

#

62-F-87

#

W.P. 170-61

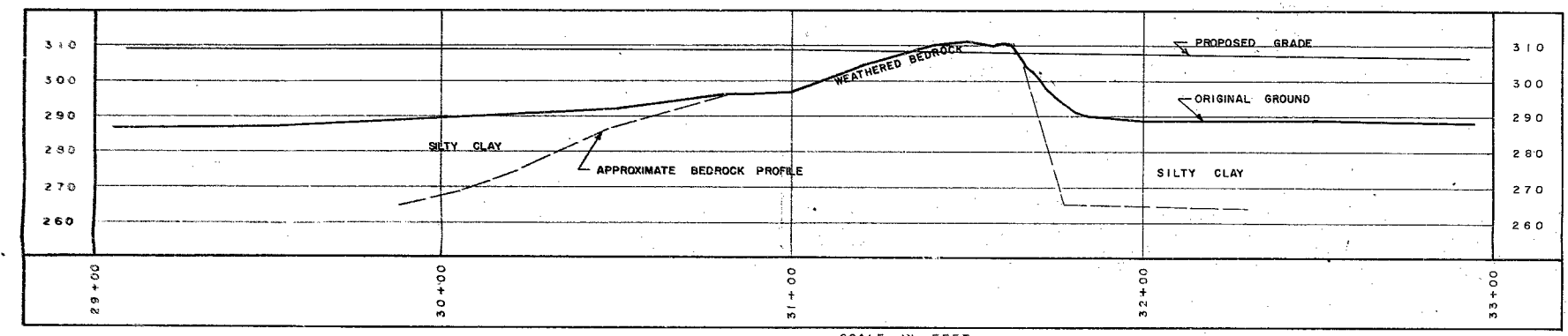
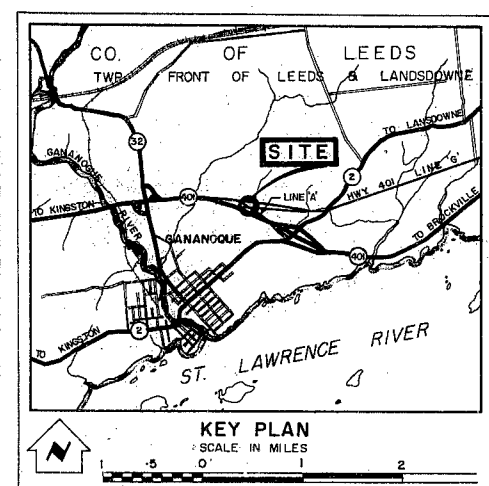
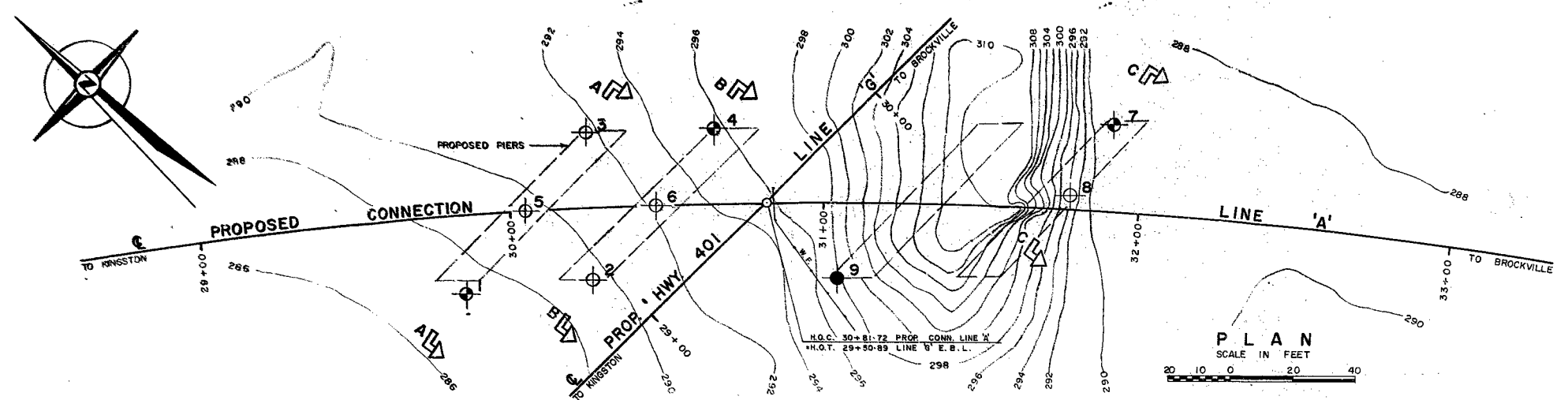
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Hwy 401

CONNECTION

" "

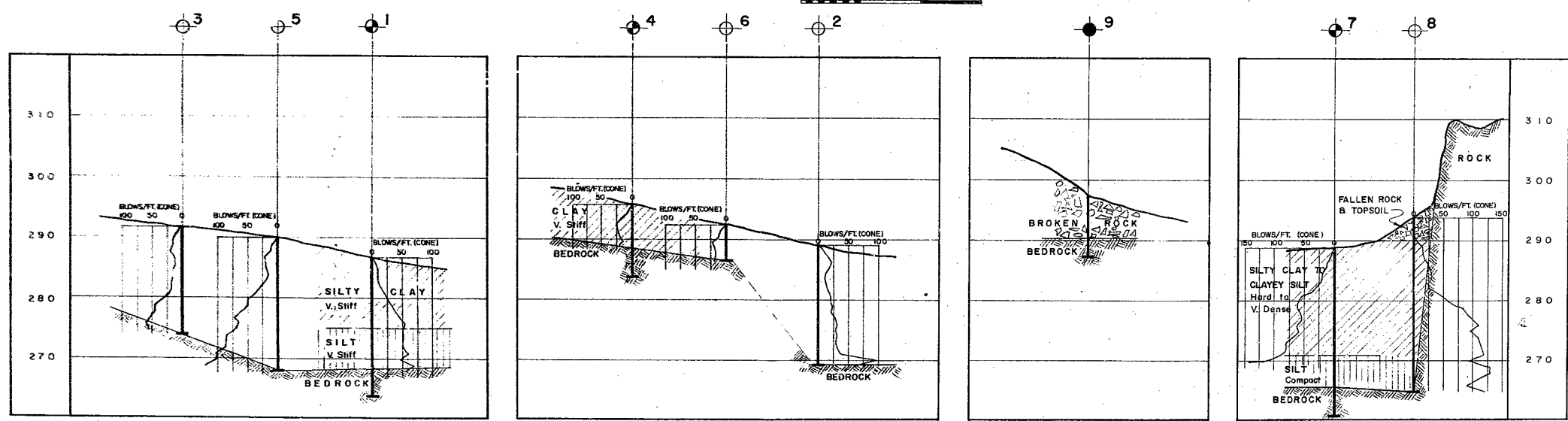
LINE A



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation.		

