DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. SIE-89

DIST. 11 REGION

W.P. No. 119-68-01

CONT. No. 80-64

W. O. No.

STR. SITE No. 40-32

HWY. No. 35

LOCATION Mountain Lake Bridge

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

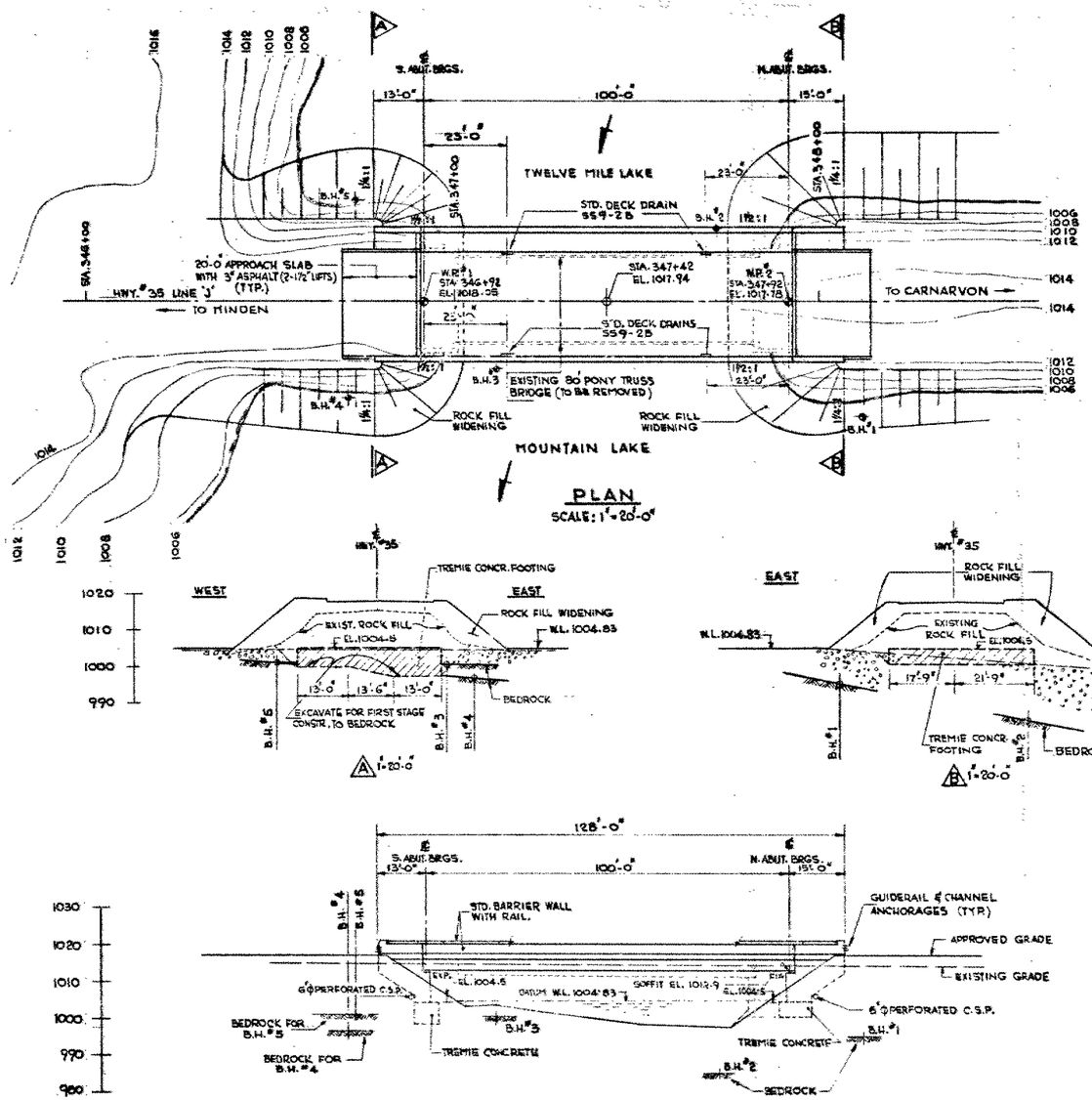
REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 3118 DRGRIS 4-75

DIST. 11
CONT No
WP No 119-68-01

MOUNTAIN LAKE BRIDGE
3.2 MILES SOUTH OF CARNARVON
GENERAL LAYOUT

SHEET



ELEVATION
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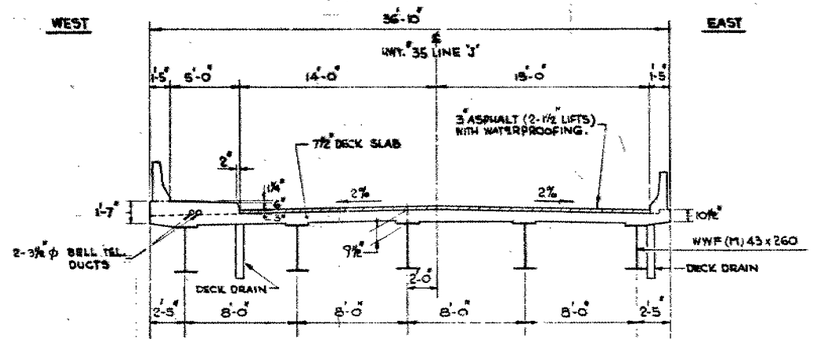
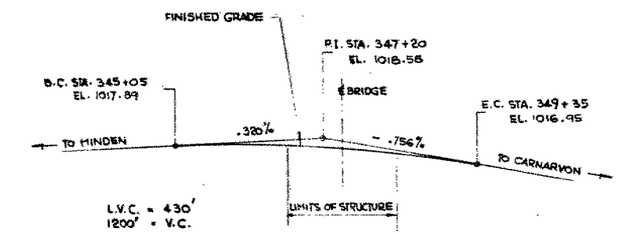


TYPICAL DECK SECTION
SCALE: 3/16"=1'-0"



PROFILE OF HWY. #35 LINE 'J'
N.T.S.

B.M. 1019-82
GEODETIC DATUM
N. & W. INE. ROOT 2·5' PINE
39·5' LT. 345+19

NOTES:

REINFORCING STEEL
GRADE ---------- 400
REINFORCING BARS WITH THE DESIGNATION 'C' AT THE END OF BAR MARKS SHALL BE COATED BARS.

CLASS OF CONCRETE
DECK & BARRIER WALLS ---------- 4000 P.S.I.
REMAINDER ---------- 3000 P.S.I.

CLEAR COVER TO REINFORCING STEEL:
FOOTINGS & ABUTMENTS 3",
DECK TOP 2", BOTTOM 1" AND/OR AS NOTED ON DRAWINGS.

CONSTRUCTION NOTES:
THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8".
NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL CONCRETE IN DECK HAS BEEN PLACED.

