

MEMORANDUM

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

From: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McFarlane

DATE: September 24, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

BA 1916

FOUNDATION INVESTIGATION REPORT

For

The Extension of Little Credit River
Bridge, Hwy. #10, Twp. of Caledon,
District #6
W.J. 64-1-79, -- W.P. 153-63

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design requirements. Should additional information be required, please feel free to contact our Office.

RYL/MGeP
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Prescher
H. D. McMillan
G. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt


A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
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FOUNDATION INVESTIGATION REPORT

For

The Extension of Little Credit River
Bridge, Hwy. #10, Twp. of Caledon,
District #6
W.J. 64-F-79 -- W.P. 153-63

1. INTRODUCTION:

A request by Mr. J. B. Curtis, Regional Bridge Location Engineer of the Bridge Design Division, to carry out a foundation investigation at the above-noted site was received by this Section on June 25, 1964. A field investigation was carried out by this Section during the period August 31 to September 3, 1964, to determine the subsoil conditions at the site of the proposed extension of the structure.

This report contains the field investigation findings, laboratory test results and recommendations pertaining to the type of foundations for the extension of the existing structure.

2. DESCRIPTION OF THE SITE:

The site is located at the crossing of Little Credit River and Hwy. #10. It is approximately 3.5 miles north of Victoria on the same highway. The area adjacent to the river at the crossing is covered by small brush. In general, the site is fairly flat.

The river, approximately 30 ft. wide and 1 to 3 ft. deep at the crossing, flows south-westerly. The rate of flow near the west side of the structure was about 1 ft./sec. during the time of the investigation. The flow of water varies under and adjacent to the structure. The flow was faster on the east side of the structure owing to the narrowing of the river channel.

3. FIELD AND LABORATORY WORK:

Field work consisting of two sampled boreholes and one dynamic cone penetration test was carried out by means of a diamond drillrig adapted for soil sampling. Samples were recovered at required depths by means of a 2" O.D. split-spoon sampler. The dimensions of this sampler and the energy used to drive it, conform to the requirements of the Standard Penetration Test. A dynamic cone penetration test was carried out adjacent to borehole #2. Driving energy to advance the 2-inch cone was 350 ft.-lbs. per blow.

The locations and elevations (estimated from the contour lines) of the boreholes are shown on Dwg. #64-F-79A. attached to this report.

Samples were visually examined and identified in the field as well as in the laboratory. Grain size distribution for a selection of representative soil samples were determined in the laboratory. The results are attached in the Appendix.

4. SUBSOIL CONDITIONS:

The subsoil at the site essentially consists of a granular deposit containing silt, sand and gravel. This was observed in all the boreholes and extends at least some 40 ft. below the ground surface. The percentage of silt and gravel within the stratum varies somewhat, but in general, the deposit may be described as sand with some silt and gravel. Standard penetration values ranged from 9 blows/ft. generally increasing with depth. From these values it is estimated that the relative density varies from loose to very dense.

cont'd. /3 ...

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

Grain size distribution analyses yield the following ranges:

Gravel	:	1%	-	25%
Sand	:	65%	-	88%
Silt	:	10%	-	18%

5. GROUND WATER CONDITIONS:

No attempt was made to establish an accurate ground water level by means of piezometers. Observations carried out during the time of the field investigation indicated that the water level in borehole #1 is slightly higher than the water level in the river. The elevations of the water levels are shown in the borehole logs (Appendix I). In borehole #2, an artesian condition was encountered at the depth of 15 ft. approximately and the excess hydrostatic pressure was about 2 ft. above the water level in the river.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to widen the existing Hwy. #10 and this requires widening the existing structure over the Little Credit River. The proposed widening will be some 10 ft. on either side of the existing structure.

Subsoil at the site consists of a deposit of sand with silt and gravel.

In view of the subsoil conditions, it is recommended that the extended structure be supported on spread footing type foundations. A safe bearing pressure of 2.5 T.S.F. may be used

cont'd. /4 ...

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

for design purposes for footings 3.5 ft. in width and located 4 ft. below the stream bed. These dimensions conform with those of the footings of the existing structure. It should be noted that the depth of footings should be governed by the hydrological requirements.

As it will be necessary to carry out excavations for the footings below the ground water level, a dewatering scheme will be required. If steel sheeting is used in a dewatering scheme or as a scour protection, this should be driven to a minimum depth below the excavation bottoms equal to the height of the prevailing water above them so that 'boiling' of the soil due to unbalanced hydrostatic head will be avoided.

7. SUMMARY:

The site is underlain by a deposit of sand with gravel.

It is recommended that the proposed extension of the existing bridge be founded on spread footings. A design load of 2.5 T.S.F. may be used.

No major dewatering problems are anticipated if normal construction and dewatering procedures are followed.

8. MISCELLANEOUS:

The field work, performed during the period from August 31 to September 3, 1964, was undertaken by Mr. T. Chan, Project Foundation Engineer, who also presented this report. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

September 1964. .

APPENDIX I.

DEPARTMENT OF HIGHWAYS - DIVISION
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 64-F-79

LOCATION Hwy. #10, Sta. 45+92, 36' Rt.