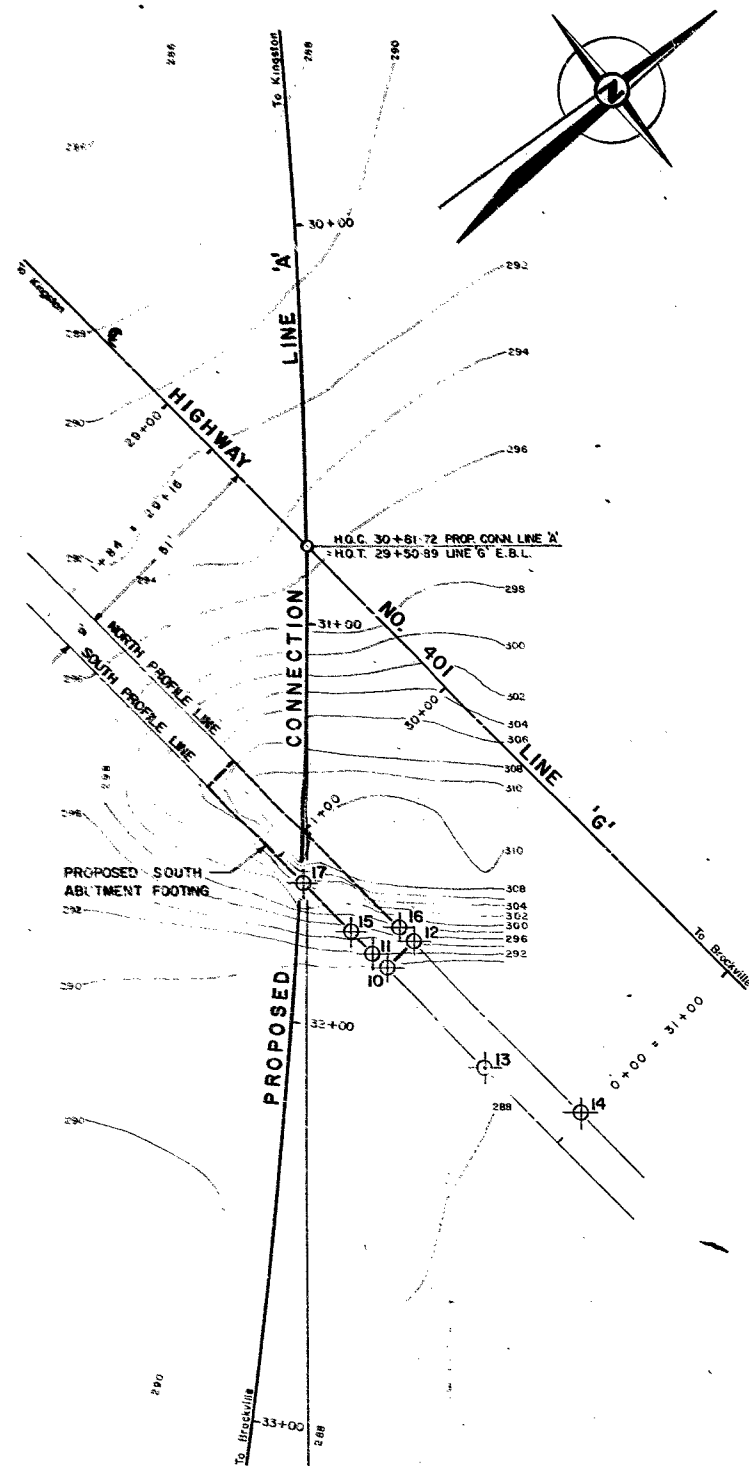
NO.	ELEVATION	STATION	OFFSET
1	287.0	29+84	25' RT.
2	289.1	30+25	23' RT.
3	291.9	30+25	24' LT.
4	295.8	30+65	24' LT.
5	290.0	30+05	0
6	292.5	30+46	0
7	288.8	31+90	28' LT.
8	294.0	31+78	4.5' LT.
9	297.5	31+04	24' RT.



