

Mr. A. M. Teye,
Bridge Engineer,
Bridge Division.

Attn: Mr. S. McCombie.

Mr. A. C. Stermac,
Principal Foundation Engr.,
Foundation Section,

October 12, 1962.

Re: D.H.C. FOUNDATION INVESTIGATION REPORT -
Bridge Site No. 1B-2, Hwy. #41 at Hydes
Creek, 2.7 Mi. S. of Griffith, Dist. #10,
N.J. 62-P-111 -- W.P. 225-60.

Attached, we are forwarding to you, our detailed
foundation investigation report outlining the existing subsoil
conditions at the above structure site.

We believe you will find the factual data and
recommendations contained therein, adequate for your future
design work. Should there be any queries with respect to this
project, please feel free to contact our Office.

KYL/mdeF
Attach.

cc: Messrs. A. M. Teye (2)
H. A. Tregaskes
H. D. McMillan
J. Ford
W. G. Wigle
J. E. Gruspier
T. J. Kovich
J. Poy
E. P. Saint
P. Norman
A. Watt
Foundations Office
Gen. Files.

K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:

A. C. Stermac,
PRINCIPAL FOUNDATION ENGR.

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE & GEOLOGY.
 3. FIELD & LABORATORY INVESTIGATION.
 4. SUBSOIL CONDITIONS:
 - 4.1) Sand.
 - 4.2) Bedrock.
 5. DISCUSSION & RECOMMENDATIONS.
 6. SUMMARY.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION

For

Bridge Site No. 18-2,
Hwy. #41 at Hydes Creek,
2.7 Mi. S. of Griffith,
District #10
W.J. 62-F-111 -- W.P. 225-60.

1. INTRODUCTION:

A memo, dated September 7, 1962, requesting a subsoil investigation at the site of the proposed new bridge, to carry Hwy. #41, over Hydes Creek, was received from the Bridge Location Section.

Presented in this report are all the field and laboratory results, their interpretation and discussion, as well as the necessary recommendations for the foundations of the proposed new structure.

2. DESCRIPTION OF SITE & GEOLOGY:

The topography of the area, in general, is somewhat rolling to hilly. The surface deposits vary considerably from the southern end of the county to the northern end, depending upon the nature of the underlying bedrock. The northern region has a thin coating of till over bedrock and the nature of the relief is mostly a reflection of the bedrock topography.

The hilly central and northern parts of the county are underlain by precambrian rocks, which include some deposits of highly crystalline limestones. In the vicinity of the proposed structure, the rock is composed of nearly white, medium to coarse grained, impure precambrian limestone. This limestone contains many bands and masses of grey silicate minerals consisting largely of

2. DESCRIPTION OF SITE & GEOLOGY: (cont'd.) ...

silica and calcium and is enclosed in gneissic country rock.

In the vicinity of the bridge site, the highway cuts through rock exposures consisting mainly of coarse grained limestone of precambrian age. These exposures can be seen along the rock cuts north of the existing bridge. In the North-East direction of the bridge site, there are exposures of gneissic country rock which have given the area somewhat hilly to undulating topography in that direction.

3. FIELD & LABORATORY INVESTIGATION:

Three sampled boreholes, supplemented by five dynamic cone penetration tests were carried out at the site, utilizing a conventional diamond drill rig adapted for soil sampling procedures.

Samples were recovered by means of a 2-inch O.D. split-spoon sampler and a side-slit sampler where difficulties in recovery were encountered. Rock core samples were obtained by means of an AXT core barrel.

Bedrock was established in all boreholes, with the exception of borehole #5. Rock was proven by drilling in boreholes #1 and #3, whereas its surface was assumed at the refusal depth of the dynamic cone in boreholes #2 and #4. Borehole #5, was carried out in the creek bed, in order to provide information for scour depth determination.

Each sample of the subsoil was visually classified in the field before transportation to the laboratory, where a further classification was performed.

cont'd. /3 ...

3. FIELD & LABORATORY INVESTIGATION: (cont'd.) ...

In addition, moisture content and grain size distribution analyses were carried out on selected representative samples. The results of these tests are plotted on the borehole logs contained in the appendix of this report.

The locations and elevations of all boreholes are plotted on the attached Drawing No. 62-F-111A, and were established by a D.H.O. survey crew at the time of this investigation.

