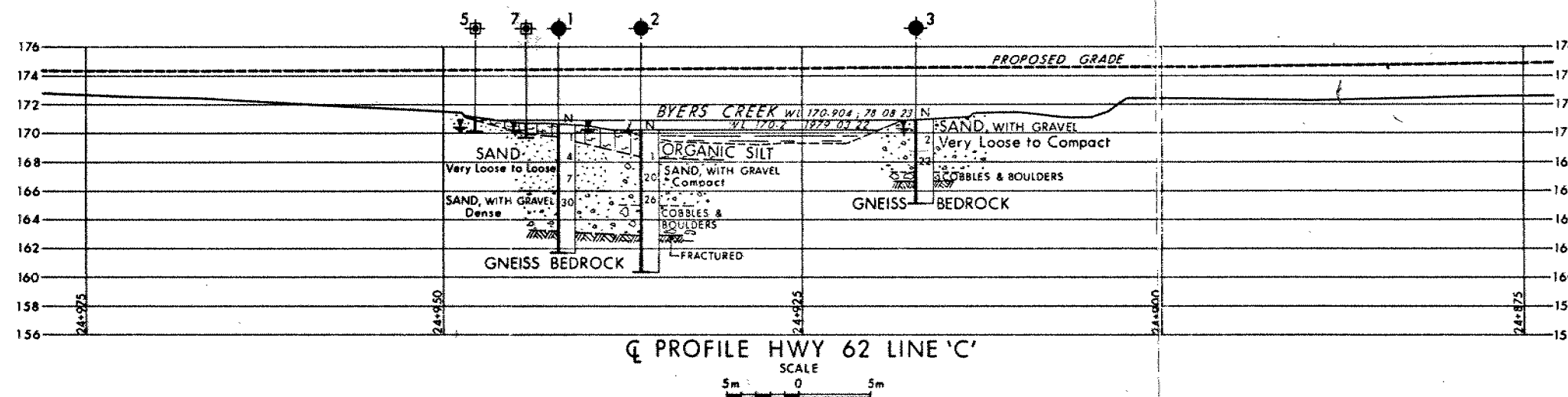
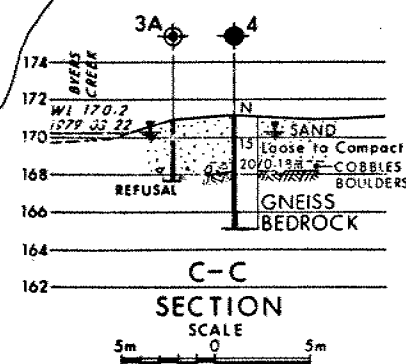
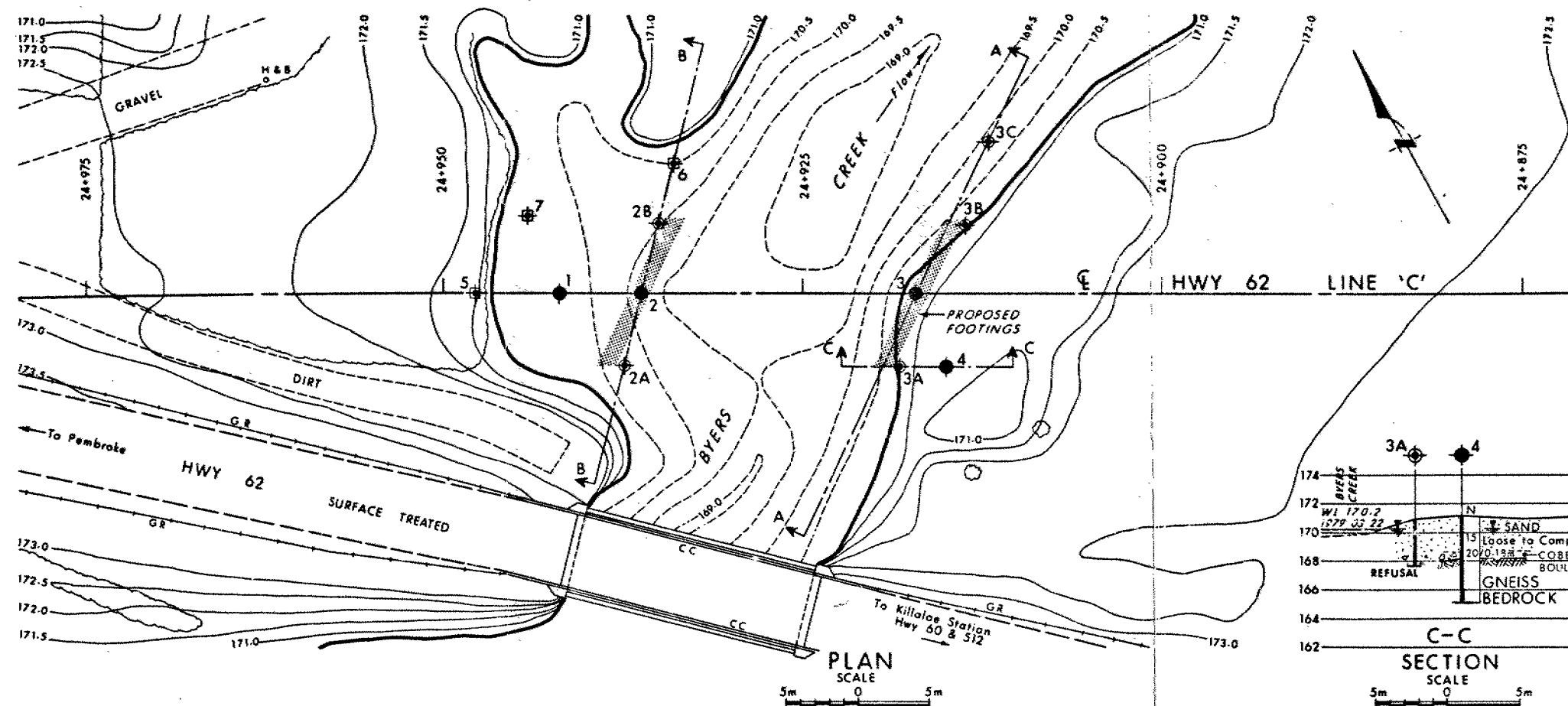
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa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