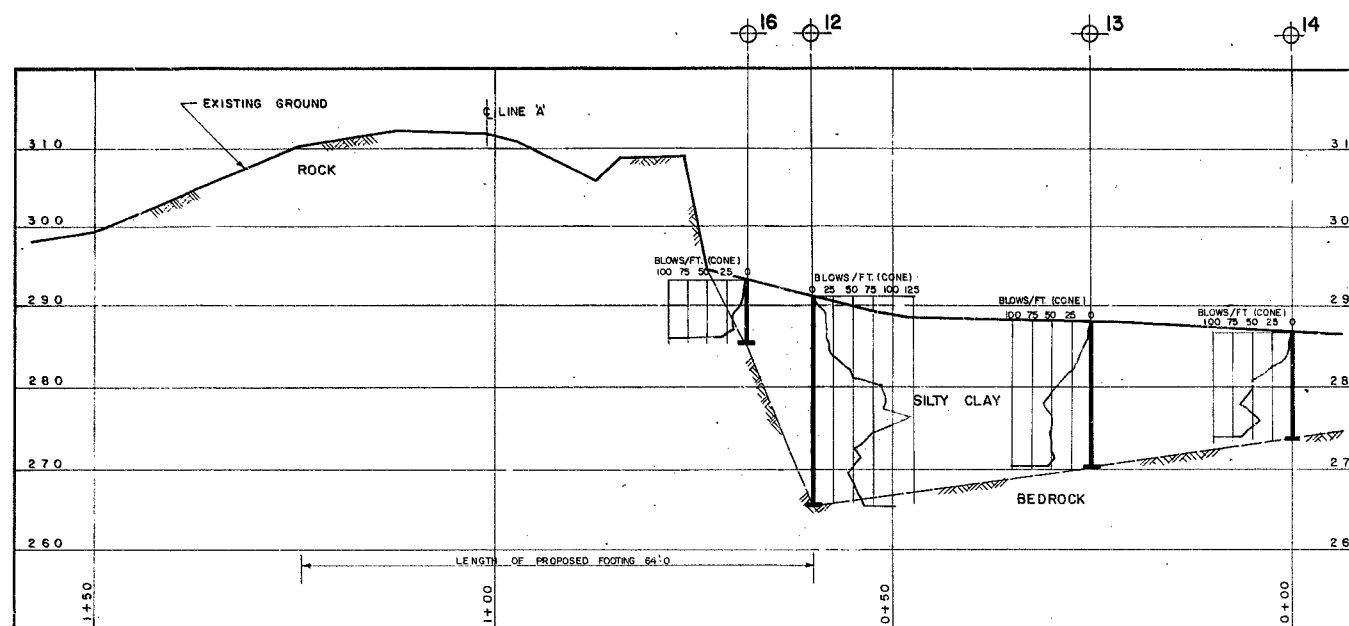
**- NOTE -**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

DEPARTMENT OF HIGHWAYS - ONTARIO		
MATERIALS & RESEARCH SECTION		
PROPOSED CONNECTION LINE 'A'		
AND		
HIGHWAY NO. 401 LINE 'G'		
ORIGINATED A. BARSVARY	DISTRICT NO. 8	DATE 24 AUGUST 1962
DRAWN D. MUMFORD	W.P. NO. 170-61	JOB NO. 62-F-87
CHECKED <i>K.L.S.</i>	CONTRACT NO.	DRAWING NO.
APPROVED <i>K.L.S.</i>		62-F-87A

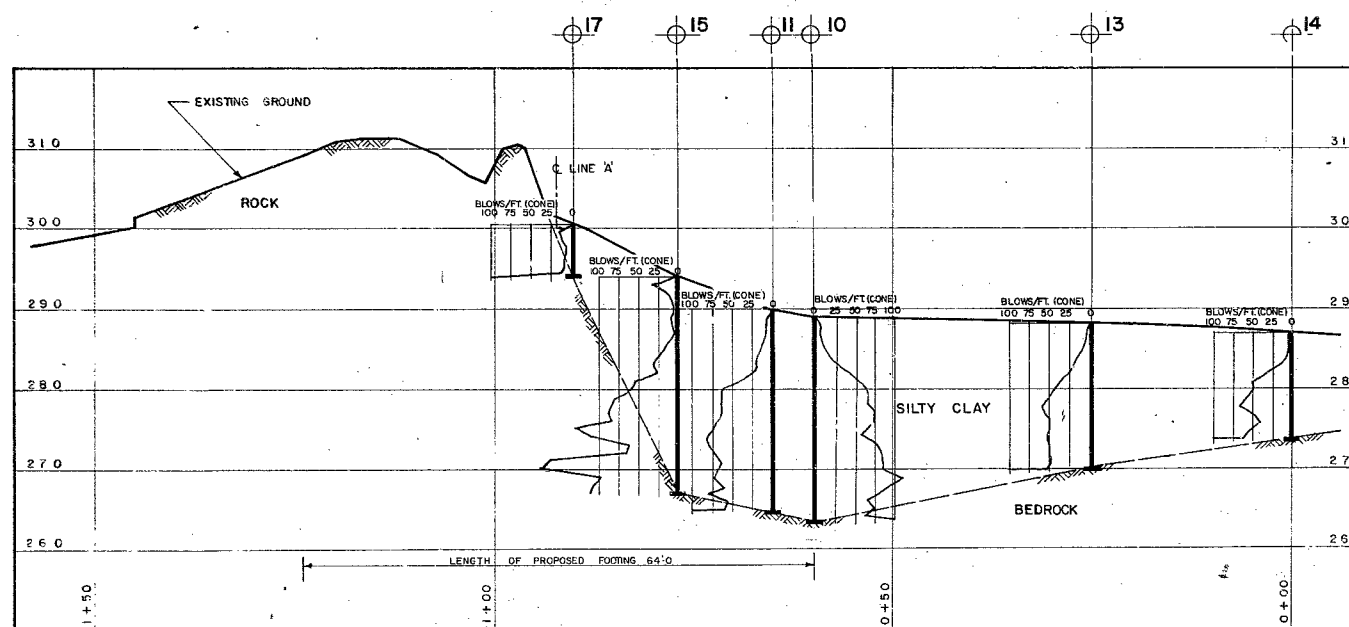
REF. NO. E-4096-1



PLAN  
SCALE IN FEET  
0 10 20 40



PROFILE ALONG NORTH SIDE OF FOOTING  
SCALE IN FEET



PROFILE ALONG SOUTH SIDE OF FOOTING  
SCALE IN FEET

SEE DRAWING 62-F-37A

KEY PLAN  
SCALE IN MILES

#### LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
10	289.0	0+61 S.	€
11	290.0	0+66 S.	€
12	291.3	0+61 N.	€
13	288.3	0+26 S.	€
14	287.0	0+01 N.	€
15	294.2	0+74 S.	€
16	293.5	0+66 N.	€
17	300.5	0+91 S.	€

#### 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.

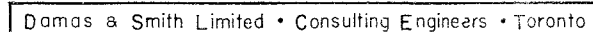
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION			
<b>PROPOSED SOUTH ABUTMENT FOOTING FOR LINE 'A' CONNECTION</b>			
KING'S HIGHWAY NO. 401 LINE 'G'		DIST. NO. B	
CO. LEEDS		TWP. 8 LANDSDOWNE	
BEDROCK DETERMINATION FOR FOOTING		M.B.R. DRAWING NO. 62-F-87B	
SUBV'D. R.M.	CHECKED K.L.B.	W.P. NO. 170-61	BRIDGE DRAWING NO.
DRAWN D.M.	CHECKED K.L.B.	JOB NO. 62-F-87	
DATE 28 JAN. 1963	SITE NO.		
APPROVED <i>A. J. Thomas</i>			SCOTT NO.