LIST OF DRAWINGS:

CONCRETE QUANTITIES FOR LUMP SUM TENDER ITEMS

CONCRETE IN ABUTMENTS, WING WALLS 3000 P.S.I.	102·50	CU. YD.
CONCRETE IN DECK	114.50	CU. YD.
CONCRETE IN BARRIER WALLS	20.00	CU. YD.
CONCRETE IN APPROACH SLABS	39.60	CU. YD.
STRUCT. STEEL QUANTITY	74.00	TONS

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION

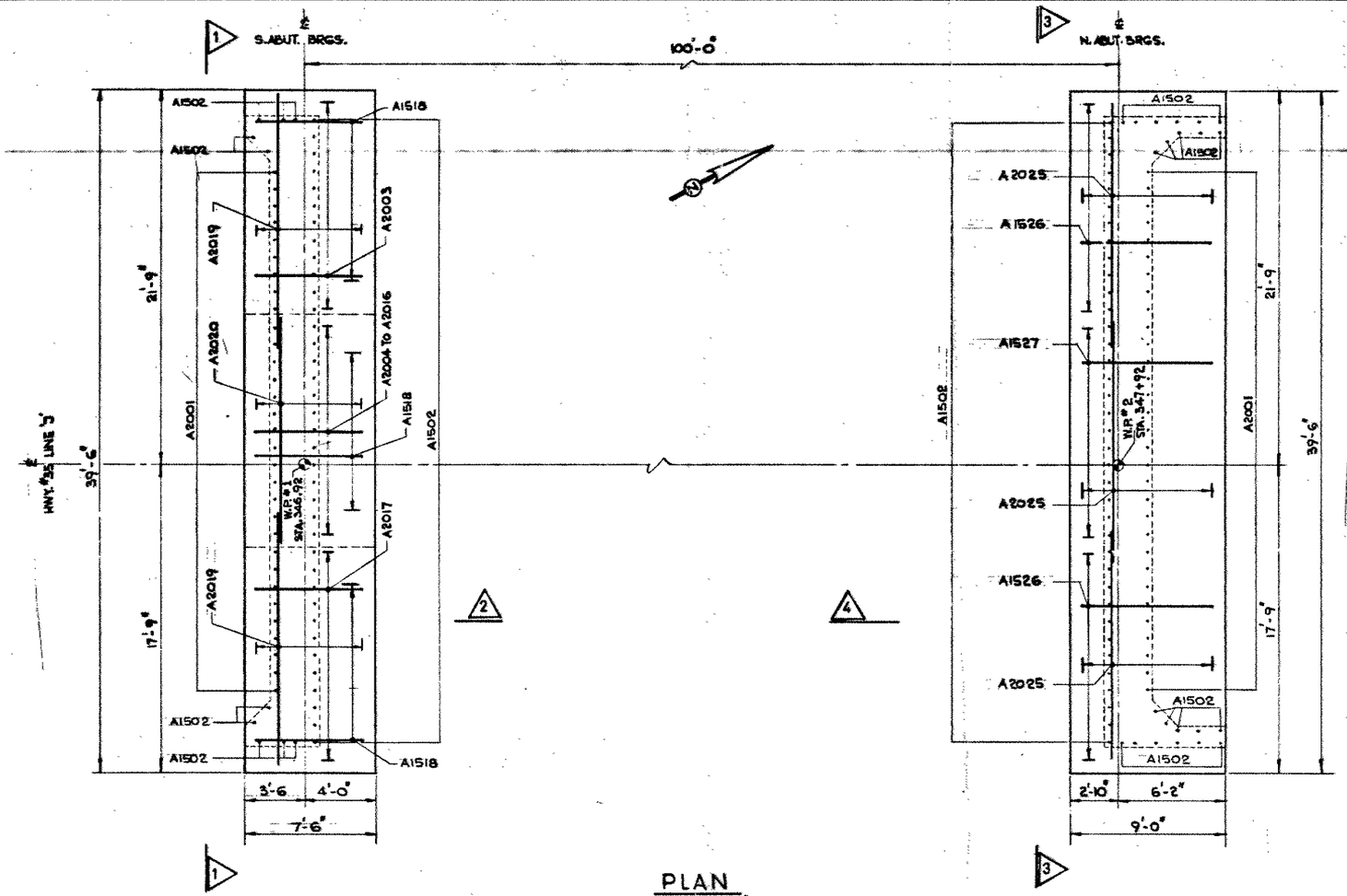
DESIGN | CHECK | LOADING HS 20-44 | DATE Nov/78
DRAWING S. | CHECK | SITE No 40-32 | DWG 1

TRANSLAR 100-4-76

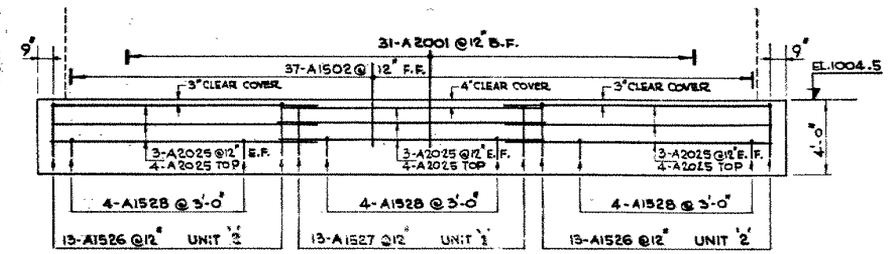
DIST. 11
CONT No
WP No 119-68-01

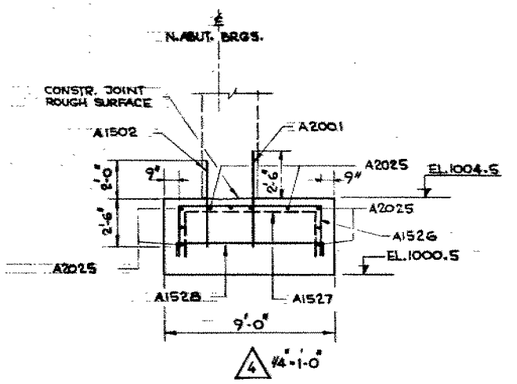
MOUNTAIN LAKE BRIDGE
32 MILES SOUTH OF CARNARVON
FOOTINGS

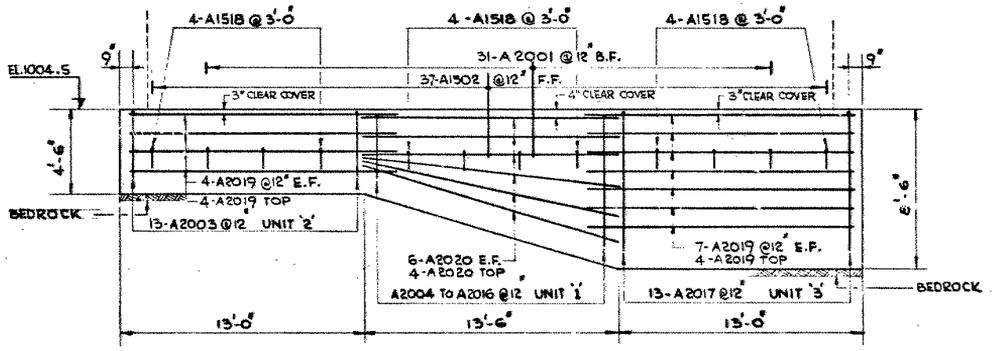
SHEET

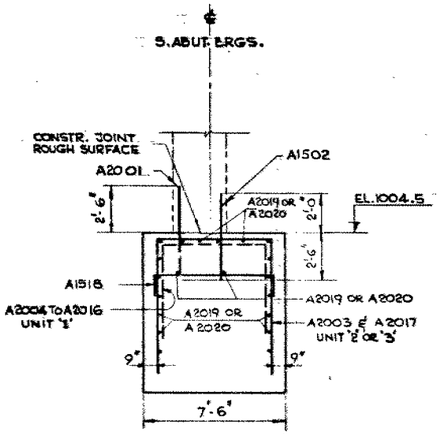


PLAN
SCALE: 1/4"=1'-0"









TYPICAL CROSS SECTION
SCALE: 1/4"=1'-0"
2

NOTE:

TREMIE CONCRETE FOOTINGS FOR SOUTH ABUTMENT SHALL BE PLACED ON THE SOUND BEDROCK, NORTH ABUTMENT WITHIN THE EXISTING ROCK FILL AT EL. 1000.5 AS SHOWN.
THE REINFORCING STEEL FOR BOTH TREMIE CONCRETE FOOTINGS HAS BEEN DETAILED IN SIX SEPARATELY PREASSEMBLED UNITS, TO BE LOWERED TO PROPER LOCATIONS INDICATED.