4. SUBSOIL CONDITIONS:

Subsoil conditions at the site were found to be generally uniform with only a varying thickness of sand overlying bedrock.

4.1) Sand:

This grey and brown deposit, extends from ground level to the bedrock; its thickness varies from 32 to 40 feet. It is a loose to compact, fine to coarse sand with occasional gravel. Standard Penetration Resistance varies from a low of 3 to a high of 35 blows per foot with an overall average of 15.

Grain size distribution analyses, showed this deposit to consist of the following particle sizes: gravel 15%, sand 83% and silt 2%.

4.2) Bedrock:

Sound bedrock was established in boreholes #1 and #3 and samples were recovered in an AXT core barrel. In borehole #1, the rock was a grey granite-gneiss, whereas in borehole #3, it was an almost white coarse crystalline limestone of metamorphic origin. In both cases, 100% recovery was achieved.

cont'd. /4 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Bedrock: (cont'd.) ...

The surface of the bedrock dips in a westerly direction and was encountered at the following elevations: 837.25, 833.0, 830.5, 840.5, in boreholes #1, #2, #3 and #4, respectively.

5. DISCUSSION & RECOMMENDATIONS:

A single 62'-0 span new bridge is proposed at the site, to carry Highway #41 over Hydes Creek.

The subsoil at the site consists of sand with some gravel, overlying sound granite and limestone bedrock.

Because of the estimated low bearing capacity of the loose sandy subsoil, it is recommended that the structure be supported on a piled foundation.

Either timber Class "A" or steel H-piles may be used. For 12" Ø timber piles (treated if not completely below the lowest established water level), a safe design load of 20 tons per pile, may be used, provided the piles are driven to an estimated elev. 850.0 ± .

If greater design loads are required, steel H-piles, driven down to bedrock are recommended. For example, a 12 BP 53 H-Bearing pile can support a design load of 60 tons.

Pile driving, for timber piles, should be controlled in the field by means of the Hiley Formula, as per D.H.O. Standards DD 1218 and DD 1219.

A dewatering scheme will be necessary, as excavations will be carried out below the creek water level. Protection against

cont'd. /5 ...

5. DISCUSSION & RECOMMENDATIONS: (cont'd.) ...

scour will be necessary for the abutment footings. If sheeting is used, it is recommended that it be driven for a distance below the excavation bottom equal to the height of the water above it.

No embankment stability problems are anticipated.

6. SUMMARY:

Subsoil at the site consists of loose to compact sand with gravel, followed by sound granite and limestone bedrock.

Foundations based on piles are recommended:

i) For 12" Ø timber piles, with approximate tip elevation of 850, a safe load of 20 tons per pile may be used. Pile driving should be controlled by the use of the Hiley Formula.

ii) Steel H-piles driven to bedrock, may also be used. For example, a 12 BP 53 pile can support a safe load of 60 tons.

A dewatering scheme will be necessary since excavations will be carried out below river water level. If sheeting is used for scour protection, it may be incorporated in the dewatering procedure.

No embankment stability problems are expected.

7. MISCELLANEOUS:

The field work, performed during the period of Sept. 13 to 26, 1962, was under the direction of Mr. T. F. Widdis. The preparation of this report was carried out by Mr. G. Mierzynski under the general supervision of Mr. M. Devata of the Foundation Section.

Equipment was owned and operated by the D.H.O.

October 1962.

APPENDIX I.

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE (N) = THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE = THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 300 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TABLES:

CONSISTENCY	"N" BLOWS/FT.	REL. DENSITY	DENSENESS	"N" BLOWS/FT.
VERY SOFT	0 - 2	0 - 25%	VERY LOOSE	0 - 4
SOFT	2 - 4	25% - 50%	LOOSE	4 - 10
FIRM	4 - 8	50% - 100%	COMPACT	10 - 30
STIFF	8 - 15	100% - 200%	DENSE	30 - 50
VERY STIFF	15 - 30	200% - 400%	VERY DENSE	> 50
HARD	> 30	> 400%		

TYPE OF SAMPLE

SS	SPLIT SPOON	TM	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	DS	DESTONBERG SAMPLE
AS	AUDIER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PM	SAMPLE ADVANCED HYDRAULICALLY	
	MM	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

CU	UNCONFINED COMPRESSION	LV	LABORATORY VANE
U	UNDRAINED TRIAXIAL	FV	FIELD VANE
CDU	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
CD	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
U	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
Q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR $= \frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_s	SENSITIVITY