NOTES:  
• LINE 'A' PROFILE HAS BEEN RAISED 1'-0".

<p align="center"><b>DEPARTMENT OF HIGHWAYS ONTARIO</b>  <b>BRIDGE DIVISION</b></p>			
<p align="center"><i>NORTHBOUND ENTRANCE UNDERPASS AT GANANOQUE</i>  <i>0.6 MILES WEST OF HWY. NO. 2</i></p>			
KING'S HIGHWAY No. <i>401</i>		DIST. No. <i>8</i>	
CO. <i>LEEDS</i>			
TWP. <i>FRONT OF LEEDS PLANS DOWN</i>		LOT <i>16 &amp; 17</i> CON. <i>I</i>	
<p align="center"><i>PRELIMINARY GENERAL ARRANGEMENT</i></p>			
APPROVED _____		SITE No. _____	W.P. No. <i>170-61</i>
BRIDGE ENGINEER _____			
DESIGN _____	CHECK _____	CONTRACT _____	No. _____
DRAWING <i>170-61</i>	CHECK _____	_____	_____
DATE <i>JAN 31 1962</i>	LOADING _____	DRAWING No. <i>D-5142-P2</i>	



13-44-303.

Mr. A. M. Towe,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)  
Attention: Mr. S. McCombie.

August 17, 1962.

D.H.O. FOUNDATION INVESTIGATION  
REPORT.  
W.J. 62-F-87 -- W.P. 170-61.

Re: Proposed Crossing at Proposed Connection - Line 'A'  
and Prop. Rev'n. - Hwy. #401 - Line 'G', Eastbound  
lane in the Town of Gananoque, District #8, Kingston.

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

We believe you will find the factual data and recommendations contained therein, adequate for your future design work. Should clarification, or additional information be required, please do not hesitate to contact our Office.

KYL/4def  
Attach.

cc: Messrs. A. M. Towe (2)  
H. A. Tregaskes  
H. D. McMillan  
J. Ford  
E. A. Cash  
J. E. Gruspier  
T. J. Kovich  
J. Roy  
E. P. Saint  
E. Norman  
A. Watt  
Foundations Office  
Gen. Files.

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

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

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# FOUNDATION INVESTIGATION

For

Proposed Crossing at Proposed Connection - Line 'A'  
and Prop. Rev'n. - Hwy. #401 - Line 'G', Eastbound  
Lane in the Town of Gananoque, District #8, Kingston.

W.J. 62-F-87 -- W.P. 170-61.

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## 1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed crossing at proposed connection - Line 'A' and proposed revision - Hwy. #401 - Line 'G' eastbound lane in the Town of Gananoque, was received verbally from the Bridge Location Section, on the 10th of July, 1962. A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed structure.

Presented in this report are the results of this investigation, together with recommendations pertaining to the design of the proposed foundations and approach fills.

## 2. DESCRIPTION OF THE SITE:

The proposed crossing is located some 290' north of the north fenceline of the present Hwy. #401, approximately 2000' north-west of the existing intersection of Hwy. #401 and Hwy. #2 in the Town of Gananoque.

The east half of the proposed structure's site is occupied by a small knob, rising roughly 20' above the general ground level. The east slope of the knob is very steep, practically

cont'd. /2 ...

2. DESCRIPTION OF THE SITE: (cont'd.) ...

a vertical cliff of exposed rock. The neighboring area has a rolling knob and basin relief, consisting of pastures and small woods. Physiographically, the site belongs to the "Leeds Knobs and Flats" geological region. The characteristics of the region are granite and other Precambrian rock knobs, and clay-filled channels between them. The rock-knobs of the Frontenac axis are relatively bare because the shallow covering of drift was removed by the waves of the Champlain Sea, and the contrast between them and the deep clay beds is clear and sharp.

3. FIELD INVESTIGATION PROCEDURE:

A total of four boreholes and eight dynamic cone penetration tests was carried out during the course of the field investigation. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. Soil samples were obtained by means of a standard split-spoon sampler driven into the soil with an energy of 350 ft.-lbs. per blow. Rock samples were taken by means of an AXT core barrel. Driving energy of the dynamic cone penetration tests was the same as that used for the split-spoon sampler.

The locations and elevations of all boreholes and penetration tests are shown on Drawing #62-F-87A which accompanies this report.

cont'd. /3 ...



4. LABORATORY TESTS:

Soil samples were visually examined and classified at the site as well as in the laboratory.

Tests in the laboratory were carried out on various representative samples to determine the natural moisture content and Atterberg limits of the overburden soil. Additional tests on cohesive samples were performed to define the shear strength and density of the samples.

Laboratory and field test results are included under Appendix I of this report.

5. SUBSOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of deposits of clay, silty clay and silt layers underlain by metamorphic bedrock. The depth of overburden at the proposed west abutment is approximately 20', and it diminishes towards the east. At the site of the knob, the rock lies on the surface; however, its upper 6 - 10' stratum is badly weathered, broken and mixed with topsoil.

The boundaries of the different deposits are shown on the accompanying borelog sheets. The estimated stratigraphical profiles and cross sections shown on Drawing #62-F-87A, are based upon this information. A more detailed description of the various soil types is given below:

cont'd. /4 ...

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

5.2) Silty Clay:

This material was observed in B.H. #1 from ground level down to 12' (El. 275.0) and in B.H. #7 from ground level down to 18.0' (El. 270.8). In B.H. #7 the deposit becomes more silty with depth. The consistency of the silty clay layer is very stiff and hard, corresponding to standard penetration 'N' values of 20 - 40 blows per foot. Average shear strength of the stratum, based upon laboratory unconfined compression tests, can be taken as 1750 p.s.f. Liquid limit values vary between 45.0% and 28.0% and those of plastic limit between 26.0% and 17.0%. Average bulk density of the material is 124.0 p.c.f.