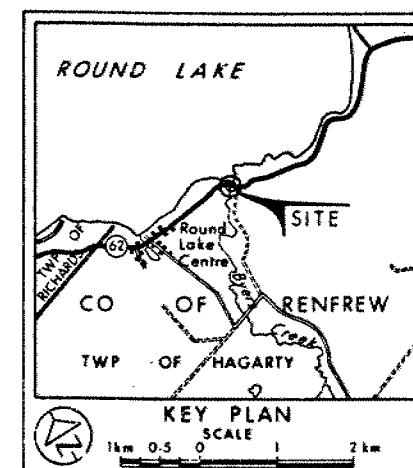
METRIC

CONT No
WP No 69-78-02

BYERS CREEK BRIDGE
(12.8 km Northwest of Hwys 60 & 512)
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 l/blow)
- CONE Blows/0.3m (60° Cone, 475 l/blow)
- W.L. at time of investigation 1979 03 22
- ⊕ Auger Hole
- ⊕ Probe Hole (dug by hand)

No	ELEVATION	STATION	OFFSET
1	170.6	24+942.0	℄
2	170.2	24+936.2	℄
2A	170.3	24+937.5	5.0m LT
2B	170.2	24+935.0	4.9m RT
3	170.9	24+917.0	℄
3A	170.9	24+918.2	5.1m LT
3B	170.9	24+913.5	4.8m RT
3C	170.2	24+912.0	10.6m RT
4	171.2	24+915.0	5.1m LT
5	171.1	24+947.8	℄
6	170.5	24+933.9	9.1m RT
7	170.7	24+944.2	5.4m RT