ASSOCIATED PROFESSIONAL ENGINEERS — CIVIL — S. KRYZEVICIUS — PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

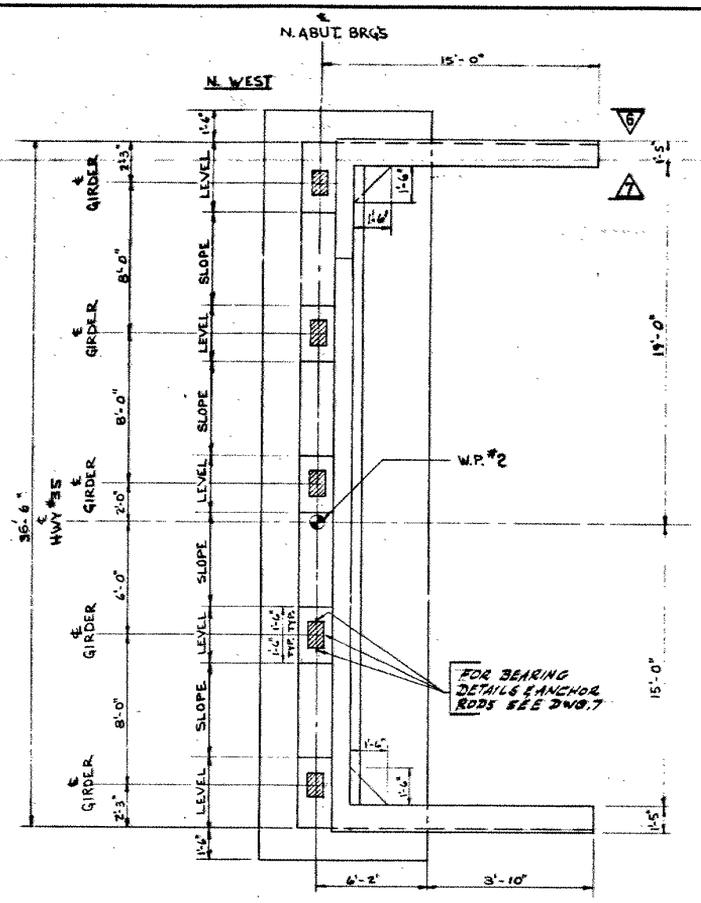
REVISIONS	DATE	BY	DESCRIPTION

DESIGN		CHECK	LOADING	H 20-44	DATE Nov 72
DRAWING		CHECK	SITE No	48-32	DWG 3

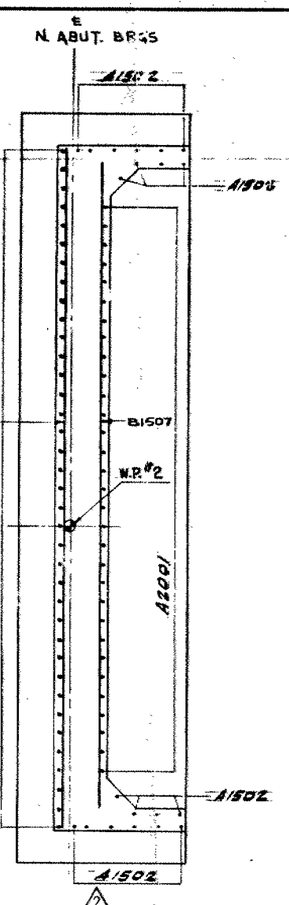
DIST 11
CONT No
WP No 119-68-01

MOUNTAIN LAKE BRIDGE
3.2 MILES SOUTH OF CARNARVON
NORTH ABUTMENT

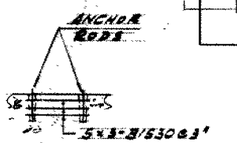
SHEET



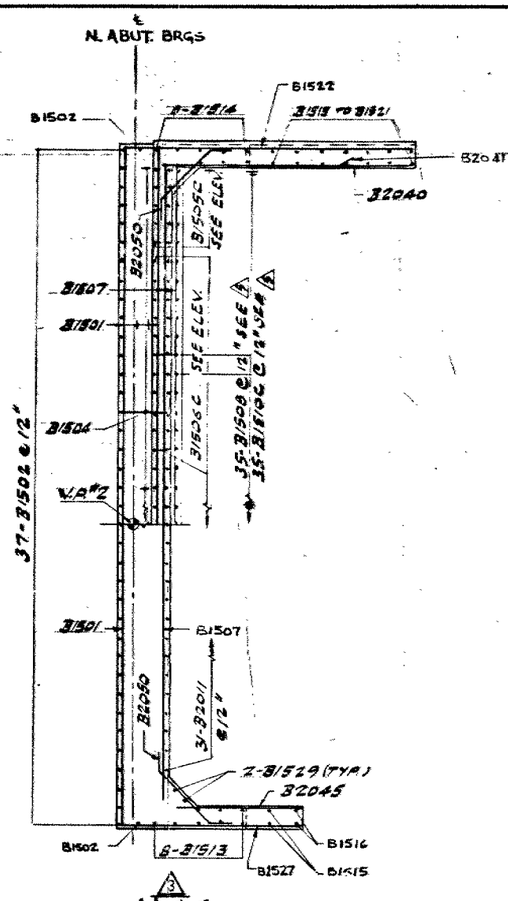
PLAN
SCALE 1/4"=1'-0"



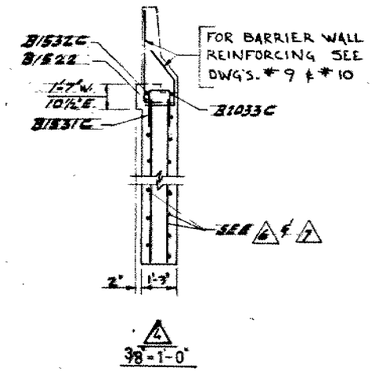
2
1/4"=1'-0"



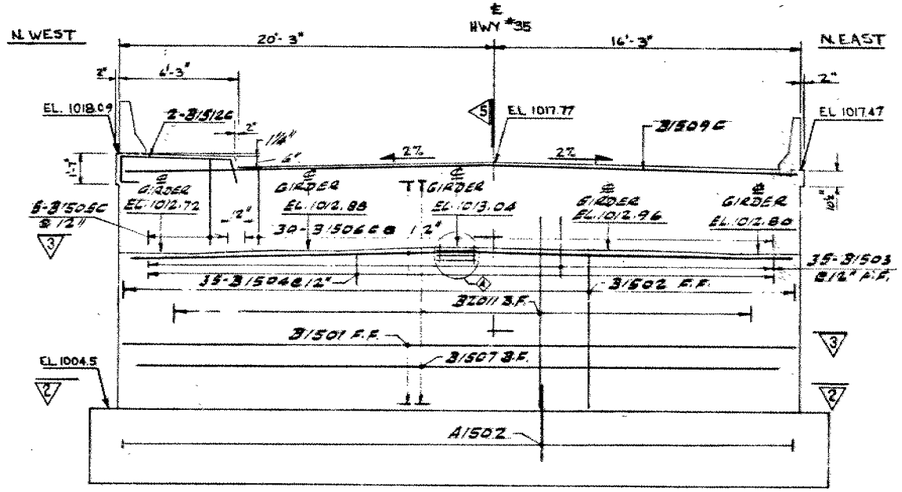
A TYP. TIE DETAIL SEE DWG. 7
N.T.S.