GENERAL

π	≈ 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

z	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SURFACES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

FOUNDATION SECTION

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — *L PLASTIC LIMIT — *P WATER CONTENT — %	BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P S F.		
75.25 0.0	Groundlevel							
	Fine to coarse sand.		1	SS	6			
	Loose to compact.		2	SS	6			
	Occasional gravel.		3	SS	6			
	Grey and brown.							
			4	SS	12			
			5	SS	20			
			6	SS	23			
			7	SS	19			
			8	SS	32			
7.25 8.0	Sound Granite - Gneiss Bedrock.		9	RC AXT	-			
						Refusal		

27.25
8.00 End of borehole.

FOUNDATION SECTION

[illegible]

FOUNDATION SECTION

SOIL PROFILE			SAMPLES		ELEV SCALE		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %	BULK DENSITY P.C.C.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30		
74.0 0.0	Groundlevel									
	Fine to coarse sand.		1	SS	3	870				
	Loose to compact.		2	SS	17					
	Occasional gravel.		3	SS	14					Gravel=28% Sand =69% Silt = 3%
	Grey and brown.		4	SS	12	860				Gravel=1 % Sand =96% Silt = 3%
			5	SS	16					
			6	SS	19	850				Gravel =8% Sand =90% Silt =2%
			7	SS	35					
40.5 33.5	Sound Crystalline Limestone Bedrock of Metamorphic Origin					840				Refusal
			8	RC AXT	-					100% Recovery
30.5 3.5	End of borehole.					830				

FOUNDATION SECTION

ORIGINATED BY G.M.

COMPILED BY G.M.

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY G.M.

COMPILED BY G.M.

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT	WATER CONTENT	WATER CONTENT		
72.25 0.0	Waterlevel										3.0' of water
69.25 3.00	Groundlevel										
	Fine to coarse sand with occasional gravel.		1	SS	4						Gravel=7% Sand =90% Silt =3%
			2	SS	5						
			3	SS	4						
			4	SS	5						
	Loose to compact.		5	SS	8						Gravel=17% Sand =80% Silt = 3%
			6	SS	8						
			7	SS	19						
45.75 26.5	End of borehole.		8	SS	22						
											Penetration ends @30.0'

Mr. A.G. Stermac,
Principal Foundations Engineer,
Lab. Bldg.,

Mr. M. Sloyanoff
Bridge Contract Engineer,
Bridge Division,

A.P. Watt

Bridge Division,
February 11, 1963.

WP #225-60, Bridge Site #18-2,
Hydes Creek Bridge,
2.7 miles south of Griffith,
Hwy 41, District #10.

Enclosed please find a copy of a letter
received from Mr. A. G. Stermac on January
15, 1963 in regards to the above noted struc-
ture.

It is felt that this matter of dewatering
can best be covered in the contract rather than
putting a note on the drawing D-5153.



A.P. Watt,
Bridge Location Eng.,

APW/dm

c.c. A.G. Stermac

Mr. A. P. Watt,
Bridge Location Engr.,
Bridge Division.

Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.
January 15, 1963.

W.P. 225-60,
Hydes Creek Bridges,
Bridge Site #18-2,
2.7 Miles South of Griffith,
Hwy. #41, District #10.

We have reviewed the Preliminary Plan
for the above structure and herewith, submit our
comments for your consideration:

Because of the granular character of
the subsoil and the proximity of the stream bed to the
footing excavation, dewatering may create quite a problem.

Therefore, we would suggest that a note
be put on the drawing or in the Contract, in which the
Contractor's attention is drawn to the necessity of
applying an appropriate dewatering scheme.

AGS/MdeF

cc: Foundations Office ✓
Gen. Files.

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

MEMORANDUM

To: Mr. A.G. Stermac
Principal Foundations Engineer,
Room 107, Lab. Bldg.,

FROM: A.P. Watt

DATE: Bridge Division,
January 14, 1963.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. #225-60,
Hydes Creek Bridges,
Bridge Site #18-2,
2.7 miles south of Griffith,
Hwy #41, District #10.

Enclosed please find one copy of the preliminary plan for the above structure.

The designer appears to have complied with the requirements of the foundation report but we would appreciate any comments you wish to make.