ORIGINATED BY H.T.C.

W.D. 153-63

BORING DATE August 31, 1964.

COMPILED BY H.T.C.

DATA G.S.C.

BOREHOLE TYPE Washboring using MX Casing.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
DEPTH	DESCRIPTION	NUMBER	TYPE						
885	Groundlevel								
0.0	Topsoil								
	Heterogeneous mixture of sand and gravel.	1	SS	9	880				
	Grey.	2	SS	14					
	Loose to very dense.	3	SS	39					
		4	SS	18					
		5	SS	43	870				
		6	SS	49					
		7	SS	51 1/3"	860				
		8	SS	99 6.5"					
		9	SS	44	850				
846.2		10	SS	89 9"					
38.8	End of borehole.								
					840				

884.7

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

BOR 64-F-79

LOCATION Hwy. #10, Sta. 45+64, 42' Lt.

ORIGINATED BY H.T.C.

V. P. 153-63

BORING DATE Sept. 2, 1964.

COMPILED BY H.T.C.

DATUM G.S.C.

BOREHOLE TYPE Washboring using NX Casing.

CHECKED BY M.D.

SOIL PROFILE

SAMPLES

DYNAMIC PENETRATION RESISTANCE

BLOWS / FOOT

20 40 60 80 100

SHEAR STRENGTH P S F

LIQUID LIMIT ——— WL

PLASTIC LIMIT ——— WP

WATER CONTENT ——— W

WP ——— W ——— WL

WATER CONTENT %

BULK
DENSITY
PC F

REMARKS

▽ 882.2

Artesian
Condition

880.5 Waterlevel

0.0

Heterogeneous mixture
of sand and gravel.

Grey.

Compact to very dense.