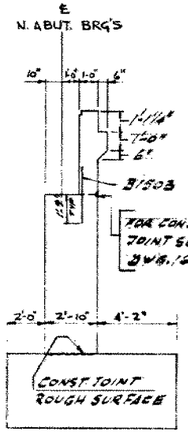
3
1/4"=1'-0"



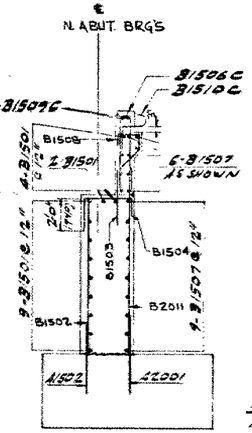
4
3/8"=1'-0"



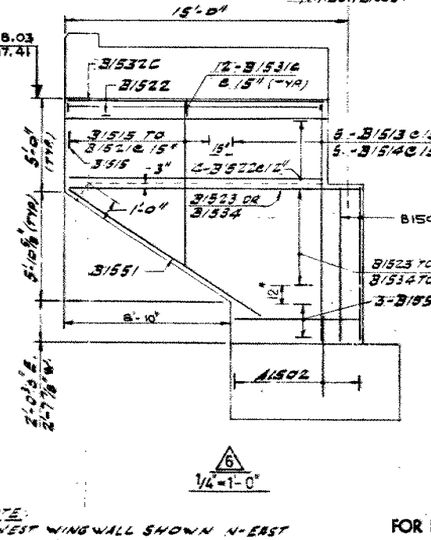
FRONT ELEVATION
1/4" = 1'-0"



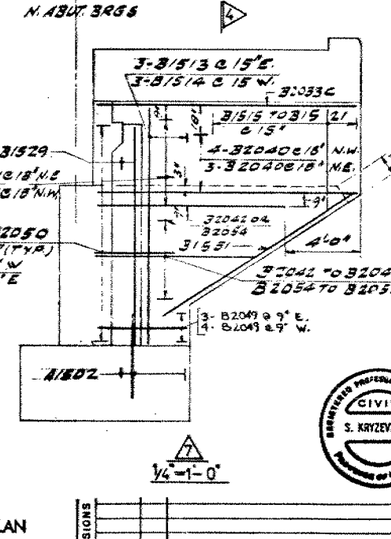
5
1/4"=1'-0"



5
1/4"=1'-0"



6
1/4"=1'-0"



7
1/4"=1'-0"

NOTE:
N-WEST WINGWALL SHOWN N-EAST WINGWALL SIMILAR EXCEPT AS NOTED.

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS			
DATE	BY	DESCRIPTION	

DESIGN	CHECK	LOADING HS 20-44	DATE NOV. 78
DRAWING	CHECK	SITE No 45-32	DWG 5

S. KRYZEVICIUS
PROFESSIONAL ENGINEERS ASSOCIATION OF ONTARIO
CIVIL

INDEX

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

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

c_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U)
ISOTROPICALLY (I) OR NOT (A)
AND SHEARED DRAINED (D) OR UNDRAINED (U)
WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS)
EG. $\overline{CIU}$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT

UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION.

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ	COEFFICIENT OF FRICTION
δ	ANGLE OF WALL FRICTION
k_o	COEFFICIENT OF EARTH PRESSURE AT REST
k_A	COEFFICIENT OF ACTIVE EARTH PRESSURE
k_p	COEFFICIENT OF PASSIVE EARTH PRESSURE
i	ANGLE OF INCLINATION OF SURCHARGE
ω	SLOPE ANGLE-BACKFACE OF WALL
β	ANGLE OF SLOPE
N_γ, N_q, N_c	BEARING CAPACITY FACTORS
D_f	DEPTH OF FOOTING
B,L	FOOTING DIMENSIONS

INDEX PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_A	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G_s	SPECIFIC GRAVITY OF SOLIDS
e	VOIDS RATIO
e_o	INITIAL VOIDS RATIO
e_{max}	e IN LOOSEST STATE
e_{min}	e IN DENSEST STATE
D_r	RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
n	POROSITY
w	WATER CONTENT
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
w_s	SHRINKAGE LIMIT
I_p	PLASTICITY INDEX = $w_L - w_p$
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
A_c	ACTIVITY = $\frac{I_p \text{ of soil}}{\% < 2\mu m \text{ Soil Fraction}}$
Om	ORGANIC MATTER CONTENT
S_r	DEGREE OF SATURATION
S	SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

STRENGTH PARAMETERS

ϕ	ANGLE OF SHEARING RESISTANCE
τ_f	PEAK SHEAR STRENGTH
τ_R	RESIDUAL SHEAR STRENGTH
c	COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	NORMAL PRINCIPAL STRESSES
u	PORE WATER PRESSURE
u_e	EXCESS u
r_u	PORE PRESSURE RATIO
q_u	UNCONFINED COMPRESSIVE STRENGTH
s_u	UNDRAINED SHEAR STRENGTH
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO
E	MODULUS OF ELASTICITY
G	MODULUS OF SHEAR DEFORMATION
k_s	MODULUS OF SUBGRADE REACTION
m,n	STABILITY COEFFICIENTS
A,B	PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS: ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE; σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
j	SEEPAGE FORCE PER UNIT VOLUME
η	COEFFICIENT OF VISCOSITY
k	COEFFICIENT OF HYDRAULIC CONDUCTIVITY
k_h	k IN HORIZONTAL DIRECTION
k_v	k IN VERTICAL DIRECTION
m_v	COEFFICIENT OF VOLUME CHANGE
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX
C_r	RECOMPRESSION INDEX
d	DRAINAGE PATH DISTANCE
T_v	TIME FACTOR
U	DEGREE OF CONSOLIDATION
OCR	OVERCONSOLIDATION RATIO

FOUNDATION INVESTIGATION REPORT

For

Mountain Lake Bridge
3.2 Miles South of Carnarvon
W.P. 119-68-01, Site No. 40-32
Hwy. 35, District 11, Huntsville

INTRODUCTION

A foundation investigation was carried out at the above location in the period from October 5th to 20th, 1977. A raft mounted diamond drill machine was used to advance 5 boreholes to depths ranging from 10.8 feet to 26.3 feet below water level. Rock core (BX and BXL) was obtained in all boreholes.

SITE DESCRIPTION

The site is located 3.2 miles south of the Township of Carnarvon on Hwy. 35. The existing structure spans the fast flowing water between Twelve Mile and Mountain Lakes. Flow is controlled by a small dam upstream of the bridge and levels are monitored regularily by the Trent Severn Waterways. The existing steel truss bridge is an 80 foot single span structure founded on rock fill. This fill is contained in a timber crib at the northern abutment and some differential settlement is apparent. The bridge approaches are made up of rock fill and are 45 feet long to the south and 140 feet long to the north. The sideslopes of the approach causeways are made up of handplaced squared stone at slopes of up to 1 horizontal to 2 vertical.