APW/dm



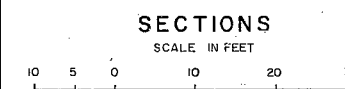
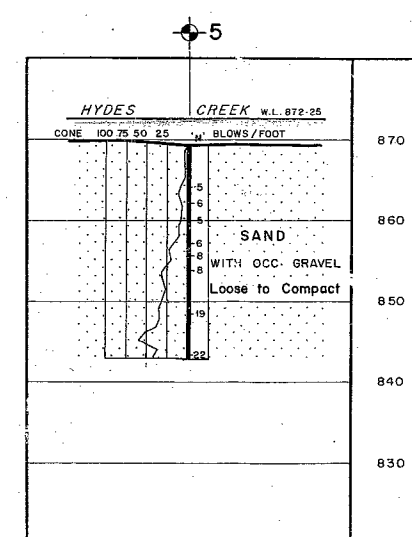
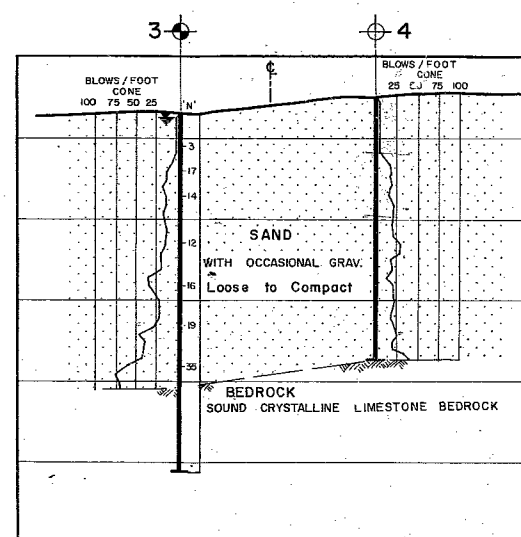
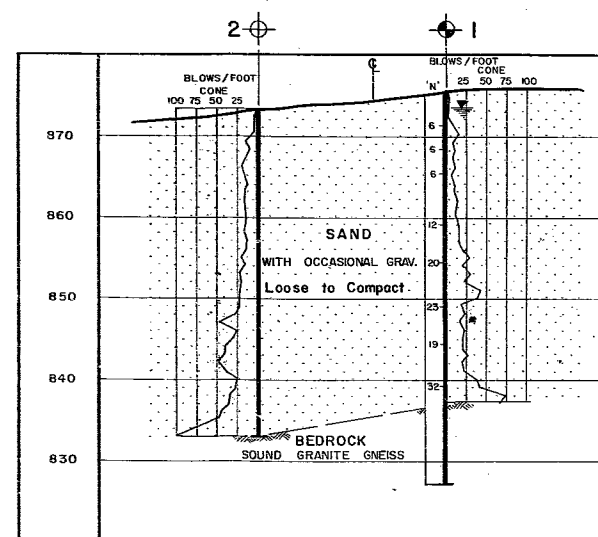