5.3) Clay:

A highly plastic clay deposit was encountered in B.H. #4 from ground level (El. 295.8) down to a depth of 7.4' (El. 288.4). The consistency of the layer is very stiff to hard; laboratory unconfined compression tests of two soil samples gave shear strength values of 4550.0 and 7700.0 p.s.f. The liquid limit of the layer is above 50% and the plastic limit = 24%; bulk density was found to be 125.0 p.c.f.

5.4) Silt:

Underlying the silty clay deposit, a 5' - 6' deep silt layer was found in B.H. #1 and B.H. #7. The silt extended from elevation 275.0 to elevation 268.3 in B.H. #1 and from elevation 270.8 to elevation 265.8 in B.H. #7. The layer was found to have compact relative density and low to zero plasticity. The approximate

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

5.4) Silt: (cont'd.) ...

shear strength of the material is 1000.0 p.s.f.: the bulk density 133.0 p.c.f.

5.5) Bedrock:

Bedrock was encountered in each borehole at various elevations and the upper contact of the bedrock was also proved by each dynamic cone penetration test. As has been mentioned earlier, at the site of the knob, the bedrock lies on the surface. The exposed bedrock is badly weathered; in many places it is broken to various sizes and mixed with topsoil.

The elevations of the bedrock in the boreholes are as follows:

B.H. #1	:	268.3'	B.H. #5	:	268.5'
B.H. #2	:	269.1'	B.H. #6	:	286.4'
B.H. #3	:	274.2'	B.H. #7	:	265.8'
B.H. #4	:	288.4'	B.H. #8	:	265.0'
B.H. #9	:	297.5'			

The bedrock is a fine-grained metamorphic type with thin seams of Haematite.

6. GROUND WATER CONDITIONS:

At the time of the investigation, the ground water level was observed in B.H. #1 at an elevation of 287.0, which is the general ground level. No definite water level was found in the other boreholes.

cont'd. /6 ...

## 7. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a three span structure at this location.

Subsoil at the site consists of layers of silty clay, clay and silt at various depths under which metamorphic bedrock was encountered.

Because of the great variations in the depths of the overburden at the site, recommendations will be given below, separately, for each member of the proposed substructure.

### 7.1) West Abutment:

The depth of overburden at this site is approximately 18' - 21'. The permissible net bearing capacity of the overburden silty clay stratum was calculated to be 1.75 T.S.F., which value is felt to be rather low to support the structure on spread footings. If the required design load is larger, a piled type foundation is recommended, piles being driven to the bedrock. Refusal of the penetration of the piles is anticipated between El. 274.0 and El. 268.0. Utilizing steel 'H' piles, a safe design load of up to 70 T/pile can be used, depending on the pile section used.

### 7.2) West Pier:

At the north side and at the middle of the proposed west pier, the overburden was found to be shallow, approximately 6 - 7.5' deep, while at the south side, the upper surface of the bedrock was encountered at a depth of some 20.0'. (See cross section on Drawing #62-F-87A.) The possible solution for this location

7. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

would be to employ spread footing for part of the pier, where the bedrock is at a shallow depth, and use piles driven to bedrock for the part of the footing where the location of the bedrock is 10' or more below the finished grade. The use of spread type of foundation for the entire length of the pier, being placed partly on bedrock, partly upon the clay deposit, would result in differential settlements within the substructure, and for this reason, it is not recommended. For the spread footing based on bedrock, a safe design load of 10 T.S.F. can be used, and for the bearing capacity of the piles, recommendations are the same as for the west abutment described under para. 7.1.

The exact location and the slope of the bedrock was not investigated throughout the entire length of footing of the proposed pier during the field work. After a final decision is made as to the type of structure and the location of the pier, this should be subsequently carried out.

7.3) East Pier:

No foundation problem exists at the site of the east pier, being located entirely on the rock knob. Although the upper stratum of the exposed rock is badly weathered and mixed with topsoil, it is anticipated that after the excavation to the final grade is completed, sound bedrock will be reached. Spread footing placed upon this bedrock can be employed, the base of the footing being as high

cont'd. /8 ...

7. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

7.3) East Pier: (cont'd.) ...

as structural requirements permit. A safe design load of 10 T.S.F. can be used for the design.

7.4) East Abutment:

As can be seen on the cross section of Drawing #62-F-87A, soil conditions at this location are similar to those existing at the site of the west pier. The site of the proposed abutment is located partly on the knob of exposed bedrock and partly right beside it where the bedrock is overlain by a 23' - 28' deep deposit of silty clay and silt. Combined spread and pile footings could be utilized at this location, as described under para. 7.2.

Remarks and recommendations given under para. 7.2 as to the safe bearing capacity; the possibility of differential settlements in case of using spread footing for the entire length of the footing; and the need for subsequent investigation as to the exact location of the bedrock, are valid for this abutment as well.

7.5) Conclusions:

Because of the above-mentioned problems in the design of the footings, we feel that consideration should be given to the construction of a single span structure. Assuming that the west abutment of the single span structure will be located at the site of the present proposal, piles driven to bedrock could be utilized as discussed under para. 7.1. The east abutment of the recommended

7. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

7.5) Conclusions: (cont'd.) ...

single span bridge should be located at or near the site of the proposed east pier, in which case it could be supported on spread footings placed upon the bedrock as discussed under para. 7.3.

7.6) Slope Stability:

No slope stability problem is anticipated with regard to the approach fills, provided that standard 2:1 slopes are used.

8. SUMMARY:

- (1) It is proposed to construct a three span structure for this location.
- (2) Subsoil at the site consists of silty clay, clay and silt in various depths under which bedrock was encountered.
- (3) Because of the great variations in the depths of the overburden, recommendations pertaining to the foundation of the proposed structure are given separately for each abutment and pier. (See para. 7.1 - 7.4).
- (4) Recommendations for the design of a single span structure is discussed under para. 7.5.
- (5) No stability problems are anticipated with regard to the approach fills, provided they are constructed with standard 2:1 slopes.

cont'd. /10 ...