Vegetation around the site is made up of a mixture of deciduous and coniferous trees. A large resort complex to the southwest overlooks the dam and bridge.

The area is hilly with numerous rock outcrops. Bedrock around the site is granitic gneiss with limestone present to the northeast of the site.

SUBSURFACE CONDITIONS

General

In all boreholes bedrock was overlain by boulders, gravel and sand. Depths to bedrock varied at all locations. Sand seams carrying groundwater under pressure were encountered in boreholes put down at the site of the north pier and abutment.

Stratigraphy based on the appended Record of Borehole Sheets can be seen on Drawing No. 40-32-2 of the Contract Drawings.

Boulder, Sand and Gravel

Causeway fill is made up of boulders with sand and gravel and was encountered in B.H.'s 1, 3, 4 and 5 at the following elevations:

	Elevation
B.H. 1	1004.6 - 995.0
B.H. 3	1004.1 - 1000.4
B.H. 4	1004.4 - 996.9
B.H. 5	1004.4 - 1000.9

In B.H. 2 alluvial deposits of boulder, sand and gravel were encountered from elevation 795.0 to elevation 985.2.

Bedrock

Gneiss bedrock was intersected in all boreholes at the following elevations.

	Elevation
B.H. 1	995.0
B.H. 2	985.2
B.H. 3	1000.4
B.H. 4	996.9
B.H. 5	1000.9

The bedrock is hard, medium grained, grey granitic gneiss and is sound at all locations. Some open joints might be present. The detailed geologists report is contained in the Appendix.

Groundwater

Silty sand seams encountered within the bedrock around elevation 976 in B.H. 1 and elevation 980 in B.H. 2 carried artesian water with a head 20 inches above lake level at the time of the investigation to approximately elevation 1006.3.

K.G. Selby, P. Eng.
Senior Foundations Engineer

APPENDIX

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1

W P 119-68-01 LOCATION Sta 348+11 o/s 31' RT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring, (BXL) COMPILED BY JM
DATUM Geodetic DATE October 7, 11, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.6	Water Level					Art Head					
0.0	Top of Overburden						1000				
	Boulders										
	Sand and Gravel		2	RC	33%						
995.0			3	RC	10%						
9.6			4	RC	62%						
	Hard Grey Gneiss Bedrock		5	RC	96%		990				
			6	RC	82%						
	Silty Sand Seam ⟹		7	RC	77%		980				
978.4						Artesian Encl.					
26.2	End of Borehole										

RECORD OF BOREHOLE No 2

W P 119-68-01 LOCATION STA 347+72 o/s 20' LT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM
DATUM Geodetic DATE October 18, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.7	Water Level					Art Head					
0.0	Water						1000				
996.4	Top of Overburden										
8.3	Boulders		2	RC	13%						
	Sand and Gravel		3	RC	8%		990				
985.2											
19.5	Hard Grey Gneiss Bedrock		4	RC	20%						
			5	RC	100%						
980.4	Silty Sand Seam ⟹		6	RC	42%						
24.3	End of Borehole					Artesian Encountered					

+3, ×5 : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

W P 119-68-01 LOCATION Sta 347+12 o/s 18' RT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM
DATUM Geodetic DATE October 12, 13, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH o UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.6 Water Level											
0.0	Top of Overburden										
1000.3	Boulders Sand and Gravel						1000				
4.3	Hard Grey Gneiss Bedrock		1	RC	100%						
993.9			2	RC	80%						
10.7	End of Borehole										

RECORD OF BOREHOLE No 4

W P 119-68-01 LOCATION Sta 346+72 o/s 26' Rt Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM
DATUM Geodetic DATE October 13, 17, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH o UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.4 Water Level											
0.0	Boulders		1	RC	50%						
	Sand and Gravel		2	RC	33%		1000				
996.9			3	RC	0%						
7.5	Hard Grey Gneiss Bedrock		4	RC	10%						
			5	RC	0%						
991.0			6	RC	98%						
			7	RC	100%						
13.4	End of Borehole		8	RC	39%						

RECORD OF BOREHOLE No 5

W P 119-68-01 LOCATION Sta 346+74 o/s 28' LT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring BXL COMPILED BY JM
DATUM Geodetic DATE October 19, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH o UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.9 Water Level											
0.5	Top of Overburden										
1000.9	Boulders Sand and Gravel		1	RC	66%		1000				
4.0	Hard Grey Gneiss Bedrock		2	RC	67%						
	Silty Sand Seam		3	RC	80%						
989.2			4	RC	100%		990				
15.7	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation and Communications
Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1 of 2

PROPERTY W.P. 119-68-01
LOCATION Hwy. 35
Mountain Lake Bridge
LATITUDE
DEPARTURE
BEARING

DIP
90°

TOTAL FOOTAGE

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE FROM	FOOTAGE TO	FORMATION	SAMPLE NUMBER			REMARKS
		HOLE No. 1				
9.6	19.3	Gneiss, grey colour, medium texture, hard, close lineation				12.2 - 13.0 broken core
						14.7 - 15.0 broken core
						17.3 - 19.3 broken core
						14.7 - 15.0 vertical joint
						16.0 - 16.4 vertical joint
						17.3 - 17.6 micaceous seam
19.3	26.2	Gneiss, grey colour with pink layers, medium texture, hard, close lineation				lost core 3.5 (overall)
		HOLE No. 2				
19.5	25.0	Gneiss, light grey colour, medium texture, hard, close lineation at 12°				24.5 silty seam
		HOLE No. 3				
6.3	8.9	Gneiss, pigmatite, pink to grey colour, coarse texture, hard				
8.9	12.8	Gneiss, dark grey colour, medium texture, hard, lineation close at 10°.				

DATE OF EXAMINATION November 8, 1977

Z. Koniuszy

08-MT-113

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Ministry of Transportation and Communications
Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 2 of 2

PROPERTY W.P. 119-68-01
LOCATION Hwy. 35
Mountain Lake Bridge
LATITUDE
DEPARTURE
BEARING

DIP
90°
TOTAL FOOTAGE

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE FROM	FOOTAGE TO	FORMATION	SAMPLE NUMBER			REMARKS
		HOLE No. 4				
7 5	13 4	Gneiss, pink to grey colour, medium texture, hard, lineation at 0° to 5°.				12 1 - 12 7 high % mica 12 - 12 5 joint fracture at 60°
		HOLE No. 5				
4	15 7	Gneiss, grey colour with pink banding, medium texture, hard, close lineation at 0° - 5°.				5 4 - 5 9 high % mica

DATE OF EXAMINATION November 8, 1977

Z. Koniuszy

08-MT-113

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 119-68-01 DIST 11

HWY 35 STR SITE 40-32

Mountain Lake Bridge
3.2 Miles South of Carnarvon

DISTRIBUTION

J.C. McAllister (2)
W.J. Peck
S. McCombie
J.M. Bernhardt (2)

E. Van Beilen
G.A. Wrong
B.J. Giroux
R.S. Pillar

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L. Argo)
J. Anderson) cover only
G. Sloan)

Files

SAMPLE DISPOSITION NOTICE

TYPE	DISCARD AFTER	RECOMM. BY
JARS	77-12-19	KRS
TUBES	77-12-19	KRS
ROCK CORES	CONTRACT AWARD	KRS

GEOCRES 31E-89

DATE DEC 0 8 1977

FOUNDATION INVESTIGATION REPORT

For

Mountain Lake Bridge
3.2 Miles South of Carnarvon
W.P. 119-68-01, Site No. 40-32
Hwy. 35, District 11, Huntsville

INTRODUCTION

A foundation investigation was carried out at the above location in the period from October 5th to 20th, 1977. A raft mounted diamond drill machine was used to advance 5 boreholes to depths ranging from 10.8 feet to 26.3 feet below water level. Rock core (BX and BXL) was obtained in all boreholes.