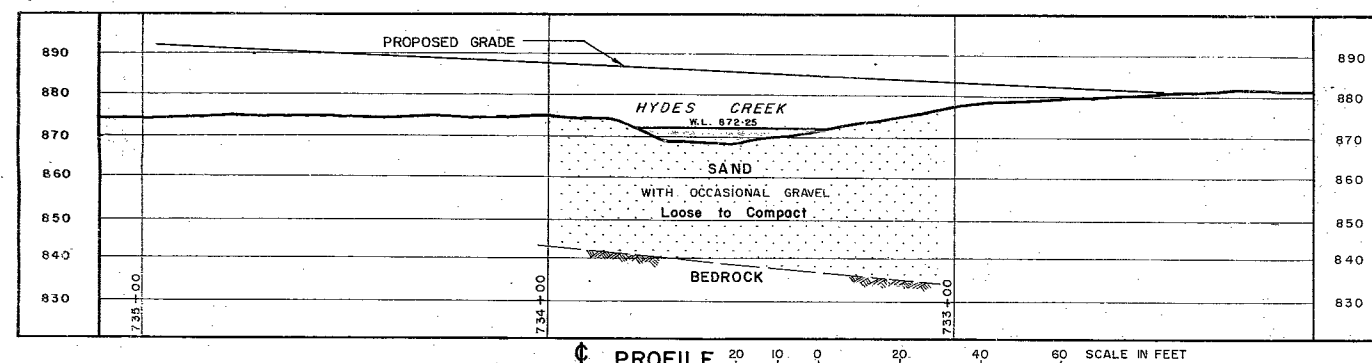
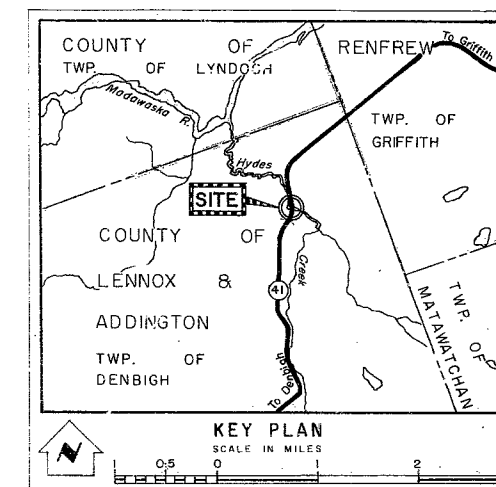
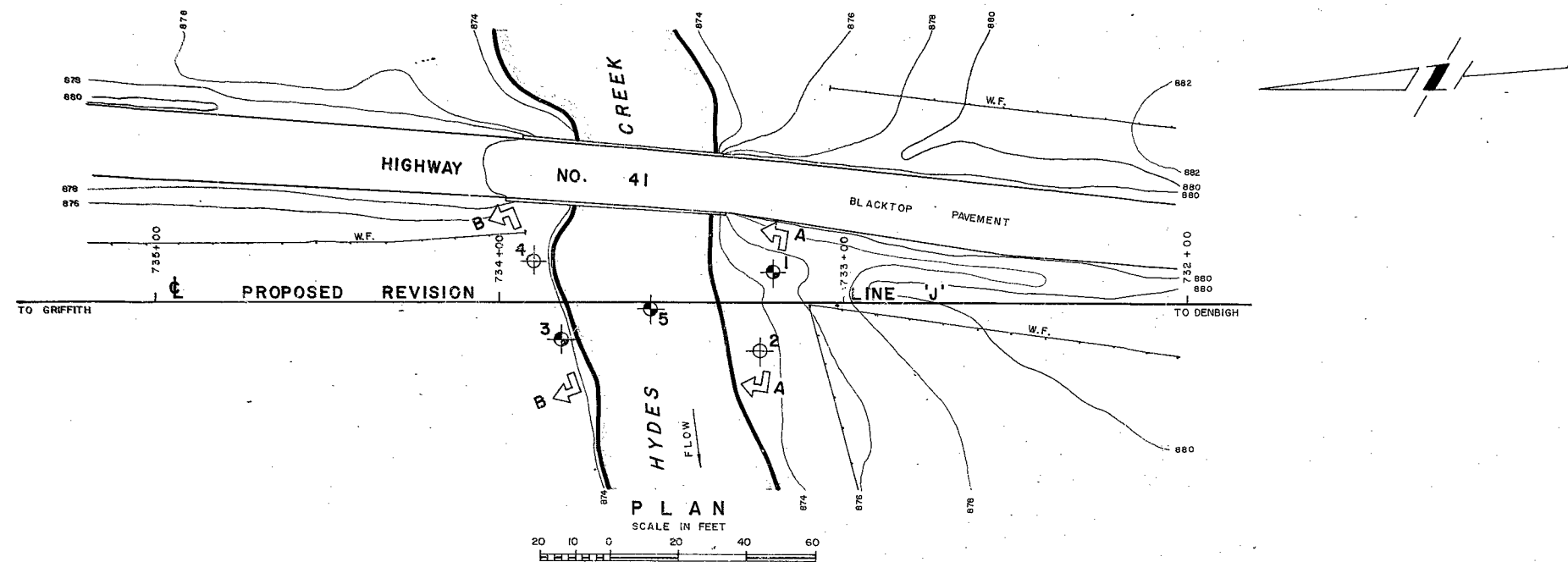
A.P. Watt,
Bridge Location Engineer.