9. MISCELLANEOUS:

The field work, performed during the period from July 11th to 20th, 1962, together with the preparation of this report, was undertaken by Mr. A. K. Barsvary. The investigation was carried out under the general supervision of Mr. K. Selby, who also reviewed this report.

Equipment used was owned and operated by F. E. Johnston Drilling Co., Ltd. of Ottawa.

August 1962.



APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-87 LOCATION Line 'A' Sta. 29+84 25' Rt. of E DESIGNATED BY A.B.  
W.P. 170-61 BORING DATE July 11, 1962. COMPILED BY B.A.  
DATUM G.S.C. BOREHOLE TYPE Washboring BX Casing. CHECKED BY A.B.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. Unconfined shear strength Field Vane —" —"					W.P. — % W.L. — %		
							2000	4000	6000	8000	10000	20 40 60		
287.0 0.0	Groundlevel													
	Silty clay Very Stiff Grey.		1	SS	23									
			2	TW	25	280							119.0	
			3	TW	19								122.0	
275.0 12.0	Silt Compact Grey		4	TW	P								131.0	
			5	SS	18	270								
268.3 18'8"	Metamorphic Bedrock		6	RC	-									
264.0	End of borehole.					260								

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

108 62-F-87

LOCATION Line 11 Sta. 30+25 23' Rt. of C.

WITNESSED BY A.B.

W. P. 170-61

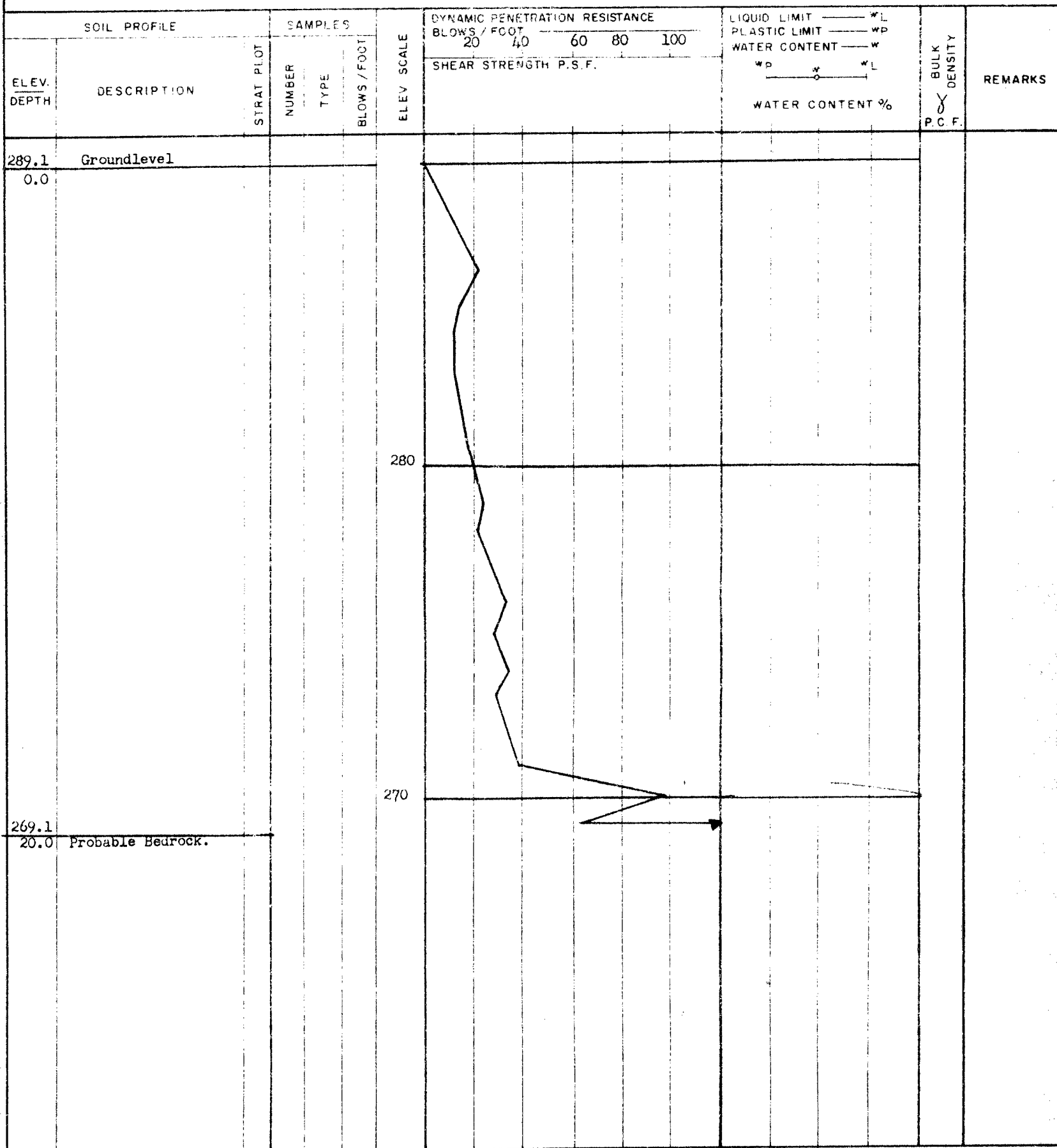
BOHRING DATE July 12, 1962.

COMPILED BY B.K.

DATUM G.S.C.

BOREHOLE TYPE Dynamic Cone Penetration.

CHECKED BY A.B.



FOUNDATION SECTION

JOB 62-F-87 LOCATION Line 'A' Sta. 30+25.24' Lt. of E DESIGNED BY A.B.  
W.P. 170-61 BORING DATE July 12, 1962. COMPILED BY B.K.  
DATUM G.S.C. BOREHOLE TYPE Dynamic Cone Penetration. CHECKED BY A.B.

SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT  NUMBER TYPE	 20    40    60    80    100 SHEAR STRENGTH P.S.F.	W.P. — W.O. — W.L. WATER CONTENT %		
			ELEV SCALE			
291.9 Groundlevel						
0.0						
			290			
			280			
274.2 Probable Bedrock.						
17.7						
			270			

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION				RECORD OF BOREHOLE NO. 4				FOUNDATION SECTION				
JOB 62-F-87		LOCATION Line 'A' Sta. 30+65 24' Lt. of E		ORIGINATED BY A.B.								
W.P. 170-61		BORING DATE July 13, 1962.		COMPILED BY B.K.								
DATUM G.S.C.		BOREHOLE TYPE Washboring DX Casing.		CHECKED BY A.B.								
SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20 40 60 80 100	SHEAR STRENGTH P.S.F. Unconfined shear strength				
								2000 4000 6000 8000 10000		20 40 60		
295.8 0.0	Groundlevel											
	Clay	/										
	Very stiff	/										
	to hard	/	1	TW	22							
	Grey	/										
		/				290						
		/	2	TW	37							
288.4 7.4	Metamorphic	/										
	Bedrock	/	3	RC								
283.8 12.0	End of borehole.	/										
						280						

## FOUNDATION SECTION

JOB 62-F-87 LOCATION Line 'A' Sta. 30+05 E ORIGINATED BY A.B.  
 W P 170-61 BORING DATE July 13, 1962. COMPILED BY B.K.  
 DATUM G.S.C. BOREHOLE TYPE Dynamic Cone Penetration. CHECKED BY A.B.

[illegible]



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 62-F-87 LOCATION Line 'A' Sta. 31+90 28' Lt. of E DESIGNATED BY A.B.  
W.P. 170-61 BORING DATE July 16, 1962. COMPILED BY B.K.  
DATUM G.S.C. BOREHOLE TYPE Washboring BX Casing. CHECKED BY A.B.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT	ELEV. SCALE	20 40 60 80 100	WATER CONTENT % 20 40 60		
288.8 0.0	Groundlevel								
	Silty clay becoming clayey silt		1 SS 37						
	Hard to very stiff		2 SS 40						
	Grey		3 SS 20						
			4 TW 20						
270.8 18.0	Silt Compact Grey		5 TW 23						
265.8 23.0	Metamorphic Bedrock		6 RC						
260.8 28.0	End of borehole.								





DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 62-F-87 LOCATION Line 'A' Sta. 31+04.24' E. of C DESIGNATED BY A.B.  
W.P. 170-61 BORING DATE July 19, 1962. COMPILED BY B.K.  
DATUM C.S.C. BOREHOLE TYPE Core Drilling. CHECKED BY A.B.

SOIL PROFILE			SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			WATER CONTENT %			
297.5 0.0	Groundlevel												
	Broken and disintegrated rock.		1	RC									
290.5 7.0	Metamorphic Bedrock				290								
287.5 10.0	End of borehole.				280								

## 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 'D' - 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 350 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 TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTER TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

## ABBREVIATIONS USED IN THIS REPORT

### SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
s	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

### GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a 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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES 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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

Mr. S. McCombie,  
Bridge Planning Engr.,  
Bridge Division.

Attn: Mr. A. Watt

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.  
January 29, 1963.

Re: Proposed New Structure at Proposed  
Connection Line 'A' and Hwy. #401  
Line 'G' - W.P. 170-61 - W.J. 62-F-87  
District No. 8

As requested by you verbally, on January 3rd, we have performed additional penetration tests at the site of the proposed South abutment for the above-mentioned structure.

A total of 8 dynamic cone penetration tests - (No's. 10 - 17, incl.) was carried out in order to establish more accurately the bedrock profiles. These, together with the estimated stratigraphical profiles, are plotted on the accompanying Drawing #62-F-87B. All survey work was carried out by personnel from Engineering Surveys, Kingston Region.

It is understood that the footing will be at approximate elevation 295.0. It appears, therefore, that about 70% of the footing will be founded directly on the bedrock, leaving about 18' at the East end to be supported by some other means. It is suggested that the footing be designed to cantilever over this end section, or that support be provided in the vertical direction by means of end bearing piles. The existence of a steep rock face along the North edge of the footing rules out the possibility of driving piles battered in a northerly direction and, therefore, only vertical support can be provided by piles. This should be borne in mind when designing the footing to resist lateral forces.

If we can be of any further assistance in this matter, please contact this Office.

Note: - Please include this memo and drawing in your copy(s) of our report W.J. 62-F-87.

KGS/MdeF

Attach.

cc: Messrs. S. McCombie (2)

H. A. Tregaskes

H. D. McMillan

J. Ford

E. A. Cash

J. E. Gruspier

T. J. Kovich

J. Foy

E. R. Saint

F. Norman

A. Watt

K. G. Selby,  
SENIOR FOUNDATION ENGR.  
For:

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Foundations Office -- Gen. Files

Mr. A. Rutka,  
Materials & Testing Engr.,  
Room 102, Lab. Bldg.

Mr. A. G. Sternac,  
Principal Foundation Engr.,  
Room 107, Lab. Bldg.

February 21, 1966

Memo from Mr. E. A. Cash to J. B. Wilkes -  
January 28, 1966 - re Borings for Structure  
Foundations.

WP 170-61  
62-F-87

With reference to the above mentioned memo and your request for an explanation, we wish to make the following comments:

Since the receipt of the memo, we have been in touch with Mr. Cash who advised us that the two structures he referred to in his memo to Mr. Wilkes were: W.P. 170-61, Westbound Entrance Underpass at Gananoque, and W.P. 25-59, Blue Church Rd. Underpass. We have reviewed both jobs very carefully and have arrived at the following conclusions:

(1) The investigation for Blue Church Road (W.P. 25-59) was not carried out on the correct line (Rev. Line 'C'), but seems to have been carried out on the centre-line of the then existing Blue Church Rd. instead. This has to be considered as our mistake.