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

Geacres No 31F-96	HWY No 62 LINE 'C'	DIST 10
SUBMD BL	CHECKED DATE 1979 05 01	SITE 29-43
DRAWN	CHECKED	DWG 697802-A

RECORD OF BOREHOLE No 3

METRIC

W P 69-78-02 LOCATION Sta. 24+917.0; E Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
DATUM Geodetic DATE 1979 03 21 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
170.9	Ground Level															
0.0	Well Graded Sand With Gravel Very Loose to Compact		1	SS	2		170									
			2	SS	22		168									33 50 (17)
166.7	Cobbles and Boulders		3	RC	100%											RQD 30%
4.2	Gneiss Bedrock, Hard Moderately Sound Steeply Fractured		4	RC	Rec 100%		166									RQD 70%
165.1																
5.8	End of Borehole															

RECORD OF AUGER HOLE No 3A

METRIC

W P 69-78-02 LOCATION Sta. 24+918.2 o/s 5.1 m Lt. E Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
170.9	Ground Level															
0.0	Sand With Cobbles and Boulders (Inferred)						170									
							168									
167.7																
3.2	End of Auger Hole Refusal to Augering															

+³, x⁵: Numbers refer to
Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF AUGER HOLE No 3B

METRIC

W P 69-78-02 LOCATION Sta. 24+913.5 o/s 4.8 m Rt. of Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
170.9	Ground Level																	
0.0	Sand, Some Cobbles and Boulders (Inferred)						170											
							168											
							166											
165.6																		
5.3	End of Auger Hole Refusal to Augering																	

RECORD OF AUGER HOLE No 3C

METRIC

W P 69-78-02 LOCATION Sta. 24+912.0 o/s 10.6 m Rt. of Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Straight Augered Hole COMPILED BY BL
DATUM Geodetic DATE 1979 03 20 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
								○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)							
						● QUICK TRIAXIAL	× LAB VANE										
170.2	Ground Level (Creek Bottom)																
0.0	Sand, Some Cobbles and Boulders (Inferred)						170										
							168										
							166										
165.0																	
5.2	End of Auger Hole Refusal to Augering																

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 69-78-02 LOCATION Sta. 24+915.0 o/s 5.1 m Lt. 6 Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE 82.55 mm Hollow Stem Augers COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION [%] GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
								○ UNCONFINED	+ FIELD VANE								
						● QUICK TRIAXIAL	x LAB VANE	WATER CONTENT (%)									
171.2	Ground Level																
0.0	Well Graded Sand Loose to Compact		1	SS	15	 0.18 m	170										
168.2	Cobbles and Boulders		2	SS	207		168										19 55 (26)
3.0	Gneiss Bedrock Hard and Sound		3	RC	Rec 100%		166										RQD 97%
165.1		4	RC	Rec 100%												RQD 100%	
6.1	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF PROBE HOLE No 5

METRIC

W P 69-78-02 LOCATION Sta. 24+947.8; & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 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					
171.1	Ground Level																
170.8	Topsoil																
0.3	Fine Sand																
170.1																	
1.0	End of Hole																

RECORD OF PROBE HOLE No 6

METRIC

W P 69-78-02 LOCATION Sta. 24+933.9 o/s 9.1 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 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					
170.5	Ground Level																
0.0	Organic Silt																
169.8																	
169.5	Sand																
1.0	End of Hole																