#62-F-111

W.P. # 225-60

Hwy. # 41 AT

HYDES CR.



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, Sept. 1962.		
NO.	ELEVATION	STATION	OFFSET
1	875-25	733+21	9' RT.
2	873-0	733+25	14' LT.
3	874-0	733+82	11' LT.
4	875-0	733+90	12' RT.
5	872-25	733+56	2' 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 and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

HYDES CREEK

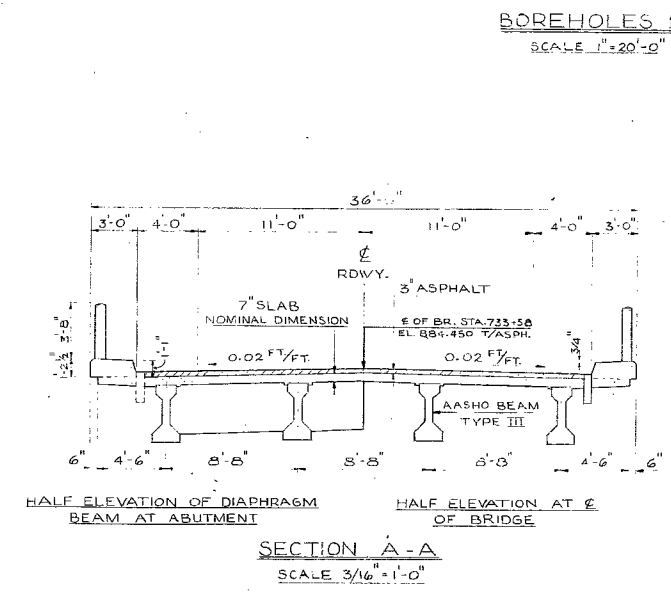
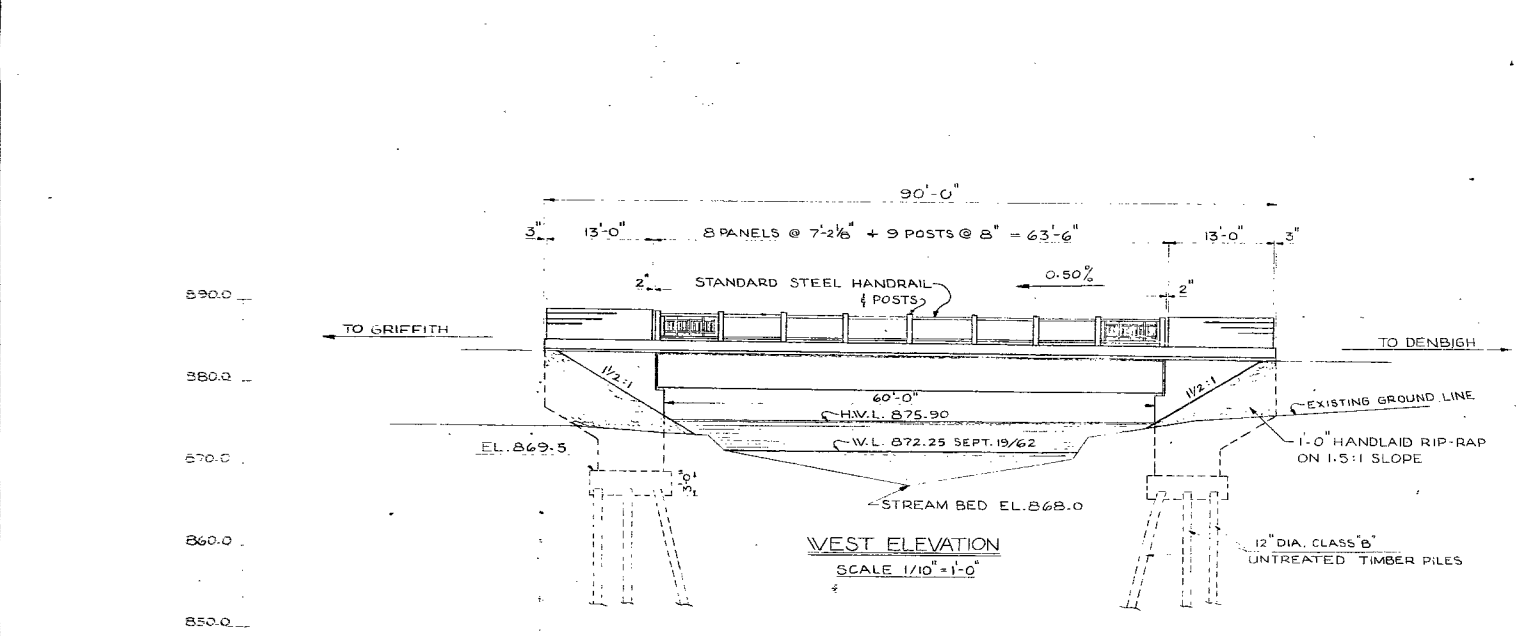
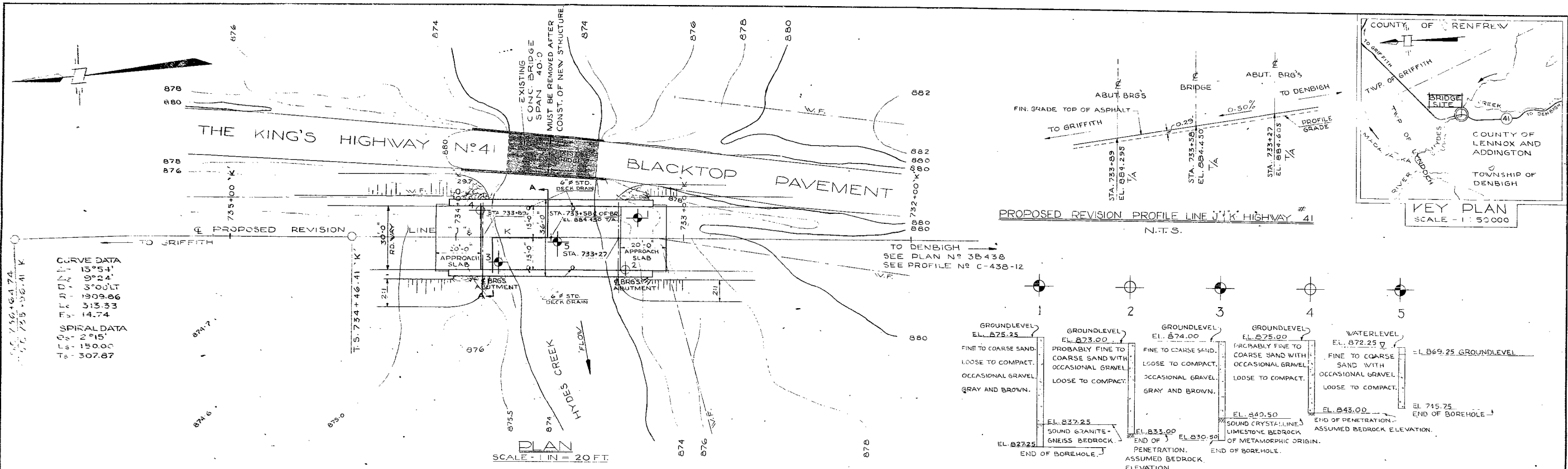
KING'S HIGHWAY NO. 41-PROP. REV'N LINE 'J' DIST. NO. 10
CO. LENNOX & ADDINGTON
TWP. DENBIGH LOT 4 CON. XV