SITE DESCRIPTION

The site is located 3.2 miles south of the Township of Carnarvon on Hwy. 35. The existing structure spans the fast flowing water between Twelve Mile and Mountain Lakes. Flow is controlled by a small dam upstream of the bridge and levels are monitored regularily by the Trent Severn Waterways. The existing steel truss bridge is an 80 foot single span structure founded on rock fill. This fill is contained in a timber crib at the northern abutment and some differential settlement is apparent. The bridge approaches are made up of rock fill and are 45 feet long to the south and 140 feet long to the north. The sideslopes of the approach causeways are made up of handplaced squared stone at slopes of up to 1 horizontal to 2 vertical.

Vegetation around the site is made up of a mixture of deciduous and coniferous trees. A large resort complex to the southwest overlooks the dam and bridge.

The area is hilly with numerous rock outcrops. Bedrock around the site is granitic gneiss with limestone present to the northeast of the site.

SUBSURFACE CONDITIONS

General

In all boreholes bedrock was overlain by boulders, gravel and sand. Depths to bedrock varied at all locations. Sand seams carrying groundwater under pressure were encountered in boreholes put down at the site of the north pier and abutment.

Stratigraphy based on the appended Record of Borehole Sheets can be seen on Drawing No. 1196801-A.

Boulder, Sand and Gravel

Causeway fill is made up of boulders with sand and gravel and was encountered in B.H.'s 1, 3, 4 and 5 at the following elevations:

	Elevation
B.H. 1	1004.6 - 995.0
B.H. 3	1004.1 - 1000.4
B.H. 4	1004.4 - 996.9
B.H. 5	1004.4 - 1000.9

In B.H. 2 alluvial deposits of boulder, sand and gravel were encountered from elevation 795.0 to elevation 985.2.

Bedrock

Gneiss bedrock was intersected in all boreholes at the following elevations.

	Elevation
B.H. 1	995.0
B.H. 2	985.2
B.H. 3	1000.4
B.H. 4	996.9
B.H. 5	1000.9

The bedrock is hard, medium grained, grey granitic gneiss and is sound at all locations. Some open joints might be present. The detailed geologists report is contained in the Appendix.

Groundwater

Silty sand seams encountered within the bedrock around elevation 976 in B.H. 1 and elevation 980 in B.H. 2 carried artesian water with a head 20 inches above lake level at the time of the investigation to approximately elevation 1006.3.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to replace the existing steel truss bridge crossing the fast flowing water between Twelve Mile and Mountain Lakes on Hwy. 35 with a 3 span structure. Abutments for the existing structure sit on the rock fill causeway which makes up the bridge approaches.

The proposed structure is 37 feet wide with 2 spans of 40 feet and a central 60 foot span. Proposed grade will be about 2 feet higher than existing across the causeway.

Structure Foundations

Abutments - Abutments may be placed on spread footings within the causeway fill with a bearing capacity for design of up to 3.0 t.s.f. The following procedure should be followed when placing the footings. Firstly, the causeway should be widened with rock fill to the required width, up to the base of the abutment footings. Note that at least 6 feet of cover is required for frost protection. Secondly, the causeway should be surcharged with earthfill to the proposed grade to allow settlement to take place. The surcharge can be removed after 1 week and the rock fill excavated to the footing base. Low slump concrete working pads poured directly on the rock fill should be used as a base for the abutments.

South pier - The south pier should be founded on bedrock around elevation 1,000. A bearing capacity for design up to 50 t.s.f. may be used. The pier should be keyed about 1 foot into the bedrock or doweled to resist the horizontal forces. The nature of the bedrock is such that it should fracture and break in irregular angular pieces. Footing placements may require use of a tremie box since bedrock is about 4 feet below water level. Alternatively, the footing could be constructed in the dry after complete dewatering.

Further fieldwork may be required at the south pier when the footing location is finalized in order to more accurately define the bedrock surface.

North pier - The north pier may be placed at or below elevation 995 at a depth governed by scour protection requirements or on bedrock around 985. Bearing capacities for design of 3.0 t.s.f. for boulder, sand and gravel and 50 t.s.f. for bedrock may be used. Due to the bouldery nature of the soil within the river bed, it will not be possible to advance sheet piling using conventional driving methods. It is recommended that a prefabricated box be placed in an excavated hole with side slopes of 1:1 at the pier location. The box should then be filled to a suitable level with tremie concrete after which the remaining portion can be constructed in the dry.

Settlements - Differential settlements up to a maximum of 1 inch might be expected between the bridge supports. Piers founded on bedrock will experience negligible settlements.

Construction sequence - Both pier foundations should be placed and backfilled prior to construction of the abutments. This precludes the chances of inducing settlement of the abutments if pier excavations are made after abutment construction.

Other Considerations

Water under artesian head was encountered at the location of the northern pier within a silty sand seam in the first 5 feet of bedrock. If the footing is placed on bedrock then careful observation will be required to determine if artesian water is entering the excavation. If discovered, it will be necessary to extend the top of the tremie box above lake level so that the hydrostatic head may be equalized to allow tremie concrete pouring.

Flow under the structure can be controlled in cooperation with the Trent Severn Waterways using dams on Twelve Mile and Mountain Lakes. It would be advisable to reduce the flow while excavations are being made for the bridge piers.

Structure Approaches

Side slopes of the causeway should be widened with suitable rock fill at a slope not steeper than 1¼ horizontal to 1 vertical. Front slopes should be placed with slopes not steeper than 1½:1. Frost protection of 6 feet cover is required at the abutments.

J Murray

J. Murray
Student Technician

K. G. Selby

K.G. Selby, P. Eng.
Supervising Engineer

KGS/JM/gs
December, 1977

APPENDIX

Ministry of Transportation and Communications
Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

W P 119-68-01 LOCATION Sta 348+11 o/s 31' RT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring, (BXL) COMPILED BY JM
DATUM Geodetic DATE October 7, 11, 1977 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) / WATER CONTENT (%) (PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.6	Water Level					Art				
0.0	Top of Overburden					Head				
	Boulders						1000			
	Sand and Gravel		2	RC	33%					
			3	RC	10%					
995.0										
9.6	Hard Grey Gneiss Bedrock		4	RC	62%		990			
			5	RC	96%					
			6	RC	82%					
	Silty Sand Seam		7	RC	77%		980			
978.4						Artesian Enct.				
26.2	End of Borehole									