1 SS 17

2 SS 17

3 SS 36

4 SS 28

5 SS 24

6 SS 98

7 SS 78

8 SS 88/8"

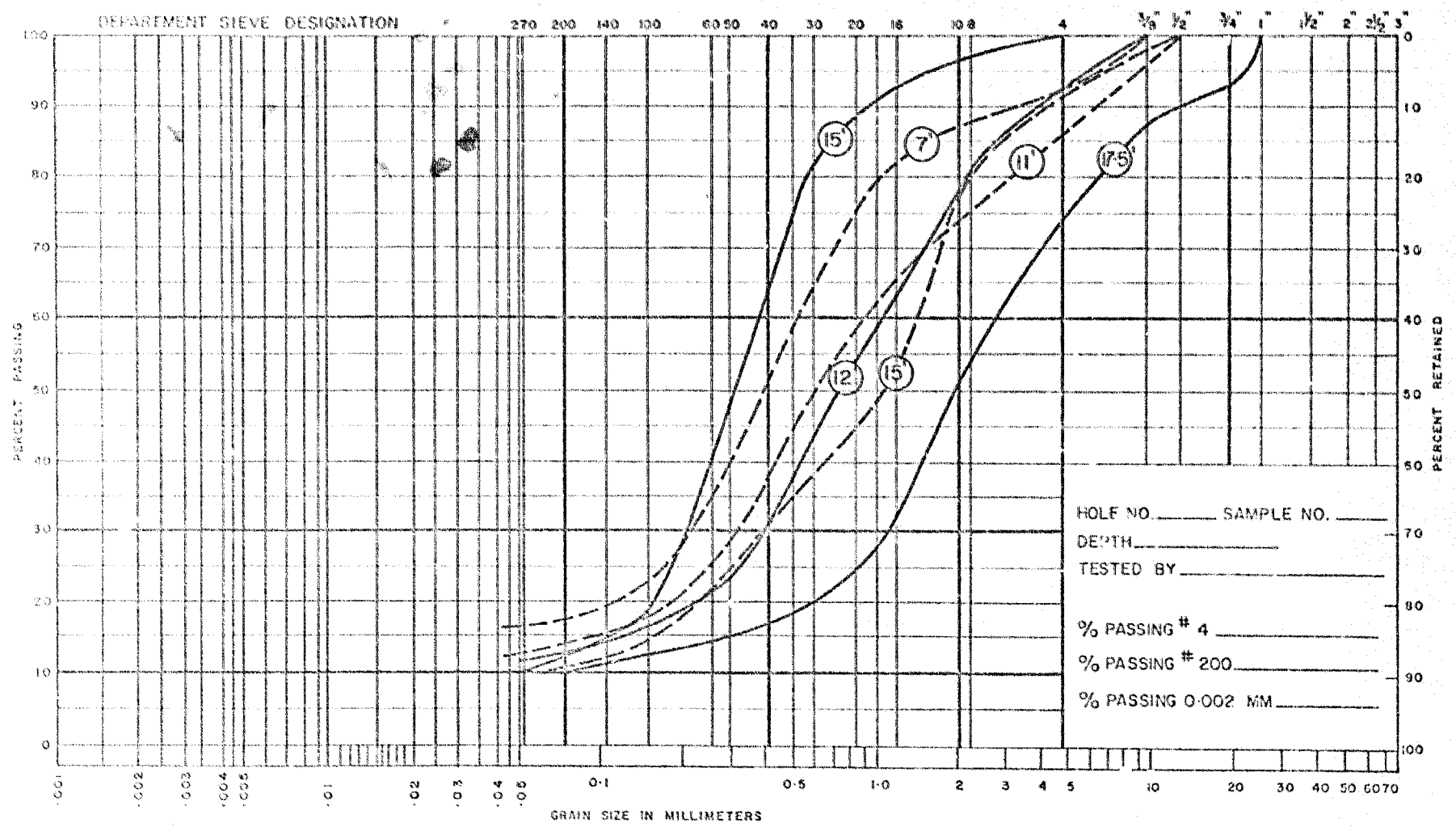
844.3

36.2 End of borehole.

840

UNIFIED SOIL CLASSIFICATION SYSTEM

Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse



HOLE NO. _____ SAMPLE NO. _____
DEPTH _____
TESTED BY _____
% PASSING # 4 _____
% PASSING # 200 _____
% PASSING 0.002 MM _____

NOTES BORE HOLE NO. 1 _____
BORE HOLE NO. 2 _____

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS & TESTING DIVISION
GRAIN SIZE DISTRIBUTION
JOB NO. 64-F-79 W.P. NO. 153-63
LOCATION LITTLE CREDIT RIVER, HWY. NO. 10

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 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	SLOTTED TUBE SAMPLE		
	P.H	SAMPLE ADVANCED HYDRAULICALLY	
	P.M	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cd}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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
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
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
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_r	SENSITIVITY

GENERAL

π	+3.1415
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

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	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
β	ANGLE OF SLOPE TO HORIZONTAL

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

FROM: Bridge Division,
Downsview, Ontario.

DATE: June 25, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: Little Credit River Bridge
3.5 Miles N. of Victoria Hwy. #10
W.P. 153-63 Site #25-55
District #6 Twp. of Caledon

64-F-79

Please find attached print # E-4236-1 marked in red showing the probable location of footings for the above structure. Also enclosed is print # D 2815-1 showing existing structure.

Would you kindly arrange to have a foundation investigation of sufficient magnitude to enable us to design the necessary extension to the structure. As noted on the accompanying drawing a borehole is also required to determine the scour.



J. Robertson,
for J. B. Curtis,
Regional Bridge Location Engineer.

JR/es

cc. R. Fitzgibbon
cc. D. Smith

June 29/64

Tony -

Message from Doug. Smith

Re: Request for foundation
investigation - memo by
John Curtis dated June 25.
for Little Credit River -
W.P. 153-63

Foundation report not
scheduled until Oct. 14/64 -
no urgency.

Mr. J. B. Curtis,
Regional Bridge Location Engr.,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. J. F. Walshe

July 29, 1965

Your Memo -- July 23, 1965.

W.P. 153-63, Site 24-55,
Little Credit River Bridge,
Hwy. No. 10, District 6 (Toronto)

We have reviewed Drawing D 5448-1P for the above structure, and as far as foundations are concerned, we have no comment. However, we would like to draw to your attention our recommendation pertaining to the dewatering of the excavations which we put forward in our Report W.J. 64-F-79. The need for a dewatering scheme should be clearly mentioned in the Contract documents.

AGS/MdeF

cc: Foundations Office ✓
Gen. Files

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

MEMORANDUM

To: Mr. K. Y. Lo,
Supervising Foundation Eng.,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: July 23, 1965.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 153-63, Site 24-55,
Little Credit River Bridge,
Hwy. #10, Dist. #6.

Herewith one print of drawing D 5448-1P for the
above structure. The structure is founded on spread
footings as recommended in your report W.J. 64-F-79.

JFW/ag

Joseph F. Walshe
J. F. Walshe,
for J. B. Curtis,
Regional Bridge Location Engineer.

*No comments
H.T. Chalk
July 27-65*

Comments: - A dewatering scheme is required for footing excavations
as recommended in our foundation report.

M. Devata
July 28/65.

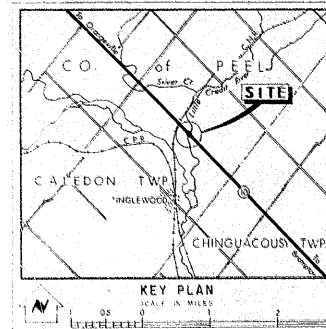
#64-F-79

W.P. #153-63

Hwy. #10

LITTLE CREDIT

RIVER BR.



- 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.

[illegible]

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

LITTLE CREDIT, RIVER

KING'S HIGHWAY NO. 10 DIST. NO. 6
CO. PEEL
TWP. CALEDON LOT 3 CON. 1 W.H.S. & 1 E.H.S.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT T.C.	CHECKED <i>[initials]</i>	W.P. NO. 153-63	M.B.R. DRAWING NO. 64-F-79A
DRAWN <i>[initials]</i>	CHECKED <i>[initials]</i>	JOB NO. 64-F-79	
DATE SEPT. 14, 1964		SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>		CONT. NO.	

[illegible]