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D G.M.	CHECKED <i>[Signature]</i>	W.P. NO. 225-60	M.B.R. DRAWING NO.
DRAWN <i>[Signature]</i>	CHECKED <i>[Signature]</i>	JOB NO. 62-F-III	62-F-III A
DATE OCT 22, 1962	SITE NO.		BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.		

PRINT RECORD	NO	FOR	DATE

REF. NO. E-3906-1



PRINT RECORD		
No.	FOR	DATE

REFERENCE PLANS

SITE PLAN - E-3906-1
 PLAN - B-438
 PROFILE - C-438-12
 B.A. - 1528
 B.W. - 402

DEPARTMENT OF HIGHWAYS ONTARIO			
BRIDGE 15/11			
HYDES RIVER BRIDGE			
2.7 MILES SOUTH OF GRIFFITH			
KING'S HIGHWAY No. 41 LINE J-1		DIST. No. 10	
CO. LENNOX & ADDINGTON		CON. 15	
TWP. DENBIGH		LOT 4	
PRELIMINARY PLAN			
APPROVED		SITE No. 18-2	
BRIDGE ENGINEER		W.P. No. 225-60	
DESIGN	M. M. CHECK	CONTRACT	No.
DRAWING	R. E. CHECK	DATE	No.
DATE	DEC. 1962	LOADING	H 20 S 16
DRAWING No.		D-5177-PI	