(2) The investigation for the Westbound Entrance Underpass at Gananoque (W.P. 170-61) was carried out on the correct line and the borings were located correctly. The contractor experienced some difficulties due to the fact that the bridge footing locations were changed slightly (about 15 ft. along the centre-line). Bedrock elevations at this site change abruptly, and since interpolations from adjacent boreholes were necessary, some erring was unavoidable.

At present our method of locating the boreholes is by chainage and offset or co-ordinates. The surveying is usually done for us at the time of our investigations, by Engineering Surveys from the Regions, unless they inform us that the centre-line is already set out. It is the responsibility of our Project Foundation Engineers, however, to request the services of surveyors when they feel that they have not the means to carry out a reasonably accurate survey themselves, or when there is even the slightest doubt about the reliability of the field information.

AGS/MdeP

cc: Foundations Office ✓  
Gen. Files

*A. G. Sternac*  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGINEER

*proposed new structure*

Mr. S. McCombie,  
Bridge Planning Engr.,  
Bridge Division.

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.  
January 29, 1963.

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E. R. Saint  
F. Norman  
A. Watt

K. G. Selby,  
SENIOR FOUNDATION ENGR.  
For:

A. C. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Foundations Office -- Gen. Files

## MEMORANDUM

To: Mr. S. McCombie,  
Bridge Planning Engr.,  
Bridge Division.

FROM: Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.

Attn: Mr. A. Watt

DATE: January 29, 1963.

OUR FILE REF.

IN REPLY TO

## SUBJECT:

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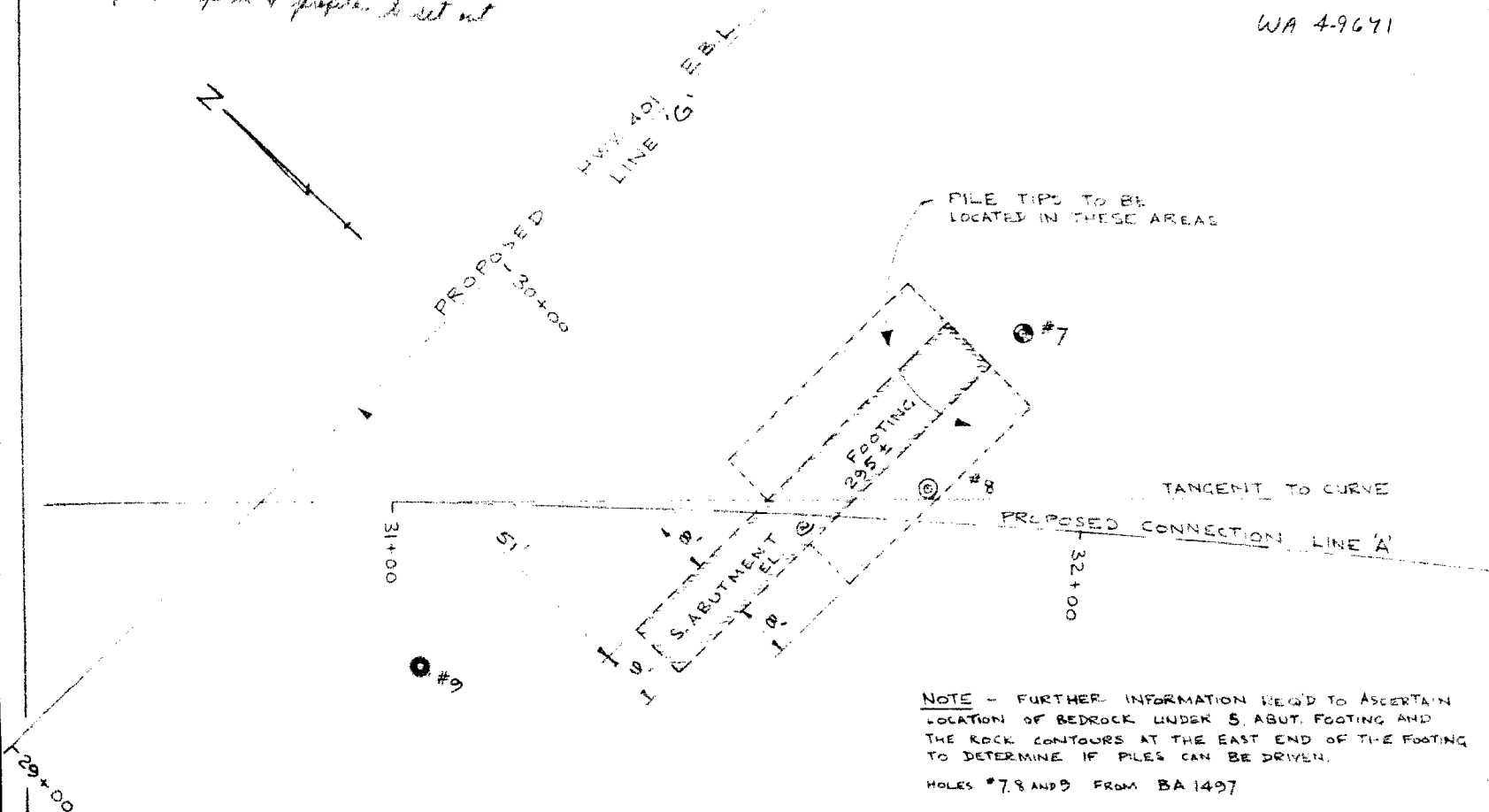
Foundations Office -- Gen. Files



1. Leave well out
2. If not plan & prepare to set out

Dumas & Smith  
George Lilly

WA 4-9671



NOTE - FURTHER INFORMATION REQ'D TO ASCERTAIN LOCATION OF BEDROCK UNDER S. ABUT. FOOTING AND THE ROCK CONTOURS AT THE EAST END OF THE FOOTING TO DETERMINE IF PILES CAN BE DRIVEN.

HOLES #7, 8 AND 9 FROM BA 1497

WESTBOUND ENTRANCE UNDERPASS

W.P 170-61 HWY 401 @ GATJANOQUE

APPROX 0.6 MI. N. OF I-57 HWY 2. DIST. #8

SCALE : 1" = 20'

DAMAS & SMITH LTD

17 DEC 1962