RECORD OF BOREHOLE No 2

W P 119-68-01 LOCATION STA 347+72 o/s 20' LT ℄ Hwy 35 Line 'J' ORIGINATED BY JM
DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM
DATUM Geodetic DATE October 18, 1977 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) / WATER CONTENT (%) (PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.7	Water Level					Art				
0.0	Water					Head				
							1000			
996.4	Top of Overburden									
8.3	Boulders		1	RC	13%					
			2	RC						
	Sand and Gravel		3	RC	8%		990			
985.2										
19.5	Hard Grey Gneiss Bedrock		4	RC	20%					
			5	RC	100%					
980.4	Silty Sand Seam		6	RC	42%					
						Artesian Encountered				
24.3	End of Borehole									

+3, ×5 : Numbers refer to Sensitivity

15 20/10 5 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

W P 119-68-01 LOCATION Sta 347+12 o/s 18' RT ℄ Hwy 35 Line 'J' ORIGINATED BY JM

DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM

DATUM Geodetic DATE October 12, 13, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.6	Water Level										
0.0	Top of Overburden										
1000.3	Boulders Sand and Gravel						1000				
4.3	Hard Grey Gneiss Bedrock		1	RC	100%						
993.9			2	RC	80%						
10.7	End of Borehole										

RECORD OF BOREHOLE No 4

W P 119-68-01 LOCATION Sta 346+72 o/s 26' Rt Hwy 35 Line 'J' ORIGINATED BY JM

DIST 11 HWY 35 BOREHOLE TYPE Rock Coring (BXL) COMPILED BY JM

DATUM Geodetic DATE October 13, 17, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.4	Water Level										
0.0	Boulders		1	RC	50%						
	Sand and Gravel		2	RC	33%		1000				
996.9			3	RC	0%						
			4	RC	100%						
			5	RC	0%						
7.5	Hard Grey Gneiss Bedrock		6	RC	98%						
991.0			7	RC	100%						
			8	RC	39%						
13.4	End of Borehole										

RECORD OF BOREHOLE No 5

W P 119-68-01 LOCATION Sta 346+74 o/s 28' LT ℄ Hwy 35 Line 'J' ORIGINATED BY JM

DIST 11 HWY 35 BOREHOLE TYPE Rock Coring BXL COMPILED BY JM

DATUM Geodetic DATE October 19, 1977 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	RECOVERY	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1004.9	Water Level										
0.5	Top of Overburden										
1000.9	Boulders Sand and Gravel		1	RC	66%		1000				
4.0	Hard Grey Gneiss Bedrock		2	RC	67%						
	Silty Sand Seam		3	RC	80%						
989.2			4	RC	100%		990				
15.7	End of Borehole										

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

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications
Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1 of 2

PROPERTY W.P. 119-68-01
LOCATION Hwy. 35
Mountain Lake Bridge
LATITUDE
DEPARTURE
BEARING

DIP
90°

TOTAL FOOTAGE

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE FROM	FOOTAGE TO	FORMATION	SAMPLE NUMBER			REMARKS
		HOLE No. 1				
9·6	19·3	Gneiss, grey colour, medium texture, hard, close lineation				12 2 - 13 0 broken core
						14 7 - 15 0 broken core
						17 3 - 19 3 broken core
						14 7 - 15 0 vertical joint
						16 0 - 16 4 vertical joint
						17 3 - 17 6 micaeous seam
19·3	26·2	Gneiss, grey colour with pink layers, medium texture, hard, close lineation				lost core 3 5 (overall)
		HOLE No. 2				
19·5	25·0	Gneiss, light grey colour, medium texture, hard, close lineation at 12°				24 5 silty seam
		HOLE No. 3				
6 3	8 9	Gneiss, pigmatite, pink to grey colour, coarse texture, hard				
8 9	12 8	Gneiss, dark grey colour, medium texture, hard, lineation close at 10°.				

DATE OF EXAMINATION November 8, 1977

Z. Koniuszy

OB-MT-113

Ministry of Transportation and Communications
Ontario

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 2 of 2

PROPERTY W.P. 119-68-01
LOCATION Hwy. 35
Mountain Lake Bridge
LATITUDE
DEPARTURE
BEARING

DIP
90°

TOTAL FOOTAGE

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

FOOTAGE FROM	FOOTAGE TO	FORMATION	SAMPLE NUMBER			REMARKS
		HOLE No. 4				
7 5	13 4	Gneiss, pink to grey colour, medium texture, hard, lineation at 0° to 5°.				12 1 - 12 7 high % mica 12 - 12 5 joint fracture at 60°
		HOLE No. 5				
4	15 7	Gneiss, grey colour with pink banding, medium texture, hard, close lineation at 0° - 5°.				5 4 - 5 9 high % mica

DATE OF EXAMINATION November 8, 1977

Z. Koniuszy

08-MT-113

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N.

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U)
ISOTROPICALLY (I) OR NOT (A)
AND SHEARED DRAINED (D) OR UNDRAINED (U)
WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS)
EG. $\overline{CIU}$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT

UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ	COEFFICIENT OF FRICTION
δ	ANGLE OF WALL FRICTION
k_o	COEFFICIENT OF EARTH PRESSURE AT REST
k_A	COEFFICIENT OF ACTIVE EARTH PRESSURE
k_p	COEFFICIENT OF PASSIVE EARTH PRESSURE
i	ANGLE OF INCLINATION OF SURCHARGE
ω	SLOPE ANGLE-BACKFACE OF WALL
β	ANGLE OF SLOPE
N_γ, N_q, N_c	BEARING CAPACITY FACTORS
D_f	DEPTH OF FOOTING
B,L	FOOTING DIMENSIONS

INDEX PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G_s	SPECIFIC GRAVITY OF SOLIDS
e	VOIDS RATIO
e_o	INITIAL VOIDS RATIO
e_{max}	e IN LOOSEST STATE
e_{min}	e IN DENSEST STATE
D_r	RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
n	POROSITY
w	WATER CONTENT
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
w_S	SHRINKAGE LIMIT
I_p	PLASTICITY INDEX = $w_L - w_P$
I_L	LIQUIDITY INDEX = $\frac{w - w_P}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
A_c	ACTIVITY = $\frac{I_p \text{ of soil}}{\% \text{ of } 2\mu m \text{ Soil Fraction}}$
Om	ORGANIC MATTER CONTENT
S_r	DEGREE OF SATURATION
S	SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