RECORD OF PROBE HOLE No 7

METRIC

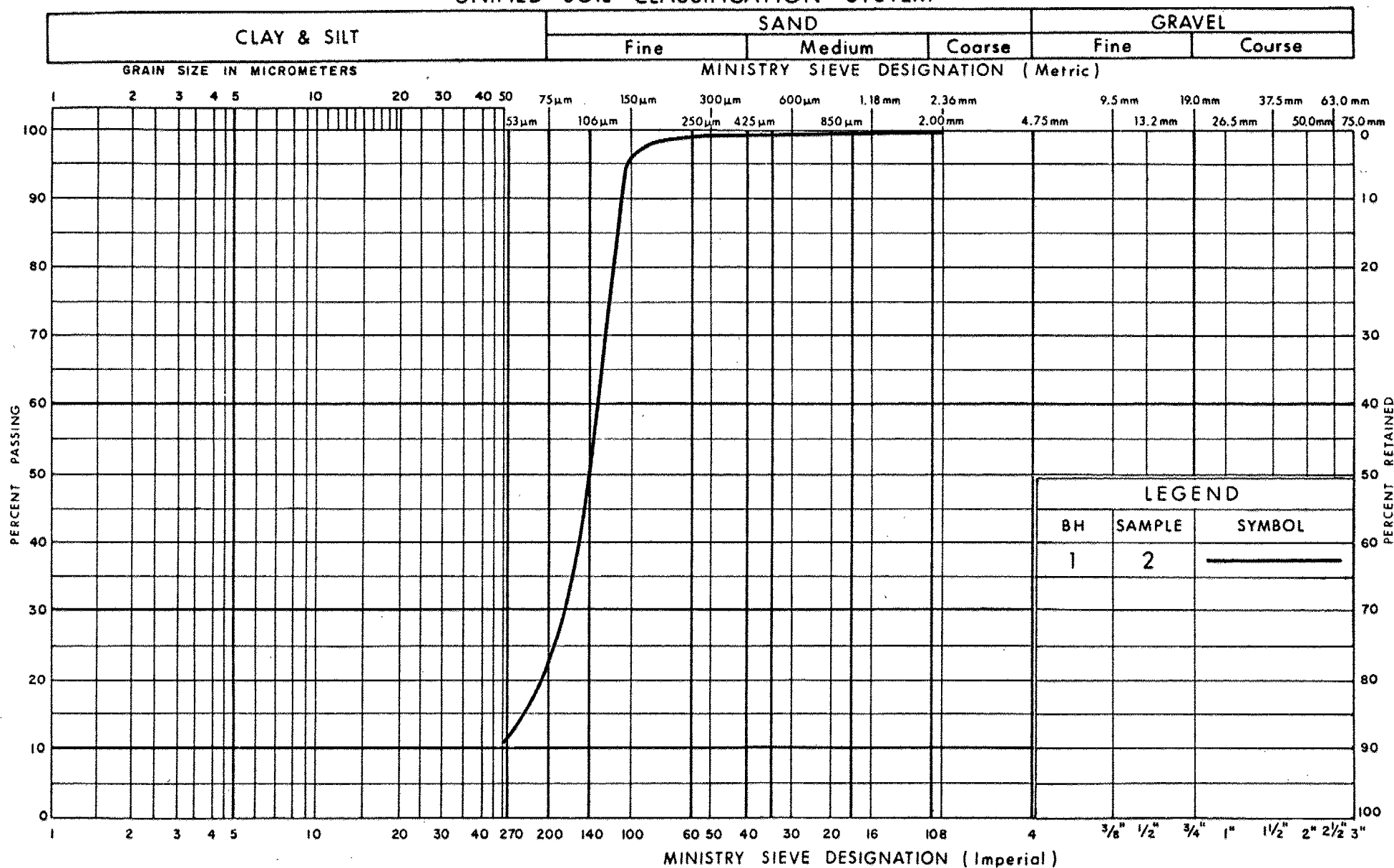
W P 69-78-02 LOCATION Sta. 24+944.2 o/s 5.4 m Rt. & Hwy. 62 Line 'C' ORIGINATED BY BL
DIST 10 HWY 62 Line 'C' BOREHOLE TYPE Hand Dug Pit COMPILED BY BL
DATUM Geodetic DATE 1979 03 22 CHECKED BY

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					
170.7	Ground Level																
0.0	Organic Silt																
169.9																	
169.7	Sand																
1.0	End of Hole																