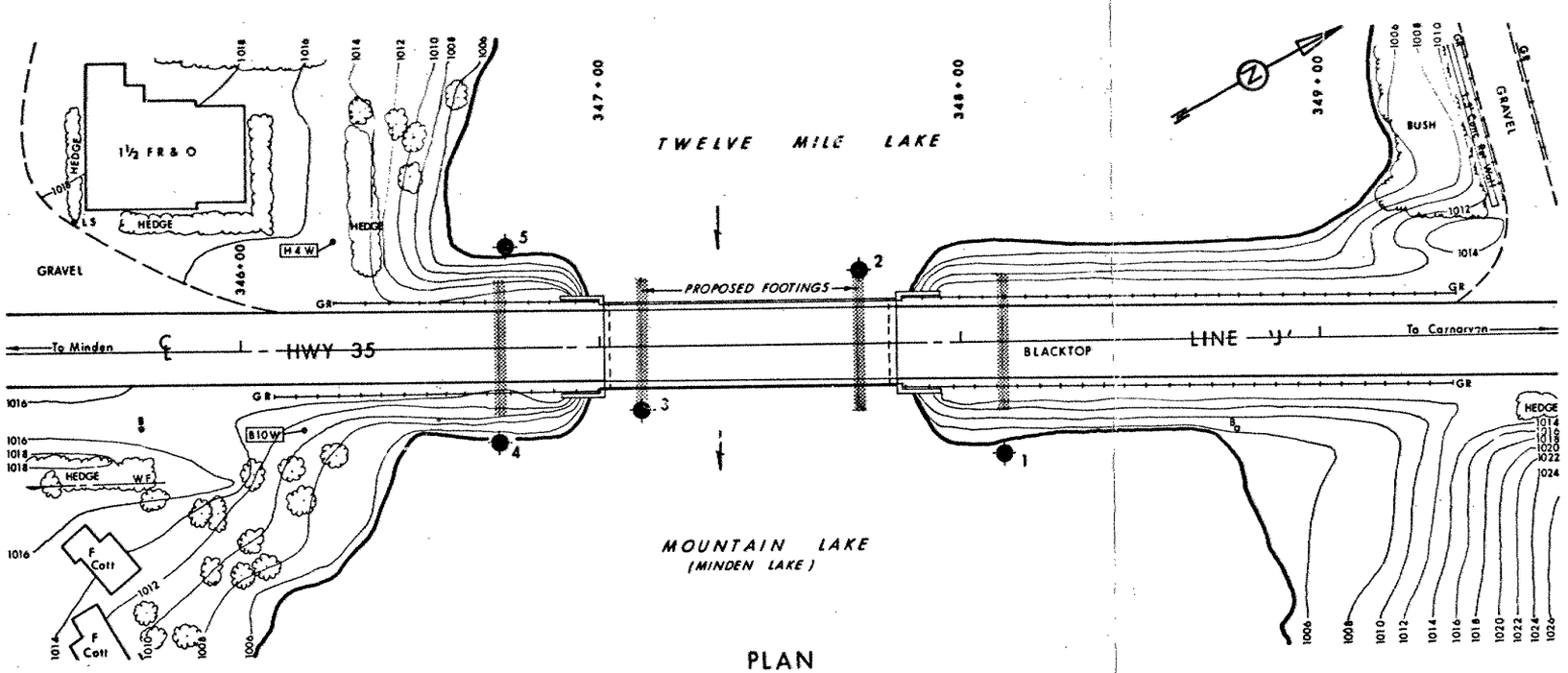
STRENGTH PARAMETERS

ϕ	ANGLE OF SHEARING RESISTANCE
τ_f	PEAK SHEAR STRENGTH
τ_R	RESIDUAL SHEAR STRENGTH
c	COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	NORMAL PRINCIPAL STRESSES
u	PORE WATER PRESSURE
u_e	EXCESS u
r_u	PORE PRESSURE RATIO
q_u	UNCONFINED COMPRESSIVE STRENGTH
s_u	UNDRAINED SHEAR STRENGTH
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO
E	MODULUS OF ELASTICITY
G	MODULUS OF SHEAR DEFORMATION
k_s	MODULUS OF SUBGRADE REACTION
m,n	STABILITY COEFFICIENTS
A,B	PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
σ' = EFFECTIVE NORMAL STRESS

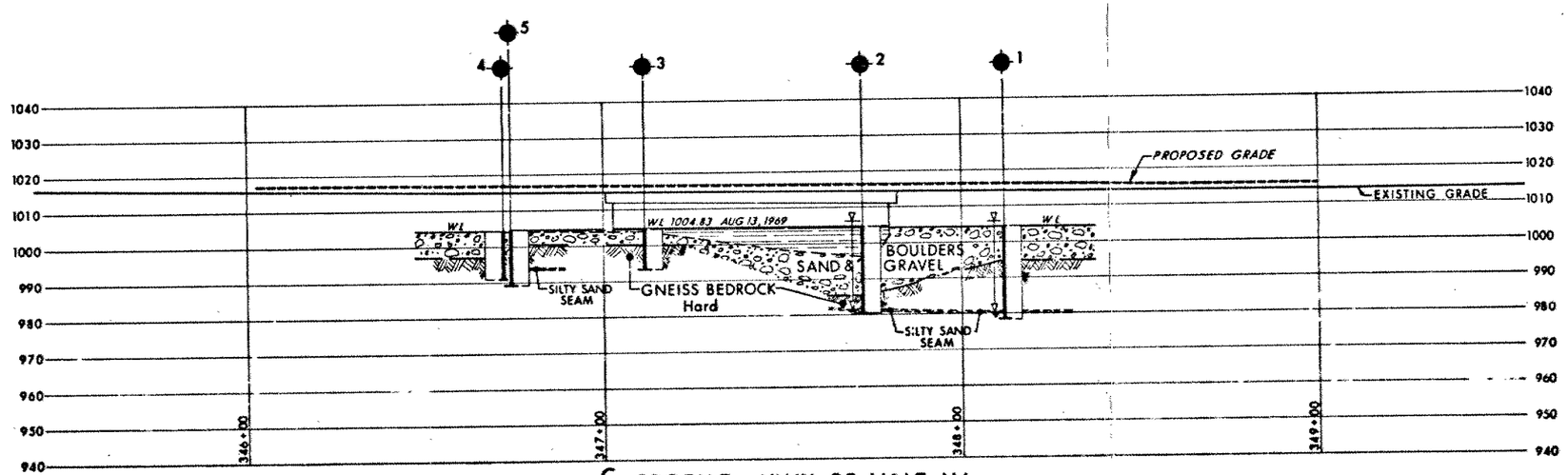
HYDRAULIC TERMS

h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
j	SEEPAGE FORCE PER UNIT VOLUME
η	COEFFICIENT OF VISCOSITY
k	COEFFICIENT OF HYDRAULIC CONDUCTIVITY
k_h	k IN HORIZONTAL DIRECTION
k_v	k IN VERTICAL DIRECTION
m_v	COEFFICIENT OF VOLUME CHANGE
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX
C_r	RECOMPRESSION INDEX
d	DRAINAGE PATH DISTANCE
T_v	TIME FACTOR
U	DEGREE OF CONSOLIDATION
O_r	OVERCONSOLIDATION RATIO (OCR)



PLAN

SCALE 20 10 0 20 FT

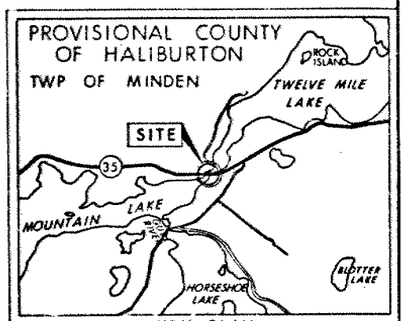


℄ PROFILE - HWY 35 LINE 'J'

SCALE 20 10 0 20 FT

REF No E - 5008 - 1 ; Nov. 1969

CONT No	
WP No 119 - 68 - 01	
MOUNTAIN LAKE 3.2 Miles South of Carnarvon BORE HOLE LOCATIONS & SOIL STRATA	SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- WL at time of investigation Oct, 1977
- Head ARTESIAN WATER Encountered

No	ELEVATION	STATION	OFFSET
1	1 004.6	348 + 11	31' RT
2	1 004.7	347 + 72	20' LT
3	1 004.6	347 + 12	18' RT
4	1 004.4	346 + 72	26' RT
5	1 004.9	346 + 74	28' LT

-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

HWY No. 35 LINE 'J' DIST 31
SUBMD J M CHECKED DATE Dec 2, 1977 SITE 40 - 32
DRAWN R S CHECKED DWG 1196803-A