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

 Ministry of
Transportation and
Communications

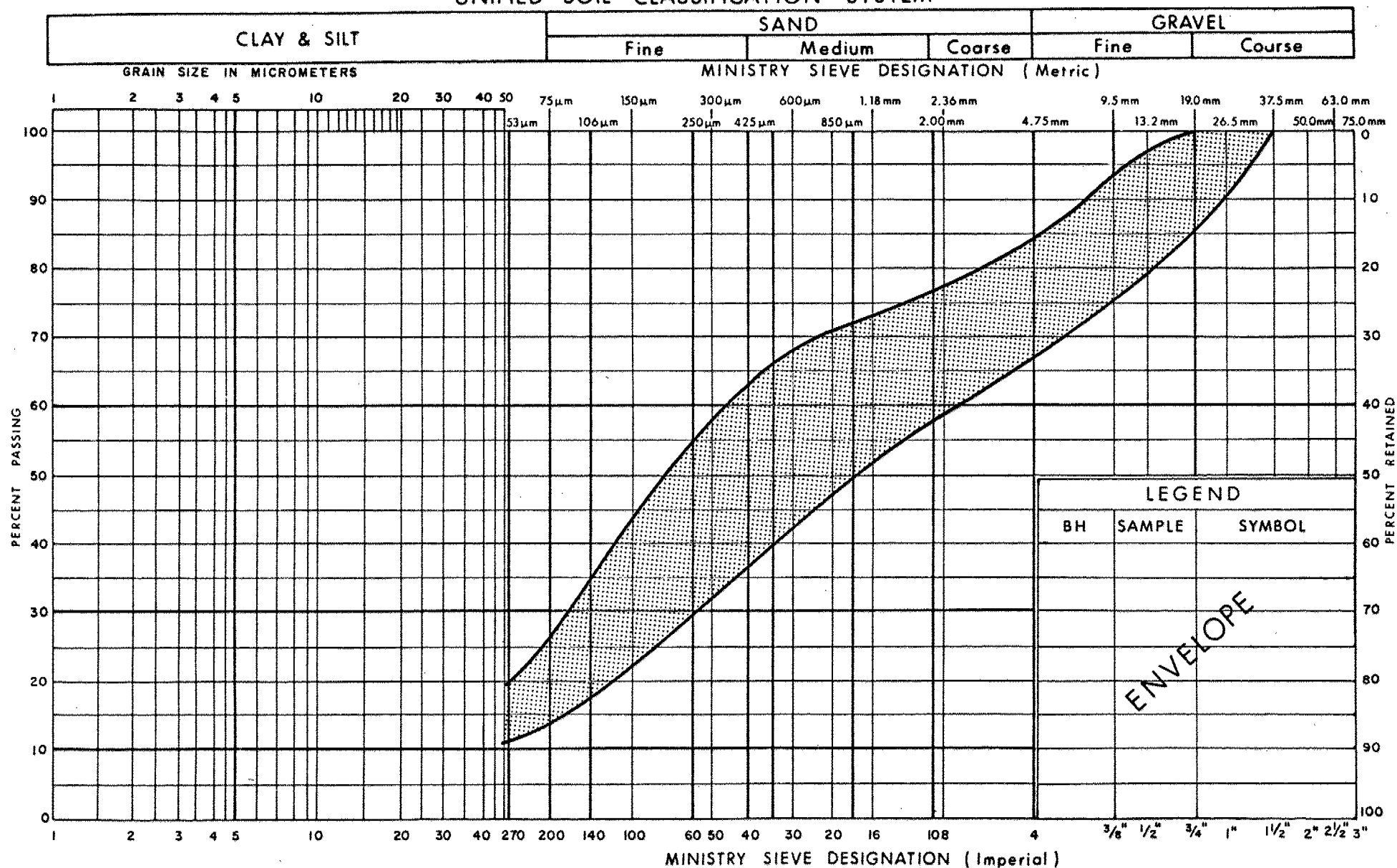
GRAIN SIZE DISTRIBUTION

UNIFORM FINE SAND

FIG No 1

W P 69-78-02

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

 Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION

WELL GRADED SAND, WITH GRAVEL

FIG No 2

W P 69-78-02